Transportation Security Administration

Planning Guidelines and Design Standards for Checked Baggage Inspection Systems

Version 4.1

September 15, 2011

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September 15, 2011

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DISCLAIMER

This document is being distributed under the sponsorship of the Transportation Security Administration (TSA) of the U.S. Department of Homeland Security (DHS) in the interest of information exchange. The U.S. Government assumes no liability for the contents or use of this document.

This document does not create regulatory requirements. The purpose of the document is to provide guidance, ideas, and suggestions on ways to implement a high performance and cost-effective checked baggage inspection system (CBIS). Recommendations and guidelines contained in this document might be highly beneficial in one airport environment while being virtually impossible to implement in another. The only exception is the information in Chapter 7, which provides design standards that should be closely followed during the design of any CBIS at U.S. airports.

VERSION HISTORY

Version	Date	Modifications
1.0	October 10, 2007	First published version
2.0	January 31, 2009	Update based on recommended follow-on studies and comments on Version 1.0
3.0	November 27, 2009	Update based on recommended follow-on studies and comments on Version 2.0
4.0	July 15, 2011	Update based on recommended follow-on studies and comments on Version 3.0
4.1	September 15, 2011	Update based on recommended follow-on studies and comments on Version 4.0

EXCEPTIONS

PGDS Applicability

Designs for new checked baggage inspection systems shall comply with the requirements set forth in this version of the Planning Guidelines and Design Standards (PGDS). However, any project sponsor that has received formal confirmation from TSA of the receipt of the complete 30% Detailed Design Package for a CBIS project prior to the publication date of this version of the PGDS shall continue to be governed by the PGDS version in effect at the time of such confirmation. Furthermore, projects that have passed the 30% Detailed Design phase—including those systems currently under construction or in operation—with TSA approval shall be held to the design standards specified by that approval (either under the previous PGDS versions or prior standards in place before the publication of Version 1.0 of the PGDS).

For Operational Analysis Reports (OARs) and CBIS which are being upgraded and/or changed, TSA reserves the right to evaluate the CBIS against the most current published PGDS version.

All CBIS will be tested to testing requirements as established in Appendix D of the latest version of the PGDS in effect at the time of testing. This will allow TSA to obtain the best set of test data to evaluate CBIS performance and to recommend fixes or improvements to the system.

Delayed Opening of CBIS

TSA reserves the right to require a project sponsor to resubmit the 30% Detailed Design Package under the requirements of the latest PGDS if the CBIS has not passed the Integrated Site Acceptance Test (ISAT), according to the PGDS version in effect at the time of the original 30% Detailed Design Package submittal, within 2 years of TSA approval of the original 30% Detailed Design Package.

Major Redesigns

Major redesign of an existing CBIS shall be required to adhere to the latest version of the PGDS at the time of the major redesign. The scope of a major redesign is to be discussed on a case-by-case basis between the project sponsor and TSA.

INDUSTRY COMMENTS

The TSA Office of Security Technology (OST) will be the recipient of all comments regarding proposed updates to the PGDS. All comments must be received by December 31 of this calendar year to be considered as part of the next update to the PGDS.

All comments will be reviewed and considered in a timely manner. The TSA values comments and input from industry stakeholders, but only those comments and input determined to enhance and improve the PGDS will be incorporated in the next release of the PGDS. An example of the standard form for comments is provided in Appendix A.

Comments should be submitted to pgds@dhs.gov using the comment form that can be found at the following address: http://www.tsa.gov/assets/xls/pgds_comment_form.xls.

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ACRONYMS AND ABBREVIATIONS

AACE	The Association for the Advancement of Cost Engineering International
ACWP	Actual Cost of Work Performed
ADPM	Average Day of the Peak Month
AL	Alarm Line
ASAC	Aviation Security Advisory Committee
ASDG-WG	Airport Security Design Guidelines Working Group
ATO	Airline Ticket Office
ATR	Automatic Tag Reader
ATSA	Aviation and Transportation Security Act
AVI	Automated Vehicle Identification
BAC	Budget at Completion
BAIT	Bag Auto-ID Transfer
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BDR	Basis of Design Report
BHS	Baggage Handling System
BHSC	Baggage Handling System Contractor
BHSO	Baggage Handling System Oversize
BIP	Baggage Insertion Point
BIT	Baggage Inspection Table
BIR	Baggage Inspection Room
BMA	Baggage Measurement Array
BOE	Basis of Estimate
BPH	Bags per Hour
BPP	Bags per Passenger
BRL	Baggage Reinsertion Line
BRP	Baggage Removal Position
BSD	Bag Status Display
BSM	Baggage System Management
BSIS	Baggage Screening Investment Study
BVS	Baggage Viewing Station
CBIS	Checked Baggage Inspection System
CBRA	Checked Baggage Resolution Area
CCI	Construction Cost Index
CPI	Cost Performance Index
CRT	Certification Readiness Test
CSI	Construction Standards Institute
CT	Computerized Tomography
CTO	Chief Technology Officer
CWE	Current Working Estimate
CY	Calendar Year
DBU	Date of Beneficial Use
DHS	Department of Homeland Security
DPS	Design Performance Standards
DT&E	Developmental Test and Evaluation
DCV	Destination-Coded Vehicle
EAC	Estimate at Completion
EBSP	Electronic Baggage Screening Program
EDS	Explosives Detection System
ETD	Explosives Trace Detection
EVM	Earned Value Management
FAA	Federal Aviation Administration
FAP	Funding Application Process
FAR	Federal Acquisition Regulations
FDRS	Field Data Reporting System
FFY	Federal Fiscal Year
FIS	Federal Inspection Services
FSD	Federal Security Director
FTE	Full-Time Equivalent
FY	Fiscal Year
GAO	Government Accountability Office
HMI	Human Machine Interface
HVAC	Heating, Ventilation, and Air Conditioning
IATA	International Air Transport Association
ID	Identification (or Identifier)
ILDT	Integrated Local Design Team
IQ	Image Quality
IQT	Image Quality Test
IRD	Interface Requirements Document
ISAT	Integrated Site Acceptance Test
ISD	In-Line Screening Device

IT	Information Technology
LCC	Life-Cycle Cost
LEO	Law Enforcement Officer
LOI	Letter of Intent
MES	Manual Encode Station
MCP	Master Control Panel
MOU	Memorandum of Understanding
NEDS	Networked Explosive Detection Systems
OA	Operations Analysis
OAR	Operational Analysis Report
OIB	Operations Improvement Branch
OOG	Out-of-Gauge
O&M	Operating and Maintenance
OMB	Office of Management and Budget
OS	Oversized
OSARP	On-Screen Alarm Resolution Protocol
OSO	Office of Security Operations
OSR	On-Screen Resolution
OSRA	On-Screen Resolution Area
OST	Office of Security Technology
OTA	Other Transaction Agreement
PGDS	Planning Guidelines and Design Standards
PEC	Photoelectric Cell
PFC	Passenger Facility Charge
PLC	Programmable Logic Controller
PMO	Program Management Office
PNR	Passenger Name Record
PSP	Passenger Screening Program
PTRI	Passive Threat Resolution Interface
PVS	Primary Viewing Station
RFI	Request for Information
RFID	Radio Frequency Identification
ROM	Rough Order-of-Magnitude
RRS	Remote Resolution System
RSEDS	Reduced-size Explosives Detection System
SAT	Site Acceptance Test
SAM	Staff Allocation Model
SG/FSSS	Stationary Gantry/Fixed Source Screening System
SOP	Standard Operating Procedures
SOS	System of Systems
SQT	System Qualification Testing
SSI	Sensitive Security Information
SSTP	Site Specific Test Plan
STZ	Security Tracking Zone
SV	Schedule Variance
SVS	Secondary Viewing Station
TAF	Terminal Area Forecast
TBD	To Be Determined
TCU	Threat Containment Unit
TEC	Total Estimated Cost
TOB	Top of Bed
TRR	Test Readiness Review
TSA	Transportation Security Administration
TSL	Transportation Security Laboratory
TSO	Transportation Security Officer
UPS	Universal Power Supply
VAC	Variance at Completion
VFD	Variable Frequency Drive
WBS	Work Breakdown Structure

ACKNOWLEDGEMENTS

The following is a list of organizations, whose staff contributed their valuable time and insights to developing previous versions of the CBIS Planning Guidelines and Design Standards:

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1 OVERVIEW

The purpose, applicability, and background of the Planning Guidelines and Design Standards (PGDS) for Checked Baggage Inspection Systems (CBISs), prepared by the Transportation Security Administration (TSA) of the U.S. Department of Homeland Security (DHS), are provided in this chapter.

1.1 PURPOSE

The main purpose of the PGDS is to provide specific guidance on ways to implement a CBIS that (1) is less costly from both capital and life-cycle perspectives and (2) has higher performance than the first generation of installed baggage screening systems.

The PGDS also establishes design standards that (1) clarify the operational parameters that must be met and (2) require evidence of the ability of the selected system to meet these parameters during the planning and design processes. These standards will reduce the risk of costly mistakes and the potential for injuries.

To expedite the nationwide installation of checked baggage screening systems in an equitable, sustainable, and cost-effective manner, as required by legislation, the PGDS:

- Establish common design principles and metrics to which all screening system designs must adhere.
- Consolidate collective industry experience and insights relating to best practices for planning, designing, and implementing baggage screening systems.
- Disseminate the latest information on screening technologies, in-line screening concepts, and screening protocols.
- Standardize the methodologies for planning, designing, and evaluating various system design alternatives.

These PGDS not only emphasizes best practices associated with screening system layouts, they also address other factors necessary to actively manage system costs and performance. The key objectives emphasized include the following:

- **Achieve the Lowest-Cost Solution**—Achieving the lowest-cost solution requires three key changes from typical past practices: (1) assuming implementation of soon-to-be-certified screening technologies during the development of alternatives (Chapter 3), (2) considering a wide range of alternatives rather than relying on a preconceived notion regarding which system would be best suited for a particular airport (Chapter 4), and (3) assessing the 20-year life-cycle costs of different alternatives, so that the ongoing costs of operating and maintaining these systems are appropriately balanced with the upfront capital costs (Chapter 8).
- **Define Design Standards**—In the past, design standards (e.g., bag time in system and error rates) have been enforced primarily at the “back end” of the design process at the system testing stage. These standards must now be met during implementation, as well as during planning and design (Chapter 7).
- **Understand the Complexity of In-Line Screening Systems and Avoid the Common Pitfalls of First-Generation Designs**—Baggage screening systems are complex, especially those with high levels of automations (see Appendix B). Many different technologies for conveyance, tracking, and screening must all work together seamlessly to achieve an efficient and reliable CBIS. Many lessons have been learned, but the communication and understanding of these lessons have been sporadic.

- **Develop Principles for Appropriate Sizing of CBISs, including Methods for Estimating Demand and Equipment Requirements**—The approach used to estimate demand and equipment needs for the initial system has a major effect on project costs. Many different approaches have been used over the last several years, with widely varying results. An overly conservative approach to estimating demand and equipment needs can result in prematurely eliminating potentially less costly screening alternatives. Under-estimating demand and equipment needs can result in excessive occurrences of demand exceeding capacity and associated operational difficulties and security degradation. The PGDS provides a recommended approach to estimate demand and equipment needs, and clarify the design year for various components of the CBIS – e.g., for screening equipment sizing the design year is 5 years beyond the date of beneficial use (DBU) (see Chapters 5 and 6 and Appendix C).

- **Develop Principles for Providing Equipment Redundancy and Establishing Contingency Operations**—Other important considerations for system sizing are equipment redundancy (see Chapter 6) and contingency operations (see Chapter 11 and Appendix E). The best approach for providing redundancy and establishing contingency operations will vary significantly depending on local conditions. In general, low-cost opportunities to "share" capacity across screening zones should be pursued before capacity is added to a specific zone. Regardless of the redundancies built into a particular system, the PGDS specifies the creation of a contingency plan agreed upon by key stakeholders, including airport and airline personnel, which defines how the CBIS will operate when screening equipment is unavailable, demand exceeds capacity, or a catastrophic system failure occurs.

- **Develop Principles for Accommodating Growth beyond Initial System Sizing**—Many of the initial baggage screening systems were designed to accommodate only 5 years of growth without explicit consideration to accommodate demand beyond that period. In some cases, marginal additional upfront investments in conveyors or facilities could significantly reduce costs over the long term. For example, significant savings and less operational disruption could be achieved by providing needed expansion space up front rather than incrementally expanding a facility over time. Also, some savings may be achieved by providing for additional queuing during initial construction to take advantage of future high-speed explosives detection system (EDS) machines. The choice of how additional capacity is to be provided will depend on the constraints of the facility, forecast growth, degree of confidence about the forecast growth, overall capacity of the terminal, expected life of the terminal, and the initial system type. Going forward, DBU plus 5 years will continue to be used as the design year for initial system sizing; however, the level of upfront investment to accommodate demand beyond DBU plus 5 years should be assessed using a 20-year life-cycle cost analysis. Also, the use of a Master Plan to forecast growth can only be used to limit future growth and cannot exceed the TAF (terminal area forecast) growth rate (see Chapters 5 and 8).

- **Provide Flexibility in Baggage Screening System Designs and Facilities**—Screening systems to date have generally been designed with existing, certified technology in mind. However, building in flexibility from the outset to accommodate future upgraded security technologies will keep future upgrade costs to a minimum while maximizing both current and future EDS performance. Given the rapidly changing nature of screening technologies and the threats facing the aviation system, flexible system design is crucial for successful implementation. Chapter 3 provides a

discussion of future technologies and systems now in the planning stages that should be considered in the planning process.

- **Use an Integrated and Participatory Approach to the Planning and Design Process, as well as the Implementation Process, by Involving All Relevant Stakeholders**—Stakeholder involvement is key to successful and cost-effective CBIS implementation. This involvement needs to occur at both the industry/federal government level and the local/airport level (see Chapter 2).

- **Upgrade the Design Review and Approval Process**—A significant upgrade to the design review and approval process is needed to support the objectives of cost management and increased quality for the screening systems. The PGDS presents three key changes associated with the design review and approval process:

  1. A mandatory Pre-Design Phase has been incorporated to provide more rigorous analysis of preliminary conceptual alternatives and to document the rationale for eliminating various alternative designs.

  2. In the design packages that must be submitted to TSA, increased emphasis is placed on economic analysis, contingency operations plans, and conformance with operational performance standards.

  3. The process of design review and approval, including the number, type, and timing of design packages that must be submitted to TSA, has been modified to provide for increased stakeholder involvement through the use of integrated design teams.

The PGDS also addresses some aspects of the installation, testing, and commissioning of CBIS (see Appendix D); however, issues related to the operation and maintenance of CBISs are not within the scope of the PGDS. In addition, reimbursable and nonreimbursable expenses related to the Electronic Baggage Screening Program (EBSP) are addressed in Appendix F.

1.2 APPLICABILITY

The PGDS was developed as an industry reference to develop cost-effective solutions and to convey TSA requirements for CBISs. The PGDS was developed for use by airport operators, airlines, CBIS planners and designers, EDS and BHS vendors, CBIS-related service providers and additional stakeholders involved in the planning, design, commissioning, operation, and maintenance of CBISs.

1.3 BACKGROUND

PGDS Version 1.0, published on October 10, 2007, was prepared as part of the Baggage Screening Investment Study (BSIS) undertaken by TSA in 2006 in consultation with the aviation industry.

The BSIS was a direct response to the requirements included in the Intelligence Reform and Terrorism Prevention Act of 2004 (Section 4019d), and was intended to respond to directives in the 2005 DHS *Appropriations Act Conference Report* and recommendations contained in the March 15, 2005, Government Accountability Office (GAO) report. The EBSP framework was developed as the basis for the BSIS. As described in the *EBSP Strategic Planning Framework* submitted to Congress in February 2006, the primary goals of the EBSP Strategic Plan are to:

1. Increase security through deploying EDS equipment to as many airports as practicable and implementing more labor-intensive explosives trace detection (ETD) screening protocols at those locations where ETD will continue to be used for primary screening.

2. Minimize EBSP life-cycle costs by deploying the best possible screening solutions at each airport, appropriately balancing capital investment and operating cost tradeoffs.

3. Minimize impacts to TSA and airport/airline operations through well-designed and well-placed EDS solutions.

4. Provide a flexible security infrastructure "platform" for accommodating growing airline traffic and other industry changes over the next 20 years and for addressing potential new threats.

To achieve these goals, the deployment of next-generation technology that has recently been certified, or is expected to be certified within the next 2 to 3 years, must be accelerated. Accordingly, the PGDS emphasizes new technology and associated performance assumptions, screening protocols, and concepts of operation.

During 2007 and 2008, many valuable industry comments on Version 1.0 of the PGDS were received from airport operators, airlines, designers, and planners, as well as from TSA. In addition, several follow-on studies were conducted to implement some of the next steps articulated in PGDS, Version 1.0 (Section 1.7). Since then, TSA has completed several rounds of review processes in which industry comments and follow-on PGDS studies were incorporated. The result of this updating, revision and review process is this Version 4.0 of the PGDS.

1.4 ORGANIZATION

The subsequent chapters of this document are as follows:

- **Chapter 2, Roles, Responsibilities, and Project Phasing**—Project roles and responsibilities and descriptions of the various phases of the project, including deliverables to TSA and TSA responsibilities.

- **Chapter 3, Screening Process and CBIS Types**—Detailed descriptions of screening equipment and screening system concepts.

- **Chapter 4, Development and Evaluation of Alternatives**—Overview of the alternatives development and evaluation process, including matching facility type to security equipment and baggage screening system design, conducting a preliminary high-level assessment, and conducting a quantitative assessment based on a life-cycle cost analysis.

- **Chapter 5, Methodology to Determine Baggage Screening Demand**—Methodology and elements of demand forecasting.

- **Chapter 6, Methodology to Determine Baggage Screening Equipment Requirements**—Methodology for initially sizing CBISs.

- **Chapter 7, Design Best Practices and Standards**—Design best practices and requirements that all CBISs must meet to ensure conformance with TSA security and operational performance standards.

- **Chapter 8, Life-Cycle Costs**—Detailed explanation on how to assess costs, establish the economic value of alternatives, and determine the most cost-effective alternatives.

- **Chapter 9, Checked Baggage Resolution Area Planning Standards**—Requirements and recommendations for Checked Baggage Resolution Areas (CBRAs).

- **Chapter 10, On-Screen Resolution Area Planning Standards**—Requirements and recommendations for the ergonomic design of On-Screen Resolution Areas (OSRAs)

- **Chapter 11, Contingency Planning**—Summary of the process for developing a contingency plan, principles of contingency design, and evaluation of contingency alternatives.

This document also contains the following appendices:

- **Appendix A, Submittal Outlines, Form Templates, and Examples**—Report submittal outlines for CBIS for the Pre-Design and Schematic Design phases and form templates.

- **Appendix B, Generic Examples of CBIS**—Generic examples of baggage screening systems, operational assumptions, and best practices, and detail explanation regarding the planning and design of standardized mini in-line CBISs.

- **Appendix C, Basis of Design Report Case Study—Oakland International Airport**—Example of a Basis of Design Report showing how the PGDS should be followed to develop and select viable CBIS alternatives.

- **Appendix D, Commissioning and Evaluation Requirements**—Guidelines for developing a Site Specific Test Plan (SSTP) used to test and commission the CBIS after installation.

- **Appendix E, Example of a CBIS Operation Guide**—Example of a best practices operation guide for an in-line CBIS.

- **Appendix F, Reimbursable/Nonreimbursable Costs for the EBSP**—Explanation on how to identify allocable and allowable costs associated with awarded Letters of Intent (LOIs) or Other Transaction Agreements (OTAs).

- **Appendix G, Contingency Plan Examples**—Two examples of how a CBIS contingency plan should be developed.

- **Appendix H, Checked Baggage Screening Equipment Sensitive Security Information Identification Guide—** Guidance on identifying which information associated with checked baggage screening equipment is and is not sensitive security information (SSI).

1.5 NEXT STEPS

It is anticipated that future versions of the PGDS—expected to be published annually—will include new and updated screening equipment specifications (Chapter 3) and cost assumptions for the life-cycle cost analysis (Chapter 8), as well as addressing industry comments to Version 4.0.

In addition, the following studies will be conducted:

- Detailed descriptions of CBIS Mini In-line designs

- Updated passenger arrival trends for use in earliness distribution tables and graphs

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2 ROLES, RESPONSIBILITIES, AND PROJECT PHASING

The objective of a CBIS project is to identify, design, and implement appropriately sized, functional, supportable, maintainable and cost-effective baggage screening systems for each airport. The benefits of an effective design and review process include minimizing project costs, schedule delays, and adverse impacts to airline and airport operations, while also maximizing system functionality and overall security. The process for submittal, review, and TSA approval for each CBIS is described in this chapter.

It is assumed that the project sponsor will establish a preliminary program for design and implementation of the optimal screening system and that this program will be submitted to TSA in compliance with the Pre-Design Phase submittal milestones described below. TSA approval of these milestones will trigger initiation of the Schematic Design Phase. Once the Basis of Design Report has been submitted and approved by TSA at the end of the Schematic Design Phase, the project sponsor will be in a position to procure full design services for the CBIS**.**

2.1 ROLES AND RESPONSIBILITIES

The following paragraphs summarize the roles and responsibilities of the parties involved in design and implementation of a CBIS.

2.1.1 Project Stakeholders

The stakeholder list should be customized to reflect the relevant stakeholders at the specific airport and is anticipated to include the following primary functions:

- **Airport**: Engineering, Operations, Information Technology (IT), Maintenance, Planning and Design, Project Management, and others, as appropriate.
- **Airline(s)**: Headquarters, Operations, Corporate Real Estate, IT, Maintenance, Engineering, Planning, Security Technology Officer(s), Station Manager(s), and others, as appropriate.
- **TSA**: Federal Security Director (FSD), local manager, occupational health and safety representative and/or other technical representatives designated by the FSD, and TSA Headquarters design review team.

It is anticipated that the following additional project stakeholders (or designees) will be included in some phases of the process (as required):

- Local law enforcement (responsible for procedures to handle suspect bags not cleared at level 3 screening in the CBRA by ETD).
- EDS equipment providers and manufacturers.

Project stakeholders should be periodically briefed on the progress of the planning and design effort.

2.1.2 Integrated Local Design Team

As part of the design process, an Integrated Local Design Team (ILDT) that includes representatives of some or all of the above-mentioned stakeholders should be formed. In addition, the ILDT should include a professional planning and design team comprised of architects, engineers, planners, CBIS designers, cost estimators, and project managers. The design team is also likely to include specialty consultants, such as simulation analysts and landscape architects, on an as-needed basis.

Responsibilities of the ILDT include:

- The development of alternative screening concepts, evaluation of those concepts, and generation of design drawings/submittals.
- Assessment of specific local conditions affecting the CBIS design, as well as the standards to be met by the design. After proper evaluation of local conditions and the CBIS design, the ILDT can, via the project sponsor, petition TSA for an exemption from the standards or design principles set forth in this PGDS if the ILDT concludes that these standards cannot be met by the CBIS designs due to local constraints. The ILDT should assess all implications of such an exemption and include full documentation supporting the request. The Request for PGDS Variance template can be found in Appendix A (Section A.7).

If Passenger Facility Charge (PFC) funding is contemplated, regular communication with the local FAA Airports Office servicing the airport should be included in the ILDT planning process.

The responsibilities of individual ILDT members must be fully understood and properly integrated to ensure the effective design and implementation of the optimal screening system.

2.1.3 Project Sponsor

The project sponsor is assumed to be an airport owner/operator or an airline (if the system is for an airline-owned terminal). Key responsibilities of the project sponsor include:

- Initiation and execution of CBIS planning and design.
- Formation of the ILDT and selection of a professional planning and design team.
- Application for TSA or other funding.
- Initiation and execution of construction, as well as testing and commissioning of the CBIS.
- Operation and maintenance of the baggage handling system (BHS) portion of the CBIS.

2.1.4 TSA Headquarters

Representatives from TSA Headquarters will be responsible for reviewing and approving/rejecting design submittals. TSA will determine funding eligibility and prioritization as well as assess issues related to occupational safety, health, and the environment.

Specifically, TSA Headquarters should have the following roles:

1. Serve as a regular forum for exchanging lessons learned as implementation moves forward and regularly updating the PGDS.
2. Perform technical and operational review of designs.
3. Review the impact of potential screening protocol changes (such as cost implications of Canadian and international recheck screening).
4. Conveying design best practices to the aviation industry.
5. Manage the EBSP, including providing periodic updates to the Strategic Plan as warranted by technology or other critical changes.
6. Serve as a stakeholder forum to brainstorm operation and policy issues as needed.

Internally within the TSA, the following stakeholders are involved in the **design review process**: design reviewers, site leads, engineering staff, Life Cycle Support staff, and EBSP program managers. In general, the design review process consists of the following steps:

- The Project Sponsor is requested to submit the design submittals to the TSA design review team.
- If, after reviewing the Project Sponsor's submittals, TSA determines additional data is needed, the Project Sponsor is requested by the TSA site lead to provide any missing information to the TSA design review team.
- TSA will then complete the review process and TSA EBSP program manager will submit TSA comments to the Project Sponsor and a meeting will be held with the Project Sponsor and the TSA site lead to review the comments.
- Based on the Project Sponsor's rebuttal of the comments, the TSA EBSP Program Manager will accept or reject the submittals.

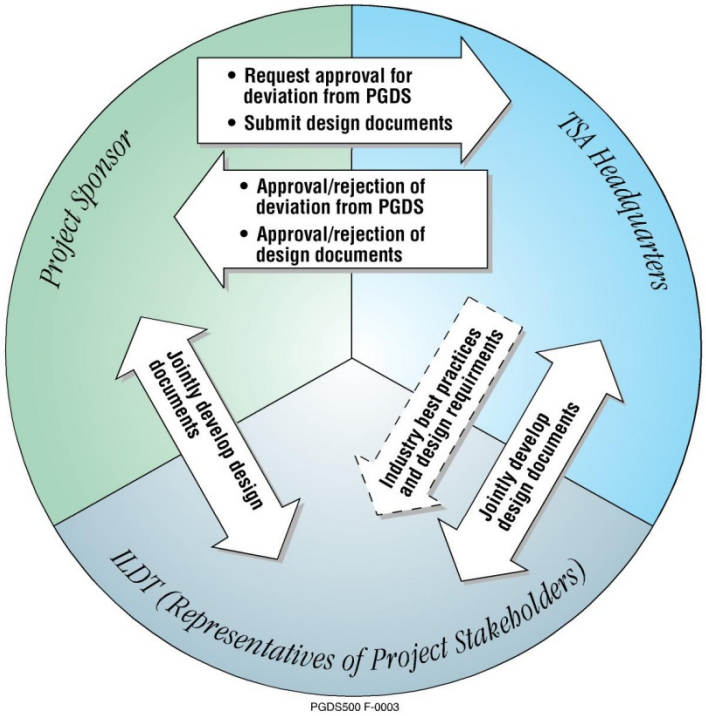
In addition, TSA will determine the specific EDS equipment type to be used and schedule the testing and commissioning of the equipment.

Upon request by the project sponsor or the ILDT, integration information pertaining to the specific EDS equipment to be deployed at the airport in question will be provided by the applicable TSA OST Regional Deployment Manager.

2.1.5 Summary

Figure 2-1 summarizes the interactions between the project sponsor, ILDT, and TSA Headquarters.

Figure 2-1
SUMMARY OF RESPONSIBILITIES DURING THE DESIGN PROCESS



2.2 PROJECT PHASING

The project phases are listed below in sequence:

- Pre-Design Phase—During this phase, estimating the design-year baggage screening demand and a recommended conceptual alternative is developed. This involves identifying existing baseline conditions and selecting a preferred alternative through an iterative process of developing and analyzing a range of candidate alternatives. TSA may provide a list of optimal preliminary alternatives for the ILDT to consider.

- Schematic Design Phase—During this phase the work product of the Pre-Design Phase is used to further develop and refine the preferred alternative(s), including initial development of design drawings, more detailed rough-order-of-magnitude construction cost estimates, and program schedule, resulting in an approved Basis of Design Report.

- Detailed Design Phase—During this phase the Basis of Design Report is used to refine and finalize detailed design drawings, rough order-of-magnitude construction cost estimates, and program schedule. Three sub-phases are assumed as milestones: 30%, 70%, and 100% design.

- Construction Phase—During this phase the CBIS is constructed following the 100% detailed design documents. Any changes to the approved documents are submitted to TSA for approval. The construction schedule, equipment delivery schedule, and the schedule for testing are finalized.

- Testing and Commissioning Phase—During this phase all the required tests are conducted before the system is commissioned.

- Project Closeout Phase—During this phase TSA provides final approval of the CBIS for beneficial use and the final documentation is submitted to TSA.

- During the entirety of the design phase, it is required that: all formulas and calculations for figures are submitted, all PGDS-provided rates/numbers are to be used in all submittals unless a RFV is submitted and approved, and all rates/numbers supplied are accompanied by all the supporting numbers and calculations,

Figure 2-2 on the following page summarizes the design phases (pre-design, schematic design, and detailed design) and the applicable chapters of the PGDS.

The high level Gantt chart shown on Figure 2-3 summarizes the planning (i.e., pre-design), design, construction, testing, commissioning, and project closeout phases, as well as key milestones and submittals within each phase.

A checklist showing the deliverables by phase for in-line CBIS is shown on Figure 2-4. Figure 2-5 shows a list of reduced deliverables for simple Mini in-line CBISs.

All Design submittals shall be separated into binders and shall include the following:

1. The title of the Design shall be located on the front and spine of the binder.

2. Each Design package shall begin with a table of contents.

3. All chapters/submittals shall be tabbed and indexed within the binder.

4. A Table of Contents listing headings and page numbers shall be included in the front of each chapter/submittal.

5. Each chapter shall be identified with a divider and index tab with permanently printed information.

Figure 2-2
SUMMARY OF PROJECT PHASES

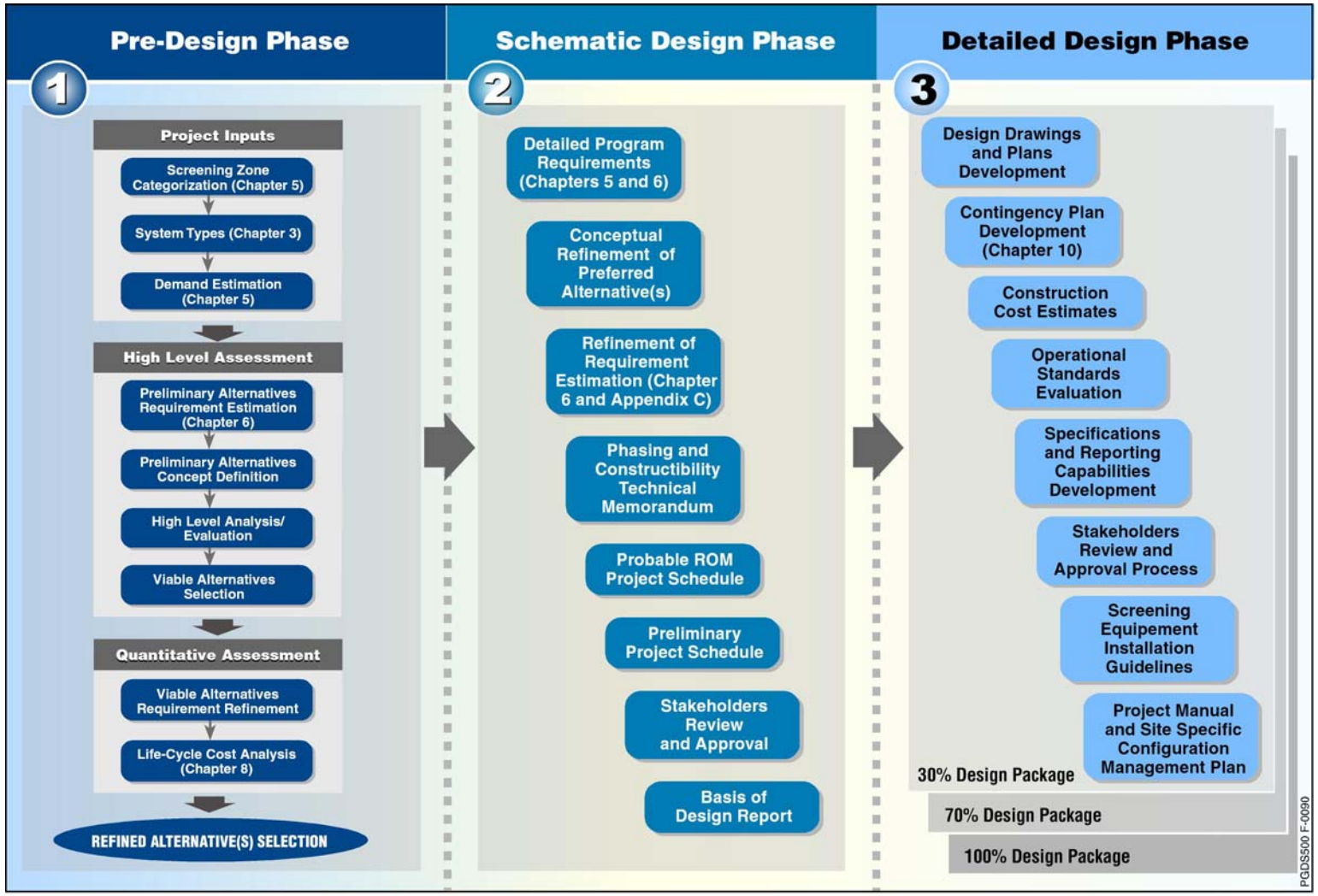
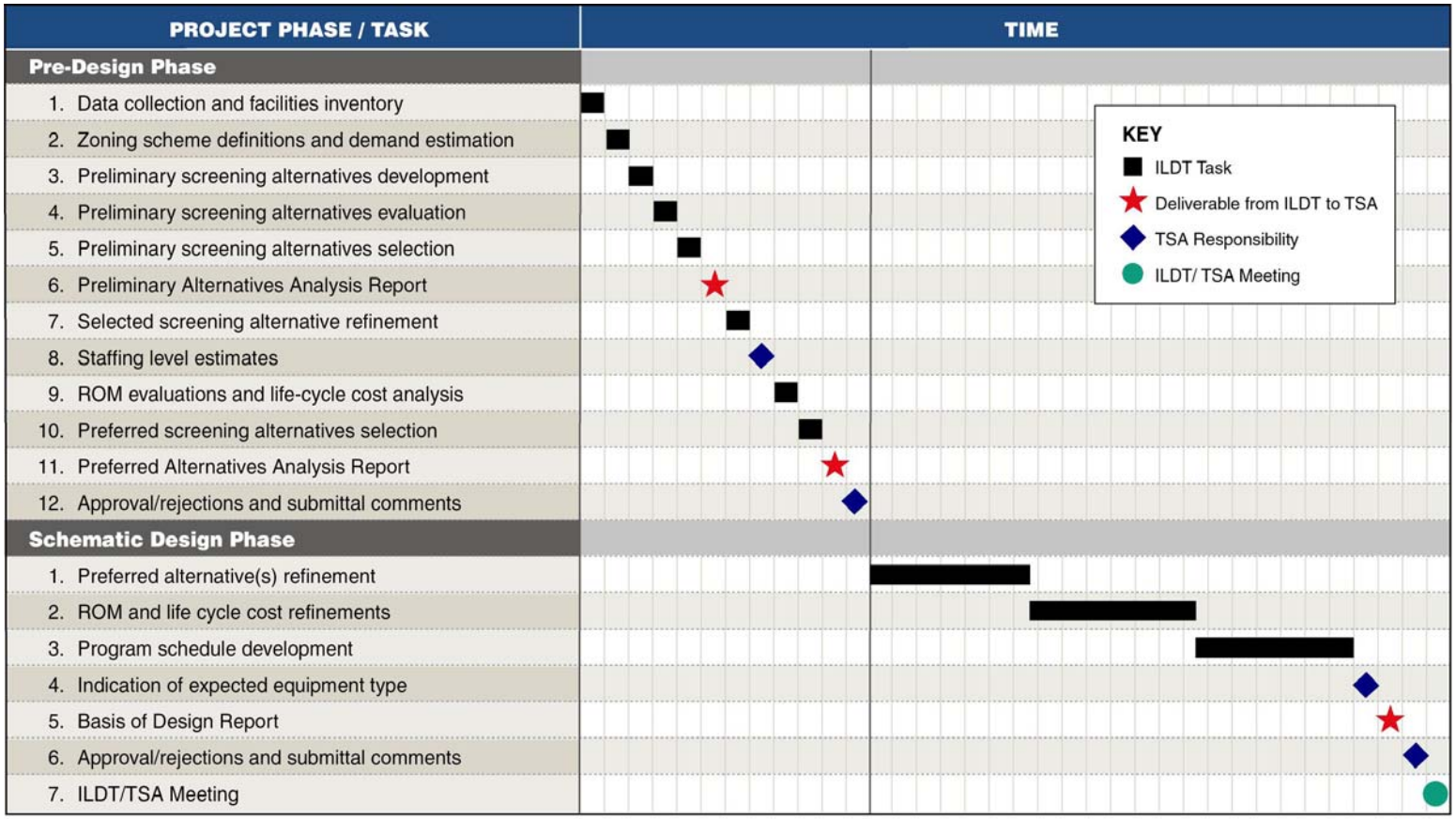


Figure 2-3
SUMMARY OF PLANNING AND DESIGN PROCESS PHASES



Note: The timetable does not reflect actual task duration.

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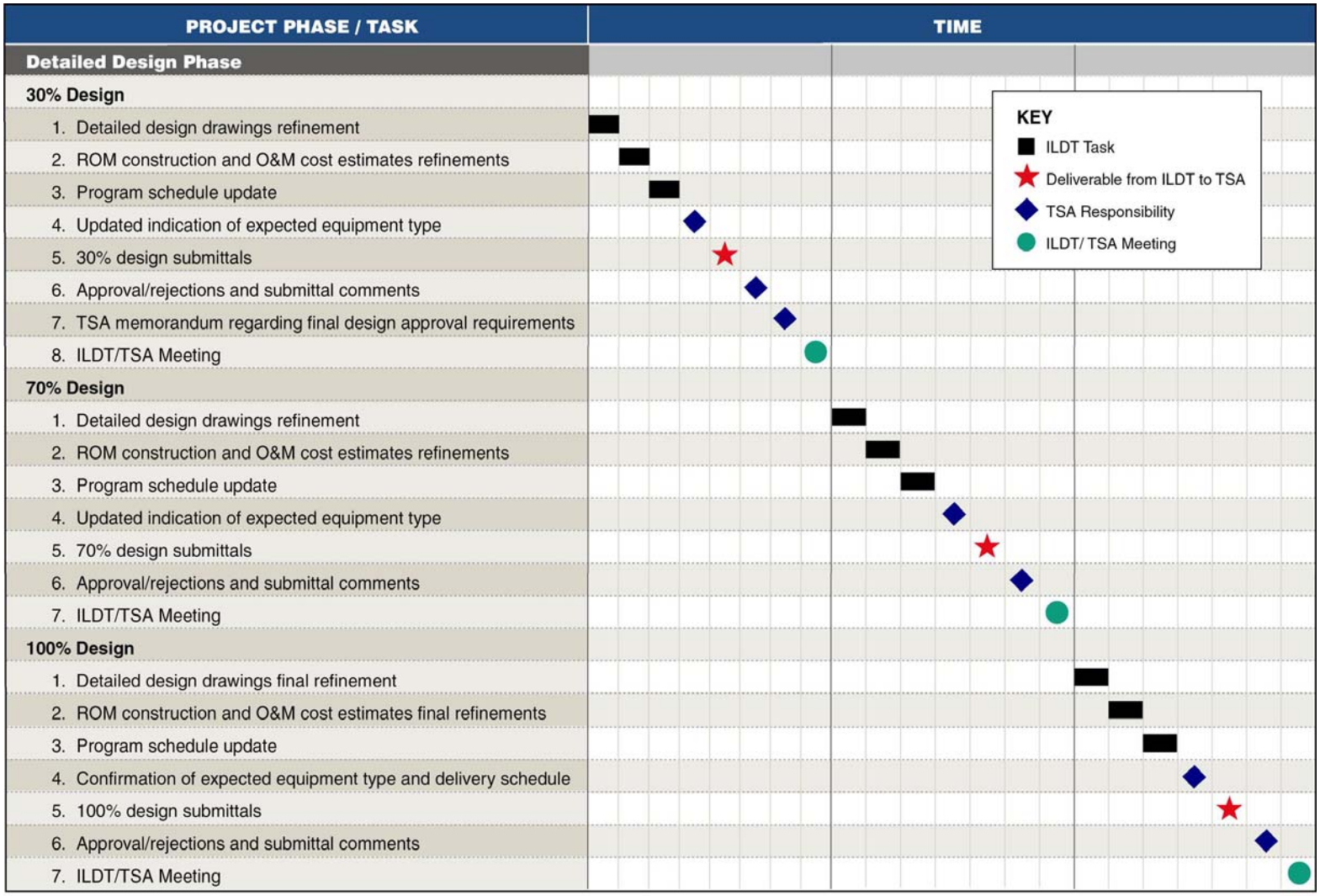
Figure 2-3 (*page 2 of 3*)
SUMMARY OF PLANNING AND DESIGN PROCESS PHASES



Note: The timetable does not reflect actual task duration.

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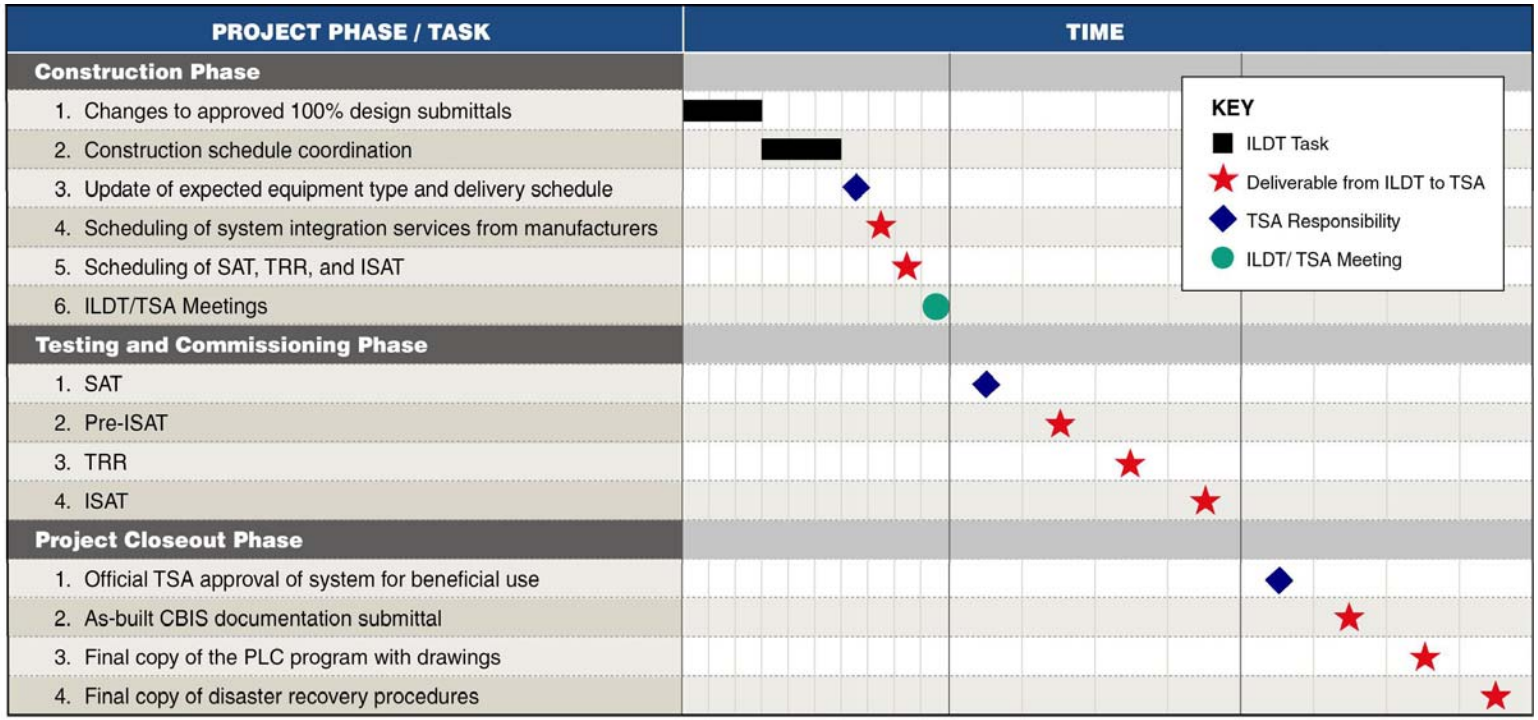
Figure 2-3 (*page 3 of 3*)
SUMMARY OF PLANNING AND DESIGN PROCESS PHASES



Note: The timetable does not reflect actual task duration.

Figure 2-4
DELIVERABLES CHECKLIST FOR IN-LINE CBIS

PROJECT PHASE DELIVERABLES	SECTION	Completed		PROJECT PHASE DELIVERABLES	SECTION	Completed	
		Yes	No			Yes	No
Pre-Design Phase	2.2.1	☐	☐	**Detailed Design Phase (continued)**		☐	☐
Preliminary Alternatives Analysis Report		☐	☐	**70% Design Submittals (continued)**		☐	☐
Preferred Alternatives Analysis Report		☐	☐	Description of Concept of Operations		☐	☐
Schematic Design Phase		☐	☐	Preliminary Contingency Plan		☐	☐
Basis of Design Report	2.2.2	☐	☐	70% Specifications		☐	☐
Detailed Program Requirements		☐	☐	Draft Site Specific Configuration Management Plan		☐	☐
High-Level Flow-Based Modeling Assumptions and Results		☐	☐	Stakeholder Review and Approval Documentation		☐	☐
Preliminary Concept Plans		☐	☐	70% Estimate of Probable Construction and O&M Costs		☐	☐
Phasing and Constructability Technical Memoranda		☐	☐	Phasing Schedule		☐	☐
ROM Estimate of Probable Construction and O&M Costs		☐	☐	Conveyor Manifest		☐	☐
Stakeholder Review and Approval Documentation		☐	☐	Updated EDS Equipment List		☐	☐
Preliminary Project Schedule		☐	☐	**100% Design Submittals**	2.2.3.3	☐	☐
Environmental Conditions Compatibility Assessment		☐	☐	Bid Documents		☐	☐
Detailed Design Phase	2.2.2	☐	☐	Final Description of Concept of Operations		☐	☐
30% Design Submittals	2.2.3.1	☐	☐	Contingency Plans		☐	☐
Updated Basis of Design Report		☐	☐	Project Specifications		☐	☐
Operational Standards Assessment		☐	☐	Final Site Specific Configuration Management Plan		☐	☐
Preliminary Plans		☐	☐	Stakeholder Review and Approval Documentation		☐	☐
Cross Sections		☐	☐	Final Estimate of Probable Construction and O&M Costs		☐	☐
Description of Concept of Operations		☐	☐	Final Phasing Schedule		☐	☐
Baggage and Data Flow Charts		☐	☐	Updated EDS Equipment List		☐	☐
Table of Contents for CBIS		☐	☐	Operations Training Materials and Documentation		☐	☐
Screening Equipment Installation Guidelines		☐	☐	**Construction Phase**	2.2.4	☐	☐
Outline of Reporting Capabilities		☐	☐	Changes to Approved 100% Design Submittals		☐	☐
Stakeholder Review and Approval Documentation		☐	☐	Construction Schedule		☐	☐
30% Estimate of Probable Construction and O&M Costs		☐	☐	Courtesy Copies of Shop and Installation Drawings		☐	☐
Preliminary Phasing Schedule		☐	☐	**Testing and Commissioning Phase**	2.2.5	☐	☐
Conveyor Manifest		☐	☐	Pre-ISAT Documentation		☐	☐
EDS Equipment List		☐	☐	ISAT Documentation		☐	☐
70% Design Submittals	2.2.3.2	☐	☐	**Project Closeout Phase**	2.2.6	☐	☐
Updated Basis of Design Report		☐	☐	As-Built CBIS Documentation Submittal		☐	☐
Updated Operational Standards Assessment		☐	☐	Final Copy of the PLC Program with Drawings		☐	☐
70% Design Drawings		☐	☐	Final Copy of Disaster Recovery Procedures		☐	☐
Cross Sections							

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Figure 2-5
DELIVERABLES CHECKLIST FOR MINI IN-LINE CBIS

PROJECT PHASE DELIVERABLES	SECTION	Completed		PROJECT PHASE DELIVERABLES	SECTION	Completed	
		Yes	No			Yes	No
Pre-Design Phase	2.2.1	☐	☐	**Detailed Design Phase (continued)**		☐	☐
Preferred Alternatives Analysis Report		☐	☐	**100% Design Submittals**	2.2.3.3	☐	☐
Schematic Design Phase		☐	☐	Bid Documents		☐	☐
Basis of Design Report	2.2.2	☐	☐	Final Description of Concept of Operations		☐	☐
High-Level Flow-Based Modeling Assumptions and Results		☐	☐	Contingency Plans		☐	☐
Preliminary Concept Plans		☐	☐	Project Specifications as related to CBIS		☐	☐
ROM Estimate of Probable Construction Costs		☐	☐	Stakeholder Review and Approval Documentation		☐	☐
Stakeholder Review and Approval Documentation		☐	☐	Final Estimate of Probable Construction and O&M Costs		☐	☐
Preliminary Project Schedule		☐	☐	Final Phasing Schedule		☐	☐
Environmental Conditions Compatibility Assessment		☐	☐	Updated EDS Equipment List		☐	☐
Detailed Design Phase	2.2.2	☐	☐	Operations Training Materials and Documentation		☐	☐
30% Design Submittals	2.2.3.1	☐	☐	**Construction Phase**	2.2.4	☐	☐
Updated Basis of Design Report		☐	☐	Changes to Approved 100% Design Submittals		☐	☐
Operational Standards Assessment		☐	☐	Construction Schedule		☐	☐
Preliminary Plans, Layout and Equipment Location		☐	☐	Courtesy Copies of Shop and Installation Drawings		☐	☐
Preliminary Contingency Plans		☐	☐	**Testing and Commissioning Phase**	2.2.5	☐	☐
Detailed Description of Concept of Operations (including CBRA)		☐	☐	Pre-ISAT Documentation (sign-off by stakeholders)		☐	☐
Table of Contents for CBIS		☐	☐	ISAT Documentation		☐	☐
Screening Equipment Installation Guidelines		☐	☐	**Project Closeout Phase**	2.2.6	☐	☐
Outline of Reporting Capabilities		☐	☐	As-Built CBIS Documentation Submittal		☐	☐
30% Estimate of Probable Construction Costs		☐	☐	Final Copy of the PLC Program with Drawings		☐	☐
Preliminary Phasing Schedule		☐	☐	Final Copy of Disaster Recovery Procedures		☐	☐
Conveyor Manifest		☐	☐				
EDS Equipment List		☐	☐				

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2.2.1 Pre-Design Phase

A process flow chart of this phase is displayed on Figure 2-6. The primary purpose of this phase is to identify a recommended conceptual alternative for submittal to TSA before the initiation of schematic design. This phase requires the identification of existing baseline conditions, estimation of design-year baggage screening demand, and development, analysis, and evaluation of alternative screening concepts. This phase represents an iterative process for selecting a preferred alternative from a range of candidate alternatives. In each iterative cycle, alternatives are further refined and evaluated.

The end product of this phase will be a Preferred Alternatives Analysis Report to be submitted to TSA describing the preferred alternative and the process and rationale used to select the preferred alternative. To satisfy TSA requirements, the report should provide sufficient documentation that a reasonably diverse range of PGDS-compliant alternatives was explored and that the preferred alternative is operationally viable, meets level of service requirements, and is the most cost-effective solution. Figure 2-7 summarizes tasks, deliverables, and TSA responsibilities for the Pre-Design Phase.

Tasks

The tasks involved in the Pre-Design Phase are outlined below:

1. Conduct data collection and facilities inventory.

2. Define the zoning scheme, select system types, and estimate design-year baggage screening demand (see Chapter 5 for detailed description of estimating baggage screening demand). The TSA possesses information that is pertinent to the Design Review process, especially at the Pre-Design level. The ILDT should interact with the RDM to obtain realistic historical values for bags per passenger (BPP), peak values for passenger arrivals, passenger arrival curves, etc.

3. Develop preliminary screening alternatives as described in Chapters 4, 5 and 6. These screening alternatives should be similar to the various system types described in Chapter 3.

4. Analyze the preliminary alternatives by conducting qualitative and high-level quantitative assessments (e.g., spatial analyses, assessment of compatibility with airline business models), including security screening equipment requirements (see Chapter 6 for additional details on the high-level quantitative assessment of equipment requirements and Appendix C for an example of how a qualitative and high-level quantitative assessment of screening alternatives could be performed).

5. Select the most promising alternatives for further development and evaluation (see Appendix C for an example of selecting the most promising screening alternatives).

6. Submit Preliminary Alternatives Analysis Report to TSA (see below).

7. Refine the level of definition needed for the selected alternatives to support more detailed evaluations (e.g., specific screening equipment types as well as screening equipment requirements).

8. Obtain TSA staff, equipment, and maintenance cost estimates to perform the life-cycle cost analysis.

9. Perform rough order-of-magnitude (ROM) evaluations, including 20-year life-cycle cost analyses (see Chapter 8).

Figure 2-6
PRE-DESIGN PHASE PROCESS FLOW

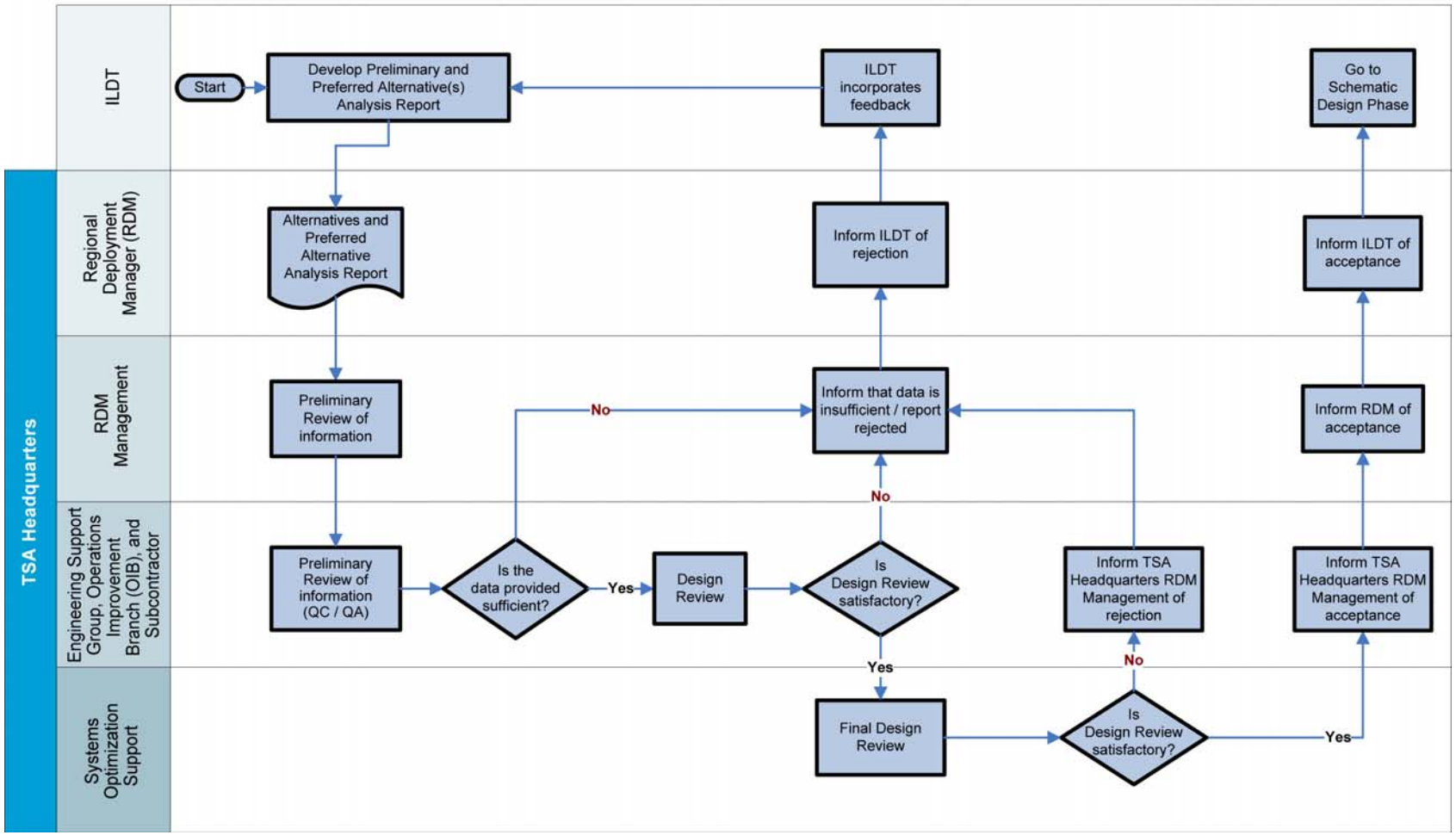
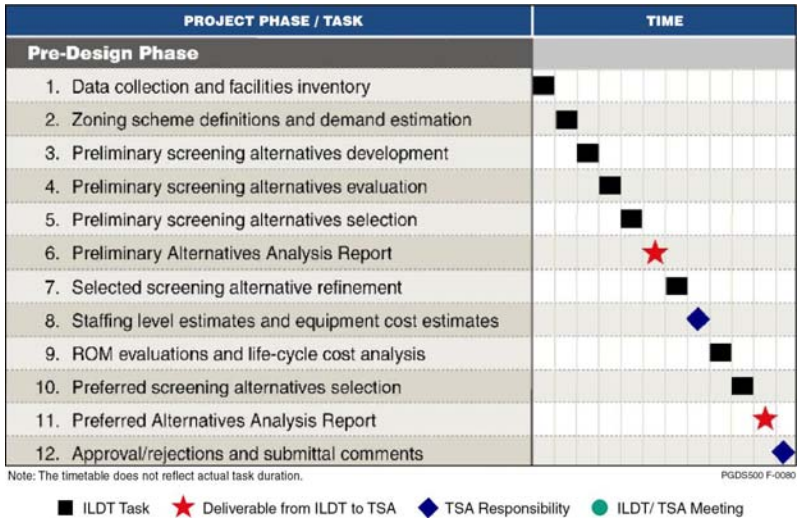


Figure 2-7
SUMMARY OF PRE-DESIGN PHASE



10. Select the preferred alternative (i.e., the alternative that is operationally viable, meets level of service requirements and has the lowest present value life-cycle costs); in addition, other promising alternatives could be carried forward to the Schematic Design Phase at the discretion of the project sponsor (see Chapter 8 as well as Appendix C regarding the process of selecting the lowest present value life-cycle cost alternative).

11. Submit Preferred Alternatives Analysis Report to TSA (see below).

12. Receive TSA comments on the Preferred Alternatives Analysis Report and formal approval/rejection.

Deliverables

The significant deliverables to be submitted by the project sponsor to TSA during the Pre-Design Phase are listed below in chronological order:

- **Preliminary Alternatives Analysis Report.** This report should document the assumptions and methodology used to derive the design-year baggage screening demand, the process used to develop alternatives, a description of all alternatives considered, and a list of the preliminary set of alternatives to be carried forward for analysis on a life-cycle cost basis. This report will be used as the basis for requesting staffing estimates from TSA for use in the life-cycle cost analysis, as described in Chapter 8. See Chapter 3 for a list of various screening system types. See Chapter 4 for a detailed description of how to develop screening alternatives and Chapter 6 for determining screening equipment requirements for the various screening alternatives. At least one alternative should have certified EDS equipment.

- **Preferred Alternatives Analysis Report.** This report should document the life-cycle cost analysis and basis for selection of the preferred alternative(s) to be further developed in the Schematic Design Phase, as described in Chapters 3, 4, 5, 6 and 8—collectively, these chapters provide an explanation of how to select the preferred alternative from a universe of screening alternatives.

TSA Responsibilities

As part of the review process during the Pre-Design Phase, TSA Headquarters is expected to provide the project sponsor with the following:

- Estimates of staffing levels necessary to complete the life-cycle cost analysis in preparing the Preferred Alternatives Analysis Report.
- Formal approval/rejection and comments on the report submittals.

Meetings

A meeting is recommended but not required at the end of this phase.

2.2.2 Schematic Design Phase

A process flow chart of this phase is displayed on Figure 2-8. During this phase, the work product of the Pre-Design Phase is used to further develop and refine the preferred alternative(s)—including initial development of design drawings and a program schedule as well as more detailed ROM construction cost estimates—resulting in an approved Basis of Design Report.

In the design packages that must be submitted during this phase, increased emphasis is placed on economic analysis, contingency operations plans, and conformance with operational performance standards.

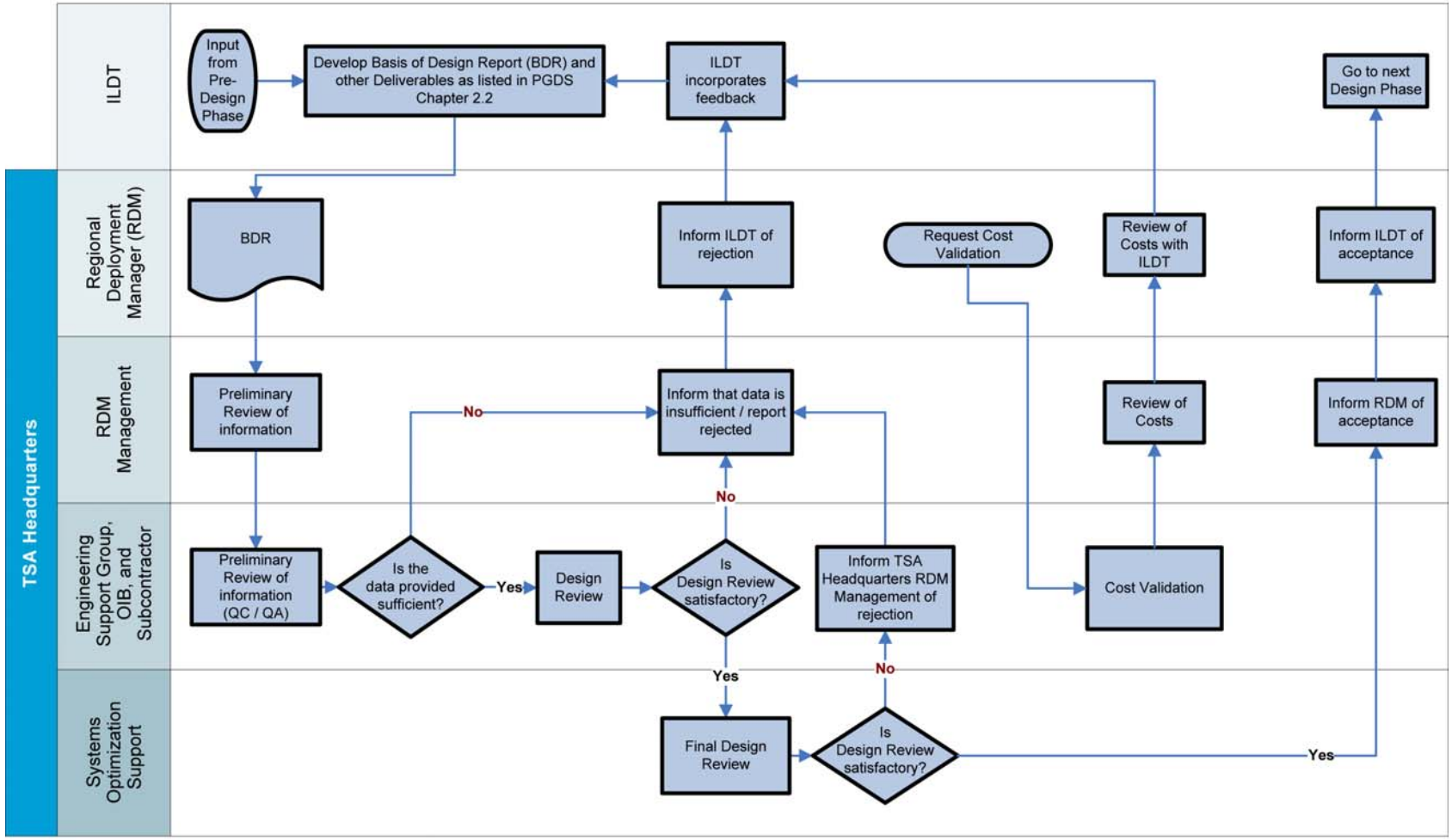
Tasks, deliverables, TSA responsibilities, and meetings during the Schematic Design Phase are addressed in the following paragraphs and summarized on Figure 2-9.

Tasks

The tasks involved in the Schematic Design Phase are outlined below:

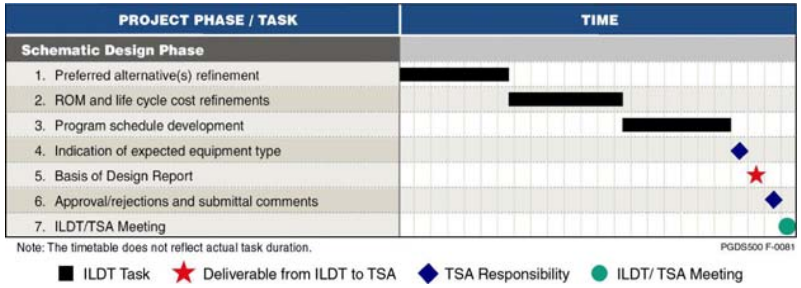
1. Further develop and refine the preferred alternative(s), including the initial development of design drawings.
2. Develop a more detailed ROM construction cost estimate to be incorporated into the life-cycle cost analysis performed in the Pre-Design Phase.
3. Develop a program schedule.
4. Obtain a preliminary indication of expected equipment types from TSA. EDS machine availability and characteristics are subject to the outcome of TSA's competitive procurement. If an EDS machine is uncertified or has no procurement contractual vehicle by the time a Basis of Design Report is submitted, then the CBIS design shall be modified to utilize available EDS machines.
5. Submit the Basis of Design Report (see below).
6. Receive comments on the Basis of Design Report and formal approval/rejection.
7. Conduct a meeting with the ILDT and TSA to review the Basis of Design Report.

Figure 2-8
SCHEMATIC DESIGN PHASE DESIGN PROCESS FLOW



Footnote: A cost validation may be requested at the RDM's discretion at any time during the design review process.

Figure 2-9
SUMMARY OF SCHEMATIC DESIGN PHASE



Deliverables

The major deliverable for this phase will be a **Basis of Design Report**, which will add the following elements to Pre-Design Phase work products:

- **Detailed Program Requirements**, including planning and modeling assumptions and results, a conceptual system overview, and a system evaluation of the preferred alternative (see Chapter 4 for further information on the selection of the preferred alternative). Planners shall make specific reference to TSA-specified CBIS design performance requirements and current commissioning requirements outlined in Chapter 7 and Appendix D. Planners shall also make specific reference to the equipment that TSA has identified to perform the screening function.
- High-level flow-based modeling assumptions and results.
- **Preliminary Concept Plans** for the existing BHS, as well as the planned configuration of the in-line CBIS.
- **Phasing and Constructability Technical Memoranda** documenting project-specific issues for each discipline, including CBIS design and architectural, structural, mechanical, plumbing, electrical, and communications considerations.
- ROM estimate of **probable construction costs** and **operating and maintenance (O&M) costs** based on the Basis of Design Report documentation.
- Documentation of stakeholder review and approval.
- Preliminary Project Schedule.
- A compatibility assessment between environmental conditions that will exist in designed CBIS and environmental requirements of EDS machines.

It is assumed that the project sponsor will engage the services of a professional design team to complete the deliverables for the Schematic Design Phase. The approved Basis of Design Report shall be an attachment to the full contract for design.

TSA Responsibilities

As part of the review process at the end of the Schematic Design Phase, TSA Headquarters is expected to provide the project sponsor with the following:

- Preliminary indication of expected equipment type to be delivered.
- Formal approval/rejection and comments on the Basis of Design Report.

Meetings

A meeting shall be conducted with the ILDT and TSA at the end of the Schematic Design Phase to review the Basis of Design Report.

Funding Application

Beginning with applications for Federal Fiscal Year (FFY) 2011 funding and continuing thereafter, project sponsors applying for facility modification funding will be required to have obtained TSA approval of the Basis of Design Report as defined in the PGDS

(i.e., to have successfully completed the Schematic Design Phase) to be eligible for facility modification funding.

The In-Line Funding Support Application Form and supporting Funding Application Process (FAP) are the primary vehicle through which TSA invites communication from project sponsors regarding project needs and funding requests, thereby providing a controlled manner for project sponsors to make funding requests known. This process allows for proper tracking and handling of funding requests and subsequent communications between TSA and airports.

Beginning with the FFY 2011 FAP submissions:

- Annual application timeframes will no longer be established. TSA will accept all project applications on a continuous or rolling basis.
- The initial requirement for applying for an EDS project is for the airport project sponsor to submit the current In-line Support Application Form through the FSD.

Project sponsors will be strongly encouraged to coordinate with local and headquarters TSA via Regional Deployment Managers as early as possible when EDS projects are being considered and conceptually planned. Early notification assists TSA in justifying federal funding for the EBSP.

Guidance and sample documentation will continue to be reviewed, updated and posted to: http://www.tsa.gov/research/checked_baggage_material.shtm under In-Line Support Application Documents.

2.2.3 Detailed Design Phase

During this phase, the Basis of Design Report is used to refine and finalize detailed design drawings, ROM construction cost estimates, and the program schedule. Three sub-phases are to be used as milestones: 30% design, 70% design, and 100% design.

Tasks, deliverables, TSA responsibilities, and meetings for the Detailed Design Phase are addressed in the following paragraphs.

2.2.3.1 30% Design

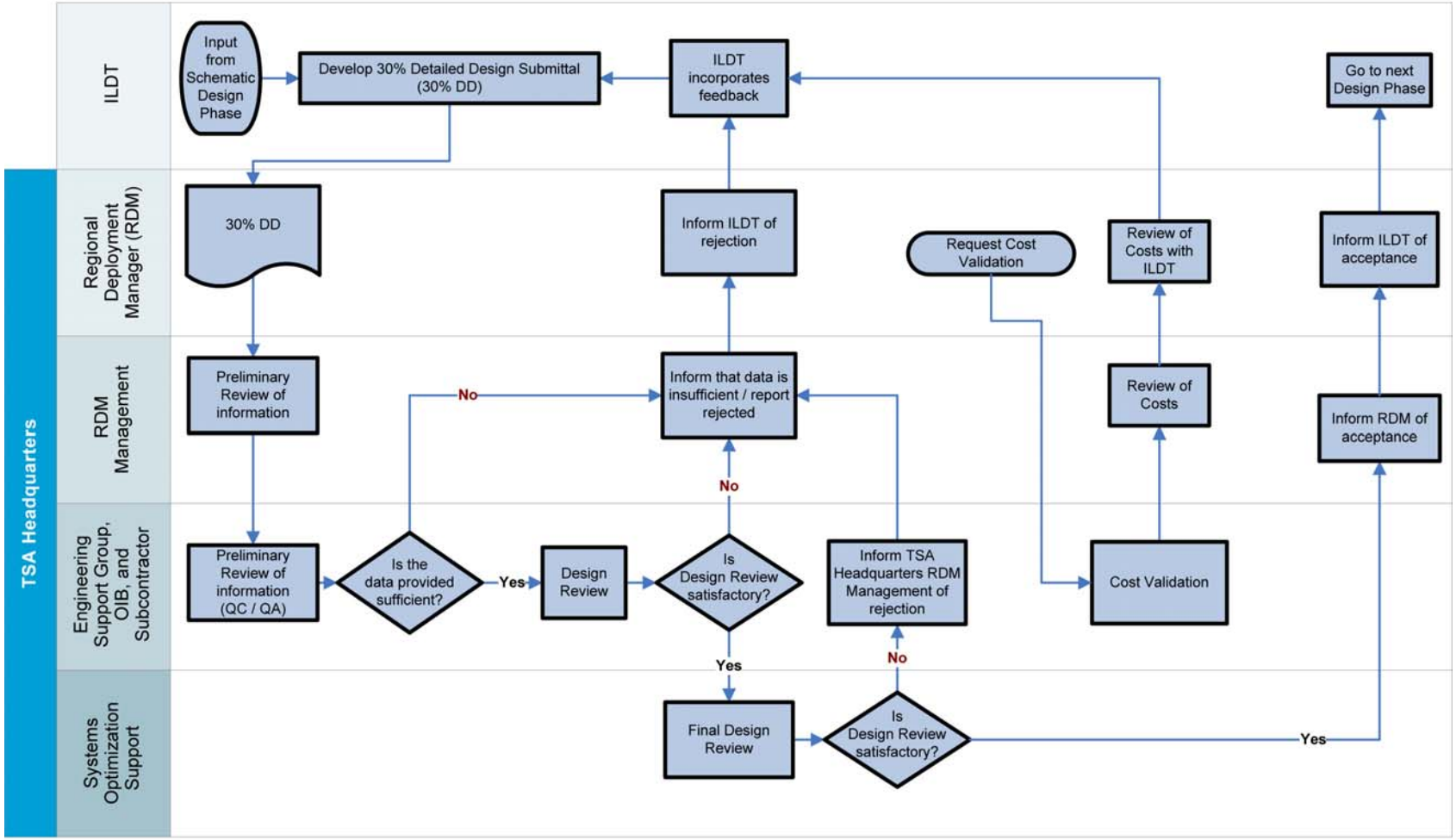
A process flow chart of this phase is displayed on Figure 2-10. Figure 2-11 summarizes tasks, deliverables, TSA responsibilities and meetings for the 30% Detailed Design Phase.

Tasks

The tasks involved in the 30% Detailed Design sub-phase are outlined below:

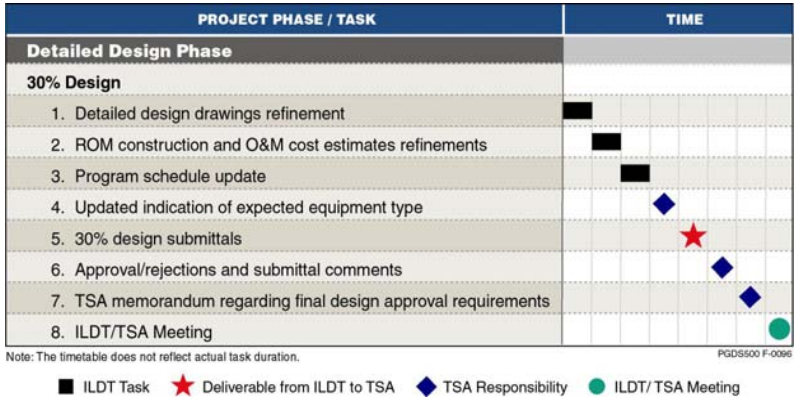
1. Based on the TSA-approved Basis of Design Report, refine detailed design.
2. Refine ROM construction and O&M cost estimates.
3. Update the preliminary program schedule developed in the Schematic Design Phase.
4. Obtain an updated indication of expected equipment type(s) from TSA.
5. Submit the 30% design deliverables specified below.
6. Receive comments on the 30% design submittals and formal approval/rejection from TSA.
7. Receive TSA memorandum stating that TSA responses must be addressed and that the CBIS design cannot be bid until after TSA approval of the 100% design submittal.
8. Conduct a meeting with the ILDT and TSA to review the 30% design submittals.

Figure 2-10
DETAILED DESIGN PHASE, 30% DESIGN PROCESS FLOW



Footnote: A cost validation may be requested at the RDM's discretion at any time during the design review process.

Figure 2-11
SUMMARY OF 30% DETAILED DESIGN PHASE



Deliverables

The 30**%** design package shall include the following documents, which shall be delivered both in the native format (Word, Excel, AutoCAD, etc.) and as a PDF file (hard copies are not required):

- Updated Basis of Design Report.
- **Operational Standards Assessment** memorandum based on a **dynamic simulation analysis** provided as an audio video interleave (AVI) or comparable format for visual output and comma-delimited text file or excel spreadsheet with simulation statistical inputs and outputs. The AVI shall have sufficient detail to clearly demonstrate that all system components and operational devices have been simulated as represented in the statistical data.

  For simple mini in-line designs (such as, for example, with manual removal decision points), dynamic simulation analysis is not required, but will be accepted in support of a specific design (see Chapter 3 for the definition of mini in-line CBIS).
- **Preliminary Plans** for all disciplines, including:
  - Plan views of outlined conveyors (and rights of ways), mechanical, showing EDS locations and CBRA area(s)
  - EDS machine removal route as well as all other O&M-related access
  - Inclines/declines
  - Conveyor delineations, especially near the EDS machines and in the CBRA
  - Conveyor identification (ID) labels
  - Elevations of significant areas (floor/wall penetrations, steep gradients, congested areas)
  - Top of Bed (TOB) approximate elevations
  - Approximate (Master Control Panel) MCP locations
  - Demolition and phasing plans
  - CBRA/Level 3 plans shall include:
    - Elevations
    - EDS pedestals if needed
    - Operational description and design prints indicating how the “no lift” policy is to be met
    - BRPs, insertion positions in relation to workstations and TSO movement space
    - Conops and layout for OS and OOG bags
    - Shrouding materials
    - Flooring material
    - Lighting design
    - Noise reduction design
    - Minimum environmental conditions
    - Printer(s)
    - Universal Power Supply (UPS) and power pole locations
    - Bag Inspection Tables (level 3 alarm resolution stations)
    - ETD locations and mounting options
    - BVS, Remote Resolution Station (RRS), Field Data Reporting System (FDRS) locations
    - Enlarged single-sheet plan view of CBRA/Level 3

- **Cross Sections** showing the vertical dimensions of the CBIS including equipment removal paths.
- **Concept of Operations** including discussion of how the overall CBIS is intended to work (see discussion in Section 3.1) with emphasis on a detailed concept of operations discussion of the CBRA (see Chapter 9 as guidance) and an emphasis on legacy BHS (if applicable). This shall include description of compatibility between legacy BHS and new CBIS, contrasting baggage rates and controls methodology as well as the results of time in system analyses through simulation studies for time in system and time in CBRA standards as detailed in Chapter 7.
- **Baggage and data flow charts** (detailed Inspection Screening Device (ISD)/BHS/CBRA data flows and examples for SFO and JFK are included in Appendix A, Section A-5).
- **Table of contents for CBIS** but not limited to specifications for equipment for On-Screen Resolution (OSR) room, CBRA, BSDs, conveyor specifications prior to EDS, insert/removal point of IQ bags, and reference to all of the TSA-furnished screening equipment to be used in the CBIS.
- **Screening Equipment Installation Guidelines**, documenting the satisfactory accommodation of the selected screening equipment in compliance with the manufacturer's site-installation guide.
- **Outline of Reporting Capabilities** to be provided by the CBIS (see Appendix A for examples of detailed reports generated).
- **Documentation of stakeholder review and approval**, including responses to TSA OSO and OST comments concerning OSR and CBRA areas for TSA review.
- **30% estimate of probable construction and O&M costs**
- **Preliminary phasing schedule**
- **Conveyor manifest showing:**
  - Conveyor identifiers
  - Approximate conveyor lengths
  - Approximate conveyor speeds
- **A list of EDS equipment,** by make, model, and serial number, that will be decommissioned after the proposed in-line system is operational.

In the event that requirements described in Chapter 7 Design Best Practices and Standards cannot be met the TSA design review team will notify the EBSP program manger and LCS manager to determine the life cycle support impact on the EDS equipment.

TSA Responsibilities

As part of the review process at the end of the 30% design sub-phase, TSA Headquarters is expected to provide the project sponsor with the following:

- Updated indication of expected equipment type to be delivered.
- Formal approval/rejection and comments on the 30% design submittals.
- A memorandum from TSA stating that TSA responses must be addressed (if appropriate) and that the CBIS design cannot be bid until after TSA approval of the 100% design submittal.

Meetings

A meeting will be conducted with the ILDT and TSA at the end of this sub-phase to review the above-mentioned deliverables.

2.2.3.2 70% Design

A process flow chart of this phase is displayed on Figure 2-12. Figure 2-13 summarizes tasks, deliverables, TSA responsibilities and meetings for the 70% Detailed Design Phase.

Figure 2-12
DETAILED DESIGN PHASE, 70% DESIGN PROCESS FLOW

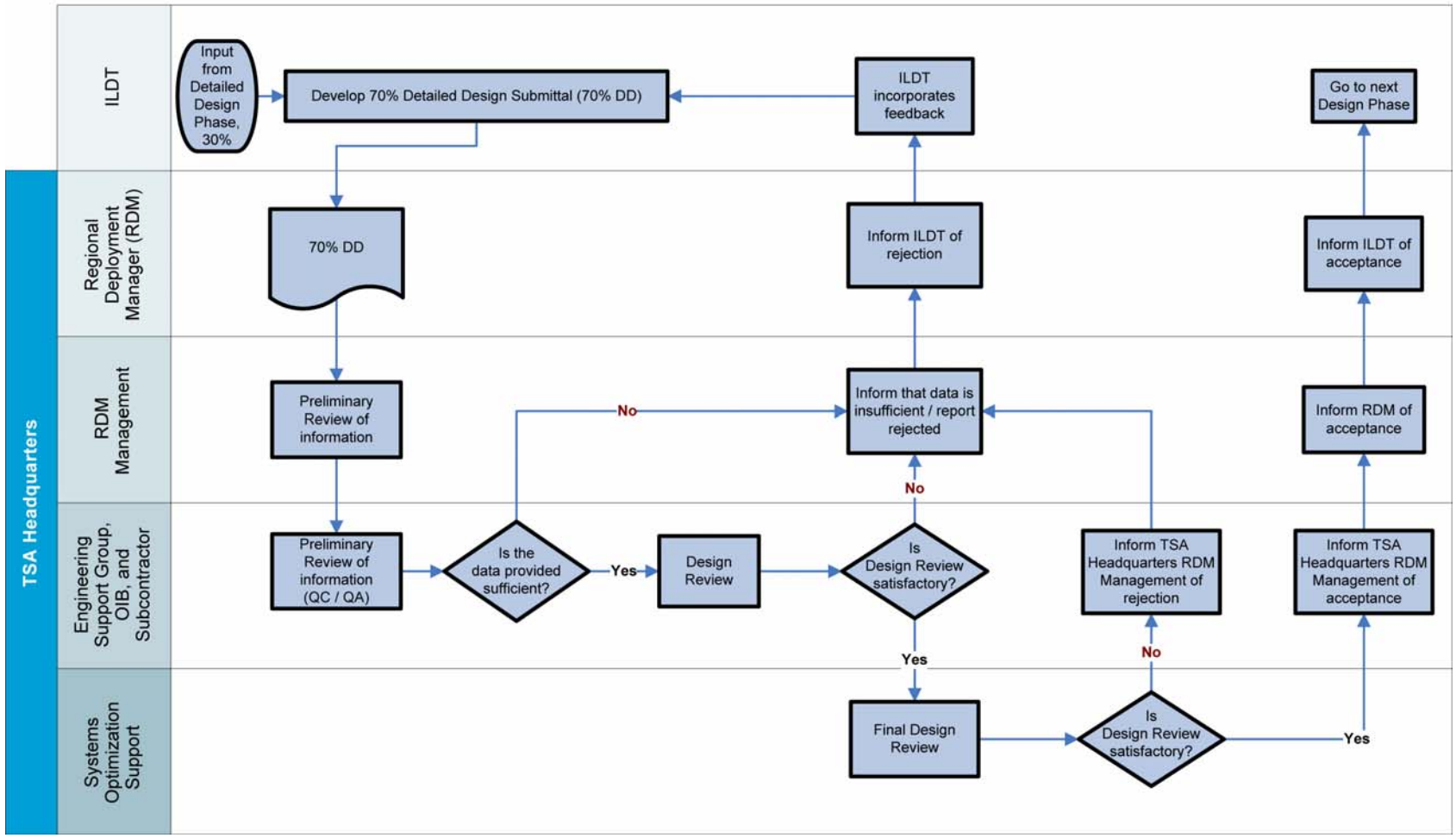


Figure 2-13
SUMMARY OF 70% DETAILED DESIGN PHASE

Tasks

The tasks involved in the 70% Detailed Design sub-phase are outlined below:

1. Based on TSA-comments on the 30% design submittals, refine detailed design drawings.

2. Refine ROM construction and O&M cost estimates.

3. Update the preliminary program schedule developed in the 30% design sub-phase.

4. Obtain an updated indication of expected equipment type from TSA.

5. Submit the 70% design deliverables specified below.

6. Receive comments on the 70% design submittals and formal approval/rejection from TSA.

7. Conduct a meeting with the ILDT and TSA to review the 70% design submittals.

Deliverables

Simple mini in-line designs are exempt from this detailed design sub-phase. However, all 70% detailed design deliverables (except dynamic simulation) are required as part of the 100% design sub-phase.

The 70% design package shall include the following documents:

- **Updated Basis of Design Report**

- **Updated Operational Standards Assessment** based on based on a **dynamic simulation analysis** provided as an AVI or comparable format for visual output and comma-delimited text file or excel spreadsheet with simulation statistical inputs and outputs. The AVI shall have sufficient detail to clearly demonstrate that all system components and operational devices have been simulated as represented in the statistical data.

- **70% design drawings** for all disciplines, including:

  - Mechanical drawings, including:
    - Motor/drive package locations
    - Catwalk/platforms/ladders and stairways
    - Dimensions of points of intersection
    - Realistic elevations and TOB identifiers, including areas of interest
    - Pertinent details (specific required structural attachments, maintenance space requirements, etc.)
    - Notable interference issues
  - Demolition requirements

- Electrical
  - Control station locations
  - E-stop zones (drawings which reflect areas and activating stations)
  - Device locations (photo-eyes, shaft encoders, audio/visual alarms, remote I/O boxes)
  - Final MCP locations and sizing
- EDS machine removal route as well as all other O&M-related access
- Control room location (if applicable)
- Demolition and phasing plans
- Any refinements to CBRA plans

- **Cross sections** showing the vertical dimensions of the CBIS.

- **Refinements to the Description of Operations** including refinements to the discussion of how the system is intended to work with emphasis on the CBRA and legacy BHS (if applicable). This shall include updates to the description of compatibility between legacy BHS and new CBIS, contrasting baggage rates and controls methodology.

- **Preliminary Contingency Plan** describing contingency operations in the event of:

  - Screening equipment failure
  - Conveyance equipment failure
  - Loss of utility power
  - Unplanned surges in system demand

- **70% specifications**, with specific reference made to the responsibility of the BHS contractor to meet TSA-specified CBIS design performance requirements and current CBIS commissioning requirements for final TSA approval as well as documentation on the reporting capabilities for which the CBIS is designed and related operational procedures (e.g., jam clear procedures). Refer to Chapter 7 for design standards and for detailed information on design performance requirements, and Appendix D for commissioning requirements.

- **Draft Site-Specific Configuration Management Plan**, including documentation of the boundaries of the screening system, areas of responsibility among TSA, the project sponsor, and the airlines (if they are not the project sponsor), and procedures for documenting and informing relevant parties of modifications to the CBIS after submission of documentation for the Site Specific Test Plan (SSTP).

- **Documentation of stakeholder review and approval**, including responses to TSA OSO and OST comments concerning OSR and CBRA areas for TSA review.

- **70% estimate of probable construction and O&M costs**

- **Refined phasing schedule**

- **Conveyor manifest, including:**

  - Motor sizing
  - Total amperage requirements
  - Conveyor speeds (refined)

- **An updated list of EDS equipment**, by make, model, and serial number, that will be decommissioned after the proposed in-line system is operational.

TSA Responsibilities

As part of the review process at the end of the 70% design sub-phase, TSA Headquarters is expected to provide the project sponsor with the following:

- Updated indication of the expected equipment type to be delivered.
- Formal approval/rejection and comments on the 70% design submittals.

Meetings

A meeting will be conducted with the ILDT and TSA at the end of this sub-phase to review the above-mentioned deliverables.

2.2.3.3 100% Design

A process flow chart of this phase is displayed on Figure 2-14. Figure 2-15 summarizes tasks, deliverables, TSA responsibilities and meetings for the 100% Detailed Design Phase.

Tasks

The tasks involved in the 100% Detailed Design sub-phase are outlined below:

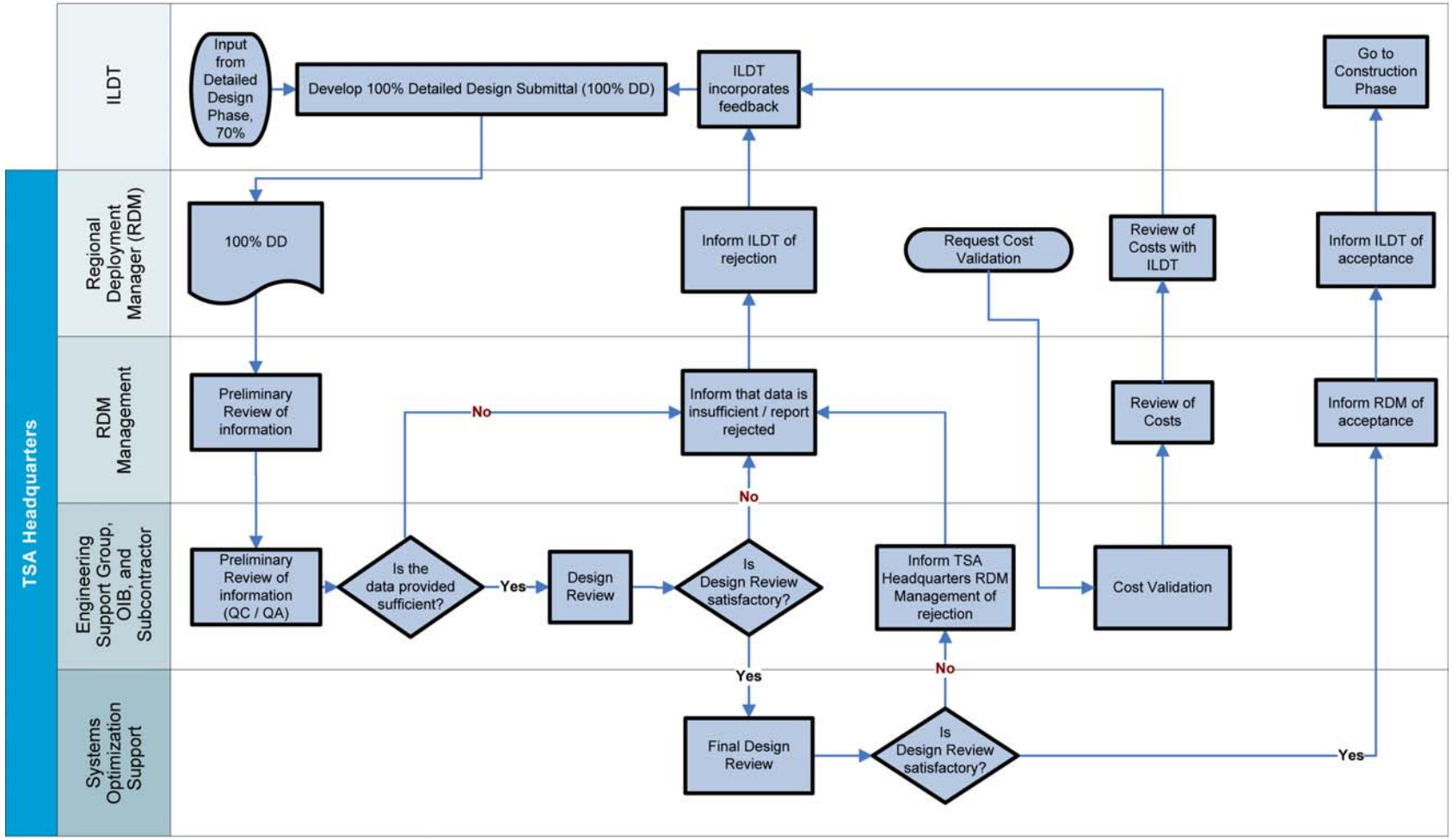
1. Based on TSA-comments on the 70% design submittals, refine and finalize detailed design drawings.
2. Refine and finalize ROM construction and O&M cost estimates.
3. Update the preliminary program schedule developed in the 70% design sub-phase.
4. Confirm with TSA the exact equipment to be delivered and expected delivery schedule.
5. Submit the 100% design deliverables specified below.
6. Receive comments on the 100% design submittals and formal approval/rejection from TSA.
7. Provide a final review of the life cycle support impacts for airport facilities that do not met the Chapter 7 Design Best Practices and Standards.
8. Conduct a meeting with the ILDT and TSA to review the 100% design submittals.

Deliverables

The 100**%** design package shall include the following documents:

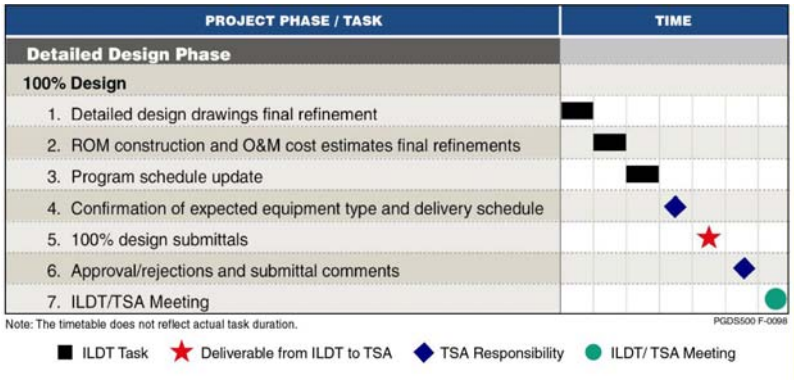
- **Bid Documents,** including:
  - Cover sheet (with noted stakeholders, project locale, title, dates, revision block).
  - Drawing index
  - Legend sheet
  - Mechanical
    - Conveyor manifest sheet(s)
    - Plan views (including catwalk, stairs, egress)
    - Elevation views
    - Project specific/standard details
    - Phasing drawings
    - Demolition requirements
  - Electrical
    - Control stations/devices/MCP locations
    - E-stop zones, with relevant control station
  - Demolition and phasing plans
  - EDS machine removal route as well as all other O&M-related access
  - CBRA plans

Figure 2-14
DETAILED DESIGN PHASE, 100% DESIGN PROCESS FLOW



Footnote: A cost validation may be requested at the RDM's discretion at any time during the design review process.

Figure 2-15
SUMMARY OF 100% DETAILED DESIGN PHASE



- **Final Description of Operations** including the final discussion of how the system is intended to work with emphasis on the CBRA and legacy BHS (if applicable). This shall include final updates to the description of compatibility between legacy BHS and new CBIS, contrasting baggage rates and controls methodology.

- **Contingency Plans**, including diagrammatic depictions of baggage screening contingencies, as well as other screening methods and mitigation measures. A consolidated document shall be provided to TSA describing the conditions that would trigger mitigation measures and protocols for operation. In addition, a directory of all project stakeholders with direct responsibilities for operation of the CBIS should be included in the document.

- **Project specifications**, with specific reference as to the responsibility of the BHS contractor to meet TSA-specified CBIS design performance requirements and current commissioning requirements for final TSA approval, including functional specifications of the system.

- **Final Site-Specific Configuration Management Plan**, including any updates on documentation of the boundaries of the screening system, areas of responsibility among TSA, the project sponsor, and the airlines (if they are not the project sponsor), and procedures for documenting and informing relevant parties of modifications to the CBIS after submission of documentation for the SSTP.

- **Documentation of stakeholder review and approval**, including responses to TSA OSO and OST comments concerning OSR and CBRA areas for TSA review.

- **Final estimate of probable construction and O&M cost**

- **Final phasing schedule**

- **An updated list of EDS equipment,** by make, model, and serial number, that will be decommissioned after the proposed in-line system is operational.

- **Operations training materials and documentation** (see Section 2.2.7).

TSA Responsibilities

As part of the review process at the end of the 100% design sub-phase, TSA Headquarters is expected to provide the project sponsor with the following:

- Confirmation of the exact equipment to be delivered and the expected delivery schedule.

- Formal approval/rejection and comments on the 100% design submittals.

Meetings

A meeting will be conducted with the ILDT and TSA at the end of this sub-phase to review the above-mentioned deliverables.

2.2.3.4 Design-Build Projects

Deliverables

Sponsors of projects anticipated for completion through a design-build contract, regardless of the design percentage at which the design-build contract is expected to be awarded, shall provide all documentation outlined above for the 30% design, 70% design, and 100% design submittals. This documentation includes not only the plans and specifications, but also:

- **An Operational Standards Assessment**, as discussed in Section 2.2.3.1.
- **Basis of Design Report**, as mentioned in Sections 2.2.3.1, 2.2.3.2, and 2.2.3.3.
- **Contingency Plans**, as discussed in Sections 2.2.3.2 and 2.2.3.3.
- **Site Specific Configuration Management Plan**, as discussed in Sections 2.2.3.2 and 2.2.3.3.
- **Updated probable construction and O&M costs**, as outlined in Sections 2.2.3.1, 2.2.3.2, and 2.2.3.3.

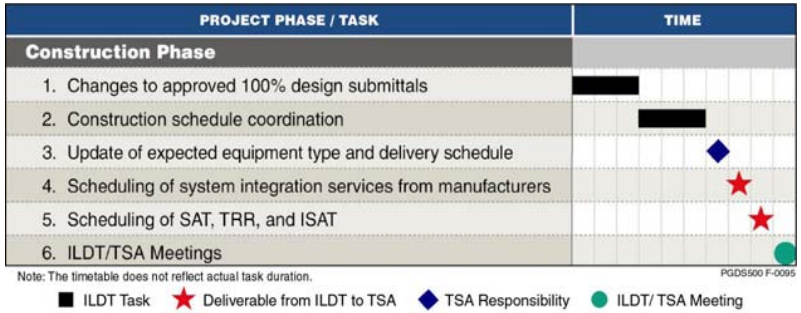
These documents shall be provided in accordance with a schedule coordinated by the ILDT and TSA to ensure applicability of the intended system to the guidelines and standards presented herein.

Additionally, shop drawings and 70% progress drawings shall be provided for CBIS being constructed through design-build contracts to demonstrate that the system being constructed conforms to the design reviewed and approved by TSA.

2.2.4 Construction Phase

Tasks, deliverables, TSA responsibilities, and meetings for the Construction Phase are addressed in the following paragraphs and shown on Figure 2-16.

Figure 2-16
SUMMARY OF CONSTRUCTION PHASE



The duration of this phase will vary significantly based on the complexity and size of the approved CBIS.

Tasks/Requirements

The following requirements shall be adhered to during the Construction Phase, regardless of project type (design-bid-build versus design-build):

1. To ensure TSA's understanding and acceptance of the projected system performance, any changes or amendments to the approved 100% design must be approved by TSA. This shall include, but not be limited to, contract document addenda or change orders and Requests for Information (RFIs) which affect the functionality of the CBIS. Any variation from the 100% approved design will not be funded without prior TSA approval of the changes.

2. Construction schedules must allow sufficient time for thorough testing and inspection (see Section 2.2.5) that must be scheduled a minimum of 120 calendar days in advance. CBIS specifications shall be developed to conform to TSA criteria for CBIS testing and commissioning as defined in Appendix D. In addition, the project sponsor shall communicate the construction schedule and solicit the participation of designated TSA representatives at appropriate intervals during system construction to confirm the availability of equipment and to schedule equipment delivery, system integration services, and tests.

3. Obtain an update of the availability of equipment and equipment upgrades and the schedule for delivery of dedicated equipment.

4. Provide to TSA the schedule for system integration services.

5. Provide to TSA the schedule for Test Readiness Review (TRR), Site Acceptance Test (SAT), pre-ISAT, and Integrated Site Acceptance Test (ISAT).

6. Conduct regular meetings with the ILDT and TSA to monitor system construction.

Deliverables

- **Any changes or amendments to the approved 100% design**, including, but not limited to, contract document addenda or change orders and requests for information (RFIs).
- **Construction schedules**
- **Courtesy copies of shop and installation drawings** to ensure the original intent of the design as reviewed up to and including the 100% design review submittal process.

TSA Responsibilities

During this phase, based on the construction schedule, TSA Headquarters is expected to confirm the availability of equipment and equipment upgrades and the schedule for delivery of specific equipment.

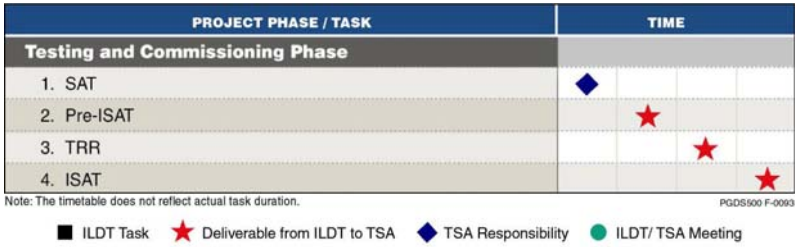
Meetings

Regular meetings should be conducted with the ILDT and TSA to monitor system construction.

2.2.5 Testing and Commissioning Phase

Tasks and TSA responsibilities for the Testing and Commissioning phases are addressed in the following paragraphs and shown on Figure 2-17.

Figure 2-17
SUMMARY OF COMMISSIONING AND TESTING PHASE



Prior to the CBIS being approved and used for security screening operations, at a minimum, the following must be completed:

1. The **SAT** is conducted by TSA to ensure that EDS equipment meets performance standards.

2. The **Pre-ISAT** (for in-line CBIS only) is a series of independent checks and confidence tests conducted by the project sponsor and may be witnessed by TSA. The Pre-ISAT is intended to independently evaluate CBIS performance and capability to meet the design standards and performance requirements defined in Chapter 7. These tests shall be conducted in accordance with the requirements set forth in Appendix D and detailed in the SSTP. Written documentation of the successful demonstration of the Pre-ISAT shall be provided by the project sponsor to TSA.

3. From the TRR forward, the ILDT shall ensure that change management processes are stringently adhered to. See Figure D-2 in Appendix D. In addition to the process outlined in Appendix D, a benchmarked copy of the PLC program controlling CBIS components shall be submitted at the following points:

   - Pre-TRR
   - Pre-ISAT
   - Post-ISAT
   - Post-Operational Run-In

4. The **TRR** is a series of tests to be conducted by ILDT as outlined in the SSTP and witnessed and validated by TSA and/or a TSA contractor to ensure that the CBIS is ready for the Testing and Commissioning phases.

5. The **ISAT** (for in-line CBIS only) is conducted by TSA with logistical/labor support from the project sponsor. Logistical/labor support shall include but is not limited to the following:

   - Baggage handlers to assist in bag induction
   - Tugs and carts to move test bags to test locations
   - Fork lift support for TSA-owned Unit Load Devices (ULDs) that transport test bags
   - Bag tags for test bags
   - Secure storage space for test bags
   - Security Identification Display Area (SIDA) badging support for TSA contractor test team
   - SIDA escort support

   TSA will ensure that the CBIS meets design performance requirements set forth in Chapter 7. This test is conducted for all in-line CBIS types in accordance with the requirements set forth in Appendix D. Test bags will be provided by TSA.

6. The **Run-In Period** should consist of a 30-day period to collect meaningful operational data (BHS and EDS) to support a well rounded test summary report that accurately depicts system performance characteristics. The Run-In period may be extended at TSA direction until open issues are resolved or if new defects are detected during the operational run-in.

7. The **Operational Analysis (OA)** will be directed by TSA on a periodic recurring basis or as the result of reported system performance anomalies.

If the CBIS fails the TRR, subsequent testing shall be conducted at intervals no less than 14 calendar days. If the CBIS fails the ISAT conducted by TSA, subsequent testing shall be conducted at intervals no less than 30 calendar days. Based on availability of testing resources, schedule constraints, credibility of proof that correction has been completed (what caused it to fail has been corrected).

TSA does not test a partial or incomplete CBIS. The system must be in final configuration for ISAT.

TSA does test a CBIS once it is tied-in to the broader BHS. However, to avoid costly change-orders to the CBIS after TSA testing (as a result of failed tests that may require a CBIS change), it is recommended that contractor and designer testing be conducted prior to TSA testing. It is recommended that the test be conducted as soon as the operator receives the TSA test plan, but prior to the TSA ISAT (and even pre-ISAT) to ensure that TSA can officially complete the test in the allotted time.

Deliverables

- Pre-ISAT documentation.
- ISAT documentation.

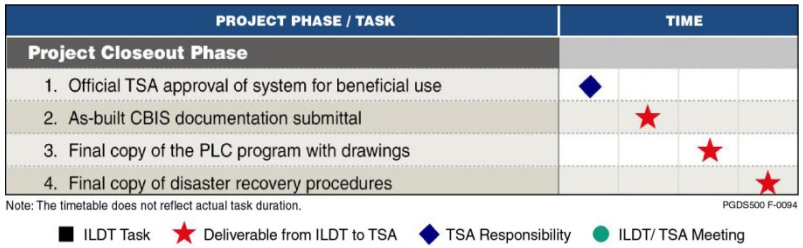
TSA Responsibilities

- Conducting SAT.

2.2.6 Project Closeout Phase

Deliverables and TSA responsibilities for the Project Closeout Phase are listed below and shown on Figure 2-18.

Figure 2-18
SUMMARY OF PROJECT CLOSEOUT PHASE



Once the CBIS has passed all necessary tests, the following actions shall be taken to close out the project. Please see a complete list of configuration information in appendix A in the Control Architecture Overview:

1. TSA shall provide official approval of the CBIS for beneficial use.

2. **As-built CBIS documentation** shall be submitted to TSA, in both CAD and PDF file format, as follows:
   - Final description of operations
   - A complete set of BHS as-built mechanical and electrical drawings, including:
     - Mechanical
     - Cover Sheet & Index
     - Legend
     - Overall Plan View
     - Overall Plan Existing (if available)
     - Isometric (if 3D)
     - CBRA Egress Plan
     - ETD Egress Plan
     - EDS Egress Plan
     - EDS Removal Path
     - ETD Plan View (1/2” scale if possible)
     - CBRA Plan View (1/2” scale, if possible)

- Flow Chart
- Standard Details
- 1/8” scale plan views
- 1/4" scale elevation views
- Catwalk Drawings
- Structural attachment drawings (including load drawings)
- Structural Details
- Phasing Drawings
- Electrical Sheet
- Cover Sheet & Index
- Legend
- Manifest with power summary and belt speeds
- Control Device Plans 1/8” scale
- E-Stop Zones
- Control Device Details
- Network Architecture
  - Upper (Sort Controller)
  - Lower (PLC)

3. **Final copy of the Programmable Logic Controller (PLC) program** shall be submitted to TSA.

4. **Final copy of PLC and software disaster recovery procedures** shall be submitted to TSA including software recovery application.

2.2.7 Operations Training

Operations training, distinct from maintenance training, shall be provided by the ILDT to TSA for mechanical, electrical, and computer functions required to properly operate the staffed portions of the system.

Training shall include, but not be limited to:

- Any BHS provided equipment provided in the CBRA
- Any BHS provided equipment provided in the On-Screen Resolution (OSR) room
- BHS control interface provided to conduct the Image Quality Test (IQT) procedures (see Appendix D)
- CBIS orientation and layout
- CBIS failsafe procedures and layout (see Appendix A)
- System safety
- Bag jam clearing procedures
- The Baggage Handling System Contractor (BHSC) shall provide SSI training for any BHS reports classified as SSI. Training must comply with government Sensitive Security Information (SSI) guidelines (see Appendix H)

All operators or individuals with access to either viewing or printing reports shall also be properly trained in SSI procedures prior to operation. The training sessions shall be conducted prior to the operational startup of the respective BHS.

Training materials and documentation to be presented must be submitted to TSA for review prior to the first scheduled training session. All training sessions shall be videotaped, copies of which are to be provided to TSA prior to live bag screening.

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3 SCREENING PROCESS AND CBIS TYPES

As previously indicated in Chapter 1, the goal of the PGDS is to assist designers in developing several CBIS alternatives and identify preferred CBIS solutions for specific airports.

Every terminal at every airport is unique, with a particular set of zones and specific demand levels. As such, many CBIS types should be considered to find the optimally scaled CBIS solution for each terminal. Many factors should be considered when selecting a specific system configuration—such as the airport or terminal zone scheme, demand levels for the various zones, and capital, operating, and maintenance costs for all alternatives for each zone—to determine the most cost-effective solution that is optimally-scaled for that airport or terminal. The methodology for developing alternatives, comparing them, and selecting the preferred alternative is discussed in Chapter 4.

Planners and designers should consider several alternative solutions during the early design process—these range from highly integrated, highly automated, and low labor-intensive systems (e.g., high-throughput in-line CBIS types) to low-automation and high labor-intensive systems (e.g., stand-alone EDS and ETD CBIS types):

- High-throughput CBIS types typically consolidate baggage flows from multiple terminal zones into one centralized screening matrix with several high-speed EDS machines that have typical screening capacities of 900 to 1,000 bags per hour (bph). These CBIS types correspond to the HS Fully-Integrated In-line EDS application type as detailed in the TSA FY 2009 Competitive EDS Procurement plan.

- Medium-throughput CBIS types are also highly integrated and automated, but tend to be less centralized given the lower screening capacity of medium-speed EDS machines used in such CBIS types (with typical screening capacity of 400 to 550 bph). These CBIS types correspond to the MS Fully-Integrated In-line EDS application type as detailed in the TSA FY 2009 Competitive EDS Procurement plan.

- Mini in-line CBIS types have EDS machines with a lower screening capacity compared to medium-speed EDS, but a higher screening capacity than typical stand-alone EDS machines (see below). Mini in-line CBIS types typically have one mini in-line EDS to screen bags that flow from a bank of ticket counters of one or two airlines onto a single take-away belt with an integrated EDS. These single take-away belts can typically deliver bags at a rate from 200 to 350 bph, which is also the typical screening capacity of mini in-line EDS. A terminal may have one or several mini in-line machines, each serving a bank of ticket counters. These CBIS types correspond to the Mini-In-line and Semi-Integrated Mini-In-line EDS application types as detailed in the TSA FY 2009 Competitive EDS Procurement plan.

- At the opposite end of the spectrum of CBIS types are very decentralized systems, such as stand-alone EDS or ETD CBIS types, whose machines have much lower screening throughputs (or capacities) and, therefore, are typically dedicated to one terminal zone (e.g., a bank of ticket counters for one airline). Typical screening capacities range from 180 to 220 bph for stand-alone EDS CBIS types and around 70 bph for stand-alone ETD CBIS types. These CBIS types correspond to the Stand-Alone EDS application type as detailed in the TSA FY 2009 Competitive EDS Procurement plan.

Within each system type, several acceptable screening equipment models may be available, with similar throughput rates, false alarm rates, and OSR rates. Appendix B provides examples of generic concepts of baggage screening systems, operational assumptions for the generic baggage screening concepts, and best practices captured in these generic concepts.

This chapter provides information about screening system types and their concepts of operation, as well as currently available and future screening equipment that can be used in the various system types.

3.1 INTRODUCTION TO AN IN-LINE CBIS

The following section provides an introductory description of a typical in-line CBIS, including a description of the way bags are directed to the screening area, the three levels of screening, and the way bags are delivered to the baggage sortation system/ makeup device.

3.1.1 Overview

An in-line CBIS is defined from the point of bag induction, through the EDS screening area, to the point where bags are delivered to the airlines' outbound sortation or makeup system.

In an in-line CBIS, screening operations are integrated with the outbound baggage handling system, as shown on Figure 3-1.

The process involves three screening levels.

- Level 1 screening is performed with EDS units. All bags that can physically fit in an EDS unit are directed to Level 1 screening and scanned using an EDS. All bags that automatically alarm at Level 1 are subject to Level 2 screening.

- During Level 2 screening, TSA personnel view alarm bag images captured during the Level 1 EDS scan, and clear any bags whose status can be resolved visually. This process is referred to as OSR, which, for in-line systems, allows the continuous flow of bags through the system until a decision is made. Although OSR typically occurs in a remote screening area, it may occur locally at the individual EDS unit, but this is not recommended. All bags that cannot be resolved at Level 2, and all bags that cannot be directed to Level 1 because of size restrictions, are sent to Level 3 screening.

- Level 3 screening is performed manually and involves opening the bag and the use of ETD technology. Bags that do not pass Level 3 screening (typically, a small percentage of total bags) are either resolved or disposed of by a local law enforcement officer (LEO).

The following paragraphs further describe key elements of an in-line CBIS.

3.1.2 Conveyor Inputs

Typically, checked bags originate at induction belts located on the public side of the terminal, which deliver bags from ticket counters and curbside check-in facilities to the baggage screening zone. In addition, the baggage screening zone may be served by input points for international or interline recheck baggage.

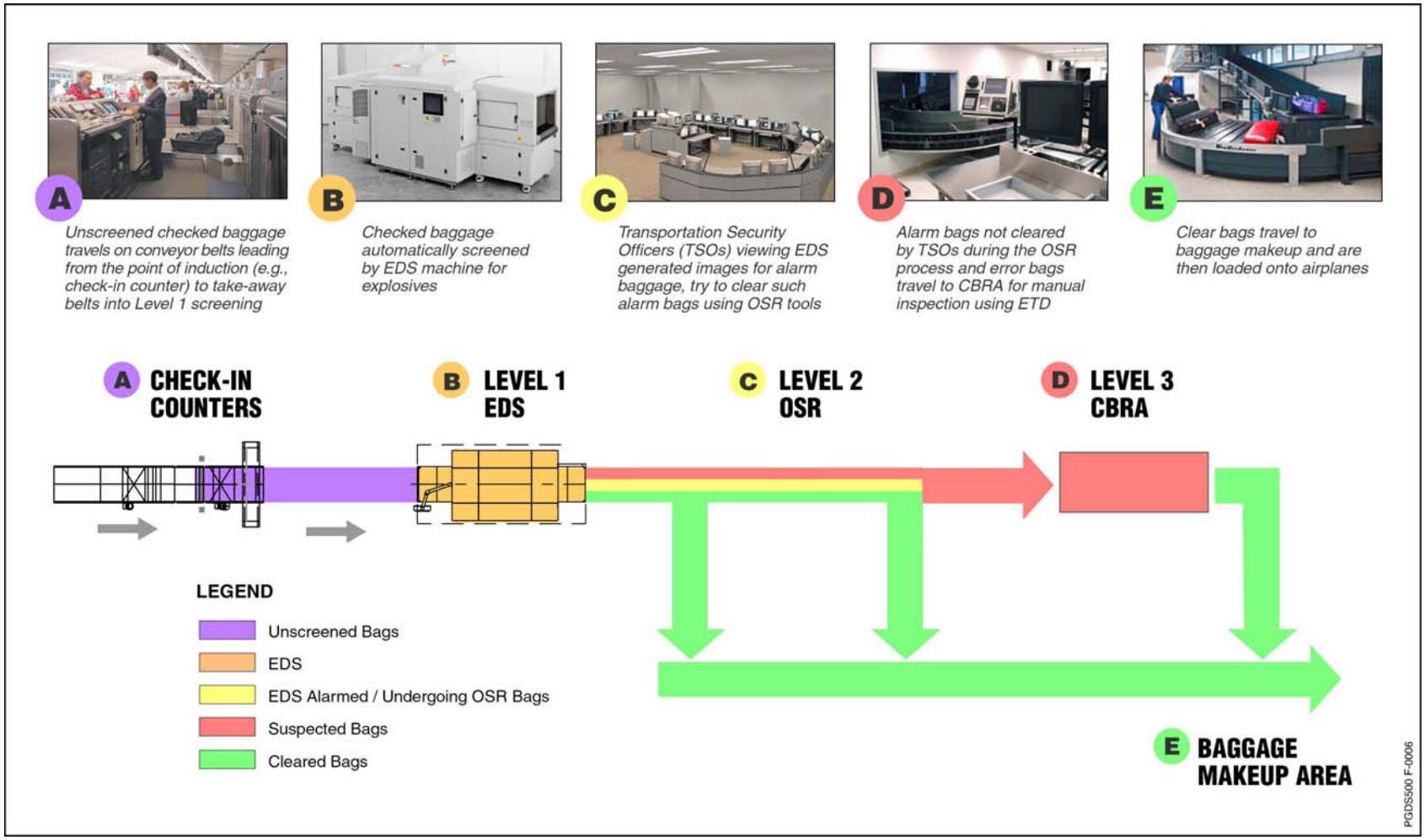
Depending on the specific CBIS design, bags typically travel along the main line conveyors to the screening zone (optionally, bags can travel over several types of load-balancing devices prior to arriving at the screening zone).

- Pre EDS main lines are conveyor lines where input lines are merged to create a main delivery conveyor line that delivers baggage for diversion to individual EDS lines.

- Post EDS main lines are conveyor lines where all EDS clear lines, which includes Level 1, Level 2, and Level 3 cleared baggage, are merged for transport to the make-up area.

- EDS lines are the conveyors that transport baggage from diversion off of the main line through the EDS machine to diversion onto either the clear line or the OSR line (they are also often referred to as spurs, shunts, or subsystems).

Figure 3-1
GENERIC IN-LINE CHECKED BAGGAGE INSPECTION SYSTEM



Typically, a Baggage Measurement Array (BMA) is used to identify bags that are too large to fit into the EDS unit (defined as Out-of-Gauge [OOG] bags) for downstream diversion to a separate conveyor that transfers the bags directly to Level 3 screening at the CBRA (also known as Baggage Inspection Room or BIR) to be screened manually using ETD equipment.

Positive tracking has to be maintained within the tracking zone of the CBIS. This zone starts at the point at which the BHS acquires positive tracking of a bag prior to the EDS (normally at a BMA or Automatic Tag Reader) to diversion to a clear line or to removal for inspection in the CBRA. When positive tracking occurs upstream of the EDS, it begins from the point of positive tracking acquisition (normally at a BMA or ATR) and ends at the last conveyor prior to entering the EDS machine. When positive tracking occurs downstream of the EDS, it typically begins from the EDS entrance tunnel and ends at the diversion point to a clear line or removal for inspection in the CBRA.

3.1.3 Level 1 – EDS Screening Zone

Unscreened bags are typically sent to EDS conveyor subsystems consisting of queue conveyors in front of each EDS unit. Various methods can be used to configure BHS control logic, which drives load balancing between or among EDS units (e.g., round-robin or first-available).

When bags enter the EDS units and are screened, a decision is made by the unit, indicating whether or not the bag has generated an automatic alarm.

Bags cleared by the EDS units typically exit and are transported through the Level 1 cleared-bag divert point located at a relatively close point downstream from the EDS unit.

In general, Level 1 EDS-cleared bags represent a significant majority of all screened bags (exact percentages will depend on the type of EDS unit used and the average false alarm rate of that unit). Level 1 EDS-cleared bags exit the screening system fairly quickly, depending on the EDS unit location and the CBIS design.

Non-clear bags are any bags pre- or post-EDS that have not received a “Clear” security screening decision at Level 1, 2, or 3 screening (i.e., alarmed, pending decision, unknown, lost-in-track, etc.).

3.1.4 Level 2 – On-Screen Resolution Room

Bags that generate an automatic alarm on the EDS units are defined as “alarm bags” and typically continue traveling on the same conveyor until they reach a BHS decision point which is referred to as the OSR line. These are conveyor lines after the EDS exit tunnel transporting baggage that has not yet received a “Clear” security screening decision. Each individual EDS machine is likely to be connected to individual OSR lines that merge on to a main OSR line that transports baggage to the Level 2 clear/alarm diversion point. OSR is performed on baggage that is traveling on these lines.

If a screener decision on an alarm bag has been made by the time the bag arrives at the decision point (based on bag images sent to a remote OSR room), the bag will be diverted accordingly (as a cleared or suspected bag). If no screener decision was made, the bag status would be determined as unknown, and the bag would be treated as a suspect bag and transported to the Level 3 CBRA.

During the travel time (or wait time at decision points) of bags pending OSR decision, bag images are sent to viewing stations within a remote screening room where TSA screeners view the images and determine whether the bag is clear or suspect. When a TSA screener makes an OSR decision or exceeds the maximum time allowed for viewing a bag image (typically, 45 seconds, see Chapter 7), the status of that bag (cleared, suspected, or unknown) is communicated to the BHS and the EDS unit and the bag is diverted accordingly (suspected and unknown bags to the CBRA and cleared bags to the bag makeup area).

If a bag is mistracked after being screened by the EDS unit, its status becomes unknown (or mistracked) and the bag would typically be diverted to Level 3 inspection at the CBRA for manual screening, similar to the manual screening of OOG or oversized (OS) bags. Specifically lost in track is a situation when the BHS loses positive tracking of a bag after the bag has (1) been acquired by the BHS and (2) assigned a BHS tracking ID to be positively tracked.

3.1.5 Level 3 – Checked Baggage Resolution Area

Bags that are not cleared by OSR screening, unknown/error bags and OOG/OS bags are diverted to the CBRA.

When a bag arrives at the CBRA, its corresponding image is typically retrieved by the TSA screener (the image is transmitted over the EDS network) using the bag identifier (ID). Based on the bag image, the TSA screener identifies and locates the alarm object(s) within the alarm bag and manually clears the object(s) using ETD (referred to as directed trace or manual inspection).

Bags clearing ETD screening are re-inserted onto a cleared bag conveyor and typically merged with the main flow of bags to the bag sortation or makeup area.

A clear bag is any bag that has received a “Clear” security screening decision at Level 1, 2 or 3 security screening.

Typically, most alarm bags (as well as unknown and OOG/OS bags) at the CBRA are cleared using ETD directed trace.

3.1.6 Level 4 – Ordnance Disposal

The small remainder of alarm bags that are not cleared by manual inspection at the CBRA are resolved according to current TSA Checked Baggage Standard Operating Procedure (SOP).

3.1.7 CBIS Nomenclature Standardization

The only acceptable bag statuses to be used for all CBISs are:

- Cleared
- Alarmed
- Errored
- EDS Unknown
- BHS Unknown
- Oversize
- Out-of-Gauge

Whenever feasible, all lines should be given a standard, two-letter designation. The two-letter designation can be followed by the line or belt number.

The following nomenclatures shall be used by CBIS designers:

- Mainline Feeds: SF (Security Feed)
- Shunt: SS (Security Shunt)
- Shunt Feed: SSM
- Shunt Exit: SS (Security Shunt, used until first divert point)
- Clear Line: CL
- Alarm Line: AL
- Re-Insert Line: RL
- ETD Clear: CL (Clear Line)
- Out-of-Gauge: OG
- Oversize: OS
- Crossovers: XO
- OSR Line: OSR

3.2 SCREENING SYSTEM TYPES

Five types of screening system configurations are described below. Alarm rates and resolution rates for the machines listed are Sensitive Security Information (SSI) and denoted as such. Environmental restrictions for all machines include non-condensing (NC) levels of humidity.

Table 3-1 summarizes all screening system types, candidate screening equipment, and throughput ranges for this screening equipment.

3.2.1 System Type 1: High-Throughput In-Line CBIS

As shown on Figure 3-2, in-line systems using high-speed EDS machines are assumed to have a very high level of integration and a sophisticated in-line conveyor infrastructure, providing sufficient queuing capacity and OSR circulation time while maintaining high throughput and accurate bag tracking. These systems are assumed to have multiplexed EDS technology (i.e., the capability of linking multiple EDS machines with multiple viewing stations), centralized control room(s), OSR capability, multiple baggage inputs, and CBRAs. Typically, these systems require automated baggage sortation.

The high-speed EDS machines are intended to provide solutions for airports that require fully automated in-line systems designed to handle very high peaks. High-speed EDS machines are estimated to achieve at least a throughput of 900 bph with a low false alarm rate. Also, these machines are expected to have improved image quality and better OSR operator tools (such as high resolution three-dimensional [3D] images of alarmed bags and alarmed objects, as well as density stripping tools). These OSR tools should enable operators to achieve higher clear rates. High-speed EDS machines are likely to be new equipment types, such as the L-3 XLB and the MDI (formerly GE) CTX-9800e.

Figures 3-3 through 3-4 present graphical representations and summarize equipment assumptions for high-speed EDS.

Table 3-1
SCREENING SYSTEM TYPES, POTENTIAL EDS MACHINES, AND THROUGHPUTS

System type number	System type name	Potential EDS machines	Realizable/ projected throughput (bph)	TSIF tested through-put	Status
1	High-through-put in-line CBIS	L-3 XLB MDI CTX-9800e	1080 1080	tbd tbd	Certified(1) Certified(1)
2	Medium-through-put in-line CBIS	L-3 3DX 6600 L-3 3DX 6600 ES MDI CTX-5800 MDI CTX-9400 MDI CTX-9800 Rapiscan RTT80 SureScan x1000	540 720 504 458 720 885 810	tbd tbd tbd tbd tbd tbd tbd	Available In development(1) Certified(1) Available Certified(1) In development(1) In development(1)
3	Mini in-line CBIS	L-3 3DX SX Reveal CT-80DR Reveal CT-80DRXL MDI CTX-5800	360 220 180 360	tbd tbd tbd tbd	Available(1) Available Available Certified(1)
4	Stand-alone EDS CBIS	L-3 3DX 6000 L-3 3DX SX MDI CTX-5500 MDI CTX-5800 Reveal CT-80 Reveal CT-80XL Reveal CT-80DR Reveal CT-80DRXL	220 220 220 220 120 100 220 180	tbd tbd tbd tbd tbd tbd tbd tbd	Available(2) Certified(1) Available(2) Certified(1) Available(2) Available Available Available
5	Stand-alone ETD CBIS	MDI Itemiser DX MDI Itemiser II Smiths IONSCAN 400B Smiths IONSCAN 500DT	33 (primary)/ 24.2 (secondary)	Tbd tbd	Available Available Available Available

(1) = EDS machine availability and characteristics are subject to the outcome of TSA's competitive procurement. If an EDS machine is uncertified or has no procurement contractual vehicle by the time a Basis of Design Report is submitted, then the CBIS design shall be modified to utilize available EDS machines.

(2) = Legacy EDS machines may be redeployed by TSA from existing sites. No new procurement of these EDS machines is currently planned.

General Notes:

- Realizable throughput is based on average bag size of 28 inches and average bag content and assuming optimal 12-inch bag spacing is provided. Throughput data represents the upper end on a spectrum of average throughput ranges given different baggage dimensions (e.g., average international bags are typically longer).
- For continuous feed machines increases in average bag length will reduce throughput. While the conveyor belt is moving at a constant speed, since bags are longer fewer bags can be scanned in a given hour and therefore effectively throughput is reduced. Similarly, reducing average bag spacing will increase the machine's throughput since more bags can be scanned in a given hour as they are more tightly spaced on the machine's belt.
- Reveal CT-80XL and CT-80DRXL are intended for screening of long bags and therefore are expected to have lower average throughput.
- Intervals of shorter duration peak machine throughputs (e.g., 10-minute peak throughput) can be higher than average hourly throughput, which may assist processing baggage micro-surges that could be higher than hourly baggage peak demand levels.
- Throughput for non-continuous feed machines (e.g., MDI 9400; CT-80DRXL) is calculated based on machine constants and collected field data, which include belt acceleration, gantry speed, software latency, and average slices per bag.
- In Stand-Alone EDS CBIS types, realizable throughput is taken to be the lesser of the machine throughput and the system configuration's inherent throughput limit (which is based on the rate at which bags can be manually loaded into the EDS).
- Throughput may vary according to baggage size as determined by airport statistical data per Section 6.3.2.

Special Notes:

- EDS machine availability and characteristics are subject to the outcome of TSA's competitive procurement. If an EDS machine is uncertified or has no procurement contractual vehicle by the time a Basis of Design Report is submitted, then the CBIS design shall be modified to utilize available EDS machines.
- Legacy EDS machines may be redeployed by TSA from existing sites. No new procurement of these EDS machine is currently planned.

Figure 3-2
SCHEMATIC VISUALIZATION OF A HIGH-THROUGHPUT IN-LINE SYSTEM

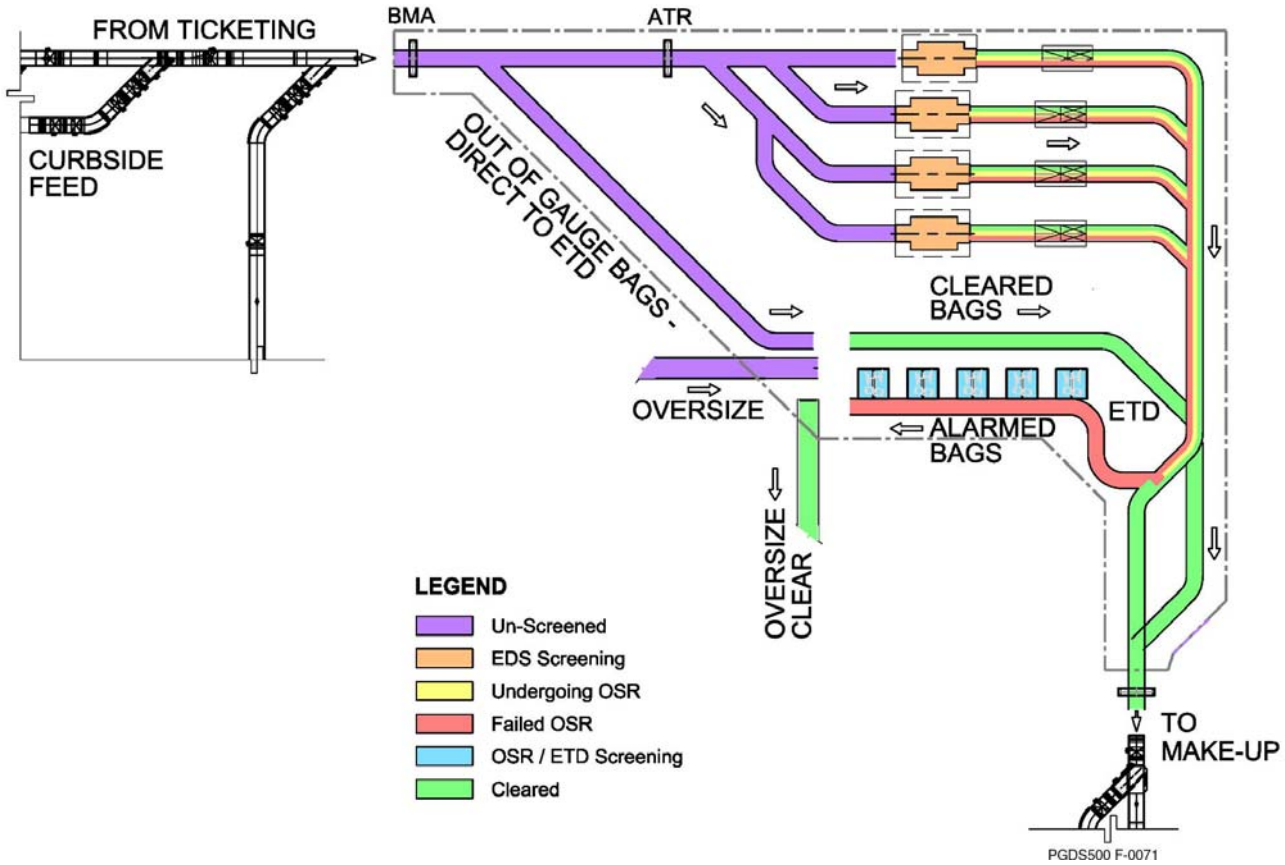
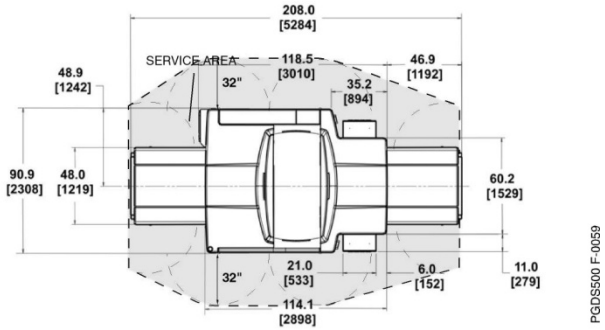


Figure 3-3
ANALOGIC: L-3 XLB
Applicable System Type: High-Throughput

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 14-113 °F Humid. 10-95% NC
Weight (lb)	8,200
Floor loading (lb/sq ft)	112
Max bag size (L_1/L_2 x W x H inch)	120/51 x 39 x 23
Average percent of OOG bags(1)	2%
Current status	Certified(2)

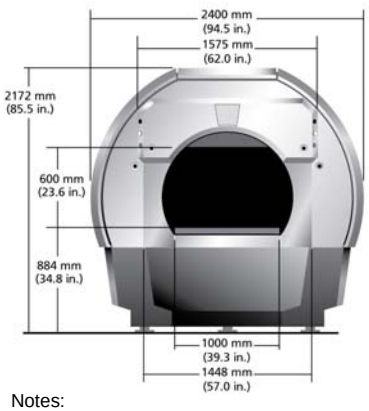
XX.X = inches
[XXXX] = millimeters

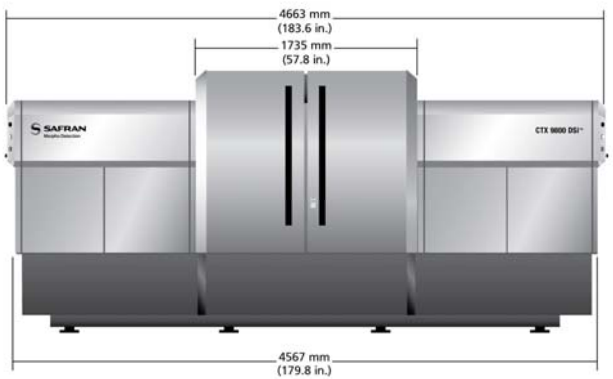


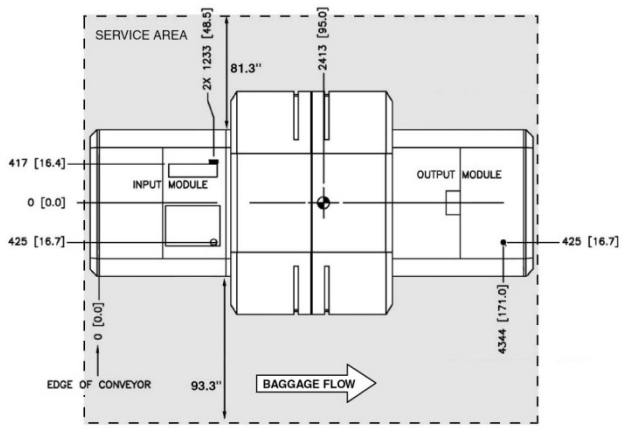
Notes:
L_1 = Maximum bag length machine can scan (see Section 3.4.2).
L_2 = Standard bag length machine can scan (see Section 3.4.2).
(1) = Based on screened bags assumptions (See Section 3.3.2).
(2) = EDS machine availability and characteristics are subject to the outcome of TSA's competitive procurement. If an EDS machine is uncertified or has no procurement contractual vehicle by the time a Basis of Design Report is submitted, then the CBIS design shall be modified to utilize available EDS machines.

Figure 3-4
MDI: CTX-9800e
Applicable System Type: High-Throughput

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 15-120 °F Humid. 10-85% NC
Weight (lb)	16,300
Floor loading (lb/sq ft)	488
Max bag size (L x W x H inch)	Max H: 71 x 30 x 24(1) Max W: 71 x 39 x 16.7
Average percent of OOG bags(2)	2%
Current status	Certified(3)







PGDS500 F-0058

Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).
(3) = EDS machine availability and characteristics are subject to the outcome of TSA's competitive procurement. If an EDS machine is uncertified or has no procurement contractual vehicle by the time a Basis of Design Report is submitted, then the CBIS design shall be modified to utilize available EDS machines.

3.2.2 System Type 2: Medium-Throughput In-Line CBIS

This system type includes the existing in-line systems, in which current generation EDS machines are used. As shown on Figure 3-5, these systems typically have multiplexed EDS technology, relatively complex baggage handling system(s), control room(s) (central or local), OSR capability, single or multiple baggage inputs, and CBRAs. Upfront capital costs can be reduced by using EDS machines with throughput rates ranging from 500 to 700 bph, as this range would allow for a reduction in the conveyor system size and complexity (compared to high-throughput in-line systems).

The assumed EDS throughput of 500 to 700 bph is expected to be achievable with either new equipment, such as the L-3 3DX 6600 (formerly, AN6400), the MDI CTX-5800, or by upgrading existing equipment, such as upgrading from an L-3 3DX 6000 to the L-3 3DX 6600 or from a MDI CTX-9000 (or MDI CTX 9400) to a MDI CTX-9800.

Figures 3-6 through 3-12 provide graphical representations and summarize equipment assumptions for current and future medium-speed EDS machines.

Figure 3-5
SCHEMATIC VISUALIZATION OF A MEDIUM-THROUGHPUT IN-LINE SYSTEM

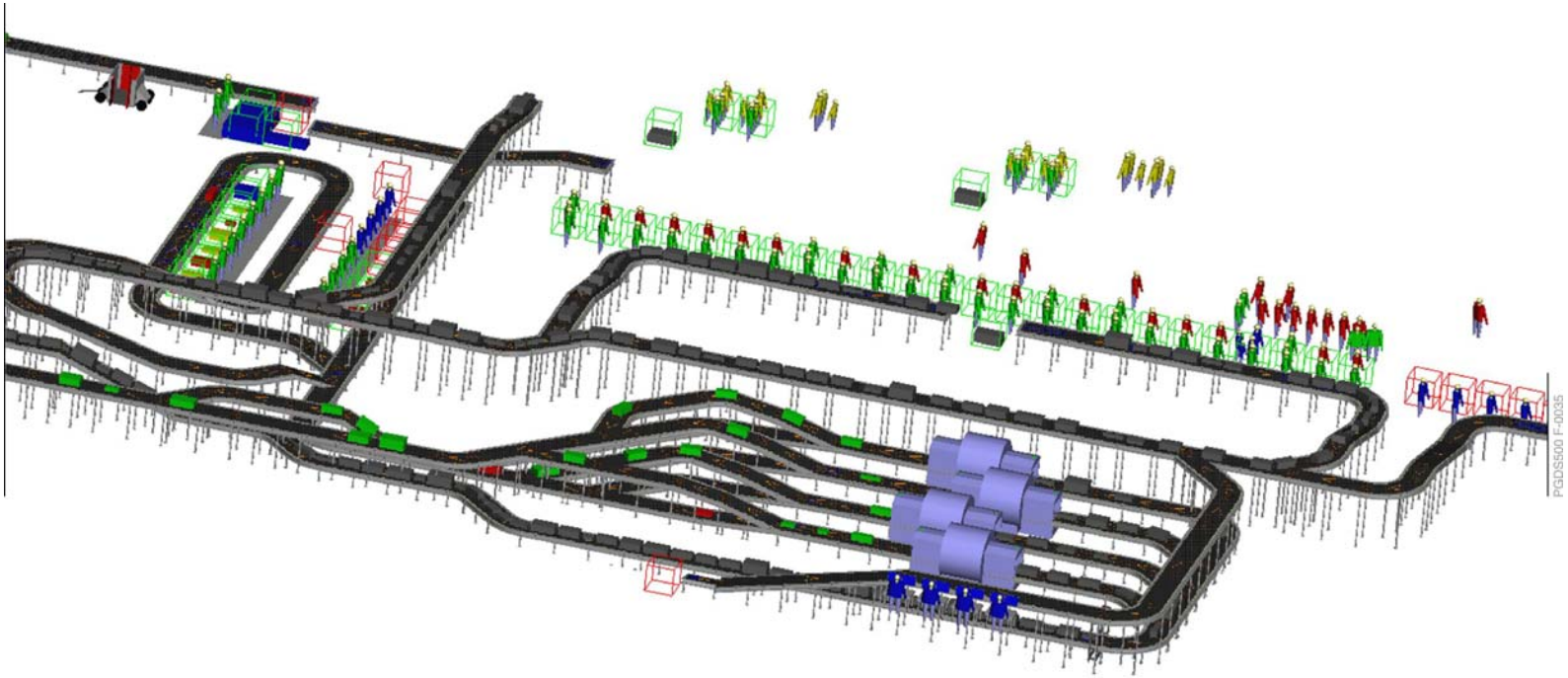
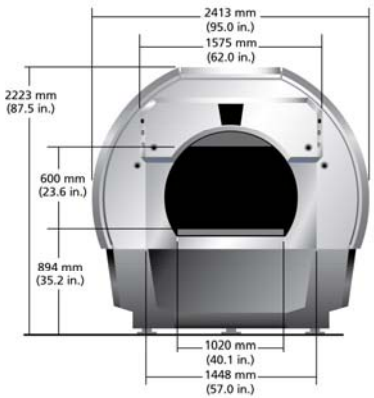
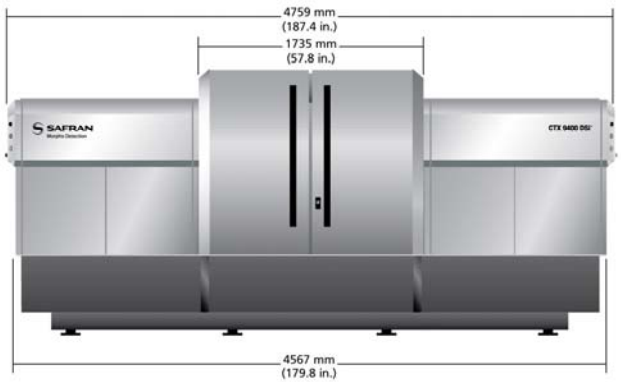
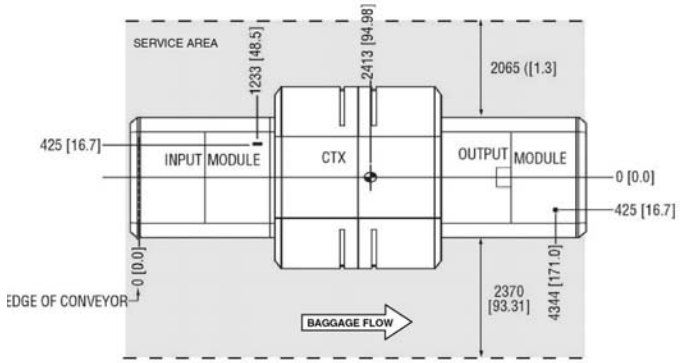


Figure 3-6
MDI: CTX-9400
Applicable System Type: Medium-Throughput

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	30
nvironmental operating envelope	Temp. 15-120 °F Humid. 10-85% NC
Weight (lb)	17,000
Floor loading (lb/sq ft)	488
Max bag size (L x W x H inch)	Max H: 55 x 30 x 24(1) Max W: 55 x 40 x 15.7
Average percent of OOG bags(2)	2%
Current status	Available



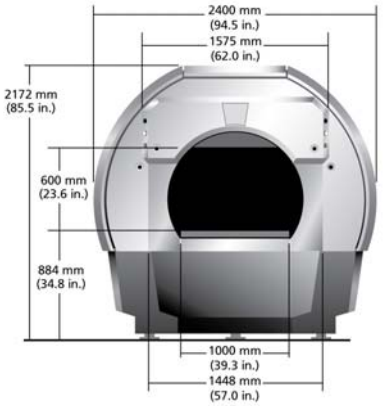


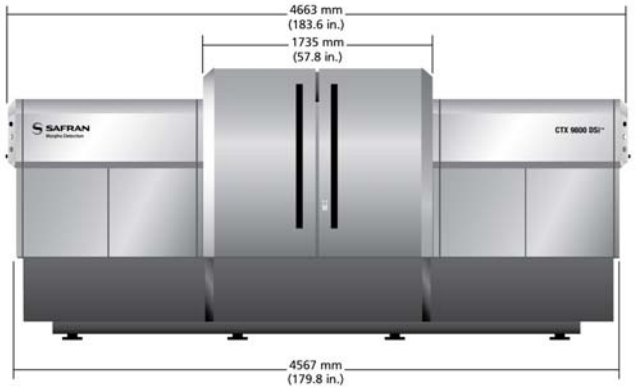


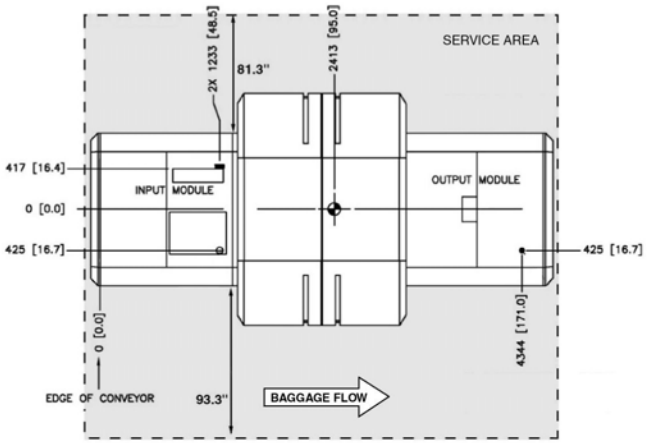
Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).

Figure 3-7
MDI: CTX-9800
Applicable System Type: Medium-Throughput

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 15-120 °F Humid. 10-85% NC
Weight (lb)	16,300
Floor loading (lb/sq ft)	488
Max bag size (L x W x H inch)	Max H:71 x 30 x 24(1) Max W: 71 x 39 x 16.7
Average percent of OOG bags(2)	2%
Current status	Certified







PGDS500 F-0058a

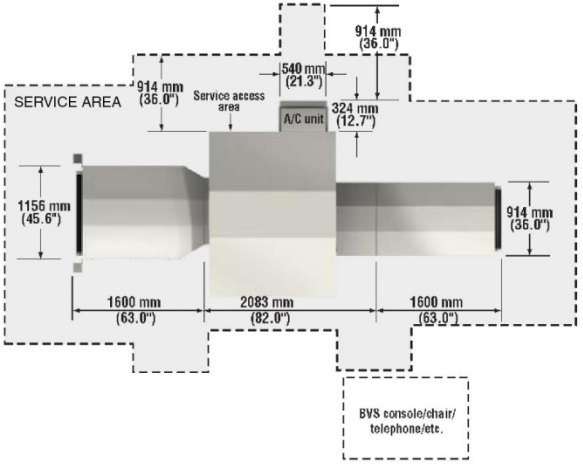
Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).

Figure 3-8
L-3: 3DX 6600
Applicable System Type: Medium-Throughput

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 32-104 °F Humid. 85% NC
Weight (lb)	8,600
Floor loading (lb/sq ft)	98
Max bag size (L_1/L_2 x W x H inch)	120/68 x 32 x 25
Average percent of OOG bags(1)	4%
Current status	Available

System Entrance View

System Entrance View
(Inline and Partial)



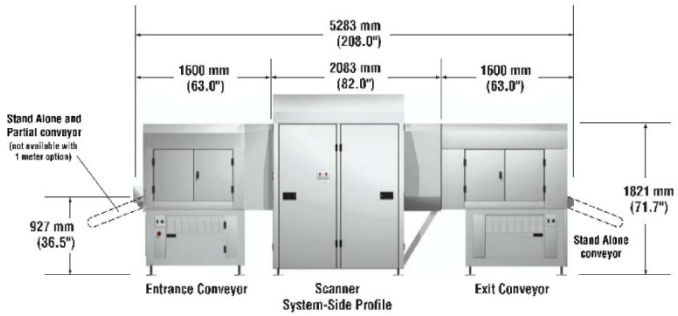
PGDS500 F-0055

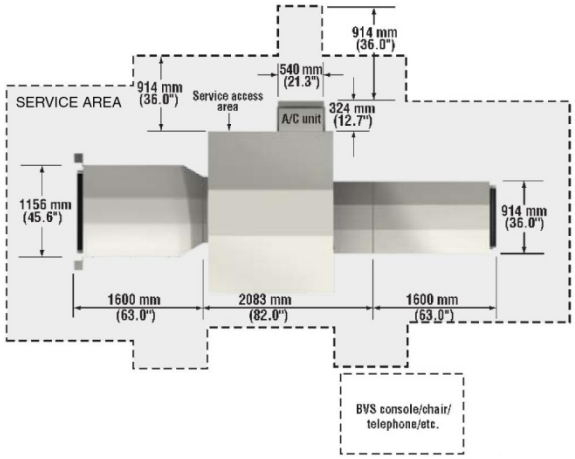
Notes:
L_1 = Maximum bag length machine can scan (see Section 3.4.2).
L_2 = Standard bag length machine can scan (see Section 3.4.2).
(1) = Based on screened bags assumptions (See Section 3.3.2).

Figure 3-9
L-3: 3DX 6600 ES
Applicable System Type: Medium-Throughput

NOT AVAILABLE

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 32-104 °F Humid. 85% NC
Weight (lb)	8,600
Floor loading (lb/sq ft)	98
Max bag size (L_1/L_2 x W x H inch)	120/68 x 32 x 25
Average percent of OOG bags(1)	4%
Current status	In development(2)



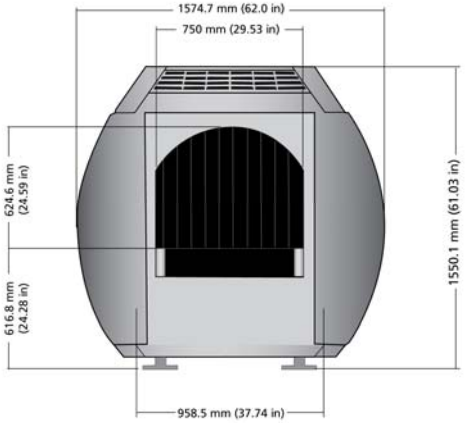


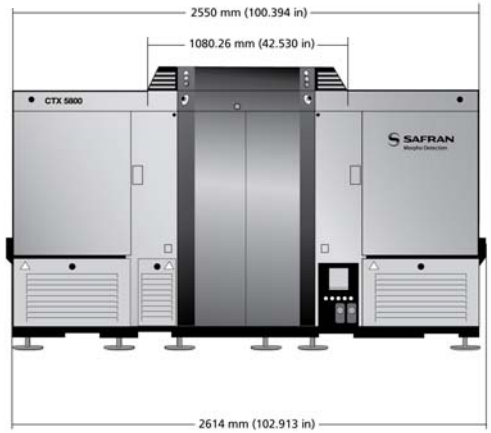
PGDS500 F-0115

Notes:
L_1 = Maximum bag length machine can scan (see Section 3.4.2).
L_2 = Standard bag length machine can scan (see Section 3.4.2).
(1) = Based on screened bags assumptions (See Section 3.3.2).
(2) = EDS machine availability and characteristics are subject to the outcome of TSA's competitive procurement. If an EDS machine is uncertified or has no procurement contractual vehicle by the time a Basis of Design Report is submitted, then the CBIS design shall be modified to utilize available EDS machines.

Figure 3-10
MDI: CTX-5800
Applicable System Type: Medium-Throughput

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 32-95 °F Humid. 10%-95% NC
Weight (lb)	4,500
Floor loading (lb/sq ft)	Stand-alone: 111 Integrated: 128
Max bag size (LxWxH inch)	Max W: N.A(4). x 29.5 x 16.0 Max H: N.A. x 12.0 x 23.6(1)
Average percent of OOG bags(2)	4%
Current status	Certified(3)



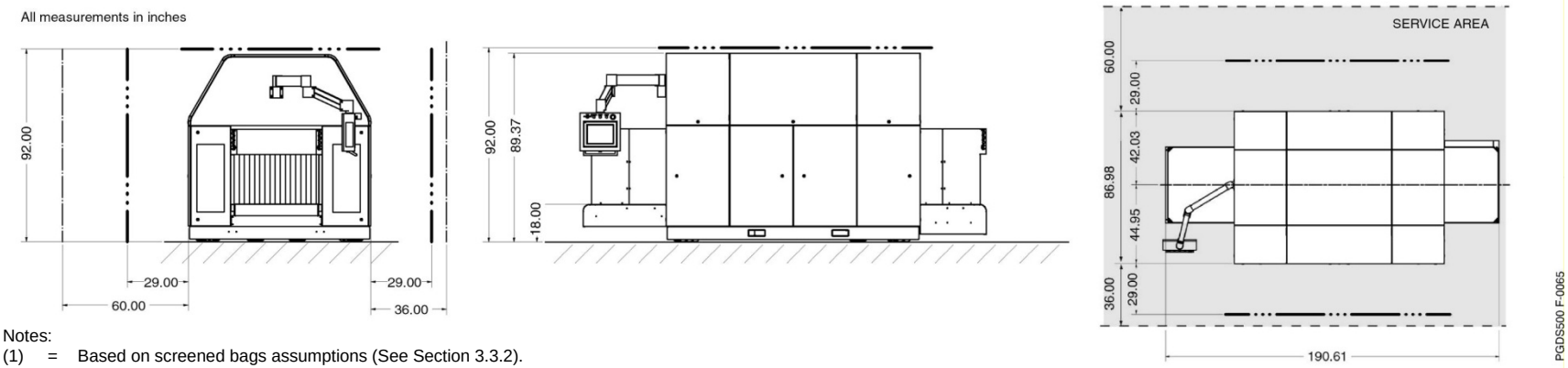


Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).
(3) = EDS machine availability and characteristics are subject to the outcome of TSA's competitive procurement. If an EDS machine is uncertified or has no procurement contractual vehicle by the time a Basis of Design Report is submitted, then the CBIS design shall be modified to utilize available EDS machines.
(4) = Not available, CTX-5800 does not have maximum bag length.

Figure 3-11
SURESCAN: X1000
Applicable System Type: Medium-Throughput

NOT AVAILABLE

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	30
Environmental operating envelope	Temp. 32-104 °F Humid. 85% NC
Weight (lb)	13,000
Floor loading (lb/sq ft)	112
Max bag size (L x W x H inch)	62 x 39 x 24
Average percent of OOG bags(1)	2%
Current status	In development(2)

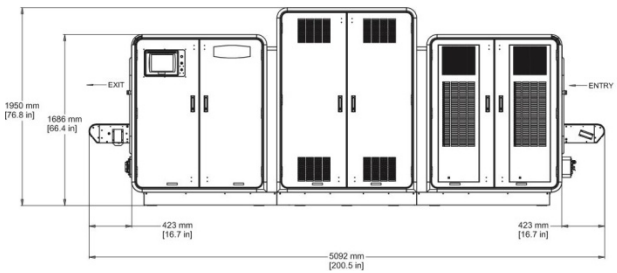


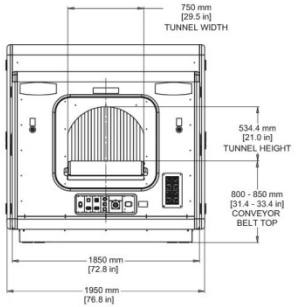
Notes:
(1) = Based on screened bags assumptions (See Section 3.3.2).
(2) = EDS machine availability and characteristics are subject to the outcome of TSA's competitive procurement. If an EDS machine is uncertified or has no procurement contractual vehicle by the time a Basis of Design Report is submitted, then the CBIS design shall be modified to utilize available EDS machines.

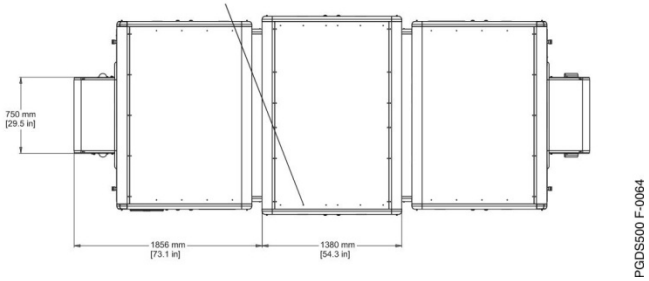
Figure 3-12
RAPISCAN: RTT80
Applicable System Type: Medium-Throughput

NOT AVAILABLE

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	30
Environmental operating envelope	Temp. 32-104 °F Humid. 10-90% NC
Weight (lb)	7,700
Floor loading (lb/sq ft)	280
Max bag size (L x W x H inch)	98 x 30 x 17(1)
Average percent of OOG bags(2)	4%
Current status	In development(3)







Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).
(3) = EDS machine availability and characteristics are subject to the outcome of TSA's competitive procurement. If an EDS machine is uncertified or has no procurement contractual vehicle by the time a Basis of Design Report is submitted, then the CBIS design shall be modified to utilize available EDS machines.

3.2.3 System Type 3: Mini In-Line CBIS

As shown on Figure 3-13, a mini in-line system would typically incorporate a simpler conveyor design and require a smaller footprint. These systems can be located closer to airline ticket counters or bag makeup devices, which can help reduce travel time and the likelihood of improper baggage sortation. Typically, a mini in-line system would be located on the takeaway belt in the bag room or in the Airline Ticket Office (ATO) area and would include a single (and no more than two) EDS machine to minimize system integration costs. Mini in-line systems designs do not require redundant EDS machines (therefore TSA will not provide redundant EDS machines for these systems). Because of the decentralized nature of these systems, staff and equipment needs would generally be higher than for centralized systems (such as in-line systems using high-speed or medium-speed EDS); however, upfront capital costs would be significantly lower. The mini in-line system would reduce upfront capital costs by using EDS machines with throughputs assumed to range from 100 to 400 bph in locations where no economic justification exists to design and implement a full in-line system. With a mini in-line system, it would be possible to use EDS equipment that is (1) currently still in warehouses waiting to be deployed, (2) scheduled to be removed from sites where high-speed or medium-speed EDS machines will be installed, or (3) next generation small EDS that can be easily integrated into existing conveyor infrastructure.

Mini in-line systems should be designed so they do not constrain the maximum throughput of the EDS machines being used. Therefore designers should follow these design considerations:

- Mini in-line system should not be designed to support a “hold on decision” EDS configuration as it severely constrains operational throughput of the system. A “hold on decision” is when a bag waits at a decision point its image is going through an OSR process.
- Sufficient queue space before and after the EDS should be provided to prevent die-back situations and support required OSR travel time.
- For each EDS machine, 2 Bag Inspection Table (BIT) positions sharing 1 ETD machine are required. If the layout permits, there should be 2 Bag Inspections Table (BIT) positions with 1 ETD machine per BIT.
- Combined OSR/ETD is recommended only in low volume systems. In higher volume systems such a configuration may constrain the overall system throughput.

The assumed EDS throughput of 100 to 400 bph is currently known to be achievable with current equipment, such as the Reveal CT-80DR (with the ImageNet add-on), the Reveal CT-80DRXL the MDI CTX-5800, and the L-3 3DX SX.

Other possible configurations are available for a mini in-line system with a lower level of integration. Less integrated systems require lower upfront capital investment, but are relatively more labor-intensive compared to the above-mentioned types of mini in-line systems.

However, it should be noted that screening systems placed close to ticket counters (and therefore with minimal conveyor distance leading to the EDS input) can be susceptible to dieback situations—where bags can quickly accumulate on the conveyors back into the check in ticket counters. Where bag demand generated by self-service kiosks or other expedited check-in processes creates volume at a faster rate than traditional check-in methods, dieback can quickly occur because there is minimal queuing capacity on the conveyor system. Special consideration is required to anticipate ticket counter configurations and baggage delivery rates (including the variable nature of those rates) as part of the planning and design processes for these systems.

Figures 3-14 through 3-16 provide graphical representations and summarize equipment assumptions for current and future mini in-line EDS machines.

Figure 3-13
SCHEMATIC VISUALIZATION OF A MINI IN-LINE SYSTEM

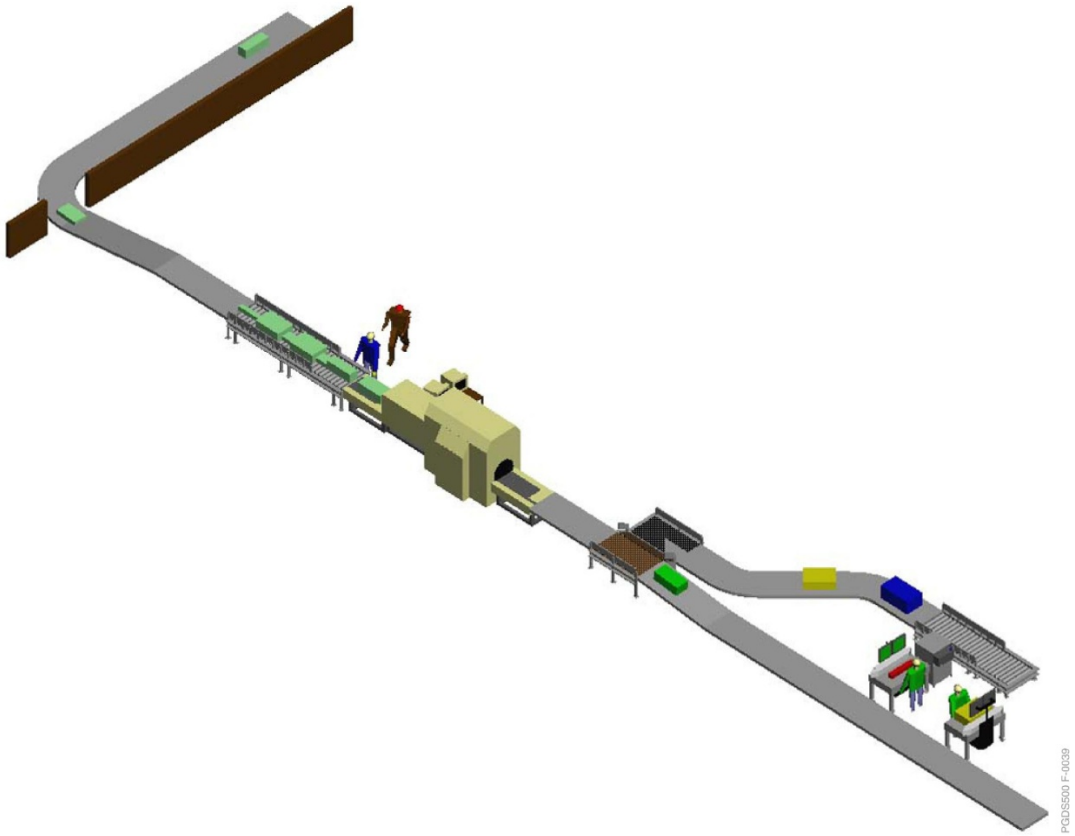
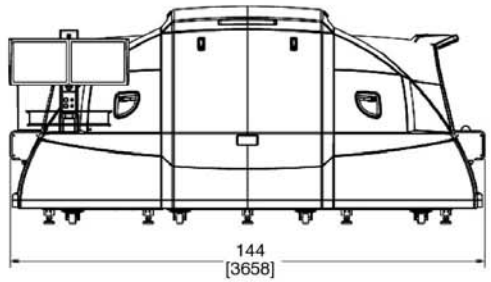
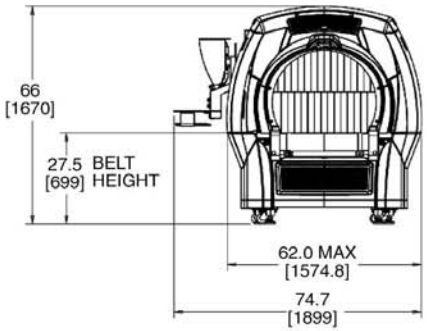


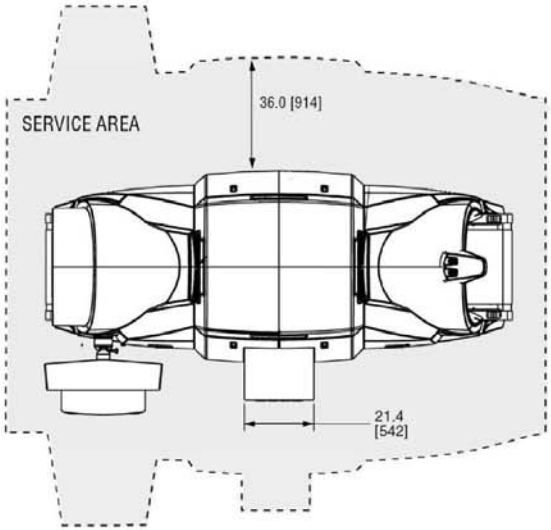
Figure 3-14
L-3: 3DX SX
Applicable System Types: Mini In-Line, Stand-Alone EDS

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 14-113 °F Humid. 10-95% NC
Weight (lb)	5,800
Floor loading (lb/sq ft)	133
Max bag size (L_1/L_2 x W x H inch)	177/63 x 32 x 26(1)
Average percent of OOG bags(2)	4%
Current status	Available

XX.X = inches
[XXXX] = millimeters



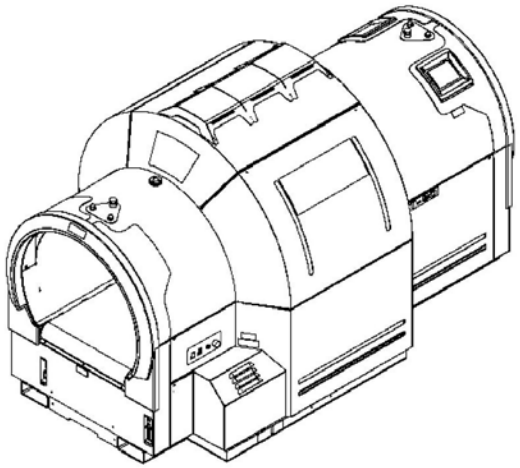




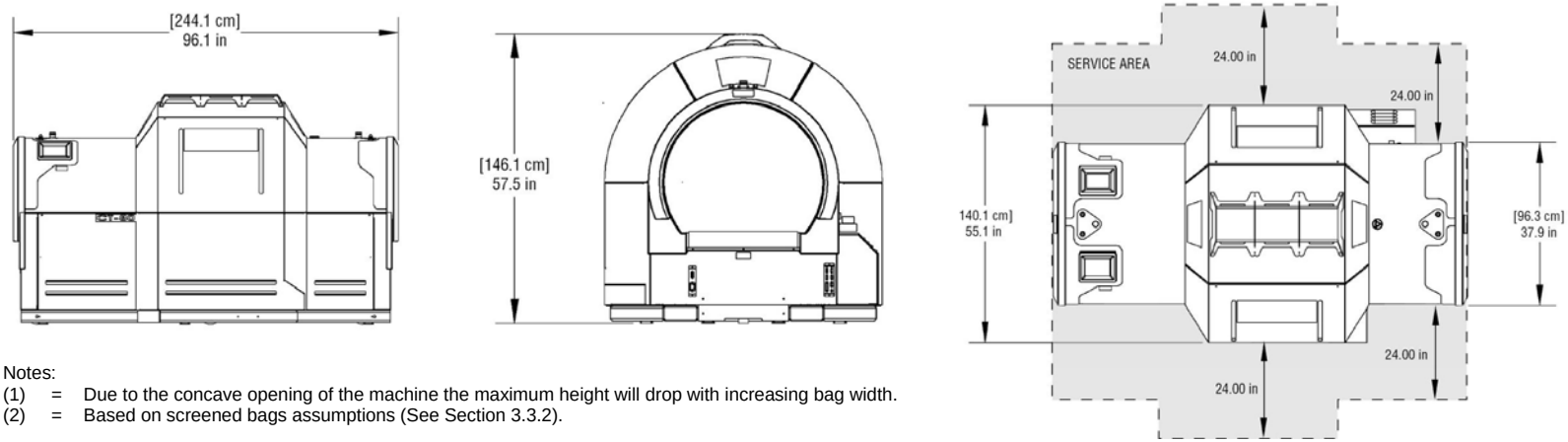
PGDS500 F-0060

Notes:
L_1 = Maximum bag length machine can scan (see Section 3.4.2).
L_2 = Standard bag length machine can scan (see Section 3.4.2).
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).

Figure 3-15
REVEAL: CT-80DR
Applicable System Types: Mini In-Line, Stand-Alone EDS



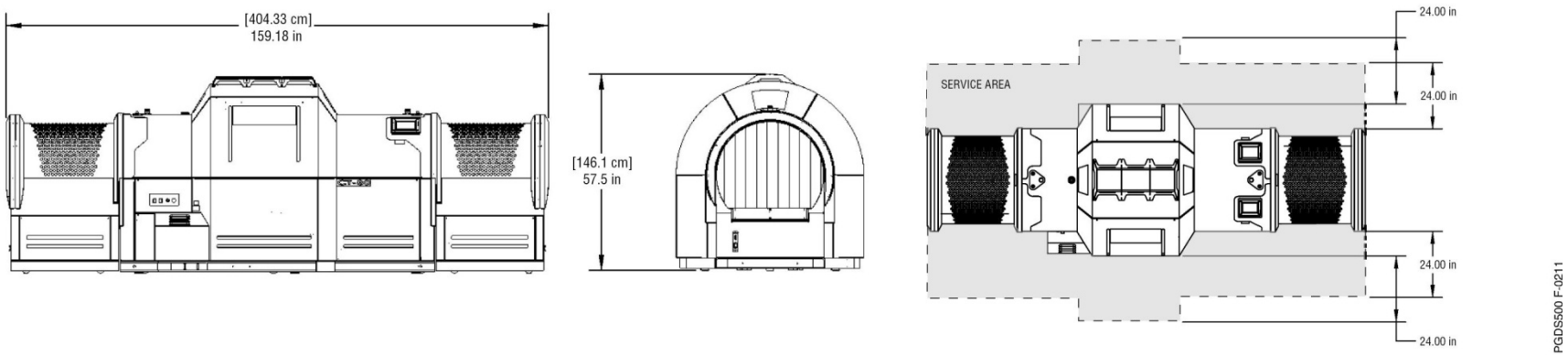
SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	30
Environmental operating envelope	Temp. 41-90 °F Humid. 5-85% NC
Weight (lb)	3,700
Floor loading (lb/sq ft)	101
Max bag size (L x W x H inch)	47 x 32 x 25(1)
Average percent of OOG bags(2)	4%
Current status	Available



Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).

Figure 3-16
REVEAL: CT-80DRXL
Applicable System Types: Mini In-Line, Stand-Alone EDS

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	30
Environmental operating envelope	Temp. 41-90 °F Humid. 5-85% NC
Weight (lb)	3,920
Floor loading (lb/sq ft)	102
Max bag size (L x W x H inch)	98.4 x 31.5 x 25(1)
Average percent of OOG bags(2)	4%
Current status	Available



Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).

3.2.4 System Type 4: Stand-Alone EDS

In small airports or in specific zones with low baggage volumes at larger airports, stand-alone EDS may be the most cost-effective option. As shown on Figure 3-17, a stand-alone EDS operates in a manner similar to lobby screening nodes installed today at many Category X and Category I airports; however, where possible, stand-alone equipment should be installed in baggage makeup areas or other appropriate locations to reduce lobby congestion. This screening system type is relatively labor intensive, but minimal capital investment is required to install the system and support the operation.

A stand-alone system would significantly reduce upfront capital costs by using currently available EDS machines with throughputs ranging from 100 to 200 bph in locations where no economic justification exists to design and implement an in-line system. A stand-alone system would allow the use of EDS equipment that is: (1) currently still in warehouses waiting to be deployed or (2) scheduled to be removed from sites where in-line EDS machines will be installed. The assumed EDS throughput rate of 100 to 200 bph is achievable with current equipment: the Reveal CT-80, the Reveal CT-80XL, the Reveal CT-80DR, the Reveal CT-80DRXL the MDI CTX-5500, MDI CTX-5800, L-3 3DX SX (formerly Analogic King Cobra) and the L-3 3DX 6000.

Figures 3-18 through 3-21 provide graphical representations and summarize equipment assumptions for current and future stand-alone EDS machines that are not already presented as part of the mini in-line CBIS type.

Figure 3-17
SCHEMATIC VISUALIZATION OF A STAND-ALONE EDS

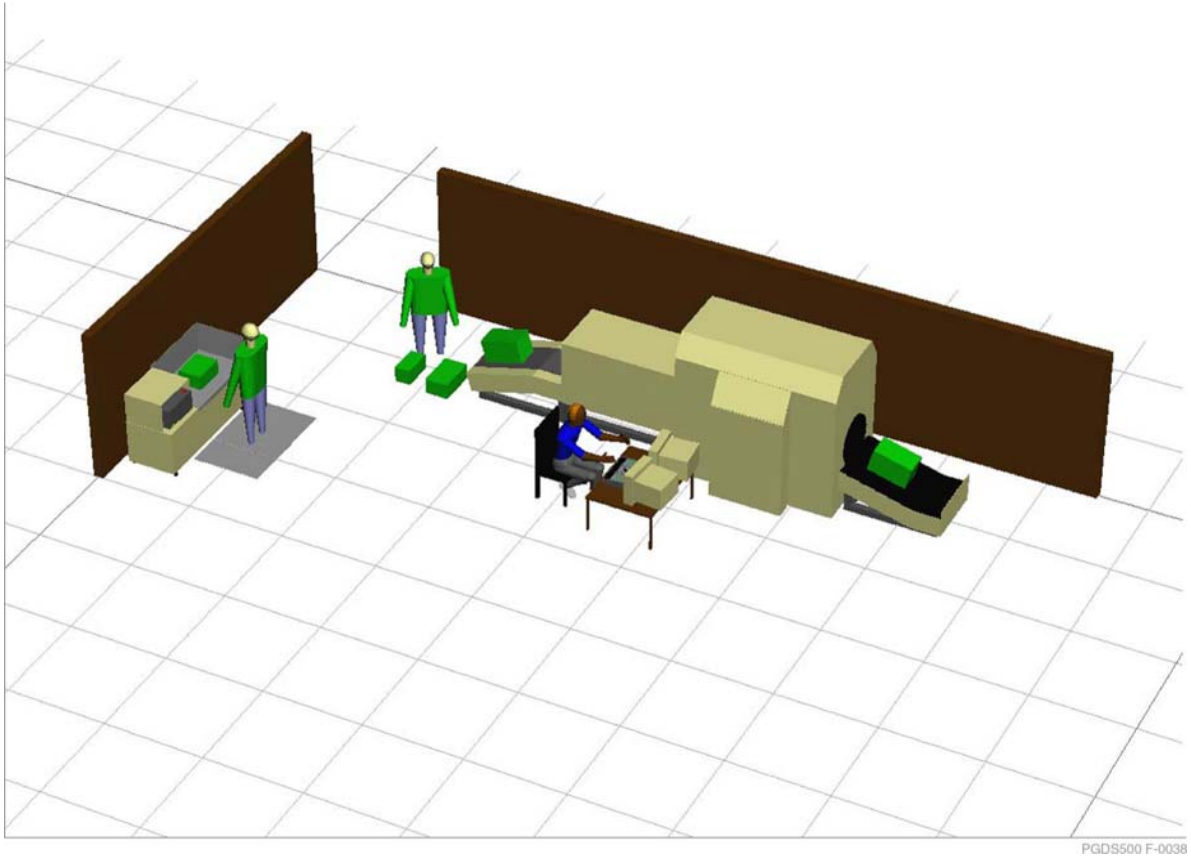
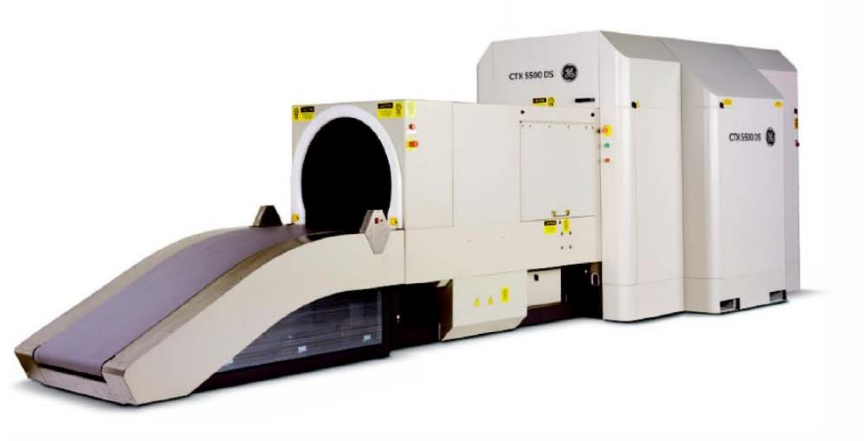
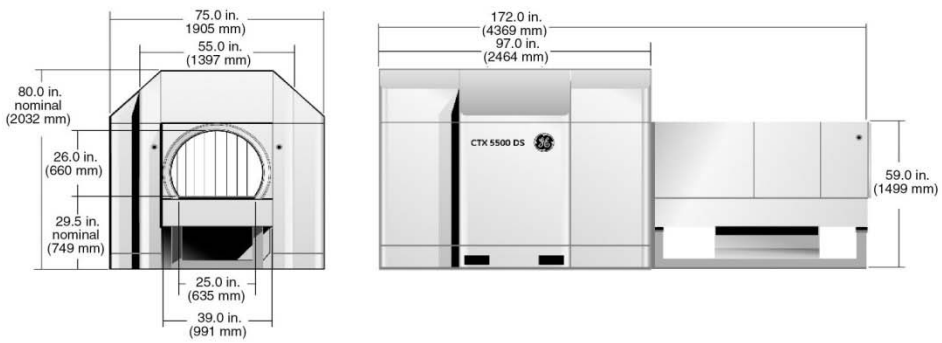
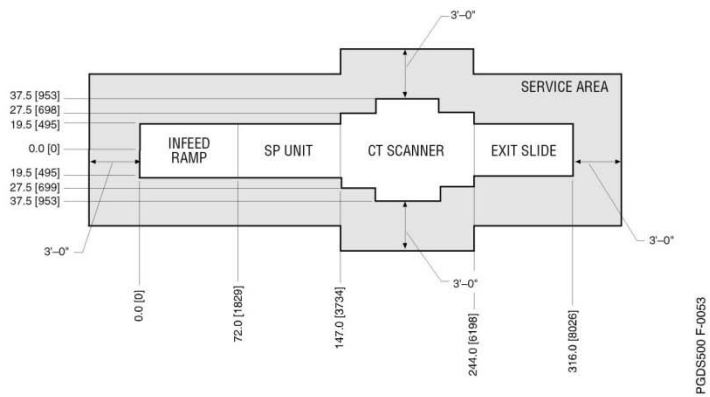


Figure 3-18
MDI: CTX-5500
Applicable System Type: Stand-Alone EDS



SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	30
Environmental operating envelope	Temp. 50-80 °F Humid. 10-60% NC
Weight (lb)	9,350
Floor loading (lb/sq ft)	145
Max bag size (L x W x H inch)	Max H: 39 x 19 x 22 Max W: 39 x 25 x 19
Average percent of OOG bags(1)	4%
Current status	Available(2)

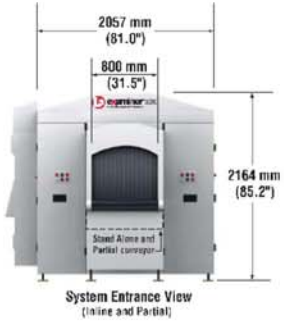


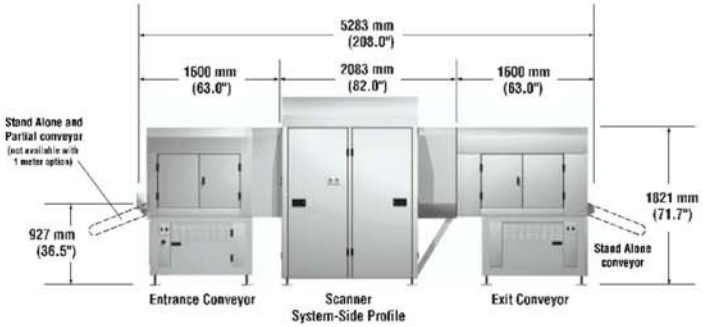


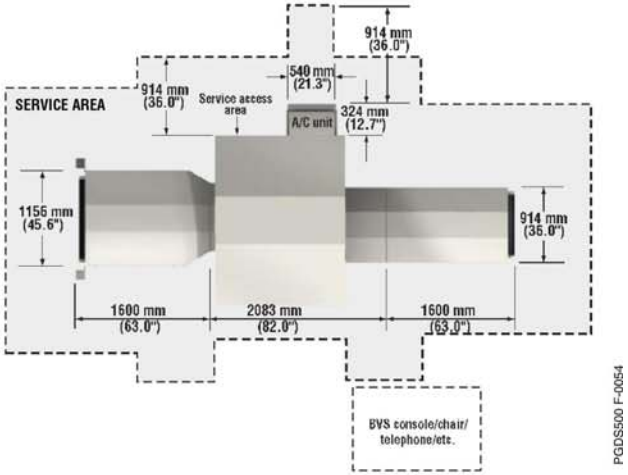
Notes:
(1) = Based on screened bags assumptions (See Section 3.3.2).
(2) = Legacy EDS machines may be redeveloped by TSA for existing sites. No new procurement of these EDS machines is currently planned.

Figure 3-19
L-3: 3DX 6000
Applicable System Type: Stand-Alone EDS

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 32-104 °F Humid. 85% NC
Weight (lb)	8,600
Floor loading (lb/sq ft)	112
Max bag size (L x W x H inch)	62 x 32 x 25[1]
Average percent of OOG bags[2]	4%
Current status	Available[3]

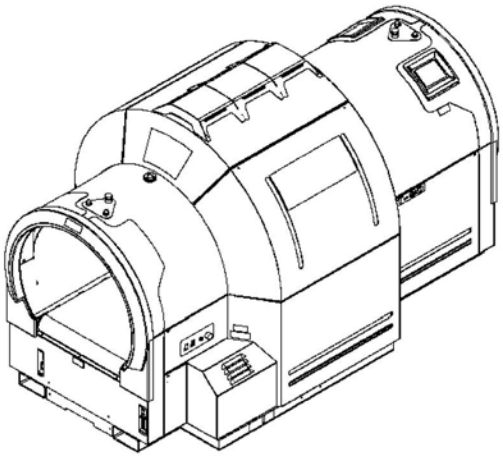




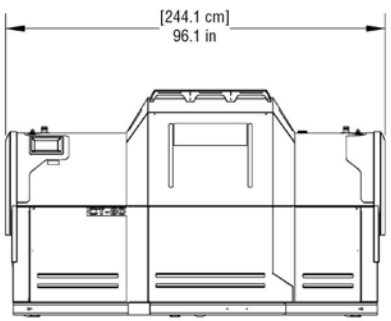


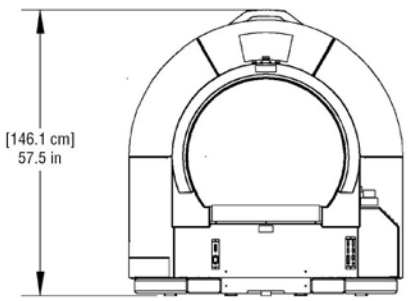
Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).
(3) = Legacy EDS machines may be redeveloped by TSA for existing sites.
No new procurement of these EDS machines is currently planned.

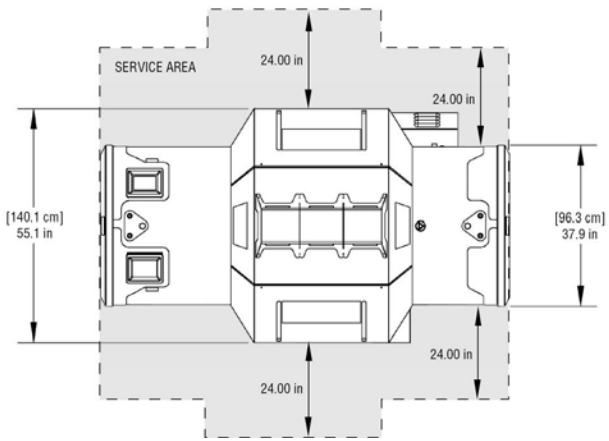
Figure 3-20
REVEAL: CT-80
Applicable System Type: Stand-Alone EDS



SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	30
Environmental operating envelope	Temp. 41-90 °F Humid. 5-85% NC
Weight (lb)	3,700
Floor loading (lb/sq ft)	101
Max bag size (L x W x H inch)	47 x 32 x 25(1)
Average percent of OOG bags(2)	4%
Current status	Available(3)



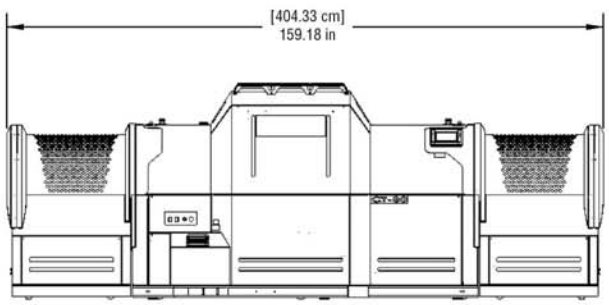


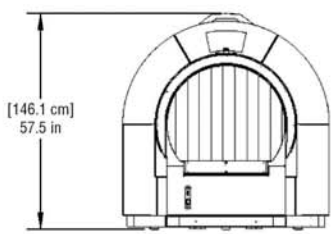


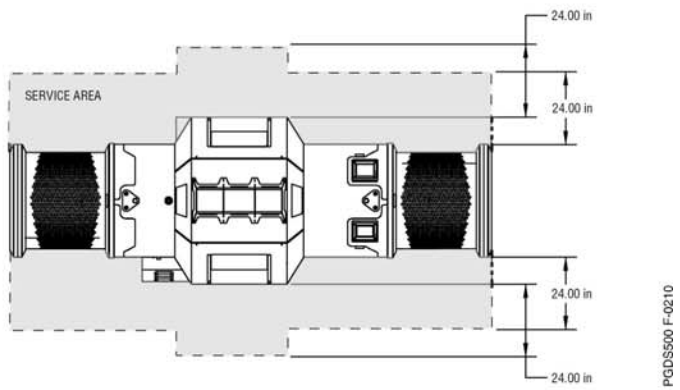
Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).
(3) = Legacy EDS machines may be redeveloped by TSA for existing sites.
No new procurement of these EDS machines is currently planned.

Figure 3-21
REVEAL: CT-80XL
Applicable System Type: Stand-Alone EDS

SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	30
Environmental operating envelope	Temp. 41-90 °F Humid. 5-85% NC
Weight (lb)	3,920
Floor loading (lb/sq ft)	102
Max bag size (L x W x H inch)	98.4 x 31.5 x 25(1)
Average percent of OOG bags(2)	4%
Current status	Available







Notes:
(1) = Due to the concave opening of the machine the maximum height will drop with increasing bag width.
(2) = Based on screened bags assumptions (See Section 3.3.2).

3.2.5 System Type 5: Stand-Alone ETD Systems

ETD equipment is currently used for primary screening (as an alternative to EDS screening and as a means to screen oversized, fragile, and other baggage that cannot be screened using EDS) and for resolution of EDS alarms. ETD systems for both applications are described below. A schematic view of a stand-alone ETD system for primary screening is shown on Figure 3-22.

3.2.5.1 Primary Screening

Stand-alone ETD equipment can currently be used for 100% checked baggage screening in lobbies, baggage makeup areas, or other appropriate locations. Primary screening with ETD should only be used to screen oversized, fragile, and other baggage that cannot be screened using EDS. However, ETD primary screening may also be used at smaller Category IV airports.

As ETD screening is the most labor-intensive screening method and has the lowest throughput compared with all other screening methods, ETD is only appropriate at airports with low baggage volumes. A stand-alone ETD system typically has a throughput on the order of 33 bph per screener (66 bph per ETD machine shared by two screeners). This throughput is known to be achievable with current equipment, such as the MDI Itemizer II, Smiths Detection IONSCAN 400B, and Smiths Detection IONSCAN 500DT.

3.2.5.2 Alarm Resolution

In addition, ETD equipment is used to screen EDS-alarmed bags that have not been cleared by screeners using an OSR protocol (based on viewing bag images). This method is referred to as directed trace (or directed search using ETD) and is focused on identifying and locating objects within baggage that have triggered EDS alarms. A typical throughput using this method is 24.2 bph per screener (a national average based on a mix of international and domestic bags of varying sizes, types, and content). Designers should verify this throughput with TSA.

For some mini in-line configurations, a more staff efficient method of using directed trace can be achieved by using a combined OSR/ETD method. This method assumes that the ETD search tables (at Level 3) also have bag viewing stations that allow screeners to view alarm bag images at the ETD search station. Viewing bag images allows screeners to quickly follow OSR protocol and clear a certain percentage of those alarm bags based on the OSR clear rate for the specified EDS. Bags that cannot be cleared using OSR protocol are screened using a directed trace method (using the bag image to direct the search to alarm objects and using ETD equipment to screen those alarm objects).

The regular throughput of the combined OSR/ETD process is driven by the OSR clear rate of the EDS as well as average OSR clear time for that EDS and the throughput of one ETD unit with two search stations.

Figures 3-23 through 3-26 provide graphical representations and summarize equipment assumptions for current and future stand-alone ETD machines.

Figure 3-22
SCHEMATIC VISUALIZATION OF A STAND-ALONE ETD SYSTEM

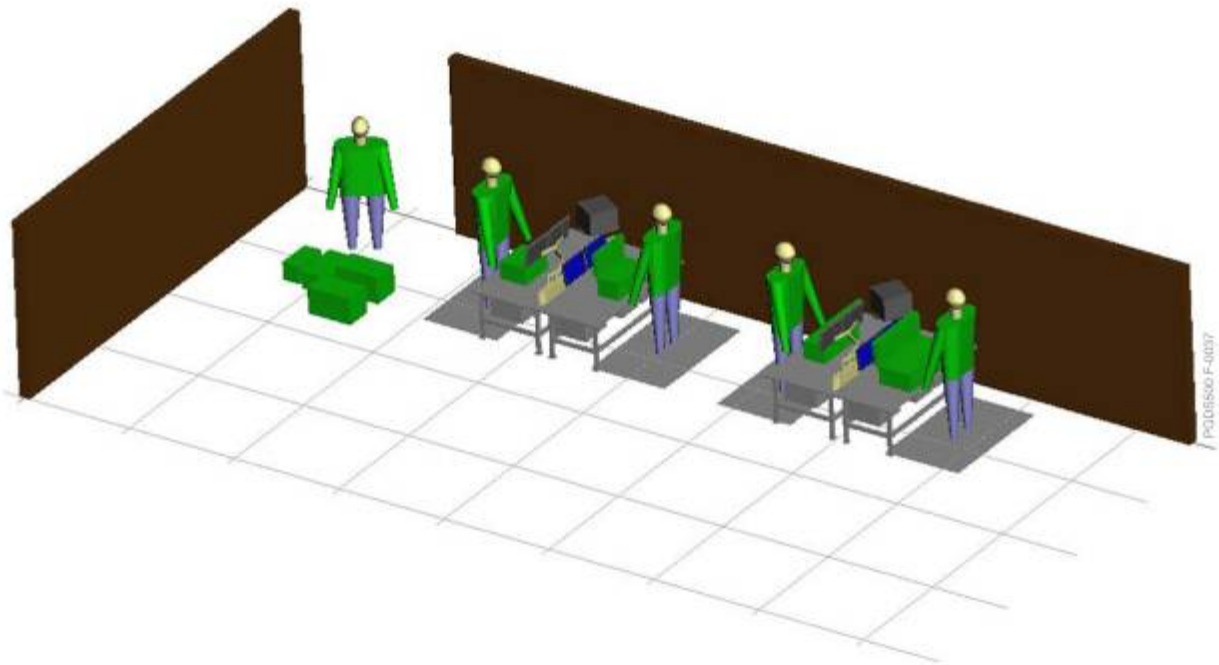
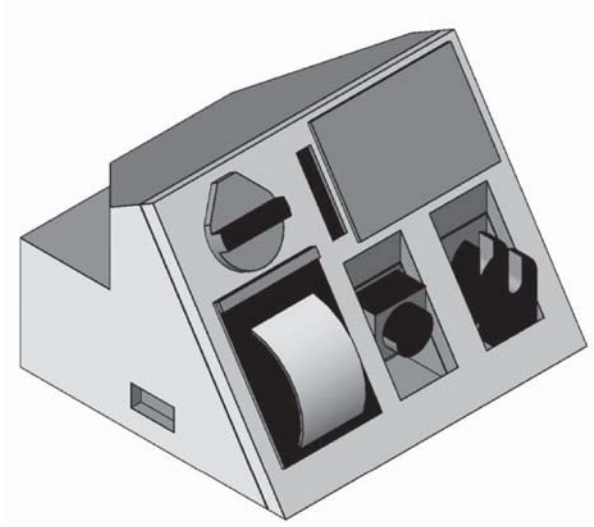


Figure 3-23
MDI: ITEMIZER II
Applicable System Type: Stand-Alone ETD

SPECIFICATIONS	
False alarm rate	SSI
Environmental operating envelope	Temp. 32-104 °F Humid. 0-95% NC
Weight (lb)	43
Current status	Available



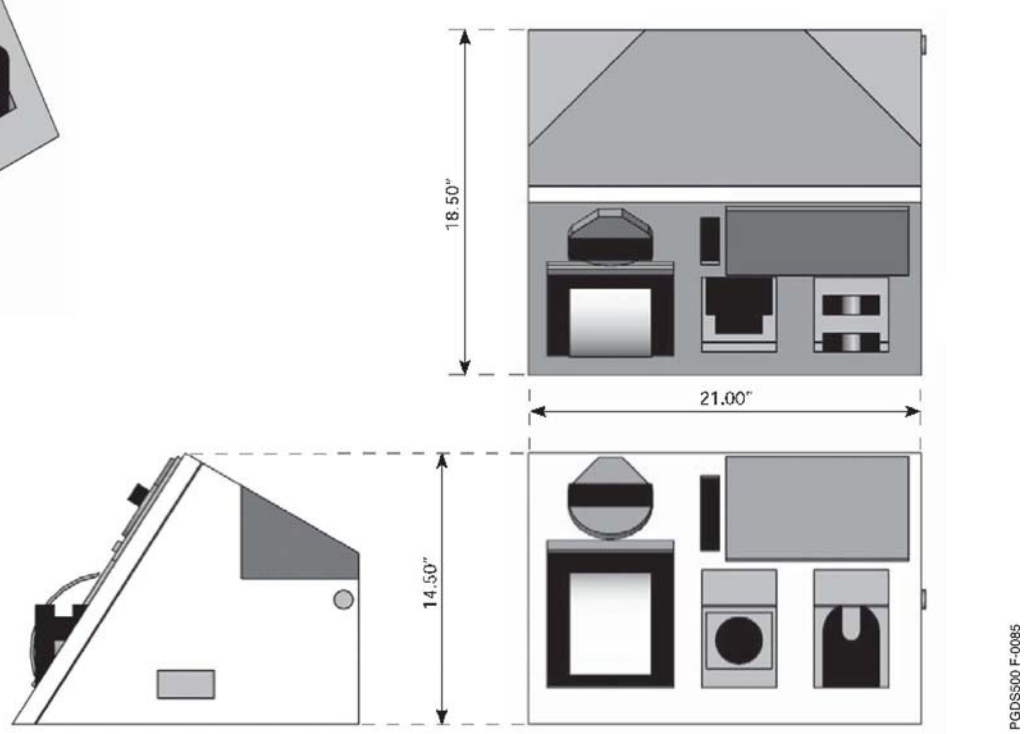


Figure 3-24
MDI: ITEMIZER DX
Applicable System Type: Stand-Alone ETD

SPECIFICATIONS	
False alarm rate	SSI
Environmental operating envelope	Temp. 32-104 °F Humid. 0-95% NC
Weight (lb)	26.5
Current status	Available

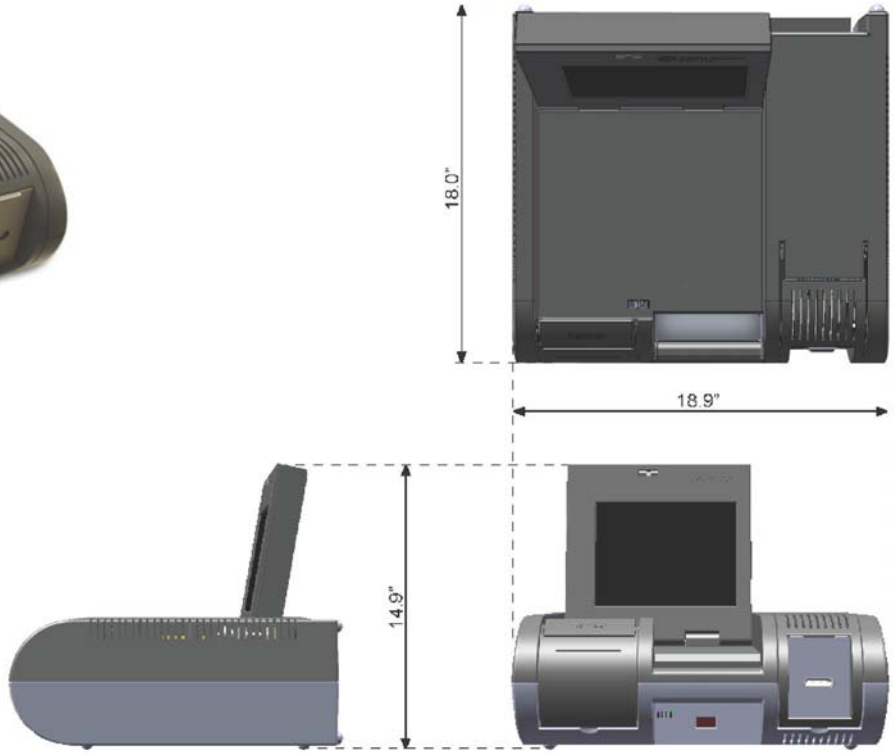


Figure 3-25
SMITHS: IONSCAN 400B
Applicable System Type: Stand-Alone ETD

SPECIFICATIONS	
False alarm rate	SSI
Environmental operating envelope	Temp. 32-104 °F Humid. 0-95% NC
Weight (lb)	47
Current status	Available

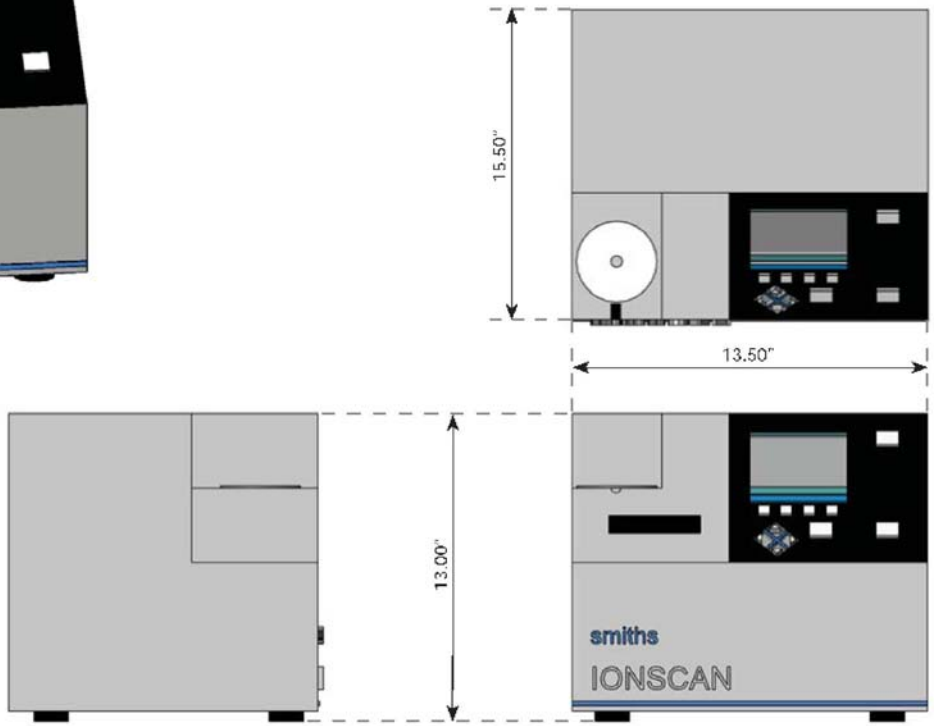
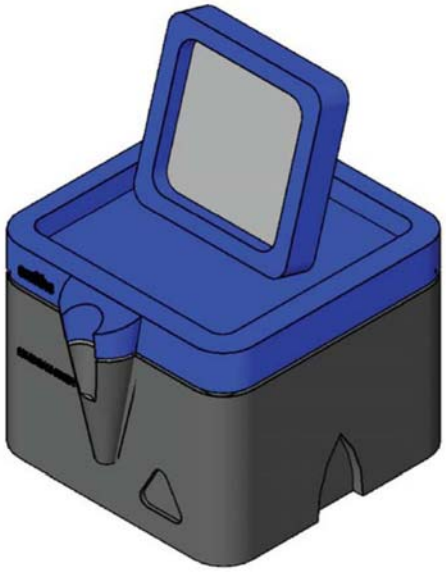
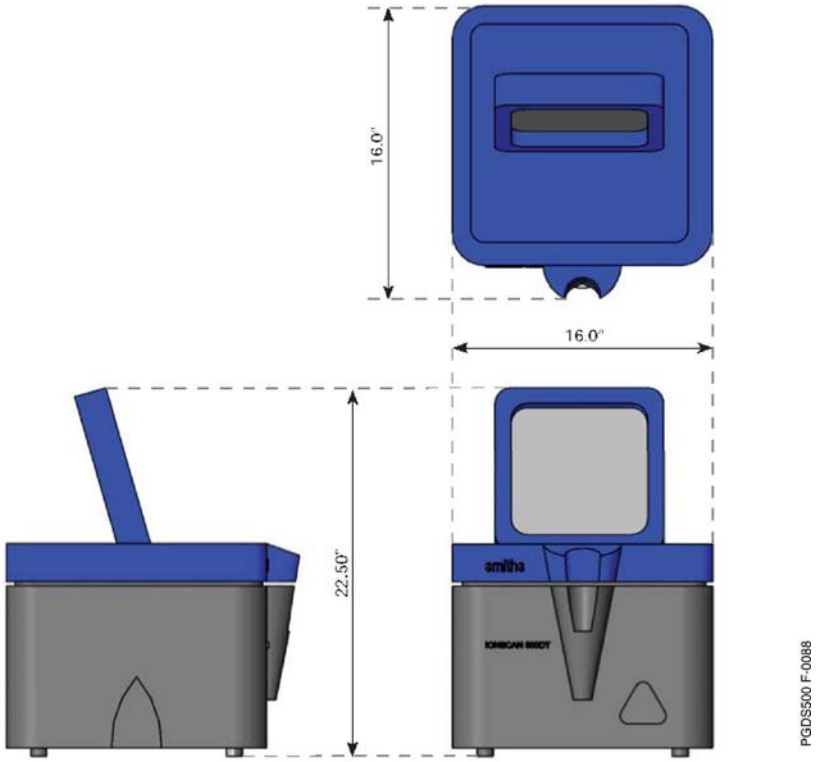


Figure 3-26
SMITHS: IONSCAN 500DT
Applicable System Type: Stand-Alone ETD

SPECIFICATIONS	
False alarm rate	SSI
Environmental operating envelope	Temp. 32-104 °F Humid. 0-95% NC
Weight (lb)	40
Current status	Available





3.3 GENERAL NOTES ON SCREENING EQUIPMENT ASSUMPTIONS

The following applies to system types described in previous sections.

3.3.1 False Alarm Rates and OSR Clear Rates Assumptions

The range of expected annual average false alarm rates for EDS is based on domestic flights (at the low-end) and international flights (at the high-end) with varying bag content.

False alarm rates for international flights are typically higher as checked bags for these flights tend to be bigger and have a higher ratio of alarms per bag due to relatively dense or highly cluttered bag content.

The OSR clear rate and clear time estimates are based on approved TSA alarm resolution protocol as well as expected EDS image quality and alarm resolution tools provided to screeners on EDS bag viewing stations (or threat resolution interfaces).

The estimated OSR clear rate and OSR clear time are annual averages for domestic and international flights (with varying bag content and varying bag images).

3.3.2 Screened Baggage Assumptions

Maximum baggage dimensions represent the maximum in every dimension and not maximum dimensions of an actual bag that can fit into the EDS. For example, with the L-3 3DX 6600, at maximum width of 32 inches the maximum height of a bag can be 14 inches.

The OOG percentage is based on annual and national average for domestic and international flights (with varying bag sizes) and on maximum bag dimensions specified by baggage handling system designers and EDS manufacturers. The OOG percentage is based on the EDS technology selected for the CBIS. The airport specific OOG percentage may differ from the national average based on the unique mix of bag sizes and types specific to the airport.

The L-3 3DX SX (formerly Analogic King Cobra) can scan and display up to 63-inch long bags on a single display but also scan and display up to 177 inches long bags using a split bag display function.

The L-3 3DX 6600 can scan and display up to 63-inch long bags on a single display but also scan and display up to 120-inch long bags using a split bag display function.

The L-3 XLB can scan and display up to 51 inch long bags on a single display but also scan and display up to 120 inch long bags using a split bag display function.

The MDI CTX-9800 can scan and display bags up to 71 inch long and 39 inch wide.

The MDI CTX-5800 does not have a maximum bag length.

3.4 STATIONARY GANTRY/FIXED SOURCE SCREENING SYSTEMS

In addition TSA is evaluating screening solutions that may use Stationary Gantry/Fixed Source Screening Systems (SG/FSSS) as an alternative to a rotating gantry computerized tomography (CT) system. SG/FSSS obtain images without resorting to mechanical rotation of the imaging source and, as such, have the potential to provide higher throughput levels while maintaining required detection capabilities, and may provide reduced maintenance and life-cycle costs. Specifically, three vendors are currently developing such systems under TSA development programs: L-3 Communications Corporation is developing the NG-MVT (Next Generation), SureScan Corporation is developing the SureScan x1000, and Rapiscan Systems is developing the RTT80SE.

4 DEVELOPMENT AND EVALUATION OF ALTERNATIVES

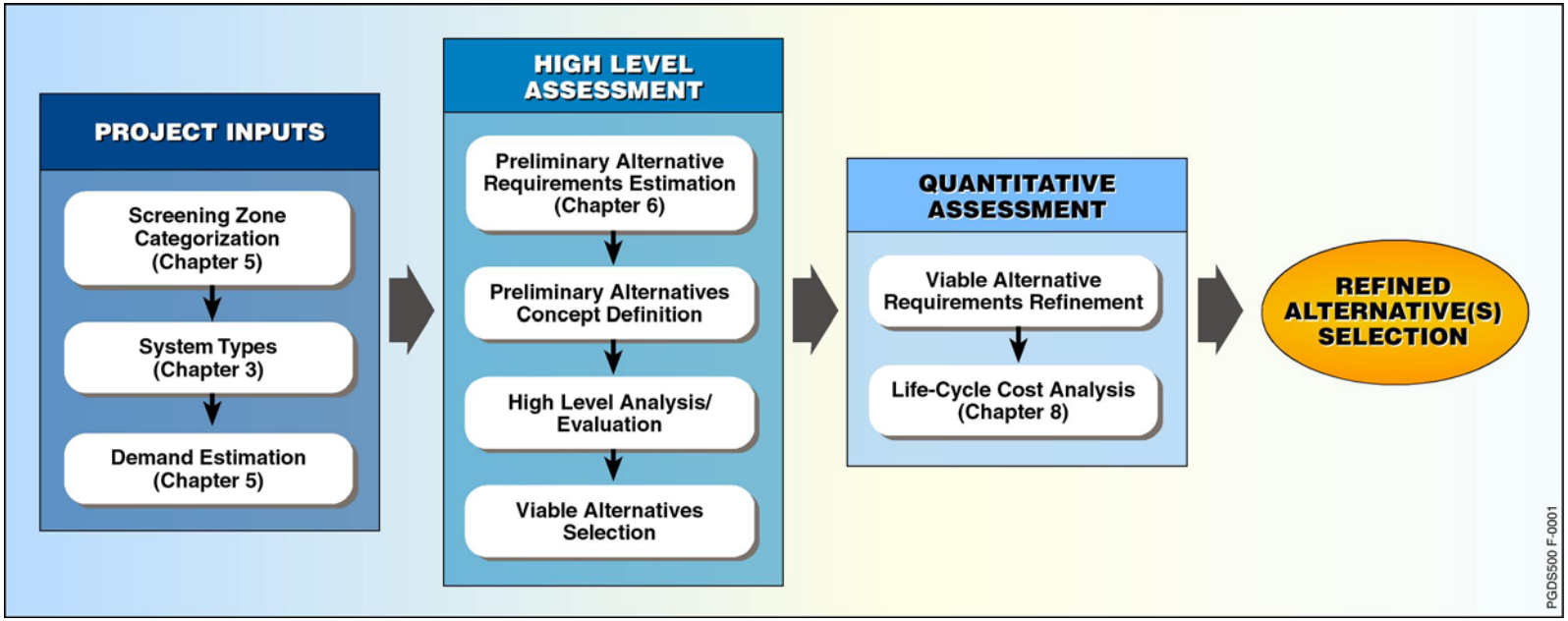
Several elements of the planning process are presented together in this chapter, enabling planners to develop and evaluate various screening solution alternatives for a particular airport or terminal.

Figure 4-1 summarizes the alternatives development and evaluation process to be carried out during the Pre-Design Phase.

As discussed in previous chapters, planners should develop optimally-scaled screening alternatives, taking into account the following:

- **Airport Spatial Data**—Terminal configurations, airline assignments, and architectural constraints that will affect the categorization into screening zones (see Chapter 5).
- **CBIS Capacity Data**—Data related to the type of screening systems and screening equipment (see Chapter 3).

Figure 4-1
PRE-DESIGN PHASE ALTERNATIVES DEVELOPMENT AND EVALUATION



- **Baggage Screening Demand Data**—Factors affecting current and future baggage flow into the CBIS, such as existing infrastructure, including ticket counter and curbside check-in positions, numbers of gates, and runway capacities (see Chapter 5).

- **Cost Data**—Equipment, infrastructure, O&M, and staffing costs (see Chapter 8).

Planners are encouraged to develop various alternatives based on the conditions of the specific airport. An initial high level assessment should be conducted to indentify spatially and operationally feasible alternatives. Subsequently, these alternatives should be evaluated on the basis of a 20-year life-cycle cost analysis for implementing, maintaining, and replacing the screening system. The lowest-cost alternative(s) that provide adequate screening solutions for the particular airport or terminal in question shall be selected as the preferred alternative(s).

To provide a potential starting point for developing alternatives, TSA has developed an integrated EDS deployment model that evaluates various screening system types at all Category X, I, II, and III airports in the nation based on the methodologies outlined in this document. The model takes into account high-level spatial and capacity constraints at airport terminals and evaluates system types on the basis of the life-cycle costs. Planners should obtain, through TSA, the model results for all screening zones that pertain to the airport for which the screening system is being designed.

The methodology for developing alternatives, assumptions for assessing the cost effectiveness of the alternatives, and the evaluation process for selecting the preferred alternative(s) at the Pre-Design Phase of the planning process are discussed in this chapter. Appendix C provides a case study of an airport installation where this methodology was applied.

4.1 ALTERNATIVES DEVELOPMENT

The screening alternatives should be developed based on the airline groupings (screening zones), as defined in Chapter 5, and the system types, as defined in Chapter 3. In addition, planners should assess the tradeoffs between providing upfront capacity and incremental capacity at an airport, as discussed in Section 5.3.

4.1.1 Screening Zone Categorization

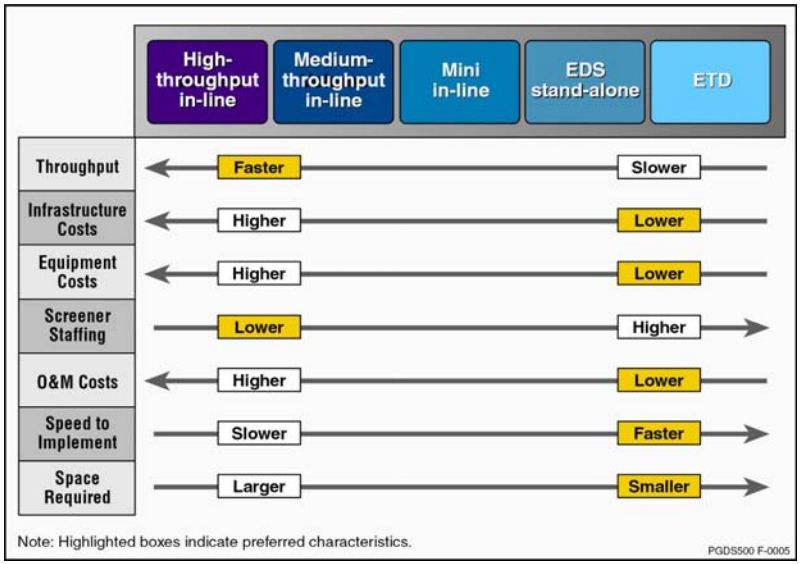
As discussed in Chapter 5, checked baggage screening systems can be designed to combine baggage flows from several airlines in a single screening system. When defining the set of screening alternatives, planners should compare screening solutions for different combinations of baggage flows. At least two different combinations of baggage flows should be analyzed to provide a meaningful comparison (e.g., centralized zones vs. airline-specific zones).

4.1.2 Screening System Type Selection

Several screening system types could serve demand in each screening zone. The system types defined in Chapter 3 provide different tradeoffs between upfront capital costs and recurring staffing and O&M costs, as illustrated on Figure 4-2 and summarized below:

- **System Type 1: High-Throughput In-Line CBIS.** High-throughput in-line systems are likely to be used in centralized screening zones that serve one or more airlines. As such, they are generally the most efficient from the perspectives of machine and staff utilization. However, the centralized nature of these systems may require more complex conveyor arrangements, and extensive building modifications; therefore, upfront capital investment and O&M costs are high. These systems are based on high-speed EDS machines (see Chapter 3) and may contain extensive buffering space and sections of conveyor allowing for sufficient OSR time.

Figure 4-2
SYSTEM TYPE COMPARISON



- **System Type 2: Medium-Throughput In-Line CBIS.** Similar to high-throughput in-line systems, medium-throughput in-line CBISs are likely to be used in centralized screening zones serving one or more airlines. Therefore, they also tend to be efficient from the perspectives of machine and staff utilization. In addition, the lower machine throughput would typically require less complex conveyor arrangements and fewer building modifications. The required upfront capital investment is likely to be lower than for high-throughput systems. O&M costs are also typically lower for medium-throughput systems than for high-throughput systems. However, labor costs are typically higher for medium-throughput systems compared with high-throughput systems because medium-throughput systems are expected to be less centralized. These systems are based on medium-speed EDS machines (see Chapter 3) and may contain moderate buffering space and conveyors allowing for sufficient OSR time.

- **System Type 3: Mini In-Line CBIS.** Mini in-line systems are decentralized systems that incorporate a simpler conveyor design and require a smaller footprint. These systems are likely to be located closer to airline ticket counters or baggage make-up devices. Travel times are, therefore, reduced, as is the likelihood of improper baggage sortation. However, staff and equipment utilization for a mini in-line system is typically lower than for high-throughput or medium-throughput systems given the lower demand placed on the system and more peaked load requirements. As a result of lower facility and conveyor modification impacts, capital and O&M costs are expected to be lower for mini in-line systems than for System Types 1 and 2 (see Chapter 3).

- **System Type 4: Stand-Alone EDS.** For facilities with very low throughput requirements or where architectural conditions may render other systems cost prohibitive, a solution based on a stand-alone EDS machine (see Chapter 3 for a list stand-alone EDS machines) may be the most economical. A conveyor infrastructure is not required with a standalone EDS and, therefore, no significant incremental increase in airport/airline O&M costs is expected. These systems offer an even lower capital cost on a per unit basis, but are also less efficient in terms of staff and machine utilization than System Type 3 (see Chapter 3).

- **System Type 5: Stand-Alone ETD Systems**. ETD systems will only be allowed at Category IV airports or at larger airports for oversized, fragile, or other items that cannot be screened by EDS. ETD solutions are typically deployed in lobbies or baggage make-up rooms and are the most labor-intensive solutions. A conveyor infrastructure is not required and, therefore, these systems offer the lowest capital and O&M cost on a per unit basis (see Chapter 3).

Centralized screening zones require a fully automated in-line system (System Type 1 or 2). Smaller in-line systems or mini in-line systems are typically better suited for more decentralized zones (such as bag rooms accommodating one or more airlines). Mini in-line systems and stand-alone systems are typically better suited for highly decentralized zones. However, planners should not explicitly assume this relationship and need to select the optimal screening system for a zone based on the particular characteristics of the zone regardless of the level of centralization.

4.1.3 Baggage Screening Demand Estimation

Once the screening zones have been defined, planners should estimate baggage screening demand for each screening zone, as explained in detail in Chapter 5.

First, the average day peak month (ADPM) checked baggage flow is developed for the base year and then the flow is projected to the design year, which is usually assumed to be 5 years after opening year (i.e., DBU + 5 years).

4.1.4 Preliminary Alternatives Equipment Requirements Estimation

The design year baggage flow and the selected system types are used to calculate equipment requirements, as explained in detail in Chapter 6.

In general, nonredundant EDS equipment requirements are based on the design year ADPM checked baggage flow. The design, however, needs to accommodate redundant EDS equipment. OSR and ETD station requirements are based on the nonredundant EDS capacity to meet baggage demand in the design year.

The anticipated baggage screening demand is then divided by screening equipment throughput assumptions (see Chapter 3) and, for OSR and ETD station requirements, multiplied by false alarm rates (to be obtained directly from TSA).

At the end of this process, planners should have determined the type of screening equipment and number of machines required for each screening zone.

4.1.5 Preliminary Alternatives Concept Definition

Preliminary screening alternatives should be developed based on the type of screening equipment and number of machines required, which, in turn, are based on the screening demand and system types initially selected.

As mentioned in previous paragraphs, planners are encouraged to develop as many screening alternatives as possible within the existing physical constraints.

These initial concepts do not require a high level of detail; however, planners should be able to qualitatively assess potential impacts on existing facilities and operations.

4.1.5.1 Tradeoff between Upfront Capacity and Incremental Capacity

Specifically, planners should assess the tradeoffs between (1) incurring additional upfront costs to increase design flexibility for accommodating future demand growth, and (2) accommodating growth based on modifying the initial system incrementally over the 20-year analysis period for the purposes on conducting alternative analysis through the use of 20-year life-cycle cost assessment. This tradeoff assessment may indicate, for instance, that systems at critical airports (such as airline hubs) should be designed with additional space to accommodate future EDS machines.

Airport planners typically assess the capacity of functional components at an airport (e.g., ticket counters, gates, runways) to determine the ultimate capacity of the terminal. The ultimate

terminal or airport capacity should be treated as the upper limit for demand estimates for the purposes of CBIS design. For example, if a 20-year demand analysis indicates that additional ticket counters, gates, or runway capacity is required beyond that available in the current terminal or airport, then planners should assume that such requirements are beyond the scope of the CBIS design. Capital-intensive expansions to accommodate additional demand at other airport functional components should also include consideration of additional baggage screening capacity to accommodate future growth of baggage demand beyond the ultimate capacity considered in the CBIS design.

4.1.5.2 Contingency Planning

Even though a contingency plan is required only at the end of the Schematic Design Phase, planners should consider the implications of potential mitigation measures regarding the development of alternatives early on, as some measures could affect the alternative system layout and level of complexity. A more detailed explanation on the contingency planning process, contingency plan development, and evaluation of contingency alternatives is included in Chapter 11.

4.2 ALTERNATIVES EVALUATION AND SELECTION

Once preliminary alternative concepts have been developed, a high-level assessment should be conducted to determine which alternatives are viable and should be considered in the life-cycle cost analysis. The life-cycle cost analysis will provide present value costs for each viable alternative so that the alternatives can be evaluated quantitatively based on these costs and the preferred alternative(s) selected.

4.2.1 High-Level Assessment

A high-level assessment is a qualitative evaluation based on general criteria with the objective of helping planners and stakeholders understand which alternatives are viable and should be considered further in the evaluation process.

The criteria to be used in the high-level assessment depend on the airport and should be developed in close coordination with project stakeholders. The following are examples of criteria used in the case study provided in Appendix C:

- **Customer Level of Service**—The effect of each alternative on the passenger's experience at the airport
- **Effect on Airport Operations**—The reliability and maintainability of the EDS equipment and the contingency procedures that could be implemented if a machine were inoperative during a peak period, as well as the effect that the alternative would have on the airlines
- **Economic Considerations**—The costs associated with TSA staff salaries and with implementing and maintaining the alternative
- **Design Criteria**—The effect that the alternative would have on existing facilities, as well as the ease with which the alternative could be constructed or expanded

Based on criteria similar to those listed above, planners and stakeholder should evaluate the alternatives and eliminate those that are not viable. It might be helpful to develop a high-level assessment matrix similar to the one shown in Appendix C, Section C.6.1. The remaining alternatives should be further refined before analyzing life-cycle costs.

4.2.2 Quantitative Evaluation Based on Life-Cycle Cost Analysis

Life-cycle costs should be analyzed for the viable alternatives identified in the high-level assessment to select the preferred alternative (or alternatives). The selection shall be based on the comparison of the present value costs of the alternatives, as explained in detail in Chapter 8.

The lowest cost alternative might not be the best in the high-level assessment. The final selection should be based on quantifiable analysis, qualitative considerations, and good judgment.

5 METHODOLOGY TO DETERMINE BAGGAGE SCREENING DEMAND

This chapter documents the methodology used to determine the design demand required to size optimal screening system(s) within an airport terminal. As explained in detail in the following paragraphs, the steps below summarize the methodology:

1. Categorize the airport terminal into screening zones
2. Generate checked baggage flow
3. Project future baggage flow

This methodology is meant only for the Pre-Design Phase of the project when the focus is on equipment sizing, rather than on system performance. During later phases of design, simulation is required to evaluate system performance. As such, detailed design-day flight schedules that reflect the best information available regarding future demand levels will be required.

The TSA possesses information that is pertinent to the Design Review process, especially at the Pre-Design level. The ILDT should interact with the RDM to obtain realistic historical values for bags per passenger (BPP), peak values for passenger arrivals, passenger arrival curves, etc.

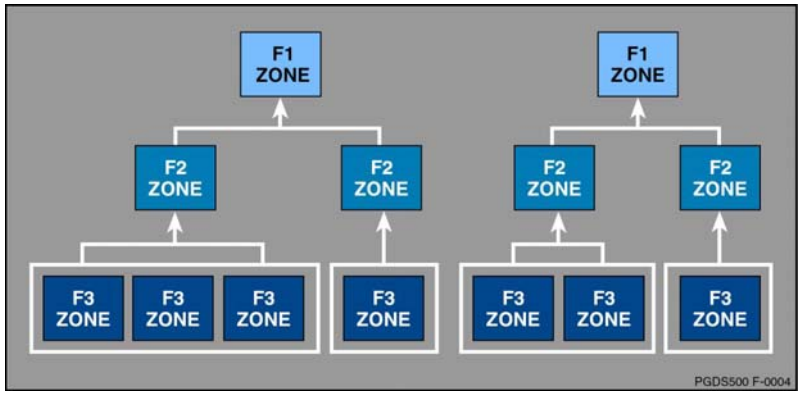
Appendix C provides a case study on how these initial steps should be conducted.

5.1 CATEGORIZE THE AIRPORT TERMINAL INTO SCREENING ZONES

Checked baggage screening systems can be designed to combine checked baggage from several airlines into a single system. As numerous options are available for combining baggage flows, planners should use their best judgment to capture (1) high-level architectural constraints and (2) airline operational constraints. It is recommended that more than one screening configuration and airline grouping be considered at the outset of a project to provide realistic alternatives for comparison.

One approach that could be used to determine feasible combinations of baggage flow is a zone hierarchy scheme that represents the spatial characteristics of airport terminals. Figure 5-1 presents a sample scheme for a tri-level hierarchy (F1, F2, and F3).

Figure 5-1
ZONE HIERARCHY REPRESENTATION



Each element in the hierarchy represents a spatially feasible zone for EDS screening, be it at a small, decentralized level or at a large, consolidated level:

- **F1 Zone**—An F1 zone is the largest feasible zone in a terminal for installation of a centralized in-line system. This zone may accommodate multiple airlines that share an EDS and are usually served by multiple baggage belts with sortation functionality downstream from the screening area.
- **F2 Zone**—An F2 zone represents a screening solution that fits somewhere between the F1 and F3 zones, and is usually determined by the feasibility of two or more adjacent airlines

sharing their screening and baggage handling facilities (e.g., a common baggage make-up area).

- **F3 Zone**—On the other end of the spectrum, an F3 zone is the smallest feasible zone in the terminal wherein a highly decentralized EDS is likely to be preferred, and is usually served by a single take-away baggage belt. A dominant airline in a terminal with multiple baggage belts would have a number of F3 zones.

For example, Figure 5-2 shows the western half of the ticketing lobby and associated baggage make-up area at Albuquerque International Sunport (ABQ). The ticket lobby, airline ticket offices (ATOs), and baggage make-up areas are all located on one contiguous level.

One potential method of developing a zone hierarchy for ABQ would be the following:

- **F3 Zones**: Each baggage take-away belt is assigned to an F3 zone.
- **F2 Zones**: An existing, contiguous baggage make-up area with several take-away belts is defined in this example as a single F2 zone.
- **F1 Zones**: As the ticketing lobby, the ATO, and the baggage make-up areas are physically divided by the entrance hall into the west and east sides, each side is designated as a single F1 zone. It would be impractical and expensive to screen all bags in a single centralized system for the entire airport; thus, at ABQ, two separate F1 zones were identified.

Because the subdivision of a terminal into zones is subjective, a detailed explanation of the reasons that a particular terminal screening zone hierarchy was selected over another hierarchy should be provided as part of the Preliminary Alternatives Analysis Report (see Chapter 2).

Screening zone selection is fundamental in generating baggage screening demand profiles and, ultimately, in determining the required baggage screening equipment, as explained in the following paragraphs.

5.2 GENERATE CHECKED BAGGAGE FLOW

The methodology to be used to derive existing checked baggage flows for each screening zone is presented in this section. In deriving screening equipment requirements, the average day of the peak month (ADPM) is used as the design day.

The ADPM is used as the design day to ensure that systems are designed to meet average-day conditions in the peak month, with the understanding that contingency plans are in place, as discussed in Chapter 11. Where designing for the ADPM does not provide sufficient capacity given the agreed-upon contingency plans, alternative design days can be used with TSA approval.

The key inputs necessary to derive the checked baggage flows for the ADPM are described below.

5.2.1 List of Airlines

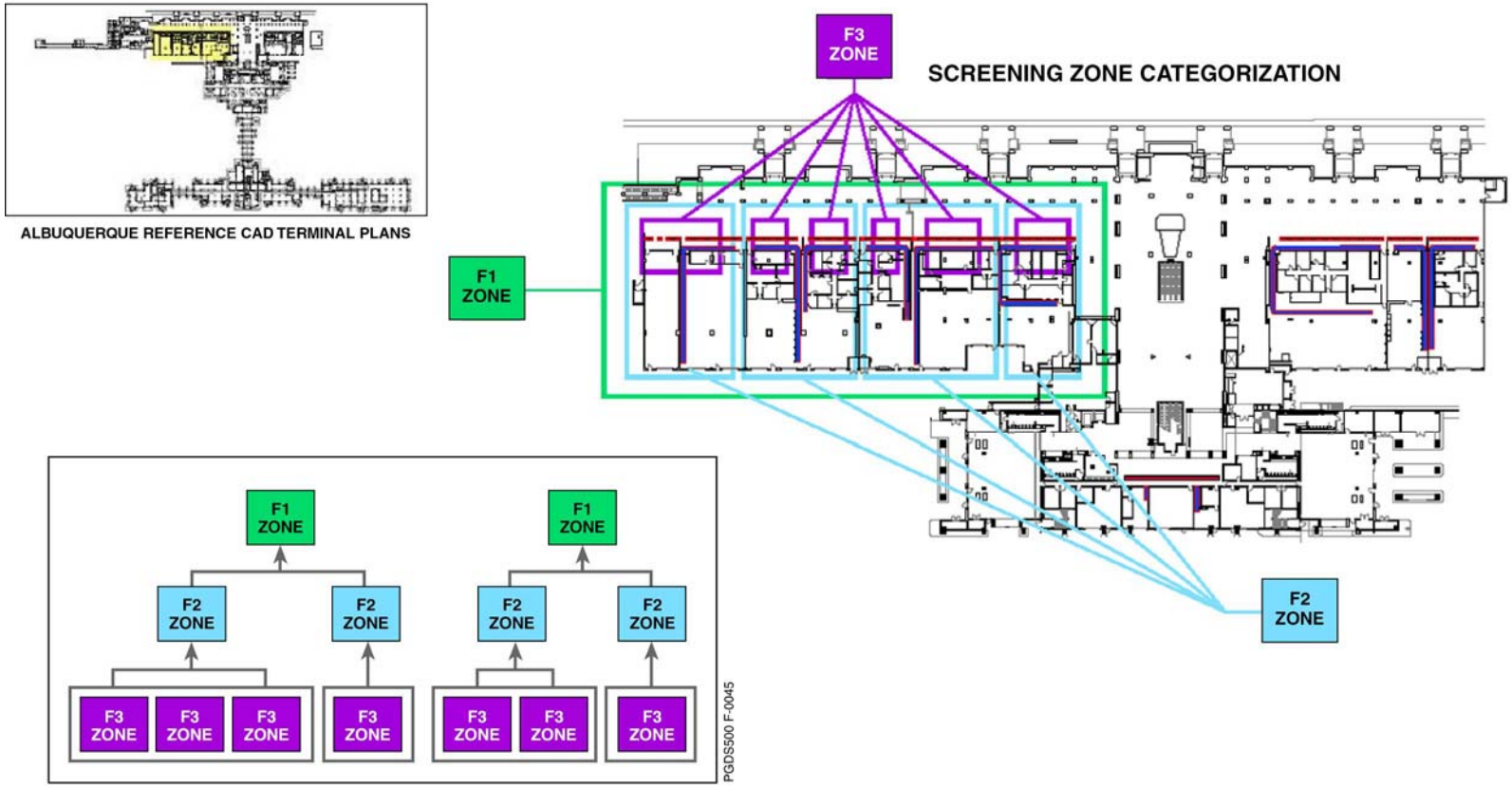
All airlines (including charter airlines) operating in each screening zone should be identified.

5.2.2 Determination of the ADPM per Screening Zone

To identify the ADPM, it is necessary to first identify the peak month and then the average day in terms of originating bags as well as international recheck bags for each zone.

- For each screening zone, the total number of monthly originating bags and international recheck bags for all airlines in that zone should be calculated. The month with the maximum number of originating and international recheck bags is referred to as the peak month.

Figure 5-2
ASSUMED SCREENING ZONES AT ALBUQUERQUE INTERNATIONAL SUNPORT



- For each screening zone, the total number of daily originating and international recheck bags for all airlines in that zone during the peak month should be calculated, and a mathematical average should be derived. The day on which the number of originating and international recheck bags is closest to the calculated mathematical average is the ADPM.

Depending on the airlines operating in each zone, the ADPM might differ from zone to zone.

Planners should include charter airline originating bags or international recheck bags if that information is relevant and available when determining the ADPM for each zone.

5.2.3 Flight Schedule

Once the ADPM for each zone has been determined, a design-day flight schedule for each screening zone should be obtained. These flight schedules should only contain information on nonstop flights from the subject airport. Flight schedules should specify for each flight: destination, flight departure time, flight number, published carrier, operator, aircraft type, and number of seats.

In addition, to derive international recheck baggage demand, it is necessary to know the arrival schedule of international flights whose passengers will be connecting to domestic flights. Baggage arriving from international destinations where security screening protocols differ from those used by TSA must be re-screened at the first United States port of entry before being loaded onto any domestic flight.

5.2.4 Load Factors

A load factor is the percentage of seats on a flight occupied by ticketed passengers. Load factors vary by flight (e.g., by airline, time of day, and destination), by day of the week, and by season. Extensive surveys conducted at airports nationwide and data obtained from domestic and international carriers show that peak-day load factors vary from 20% to 100%. Because of the wide variance in load factors, it is important to obtain the most accurate data that reflect the specific conditions of the selected ADPM directly from the airlines whenever possible.

In addition, load factors on international arrival flights must be obtained to derive international recheck baggage demand.

5.2.5 Origin/Destination and Connecting Passenger Percentages

Originating passengers are passengers whose itinerary begins at the subject airport; an originating passenger checks in with the appropriate airline and proceeds through the security checkpoint to the departure gate. Similar to load factors, the percentage of originating passengers may vary by flight (e.g., by time of day, destination, and airline), by day of the week, and by season.

Domestic flights departing from the airport prior to 9 a.m. have significantly higher percentages of originating passengers than those departing after 9 a.m. because of the nature of connecting passenger traffic. In general, the first arrival bank of domestic flights permits very few passengers to connect with flights departing from the airport prior to 9 a.m.; therefore, most of the passengers on those flights are originating passengers. Thus, the percentage of originating passengers before 9 a.m. is close to 100%, after 9 a.m., the percentage ranges from 5% to 100%.

Because of the wide variance in originating passenger percentages, it is important to obtain the most accurate data that reflect the specific conditions of the ADPM at the subject airport directly from the airlines whenever possible.

In addition, the percentage of passengers arriving on international flights and connecting to domestic flights must be obtained to derive international recheck baggage demand.

The estimated number of **originating passengers** is calculated using the number of seats, the load factor, and originating percentage assumptions for the ADPM.

Originating Passengers =
Seats x Load Factor x Percentage of Originating Passengers

The estimated number of **connecting passengers** from international to domestic flights is calculated using the number of arriving seats, the load factor, and connecting percentage assumptions for the ADPM.

Connecting Passengers from International to Domestic Flights =
Seats x Load Factor x Percentage of Connecting Passengers

5.2.6 Earliness Distributions

An earliness distribution specifies the percentages of passengers that arrive at the airport a specific number of minutes before their flights. The earliness distributions are used to determine the flow of departing passengers at the airport. Significant differences exist in the earliness distributions between:

- Passengers on domestic flights departing at peak hours versus off-peak hours
- Passengers on flights departing before 6:30 a.m. and after 6:30 a.m. (represented by peak and off-peak domestic)

Earliness distributions for flights departing the airport before 6:30 a.m. and at peak hours are generally of shorter duration and thus more peaked; therefore, it is important to use the appropriate earliness distributions to accurately derive actual baggage flows. Where possible, it is recommended that earliness distributions reflecting the specific conditions of the ADPM be obtained directly from the airlines.

Figure 5-3 shows example earliness distributions for domestic carriers; as shown, the distribution of flights departing before 6:30 a.m. and peak hours exhibits higher peaking characteristics and has a much shorter duration than the distribution of flights departing on off-peak hours.

Figure 5-3
EXAMPLE EARLINESS DISTRIBUTIONS
DOMESTIC CARRIERS PEAK, OFF PEAK, AND BEFORE 6:30 A.M.

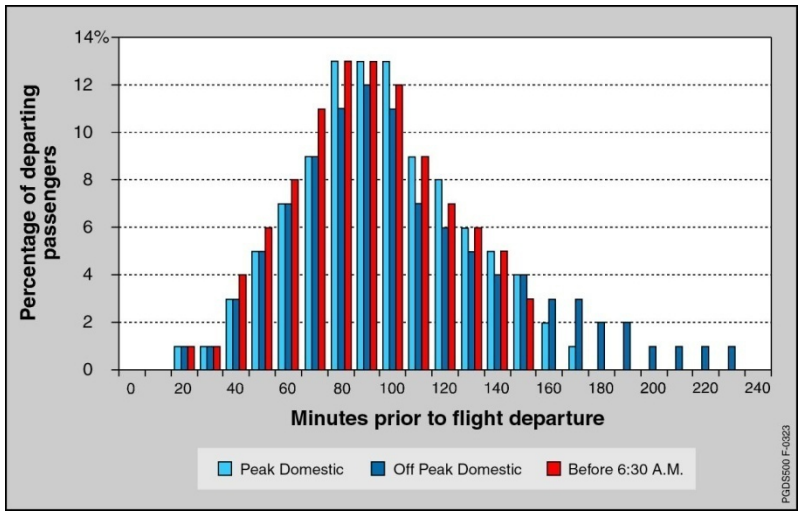
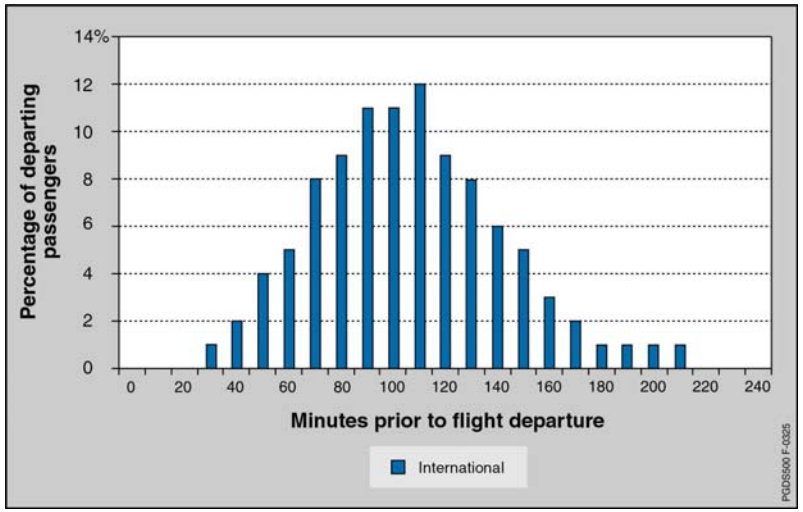


Table 5-1
EXAMPLE EARLINESS DISTRIBUTION – TSA Staffing Model – SAM11

Minutes before departing flight	Before 6:30 a.m.	Peak Domestic	Off-peak Domestic	FIS Flight	International
0 to 10	0	0	0	0	0
10 to 20	0	0	0	0	0
20 to 30	1	1	1	0	0
30 to 40	1	1	1	2	1
40 to 50	4	3	3	3	2
50 to 60	6	5	5	19	4
60 to 70	8	7	7	27	5
70 to 80	11	9	9	25	8
80 to 90	13	13	11	20	9
90 to 100	13	13	12	4	11
100 to 110	12	13	11	0	11
110 to 120	9	9	7	0	12
120 to 130	7	8	6	0	9
130 to 140	6	6	5	0	8
140 to 150	5	5	4	0	6
150 to 160	3	4	4	0	5
160 to 170	1	2	3	0	3
170 to 180	0	1	3	0	2
180 to 190	0	0	2	0	1
190 to 200	0	0	2	0	1
200 to 210	0	0	1	0	1
210 to 220	0	0	1	0	1
220 to 230	0	0	1	0	0
230 to 240	0	0	1	0	0
Total	100%	100%	100%	100%	100%

Figure 5-4 shows example earliness distributions for international carrier flights as shown, the distribution variance for international carriers is higher than for domestic carriers and a larger percentage of international passengers tend to arrive at the airport earlier than for domestic flights.

Figure 5-4
EXAMPLE EARLINESS DISTRIBUTION
INTERNATIONAL CARRIERS



5.2.7 International Recheck Passenger Lateness Distributions

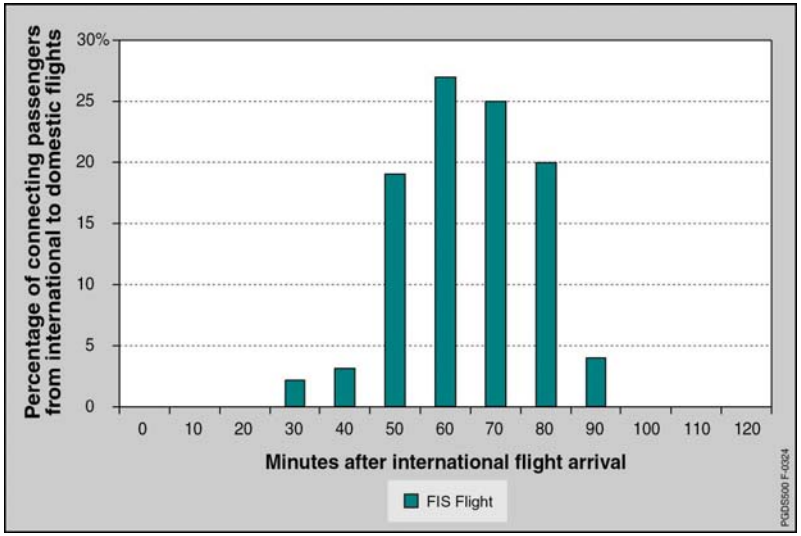
A lateness distribution for international recheck passengers specifies the percentage of passengers that exit the Federal Inspection Services (FIS) facility a specific number of minutes after their flights have landed. Specifically, the lateness distribution is applied to international recheck passengers that need their bags screened. Passengers arriving from international destinations where security screening is not conducted according to TSA protocols and who are connecting to domestic flights need to have

their bags screened at the first port of entry into the United States before they are loaded onto any domestic flight.

Lateness distributions have a much shorter duration than earliness distributions because all passengers deplane upon arrival within a relatively short period of time for any given flight. For this reason, the international recheck baggage flows show marked peaks and have very short durations, as shown in the example on Figure 5-5.

Where possible, it is recommended that international recheck passenger lateness distributions reflecting the specific conditions of the ADPM at the subject airport be obtained directly from the airlines.

Figure 5-5
EXAMPLE LATENESS DISTRIBUTION



Passenger arrival distributions were taken from the latest version of the TSA Staff Allocation Model (SAM).

5.2.8 Checked Bags per Passenger

The average number of checked bags per originating passenger varies by airline, by destination, and by time of year. Extensive in-field data collection efforts and specific data provided by the airlines demonstrate that the actual numbers of checked bags per passenger are lower than the common “rules of thumb” of 1.5 bags for domestic flights and 2.0 bags for international flights used by many planners and designers. Generally, data collection efforts have shown that a more reasonable range is:

- Average of 0.7 checked bags per originating passenger for domestic airlines;
- Average of 1.3 checked bags per originating passenger serving international markets; and
- Average of 1.3 recheck bags per international-to-domestic connecting passenger.

These are very generic ranges, and planners should obtain locally collected specific values for the types of carriers and markets served whenever possible. If such local and specific values are not available, designers can contact local TSA for such data. Planners should consider protocol modifications, such as the one prohibiting and subsequently limiting liquids in carry-on baggage that may also affect these ratios.

The estimated number of originating checked bags is calculated using the estimated number of originating passengers and the checked bags per passenger assumptions for the ADPM:

Originating Checked Bags =
Originating Passengers x Number of Checked Bags per Originating Passenger

The estimated number of international recheck bags is calculated using the estimated number of connecting passengers from international to domestic flights and the international recheck bags per passenger assumptions for the ADPM:

International Recheck Bags =
Connecting Passengers x Number of International Recheck Bags per Connecting Passenger

The earliness and lateness distributions are used to derive the flows of originating and international recheck bags throughout the day.

Table 5-2 summarizes several potential sources of the key input data used to derive ADPM baggage flows.

Table 5-2
SUMMARY OF INPUT DATA NEEDS AND POTENTIAL DATA SOURCES

Data	Source(s)
Scheduled airline activity	Official Airline Guides, Inc. Seabury APG Database Airport sponsor Airlines
Charter airline activity	Airport sponsor Charter airlines
Airline boarding load factors	U.S. Department of Transportation Airlines
Percentage of originating passengers	U.S. Department of Transportation Airlines
Earliness and lateness distributions	Airlines In-field surveys
Checked bags per passenger	Airlines In-field surveys

5.2.9 Calibration of Flight Schedule-Driven Demand

It is recommended that, whenever possible, planners obtain actual baggage counts from all airlines that operate at the screening zones being considered for CBIS design. The above-mentioned methodology for generating baggage flows (using flight schedules, load factors, origin/destination percentage, earliness/lateness distributions, and ratio of bags per passenger) should be calibrated with actual baggage counts of the relevant airlines. If a significant discrepancy in peak hour baggage flow (for the ADPM) is found between the two sources, then planners should consult with the ILDT (see Chapter 2) to resolve the discrepancy.

5.3 PROJECT FUTURE BAGGAGE FLOW

The baggage flows derived using the process explained in the previous paragraphs represent the ADPM baggage flows for a particular screening zone in the base year. Baggage flows must be projected to a specific design year before they can be used to determine screening equipment requirements.

5.3.1 Design Year for Equipment Requirements

The design year for equipment requirements is assumed to be 5 years after the opening year for a given baggage screening system (i.e., DBU + 5 years). This assumption is based on current TSA policy for system approval. Thus, if a system is scheduled to become operational in 2010, the design year for that system will be 2015.

The EDS equipment requirements shall be listed in one-year increments, from DBU through DBU+5 years (this is typically a chart listing EDS machines, Primary Viewing Screen (PVS) and Secondary Viewing Screen (SVS) workstations by yearly requirements).

Equipment requirements shall be revalidated 12 months prior to equipment delivery. If 100% detailed design is submitted, or the construction is delayed more than 12 months beyond the expected DBU, then a revalidation of equipment shall be submitted.

Baggage flow projections can be based on the Federal Aviation Administration's (FAA's) *Terminal Area Forecast* (TAF) or on the specific airport's Master Plan forecast (if the Master Plan is current). However, the use of a Master Plan for forecast growth can only be used to limit future growth and cannot exceed the TAF growth rate. In general, the FAA must approve the forecast used to determine design year baggage flows. If, for any reason, local airport and airline staff and their consultants believe that the TAF or the Master Plan forecasts do not properly represent expected growth at the airport, a revised forecast and a detailed explanation of the reasons that the FAA-approved forecast is not acceptable should be provided to TSA for approval. In any case, the baggage demand projections for the design year should not exceed those resulting from a forecast reflecting ultimate gate capacity or overall terminal capacity. In other words, the demand cannot be higher than the activity level that can be supported by the existing terminal gates for which the CBIS is designed.

The growth rate from the TAF or Master Plan forecast may be uniformly applied to the existing baggage flow, thus preserving current activity patterns, or applied differently if a detailed explanation of the reasons that the current activity pattern is expected to change is provided.

5.3.2 Accommodating Traffic Growth after the Design Year

The equipment requirements documented above are based on a design demand for 5 years beyond the system opening date (i.e., DBU + 5 years). It is likely that the initial system will have some excess capacity (e.g., equipment requirements are rounded up and, therefore, equipment will not necessarily reach 100% utilization after 5 years). This excess capacity should be used to accommodate as much traffic growth as possible before additional costs are incurred to expand the CBIS.

While increased system utilization may accommodate some additional demand, designers should also seek to provide low-cost flexibility options in the system to incorporate one or more of the following capacity enhancements:

1. Upgraded software and/or hardware to improve throughputs of installed equipment.

2. Reduced bag spacing to improve throughput of continuous-feed EDS equipment.

3. Replacement of installed equipment with higher-throughput machines and necessary modifications to the BHS to support these machines.

4. Additional new equipment and associated BHS infrastructure.

In practice, a combination of one or more of the above approaches could be used. The choice of how additional capacity is to be provided will depend on the constraints of the terminal, the degree of certainty about future traffic growth, the overall capacity of the terminal, and the optimal system type to be installed.

To accommodate future growth, some designs may require additional marginal upfront investment in conveyors or facilities. This additional upfront investment can significantly lower long-term costs. For example, if expansion space is provided upfront instead of expanding space incrementally (as needed to accommodate growth beyond DBU + 5), then significant future savings could be achieved. As another example, when designing a medium-throughput full in-line system, if the CBIS were designed so that it could accommodate high-speed EDS machines, then significant future savings (capital as well as O&M) may be achieved by accommodating growth by a relatively simple replacement of the medium-speed EDS machines.

Several examples of how additional capacity could be provided for specific system types are provided below:

- **High-Throughput In-Line CBIS**—High-throughput systems should be assumed to accommodate additional demand through the provision of additional equipment and associated BHS infrastructure. Therefore, if expected traffic growth warrants, designs should preserve space for additional equipment or provide areas where low-cost modifications to facilities might be possible to install additional machines.

- **Medium-Throughput In-Line CBIS** —These systems could be designed with sufficient queuing capacity, variable frequency drives, and other components to support replacement of medium-speed EDS machines with high-speed EDS machines to accommodate traffic growth. Alternatively, designs could preserve space for additional equipment or provide areas where low-cost modifications to facilities might be possible to install additional machines. The choice will depend on local traffic, spatial and operational considerations, and life-cycle cost projections.

- **Mini In-Line CBIS** —As this system type is based on minimal BHS modifications, it is likely that the BHS of a mini in-line system will not support significantly higher-throughput EDS equipment without significant modifications. Therefore, growth beyond DBU + 5 years can be accommodated by (1) new machines and associated BHS infrastructure, (2) upgrading the BHS (and possibly the EDS) to support higher throughputs, or (3) replacing the mini in-line system with a medium-throughput or high-throughput in-line system.

- **Stand-Alone CBIS** —Software and hardware improvements may increase system throughput (assuming that bags can be loaded into the EDS machines at a fast enough rate to fully utilize the machine). However, it is expected that additional machines will be the most likely means of enhancing capacity.

To determine when and if additional capacity will be required, baggage demand and system performance should be monitored and projected on an annual basis. Planners would then be able to anticipate the need for additional capacity and perform any necessary analyses to determine the most cost-effective approach to enhancing system capacity.

As discussed in more detail in Chapter 8, planners should conduct a 20-year life-cycle cost analysis for each screening alternative identified and the preferred alternative should be spatially feasible as well as have relatively low life-cycle cost. The life-cycle cost analysis should include an assessment of the overall costs of different approaches for accommodating growth.

Despite the fact that EDS machines are assumed to have 10 years of useful life and ETD machines 7 years of useful life, 20 years is the proper analysis period for the purposes of life-cycle cost analysis. This is needed in order to properly assess economic trade-offs between the more capital intensive in-line CBIS with the more labor-intensive stand-alone CBIS. The 20-year analysis period is also the assumed useful life of the BHS equipment.

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6 METHODOLOGY TO DETERMINE BAGGAGE SCREENING EQUIPMENT REQUIREMENTS

This chapter provides a high-level methodology to determine EDS equipment requirements, OSR station requirements, and ETD screening station requirements in the Pre-Design Phase, as well as an overview of the approach recommended during later design phases to finalize equipment requirements.

During the Pre-Design Phase, the focus is on determining how many EDS machines, OSR stations, and ETD screening stations are required, given a certain airline grouping, CBIS type, and EDS equipment type. Once all feasible screening zones (airline groupings) have been determined and the baggage flow for each screening zone has been projected for the design year, it is possible to determine the high-level equipment requirements for each screening zone.

6.1 PRE-DESIGN PHASE

During the Pre-Design Phase, EDS equipment requirements, EDS equipment redundancy, OSR station requirements, and ETD screening station requirements need to be determined. In determining EDS equipment requirements, the peak 10-minute period of the ADPM in the design year shall be used. OSR station and ETD screening station requirements shall be based on the capacity of the EDS equipment.

6.1.1 EDS Equipment Requirements

The following key steps must be completed to determine EDS equipment requirements:

1. Group airlines into screening zones (as discussed in Chapter 5).
2. Project design year baggage demand for each screening zone (as discussed in Chapter 5).
3. Surge design year baggage demand for each screening zone (an explanation of how to surge demand is provided below).
4. Select CBIS type and EDS equipment type (a list of system types, including EDS equipment types and their throughputs, is provided in Chapter 3).

Equipment requirements should not be based on average baggage flows, but rather on surged flows obtained by multiplying the design year ADPM checked baggage flow by a zone-specific surge factor* (for each 10-minute bin). The use of a surge factor is recommended to capture the intrinsic variance of baggage demand and to ensure that equipment requirements are not undersized. For mini in-line systems the application of a surge factor may not be required. This will be at TSA's discretion. The following formula shall be used to calculate the surge factor:

$$SF = \frac{x + 2\sqrt{x}}{x}$$

where:

SF = Surge Factor, and

x = 10-minute baggage flow.

*To account for random variability in the expected average flow rate, a surge factor derived from an assumed Poisson arrival process distribution is applied to the peak 10-minute baggage flow. The surged peak 10-minute rate is then normalized to an hourly equivalent load to obtain a design-hour flow rate.

Figure 6-1 shows the 10-minute ADPM checked baggage flow by airline for an example airport; the surged flow is shown by the red dashed line. Each airline is represented by a different color on this figure.

To calculate EDS equipment requirements, the surged peak 10-minute design year baggage flow is first converted to surged peak-hour design year baggage flow and then divided by the appropriate hourly EDS machine throughput:

$$N_{EDS} = \frac{\text{SurgedPeak10Minute Flow x 6}}{\text{Throughput}_{EDS}}$$

where:

N_{EDS} = Number of EDS machines, and

Throughput_{EDS} = Number of EDS screened bags per hour (see Chapter 3).

Example: For instance, the peak 10-minute flow shown on Figure 6-1 is 198 bags per 10-minute period. The surge factor applied to this flow is approximately 1.14, which yields a surged flow of 224 bags per 10-minute period, or 1,357 bags per hour. To calculate EDS equipment requirements for a medium-throughput in-line CBIS using L-3 3DX 6600 equipment at a throughput of 550 bags per hour (assuming domestic bags), 1,357 bags per hour would be divided by 550 bags per hour, which results in 2.47. Rounding up to the nearest whole number of EDS machines required implies that a CBIS with three EDS machines would be necessary, without considering redundancy (as discussed later in this chapter).

As screening systems are sized using the ADPM, screening demand will, at times, exceed capacity over the course of the year. Depending on the duration of the over-capacity conditions, specific contingency measures should be implemented, as described in Chapter 11. Planners shall develop a mutually agreed-upon contingency plan in collaboration with stakeholders, including airline representatives, key airport personnel, the local TSA FSD, and representatives of TSA Headquarters.

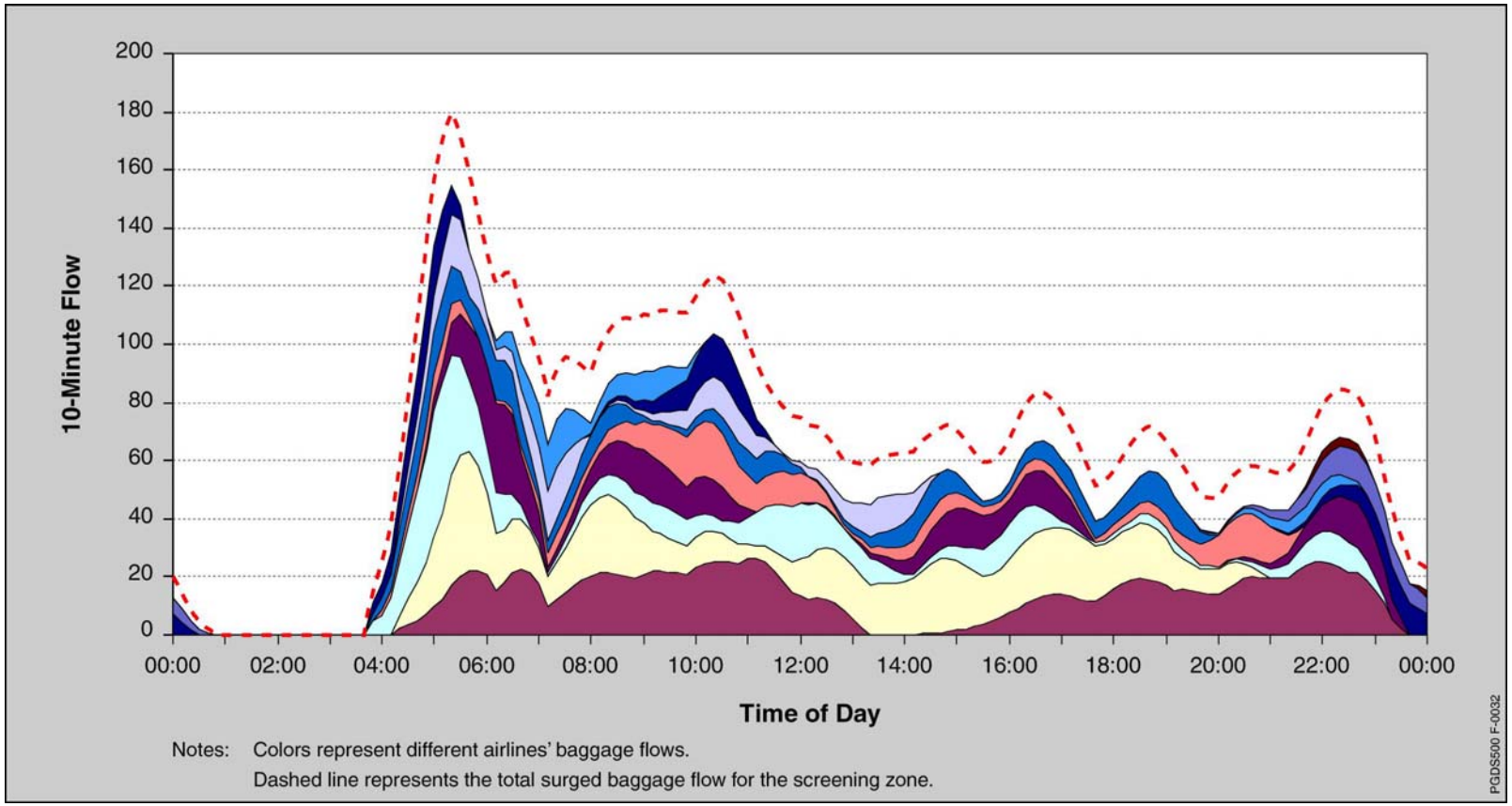
6.1.2 EDS Equipment Redundancy

Estimating EDS equipment requirements based on surged peak-hour baggage flow will result in adequate capacity during typical operating conditions. However, EDS equipment cannot be assumed to be 100% reliable. Given the central role of EDS as the primary screening technology for checked baggage inspection, redundancy must be provided to account for the potential that EDS equipment will be inoperable during certain peak periods. For mini in-line systems redundant EDS equipment is not allowed.

If possible, redundancy should be achieved through directing baggage to another CBIS using cross-over conveyors, assuming that their peaks do not occur simultaneously. The cost of implementing such a redundancy measure should be evaluated and compared to costs of implementing other redundancy measures (e.g., providing additional screening equipment).

When spatial constraints make cross-over conveyors between separate screening systems cost-prohibitive, EDS equipment redundancy should be calculated based on an assessment of the number of machines necessary to maintain 99% availability of the design capacity.

Figure 6-1
10-MINUTE SURGED ADPM CHECKED BAGGAGE FLOW



The multiyear average of the availability of EDS machines installed in-field is approximately 98%, as reported by TSA*. In other words, throughout the year, any EDS machine currently in use was operational 98% of the time. For planning purposes, designers should use an EDS availability (or operational percentage of uptime) of 98% for any single EDS machine and 99% availability for multiple EDS units in a CBIS (where redundant EDS machines can increase overall CBIS availability).

Based on the 99% availability goal and given an individual machine availability of 98%, only one additional EDS machine is required for systems with fewer than seven EDS machines. For systems with seven or more EDS machines,** two additional EDS machines would be required to reach that availability goal. For mini in-line systems additional EDS machines for purposes of redundancy are not allowed. For all other in-line systems the following calculation will apply:

If $N_{EDS} < 7 \rightarrow N_{EDS} + 1$
If $N_{EDS} \geq 7 \rightarrow N_{EDS} + 2$

where:
N_{EDS} = Number of EDS machines.

The redundant EDS machines are intended to provide additional capacity in case some of the nonredundant EDS machines are out-of-service for an extended period of time. When simulating the system, as required during the Detailed Design Phase (see Chapter 2), the redundant EDS machine should be assumed out-of-service for the entire simulation period.

*Availability is based on annual data collected in-field from TSA-certified EDS screening equipment, on short-term as well as long-term EDS machine outages.

**Theoretically, for systems with 20 or more EDS machines, 3 additional EDS machines are required to guarantee 99% system availability. However, even for highly centralized systems, the maximum number of EDS machines is likely to be fewer than 12.

For the purpose of calculating EDS throughput, a weighted average of the ranges provided in Chapter 3 Table 3-1 (screening equipment throughput rates) should be used for determining the weighted average. This weighting should be based on the mix of domestic (represented by the upper bound of the throughput range in Table 3-1) and international bags (represented by the lower bound of the throughput range in Table 3-1) in the zone for which the EDS equipment is being considered).

Redundant equipment shall only be provided when no lower-cost redundancies are possible. For instance, for decentralized systems (such as mini in-line or stand-alone systems), redundancy can be provided through the use of other nearby systems. It is expected that redundant equipment will only be cost-effective for high-throughput and medium-throughput systems, where (1) machine downtime can have a significant effect on system performance because of the high throughput of each machine and (2) opportunities for diverting bags to another screening area are cost prohibitive.

TSA will endorse the CBIS buildout for future growth but reserves the right to delay providing all screening equipment beyond those necessary to accommodate DBU+5 years until growth projections are met.

6.1.3 OSR Station Requirements

As explained in Chapter 3, for certain system types, OSR can be centralized and remotely located.

The degree of centralization can also vary from totally centralized OSR systems that serve the entire airport to OSR systems dedicated to each CBIS. If the system type supports a remotely located OSR system, several considerations should guide the selection of the appropriate degree of system centralization, including TSA staffing, space requirements, and information technology (IT) infrastructure requirements.

Thus, to select the best OSR system, it is recommended that OSR options be evaluated by assessing OSR staffing needs, capital costs of IT infrastructure and building modifications, and O&M costs.

OSR system requirements shall be derived based on the nonredundant EDS capacity sized to meet baggage demand in the design year and taking into account the queuing of images and bags.

OSR stations (N_{OSR}) should be estimated as follows:

$$N_{OSR} = \frac{N_{EDS} \times Throughput_{EDS} \times FA_{EDS}}{Throughput_{OSR}}$$

where:

$N_{EDS} \times Throughput_{EDS}$ = Total sum of nonredundant EDS capacity (throughput) for all EDS machines connected to the remote OSR system;

FA_{EDS} = EDS false alarm rate for the EDS equipment selected (see Chapter 3).

$$Throughput_{OSR} = \frac{3600}{\text{Screening Processing Time}_{OSR}}$$

where:

Screening Processing $Time_{OSR}$ = Average screening time that the OSR operator needs for each bag (see Chapter 3).

Example: Continuing the example earlier in this section, a CBIS with three L-3 3DX 6600 EDS machines would need a total of two OSR stations [(3 EDS machines x 550 bags per hour x 20%)/ (180 bag images per hour) = 1.8 OSR operators, rounded up to two OSR operators or two stations.

The false alarm rate shown in the above example is used for illustrative purposes only. Official planning values for EDS false alarm rates are considered Sensitive Security Information. Please contact TSA to obtain this information. For the purposes of calculating the EDS false alarm rate for OSR station requirements, a weighted average of the ranges provided in Chapter 3 figures for screening equipment should be used. This weighting should be based on the mix of domestic (represented by the upper bound of the false alarm and OSR clear rates range) and international bags (represented by the lower bound of the false alarm and OSR clear rates range). Weighting should be based on the mix of domestic and international bags in the zone for which the EDS equipment is being considered.

6.1.4 ETD Screening Station Requirements

ETD screening stations are accommodated in CBRAs. In general, an ETD machine is shared between two screeners because the amount of time the ETD machine is used during the total screening process for a bag is relatively short. Thus, the ratio of ETD screening stations to ETD equipment is assumed to be 2 to 1.

As mentioned above, for certain system types, OSR can be centralized and remotely located, while, in other cases, OSR and ETD screening functions can be combined and performed by the same ETD screener.

The following key inputs are necessary to estimate ETD screening station requirements:

- Total sum of nonredundant EDS capacity (throughput) for all EDS machines connected to the CBRA (sum of $Throughput_{EDS}$).
- EDS false alarm rate for the EDS equipment selected (FA_{EDS}) (see Chapter 3).
- OSR clear rate (CR_{OSR}) (see Chapter 3).

- Average ETD screening time per screener, from which it is possible to derive the average ETD throughput per screener ($Throughput_{ETD}$) (if OSR is remote) (see Chapter 3).
- Average combined OSR/ETD screening time per screener, from which it is possible to derive the average OSR/ETD throughput ($Throughput_{OSR/ETD}$) (if OSR and ETD screening functions are combined) (see Chapter 3).
- Average rate of OOG bags.
- Average rate of Lost-in-Tracking bags.

Depending on the selected OSR option, ETD screening station requirements are derived as follows:

ETD Screening Station Requirements with Remote OSR

$$N_{ETDStations} = \frac{N_{EDS} \times Throughput_{EDS} \times [FA_{EDS} \times (1-CR_{OSR}) + R_{OOG} + R_{LIT}]}{Throughput_{ETDScreener}}$$

where:

$N_{EDS} \times Throughput_{EDS}$ = Total sum of nonredundant EDS capacity (throughput) for all EDS machines connected to the CBRA (see Chapter 3);

FA_{EDS} = EDS false alarm rate for the EDS equipment selected (see Chapter 3).

CR_{OSR} = OSR clear rate (see Chapter 3);

R_{OOG} = OOG rate (see Chapter 3);

R_{LIT} = Lost-in-Tracking rate; and

$Throughput_{ETD\ Screener}$ = Number of bags screened by ETD screener during a certain period of time (see Chapter 3).

ETD Screening Station Requirements with Combined OSR and ETD Screening

$$N_{ETDStations} = \frac{N_{EDS} \times Throughput_{EDS} \times FA_{EDS} \times (1 + R_{OOG})}{Throughput_{OSR/ETDScreener}}$$

where:

$N_{EDS} \times Throughput_{EDS}$ = Total sum of nonredundant EDS capacity (throughput) of all EDS machines connected to the CBRA; and

$Throughput_{OSR/ETD\ Screener}$ = Inverse of average OSR/ETD screening time per screener (see Chapter 3).

Note: Combined OSR and ETD screening is appropriate only in mini in-line systems and shall not be used for fully in-line systems.

ETD Machine Requirements

The number of ETD machines required is calculated as:

$$N_{ETDMachines} = \frac{N_{ETDStations}}{2}$$ (Round up to the next ETD)

Example: Continuing the example used earlier in this section, a CBIS with three L-3 3DX 6600 EDS machines would need a total of seven ETD stations [(3 EDS machines x 550 bags per hour x 20% x 40%+4%+1%)/(24.2 bags per hour) = 8.86 ETD stations, rounded up to nine stations]. The total number of ETD machines required would be five (9/2 = 4.5 rounded up to five ETD machines).

Notes:

- In determining ETD screener throughput rates for remote OSR and combined OSR/ETD, it is assumed that each screener has a dedicated viewing station.

- The false alarm rate shown in the above example is used for illustrative purposes only. Official planning values for EDS false alarm rates are considered SSI. Please contact TSA to obtain this information.

- For the purposes of calculating the EDS false alarm rate for ETD screening station requirements, a weighted average of the ranges provided in Chapter 3 figures for ETD screening equipment should be used. This weighting should be based on the mix of domestic (represented by the upper bound of the false alarm and OSR clear rates range) and international bags (represented by the lower bound of the false alarm and OSR clear rates range). This weighting should be based on the mix of domestic and international bags in the zone for which the EDS equipment is being considered. This assumes that a baggage reinsertion line (BRL) is present in the CBRA.

CBRA design requirements are addressed in Chapter 9.

6.2 SCHEMATIC AND DETAILED DESIGN PHASES

As mentioned at the beginning of this chapter, during the Pre-Design Phase, several conceptual screening alternatives should be evaluated. Thus, the methodology used during that phase is intended to provide quick estimates of EDS, OSR, and ETD screening requirements for each alternative concept. As explained earlier in this chapter, this methodology is based on baggage flow estimates and assumptions regarding average throughputs and false alarm rates.

Once the number of feasible alternatives has been reduced and the feasible alternatives compared based on the life-cycle cost methodologies described in Chapter 8, detailed simulation modeling is required to further evaluate the alternatives, refine equipment requirements, and evaluate CBIS performance. Simulation modeling helps planners, architects, and CBIS designers transition from high-level concepts to more detailed design.

At the **Schematic Design Phase**, high-level flow-based modeling is still allowable to determine average baggage time in system and refined equipment and staffing requirements. For complicated system designs, nonvisual simulation modeling may prove beneficial and can be performed at the project sponsor's discretion.

At the **Detailed Design Phase**, once the preferred CBIS has been identified, dynamic simulation is required to:

1. Finalize the detailed components of the baggage handling and screening system (e.g., number of queuing belts, conveyor speeds, exact location of merge and diversion points, exact amount of buffering required).

2. Assist baggage designers with programmable logic controller (PLC) specifications and requirements.

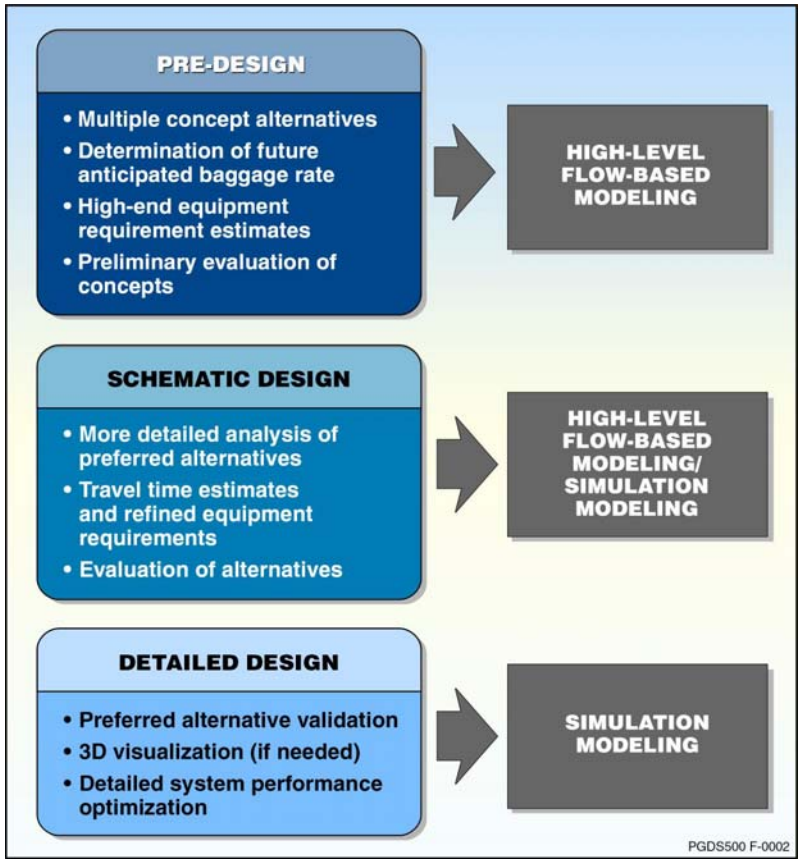
3. Refine the evaluation of system performance.

4. Visualize the final design to assist with stakeholder review and approval.

Commercially available simulation packages, as well as proprietary packages, can be used for the Detailed Design Phase.

Figure 6-2 summarizes the key elements of each phase and the analytical modeling approach used to assess requirements.

Figure 6-2
APPROACH TO MODELING CBIS REQUIREMENTS



6.3 RECOMMENDED SIMULATION APPROACH

When developing CBIS simulations, it is recommended that the following approach be used to verify the performance of CBIS designs and to ensure standardization of simulation development. Using a commonly accepted approach during simulation development will enable more efficient use of the simulation results and improve the screening solutions.

The CBIS simulation should include CBRA operations (i.e., conveyors leading to CBRA, bags queuing within CBRA, screening process, and bag reinsertion into the CBIS).

6.3.1 General Approach

As shown on Figure 6-2, the following standards and methodology should be used during the development of any simulation:

1. Begin with a layout of the CBIS, including accurate conveyor lengths, equipment used, and conveyor belt speeds.

2. Program system control logic, including transfers, merges, belt speeds, and bag spacing designed for the EDS equipment being used.

3. Develop a design day flight schedule and other assumptions (load factors, earliness distributions, etc.) regarding the flight schedule to determine baggage demand input to the simulation model for the specific airport. Designers shall list all data and assumptions used in the simulation model.

4. Assume that the redundant EDS machine (see Section 6.1.2) is out-of-service for the entire simulation period.

5. For systems using laser scanners, assume a no-read or misread rate of 8.0%. For systems using radio frequency identification (RFID) scanners, assume a no-read or misread rate of 1.5%.

6. Identify potential locations for jams throughout the system and program an overall 0.5% jam rate to occur randomly at the identified locations.

6.3.2 Statistical Distributions

Whenever possible, planners should obtain specific and updated ETD and OSR processing distributions from TSA. However, if these distributions are not available, the following distributions can be used:

- **Time to clear bag jams**—Use a triangular probability distribution to simulate the clearing of jams, with a minimum time value of 0.5 minute, most likely time value of 1.5 minutes, and maximum time value of 5.0 minutes.

- **OSR** protocol for EDS alarmed bags—Use a gamma distribution where the mean is 30.0 seconds, the standard deviation is 7.5 seconds, the minimum value is 5.0 seconds, and the maximum value is 45.0 seconds.

- **ETD** protocol for oversized bags—Use a gamma distribution. Distribution parameters are considered Sensitive Security Information. Please contact TSA to obtain required information.

- **ETD directed search** of EDS alarmed bag—Use a gamma distribution. Distribution parameters are considered Sensitive Security Information. Please contact TSA to obtain required information.

- If possible, **baggage size** (length, width, height, and weight) should be distributed based on data collection at the airport or data provided by the airport operator or airlines. When actual data are unavailable, an average bag length of 28 inches (a conservative average for domestic baggage length) and bag spacing of 12 inches is recommended.

- The **baggage weight** distribution will assist TSA in selecting the type of lift-assist devices to reduce or eliminate manual baggage lifting and handling in the CBRA.

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7 DESIGN BEST PRACTICES AND STANDARDS

A properly designed CBIS shall meet TSA's security, supportability, maintainability and safety standards as defined in this chapter while maximizing efficiency, customer service level, and cost effectiveness. This chapter presents a discussion of:

1. Overall CBIS design principles related to security, efficiency, customer service level, cost-effectiveness, and safety.

2. Specific design best practices and standards to assist designers and planners in developing CBIS designs in accordance with the PGDS.

The Design Performance Standards (DPS) to be achieved by the CBIS designs are described in detail in this chapter. The standards shall be used by the CBIS designers in developing CBIS plans and specifications.

The goal of this Chapter structure is to convey TSA's design best practices as desired goals for designers together with their corresponding standards which must be met by the designed CBIS. Meeting these corresponding standards will ensure that the best practices are also achieved. Best practices and standards are each identified by their separate section titles.

7.1 SUMMARY OF OVERALL CBIS DESIGN PRINCIPLES

7.1.1 Security

When designing a CBIS, one of the priorities is security. The following paragraphs describe key security-related best practices to be met in planning and designing a new CBIS.

7.1.2 Efficiency

Efficient operation is a requirement of every CBIS design. To operate efficiently, CBIS designs must minimize the frequency of errors and faults. In particular, the frequency or rate at which non-alarmed bags are sent to the CBRA because of tracking or misread errors must be minimized. Manually inspecting these error bags at the CBRA can increase system operating costs, as well as the time a bag is in the system.

7.1.3 Customer Service Level

CBISs must meet TSA security standards without compromising the level of service that airlines provide to their passengers. The delay incurred by the baggage screening process must be kept within acceptable limits to ensure that bags do not miss their intended flights and airline operations are not unduly affected. As described in this chapter, CBIS designs will be evaluated to assess compliance with the DPS for bag time in the system.

7.1.4 Cost Effectiveness

Alternative system types, if properly sized, will offer equivalent levels of security and performance in terms of customer service level. Selection of the preferred alternative will, therefore, be based on cost effectiveness. When evaluating cost effectiveness, it is essential to consider not only the upfront capital costs involved, but also the recurring costs associated with operating, maintaining, and staffing the system. The methodology for evaluating cost-effectiveness is discussed in Chapter 8.

7.1.5 Concept of Operation

A CBIS is designed to accommodate a particular screening process, or concept of operation. When planning and designing a CBIS, the process should begin with a thorough understanding of the concept of operation. Planners and designers must document a concept of operation tailored to the specific CBIS and CBRA which must accompany the 30% submission. A generic CBIS

concept of operation is described in Chapter 3, but a specific CBIS concept of operation pertaining to the CBIS design for a specific airport should be developed by the designers or planners of that system. A set of generic CBIS types and related concepts of operation are described in Appendix B and can be used as a starting point for further development of airport-specific CBIS concepts of operation.

7.1.6 Proper System Selection and Sizing

In planning a CBIS, proper system selection and sizing are essential to ensuring that the system provides the required level of security. An undersized system that cannot accommodate the demand routinely experienced presents not only a security issue, but can also negatively affect customer service level. Separate chapters of this PGDS are devoted to the key steps involved in proper system selection and sizing. Chapter 3 describes the range of system types and screening equipment to be considered. Chapter 4 describes the process used in developing and evaluating alternatives. Chapter 5 describes the process for determining baggage screening demand. Chapter 6 describes the methodology for determining baggage screening equipment requirements.

7.1.7 Safety

In planning a CBIS, ergonomic design goals should be considered to reduce the potential for injuries caused by improper ergonomic designs. Safety should be considered in conjunction with other security parameters during the planning phase to avoid any costly retro-fitting solutions to reduce injuries.

7.2 SPECIFIC DESIGN BEST PRACTICES AND STANDARDS

Specific design standards specify key operational objectives that CBISs must meet or exceed. This section describes those standards to assist designers to successfully pass the design review process.

CBISs shall be evaluated during the design, construction, testing, and commissioning phases to ensure compliance with specific design standards:

1. **Design Phases** – As described in Chapters 2 and 6, a proposed in-line CBIS will be evaluated using high-level flow-based modeling during the Schematic Design Phase and visual simulation modeling at the 30% and 70% Detailed Design Phase (except for simple mini in-line designs). Modeling will enable designers to assess whether the proposed CBIS will meet the DPS. Modeling will also assist designers by confirming preliminary equipment requirements and revealing potential weaknesses to be addressed as designs are refined. Before receiving approval from TSA, proposed in-line CBIS designs will be evaluated to demonstrate compliance with the DPS described in this chapter.

2. **Construction, Testing, and Commissioning Phases** – Before final TSA acceptance, a number of system and component tests will be performed on installed CBISs as part of the commissioning process. See Appendix D for a description of how the Integrated Site Acceptance Test and Site Specific Test Plan will be developed.

The following Table 7-1 summarizes design best practices and their corresponding design standards.

Table 7-1
SUMMARY OF DESIGN BEST PRACTICES AND STANDARDS

Section	Design Best Practices	Section	Design Standards
7.2.1	BHS Capacity	7.2.1.1 7.2.1.2	Main Line Tail-to-Head Spacing
7.2.2	Screening Throughput Capacity	7.2.2.1	Actual Screening Throughput
7.2.3	Bag Time in System	7.2.3.1	Time in System
7.2.4	OSR Decision Time	7.2.4.1	OSR Travel Time
7.2.5	BHS Tracking	7.2.5.1 7.2.5.2 7.2.5.3	Tracking Standard Primary ID Positive Bag Tracking
7.2.6	Bag Tag Identification	7.2.6.1	Read Rate
7.2.7	Conveyor Management	7.2.7.1 7.2.7.2 7.2.7.3 7.2.7.4 7.2.7.5	Conveyor Breaking Gradual Conveyor Speed Transitions Avoidance of Steep Conveyor Slopes Divert and Merge Bag Orientation/Positioning
7.2.8	System Conveyable Items	7.2.8.1 7.2.8.2	Oversized Bag (OS) Out-of-Gauge Bag (OOG)
7.2.9	Fail-Safe Operations	7.2.9.1	Fail-Safe Operations
7.2.10	Image Quality Test	7.2.10.1	IQ Test
7.2.11	Bag Jam Rate	7.2.11.1	Bag Jam
7.2.12	BHS Displays at CBRA	7.2.12.1	BHS Displays at CBRA
7.2.13	CBIS Layout	7.2.13.1 7.2.13.2 7.2.13.3 7.2.13.4 7.2.13.5	Power Turn Standard Reinsertion Line Non-Powered Rollers Draft Curtains EDS Accessibility
7.2.14	CBIS Reporting	7.2.14.1 7.2.14.2 7.2.14.3	Reporting Frequency Reporting Detail Daily Reporting Standards

7.2.1 BHS Capacity Best Practices

The BHS of the proposed CBIS shall be designed for current EDS technology with built-in flexibility to be able to accommodate future EDS technology (such as high-speed EDS), and shall not constrain the maximum potential capacity of the EDS technology. In determining the BHS capacity, the following main line and tail-to-head bag spacing standards shall be met, using the evaluation assumptions described.

7.2.1.1 Main Line Standards

1. All main lines delivering bags to or taking bags away from a group of EDS machines shall be capable of feeding the CBIS at equal to or greater than the minimum rate of the total screening capacity of the non-redundant combined EDS matrix.

2. The number of merges and diverts on any one main line shall be limited so as not to affect throughput capacity or the ability to maintain positive bag tracking.

3. The CBIS shall meet the minimum throughput capacity, as stated above, without jeopardizing positive bag tracking.

7.2.1.2 Tail-to-Head Bag Spacing Standard

For EDS machines, bag spacing, both tail-to-head and head-to-head, should be optimized to meet the required rate. The ILDT shall ensure that all tracking and spacing is compliant with the OEM's site planning and installation guidelines. At no time shall the gap be less than 12 inches when entering the EDS machine.

7.2.1.3 Standard Evaluation Assumptions

The following assumptions are to be used in determining BHS performance:

1. All of the systems and functional components of the proposed CBIS are to be operational without failure modes or faults.

2. All grouped EDS machines in operation less any redundant machines shall not exceed any main line throughput capacity (see discussion of EDS equipment redundancy in Chapter 6).

3. Legacy baggage handling systems shall not affect the performance of the new CBIS. To ensure the legacy BHS does not affect the system's ability to deliver bags to or convey bags from the CBIS at the designed throughput, TSA will consider reimbursement of the costs for specific replacement and upgrade of the conveyor system necessary to support integration of the EDS machines (see Appendix F, Section F.3.1).

4. The EDS throughput capacity on which the system was based shall be in accordance with the information in the Table 3-1 in Chapter 3. The CBIS design shall be optimized for current EDS screening equipment.

5. The CBIS design must account for appropriate staffing required for OSR and CBRA processes. (See discussion in Chapter 6 on calculating required staffing for OSR and CBRA.)

7.2.2 Screening Throughput Capacity Best Practices

Designed and installed CBIS need to provide adequate screening throughput capacity and meet the throughput and capacity standards set in this chapter. The following are the corresponding screening throughput capacity standards.

7.2.2.1 Actual Screening Throughput Standard

The actual screening throughput capacity as tested in accordance with the information presented in Appendix D shall meet or exceed the designed screening throughput capacity.

7.2.2.2 Standard Evaluation Assumptions

1. The design throughput capacity is calculated as the product of: (a) the number of EDS machines provided (excluding any redundant machines) and (b) the screening throughput capacity per EDS machine.

2. For purposes of this evaluation, the average screening throughput capacity per EDS machine will be confirmed by the ILDT and shall meet or exceed the values presented in Chapter 3.

3. If the design cannot meet the required screening throughput capacity, the project sponsor must justify the designed screening throughput capacity to TSA.

7.2.3 Bag Time in System Best Practices

When designing the CBIS, the amount of time a bag is in the system needs to be considered. The proposed CBIS shall not cause unacceptable levels of delay to bags processed during normal operations.

7.2.3.1 Time in System Standard

All CBISs shall be designed to accommodate for 10 minutes of TSA accumulation and processing time of bags in CBRA at the peak hour load. The time in CBRA is defined as starting at the "last chance divert", including the travel time to the CBRA queues (up to 1-min maximum), including any staging queues leading into the CBRA ETD area, the manual screening and bag handling time, and ending at the point the bag exits the CBRA via the clear line.

Figure 7-1 illustrates bag time in system and bag time in CBRA.

The bag time in system from insertion at the furthest load point, through EDS screening to arrival at the sortation system mainlines which feed the baggage makeup area shall be no more than 10 minutes for 95% of peak-hour bags during normal operations. The time includes all screening time (i.e., including alarm resolution in the CBRA). This shall be validated by averaging across at least 10 simulation runs.

Additionally, bag time in CBRA from point T3 to T5 on Figure 7-1 shall be no more than 10 minutes for 95% of the peak-hour bags entering CBRA during normal operations. This shall be validated by averaging across at least 10 simulation runs using the statistical modeling methods given in Chapter 6.3 of this document. See Figure 7-2 for a graphical example of the relationship between time in system and time in CBRA.

However for specific CBISs and on a case-by-case basis (e.g., with especially long delivery lines from check-in areas to centralized CBIS, or CBIS with legacy EDS that typically run with high false alarms rates), TSA may consider a bag time in system standard of longer than 10 minutes for 95% of the bags.

7.2.3.2 Standard Evaluation Assumptions

For purposes of this evaluation, normal operations shall be interpreted to mean the following:

1. All of the systems and functional components of the proposed CBIS are operational without failure modes or faults.

2. All EDS machines that are not provided for redundancy/ system reliability are fully operational during all hours of normal CBIS operations (see discussion of EDS equipment redundancy in Chapter 6).

3. Adequate staffing is provided for required OSR and CBRA processes.

4. Legacy BHS components shall not negatively affect the CBIS bag time in system. If legacy BHS input conveyors are not capable of feeding bags to the new CBIS at the CBIS-required rate, the legacy BHS must be upgraded so that it does not negatively affect the new CBIS.

7.2.4 OSR Decision Time Best Practices

Sufficient decision time shall be provided for OSR screening before bags are diverted to a Clear Line for transport to bag makeup or an Alarm Line for transport to the CBRA.

7.2.4.1 OSR Travel Time Standards

The CBIS must allow a minimum of 45 seconds of travel time between the exit from the EDS and the final diversion point to the CBRA. This 45-second travel time shall be confirmed using dynamic simulations.

Regardless of the methodology used to achieve the 45-second travel time, the CBIS throughput must meet the performance requirements specified in this chapter.

Mini in-line CBISs are not required to meet the 45-second travel time to the last chance divert point (for OSR) however where space is available, the OSR decision point shall be placed far enough downstream of the EDS machines to allow for 30 seconds of travel time. Maximizing the amount of travel time will optimize the OSR clear rate.

Figure 7-1
BAG TIME IN SYSTEM AND BAG TIME IN CBRA

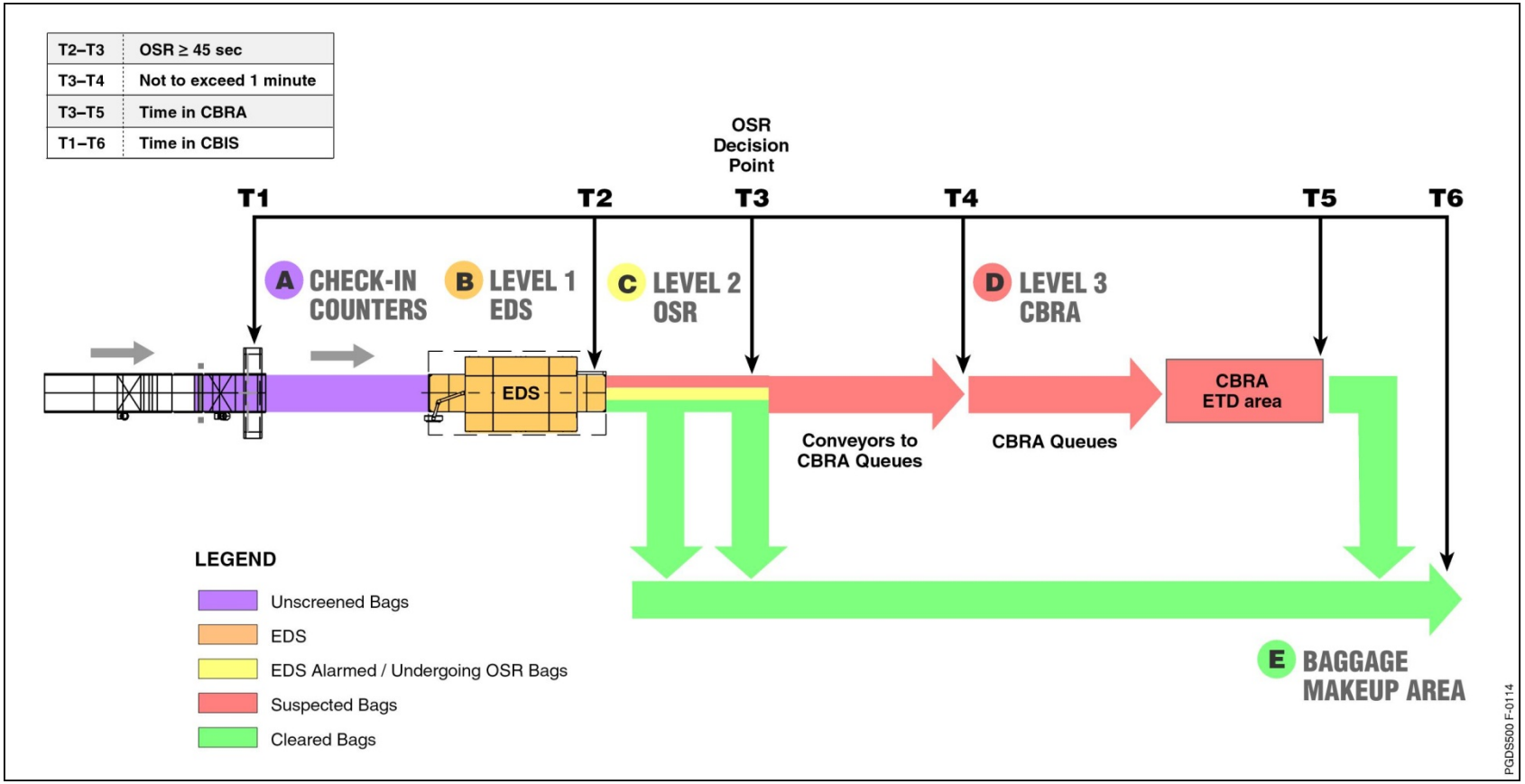
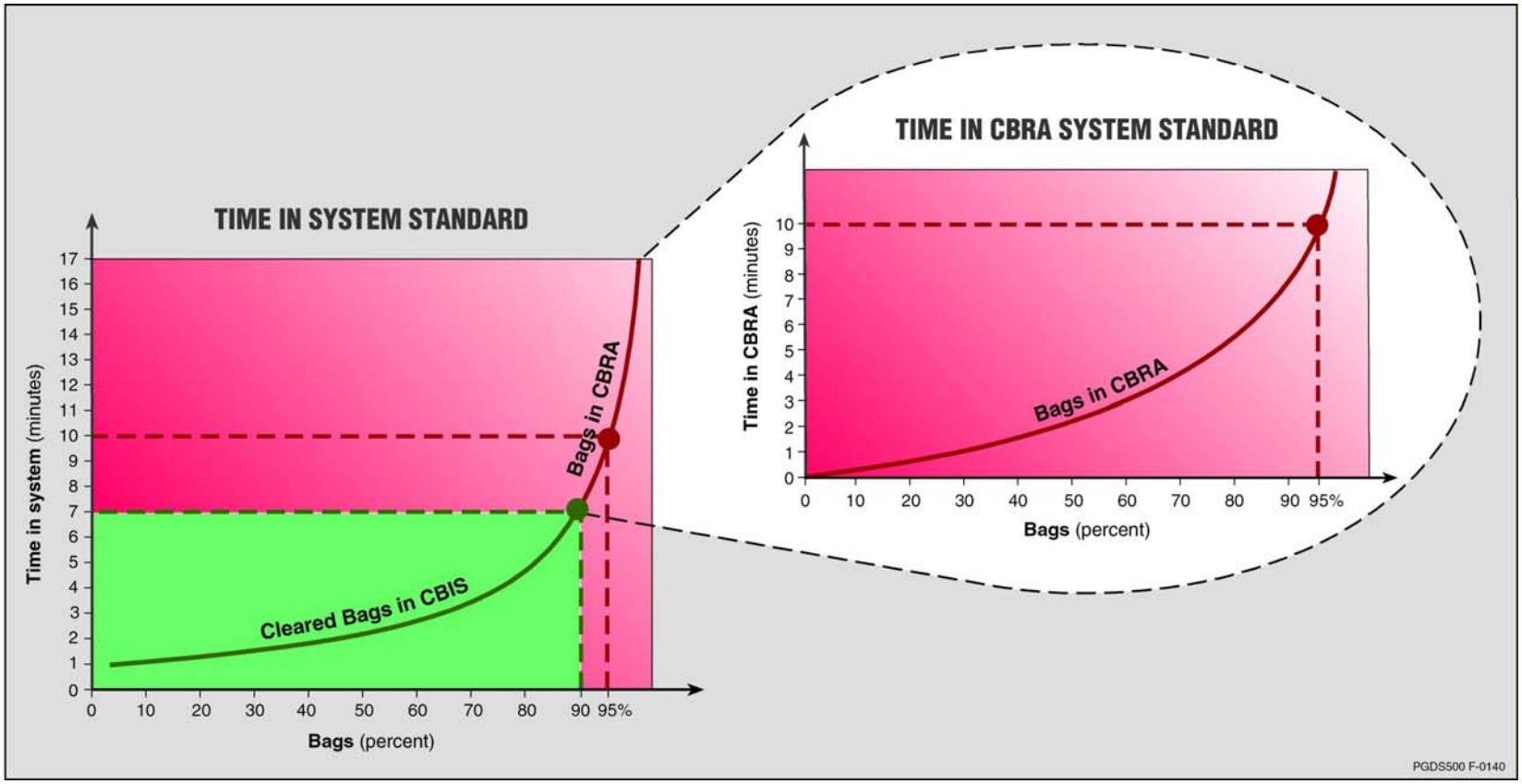


Figure 7-2
TIME IN SYSTEM AND TIME IN CBRA STANDARDS



7.2.5 BHS Tracking Best Practices

This section defines the BHS baggage tracking best practices and corresponding standards to achieve these best practices. A key best practice is using positive bag tracking which is a method where the BHS maintains a known position for all bags within the CBIS at all times. Bag positions can be tracked by such methods as monitoring the conveyor belt speeds, distances, routing events, bag length, and other information associated with its travel path through the tracking zones. Positive tracking is essential to monitoring the threat status of each bag as it passes through the CBIS.

7.2.5.1 Tracking Standard within the Security Tracking Zone

Tracking accuracy within the Security Tracking Zone (STZ) shall be 95% or better.

7.2.5.2 Primary ID Standards

1. The BHS shall assign a unique bag ID to each bag at the beginning of tracking within the CBIS for the purposes of positive bag tracking.

2. The BHS-assigned tracking ID and, if available, the bag tag data shall be transferred between BHS and EDS equipment and shall be compliant with the OEM's integration guide.

   Where the BHS has an ATR installed upstream of an EDS unit, the BHS shall also pass the bar code data to the EDS unit as defined by each EDS manufacturer's interface requirements document. Only a ten-digit unique bag identifier is acceptable. This data shall also be maintained by the BHS in a database that allow the BHS to "associate" the generated bag ID with the bar code data. Additional information can be obtained via the latest published version of the TSA's Checked Baggage Inspection System Integration Requirements Document.

7.2.5.3 Positive Bag Tracking Standards

1. The CBIS shall be capable of maintaining positive bag tracking even during adverse events (e.g., jams, diebacks, fail-safes, etc.) that are typical of situations which may occur in baggage handling systems.

2. If the BHS tracking ID becomes unknown or unavailable, the EDS will generate a pseudo ID for tracking purposes. This format and ID range is specified in the OEM's integration guide. ID ranges shall be coordinated with the OEM and ensure ID overlap does not occur between any EDS unit within any matrix.

3. The measurement of tracking performance standards of the CBIS and the monitoring of the events within the CBIS shall start at the beginning of the CBIS tracking zone and shall end at the clear line of the first decision point, or the clear line of the second decision point, or the exit of CBRA.

4. Invalid arrivals at CBRA shall be monitored and logged via the BHS reporting system. The acceptable rates for invalid arrivals at CBRA vary depending on whether the design includes a baggage reinsertion line (BRL). Invalid arrivals at the CBRA are all bags that are not valid bags arriving at CBRA (including bags with an incorrect associated status). The **ONLY** valid bags at the CBRA are:

   - Suspect bags
   - OOG bags
   - EDS unknown bags (bags with "no data", "EDS error", or an "EDS unknown" status)
   - OS bags (assuming OS line arrives to CBRA)

5. Invalid arrivals rate at the CBRA shall:

   a. Not exceed 3% in CBRAs designed with a BRL

   b. Not exceed 2% in CBRAs designed without a BRL

6. At no time shall the system swap or transfer BHS tracking IDs on or between bags or swap or transfer security screening decisions on or between bags.

7. Any bag with a conveyable dimension less than 12 inches shall be placed in a tub. The CBIS shall be capable of detecting when any bag infringes on the tracking window of any other bag as long as the bags are at or above the minimum conveyance size and the bag is not on top of, underneath, or directly beside another bag. The CBIS shall

be capable of detecting a bag that is leading edge to trailing edge or trailing edge to leading edge with another bag and route the bags appropriately. See Figure D-1 in Appendix D.

At no time, shall the BHS override a decision sent from the EDS where all bags must be retained and tracked with the status from the EDS. The only exception are when a decision has not been received from the EDS and the BHS must assign a status for tracking purposes and be clearly identifiable as a bag which has not received a decision from the EDS or when the security status of a bag is in question.

8. If the EDS is controlling the conveyors immediately before and after the EDS, the CBIS/EDS is still required to meet the same criteria for tracking as in any other tracking zone.

9. The tracked portion of the CBIS shall be capable of detecting when a bag is no longer within its assigned tracking window.

10. The CBIS shall be capable of detecting when a bag has been delayed or accelerated more than 12 inches. One of the following will apply:

    a. Upstream of EDS (single bag): The CBIS shall reacquire the bag and continue tracking.

    b. Downstream of EDS (single bag): If the bag has already been screened and traveled downstream of the EDS, any security status assigned to the bag will no longer be considered valid and the bag shall be routed to the CBRA.

    c. Downstream of EDS (multiple bags): If multiple bags are involved and tracking windows have been infringed upon, then the CBIS shall be capable of detecting this condition and route all bags involved to the CBRA.

11. The CBIS shall be capable of detecting when a bag has been added within the tracking zone as long as that bag is added anywhere other than on top of, underneath, directly beside another bag.

    a. Upstream of EDS (single bag): The CBIS shall acquire the bag and continue tracking.

    b. Downstream of EDS (single bag): If the addition occurs downstream of the EDS and only the added bag itself is affected (added bag does not infringe on the tracking window of another bag), then the added bag shall be routed to the CBRA.

    See Section D.3.3 for testing standards related to added bags.

12. The system shall maintain tracking and security statuses of all bags that have been screened by the EDS and the security decision transmitted from the EDS to the BHS prior to or after activation of either a BHS or EDS emergency-stop (e-stop). The EDS shall recover from the e-stop condition in accordance with published criteria from the EDS vendor and the BHS shall recover per established e-stop recovery procedures defined in the BHS specifications and in accordance with the OEM's Integration Guidelines.

13. The ILDT shall ensure proper tracking devices have been included in the BHS specifications.

14. PECs are used to maintain baggage tracking and to ensure that bags stop on the appropriate conveyor and do not allow any part of the bag to drift onto the next downstream conveyor.

7.2.6 Bag Tag Identification Best Practices

Bag tag identification is a method in which a tag or chip with a unique readable ID number is physically attached to each bag and linked to the passenger name record (PNR). The bag tag is positively identified by scanning or reading the attached tag or chip.

The technology used for positive identification may be either optical or RFID based, as long as the technology does not affect CBIS throughput performance.

7.2.6.1 Read Rate Standards

During controlled testing, read rates shall be no less than 98% for laser arrays and 99% for RFID applications.

7.2.7 Conveyor Management Best Practices

To properly maintain baggage tracking, CBIS designs must provide for sufficient conveyor control through the use of the components/design standards listed below.

1. A key best practice for conveyor management are avoidance of steep slopes which lead to baggage rolling and sliding on the conveyor, which often results in tracking losses, bag jams, and bags doubling up. Double bags inducted into the EDS are likely to result in machine faults, reduced throughput, equipment down time, increased maintenance, and a reduced level of security. Keeping incline and decline angles to a minimum is required.

2. The proper use of diverters, pushers, and merges is essential to reducing tracking errors and bag jams. Improper merging/diverting and the use of multiple conveyor merge/divert points on an individual line increases the number of mistracked bags and reduces the overall CBIS throughput.

3. CBIS designers shall strive to ensure proper orientation is maintained throughout the system, especially into the EDS to prevent unnecessary EDS error bags, unnecessary losses in tracking through the EDS, and jam events.

4. The effective application of bag orientation/positioning devices is achieved through proper application of static deflectors and belt type to guide bags or tubs off of side walls to improve system throughput prior to baggage induction to EDS equipment, ATRs, or BMAs. For these static deflectors to work efficiently and effectively, the type of conveyor belt under the static deflectors becomes critical.

7.2.7.1 Conveyor Braking Standard

To properly maintain baggage tracking, CBIS designs must provide for sufficient conveyor braking on all tracked conveyors.

7.2.7.2 Gradual Conveyor Speed Transitions Standard

The transitions in conveyor belt speeds between any two consecutive conveyor belts shall be in a range not exceeding 30 feet per minute so as not to affect the stability, orientation, or spacing of bags while still maintaining accurate bag tracking.

7.2.7.3 Avoidance of Steep Conveyor Slopes Standard

The CBIS shall be designed with incline and decline angles no greater than 18 degrees in non-tracking zones (i.e., zones where bags are not positively tracked) and no greater than 12 degrees in tracking zones (i.e., zones where bags are positively tracked).

7.2.7.4 Divert and Merge Standards

1. Static ploughs and roller diverters shall not be used.

2. Directly opposing diverters shall not be used.

3. Pushers shall be not used in the CBIS until the bags have been cleared, and are being pushed to a Clear Line or are on a post-EDS main line proceeding to bag makeup areas for sortation.

4. Designers shall consider incorporating separate conveyors when system throughput and/or bag tracking would be negatively affected by excessive merges/diverts on any given line.

5. As soon as possible, bags exiting each EDS machine shall be separated by their clear or non-clear screening status for merging onto the post-EDS main line or OSR line. Level 1 cleared bags shall not exit the CBIS for a minimum of 15 seconds.

6. After clear and non-clear bags have been separated, they shall not be commingled. OOG bags should be routed directly to the CBRA on separate conveyors. If space or design limitations exists and a direct route to the CBRA is not cost effective or feasible, then OOG bags can be merged with alarm bags after the Level 2 (OSARP) decision point.

7.2.7.5 Bag Orientation/Positioning Standards

For static deflectors to work efficiently and effectively, a low coefficient of friction belt under the static deflectors is required. The EDS in-feed and exit conveyors are typically high coefficient of friction belting. Static deflectors shall not be utilized on the EDS in-feed conveyor.

7.2.8 System Conveyable Items Best Practices

Items that are conveyable in a CBIS vary from system to system. Variables that determine whether or not items are conveyable include: BHS equipment used, EDS equipment used, legacy system constraints, and cost versus operational advantages, among other variables. Typically OS and OOG items in the CBIS create excessive jam conditions.

7.2.8.1 Oversized Bag Standard

The dimensions of OS items exceed the conveyance limitations of any CBIS conveyor belts. Therefore, if automated conveyance of oversized bags is needed, Dedicated OS conveyors must be used to transport OS items.

7.2.8.2 Out-Of-Gauge Bag Standard

The CBIS shall be designed to transport OOG bags directly to the CBRA. OOG bags are those bags that can be transported by the BHS, but are too large to fit through the EDS machines deployed for that CBIS without causing damage. The most effective way to filter OOG is to locate BMAs upstream of the EDS lines.

7.2.9 Fail-Safe Operation Best Practices

A fail-safe operation is one that, in the event of any system or component failure affecting the CBIS, does not permit the conveyance of any suspect or non-clear bags to airside locations where they would be loaded onto a flight. Events likely to cause fail-safe activation include power outages, bag mistracking or misreading, diverter malfunctions, and bag jams. Following are fail-safe corresponding standards.

7.2.9.1 Fail-Safe Operation General Standards

1. In the event of a fail-safe activation, the default path for any non-clear bag must be to a secure location—non-clear bags shall never be sent to an airside location.

2. Fail-safe activations shall not exceed 0.5% of total daily bag volume.

Figure 7-3 describes required fail-safe CBIS designs.

Figure 7-3
CBIS FAIL-SAFE DESIGNS

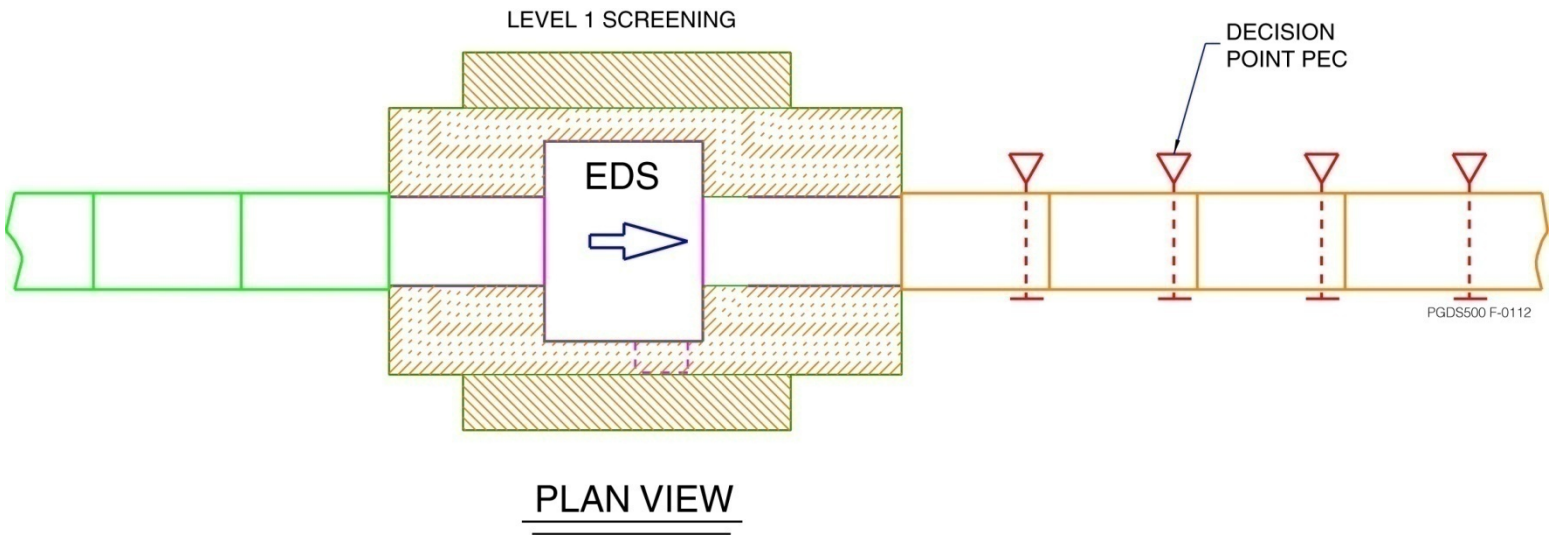
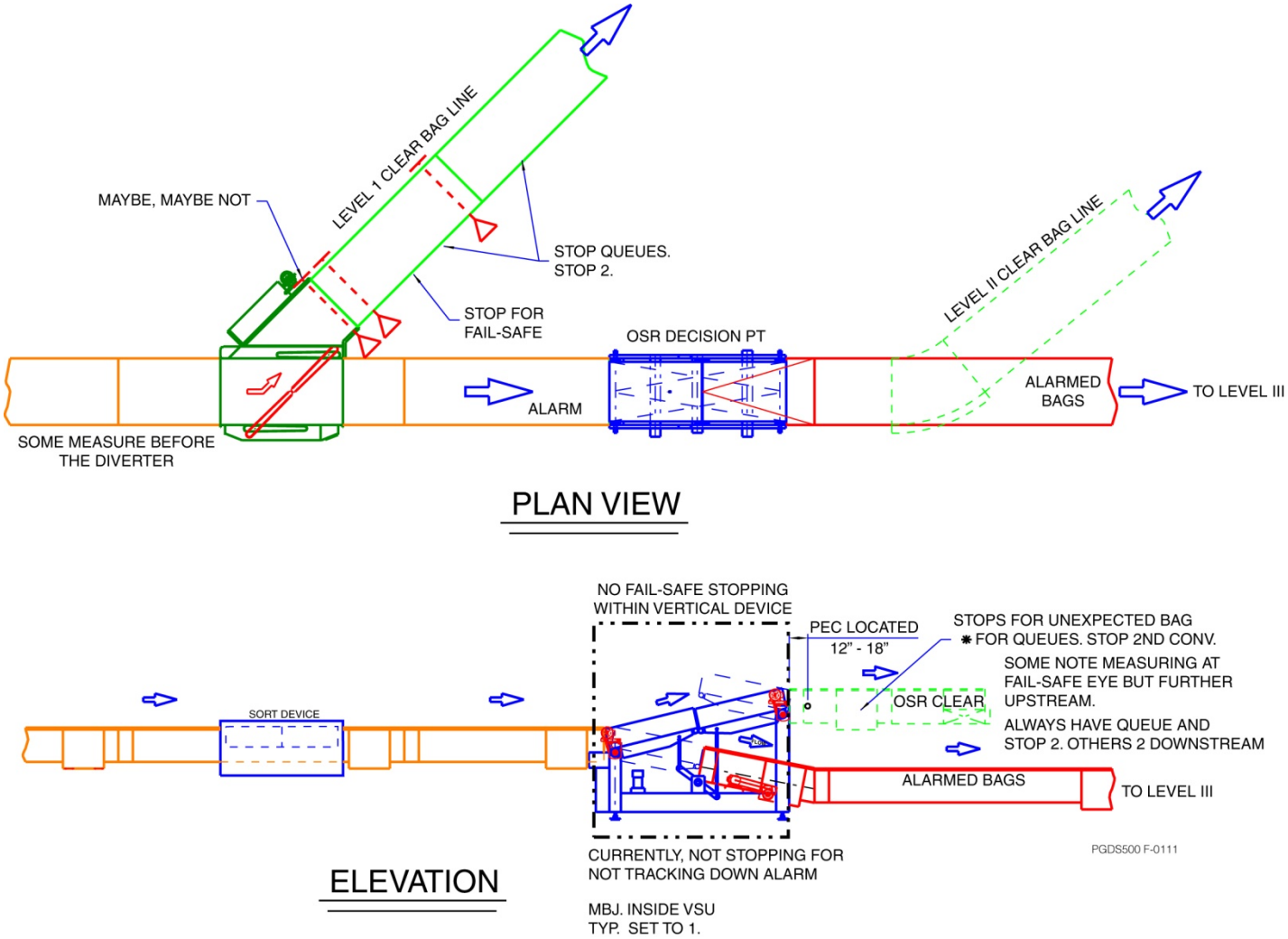


Figure 7-3 *(page 2 of 2)*
CBIS FAIL-SAFE DESIGNS



7.2.9.2 Fail-Safe Operation Standards for In-Line CBIS

In case of a fail-safe event, the BHS shall identify non-clear bags and perform the following actions:

1. Halt the conveyor that has the fail safe detection as well as the next downstream conveyor or adequate conveyors to ensure that any bag involved will not be routed to an airside location and notify TSA of the event; **and,**

2. Audible and visible fail safe alarms should be activated in whatever locations(s) will best allow TSA to respond to the event.

7.2.9.3 Fail-Safe Operation Standards for a Manually Operated In-Line Decision Point CBIS

In case of a fail-safe event, the BHS shall identify non-clear bags and perform one of the following actions:

1. Recognize the condition as a non-clear bag on the Clear Line; **or,**

2. Maintain a halt condition on the Clear Line beyond the manually operated in-line decision point except when a clear bag has been successfully transported through the in-line decision point (i.e., bag information for any non-clear bags has been cleared and a clear bag is either approaching the in-line point or a bag has been processed manually at the CBRA and is reinserted at the reinsertion point through the use of local BHS controls); **and,**

3. Audible and visible fail safe alarms should be activated in whatever location(s) will best allow TSA to respond to the event.

7.2.10 Image Quality Test Best Practices

Design of Image Quality (IQ) bag insertion and removal locations (conveyor sideguards, EDS and BHS e-stop, etc.) need to properly address applicable safety and ergonomic standards. The following are design standards for IQ test

7.2.10.1 IQ Test Standards

Specific controls shall be built into the CBIS in coordination with the EDS and BHS vendors and their integration documentation. Location for these controls will be up no more than two conveyor sections upstream of the EDS entrance. Emphasis should be on coordinating in advance with the BHS vendors to optimize layout for quick and efficient conduct of the daily Image Quality Test (IQT) These controls shall enable to:

1. Stop the normal flow of bags into the EDS without losing track of bags already in the system.

2. Allow the IQT bag to be placed safely and properly onto the EDS entrance conveyor. The sideguard height at this interface point shall not exceed 4 inches.

3. Restart the EDS entrance conveyor to feed the IQT bag into the EDS.

4. Stop the IQT bag on the EDS exit conveyor to allow removal of the IQT bag. The sideguard height at this removal point shall not exceed 4 inches.

5. Allow repeat IQTs as necessary.

6. Return the system to normal screening operation.

All of the above processes shall be supported without requiring a shutdown and restart of the CBIS from a Master Control Panel (MCP) or other location.

7.2.11 Bag Jam Rate Best Practices

1. A hard bag jam is defined as an event during which a PEC is blocked for an inordinate amount of time while the associated conveyor belt is running.

2. A missing bag jam occurs when three sequentially tracked bags are sensed at any tracking PEC and not sensed at the next downstream tracking PEC.

3. The BHSC may utilize the option of setting the missing bag jam counter to a value of one at the clear-bag line divert point.

4. CBIS designs shall allow for safe, quick, and effective clearing of any bag jam.

5. When a bag jam does occur, adequate and proper bag jam clearing procedures are required to ensure safe and secure operations throughout the CBIS.

6. The ILDT shall ensure that all appropriate airline, airport, and/or third party maintenance personnel, as well as TSA staff, are trained on the approved jam clearing procedures.

7.2.11.1 Bag Jam Standards

Bag Jam clearing procedure shall at a minimum, include the following:

1. Applicable activation of e-stop controls. (This is not a requirement for the actual clearing of the logical fault.)

2. Lock out/tag out procedures

3. Removal of article(s) from the affected jam location.

4. Proper reinsertion of the affected articles either upstream or downstream of the jam location, depending on the specific zone (pre-EDS, post-EDS, fail safe, etc.). In any tracked portion of the EDS, care should be taken to ensure proper bag spacing when placing articles back onto the respective conveyor(s) to ensure bags are not re-inserted into another bag's tracking window.

5. Restart of the affected conveyor subsystem via normal operating protocol.

6. Safe personnel maneuvering in and around the jam area.

7. The pre-EDS bag jam rate shall be 1% or less. The bag jam rate is calculated based upon the number of all jams (Hard and Missing) divided by the total bag volume.

Procedures shall be identified for all areas within the CBIS, including tracked, non-tracked, and fail safe zones. In the case of fail safe zone jam events, the procedures must include notification of the event to local TSA personnel for witnessing of the jam removal procedures to ensure proper routing and resolution of cleared, non-cleared, and unknown baggage.

The design team shall ensure that this information is translated into the Baggage Handling System Contractor's (BHSC's) training manuals, ensuring that all maintenance personnel have been properly trained and that continuous training and refresher classes are provided by the maintenance organization.

7.2.12 BHS Displays at CBRA Best Practices

Passive BHS graphic displays shall be installed in the CBRA to provide a display of the current status of the CBIS.

7.2.12.1 BHS Displays at CBRA Standards

Bag Status Displays (BSDs) shall be located at each Bag Removal Point (BRP) on all incoming reconciliation line and at all CBRA ETD screening stations. BSDs at the CBRA shall include at a

minimum visual indication of the BHS bag ID number, (may include pseudo as well as IATA ID), EDS machine number, and bag screening status. The following primary screening statuses will be displayed for all bags arriving at the CBRA and are the only acceptable bag statuses to be used for all CBISs:

1. Cleared
2. Alarmed
3. Errored
4. EDS Unknown
5. BHS Unknown
6. OS
7. OOG

See Chapter 9 for screen shot examples and more detailed description of operations

Following are bag statuses also used for reporting. The naming convention of each status can be decided by the project sponsor; however, each report must include a glossary of these bag statuses which clearly states the definition in non-technical terms. These statuses include, but are not limited to:

1. Cleared
2. Suspect
3. Pending
4. No Decision
5. Purged
6. OSR Time-Out
7. EDS Time-Out
8. Lost Tracking
9. Bag Length Tracking
10. Following Lost Bag
11. Too Close
12. Unscreened
13. Flushed Bag
14. Security Re-route

Passive BHS graphic status displays shall be installed in the OSR rooms to provide a display of the current condition of the CBIS conveyor subsystems.

7.2.13 CBIS Layout Best Practices

The following section describes CBIS layout related best practices and their corresponding standards:

1. To prevent reduced throughput and potential bag tracking problems that may occur as a result of cleared and non-cleared bags being reintroduced to the EDS (after such bags have already been screened), reinsertion of bags needs to be properly designed.

2. In addition to individual EDS machine access requirements as provided by the EDS vendor, a certain degree of ergonomically unfettered access to the CBIS is required for the routine operation and maintenance of the units. Forklift access or space for an overhead trolley with a hoist system for the transport of heavy spare parts should be considered, but will be system dependent. Access routes for EDS equipment replacement shall also be considered. Planners and designers should ensure that conditioned space is provided for the storage of newly delivered screening equipment prior to its installation and commissioning. The acceptability of the identified space should be confirmed with TSA and documented on phasing plans.

7.2.13.1 Power Turn Standard

Power turns immediately after the EDS exit shall be avoided; however, if they are used in this location, positive bag tracking must be maintained.

7.2.13.2 Reinsertion Line Standards

1. Cleared bags shall only be reinserted downstream of the associated decision point.

2. Non-cleared bags shall only be reinserted upstream of the associated EDS machines.

3. If bag tag identification (optical, RFID, etc.) is being used, then the bag shall be reinserted upstream of the device being used for bag tag identification (ATR, RFID reader, etc.).

7.2.13.3 Non-Powered Rollers Standards

Non-powered rollers shall be avoided as much as possible when designing the CBIS, as they can cause bag jams and tracking losses as bags slow, hang, and get caught on the rollers. Frequent cleaning is also required, as bag tags and other stickers get caught and adhere to the rollers.

Non-powered rollers shall not be used in tracking zones in the CBIS. The only exception is non-powered rollers that are an integral part of the transition plates for High Speed Diverters (HSD).

7.2.13.4 Draft Curtains Standard

When used, draft curtains shall be positioned to remain clear of the nearest PEC.

7.2.13.5 EDS Maintainability Standards

1. CBIS designers shall provide sufficient access to the EDS machines for the following purposes:

    - TSA operations (e.g., TSOs conducting regular tests preventive maintenance, (PM) or operation of EDS)
    - Corrective Maintenance (CM)
    - Equipment removal Equipment replacement
    - Equipment upgrades

    Designers shall use the EDS PGDS Maintainability Standards Exhibit (Environment Checklist) displayed in Table 7-2 to ensure that the required environmental standards described in this chapter are met.

2. **Service Access.** A required minimum service area of 3 feet around all four sides of the equipment along with a minimum clearance of 9 feet above the EDS is required. Unimpeded access to the equipment for maintenance by engineers and technicians should be planned to the maximum extent possible. If it is not possible, or if the units are installed on a mezzanine or in other inaccessible areas, provisions should be made for hoisting or transporting heavy items to the installation site (i.e., trap doors, removable conveyor sections, and overhead lifting equipment). It is recommended that a winch or chain lift from an overhead beam is available for the movement of heavy and large parts for maintenance purposes. Failure to provide access or lifting equipment will result in longer repair times.

3. **Environment.** The ILDT shall ensure that all operating environmental requirements as set by the equipment manufacturers are met. Within the facility the temperature range in the operating environment must be between 50°F and 80°F. The relative humidity must range between 10% and 60% non-condensing. There should also be adequate illumination and sufficient dedicated power source outlets to perform maintenance activities. Adequate heating, ventilation, and air conditioning (HVAC) systems are necessary to ensure acceptable performance of the CBIS.

4. **Storage and Spare Parts Access.** Secure storage space shall be provided for spare parts and tools. This space should be approximately 150 square feet and shall be located close to the EDS machine. Items such as forklift access or an overhead trolley with a hoist system for the transport of heavy spare parts should be considered.

Table 7-2

EDS PGDS Maintainability Standards Exhibit (Environment Checklist)

Airport: _____ **Date:** _____

Location/Terminal: _____

Completed by: _____

Service Access	***Yes***	***No***
Does the EDS area provide 3 feet or more around all four sides of the unit(s) and a clearance of 9 feet or more above the unit(s)?	☐	☐
Measured area around all four sides, and overhead clearance, of EDS **(please provide):**		
Environment		
Heating, Ventilation, and Air Conditioning (HVAC) Systems	***Yes***	***No***
Does the EDS area provide for consistent warmed, cooled and dehumidified air flows?	☐	☐
Model and make of the HVAC system in place **(please provide):**		
Temperature	***Yes***	***No***
Does the temperature of the EDS area maintain a consistent range between 50°F and 80°F?	☐	☐
Measured temperature range in the EDS area **(please provide):**		
Humidity	***Yes***	***No***
Does the humidity of the EDS area maintain a consistent range between 10% and 60% non-condensing?	☐	☐
Measured humidity range in the EDS area **(please provide):**		
Storage and Space Parts Access		
Secure Storage Space	***Yes***	***No***
Is there a secure storage space for spare parts and tools with an area of 150 square feet or more, and within close proximity of the EDS?	☐	☐
Describe secure storage space **(please provide):**		
Distance from EDS to secure storage area **(please provide):**		
Heavy Equipment Lifting	***Forklift***	***Overhead trolley hoist***
Is their heavy equipment lifting equipment and/or systems are in place for use in maintaining the EDS unit(s)?	☐	☐
Specify heavy equipment lifting equipment or system that is in place **(please provide):**		
Quick Disconnect Standard	***Yes***	***No***
Are the EDS conveyor components readily removable through the use of available hand or power tools?	☐	☐

Note/Comments:

5. **Quick Disconnect Standard.** CBIS designers shall identify the appropriate number of conveyor components immediately before and after the EDS machine that will be readily removable using commonly available hand or power tools. Designers shall also identify the methodology for removal of any ancillary equipment before or after the EDS machines to allow for easy access to the EDS machines for maintenance, removal or replacement.

6. **Radiation Survey.** The CBIS designer shall provide sufficient access for the maintenance provider to complete radiation survey requirement in accordance with 21 CFR Part 1020.40.

7.2.14 CBIS Reporting Best Practices

Investment in CBIS error logging and reporting (or some other form of system diagnostic capability) is valuable in CBIS operation. Such capability allows for monitoring of the CBIS performance so that developing problems can be spotted early, directing predictive or preventive maintenance efforts. Following are the minimum CBIS reporting standards.

7.2.14.1 Reporting Frequency Standard

The CBIS reporting system shall be capable of providing data in real time (±30 seconds) and in hourly, daily, weekly, monthly, quarterly, annual, and manually entered time periods.

Not all data to support the reporting standards listed below are available from all EDS vendors.

7.2.14.2 Reporting Detail Standards

1. The CBIS reporting system shall be capable of providing detailed data by baggage ID number and EDS machine.

2. The reporting system shall be capable of providing the following minimal features, reports:

   - Bag Data
     - Bag tag number (with ATR/RFID installed)
     - Time stamped at BMA
     - BHS tracking ID number for each bag (shared by BHS and EDS machine)
     - Bag type (OS, OOG, in-spec)
     - Time stamped when bag enters the EDS machine or time stamped when OOG bags are diverted to OOG Line
     - Level 1 screening status
     - Level 2 screening status
   - Critical Tracking PEC
     Immediately upstream and downstream of each EDS, prior to and after each tracked divert point, and at the last tracked PEC entering the CBRA, the BHS shall report the following for each activation of the PEC:
     - Bag ID
     - Bag screening status
     - Note: This is not a report for a given PE, but rather the status of a given bag at critical PEs in the system.
   - BHS Faults
     - Fault type (note: a "fault" is defined as a “cause” such as lost in track, motor overload, PEC failure, encoder failure, etc.)
     - Fault location
     - Fault time
     - Fault time cleared
     - Total fault time

- BHS Events
  - Event type (note: an "event" is defined as the “effect” of a fault, such as re-establish tracking, fail-safe, jams, etc., or the “effect” of human interaction on the system, such as via Human Machine Interface (HMI) or control station – e.g., pushing an e-stop)
  - Event location
  - Event time
  - Total event time
- EDS Statistics
  The following statistics
  - SSI - Number of bags alarmed by specific EDS machine
  - SSI - Number of bags cleared by specific EDS machine
  - EDS machine faults (if known)
  - EDS machine hours of operation
  - Start time of operation
  - Start time of fault
  - End time of fault
  - End time of operation
- BMA Statistics
  - Total number of bags through the BMA
  - Total number of OS bags
  - Total number of OOG bags
- System Baggage Volumes
  - By input conveyors (ticket counter conveyors, curbside conveyors, oversized conveyors)
  - By makeup device (total bags to makeup area, total bags to oversized bag makeup area, by screening area including EDS machine and CBRA)
- CBRA Statistics—CBRA statistics shall be presented as stated in Appendix A and considered SSI:
  - PEC tracking Statistics
    - Total number of bags seen at each PEC
    - Total number of missing bags at each PEC
    - Total number of unknown bags at each PEC
    - Total number of “hard” jams at each PEC
    - Total number of missing bag jams at each PEC

3. The reporting system shall provide BHS Reports which should be within 3 to 5% difference or accuracy compared to the EDS Counts per screening line. (When analyzing this data, the point of bag ID acquision at the EDS must be taken into consideration. Ie, if the ID is germanated at the in-feed and passed to the EDS, the ID may be processed and logged in the FRD. However, if the unit faults, that ID and decision may not be passed back to the BHS for logging.)

7.2.14.3 Daily Reporting Standards

At a minimum, the following daily reports in the format shown in Table A-1 to A-3 in Appendix A shall be provided to the local TSA representative:

1. Daily CBIS Summary Report (Table A-1)
2. Daily CBIS Bag Volume Report (Table A-2)
3. CBIS Executive Summary Report
4. PEC Tracking Reports for all PECs within a tracking zone which include:
   - Total Bag Count
   - Total Missing Bag Count
   - Total Unknown Bag Count
   - Purged Bag

7.3 CBIS OPERATING AND MAINTENANCE BEST PRACTICES

Designing optimal CBISs should also include implementation of design practices that will ensure optimal CBIS Operation and Maintenance (O&M). High quality and cost-effective operation and maintenance of CBISs can help maintain good performance of the CBIS and prevent unnecessary performance degradation. CBIS performance monitoring can be used to help indentify corrective maintenance and schedule preventive maintenance actions to improve the overall operations.

The paragraphs below discuss CBIS O&M best practices that designers should be cognizant of during the CBIS design phase to ensure that optimal CBIS design allows for implementation of such O&M best practices when the CBIS is operational.

7.3.1 CBIS Operating Best Practices

When designing CBISs, designers should allow for the following best practices to ensure a high-quality and cost-effective CBIS operation.

7.3.1.1 CBIS Reporting Tools

A combination of detailed reports (listed in Appendix A), an executive summary report, and a CBIS dashboard (a real-time display of key CBIS statistics and data) in the BHS control room are important to allow for cost-effective monitoring and quick detection of any CBIS performance degradation or malfunction.

In compliance with the current TSA Interface Requirement Document (IRD) for BHS and CBIS and to facilitate such reporting tools, designers should aim to design a common database for EDS and BHS reporting data. A common database would enable the provision of a dashboard report in the BHS monitoring system during CBIS operation, which can show simple trend indicators.

One recommended method of designing and implementing a CBIS dashboard is to use a separate Internet-based system from the BHS control system to combine the output into one user-friendly dashboard. Output information is displayed on screen and also allows for audible and visible alarms when required. New CBIS dashboards could communicate the status of EDS machines (CBIS in compliance with IRD). For legacy CBISs, a TSA EDS control slave monitor would need to be used and placed close to this dashboard. In both cases, as more information becomes available because of wider compliance with the TSA IRD, the reporting system will become more robust.

7.3.1.2 CBIS Reporting Trends

One of the most effective tools used to monitor CBIS performance, ensure seamless operations, and quickly identify and address problems is to be able to review CBIS operating trends. The following are key trends that provide important information about CBIS performance and are vital to detecting CBIS performance degradation:

1. Increase in CBRA error percentages – at the time the system was commissioned an error rate was established that rate should remain within a relatively constant range and an increase trend can signal that more bags are labeled as unknown or error bags, which may be due to CBIS performance degradation or malfunction (e.g., bag tracking system).

2. EDS false alarm rates – EDS false alarm rates should remain relatively constant over time (assuming no changes in protocol). An increasing or decreasing trend may indicate a degradation in the CBIS or EDS performance.

7.3.1.3 CBIS Testing

The most valuable CBIS tests are often the most difficult, and costliest, to perform. A complete battery of tests cannot be completed on a live CBIS without a severe interruption of regular

operations. Therefore, in addition to the above-mentioned improved diagnostics and monitoring CBIS trends through the use of reports, spot checks (subsets of the ISAT) are the best way to ensure that the system is efficient, secure, and not deteriorating.

Ensuring that EDS-required detection levels are maintained can be achieved through the periodic use of test bags, such as the TSA-qualified IQT kit or other TSA-qualified test bags. Designers should allow for the conduct of such periodic testing as seamlessly as possible with regular operation of the CBIS. Examples for such design principles are:

1. Hinged BHS sideguards to allow for easy and quick placement of the IQT kit before the EDS and easy and quick collection of that kit once it has been screened by the EDS.

2. Communications system between TSO testing at the EDS and TSO testing at the CBIS control room (TSOs need to switch the EDS to test mode and switch back to regular screening mode after the test is complete).

7.3.1.4 BHS O&M Contracts

System monitoring should be used to avoid “break-fix” contracts, which allow for the slow deterioration of the system. Performance metrics should be used to monitor system performance for maintenance contracts. It is recommended that minimum specifications for performance metrics be implemented as part of the BHS O&M contract.

7.3.1.5 Communications

An important key element to ensuring efficient and high-quality CBIS operations is effective communications between all relevant stakeholders. Communication is vital to quickly identify and address problems that will inevitably arise during the course of operation. Considerations related to communications between stakeholders should include the following:

1. Ensuring that the proper communication can occur between EDS machines and the BHS control room.

2. Improved communications between TSA and the BHS operator (e.g., BHS operators should be notified by TSA of any EDS failure).

3. Review of data by all stakeholders (airport operators, airlines, airport engineers, TSA, BHS operators) and the scheduling of biweekly (or at least monthly) meetings to review both non-SSI and SSI CBIS reports.

While project sponsors and/or airlines are usually responsible for BHS maintenance, TSA is responsible for the maintenance of EDS machines, which are owned by TSA. As such, non-TSA personnel clearing bag jams from EDS machines may create contractually challenging situations. Therefore, only authorized TSA personnel are allowed to clear bag jams from EDS machines.

7.3.2 Maintenance Best Practices

Effective CBIS maintenance is an important element in ensuring that the CBIS is operating as required (preventive maintenance) and is efficiently remediated during malfunctioning.. The following is a list of recommended preventive and corrective maintenance best practices.

7.3.2.1 Maintenance Responsibility Matrix

TSA and the BHS operator (and the contracted maintenance providers) must have a clear picture of their responsibilities. A responsibility matrix should be created once the core team is established. An OTA or Memorandum of Understanding document between TSA and the project sponsor should be created outlining all responsibilities and include technical upgrades to the CBIS.

7.3.2.2 Operator Training

This training is an important element in preventive maintenance, which, if conducted well, can improve CBIS operating time and Mean Time Between Critical Failure (MTBCF). Training should include items such as what the operator sees, hears, and smells to determine the correct operation of the CBIS. Operators should report anything unusual that can be an indication of required maintenance. For example, oil stains, smell of burning rubber/ plastic, etc., can be important indicators of a CBIS malfunction or an imminent malfunction and, if reported promptly and accurately, can be addressed with preventive maintenance. Training should also include Level 1 preventive and corrective maintenance requirements as identified by the equipment manufacturer (see 7.3.2.5).

7.3.2.3 Frequency of Preventive Maintenance

The operator should conduct Level 1 preventive maintenance on the EDS as identified by the equipment manufacturer. Level 1 PM are normally required every shift, daily, or weekly without the need to open the CBIS that will help improve the reliability of the CBIS (e.g., inspect/clean filters, replace paper, etc.). Level 2 PMs on the EDS are normally performed every month, quarter or year and require a trained maintenance technician to perform the action (e.g., replace gaskets, clean exhaust port, etc.). These actions are conducted by the equipment manufacturer during the warranty period or under the Contractor Logistics Support CLS) contract. BHS preventive maintenance should be performed daily, weekly, monthly, and semi-annually in accordance with the airport project sponsor maintenance contract.

7.3.2.4 CBIS Environment

The cleanliness of the overall CBIS environment can significantly affect the overall performance of the BHS and EDS machines, as dust and dirt can cause computers to malfunction. An adequate heating, ventilation, and air conditioning (HVAC) system often helps improve the performance of a CBIS over time and is, therefore, a worthy investment.

7.3.2.5 Aligning BHS and EDS Preventive Maintenance

Contractually, aligning BHS and EDS maintenance would be difficult; however, face-to-face communication can greatly improve this alignment and create good O&M synergy. This successful alignment typically varies from airport to airport. Best practices to allow for such successful alignment include:

- Routine maintenance
- Onsite teams
- Well-trained people
- Audit teams

7.3.2.6 EDS Maintenance Best Practices

The following is a list of EDS maintenance best practices that, when implemented, have led to significant improvements in operating time and MTBCF of EDS machines:

1. **Safety** – Insist that the work environment is safe for all personnel who work in the area. Immediately report any injuries that occur on site. Provide personal protective gear to service personnel and ensure that it is used appropriately.

2. **Accountability** – Ensure that policies are put in place that will promote accountability for performing preventive and corrective maintenance. Also ensure that consequences are understood if the preventive maintenance is not performed on time and as directed in the preventative maintenance manual. Perform spot checks and peer reviews on individual equipment or subsystems to ensure that quality standards are achieved. Performance should be driven by data metrics. Accountability should be driven by data metrics and ownership.

3. **Application** – Prioritize preventive maintenance quality, as quality dictates performance. Provide the necessary and appropriate tools to perform Level 1 preventive maintenance tasks and assignments. Understand the customers and their specific needs based on the environment. Build the appropriate team that can meet local needs.

4. **Training** – Ensure that all personnel are trained in the proper procedures for Level 1 performing preventive maintenance on the entire system, as well as on each component as required. Provide up-to-date recurrent training as needed. Provide individualized training when quality standards are not being met. Target high failure rate items and provide specific training to reduce failures.

5. **Documentation** – Target key components and subsystems in the preventative maintenance manual that have been identified as requiring frequent preventive inspections. Ensure that the frequency of inspections is adequate for high wear and tear components. Acquire appropriate signoff for each task performed.

7.3.2.7 BHS Reporting During Maintenance

BHS Reporting capabilities should be designed such that logging of system events and bag counts are able to be turned off for maintenance activities. Analysis of operational run-in data has been thrown off and skewed when PEC Cleaning, Belt Adjustments and Tensioning, Motor replacements, cleaning etc., have gone on while the system was live or logging events. Turning reporting off during maintenance periods would help eliminate false diagnostics from the BHS Reports.

8 LIFE-CYCLE COSTS

The design principles defined in the PGDS emphasizes the need to define and implement the lowest-cost screening alternative for the particular airport or terminal. To establish the lowest-cost alternative, planners shall calculate the life-cycle costs of developing, maintaining, and replacing the CBIS. These costs will include those to be borne by TSA as well as airport operators and airlines.

The analysis assumptions, life-cycle costs to consider, including capital costs, O&M costs, and staffing costs, and how to select the preferred alternative are discussed below.

8.1 ANALYSIS ASSUMPTIONS

Life cycle cost analysis assumptions include the following:

- Life-cycle cost analysis period
- Equipment life cycle
- Construction period
- Constant dollar cost

8.1.1 Life-Cycle Cost Analysis Period

To provide a standardized period for assessing life-cycle costs, a 20-year total life-cycle shall be assumed based on DHS guidance to fully capture the upfront capital costs as well as recurring costs for staffing, O&M, and life-cycle replacements. The 20-year analysis period allows planners to account for: (1) screening equipment refurbishment and replacement and (2) accommodating traffic growth beyond the initial equipment design year (DBU + 5 years).

8.1.2 Equipment Life Cycle

Equipment life-cycle assumptions are as follows (see Chapter 3 for details by equipment model):

- **EDS Equipment**. The useful life of an EDS machine is assumed to be 10 years. TSA does not currently plan to refurbish machines beyond this period to extend their life.

- **ETD Equipment**. The useful life of an ETD machine is assumed to be 7 years. No refurbishment options are available to extend ETD machine life beyond this period.

8.1.3 Construction Period

It is expected that the construction period will be, on average, about 2 years for the high-throughput and medium-throughput in-line systems and 1 year or less for mini in-line and stand-alone systems. The exact construction period will be airport-specific and depend on the complexity of and contracting requirements for the airport. Therefore, planners should estimate appropriate construction periods for the particular airport in question.

8.1.4 Constant Dollar Cost

Cash flows can be expressed in real or nominal dollars. Nominal (or current) values represent the expected price that will be paid when a cost is due to be paid. These values include inflation. For instance, if a machine costs $1.0 million today and is expected to cost $1.1 million in 2010, $1.1 million is the nominal cost of the machine in 2010. Real (or constant) values are adjusted to eliminate the effect of inflation. In the example above, the real value of the machine is $1.0 million, whether purchased today or in 2010. Real values are used to provide a consistent comparison of costs over time and shall be used to estimate all costs considered in the life-cycle analysis. These costs shall be based on the year in which the analysis is conducted. Therefore, no assumptions regarding cost escalation or inflation are necessary for this analysis.

8.2 LIFE-CYCLE COSTS TO CONSIDER

At a minimum, planners should assess the following costs in determining the overall cost of each screening alternative:

- Capital costs
- O&M costs
- Staffing costs

Planners should calculate overall life-cycle costs for all alternatives based (as much as possible) on actual costs. Cost assumptions, averages, and estimates provided in this chapter should serve as a baseline to verify that actual costs are within a reasonable range. Details regarding estimation of the above costs are described in the paragraphs below. All costs are shown in FFY 2010 dollars.

8.2.1 Capital Costs

Capital costs to be considered include:

- Screening equipment acquisition costs
- Screening equipment direct installation costs
- Screening equipment upgrade costs
- Screening equipment replacement costs
- EDS removal costs
- EDS residual value and disposal costs
- Required building and BHS infrastructure modification costs

8.2.1.1 Screening Equipment Acquisition Costs

The cost to acquire existing technology equipment and the assumed acquisition cost of future technology equipment should be obtained from TSA.

8.2.1.2 Screening Equipment Direct Installation Costs

Direct installation costs relate to the set up and preparation of equipment for use. The components of direct installation costs are summarized in Table 8-1.

Table 8-1
COMPONENTS OF DIRECT INSTALLATION COSTS

Equipment	Labor	Logistics	Onsite installation
Auxiliary equipment (including hardware and software)	Program management (on-site and TSA Headquarters), including technical contracts	Warehousing	Site preparation
Initial spares/repair parts and consumables	Systems engineering personnel	Shipping and handling	Facility modifications (construction) and design *(a)*
	Initial training	Data (training manuals, maintenance manuals, operations manuals)	Integration and multiplexing
		Travel	Testing and evaluation
		Other	

(a) Includes any onsite modifications required to install screening equipment. Does not cover expenses related to baggage handling system design and associated facility modifications.

Direct installation costs vary significantly among configurations of the same model of EDS machine. For example, the installation of an L-3 3DX SX in a stand-alone configuration will cost significantly less than the same unit installed in an integrated configuration. Similarly, a higher installation cost for a mini in-line system using L-3 3DX SX equipment compared to one using Reveal CT-80 equipment should be assumed, as the L-3 3DX SX EDS is capable of operating at higher throughput rates. Table 8-2 details the installation cost assumptions for each system type.

Table 8-2
DIRECT SCREENING EQUIPMENT INSTALLATION COST

System type	Installation cost per machine
High-speed in-line	$520,000
Medium-volume speed in-line	$520,000
Mini in-line	$120,000 – $520,000
Stand-alone EDS	$12,000 – $65,000
Stand-alone ETD	$4,000

Note: Stand-alone EDS installations using light-weight machines do not require the same floor reinforcement as installations of heavier stand-alone equipment.

Source: TSA, June 2005, escalated to FFY 2010 dollars.

8.2.1.3 Screening Equipment Upgrade Costs

Screening equipment upgrades can provide extended capabilities—in terms of throughput, false alarm rate, detection, or other operational improvements—but do not extend the life of the screening equipment (life extensions are referred to as refurbishments).

Planners should consult with TSA about upgrade options, as well as the costs of those options that are available for the screening equipment being considered in the CBIS design for the particular airport.

8.2.1.4 Screening Equipment Replacement Costs

Whenever it is necessary to replace screening equipment with a new type of screening equipment, it may be necessary to modify the BHS so that it can support the new machine types (if the BHS were not already designed to support the new type of screening equipment). Costs associated with the modification of infrastructure to support EDS machine replacement are presented in Table 8-3.

Table 8-3
INFRASTRUCTURE MODIFICATION COSTS
FOR EDS REPLACEMENT

Screening system type	Infrastructure modification cost per EDS replacement
High-speed in-line	$265,000
Medium-speed in-line	$180,000
Mini in-line (all equipment types)	$70,000
Stand-alone	$0

Source: Input from TSA and EDS vendors, December 2006, escalated to FFY 2010 dollars.

BHS modification costs can vary significantly among CBIS types. It is highly recommended that actual cost estimates be developed for the specific site and CBIS design rather than using the cost estimates provided herein. These cost estimates are included mainly to provide planners with a rough estimate based mostly on high-level conceptual designs.

Planners should consult with TSA regarding new machine types that should be considered as replacement options. Costs of those replacement options should be assessed by planners based on actual CBIS design and actual modifications that are required for the BHS to be able to support the new types of EDS screening equipment.

8.2.1.5 EDS Removal Costs

Prior to replacing EDS machines, installed EDS equipment must be removed. This removal may result in costs to access equipment in space-constrained installations, disassemble conveyor segments, and temporarily modify surrounding facilities. Planners should estimate EDS removal costs for the specific screening alternatives.

8.2.1.6 EDS Residual Value

It should be assumed that the EDS has no residual value at the end of its useful life.

8.2.1.7 Required Building and BHS Infrastructure Modification Costs

Facility modifications and infrastructure costs represent the majority of the upfront costs associated with implementing an in-line system. Compared with other types of security screening equipment, EDS machines require significant facility design and construction costs because of their size and weight and the need to integrate these machines into the BHS. Examples of facility modification work include, but are not limited to:

- Constructing extra baggage make-up rooms to replace existing baggage make-up areas displaced by EDS equipment.
- Constructing CBRAs to provide conditioned workspace for alarm resolution screening (e.g., alarm resolution with OSR or ETD).
- Redesigning and upgrading BHS conveyors to support integration with EDS equipment.
- Moving walls, partitions, and any other structural components.
- Reinforcing flooring to support additional weight.
- Upgrading mechanical and electrical systems (and heating, ventilation, and air conditioning [HVAC] systems if required).

As the nature of the work will vary significantly from airport to airport and greatly depends on the type of checked baggage inspection system installed, facility modification costs can vary significantly. Planners shall develop a detailed, bottom-up cost estimate for facility modification and infrastructure costs for all alternatives being considered.

Because of their high upfront capital cost and the high degree of cost variability, facility modifications and infrastructure represent the highest risk to overall project cost and schedule. Small percentage changes in these costs can significantly affect the life-cycle cost of a project.

For each screening system type, the assumed average cost of facility modifications and infrastructure per EDS machine is presented in Table 8-4. Facility modification costs should be adjusted to account for regional differences in construction costs based on the latest *Means Construction Cost Indexes* published by Reed Construction Data or by other industry-standard cost adjustment practices. Given the high variability of this cost category, these assumed averages are provided herein as a starting point only and should be refined by planners in the life-cycle cost analysis to reflect site-specific conditions.

Table 8-4
AVERAGE COST OF FACILITY MODIFICATIONS AND INFRASTRUCTURE

System type	Average cost per machine	Source
High-throughput in-line	$8,000,000	*(a)*
Medium-throughput in-line	$5,200,000 – $7,000,000	*(b), (c)*
Mini in-line	$425,000 – $900,000	*(c), (d)*
Stand-alone EDS	$35,000	*(e)*
Stand-alone ETD	$6,000	*(e)*

(a) Bottom-up cost estimate from template baggage handling system designs and adjusted for variation between template designs and actual installations of medium-throughput in-line systems.
(b) Average of selected existing in-line installations with fully integrated EDS equipment.
(c) Facility modification and infrastructure cost per EDS depends on the level of integration with the baggage handling system.
(d) Bottom-up cost estimates of template designs and data from existing installations of mini in-line EDS machines.
(e) TSA estimates from existing installations. Estimates include recent installations of reduced size and weight EDS machines, which require lower facility modification and infrastructure costs because of the greater opportunities for a better fit in existing buildings.

8.2.2 O&M Costs

O&M costs to be considered include:

- Screening equipment maintenance costs
- Screening equipment operating costs
- Incremental BHS maintenance costs (including additional maintenance personnel)
- Incremental BHS operating costs

8.2.2.1 Screening Equipment Maintenance Costs

Screening equipment maintenance costs include costs for preventive and corrective maintenance, related program management, moving equipment, replenishment of spares, repair parts, shipping and handling, technical update training, data manuals, other direct expenses. Since spring 2005, all screening equipment maintenance contracts negotiated by TSA have been on a fixed price per unit basis. Maintenance costs for new technology equipment are assumed to also be on a fixed price per unit basis, equal to 10% of the purchase price.

Consistent with previous contracts, all EDS vendors would be responsible for assuming the first year's maintenance contracts. Typically, the first year's maintenance cost is included in the equipment purchase price. Planners should confirm equipment maintenance cost assumptions with TSA for the specific screening equipment being considered as part of the alternatives under development.

8.2.2.2 Screening Equipment Operating Costs

The largest operating cost for screening equipment is the electrical consumption of the EDS equipment. Typically, electrical consumption per machine can be estimated from equipment specifications and duration of use (which can be estimated based on baggage flow). Table 8-5 provides information regarding the power consumption of screening equipment. Planners should take into account the costs of local electricity (in cents per kilowatt hour) and calculate overall utility costs of the screening equipment.

Table 8-5
SCREENING EQUIPMENT ELECTRICAL CONSUMPTION

Screening equipment	Kilowatts per hour
L-3 XLB	13.5
MDI CTX-5800	2.1
MDI CTX-9400	9.7
MDI CTX 9800e	10.3
MDI CTX 9800	10.3
L-3 3DX 6600	5.7
L-3 3DX 6600 SE	Obtain from TSA
L-3 3DX SX	4.4
Rapiscan RTT	Obtain from TSA
Reveal CT-80XL	Obtain from TSA
Reveal CT-80DR	Obtain from TSA
Reveal CT-80DRXL	Obtain from TSA
SureScan x1000	Obtain from TSA
ETD	0.3

Sources: TSA and screening equipment manufacturers, August 2009.

8.2.2.3 Incremental BHS Maintenance Costs

In addition to EDS equipment maintenance costs, incremental costs for BHS maintenance costs directly related to the CBIS should also be accounted for. These costs typically include preventive as well as corrective maintenance to all BHS components above and beyond the current BHS maintenance costs.

For the purposes of the life-cycle cost analysis of screening alternatives, only the incremental cost of BHS maintenance shall be considered. To calculate the incremental BHS maintenance cost, planners shall subtract the existing maintenance cost of the current BHS from the total estimated maintenance cost of the BHS with CBIS.

Table 8-6 provides estimated national average costs for incremental annual BHS maintenance. However, planners should obtain accurate maintenance costs from airport personnel or the BHS operator.

Table 8-6
ESTIMATED ANNUAL INCREMENTAL BHS MAINTENANCE COSTS

Screening system type	Incremental BHS maintenance cost per EDS machine
High-speed in-line	$400,000
Medium-speed in-line	$260,000
Mini in-line (all equipment types)	$35,000
Stand-alone	$0

Source: Existing in-line systems data, May 2006, escalated to FFY 2010 dollars.

8.2.2.4 Incremental BHS Operating Costs

Planners shall compare utility costs for the BHS on an incremental basis. To calculate the incremental BHS operating costs, planners shall subtract the existing operating cost of the current BHS from the total estimated operating cost of the BHS with CBIS.

8.2.3 Staffing Costs

Staffing costs to be considered include:

- TSA screener and supervisor costs
- Incremental staff costs associated with clearing bag jams or for baggage porters (if not included in O&M costs described earlier)

In addition, if other airport-specific staff costs are expected, such costs should be included in staffing or O&M costs as applicable.

8.2.3.1 TSA Screener and Supervisor Costs

TSA will assess staffing costs for TSA screeners and supervisors. Planners shall request staffing cost estimates for the screening alternative(s) under consideration upon submittal of the Preliminary Alternatives Analysis Report (see Chapter 2). As part of this request, planners must provide TSA with the following:

- Descriptions of the screening zones (including airline groupings)
- Descriptions of the screening system type and equipment for each screening zone assumed in the concept
- Estimated baggage flow for the ADPM in 10-minute bins (or increments)
- Assumed annual growth rate based on the forecasts used to determine equipment requirements

TSA will provide estimates of the total screening cost by year for each alternative under consideration.

8.2.3.2 Incremental Costs for Baggage Porters and Other Airport/Airline Staff

Any increase or decrease in costs for baggage porters or other airport/airline staff should be included in the life-cycle cost analysis. Planners shall include only incremental costs.

8.3 SELECTING THE PREFERRED ALTERNATIVE

Alternatives shall be evaluated on the basis of the present value of total life-cycle costs, defined as the present value of the annual sum of capital, O&M, and staffing costs. Where possible, costs should be separated by stakeholder (e.g., TSA, airport operator, and airline) for transparency in the evaluation process.

For the purposes of estimating the present value of these costs, a real discount rate of 7% shall be used. This discount rate corresponds to guidance from the Office of Management and Budget (OMB) for projects that accrue costs and/or benefits to governmental and nongovernmental parties. Discounting of life-cycle costs is necessary to ensure that all alternatives are compared on a standardized basis. The discount rate is meant to reflect the time value of money (cash received today is worth more than the same amount of cash received tomorrow because of the opportunity to invest that cash in other projects) and the risk associated with uncertain future cash flows.

The formula below can be used to calculate the present value cost of the screening system alternative.

$$PV = \frac{C_1}{(1.07)^1} + \frac{C_2}{(1.07)^2} + \ldots + \frac{C_{20}}{(1.07)^{20}}$$

where C_1 is the total cost in year 1.

Once the costs of all concept-level alternatives have been developed to include the full present value life-cycle costs, alternatives shall be ranked based on present value life-cycle costs and the lowest-cost alternative that meets all other requirements shall be selected as the preferred alternative. Other higher-cost alternatives may be carried forward for further development and evaluation in the Schematic Design Phase with approval from TSA and the ILDT.

9 CHECKED BAGGAGE RESOLUTION AREA PLANNING STANDARDS

This chapter provides requirements for Checked Baggage Resolution Areas.

9.1 BACKGROUND

A CBRA provides the space and equipment required by Transportation Security Officers (TSOs) to conduct: (a) Level 3 searches of checked bags that have not been cleared by TSOs through Level 2 OSR and (b) primary screening using ETD for unknown, out-of-gauge (OOG), and oversized (OS) bags from the BHS.

The proper layout and furnishing of the CBRA are essential to ensuring that TSOs can properly, efficiently, and safely conduct the process of screening baggage. Careful consideration needs to be given to the operational controls, the ergonomic configuration, and to the equipment specified for the CBRA.

9.2 DESCRIPTION OF OPERATIONS FOR A GENERIC CBRA

Although each CBIS may employ different means to positively track bags, all CBRAs shall maintain the same base functionality. High level concepts of optimal CBRA concepts are shown on Figures 9-1 to 9-3. These are meant to represent a generic concept of operations.

The design shall be as such that all bags advance to the most downstream enabled Baggage Removal Point (BRP). If no BRP's are enabled, the bags will queue on the conveyor before the first BRP at the entrance to the CBRA TSA will staff from the position furthest from the CBRA entry point, and staff towards the position closest to the CBRA entry point. This staffing approach will maximize queue utilization and avoid unnecessary CBIS die-backs.

9.2.1 Types of Checked Bags

The following bag types arrive at the CBRA (the letter designator in parenthesis is the expected data to be on the BSDs):

NOTE: The abbreviation of the complete text may be used.

- **Alarmed Bags (AL)** – Bags that generate an automatic alarm on the EDS units and that were not cleared by the Level 2 OSR process (either because TSOs could not clear those bags or because the maximum OSR view time for TSOs elapsed), will be routed to the CBRA. These bags arrive on the Alarm Line (AL) in the CBRA room. Once cleared, these bags are placed on the outbound Clear Line.

- **OOG Bags (OG)** – Bags that do not fit into EDS machines are redirected around the EDS machines and go to the CBRA via the AL. Once cleared, these bags are placed on the outbound Clear Line.

- **OS Bags (OS)** – Bags that do not fit into the typical BHS conveyors are directed straight to the CBRA on the OS line. Once cleared, these bags exit the CBRA via a defined route which is not on the outbound Clear Line.

- **Error Bags (ER)** (also EDS Unknown) – Bags that received an error status from the EDS (for a number of possible reasons) are conveyed to the CBRA for primary screening. In CBISs that have re-insertion lines, these bags may be re-inserted to the CBIS pre-EDS for rescreening by the EDS.

- **Cleared Bags (CL)** – Under rare circumstances Clear bags can arrive in the CBRA. These bags are transferred to the Clear Line.

- **BHS Unknown (UNK)** – Bags that have become lost in tracking between the exit of the EDS and the BRP.

Figure 9-1
OPTIMAL CBRA LAYOUT

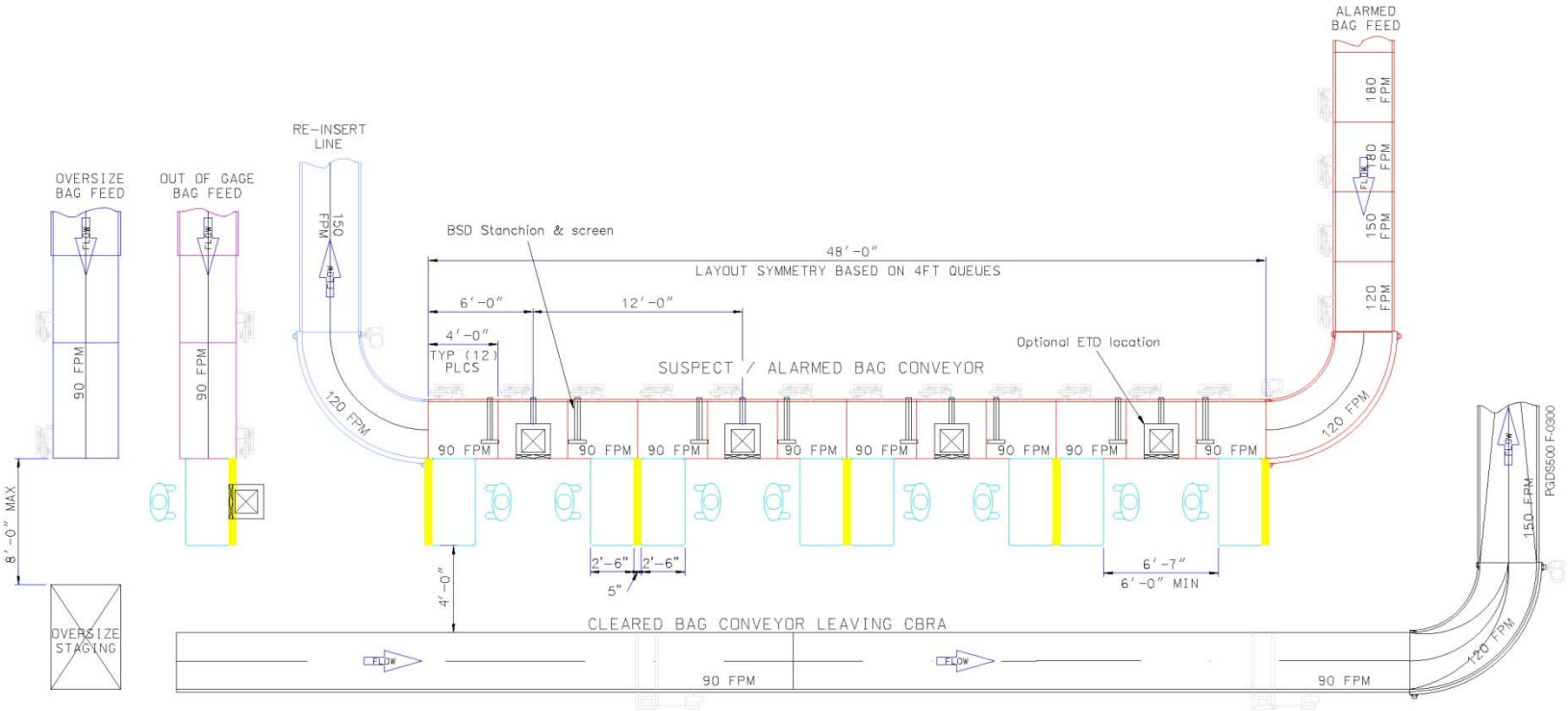


Figure 9-2
CBRA CROSS SECTION AND BIT ELEVATIONS

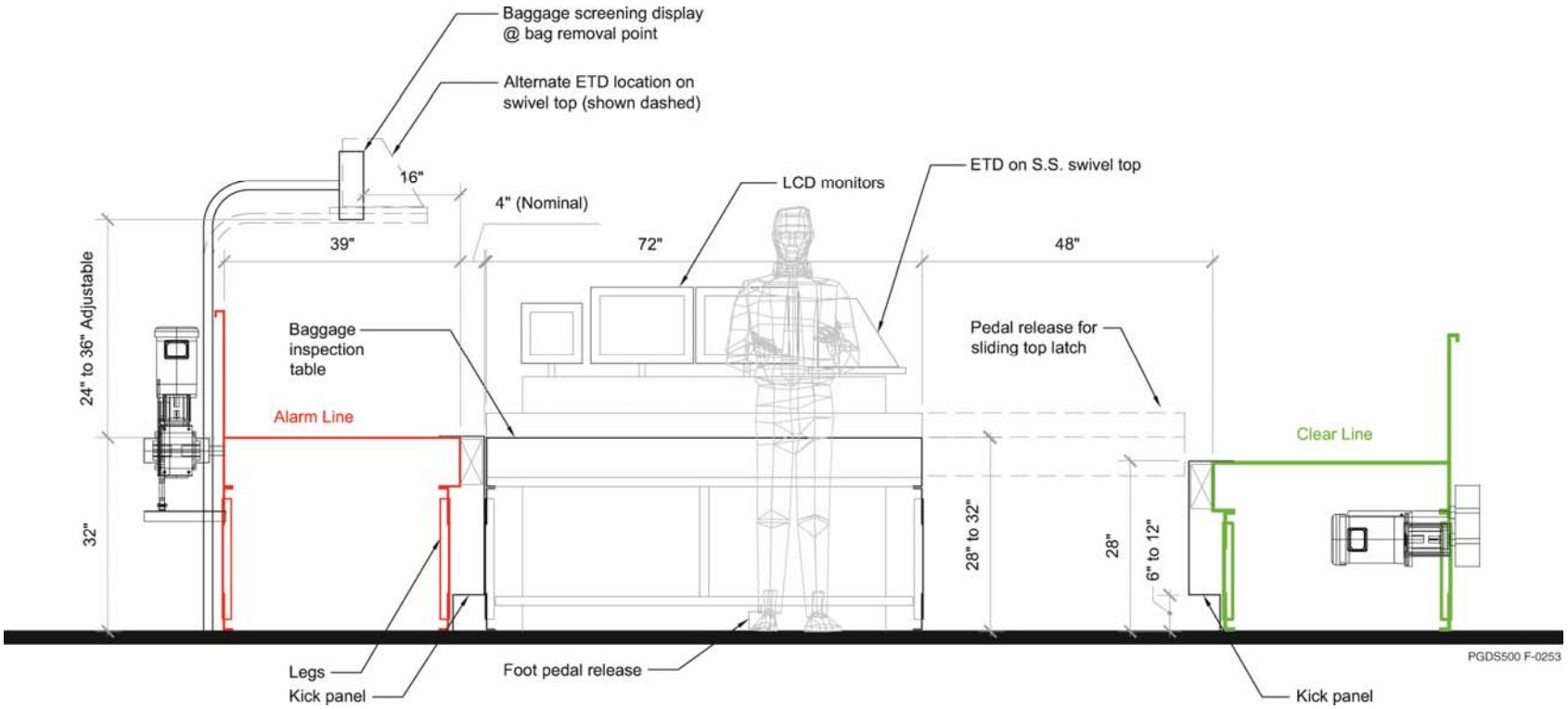
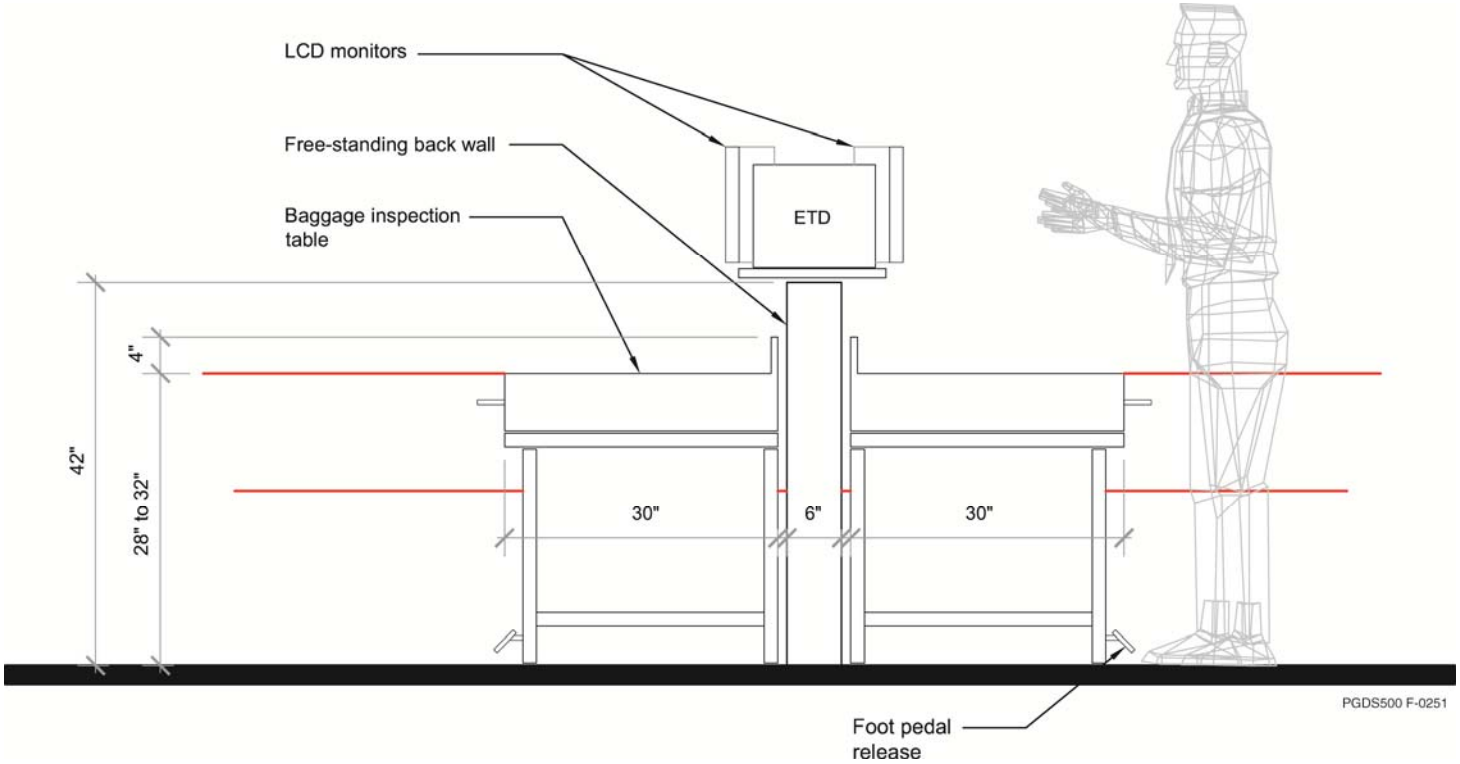


Figure 9-3
CBRA CROSS SECTION



9.2.2 CBRA Concept of Operations – All Non-Cleared Checked Bags

The CBRA concept of operations for all non-cleared checked bags consists of the following steps:

- These bags automatically travel on the AL to the next available Enabled BRP on the AL conveyor within the CBRA. The design shall be as such that all bags advance to the last enabled BRP. If no BRP's are enabled, the bags will queue and hold on the conveyor before the first BRP at the entrance to the CBRA. TSA will staff from the position furthest from the CBRA entry point, and staff towards the position closest to the CBRA entry point. This staffing approach will maximize queue utilization and avoid unnecessary CBIS die-backs. (Bags will not be queued on the intermediate queues between the BIT's. However, if bags are queuing outside the CBRA during normal operations and there are BRP's enabled bags will move forward and fill the intermediate queues.)

- When a bag arrives at the BRP:

  - The TSO selects the BIT where the bag will be inspected and then removes the bag from the AL and places it onto the appropriate screening station.

  - The BRP BSD transfers the ID to the Last Bag from BRP line on the BIT display at the selected station.

  - Once the TSO has moved the bag to the selected BIT - and the Secondary Viewing Station (SVS) is available - the "Send BAIT" (Bag Auto ID Transfer) button located on the BIT BSD is selected by the operator and the ID is be sent to the SVS via serial connectivity. Bag data is transferred to the Last Bag sent to SVS line on the BIT.

- Note: After the bag has been removed from the BRP, the system controls shall have an adjustable timer for the BRP belt to automatically restart. The default value shall be 5 seconds after the photo-eye has been cleared.

  - If the bag ID transferred to the SVS has been found by the EDS database, and there is an image associated with that ID, the image is recalled for inspection by the TSO.

- In cases where either the BHS or EDS has lost tracking of the bag, the ID of the bag may not be associated with the bag's image. For all bags lost in tracking by the BHS, a unique bag ID should be generated that correlates to the location where the bag was lost, and will contain the same nomenclature as in the BHS.

- For example: if a bag becomes lost downstream of an EDS, the BHS will assign a tracking number of pe where the bag was "found" at. Ie, if the bag is found in tacking at PE-AL-14, it will be assigned an ID of PE-AL-14 and the bag will have an "UNK" status. While the information displayed on the BSD is alphanumeric, the internal tracking ID is understood to be unique to that bag.

- The TSO then uses the bag images to find alarmed object(s) within the alarmed checked bag and to conduct a directed ETD search on bag until it can be cleared.

- A cleared bag status is then indicated on the EDS secondary viewing stationand and the cleared bag is moved (using a lift-assisted device) onto the Clear Line in the CBRA.

9.2.3 CBRA Concept of Operations – OOG Bags

The CBRA concept of operations for out-of-gauge checked bags consists of the following steps:

- The queuing and load-balancing logic for OOG bags follows the same logic as indicated above for the alarmed bags.
- The TSO conducts primary screening on the OOG bag using the Checked Baggage ETD protocol.
- A cleared bag status is then indicated and the cleared bag is moved (using a lift-assisted device) onto the Clear Line in the CBRA.

9.2.4 CBRA Concept of Operations – OS Bags

The CBRA concept of operations for oversized checked bags consists of the following steps:

- These bags typically travel on an OS line to a dedicated ETD station, or in the proximity of several stations.
- If multiple ETD stations are needed for OS bags, then the queuing and load-balancing logic follows the same process as the logic indicated above for alarmed checked bags.
- Since these bags have not been screened by EDS, the TSO conducts primary screening using the Checked Baggage ETD protocol to screen these bags until the entire bag can be cleared.
- The cleared bag is moved (using a lift-assist device) to the OS Clear Line at the CBRA.
- If a reduced-size EDS (RSEDS) is available at the CBRA, OOG and OS bags may be screened using the RSEDS. Ideally CBISs need to be designed to eliminate the use of RSEDS in a CBRA room, except in special situations with unique bag types (e.g., ski resort destination airports) that can be more efficiently screened using RSEDS in CBRA.

9.2.5 CBRA Concept of Operations – Invalid Arrival Bags

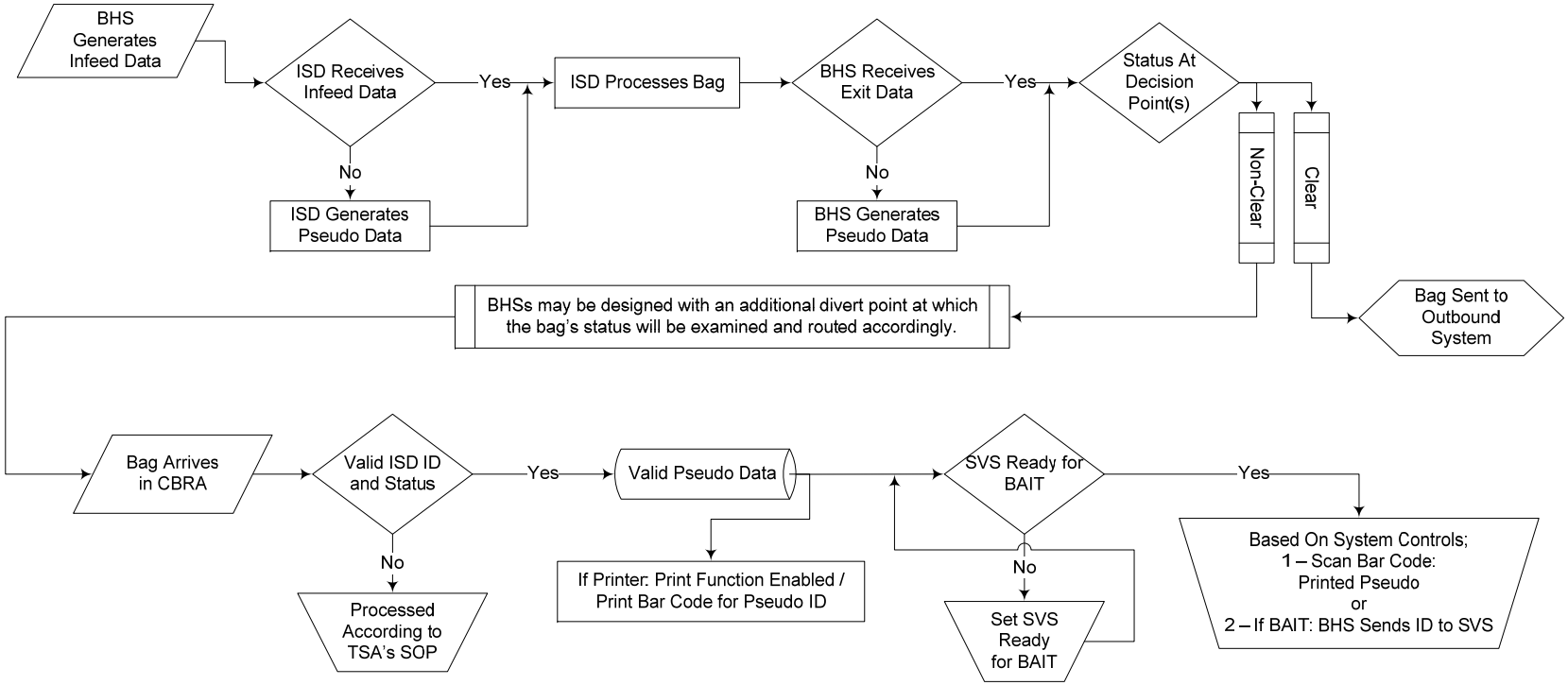
The CBRA concept of operations for invalid arrival bags consists of the following steps:

- These bags arrive in the CBRA via the AL conveyor line.
- The process described in Section 9.2.2 is applicable to these bags.
- Invalid arrival bags may have been (a) screened by the EDS but mis-tracked by the BHS, (b) not properly read by the BHS automatic tag reader (ATR) and have no BHS IATA ID, and/or (c) not screened properly by the EDS (e.g., irregularly shaped bags may roll inside the EDS, or restrained inside the EDS, etc). In these cases, error bags do not have a valid associated EDS image, so an ETD Directed Trace process cannot occur.
- Using the CBRA re-insertion line, these bags can be manually scanned and re-inserted into the CBIS prior to the EDS units for re-screening.
- If the CBIS does not have a re-insertion line, then error bags are screened similarly to OS or OOG bags (i.e., primary screening using ETD) until the entire bag can be cleared.
- The cleared bag is moved (using a lift-assist device) onto the Clear Line at the CBRA.

9.2.6 High Level CBRA Flow Charts

- Figures 9-4 through 9-6 show a high level flow of bags and data for several possible types of optimal CBRAs.

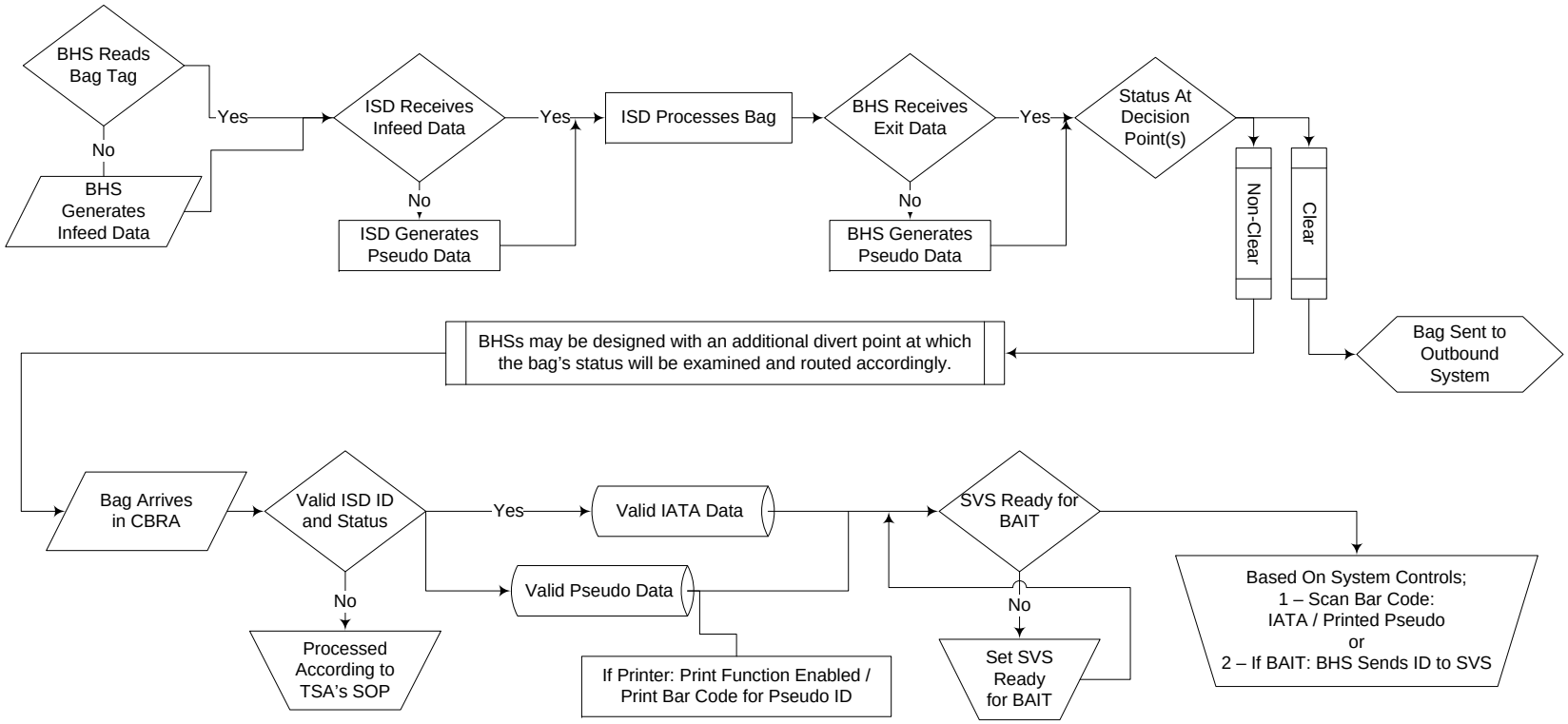
Figure 9-4
SIMPLIFIED ISD/BHS/CBRA DATA FLOW – NO ATR



Note: Upon a bag's arrival in CBRA, its IDs can be transferred from the BHS to the SVS via connectivity through a serial port on the SVS. The process of Bag Auto-ID Transfer (BAIT), must receive authorization from TSA during the 30% design phase of the project.

The printer function shall incorporate a soft key selection to turn functionality on/off. This is intended only to be installed at the first position and is intended to be used only for mitigation plans.

Figure 9-5
SIMPLIFIED ISD/BHS/CBRA DATA FLOW – UPSTREAM ATR



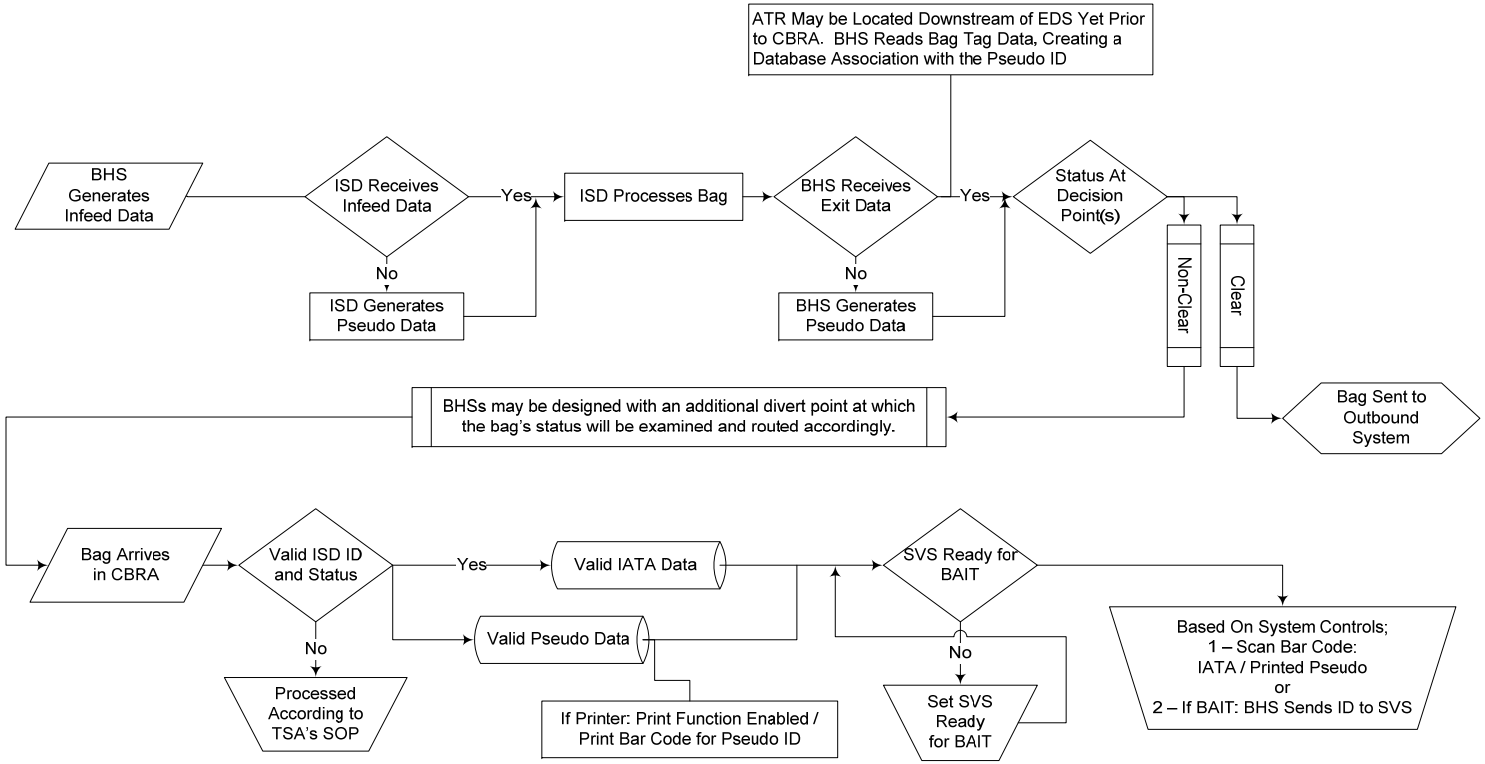
Pros:

- Allows the ISD to associate the IATA or bag tag data with the bag's image.
- For non-clear bags that become lost in tracking by the BHS downstream of the ISD, the image may be re-associated with the bag by the use of a hand-held bar code scanner.
- In the rare cases of a mis-directed bag, the bag tag data will allow better guidance as to which is the airline carrier for the bag and in which CBRA the bag may be found.

Cons:

- Requires airport and airline carriers to have good bag hygiene and properly maintain bag tag printers.
- Maintenance cost associated with bar code scanners.

Figure 9-6
SIMPLIFIED ISD/BHS/CBRA DATA FLOW – DOWNSTREAM ATR



Pros:

- For non-clear bags that become lost in tracking by the BHS downstream of the ATR, the image may be re-associated with the bag by the use of a hand-held bar code scanner.
- In the rare cases of a mis-directed bag, the bag tag data will allow better guidance as to which is the airline carrier for the bag and in which CBRA the bag may be found.

Cons:

- The ISD is unable to associate the IATA or bag tag data with the bag's image.
- Requires airport and airline carriers to have good bag hygiene and properly maintain bag tag printers.
- Maintenance cost associated with bar code scanners.

9.3 CBRA EQUIPMENT DESIGN CONSIDERATIONS

A typical CBRA workstation consists of a table and a backing for other tools that are provided by TSA. Specifically these workstations include:

- A computer
- A scan gun
- Note: Where scan guns are provided, they will be connected to the BSD at the BIT where data will be passed from the BHS to the EDS via a predefined communication port on the SVS. A file will be added to the BSD to show the ID of the scanned bag.
- Mounting system with brackets unique to each EDS vendor's machines
- Dedicated TSA tables

9.3.1 CBRA Screening Workstations

Each CBRA screening workstation should be designed to provide or accommodate a 30-inch x 60-inch work surface.

TSA provided tables are typically 30 inches wide x 60 inches long and are adjustable in height from 28 inches to 36 inches in 1-inch increments. However, exact specifications for search tables will be based on TSA procurement awards. Planners should confirm with TSA regarding specific table dimensions as CBRA designs are refined.

All CBRA tables regardless of the provider shall be height-adjustable.

All associated equipment (ETD, scan guns, monitors, computers, etc.) should be mounted separate and independent from the screening table and allow for complete access of the top screening surface.

A preferred design should have a free-standing (not connected to the screening table) back wall that allows for monitors and other peripherals to be mounted clear of the screening surface, as well as provide additional 110V power outlets for maintenance use (see optimal CBRA layout on Figure 9-1).

The workstation should align with the BRP's on the BHS AL. Proper alignment minimizes baggage handling and enhances the ergonomics of the area.

The screening workstation should include a proper light source as described in Section 9.5.2.

Each pair of workstations will share an ETD machine, which can be secured either to the wall or to the floor, but should be movable for sharing and maintenance purposes.

Screening stations must not be planned in a side-by-side fashion since they would require a TSO to walk past another to retrieve or place a bag.

9.3.2 ETD Machines

The CBRA design and layout should allow for the ETD machine to be shared by two screening stations to the extent practicable. The ETD should be located so as not to interfere with the screening process, but still allow easy access. See Figures 9-2 and 9-3.

9.3.3 EDS Displays

EDS displays will be supplied by TSA as part of the EDS equipment deployment. These displays vary by manufacturer and are used for viewing the images of bags with a suspect status.

9.3.4 Bag Status Displays

9.3.4.1 General Design Considerations

BSDs or control devices will be provided by the BHS vendor. BSDs should not be mounted to the screening table/surface and should be mounted so as not to interfere with screening operations, but still be located for easy operation.

The primary users of BSDs are the TSOs and, as such, the information provided should only include information useful to the TSOs. The primary screen should be simple to use. The screen may include the functionality to toggle between screens to allow viewing diagnostic data such as data points between the EDS and BHS, active ID being passed from the EDS to the BHS, photo-eye reports, system jams, fail-safe faults, and EDS status.

The BSD located at the workstation (or BIT), should be a minimum of a 10-inch color touch screen display. Information on the BIT BSD should include:

- Machine ID (serial number)
- Bag ID
- Pseudo ID and/or IATA ID
- Bag status (bag status can be color-coded; however, text should remain the main indicator of bag status)
- Soft button to transfer ID to SVS

A smaller display should be placed over each BRP. This display should be at a minimum a 9-inch monitor and include:

- Bag ID
- Pseudo ID and/or IATA ID
- Bag status
- A button to select which BIT or set of BITs are serviced by the BRPs. This button will transfer the ID and associated data to the BIT BSD where it can be transferred to the SVS

There are several bag statuses. However, the statuses listed below represent the absolute statuses that should be shown on BSDs.

The primary statuses used on the BSD should include:

- Cleared – Green
- Alarmed – Red
- Errored/EDS Unknown – Yellow
- BHS Unknown – Blue
- Oversized – Orange
- Out-of-Gauge – Orange

The statuses listed below are also used for reporting. The naming convention of each status shall be consistent with the following list and any change must be approved during the design review process. Each report should include a glossary of these statuses that clearly states the definitions in nontechnical terms. These statuses include, but are not limited to:

- Cleared
- Suspect
- Pending – Red
- No Decision – Red
- Purged – Red
- OSR Time-Out – Red
- EDS Timed Out - Red
- Lost Tracking – Red
- Bag Length Tracking – Red
- Following Lost Bag – Red
- Too Close – these bags may retain their original status but must be routed to the CBRA (color will be associated with original status)
- Unscreened – Yellow
- Flushed Bag – these bags may retain their original status but must be routed to the CBRA (color will be associated with original status)

BHS- and/or EDS-generated pseudo Bag IDs cannot repeat themselves within 24 hours (i.e., unique bag IDs are required for a duration of 24 hours) which is the definition of a day (a 24-hour period and not as an operational day). This shall be coordinated with the BHS and EDS vendors during the coordination meetings and will be according to the TSA *Checked Baggage Inspection System Interface Requirements Document* (IRD) that states required ID ranges.

9.3.4.2 Optimal CBRA Displays

Figures 9-7 to 9-11 depict the displays that are implemented at both the Baggage Removal Point (BRP) and the Baggage Inspection Table (BIT).

Note: The BHSC is not permitted to implement a control scheme that allows a "request" button to be implemented.

BSD at BRP consists of:

- BRP\XXXX-XX: Station ID naming convention based on the conveyor to which the BRP is mounted.
- Each of the BIT stations has an ENABLE/DISABLE button to activate/de-activate the BIT station as shown on Figures 9-8 to 9-12.
- Pseudo ID: Generated Bag ID (by the BHS or the EDS).
- ISD #: EDS machine number that processed the current bag.
- Bag Status: Disposition of Bag indicated by color and abbreviated status (colors and designators are listed in Section 9.3.4).
- Seq ID: This is an internal BHS tracking ID.
    - A sequence ID may or may not be used by all BHSCs.
- IATA ID: IATA Bag Tag ID
    - This is typically the IATA bag tag number and is compliant with IATA 740c. This is required to be a 10 digit unique identifier.
- RFID: RFID Tag ID If used
    - This field is only applicable to systems utilizing RFID in conjunction with the IATA bag tag data.
- Bag Present: This line will toggle between "BAG PRESENT – SELECT BIT" if a bag is queued at this BRP, and "WAITING FOR BAG" if the queue is empty. (See 9.2.2)
- Dispatch Bag To: Pressing this button will send the bag's information on the BRP to the selected BIT. (The number of "BIT" buttons is configurable by each site and is predicated on the number of BITs serviced by an individual BRP.) The primary BIT station (the one located nearest to the BRP station) will be distinguishable from the rest and show as bright green.
- BIT Selection: BITs will highlight when active, and gray out and display "Not Available" when the associated BIT is not Enabled.
- E-Stop: Each BRP is expected to have an E-Stop or access to an E-Stop device at each location. (Note: For safety reasons, a single "Start" push button will be located at an agreed upon location in the CBRA.)

Figure 9-7
GENERIC DISPLAYS FOR A BRP AND A BIT

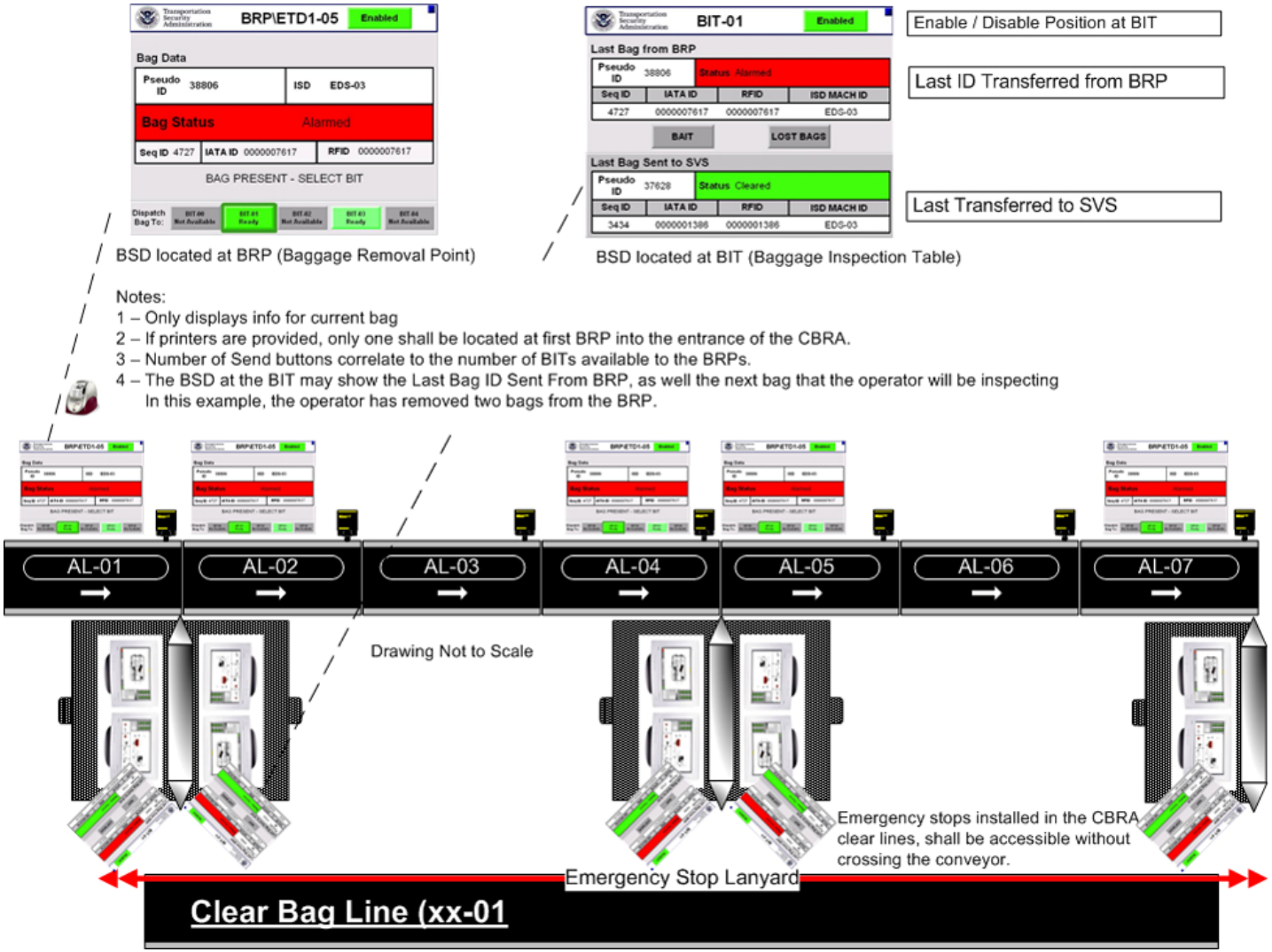


Figure 9-8
BAGGAGE SYSTEM DISPLAY AT BRP

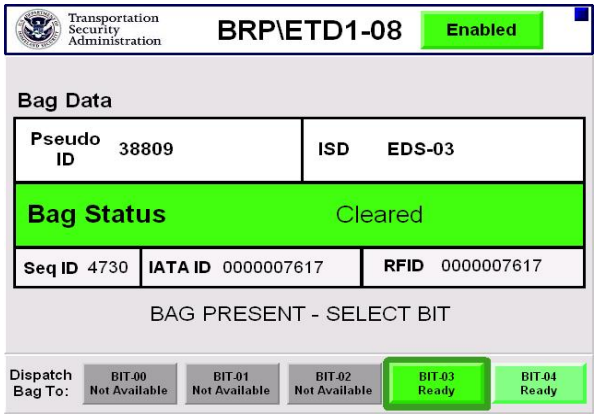
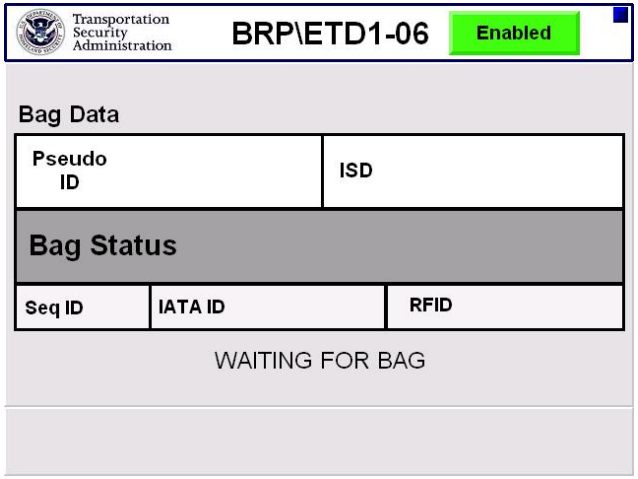


Figure 9-9
BAGGAGE SYSTEM DISPLAY AT BRP "DISABLED"

- When Baggage Removal Point (BRP) is "DISABLED"
  - Station screen shall be grayed out
  - Display will read "STATION DISABLED"
  - The "DISABLED" button shall be red.
  - Bags will not advance to this position.
  - Bags may queue at a disabled position if the downstream BRPs are enabled and have bags queued.

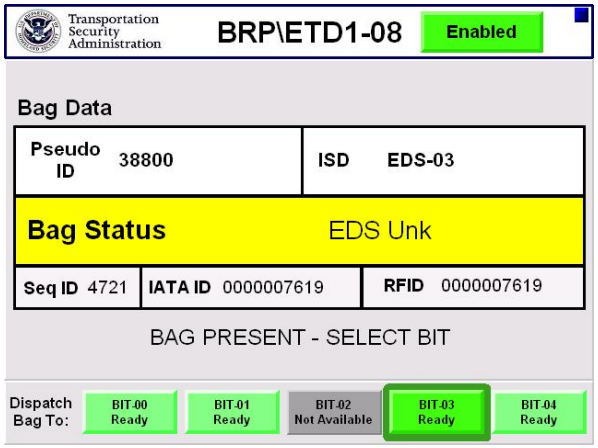
Figure 9-10
BAGGAGE SYSTEM DISPLAY AT BRP "ENABLED"



- When the Baggage Removal Point (BRP) is "ENABLED"
  - The station screen shall display their normal data fields.
  - The "ENABLED" button shall be green
  - Status will display "WAITING FOR BAG"

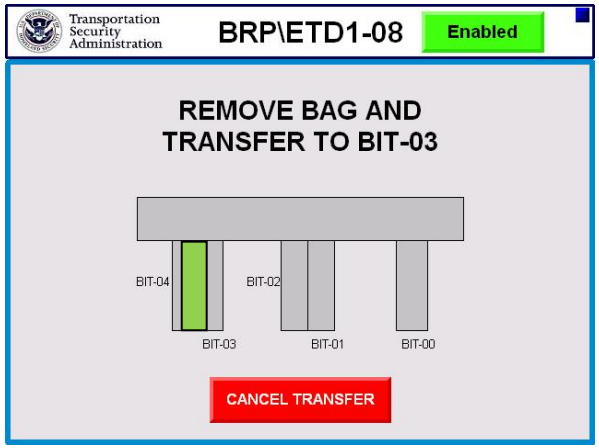
- o Bags will advance to this position and will queue here if it is the last position enabled or bags are queued downstream.

Figure 9-11
BAGGAGE SYSTEM DISPLAY AT BRP "BAG AT BRP"



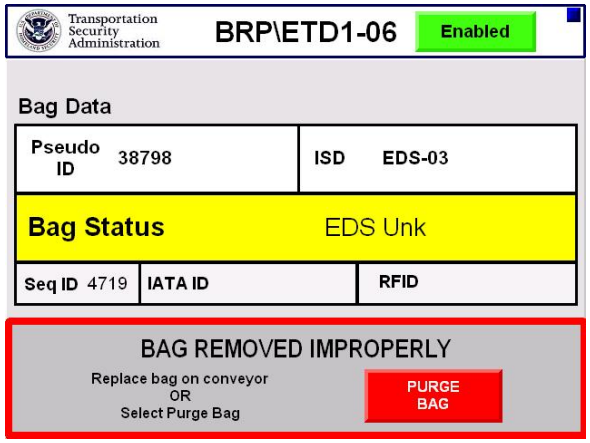
- When the BRP is "ENABLED" and a bag arrives at the BRP
  - o All data field are populated
  - o Status displays "BAG PRESENT – SELECT BIT"
  - o All BIT stations which are "Not Available" will be indicated by a gray background.
  - o Dispatch Bags To: All available BIT stations will be green and indicate "Ready". The primary BIT station (the one located nearest to the BRP station) will be distinguishable from the rest and show as bright green.
  - o When a "Dispatch Bag To" button is selected, the screen shown on Figure 9-12 is displayed.

Figure 9-12
BAGGAGE SYSTEM DISPLAY AT BRP "TRANSFER BAG"



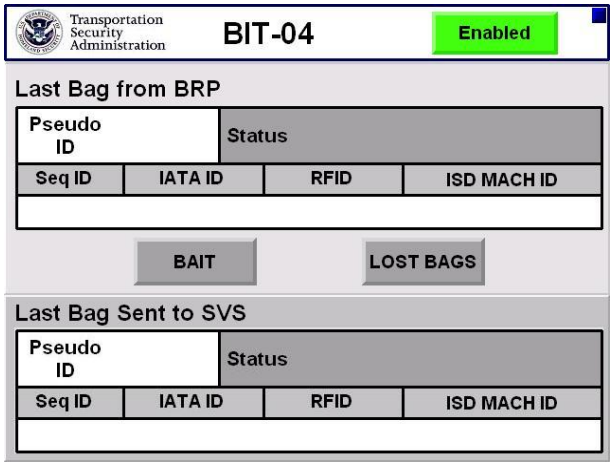
- o Conveyor Graphics will be disabled with the appropriate conveyors and BITs.
- o Text will display "REMOVE BAG AND TRANSFER TO BIT-XX"
- o BRP conveyor and selected BIT will highlight showing the selected destination.
- o CANCEL TRANSFER button will be displayed. (The Cancel Transfer button will cancel the selected transfer and return to the BAG AT BRP screen 9-2-3.)
- o Data will remain on BRP until bag is removed or purged.

Figure 9-13
BAGGAGE SYSTEM DISPLAY AT BRP "BAG REMOVED"



- When BRP is "ENABLED" (Figure 9-13), and a bag is improperly removed from the BRP without selecting a BIT. The BSD will display "BAG REMOVED IMPROPERLY" as indicated on Figure 9-13.
- The bag must be replaced on the conveyor – or the operator must select the Purge Bag option (Figure 9-13).
- If the bag is not replaced onto the queue, and the PURGE BAG button is selected, all data will be cleared from the screen and the screen will return to "Waiting for Bag," as shown by Figure 9-10 (there is no bag present on the queue).
- If the bag is replaced onto the queue, the screen will revert back to the previous screen (typical of Figure 9-11).

Figure 9-14
BAGGAGE SYSTEM DISPLAY AT BIT



The BSD at BIT consists of:

- BIT-XX: Station ID
- Enabled: Pressing this button will toggle between "ENABLED" and "DISABLED" (Figure 9-14). This condition is also reflected on the BSD at the BRP.

Last Bag from BRP:

- Pseudo ID: Generated Bag ID.
- Bag Status: Bag data which is shaded by color to indicate the disposition of the bag and its abbreviated status (colors and designators are listed in Section 9.3.4).

- Seq ID: This is a internal BHS tracking ID.
  - o A sequence ID may or may not be used by all BHSCs.
- IATA ID: IATA Bag Tag ID
- This is typically the IATA bag tag number and is compliant with IATA 740c. This is required to be a 10 digit unique identifier.
- RFID: RFID Tag ID If used
- ISD MACH ID: EDS machine number which processed the current bag.
- "BAIT" (Bag Auto ID Transfer): Automatically transfers the bag ID data to the SVS.
  - o Note: Cleared bags lost in tracking will not have an image associated with them.

9.3.5 CBRA Printers

Prior to printers being integrated into the CBRA operations, the ILDT shall coordinate with TSA for approval. TSA will make the decision as to whether printers are appropriate for each CBRA and provide them if deemed necessary based on the Description of CBRA Concept of Operations provided by the ILDT.

Ideally one printer would be provided in the CBRA and only used in contingency situations. If printers are used, the printed tag should include the same information as on the BSD, as outlined above. This functionality should be turned on and off at the discretion of the TSA supervisor for the CBRA.

Systems should be designed so that use of pseudo numbers and tags are not part of the daily procedure, but can be used to support contingency plans and should be reflected in the Description of Operations.

Each printed tag should include the following data:

- Pseudo ID
- IATA ID
- Status
- Time and date of arrival in CBRA
- Barcode, if applicable

9.4 GENERAL DESIGN CONSIDERATIONS

The following sections describe general design considerations for the no bag lifting policy, re-insert lines, OOG and OS lines, and screening station queuing at CBRA.

9.4.1 No Bag Lifting Policy

The lifting and carrying of bags by TSOs are major sources of on the job injuries. The CBRA should be designed and equipped to minimize TSO on the job injuries, as well as to improve the efficiency of the screening process.

The TSOs should no longer lift bags for inspection in the CBRA. To achieve this goal, several design best practices are available for automated and non-automated types of lift-assist equipment. Designers should use one or more best practices in specific CBRA designs per the local CBIS and CBRA conditions. The following is a list of lift-assist best practices:

- Screening workstations should be aligned to BHS BRPs on the AL to minimize the need to move bags.
- Sliding table tops may be provided on workstations, which can be unlocked so that the bag can be slided over to the Clear Line. This setup also leaves an adequate pathway in the event of an emergency.

- A mechanical lift-assist device is also an available option. Once the TSO has inspected the bag at the workstation, a conveyor can extend to place the bag on the Clear Line. The conveyor retracts to allow adequate access when not in use.

- A retractable slide gate, pole slides, or other hinged gates may be provided for each workstation area to allow TSOs to slide bags from the AL to the screening workstation. If retractable slide gates are used, they should automatically return to a position that will not impede the egress path for the TSOs.

- All vertical dimensions of equipment within the CBRA should be designed to create a "waterfall" effect, from high to low at each successive position for bag placement.

- See Section 9.5.6 for dimension and height requirements within the CBRA.

9.4.2 Re-Insert Lines

CBRAs should be designed with a re-insert line for error and unknown bags arriving into the CBRA. Re-insert lines should not require baggage lifting by TSA personnel and automated re-insert lines are preferred. See Figure 9-1 for an optimal CBRA layout with re-insert lines.

If a connection between the alarm line and re-insertion line is impossible due to space constraints in the CBRA, the re-insertion line should be set up so that the total carry distance for bags being placed on the re-insertion line will not exceed the length of the AL. Lift-assist devices should be provided to minimize manual lifting.

9.4.3 OOG and OS Lines

OOG bags should have a defined flow into and out of the CBRA. The preferred CBRA design should have OOG bags that arrive via the CBRA inbound line (AL) and leave via the CBRA outbound line (Clear Line). However, an acceptable design can have OOG bags that arrive via the OS line or a dedicated OOG line and leave via the defined OS Clear Line or a dedicated OOG Clear Line.

The baggage system shall be designed to accommodate the screening of a variety of baggage including odd-sized baggage such as strollers, golf clubs, ski equipment, etc.

The preferred CBRA design should have OS bags flow into and out of the defined CBRA without affecting normal CBRA screening or personnel movement. The design will be as such to accumulate OS bags on the inbound line. TSA's operation requires bag movement to be minimized to avoid injuries.

A design and routing plan for OS and OOG bags should be provided as part of the CBRA design.

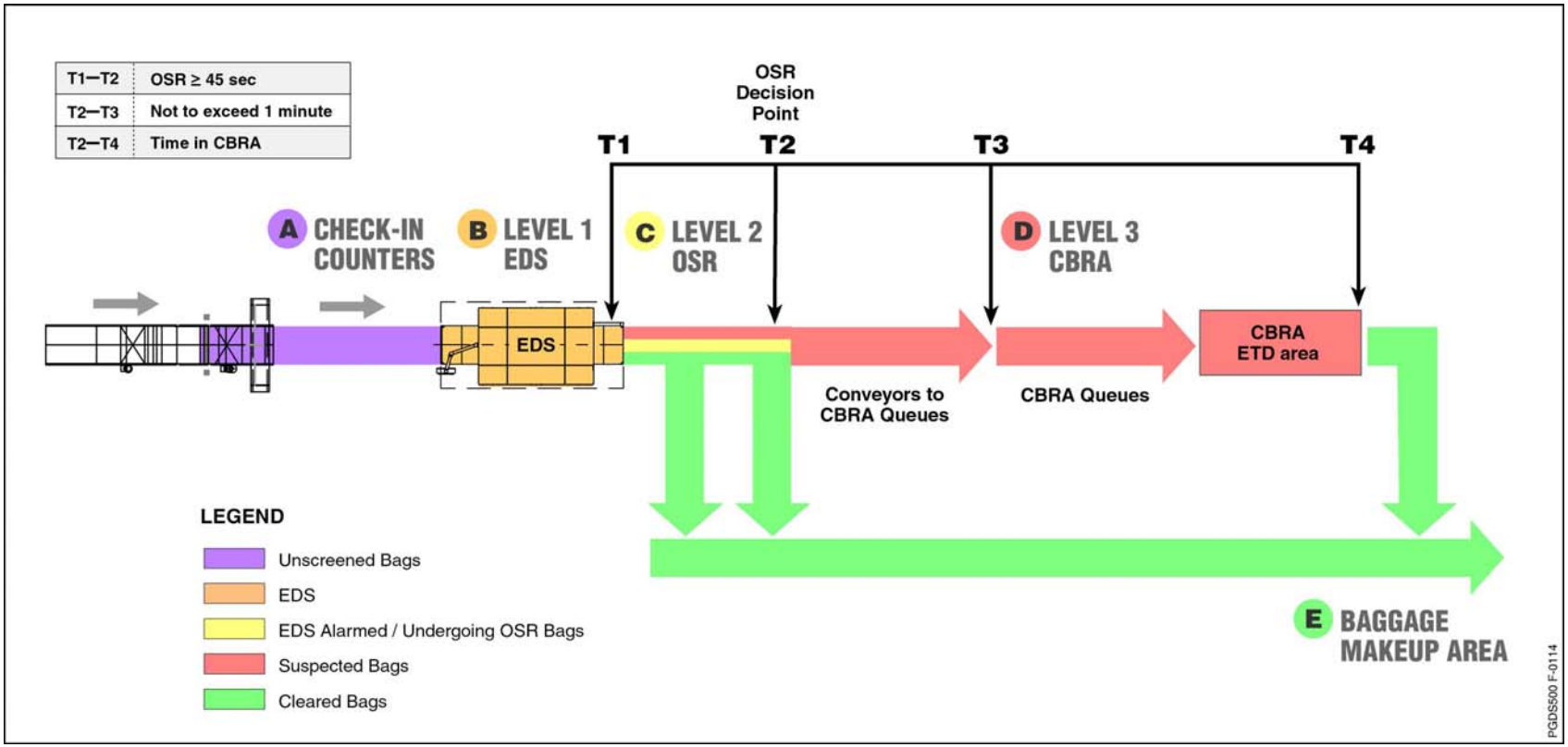
9.4.4 Screening Station Queuing at CBRA

CBRA inbound lines should provide sufficient queuing to allow for the processing of bags within a maximum of 10 minutes from the last chance divert during CBIS peak performance. See Figure 9-15 for a detailed time diagram in CBIS and CBRA. In addition there should be sufficient queuing to ensure no die-back of the baggage system during CBIS peak performance.

The CBIS design or contingency plan will not allow for storage or accumulation of bags in the CBRA. Bags entering the CBRA in excess of the design parameters will either die-back the system or need to be manually removed by O&M personnel.

The CBRA shall be designed to allow for sufficient staging queues per screening position, one of which may be a BRP and/or a BIT (see Figure 9-1 for an example of an optimal CBRA layout). Typically each screening position should have 1 to 2 queues however TSA will consider CBRA designs with higher number of queues if sufficiently justified by the project sponsor.

Figure 9-15
BAG TIME IN SYSTEM AND BAG TIME IN CBRA



Additional queues required to optimize the CBRA operation may be positioned as part of the inbound line leading into the CBRA room (it is not necessary that they be inside the walled room).

9.5 CBRA PHYSICAL REQUIREMENTS

The CBRA is an enclosed space separated from the bag room and should be designed accordingly. The CBRA should be viewed as an office/laboratory environment and provided with the necessary infrastructure to ensure a secure and climate-controlled environment with adequate acoustic controls to provide a safe working environment for the TSA. The size of the room is dictated by the number of queues and workstations required to adequately meet the screening demands of the CBIS. Refer to Chapter 6 to determine the number of queues and workstations required. See Figure 9-1 for an optimal CBRA layout with physical requirements.

9.5.1 Architectural Features

The CBRA should be fully enclosed with demising partitions extending to the structural deck to allow for the security and comfort of the TSOs. The CBRA should be provided with finished horizontal and vertical surfaces as follows:

- **Flooring** – CBRA designs should include the use of resilient material, such as vinyl (tile or seamless) or rubber. This should be flush or tapered to surrounding floor surfaces. An acceptable design can include exposed concrete, sealed and finished.

  Flooring should be a safety/anti-fatigue material configured for a wall-to-wall installation and be easily cleanable (reference www.satechinc.com, www.commercialmat, www.rubber.com, www.bare-footflooring.com, or equal for examples), which will eliminate the need for mats and runners that can contribute to tripping hazards.

- **Walls** – A preferred design should have durable, impervious surfaces, such as painted masonry or plastic laminate. An acceptable design can include drywall, taped, bedded, and textured with epoxy or enamel paint.

- **Ceilings** – Minimum height 9 feet. A preferred design should include the use of suspended drywall, painted, or suspended, lay-in acoustical tile. An acceptable design can include no ceiling, exposed structure. See Section 9.5.7 below for sound /noise abatement recommendations.

- **Access** – CBRAs will include at least one set of double doors or a rollup door providing access for equipment movement into and out of the area.

  In addition, designers should consult with local authorities to determine the proper protocol and routing for the removal of threat bags from the CBRA. There should be a designated exit path for TSOs when a threat is discovered, as well as adequate access to the CBRA room for local authorities with threat containment units.

9.5.2 Lighting

Proper illumination is required in the CBRA to allow the TSOs to perform their duties without unnecessary fatigue and eye strain. Luminance should be measured at the surface of the work table, and found to be in the range of 500 to 800 lux. In other areas of the CBRA, the luminance shall not fall below 300 lux.

These values are easily realized with the proper placement of light sources. Color rendition by the TSO is important; therefore, color corrected and full spectrum lighting lamps are required. Fluorescent lights are preferred.

9.5.3 Heating, Ventilation, and Air Conditioning

The CBRA space should be a climate controlled space. Temperature and humidity control should be supplied commensurate with the locale. A separate temperature control thermostat should be provided for the CBRA.

If forced-air ventilation is provided, fresh outside air should be delivered to the CBRA at rates specified by the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) Standard 62.1-2007 *Ventilation for Acceptable Indoor Air Quality*. Ideally, the CBRA should be under positive pressure relative to ambient BHS areas to minimize the migration of contaminants (e.g., products of combustion from tugs and vehicles) into the CBRA

9.5.4 Power and Communications

Power should be provided to the CBRA to support TSA- and airport operator-provided equipment. The ILDT should coordinate the final requirements based on the actual equipment list and layout, but as a minimum:

- One 120V; 20 amp quad receptacle should be provided for each TSA workstation.
- Convenient outlets should be provided on the perimeter walls as required by local codes.

The CBRA requires both voice and data communication provisions. The ILDT will determine the requirements based on the actual equipment selected for the CBRA, but as a minimum:

- Provide a wall-mounted telephone for use by TSOs, with access to the airport communication network and for placing outside calls.
- Provide the network cabling and conduit required to support the BHS, EDS, and TSA workstations.
- All cabling and associated outlets should be installed in a location where they cannot to be damaged by ETD tables or cause a safety hazard.

9.5.5 Connectivity to TSA Network

The TSA will coordinate the connection of the CBIS and CBRA equipment to the TSA Network (TSANet) via “data drops.” This connectivity allows TSA to collect valuable information on the screening performance of the equipment in place within each CBIS.

Table 9-1 summarizes the connectivity requirements in terms of number of data drops by equipment.

Table 9-1
CONNECTIVITY STANDARDS

Equipment	Number of Data Drops
ETD	1 dual per unit
EDS	1 single per unit
Multiplex Cabinet	1 single per unit
Wireless Access Points EDS	1 single per unit
Wireless Access Points	1 per unit

A “Dual Drop” consists of two RJ45 Cat5e/Cat6 connections terminated at a wall or floor box. A “Single Drop” consists of two RJ45 Cat5e/Cat6 connections which are terminated at a wall or floor box.

In addition, the following requirements should be met:

1. All ETDs will have one (1) “Dual Drop”
2. It is assumed that when a multiplex server is present, connectivity to TSANet will terminate at the multiplex server cabinet, therefore connectivity to TSANet for each EDS is not required
3. All core drilling will support a minimum of four (4) “Dual Drops”
4. All new fiber installations will be single-mode, six-strand bundles enclosed in interduct
5. All cabinet installations require two (2) 110v 20A dedicated service
6. All cabinet installations will meet local seismic rating requirements and can be floor/bracket mounted
7. All cabling outside of TSA controlled space must be in Rigid Metal Tubing (RMT) conduit

9.5.6 Sound/Noise Abatement

The CBRA should be provided in an environment that minimizes noise as much as possible. As a result of the likely proximity to the BHS bag room, the walls and ceiling of the CBRA require adequate sound insulation to limit the background sound level to 65dBA at each screening station.

9.5.7 Ergonomic Design Dimensions

CBRAs should be designed to provide a minimum of 15 square feet (36 inches x 60 inches) of employee working space associated with each 30 inches x 60 inches screening station. The table provided by TSA is 30 inches x 60 inches (see Figure 9-1). The clear distance between the edge of the screening table and the outbound Clear Line should be planned for a minimum of 48 inches.

Designers should verify with the local authorities that the clear distance and method of bag lift assist comply with local fire codes and provide adequate clearance for the bomb disposal robot (see Figure 9-1).

Typical work station height is 30 inches above the finished floor (all of the TSA furnished tables are height adjustable) so that the inbound belt and outbound belt should be at a height that allows for ease of bag movement and allows for 1 inch of adjustability when specifying a TSA screening table.

Designers should set the inbound belt height at 32 inches above the finished floor and the outbound belt height at 28 inches above the finished floor.

Peripheral equipment, monitors, ETDs, and BSDs should be mounted to allow adequate distance from the belt and work surfaces so as not to interfere with baggage screening (typically 17 inches to 20 inches from the top of the work surface to the bottom of the peripheral) while maintaining a vertical height that allows viewing and reaching heights to comply with ergonomic standards applicable to the site installation.

A preferred design should have sturdy and durable mounting systems that allow vertical and lateral adjustments. Adjustability should allow TSOs to function from a standing position with good posture in accordance with DOT/FAA/CT-03-05, *Human Factors Design Standard for Acquisition of Commercial Off-the-Shelf, Non-developmental, and Developmental Systems* to accommodate the 95th percentile male and 5th percentile female.

The following horizontal dimensions should be maintained in the CBRA:

- Between work stations: 6 feet
- Between the suspect line and roller bed: 4 feet clear

The contractor shall ensure that the working space at the workstation and visual acuity ranges for off-station displays conform ISO standards 11064-01, -02, and -03.

9.5.8 Design for Safety

All motor drives and associated tracking devices shall not be intrusive to the screening workspace. The design should use motor drives mounted on the opposite side of the inbound line from the screening personnel. If this not feasible, the designers should ensure that all hazardous moving parts (e.g., drive shafts, roller spindles, etc.) are guarded to prevent accidental contact.

Any moving part in any of the CBIS where TSA is required to perform their duites, must be sheielded to avoid injury.

Emergency stop push buttons must be at, and accessible from, all conveyor belts in the CBRA. Buttons should be readily accessible to employees in an emergency.

Alternatively, on the suspect/alarmed bag conveyors, buttons should be placed near both ends of the belt. Additional buttons may be required if the location of equipment precludes ready access to the buttons.

A single start push button should be installed to ensure the system can only be started from one location within the CBRA after an emergency stop has been pulled.

All bearings and components exposed in the screening work area should be covered with no sharp, pointed edges.

A shroud should prevent TSOs from accessing underneath the inbound and outbound lines (dropped items should be prevented from rolling under a belt and having to be retrieved).

Work stations must be adjustable in height, and viewing screens should be adjustable to accommodate various worker heights. Work stations must also be located in relationship to the AL and Clear Line to allow easy access to control panels, printers, screens, etc., that are necessary in managing the bags through the screening process.

Control stations locations should take into consideration the following:

- If the conveyors are worked from both sides, then control stations must be located on each side.

- Control stations should be located as to not be inadvertently activated by bag movement or “bumping.”

9.6 CBRA SIZING

See Chapter 6 for establishing how many screening stations are required for a CBRA.

The CBRA size calculation is based on the system maximum throughput, taking into consideration the OOG, OS, unknown, and error bags. The domestic and international demographics, as well as the blended domestic/international processing rates should be part of the calculation.

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10 ON-SCREEN RESOLUTION AREA PLANNING STANDARDS

10.1 BACKGROUND

This chapter provides ergonomic requirements and recommendations for the layout of on-screen resolution areas (OSRAs), workstation arrangements, the use of off-workstation visual displays and OSRA maintenance. This chapter draws on guideline provisions and other information provided in ISO 11064-1, ISO 11064-2, ISO 11064-3, as well as the OSHA website on computer workstations.

OSRAs are devoted to Level 2 of the CBIS screening process. During Level 2 screening, TSA personnel view alarm bag images captured during the Level 1 EDS scan, and clear any bags whose status can be resolved visually. This allows the continuous flow of bags through the BHS system as bag decision status are made. Any bags that cannot be resolved at Level 2, and all bags that cannot be directed to Level 1 because of size restrictions, are sent to Level 3.

The following is a list of key OSRA equipment:

- Control/supervisor work station with a CI, CCTV interface, and communications
- Individual work stations with TRIs
- Administrative area that includes a printer
- Wall mounted BHS display
- CCTV display of the CBRA

10.2 GENERAL ERGONOMIC RECOMMENDATIONS

Several high level ergonomic considerations are listed below which should be used to guide the OSRA design process:

- TSO population
- TSO attributes
- Work organization
- Job aids and working practices
- Shift rotation system
- Personnel qualification
- Training program
- Technology transfer
- Cross-cultural aspects

10.3 ARCHITECTURAL CONSIDERATIONS

10.3.1 Traffic and Routing

When designing OSRAs it is important to take into account the flow of both people and equipment:

- Distances should be minimized to take travel and communication needs into account.
- Any restrictions placed on access for unauthorized personnel should not impede access for authorized personnel.
- Special consideration should be given to undesirable walking routes, such as short cuts using emergency exits. The

layout of the site should be such as to permit easy access to all areas that might legitimately need to be visited.

- TSOs may feel uncomfortable sitting with their backs to an entrance or frequently used walkways.

10.3.2 Entrances/Exits

Main entrances and exits should not form part of the working visual fields of the TSOs.

Entrances and exits should not be positioned behind the TSOs.

10.3.3 Future Expansion

OSRA layouts should allow for expansion. As referenced in section 5.3.1 the design year for equipment requirements is assumed to be 5 years after the initial operation startup for a given baggage screening system (i.e., DBU + 5 years). This is the time horizon which should be used when designing OSRAs and planning for future baggage flow growth.

10.3.4 Plan Space Provision

The selection of space for an OSRA should be consistent with the following guidelines:

- The selection of a space for an OSRA should be based on the usable area, not the gross area.

- Obstructions and structural features, such as pillars and awkward corners, within a proposed/planned OSRA, will severely reduce the available space and could result in sub-optimal work layouts.

- Provisions should be made to allow TSOs to cover several monitors at once from a singular position during non-peak hours in order to account for periods of lighter staffing.

- A typical heuristic value for planning floor-space allocation is to allow for 29 ft^2 to 49 ft^2 per working position with a minimum of not less than 29 ft^2. This has been found to be satisfactory for rooms with more than one TSO workstation which are permanently staffed. It takes account of typical equipment volumes, seating space and maintenance access and no large, off-workstation shared visual displays. Precise requirements shall be based on a task analysis. This space provision is based on “usable” area. In some OSRAs, where large, shared overview displays are a dominant operational feature, space allocations of up to 164 ft^2 have been measured. These displays may include control interfaces and split displays showing various CCTV images from BHS and CBRAs.

- If additional staff, for example trainees, need to be accommodated during off-normal operations, within the OSRA, sufficient space should be allowed for these additional staff to be housed.

- Temporary positions should be provided alongside permanent TSO operator positions, where this additional staff is expected to be present during shift changes.

- Square, circular and hexagonal spaces are preferred for the arrangement of functional groups, because they offer the potential of maximizing the number of links; long narrow spaces should be avoided since they can unduly reduce options.

- The information presented in Section 10.4.4 illustrates different ways in which workstations can be arranged. Some of the factors considered include views to shared off-workstation visual displays, operational links between OSRA operators' and contact between supervisors and operators. The diagrams are intended to highlight some of the advantages and disadvantages of alternative groupings of

workstations. They are not intended to be exhaustive or prescriptive.

10.3.5 Vertical Space Provision

When designing the vertical space of an OSRA the following should be taken into account:

- OSRAs with a single finished floor height offer greater flexibility for future change and for the movement of equipment and personnel, especially those with disabilities.
- For a given OSRA, single height ceilings are preferred.
- As a "rule of thumb," slab-to-slab heights should preferably be a minimum of 13 ft, to include false floors, false ceilings, indirect lighting systems and the accommodation of shared off-workstation visual displays. In practice, such a design would result in finished floor to finished ceiling heights of at least 9 feet. This would accommodate the 99 percentile of the male population. Note that the appropriate user population data should be used.
- Uncluttered ceilings are preferred to avoid any distractions or stray reflections from luminaries; such plain finishes are also recommended for walls and any structural elements.
- Differing finished floor heights can sometimes offer advantages for viewing areas, supervisory overviews and a means of keeping "public area" segregated. To avoid various safety hazards, including trip hazards, ramps should be considered for movement of equipment and personnel.

The viewing of shared off-workstation visual displays by groups of TSO operators can sometimes be improved through the introduction of multi-level floor heights.

10.3.6 Exits, Entrances and Walkways

Due the specific requirements of OSRAs the design of exits, entrances and walkways must take into account the following considerations:

- The location and number of the exits and entrances should take account of the number of TSO operators and the functional links to areas outside the OSRA.
- A single main entrance and exit offers the best solution for security and staff control. However, other emergency exits may need to be provided.
- Entrance location should be considered in relation to supporting functions situated around the OSRA, such as toilets, relaxation areas, supervisors, offices.
- The sizes of entrances/exits should allow for the movement of equipment and the introduction of any other maintenance equipment which can sometimes be required to be used in the OSRA. Entrances that are sized for equipment passage are usually adequate for persons using wheelchairs.

10.3.7 Windows

Windows should be provided in OSRAs for operational, psychological and physiological reasons, not necessarily for illumination. Large luminance differences between the visual displays, used at a workstation, and areas around them, shall be avoided. The ratio of luminances for task areas that are frequently viewed in sequence (e.g., screen, document and windows) should be lower than 10:1. Within a static visual field a significantly higher ratio of luminance's can be tolerated between the task area and its surrounds (e.g., display housing and walls) and should not have any adverse effect. A glare-free usage of displays shall be guaranteed.

The provision of windows often gives rise to conflicting demands sometimes leading to the exclusion of windows from the OSRA (i.e., for security or safety reasons). When windows are included in OSRAs, the following shall be taken into account:

- Workstations shall not be facing windows.
- Windows, which are located on the left and/or right side of the workstation, shall have a minimum distance of 9ft to the workstation.
- Windows shall be included in meeting and relaxation areas and offer an alternative visual environment to that of the OSRA.

10.4 OPERATIONAL CONSIDERATIONS

10.4.1 General Recommendations

OSRA layouts should be based on an agreed set of principles derived from operational feedback (if available), task analysis and an understanding of the TSO population including workers with disabilities: these underlying principles should be fully documented (see 10.5). The following elements should be included:

- The layout of OSRAs should facilitate team working opportunities and social interaction for TSOs.
- The OSRA layout should reflect the allocation of responsibilities and the requirements for supervision.
- Optimizing key operational links, including sightlines between OSRA staff, or direct speech communication between OSRA as well as between OSRA and CBRA staff should be a goal in OSRA layouts (see 10.4.3).

10.4.2 OSRA Layout

In order to develop design specifications for an OSRA arrangement, the following activities shall be performed:

- Confirm the functional areas making up the OSRA.
- Estimate the space requirements for each functional area, for example, administration areas, rest areas and provision for visitors.
- Confirm suitability of the planned site within terminal, for example space restrictions, local hazards, environment.
- Acquire current copies of all pertinent standards, building codes, user building policies and so on.
- Verify availability of necessary utilities.

Determination of the operational links between the functional areas and the development of a preliminary OSRA layout should have been performed during the conceptual design.

Functional entities to be included are:

- OSR room
- Meeting room
- Training facilities
- Office
- Break room
- Locker rooms and toilets
- The proposed design specifications should facilitate the smooth transition between all the activities in the OSRA.

10.4.3 OSR Room Layout

The following tasks have to be undertaken in order to design a layout of an OSR room properly:

- Determine the usable space;
- Identify the furniture and equipment to be accommodated within the OSR room;
- Determine operational links which need to be provided between items to be housed within the OSR room, including personnel;
- Specify circulation requirements for staff and visitors;
- Specify maintenance access requirements.

Items that shall be taken into consideration in all layouts include:

- Workstations
- Supervisor/CI workstations
- Separation between the OSR room and the BHS control room, the two cannot be one in the same
- A BHS monitor screen in the OSR room. This screen should only show the CBIS area as related to TSA operations.
- A centralized remote stop/start device in order to minimize delays in re-setting EDS in faulted conditions
- CCTV displays of EDS entrances and exits in order to enhance situational awareness and expedite responses to jam or machine fault events
- Layout drawings should show complete layout of components.
- A direct line of communication from the airport operator to the OSR room and to the CBRA as well as a direct line of communication between the OSRA and CBRA with a visual indicator in addition to an audio indicator
- The area should be insulated to limit the background sound level to 65 dBA at each workstation.
- The lighting in the area should include dimmers to allow for better screen viewing.
- Equipment racks.
- Storage both on and off the workstation.
- Notice board.
- Where access into the OSR room is required for work other than screening, adequate account should be taken of circulation routes and temporary waiting areas so as not to interfere with the work of the screeners.
- Where counters are used for the receipt or collection of documents, these often need to be near entrances or easily accessible from certain operating positions.
- Where changes of floor level are introduced in conjunction with entrances or exits, proper physical “aids” should be provided (such as guard rails, handrails, anti-slip surfaces) to minimize potential hazards.
- Space to enable supervision of the entrances(s) should be taken into account.

- Ready access to first aid equipment, emergency equipment and emergency exits shall be provided.
- Windows shall not be located behind the TSO operator in order to avoid glare or disturbing reflections on displays.
- Primary workstations shall be shielded from windows present in non-operational areas of the OSR room.
- Shared off-workstation displays.
- Desks, filing cabinets, bookcases as needed.
- Printer stands, photocopying machines and other office equipment as necessary.
- The proposed layout shall support the operating links, including face-to-face communication, equipment sharing and team work.

10.4.4 Workstation Arrangements and Ergonomic Considerations

The arrangement of workstations is closely linked to the ergonomic considerations of individual workstations, the positioning of supervisory workstations, vertical space usage and secondary workstations as all affect space and movement within the OSR room. Before going into details of each specific consideration there a number of general aspects that deserve attention:

- OSR rooms which exhibit either overcrowding of work positions, or widely dispersed work positions, are not recommended. Layouts should allow, wherever practical, direct verbal communication between the TSOs and avoid excessively short separations between adjacent TSOs (see Section 10.4.3).
- OSR rooms in the same terminal facility should adopt the same ergonomic principles of room layout to facilitate decision-making and teamwork.
- There are ergonomic benefits in varying postures during periods of work. Wherever practicable, it is recommended that TSO workstation layouts and work regimes allow TSOs to change their posture at the workstation and to move from their workstations from time to time (see ISO 9241-5:1998).
- TSOs using visual displays should not be facing windows. The location of TSO workstations where windows are behind the operator should be avoided since this may give rise to reflections on the display screen. If TSO operators do have to face windows, while using visual display terminals, the differences in luminances should not lead to glare.
- Where confidential information is presented, it should not be possible to see this from the public viewing areas.

10.4.4.1 Plan Arrangements

Figure 10-1 illustrates the wide range of alternative workstation arrangements which can be possible. The most suitable form of layout should be determined through the conduct of a task analysis. When designing an arrangement plan the following elements should be considered:

- Operational links between TSOs, such as speech, sightlines or direct voice communication, should be documented using link association tables prior to developing workstation layouts. These should provide a benchmark against which alternative layouts can be assessed and detail primary and secondary operational means including direct visual, message passing or equipment sharing requirements.

- When considering alternative ways of laying out a number of workstations the following factors should be considered:
  - Dedicated or shared workstations between TSOs.
  - Whether each workstation is identical.
  - Whether control operations and OSARP can be done from a single dual-use workstation or tasks are spread amongst a number of dedicated stations.

  NOTE: Where clusters of workstations are grouped together to form a single unit, the way in which operators are arranged around the workstation can offer different advantages (see Figure 10-1).

- Where a number of OSRAs operating on the same system but located on various sites throughout the airport are needed, each should have similar layouts. Adopting this approach facilitates the transfer of personnel from one site to another and can reduce training time and errors.

- Workstation arrangements shall take into account operations under normal and abnormal modes of system operation. For example, fall-back arrangements for information transmission by paper or other non-electronic means.

- Where ventilation systems, light fittings and windows have already been installed, positioning of workstations should take account of these to avoid draughts, glare and reflections on visual display screens.

- When using monitors the room lights should be between 20-50-foot candle bulbs. With LCD monitors up to 73-foot candle bulbs can be used as room lights.

- Light sources should not be placed directly behind workstations, rather lighting should be diffuse throughout the OSRA so as to limit glare.

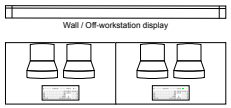
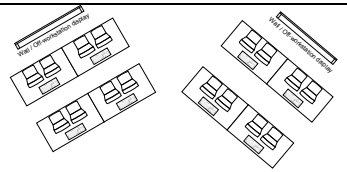
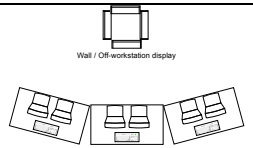
- Workstation layouts should provide an operationally satisfactory working environment under both maximum and minimum staffing levels.

- Workstation layouts should provide for the convenient storage and display of all necessary reference documentation which TSOs require to access as part of their duties as well as items which can be required in emergencies.

- Where workstations are grouped together, the minimum distances between adjacent positions should not result in individuals sitting within each other's personal spaces. While occasional close working may be acceptable, working positions adopted for extended periods should avoid TSOs having to intrude within each other's personal spaces.

- Spacing between TSOs should take account of shared equipment, where consideration of common reach zones or potential problems of interference due to noise need to be applied.

Figure 10-1
WORKSTATION LAYOUTS

Spatial layout	Layout description	Layout advantages/disadvantages
	*Single one sided linear:* TSO and supervisor workstations are placed linearly facing the same direction.	• Off-workstation displays can be shared • Easier access for walkways, emergency egress and maintenance • Easier to place windows • Does not foster team communication
	One sided multiple banks: Variants include positioning of the supervisor position and staggering the banks.	• Large off-workstation displays may be shared • Easier access • Allows for separation of groups • Does not foster team communication
	*Angled banks:* Workstations are split evenly into banks. These banks are placed angularly (either at obtuse or acute angels). The supervisor workstation may be placed behind the TSO workstations.	• Off-workstation displays can be shared • Can foster verbal communication without interrupting other teams • Easier access for walkways and maintenance
	*Circular:* Workstations are placed along the circumference with the off-workstation display at the center.	• Equipment can be shared • Difficult for team communication • Difficult from a external lighting perspective • Inefficient access for maintenance
	Opposite facing linear rows: TSOs can be placed either inside or outside of the arrangement.	• Group separation possible • Verbal communication encouraged • Efficient access for emergency egress and maintenance • Equipment cannot be shared

Source: ISO 11064-3: 1999, Design of Control Centers. Part 3: Control room layout.

- Approximate workstation sizing for initial room layout purposes should take account of such factors as equipment sizes, flat worktop provision and the requirements for on-workstation storage and accommodation for workers with disabilities: any such layouts should be fully checked through workstation and room trials prior to being finalized.

- When selecting room layouts, attention should be paid to training requirements for TSOs, for example, additional space for equipment adjacent to a normal operator's position or a separate, discrete training workstation.

- Layouts should take account of maintenance requirements and access space for technicians and equipment removal, particularly where this involves bulky items.

- The general arrangement of workstations should be such that flow from general circulation areas is inhibited. However, the use of actual physical barriers to do this is not advocated.

- Layouts should optimize key operational links, such as sight lines to BHS, displays, CCTV displays, and communication links between OSR and the CBRA staff

10.4.4.2 Control Workstations

OSRAs will have an area designated as the CI/Supervisory station and additional requirements can be associated with their location in the OSRA:

- The CI/Supervisory workstation should take full account of the additional reference material which is sometimes required to be stored, displayed and used at these positions.

- In arranging CI/Supervisory layouts it must be considered that the person at this station will be monitoring the EDS and CBRA processes, as well as providing supervisory support to the OSR operation. Layouts should place a high priority on equipment positioning (CI, CCTV, BHS monitors), while allowing for direct verbal communication with those positioned at the screening work stations.

- A CI/Supervisor desk/work area including communications for telephone and TSA network access.

- Layouts should allow for additional circulation around supervisory/control positions and for the temporary accommodation of visitors.

- Where major screening incidents are handled from the supervisory/control area, the provision of extra vertical display surfaces needs to be considered for the presentation of additional images and/or procedures. Additional space may be required by extra staff who may need to be accommodated in this area.

10.4.4.3 Vertical Arrangements

The use of varying floor levels in an OSRA can offer some advantages in viewing shared overview visual displays and improving sightlines between TSO operators. These benefits can also be achieved by other means, such as the careful layout of the OSRA or the duplication of overview equipment. When considering adopting a solution based on varying floor levels in an OSRA, the following are some of the drawbacks which should be taken into account:

- Can restrict direct visual and verbal links.

- Can create obstacles to the movement of people.

- Movement of larger items of equipment can be restricted.

- Future changes in room layout can be more difficult and flexibility can be reduced.

- Variation in workstation heights and locations of TSO operators can require additional measures to ensure proper lighting and heating control.

- Wheelchair access will need to be provided by ramps which will require additional floor space or wheelchair lifts.

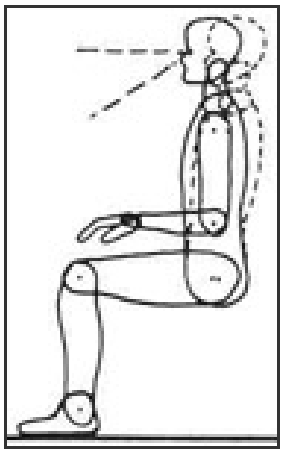
10.4.4.4 Secondary Workstations

Where it is impractical to store all equipment or reference material at the workstation (or a position included which can deal with an overflow of tasks during peak workloads), the provision of a secondary workstation should be considered. The layout and design of any such workstations should adhere to the same ergonomic principles as presented for primary positions and their layout based on a task analysis.

10.4.4.5 Specific Ergonomic Considerations

When designing workstations the following specific ergonomic considerations should be taken into account in order to achieve a neutral body position which reduces strain on muscles, tendons, and the skeletal systems and allows TSOs to vary their postures throughout the day. Figure 10-2 provides a visual reference, while Table 10-1 summarizes many of these points.

Figure 10-2
NEUTRAL BODY POSITION



Source: United States Department of Labor, Occupational Safety & Health Administration available at www.osha.gov/SLTC/etools/computerworkstations/index.html

Table 10-1
MONITOR/DESK/CHAIR ERGONOMIC DESIGN REFERENCE

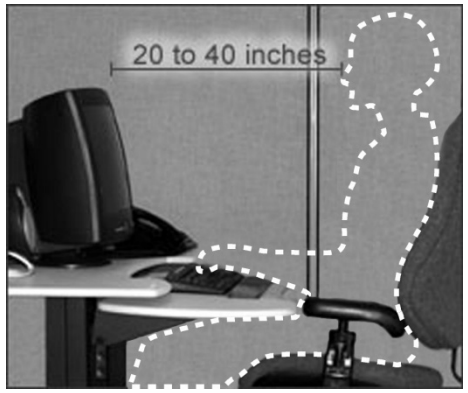
Monitors	Desks	Chairs
Height: should be at or below eye level	*Height:* should be adjustable between 20-in. and 28-in.	*Height:* should be fully adjustable with a minimum range of 16-in.
Size: 15-20-in. monitor should be sufficient	*Clearance:* 15-in. for knees and 24-in. for feet, width at least 20-in.	*Backrest:* at least 15-in. high and 12-in. wide, and should recline 15 degrees from vertical
Distance: 20-40-in. from TSO	*Area:* should provide space for at least 20-in. distance from TSO to monitor	*Chair Rotation:* 360 degrees is preferred
Position: directly in front of the TSO in order to limit head and neck twisting	*Equipment Positions*: desk space should allow for the placement of equipment directly in front of the TSO	*Seat size:* seat pan length should be 15-in. to 17-in.
Glare: should be positioned away from windows	*Glare:* desktops should have a matte finish, avoid glass tops	*Armrests:* should be removable, distance between them should be 16-in. and adjustable

Source: United States Department of Labor, Occupational Safety & Health Administration available at www.osha.gov/SLTC/etools/computerworkstations/index.html

NOTE: Where physically disadvantaged TSOs or visitors (those exhibiting a disability) are expected to use the OSRA, these measurements will differ. Please refer to any local or national regulations.

- Workstations should be designed so as to allow hands, wrists, and forearms to be in-line and parallel to the floor.
- Workstations should be designed so as the TSO's head is level and in-line with the torso.
- While seated the design of the workstations should allow the TSO's elbows to stay in close to the body and be bent between 90 and 120 degrees.
- Accommodations should be made so that while TSOs are seated at their workstations their backs are fully supported when sitting vertically or leaning back slightly.
- When seated the design of the workstation should allow for the TSO's knees to be at the same height as the hips with the feet slightly forward.
- The preferred viewing distance from the TSO to their monitor should be between 20 and 40 inches and the center of the workstation screen(s) should be located 15 to 20 degrees below the horizontal eye level of the TSO(see Figure 10-3).
- Adequate desk space should be provided so as to allow the placement of monitors within the viewing range previously noted from the TSO of 20 to 40 inches. As well as to provide adequate room for the placement of any reference materials/other equipment which may be needed.
- Desks should be provided which have leg clearance of between 20 and 28 inches. Preferably height-adjustable desks will be provided in order to provide maximum flexibility within the TSO population.

Figure 10-3
VIEWING DISTANCE



Source: United States Department of Labor, Occupational Safety & Health Administration available at www.osha.gov/SLTC/etools/computerworkstations/index.html

- Chairs should be provided which have proper lumbar support, allow the TSO to recline up to 15 degrees from vertical, and which are height-adjustable.

- OSR room dimensions and workstation layout dimensions and features for which peoples' sizes are relevant, e.g., seated view over workstations, shall take account of the range of TSOs for which these items are being provided.

10.4.4.6 Additional Considerations

In particular, the following must be considered:

- The layout of workstations should take account of future requirements. OSRA workstation layout should take account of the initial operation as well as the requirements likely to be in place at the end of the planned life span of the OSRA (refer to chapter 5, section 5.3.1).

- The needs of those with disabilities should be considered during the layout of the OSRA by, for example, allowing additional circulation spaces and introducing ramps for wheelchair access.

- Hard-copy information storage should be classified such that the most appropriate provisions can be made within the OSRA. An appropriate classification is suggested in Table 10-2.

- Adequate provision should be made for the storage of items of a personal nature, both in the OSRA at the workstation (briefcases, purses) or outside the OSRA in locker rooms (for clothing etc.).

The requirements of secondary users who sometimes need to work in the OSRA on a temporary basis should be considered. All such requirements should be fully determined by the conduct of an appropriate task analysis.

Table 10-2
CONTROL ROOM STORAGE—CLASSIFICATION OF TYPES

Storage requirement	Typical location	Example
Immediate access	Primary workstation	Operational procedures High-priority telephone numbers Emergency procedures Diagnostics
Secondary access	Secondary workstation	Internal telephone directory Secondary operating procedures
	Adjacent workstation	Architectural/engineering drawings
Occasional access	Library	Non-critical screening equipment failure procedures

Source: ISO 11064-3: 1999, Design of Control Centers. Part 3: Control room layout.

10.4.5 Off-workstation Shared Visual Displays

The layout of the OSRA shall ensure that all off-workstation visual displays, necessary for the TSOs task, are visible from all relevant workstations (see 10.4.3).

The requirements presented in this section concern the location of shared visual displays within the OSRA. Many differing technologies can be used for overview visual displays, including banks of CCTV monitors, projected displays, hard-wired mimics and static maps/diagrams. When designing OSRA layouts for these differing solutions, the constraints imposed by the various solutions will need to be considered. Such constraints include limitations on viewing angle, contrast ratios and image construction.

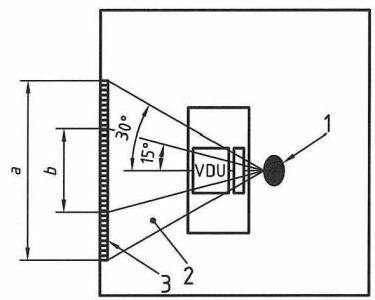
As an alternative to large shared displays, the option of presenting this information on the workstation, with smaller schematics, should be considered.

10.4.5.1 Horizontal and Vertical Viewing Distances

In particular, the following has to be taken into account:

- Where off-workstation visual displays need to be used on a regular or continuous basis, the preferred position is directly in front of the TSO such that they can easily be seen when looking over the workstation or can be scanned by eye-movement alone (see Figure -4).

Figure 10-4
PREFERRED LOCATION OF
OFF-WORKSTATION VISUAL DISPLAYS



Key
1 Operator
2 Horizontal visual field
3 Off-workstation visual display

NOTE This plan view is intended to show general principles.

Source: ISO 11064-3: 1999, Design of Control Centers. Part 3: Control room layout.

- Where the information presented on an off-workstation shared visual display does not have to be read while operating the console or provides secondary information, the displays can sometimes be mounted to one side of the workstation. Such displays should be positioned so that all information required can be reliably read from the TSO 's normal position, by a simple rotation of the their chair.

- For very large off-workstation visual displays which need to be monitored on a continual or regular basis, it is recommended that TSOs be allocated sections of the common display which they can effectively and conveniently monitor.

- Where the information on an off-workstation overview visual display needs to be regularly used by TSOs, the design of the visual display and the layout of the OSRA should ensure that all of the information which needs to be used by a TSO can be seen from the normal working position for both the vertical and horizontal planes.

- Necessary information presented on shared overview visual displays shall be visible by personnel, with applicable 5th to 95th percentile body dimensions of the TSO population, from their normal working positions. There can be a requirement for safety critical information to be seen. Under these circumstances, the user percentile range to be accommodated may need to be greater.

- Operational information presented on the lowest part of an off-workstation visual display shall be visible to a 5t^{h} percentile, seated, non-upright TSO. The following formula may be used to determine this measurement:

$$H_1 = H_c - (D + d)\,\frac{H_e - H_c}{D_c + d}$$

where

H_1 is the lowest height at which the visual display can be seen;

H_e is the design-eye-position, measured from the floor to the outer corner of the eye; 5th percentile shall be applied;
NOTE He is a combination of the adjusted seat height and the anthropometric data of “eye height, sitting”

H_C is the height of the console;

D is the horizontal distance between the front edge of the console and the surface of the wall panel;

D_c is the depth of the console;

d horizontal distance between the design-eye-position and the front edge of the console.

10.4.5.2 Relationship of Shared Visual Displays to Other Features

In particular, the following has to be taken into account:

- Windows should not be located adjacent to off-workstation visual displays or within the same field of view.

- Artificial room lighting should not interfere with the visibility of any sections of the off-workstation, shared visual displays.

- Finishes around off-workstation, shared visual displays should be carefully controlled so as not to interfere with the visibility of parts of the shared visual display.

- Entrances and exits should not be located within the same field of view as major off-workstation visual displays.

10.4.6 Personnel Circulation and Maintenance Access

The requirements and recommendations presented in this section concern the provision of appropriate space for general circulation, maintenance and cleaning.

Circulation of OSRA staff, maintenance staff and all visitors should be achieved with minimum disruption to the work of TSOs (see Section 10.4.6.1).

Where it is anticipated that the supervisory positions will give rise to additional circulation from outside the OSRA, it is recommended

that these positions be located close to main entrances (see Section 10.4.6.1).

OSRA designs should incorporate a means of restricting thoroughfare access (see Section 10.4.6.1).

All aspects of OSRA layout shall take account of the requirements for maintenance access (see Section 10.4.6.1).

10.4.6.1 Personnel Circulation

Planning for the circulation of personnel throughout the OSRA should follow these guidelines:

- Adequate provision should be made for the general circulation, such that OSRA operations are not interrupted by either visual or auditory distraction.
- Particular care should be taken to provide adequate circulation areas where shift changeover is protracted and two shifts are present at the same time.
- The layout of the OSRA shall allow for the orderly evacuation of the area.
- OSRA circulation routes should be arranged to avoid cross-circulation.
- Restricted ceiling heights should be indicated: the use of ceiling-mounted warning signs can be considered for these purposes.
- The following formula should be used for the minimum dimensions of circulation spaces where a single individual needs to pass with forward movement and in an upright posture (see Figure 10-5). Additional space should be allowed if tool boxes or other items are to be carried.

For non-emergency exits:

$$A = h(P95) + x \qquad (2)$$
$$B = a(P95) + y \qquad (3)$$

For emergency exits:

$$A_{em} = h(P99) + x \qquad (4)$$
$$B_{em} = a(P99) + y \qquad (5)$$

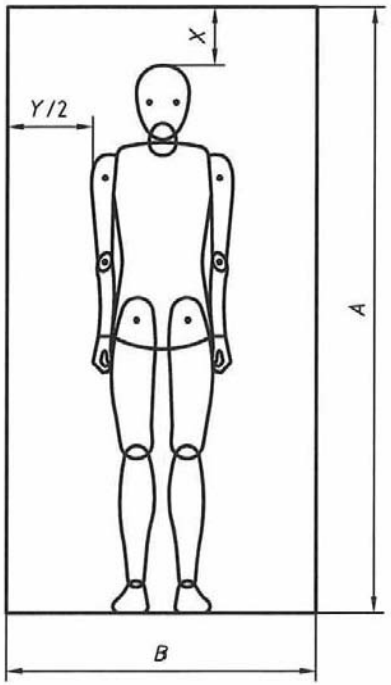
where

A	is the opening height;
A_{em}	is the opening height for emergency exits;
B	is the opening width;
B_{em}	is the opening width for emergency exits;
h	is the stature (body height);
a	is the elbow-to-elbow breadth;
x	is the height allowance (to allow adequate clearances for such items as helmets, caps and shoe height);
y	is the width allowance (to allow adequate clearances for bulky clothing);
P	is the percentile;
P95	is the 95th percentile of the expected user population;
P99	is the 99th percentile of the expected user population.

Concerning the definitions of human body measurements, see ISO 7250.

- Emergency exits shall use the appropriate P99 value whereas those for non-emergency may use the appropriate P95 value; these values to be derived for the TSO population. The distinction between the P95 and the P99 value can become blurred when clearances take account of the dynamics of walking movement.

Figure 10-5
MINIMUM CIRCULATION SPACE FOR PERSONNEL



Source: ISO 11064-3: 1999, Design of Control Centers. Part 3: Control room layout.

- The space provision for two-person circulation should be based on Formulas 2 to 5 presented above and doubled with the appropriate allowances made for tool boxes or other items being carried.

- Fixed items should be placed far enough from the swept area of hinged doors in order to avoid pinch points. The possibility of individuals being overcome by fire, smoke or gas should be considered in the design of door swings such that the likelihood of an unconscious individual obstructing the door is eliminated.

- For wheelchair users, allowances need to be made for the maximum width of the largest wheelchair and clearances for elbows to propel the chair.

- Wheelchair users will require additional space for turning and these should be provided at appropriate locations in the OSRA.

10.4.6.2 Maintenance Access

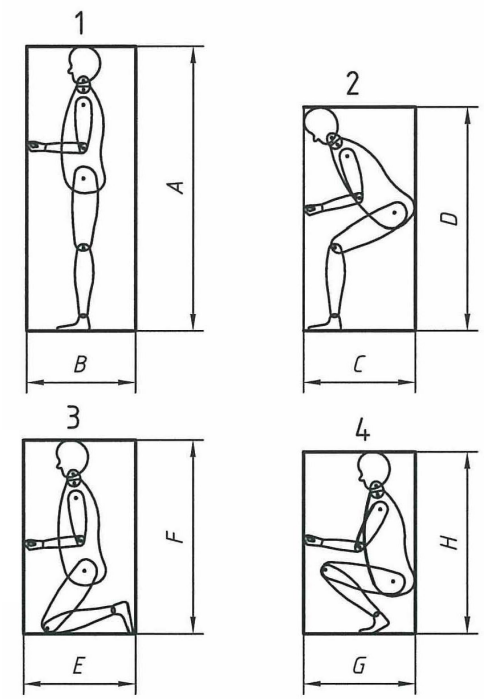
The ability for maintenance personnel to quickly and easily make repairs without interfering with OSRA operations is vital and should use the following guidelines:

- Space shall be allowed for maintenance such that inadvertent activation of equipment or systems is avoided.

- Experience shows that items of equipment housed on mimic panels should be mounted at least 27.5 inches above the finished floor height for reasons of visibility and access for maintenance.

- Rear access to workstations is recommended, since it allows staff to continue their operations. Adequate clearance behind the workstation should be allowed for kneeling maintenance staff to work. Some suggested space provisions based on world populations are presented as guidelines in Table 10-3 and on Figure 10-6.

Figure 10-6
MINIMUM SPACE REQUIREMENTS FOR MAINTENANCE OF CONTROL PANELS



Key
1 Standing work position
2 Stooping work position
3 Kneeling work position
4 Squatting work position

Source: ISO 11064-3: 1999, Design of Control Centers. Part 3: Control room layout.

Table 10-3
MINIMUM SPACE REQUIREMENTS AND ALLOWANCES

Dimension	Minimum space requirements in inches.	Allowances to be taken into consideration
A	75	for largest maintenance technician p95[(a)]
	1	for shoes
B	27.5	for largest maintenance technician P95
C	30	for largest maintenance technician P95
D	59	for largest maintenance technician P95
E	30	for largest maintenance technician P95
F	54	for largest maintenance technician P95
	1	for shoes
G	30	for largest maintenance technician P95
H	48	for largest maintenance technician P95

Note: The table above covers the whole world population. Where available, equivalent user population data should be used.

(a) P95: 95th percentile of the expected user population.

Source: ISO 11064-3: 1999, Design of Control Centers. Part 3: Control room layout.

- Off-workstation panels and displays sometimes require maintenance access to the rear. For such units, adequate space shall be allowed for the larger maintenance technician from the user population, 95th percentile and consideration given to the use of ladders and carrying of tool boxes.

- Where heavy or bulky items of equipment need to be removed the appropriate manual handling guidelines should be consulted. It is sometimes necessary to provide mechanical assistance or hoist points.

Access to service ducts and serviced equipment should, wherever practical, be from outside the OSRA.

10.4.6.3 Cleaning

As with maintenance the ability of cleaning staff to carry out their duties without interfering with the operations of the OSRA is very important to the day-to-day operations of the facility. Planning for regularly scheduled cleaning activities should rely on the following guidelines:

- Inadvertent activation of any safety-critical controls shall not be possible during cleaning.
- An adequate number of power outlets should be provided which will enable cleaning appliances to be used and maintenance to be undertaken without causing electrical interference or disturbing OSRA operations.
- Where gaps occur between items of equipment or furniture, adequate clearances should be allowed for cleaning to be undertaken.
- It should be possible for all necessary cleaning to be undertaken without interruption to OSR activities.
- Special provision is sometimes required where food and other refreshments are permitted to be consumed in the OSRA.
- The OSRA layout should not give rise to unsuitable working postures or working movements for cleaning staff.

10.5 VERIFICATION AND VALIDATION OF OSRA LAYOUT

Verification and validation should be integrated with the design process and should be performed in parallel with top level design, detailed design and during the development of prototypes. It is recommended that verification and validation should be an iterative process during the development of the design. It should give feedback to the designer in moving towards the best possible solution. It may include a number of different methods and techniques.

Examples of these are:

- Guideline evaluations (or use of checklists), i.e., using human factor guidelines and standards to check the design.
- Different task analysis techniques such as link analysis or timeline analysis, where communication and co-ordination can be tested.
- The use of “walk and talk through” techniques, where the idea is to work through scenarios/sequences in the new design.
- Evaluation criteria, compromises and decisions based on ergonomic principles should be documented and securely stored so that future modifications can take proper account of these factors.

In all cases local and federal regulations regarding design and construction shall supersede the recommendations included in this chapter. This is especially relevant concerning the provision of allowances for the disabled as covered by the Americans with Disabilities Act (ADA).

11 CONTINGENCY PLANNING

This chapter summarizes the contingency planning process, contingency plan development, and an evaluation of contingency alternatives. Appendix G provides a sample contingency plan, showing how contingency design principles are applied during the CBIS design process.

11.1 CONTINGENCY PLANNING PROCESS

Design of any CBIS shall include contingency plans for instances when baggage demand exceeds CBIS capacity, whether as the result of the failure of CBIS components or peak baggage flow that exceeds the maximum capacity of the CBIS, and for instances where alarm bags at the CBRA are defined as suspect bags (i.e., they cannot be cleared using directed search with ETD) and would need to be placed in the threat containment unit (TCU) for further inspection by law enforcement officer (typically from a bomb disposal squad).

CBIS design teams and other stakeholders, such as airports, airlines, TSA FSD, TSA headquarters, and all other relevant federal, state, and local authorities, shall mutually develop a set of agreeable mitigation measures within a comprehensive contingency plan during the design process. Design criteria associated with rapid recovery from a critical failure within the CBIS should be established within a range of technological and procedural solutions applicable at the individual screening zone level.

The initial contingency plan shall be reviewed by the full ILDT and included as an attachment to the Basis of Design Report. The contingency plan shall be reviewed by TSA as part of the overall design review and approval process for that CBIS design.

11.2 GENERAL CONSIDERATIONS

When developing a contingency plan, the CBIS design team should consider the following:

- Roles and responsibilities of the various stakeholders regarding system operation during all contingency scenarios (e.g., approval of various mitigation methods and approving entities).
- Overall processing capacity of the CBIS and expected occurrences of baggage flow demand exceeding CBIS capacity (e.g., during known peaks of the year that may exceed the ADPM flow).
- Set of eligible mitigation methods as approved by TSA and applicable for the particular CBIS design (taking into account relevant spatial and operational constraints at the particular airport).
- Maintenance of baggage screening and conveyance operations during critical EDS failures and/or mission critical components of the BHS within the context of the screening system automation continuum and the wide variation in associated costs, both capital and operational. Contingency planning should address critical failures along a continuum that ranges from the installation of additional automation to baggage screening mitigation processes. The trade-off between capital investment and O&M costs should be analyzed in detail.
- Other contingency plans that may affect checked baggage, such as Airport Operations Emergency Response Plan, local standard operating procedures (SOP) for transportation security incidents, Airport Emergency/Incident Response Plan, and Airport Emergency/Incident Recovery Plan.

- Temporary alternative screening location for baggage. If CBRAs are to be used for alternative screening, they should be sized to accommodate the temporary alternative screening operations.

- Threat evacuation and associated impact on baggage screening.

- Natural disaster impact on the screening operation.

11.3 DESIGN RECOMMENDATIONS TO FACILITATE CONTINGENCY PLANNING

Contingency plans should be customized to the specific CBIS design and terminal constraints. Several design features can be incorporated to provide for improved operation during failure events.

11.3.1 Equipment Redundancy

Redundancy can be applied to the design of CBIS to minimize single points of failure that can severely limit the operation of the conveying system. Some level of redundancy is critical for larger capacity systems when the nearest alternate conveying system for the rerouting of baggage is prohibitively remote or nonexistent. The higher capacity system design templates discussed in this document include the provision of increased redundancy.

However, the increased cost and area requirements associated with providing the additional conveying equipment necessary for redundancy must be balanced with the potential savings of labor and time that will result during periods of equipment failure. While CBIS designers should be concerned with minimizing single points of failure, the complete elimination of all single points of failure is likely to be cost prohibitive and provide minimal additional reliability. Designers must take care to provide an appropriate level of redundancy based on a proper assessment of the operational and economic implications of various failure scenarios.

11.3.2 Programming Logic

In the event that one or more EDS machines (depending on the size of the CBIS) experience equipment failure, the system should be programmed so that a certain percentage of bags can be diverted directly to ETD to avoid excessive dieback situations (where baggage is being gradually accumulated back to the take-away belts and the check-in ticket counters) and maintain throughput volumes during peak periods. The percentage of diverted bags depends on the overall processing capacity of the working EDS machines. When the BHS is able to monitor the bag input rate into the screening zone and ascertain that the maximum input rate does not exceed overall screening system capacity, bags can be diverted to the operational EDS machine(s). Designers should program the system to divert baggage as required to maintain throughput and avoid dieback

11.3.3 Out-of-Gauge Diverter—Bypass to ETD

The CBIS should be configured with a BMA that will identify baggage with dimensional characteristics (height, width, or length) that the screening equipment does not have the capability to accommodate. OOG baggage should be automatically diverted to ETD for manual screening. This conveyor line requires access to standby power to function during power outages.

In the event that conveying or screening equipment failures occur down-line of the OOG divert, the OOG diverter may be programmed to operate in a “limited operation” mode in which all baggage is conveyed directly to ETD for manual screening (this added functionality must be coordinated with local TSA to determine operations).

11.3.4 Provision for Manual Conveyance of Baggage

CBIS design should allow for a clear, securable path for manual conveyance of baggage to the manual screening area. Designs should provide for manual conveyance of bags from the ticket lobby to the screening area. As much as possible, designs should make use of dedicated conveyors (preferably with access to standby power), such as crossover conveyors and OOG conveyors. CBIS analysis and design must account for the likelihood of increased staffing levels (and the associated labor expense) necessary to maintain a system that lacks mechanical mitigation measures to accommodate equipment failures.

11.3.5 Emergency and Standby Power

If there is no access to standby power for manual screening (using ETD), baggage cannot be processed using conventional ETD screening protocols. The design team should consider, at a minimum, the provision of standby or emergency power to support full manual screening using ETD.

11.4 ALTERNATIVE TSA SCREENING MEASURES

While the design recommendations above can be used to reduce the operational and security impact of equipment failures, certain long-duration failures or failures that occur during peak periods may necessitate the application of alternative TSA screening measures. Planners should consult with TSA regarding the use of mutually agreeable alternative screening measures and document how such measures would be implemented if used as part of the contingency plan.

11.5 FAILURE TYPES AND MITIGATION MEASURES

This section describes baggage handling and screening equipment failures along with examples of potential mitigation strategies that could be used based on the duration of the failure.

Two principal factors cause the failure of CBIS—power failures produced by external events and conveying and/or screening equipment failures. For the purposes of contingency planning, the cause of a failure is of less importance than its duration. Failures can be classified based on their duration or based on the recovery period during peak times or non-peak times.

Mitigation measures are used to overcome various CBIS failures by the application of mechanical and/or manual methods (for example additional conveyers to allow appropriate transfer of baggage or backup power sources for BHS sections). In addition, as a last resort, alternative screening measures can be used with TSA approval to mitigate CBIS failures.

11.5.1 Short-Duration Failures

Short-duration failures (also referred to as non-critical failures) are failures lasting less than 10 minutes. Typically, during this class of failure, a CBIS cannot perform its function, but the failure can be cured without maintenance personnel being called. In the event of short-duration failures, airport and TSA protocols generally follow the logic that the CBIS will be returned to operation quickly.

Typical mitigation measures for short-duration failures include the following:

- **Freeze Situation until System Restarts**. In the event that the system could restart momentarily, cleared bags may remain in place, alarmed bags may remain in place (if the alarm status is positively maintained), and bags with unknown status are manually conveyed to the CBRA. Unscreened baggage would remain in place within the system. Checked baggage would be held for induction into the CBIS until after the system restarts.

- **Manual Conveyance**. In the event of uncertainty regarding short term re-start or when freezing the situation is not an option (e.g., if the failure occurs in the middle of a peak period), cleared bags may be manually conveyed to bag make-up. Alarmed bags, as well as bags with unknown status, are manually conveyed to the CBRA. Unscreened baggage would remain in place within the system. Checked baggage would be held for induction into the CBIS until after the system restarts.

11.5.2 Medium-Duration Failures

Medium-duration failures (also known as critical failures) are failures lasting longer than 10 minutes, but less than 2 hours. Typically, during this class of failure, critical components of a CBIS stop performing their function and maintenance personnel are necessary to fix these failed components. In the event of medium-duration failures, airport and TSA protocols will vary, depending on the availability of power.

Typical mitigation measures for medium-duration failures include the following:

- **Manual Conveyance.** When the BHS is not operational, cleared baggage is manually conveyed to bag make-up. Unscreened baggage, alarmed baggage, and baggage with unknown status is sent to another EDS machine in a separate CBIS (if possible) or manually conveyed to an area designated by TSA for manual and/or alternative screening.

- **Use of Dedicated Conveyors with Standby Power.** If a limited-operation conveyance system exists, it can be used to convey baggage to the CBRA and/or another area designated by TSA for manual screening (e.g., OOG conveyor(s) and oversize conveyor(s)). When the limited operation conveyor system is available (temporary power-loss for entire BHS, but limited system can run using a standby power source), cleared baggage will stay within the system (until system restart) or may be conveyed to bag make-up. Alarmed or unknown baggage may be conveyed to another EDS machine within a separate CBIS (if possible) or the CBRA. Unscreened baggage is conveyed to another EDS machine in a separate CBIS (if possible) or to an area designated by TSA for manual and/or alternative screening.

11.5.3 Long-Duration Failures

Long-duration failures (also referred to as catastrophic failures) are failures lasting longer than 2 hours. Typically, during this class of failure, the entire CBIS is inoperable due to power outages or major failures of critical components for an extended duration. Catastrophic failures may follow the same protocols described above for medium-duration failures. Alternate TSA screening protocols may be applied, as specified in the approved contingency plan.

Typically mitigation measures for long-duration failures are similar to those for medium-duration failures. If it is the policy of CBIS stakeholders that the airport operates during extended-duration power outages, then the design team should include in its design the provision of a limited operation conveyance system(s) with access to standby power. Power failures may also be mitigated by the use of standby power with the capacity to enable operation of the entire CBIS.

11.6 EVALUATION OF CONTINGENCY ALTERNATIVES

When evaluating mitigation measures, planners and designers should consider a broad continuum of solutions. Common critical failures of system components (e.g., EDS unit, vertical sorter, optical scanner) within the CBIS should be analyzed to inform the selection of appropriate contingency measures. Catastrophic failures, which may involve total system failures of any duration or a component failure of long duration, should also be considered.

11.6.1 General Principles for Evaluation

The tradeoffs between providing for mechanical versus manual mitigation measures should be based on the complexity of the screening systems and the demand placed on that system. For smaller screening matrices, manual conveyance of bags to another nearby screening system or to a TSA-designated screening area for manual and/or alternative screening processes is likely to be the most cost-effective option. For larger screening systems, mechanical measures are likely to be necessary to handle the high baggage volumes processed by the system. The exact measures implemented should be evaluated based on both operational and economic (life-cycle cost) considerations. In each case, the mutually developed and approved contingency plan shall list the range of mitigation measures and the conditions that trigger those measures.

11.6.2 Mini In-Line System Example

As an example of the tradeoffs and options that should be evaluated, consider a mini in-line system with two EDS machines. Critical failure of either EDS unit or the BHS may be dealt with by relatively low-cost manual processes. The failure of a single EDS machine, however, could be mitigated by manually carrying bags to the in-feed belt serving the remaining operational EDS machine. Additionally, unscreened bags may be sent directly to the CBRA via the OOG belt. In this manner, bags are screened by ETD, with the possibility that some level of mitigation may be applied.

Alternatively, the design and operation of the two EDS-unit system could incorporate an automated feature to convey bags to a single EDS machine in the event of a critical failure of the other EDS machine. Such a feature could be included by adding a dedicated cross-over conveyor line. In this type of application, unscreened bags are diverted away from the inoperable EDS machine and merge into the input line for the remaining EDS machine. During peak periods, a logjam could result if sufficient storage capacity is not provided by the CBIS. Depending on the baggage flow for the system, the marginal costs associated with this type of failure recovery mechanism may be high relative to the marginal benefits of the solution.

In the event that both EDS machines experience medium-duration failures simultaneously, diverting bags to the CBRA would be the most effective option. A long-duration failure of the entire CBIS would require yet another mitigation process, such as increasing the number of ETD screenings and the number of screening personnel in the lobby or bag rooms prior to bag make-up for individual flights.

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REFERENCES

The PGDS was developed with reference to several documents and models previously developed by TSA and its contractors, as discussed below:

1. *Recommended Security Guidelines for Airport Planning, Design and Construction*, Revised May 2011

   This revised document was issued by TSA in May 2011 and presents recommendations for incorporating sound security considerations into the planning, design, construction, and modification of security-related airport facilities and airport terminal buildings. It consolidates information developed through the participation of TSA and other government and aviation industry professionals. The Recommended Security Guidelines document is intended to help users ensure that security considerations and requirements are a component of the planning and design of airport infrastructure, facilities and operational elements. Intended users include aviation user-agencies (airport operators, aircraft operators and airport tenants), airport planners and consultants, designers, architects, and engineers engaged in renovation and new airport facility planning, design or construction projects.

2. *Integrated Deployment Model*

   As part of the BSIS, TSA also developed the Integrated Deployment Model, which is an economic model based on a life-cycle cost approach to screening system selection. The model is used to conduct a top-down evaluation of various schematic concepts of EDS screening systems, based on the methodologies outlined in this document. These schematic concepts take into account high-level spatial constraints at airport terminals and are optimally sized according to the estimated checked baggage demand. The concepts were then evaluated on the basis of the life-cycle costs of developing, maintaining, and replacing the EDS screening systems. Though schematic in nature, these concepts may serve as a useful starting point for any airport or airline that plans to implement a checked baggage screening system and would be made available upon request.

   The Integrated Deployment Model is a working model that will be continuously updated as new technologies are developed and performance characteristics are updated.

3. TSA's *Checked Baggage Inspection System Interface Requirements Document* (IRD) for BHS and In-Line Screening Device (ISD)

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Appendix A

SUBMITTAL OUTLINES, FORM TEMPLATES, AND EXAMPLES

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APPENDIX A: SUBMITTAL OUTLINES, FORM TEMPLATES, AND EXAMPLES

A.1 INTRODUCTION

This appendix provides the following:

A.2 Preliminary Alternatives Analysis Report—Sample Outline

A.3 Preferred Alternative(s) Analysis Report—Sample Outline

A.4 Basis of Design Report—Sample Outline

A.5 Baggage and Data Flow Charts—Generic Examples and Specific Examples for San Francisco and John F. Kennedy International Airports

A.6 Configuration Management Plan—Sample Outline

A.7 Daily CBIS Report Examples

A.8 Control Configuration Architecture Overview

A.9 Change Request Example

A.10 MIA CBIS PLC Code Change Propogal

A.11 Request for Planning Guidelines and Design Standards (PGDS) Variance Template

A.12 Industry Comment Template

Appendix C contains an example of a Basis of Design Report for Oakland International Airport.

A.2 PRELIMINARY ALTERNATIVES ANALYSIS REPORT—SAMPLE OUTLINE

The following is a sample outline for the Preliminary Alternatives Analysis Report, as introduced in Chapter 2, to be prepared in the Pre-Design Phase. This report will be incorporate in the Basis of Design Report, in the Schematic Design Phase. An example can be found in Appendix C.

1 Preliminary Alternatives Definition
2 Design Year Baggage Screening Demand Determination
  2.1 Base Year Assumptions
  2.2 Base Year Surged Average Day Peak Month (ADPM) Baggage Screening Demand Determination
    2.2.1 Base Year Peak Month Determination
    2.2.2 Base Year ADPM Determination
    2.2.3 Base Year ADPM Flight Schedule
    2.2.4 Base Year Surged Peak Hour ADPM Baggage Screening Demand Calculation
    2.2.5 Design Year Surged Peak Hour ADPM Baggage Screening Demand Calculation
3 Proposed System Types Selection
4 Qualitative Evaluation and Selection of Feasible Alternatives

A.3 PREFERRED ALTERNATIVES ANALYSIS REPORT—SAMPLE OUTLINE

The following is a sample outline for the Preferred Alternatives Analysis Report to be prepared in the Pre-Design Phase. The content of this report will be revisited and further expanded in the Basis of the Design Report in the Schematic Design Phase. An example can be found in Appendix C. A detailed explanation of the life cycle cost analysis can be found in Chapter 8.

1 Life-cycle Costs Estimation
- 1.1 Analysis Assumptions
- 1.2 Life Cycle Costs Calculation

2 Selection of the Preferred Alternative

A.4 BASIS OF DESIGN REPORT—SAMPLE OUTLINE

The following outline should be followed by designers when preparing the Basis of Design Report in the Schematic Design Phase.

1 Background

2 Executive Summary

3 CBIS Alternatives
- 3.1 Identification of Initial Alternatives
  - 3.1.1 Identification of Likely Screening Zones (Airline Grouping Assignments)
  - 3.2.2 Identification of Likely Screening System Types
- 3.2 Qualitative Assessment of Preliminary Alternatives (Identification of Feasible Alternatives)

4 Quantitative Assessment of Feasible Alternatives—Design Year Baggage Screening Demand for Each Feasible Alternative
- 4.1 Feasible Alternative 1
  - 4.1.1 Planning and Modeling Assumptions
    - 4.1.1.1 List of Airlines for Alternative 1 Screening Zone
    - 4.1.1.2 Average Day Peak Month (ADPM)
    - 4.1.1.3 Airline Flight Schedule
    - 4.1.1.4 Airline Load Factors
    - 4.1.1.5 Passenger Arrival Profiles
  - 4.1.2 Future Baggage Flow Projections
    - 4.1.2.1 Design Year (DBU plus 5 Years)
    - 4.1.2.2 Surged Flow
  - 4.1.3 EDS Equipment Identification.
    - 4.1.3.1 EDS Equipment Quantities
    - 4.1.3.2 EDS Equipment Redundancy.
    - 4.1.3.3 OSR Station Requirements.
    - 4.1.3.4 ETD Screening Station Requirements.
- 4.2 Feasible Alternative 2
  - 4.2.1 Planning and Modeling Assumptions
    - 4.2.1.1 List of Airlines for Alternative 2 Screening Zone
    - 4.2.1.2 Average Day Peak Month (ADPM)
    - 4.2.1.3 Airline Flight Schedule
    - 4.2.1.4 Airline Load Factors
    - 4.2.1.5 Passenger Arrival Profiles
  - 4.2.2 Future Baggage Flow Projections
    - 4.2.2.1 Design Year (DBUse plus 5 Years)
    - 4.2.2.2 Surged Flow
  - 4.2.3 EDS Equipment Identification.
    - 4.2.3.1 EDS Equipment Quantities
    - 4.2.3.2 EDS Equipment Redundancy.
    - 4.2.3.3 OSR Station Requirements.
    - 4.2.3.4 ETD Screening Station Requirements.

4.3 Feasible Alternative 3
- 4.3.1 Planning and Modeling Assumptions
  - 4.3.1.1 List of Airlines for Alternative 3 Screening Zone
  - 4.3.1.2 Average Day Peak Month (ADPM)
  - 4.3.1.3 Airline Flight Schedule
  - 4.3.1.4 Airline Load Factors
  - 4.3.1.5 Passenger Arrival Profiles
- 4.3.2 Future Baggage Flow Projections
  - 4.3.2.1 Design Year (DBU plus 5 Years)
  - 4.3.2.2 Surged Flow
- 4.3.3 EDS Equipment Identification.
  - 4.3.3.1 EDS Equipment Quantities
  - 4.3.3.2 EDS Equipment Redundancy.
  - 4.3.3.3 OSR Station Requirements.
  - 4.3.3.4 ETD Screening Station Requirements.

5 Preferred Alternatives Analysis (Life-Cycle Analysis)

5.1 Feasible Alternative 1
- 5.1.1 Analysis Assumptions
- 5.1.2 Considered Costs
  - 5.1.2.1 Capital costs
  - 5.1.2.2 Operations and Maintenance Costs
  - 5.1.2.3 Staffing Costs

5.2 Feasible Alternative 2
- 5.2.1 Analysis Assumptions
- 5.2.2 Considered Costs
  - 5.2.2.1 Capital costs
  - 5.2.2.2 Operations and Maintenance Costs
  - 5.2.2.3 Staffing Costs

5.3 Feasible Alternative 3
- 5.3.1 Analysis Assumptions
- 5.3.2 Considered Costs
  - 5.3.2.1 Capital costs
  - 5.3.2.2 Operations and Maintenance Costs
  - 5.3.2.3 Staffing Costs

5.4 Selection of Preferred Alternative

5.5 Preferred Alternative Description of System Operations

5.6 Preferred Alternative Phasing and Constructability Technical Memoranda

In addition, the following appendices should be included in the Basis of Design Report for the Preferred Alternative:

Appendix A: Documentation of Stakeholder Review and Approval
Appendix B: Probable Construction Cost and O&M Cost
Appendix C: Preliminary Project Schedule
Appendix D: Sheet Index of Preliminary Concept Plans

A.5 BAGGAGE AND DATA FLOW CHARTS—GENERIC EXAMPLES AND SPECIFIC EXAMPLES FOR SAN FRANCISCO AND JOHN F. KENNEDY INTERNATIONAL AIRPORTS

Figures A-1 to A-3 show generic examples of In-Line Screening Device (ISD)/BHS/CBRA data flows with no ATR, upstream ATR, and downstream ATR.

Figure A-4 shows the outbound baggage handling system flow chart for the International Terminal at San Francisco International Airport.

Figure A-5 shows the outbound baggage handling system flow chart for Terminal 8 at John F. Kennedy International Airport.

Figure A-1
DETAILED ISD/BHS/CBRA DATA FLOW – NO ATR

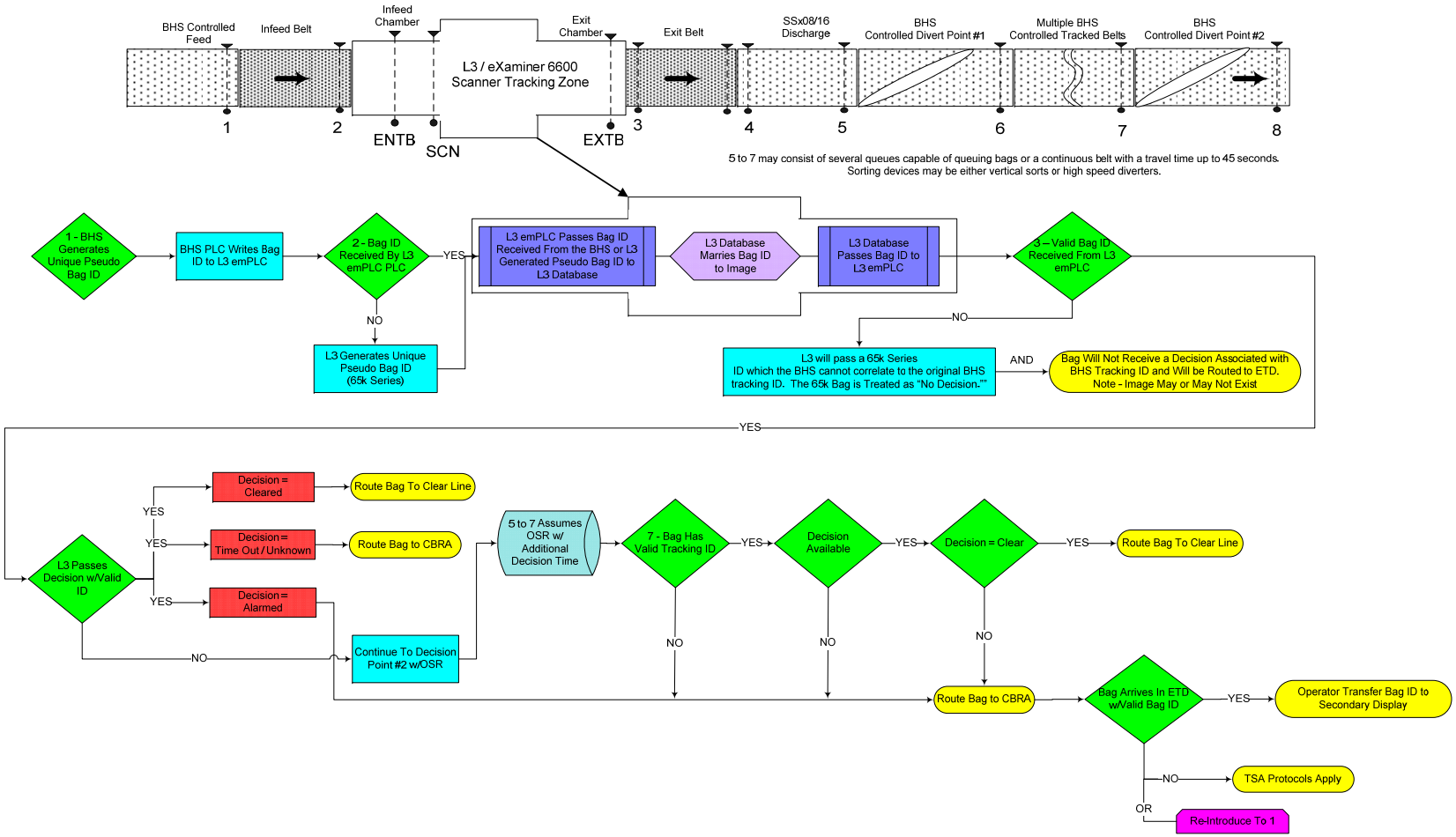


Figure A-2
DETAILED ISD/BHS/CBRA DATA FLOW – UPSTREAM ATR

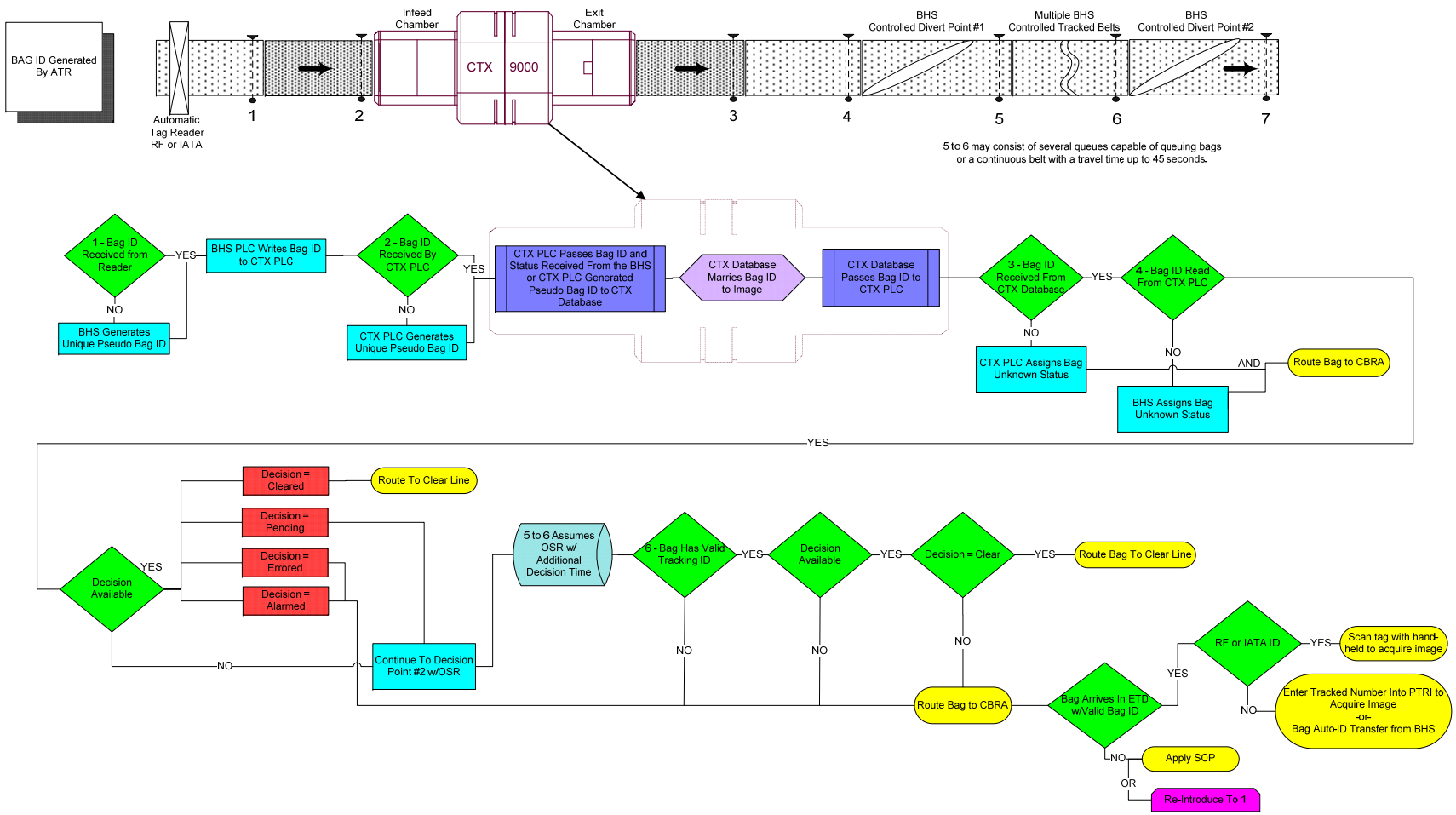


Figure A-3
DETAILED ISD/BHS/CBRA DATA FLOW – DOWNSTREAM ATR

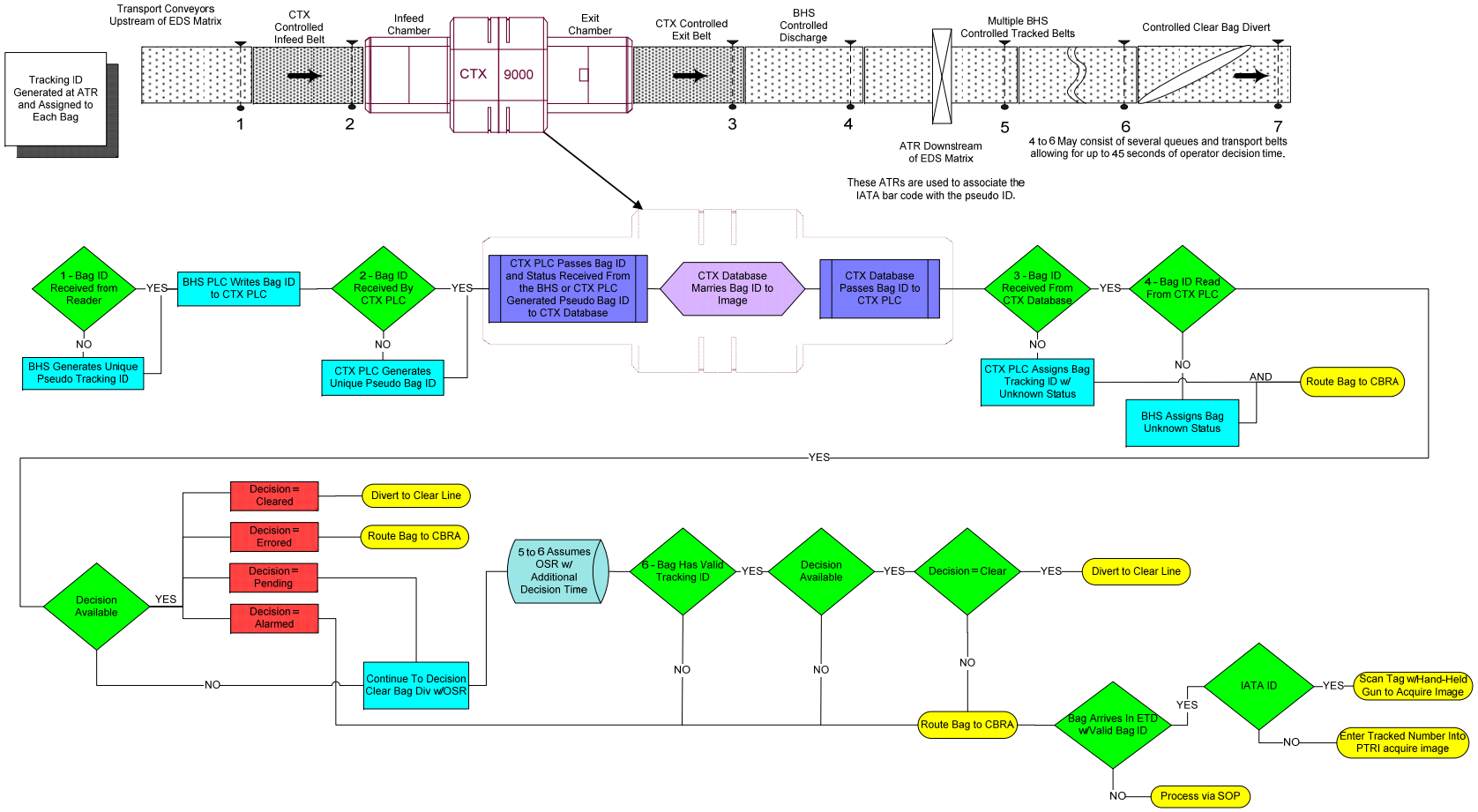


Figure A-4
OUTBOUND BHS, INTERNATIONAL TERMINAL, SAN FRANCISCO INTERNATIONAL AIRPORT

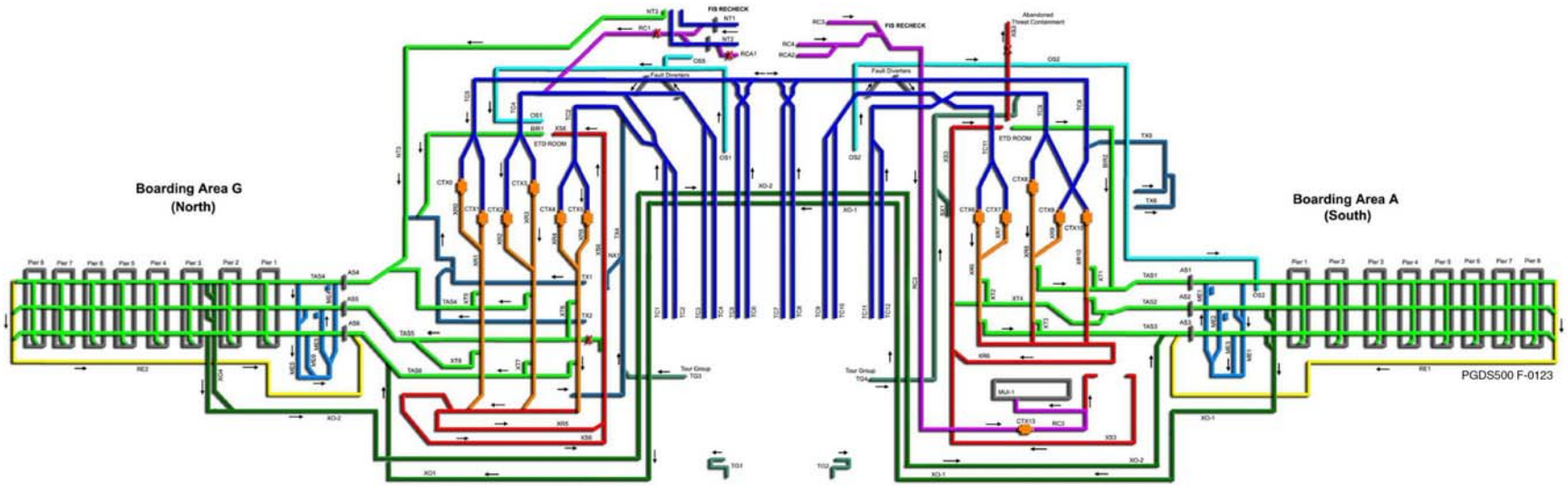
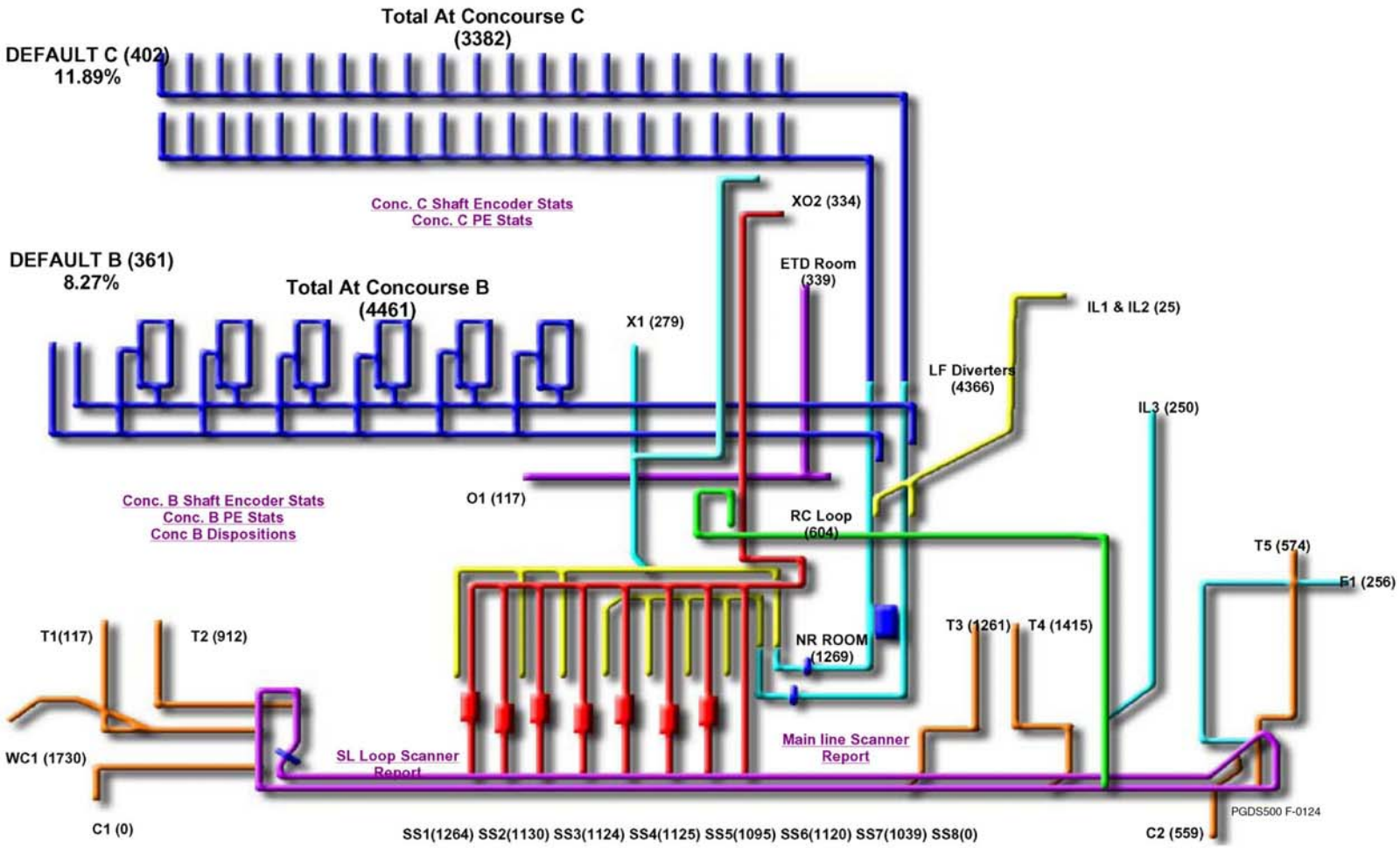


Figure A-5
OUTBOUND BHS, TERMINAL 8, JOHN F. KENNEDY INTERNATIONAL AIRPORT



A.6 CONFIGURATION MANAGEMENT PLAN—SAMPLE OUTLINE

A configuration management plan shall be submitted following the outline below:

1 Introduction
- 1.1 Background
- 1.2 Purpose
- 1.3 Configuration Management Defined

2 Organizational Construct – Configuration and Organization Integration Baseline
- 2.1 Airport roles and responsibilities
- 2.2 TSA roles and responsibilities
- 2.3 Airlines roles and responsibilities

3 Configuration Control: Management, Organization, and Responsibilities

4 Configuration Control Board
- 4.1 Purpose
- 4.2 Organization and membership
- 4.3 Change Request Process and Protocol
- 4.4 Communications Management Plan
  - 4.4.1 Post Commissioning Change Management
  - 4.4.2 Documentation and Audit

A.7 DAILY CBIS REPORT EXAMPLES

At a minimum, the following daily reports in the format shown in Tables A-1 to A-3 shall be provided to the local TSA representative:

1. Daily CBIS Summary Report (Table A-1)
2. Daily CBIS Bag Volume Report (Table A-2)
3. CBIS Executive Summary Report (Table A-3)
4. PEC Tracking Reports for all PECs within a tracking zone which include:
   - A Total Bag Count
   - B Total Missing Bag Count
   - C Total Unknown Bag Count
   - B Purged Bag

Table A-1
DAILY CBIS SUMMARY REPORT

Transportation Security Administration

Daily CBIS Summary Report	
Screening System Name	[Text]
Terminal	[Text]
Airport	[Text]

Report Type	Daily	**Report Run Date**	**[Date/time]**
From	[Date/time]		
To	[Date/time]		

Total CBIS Baggage Throughput	0 bags
Average Time Bag in CBIS	0.0 minutes

1 Bag Volume	**In-Gauge**	**Out-of-Gauge**	**Oversize**	**Total**
Number of bags	0	0	0	0
Percentage of Total Bag Volume	0.00%	0.00%	0.00%	0.00%

2 CBIS/BHS Faults/Events	**Number**	**Down Time**	**Average Time to Clear**
Faults	0	0:00:00	0:00:00
Lost in Track	0	0:00:00	0:00:00
Events	0	0:00:00	0:00:00
Jams	0	0:00:00	0:00:00
Fail Safe	0	0:00:00	0:00:00
Other	0	0:00:00	0:00:00
Total Faults/Events	0	0:00:00	0:00:00

3 Bag Time in CBIS (Minutes)	**Minimum**	**Maximum**	**Average**
	0.0	0.0	0.0

Table A-2
DAILY CBIS BAG VOLUME REPORT

Transportation Security Administration

Daily CBIS Bag Volume Report

Screening System Name	[Text]
Terminal	[Text]
Airport	[Text]

Report Type	Daily	**Report Run Date**	**[Date/time]**
From	[Date/time]		
To	[Date/time]		

1	**Input Conveyors**	**Number of Bags**	**Percentage**
	TC1	0	
	TC2	0	
	Subtotal	0	0.00%
	CS	0	
	Subtotal	0	0.00%
	MIC	0	
	Subtotal	0	0.00%
	OS	0	
	Subtotal	0	0.00%
	Total	0	
2	**Sizing**		
	In-Gauge	0	0.00%
	Out-of-Gauge	0	0.00%
	Oversize	0	0.00%
	Total	0	

Table A-3
CBIS EXECUTIVE SUMMARY REPORT

Transportation Security Administration

CBIS Executive Summary Report

Screening System Name	TSIF CBSS
Airport	TSA Systems Integration Facility
Terminal	N/A

Report Type	Daily	**Report Run Date**	**2009-01-08 13:45**
From	2009-01-08 04:00		
To	2009-01-08 22:00		

	Total	Machine Decisions					OSR Decisions					Bags Tracked	Tracking
EDS Machine	**Bags**	**Total**	**Cleared**	**% Clear**	**Alarmed**	**% Alarm**	**Total**	**Cleared**	**% Clear**	**Alarmed**	**% Alarm**	**To CBRA**	**Accuracy %**
EDS-ST1	2,056												99.85 %
EDS-ST2	6,228												100.00 %
EDS-ST3	6,302			SSI					SSI			SSI	99.94 %
EDS-ST4	6,285												99.95 %
EDS-ST5	6,283												100.00 %
Total	27,154												99.96 %

A.8 CONTROL CONFIGURATION ARCHITECTURE OVERVIEW

The TSA requires that all configuration information be submitted at various stages of the system life-cycle for each and every checked baggage inspection system (CBIS). The requirements of these submittals are contained herein.

A.8.1 Summary and Index

A.8.1.1 Summary

A descriptive summary narrative of the submittal shall be included in Microsoft Word and PDF format. Refer to Section A.8.10 for electronic file naming convention. This summary shall include, at a minimum, the following information:

- Airport name and area of the airport included in the submittal such as terminal, matrix, node, etc.
- Description of the included area including:
  - Number and type of EDS machines
  - type and quantity of infeed conveyor systems such as ticket counter sub-systems, curbside sub-systems, mainlines, etc
  - type and quantity of outfeed conveyor systems such as mainlines to sort piers, make-up units, etc
- Description of the conveyors / sub-systems and their controller equipment. At a minimum, the following information shall be provided:
  - List of each PLC and the conveyors / sub-systems it controls
  - List of each MCP and the conveyors / sub-systems it controls
- Contact information for:
  - Airport director, engineering manager or other primary contact point responsible for this CBIS
  - Airline(s) primary contact for this CBIS
  - Operation and/or maintenance contractor (if applicable) primary point of contact
  - Point of contact responsible for follow-up submittals.

A.8.1.2 Index

An index of the documents included in the submittal shall be included. This index shall be submitted in Microsoft Excel and PDF format. The index shall include, at a minimum, the title of each file, the file date and the electronic file name.

A.8.2 Control System Architecture Drawing

A control system architecture drawing shall be summated for each CBIS. This drawing shall be submitted in DXF and PDF format. All high and low level networks shall be included. Detail shall be down to the motor control panel (MCP) or PLC chassis level for high level networks; PEC and/or device for low level networks. Configuration information such as node numbers and IP addresses shall be included. Multiple drawings by different network types will be acceptable provided a high level overall drawing is provided. This information may be segregated by airport, terminal, matrix or other functional level to correspond with individual projects.

A.8.3 PLC Code and Associated Configuration Information

The low level, or PLC control, submission shall include the following at a minimum.

A.8.3.1 PLC Program

A copy of the PLC program shall be submitted in its native format for all PLCs included as a part of the CBIS. In the event multiple levels of PLCs are utilized all programs are to be included. This shall include any redundant PLCs that may exist. All software keys and or passwords shall be provided if programs are protected and or locked in some way.

A.8.3.2 Network Configuration

A copy of all network configuration files shall be submitted in its native format. This shall include any redundant networks that may exist.

A.8.3.3 VFD Configuration

A copy of the configuration of each VFD (including any firmware information) in the CBIS shall be submitted in both the native format. The configuration submittal shall include all parameters including unchanged or default settings.

A.8.3.4 Communication and Other Controllers

A copy of the configuration and/or code for all other devices as a part of the control system shall be submitted in both the native format. An example of these devices might be co-processors or multi vendor interfaces.

A.8.3.5 Firmware Configuration

A spreadsheet listing all control devices and their associated firmware levels, where firmware is used, shall be submitted. This spreadsheet shall be submitted as both a Microsoft Excel document and as a PDF file. All devices which have firmware shall be included. Examples of these devices are PLC chassis, PLCs, I/O modules, Network modules, Communication modules and VFDs.

A.8.4 HMI Configuration

A copy of all HMI configurations shall be submitted in their native format. Examples of these HMIs are control room graphical display systems, operator interface panels, bag display monitors or any other computer or dedicated display modules. Refer to Section A8.6 for configuration software requirements.

Soft copies of these programs shall also be proved including any portion which is required to operate the system. This includes applications such as those residing in touch screens or other types of dedicated displays or interfaces.

A.8.5 High Level Computer Configuration

A descriptive narrative of the high level computer equipment of the CBIS shall be submitted in Microsoft Word and PDF format. Included in the narrative shall be a description of each computer and the function/task of the computer. Any data exchange between any computer and/or PLC that controls or affects bag decisions shall be included. In addition, the narrative shall describe the results of any computer failure and the ability of the CBIS to continue screening baggage.

A.8.6 Programming and Configuration Software

A spreadsheet listing all programming and configuration software with the revision level used shall be submitted. This spreadsheet shall be submitted as both a Microsoft Excel document and as a PDF file. Examples of this software are PLC programming software, network configuration software, HMI configuration software and multi vendor interface programming / configuration software.

A.8.7 CBIS/ISAT Benchmark Data

A descriptive summary narrative of the system status at time of submittal shall be included in Microsoft Word and PDF format. This summary shall include, at a minimum, the following information:

- Scan time for each PLC, average and maximum
- Memory utilization for each PLC
- Network utilization for each network, high and low level networks. Where deterministic networks with set update times are used provide all settings and times.

A.8.8 Submittal Requirements

The submittal data described herein shall be submitted to the TSA as follows:

A.8.8.1 30-Day Post DBU Submission

Within 30 days following DBU the initial submittal, as defined in Section 2.2.6, shall be made.

A.8.8.2 Submission Procedure

Submission of all data shall be coordinated with the FSD or his designee. All data shall be submitted via electronic files – paper copies will not be accepted.

A.8.8.3 System Change Submission

When any change is required (i.e., program, configuration, firmware, etc.) and implemented on the CBIS post-ISAT (note: all changes made post-ISAT must adhere to the procedures outlined in Section 8 and 9 below), all affected data shall be updated and submitted within 5 business days of live operation. All updated data shall be presented as described in this document and submitted to the TSA.

A.8.9 Electronic File Naming Convention

The electronic file names shall conform to the following convention:

ABC_XXXX_LOCATION_MMDDYYYY_TYPE_DESCRIPTION.EXT

Where:

- ABC is the FAA airport identifier
- XXXX is the IATA airport identifier
- LOCATION is a unique description of the project location such as T1, NODE1, etc.
- MMDDYYYY is the file date represented as month, day, and year utilizing leading zeroes where applicable
- TYPE is the file type as follows:
  - NARR is a narrative
  - PLC is a PLC program
  - NET is a network configuration
  - DWG is a drawing
  - VFD is a VFD configuration
  - IDX is an index
  - HMI is an HMI configuration
  - LIST is a spreadsheet list
  - FIRM is a firmware listing
- DESCRIPTION is a free text field to describe the file contents
- EXT is the file extension

A.8.10 System Change Implementation and Test Data

A descriptive summary narrative of the procedures and protocols in place to implement, test, and document changes made to the CBIS post-ISAT. This shall include the following at a minimum:

- Change request proposal
- Change request log
- TSA approval
- Testing procedures
- Notification to all stakeholders
- Test Results Submittal

A.8.10.1 Change Request Proposal

Any changes made to the CBIS post-ISAT must be approved by the TSA prior to implementation. A change request log detailing the proposed change(s) shall be included in the change request submittal.

A.8.10.2 Change Request Log

A log of each change made to the CBIS post-ISAT shall be maintained. This log shall be included in the change request submittal for TSA approval. The log shall include the following data at a minimum:

- CBIS designation
- Name of person(s) implementing the change
- Description of change
  - Reason for the change (i.e., problem being resolved)
  - Expected resolution
- Identification / Location of the change
  - Name of device (e.g., PLC-1, HM1-1, SC-1, etc.)
  - Name of program / subprogram
  - Location in the program / subprogram (e.g., rung 1, line 1, etc.)
- Test Methodology
  - Description of test
  - Expected results

A.8.10.3 TSA Approval

In response to the change request submittal, the TSA will provide direction on the request. The proposed change shall only be implemented for testing and live operations if and only if approved by the TSA. The testing results shall be submitted to the TSA within 5 business days upon the completion of testing.

A.8.10.4 Testing Procedures

Testing procedures shall be developed and followed during any BHS testing on the CBIS post-ISAT. At a minimum, the procedures shall include:

- Available times for testing
- Contingency plan
- Documentation
- Definition of testing process
  - Software download / upload
  - Hardware modification / restoration
  - Wiring modification / restoration
- Notification to all stakeholders
  - Testing Period
  - Live Operations

A.8.10.5 Test Results

Empirical data shall be recorded during testing. A summary of the data shall be provide explaining how the collected data met (or not meet) the expected results.

A.8.11 Change Summary Log

A log of all changes made to the CBIS post-ISAT shall be maintained. The log shall be an itemized list of all the implemented and pending changes to date. This log shall be included in all submittals after its creation. The log shall include the following data at a minimum:

- CBIS designation
- Name of Change
- Description of change
- Status of change (i.e., in testing, operational, pending, etc.)
- Date of TSA approval
- Date of live operational use

A.9 CHANGE REQUEST EXAMPLE

A change request can be submitted for the following changes:

- Mechanical and electrical drawings
- PLC program pre-change
- PLC program post-change
- Configuration management process
- Testing procedures

- Mitigation/recovery/contingency plan
- Schedule
- Expected results

PLC or computer code changes to the CBIS are defined as:

- Any change that may affect any portion of the system throughput either feeding into or out of the CBIS
- Any change that may affect bag presentation to the EDS units (e.g., merges upstream too close causing double bags to enter)
- Any change to the EDS interface or to how the BHS handles the bag IDs and decisions
- Any change to the CBIS tracking model (i.e., shaft encoding pulses, merges downstream allowing one bag to encroach into another bags tracking window)
- Any changes to the bag allocation method
- Any change of any type from the exit of the EDS unit to the last clear bag divert point
- Any change of any type after the last chance divert point into the CBRA including the CBRA

The request for changes shall be submitted to OST engineering at baseteam@dhs.gov.

The following is an example of a Change Request document provided by Siemens. Designers and should follow the same outline when they submit a design change request.

A.9.1 Introduction

The purpose of this document is to describe the changes of the PLC code to be reviewed and approved by TSA or authorized agent.

A.9.2 Proposed Change Description

A.9.2.1 Purging of the Reconciliation Lookup Table for IR Bag

A.9.2.1.1 Detected Problem

When bag arrives to CBRA with Unknown status it can be reintroduced in the system through RI line. At the RI IATA Bag Tag is scanned using hand scanner or entered using station display. Once scanned, the bag is tracked to EDS2 line and handled just like a new bag introduced at the ticket counter and scanned by ATR.

BHS includes reconciliation scanner ATR SB1. The purpose of this scanner is to reconcile bags with the EDS decision when bag is lost between exit of EDS and ATR SB1.

Because of the reconciliation process special attention has to be paid to the reinserted bags that screened twice. Procedure has to include provisions to prevent conditions when on the first pass bag is cleared, on the second pass is alarmed, lost in tracking downstream from the EDS and reconciled to the first clear decision. Algorithm of the current program handles this issue correctly. However, in order to completely avoid possibility of the manual intervention in the reconciliation process, additional safeguards are introduced.

A.9.2.1.2 Corrective Action

IATA Bag Tag of the re-inducted bag will be purged from the reconciliation table in order to guarantee that the bag will never reconcile with data from the first screening process.

Procedure was added to re-induct functionality (FC98, Network 69) to search through the look up table and delete the record created by the first screening.

A.9.2.1.3 Testing Procedure

In order to validate the requested change the following test procedures will be performed:

1. Introduce a suspect bag upstream of ATR EDS2
2. Clear bag status from OSR after 10 sec to make sure that bag is routed to SB line
3. Delay bag at SB1-07 just after ATR SB1 to create loss of tracking
4. Re-induct bag from RI1-01
5. Verify that bag is Alarmed by EDS
6. Delay bag on SB1-02 to create loss of tracking
7. Verify that bag is reconciled on ATR SB1 to the Alarmed status and routed to CBRA

A.9.2.2 Adjustment of Tracking Parameters for SS3

A.9.2.2.1 Detected problem

During high volume baseline test bag ID exchange was detected on SS3-01. After analysis of the Bag History Report and CCTV recording it was determined that main reason was insufficient gap between bags created at the Ticket Counter merge leading to bag collisions.

Merge window parameters were adjusted and additional gapping introduced on the queue conveyors just downstream of the merge TC1-TC4.

A.9.2.2.2 Corrective Actions

In addition to already mentioned changes measures following adjustment are proposed:

1. Increase Run Time delay on EDS1-08 to allow downstream conveyors to clear before restarting EDS line and minimize possible tracking losses
2. Decrease Missing bag detection timer to improve tracking loss detection

A.9.2.2.3 Testing Procedure

Perform Added Bag Test on Zone 1A and 1B for the SS3 line.

Added bag test shall be performed according to SSTP procedures.

A.9.3 EDS1-08 Stops When SS2 is Unavailable

A.9.3.1 Detected Problem

South Security Matrix consists of three lines SS1 – SS3. When SS2 becomes unavailable it also stops conveyor feeding all three lines - EDS1-08, even if SS3 is still available. A_Takeaway_Running parameter defines the name of the downstream conveyor in straight direction that needs to available for EDS1-08 to run. Parameter review showed that it was set to incorrect value.

A.9.3.2 Corrective Action

A_Takeaway_Running parameter needs to point to a conveyor downstream from EDS1_08. Replace the Current A_Takeaway_Running with the true A destination SS3_01.Running Forward. This will ensure that EDS1-08 will continue to run as long as SS3 is available.

A.9.3.3 Testing Procedure

1. Disable the SS2 line.
2. Place HSD-SS2 is in Automatic mode.

Expected Result: EDS1-08 to continue to run until SS3 become full.

A.9.4 CBIS Change Request Form

The following is the CBIS Change Request Form.

CBIS CHANGE REQUEST FORM

This form is only used to request changes to a CBIS after it has been determined ready for TSA acceptance testing. Upon completion of this form, it should be submitted to the TSA designated agent for distribution and review.				
TRR ☐	**iSAT** ☐		**Post Com.** ☐	
Airport Code:		**Bag Room / CBIS / Terminal**		
Requested By:	**Name:**		**Company:**	
	Phone:		**Email:**	
BHS Installer / Maintenance	**Name:**		**Company:**	
	Phone:		**Email:**	
BHS Controls Support:	**Name:**		**Company:**	
	Phone:		**Email:**	
Date of Request:				
Type of Integration:	Fully ☐	Semi ☐	Mini ☐	Other ☐
Affected Area	STZ ☐	Non-STZ ☐	Pre-EDS ☐	Post-EDS ☐ CBRA ☐
Change Description				
Detected Problem:				
Proposed Corretive Action/Change:				
Describe Testing to verify Change:				
Implementation Time (man hrs)				
Disposition	By:	Approved ☐	Rejected ☐	Deferred ☐

A.10 MIA CBIS PLC CODE CHANGE PROPOSAL

The following section showing an example of a Siemens CBIS Change Request Form has been reproduced and reformatted with permission.

A.10.1 Introduction

A.10.1.1 Contributors

Name/Function	Company	Department
Dave Suarez	Siemens	Controls Lead
Keith Oliver	Siemens	SR. System Engineer
Ramdas Kulal	Siemens	Controls Engineer
Rodney Maynard	Siemens	SR. System Engineer

A.10.1.2 Purpose

The purpose of this document is to submit change request to TSA to modify locked down MIA PLC code for items found during pre-ISAT, ISAT, final system testing, or by new change orders issued to Siemens. This document includes changes to all screening matrixes contained within the MIA BHS system. The content of this document include changes that are needed to correct issues and to add functionality that is required per the contract for the MIA BHS system. These change requests are the result of punch list items or observed conditions that are not functionally correct or base scope requirements of the contract. The Additional Faults for the T1, T2 and T3 Doors is scope that has been added to Siemens via change order to allow the airport to meet security requirements needed prior to live operations.

A.10.2 Remove Bit from X5 Door Clear Fault Logic

A.10.2.1 Area controlled by Change Requested PLC

PLC	MCP	CONV	Area Controlled
32	MCP-14	X5-1, X5-2	East Matrix/Central Matrix

A.10.2.2 Executive Summary of Changed Impact

Effect on SSTP tested Area	None
Effect on Tracking in the SSTP Tested Area	None
Effected PLC	PLC-32
Tested with Battelle (with current code)	Yes

A.10.2.3 Problem Detected

The door clear fault does not come on until the discharge conveyor of X5-2 is running which is down stream of the door X5-1.

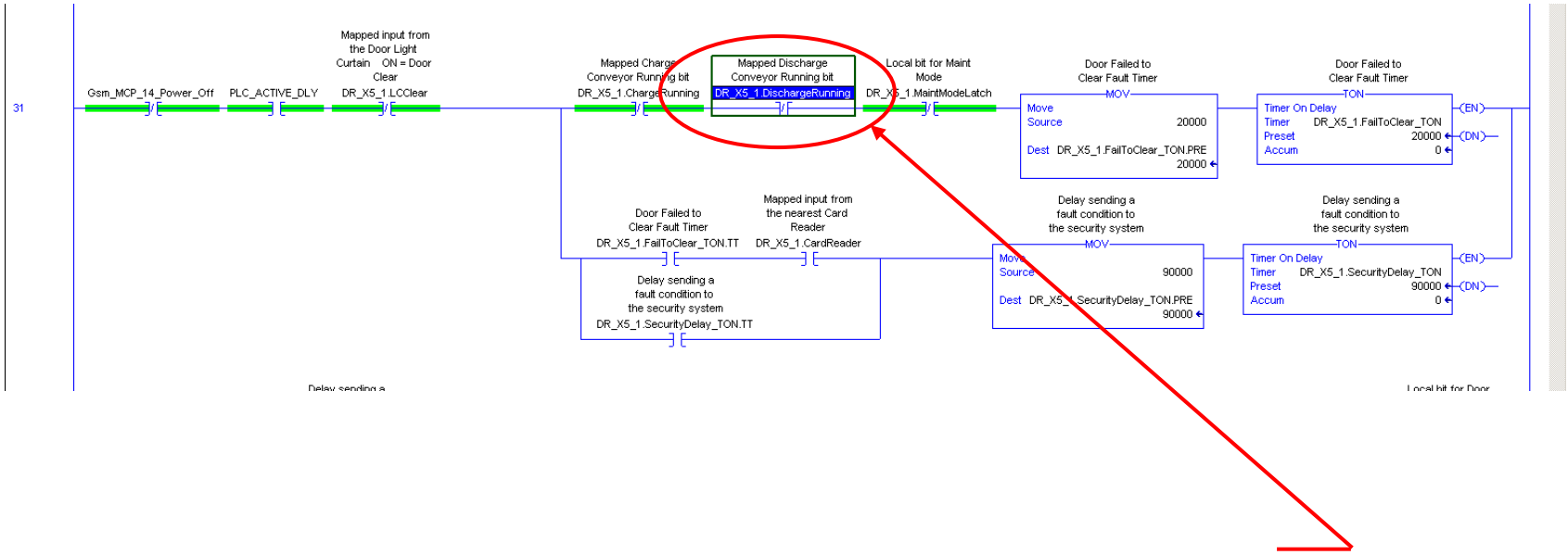
A.10.2.4 Corrective Action

The contact of “DR_X5_1.DischargeRunning” needs to be removed from the logic for the door clear fault.

Note: All A & B PLC’s will need to be updated with the same changes.

A.10.2.5 Current PLC Code

The screen shot below shows the PLC code in its current configuration in Routine “MCP_14_X5_Door” rung 31.



A10.2.6 Proposed Change

The contact of "DR_X5_1.DischargeRunning" needs to be removed from the logic for the door clear fault.

A.10.3 Remove Temporary Logic from the C1 Door

A.10.3.1 Area controlled by Change Requested PLC

PLC	MCP	CONV	Area Controlled
19	MCP-92	C1 Door Logic	East Matrix/Central Matrix

A.10.3.2 Executive Summary of Changed Impact

Effect on SSTP tested Area	None
Effect on Tracking in the SSTP Tested Area	None
Effected PLC	PLC-19
Tested with Battelle (with current code)	Yes

A.10.3.3 Problem Detected

Temporary bit signal disables the proper functionality of the door for the door faults. This bit was used for the testing and was never removed.

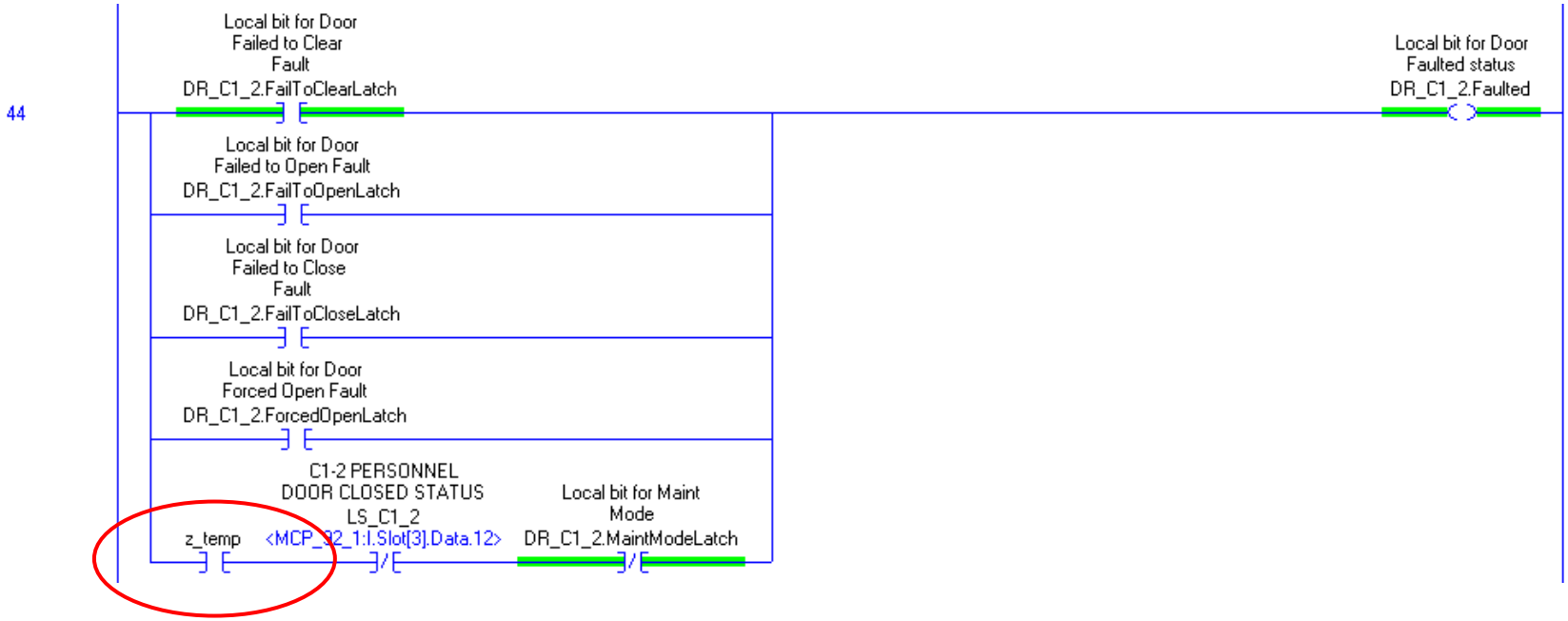
A.10.3.4 Corrective Action

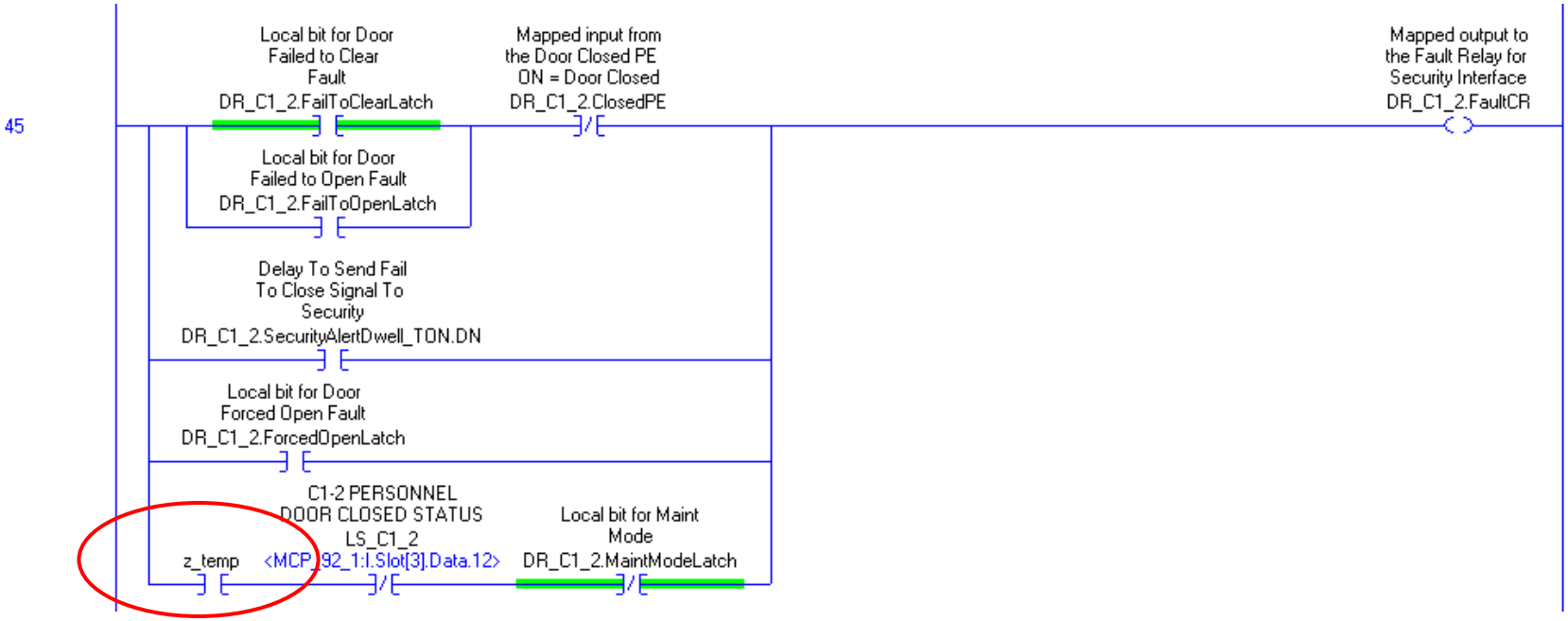
Remove the “Z_temp” signal bit from the logic for the door fault. No other graphics changes required, as well this change is not going to affect the tracking in this PLC.

Note: All A & B PLC’s will need to be updated with the same changes.

A.10.3.5 Current PLC Code

The screen shot below shows the PLC code in its current configuration in Routine “MCP_92_C1_2_Door” rung 44 and 45.





A.10.3.6 Proposed Change

Remove the “Z_temp” bit from both rungs 44 and 45.

A.10.4 Remove AFI from T5 Door Logic

A.10.4.1 Area controlled by Change Requested PLC

PLC	MCP	CONV	Area Controlled
40	MCP-21	T5-4	East Matrix/Central Matrix

A.10.4.2 Executive Summary of Changed Impact

Effect on SSTP tested Area	Yes
Effect on Tracking in the SSTP Tested Area	No
Effected PLC	PLC-40
Tested with Battelle (with current code)	Yes

A.10.4.3 Problem Detected

The T5-4 door failed to open fault did not work during testing with MDAD and it was found that the fault had been disabled with an AFI in the logic.

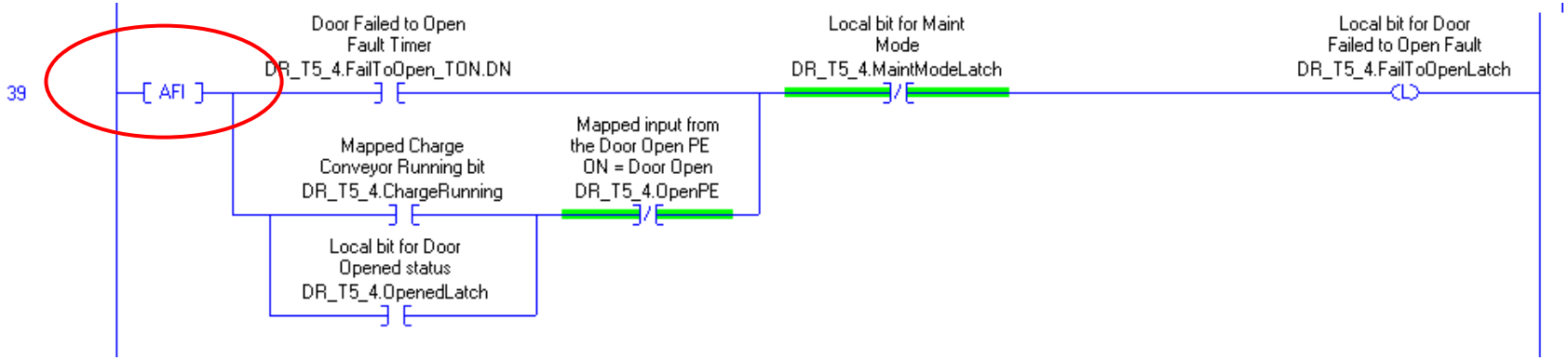
A.10.4.4 Corrective Action

Remove the AFI in the PLC logic. No other graphics changes required, as well this change is not going to affect the tracking in this PLC.

Note: All A & B PLC's will need to be updated with the same changes.

A.10.4.5 Current PLC Code

The screen shot below shows the PLC code in its current configuration in Routine "MCP_21_T5_4_Door" rung 39.



A.10.4.6 Proposed Change

Remove the "AFI" from rung 39.

A.10.5 Change First Scan Delay Timer Preset

A.10.5.1 Area Controlled by Change Requested PLC

PLC	MCP	CONV	Area Controlled
PLC-32B, PLC-11B, PLC-13B, PLC-19B, PLC-22B, PLC-24B, PLC-27B, PLC-28B, PLC-33B, PLC-34B, PLC-37B, PLC-38B, PLC-39B, PLC-40B, PLC-42B, PLC43B, PLC-44B, PLC-45B	NA	NA	East Matrix/ Central Matrix/West Matrix/Cruise Matrix

A.10.5.2 Executive Summary of Changed Impact

Effect on SSTP tested Area	Yes
Effect on Tracking in the SSTP Tested Area	No
Effected PLC	PLC-32B, PLC-11B, PLC-13B, PLC-19B, PLC-22B, PLC-24B, PLC-27B, PLC-28B, PLC-33B, PLC-34B, PLC-37B, PLC-38B, PLC-39B, PLC-40B, PLC-42B, PLC43B, PLC-44B, PLC-45B
Tested with Battelle (with current code)	Yes

A.10.5.3 Problem Detected

The PLC pairs have a minor issue during the process of synchronizing the PLC's. The B set of all PLC's are to be set .5 seconds longer on the First_Scan_Delay Timer so that the A PLC will always become the active primary.

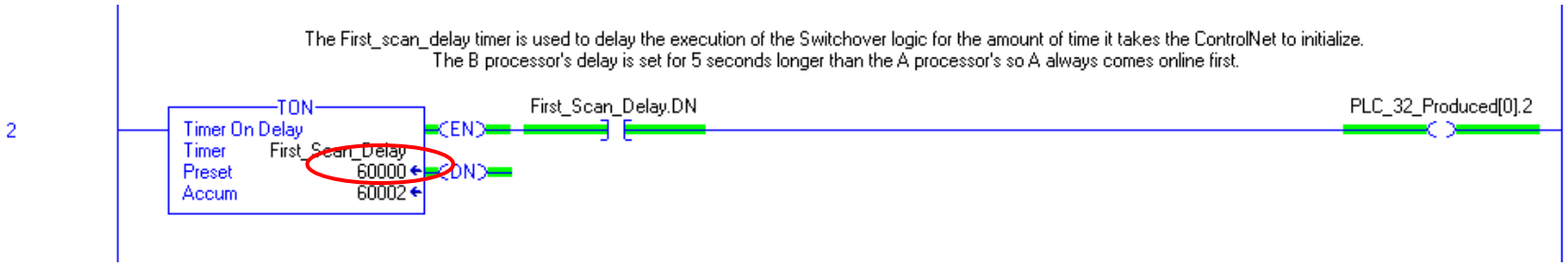
A.10.5.4 Corrective Action

Change the preset of the First_Scan_Delay Timer from 60000 to 65000 (6 seconds to 6.5 seconds).

Note: All A & B PLC's will need to be updated with the same changes.

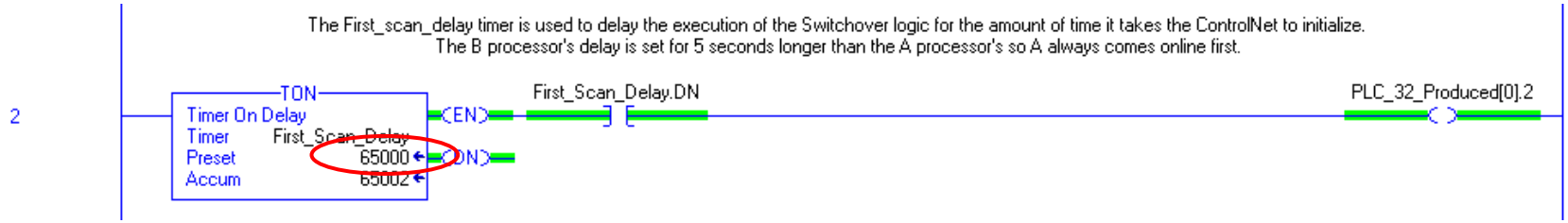
A.10.5.5 Current PLC Code

The screen shot below shows the PLC code in its current configuration in Routine "Switch_Over_Logic" rung 2.



A.10.5.6 Proposed Change

Changed timer preset to 65000.



A.10.6 Add Additional Faults for the T1, T2 and T3 Doors

A.10.6.1 Area controlled by Change Requested PLC

PLC	MCP	CONV	Area Controlled
19	108, 3, 4	T1, T2, and T3 door	East Matrix Central Matrix

A.10.6.2 Executive Summary of Changed Impact

Effect on SSTP tested Area	Yes
Effect on Tracking in the SSTP Tested Area	No
Effected PLC	PLC-19
Tested with Battelle (with current code)	Yes

A.10.6.3 Problem Detected

The fire doors of T1, T2, and T3 are existing doors and do not have the functionality required to support live operations. Under a change order issued by MDAD to Siemens the door faults “Failed to Clear” and “Forced Open” are to be added.

A.10.6.4 Corrective Action

Add the logic for the door faults of “Failed to Clear” and “Forced Open.”

Note: All A & B PLC’s will need to be updated with the same changes.

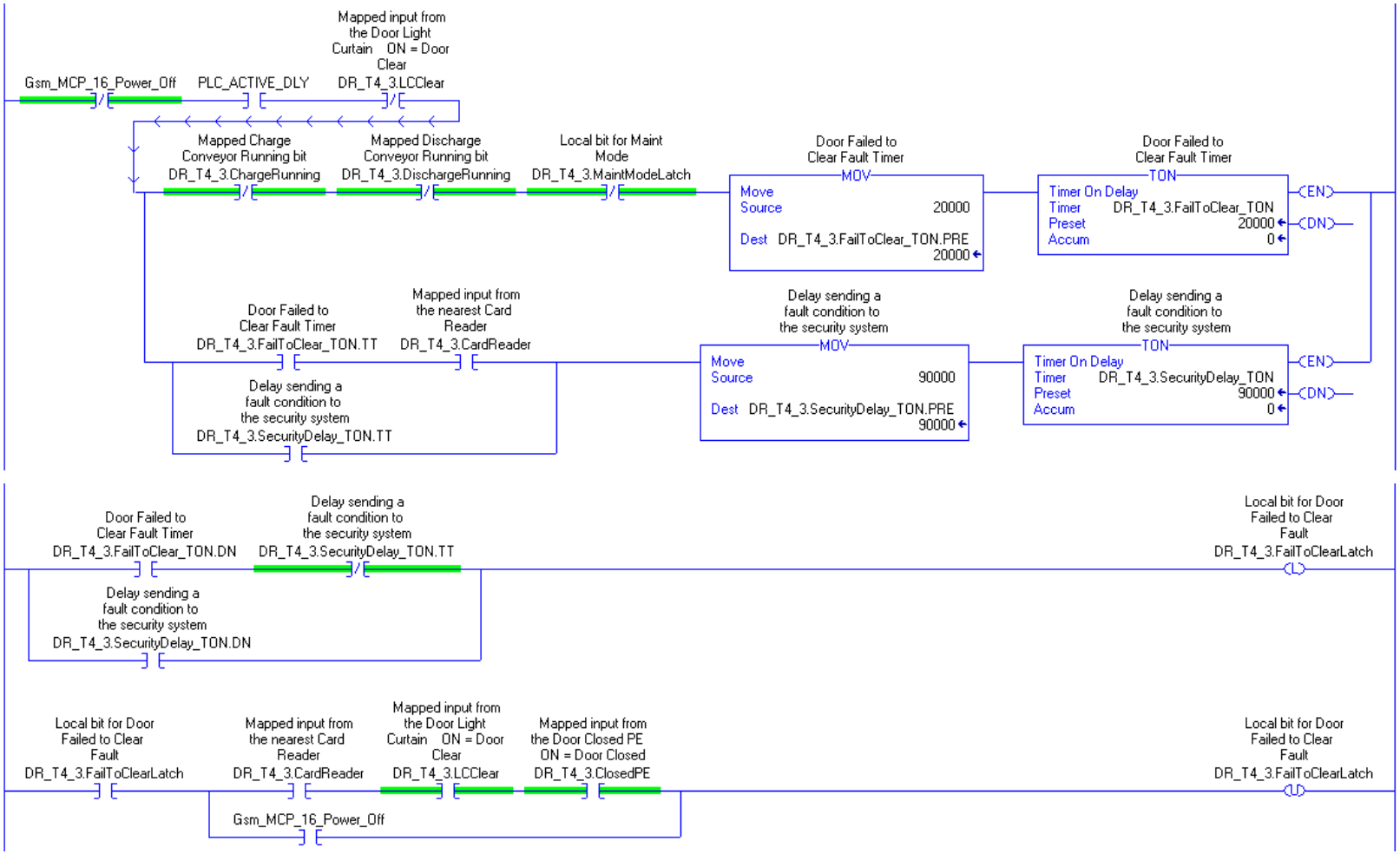
A.10.6.5 Current PLC Code

Current PLC code for these faults do not exist for these doors and will have to be added. Logic from other doors such as T4 will be used to create the logic for these new faults. Section A.10.6.6 represents the changes that will be required and is used as an example for the logic to be implemented.

A.10.6.6 Proposed Change

The below screen shots are from PLC 32 T4-3 door logic and represents the logic that will be used to implement the new faults that will be used on the T1, T2, and T3 doors.

Door Failed to clear logic.

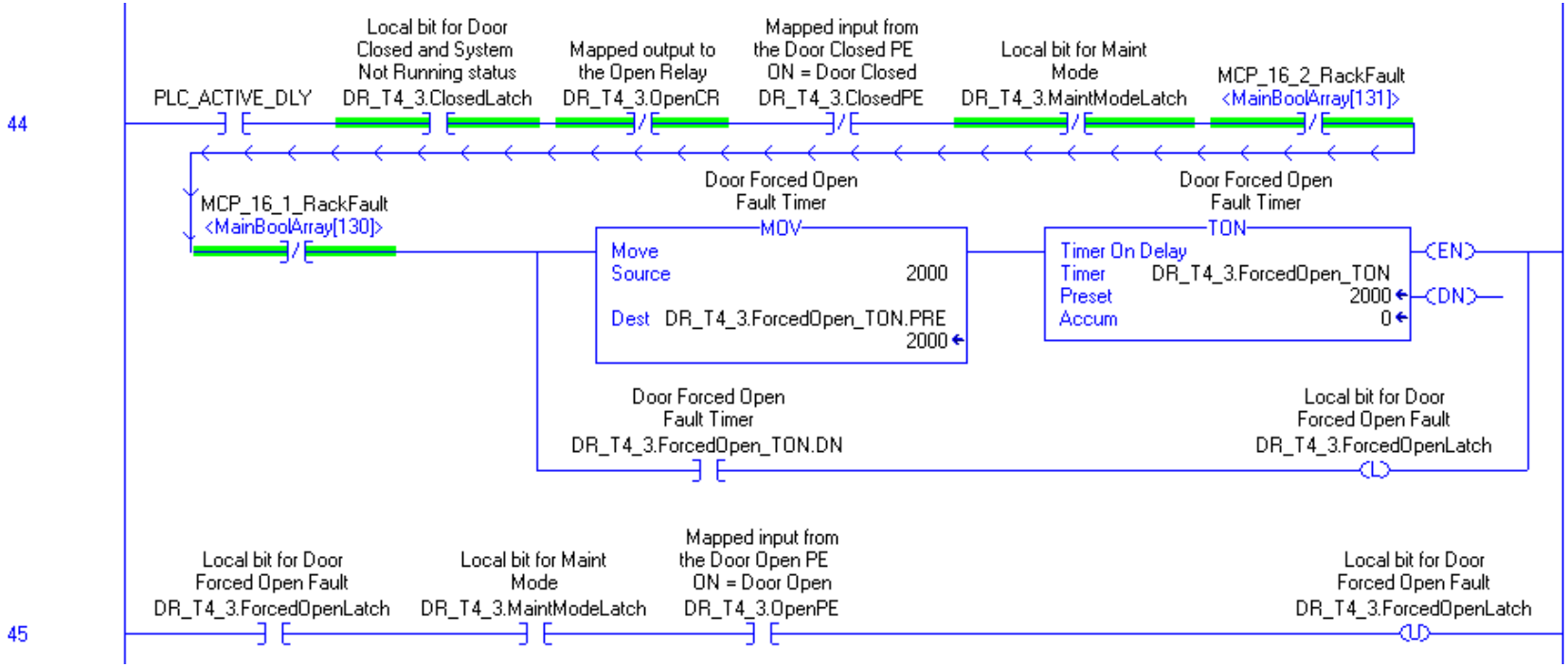


The Failed to clear latch is used in multiple places in the program and the screen shot below represents all locations.

Name: DR_T4_3.FailToClearLatch Refresh

Element	Container	Routine	Location	Reference	BaseTag	Destructive	Description
OTL	MainProgram	MCP_16_T4_3_Door	Rung 35	DR_T4_3.FailToClearLatch		Y	Local bit for Door Failed to Clear Fault
OTU	MainProgram	MCP_16_T4_3_Door	Rung 36	DR_T4_3.FailToClearLatch		Y	Local bit for Door Failed to Clear Fault
XIC	MainProgram	MCP_16_T4_3_Door	Rung 36	DR_T4_3.FailToClearLatch		N	Local bit for Door Failed to Clear Fault
XIC	MainProgram	MCP_16_T4_3_Door	Rung 46	DR_T4_3.FailToClearLatch		N	Local bit for Door Failed to Clear Fault
XIC	MainProgram	MCP_16_T4_3_Door	Rung 47	DR_T4_3.FailToClearLatch		N	Local bit for Door Failed to Clear Fault
XIC	MainProgram	MCP_16_T4_3_Door	Rung 50	DR_T4_3.FailToClearLatch		N	Local bit for Door Failed to Clear Fault
OTE	Software_Redundancy	Sync_Status	Rung 236	DR_T4_3.FailToClearLatch		Y	Local bit for Door Failed to Clear Fault
XIC	Software_Redundancy	Write_Status	Rung 236	DR_T4_3.FailToClearLatch		N	Local bit for Door Failed to Clear Fault

Door Forced Open logic.



Forced Open latch is used in multiple places in the program and the screen below shot represents all locations.

Name: DR_T4_3.ForcedOpenLatch Refresh

Element	Container	Routine	Location	Reference	BaseTag	Destructive	Description
OTL	MainProgram	MCP_16_T4_3_Door	Rung 44	DR_T4_3.ForcedOpenLatch		Y	Local bit for Door Forced Open Fault
OTU	MainProgram	MCP_16_T4_3_Door	Rung 45	DR_T4_3.ForcedOpenLatch		Y	Local bit for Door Forced Open Fault
XIC	MainProgram	MCP_16_T4_3_Door	Rung 45	DR_T4_3.ForcedOpenLatch		N	Local bit for Door Forced Open Fault
XIC	MainProgram	MCP_16_T4_3_Door	Rung 46	DR_T4_3.ForcedOpenLatch		N	Local bit for Door Forced Open Fault
XIC	MainProgram	MCP_16_T4_3_Door	Rung 47	DR_T4_3.ForcedOpenLatch		N	Local bit for Door Forced Open Fault
XIC	MainProgram	MCP_16_T4_3_Door	Rung 50	DR_T4_3.ForcedOpenLatch		N	Local bit for Door Forced Open Fault
OTE	Software_Redundancy	Sync_Status	Rung 239	DR_T4_3.ForcedOpenLatch		Y	Local bit for Door Forced Open Fault
XIC	Software_Redundancy	Write_Status	Rung 239	DR_T4_3.ForcedOpenLatch		N	Local bit for Door Forced Open Fault

A.10.7 VFD Faults Using MCP Power Off Bit

A.10.7.1 Area controlled by Change Requested PLC

PLC	MCP	CONV	Area Controlled
All Security Line PLC's 27, 28, 35, 36, 37, 39, 45	NA	All Security Lines	East Matrix Central Matrix

A.10.7.2 Executive Summary of Changed Impact

Effect on SSTP tested Area	Yes
Effect on Tracking in the SSTP Tested Area	No
Effected PLC	All Security Line PLC's, 27, 28, 35, 36, 37, 39, 45
Tested with Battelle (with current code)	Yes

A.10.7.3 Problem Detected

During system testing it was observed that an intermittent issue would occur with the VFD operated conveyors that they would become idle and upstream conveyors would cascade and no fault would be present on the graphics. During the commissioning of the system an issue occurred that when the MCP was powered off that contained VFD's all the faults for the VFD's would be displayed on the graphics. A rung was created to prevent this however if there is a fault on the C-Net card of the VFD the graphics will not display the fault. Normally the Comm Ok bit would be used in parallel with the MCP Power Off bit so that if the C-Net card of the VFD faulted without a VFD fault it would still be indicated on the graphics as a VFD fault. A separate change order has been submitted to MDAD to add C-Net node faults to the graphics.

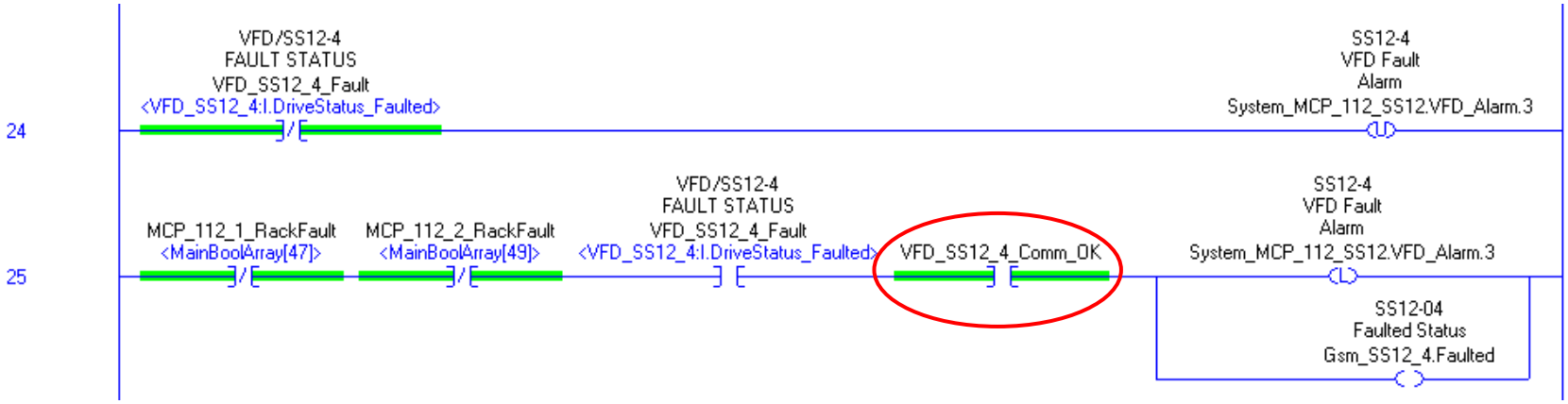
A.10.7.4 Corrective Action

The VFD_xxx_Comm_OK bit should be replaced with the MCP Power Off bit. The MCP Power Off logic was added later to the PLC's to indicate the loss of control power within each MCP. The corresponding MCP bit should be used with the corresponding VFD's.

Note: All A & B PLC's will need to be updated with the same changes.

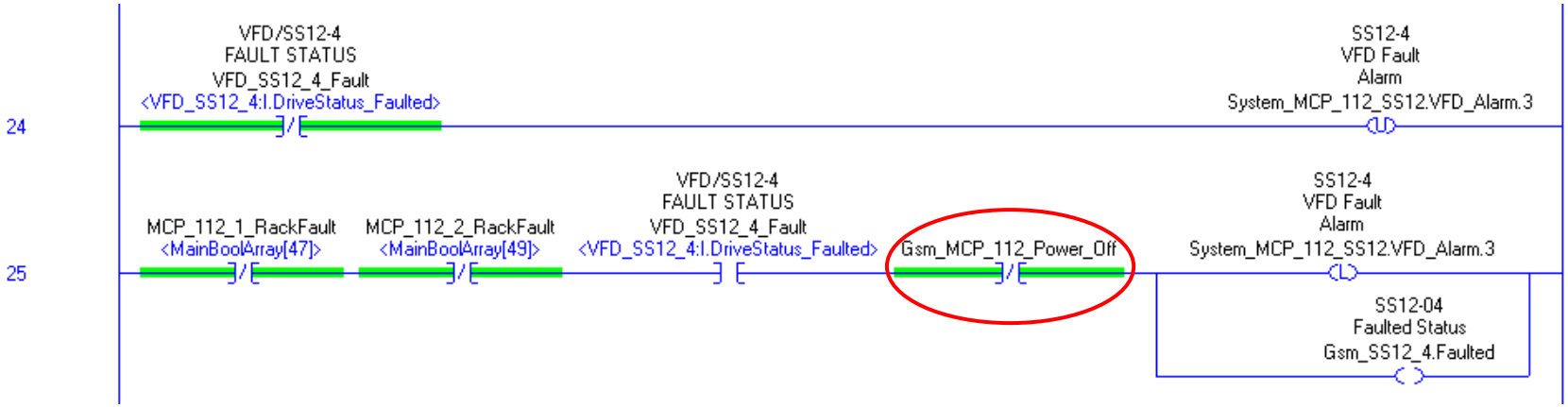
A.10.7.5 Current PLC Code

All faulted logic for the VFD's is the same in all matrix PLC's so only one is used in this example. The below screen shot is for the VFD fault on SS12-4.



A.10.7.6 Proposed Change

The below screen shot is the example for the VFD fault of SS12-4 using the MCP-112 Power Off bit. Using this instead of the Comm Ok bit will prevent the fault from showing on the graphics if the MCP is powered off but allow the fault if the C-Net card of the VFD is faulted.



A.11 REQUEST FOR PGDS VARIANCE TEMPLATE

Transportation Security Administration

PGDS Request For Variance

The PGDS Request for Variance (PRFV) form is used by the CBIS ILDT to request a variance from the requirements set forth in the PGDS. The RFV is used prior to TSA's Acceptance Testing, and should be submitted to the TSA Regional Deployment Manger (RDM) for review and acceptance.

RFV #:
SUBJECT:

FROM:
ADDRESS:

TO:
ADDRESS:

PGDS REFERENCE: _____
MOA/LOI/OTA NO.: _____

AIRPORT CODE: _____
CB PROJECT NO: _____

ATTACHED DWG's: Yes ☐ No ☐
DWG LISTING:

OTHER DOCUMENTS ATTACHED: Yes ☐ No ☐
OTHER DOCUMENTS LISTING:

REQUESTED VARIANCE:

PROPOSED METHOD FOR MEETING PGDS PERFORMANCE REQUIREMENT:

REQUESTOR:
PRINT NAME: _____
SIGNATURE: _____

DATE REQUEST SUBMITTED: _____

TSA RESPONSE TO VARIANCE:

RFV #:

Accepted ☐ Rejected ☐

PRINT NAME: _____
SIGNATURE: _____

DATE RESPONSED: _____

Cc:

A.12 INDUSTRY COMMENT TEMPLATE

The TSA Office of Security Technology (OST) will be the recipient of all comments regarding proposed updates to the PGDS. All comments must be received by December 31 of the next calendar year to be considered as part of the next update to the PGDS. All comments will be reviewed and considered in a timely manner. The TSA values comments and input from industry stakeholders, but only those comments and input determined to enhance and improve the PGDS will be incorporated in the next release of the PGDS. An example of the standard form for comments is provided in Appendix A.

Comments should be submitted to the pgds@dhs.gov mailbox, through the comment form at the following address: http://www.tsa.gov/assets/xls/pgds_comment_form.xls.

Section	Paragraph No.	Page No.	Comment	Rationale	Suggest Revision	Submitter Name

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Appendix B

GENERIC EXAMPLES OF CHECKED BAGGAGE INSPECTION SYSTEMS

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APPENDIX B: GENERIC EXAMPLES OF CHECKED BAGGAGE INSPECTION SYSTEMS

This appendix provides generic examples of various design concepts of checked baggage inspection systems (CBISs), relevant operational assumptions for those examples, and specific best practices related to the CBIS examples to supplement the information contained in Chapter 7 of the Planning Guidelines and Development Standards (PGDS).

The high-level generic examples (i.e., examples that are not highly detailed, but rather convey a conceptual screening system) are provided to assist planners at the Pre-Design Phase of CBIS design with the development of conceptual alternatives. The examples are not site-specific and should not be used as is. These examples are intended to serve as a starting point for planners to provide ideas on different concepts of CBISs, some of the pros and cons of each concept, and some of the best practices that relate to specific CBIS design concepts. When developing design concepts, planners should consider local operational and spatial conditions, which are likely to significantly influence the actual CBIS design concepts developed.

The following generic examples of CBIS concepts are presented in this appendix:

- Three variations of linear CBIS design concepts (A, B, C)
- One decentralized CBIS design concept (D)
- Three variations of mini in-line CBIS design concepts (E, F, G)

B.1 METHODOLOGY FOR DEVELOPING GENERIC EXAMPLES

Most of the following generic CBIS examples were developed and evaluated using high-volume explosives detection system (EDS) machines as the basis of design (although some were designed for low- and medium-speed EDS machines more suitable for mini in-line CBIS concepts). For most examples, a medium-speed EDS machine can be considered as an alternate to the high-speed EDS machine in applications where anticipated throughput does not justify the need for a high-speed EDS machine. Higher throughput could be accomplished in most cases by a relatively simple substitution of the EDS machines, without otherwise changing the layout of the main EDS processing system (i.e., changing baggage handling system [BHS] conveyors in the immediate vicinity of the EDS machines, and checked baggage resolution area [CBRA] conveyors), and without requiring changes to ticketing/curbside belts and bag makeup/sortation conveyors.

In some examples, other minor layout revisions may be required to provide a better match between BHS conveying capacity and EDS design throughput, but these revisions are unlikely to have much effect on BHS capital costs or building area requirements. Planners should consider such modifications when developing specific CBIS design concepts. The substitution of a high-speed EDS machine with a medium-speed EDS machine will likely result in revised values for on-screen resolution (OSR) and explosives trace detection (ETD) screener staffing requirements and for the associated equipment/space requirements for this equipment and personnel.

A useful strategy may be to design a system based initially on the use of medium-speed EDS machines and subsequent replacement by high-speed EDS machines as demand increases. This strategy would provide a convenient method of achieving a 35% to 40% increase in system throughput capacity without requiring significant revisions to the main EDS and BHS layout (other than EDS machine substitution and additional ticketing and makeup capacity, as required).

The following assumptions were the basis for developing the generic CBIS examples:

- A separate line is used for oversized (OS) bags. These bags are too large to be loaded on the ticketing/curbside belts

(e.g., surfboards, skis, and golf clubs) and are screened using ETD for primary screening.

- A bypass belt is used (except in low capacity applications) to divert out-of-gauge (OOG) bags that will not fit the aperture dimensions of the EDS tunnel. The diverter directs OOG bags directly to the CBRA, bypassing the EDS machines.
- A minimum of 45 seconds is provided after the bag has been screened by an EDS machine for OSR processing in high-throughput and medium-throughput CBIS designs. Low throughput systems will be required to have at least 30 seconds of OSR time.
- Chapter 3 provides screening throughputs for EDS and ETD machines.
- All main lines delivering bags to or taking bags away from a group of EDS machines are assumed to be capable of feeding the CBIS at the minimum rate of the total screening capacity of the nonredundant combined EDS matrix.

B.2 GENERIC EXAMPLES OF LINEAR CBIS DESIGN CONCEPTS

Linear CBIS design concepts typically have a relatively straight forward linear conveyor system transporting baggage from ticketing/curbside take-away belts to the screening zones and from the screening zones to the CBRA zone(s) and bag makeup device(s).

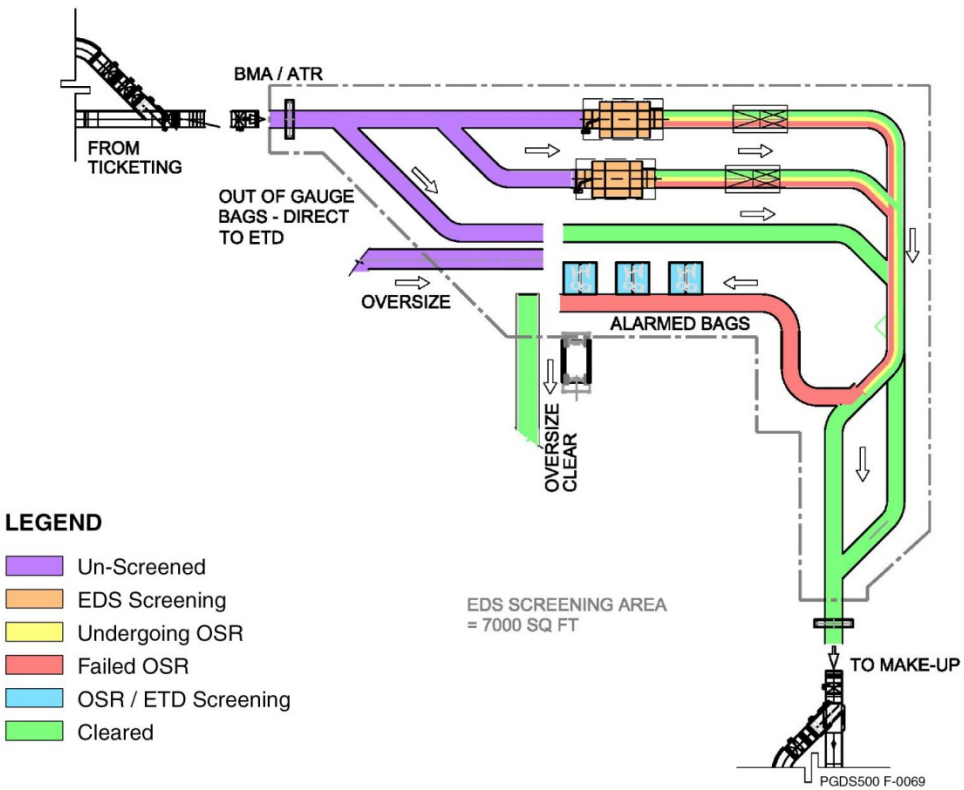
Three variations of linear CBIS design concepts are described below:

- **Linear CBIS Design Concept A**—Baggage is transferred from ticketing on a single conveyor to the EDS, and vertical sorters or 45-degree diverters separate clear/alarmed bags soon after the bags exit the EDS machines.
- **Linear CBIS Design Concept B**—Similar to design Concept A, but intended to handle a higher volume of bags transferred from the induction lines.
- **Linear CBIS Design Concept C**—Similar to design Concept B, but provides even higher capacity with triple induction conveyors and triple conveyors leading from the screening zone to the bag makeup area.

B.2.1 Example of Linear CBIS Design Concept A

A conceptual layout of linear CBIS design Concept A is shown on Figure B-1 on the following page.

Figure B-1
LINEAR CBIS DESIGN CONCEPT A



B.2.1.1 Description of Linear CBIS Design Concept A

Ticketing/curbside take-away belts are merged into a single main line conveyor belt leading to the security screening and bag makeup area. A baggage measurement array (BMA) is used to identify OOG bags that exceed the available cross-sectional area that can be accommodated by the EDS machines. OOG bags are diverted to a conveyor leading directly to the CBRA for manual inspection and clearance. All other bags proceed to a diverter that allocates bag flow between the two EDS machines. After screening by EDS equipment, bags proceed to a vertisorter (a 45-degree diverter with parallel conveyors could also be configured) where alarmed bags are diverted to an accumulation conveyor, pending OSR inspection by Transportation Security Administration (TSA) personnel.

Bags that are cleared by the EDS machines are immediately segregated from alarmed bags and proceed directly to a single main line delivery conveyor leading to the baggage makeup area. There is a subsequent merge point for bags cleared by OSR or ETD. Upon reaching the end of the OSR conveyor, bags that have been cleared by TSA personnel are diverted (vertisorter or 45-degree diverter) to a cleared bag belt, which, in turn, merges with the main line delivery conveyor leading to the baggage makeup area, as described above. Bags that are not cleared by TSA personnel (including bags for which no clearance decision has been reached by the time the bag reaches the decision point) will default to the CBRA for manual inspection.

Positive bag tracking controls are used to monitor the locations of all bags processed by the EDS machines and to enable EDS images of screened bags sent to the CBRA to be accessed by TSA screening/search personnel. EDS images are transferred to the corresponding ETD inspection position to assist with directed ETD screening of the bag. Bags that are cleared after ETD screening/search are loaded onto a return conveyor, which merges with the main line delivery conveyor leading to the bag makeup area. Any “threat” bags identified during the ETD screening/search process are loaded to a threat containment unit (TCU) for removal to a secure area for processing or are handled according to other procedures defined by local law enforcement.

Design Concept A can be simplified by not separating cleared and alarmed bags (as predicated on the expected baggage flow) prior to the OSR decision point. This approach would be advantageous for smaller spaces. After screening by the two EDS machines, all bags are merged onto a main line conveyor. Bags not cleared by the EDS machines are inspected by TSA personnel using OSR protocols. Those bags that have initially been cleared by EDS machines or cleared by TSA OSR personnel continue on the main line conveyor leading to the bag makeup area. Bags that are not cleared by TSA personnel (including OSR bags for which no clear decision has been reached by the time the bag reaches the decision point) are diverted off of the main line conveyor and delivered to the CBRA for manual inspection. ETD screening/search is carried out as in Concept A, above.

B.2.1.2 Evaluation of Linear CBIS Design Concept A

This design concept is well suited for a moderately sized application. However, the concept may involve a high cost for EDS machines because a backup machine may be necessary to maintain operations in the event of machine failure, resulting in average machine utilization of about 50% during peak period operations when both machines are operational. An alternative solution would be to design the CBRA so that bags could be accumulated in that area and then screened using ETD equipment at the CBRA. CBRA space and equipment requirements should be identified in light of the agreed-upon contingency plan developed by the Integrated Local Design Team (ILDT) (see Chapter 11). Separation of alarmed and cleared bags immediately downstream of the EDS machines minimizes the risk of bag mistracking by diverting the majority of bags to an untracked conveyor environment, but involves some system complexity (programmable logic controller [PLC] programming due to a larger tracking zone) and cost.

B.2.2 Example of Linear CBIS Design Concept B

The conceptual layout of linear CBIS design Concept B is shown on Figure B-2.

B.2.2.1 Description of Linear CBIS Design Concept B

Ticketing/curbside take-away belts are merged into a single main line conveyor belt leading to the security screening and bag makeup area. A BMA is used to identify OOG bags that exceed the available cross-sectional area that can be accommodated by the EDS machines. The OOG bags are diverted directly to a conveyor leading to the CBRA for manual inspection and clearance. All other bags proceed to a diverter zone, typically consisting of three 45-degree diverters, which divide bag flow among four EDS machines. After EDS screening, bags proceed to a vertisorter (a 45-degree diverter with parallel conveyors could also be configured), where alarmed bags are diverted and then merged onto an accumulation (OSR) conveyor pending OSR screener decision.

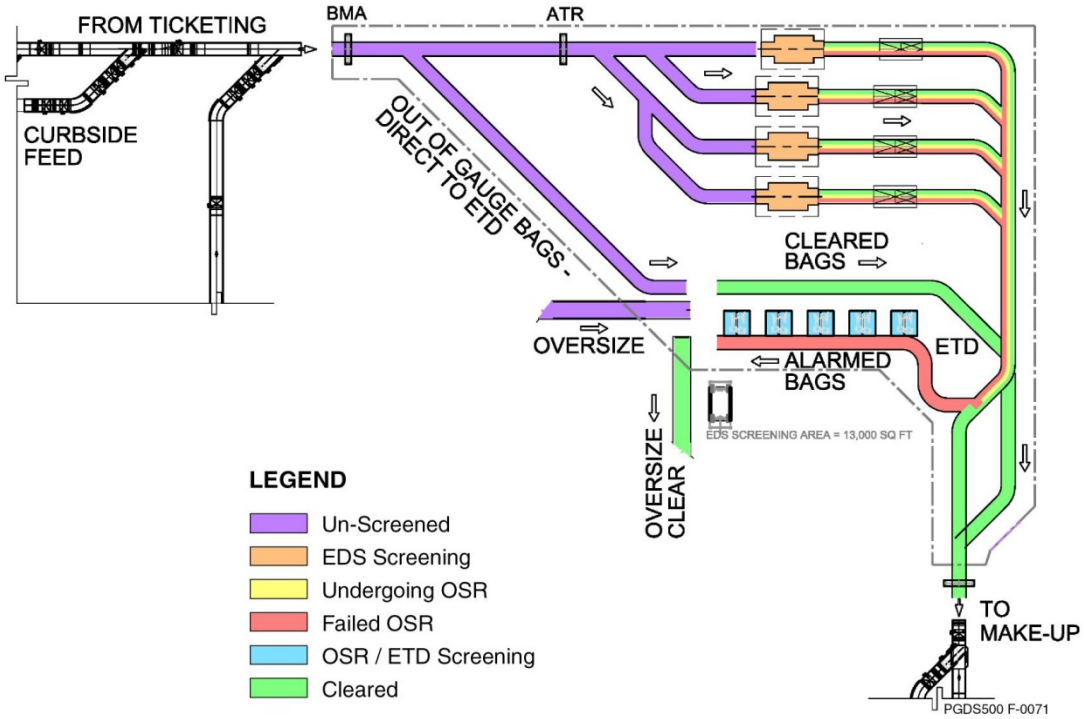
Bags cleared by the EDS machines proceed directly and merge onto a single main line conveyor leading to the bag makeup area to be discharged to a sort system. Upon reaching the end of the OSR accumulation conveyor, bags that have been cleared by TSA personnel are diverted (vertisorter or 45-degree diverter) to a cleared bag belt, which, in turn, merges with the cleared bag main line conveyor leading to the bag makeup area.

Bags that are not cleared by TSA personnel (including bags for which no clearance decision has been reached by the time the bag reaches the decision point) default to the CBRA for manual inspection. Positive belt tracking controls are used to monitor the location of all bags processed by the EDS machines and to enable images of screened bags sent to the CBRA to be accessed by TSA screening/search personnel to assist with directed ETD screening of the bag. Bags cleared after ETD screening/search are manually transferred onto a return conveyor, which merges with the cleared bag main line conveyor leading to the bag makeup area. Any “threat” bags identified during the CBRA process are loaded to a TCU for removal to a secure area for processing or are handled according to other procedures defined by local law enforcement.

In most systems with this throughput capacity, the cleared bag main line conveyor leading to the bag makeup area leads to a separate sortation area, where bags are typically distributed among a number of makeup loops or piers for final sort to individual flights. This process usually requires an automatic tag reader (ATR) and manual encode spur upstream of the makeup loops or piers. Sortation to individual loops or piers is typically via vertisorters or 45-degree diverters, as appropriate. The sortation component of the BHS is not included in this analysis.

A similar design concept to Concept B with improved system capacity is provided by the use of dual main line conveyors delivering bags between ticketing/curbside and EDS machines, and dual cleared main line conveyors delivering bags between EDS machines and the baggage makeup/sortation area.

Figure B-2
LINEAR CBIS DESIGN CONCEPT B



B.2.2.2 Evaluation of Linear CBIS Design Concept B

The use of multiple EDS machines increases the average peak period use of each machine (compared with Concept A) from about 50% to about 75%, as redundant screening equipment represents a smaller percentage of the system. However, the baggage conveying systems serving the EDS machines in this concept are more complex and costly. Linear CBIS design Concept B depends on a single main line conveyor feeding bags to the EDS machine array and a single main line conveyor feeding bags to the makeup/sort area. The bag throughput rate on these single conveyors is also relatively high during peak periods. This concept generally requires a separate sortation system downstream of the EDS/ETD screening area to sort bags by flight or by airline.

As with linear CBIS design Concept A, the design for Concept B maintains the separation of cleared/alarmed bags; Concept B potentially has higher reliability compared with Concept A because the additional conveyors leading to a higher number of EDS machines can compensate for an EDS machine failure.

B.2.3 Example of Linear CBIS Design Concept C

The conceptual layout of linear CBIS design Concept C is shown on Figure B-3.

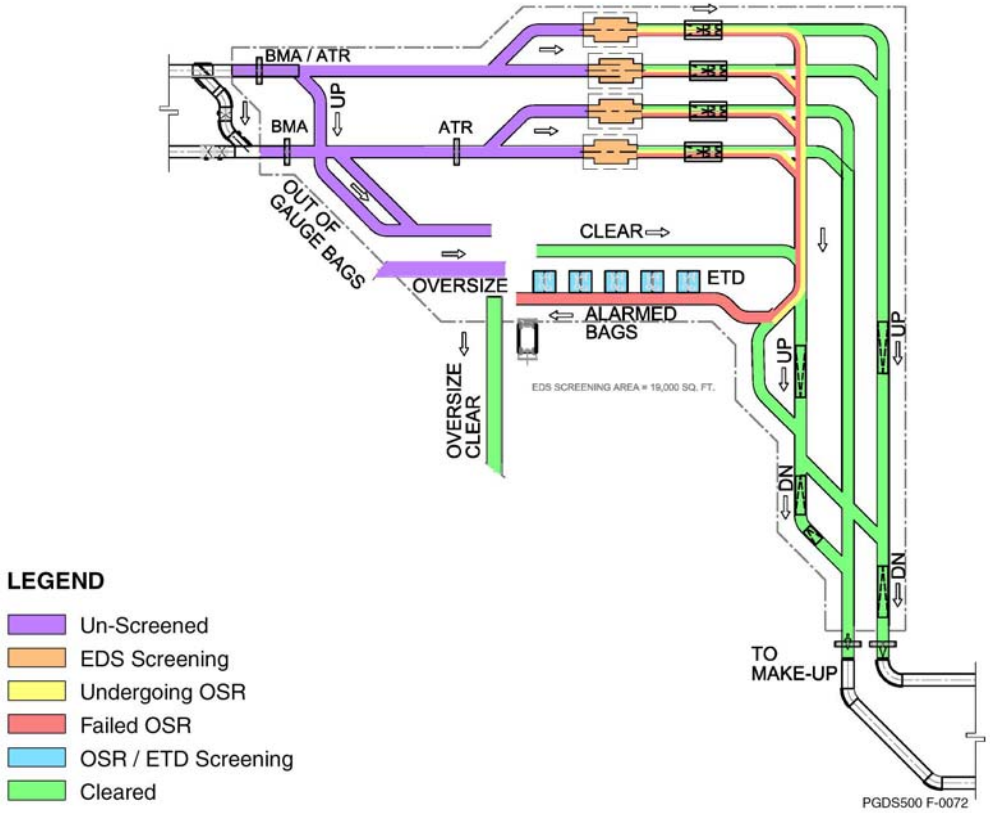
B.2.3.1 Description of Linear CBIS Design Concept C

This design concept is similar in functionality to Concept B, except that improved system capacity are provided by the use of dual main line conveyors delivering bags between ticketing/curbside and EDS machines, and dual cleared main line conveyors delivering bags between EDS machines and the makeup/sortation area.

Where possible, ticketing and curbside belts are arranged to achieve an approximately balanced flow during the peak period to the two main line conveyors leading to the EDS screening zone. Upstream of the EDS, screening zone diverters on each of the two main line conveyors allow crossover from one main line conveyor to the other, for load balancing. Each main line conveyor is equipped with a BMA to identify OOG bags that exceed the available cross-sectional area that can be accommodated by the EDS machines. These OOG bags are diverted from the two main line conveyors via a merge unit to a single conveyor leading directly to the CBRA for manual inspection and clearance. All other bags proceed to a diverter (one on each delivery belt), which divides bag flow among the four EDS machines. After Level 1 screening, bags proceed to a sort point (vertisorter or 45-degree diverter) where alarmed bags are diverted and then merged onto an OSR accumulation conveyor, pending OSR inspection by TSA personnel. Bags cleared by the EDS machines proceed directly and merge onto one of two main line conveyors leading to the bag makeup area, to be discharged to a sort system..

Upon reaching the end of the OSR conveyor, bags that have been cleared by TSA personnel are diverted (vertisorter or 45-degree diverter) to a cleared bag belt, which, in turn, merges with the main line conveyor leading to the bag makeup area. Bags that are not cleared by TSA personnel (including bags for which no clearance decision has been reached by the time the bag reaches the decision point) default to the CBRA for manual inspection. Positive belt tracking controls are used to monitor the location of all bags processed by the EDS machines and to enable images of screened bags sent to the CBRA to be accessed by TSA screening/search personnel to assist with directed ETD screening of the bag. Bags cleared after ETD screening/search are loaded onto a single return conveyor that leads to a divert point to allow bags to merge with either of the two main line conveyors leading to the bag makeup area. Any “threat” bags identified during the ETD screening/search process are loaded to a TCU for removal to a secure area for processing or are handled according to other procedures defined by local law enforcement.

Figure B-3
LINEAR CBIS DESIGN CONCEPT C



The two cleared bag main line conveyors leading to the bag makeup area, in most applications, lead to a sortation area, where bags are typically distributed among a number of makeup loops or piers for final sort to individual flights. This process usually requires two ATRs and one or more manual encode spurs upstream of the makeup loops or piers. Sortation to individual loops or piers would typically be via vertisorters or 45-degree diverters, as appropriate.

B.2.3.2 Evaluation of Linear CBIS Design Concept C

Concept B offers a measured level of improved system reliability by providing two independent routes from ticketing/curbside to the bag makeup/sortation area. This design ensures that, a significant portion of peak-period throughput capacity can be maintained even in the event of a major subsystem failure (e.g., failure or jam on a main line conveyor to one pair of EDS machines). The level of redundancy incorporated into a CBIS design should address the economical cost in order to achieve the desired level of system reliability and performance. This CBIS concept generally requires a separate sortation system downstream of the EDS/ETD screening area, to sort bags by flight or by airline. This sortation system could, in many cases, incur considerable extra expense.

Linear CBIS design Concept B offers the added benefit of system reliability through the incorporation of the redundant main line conveyor over Concept B, but it does involve additional conveyor complexity and cost as a result of the additional main line conveyor and crossover connections required. The conceptual layout for Concept C is shown on Figure B-3.

The main line conveyors leading to the makeup area, in most applications, lead to a separate sortation area, where bags are typically distributed among a number of makeup loops or piers for final sort to individual flights. This design usually requires ATRs and a manual encode spur upstream of the makeup loops or piers. Sortation to individual loops or piers would typically be via vertisorters or 45-degree diverters, as appropriate.

B.3 GENERIC EXAMPLES OF DECENTRALIZED CBIS DESIGN CONCEPTS

Decentralized CBIS design concepts provide dedicated EDS machines for each ticket counter bank or each ticket counter. In addition, each EDS machine would typically have a dedicated CBRA in which both OSR and ETD search can be conducted. It may be that the CBRAs can be combined, which would then typically require additional ATRs on the conveyor, allowing automated sortation of alarmed bags subsequently cleared at the CBRA to dedicated bag makeup devices.

One decentralized CBIS design concept is described below:

- **Decentralized CBIS Design Concept D** (Figure B-4)—Baggage from a ticketing/curbside take-away belts is transferred through a single conveyor to a dedicated EDS machine.

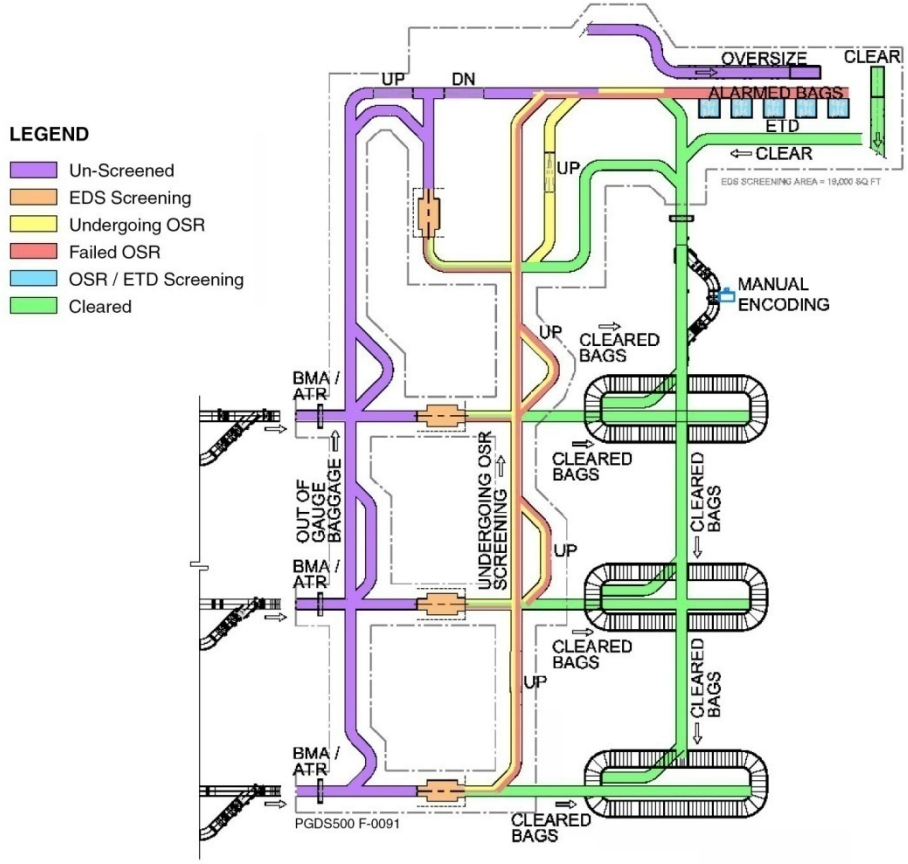
B.3.1 Example of Decentralized CBIS Design Concept D

A conceptual layout of decentralized CBIS design Concept D is shown on Figure B-4.

B.3.1.1 Description of Decentralized CBIS Design Concept D

This concept is configured to provide dedicated EDS machines for each check-in zone, with a backup machine provided as a common-use unit or to provide overflow capacity. Each of the three ticketing/curbside zones would deliver bags through a BMA to a dedicated EDS machine. A diverter immediately downstream of the BMA would divert OOG bags to a bypass line leading directly to the

Figure B-4
DECENTRALIZED CBIS DESIGN CONCEPT D



CBRA. This bypass line can also be used in the event of failure of one of the three dedicated EDS machines to divert bags to the fourth backup EDS machine. Positive bag tracking controls are required to differentiate between OOG bags and those that have been rerouted because of an equipment failure. OOG bags would proceed directly to the CBRA, whereas other bags would be diverted to the backup EDS machine for EDS screening. Immediately downstream of each of the four EDS machines, a diverter would be used to deliver alarmed bags to the CBRA via an OSR accumulation conveyor to facilitate OSR screening. Bags cleared by each of the three dedicated EDS machines would proceed directly to a dedicated makeup loop, allowing a relatively fast processing time for the majority of bags. Bags cleared by the fourth backup EDS machine and bags cleared by OSR or by personnel in the CBRA would be merged on a single sort line equipped with an ATR and three sort outputs leading to the three bag makeup loops. Figure B-4 shows this sort line terminating at the third makeup loop; in this case, any bag that fails to be read at the ATR would default to this loop, together with any bag destined for the first or second makeup loop that is not correctly sorted as a result of, for example, mistracking or diverter malfunction. In this case, personnel at the third makeup loop would be required to check bag tags and redistribute any bags that should have been sorted to the first or second makeup loop. A manual encoding station is shown at the upstream end of the sort line (downstream of the ATR) to encode bags that fail to be read by the ATR.

B.3.1.2 Evaluation of Decentralized CBIS Design Concept D

The primary advantage of this design concept is that it provides a direct and relatively fast point-to-point delivery path for the majority of bags processed, with, under normal circumstances, only a small percentage of bags requiring additional processing or longer delivery times. The disadvantage of the layout is that it does not readily permit load balancing across all four machines.

Typically, this concept is appropriate for three separate airlines with approximately equal throughput and demand profiles, where it is desirable to operate independent systems for the majority of bags and to limit shared facilities to the minority of bags that need special handling.

This decentralized CBIS design concept also provides relatively quick separation of cleared/alarmed bags (similar to some linear CBIS concepts), requires simple programmable logic controller (PLC) configuration, and has a relatively flexible provision for OSR view time. This concept provides a medium level of reliability as there would be only one EDS machine and transfer conveyor for each ticket counter bank; therefore, if that dedicated EDS machine fails, bags could be screened by the backup EDS machine. However, because equipment is spread out over a relatively larger floor area (mainly in bags rooms and Airline Ticket Office [ATO] space), challenges for rights-of-way and maintenance may result.

B.4 MINI INLINE EDS SYSTEM OPERATIONAL OVERVIEW

Three mini in-line CBIS design concepts with either one or two EDS machines are described on the following pages and illustrated on Figures B-5, B-6 and B-7.

B.4.1 Out of Gauge Bags

Out-of-gauge bags will be detected and manually removed from the conveyors prior to the EDS machines. These bags will be manually taken to and screened at the ETD stations.

Upon removing the OOG bag from the conveyor, the Transportation Security Officer (TSO) presses the OOG Reset pushbutton and the BHS resumes processing of normal baggage.

Once the OOG bag has been cleared, the TSO places the bag on the clear bag insertion point for placement onto the takeaway conveyor.

Figure B-5
MINI-IN-LINE CBIS DESIGN CONCEPT E

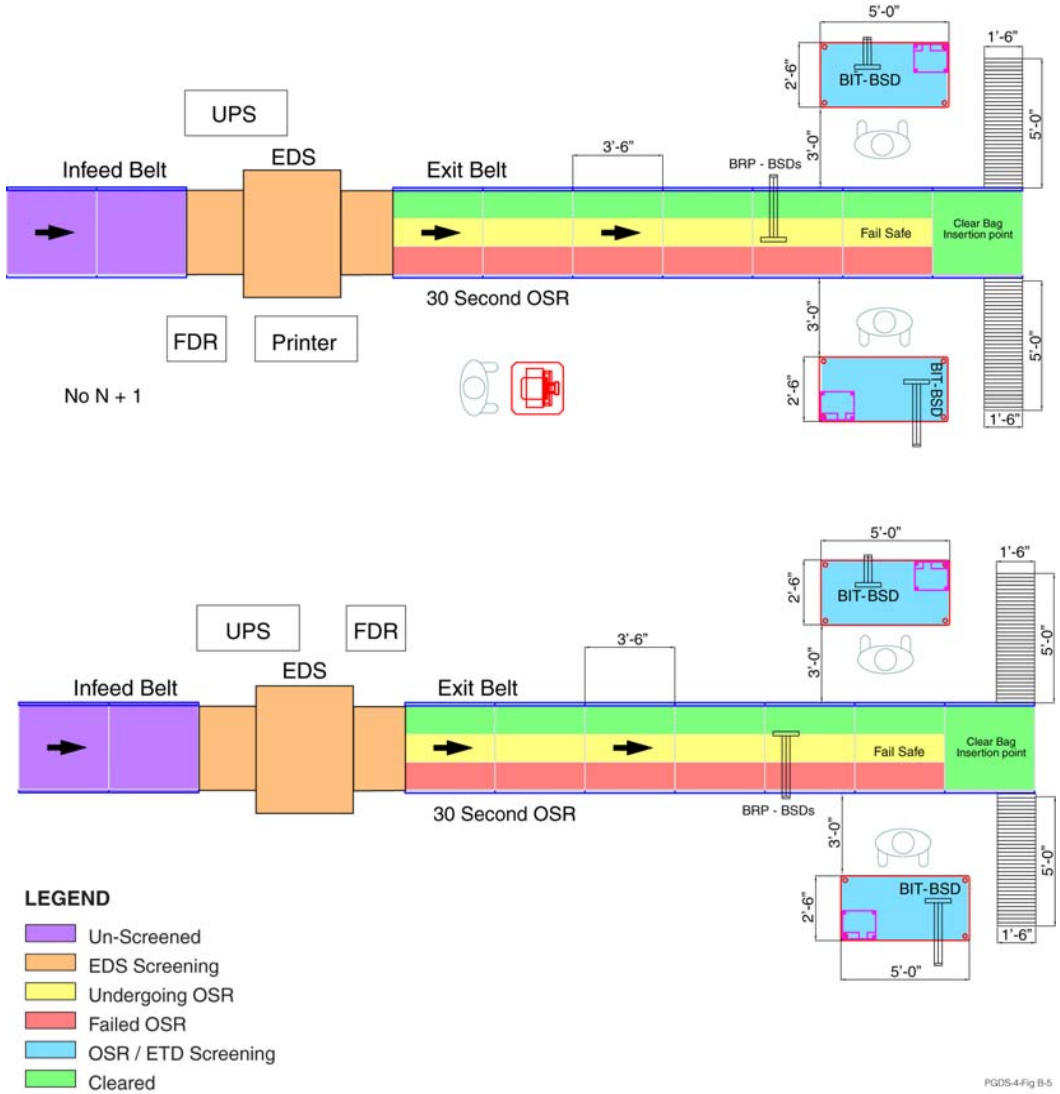


Figure B-6
MINI-IN-LINE CBIS DESIGN CONCEPT F

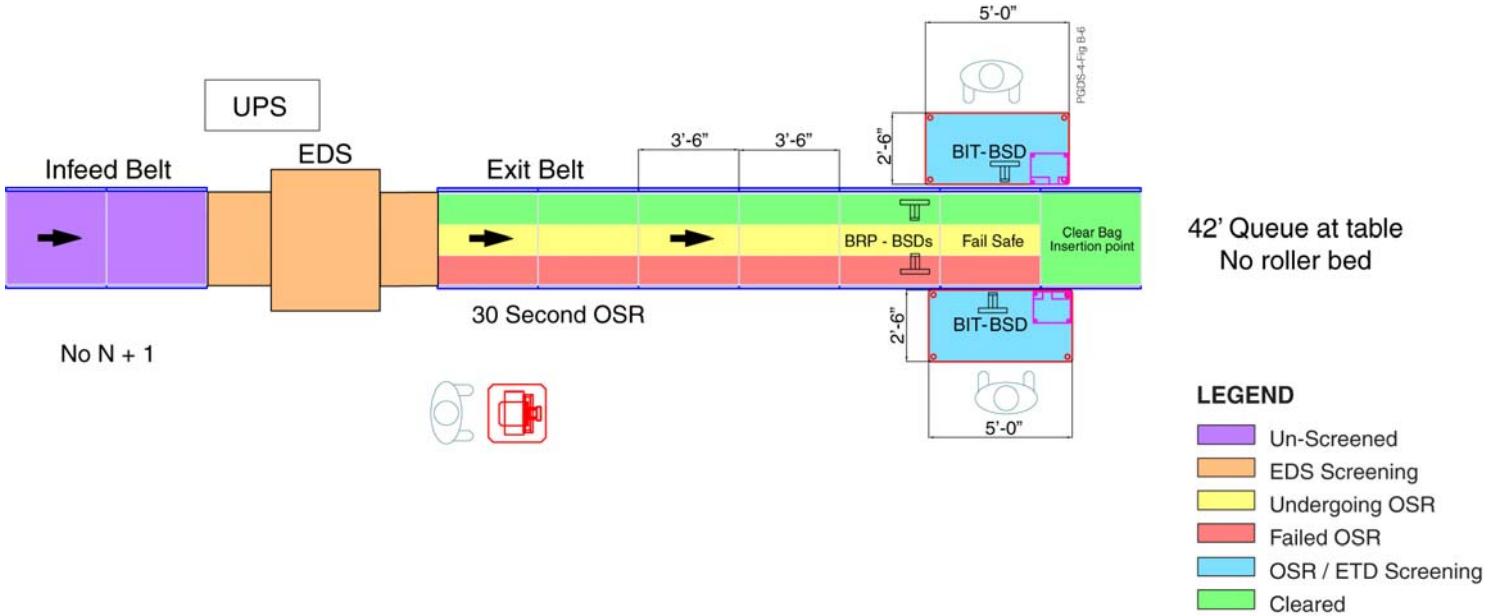
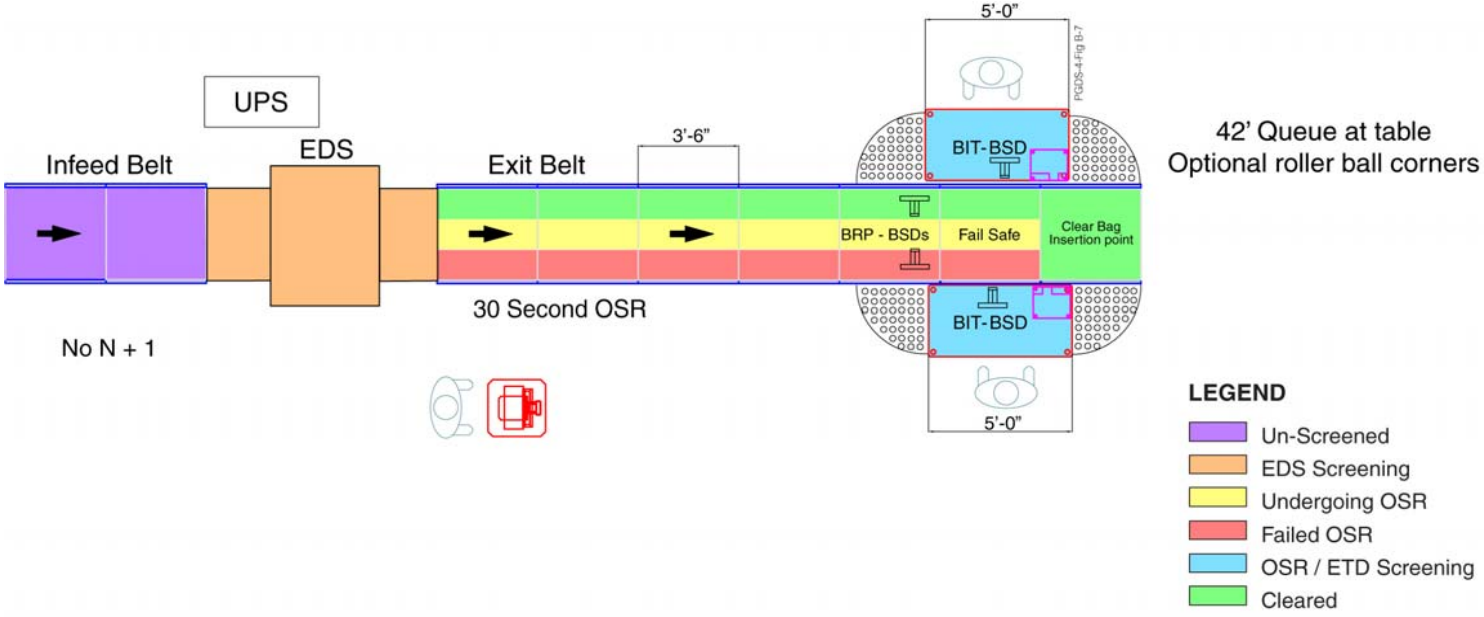


Figure B-7
MINI-IN-LINE CBIS DESIGN CONCEPT G



B.4.2 Level 1 Screening

Bags cleared by an EDS machine will automatically continue onto the conveyors leading to the Bag Removal Point (BRP). Bags not cleared will be stopped at the Bag Removal Point (BRP). Stack lights are placed at the BRP. The standard setup will have a four-light stack with white for unknown bags and pending decision, green for cleared bags, red for suspect, and blue for a fail-safe condition.

The queue immediately after the BRP will be designated as a "FAIL SAFE" position and shall stop and illuminate the "Blue" stack light any time a non cleared bag crosses the queue.

As the bag enters the EDS a unique identifier is handed off from the BHS to the screening machine. The machine will then use this identifier to associate the individual bag with the ultimate 'clear' or 'suspect' decision.

Bags that are 'cleared' before or at the BRP will display the status on the BRP BSD and illuminate the stack light 'green' and stay illuminated until the bag has traversed past the BRP and continue downstream to its destination.

B.4.3 Level 2 Screening

Level 2 screening utilizes the On Screen Alarm Resolution Protocols (OSARP) and will be performed by the TSO at the BVS, allowing viewing of the EDS images. This allows remote clearing or alarming of the bag. Bags that do not receive a clear or suspect signal from at EDS machine will have 30 seconds of OSR transit time before reaching the BRP position. The BSD will display the status of the bag and the stack light will illuminate white.

The EDS units will provide the EDS decision no later than 30 seconds after the scan to the BHS system via the EDS/BHS interface. If the bag is given a Level 1 "suspect" decision, it will exit the machine onto the takeaway conveyor. Simultaneous to the alarmed decision, the bag image will be sent to a Level 2 On-Screen Resolution (OSR) operator at the BVS station for further inspection. If the bag is Level 2 "cleared," the stack light will illuminate green at the BRP and the bag will proceed as above described for a Level 1 cleared bag.

If a bag is determined to be a threat by the Level 1 EDS, its image is sent to the SVS monitors procedures defined in Chapter 9. TSA operators will use the image using the Threat Resolution Interface (BVS terminal) to assist in a directed search. If the Level 2, OSR TSA operators give the bag a "suspect" decision or fail to give a decision before the OSR time period for review expires (approximately 30 seconds) or if no one has logged onto any of the BVS terminals, the tack light will switch to a constant 'red' illumination. This maintained 'red' illumination alerts the TSOs that the bag status can only be resolved via a Level 3 examination.

Bags not cleared are removed from the BRP and the queue conveyor is released to allow the next bag to advance.

B.4.4 Level 3 Screening

Removed bags that were not cleared by the EDS machine or by an OSR operator will be searched using directed methods, dumped searched, or other established TSA search protocol.

Agents will utilize a RRS (Remote Resolution Station) located at ETD search area for directed search utilizing the EDS image. At the BRP, the TSO will remove the bag to BIT. To remove the Level 3 bag from the BRP, the TSO shall follow the procedure defined in Chapter 9 and the BHS resumes normal processing of baggage.

Cleared bags are placed back onto the queue at the bag insertion point. A reinsertion pushbutton will be pressed to stop the queue conveyor used to place bags back onto the line.

The line will automatically restart when the bag breaks to head-end photocell beam for the line or after a set period of time, nominally five seconds.

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Appendix C

BASIS OF DESIGN REPORT CASE STUDY
Oakland International Airport

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C.1 EXECUTIVE SUMMARY

This Basis of Design Report case study focuses on the Port of Oakland's recent study to identify an optimally scaled checked baggage inspection system (CBIS) for Terminal 1 at Oakland International Airport (referred to in this case study as “the Airport”).

At the time this recent study was conducted, Terminal 1 served a mix of domestic airlines and their affiliated regional/commuter airlines, and the majority of bags were screened using explosives trace detection (ETD) instead of explosives detection system (EDS) machines. To improve customer service and support Airport growth opportunities, the Port was interested in evaluating in-line baggage screening alternatives. Key study objectives included: (1) minimizing the number of manual baggage screening inspections and (2) improving overall customer service at the Airport while screening 100% of checked bags.

Several conceptual alternatives for in-line screening, ranging from highly centralized systems with high-speed EDS machines to more decentralized systems using lower-speed EDS machines (a mini in-line CBIS), were considered.

As Terminal 1 was designed to serve a mix of domestic and international airlines, a high-throughput in-line CBIS was not feasible because of the spatial requirements and additional complexity associated with assigning bags to specific airlines after screening at a centralized location. Therefore, only four mini in-line CBIS alternatives were found to be operationally and spatially feasible for Terminal 1. For the mini in-line alternatives, Reveal CT-80 and Analogic King Cobra (AN KC) EDS machines were evaluated based on life-cycle cost, potential screening capacity, customer level of service, and other qualitative factors.

To support the evaluation, two models were developed. The first was a life-cycle- cost (LCC) model to determine the cost-effectiveness of each alternative over a 20-year period, and the second was a simulation model to evaluate screening capacity, level of service, and operational performance.

After all constraints were evaluated, Alternative 3, a mini in-line system consisting of seven AN KC EDS machines, was deemed to be the best CBIS alternative for Terminal 1 at the Airport.

C.2 BACKGROUND

In spring 2004, the Port initiated a design study for the replacement of an existing baggage screening system using ETD technology with a set of automated EDS machines to serve Southwest Airlines (the sole airline tenant at the Airport's Terminal 2). The design concept called for a conveyor system to transfer baggage from ticket counters to an in-line EDS screening area adjacent to the terminal where EDS machines automatically screen baggage for explosives and divert false alarm and oversize baggage to a checked baggage resolution area (CBRA). Baggage cleared by the EDS machines proceeds to Southwest’s outbound baggage makeup carousel. The Terminal 2 in-line system became operational in February 2006; the in-line design study for that system is not included in this case study.

Terminal 1 serves a mix of domestic airlines and affiliated commuter operators. Currently, three EDS machines are used for screening checked baggage at Terminal 1.

United Airlines uses one stand-alone EDS machine (GE CTX-2500) located behind the airline ticket counter. Bags moving along the conveyor to the United Airlines’ baggage makeup area are manually removed and sent through the EDS machine for security screening.

JetBlue Airways uses a semi-integrated EDS machine (GE CTX-5500) located behind the JetBlue ticket counter. A conveyor connects the ticket counters to the EDS machine. All JetBlue bags are first screened by the CTX-5500. Cleared bags are sent to the baggage makeup area and alarmed bags are sent

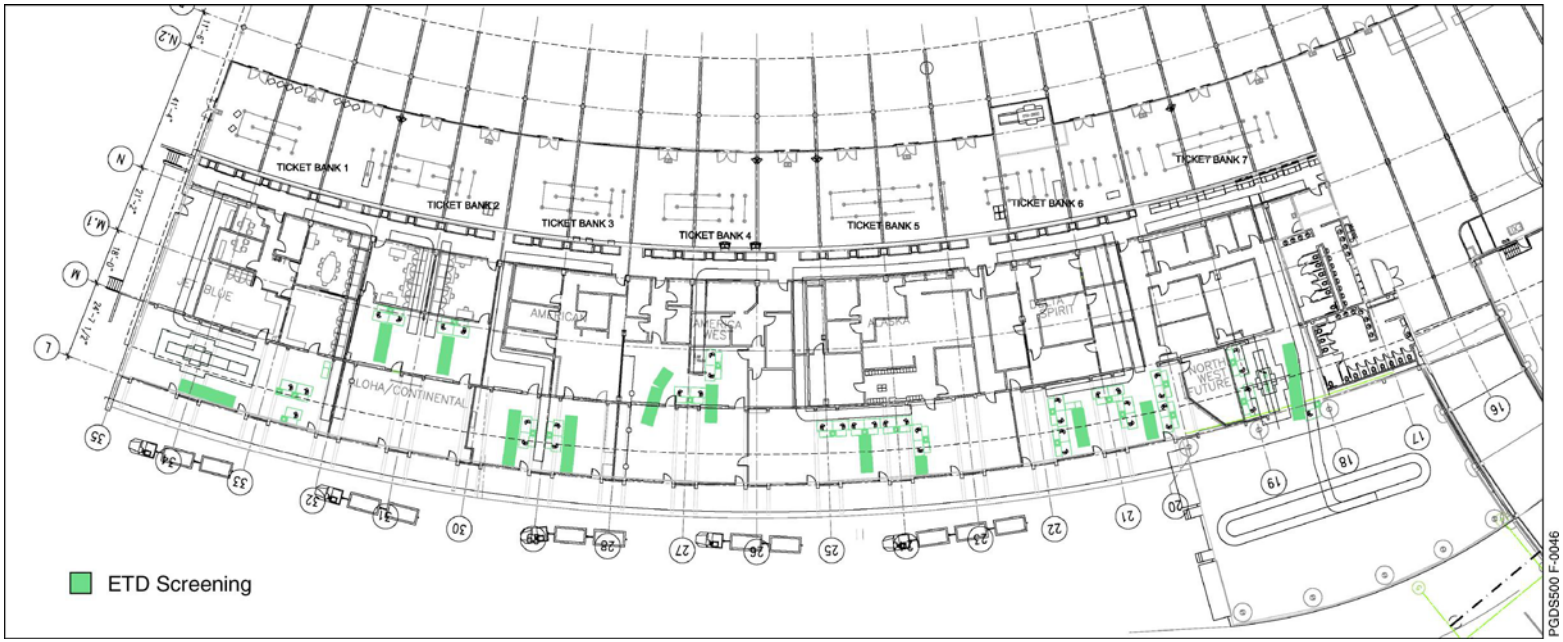
to a CBRA, where alarms are resolved by Transportation System Administration (TSA) agents.

The remainder of the Terminal 1 airlines use manual ETD screening located in the baggage makeup rooms. In addition, bags that belong to passengers with a high-risk profile (referred to as "selectees") are manually carried to the third EDS machine (GE CTX-5500) located in the lobby, where they are screened, sorted, manually placed on the conveyor, and sent to the appropriate airline baggage makeup room.

The Airport is achieving 100% checked bag screening; however, the process is labor intensive, with the majority of the bags undergoing ETD screening instead of being screened by EDS machines. The Port wants to move ahead with an in-line EDS to improve customer service, scalability, and Airport growth opportunities.

Existing conditions at Terminal 1 are shown on Figure C-1.

Figure C-1
EXISTING CONDITIONS
Terminal 1



C.3 CBIS ALTERNATIVES

C.3.1 Zoning Schemes

As explained in Chapter 5 of Version 3 of the Planning Guidelines and Design Standards (PGDS), checked baggage can be combined in the screening systems in several ways. Taking into consideration spatial and operational constraints, two zone hierarchy schemes were developed for Terminal 1, as shown on Figures C-2 and C-3.

For Terminal 1, the "F3 Zones" correspond to each baggage take-away belt, while the "F1 Zone" consists of the entire terminal. At the intermediate "F2 Zones," several options are available to combine checked baggage into screening systems. For the purpose of this case study, two options were considered for F2 Zone groupings: Option A (Figure C-2) divides the ticket counters into three groups combining checked baggage into three screening systems, while Option B (Figure C-3) divides the ticket counters into two groups combining checked baggage into two screening systems.

Figure C-2
ZONING SCHEMES, OPTION A
Terminal 1

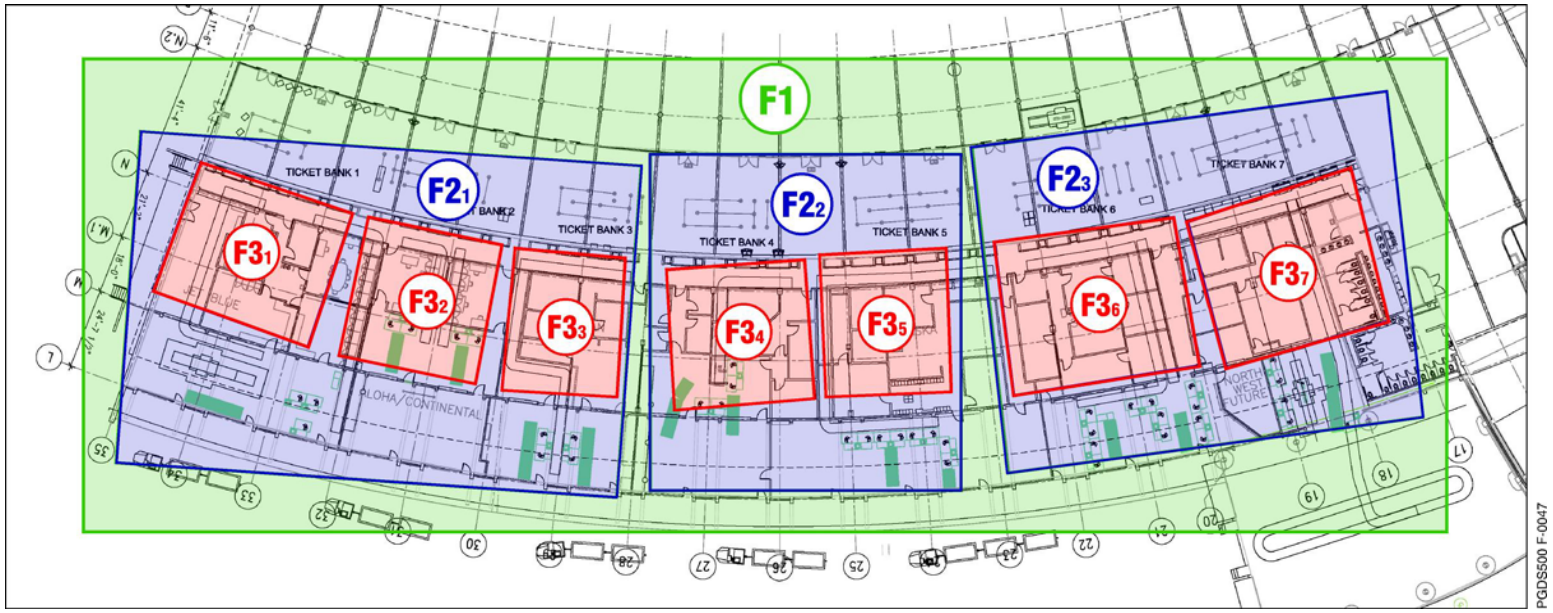
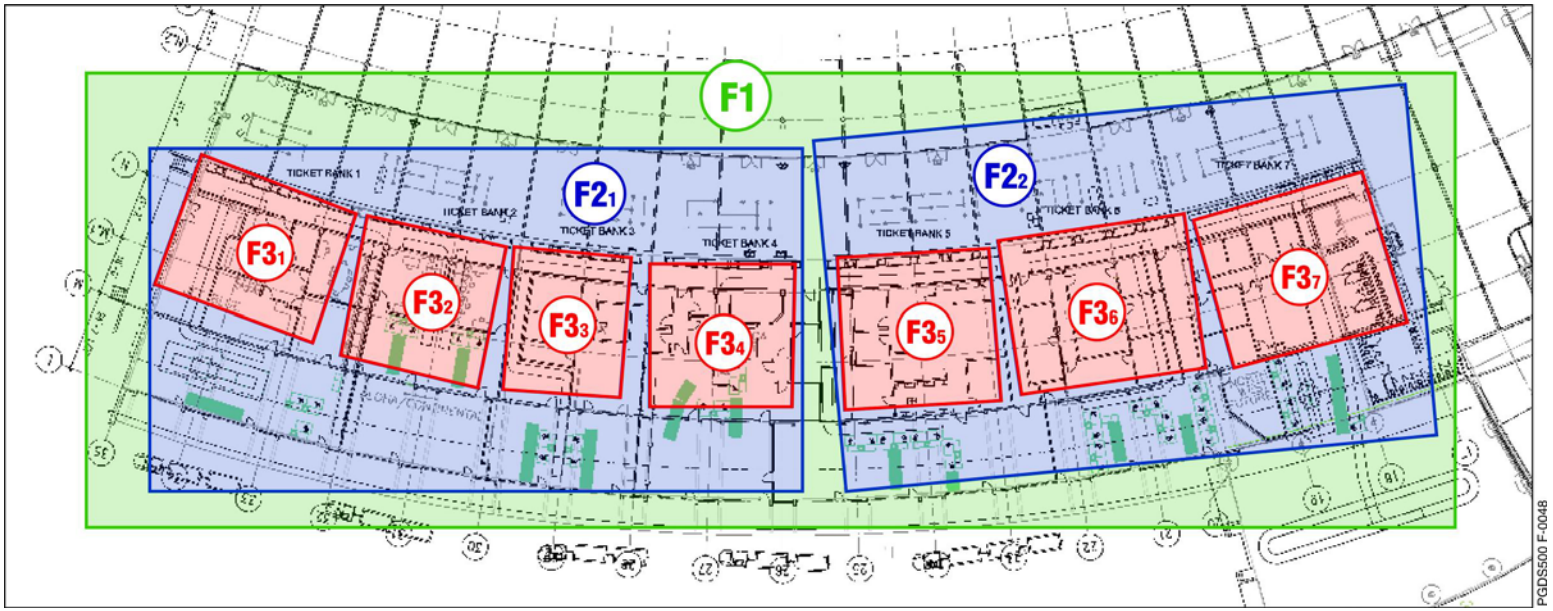


Figure C-3
ZONING SCHEMES, OPTION B
Terminal 1



C.3.2 Screening System Types

As explained in detail in PGDS Chapter 3, several system types and EDS equipment are available for in-line systems, ranging from highly centralized systems using high-speed EDS machines to very decentralized systems using low-speed EDS machines. As the zoning schemes, the system type selection, and the estimated demand are inter-related, several iterations were necessary to determine an optimally scaled solution. Thus, at this early stage of analysis, all spatially feasible system options were considered and carried forward in the evaluation.

The following is a general description of potential system types for three zoning levels at Terminal 1 that were considered initial candidates for screening alternatives:

- **Terminal 1, F3 Zone Groupings**—Decentralized screening systems are recommended for F3 Zone groupings. Thus, at the F3 Zone level, mini in-line systems are acceptable options. Stand-alone EDS machines were not considered because they would present spatial constraints to any expansion that would be necessary to accommodate growth beyond the design year.

- **Terminal 1, F2 Zone Groupings**—At the F2 Zone level, depending on the expected checked baggage demand volumes, high-throughput centralized systems, such as high-volume and medium-volume in-line systems, or lower-throughput systems, such as mini in-line systems, are acceptable options.

- **Terminal 1, F1 Zone Grouping**—A centralized system is recommended at the F1 Zone level. Thus, both high-volume and medium-volume in-line systems are acceptable options for Terminal 1. The choice between high-volume and medium-volume system types depends on the date of beneficial use (DBU), since that will dictate the type of EDS equipment expected to be certified by that date. Since DBU is expected to be after 2008, both high-volume and medium-volume in-line systems would be viable. If a medium-volume system is ultimately selected, all necessary steps should be taken to make the system flexible enough to accommodate high-speed EDS machines when they become available.

C.3.3 Qualitative Assessment of Preliminary Alternatives

An initial assessment of a relatively large number of alternatives was performed and all alternatives that were clearly not feasible were immediately eliminated without further consideration. In this initial assessment, it was determined that structural and spatial constraints would render any expansion or major building modification required to accommodate the in-line systems cost prohibitive. Accordingly, at Terminal 1, all of the full in-line concepts were found to be infeasible. Only the mini-in-line system type layouts designed for the F3 Zone were found to be operationally and spatially feasible at Terminal 1.

For the F3 Zone alternatives, the Reveal CT-80 and Analogic King Cobra EDS machines were considered to be better options for the Airport compared to the L-3 3DX 6000 and GE CTX-5500 machines with ViewLink. The CT-80 and AN KC machines are considered superior products because they are newer, have better performance capabilities, and have strong upgrade possibilities for the future. Therefore, the L-3 3DX 6000 and GE CTX-5500 with ViewLink were also eliminated from further consideration.

Table C-1 provides a list of all preliminary alternatives considered and brief reasons for rejecting the initial alternatives.

C.3.4 Feasible Alternatives

The list of preliminary alternatives was reduced to three feasible alternatives based on F3 zoning and the following mini in-line system types. Each of the alternatives incorporates the same F3 zoning, i.e., the ticket counters are divided into seven ticket counter groups, one for each take-away belt, creating seven F3 Zones. These feasible alternatives are investigated further in the following sections.

1. Alternative 1: Each F3 Zone is served by the required number of CT-80 EDS machines and one CBRA where the on-screen resolution (OSR) process is combined with ETD alarm resolution.

2. Alternative 2: Each F3 Zone is served by the required number of in-line AN KC machines. This alternative was split into two parts, Alternative 2a and Alternative 2b. Alternative 2a incorporates a combined OSR/ETD screening function, similar to Alternative 1. Alternative 2b incorporates dedicated OSR screening, which would be conducted in a separate screening room.

3. Alternative 3: Each F3 Zone is served by the required number of in-line AN KC machines. ETD screening and baggage makeup functions are partially consolidated as there would be a common CBRA and baggage makeup area for every two EDS machines. In addition, OSR would be performed remotely, while ETD screening functions would be performed in the CBRA, as this more staff-efficient screening method can effectively be used when the CBIS design incorporates common use CBRAs.

Table C-1
INITIAL EVALUATION OF ALTERNATIVES
Terminal 1

	Accepted/ rejected	Alternative name/reason for rejection
F3 ZONE - MINI-IN-LINE SYSTEM TYPE		
Reveal CT-80	Accepted	Alternative 1
Analogic King Cobra	Accepted	Alternatives 2 and 3
L-3 3DX 6000	Rejected	Inferior performance and limited upgrade opportunities
GE CTX-5500 (with ViewLink)	Rejected	Inferior performance and limited upgrade opportunities
F2 ZONE OPTION 1 – MINI IN-LINE SYSTEM TYPE		
Reveal CT-80	Rejected	Spatial constraints
Analogic King Cobra	Rejected	Spatial constraints
L-3 3DX 6000	Rejected	Spatial constraints
GE CTX-5500 (with ViewLink)	Rejected	Spatial constraints
F2 ZONE OPTION 2 - MEDIUM-THROUGHPUT IN-LINE SYSTEM TYPE		
GE CTX-9000	Rejected	Spatial constraints
GE CTX-9800	Rejected	Spatial constraints
L-3 3DX 6000	Rejected	Spatial constraints
L-3 3DX 6600	Rejected	Spatial constraints
F1 ZONE - MEDIUM- THROUGHPUT IN-LINE SYSTEM TYPE		
GE CTX-9000	Rejected	Spatial constraints
GE CTX-9800	Rejected	Spatial constraints
L-3 3DX 6000	Rejected	Spatial constraints
L-3 3DX 6600	Rejected	Spatial constraints

C.4 NONSTANDARD DETERMINATION OF DESIGN DAY BAGGAGE DEMAND

Using the methodology outlined in PGDS Chapter 5, a baseline baggage demand is calculated from the most recent flight schedule data available. The flight schedule data are used to calculate the checked baggage volume for the average day of the peak month (ADPM) for each screening zone. This baseline checked baggage demand is then surged and projected to the design day, which is the DBU of the CBIS plus 5 years. Flight schedules for 2006 were used for this analysis with a projected DBU of 2008 and subsequent DBU of 2013. In projecting future demand, the

capacity of the functional components at the Airport must be considered. The ultimate terminal or Airport capacity should be treated as the upper limit for projected demand for the purposes of CBIS design.

Based on the Port's strategy for the Airport, it is unlikely that the capacity of Terminal 1 will be increased substantially in the foreseeable future. The reasons for this slowdown in growth at Terminal 1 include:

1. The Terminal 2 expansion plan is under way and, once completed, all international flights and Southwest Airlines flights will be accommodated at Terminal 2 (making the current four Southwest gates at Terminal 1 available).

2. It is expected that either a new entrant airline will begin service at Terminal 1 or a current airline located at Terminal 1 will expand at the Airport in subsequent years, requiring two of the four Terminal 1 gates currently used by Southwest. This new service is represented by flights of a fictitious future airline, "XX Airlines".

Therefore, to ensure that the screening system alternatives were designed based on a realistic growth rate given the constraints on the terminal, two design days were considered, as described below. For this analysis, the entire Terminal 1 was treated as a single F1 screening zone.

1. Standard methodology – This design day was constructed based on the methodology outlined in PGDS Chapter 5. The ADPM flight schedule for Terminal 1 was identified, and using the forecast growth rates in the then-current Federal Aviation Administration's (FAA's) *Terminal Area Forecast* (TAF), increased to reflect 2013 passenger volumes (2013 is DBU + 5 years for the proposed in-line system). According to the TAF, total enplaned passengers at the Airport are expected to grow from 7.12 million annual passengers (MAP) in 2006 to 9.90 MAP in 2013. This represents an average annual growth rate of 4.82%. Using this method, baggage flows for the ADPM were increased by 4.82% annually to 2013.

2. Strategy-oriented methodology – This design day was constructed based on the Port's future strategy that no additional gates will be built at Terminal 1 and that Southwest will move completely to Terminal 2. Two of the four vacated gates at Terminal 1 would be used by a future airline (XX Airlines). The remaining two gates could be used to accommodate growth of airlines currently serving the Airport. To properly reflect Terminal 1 capacity, the design day flight schedule was based on the 2006 peak day of the peak month (PDPM) flight schedule. This schedule was sent to the airlines for verification, and new flights were added to the schedule in accordance with the airlines' requests. In line with the Port's strategy for the Airport, Southwest was eliminated from the flight schedule and was replaced by XX Airlines. The flight schedule for XX Airlines was based on Southwest's gating schedule for two of Southwest's four gates at Terminal 1. Gate utilization was analyzed based on gating information provided by Airport staff. For gates with low utilization, flights were added to create the design day flight schedule. Using this method, a design day flight schedule based on the detailed information provided by the airlines and Airport staff was created and baggage flows were generated from this flight schedule.

C.4.1 Terminal 1 ADPM and PDPM

Determination of the ADPM and PDPM design day values were based on Terminal 1 flight schedules to determine the peak month (August) and the ADPM (August 26) and PDPM (August 25). Load factors, origin and destination (O&D) percentages, earliness distributions, and checked bags per passenger for those days were applied to the maximum seat capacities for the ADPM and PDPM flight schedules to arrive at the base ADPM and PDPM baggage flows.

Two design days were then created. The design days were based on the standard and strategy-oriented methodologies described above. One design day was created by increasing the ADPM baggage flows to 2013 levels based on the TAF growth rates (standard methodology). The other design day was created by using the PDPM flight schedule and adding flights based on the Port's future strategy (strategy-oriented methodology).

The following sections provide details of the design-day selection process.

C.4.1.1 Peak Month

Table C-2 shows the monthly totals and daily averages for all flights in Terminal 1 used to identify August as the peak month.

Table C-2
TERMINAL 1 PEAK MONTH
Available Seats 2007

	Monthly seats	Average daily seats
January	279,034	9,001
February	254,786	9,100
March	286,400	9,239
April	271,707	9,057
May	309,719	9,991
June	320,829	10,694
July	324,051	10,802
August	335,573	10,825
September	293,789	9,793
October	299,965	9,676
November	279,911	9,330
December	288,890	9,319

C.4.1.2 Terminal 1 ADPM and PDPM

The ADPM and PDPM were determined by analyzing the numbers of Terminal 1 daily seats calculated from the *Official Airline Guide* (OAG) flight schedules for the peak month (August). The day closest to the peak month's average daily load determines the ADPM. The day closest to the peak month's daily peak determines the PDPM. Tables C-3 and C-4 show the daily seat totals, their variance from the monthly average and the ADPM and PDPM, respectively, for Terminal 1. This analysis determined that August 26 is the ADPM and that August 25 is the PDPM.

Table C-3 shows the total number of daily departing seats for all domestic Terminal 1 flights (excluding those of Southwest Airlines) obtained from the OAG.

The ADPM flight schedule is provided in Table C-4. This flight schedule was used in the standard methodology.

The PDPM flight schedule is provided in Table C-5 below. Additional flights, as indicated in the table, were added to the PDPM based on the Port's future strategy for Terminal 1. Specifically, flights were added based on feedback from the airlines regarding their future flight strategies as well as flights for XX Airlines, the new entrant airline that would use two of Southwest Airlines' four vacated Terminal 1 gates.

Table C-3
AVERAGE DAY AND PEAK DAY OF THE PEAK MONTH: AUGUST 2006
Daily Available Seating

Average day seats: 10,387

Day	Available seats	Variance from average
1	10,368	-19
2	10,368	-19
3	10,368	-19
4	10,492	105
5	10,388	1
6	10,244	-143
7	10,492	105
8	10,368	-19
9	10,368	-19
10	10,368	-19
11	10,492	105
12	10,388	1
13	10,244	-143
14	10,492	105
15	10,368	-19
16	10,368	-19
17	10,368	-19
18	10,492	105
19	10,388	1
20	10,244	-143
21	10,492	105
22	10,368	-19
23	10,368	-19
24	10,368	-19
25 *(a)*	10,492	105
26 *(b)*	10,388	1
27	10,244	-143
28	10,492	105
29	10,368	-19
30	10,368	-19
31	10,368	-19

(a) August 25 is the PDPM.
(b) August 26 is the ADPM.
Source: Official Airline Guide.

Table C-4
OAKLAND TERMINAL 1 ADPM SCHEDULE

Published carrier	Operator	Flight number	Departure time	Destination	Aircraft type	Number of seats
AA	AA	1008	6:26	DFW	M80	136
AA	AA	1612	8:09	DFW	M80	136
AA	AA	1092	12:43	DFW	M80	136
AA	AA	2256	15:06	DFW	M80	136
AQ	AQ	473	8:00	OGG	73W	124
AQ	AQ	441	9:00	HNL	73W	124
AS	AS	372	6:40	SNA	734	144
AS	AS	355	9:05	SEA	734	144
AS	AS	340	12:17	SNA	734	144
AS	AS	346	13:40	SNA	734	144
AS	AS	365	16:17	PDX	734	144
AS	AS	541	17:10	SEA	734	144
AS	AS	446	17:20	SNA	734	144
AS	AS	459	20:15	SEA	734	144
AS	AS	321	21:14	PDX	734	144
AS	AS	351	6:00	SEA	739	172
AS	AS	343	7:55	SEA	739	172
AS	AS	573	10:01	SEA	739	172
AS	AS	85	15:33	SEA	739	172
AS	AS	378	18:55	SNA	73G	124
AS	AS	579	7:20	PDX	M80	140
AS	AS	357	12:24	SEA	M80	140
AS	QX	2468	9:10	PDX	CR7	70
AS	QX	2534	19:10	PDX	CR7	70
B6	B6	241	6:30	LGB	320	156
B6	B6	94	7:10	JFK	320	156
B6	B6	474	7:40	BOS	320	156

Table C-4 *(page 2 of 3)*
OAKLAND TERMINAL 1 ADPM SCHEDULE

Published carrier	Operator	Flight number	Departure time	Destination	Aircraft type	Number of seats
B6	B6	100	8:50	JFK	320	156
B6	B6	312	9:20	IAD	320	156
B6	B6	472	10:05	BOS	320	156
B6	B6	96	11:05	JFK	320	156
B6	B6	302	12:05	IAD	320	156
B6	B6	102	13:30	JFK	320	156
B6	B6	247	13:30	LGB	320	156
B6	B6	82	15:30	JFK	320	156
B6	B6	253	17:25	LGB	320	156
B6	B6	317	19:20	LGB	320	156
B6	B6	249	20:30	LGB	320	156
B6	B6	110	21:35	JFK	320	156
B6	B6	476	22:35	BOS	320	156
B6	B6	318	22:45	IAD	320	156
B6	B6	270	23:30	FLL	320	156
CO	CO	284	0:20	IAH	733	124
CO	CO	758	6:30	IAH	738	155
CO	CO	231	12:14	IAH	739	167
DL	DL	800	7:10	ATL	738	150
DL	DL	494	12:05	ATL	738	150
DL	DL	709	22:30	ATL	738	150
DL	DL	715	13:20	SLC	M90	150
DL	OO	3796	6:15	SLC	CRJ	50
DL	OO	3957	9:41	SLC	CRJ	50
DL	OO	3998	16:02	SLC	CRJ	50
DL	OO	3928	18:30	SLC	CRJ	50
HP	HP	855	9:00	PHX	319	124

Table C-4 *(page 3 of 3)*
OAKLAND TERMINAL 1 ADPM SCHEDULE

Published carrier	Operator	Flight number	Departure time	Destination	Aircraft type	Number of seats
HP	HP	567	6:00	PHX	320	150
HP	HP	721	13:46	LAS	320	150
HP	HP	191	15:40	PHX	320	150
HP	HP	611	20:20	LAS	320	150
HP	HP	753	12:29	PHX	733	134
HP	YV	6617	9:25	PHX	CR9	80
HP	YV	6557	18:22	PHX	CR9	80
TZ	TZ	4627	9:35	OGG	73H	175
TZ	TZ	4625	10:55	HNL	73H	175
TZ	TZ	4517	17:20	HNL	73H	175
TZ	TZ	4523	19:35	ITO	73H	175
UA	A296	6515	12:37	LAX	CRJ	49
UA	A296	6505	16:34	LAX	CRJ	49
UA	A296	6507	17:35	LAX	CRJ	49
UA	A296	6501	19:56	LAX	CRJ	49
UA	UA	1193	6:30	LAX	319	120
UA	UA	1230	13:50	ORD	319	120
UA	UA	388	22:55	IAD	319	120
UA	UA	644	23:00	ORD	319	120
UA	UA	1122	6:00	DEN	320	138
UA	UA	242	6:20	ORD	320	138
UA	UA	386	8:10	DEN	320	138
UA	UA	808	15:34	DEN	733	120
UA	UA	364	11:05	DEN	735	116
UA	UA	738	14:00	DEN	735	116
UA	UA	328	16:45	DEN	735	116

Source: Official Airline Guide.

Table C-5
OAKLAND TERMINAL 1 PDPM SCHEDULE

Published carrier	Operator	Flight number	Departure time	Destination	Aircraft type	Number of seats	Added to PDPM
AA	AA	1008	6:26	DFW	M80	136	
AA	AA	1612	8:09	DFW	M80	136	
AA	AA	9992	10:00	DFW	M80	136	*
AA	AA	1092	12:43	DFW	M80	136	
AA	AA	2256	15:06	DFW	M80	136	
AA	AA	9993	17:00	DFW	M80	136	*
AQ	AQ	473	8:00	OGG	73W	124	
AQ	AQ	441	9:00	HNL	73W	124	
AQ	AQ	477	10:40	KOA	73W	124	
AS	AS	351	6:00	SEA	739	172	
AS	AS	372	6:40	SNA	734	144	
AS	AS	579	7:20	PDX	M80	140	
AS	AS	343	7:55	SEA	739	172	
AS	QX	2468	9:00	PDX	CR7	70	
AS	AS	355	9:05	SEA	734	144	
AS	AS	573	10:01	SEA	739	172	
AS	AS	340	12:17	SNA	734	144	
AS	AS	357	12:24	SEA	M80	140	
AS	AS	346	13:40	SNA	734	144	
AS	AS	9991	14:00	PDX	734	144	*
AS	AS	85	15:33	SEA	739	172	
AS	QX	2409	16:10	SUN	DH4	74	
AS	AS	365	16:17	PDX	734	144	
AS	AS	541	17:10	SEA	734	144	
AS	AS	446	17:20	SNA	734	144	
AS	AS	378	18:55	SNA	73G	124	
AS	QX	2534	19:10	PDX	CR7	70	

Table C-5 *(page 2 of 5)*
OAKLAND TERMINAL 1 PDPM SCHEDULE

Published carrier	Operator	Flight number	Departure time	Destination	Aircraft type	Number of seats	Added to PDPM
AS	AS	459	20:15	SEA	734	144	
AS	AS	9990	20:30	SNA	734	144	*
AS	AS	321	21:14	PDX	734	144	
B6	B6	241	6:30	LGB	320	156	
B6	B6	94	7:10	JFK	320	156	
B6	B6	474	7:40	BOS	320	156	
B6	B6	100	8:50	JFK	320	156	
B6	B6	312	9:20	IAD	320	156	
B6	B6	472	10:05	BOS	320	156	
B6	B6	96	11:05	JFK	320	156	
B6	B6	302	12:05	IAD	320	156	
B6	B6	102	13:30	JFK	320	156	
B6	B6	247	13:30	LGB	320	156	
B6	B6	82	15:30	JFK	320	156	
B6	B6	253	17:25	LGB	320	156	
B6	B6	317	19:20	LGB	320	156	
B6	B6	249	20:30	LGB	320	156	
B6	B6	110	21:35	JFK	320	156	
B6	B6	476	22:35	BOS	320	156	
B6	B6	318	22:45	IAD	320	156	
B6	B6	270	23:30	FLL	320	156	
CO	CO	284	0:20	IAH	CO 733	124	
CO	CO	284	0:20	IAH	CO 733	124	
CO	CO	758	6:30	IAH	CO 738	155	
CO	CO	231	12:14	IAH	CO 739	167	
DL	OO	3796	6:15	SLC	CRJ	50	
DL	DL	800	7:10	ATL	738	150	

Table C-5 *(page 3 of 5)*
OAKLAND TERMINAL 1 PDPM SCHEDULE

Published carrier	Operator	Flight number	Departure time	Destination	Aircraft type	Number of seats	Added to PDPM
DL	OO	3957	9:41	SLC	CRJ	50	
DL	DL	9994	10:30	ATL	738	150	*
DL	DL	494	12:05	ATL	738	150	
DL	DL	1743	13:20	SLC	M90	150	
DL	DL	9995	16:00	ATL	738	150	*
DL	OO	3998	16:02	SLC	CRJ	50	
DL	OO	3928	18:30	SLC	CRJ	50	
DL	DL	709	22:30	ATL	738	150	
HP	HP	567	6:00	PHX	320	150	
HP	HP	381	7:40	SJD	733	134	
HP	HP	855	9:00	PHX	319	124	
HP	YV	6617	9:25	PHX	CR9	80	
HP	HP	753	12:29	PHX	733	134	
HP	HP	721	13:46	LAS	320	150	
HP	HP	626	15:40	PHX	733	134	
HP	YV	6557	18:22	PHX	CR9	80	
HP	HP	539	20:20	LAS	319	124	
TZ	TZ	4627	9:35	OGG	73H	175	
TZ	TZ	4625	10:55	HNL	73H	175	
TZ	TZ	4517	17:20	HNL	73H	175	
TZ	TZ	4523	19:35	ITO	73H	175	
UA	UA	1122	6:00	DEN	UA 320	138	
UA	UA	242	6:20	ORD	UA 320	138	
UA	UA	281	7:30	IAD	UA 320	138	
UA	UA	386	8:10	DEN	UA 320	138	

Table C-5 *(page 4 of 5)*
OAKLAND TERMINAL 1 PDPM SCHEDULE

Published carrier	Operator	Flight number	Departure time	Destination	Aircraft type	Number of seats	Added to PDPM
UA	UA	9980	9:40	LAX	UA 733	137	*
UA	UA	9981	12:00	ORD	UA 73G	137	*
UA	A296	6515	12:37	LAX	CRJ	49	
UA	UA	1230	13:50	ORD	UA 319	120	
UA	UA	9982	14:50	LAX	UA 73G	137	*
UA	UA	808	15:34	DEN	UA 733	120	
UA	UA	9983	16:20	ORD	UA 733	137	*
UA	A296	6505	16:34	LAX	CRJ	49	
UA	A296	6507	17:35	LAX	CRJ	49	
UA	A296	6501	19:56	LAX	CRJ	49	
UA	UA	9996	22:00	ORD	UA 320	138	*
UA	UA	388	22:55	IAD	UA 319	120	*
XX	XX	398	6:05	SAN	73G	137	*
XX	XX	1380	6:30	LAX	733	137	*
XX	XX	825	6:55	ONT	73G	137	*
XX	XX	2432	7:25	BUR	733	137	*
XX	XX	1233	7:40	SAN	733	137	*
XX	XX	1474	7:40	RNO	733	137	*
XX	XX	1215	7:50	SEA	73G	137	*
XX	XX	997	9:00	MDW	73G	137	*
XX	XX	1726	9:35	BUR	733	137	*
XX	XX	493	11:00	LAX	733	137	*
XX	XX	622	11:10	BOI	733	137	*
XX	XX	1409	11:35	LAS	733	137	*
XX	XX	1041	11:40	BUR	73G	137	*
XX	XX	1284	13:35	BUR	733	137	*

Table C-5 *(page 5 of 5)*
OAKLAND TERMINAL 1 PDPM SCHEDULE

Published carrier	Operator	Flight number	Departure time	Destination	Aircraft type	Number of seats	Added to PDPM
XX	XX	530	13:55	LAS	733	137	*
XX	XX	1790	14:40	ONT	73G	137	*
XX	XX	1385	16:00	LAX	733	137	*
XX	XX	907	17:30	LAX	73G	137	*
XX	XX	1853	17:35	SNA	73G	137	*
XX	XX	1055	18:10	ONT	733	137	*
XX	XX	1735	18:15	BUR	733	137	*
XX	XX	1381	19:20	SLC	733	137	*
XX	XX	1834	19:55	SAN	73G	137	*
XX	XX	1795	20:05	ONT	73G	137	*
XX	XX	1776	22:00	LAX	73G	137	*

Source: Official Airline Guide.

C.4.1.3 Terminal 1 Demand Estimation

C.4.1.3.1 Design Load Adjustment Factors

Tables C-6 summarizes the factors used to determine the baggage load profiles for each of the ADPM and PDPM flight schedules. Load factors and O&D percentages were directly obtained from the airlines for the month of August. Typical earliness distributions for the domestic airlines were assumed and later confirmed by the airlines. The number of checked bags per passenger was provided by the airlines. If the airlines were unable to provide these data, then the data were derived from surveys conducted at the Airport in summer 2002.

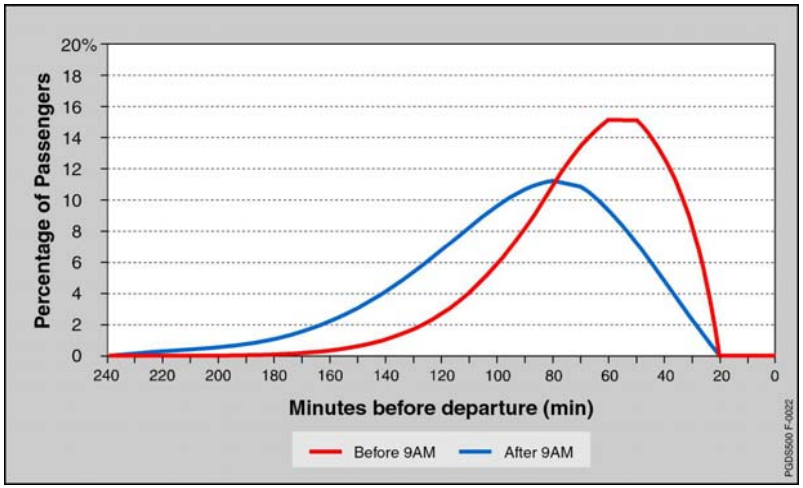
Table C-6
DESIGN LOAD ADJUSTMENT FACTOR PER AIRLINE

Operator name	Operator code	Load factor	Percent originating before 9 a.m.	Percent originating after 9 a.m.	Percent of parties checking pre-gate	Average number of checked bags per passenger
Continental Airlines	CO	96%	100%	100%	75%	0.79
Alaska Airlines	AS	98	100	100	80	0.71
America West Airlines (domestic destinations)	HP	83	100	100	84	0.68
United Airlines	UA	85	100	100	45	0.87
XX Airlines	XX	77	100	85	34	0.92
SkyWest Airlines	OO	91	100	100	79	0.91
American Airlines	AA	98	100	100	90	0.71
JetBlue Airways	B6	90	100	100	90	0.90
Delta Air Lines	DL	89	100	100	92	0.98
America West Airlines (Mexican destinations)	HP	83	100	100	100	1.30
Aloha Airlines	AQ	85	100	100	97	1.30
Horizon Air	QX	60	100	100	77	0.95
Mesa Airlines	YV	85	100	100	51	0.96
ATA Airlines	TZ	85	100	80	64	1.23
United Express/ SkyWest Airlines	A296	91	100	100	66	0.87

Based on discussions with Airport staff, 1% of all arriving bags were assumed to be out-of-gauge (OOG).

The passenger arrival profiles for the Terminal 1 design day were used for passenger arrivals before 9:00 a.m. and after 9:00 a.m.

Figure C-4
PASSENGER ARRIVAL PROFILES



C.4.1.3.2 Base Demand Estimation

The baseline CBIS design loads were calculated every 10 minutes over the duration of the design day. A surge factor was calculated according to the methodology in PGDS Section 6.1.1, and applied to the CBIS design load for each 10-minute time period. These 10-minute results are shown graphically on Figures C-5 and C-6 below.

C.4.1.3.3 Design Year Demand Estimation

Baggage load profiles for Terminal 1 are provided below. The baggage load profiles calculated using the standard methodology and strategy-oriented methodology are provided on Figures C-5 and C-6, respectively.

Figure C-5
STANDARD METHODOLOGY DESIGN LOAD PROFILE

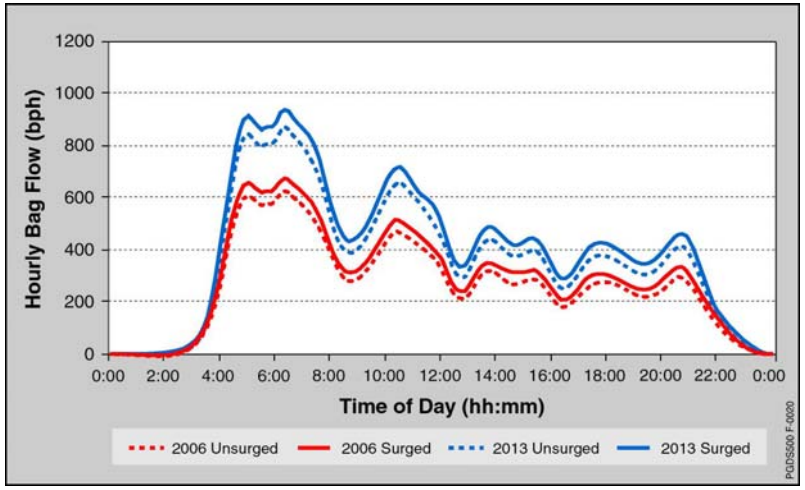
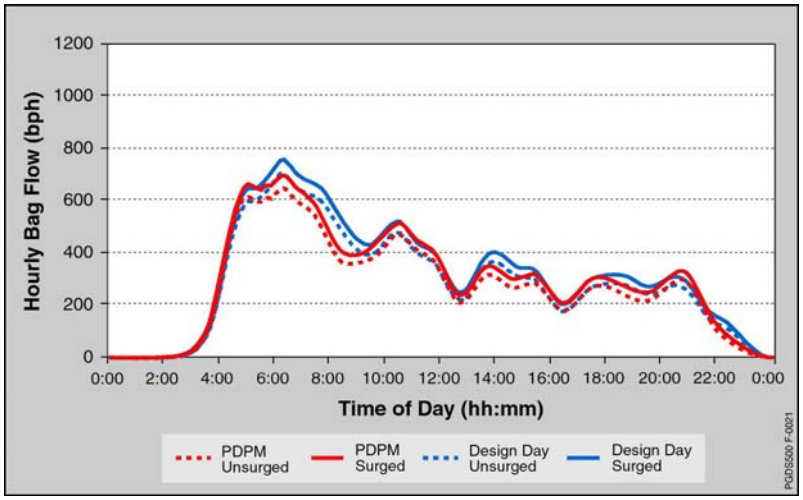


Figure C-6
STRATEGY-ORIENTED METHODOLOGY DESIGN LOAD PROFILE



A comparison of the two design day baggage flows for Terminal 1 is provided in Table C-7 below.

C.4.1.4 Terminal 1 Design Day Baggage Demand

The peak hour baggage flows of the PDPM (701 bags) and ADPM (675 bags) were very similar, as can be seen in Table C-7 above. The strategy-oriented methodology increased the peak hour baggage flow by 8% from the PDPM, while the peak hour baggage flows calculated using the standard methodology grew by 39%. A 39% increase in the predicted peak hour baggage flow is considered to be very aggressive given the operational constraints of the airlines at Terminal 1.

Table C-7
COMPARISON OF DESIGN DAY BAGGAGE FLOWS AT TERMINAL 1
(Excluding Southwest Airlines) *(a)*

	ADPM (August 26, 2006) *(b)*	Standard methodology design day 2013 ADPM	PDPM (August 25, 2006) *(b)*	Strategy-oriented methodology design day
Peak hour baggage flow (bags)	675	938	701	760

(a) Southwest currently uses its own in-line system located at terminal 2. Therefore, southwest flights were eliminated from all baggage flow calculations.
(b) The ADPM and PDPM flight schedules used in this analysis were based on Oag data for march 2006 and could vary from the actual schedules that occurred on those days.

Based on the above findings and further consultation with Airport staff, the strategy-oriented design day based on the Port's future strategy for the Airport was selected as the preferred design day. This design day is used throughout the remainder of this case study.

The design day accepted by the Port is summarized as follows:

- 116 departing operations
- 15,585 departing seats
- 12 gates available (approximately 10 daily turns per gate)

This method for estimating baggage demand differs from the standard methodology described in PGDS Chapter 5 and is included here as an example in which an alternative method can be used if there is sufficient rationale for doing so. The rationale in this case was based on two key observations. The first

observation is that the high gate utilization indicates that the terminal is currently operating at or near maximum capacity. The second observation is that site constraints limit future gate expansion to two gates. The schedule that was developed represents a reasonable estimate of the maximum demand that the terminal could accommodate. When using a demand estimation methodology different from that described in PGDS Chapter 5, justification for doing so must be provided to TSA. TSA must review and approve the method and results before design can proceed.

C.5 QUANTITATIVE ASSESSMENT

C.5.1 Baseline Demand Estimation

Existing checked baggage screening flows were estimated for each of the seven F3 screening zones. The F3 screening zones and CBRA were the same for feasible Alternatives 1 and 2. Alternative 3 combines ticket counter groups into common CBRAs. However, each ticket counter group still feeds its own EDS scanner. Therefore, the baseline demand and design day peak hour surged baggage volume calculations to determine the required number of EDS machines for each F3 Zone (ticket counter group) are applicable to all of the feasible alternatives.

C.5.1.1 List of Airlines

Table C-8 lists Terminal 1 airlines by screening zone. The F1 and F2 Zone groupings have been eliminated, as all F1 and F2 alternatives were deemed spatially infeasible during the initial assessment of alternatives described in Section C.3.4 above.

Table C-8
LIST OF AIRLINES BY SCREENING ZONE
Terminal 1

Zone	Airlines
$F3_1$	B6
$F3_2$	AQ, CO
$F3_3$	AA
$F3_4$	HP, YV, US
$F3_5$	AS, QX
$F3_6$	DL, OO, TZ
$F3_7$	UA, A296, XX *(a)*

Legend:

A296 - United Express
AA - American Airlines
AQ - Aloha Airlines
AS - Alaska Airlines
B6 - JetBlue Airways
CO - Continental Airlines
DL - Delta Air Lines
HP - America West Airlines
OO - SkyWest Airlines
QX - Horizon Air
TZ - ATA Airlines
UA - United Airlines
US - US Airways
YV - Mesa Airlines
XX - New Entrant Airline

Note: Please refer to Figure C-3 for locations of screening zones.

(a) Assumed new entrant airline using currently occupied gates that will be available after completion of the Terminal 2 expansion.

The design day flight schedules for each screening zone were created using the strategy-oriented methodology described in Section C.4 above. These flight schedules identify the maximum number of aircraft seats available and form the basis for the baggage handling system (BHS) design load profile. Flight schedules for each screening zone were presented earlier in Tables C-4 and C-5.

C.5.1.2 Base Year Demand Estimation

As described in PGDS Chapter 5, a separate analysis should be conducted to determine the PDPM for each F3 screening zone based on flight schedules obtained from the OAG. Because the strategy-oriented methodology was used, and flights were added to the schedule based on feedback from the airlines, the design day schedule included more seats for each F3 Zone than any of the other days in the peak month (August). Table C-9 below lists the peak month and peak day for each zone.

Table C-9
F3 SCREENING ZONE PEAK MONTH AND PEAK DAY

Zone	Airlines	Peak month	Peak day
$F3_1$	B6	August	25
$F3_2$	AQ, CO	August	25
$F3_3$	AA	August	25
$F3_4$	HP, YV, US	August	25
$F3_5$	AS, QX	August	25
$F3_6$	DL, OO, TZ	August	25
$F3_7$	UA, A296, XX	August	25

Legend:

A296 - United Express
AA - American Airlines
AQ - Aloha Airlines
AS - Alaska Airlines
B6 - JetBlue Airways
CO - Continental Airlines
DL - Delta Air Lines
HP - America West Airlines
OO - SkyWest Airlines
QX - Horizon Air
TZ - ATA Airlines
UA - United Airlines
US - US Airways
YV - Mesa Airlines
XX - New Entrant Airline

The Terminal 1 design load adjustment factors and rates identified in Table C-6 and the passenger arrival profiles identified on Figure C-4 were applied to the maximum seat capacity identified in each of the PDPM flight schedules for each of the F3 screening zones.

Figures C-7 through C-13 below are the CBIS design load graphs for the $F3_1$ through $F3_7$ screening zones. The base year CBIS design loads were calculated every 10 minutes over the duration of the design day. A surge factor was calculated according to PGDS Section 6.1.1, and was applied to the CBIS design load of each 10-minute period. These 10-minute results are shown graphically on Figures C-7 through C-13.

C.5.2 Design Day Demand Estimation

The surged design load for each F3 screening zone is provided below based on the strategy-oriented methodology. These 10-minute baggage flow results are shown graphically on Figures C-7 through C-13.

Figure C-7
STRATEGY-ORIENTED METHODOLOGY DESIGN LOAD PROFILE, $F3_1$ ZONE

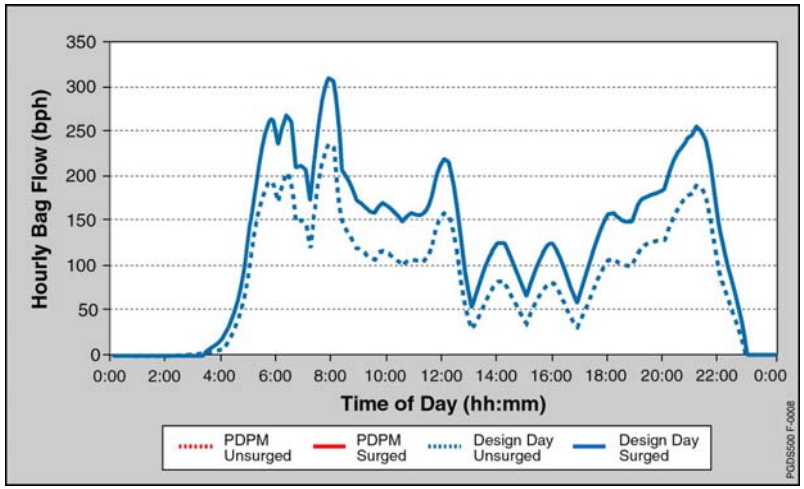


Figure C-8
STRATEGY-ORIENTED METHODOLOGY DESIGN LOAD PROFILE, $F3_2$ ZONE

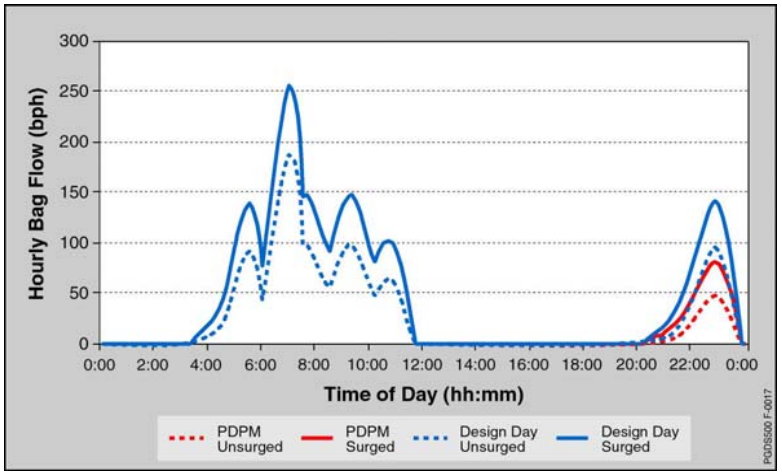


Figure C-9
STRATEGY-ORIENTED METHODOLOGY DESIGN LOAD PROFILE, $F3_3$ ZONE

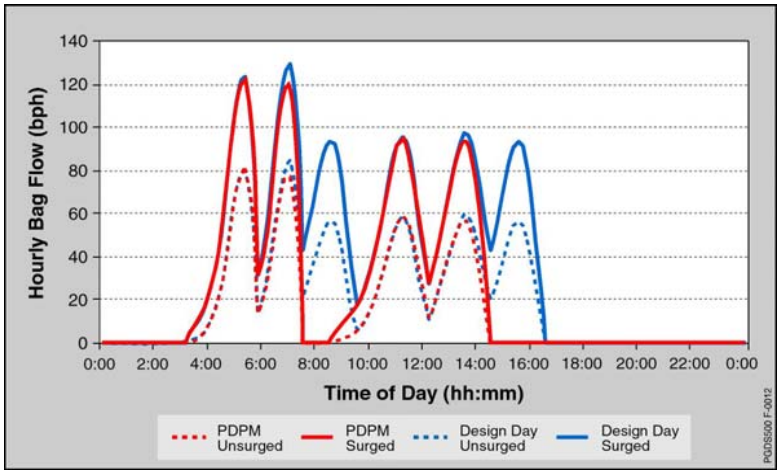


Figure C-10
STRATEGY-ORIENTED METHODOLOGY DESIGN LOAD PROFILE, $F3_4$ ZONE

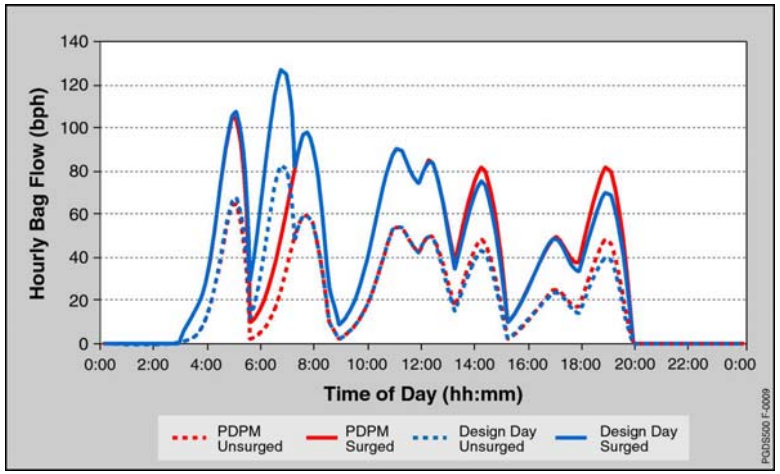


Figure C-11
STRATEGY-ORIENTED METHODOLOGY DESIGN LOAD PROFILE, $F3_5$ ZONE

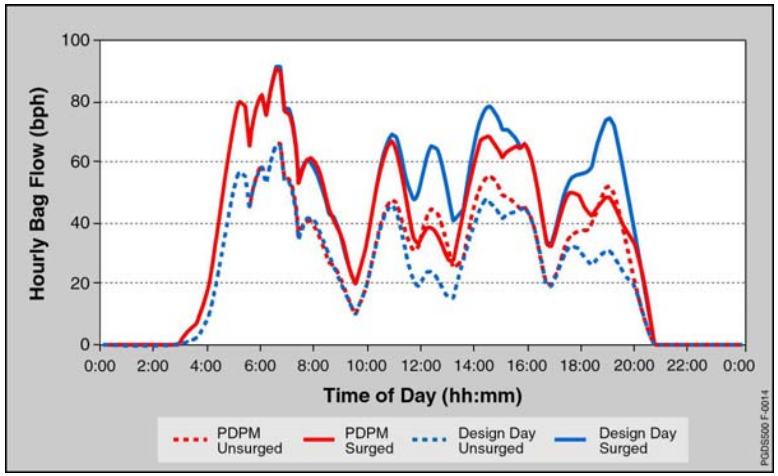


Figure C-12
STRATEGY-ORIENTATED METHODOLOGY DESIGN LOAD PROFILE, $F3_6$ ZONE

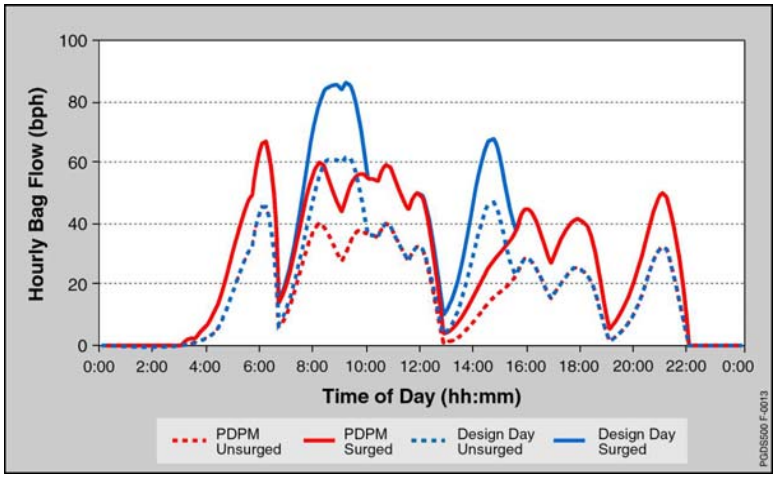


Figure C-13
STRATEGY-ORIENTATED METHODOLOGY DESIGN LOAD PROFILE, $F3_7$ ZONE

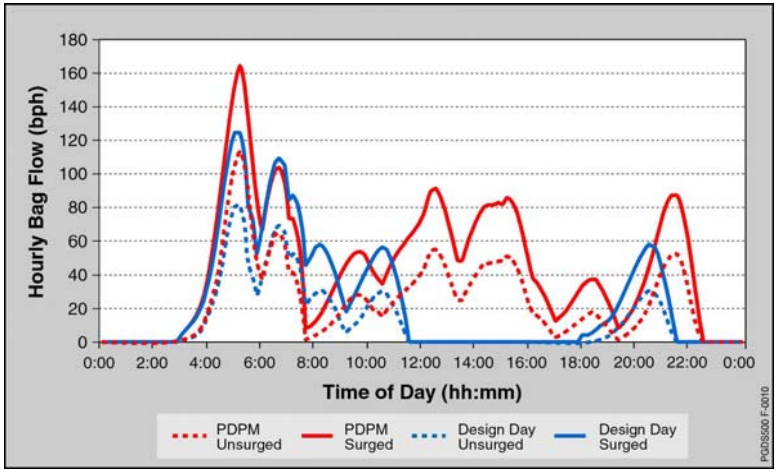


Table C-10 summarizes the PDPM (2008), PDPM surged, and design day and design day surged peak hour baggage volumes for each of the F3 screening zones.

Table C-10
F3 SCREENING ZONE PEAK HOUR BAGGAGE VOLUMES

Zone	Airlines	PDPM	Peak hour baggage volume: PDPM surged	Peak hour baggage volume: Design day	Design day surged
$F3_1$	B6	236	311	236	311
$F3_2$	AQ, CO	188	256	188	256
$F3_3$	AA	80	123	84	129
$F3_4$	HP, YV, US	65	105	161	224
$F3_5$	AS, QX	164	227	166	229
$F3_6$	DL, OO, TZ	114	166	154	215
$F3_7$	UA, A296, XX	113	165	186	253

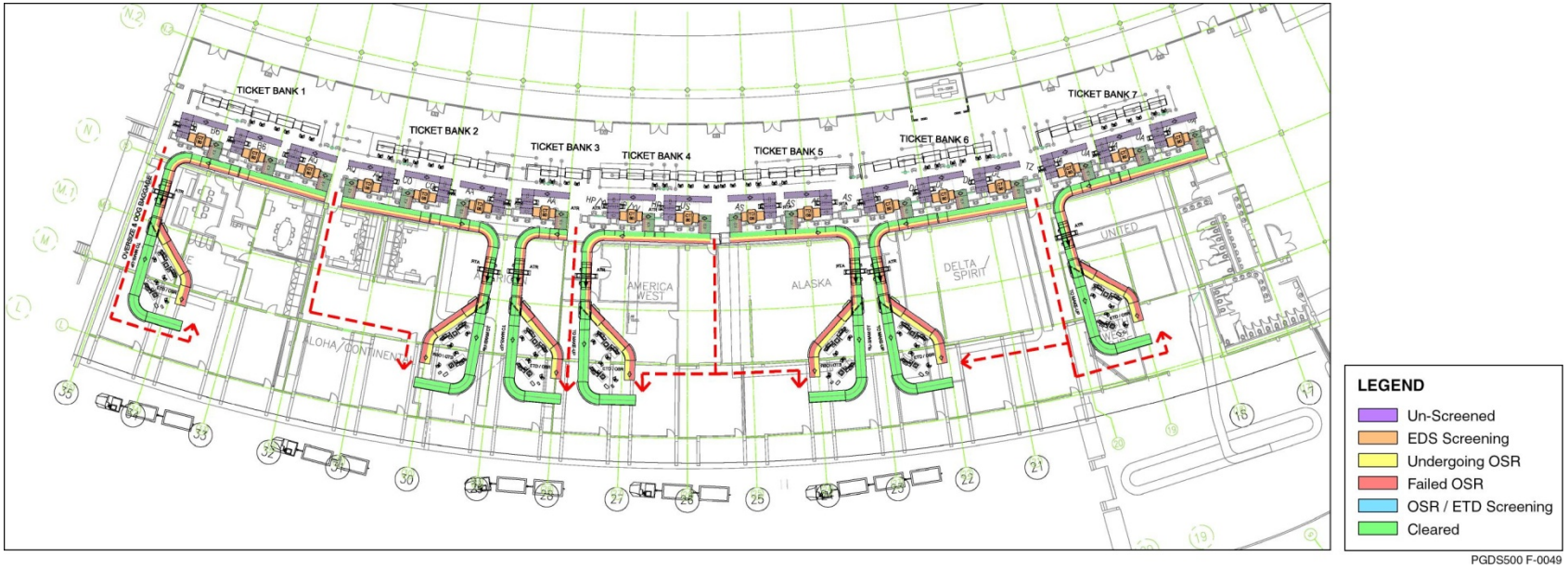
Legend:
A296 - United Express
AA - American Airlines
AQ - Aloha Airlines
AS - Alaska Airlines
B6 - JetBlue Airways
CO - Continental Airlines
DL - Delta Air Lines
HP - America West Airlines
OO - SkyWest Airlines
QX - Horizon Air
TZ - ATA Airlines
UA - United Airlines
US - US Airways
YV - Mesa Airlines
XX - New Entrant Airline

Using the surged peak hour design day baggage volume, EDS, OSR, and ETD equipment requirements can be calculated for each of the three feasible alternatives based on the high-level methodology described in the following paragraphs, and in more detail in PGDS Chapter 6.

C.5.3 Feasible Alternative 1 – CT-80 EDS Machines

This alternative is a conceptual layout for the F3 Zone grouping at Terminal 1. Under this alternative, 17 Reveal CT-80 EDS machines would be placed directly behind and parallel to the ticket counters. The ticket counters would be divided into seven groups (F3 Zone grouping). Each group would be served by one, two, or three EDS machines and one CBRA, where combined OSR and ETD screening functions would be performed. Each grouping of machines would have a single conveyor leading to the baggage makeup area and the CBRA. The differences between dedicated and combined OSR functionality would be investigated further if Alternative 1 were selected as a preferred alternative; however, given the highly decentralized nature of this alternative, combined OSR/ETD is likely to be the most cost-effective approach. A conceptual diagram of Alternative 1 is provided on Figure C-14.

Figure C-14
ALTERNATIVE 1 CONCEPTUAL DIAGRAM
Terminal 1



C.5.3.1 EDS Screening Equipment

Alternative 1 is based on the use of Reveal CT-80 EDS machines. As discussed in PGDS Chapter 3, the use of CT-80 EDS machines in a mini in-line system yields a throughput of 120 bags per hour (bph). The peak-hour surged baggage volume is divided by the assumed EDS equipment throughput, yielding the quantity of required EDS machines. The number of required machines should always be rounded up to the next whole EDS machine without considering redundancy.

As discussed in previous paragraphs, activity at Terminal 1 is constrained by the number of gates and the design year activity was projected based on this constraint; therefore, additional growth beyond the projected design year levels would not be possible. For this reason, the system would not need additional flexibility to accommodate growth beyond the design year. Given the decentralized nature of Terminal 1 mini in-line systems, redundancy would be provided through the use of nearby systems. While the demand profiles indicate that peaks generally occur early in the morning, some of the EDS machines are not fully utilized and could offer spare capacity if needed.

Redundant equipment is only cost-effective for high-throughput and medium-throughput in-line systems, where machine downtime can have a significant effect on system performance because of the high throughput of each EDS machine.

Table C-11 indicates the number of EDS machines required for Alternative 1.

Table C-11
ALTERNATIVE 1 EDS MACHINE CAPACITY CALCULATIONS

			EDS machines		
Zone	Airlines	Peak hour bag volume	Throughput (bags/hour)	No.	With redundancy
$F3_1$	B6	311	120	3	Same
$F3_2$	AQ, CO	256	120	3	Same
$F3_3$	AA	129	120	2	Same
$F3_4$	HP, YV, US	224	120	2	Same
$F3_5$	AS, QX	229	120	2	Same
$F3_6$	DL, OO, TZ	215	120	2	Same
$F3_7$	UA, A296, XX	253	120	3	Same

Legend:
A296 - United Express
AA - American Airlines
AQ - Aloha Airlines
AS - Alaska Airlines
B6 - JetBlue Airways
CO - Continental Airlines
DL - Delta Air Lines
HP - America West Airlines
OO - SkyWest Airlines
QX - Horizon Air
TZ - ATA Airlines
UA - United Airlines
US - US Airways
YV - Mesa Airlines
XX - New Entrant Airline

C.5.3.2 OSR/ETD Screening Equipment

C.5.3.2.1 OSR/ETD Screening

As a mini in-line system, Alternative 1 is based on the use of OSR and ETD screening functions combined and performed by the same ETD screener with individual CBRAs dedicated to each screening zone or system. In general, an ETD machine would be shared between two screeners. Thus, the ratio of ETD screening stations to ETD equipment was assumed to be 2 to 1.

The formula for calculating the combined OSR and ETD station requirements is explained below in accordance with PGDS

Chapter 6. Please note that the values used in these calculations are based on the equipment assumptions listed in PGDS Chapter 3. The calculation for screening zone $F3_1$ is shown below. Similar calculations were performed for the other six screening zones.

Note: All EDS false alarm rates and OSR clear rates are notional and are used for this example only. False alarm rates are considered Sensitive Security Information (SSI) and can be requested from TSA, along with OSR clear rates.

The number of combined OSR and ETD screening stations required for zone $F3_1$:

$N_{ETD\ Station\ Screener}$ = (Sum of $Throughput_{EDS}$ x FA_{EDS})/($Throughput_{OSR/ETD}$)
= (360 bph x 19.5%)/34.5 bph
= 2.03 → 3 (rounded up)

$N_{ETD\ Machines}$ = (N_{ETD} Screeners/2) rounded up to the next ETD
= (3/2)
= 2 ETD Machines

Table C-12 indicates the quantity of combined OSR/ETD stations and ETD machines required for Alternative 1.

C.5.3.2.2 ETD Screening for Oversize and Out of Gauge Baggage

Based on discussions with Airport staff and analysis of the CT-80 and AN KC design specifications, it was assumed that 1% of all checked baggage at Terminal 1 is either oversized or OOG. These bags would be manually carried by the ticketing agent to the opposite end of the CBIS and given to TSA agents working at the ETD stations for directed trace screening.

C.5.4 Feasible Alternative 2 – Analogic King Cobra EDS Machines

This alternative is a conceptual design for the F3 Zone grouping at Terminal 1. As shown on Figure C-15, seven AN KC EDS machines would be used under this alternative. The ticket counters would be divided into the same seven ticket counter groups as under Alternative 1. However, each group would be served by one EDS machine integrated downstream of the ticket counter take-away conveyor. This alternative was further split into two parts, Alternative 2A and Alternative 2B. Under Alternative 2A, OSR and ETD screening functions would be combined, similar to Alternative 1. Under Alternative 2B, dedicated OSR screening would be conducted in a separate screening room. The conceptual diagrams for Alternative 2A and Alternative 2B are the same, except for the remote OSR room, which is already built as part of the existing in-line system in Terminal 2.

C.5.4.1 EDS Screening Equipment

Alternatives 2 and 3 are based on the use of Analogic King Cobra (AN KC) EDS machines. As each ticket counter line under both alternatives would feed an EDS scanner, the EDS equipment requirements would be the same under both alternatives. As reported in PGDS Chapter 3, the use of AN KC EDS machines in a mini in-line system yields a throughput of 350 bags per hour per machine. The peak-hour surged baggage volume is divided by the assumed EDS equipment throughput, yielding the quantity of required EDS machines. In accordance with the PGDS, machine requirements should be rounded up to the next whole EDS machine exclusive of redundancy considerations.

Given the decentralized nature of the Terminal 1 mini in-line systems, redundancy would be provided through the use of nearby systems. While the demand profiles indicate that peaks generally occur early in the morning, some of the EDS machines are not fully utilized and could offer spare capacity if needed.

Table C-12
ALTERNATIVE 1 OSR/ETD EQUIPMENT CALCULATIONS

Zone	Airlines	Peak hour bag volume	EDS machines			Number of combined OSR/ETD stations	Number of ETD machines
			Throughput (bags/hour)	No.	With redundancy		
$F3_1$	B6	311	120	3	Same	3	2
$F3_2$	AQ, CO	256	120	3	Same	3	2
$F3_3$	AA	129	120	2	Same	2	1
$F3_4$	HP, YV, US	224	120	2	Same	2	1
$F3_5$	AS, QX	229	120	2	Same	2	1
$F3_6$	DL, OO, TZ	215	120	2	Same	2	1
$F3_7$	UA, A296, XX	253	120	3	Same	3	2

Legend:

A296 - United Express
AA - American Airlines
AQ - Aloha Airlines
AS - Alaska Airlines
B6 - JetBlue Airways
CO - Continental Airlines
DL - Delta Air Lines
HP - America West Airlines
OO - SkyWest Airlines
QX - Horizon Air
TZ - ATA Airlines
UA - United Airlines
US - US Airways
YV - Mesa Airlines
XX - New Entrant Airline

Figure C-15
ALTERNATIVES 2A AND 2B CONCEPTUAL DIAGRAM
Terminal 1

Redundant equipment is only cost-effective for high-throughput and medium-throughput in-line systems, where machine downtime can have a significant effect on system performance because of the high speed of each EDS machine.

Table C-13 indicates the quantity of EDS machines that would be required for Alternatives 2 and 3.

Table C-13
ALTERNATIVES 2 AND 3 EDS MACHINE CALCULATIONS

Zone	Airlines	Peak hour bag volume	EDS machines Throughput (bags/hour)	EDS machines No.	EDS machines With redundancy
$F3_1$	B6	311	350	1	Same
$F3_2$	AQ, CO	256	350	1	Same
$F3_3$	AA	129	350	1	Same
$F3_4$	HP, YV, US	224	350	1	Same
$F3_5$	AS, QX	229	350	1	Same
$F3_6$	DL, OO, TZ	215	350	1	Same
$F3_7$	UA, A296, XX	253	350	1	Same

Legend:

A296 - United Express
AA - American Airlines
AQ - Aloha Airlines
AS - Alaska Airlines
B6 - JetBlue Airways
CO - Continental Airlines
DL - Delta Air Lines
HP - America West Airlines
OO - SkyWest Airlines
QX - Horizon Air
TZ - ATA Airlines
UA - United Airlines
US - US Airways
YV - Mesa Airlines
XX - New Entrant Airline

C.5.4.2 OSR and ETD Screening Equipment

C.5.4.2.1 Alternative 2A, Combined OSR/ETD

As a mini in-line system, Alternative 2A is based on combined OSR and ETD screening functions that would be performed by the same ETD screener, with individual CBRAs dedicated to each screening zone or system. In general, an ETD machine would be shared between two screeners. Thus, the ratio of ETD screening stations to ETD equipment was assumed to be 2 to 1.

The formula for calculating the combined OSR and ETD station requirements is explained below in accordance with PGDS Chapter 6. Please note that all of the values used in these calculations are based on the equipment assumptions listed in PGDS Chapter 3. False alarm rates are considered SSI and can be requested from TSA. The calculation for screening zone $F3_1$ is shown below. Similar calculations were performed for the other six screening zones.

The number of combined OSR and ETD screening stations required for zone $F3_1$:

$$N_{ETD\ Stations} = \frac{N_{EDS} \times Throughput_{EDS} \times FA}{Throughput_{OSR/ETDScreener}}$$

$$N_{ETD\ Stations} = (350\ bph \times 15\%)/45.3\ bph = 1.16 \rightarrow 2\ (rounded\ up)$$

$$N_{ETD\ Machines} = \frac{N_{ETD\ Stations}}{2}$$

$$N_{ETD\ Machines} = (2/2) = 1\ ETD\ Machine$$

C.5.4.2.2 Alternative 2B, Dedicated OSR Screening

As a mini in-line system, Alternative 2B is based on the use of dedicated OSR and ETD screening functions that would be performed by different screeners, with individual CBRAs dedicated to each screening zone or system. In general, an ETD machine would be shared between two screeners. Thus, the ratio of ETD screening stations to ETD equipment was assumed to be 2 to 1.

The formula for calculating dedicated OSR and ETD station requirements is explained below in accordance with PGDS Chapter 6. Please note that the values used in these calculations are based on the equipment assumptions listed in PGDS Chapter 3. The calculation for screening zone $F3_1$ is shown below. Similar calculations were performed for the other six screening zones.

Note: All EDS false alarm rates and OSR clear rates are notional and used for this example only. False alarm rates are considered SSI and, along with OSR clear rates, can be requested from TSA.

The number of separate OSR and ETD screening stations required:

$$N_{OSR} = \frac{N_{EDS} \times Throughput_{EDS} \times FA_{EDS}}{Throughput_{OSR}}$$

$$N_{OSR} = (350 \text{ bph} \times 15\%)/(180 \text{ bph}) = 0.29 \rightarrow 1 \text{ (rounded up)}$$

$$N_{ETD\ Stations} = \frac{N_{EDS} \times Throughput_{EDS} \times FA \times (1\text{-}CR_{OSR})}{Throughput_{ETDScreener}}$$

$$N_{ETD\ Stations} = (350 \text{ bph} \times 15\% \times (40\%))/24.2 \text{ bph} = 0.87 \rightarrow 1 \text{ (rounded up)}$$

Table C-14 indicates the quantity of combined OSR/ETD stations and ETD machines that would be required for Alternative 2.

C.5.4.2.3 ETD Screening for Oversize and Out of Gauge Baggage

Based on discussions with Airport staff and analysis of the CT-80 and AN KC design specifications, it was assumed that 1% of all checked baggage at Terminal 1 is either oversized or OOG. These bags would be manually carried by the ticketing agent to the opposite end of the CBIS and given to TSA agents working at the ETD stations for directed trace screening.

C.5.5 Feasible Alternative 3 – Analogic King Cobra EDS Machines

This alternative is also a conceptual design for the F3 Zone grouping at Terminal 1. Seven AN KC EDS machines would be used. The ticket counters would be divided into seven ticket counter groups. Each group would be served by a single EDS machine integrated downstream of the ticket counter take-away conveyor. ETD screening and baggage makeup functions would be partially consolidated because a common CBRA and makeup area would serve every two EDS machines. In addition, OSR would be performed remotely, while ETD screening functions would be performed in the CBRA, as Alternative 3 represents a more staff-efficient screening method that could be effectively used when the CBIS design calls for common use CBRAs. A conceptual diagram of Alternative 3 is provided on Figure C-16.

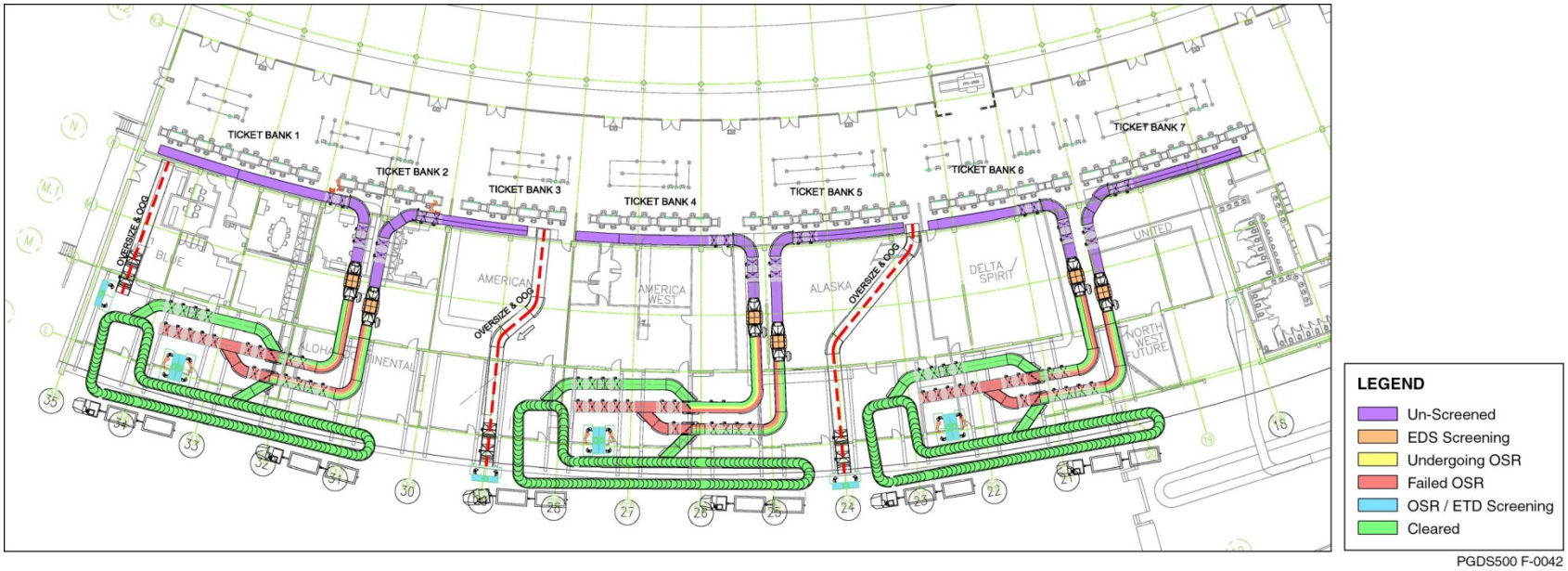
Table C-14
ALTERNATIVE 2 OSR/ETD EQUIPMENT CALCULATIONS

Airlines	Peak hour bag volume	EDS machines			Alternative 2A Number of combined OSR/ETD stations	Alternative 2B Number of separate OSR ETD	
		Throughput (bags/hour)	No.	With redundancy		OSR machines	ETD machines
B6	311	350	1	Same	2	1	1
AQ, CO	256	350	1	Same	2	1	1
AA	129	350	1	Same	2	1	1
HP, YV, US	224	350	1	Same	2	1	1
AS, QX	229	350	1	Same	2	1	1
DL, OO, TZ	215	350	1	Same	2	1	1
UA, A296, XX	253	350	1	Same	2	1	1

Legend:

A296 - United Express
AA - American Airlines
AQ - Aloha Airlines
AS - Alaska Airlines
B6 - JetBlue Airways
CO - Continental Airlines
DL - Delta Air Lines
HP - America West Airlines
OO - SkyWest Airlines
QX - Horizon Air
TZ - ATA Airlines
UA - United Airlines
US - US Airways
YV - Mesa Airlines
XX - New Entrant Airline

Figure C-16
ALTERNATIVE 3 CONCEPTUAL DIAGRAM
Terminal 1



C.5.5.1 Baseline Demand for Combined CBRAs

C.5.5.1.1 Surged PDPM for the Combined CBRAs

Alternative 3 combines ticket counter groups into common CBRAs for OSR and ETD screening. There are currently three common CBRAs consisting of screening zones $F3_{1\text{-}3}$, $F3_{4\text{-}5}$, and $F3_{6\text{-}7}$. See earlier Figure C-2. To accurately calculate the design day peak baggage flow that would reach the common CBRAs, separate baseline demand and peak day demand calculations must be run based on the combined airline and flight schedules for each common CBRA.

The peak month and the ADPM for each CBRA zone should be calculated if the standard methodology is used, as shown on Table C-15. However, as the strategy-oriented methodology was used, wherein the design day was created based on feedback from the airlines, this approach would not apply.

Table C-15
COMBINED CBRAs PEAK MONTH AND PEAK DAY

Zone	Airlines	Peak month	Peak day
$F3_{1-3}$	B6, AQ, CO, AA	August	25
$F3_{4-5}$	HP, YV, US, AS, QX	August	25
$F3_{6-7}$	DL, OO, TZ, UA, A296, XX	August	25

Legend:

A296 - United Express
AA - American Airlines
AQ - Aloha Airlines
AS - Alaska Airlines
B6 - JetBlue Airways
CO - Continental Airlines
DL - Delta Air Lines
HP - America West Airlines
OO - SkyWest Airlines
QX - Horizon Air
TZ - ATA Airlines
UA - United Airlines
US - US Airways
YV - Mesa Airlines
XX - New Entrant Airline

The Terminal 1 design load adjustment factors and rates identified earlier in Table C-6 and the passenger arrival profiles identified on Figure C-4 were applied to the maximum seat capacity identified in each of the PDPM flight schedules for each of the combined CBRA zones.

C.5.5.1.2 Design Day Demand Estimation for Combined CBRA

Figures C-17 through C-19 below represent the CBIS design load graphs for the $F3_{1-3}$, $F3_{4-5}$, and $F3_{6-7}$ screening zones. The base year CBIS design loads were calculated every 10 minutes over the duration of the design day. A surge factor was calculated according to PGDS Section 6.1.1, and applied to the CBIS design load of each 10-minute period. These 10-minute results are shown graphically in the following charts.

Figure C-17
STRATEGY-ORIENTED METHODOLOGY DESIGN LOAD PROFILE, $F3_{1-3}$ ZONE

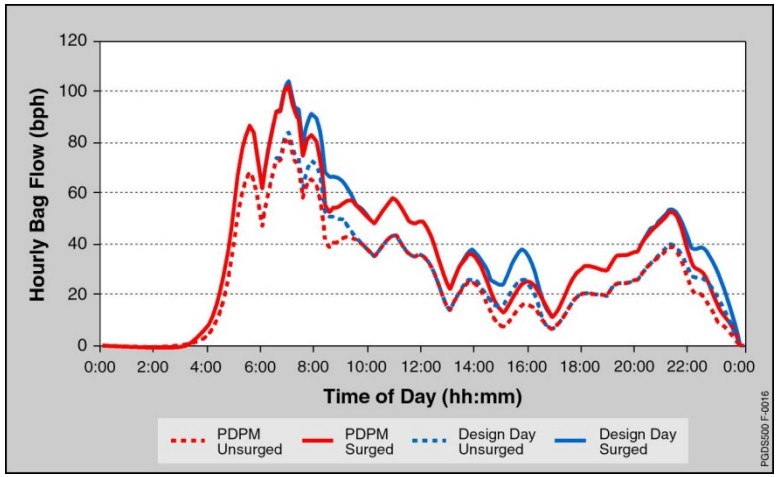


Figure C-18
STRATEGY-ORIENTED METHODOLOGY DESIGN LOAD PROFILE, $F3_{4-5}$ ZONE

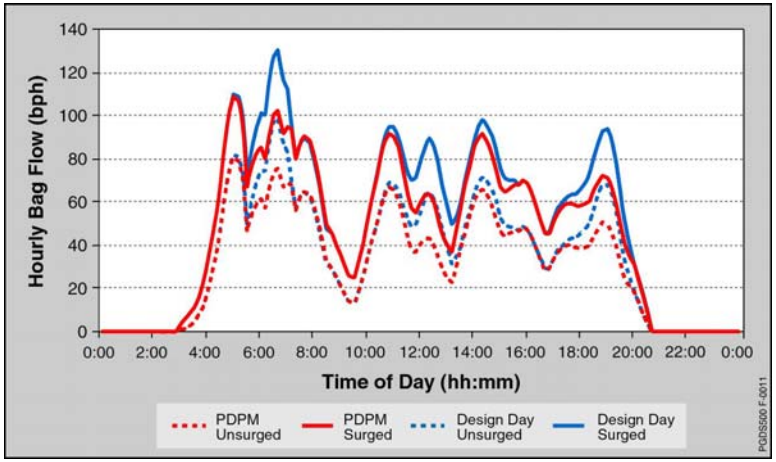


Figure C-19
STRATEGY-ORIENTED METHODOLOGY DESIGN LOAD PROFILE, $F3_{6-7}$ ZONE

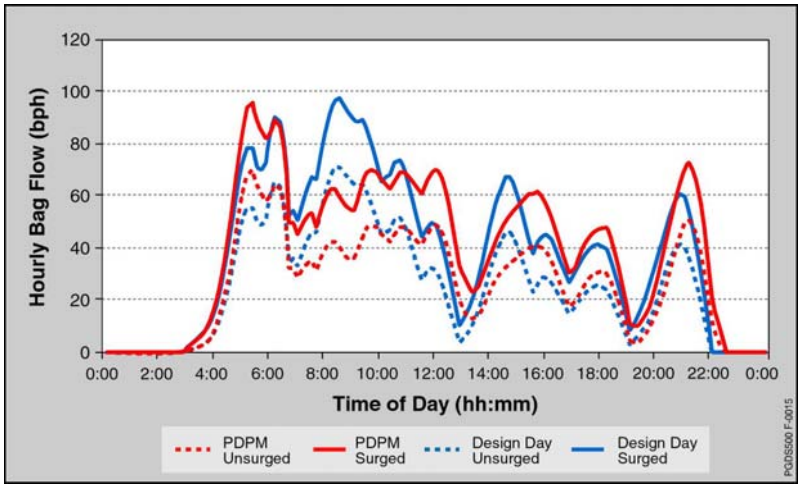


Table C-16 summarizes the PDPM, PDPM surged, and design day peak hour baggage volumes for each of the combined CBRA zones.

Using the surged peak hour design day baggage volume, EDS, OSR, and ETD equipment requirements can be calculated for each of the three combined CBRA zones based on the high-level methodology described in PGDS Chapter 6.

Table C-16
COMBINED CBRA ZONE PEAK HOUR BAGGAGE VOLUMES

Combined zones	Airlines	PDPM	Peak hour baggage volume: PDPM surged	Peak hour baggage volume: Design day	Design day surged
$F3_{1-3}$	B6, AQ, CO, AA	412	511	419	520
$F3_{4-5}$	HP, YV, US, AS, QX	201	271	326	415
$F3_{6-7}$	DL, OO, TZ, UA, A296, XX	175	240	273	354

Legend:
- A296 - United Express
- AA - American Airlines
- AQ - Aloha Airlines
- AS - Alaska Airlines
- B6 - JetBlue Airways
- CO - Continental Airlines
- DL - Delta Air Lines
- HP - America West Airlines
- OO - SkyWest Airlines
- QX - Horizon Air
- TZ - ATA Airlines
- UA - United Airlines
- US - US Airways
- YV - Mesa Airlines
- XX - New Entrant Airline

C.5.5.2 EDS Screening Equipment

See Table C-13 for EDS screening equipment for Alternative 3.

C.5.5.3 OSR and ETD Screening Equipment

C.5.5.3.1 Dedicated OSR Screening

As a mini in-line system, Alternative 3 is based on the use of dedicated OSR and ETD screening functions performed by different screeners in each of the combined CBRA zones. In general, an ETD machine would be shared between two screeners. Thus, the ratio of ETD screening stations to ETD equipment was assumed to be 2 to 1.

The formula for calculating dedicated OSR and ETD station requirements is explained below in accordance with PGDS Chapter 6. Please note that the values used in these calculations are based on the equipment assumptions listed in PGDS Chapter 3. The calculation for combined screening zone $F3_{1\text{-}3}$ is shown below. Similar calculations were performed for the other two combined screening zones.

Note: All EDS false alarm rates and OSR clear rates are notional and are used for this example only. False alarm rates are considered SSI and, along with OSR clear rates, can be requested from TSA.

The number of separate OSR and ETD screening stations required:

$$N_{OSR} = \frac{N_{EDS} \times Throughput_{EDS} \times FA_{EDS}}{Throughput_{OSR}}$$

$$N_{OSR} = (xxx\ bph \times 15\%)/(180\ bph) = xxx$$

$$N_{ETD\ Stations} = \frac{N_{EDS} \times Throughput_{EDS} \times FA \times (1\text{-}CR_{OSR})}{Throughput_{ETDScreener}}$$

$$N_{ETD\ Stations} = (xxx\ bph \times 15\% \times (40\%))/24.2\ bph = xxx$$

Table C-17 indicates the quantity of combined OSR/ETD stations and ETD machines that would be required for Alternative 3.

C.6 ANALYSIS AND EVALUATION

The alternatives were evaluated using both qualitative assessment based on expert judgment and quantitative analysis of the life-cycle costs (LCCs) of the alternatives.

C.6.1 Qualitative Assessment

Table C-18 shows the qualitative assessment matrix and criteria used to assess all spatially feasible alternatives for Terminal 1. Several qualitative criteria were used to assess the alternatives based on expert judgment, namely:

1. Customer level of service – the effect that each alternative would have on the passenger's experience at the Airport.

2. Effect on Airport operations – the reliability and maintainability of the EDS equipment and the contingency procedures that could be implemented if a machine were inoperative during a peak period, as well as the effect that the alternative would have on the airlines.

3. Economic considerations – the costs associated with TSA staff salaries and with implementing and maintaining the alternative.

4. Design criteria – the effect that the alternative would have on existing facilities as well as the ease with which the alternative could be constructed or expanded.

Results of the qualitative assessment are shown in Table C-18 by alternative.

Table C-17
COMBINED CBRA OSR/ETD CALCULATIONS

			EDS machines			Separate OSR ETD	
Zone	Airlines	Peak hour bag volume	Throughput (bags/hour)	No.	With redundancy	No. of OSR machines	No. of ETD machines
$F3_{1-3}$	B6, AQ, CO, AA	520	350	3	Same	1	2
$F3_{4-5}$	HP, YV, US, AS, QX	415	350	2	Same	1	2
$F3_{6-7}$	DL, OO, TZ, UA, A296, XX	354	350	2	Same	1	2

Legend:

A296 - United Express
AA - American Airlines
AQ - Aloha Airlines
AS - Alaska Airlines
B6 - JetBlue Airways
CO - Continental Airlines
DL - Delta Air Lines
HP - America West Airlines
OO - SkyWest Airlines
QX - Horizon Air
TZ - ATA Airlines
UA - United Airlines
US - US Airways
YV - Mesa Airlines
XX - New Entrant Airline

All alternatives would provide adequate screening capacity, meet performance standards, be equally maintainable, and provide moderate EDS utilization (typical of decentralized alternatives).

Alternative 1. Alternative 1 would have the greatest effect on customer level of service because lobby space would be reduced by approximately 40% to accommodate the EDS machines behind the ticket counters. The maintainability of this alternative would be the lowest because it would involve the highest number of EDS machines. Alternative 1 was determined to be the worst performing alternative from economic and design standpoints as it would have high capital, maintenance, and operating costs; require the highest number of TSA screeners; have the greatest effect on existing facilities; and would be the most difficult to construct, phase, and expand.

Alternative 2A. Alternative 2A was rated the best in terms of the evaluation criteria. It was determined that Alternative 2A is the most suitable type of checked baggage screening system to be implemented in Terminal 1. Alternative 2A has cost and operational characteristics consistent with the Port's expansion plans and is sufficiently flexible to quickly adapt to changes (e.g., different EDS equipment).

Table C-18
QUALITATIVE ASSESSMENT MATRIX

	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3
Screening capacity	Adequate	Adequate	Adequate	Adequate
Customer level of service	Affected	Same	Same	Same
Operations				
Performance	Adequate	Adequate	Adequate	Adequate
Utilization of EDS equipment	Moderate	Moderate	Moderate	Moderate
Reliability and availability	Lower	Moderate	Moderate	Moderate
Contingency operations	Adequate	Moderate	Moderate	Moderate
Maintainability	Adequate	Adequate	Adequate	Adequate
Impact to airline operations	Moderate	Moderate	Moderate	Higher
Design				
Impact on existing facilities	Higher	Lower	Lower	Moderate
Expandability	More difficult	Feasible	Feasible	Feasible
Constructibility and phasing	More difficult	Moderate	Moderate	More difficult

Alternative 2B. Alternative 2B was rated the second best in terms of the evaluation criteria. Alternative 2B would not be as well suited to the Airport as Alternative 2A because of the higher capital cost required to install the remote OSR. Also the 95th percentile bag time in system was 8.90 minutes compared with 6.34 minutes for Alternative 2A. Although fewer bags were processed in the Baggage Inspection Room for Alternative 2B than for Alternative 2A, Alternative 2B still had a higher 95th percentile bag time in system because all of the bags that were sent to the Baggage Inspection Room were subject to a directed ETD search, which requires a longer processing time than the combined OSR/ETD search performed under Alternative 2A.

Alternative 3. Alternative 3 would have a great effect on airline operations because of the combined baggage makeup areas, which are not airline specific. In addition, the Baggage Inspection Room would not be easily accessible, and that may create operational and security difficulties. Alternative 3 also has high capital costs; is difficult to construct and phase; and would have a significant effect on the airline baggage makeup operations

because airlines would be required to share baggage carousels. In addition, Alternative 3 would occupy more space because of the increased number of automated conveyors.

Alternatives 2A and 2B had the highest scores, while Alternative 1 had the lowest score among the alternatives based on the above high-level qualitative assessment and expert judgment.

C.6.2 Quantitative Life-Cycle Cost Analysis

A life cycle cost analysis of the alternatives was then conducted. Based on the LCC analysis of each alternative, the preliminary ranking, and discussions with TSA and Airport staff, a decision was made as to the optimal solution that would best meet the Airport's needs while remaining a viable cost-effective alternative for TSA.

The LCC analysis was based on the methodology presented in PGDS Chapter 8. A real discount rate of 7% per year and an analysis period of 20 years were used. The costs used in the LCC analysis were based on the costs provided in PGDS Chapter 8 unless otherwise stated. A summary of the costs is provided in Table C-19.

The methodology used to calculate the LCCs is described below:

- It was assumed that installation of the in-line system would begin in 2007 and that the DBU of the in-line system would be in 2008.
- All EDS machines were assumed to be refurbished after 7 years and replaced with new machines 4 years later.
- All maintenance costs were assumed to be covered by the manufacturer during the first year of operation of a new EDS machine.
- Using expert judgment, incremental BHS operating costs were calculated at 10% of the screening equipment operating costs.
- It was assumed that the EDS machine residual value equals the disposal cost of the EDS machine. As these two costs balance each other, they were not included in the calculations.

Based on the assumptions and costs provided above, the total net present value of the LCCs for each of the alternatives is presented in Table C-20. Please refer to Tables C-21 through C-24 for more detailed calculations.

The lowest LCC for Terminal 1 was for Alternative 2B ($22.77 million), with Alternative 2A having the next lowest LCC ($25.27 million).

The difference in LCC between Alternatives 2A and 2B was relatively small (the LCC for Alternative 2B is approximately 10% lower than for Alternative 2A), so these two alternatives were kept for presentation to stakeholders while Alternatives 1 and 3 were eliminated from further consideration.

As the LCCs for Alternatives 2A and 2B were similar and Alternative 2A was rated as qualitatively superior to Alternative 2B (see Table C-18), Alternative 2A was selected as the preferred alternative for Terminal 1. Note that this decision was based on input from stakeholders, assessment of the qualitative effects of the systems, and the marginal difference in LCCs between Alternatives 2A and 2B. Therefore, while Alternative 2A would be slightly more expensive from a life-cycle cost perspective, the qualitative benefits of the system outweighed the slightly higher life-cycle cost.

Table C-19
UNIT COSTS USED IN THE LIFE CYCLE COST ANALYSIS

Life cycle costs *(a)*	Alternative 1 CT-80	Alternative 2A AN KC	Alternative 2B AN KC	Alternative 3 AN KC
Capital Costs				
Screening equipment purchase	$285,000	$350,000	$350,000	$ 350,000
Screening equipment installation	100,000	100,000	100,000	100,000
Screening equipment refurbishment	80,000	85,000	85,000	85,000
Screening equipment replacement	50,000	50,000	50,000	50,000
EDS cost of removal *(b)*	20,000	20,000	20,000	20,000
Required infrastructure modifications to the building and BHS	350,000	650,000	700,000	2,100,000 *(c)*
Operating and Maintenance Costs				
Screening equipment maintenance	$28,500	$35,000	$35,000	$35,000
Screening equipment power consumption	1.6 kWh	4.4 kWh	4.4 kWh	4.4 kWh
Incremental BHS maintenance costs (including additional maintenance personnel)	33,040	33,040	33,040	33,040

BHS = Baggage handling system
EDS = Explosives detection system

(a) All of the costs listed are unit costs per machine.
(b) Costs not provided in the Planning Guidelines and Design Standards, but rather determined using expert judgment.
(c) The costs vary by alternative because some alternatives require significantly more infrastructure modifications than others. Whenever necessary, expert judgment was used.

Table C-20
ALTERNATIVE LIFE CYCLE COSTS

Alternatives	Life cycle costs*
Alternative 1	$41,348,128
Alternative 2A	25,272,491
Alternative 2B	22,771,578
Alternative 3	31,577,852

*Present value costs over 20 years.

C.7 FINAL CONSIDERATIONS

The development of conceptual alternatives and selection of the preferred solutions for any airport terminal is an iterative process based both on quantifiable analysis and good judgment. Terminal space constraints, airline preferences, and TSA security and operational considerations play major roles in determining which zoning schemes can be successfully translated into a feasible concept. Cost considerations are fundamental in determining which concepts should be eliminated in the process of selecting the preferred alternative(s).

In this particular case study, the preferred alternative had the second lowest cost as identified by the life cycle cost analysis, the best design, and the fewest operational effects on the Airport, as identified in the qualitative assessment matrix (Table C-18).

Table C-21
TERMINAL 1, ALTERNATIVE 1, LIFE CYCLE COST ANALYSIS

Cost Categories	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Capital Cost										
Screening equipment purchase		$4,845,000								
Screening equipment installation		1,700,000								
Screening equipment refurbishment									$1,360,000	
Screening equipment replacement									850,000	
EDS removal										
Required infrastructure modifications to the building and BHS	$5,950,000									
O&M Costs										
Screening equipment maintenance		--	$ 484,500	$ 484,500	$ 484,500	$ 484,500	$ 484,500	$ 484,500	484,500	$ 484,500
Screening equipment operating		23,827	23,827	23,827	23,827	23,827	23,827	23,827	23,827	23,827
Incremental BHS maintenance (including additional maintenance personnel)		561,680	561,680	561,680	561,680	561,680	561,680	561,680	561,680	561,680
Incremental BHS operating		2,383	2,383	2,383	2,383	2,383	2,383	2,383	2,383	2,383
Staffing Costs										
TSA screener and supervisor *(a)*		1,310,074	1,310,074	1,310,074	1,358,147	1,358,147	1,358,147	1,358,147	1,358,147	1,358,147
Staff associated with clearing bag jams or portering bags (if not included in O&M costs described above)		--	--	--	--	--	--	--	--	--
Total	$ 5,950,000	$8,442,964	$2,382,464	$2,382,464	$2,430,537	$2,430,537	$2,430,537	$2,430,537	$4,640,537	$2,430,537
Discount Factor	1.000	1.070	1.145	1.225	1.311	1.403	1.501	1.606	1.718	1.838
Discounted Annual Costs	$ 5,950,000	$7,890,620	$2,080,936	$1,944,800	$1,854,245	$1,732,939	$1,619,569	$1,513,616	$2,700,835	$1,322,051
Present Value of Costs	$41,348,128									

Table C-21 *(page 2 of 2)*
TERMINAL 1, ALTERNATIVE 1, LIFE CYCLE COST ANALYSIS

Cost Categories	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Capital Cost										
Screening equipment purchase			$4,845,000							
Screening equipment installation			1,700,000							
Screening equipment refurbishment										$1,360,000
Screening equipment replacement										850,000
EDS removal			340,000							
Required infrastructure modifications to the building and BHS										
O&M Costs										
Screening equipment maintenance	$ 484,500	$ 484,500	-	$ 484,500	$ 484,500	$ 484,500	$ 484,500	$ 484,500	$ 484,500	484,500
Screening equipment operating	23,827	23,827	23,827	23,827	23,827	23,827	23,827	23,827	23,827	23,827
Incremental BHS maintenance (including additional maintenance personnel)	561,680	561,680	561,680	561,680	561,680	561,680	561,680	561,680	561,680	561,680
Incremental BHS operating	2,383	2,383	2,383	2,383	2,383	2,383	2,383	2,383	2,383	2,383
Staffing Costs										
TSA screener and supervisor *(a)*	1,358,147	1,358,147	1,358,147	1,358,147	1,358,147	1,358,147	1,358,147	1,358,147	1,358,147	1,358,147
Staff associated with clearing bag jams or portering bags (if not included in O&M costs described above)	--	--	--	--	--	--	--	--	--	--
Total	$2,430,537	$2,430,537	$8,831,037	$2,430,537	$2,430,537	$2,430,537	$2,430,537	$2,430,537	$2,430,537	$4,640,537
Discount Factor	1.967	2.105	2.252	2.410	2.579	2.759	2.952	3.159	3.380	3.617
Discounted Annual Costs	$1,235,562	$1,154,731	$3,921,086	$1,008,586	$942,604	$880,938	$823,307	$769,446	$719,108	$1,283,147
Present Value of Costs										

(a) Costs for TSA staffing are notional and may not reflect existing staffing estimates, unit costs, or policies.

Note: This example is based on a study that has been commissioned by the Port of Oakland, however, some costs estimates are derived from the BSIS Guidelines rather than the actual cost estimates developed by the Oakland study.
These cost estimates do not necessarily reflect final results and conclusions for the study commissioned by the Port.

Table C-22
TERMINAL 1, ALTERNATIVE 2a, LIFE CYCLE COST ANALYSIS

Cost Categories	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Capital Cost										
Screening equipment purchase		$2,450,000								
Screening equipment installation		700,000								
Screening equipment refurbishment									$ 595,000	
Screening equipment replacement									350,000	
EDS removal										
Required infrastructure modifications to the building and BHS	$ 4,550,000									
O&M Costs										
Screening equipment maintenance		--	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	245,000	$ 245,000
Screening equipment operating		26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981
Incremental BHS maintenance (including additional maintenance personnel)		231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280
Incremental BHS operating		2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698
Staffing Costs										
TSA screener and supervisor *(a)*		847,329	973,563	973,563	1,021,636	1,021,636	1,069,709	1,069,709	1,069,709	1,069,709
Staff associated with clearing bag jams or portering bags (if not included in O&M costs described above)		--	--	--	--	--	--	--	--	--
Total	$ 4,550,000	$4,258,288	$1,479,522	$1,479,522	$1,527,595	$1,527,595	$1,575,668	$1,575,668	$2,520,668	$1,575,668
Discount Factor	1.000	1.070	1.145	1.225	1.311	1.403	1.501	1.606	1.718	1.838
Discounted Annual Costs	$ 4,550,000	$3,979,708	$1,292,272	$1,207,731	$1,165,395	$1,089,154	$1,049,934	$981,247	$1,467,052	$857,059
Present Value of Costs	$25,272,491									

Table C-22 *(page 2 of 2)*
TERMINAL 1, ALTERNATIVE 2a, LIFE CYCLE COST ANALYSIS

Cost Categories	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Capital Cost										
Screening equipment purchase			$2,450,000							
Screening equipment installation			700,000							
Screening equipment refurbishment										$ 595,000
Screening equipment replacement										350,000
EDS removal			140,000							
Required infrastructure modifications to the building and BHS										
O&M Costs										
Screening equipment maintenance	$ 245,000	$ 245,000	--	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	245,000
Screening equipment operating	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981
Incremental BHS maintenance (including additional maintenance personnel)	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280
Incremental BHS operating	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698
Staffing Costs										
TSA screener and supervisor *(a)*	1,069,709	1,069,709	1,069,709	1,069,709	1,069,709	1,069,709	1,069,709	1,069,709	1,069,709	1,069,709
Staff associated with clearing bag jams or portering bags (if not included in O&M costs described above)	--	--	--	--	--	--	--	--	--	--
Total	$1,575,668	$1,575,668	$4,620,668	$1,575,668	$1,575,668	$1,575,668	$1,575,668	$1,575,668	$1,575,668	$2,520,668
Discount Factor	1.967	2.105	2.252	2.410	2.579	2.759	2.952	3.159	3.380	3.617
Discounted Annual Costs	$800,990	$748,588	$2,051,632	$653,846	$611,071	$571,095	$533,733	$498,816	$466,183	$696,986
Present Value of Costs										

(a) Costs for TSA staffing are notional and may not reflect existing staffing estimates, unit costs, or policies.

Note: This example is based on a study that has been commissioned by the Port of Oakland, however, some costs estimates are derived from the BSIS Guidelines rather than the actual cost estimates developed by the Oakland study.
These cost estimates do not necessarily reflect final results and conclusions for the study commissioned by the Port.

Table C-23
TERMINAL 1, ALTERNATIVE 2b, LIFE CYCLE COST ANALYSIS

Cost Categories	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Capital Cost										
Screening equipment purchase		$2,450,000								
Screening equipment installation		700,000								
Screening equipment refurbishment									$ 595,000	
Screening equipment replacement									350,000	
EDS removal										
Required infrastructure modifications to the building and BHS	$ 4,900,000									
O&M Costs										
Screening equipment maintenance		--	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	245,000	$ 245,000
Screening equipment operating		26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981
Incremental BHS maintenance (including additional maintenance personnel)		231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280
Incremental BHS operating		2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698
Staffing Costs										
TSA screener and supervisor *(a)*		751,183	751,183	751,183	751,183	751,183	751,183	751,183	751,183	751,183
Staff associated with clearing bag jams or portering bags (if not included in O&M costs described above)		--	--	--	--	--	--	--	--	--
Total	$ 4,900,000	$4,162,142	$1,257,142	$1,257,142	$1,257,142	$1,257,142	$1,257,142	$1,257,142	$2,202,142	$1,257,142
Discount Factor	1.000	1.070	1.145	1.225	1.311	1.403	1.501	1.606	1.718	1.838
Discounted Annual Costs	$ 4,900,000	$3,889,852	$1,098,036	$1,026,202	$959,068	$896,325	$837,687	$782,885	$1,281,667	$ 683,802
Present Value of Costs	$22,771,578									

Table C-23 *(page 2 of 2)*
TERMINAL 1, ALTERNATIVE 2b, LIFE CYCLE COST ANALYSIS

Cost Categories	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Capital Cost										
Screening equipment purchase			$2,450,000							
Screening equipment installation			700,000							
Screening equipment refurbishment										$ 595,000
Screening equipment replacement										350,000
EDS removal			140,000							
Required infrastructure modifications to the building and BHS										
O&M Costs										
Screening equipment maintenance	$ 245,000	$ 245,000	--	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	245,000
Screening equipment operating	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981
Incremental BHS maintenance (including additional maintenance personnel)	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280
Incremental BHS operating	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698
Staffing Costs										
TSA screener and supervisor *(a)*	751,183	751,183	751,183	751,183	751,183	751,183	751,183	751,183	751,183	751,183
Staff associated with clearing bag jams or portering bags (if not included in O&M costs described above)	--	--	--	--	--	--	--	--	--	--
Total	$1,257,142	$1,257,142	$4,302,142	$1,257,142	$1,257,142	$1,257,142	$1,257,142	$1,257,142	$1,257,142	$2,202,142
Discount Factor	1.967	2.105	2.252	2.410	2.579	2.759	2.952	3.159	3.380	3.617
Discounted Annual Costs	$ 639,067	$ 597,259	$1,910,202	$ 521,669	$ 487,541	$ 455,646	$ 425,837	$ 397,979	$ 371,943	$608,911
Present Value of Costs										

(a) Costs for TSA staffing are notional and may not reflect existing staffing estimates, unit costs, or policies.

Note: This example is based on a study that has been commissioned by the Port of Oakland, however, some costs estimates are derived from the BSIS Guidelines rather than the actual cost estimates developed by the Oakland study.
These cost estimates do not necessarily reflect final results and conclusions for the study commissioned by the Port.

Table C-24
TERMINAL 1, ALTERNATIVE 3, LIFE CYCLE COST ANALYSIS

Cost Categories	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Capital Cost										
Screening equipment purchase		$2,450,000								
Screening equipment installation		700,000								
Screening equipment refurbishment									$ 595,000	
Screening equipment replacement									350,000	
EDS removal										
Required infrastructure modifications to the building and BHS	$14,700,000									
O&M Costs										
Screening equipment maintenance		--	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	245,000	$ 245,000
Screening equipment operating		26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981
Incremental BHS maintenance (including additional maintenance personnel)		231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280
Incremental BHS operating		2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698
Staffing Costs										
TSA screener and supervisor *(a)*		655,037	655,037	655,037	655,037	655,037	655,037	655,037	655,037	655,037
Staff associated with clearing bag jams or portering bags (if not included in O&M costs described above)		--	--	--	--	--	--	--	--	--
Total	$14,700,000	$4,065,996	$1,160,996	$1,160,996	$1,160,996	$1,160,996	$1,160,996	$1,160,996	$2,105,996	$1,160,996
Discount Factor	1.000	1.070	1.145	1.225	1.311	1.403	1.501	1.606	1.718	1.838
Discounted Annual Costs	$14,700,000	$3,799,996	$1,014,059	$947,718	$885,718	$827,774	$773,621	$723,010	$1,225,709	$631,505
Present Value of Costs	$31,577,852									

Table C-24 *(page 2 of 2)*
TERMINAL 1, ALTERNATIVE 3, LIFE CYCLE COST ANALYSIS

Cost Categories	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Capital Cost										
Screening equipment purchase			$2,450,000							
Screening equipment installation			700,000							
Screening equipment refurbishment										$ 595,000
Screening equipment replacement										350,000
EDS removal			140,000							
Required infrastructure modifications to the building and BHS										
O&M Costs										
Screening equipment maintenance	$ 245,000	$ 245,000	--	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	$ 245,000	245,000
Screening equipment operating	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981	26,981
Incremental BHS maintenance (including additional maintenance personnel)	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280	231,280
Incremental BHS operating	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698	2,698
Staffing Costs										
TSA screener and supervisor *(a)*	655,037	655,037	655,037	655,037	655,037	655,037	655,037	655,037	655,037	655,037
Staff associated with clearing bag jams or portering bags (if not included in O&M costs described above)	--	--	--	--	--	--	--	--	--	--
Total	$1,160,996	$1,160,996	$4,205,996	$1,160,996	$1,160,996	$1,160,996	$1,160,996	$1,160,996	$1,160,996	$2,105,996
Discount Factor	1.967	2.105	2.252	2.410	2.579	2.759	2.952	3.159	3.380	3.617
Discounted Annual Costs	$590,191	$551,581	$1,867,512	$481,772	$450,254	$420,798	$393,269	$367,542	$343,497	$582,325
Present Value of Costs										

(a) Costs for TSA staffing are notional and may not reflect existing staffing estimates, unit costs, or policies.

Note: This example is based on a study that has been commissioned by the Port of Oakland, however, some costs estimates are derived from the BSIS Guidelines rather than the actual cost estimates developed by the Oakland study.
These cost estimates do not necessarily reflect final results and conclusions for the study commissioned by the Port.

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Appendix D

COMMISSIONING AND EVALUATION REQUIREMENTS

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D.1 INTRODUCTION

The Commissioning and Evaluation Requirements include a top level suite of tests used to evaluate a checked baggage inspection system (CBIS) for adherence to the Design Performance Standards (DPS) established in Chapter 7 of the PGDS. Each CBIS being commissioned or evaluated by or on behalf of the Transportation Security Administration (TSA) will be tested in accordance with a Site Specific Test Plan (SSTP) developed for this top level suite of tests. As each CBIS is unique, the individual tests contained in the SSTP may be a subset of this overall suite and may contain additional or modified tests as needed to evaluate the individual CBIS for adherence to the DPS.

The tests described herein apply to all CBIS (low, medium, and high throughput), and associated baggage handling systems (BHSs), including the delivery to and takeaway from the screening system unless specifically stated otherwise.

The entire CBIS (Physical, Programming, Networking and Reports) as well as all Legacy BHS components delivering bags to the CBIS and taking bags away from the CBIS shall be in complete and final configuration for all tests. Any components not in final configuration or any situation requiring Phased Commissioning shall be submitted to TSA for approval via the "Request for PGDS Variance Template" contained in Appendix A.

This appendix presents standard test procedures and processes normally encountered in standard CBIS configurations. TSA reserves the right to execute additional tests to assess all actual modes of operation of the system to ensure that minimum security and efficiency criteria are met.

The BHSC shall submit to TSA or their designee the PLC Code for all PLCs controlling CBIS components in the STZs both at the initial start of iSAT and at the conclusion. In addition to the specific tests described in this appendix, the individual SSTPs shall contain requirements to verify that the reporting capabilities defined in Section 7.2.14 have been provided and that the reports are accurate.

TSA and/or TSA's independent test and evaluation contractor will verify that the tests contained in the SSTP and this appendix have been performed either by witnessing the testing performed by the entity responsible for system construction or by performing an independent test of the system.

The testing suite is divided into three parts:

1. Introductory testing
2. Detailed testing
3. Systemwide testing

D.2 INTRODUCTORY TESTING

Introductory tests shall be performed on each spur line containing an explosives detection system (EDS). At a minimum, bags are inducted from the point of acquisition of tracking through the EDS to the point(s) of diversion to the Clear or outbound lines and into the checked baggage resolution area (CBRA), "the Security Tracking Zone" (STZ). When possible, bags should be inducted from their natural point(s) of origin (e.g., ticket counters, curbside, etc.).

For all EDS, bag spacing, both tail to head and head to head, should be optimized to meet the required throughput rate and still maintain positive bag tracking. The ILDT shall ensure that all tracking and spacing is compliant with the OEMs Site Planning and Installation guidelines.

D.2.1 Travel Time/On-Screen Resolution Test

Purpose: The Travel Time/On-Screen Resolution (OSR) Test shall be performed to ensure that sufficient conveyor travel distances are available for the use of OSR protocols.

Procedure: A Suspect bag is screened through the EDS and a Suspect decision is issued for that bag. In a system where there are multiple divert points, the screening decision should be withheld until the bag passes all but the last diversion opportunity. Measure the length of time between when the bag exits the EDS and when it reaches the final decision/diversion point PEC.

This test is to be conducted for each EDS line.

Outcome: The performance of the system is then judged against the DPS set forth in the following best practices section (see Chapter 7):

7.2.4 OSR Decision Time Best Practices

Note: This test does not apply to systems designed with manual removal in-line decision points.

D.2.2 Over-Height Bag, Over-Width Bag, and Over-Length (H/W/L) Tests

Purpose: These tests shall be conducted to ensure that the CBIS recognizes over-height, over-width and over-length baggage and prevents it from entering any EDS.

Procedure: The H/W/L Tests are conducted as follows:

- Record the measurement at which bags will activate the over-H/W/L detector.
- Ensure that this setting is equal to or less than the maximum bag H/W/L for the EDS in question.
- Introduce a stream of bags upstream of both the point of acquisition of tracking and upstream of the device used to measure bag dimensions. Bags used for testing shall include those slightly greater and slightly smaller than the system's programmed H/W/L settings.

This test is to be conducted at each location in the CBIS where over-H/W/L bag detection is provided.

Outcome: Record if the system properly detects over-H/W/L bags and prevents them from entering the EDS. Also, record if any non-over-H/W/L bags are incorrectly detected as over-H/W/L. At the conclusion of this test, the screening status and bag ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7):

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

D.2.3 Out-of-Gauge/Lost Bag Routing Test

Purpose: This test is conducted to evaluate routing of both in gauge and out of gauge (OOG) bags when their dimension status tracking data is lost after passing through the bag measuring device.

Procedure: Introduce a bag that exceeds OOG height or width dimensions upstream of the BMA. After the bag has been processed through the BMA and prior to the OOG or first screening line diversion, the OOG bag will be delayed to cause a loss of dimensions status tracking data. The routing of the OOG (lost) bag will be evaluated. This procedure will be repeated using a bag that does not exceed OOG dimensions.

Outcome: The CBIS shall handle lost OOG bags in a manner that ensures the EDS equipment is protected from bags that exceed maximum size specifications. If an OOG bag is inducted into the EDS, this test will be assigned a "Fail" status. In addition, OOG bags should be differentiated from other bag statuses if they arrive in the CBRA on a common conveyor subsystem. The performance of the system is then judged against the following DPS sections:

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices
7.2.8.2 Out-of-Gauge Bag Standard

D.2.4 Mixed Bag Line Test

Purpose: This test is conducted to verify the basic operation of the CBIS, specifically to ascertain if BHS tracking can properly handle multiple bags with differing decisions. It also familiarizes the test team with system performance characteristics.

Procedure: A minimum of 20 bags (5 Suspect and 15 Clear) are introduced to the EDS from the BHS. Bag identifiers (IDs) and EDS decisions are recorded at the EDS console, and the final status of the bags is recorded at the CBRA. Bag status may also be recorded at the Level 1, Level 2, and/or bypass decision point(s). Test bag quantities may be adjusted depending upon the complexity of the CBIS.

Outcome: The screening status and ID for all test bags processed are compared reported EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7):

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

D.3 DETAILED TESTING

Detailed tests shall be performed on all EDS spur lines and performed in multiple logical "tracking zones" on spur, mainline, and other lines. These tracking zones are defined as follows:

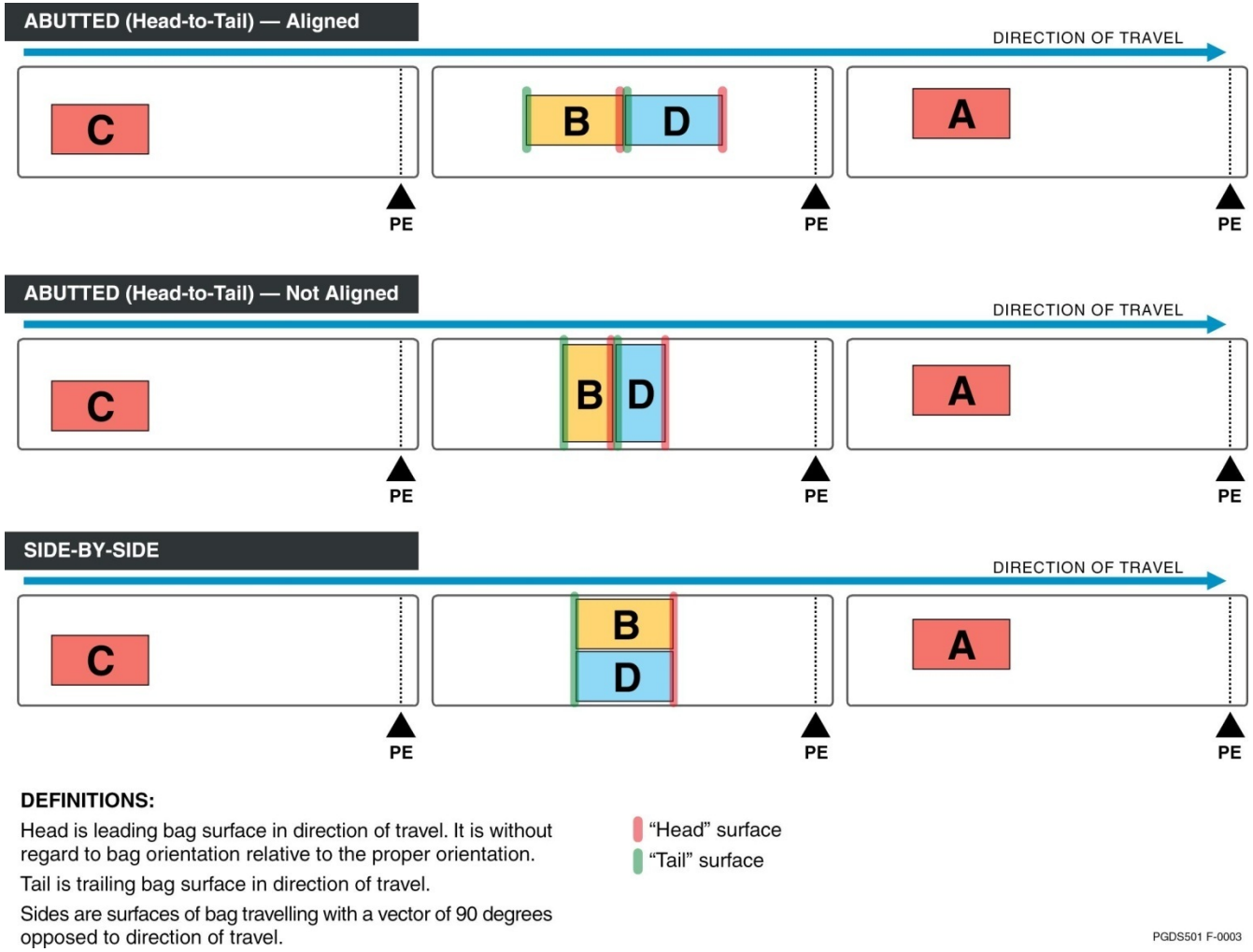
- Zone 1: Point of acquisition of tracking to bag handoff to the EDS
- Zone 2: Bag handoff to the EDS and the Level 1 Clear/Suspect diversion
- Zone 3: Between the Level 1 and Level 2 Clear/Suspect diversion
- Zone 4: Between the final Diversion Point and the CBRA

Test bags are inducted from the point of acquisition of tracking through the EDS to the point(s) of diversion to the Clear or outbound lines and into the CBRA, the STZ. Test bags should be inducted from their natural point(s) of origin, deviations from testing in this final configuration will need to be approved by TSA in advance.

For specific tests, the induction and testing zones may be fewer than what specified above and are noted as such in the Purpose and/or Procedure sections.

In the following sections, several references will be made to bag positioning. Refer to Figure D-1 for illustration purposes.

Figure D-1
PROBLEMATIC BAG ALIGNMENTS



D.3.1 Removed Bag Test

Purpose: This test shall be conducted to ensure that the BHS handles bags securely when one or more bags are removed from the system.

Procedure: A series of at least 10 bags (7 Clear and 3 Suspect) enters the EDS through the BHS. The bag IDs and EDS decisions are recorded at the EDS console, and the final disposition of the bags is recorded at the CBRA. Bag status may also be recorded as necessary at other decision/diversion points. One or two bags are then removed from the baggage stream to simulate missing bags. This test shall be run in each tracking zone on each line.

Outcome: At the outcome of this test, the screening status and ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7):

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

D.3.2 Delayed and Accelerated Bag Tests

Purpose: These tests shall be conducted to ensure that the BHS handles bags securely when one or more bags are delayed or accelerated outside their tracking window(s).

Procedure: A series of at least 10 bags (7 Clear and 3 Suspect) enters the EDS through the BHS. The bag IDs and EDS decisions are recorded at the EDS console and the final disposition of the bags is recorded at the CBRA. Bag status may also be recorded as necessary at other decision/diversion points.

Within each tracking zone of each EDS line, two nonconsecutive bags are held back (delayed test) or accelerated (accelerated test) within the baggage stream to simulate bags that slid outside their tracking windows. In each test, one bag should be moved so that it does not interfere with the tracking window of any other bag, while the other bag should be moved so that it does interfere with the tracking window of another bag.

Interfering can and does include the case where the trailing edge of a leading bag is directly abutted against the leading edge of a trailing bag.

Outcome: The screening status and ID for all processed test bags are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7):

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

D.3.3 Added Bag Test

Purpose: This test is conducted to ensure that the BHS handles bags securely when one or more bags are added to the system and to verify that added bags are not misdirected and that the tracking of other bags is not affected.

The Added Bag Test shall be applied to CBIS lines that have demonstrated a propensity for jam events and an increased vulnerability to human intervention.

Procedure: A series of at least 10 bags (7 Clear and 3 Suspect) enters the EDS through the BHS. The bag IDs and EDS decisions are recorded at the EDS console, and the final disposition of the

bags is recorded at the CBRA. Bag status may also be recorded as necessary at other decision/diversion points.

Within each tracking zone of each EDS line, two nonconsecutive bags are added to the baggage stream to simulate added bags. One bag should be added such that its leading and trailing edge is no closer than 15" to any other bag. The second bag should be added such that either its leading or trailing edge is between 8" and 12" from another bag.

Outcome: At the conclusion of this test, the screening status and ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7):

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

D.3.4 Bag Spacing Test

Purpose: This is a two part test. The first part is conducted to determine if the CBIS delivers bags to EDS machines in accordance with the Original Equipment Manufacturers (OEM) Guidelines and/or Integration Manuals. The second part is conducted to ensure that the CBIS routes bags securely if proper bag spacing into the EDS is not maintained.

Procedure: Part 1 – A series of at least 10 bags (7 Clear and 3 Suspect) enters the EDS through the BHS. The bags' IDs and EDS decisions are recorded at the EDS console, and the final disposition of the bags is recorded at CBRA. Tail-to-Head bag spacing is monitored and recorded at the EDS Entrance. Bags are inducted from natural points of origin (i.e., Ticket Counters, Curbside Induction). Tail-to-Head bag spacing at induction shall be maintained at 15 inches or greater except for two sets of two bags. One set shall have Tail-to-Head spacing of between 8 to 10 inches and the second set shall be inducted with the tail and head abutted (zero gap). Bags shall then flow through the system and be directed to one EDS Spur Line at a time. The test shall be repeated until all EDS Spur Lines have been tested.

Procedure: Part 2 – Induct two bags just upstream of the start of STZ. Ensure these bags are close together, but separate at the point of induction such that final manipulation can occur. Configure the BHS to send these two bags to a single EDS Spur Line. Just as the leading bag is entering the immediate upstream queue conveyor from the EDS, force the second bag to become abutted to the first bag such that they enter the EDS together and in direct contact with each other. The test shall be repeated for each EDS Spur Line.

Outcome: Part 1 – The screening status and ID for all bags processed are compared against the EDS status and bag IDs. Further, the Tail-to-Head bag spacing shall be compared against the EDS required spacing. The performance of the system is then judged against the DPS set forth in the following best practices sections:

7.2.1.2 Tail-to-Head Bag Spacing Standard
7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

Outcome: Part 2 – The screening status and ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections:

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

No waivers will be issued for the bag spacing test or the requirement for bag singulation into EDS machines.

D.3.5 E-Stop Test

Purpose: This test shall be conducted to ensure the ability of the EDS and BHS to activate and recover from E-Stops, and to maintain tracking of bags during E-Stop conditions. This test is to be conducted for both EDS and BHS E-Stops.

Procedure: In the EDS E-Stop Test, a series of at least 10 bags (7 Clear and 3 Suspect) is sent to the EDS through the BHS. When bags are in a position such that bags are leaving, entering, and within the EDS, an EDS E-Stop is activated. The EDS must immediately disable its X-rays and the EDS conveyors should stop operating. As an operational safety precaution, adjacent BHS conveyors, including at least the entrance and exit BHS queue conveyors, should also immediately stop operating. The BHS should recognize the E-Stop and halt any further bags from being sent to the EDS.

In the BHS E-Stop Test, a series of at least 10 bags (7 Clear and 3 Suspect) is sent to the EDS through the BHS. When bags are in a position such that bags are leaving, entering, and within the EDS, a BHS E-Stop is activated. The EDS should recognize the E-Stop, and prevent additional bags from being sent to the BHS. Further, the system should not allow bags on EDS conveyors to be forced forward onto stopped BHS conveyors.

This test is to be conducted for each EDS line.

Outcome: The screening status and bag ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7):

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

D.3.6 Halt/Fail-Safe Test

Purpose: The purpose of this test is to ensure that the CBIS does not pass any non-Clear or unscreened bag to the outbound/sortation system. In addition, this test verifies that TSA is immediately notified of a Fail-Safe event, allowing an appropriate response.

D.3.6.1 Fail-Safe Operation for In-Line CBIS

A Fail-Safe condition is generated when an unexpected bag is detected at the first PEC downstream of the Clear bag divert point on the Clear bag line. If the BHS cannot positively confirm that the bag is a Clear bag, then the Clear bag line is halted, audible and visual indications are activated, and the bag must be manually removed from the conveyor.

- or -

A Fail-Safe condition is generated when any non-Clear bag is detected at the tracking PEC on the EDS output line immediately

upstream of any Clear bag divert point and not detected at the tracking PEC on the alarm line immediately downstream of the divert point. If the BHS detects this condition, then the Clear bag line is halted, audible and visual indications are activated, and the bag must be manually removed from the conveyor.

All conveyors associated with the Fail-Safe zone shall be clearly marked or identified.

Procedure: The test is conducted with bags flowing normally through the CBIS in sufficient quantity such that bags are present from the EDS output through the Clear/Suspect bag diversion point(s). A Suspect or mistracked bag is manually forced onto the outbound/sortation line (while all safety precautions are observed). This process may need to be accomplished by blocking the Fail-Safe **PEC** manually rather than by physically forcing the bag. The CBIS should either, depending on design and programming:

> Recognize the condition as a non-Clear bag on the Clear line
>
> - or -
>
> Recognize that the non-Clear bag did not pass the photo-eye programmed for fail-safe detection on the conveyor leading to the CBRA
>
> - and -
>
> Audible and visual Fail-Safe alarms should be activated in whatever location(s) will best allow TSA to respond to the event.

The CBIS behavior when the Fail-Safe alarm is activated shall be recorded, including methods of Fail-Safe activation, and type and location of audible and visual Fail-Safe indications.

This test is to be conducted for each EDS line and at each point on each line where Clear bags are separated from non-Clear bags.

Repeat this test with the diversion device placed in all modes. Fail-safe functionality shall be present regardless of the mode of the diverting mechanism.

D.3.6.2 Fail-Safe Operation for a Manually Operated In-Line Decision Point CBIS

A Fail-Safe condition is generated when an unexpected bag is detected at the first PEC downstream of the Clear bag divert point on the Clear bag line.

- and -

Audible and visual Fail Safe alarms should be activated at the manual decision point to permit TSA to respond to the event.

Procedure: The test is conducted with bags flowing normally through the CBIS in sufficient quantity so that bags are present on the conveyors from the EDS output through the manual removal decision point.

> A Suspect or mistracked bag is transported to the manual removal decision point. The system should recognize the condition as a non-Clear bag at the decision point and stop both conveyors immediately upstream and downstream of the decision point.
>
> - and -
>
> Audible and visual Fail-Safe alarms at the manual decision point should be activated to allow TSA to respond to the event.

The CBIS behavior when the Fail-Safe alarm is activated shall be recorded, including methods of Fail-Safe activation, and type and location of audible and visual Fail-Safe indications.

Outcome: The screening status and bag ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the best practices and DPS set forth in the following best practices sections (see Chapter 7):

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

D.3.7 Accidental Flag of Decision Point Photo-Eye Tracking Test

Purpose: This test is conducted to ensure that the BHS handles bags securely when the Decision Point Photo-Eye (DP PE) is accidentally flagged when a bag is not expected.

Procedure: A series of 6 bags (3 Clear and 3 Suspect) are sent through the EDS, beginning with a Clear bag followed by a Suspect bag and alternating in this manner so that bags processed first, third, and fifth are Clear bags, while bags processed second, fourth, and sixth are Suspect bags. The bags' IDs and EDS decisions are recorded at the EDS console, and the final disposition of the bags is recorded at CBRA. Prior to a Clear bag arriving at the decision point, following the removal of a Suspect bag from the decision point (i.e., between processed bag 2 and bag 3, or between processed bag 4 and bag 5), the DP PE shall be flagged. The expectation is that the proper bag status and ID will be retained or an unknown decision and mistracked ID will be assigned to the Clear bag next approaching the decision point (i.e., once the "ghost bag" information is cleared from the decision point CBRA information display). All subsequently processed bags should arrive at CBRA with the proper status and bag tracking ID.

Outcome: The screening status and ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the following DPR sections:

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

D.3.8 Image Quality Functionality Test

Purpose: This test shall be conducted to evaluate the ability of the CBIS to perform daily and shift-change Image Quality (IQ) Functionality Tests.

Procedure: The IQ Functionality Test is conducted as follows:

- Record the specific steps taken to prepare the BHS for insertion of the EDS IQ Functionality Test bag.
- Begin to process no fewer than 10 bags (7 Clear and 3 Suspect).
- While these bags are entering, leaving, and within the continuous feed EDS, using available EDS/BHS controls, place the system in the IQ Functionality Test mode and record the results (Phase 1). For a noncontinuous feed EDS, all bags must be purged from the EDS prior to conducting the IQ Functionality Test.
- Conduct no fewer than three IQ Functionality Tests and record the results (Phase 2).

- Return the system to its normal mode of operation.
- Complete the processing of the original 10 bags and record the results (Phase 3).

This test is to be conducted on each EDS line.

Outcome: Report any nonsecure handling of the IQ Functionality Test bag or other test bags. Report any faults or system behavior that requires BHS or EDS restart. The screening status and bag ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7):

7.2.5 BHS Tracking Best Practices
7.2.6 Bag Tag Identification Best Practices
7.2.8 System Conveyable Items Best Practices
7.2.9 Fail-Safe Operation Best Practices
7.2.10 Image Quality Test Best Practices
7.2.12 BHS Displays at CBRA Best Practices
7.2.14 CBIS Reporting Best Practices

D.4 SYSTEMWIDE TESTING

Systemwide tests shall be performed on the entire system from natural point(s) of bag induction through the screening matrix and to the outbound system and CBRA. The entire system shall be configured and staffed in the same way that it is expected to operate during normal daily operations.

D.4.1 System Dieback Test

Purpose: This test shall be conducted to determine the ability of the system to properly track and handle bags during systemwide conveyor halt conditions.

Procedure: Induct as many Suspect bags (or force Suspect decisions on bags) as needed to completely fill the CBRA line conveyors upstream through all primary and secondary decision points. Continue to fill the BHS with mixed decision bags until the conveyors stop to either just before the EDS or to the start of tracking. This condition is defined as “dieback”. Once dieback has occurred, begin taking bags off the CBRA line conveyor and process the remaining bags normally.

Outcome: The screening status and bag ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7):

All sections except:

7.2.2 Screening Throughput Capacity Best Practices
7.2.3 Bag Time in System Best Practices

D.4.2 System Mixed Bag Test

Purpose: The System Mixed Bag Test shall be conducted to demonstrate the ability of the CBIS to operate in a normal fashion under less than peak throughput conditions.

Procedure: The preferred method for system configuration is the equivalent of "Alarms Only" or "Show on Alarm." Process a mix of bags (Suspect/Clear) with a certain percentage for the Level 1 Alarm Rate and a certain percentage of Suspect bags being cleared through simulated OSR (exact percentages are considered sensitive security information (SSI) and can be requested from TSA). The induction rate should reflect normal operations in less-than-peak throughput conditions. The minimum number of bags to be inducted should be equivalent to 100 bags per EDS.

For High-Throughput In-Line EDS, the test should be broken down into groupings of mainlines (usually no more than two High-Speed

EDS per mainline) and the volume processed shall be no less than 250 bags per EDS.

For partially integrated EDS, or for CBIS with in-line, manual removal decision points, the minimum number of bags processed through each EDS line shall be 200 bags. This increase in bags for Mini In-Line Systems is intended to increase the sample rate because a rate test will not be performed on these lower volume systems.

The IDs and decisions for each bag will be recorded at the alarm resolution workstations, in the CBRA, and at any other available terminals, printers, and displays. On completion of the test, the datasheets from the workstations, decision point(s), and CBRA will be compared to evaluate baggage tracking.

During the test, personnel will not prevent bag jams from occurring. Only after bag jams occur will personnel clear the jams. The location of each bag jam will be recorded along with any observations that will help reduce the jam rate.

Outcome: The screening status and bag ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7).

All sections except:

7.2.2 Screening Throughput Capacity Best Practices

D.4.3 System Throughput Test

Purpose: The System Throughput Test shall be conducted to demonstrate the ability of the CBIS to operate under conditions at or approaching peak throughput rates.

Procedure: Induct bags at the ticket counter, curbside, and inter-line transfer lines (and any other input lines).

Process bags correctly through the CBIS such that:

1. Clear bags are sent directly to the outbound sortation system.
2. Suspect bags are sent directly to the CBRA, and once cleared, are sent to the outbound sortation system.
3. Faulted, mistracked, and errored bags are sent to the CBRA.

Induct baggage as fast as the system will allow while not violating system-required minimum bag spacing.

The test will demonstrate the ability of all interconnected non-redundant EDS screening lines to process bags simultaneously under high throughput rates. The minimum number of bags inducted should be equivalent to 100 bags per EDS except for systems built according to PGDS Section 3.2.1 High-Speed In-Line EDS. For these high-throughput systems, the test should be broken down into groupings of mainlines (usually no more than two High-Speed EDS per mainline) and the volume processed shall than be no less than 250 bags per EDS.

If technically possible, and working with the EDS vendor, configure the CBIS to save all bag images. In this way, when reconciling the test data, any CBRA anomalies can be more thoroughly investigated by examining the EDS and BHS data logs and all saved images.

Using available inputs (e.g., ticket counters, curbside, and transfer lines), induct a mix of bags (Suspect/Clear) as fast as the system will allow while not violating system-required minimum bag spacing. Process a mix of bags (Suspect/Clear) with a certain percentage for the Level 1 Alarm Rate and a certain percentage of

Suspect bags being cleared through simulated OSR (exact percentages are considered SSI and can be requested from TSA). Should construction constraints not permit induction of bags at the normal points of origin, then the System Throughput Test shall be conducted when these constraints are lifted. For partially integrated EDS, or for CBIS with in-line, manual removal decision points, the System Throughput Test shall not be conducted.

The IDs and decisions for each bag will be recorded at the alarm resolution workstations in the CBRA, and at any other available terminals, printers, and displays. On completion of the test, the datasheets from the workstations, decision point(s), and CBRA will be compared to evaluate baggage tracking. During the test, personnel will not prevent bag jams from occurring. Only after bag jams occur will personnel clear the jams. The location of each bag jam will be recorded along with any observations that will help reduce the jam rate.

Outcome: The screening status and bag ID for all bags processed are compared against the EDS status and bag IDs. The performance of the system is then judged against the DPS set forth in the following best practices sections (see Chapter 7).

All DPS sections apply to the System Throughput Test.

D.5 OPERATIONAL RUN-IN

Purpose: The Run-In Period should consist of a 30-day period to collect meaningful operational data (BHS and EDS) to support a well-rounded test summary report that accurately depicts system performance characteristics. This kind of information will be invaluable to the ILDT to correct defects found during commissioning and evaluation of the CBIS, and to ensure that the system remains stable and secure under actual operational use. The Run-In period may be extended at TSA direction until open issues are resolved or if new defects are detected during the operational run-in.

Procedure:

- After successful completion of the iSAT, and on notification from TSA OST that the system may be used for screening (delivery of a TSA-signed Quick Look Report [QLR]), the system may enter live screening operations. The Run-In period will extend for a minimum of 30 days from the start of substantial operations. Substantial operations are the point at which the system encounters 85 percent of its normal daily baggage volume.

- During the Run-In period, the site shall submit weekly data reports in electronic format, preferably in native CSV or PDF format (i.e., not scanned hard copies) to the TSA Independent Verification and Validation (IV&V) Contractor. These reports shall include all BHS reports required by PGDS Section 7.2.14 CBIS Reporting Best Practices, and the EDS Vendor Specific Reports equivalent to the Bag Info Report and EDS Equipment Summary Report shall also be provided. In the event that the site does not comply with 7.2.14, then the site will supply existing BHS & EDS Reports that define at a minimum the following information:

  - CBRA Bag Arrival Screening Status
  - Bag Induction Volume per Mainline and Spur Line
  - Jam Statistics by Location
  - Failsafe Statistics by Location
  - Unknown/Lost in Tracking Statistics by PE Location
  - Baggage Measuring Array (BMA) and Automatic Tag Reader (ATR) Read Rates
  - OS/OOG Statistics

- EDS Bag Info Report
- EDS Equipment Summary Report

- On successful completion of testing, the Baggage Handling System Contractor (BHSC) shall supply an electronic copy of the "As Tested" version of all PLC Code to TSA and/or its IV&V Contractor as required by PGDS Section 2.2.6 Project Close-Out Phase.

- After all submitted BHS and EDS Reports have been analyzed, the IV&V Contractor shall return to the site to verify the close-out of open deficiencies from the original iSAT and observe system operation against reported data. This on-site observation will normally occur over a minimum of three days. The TSA Contractor will then prepare and submit a Test Summary Report (TSR) detailing original testing and the state of all previous or new deficiencies. The TSR will recommend to TSA whether to end the Run-In period, extend the Run-In period, or change the operational status of the CBIS.

D.6 OPERATIONAL ANALYSIS

Purpose: The Operational Analysis (OA) allows TSA the opportunity to diagnose and evaluate the performance of CBIS systems after commissioning. An OA will be directed and performed by TSA on a periodic recurring basis or as the result of reported system performance anomalies.

Procedure:

- Upon notification from TSA/OST that an OA has been directed, the authority with jurisdiction at the airport along with local TSA shall submit to the TSA IV&V Contractor and/or the TSA/OST Base Team the immediate past 30 days of BHS and EDS reports in electronic format, preferably in native CSV or PDF format (i.e., not scanned hard copies). These reports shall include all BHS reports required by PGDS Section 7.2.14 CBIS Reporting Best Practices, and the EDS Vendor Specific Reports equivalent to the Bag Info Report and EDS Equipment Summary Report shall also be provided. In the event that the site does not comply with 7.2.14, then the site will supply existing BHS & EDS Reports that define at a minimum the following information:
  - CBRA Bag Arrival Screening Status
  - Bag Induction Volume per Mainline and Spur Line
  - Jam Statistics by Location
  - Failsafe Statistics by Location
  - Unknown/Lost in Tracking Statistics by PE Location
  - Baggage Measuring Array (BMA) and Automatic Tag Reader (ATR) Read Rates
  - OS/OOG Statistics
  - EDS Bag Info Report
  - EDS Equipment Summary Report

- The TSA IV&V Contractor and/or the TSA/OST Base Team shall analyze these reports to attempt to determine if the CBIS performs in compliance with the DPS criteria in Chapter 7. Further, this analysis shall attempt to identify specific areas of non-compliance.

- Once the analysis is completed the TSA IV&V Contractor and/or TSA/OST Base Team shall recommend to TSA/OST whether additional on-site testing is required to diagnose the nature of the problem. At the conclusion of analysis and/or

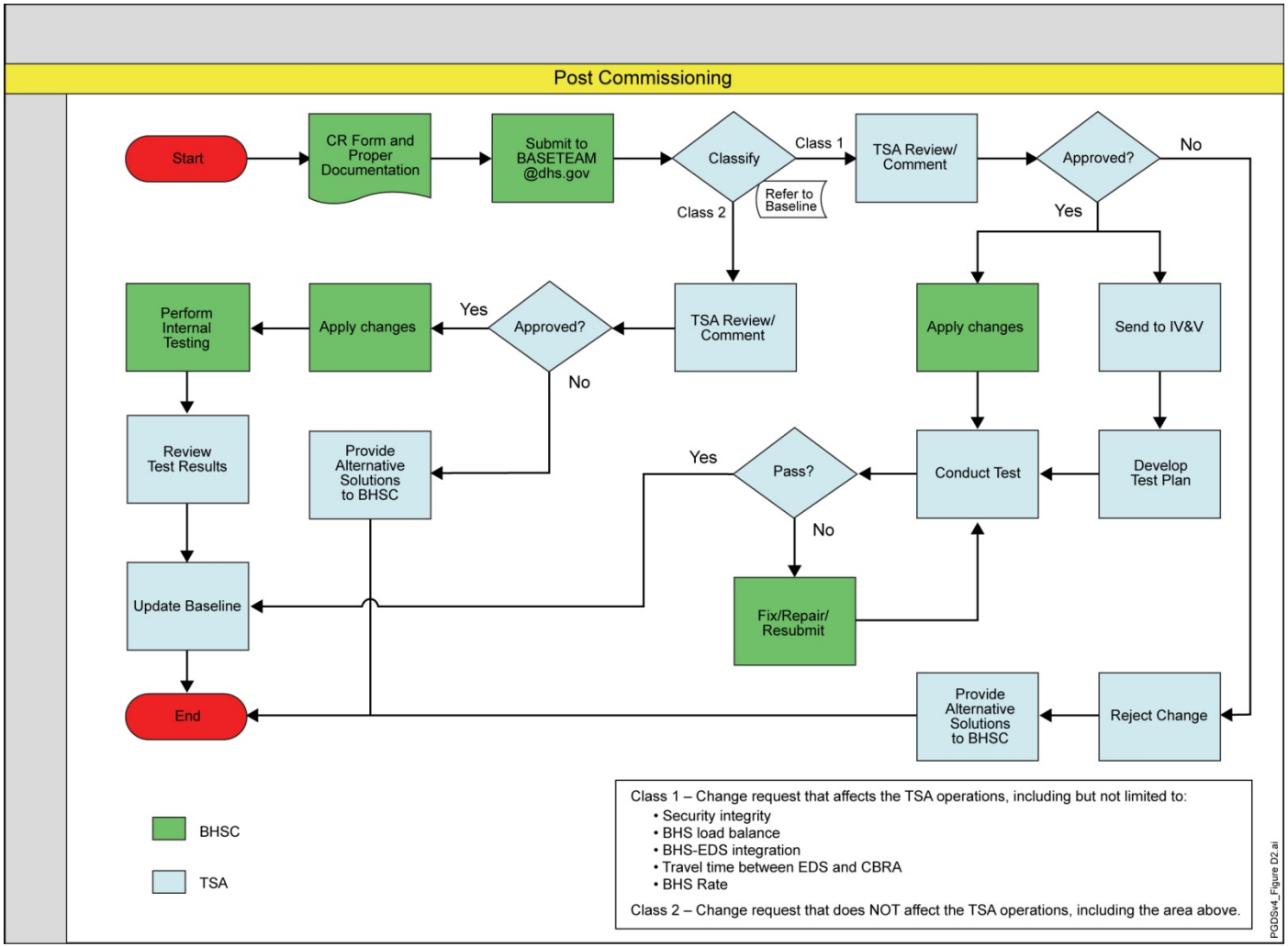
testing, the teams shall prepare and submit an Operational Analysis Report (OAR). This report shall present all findings uncovered during the analysis and recommend to TSA/OST and the airport authority whether the system remains secure and efficient, and whether any fixes recommended.

D.7 POST COMMISSIONING REQUIREMENTS

All proposed changes to the CBIS must be submitted to TSA for a CM process prior to implementation using the CBIS change request form as shown in Section A.9.4. Overall, the CM process consists of three steps: First, the BHSC starts developing the proper documentation, filling out the change request form, and submitting it to TSA; Second, TSA receives, reviews, and provides disposition to the CR; Third, BHSC implements the change, performs the testing, and provides results to TSA proving a successful implementation. A detailed block diagram outlining the roles of the BHSC and TSA, as well as the detailed steps required to complete the process is shown on Figure D-2.

It is essential for the continued secure and efficient operation of the CBIS that changes to the system are evaluated, reviewed, and approved by TSA before they are implemented. A Configuration Management (CM) process has been established and must be followed throughout the lifecycle of the CBIS. Related documentation and requirements are found in Appendix A, Section A.8 D.7.1 Configuration Management Process.

Figure D-2
CBIS CONFIGURATION MANAGEMENT PROCESS



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Appendix E

EXAMPLE OF A CBIS OPERATION GUIDE

Example from
Rogue Valley Medford International Airport
Medford, Oregon

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E.1 INTRODUCTION

This appendix serves as a best practice example of the operation guideline of an in-line CBIS. Depending on the design, equipment or other differences among CBIS the descriptions and detailed instructions of this operations guideline may not be fully transferable to other CBIS.

The Rogue Valley International-Medford Airport's baggage handling system has both an outbound system and an inbound system. The outbound system consists of a ticket counter line, an in-line screening area of three security screening (SS) lines, SS1, SS2 and SS3, with three Reveal EDS machines, and a take-away conveyor that transports clear bags to a make-up unit. The inbound system consists of an inbound line and a claim unit.

Bags enter the outbound system at ticket counter TC1, are conveyed to a dimensioner and then are sorted to one of the three security lines, SS1, SS2 and SS3 for screening by a Reveal CT-80 EDS machine. After exiting an EDS machine bags are transported to a decision point. At the decision point the status of each bag is annunciated. Reject/suspect, no decision and unknown bags are removed from the line for inspection by TSA personnel. Clear bags, after their status is annunciated, continue through along the line and are merged onto the Main Line, ML1. Bags cleared by TSA are placed on a conveyor downstream of the decision point. Bags cleared by an EDS machine or TSA are transported to the make-up unit from which they are delivered to and loaded onto their designated flight.

The inbound system is made up of a single claim unit. A set of conveyors transport bags from the tarmac area to the claim unit for passenger retrieval.

The section below provides a written description of the flow of bags through the outbound and the inbound system as well as graphical overview/detailed views of each system.

E.2 OUTBOUND CONVEYOR SYSTEM

At ticket counter TC1, when passengers check-in for a flight, their ticket agent, based on the ticket agent's location on the ticket counter, places their checked luggage on conveyor TC1-01 or TC1-02. In the process of checking bags in, it is the ticket agent's responsibility to determine if a bag is oversize, meaning that it is not conveyable on the BHS. The minimum and maximum parameters of bags that can be handled on the system are set forth in the table below.

	Height	Width	Length	Weight
Minimum	4-inches	4-inches	9-inches	5 lbs.
Maximum	30 inches	30-inches	54-inches	120 lbs.

After bags are checked-in and placed on conveyor TC1-01 or TC1-02, they pass through a fire/security door, DR/TC1-03, mounted over conveyor TC1-03. Before passing through the fire/security door, the height of each bag is checked to ensure it will pass through the door.

If a bag blocks the over height photo eye, PE1/TC1-03, which is set in front of and 30-inch above conveyor TC1-03, an over height fault is generated. Conveyor TC1-03 stops and upstream conveyors cascade stop. The start-up/fault audible warning horn and the fault beacon on the MCP energize and the OVER HEIGHT RESET pushbutton's white integral pilot light on control station CS/TC1-03 illuminates solid. Personnel must either remove the bag or reposition it on the conveyor so that it clears the over height photo eye and will still pass through the fire/security door. When the over height photo eye is clear, the OVER HEIGHT RESET pushbutton's white, integral pilot light shifts from solid to flashing illumination. Pressing the OVER HEIGHT RESET pushbutton, when the pilot light is flashing, resets the fault. Pressing the START pushbutton initiates the start warning after which the conveyors starts. Any cascade stopped conveyors restart automatically.

Bags that clear the over height photo cell, PE1/TC1-03 pass through the fire/security door DR/TC1-03 and continue along the TC1 line. On conveyor TC1-06 bags pass through a second fire/security door, DR/TC1-06. Since the height of each bag was checked prior to the initial fire/security door, DR/TC1-03, and, if necessary, any over height bags were removed, bag height is not checked again

From conveyor TC1-07 bags flow onto conveyor SS1-01. At conveyor SS1-03 bags pass beneath a dimensioner which measures each bag's height, width and length. Each bag's measurements are compared with the Reveal machine's maximum bag specifications. If a bag's measurements exceed any of the EDS machine's parameters, it is designated as out-of–gauge.

	Height	Width	Length	Weight
Maximum	25 inches	31.5-inches	47.2-inches	121.3 lbs.

After being dimensioned, bag tracking for the out-of-gauge sorting is initiated. Each bag's measurements are embedded in its tracking data along with its status as being in-gauge or out-of-gauge. Additionally, bags pass through another fire/security door, DR/SS1-04.

Downstream of the fire/security door, on conveyor SS1-05, there is a routing plow which diverts bags onto the SS2 line for distribution to EDS machines SS2-12 and SS3-07. If a bag is designated as out-of-gauge, has a no-read status or has a "lost" tracking status, it will not be diverted and will continue on the SS1 line to the out-of-gauge removal point.

In-gauge bags are sorted to the SS2 line by diverter SD/SS2-01 as long as one of the EDS machines is running and there is space available on the conveyors upstream of the EDS machine. At diverter SD/SS3-01 the PLC (Program Logic Control) checks the status of the SS3 EDS machine and lane availability. As long as the machine is running and space is available on the upstream conveyors, bags are diverted to the SS3 line.

When the SS3 lane prior to the EDS machine becomes full and/or the EDS machine becomes faulted or is taken out of service, bags are not diverted and continue on the SS2 lane to the SS2 EDS machine. If both the SS2 and the SS3 lanes become full and/or the EDS machines become faulted or are taken out of service, all bags continue on the SS1 line to the SS1 EDS machine.

If the SS1 EDS machine is take out of service, all bags except those that are out-of-gauge are diverted to the SS2 line by divert SD/SS2-01. Should an out-of-gauge bag be detected, the bag is not diverted and continues on the SS1 line even though the EDS machine is not in-service. Out-of-Gauge bags are stopped at the SS1-08 conveyor for removal and inspection by TSA.

Bags diverted to the SS2 line are not tracked. However, bags that continue on the SS1 line rather than being diverted to the SS2 line continue to be tracked in order to keep tabs on the out-of-gauge/ faulted bags.

E.3 SYSTEM START-UP

E.3.1 The System Calibration Process

At the beginning of each shift, the CT80 and Barringer ETD Machines will need to be calibrated prior to BHS startup. The orders of operations are as follows:

1. Obtain CT80 keysets 1-3, Building D M-4 Key, TSA travel sentry keys located in the supervisor office in key box 1.

2 Ensure the BHS SYSTEM ENABLE switch is in the ON position on the main control panel. Energize the BHS system by pushing the GREEN "SYSTEM START" button located next to the "SYSTEM ENABLE" switch (Figures E-1 and E-2).

Figure E-1
BHS OPERATION UNIT

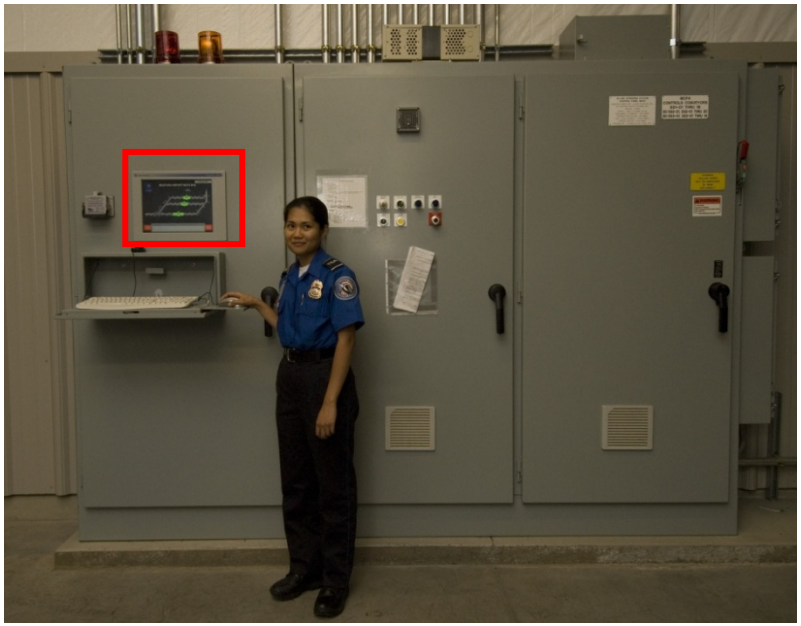


Figure E-2
THE BHS MAIN CONTROL PANEL

3. Insert the BHS conveyor key labeled BHS CNVR-1, 2, 3; into the Input Control Module at CS/SS1-08, CS/SS2-11, and CS/SS3-06. Turn the ignition into TEST mode at CS/SS1-08, CS/SS2-11, and CS/SS3-06 (Figure E-3).

Figure E-3
THE BHS CONVEYOR KEY AND SWITCH

4. See CT80 System Startup Appendix 1 for startup procedures of CT80 machines.

5. While the CT80 is in calibration mode, select Maintenance on the MCI unit of the CT80. From there, select "Run OP Test." You will then place the OP Test Kit onto the input of CS/SS1-08, CS/SS2-11, and CS/SS3-06, making sure to place the kit in front of the photo eye. Press the BLUE "INSERT TEST BAG" button which will feed the OP Test Kit into the CT80. If the OP Test is successful, press the "OK" button on the CT80 MCI.

6. Obtain the Building D M-4 Keys to open the ETD cabinets. Calibrate the ETD machines per SOP.

7. Leave the ignition switch located at CS/SS1-08, CS/SS2-11, and CS/SS3-06 in the "Test" position and remove key. Store in ETD cabinet #7 with all other key sets.

8. When opening the BHS system for operations, use BHS CNVR-1 key to turn ignition to CS/SS1-08, CS/SS2-11, and CS/SS3-06 into the "NORM" position. Ensure "SYSTEM ENABLE" switch located on the BHS MCI is in the "ON" position. Press the GREEN "SYSTEM START" button located next to the "SYSTEM ENABLE" switch. The system is now ready to process baggage (Figures E-2 and E-1).

E.3.2 The System Start-Up Process (CT-80dR)

Pre Startup Safety Walk Around

- Walk around the CT-80 to ensure the area is clear of debris, food, beverages, foreign objects, and obstructions; and free of spill or trip hazards.

- Pick up any trash in, near, or on machine.

- Check the condition of the lead curtains to verify there are no rips, tears, or missing flaps on the curtain. If any are missing ripped, or torn notify a supervisor.

- Ensure al access panels are secure.

- Check the E-Stop buttons at the entrance tunnel and exit tunnel on the CT-80 DR and at the BVS. If any have been pressed release them by twisting slightly in the direction of the arrows.

- Check the conditions of the infeed and outfeed conveyor belts for irregularities or tears.

- Check inside the entrance and exit tunnels to ensure the scanner is empty.

- Report any unsafe or hazardous conditions to your supervisor.

Start Up Procedures

1. **Power on the BVS and MCC/FDRS**
   - Power on the BVS computer (Key is required to unlock the door on the BVS).
   - Power on the BVS monitor if powered off.
   - Power on the MCC/FDRS computer (Key is required to unlock the door on the MCC/FDRS).
   - Power on the MCC/FDRS monitor if powered off.

2. **Start CT-80 DR Scanner**
   - Open startup switch panel cover
   - Verify the main circuit breaker is in the ON position (up). Do not touch the breaker. If in the **OFF** position (down), notify your supervisor.
   - Put key into key switch, push in and turn to the **ON** position.

- Push the **START** button (the X-ray indicator light on the top of the machine will turn orange momentarily as verification that the startup process has been initiated).
- The scanner will begin warming up (this may take a few minutes).

Note: The message "waiting for Reveal network to start" may appear on the BVS and the MCI while the MCC/FDRS computer is booting up. Once the network connection is established between the BVS, MCI, and MCC/FDRS is on. If the reason cannot be found for the network error, contact your supervisor.

3. **Log In**
   - Log in to the BVS

   Note: Before logging into the BVS, ensure the FDRS/MCC Log in Screen appears. Failure to do so will result in a User/Password error on the BVS.

   - Click User ID field:
     Enter User ID in the block. Password field will be grayed out.
   - Click **Password** field:
     Enter password in the block, and then Enter.
     NOTE: If a user enters incorrect Password 3 consecutive times, the BVS locks out the user from the system.
   - Log In is NOT REQUIRED on the MCC/FDRS for screening.

4. **Start the Machine Control Interface (MCI):**
   - Touch **START** on the MCI when prompted to do so **(DO NOT TOUCH THE RESTART BUTTON).**
   - Touch **OK** to acknowledge "Tunnel Flush" message on the MCI.
   - The MCI Start process will begin. The system requires a few moments to initialize the software. The MCI Load Screen will appear when the software has been initialized.
   - Perform Operational Test.

Operational Test

The Operational Test must be performed daily, prior to scanning baggage:

- Touch **Change Screen**
- Touch **Maintenance**
- Touch **Run Op Test** on the **Maintenance** screen
- Touch **OK** on the Detector Analysis message window

  The system will display a message indicating the system is being "flushed", followed by a "caution" message when detector analysis begins.

  The caution message "Analyzing detectors; please wait" displays along with a progress bar.

- When detector analysis completes, the Op Test window will display instructing you to place the Operational Test Kit (OTK) on the conveyor.

  NOTE: If the detector analysis fails, follow the directions displayed on the MCI and re-run the Op Test. If detector analysis fails again, notify the supervisor.

- Place OTK flat and straight on the belt with the label facing upward and arrow pointed toward the tunnel entrance and touch **OK**.

- Turn the key to test and push blue button to advance OTK into CT-80.

- When the Op Test has passed, the OP Test window will display "Op Test Succeeded."
- Touch **OK** to return to the Load Screen. The scanner is now operational.
- When the Op Test has completed, a message displays instructing you to remove the Op Test kit from the conveyor. The message disappears when the OTK is removed.
- Return the key switch to "**Normal.**"
- Secure the OTK once the test is completed and successful.

Operational Test Failure

- If the Op Test fails, the OP Test window will display "OP Test Failed". Touch **OK** to acknowledge the message.
- Perform the test again ensuring the OTK is straight and flat on the conveyor belt.
- If the Op Test fails again (2 total failures), notify the supervisor.

Note: The machine may not be used to screen passenger bags until it has successfully passed the Operational Test.

Fault Recovery

If the scanner does not restart the software automatically, a Fault message will be displayed on the MCI. Perform the following:

- Ensure you record the original fault code.
- Locate the reason for the fault, if necessary. Acknowledge the Fault message on the MCI.
- When the Operations menu displays, touch **Fault Reset**.
- Touch Start on the MCI Start screen. (**DO NOT TOUCH THE RESTART BUTTON**.)
- Touch **OK** to acknowledge "Tunnel Flush" message on the MCI.
- If fault message clears, resume normal operations.
- If the fault does not repeat the Fault Reset two more times, up to a total of three times.
- If the fault does not reset, perform the following procedure:
  1. Turn the key switch to the off position
  2. Leave the key switch off until the green light goes out (about 30 seconds)
  3. Wait 30 seconds after the green light goes out
  4. Turn the key switch to the on position
  5. Press the **start** button
  6. Touch **start** on the MCI start screen
  7. Touch OK to acknowledge "Tunnel Flush" message on the MCI. **If the fault persists, notify the supervisor**.

Bag Handling Errors

A bag may become lodged in the infeed or outfeed tunnels, or be delayed entering the infeed tunnel. The system will display a message to indicate one of these possible conditions. Refer to the appropriate message listed below for recovery procedures.

Note: If a bag is lodged inside the scanner, a system fault will be generated. Refer to the fault recovery procedures.

1. "Bag Missed"

   Message displays on the MCI to indicate a bag is lodged or delayed at the infeed tunnel.

NOTE: If the "Bag Missed" message appears on the MCI while a bag image is displayed on the BVS, continue resolving the bag (i.e.; make a decision on all threats; release image; and remove the bag from the exit conveyor) before proceeding.

- Ensure bag is not lodged at the infeed tunnel entrance and dislodge bag, if necessary.
- Touch **OK** to acknowledge message on MCI.
- Touch **OK** to acknowledge " Tunnel Flush" message on MCI.

NOTE: Any bag that has been flushed from the scanner must be rescanned. If during this process any bag image appears on the BVS, suspect the image since all bags that are flushed must be rescanned.

- Wait for MCI startup to complete.
- Rescan any bags that were flushed and then resume scanning bags.

2. "This bag has been removed from the outfeed conveyor. Message displays on the BVS to indicate Outfeed location:

- Determine if previous scanned bag was removed from the Outfeed conveyor before reaching the end of the conveyor.
- If a bag was NOT removed from the conveyor:
  1. Click **OK** to acknowledge message on BVS
  2. Press E-stop to ensure X-ray is OFF
  3. Look inside Outfeed tunnel and remove bag, if present
  4. If a bag image is displayed on the BVS, complete bag image
  5. Resolution (i.e., suspect or clear) and forward bag as appropriate
  6. (I.e., ETD/Physical Search or clear to aircraft).
  7. Perform E-Stop Fault Recovery procedures

Emergency Stop/Panel Interlock Recovery

- In an E-stop is pressed "An E-stop or Panel Interlock has been triggered!" message appears on the MCI. The MCI will display a picture of the CT-80 DR (both front and back) and a place a blue flashing circle at the location where the E-stop has been pressed on the scanner. If the remote E-stop is pressed on the BVS, the message "Remote E-stop (BVS) will appear on the MCI.

- Verify the reason the E-stop was pressed before returning the CT-80 DR to normal operating condition.

- Follow instructions displayed on the MCI to recover from the E-stop condition:
  1. Twist E-stop by rotating in the direction of the white arrows. A new E- stop message will appear "Please press the Start button to start the system."
  2. Press the **Start** button on the Startup Switch panel.
  3. Touch **OK** on the "Tunnel Flush" message.
- Verify normal operating conditions (MCI Load Screen appears) before processing passenger baggage.

Shutdown Procedures

Shut down the entire system by performing the following in sequence:

1. **BVS**
   - Log off the BVS
   - Enter **UserID and Password(Level 2)**
   - Click **Shutdown** on the log in screen
   - Click Yes in the pop-up window
   - The BVS computer will shut down and the monitor will go blank

Important note: If the Microsoft Windows desktop appears (instead of blank monitor) during shutdown and stay on, click on start menu at task bar and select **shutdown**. Do **NOT** shut down the BVS by pressing the Power button on the computer tower.

2. **MCC/FDRS**
   - Log Off (if logged on)
   - Enter **UserID and Password(Level 2)**
   - Click **Shutdown** on the log in screen.
   - Click **YES** in the pop-up window.
   - The MCC/FDRS computer will shut down and the monitor will go blank

   Important note: If the Microsoft Windows desktop appears (instead of blank monitor) during shutdown and stay on, click on start menu at task bar and select shutdown. Do NOT shut down the MCC/FDRS by pressing the Power button on the computer tower.

   - Turn off both the BVS and MCC/FDRS monitors.

3. **CT-80 DR SCANNER**
   - A message may appear on the MCI concerning the Reveal Network and restarting the CT-80 DR scanner (ignore this message and do **NOT** press OK).
   - Turn off the CT-80 DR by turning the key switch to the **Off** position on the Startup Switch Panel.
   - When the Green light turns off, remove the key and secure in accordance with local airport procedures.
   - Do **NOT** turn off the Main circuit breaker.

E.4 OUT-OF-GAUGE, NO READ AND "LOST" BAGS

Out-of-gauge, no read, no dimensions (see note below) and "Lost" bags remain on the SS1 line. If a bag has been designated out-of-gauge solely on the basis of its length and as long as it is not over 98-in. long, it will continue on the SS1 line. When bags that have been designated as out-of-gauge for height or width, or their length exceeds 98-inches; that are no reads or that have either a "No Dimensions" status or a "Lost" tracking status block the photo cell at the discharge end of conveyor SS1-08, the conveyor stops.

NOTE:	The dimensioner measures the length of bags up to 78-in. If a bag's length exceeds 78-in., the dimensioner sends a code to the BHS PLC indicating "No Dimensions." Even though the bag could be screened by the CT-80XL, it is stopped at conveyor SS1-08 for removal and manual inspection because it has a "No Dimensions" designation.

The EDS Machine on the SS1 line has an extra long tunnel which allows it to screen bags that are a maximum of 98-inches in length. For this reason, length out-of-gauge bags are not stopped at conveyor SS1-08 and are screened by the SS1 CT-80 EDS machine.

When a bag is stopped at conveyor SS1-08, upstream conveyors cascade stop and the red beacon and horn combination, WA/SS1-07, energizes (Figure E-4). This is an indication to TSA personnel that an out-of-gauge, no read or "Lost" tracking bag is present and needs to be removed for inspection. If TSA personnel determine that the presented bag will fit into the CT80XL, the TSO will press the BLUE "INSERT TEST BAG" button (Figure E-5) to process the bag through the machine.

Figure E-4
RED BEACON INDICATING STOPPED CONVEYORS

Figure E-5
THE BLUE 'INSERT TEST BAG BUTTON

Before removing the bag, TSA personnel must press the GREEN "BAG REMOVAL RESET" pushbutton on control station CS/SS1-07 (Figure E-6). When the button is pressed, the bag can be removed. Upon removal of the bag and clearing of photo eye PE/SS1-08, conveyor SS1-08 restarts, cascade stopped conveyors restart and the beacon and horn combination extinguishes. If the button is not pressed before the bag is removed, conveyor SS1-08 and the cascade stopped conveyors will not restart and the beacon and horn combination will not extinguish. Conveyor SS1-08 will restart and the horn and beacon combination will extinguish only when the GREEN "BAG REMOVAL RESET" pushbutton is pressed and the photo eye, PE/SS1-08 is clear.

Figure E-6
THE 'BAG REMOVAL RESET' BUTTON

E.5 BAG SCREENING

In-gauge bags on the SS1 line and those diverted to either the SS2 line or the SS3 line are transported to their respective EDS machines. When a bag blocks the photo eye at the discharge end of the conveyor prior to its EDS machine, PE/SS1-08, PE/SS2-11 or PE/SS3-06, the BHS PLC sends the CT-80 PLC a QUEUE BAG WAITING signal. The CT-80 PLC responds with a READY FOR BAG signal. When the BHS PLC receives the READY FOR BAG signal from the EDS machine, it releases the bag to enter the machine.

If the CT-80 PLC does not respond with a READY FOR BAG signal after the BHS PLC has sent a QUEUE BAG WAITING signal within 2 minutes, a bag waiting fault is generated. Conveyor SS1-07, SS2-10 or SS3-05 stops, upstream conveyors cascade stop, the visual fault beacon and audible start-up/fault horn on the MCP energize, a message appears on the alarm screen and a color change occurs on the Versa View's graphics screen (Figure E-7).

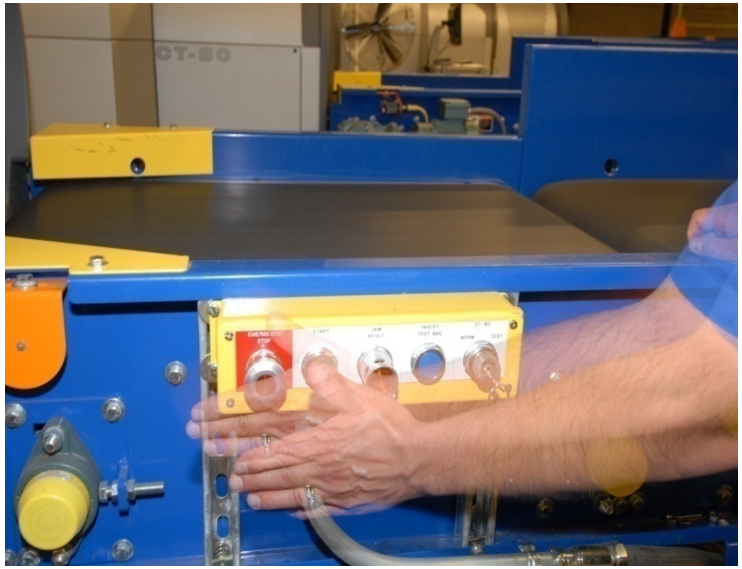
Figure E-7
THE 'BAG WAITING FAULT' SCREEN

Refer to the Versa View legend/ CT 80 binders for trouble shooting guidance.

When there is a photo eye blockage jam, the YELLOW "JAM RESET" button will be lit solid. To clear a fault at any of the photo eyes, follow the procedures outlined below.

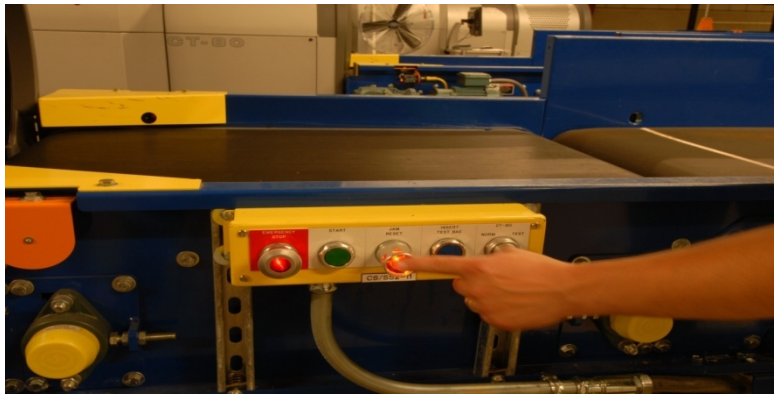
1. Press the RED "EMERGENCY STOP" button (Figure E-8).
2. Remove the jammed item from in front of the photo eye.
3. Release the RED "EMERGENCY STOP" button by pulling out.

Figure E-8
THE RED 'EMERGENCY STOP' BUTTON



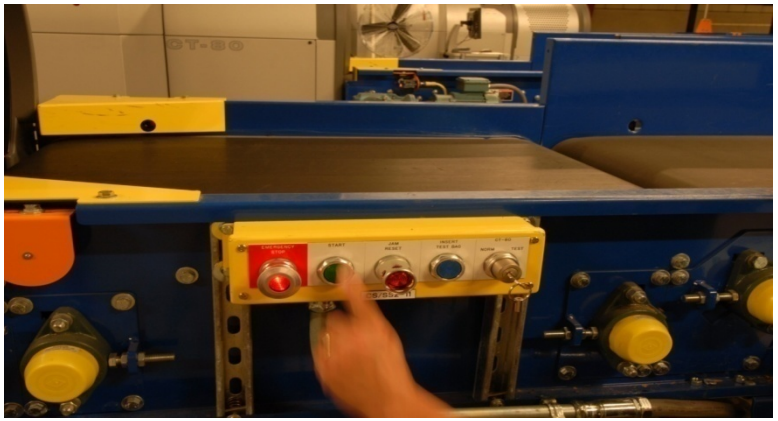
4. Once the item has been cleared from the photo eye, the YELLOW "JAM RESET" button will flash on and off. Press, the YELLOW "JAM RESET" button to extinguish light (Figure E-9).

Figure E-9
THE YELLOW 'JAM RESET' BUTTON



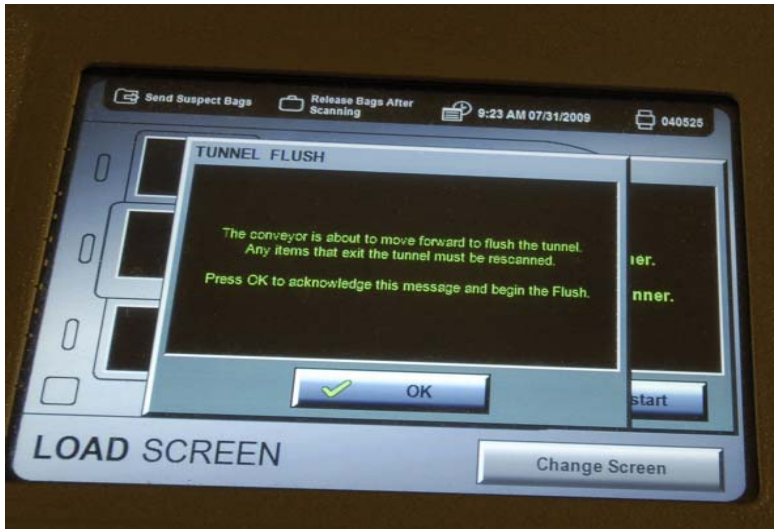
5. Release the RED "EMERGENCY STOP" button by pulling out.
6. Press the GREEN "START" button (Figure E-10).
7. **This will cause the BHS to resume normal operating functions after a short audible alarm**.

Figure E-10
THE GREEN 'START' BUTTON



When a photo eye blockage occurs in front of any of the CT80 Machines, it will produce an error for the CT80 as well. There will be an indicator on the Machine Control Interface (MCI) of the CT80 (Figure E-11). It will produce the following message; BAG MISSED "A bag was not found in the x-ray beam. Remove any bags from the tunnel entrance before proceeding. Press OK to acknowledge this message." When you press the "OK" button on the MCI, the following message will appear; TUNNEL FLUSH "The conveyor is about to move forward to flush the tunnel. Any items that exit the tunnel must be rescanned". Press OK to acknowledge this message and begin the Flush. After pressing the "OK" button, the Flush will occur. The BHS and CT80 will now be ready for normal operations.

Figure E-11
ERROR MESSAGE INDICATING PHOTO EYE BLOCKAGE



When a bag enters the machine, the CT-80 PLC assigns it a bag ID. This bag ID becomes part of the tracking ID when it exits the CT-80. It is through this ID that TSA personnel can call up the machine's image of the bag.

After the bag enters the CT-80 machine, the BHS PLC releases the waiting bag on the upstream conveyor, SS1-08, SS2-11 or SS3-06, if there is one, but waits 15 seconds before sending the next QUEUE BAG WAITING signal.

When screening of a bag is completed, the CT-80 PLC sends a READY TO EXIT signal to the BHS PLC. The BHS PLC ensures that conveyor SS1-10, SS2-13 or SS2-08 is free of baggage and then responds with an EXIT QUEUE READY signal. Upon receipt of the EXIT QUEUE READY signal, the CT-80 PLC releases the bag.

When the exiting bag blocks the exit conveyor's charge-end photo eye PE1/SS1-10, PE1/SS2-13 or PE1/SS3-13, the CT-80 PLC sends the bag's ID number and its decision status, clear or reject, to the BHS PLC. If the CT-80 PLC does not send a decision status, no decision has been rendered.

Additionally, the BHS PLC generates a tracking ID and measures the bag's length. In the bag's tracking data the BHS PLC incorporates its bag ID, decision and length among other things. The generation of tracking ID initiates tracking of the bag.

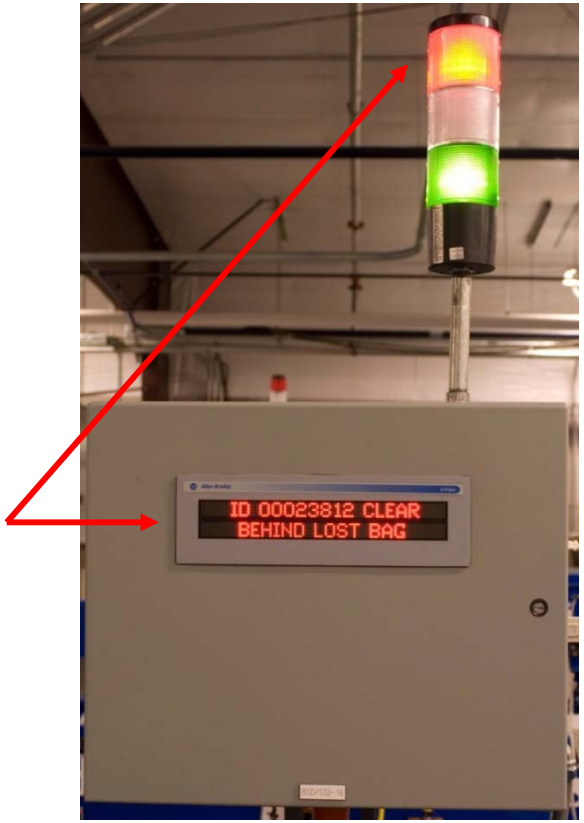
After exiting a CT-80, bags are tracked as they move along their respective lines toward the decision point. When a bag blocks a tracking conveyor's discharge photo eye, its tracking data is updated. If, when the bag blocks the photo cell, there is no data on the bag in the PLC's tracking register, the bag is categorized as a "NO TRACKING" bag (Figure E-12). When a bag is categorized as a "NO TRACKING" bag, a new tracking ID is generated identifying it as a "NO TRACKING" bag and the bag is flagged for inspection by TSA personnel. At this point, you can clear the bag using ETD based Primary Screening Protocol, or RERUN the bag back through the CT80. (TSA Checked Baggage SOP, Section 3.3.2. C.)

Figure E-12
THE 'NO TRACKING' MESSAGE

If a bag's data within the PLC's tracking data arrives at a virtual tracking update photo eye and the associated bag does not arrive at the actual photo eye within a predetermined plus/minus time frame, the bag is categorized as a "Lost Bag" and the "Lost Bag" counter is incremented. If three (3) "Lost Bag" occur

consecutively, a “BEHIND LOST BAG” fault is generated (Figure E-13). At this point, you can clear the bag using ETD based Primary Screening Protocol, or RERUN the bag back through the CT80. (TSA Checked Baggage SOP, Section 3.3.2. C.)

Figure E-13
THE ‘BEHIND LOST BAG’ MESSAGE



At the discharge photo eye on the conveyor upstream of the decision point, SS1-14, SS2-16 and SS3-11, the bag’s length is measured. The measurement is then compared to the length measurement embedded in the bag’s tracking data.

If the two measurements match within a prescribed plus or minus tolerance, the bag is deemed to be same one that exited the EDS machine. If the two measurements do not match within the preset tolerance, it is possible that the bag is not the same one that exited the EDS machine causing the bags to be flagged.

When a bag blocks the photo eye at the discharge end of the decision-point conveyor, SS1-16, SS2-17 or SS3-12, the PLC checks the bag’s CT-80 decision and its BHS status, which includes the bag’s length. Based on the bag’s EDS decision and/or its BHS status, one of the three beacons—red, white and green—on the stacklight adjacent to each decision-point conveyor illuminates and a message appears on the baggage status display (BSD), mounted above the conveyor upstream of the decision point.

The red two-line alpha-numeric display shows the ID of the bag on decision-point conveyor, its EDS status and its BHS status. There are four EDS statuses: Clear, Pending, No Decision or Suspect. There are also three BHS statuses: Too Close, Behind Lost Bag and Length Change.

The messages displayed on the BSD, indicate both the EDS status and the BHS status. The messages that can be displayed on the BSD are shown in Table E-1.

Table E-1
OVERVIEW OF BAGGAGE STATUS DISPLAY MESSAGES

EDS Decision	BHS Decision	General Decision	Decision Conveyor Action
		No Tracking	Stops
		Fail-Safe Fault	Stops
Clear	OK	N/A	Does not stop
Clear	Too Close	N/A	Stops
Clear	Behind Lost Bag	N/A	Stops
Clear	Length Change	N/A	Stops
Pending	OK	N/A	Stops
Pending	Too Close	N/A	Stops
Pending	Behind Lost Bag	N/A	Stops
Pending	Length Change	N/A	Stops
No Decision	OK	N/A	Stops
No Decision	Too Close	N/A	Stops
No Decision	Behind Lost Bag	N/A	Stops
Suspect	OK	N/A	Stops
Suspect	Too Close	N/A	Stops
Suspect	Behind Lost Bag	N/A	Stops
Suspect	Length Change	N/A	Stops

If a bag arrives at the decision-point conveyor with a “CLEAR” decision and an OK BHS status, the green beacon on the stacklight illuminates, and a message appears on the BSD displaying the bag’s ID, its EDS status and its BHS status. The bag does not stop (Figure E-14). It continues onto the downstream conveyor and is transported to the make-up unit. When the bag clears the photo eye at the discharge end of the decision-point conveyor, the stacklight’s green beacon extinguishes and the message on the BSD clears.

Figure E-14
THE ‘CLEARED AND OK BAG’ MESSAGE

If a bag arrives at the decision-point conveyor with a pending decision, it indicates that a final decision has not been made on the bag. All bags given a “SUSPECT” decision by a CT-80 EDS machine are reviewed through On-Screen Alarm Resolution Protocol (OSARP) by TSA personnel (Figure E-15). Through OSARP, bags can remain suspect or can be cleared. TSA

personnel can determine through OSARP if a bag is clear or suspect and release the bag's image before the bag reaches the decision-point conveyor. However, this is not a requirement. The "SUSPECT" bag can sit on the decision point conveyor until you have completely made your decision.

Figure E-15
THE 'SUSPECT BAG' MESSAGE

If a bag is not cleared or suspected through OSARP and the bag's image released before it blocks the photo eye at the discharge end of the decision-point conveyor, the bag's EDS status on the BSD will appear as "PENDING" (Figure E-16). A bag with a "PENDING" EDS status is handled as if it was a suspect bag; the red beacon on the associated stacklight illuminates and a message appears on the BSD showing the bag's ID, its "PENDING" EDS decision and its bag status.

Figure E-16
THE 'PENDING BAG' MESSAGE

The bag will be held at the decision-point conveyor until a decision is made through OSARP. While a bag is being held at the decision-point conveyor, upstream conveyors cascade stop. If the bag's final decision continues to be suspect, the EDS status on the BSD changes from "PENDING" to "SUSPECT" and the bag must be removed for inspection following the standard bag removal procedure (Figure E-17).

Figure E-17
STATUS CHANGE TO "SUSPECT BAG' SIGNAL

When checked baggage alarms an EDS, the ETD operator must view the image to identify the location of the alarming object within the checked baggage before removing the checked baggage from the EDS. Before clearing the image from the Baggage Viewing Screen (BVS) annotate the 16 digit numeric code onto the baggage inspection tracking form and save image onto the BVS computer.

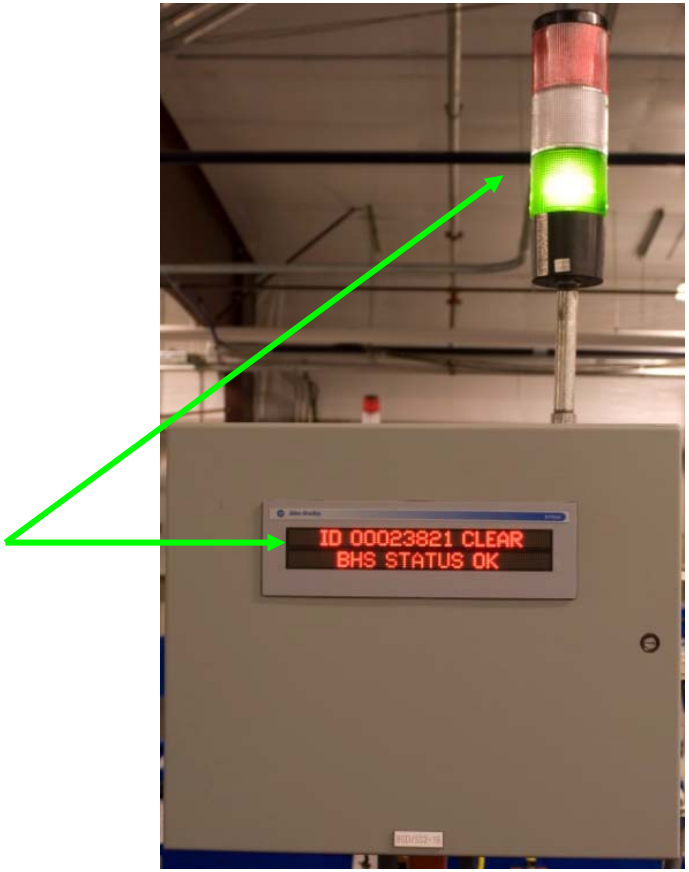
The ETD operator must locate, remove, and sample each item that caused an EDS alarm, one at a time. Do not repack the items until all suspect items have been cleared.

Once all alarms have been cleared, carefully and neatly repack the bag and insert notification of inspection form. Make certain notification form has the current date and time stamped.

If the final decision is "CLEAR," the red beacon on the stacklight extinguishes, the green beacon illuminates, the EDS decision on the BSD changes from "PENDING" to "CLEAR" (Figure E-18) and the decision-point conveyor restarts transferring the bag onto the downstream conveyor for transportation to the make-up unit. As soon as the bag clears the photo eye at the discharge end of the decision-point conveyor, the green beacon on the stacklight extinguishes and the message on the BSD is cleared.

Once a bag with a "PENDING" EDS status reaches the decision-point conveyor, TSA personnel are not obligated to wait a specific length of time for a final decision through OSARP. TSA personnel have the option to remove the bag for inspection, while a final decision is pending, following standard bag removal procedures.

Figure E-18
STATUS CHANGE FROM 'PENDING' TO 'CLEAR'



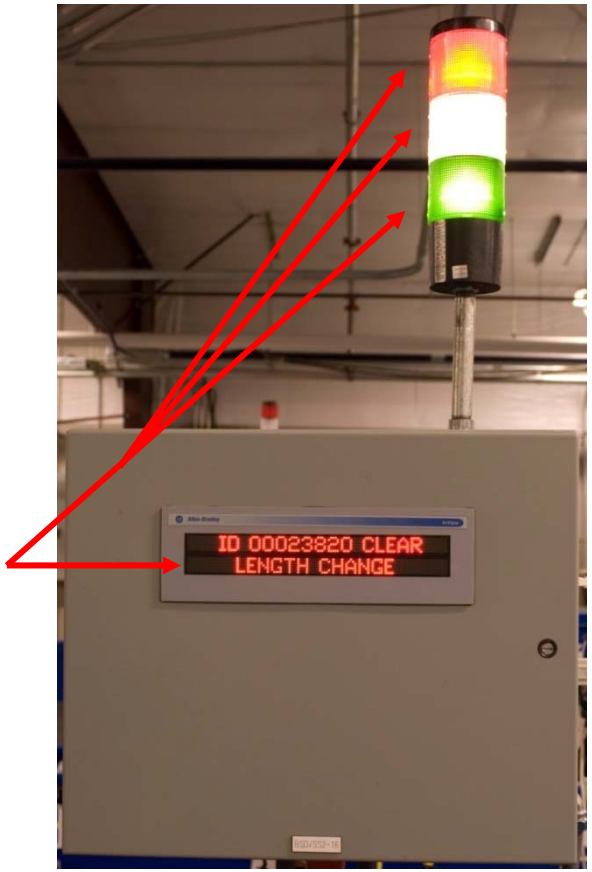
If a bag arrives at the decision-point conveyor with "NO DECISION," the bag's tracking data has no data embedded to indicate that the bag was screened. When a "NO DECISION" bag is detected at the decision-point, the bag is treated as if it has a "SUSPECT" decision (Figure E-19). The decision-point conveyor stops, the red beacon on the stacklight illuminates and a message appears on the BSD showing the bag's ID, its "NO DECISION" EDS decision and its bag status. The bag must be removed by TSA personnel for inspection following standard bag removal procedures. (TSA Checked Baggage SOP, Section 3.3.2. C.)

If a bag arrives at the decision-point conveyor with a "SUSPECT" the decision-point conveyor stops, the red beacon on the stacklight illuminates and a message appears on the BSD showing the bag's ID, its "SUSPECT" EDS decision and its bag status. The bag must be removed by TSA personnel for inspection following standard bag removal procedures. (TSA Checked Baggage SOP, Section 3.3.2. C.

If a bag arrives at the decision-point conveyor with a BHS status of "FOLLOWING LOST BAG" or "LENGTH CHANGE," the decision-point conveyor stops, the red, white and green beacon on the stacklight illuminates solid and a message appears on the BSD showing the bag's ID, its decision and its BHS status (Figure E-20). The bag must be removed by TSA personnel for inspection following standard bag removal procedures. (TSA Checked Baggage SOP, Section 3.3.2. C.)

Figure E-19
A 'NO DECISION' BAG IS TREATED AS 'SUSPECT' BAG

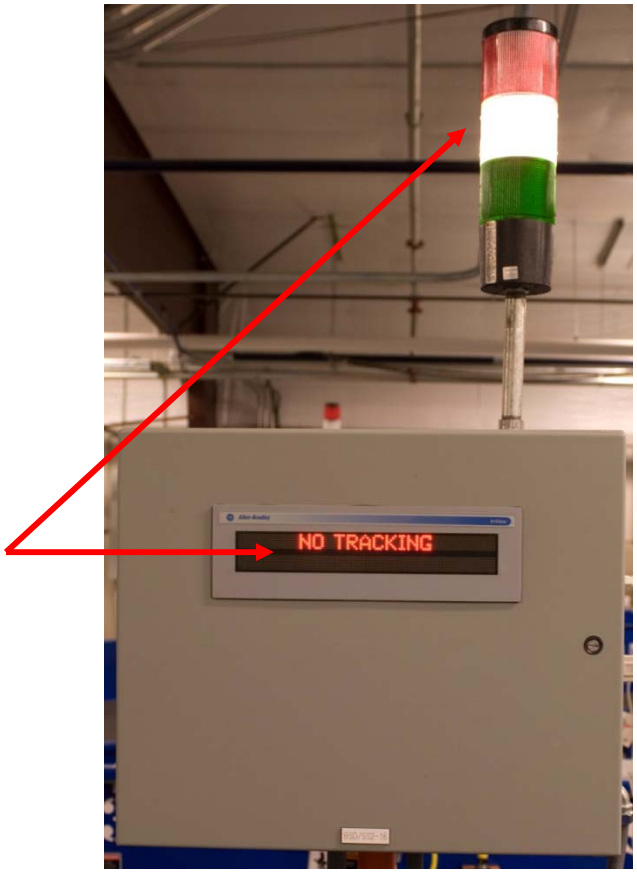
Figure E-20
LENGTH CHANGE' STATUS REQUIRES BAG TO BE REMOVED



If a bag arrives at the decision-point conveyor with a BHS status of "NO TRACKING," the decision-point conveyor stops, the white beacon on the stacklight illuminates solid and a message appears on the BSD showing the bag's ID, its decision and it BHS status (Figure E-21). The bag must be removed by TSA personnel for

inspection following standard bag removal procedures. (TSA Checked Baggage SOP, Section 3.3.2. C.)

Figure E-21
THE 'NO TRACKING' STATUS MESSAGE



NOTE:	When a bag is stopped at the decision point, a Dymo label printer near the decision-point conveyor generates a label with the bag's ID, its EDS status, its BHS status and a bar code. The label is to be placed on the bag once it is removed from the decision-point conveyor. (Not local TSA policy, HQ may consider this procedure for future configurations.)

E.6 FAIL-SAFE CONDITIONS AND HANDLING

If TSA personnel remove an item from the decision-point conveyor without first pressing the GREEN "BAG REMOVAL RESET" pushbutton, a fail-safe fault is generated. Additionally, when a bag passes through the decision-point conveyor and blocks the discharge photo eye, PE/SS1-16, PE/SS2-17 or PE/SS3-12, the bag's EDS status and its BHS status is rechecked.

When a bag blocks the photo eye at the discharge end of the decision-point conveyor, the length measurement taken when it exited the EDS machine and its length measurement taken at the downstream photo eye are compared. If the two measurements don't match within a preset tolerance, a fail-safe fault is generated.

When a fail-safe fault is generated, the decision-point conveyor and the next downstream conveyor stop, the three beacons on the stacklight illuminate, flashing simultaneously; an audible alarm sounds and the beacon on the MCP illuminates; and a "FAIL SAFE FAULT" message appears on the BSD and the Versa View mounted in MCP4's door (Figure E-22).

TSA personnel should follow their procedure for handling fail-safe bags. (TSA Checked Baggage SOP, Section 3.3.2. C.) Once the procedure has been completed, TSA personnel can reset and clear the fail-safe fault by pressing the GREEN "START" pushbutton on control station CS/SS1-14, CS/SS2-15, or CS/SS3-14 (Figure E-23). When the button is pressed, the three beacons on the stacklight extinguish, the amber beacon and

warning/fault horn on the MCP extinguish, the messages on the Versa View and the BSD are cleared and the conveyors restart.

Figure E-22
THE 'FAIL-SAFE' SIGNAL

Figure E-23
CLEARING THE 'FAIL-SAFE' FAULT BY PRESSING THE START BUTTON

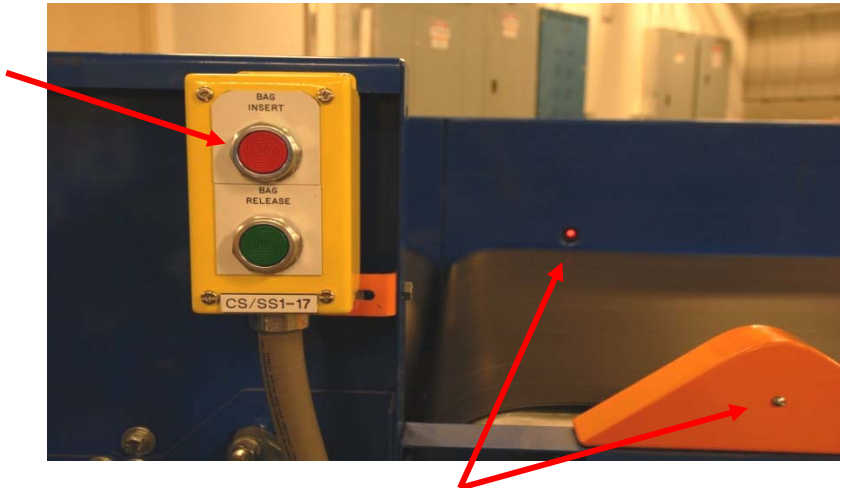
E.7 CLEARED BAGS

Bags removed from the decision-point conveyor with an EDS status of "PENDING," "NO DECISION" or "SUSPECT," or a BHS status of "TOO CLOSE," "BEHIND LOST BAG" LENGTH CHANGE" or a general status of "NO TRACKING" or "FAIL SAFE FAULT" are inspected by TSA per (TSA Checked Baggage SOP,

Section 3.3.2. C.) **Once a bag has been cleared by TSA, it can be reinserted into the system**.

Each line has an insertion point for cleared bags. On the SS1 line it is at SS1-17; on the SS2 line it is at SS2-18, and on the SS3 line it is at SS3-13. When TSA personnel are ready to insert a cleared bag on a line, the TSA agent must press the RED "BAG INSERT" pushbutton on control station CS/SS1-17, CS/SS2-18 or CS/SS3-13 (Figure E-24). Pressing the button causes upstream conveyor, SS1-16, SS2-17 or SS3-12, respectively, to stop when its discharge photo eye, PE/SS1-16, PE/SS2-17, or PE/SS3-12 is blocked. The insertion conveyor continues to run until its discharge photo eye is clear. Once the photo eye is clear, the conveyor stops and TSA can place the bag onto the conveyor.

Figure E-24
THE RED 'BAG INSERT' BUTTON



(Photo eye)

In placing the bag on the conveyor, TSA personnel should ensure that the bag blocks the conveyor's discharge photo eye, PE/SS1-17, PE/SS2-18 or PE/SS3-13. When the bag is on the conveyor and properly positioned in relationship to the discharge photo eye, the GREEN "BAG RELEASE" pushbutton on the control station must be pressed. Pressing the button restarts the insert conveyor, the upstream conveyor and any cascade stopped conveyors (Figure E-24).

If the bag is not blocking the discharge photo eye when the GREEN "BAG RELEASE" pushbutton is pressed, the conveyor starts; the bag advances blocking the discharge photo eye and a fail-safe fault is generated.

When a fail-safe fault is generated, the upstream conveyor and the insertion conveyor stop, the three beacons on the stacklight illuminate flashing simultaneously; an audible alarm sounds and the beacon on the MCP illuminates; and a Fail-Safe message appears on the BSD and the Versa View mounted in MCP4's door.

TSA personnel should follow their procedure for handling fail-safe bags. (TSA Checked Baggage SOP, Section 3.3.2. C.) Once the procedure has been completed, TSA personnel can reset and clear the fail-safe fault by pressing the GREEN "START" pushbutton on control station CS/SS1-14, CS/SS2-15, or CS/SS3-14 (Figure E-25). When the button is pressed, the three beacons on the stacklight extinguish, the audible alarm and the beacon on the MCP extinguish, the messages on the Versa View and the BSD are cleared and the conveyors restart.

Figure E-25
RESTARTING THE BHS

E.8 TRANSPORTATION OF CLEAR AND CLEARED BAGS

Clear and cleared bags are transported to the make-up unit. Those bags on the SS1 line continue on it. Clear and cleared bags on the SS3 line are merged onto the SS1 line at SS1-14. From conveyor SS1-14, bags flow onto the ML1-03 conveyor.

Clear and cleared bags on the SS2 line are merged onto the ML1 line at ML1-04. At conveyor ML1-05 bags pass through fire/security door DR/ML1-05 and then are transported to the make-up unit, ML1-MU. Bags are merged onto the make-up in an unregulated manner. From the make-up unit, baggage handlers take bags to their flight and load them on the plane

E.9 SYSTEM SHUT-DOWN

1. Complete and collect shift paperwork for Checked Baggage screening operations.

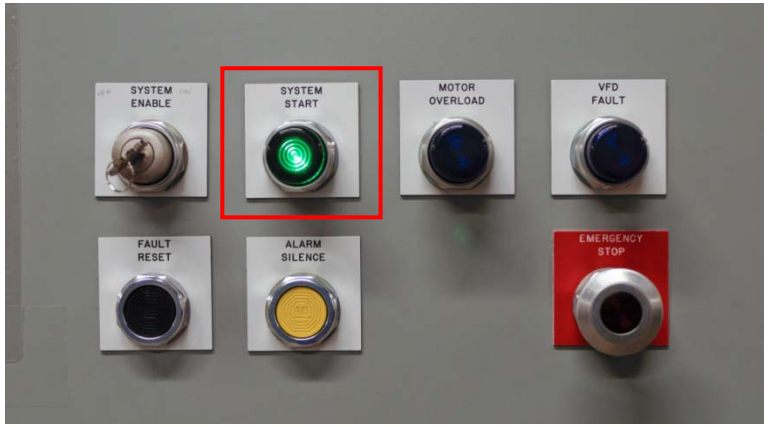
2. Complete Shutdown process of Reveal CT-80 EDS systems following manufacturers approved procedures.

3. Ensure all cabinets for Baggage viewing screen and Field Data Reporting System are closed and secured.

4. Turn the SYSTEM ENABLE switch to OFF on the MCP (Figure E-26).

5. Return all CT80 and ETD keys to the key box in the Supervisor's office. Sign TRAVEL SENTRY MASTER keys into the KEY CONTROL LOG and have Supervisory Officer place them into the safe.

Figure E-26
TURNING THE 'SYSTEM ENABLE' SWITCH OFF



E.10 MEDFORD BHS: LESSONS LEARNED

Ergonomics:

- CT-80 DR Circuit Breaker panel location – multi side configuration (one side of scanner has limited space due to belt system layout)
- Bag Search area – provide for adequate space during planning stages to avoid bottleneck configuration
- Primary work area satellite monitor – a remote or secondary MCP located in the primary work area saves unnecessary trips over catwalk to clear faults or diagnose system faults
- ETD's on poles – if possible, may increase available space in work areas
- Search tables – type (width/height/wheels/rollers) and positioning
- Fatigue mats – multiple mats per line
- Adequate HVAC system – heating, cooling & circulation issues
- Temperature gauge / thermometer – aides in monitoring environmental comfort & contractual compliance
- Bag pusher – both long and short models of wood or PVC preferably with "T" end

Logistics:

- Adequate fiber optic cables – BVS may need to be moved, plan for ability to execute moves
- Baggage carts – size and number
- Oversize bas search area – ETD's, search tables, supply storage need to be looked at
- Hard line availability – phone and data lines
- CCTV systems – TSO safety, claims mitigation; better to plan ahead than to try and catch up
- Adequate amount of electrical outlets – EDS scanner, BVS, FDRS, time/date stamp clock, ETD, UPS and 2 extras are needed for each line. Also plan for fans, phones and possibly appliances in break areas
- Metal storage cabinets – for equipment and screening supplies
- Chairs – for both work and break areas
- Clip boards – for tracking forms

- TSA computers – for training and administrative purposes
- Clocks – to coordinate breaks, meals, etc.
- Key hooks – keeps area tidy and keeps keys in one know place
- Power back up – priority
- GSA involvement – earlier the better, help resolve lease issues

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Appendix F

REIMBURSABLE/NONREIMBURSABLE COSTS FOR THE ELECTRONIC BAGGAGE SCREENING PROGRAM

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APPENDIX F: REIMBURSABLE/NONREIMBURSABLE COSTS FOR THE ELECTRONIC BAGGAGE SCREENING PROGRAM

F.1 INTRODUCTION

The Transportation Security Administration (TSA), through its Electronic Baggage Screening Program (EBSP), is responsible for the deployment and installation of explosives detection system (EDS) equipment at airports across the nation. As part of the deployment program, EBSP management may issue Letters of Intent (LOIs) or Other Transaction Agreements (OTAs) to provide funding support for facility modifications or equipment acquisitions at airports where checked baggage inspection systems (CBISs) are being implemented. Funded systems must comply with the TSA's *Planning Guidelines and Design Standards for Checked Baggage Inspection Systems* (PGDS).

The PGDS is aimed to guide airports and project sponsors to achieve the lowest-cost CBIS solution. Achieving the lowest-cost solution requires three key changes from typical past practices: (1) assuming implementation of soon-to-be-certified screening technologies during the development of alternatives (Chapter 3 in PGDS), (2) considering a wide range of CBIS alternatives rather than relying on a preconceived notion regarding which system would be best suited for a particular airport (Chapter 4), and (3) assessing the 20-year life-cycle costs of different CBIS alternatives, so that the ongoing costs of operating and maintaining these systems are appropriately balanced with the upfront capital costs (Chapter 8) and ensuring that the optimal CBIS solution used for the preferred alternative indeed achieves the lowest 20-year life cycle cost compared to all other CBIS alternatives. Naturally, all CBIS alternatives including the preferred alternative, need to comply with the stated design and performance standards for CBIS (Chapter 7).

Based on annual Congressional appropriations, TSA formulates a spend plan for the EBSP. The available monetary resources are directed first to fund previously executed multiyear funding obligations, followed by equipment-only requests, and then projects with construction deadlines. After these priorities are addressed, project sponsor requests for other in-line CBIS facility modifications are considered.

This appendix to the PGDS is provided to identify allocable and allowable costs associated with awarded LOIs and OTAs. TSA will use the allocable and allowable costs identified in this document when:

- Reviewing funding applications (thus affecting the cost share calculation, which is part of the overall funding application scoring process)
- Negotiating LOIs and OTAs with project sponsors
- Reviewing invoices submitted by airport or project sponsors for reimbursement

The processes and procedures outlined in this appendix are based on industry-accepted standard practices for cost estimating, and are representative of the processes and procedures already in use by airport sponsors in estimating the costs for proposed baggage handling system (BHS) projects.

F.2 FACILITY COSTS

Projects submitted to TSA for funding can typically be divided into four primary categories:

1. Modifications of an existing BHS within an existing facility/terminal
2. The in-line screening portion of a new facility/terminal, including a BHS
3. Modifications of an existing BHS to support the in-line screening as part of the expansion of existing facilities
4. Redesigns or upgrades of an existing in-line CBIS to meet new CBIS performance requirements

TSA will only fund those construction costs directly necessary to implement an EDS screening solution and support the on-screen resolution (OSR) room and checked baggage resolution area (CBRA). Funding should be provided based on an agreed-upon percentage of the "allocable" costs of TSA-required installations at the facility plus facility costs based on the average national cost per square foot for similar functional space. Any agreed-upon program management, construction management, escalations, or design fees will be in addition to funding for the BHS and facility costs. The square foot facility cost will be adjusted based on locality in accordance with the most current version of the RSMeans construction cost indices.

TSA will identify those portions of the BHS design required to meet TSA screening requirements, as outlined in the most current version of the PGDS. Facility costs, structural, mechanical (heating, ventilation, and air conditioning [HVAC]), plumbing, electrical, and other systems necessary to support the portion of the airport used to meet TSA screening requirements should be funded on a square foot basis as identified in the previous paragraph. These include any areas necessary for the OSR room or the CBRA.

F.3 ALLOWABLE/ALLOCABLE AND REASONABLE COSTS

The TSA is not a party to the contracts an Airport executes in support of the TSA CBIS project. The Airport (or its appropriate procurement authority) is the responsible contractual authority for establishing and administering the contract agreements and is responsible for all contractual matters, including evaluation and award of contract, resolution of claims and disputes, and settlement of litigation issues. The Airport is the responsible authority, without recourse to the TSA regarding the settlement and satisfaction of all contractual and administrative issues arising from procurements entered into, in support of the TSA CIBS Project. This includes, but is not limited to, disputes, claims, protests of award, source evaluation, or other matters of a contractual nature.

The TSA encourages that all procurement transactions be conducted in a manner providing full and open competition. The type of contract awarded by the Airport shall be appropriate for the particular procurement and for promoting the best interest of the Project involve; however the "cost-plus-a-percentage-of-cost" method of contracting shall not be used for the TSA CBIS Project.

As used in this appendix, allowable, allocable and reasonable costs are referred to as reimbursable costs. Nonreimbursable costs, as used in this document, are costs that are not currently deemed allowable, allocable or reasonable costs by TSA.

Per the Office of Management and Budget (OMB) Circular A-87 (OMB A-87), *Cost Principles for State, Local, and Indian Tribal Governments*, costs are allocable to a particular cost objective (in this case, a CBIS project) if the goods or services involved are chargeable or assignable to such cost objective in accordance with the relative benefits received. OMB A-87 does not allow allocable costs identified or submitted to TSA to be charged to other federal agencies to overcome funding deficiencies or to avoid restrictions imposed by law or terms of the award. It is not acceptable for an airport or project sponsor to use funds received from the Federal Aviation Administration (FAA) as part of an Airport Improvement Program (AIP) grant to fulfill the local cost share required by an agreement with TSA.

A cost is reasonable if, in its nature and amount, it does not exceed that which would be incurred by a prudent person. In determining reasonableness of a given cost, consideration shall be given to:

1. Whether the cost is of a type generally recognized as ordinary and necessary for the CBIS project.

2. The restraints or requirements imposed by such factors as: sound business practices; arms length bargaining; Federal, State and other laws and regulations; and, terms and conditions of the TSA Project Agreement.

3. Market prices for comparable goods or services.

4. Generally accepted accounting principles.

5. Terms of the TSA Agreement for the CBIS Project

Federal Acquisition Regulations (FAR) Subpart 31.2, *Contracts with Commercial Organizations*, identifies "allowability" in the following terms:

1. Reasonableness (cost is defined as "reasonable" if, in its nature and amount, it does not exceed that which would be incurred by a prudent person in the conduct of competitive business FAR 31.201-3)

2. Allocability (costs are allocable if assignable or chargeable to one or more cost objectives on the basis of relative benefits received; incurred specifically for the effort, and necessary to the operation)

F.3.1 Typical Reimbursable and Nonreimbursable Costs for TSA Baggage Screening Projects

In evaluating and identifying reimbursable costs, TSA will assess each design with regard to the following items:

F.3.1.1 Reimbursable/Allowable Costs

1. TSA generally supports basic interior wall construction only. Costs in excess of basic interior wall construction and finish are nonreimbursable. TSA supports basic interior wall finishes and buildout of interior spaces in bag inspection rooms, CBRA areas, and OSR room(s). Costs in excess of basic finishes are nonreimbursable.

   Buildout of the interior space is defined to include:

   - Installation of electrical and communications systems, including:
     - Circuit panels
     - Telephone or communication junctions
     - Transformers and other electrical components required to support TSA
   - Installation of any necessary heating or cooling systems to ensure that the environment in which EDS machines are located will support their operation
   - Sprinkler systems and alarms as required by code
   - Insulation and drywall associated specifically with the CBRA or OSR room
   - Provision for adequate lighting in the CBRA, OSR room, and CBIS area
   - OSHA requirements for spaces inhabited by personnel

   Items may be negotiated by TSA as necessary to address the specific airport's CBIS installation. These costs may include installation of a reinforced floor or added cost for installation of structural steel necessary to bolster flooring under the CBIS, CBRA, and/or OSR areas to meet structural load requirements.

2. TSA supports costs associated with the demolition of existing spaces, modification or renovation of existing spaces, or fit out of newly constructed spaces necessary to support TSA operations. However, TSA will only consider those costs associated with areas necessary for its operation or directly supporting baggage screening operations (e.g., CBRA, OSR room, and CBIS area). (See Section F.3.1.2(a) regarding exterior walls and building shell.)

3. TSA supports air conditioning of the OSR room, CBRA, and other areas that will be staffed by TSA field personnel. The exact extent of the heating, ventilation, and air conditioning (HVAC) cost that will be considered eligible for TSA reimbursement is assessed on a case-by-case basis.

4. TSA requires lighting, fixtures, switching, and appurtenances in CBIS areas, the CBRA, and the OSR room that meet current minimum National Electrical Code, International Building Code, and Occupational Safety and Health Administration requirements for lighting (lumen per square foot) for office space and to support associated computers, conditioning units, printers, and other ancillary equipment. If the following are allocable to the CBIS, OSR room, or CBRA, the following are allowable costs:

   - New power drops
   - Associated transformers
   - Electrical panels or subpanels
   - Communication and network wiring
   - Network and/or communications exchanges

   Lighting and electrical costs in excess of basic fixtures are TSA nonreimbursable.

5. TSA supports basic furnishings within the CBRA and OSR room only, including minimum requirements for work surfaces and lift assist devices, as referenced in the latest revision of the PGDS in effect at the time of OTA enactment. Such minimum requirements include, but may not be limited to, adjustable height work stations and non-powered gravity rollers. Stainless steel CBRA tables are expensive to manufacture and should this type of CBRA table be proposed for use, the Airport should specify the quantity of tables required and the cost of each table in their basis of estimate. Costs in excess of basic furnishings are nonreimbursable.

6. Automatic tag readers (ATRs) are eligible for reimbursement by TSA if installed pre-EDS and used to support bag tracking in a security zone. Eligibility and the exact amount of reimbursement will be determined on a case-by-case basis. If the ATRs are post EDS and only used for reading International Air Transport Association (IATA) bag tags for the purposes of identifying bag destination and associated passenger(s) for baggage reconciliation, then the ATR costs are nonreimbursable.

7. Sortation cost may be considered reimbursable for systems where bags from multiple ticket counter inputs are merged to be screened in a common matrix then delivered from the matrix and sorted back to the original delivery system. Conveyor sections required to intercept bags on original delivery lines, deliver to CBIS, and return back to the original conveyance will be considered for reimbursement. TSA will not reimburse for a host Baggage Sortation Message to a sort controller for the purpose of individual air carrier sort functions. Sortation function will be performed by basic airline code. Figures F-1 and F-2 show high-level block diagrams of reimbursable ATRs compared to non-reimbursable ATRs.

8. Due to the remoteness of the OSR room from the CBIS and CBRA areas at some airports, and the need for communications during BHS maintenance or the need to notify personnel in the CBIS of OSR decisions, the costs for telephone, radio, intercom, airport-only cellular phones, or other telecommunications are supported and reimbursable by TSA.

Figure F-1
DIAGRAM OF REIMBURSABLE ATRS (DECENTRALIZED SORTATION)

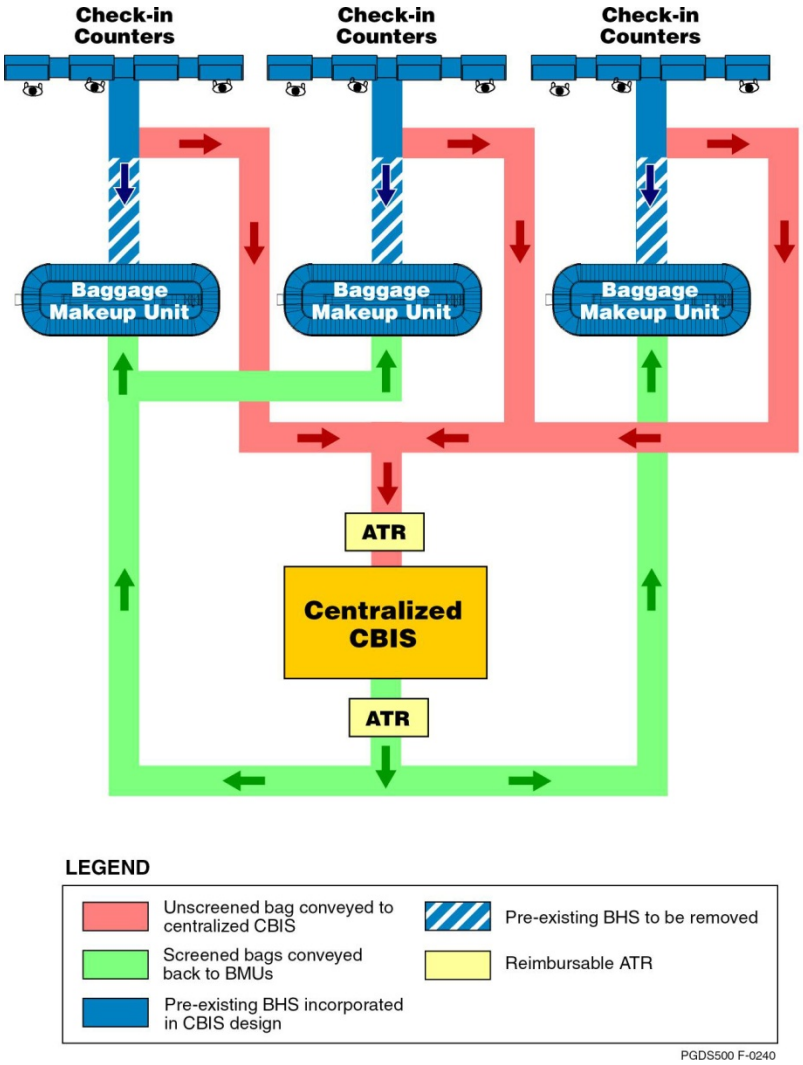
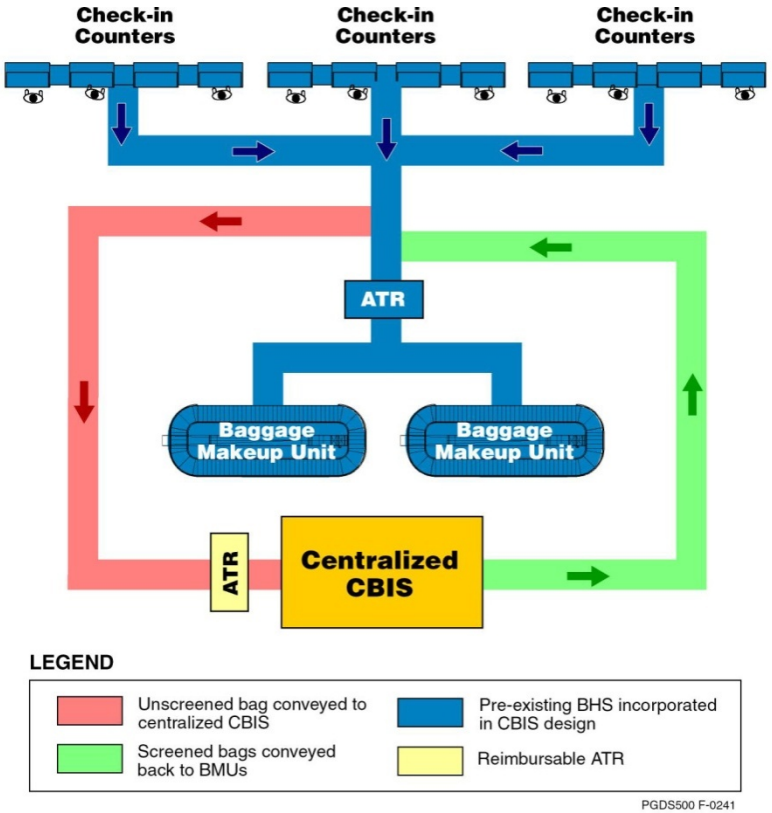


Figure F-2
DIAGRAM OF REIMBURSABLE ATRS (CENTRALIZED SORTATION)



9. Closed Circuit Television (CCTV) at the following locations is reimbursable by TSA on a case-by-case basis:

   - The divert point going into the EDS shunt
   - The EDS entrance
   - The exit of the EDS
   - The machine clear bag divert point
   - The point where the OSR line merges into the mainline
   - Last chance divert point

   TSA also supports the expansion of the existing video surveillance system to provide coverage of CBIS areas that are not open to public view based on the needs of the local FSD and airport operator. This may be facilitated via a separate agreement with TSA through the Advance Surveillance Program (ASP). For additional information use the following email contact: OST_ASP_Video_Surveillance@tsa.dhs.gov.

10. Appropriately-sized passive BHS monitors in the OSR room or in the CBRA for TSO use are reimbursable costs.

11. TSA will only consider reimbursement of programmable logic controllers (PLCs) if the addition of an in-line screening system requires a modification/addition to current systems. TSA will only consider reimbursement for the additional programming to control the in-line screening portion of the BHS, and will only reimburse the project sponsor for the costs of that portion of the controls necessary to support CBIS, OSR, and CBRA operations. See Section F.3.1.2(g) regarding eligibility of full replacement of the PLC.

12. TSA will consider reimbursement of the costs for specific replacement and upgrade of the conveyor system necessary to support integration of the EDS machines on a case-by-case basis within the TSA designated areas.

13. Costs related to compliance of a CBIS with TSA Security Technology Integration Program (STIP) requirements will be reimbursed by TSA. These include costs related to connectivity of security technology such as EDS, ETD as well as primary and secondary EDS workstations to the TSA network (see chapter 9 for STIP connectivity requirements as well as latest STIP document which can be obtained from TSA. Costs associated with STIP requirements include data drops, runs consisting of RJ45 Cat5E/Cat 6 connections; cabinet installation requiring 110V 20A dedicated services and meet seismic requirements. Cabling outside of TSA controlled spaces must be rigid metal tubing conduit.

    Costs associated with complying to STIP connectivity requirements include material and installation expenditures for:

    - Cat 5e/Cat 6 copper cable runs
    - Cat 5e/Cat 6 data jacks and connectors
    - Electrical metallic conduit (EMT) where required
    - Cat 5e/Cat 6 24 or 48 port Patch Panels
    - Cable Management brackets
    - Lockable IT Cabinets (minimum 12U)
    - Dedicated Electrical Circuit (120V 20A) for each IT Cabinet
    - Fiber Cabling and Terminations
    - Fiber Patch Panel

F.3.1.2 Nonreimbursable Costs

1. TSA does not reimburse costs associated with the building shell or exterior enclosure. TSA does not reimburse the cost of construction of terminal expansions, whether necessary to support TSA operations or for other purposes. Roofing, with associated joists, structural steel, shingles, membranes, etc., for the CBIS, OSR, and CBRA areas is not an allowable cost, as the project sponsor would be required to provide roofing for any BHS being installed.

2. TSA does not reimburse construction costs for TSA-leased spaces. If TSA is leasing the space from the airport sponsor or airline, funding for facility construction costs or modification costs will not be approved, as it will be assumed that the airport/project sponsor will recover the construction cost of such spaces via the terms of the applicable lease.

3. Costs for centralized BHS control rooms and associated BHS control workstations are not reimbursed by TSA (see Section F.3.1.1(j)).

4. Costs for extended warranties and the procurement of extended warranties are not reimbursed by TSA.

5. On-site technical support is considered part of the CBIS operating and maintenance (O&M) expense, which TSA does not reimburse. On-site technical support is reimbursable by TSA only during startup and preparation for the Integrated Site Acceptance Test (ISAT) and during the ISAT Test.

6. TSA does not reimburse the cost of any spare parts nor areas for storage of spare parts for Airport Terminal infrastructure components or BHS components installed for the TSA CBIS Project.

7. The full replacement of an existing PLC package is a decision made by the airport sponsor/airline when soliciting bids. TSA will not reimburse full replacement of existing PLC programs to integrate EDS screening. See Section F.3.1.1(k) regarding sections of the PLC eligible for reimbursement consideration.

8. TSA does not reimburse the cost of laptop computers used for maintenance of the BHS.

9. Baggage reconciliation systems (carousels or sortation systems) are not required in support of the CBIS and the costs for such systems are therefore nonreimbursable by TSA.

10. TSA generally does not reimburse costs associated with connectivity to Baggage System Management (BSM) data providers and/or BSM systems, as the BSM is usually used solely by the airlines for internal processing and is not a requirement of in-line screening. However, if TSA requests or supports initiation of CBIS selectee screening where BSM is required, reimbursement of BSM will be evaluated on a case-by-case basis.

11. Manual encoding consoles are required only for sorting baggage with either unreadable tags, no bag tag destinations in the system, or damaged tags. Manual encoding systems are not required as part of the CBIS and the costs for such systems are, therefore, not reimbursable by TSA.

12. TSA does not support costs for full replacement of conveyor systems, as new in-feed, take away, and transfer point conveyors benefit the airport (i.e., ticket counter belts and conveyors for the sortation area are not eligible for reimbursement).

13. As a general rule, TSA will cover cost for relocating inbound and outbound devices to enable placement of new systems but will not refund replacement cost for these types of items.

14. TSA does not support costs related to changes in CBIS or BHS growth that may happen prior to the design year of DBU+5, which differ from the ILDT submitted design for DBU+5 growth.

15. TSA does not support costs related to the construction of new or replacement terminal buildings and infrastructure unless such construction is proven to be cost-beneficial to TSA.

    If additional EDS and/or ETD equipment is required beyond what has already been provided by TSA for the original CBIS design due to such construction, TSA will utilize a Memorandum of Understanding (MOU) with the terminal or airport expansion sponsor to provide such equipment. Additional costs related to the installation of such equipment will be covered by the terminal or airport expansion sponsor.

16. TSA does not support any costs to retrofit an existing CBIS as a result of airline mergers unless such construction is proven to be cost-beneficial to TSA.

    If additional EDS and/or ETD equipment is required beyond what has already been provided by TSA for the original CBIS design due to such airline mergers, TSA will utilize a MOU with the project sponsor (airline or airport operator) to provide such equipment. Additional costs related to the installation of such equipment will be covered by the project sponsor.

F.4 COST ESTIMATING

The PGDS requires airport and project sponsors to submit cost estimates as part of the design package submission at each design phase (Pre-Design, Schematic, 30%, 70%, and 100%). While the Pre-Design and Schematic Design phases require rough order-of-magnitude (ROM) costs, the 30% through 100% designs require detailed cost estimates based on the Basis of Design Report.

To ensure that TSA is only the funding that portion of a project that is necessary to implement a CBIS, airport sponsors requesting funding support from TSA should provide a detailed cost estimate summary as included in Attachment F-A at each phase of design. Additionally, estimates submitted for funding request purposes should include a Basis of Estimate (BOE) document, developed from the perspective of the prime contractor for construction, which includes, at a minimum, the following elements:

- Purpose
- Executive Summary
- Project Scope Description
- Estimate Methodology
  - Work Breakdown Structure
  - Tools and Data Sources
  - Level of Project Definition “Contingency”
  - Estimate Practices for Labor, Equipment, and Material
    - Prime and Subcontractor General Requirements and Fees
    - Other Costs
- Schedule
- Assumptions, Inclusions, Exclusions, Risks, etc.

Further explanation of each section of the BOE is provided on the following page.

F.4.1 Purpose

This section of the BOE is intended to provide a brief description of the major components of the project scope, level of the estimate, and major exclusions. A clearly stated purpose will provide context for the Executive Summary of the project and those efforts that took place prior to preparing the estimate, as well as readying the user for the ensuing detail throughout the estimate.

F.4.2 Executive Summary

The Executive Summary shall provide a brief (no more than one page) overview of the project for which the independent cost estimate, cost estimate validation, or cost to complete report is being prepared. This section shall include, not necessarily in this order, discussions of:

- Where the project sponsor is in the bid and construction contract award process
- Whether construction has already begun and, if so, how much of the construction has been completed
- If the airport sponsor has awarded the construction contract, the type of construction contract instrument (firm fixed price, time and materials, design-build, etc.)
- Name of the general contractor and BHS contractor, if available
- Name and telephone number of the airport representative that provided the cost information
- Brief statement of the design level the estimate was based on and statement as to whether the Current Working Estimate (CWE) is authored by a single entity or is a reconciliation of two or more estimates
- Statement of the escalation that has been used, based on a project schedule and a summary of the CWE at a high level to show BHS costs, other construction-related costs, and soft costs
- Discussion of any known areas of risk
- Total estimated cost (TEC)
- Statement regarding whether the airport sponsor's estimate is reflective of current market conditions. This statement should address:
  - Description of current bidding climate relative to number of bidders responding to requests for proposals
  - Use of Davis Bacon Act wage rates, where applicable
  - List of current construction projects, including project name, type, approximate construction value, and schedule
  - Use of union versus nonunion labor
  - Narrative of labor availability
  - Narrative of material and equipment availability
  - Review of typical contracting methods used in location
- Statement of the currency (i.e., age) of the airport sponsor estimates. Estimates for projects constantly change. In order to maximize use of limited funding cost estimates for projects must be current and validated for funding to be approved.

F.4.3 Project Scope Description

This section of the estimate should be organized to correspond to the Work Breakdown Structure (WBS) and will include a more detailed description of the major components of the project and the means and methods assumed in the estimate to construct them.

F.4.4 Methodology Used to Prepare the Estimate

F.4.4.1 Work Breakdown Structure

The explanation of the estimate structure plays a significant role in any future required reconciliation. As such, a generic description of the estimate format and relationships of detailed cost items to their hierarchy should be presented. A sample WBS is provided in Attachment F-B.

F.4.4.2 Tools and Data Sources

The BOE should indicate the primary estimating methodology used in preparing the cost estimate, including that used for cost resources, historical data, and estimating tools and documents.

F.4.4.3 Major Cost Components: Labor, Equipment, Material

Major cost elements used in preparing the estimate should be described, thereby further demonstrating the estimator's level of effort and knowledge of the project requirements. For example: "equipment cost estimates were derived from multiple indexes, including RSMeans' Blue Book equipment rental rates; in the case of the casting yard equipment and specialized erection equipment, actual invoices from other projects were used."

F.4.4.4 Subcontractor and Prime Contractor Markups and Fees

Since markups and fees can be subjective, articulating the style of contract and the expected general requirements and fees used is inherent to the BOE's purpose.

F.4.4.5 Allowances

Allowances used in the estimate and the reason they were used should be clearly stated. For example, "a 10% cost allowance has been included for project phasing due to the contractor being required to fully mobilize and demobilize workers and equipment to the project site each day."

F.4.4.6 Other Factors

For the effort to be factual and complete, the estimator should describe any other elements bearing on the estimated calculations, including: project options, cost risks, and deviation from standard practices.

F.4.4.7 Schedule Requirements

A complete BOE must address the project schedule. A complete BOE will address those specific requirements provided for in the estimate to maintain all major and interim milestones, including: procurement, fabrication, anticipated shift work, and work week schedule. Any assumptions made regarding the key project milestones should be stated.

The airport or project sponsor should submit a cost and resource loaded schedule in Microsoft Project within 30 days of award of the contract or subcontract for construction of the BHS/CBIS identified/agreed to in the LOI or OTA. The schedule should be submitted in both hard and soft copies, and must contain enough detail for TSA to monitor the status of activities related to the design, construction, installation, and testing of the CBIS, OSR room, and CBRA. In addition, the schedule should include anticipated delivery dates for EDS, ETD, and any other equipment TSA is anticipated to provide.

This schedule, in conjunction with the project cost estimate, provides the basis for the Earned Value Management (EVM) information required in Section F.9.

F.4.4.8 Assumptions, Exclusions, and Exemptions

The BOE should include three separate and distinct bulleted listings that concisely identify the assumptions, exclusions, and exemptions used in developing the estimate. The assumptions should document any assumed premiums for shift work, compressed phasing, and work anticipated to be completed by other entities. Additionally, a clear list of all activities and work that is not included in the assumption or presumed to be excluded based on the statement of work should be clearly identified.

F.4.4.9 Areas of Risks

Once existing conditions have been established and reflected in the design documents, the estimate should include material and equipment costs—as either pricing factors on line items or as

estimate-wide factors that inflate the costs of labor—as globally as necessary, as well as assessments for:

- The sequence of work to adjust for labor productivity, shift premiums, unusual daily access to the site, multiple and phased staging
- Area/space constraints that may require hand tool versus large equipment use
- Any other subsidiary work the contractor will be required to perform to safely proceed with construction
- Any other constructability issues

F.5 COST ESTIMATE BREAKOUTS

Estimates submitted for funding request purposes should, at a minimum, include the elements shown in Attachment F-A and summarized below:

- Subtotal estimated construction values as cost accounts (columns):
  - Baggage handling system
  - Checked baggage inspection system
  - On-screen resolution area
  - Checked baggage resolution area
  - Infrastructure construction

  Each account above should be organized in a report by CSI Division Summary Master Format 2004.

- The CWE includes the following contractor markups:
  - Insurance and Bond
  - Home office overhead
  - Profit
  - Sales tax

- The CWE also includes the following soft costs:
  - Construction contingency
  - Design and programming
  - Project/construction management
  - Escalation

- Additionally, the CWE includes BHS estimates listed separately under Construction Standards Institute (CSI) division 34 “Transportation,” and includes as separate items each of the following:
  - Project management
  - Equipment
  - Installation
  - Engineering
  - Controls
  - Testing

F.6 DETERMINATION OF FUNDING LEVEL

Project management, construction management, escalation, design fees, and other so-called “soft costs”, many of which are undefined, can range from 2% to 3% or as much as 47% of the project construction cost.

Project management as discussed in this appendix refers solely to the airport, project sponsor or project sponsor’s existing Program Management Office (PMO) contractor’s oversight and management of activities necessary to install a CBIS solution (whether in-line, stand-alone, or otherwise). Conversely, construction management, as discussed in this appendix, consists of the management activities undertaken by the general construction contractor and/or BHSC to construct and install the CBIS solution (whether in-line, stand-alone, or otherwise). Allowable project management and construction

management costs are outlined in Table F-1: Allowable Fee Percentages.

Table F-1
ALLOWABLE FEE PERCENTAGES

Description	Allowable Percentages
Project Management	2%
Construction Management	4%-6%
Escalation	See Section F.7
Design Fees	6% (up to 8% if including Construction Administration)
Contingency – Design	See Section F.6.1
Contingency – Construction	5% of Projected Construction Cost, see Section F.6.2

TSA will only reimburse project management, construction management, escalation, and design fees that can be directly apportioned to the TSA "allocable" portion of the BHS project. For example: if the overall project costs $100 million, but TSA's allocable costs are only 25% (or $25 million) of that cost, all project management, construction management, escalation, design fees, and other costs will only be reimbursed as they relate to the $25 million in costs attributable to TSA requirements.

Further, TSA will only reimburse project management, construction management, and design fees up to the levels identified in Table F-1 unless specific justification is provided and approved in writing by the TSA Contracting Officer at the time of the negotiation (i.e., rates varying from those identified directly in the OTA will not be accepted).

F.6.1 Design Contingencies

Design contingencies should be noted as separate and distinct items apart from direct construction costs and other associated markups. Design contingencies are understood to represent amounts added to the estimate to allow for items, conditions, or events for which the status, occurrence, or effect is uncertain, but that experience shows will likely result in additional costs.*

Design contingencies may include:

- Errors and omissions in the estimating process
- Variability associated with the quantification effort
- Incomplete design of anticipated final quantities
- Minor variability in labor (productivity, availability, etc.)
- Historically supported weather impacts
- Minor variability in wage rates
- Minor variability in material and equipment costs
- Substitute construction materials

Design contingencies do not include:

- Significant changes in scope
- Errors and omissions in design
- Major unexpected work stoppages (strikes, etc.)
- Disasters (hurricanes, tornadoes, etc.)
- Excessive, unexpected inflation
- Excessive, unexpected currency fluctuations
- Other areas of risk

*Association for the Advancement of Cost Engineering (AACE) International, Recommended Practice No. 10S-90, "Cost Engineering Terminology", copyright 2004.

Design contingency amounts shall correspond to the level of project design in accordance with the following table.

Table F-2
ALLOWABLE DESIGN CONTINGENCY PERCENTAGES BY DESIGN PHASE

Overall design completion (percent)	Contingency (percent)
0-30%	20%
30-70	15
70-90	10
90-100	5
100	0

Design contingencies shall be applied to the sum total of the direct construction costs, including labor, material, and equipment costs. Design contingencies shall be applied as a cumulative markup as indicated in the CWE (see Attachment F-A).

F.6.2 Construction Contingencies

In most construction budgets, an allowance is provided for contingencies or unexpected costs occurring during construction. Construction contingencies cover the uncertainty associated with inadequacies of project scope definition, estimating methods, and estimating data. For example, construction contingencies may include:

- Design development changes
- Schedule adjustments
- General administration changes (such as wage rates)
- Differing site conditions for those expected
- Third party requirements imposed during construction, such as new permits

TSA will allow construction contingencies of up to 10% of the total construction budget for allocable items. For example: If the total project budget is $100 million, but TSA has determined that its allocable share of the project is $25 million, then the 10% contingency would be developed against the $25 million budget only.

However, contingency will not be added into the base budget for negotiation. Change orders must be submitted to TSA outlining the change in condition that requires the additional funding and supplying the necessary supporting documentation, including modified plans and specifications for the change. Further, the contractor/airport sponsor should submit a cost estimate, meeting all requirements of this document, with the change order justifying the change in cost.

Access to the 10% contingency funding should only be provided based on written approval of the proposed change order by TSA's Contracting Officer.

F.7 ESCALATION

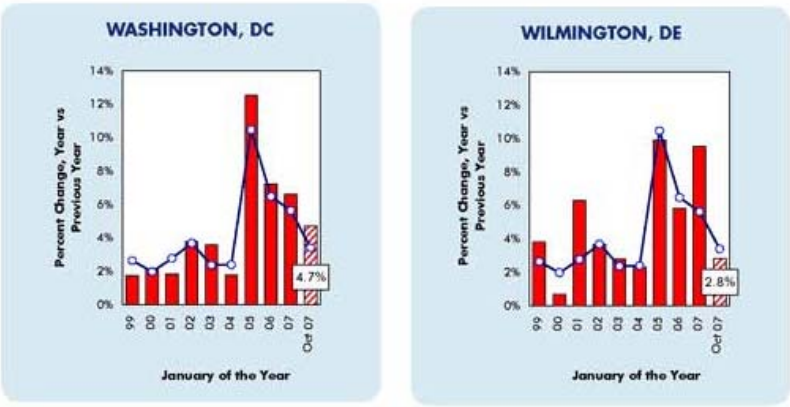
F.7.1 Current Escalation

It is typical practice for estimators to use or reference legacy estimates/quotes and commercial databases that have aged several months to several years as part of their CWE. The body/details of the estimate should have all cost items in current year dollars. The historical escalation rate used to make data current should be based on the RSMeans Building Construction Cost Index (CCI) from the relevant source date to the current date.

F.7.2 Forward Escalation

Escalation should be based on the average annual rate of cost escalation for the 3 years prior to the estimate development date, as established by the most current quarterly published RSMeans Building CCI. The rate used should be based on data for the nearest city provided in the CCI. Figure F-3, an excerpt from the CCI, is provided as an example.

Figure F-3
RSMEANS BUILDING CONSTRUCTION COST INDEX (CCI) – MAJOR U.S. CITIES (W) – OCTOBER 2007



The Means CCI is based on a composite model of 9 building types. Costs in the index are a weighted average of material and installation by Construction Specifications Institute (CSI) MasterFormat™ division. The model is priced quarterly in 316 cities in the U.S. and Canada.

Data source: Reed Construction Data – RSMeans.
Charts: Reed Construction Data – CanaData.

Escalation should be noted as a separate and distinct item apart from direct construction costs and other associated markups. Escalation is understood to represent a provision in actual or estimated costs for an increase in the cost of equipment, material, labor, etc, over that specified in the purchase order or contract due to continuing price level changes over time*.

Escalation should be calculated from the scheduled construction start date to the midpoint of construction on a compounding basis. Escalation should be applied to the sum total of direct construction costs, contingency, general conditions, overhead, and profit. Other related markups should be based on the sum total as described above.

Should a construction schedule not be available, the CWE should be presented in nonescalated dollars and clearly noted as such.

F.7.3 Cost Estimate Currency/Age

CWEs should have an effective pricing date no later than 90 days from the time of submittal or used for funding reimbursement request purposes. The BOE documentation should clearly indicate that the estimate is reflective of current market conditions. Estimates dated prior to 90 calendar days from the funding submittal date will require updating.

*AACE International, Recommended Practice No. 10S-90, "Cost Engineering Terminology," copyright 2004.

Estimates submitted for funding reimbursement request purposes should be accompanied by a market analysis specific to the airport location and timeframe during which proposed improvements will be implemented. At a minimum, the analysis should include:

- Description of the current bidding climate relative to the number of bidders responding to requests for proposals
- Use of Davis-Bacon Act wage rates, where applicable
- List of current construction projects, including project name, type, approximate construction value, and schedule
- Use of union versus nonunion labor
- Narrative of labor availability
- Narrative of material and equipment availability
- Review of typical contracting methods used in location

F.7.4 Estimate Reconciliation

It is common practice for two or more independent estimates to be prepared at a given design level to increase confidence and accuracy in the CWE for project and budget decisions. If a reconciled estimate is sought, which is recommended for variances exceeding 10% between the airport sponsor's estimate and TSA allowable costs, the approach to reconcile the estimates should proceed with the following ground rules:

1. Estimate summaries should strictly adhere to the CWE format illustrated in Attachment F-A. As a rule of thumb, variances in excess of 10% for each division should be reconciled further. The rationale for the reconciliation should be documented to provide an understanding of the reconciled value.
2. The formats for the estimate should strictly adhere to a WBS to evaluate the scope of the project. A sample WBS is provided in Attachment F-B. Scope variance should be reconciled prior to review of pricing. Once scope differences are resolved, updated estimate summaries should be generated.
3. The “reconciled” estimate should be used as the go-forward estimate.

F.7.5 Estimate Trending

As the subsequent design level is completed, the CWE should be compared with the prior design phase CWE. Major changes to scope should be identified in a report along with the associated cost impacts. These changes should be approved by the appropriate TSA Regional Deployment Manager prior to initiation of the next design phase. Once a project budget has been established, minor changes in cost should be added or deducted from the design contingencies. Hence, with the exception of major changes, the TEC should remain the same as the CWE for the prior phase.

F.8 TSA REIMBURSEMENT

In general, the CWE contains TSA reimbursable and nonreimbursable costs. TSA nonreimbursable costs are segregated in the Infrastructure column of the CWE. All reimbursable costs associated with the CBIS, CBRA, and OSR room should be included in the appropriate column (see example on Figure F-4). TSA will only reimburse the airport or project sponsor for those costs that are deemed TSA reimbursable and properly identified as such on the CWE. Inclusion of the nonreimbursable costs in the CWE allows TSA to view the complete project scope and budget.

Figure F-4
TSA REIMBURSABLE FUNDING BREAKOUT SAMPLE

ESTIMATED PROJECT COMPLETION DATE:	TBD	ECCA ($s)	TSA ALLOCABLE COSTS		TSA AGREED TO FUNDING		Additional Allocable Funding Needed (Non-TSA)
Current Working Estimate - Effective Pricing Date:	May-08	TOTAL ESTIMATE					
CWE Scope Based on Design Level of:	10%		%	$s	%	$s	
HARD COSTS (ECCA)							
a. Subtotal BHS (Rounded)		23,615,000	100%	23,615,000	90%	21,253,500	2,361,500
b. Subtotal Other Construction Related Costs (Rounded)		16,702,000	100%	16,702,000	90%	15,031,800	1,670,200
c. Hard Costs Subtotal (a. + b.)		40,317,000	100%	40,317,000	90%	36,285,300	4,031,700
SOFT COSTS							
Construction Contingency	5.00%	2,015,000	100%	2,015,000	90%	1,813,500	201,500
Design w/Const Admin	8.00%	3,226,000	100%	3,226,000	90%	2,903,400	322,600
Project & Construction Management	7.00%	2,823,000	100%	2,823,000	90%	2,540,700	282,300
Escalation NONE	0.00%	-	100%	-	90%	-	-
Soft Costs Subtotal		8,064,000	100%	8,064,000	90%	7,257,600	806,400
TOTAL ESTIMATED COSTS (TEC) (CURRENT $s)		48,381,000	100%	48,381,000	90%	43,542,900	4,838,100

F.9 INVOICING AND EARNED VALUE MANAGEMENT

Invoices/requests for payment should include a summary page presented in the same format as the cost estimate to allow for ease of tracking and comparing actual expenses to agreed-upon costs.

Additionally, because of the widely accepted practice of earned value management (EVM) and the equation's ability to measure cost performance, airport sponsors, airlines, or other organizations requesting funding support from TSA should provide a current EVM analysis. This analysis should identify work completed to date and include a forecast of the work anticipated to be completed during the next month or invoicing period, whichever is longer. The EVM data should be representative of the entire project scope in the WBS format, using the most current cost-loaded project schedule. Estimates with EVM calculations submitted for funding reimbursement request purposes should include, at a minimum, the following EVM elements:

- Budgeted Cost of Work Scheduled (BCWS) - Representative of all costs, including indirect costs that are planned or scheduled. A well designed schedule usually reflects these planned cost as a traditional S-curve shape.

- Actual Cost of Work Performed (ACWP) – Representative of all costs, including indirect costs charged against activities that are completed.
- Budgeted Cost of Work Performed (BCWP) – More traditionally described as "earned value", these costs are representative of the costs, including indirect costs, for activities that are completed. These costs are distinct from the BCWS, which is for activities that are planned to be completed.
- Budget at completion (BAC)
- Estimate at completion (EAC)
- Schedule variance (SV)
- Variance at completion (VAC)
- Cost performance index (CPI) (which equals ACWP/BCWP)

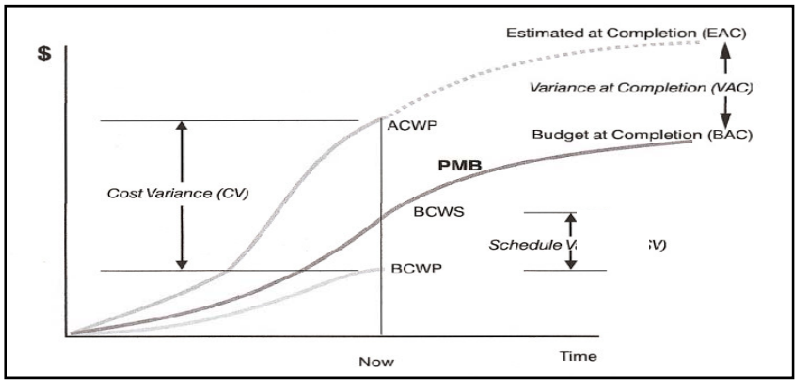
The BCWS, ACWP, and ACWS provide the mechanics for a full analysis of project progress and performance in the EVM environment. As depicted on Figure F-5, the projections of EAC, SV, and VAC will be derived from these initial investments.

where the EAC for the data on the date compiled is:

$$EAC = \frac{(BAC-BCWP)}{CPI} + ACWP$$

Note: CPI = ACWP/BCWP (poor performance is greater than 1).

Figure F-5
EVM GRAPH



Attachment F-A

CURRENT WORKING ESTIMATE SUMMARY		Prepared by:				
AIRPORT IDENTIFIER:						
AIRPORT NAME:						
PROJECT NAME:						
ESTIMATED PROJECT COMPLETION DATE:		Estimate Construction Cost at Award ($s)				
Current Working Estimate - Effective Pricing Date:		CBIS Matrix Estimate	CBRA Area Estimate	OSR Room Estimate	Non Allocable Estimate (NA)	TOTAL ESTIMATE ALLOCABLE
Current Working Estimate - Level of Design:						
Currency:	US					
HARD COSTS (ECCA)						
BAGGAGE HANDLING SYSTEM/CHECKED BAGGAGE INSPECTION SYSTEM COSTS						
Div. 34 Transportation, includes items below						
Project Management						
Equipment						
Installation						
Engineering						
Controls						
Testing						
a. Subtotal BHS (Rounded)		$ -	$ -		$ -	$ -
OTHER CONSTRUCTION RELATED COSTS						
Div. 1 General Requirements						
Div. 2 Existing Conditions						
Div. 3 Concrete						
Div. 4 Masonry						
Div. 5 Metals						
Div. 6 Woods and Plastics, and Composites						
Div. 7 Thermal and Moisture Protection						
Div. 8 Openings						
Div. 9 Finishes						
Div. 10 Specialties						
Div. 11 Equipment						
Div. 12 Furnishings						
Div. 13 Special Construction						
Div. 14 Conveying Systems4						
Div. 21 Fire Suppression						
Div. 22 Plumbing						
Div. 23 Heating Ventilation, and Air Conditioning						
Div. 25 Integrated Automation						
Div. 26 Electrical						
Div. 27 Communications						
Div. 28 Electronic Safety and Security						
Div. 31 Earthwork						
Div. 32 Exterior Improvements						
Div. 33 Utilities						
Div. 34 Transportation w/o BHS						
Div. 35 Waterway and Marine Construction						
Div. 40 Process Integration						
Div. 41 Material Processing and Handling Equipment						
Div. 42 Process Heating, Cooling and Drying Equipment						
Div. 43 Process Gass and Liquid Handling, Purification and Storage Eqp.						
Div. 44 Pollution Control Equipment						
Div. 45 Industry Specific Manufacturing Equipment						
Div. 48 Electrical Power Generation						
b. Subtotal Other Construction Related Costs (Rounded)		$ -	$ -	$ -	$ -	$ -
PRIME CONTRACTOR MARK-UPS						
Insurance & Bond	0.00%	$ -	$ -	$ -	$ -	$ -
Home Office Overhead	0.00%	$ -	$ -	$ -	$ -	$ -
Profit	0.00%	$ -	$ -	$ -	$ -	$ -
Sales Tax (Material only)	0.00%	$ -	$ -	$ -	$ -	$ -
Design Contingency	0.00%	$ -	$ -	$ -	$ -	
c. Contractor Mark-ups (Rounded)		$ -	$ -	$ -	$ -	$ -
Hard Costs Subtotal (a + b + c)		$ -	$ -	$ -	$ -	$ -
SOFT COSTS						
Construction Contingency	0.00%	$ -	$ -	$ -	$ -	$ -
Design w/Const Admin	0.00%	$ -	$ -	$ -	$ -	$ -
Project & Construction Management	0.00%	$ -	$ -	$ -	$ -	$ -
Escalation	0.00%	$ -	$ -	$ -	$ -	$ -
Soft Costs Subtotal		$ -	$ -	$ -	$ -	$ -
TOTAL ESTIMATED COSTS (TEC) (CURRENT $'s)		$ -	$ -	$ -	$ -	$ -

Attachment F-B

TSA CBIS Project
Sample Work Breakdown Structure

010000 General Requirements
020000 Existing Conditions
- 022000 Assessment
- 023000 Subsurface Investigation
- 024000 Demolition and Structure Moving
- 025000 Site Remediation
- 026000 Contaminated Site Material Removal
- 027000 Water Remediation
- 028000 Facility Remediation

030000 Concrete
- 031000 Concrete Forming and Accessories (Typically not allocable)
- 032000 Concrete Reinforcing (Typically not allocable)
- 033000 Cast-in-Place Concrete (Typically not allocable)
- 034000 Precast Concrete (Typically not allocable)
- 035000 Cast Decks and Underlayment (Typically not allocable)
- 036000 Grouting
- 037000 Mass Concrete (Typically not allocable)
- 038000 Concrete Cutting and Boring

040000 Masonry
- 042000 Unit Masonry
- 044000 Stone Assemblies
- 045000 Refractory Masonry
- 046000 Corrosion-Resistant Masonry
- 047000 Manufactured Masonry

050000 Metals
- 051000 Structural Metal Framing (Typically not allocable)
- 052000 Metal Joists (Typically not allocable)
- 053000 Metal Decking (Typically not allocable)
- 054000 Cold-Formed Metal Framing (Typically not allocable)
- 055000 Metal Fabrications
- 057000 Decorative Metal (Not allowable)

060000 Wood, Plastics, and Composites
- 061000 Rough Carpentry
- 062000 Finish Carpentry
- 064000 Architectural Woodwork
- 065000 Structural Plastics
- 066000 Plastic Fabrications
- 067000 Structural Composites
- 068000 Composite Fabrications

070000 Thermal and Moisture Protection
- 071000 Damp proofing and Waterproofing
- 072000 Thermal Protection
- 073000 Steep Slope Roofing (Typically not allocable)
- 074000 Roofing and Siding Panels (Typically not allocable)
- 075000 Membrane Roofing (Typically not allocable)
- 076000 Flashing and Sheet Metal
- 077000 Roof and Wall Specialties and Accessories
- 078000 Fire and Smoke Protection
- 079000 Joint Protection

080000 Openings
- 081000 Doors and Frames
- 083000 Specialty Doors and Frames
- 084000 Entrances, Storefronts, and Curtain Walls (Typically not allocable)
- 085000 Windows (Typically interior only)
- 086000 Roof Windows and Skylights (Typically not allocable)
- 087000 Hardware
- 088000 Glazing (Typically interior only)
- 089000 Louvers and Vents

090000 Finishes
- 090000 Painting and Coating
- 092000 Plaster and Gypsum Board
- 093000 Tiling
- 095000 Ceilings
- 096000 Flooring
- 097000 Wall Finishes
- 098000 Acoustic Treatment

100000 Specialties
- 101000 Information Specialties
- 102000 Interior Specialties
- 104000 Safety Specialties
- 105000 Storage Specialists
- 108000 Other Specialties

110000 Equipment

120000 Furnishings
- 121000 Art (Not Allowable)
- 122000 Window Treatments (Typically not allowable)
- 123000 Casework
- 124000 Furnishings and Accessories
- 125000 Furniture
- 126000 Multiple Seating (Typically not allowable)
- 129000 Other Furnishings

130000 Special Construction
- 131000 Special Facility Components
- 132000 Special Purpose Rooms
- 133000 Special Structures
- 134000 Integrated Construction
- 135000 Special Instrumentation

140000 Conveying Equipment
- 142000 Elevators
- 143000 Escalators and Moving Walks (Typically not allowable)
- 144000 Lifts
- 147000 Turntables (Typically not allowable)
- 148000 Scaffolding
- 149000 Other Conveying Equipment

210000 Fire Suppression
- 211000 Water-Based Fire Suppression Systems
- 212000 Fire-Extinguishing Systems
- 213000 Fire Pumps
- 214000 Fire-Suppression Water Storage

220000 Plumbing
- 221000 Plumbing Piping and Pumps
- 223000 Plumbing Equipment
- 224000 Plumbing Fixtures

230000 Heating Ventilating and Air-Conditioning (HVAC)
- 231000 Facility Fuel Systems
- 232000 HVAC Piping and Pumps
- 233000 HVAC Air Distribution
- 234000 HVAC Air Cleaning Devices
- 235000 Central Heating Equipment
- 236000 Central Cooling Equipment
- 237000 Central HVAC Equipment
- 238000 Decentralized HVAC Equipment

250000 Integrated Automation
- 251000 Integrated Automation Network Equipment
- 253000 Integrated Automation Instrumentation and Terminal Devices
- 255000 Integrated Automation Facility Controls
- 259000 Integrated Automation Control Sequences

260000 Electrical
- 261000 Medium-Voltage Electrical Distribution
- 262000 Low-Voltage Electrical Transmission
- 263000 Facility Electrical Power Generating and Storing Equipment
- 264000 Electrical and Cathodic Protection
- 265000 Lighting

270000 Communications
- 271000 Structured Cabling
- 272000 Data Communications
- 273000 Voice Communications
- 274000 Audio-Video Communications
- 275000 Distributed Communications and Monitoring Systems

280000 Electronic Safety and Security
- 281000 Electronic Access Control and Intrusion Detection
- 282000 Electronic Surveillance
- 283000 Electronic Detection and Alarm
- 284000 Electronic Monitoring and Control

310000 Earthwork (Typically not allocable)
- 311000 Site Clearing
- 312000 Earth Moving
- 313000 Earthwork Methods
- 314000 Shoring and Underpinning
- 315000 Excavation Support and Protection
- 316000 Special Foundations and Load-Bearing Elements
- 317000 Tunneling and Mining

320000 Exterior Improvements (Typically not allocable)
- 321000 Bases, Ballasts, and Paving
- 323000 Site Improvements
- 327000 Wetlands
- 328000 Irrigation
- 329000 Planting
- 330000 Utilities
- 331000 Water Utilities
- 332000 Wells
- 333000 Sanitary Sewerage Utilities
- 334000 Storm Drainage Utilities
- 335000 Fuel Distribution Utilities
- 336000 Hydronic and Steam Energy Utilities
- 337000 Electrical Utilities
- 338000 Communications Utilities

340000 Transportation
- Baggage Handling Systems
  - Project/Site Management – The costs associated with the baggage contractor's project management, site supervision, administration and support infrastructure associated with the project
  - Equipment – The costs for the conveyor components excluding motor control panels, PLCs and other control equipment
  - Installation – The costs for the millwright's and electrician's labor associated with the installation of the baggage system.
  - Engineering – The cost for the baggage system contractor to prepare shop drawings for the baggage system
  - Controls (limited to those control necessary to operate the CBIS and tie into the existing system) – The costs for the Equipment, hardware, software and labor associated with programming and installation of the controls
  - Testing – The cost for labor associated with testing the motors and providing labor to support the ISAT process

350000 Waterway and Marine Construction (Typically not allocable)

400000 Process Integration (Typically not allocable)

410000 Material Processing and Handling Equipment (Typically not allocable)

420000 Process Heating, Cooling, and Drying Equipment (Typically not allocable)

430000 Process Gas and Liquid Handling, Purification and Storage Equipment (Typically not allocable)

440000 Pollution Control Equipment (Typically not allocable)

450000 Industry-Specific Manufacturing Equipment (Typically not allocable)

480000 Electrical Power Generation

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Appendix G

CONTINGENCY PLAN EXAMPLES

This appendix provides two examples of Contingency Plans developed for the Checked Baggage Inspection Systems (CBISs) at Oakland International Airport's Terminal 2 and Nashville International Airport. The Contingency Plan is intended to: (1) identify all likely scenarios for system or component failure that may occur during operation of the CBIS, and (2) describe the protocols and procedures to be followed by baggage handling system (BHS) control, the airlines, and the Transportation Security Administration when these scenarios occur.

Sources: Contingency Plan for Oakland International Airport's Terminal 2 provided by Southwest Airlines (reproduced and reformatted with permission); Contingency Plan for Nashville International Airport provided by Cage, Inc. (reproduced and reformatted with permission).

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G.1 CONTINGENCY PLAN FOR TERMINAL 2, OAKLAND INTERNATIONAL AIRPORT

G.1.1 Introduction

This Contingency Plan was prepared for the in-line checked baggage inspection system (CBIS) designed for Oakland International Airport's Terminal 2. The system, which became operational in February 2006, is a medium-speed in-line system with four GE CTX-9000 machines that serves all Southwest Airlines flights; Southwest is the terminal's sole airline tenant. Throughout this document, explosives detection system (EDS) machines are referred to as computerized tomography (CT) machines.

G.1.2 Standby Power—Overview

In the event of a loss of utility power, the in-line EDS is designed to operate on standby power when available. In this instance, the system will operate in an alternate "limited operation" mode. During limited operation, the in-line EDS equipment furnished by the Transportation Security Administration (TSA) must remain switched off. When utility power is restored, the equipment may only be restarted by TSA-assigned Field Service Engineer (FSE) staff in accordance with the protocols described below.

The baggage handling system (BHS) controls have an uninterruptible power supply to protect the programming functions of the system for continued operation. The TSA-furnished Multiplexer (MUX) server is not furnished with an uninterruptible power supply backup and will require formal restart by TSA/FSE. When the conveying system is operating in the limited operation mode, all bags are diverted directly to explosives trace detection (ETD) for manual screening. Upon the loss of utility power, a signal is sent by the Power Management Control System to the Master Control Panel area. The signal indicates that standby power has become operational. After the in-line EDS has been cleared, the BHS control system shall be re-started by the BHS operator in the limited operation mode. When utility power is restored, the transition from standby power should not be detectable. The Port of Oakland shall notify the BHS operator when utility power has been fully restored. The BHS operator shall perform a controlled shutdown and restart the in-line EDS in full "operation" mode. In the event of a power outage, the BHS operator shall immediately contact TSA and the onsite FSE under contract to the TSA. The FSE shall throw the manual disconnects to each EDS to avoid short-term power surges when power is restored. Haste is emphasized to avoid damage to the CT machines. The FSE shall be solely responsible for restarting the CT MUX interface and the individual CT machines when power is restored. The FSE shall notify the BHS operator when the MUX and CT machines are available to support the renewed operation of the full in-line EDS.

Manual bag clearing procedures will be performed by Southwest Airlines in conformance with its own protocols and the protocols described below.

During power outages, outbound baggage will be manually conveyed directly from the ticket lobby to the new ETD screening area through the security door and down the adjacent stairway. From there, the bags will need to be manually conveyed to a TSA-designated holding area or alternate screening area (with access to power) where TSA manual screening can occur.

The startup procedure once utility power is restored shall be in conformance with the protocols documented below. The Port shall communicate to the BHS operator and Southwest when full utility power has been restored and Port Equipment Systems has closed the existing breakers at the substation above. Port Engineering Services typically operates with a 20-minute response time.

The BHS operator shall reciprocate communication with the Port, Southwest, and TSA in advance of restarting the in-line EDS.

G.1.3 Operational Protocols and Procedures

The protocols and procedures for handling all likely scenarios that Southwest operations, BHS control, and TSA staff may face during operation of the in-line EDS are outlined below. The proper implementation of these protocols is critical to the successful operation of the system, the resolution of unplanned events, and the maintenance of optimal system throughput.

G.1.3.1 Treatment of Threat Bags When Positively Identified by TSA Staff

When TSA staff cannot clear an alarmed bag by following standard operating procedures, the Airport Manager on Duty and the designated Airport Law Enforcement Officer (LEO) shall be contacted for resolution of the identified threat. The designated LEO shall assume full responsibility for the alarmed bag. Locally, procedures typically involve immediate response by the Oakland Police K-9 unit. If additional support is required, the Alameda County Bomb Squad will respond. A Threat Containment Unit is available onsite to assist in the removal of the threat bag. The Airport Manager on Duty and Airport LEO shall be jointly responsible for formal notification of events to airline and Airport staff as well as the general public.

G.1.3.2 Positively Identified Contraband or Undeclared Weaponry

When the TSA identifies contraband or undeclared weaponry during the standard search procedure, it shall immediately contact local LEOs and designated airline representatives. The custody of the bag is transferred to the designated LEO, who shall apply standard procedures for identifying and locating the owner of the bag in question and taking appropriate action.

G.1.3.3 Emergency Maintenance of TSA-Furnished Equipment

Notification and reporting procedures related to emergency equipment maintenance are described below.

- **Notification Procedures**. The EDS vendor FSE should be contacted for the emergency maintenance and repair of TSA-furnished equipment. This equipment includes the CT equipment, MUX interface, on-screen resolution, Passive Threat Resolution Information), and ETD equipment. Manual removal of baggage from within TSA-furnished CT equipment shall be performed by TSA staff only. Any modifications performed to the CT programming by TSA must be communicated immediately to the BHS contractor for a period of one year and to the BHS operator thereafter.

- **Reporting Procedures**. TSA protocols exist for formal documentation of repairs and maintenance of TSA-furnished equipment. The Port and the BHS operator will also be notified by TSA.

G.1.3.4 BHS Alarm and Baggage Jam Resolution

The notification procedures, actions, protocols, and reporting procedures to be undertaken in the event of a BHS alarm or baggage jam are described below.

- **Notification to Southwest and TSA by BHS Operator**. The BHS operator has access to an electronic display of all system faults. When faults occur that have a significant impact on the operation of the in-line EDS, the BHS operator shall notify designated contacts at TSA and Southwest as follows:

  TSA Control Center: _____
  Southwest: _____
  Customer Service Coordinator: _____
  Ramp Dispatcher: _____
  TSA FSE: _____

- **Action by Southwest and TSA**. Actions that must be taken by Southwest and TSA are summarized below:

  1. Southwest will be responsible for clearing all conveyors outside the CT equipment. Detailed procedures for clearing jams can be found in the project operation and maintenance manual. General guidelines for clearing all jams are as follows:

     – All jam locations will be announced on the BHS system workstation located in the BHS control room.

     – Before moving bags or climbing on the conveyor, press the Emergency Stop Pushbutton in the area of the jam.

     – Clear the jammed baggage and ensure that the jammed PEC is clear.

     – Reset the Emergency Stop Pushbutton that was pressed.

     – Press the Reset/Restart Pushbutton

  2. TSA will be responsible for clearing baggage from within the CT equipment. TSA protocols for CT-screened baggage are:

     – Cleared bags shall be re-inducted on a clear line.

     – Alarmed bags shall be re-inducted on a line for alarmed bags for conveyance directly to ETD.

     – Any bag with unknown status shall be re-inducted on a line for alarmed bags for conveyance directly to ETD.

- **Southwest Protocols and Reporting Procedures**. These protocols and reporting procedures are as follows:

  1. Southwest has attached baggage handling protocols and procedures to the contract for construction. The BHS contractor shall accommodate the reporting system to maintain these protocols and the BHS operator shall maintain them.

  2. "Recurring Jam" resolution shall be handled as follows. The BHS contractor shall be responsible for the correction/resolution of recurring equipment or programming related jams or faults for a period of XX days from the commencement of full system operation.

G.1.3.5 Protocols for Bag Jams Related to TSA-Furnished Equipment

TSA field personnel shall take the following corrective actions:

- TSA staff shall clear CT equipment when notified by the BHS operator in conformance with protocols described above.

- TSA protocols exist for formal written documentation by TSA staff of incidents affecting TSA-furnished equipment.

- The BHS operator shall formally notify TSA of jams or alarms produced by TSA-furnished equipment.

G.1.3.6 Protocols for Power Outages

The following are the procedures for loss of power to be followed by the various entities when standby power is available:

- **Operator Procedures**. In the event of power loss, the operator will shut down the BHS. TSA, Southwest, and Port staff in the vicinity shall be aware by observation.

  1. The BHS operator shall immediately contact TSA.

  2. The BHS operator shall communicate any irregularities or observations of potential electrical problems to Port Aviation Operations.

- **TSA Procedures**. Upon receiving notification from the system operator, TSA staff shall:

  1. Throw the manual disconnects to each CT machine to avoid short-term surges if power restarts unexpectedly. Haste is emphasized to avoid potential damage to CT machines when power is restarted.

  2. TSA will subsequently contact the EDS FSE under contract with TSA. The FSE shall be solely responsible for restarting the CT MUX interface. The FSE shall also be responsible for restarting the individual CT machines and shall notify the BHS operator when the MUX and CT machines are available to support the renewed operation of the full in-line EDS.

- **Port Procedures.** Port Equipment Systems and/or Facilities shall contact the BHS operator with relevant information related to the status of utility power (e.g., cause of outage, estimated duration, limitations to available power).

- **Manual Baggage Clearing Procedure**. The BHS contractor shall produce a document itemizing specific protocols for the system operator and TSA regarding the safe, manual removal of bags from the inoperative conveyor system by zone. These protocols will include the following:

  1. *Short-term power outage baggage clearing procedures (when short-term status is confirmed by Port Equipment Systems staff)*. When information is provided to the BHS operator that power will be restored in the short term, CT-screened bags with unknown status shall be positioned for induction on a line dedicated for the conveyance of alarmed bags direct to ETD. Screened bags with known status shall remain in place on the conveyor system, awaiting system restart. BHS startup after a short term (under 10 minutes) will be the same as a normal startup in the morning. The BHS control system is equipped with uninterruptible power supply units that will keep the BHS workstation and the control processor powered up. If no baggage has been moved during the power outage, all baggage should continue to be tracked and will proceed to the proper destinations.

  2. *Long-term power outage baggage clearing procedures (when long-term status is confirmed by Port Equipment Systems staff)*. Baggage clearing procedures shall include the removal and manual conveyance of the following categories of baggage:

     – CT-cleared baggage—manual conveyance to Southwest-designated baggage makeup staging area

     – CT-alarmed baggage—manual conveyance to TSA-designated manual screening staging area

     – CT-screened baggage with unknown status—manual conveyance to TSA-designated manual screening staging area

– Unscreened baggage—manual conveyance to TSA-designated manual screening staging area

– Baggage stranded within TSA-equipment—manual conveyance by TSA to TSA-designated manual screening staging area

- **Startup Procedure Once Power Restored**. The procedure is as follows:

  1. Port Equipment Systems / Facilities shall notify the BHS operator that utility power has been restored and is available. Any limitations to the amount of utility power available for the BHS shall be clearly stated. The BHS operator will communicate with Southwest staff to clear the limited conveyor system of bags. When bags have been cleared, a controlled shutdown of the limited operation conveyor system shall occur. The BHS operator will coordinate with TSA, which shall be solely responsible for restarting the CT equipment and MUX interface, as described above. The BHS operator shall follow the operations manual for formal restart of the in-line EDS once the bags (described above) have been manually cleared and TSA has formally communicated to the BHS operator that all TSA-furnished equipment is operational.

  2. The BHS operator will communicate with the Port Manager on Duty, Southwest, and TSA in advance of restarting the system to confirm that all supporting systems are ready.

  3. BHS startup after a long-term power outage will need to follow the following procedure:

     – The BHS workstation is powered up.

     – The main control processors located in the BHS control room are powered up.

     – When the BHS workstation has been powered up and the system graphic display application is running, the BHS can be started normally.

G.1.3.7 TSA Protocols When CT Units Are Down

TSA protocols to be followed when one, two, or three or four CT machines experience equipment failure are described below.

- **One CT Unit Down**. The operational requirements, CT equipment failure notification procedures, and CT programming protocols to be followed when one CT experiences equipment failure are summarized below:

  1. *Operational Requirements*. Design modeling indicates that three CT machines should handle normal operations in the near term. Southwest indicates that it is currently documenting peak hour flows of 1,100 bags per hour. Peak period throughput requirements may require modified system programming in future years. The BHS operator shall carefully monitor throughput demand and performance during the first year of operation and regularly communicate findings with the Port, Southwest, and the BHS contractor. For a period of one year, the BHS contractor shall modify BHS programming as required to maintain throughput rates and system functionality in conformance with the specifications.

  2. *CT Equipment Failure Notification Procedures*. The BHS operator shall immediately notify TSA, Southwest, and Port Equipment Systems of TSA CT equipment failure. TSA personnel require immediate notification with as much information as possible to assist them in evaluating potential changes to TSA staffing requirements. TSA equipment maintenance staff should also

be contacted immediately and their response time will be critical to restore optimal throughput for the system to maintain Southwest operations.

3. *CT Programming Protocols*. The BHS operator shall immediately notify TSA, Southwest, and Port Equipment Systems of operational demands necessitating CT equipment programming changes. As stated above, the BHS contractor shall be solely responsible for modification of in-line EDS programming for a period of one year in conformance with the specifications. When the BHS operator assumes responsibility for system programming, it shall be responsible for performing any programming changes. In all instances, any proposed programming changes affecting the CT equipment shall be formally communicated to TSA before the changes occur. TSA shall be responsible for coordinating communications between the EDS vendor, FSE representatives, the Port, and the BHS operator.

- **Two CT Units Down**. The operational requirements, CT equipment failure notification procedures, and CT programming protocols to be followed when two CT machines experience equipment failure are summarized below:

  1. *Operational Requirements*. Design phase modeling indicated that a certain percentage of bags will need to be diverted directly to ETD to avoid conveyors upstream of the CT machines to stop because bags cannot be processed (i.e., dieback) and meet the 10-minutes elapsed time processing requirement during peak periods. The BHS contractor and the BHS operator shall program the system to divert baggage as required to maintain throughput and avoid dieback.

  2. *CT Equipment Failure Notification Procedures*. See above (TSA protocols for EDS operation with one CT unit down).

  3. *CT Programming Protocols*. See above (TSA programming protocols for EDS operation with one CT unit down).

- **Three or Four CT Units Down**. See description above (TSA protocols for EDS operation with two CT units down). The BHS contractor shall program the system to increase the divert percentage of baggage sent directly to ETD for manual inspection.

G.2 CONTINGENCY PLAN FOR NASHVILLE INTERNATIONAL AIRPORT

G.2.1 Introduction

The Nashville International Airport (BNA) employs two separate areas within the Main Terminal and Concourse C for conveying and security screening baggage. Baggage is placed into the system at passenger check-in areas and delivered to the ramp-side tug cart areas for loading the baggage onto airplanes. The Baggage Handling System (BHS) provides baggage induct, two Explosive Detection System (EDS) screening matrices, and final sort services. The system includes multiple ticket counter lines and curbside lines, out-of-gauge lines, purge lines, in-line EDS machines, On-Screen Resolution (OSR) capabilities, Check Baggage Resolution Areas (CBRA), and sort piers and make-up devices for baggage cart access.

The following guidelines and procedures for contingencies resulting from failed systems are prepared for the Metropolitan Nashville Airport Authority, the Transportation Security Agency (TSA), the airlines using the airport, and the BHS maintenance service for the airport. These guidelines and procedures should be viewed as a basis for understanding the possible approaches the

airport may undertake during events that place baggage handling operations in jeopardy. Obviously, all contingencies cannot be accounted for and, in many cases, alternatives to the suggestions made here may be successfully implemented. The airport and airlines should always be prepared to improvise and create new methods for dealing with the many possible contingencies that can arise relative to the baggage handling system.

G.2.1.1 Contingency Planning Purpose

This action guide will present step-by-step procedures for successfully operating the BHS or moving baggage from the ticket counters to the baggage tug cart areas while different subsystems are inoperable. Many cases will require adjustments to loading bags at the various input lines; that is, moving bags to lines that are operational from those that are not. Other cases will require baggage handling personnel to manually move bags already inducted into the affected system from the last operational conveyor to the next operational conveyor and thereby bypassing the faulted conveyors. Most contingencies allow the control system to automatically alter the system's operation. Whatever the case, all efforts will be made to mitigate the disruption created by these system failures.

G.2.2 General Conditions and Procedures

G.2.2.1 Event Acknowledgment

When something happens to the system to cause conveyors to stop, the first step in correcting the fault and determining the extent of the potential disruption of services is to identify the issue. From there begins set procedures for correcting the condition and implementing a baggage handling contingency plan if necessary.

These should occur in the following order:

Failure Event → Assessment of Event → Implementation of Contingency Plan → Correction of System Failure → Resumption of Services → Event Review

G.2.2.2 Event Significance Determination

G.2.2.2.1 Non-Contingency Continued Operation

An assessment must be made once an event occurs to determine if the event will stop conveyor transport in the affected area for a period exceeding 10 minutes. Typical baggage jams do not meet this criteria, a ripped conveyor belt that cannot transport baggage will meet the criteria. Typical baggage jams should be observed by or reported to the BHS maintenance group which then implements its own procedures for clearing the jam in an acceptable amount of time–within the ten minute period. Those events requiring more than ten minutes to correct will necessitate a formal declaration of a specific contingency for continued baggage handling operation.

A determination can be made on the ability to work with the fault during the working day until time is available to correct the problem. If a problem occurs that may slow or hamper baggage flow but not stop it, a decision can be made to continue operation at a reduced level until close of business and BHS maintenance staff can correct the problem without affecting active operations.

G.2.2.2.2 Defining Contingency Operations

The following must be taken into consideration before a full need assessment can be made on the best course of action for any event. As is the case in most instances, immediate action will be undertaken to deal with pressing needs, and this may be all that is required; but, as the extent of the event becomes more evident and more pressing, these are issues to consider when implementing a comprehensive plan.

- Peak or non-peak hours of operation
- Critical nature of failed components
- Difficulty in correcting failure
- Availability of new components to correct failure
- Availability of appropriate personnel to correct or manage event
- Time needed to correct failure

G.2.2.2.3 Event Oversight

A single source of oversight and control will be instituted for the purpose of coordinating activities during an event. These events can vary greatly in significance and disruption to services. Some may only be an issue for a short period of time, others for much longer; some may occur during a very busy peak hour with numerous flights and passengers, others may occur during a particularly slow period; some may be only moderately disruptive, others may cause the baggage system to become inoperable. Airport staff will take the lead in directing the dissemination of information during crucial contingency events. Actions will be both automatic and based upon a consensus of the various stakeholders.

G.2.2.2.4 Special Considerations

The events that take longer than ten minutes to correct will be formally identified with an identification number and a date and time stamp for the initial report. The initial report may be made by any member of the airport's or airline's staff. The formal data entry of the ID and date and time stamp is the responsibility of the BHS maintenance group.

An acceptable database with reporting tools must be agreed upon by the various parties and implemented by the BHS maintenance group. This database will form the basis of all reports on BHS maintenance activities for the airport that produced the longer down-time (over ten minutes) and necessitated the need for baggage handling contingency activities.

G.2.2.3 General Procedures for Each Event

While expectations for airline ticketing staff, baggage handling staff, TSA personnel and BHS maintenance staff may be different for each event, it may be generalized that additional staff will be required for each discipline. In the case of the BHS maintenance group, there is a set of standard procedures that should be followed for each event. These include the following:

G.2.2.3.1 Standard Procedures for BHS Maintenance Staff

1. Upon fault recognition at fault monitoring system or notification from TSA, ticket counter or baggage handling staff of the fault condition, dispatch appropriate personnel to conveyor or device for inspection.

2. If the fault can be corrected within a ten minute interval then it should be and affected staff may return to normal activities.

3. If the fault cannot be corrected within this time interval the affected staff will be informed that they should begin contingency operations.

4. If the fault requires more time to correct, a formal entry into the monitoring database should be made with the appropriate information and date/time stamp.

5. Plans will be implemented to correct the fault and affected staff informed of the expected time the conveyor will continue to be inoperable.

6. Once the fault is corrected, affected staff will be informed that their operations may return to normal and the database will be updated to reflect the completion of the work.

These procedures will be viewed as understood for the purposes of this contingency plan and will not be repeated as each possible event is discussed.

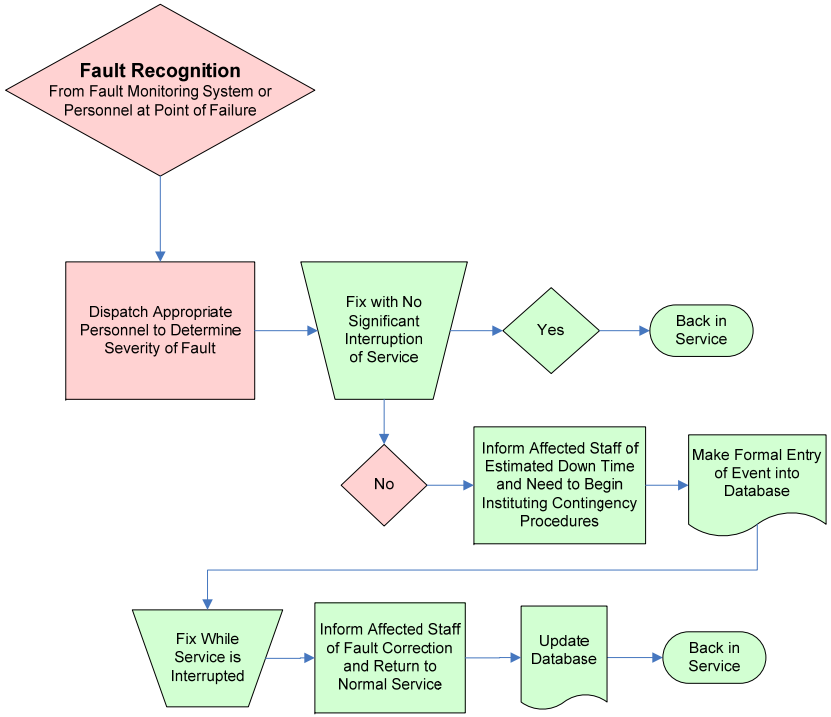
G.2.2.3.2 Automated System Control

The programmable logic controller (PLC) will incorporate coded control logic to automatically direct the conveyors to produce many of the necessary changes to the system as defined in the following contingency procedures. This will be a seamless operation that will require only minimum action by maintenance personnel.

The sort control computer system provides control features that allow operators to place subsystems in and out of service, change sort pier designations, and other features controlling BHS operation. These features allow the BHS operators to change long-term baggage routing in the event of large-scale system failures that require more time to correct.

Computer systems and PLCs require a very specific skill set to operate and maintain. Sufficient staff should be trained and retained in order to address any issues that may develop with these important components.

Figure G-1
BHS MAINTENANCE STANDARD PROCEDURES



G.2.2.4 System and Large Subsystem Failures

G.2.2.4.1 Power Failures

Power outages that affect the BHS or EDS may be mitigated initially by the uninterruptible power supplies (UPS) installed during the project. These supplies provide protection for the PLCs, the sort controller/monitoring/reporting computer system and the EDS. Primarily they provide enough power (typically around 30 minutes) to maintain the systems for short intervals, protect against power surges, and to power down the systems in a systematic and

controlled manner. This ensures that data is properly saved and applications will power back up in a successful manner.

Procedures for successfully powering down systems while using emergency UPS power are developed by the vendors for the systems and typically involve instituting the shutdown procedures at around 25 percent power remaining on each UPS. Procedures for returning the systems to operational mode are also developed by the vendors. Operators are required to conduct the procedures in an appropriate manner. Training and documentation for these systems will cover these procedures.

It is assumed that a massive power failure that shuts down automated baggage handling and EDS scanning operations will also shutdown or otherwise delay all airport operations. While it is possible to manually transport baggage to the CBRA and a designated sort area, it would be largely insufficient to process the quantities of baggage expected in such a scenario.

G.2.2.4.2 PLC Failure

A PLC failure may affect a large area resulting in loss of control for many conveyors or even a complete matrix. PLC failures are typically rare and relatively easy to fix and recover from.

Each master PLC located in the control room maintains a redundant, online clone that can be manually switched between the two when one fails. This is largely a quick and seamless action and only those PLCs associated with tracking bags in the CBIS or sort area downstream of the ATRs will create a noticeable contingency need. Tracked bags downstream of an EDS machine will be unknown to the backup PLC and will continue to the CBRA where they will be manually searched without the benefit of an image from an EDS machine. Tracked bags in the sort area downstream of an ATR will also be unknown to the backup PLC and will continue to the default runout pier where baggage handling personnel will identify the bags for the selected flight and place on the appropriate baggage cart.

It should be noted that maintenance procedures must be instituted and maintained that ensure the integrity of the backup system. All program changes made to a PLC must also be made to its backup PLC. New PLCs must be updated with the latest, specific program used for the replaced PLC.

G.2.2.4.3 Computer Systems Failures

The computer system servers–those used for sort control, reporting and fault monitoring–are all protected with redundant backup servers. These redundant servers are called hot backups in that they are constantly observing the activities of their counterpart online server and they can completely take over the activities of the online server if necessary without any intervention from an operator.

PLC sort control is an additional sort backup and it can be used to deliver bags to a single designated sort destination for each carrier in the case of complete failure of the sort control system. In this manner, the ATRs will continue to read the IATA tags that agents placed on the bags, but the PLC will only read the carrier information on them and will direct baggage for all flights to one sort destination designated for that carrier. It is also possible in a longer term sort controller failure for ticket agents to place pier tags on each bag in addition to the IATA tags and these tags can be used by the ATRs and the PLCs to direct bags to a specific sort pier/make-up destination.

As with the master PLCs, the redundant computer systems must be maintained with the same information as the online systems. All program changes made to one must be made to the other. Also, all restore procedures, techniques and materials must be carefully maintained and updated to ensure that the correct and most current applications can be successfully reinstalled if necessary on new or the same servers. There is also a separate application (or other method) accessed through the workstation that is used to download (as changes necessitate) the sort destination for each carrier to the PLCs.

It should be noted that all security screening activities may continue without the use of these computer systems.

G.2.3 Main Terminal

G.2.3.1 System Overview

The BHS contains eleven ticket counter lines (T1 through T11), eight curbside lines (CS1 through CS8) and the IL1 and IL2 input lines. These lines are separated into two sets which feed the Main Terminal EDS matrix and the Concourse C matrix.

Ticket counters T4 through T11, curbside lines CS4 through CS8, and the IL2 line merge into the two single feed lines (TC1 and TC2, and then SF1 and SF2) for the four L3 Communications eXaminer 3DX 6600D EDS machines (SS1 through SS4) in the Main Terminal. Ticket counters T1 through T3 and curbside lines CS1 through CS3 merge into the two single feed lines (TC3 and TC4, and then SF3 and SF4) for the four L3 Communications eXaminer 3DX 6600D EDS machines (SS5 through SS8) in Concourse C.

Two crossover lines are installed between TC1 and TC2 with crossover line X3 diverting from TC1 and merging onto TC2, and crossover line X4 diverting from TC2 and merging onto TC1. Both of these lines provide redundancy features for the Main Terminal EDS matrix in the event that conveyors downstream of the crossover lines become inoperable. The crossover lines also provide load balancing capability in the event that an individual EDS machine or feed line fails and bags accumulate too rapidly for the other EDS machine to scan without baggage backing up and causing system slowdown or shutdown.

Baggage Measuring Arrays (BMA) are placed at the end of the TC1 and TC2 lines, at which point the lines are designated as SF1 and SF2, respectively. These lines are the dual feed lines for the matrix of four EDS machines: two machines for each line. Upstream crossover lines provide the ability to move bags from one feed line to the other, thus providing redundancy and load balancing capability.

Once bags are placed into the system they are conveyed past a BMA where the BHS Programmable Logic Controllers (PLC) track out-of-gauge bags to the out-of-gauge line into the CBRA. Bag IDs, used for tracking and assigning the status for each bag, are assigned by the BHS PLCs at the BMA or the queue immediately prior to the EDS machines on the security shunt lines. These IDs are transferred between the EDS and BHS and will be used to identify and attach information to the bag during its time in the CBIS.

Bags are conveyed into the CBIS onto either the SF1 or SF2 EDS matrix feed lines for security scanning. They are then diverted by a High Speed Sorting Device (HSSD) onto security shunt lines feeding the EDS machines. The SF1 line feeds the SS1 and SS3 lines and machines, and SF2 line feeds the SS2 and SS4 lines and machines.

Bags measured as too large to either fit into the EDS machines or be successfully imaged will continue on the SF1 and SF2 lines. The SF2 line becomes designated as the OG1 line prior to entering the CBRA. The SF1 line ends at a tip chute that drops bags onto the OG1 line. All out-of-gauge baggage is resolved using manual processes.

The lines for each EDS machine have a vertical sorting device after the exit of the machine. The sorting device separates bags cleared by the EDS machine from those that are not. Cleared bags from the SS1 machine are diverted to the CL1 clear line, bags cleared by the SS2 machine are diverted to the CL2, the SS3 machine diverts cleared bags to the CL3 line, and the SS4 machine diverts cleared bags to the CL4 line.

The CL2 line merges onto the CL1 line which merges onto the CL3 line. The CL4 line, the CL5 clear line out of the CBRA, and the CL11 OSR clear line also merge onto the CL3 line. The CL3 line continues to an ATR where bag tag information is retrieved and the line becomes designated as the ML1 line.

Bags not cleared from the SS1, SS2, SS3 or SS4 lines are diverted to the AL1, AL2, AL3 and AL4 lines, respectively. The AL1, AL2 and AL3 alarm lines merge onto the AL4 line that travels to a second vertical sorting device for the second or On-screen Resolution (OSR) decision point.

Bags cleared by the OSR process are diverted to the CL11 cleared line that merges onto the CL3 line. Bags not cleared continue on the AL4 line on into the CBRA.

The RT1 line is the designated purge line and is used to transport bags from the alarm line prior to the CBRA and back into the system prior to the EDS machines. It is used for bags that were not successfully scanned due to an EDS machine error. It is diverted from the AL4 line by a HSSD and merges onto the TC1 line prior to the ATR.

Bags considered not cleared by an EDS machine or by OSR continue on the AL4 alarm line entering the CBRA for resolution. All bags cleared in the CBRA are placed on the CL9 cleared bag line that merges onto the CL3 line and then the ML1 line that travels to the sort area.

Oversize baggage will be manually transported to the CBRA and then placed on the roller beds between the CBRA and the ramp for baggage cart loading.

The sort area consists of a total of nine sort piers and one make-up device. The first sort pier (RO), located immediately after bags clear the CBIS and the ATR reads bag tags, is designed to direct bags to the ramp area if the ML1 mainline fails. Bags destined for a sort pier downstream of the failure may be directed to the RO line for baggage cart loading. The last sort pier, the ML1 runout pier, is used for bags that for whatever reason were not diverted to the appropriate sort destination. All other piers (SP1 through SP8) and the make-up device (MU10, which is fed bags from SP3) are used by various airlines for baggage cart loading on specific flights.

Figure G-2
MAIN TERMINAL LAYOUT

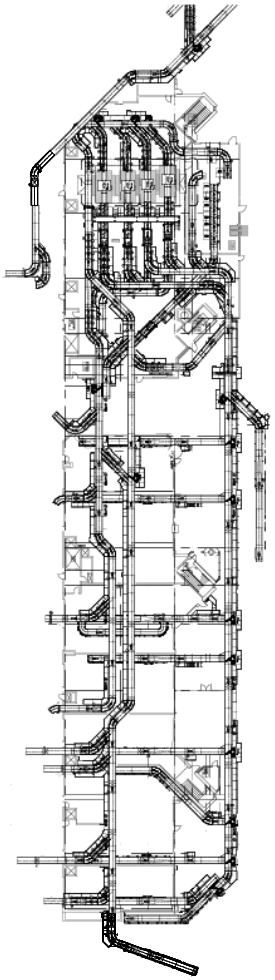


Figure G-3
MAIN TERMINAL CBIS

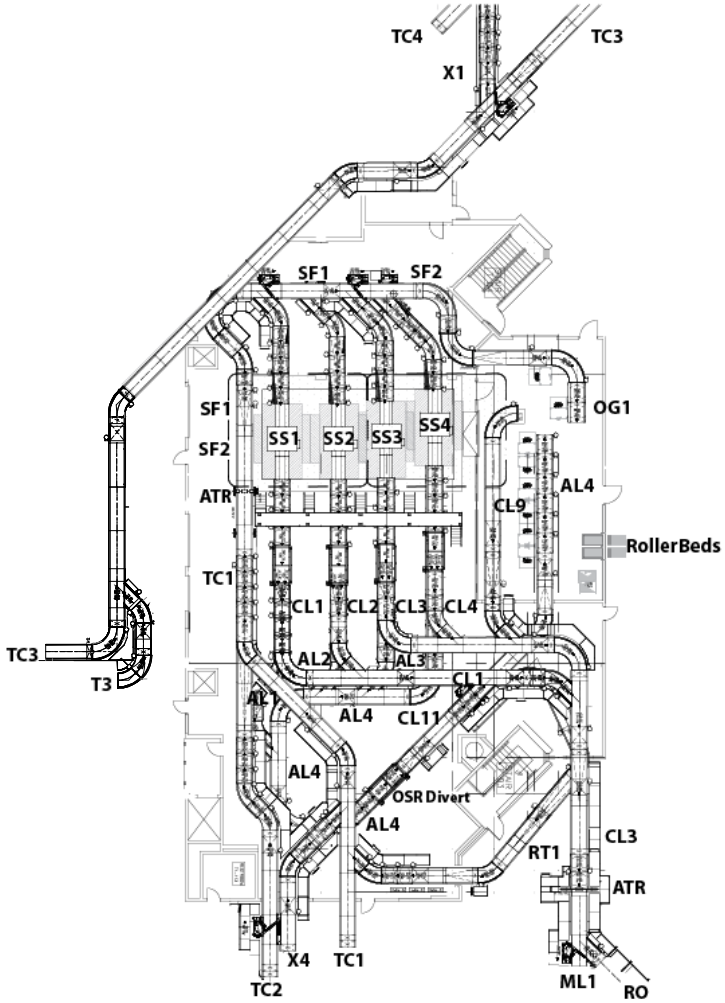
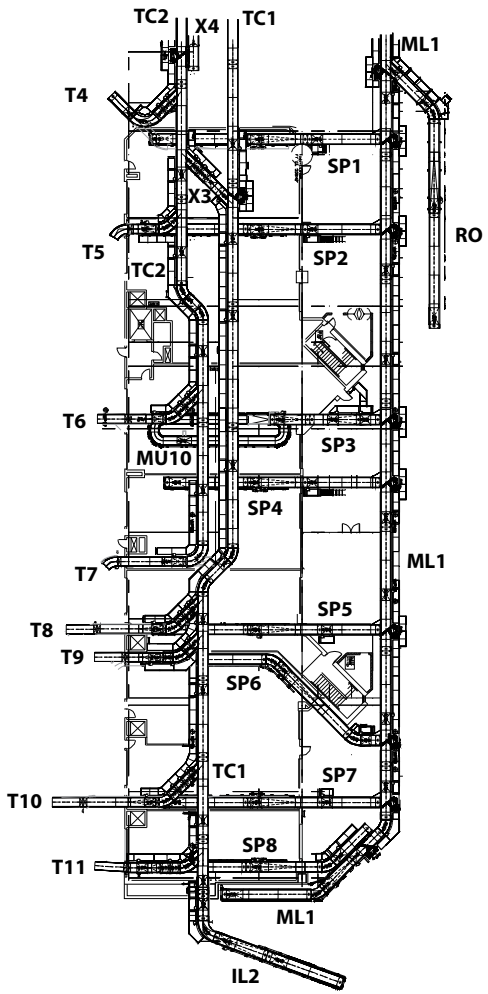


Figure G-4
MAIN TERMINAL SORT AREA



G.2.3.2 Ticket Counter and Curbside Lines

The existing ticket counter lines T4 through T11 and existing curbside lines CS4 though CS8 merge onto the new ticket counter transport lines TC1 and TC2: T4, CS4, T7, CS7, CS8, T9 and T11 feed TC1, and T5, CS5, T6, CS6, T8 and T10 feed TC2.

G.2.3.2.1 Load Belts

If the loading take-away belt for ticket counter and curbside conveyors become inoperable a conveyor immediately downstream of the conveyor may, in some instances be used. For many of the ticket counter lines the power turn prior to the security/fire door separating the public area from the bag room may be used to place baggage onto the line.

Note: Certain fault conditions may exist that will not allow this approach.

Procedures for Airline Ticketing Staff

1. Determine that failed condition on the conveyor requires intervention from BHS Maintenance staff and inform proper personnel if the condition does.

2. Request additional help for ticket agents in moving baggage to the next operable conveyor from the ticket counter area.

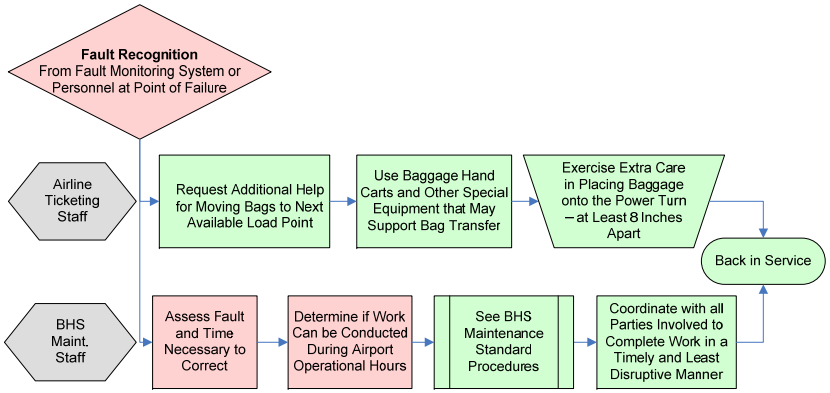
3. If necessary, especially during peak loading periods, use small cart to facilitate transfer of bags.

4. Carefully place bags lengthwise onto the conveyor in intervals at least eight inches apart.

Procedures for BHS Maintenance Staff

These fault conditions are like most in that they should be repaired as quickly as possible. As this work involves the public areas, it may be more convenient to create a suitable work-around for the problem during the active work day for the affected airline(s) and then work during close-of-business hours to ensure that the problem is corrected before the next day's start of business. This is a coordination issue that should be based upon the potential disruption of the fault and of the effort to correct the fault. The result should be agreeable to all parties involved.

Figure G-5
FAULTED LOAD BELTS



G.2.3.2.2 CS4 through CS8 and T4 through T11

If any of these conveyors fault and become inoperable, baggage intended for these subsystems will need to be moved to an associated line for loading onto the baggage system. Baggage already placed onto these conveyors will need to be removed and placed on the nearest downstream, operating conveyor; if this is not possible, the bags should be removed and taken to an associated ticket counter line for loading back into the baggage system.

Procedures for Airline Ticketing Staff

1. Determine that failed condition on the affected line requires intervention from BHS Maintenance staff and inform proper personnel if the condition does.

2. Request additional help for ticket agents in moving baggage to a nearby and available take-away load conveyor from the load area associated with the failed line.

3. Use small cart to facilitate transfer of bags to the most convenient working load conveyor.

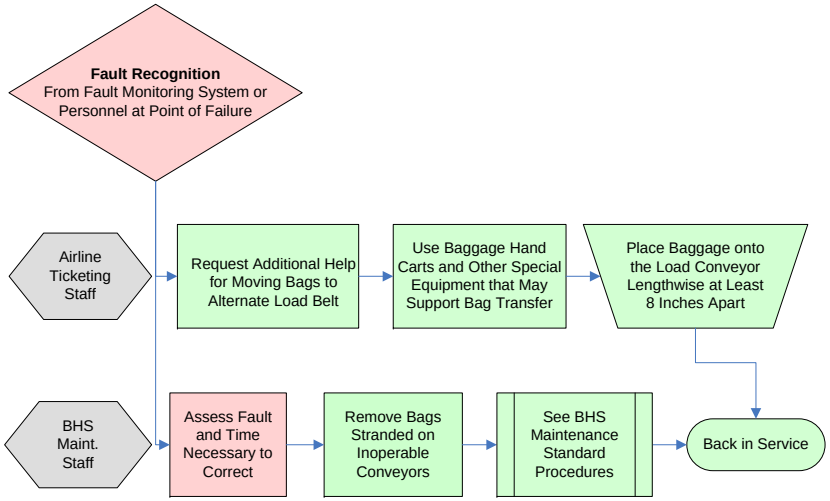
4. Carefully place bags lengthwise onto the conveyor and coordinate with all involved to ensure that the bags remain in intervals at least eight inches apart.

Procedures for BHS Maintenance Staff

1. Bags left stranded on any of the failed conveyors must be removed manually and loaded on the nearest and accessible operating conveyor either feeding or on the working line.

2. All efforts should be made to immediately correct the failure and return the conveyor to full operation.

Figure G-6
FAULTED TICKET COUNTER AND CURBSIDE LINE



G.2.3.3 TC1 and TC2 Transport Lines

These two transport lines accumulate and convey baggage from the ticket counter and curbside lines to the EDS matrix. The lines together provide a redundant feature and increased load potential for the expected demand on the system.

If one of the lines becomes inoperable prior to the crossover lines, carriers using the ticket counter and curbside lines merging onto the line will need to use different input points. This is obviously an undesirable condition that may provide some relief but during peak periods would require significant coordination between the carriers. It is a high-priority condition that would need to be corrected very quickly.

Procedures for Airline Ticketing Staff

1. Determine that failed condition on the affected line requires intervention from BHS Maintenance staff and inform proper personnel if the condition does.

2. Request additional help for ticket agents in moving baggage load points feeding the operating transport line for the appropriate matrix and sort area. Use small cart to facilitate transfer of bags.

3. Select baggage for flights with departure times greater than one hour for placement later into the system.

4. Agents may place bags in a designated area by flight for this purpose.

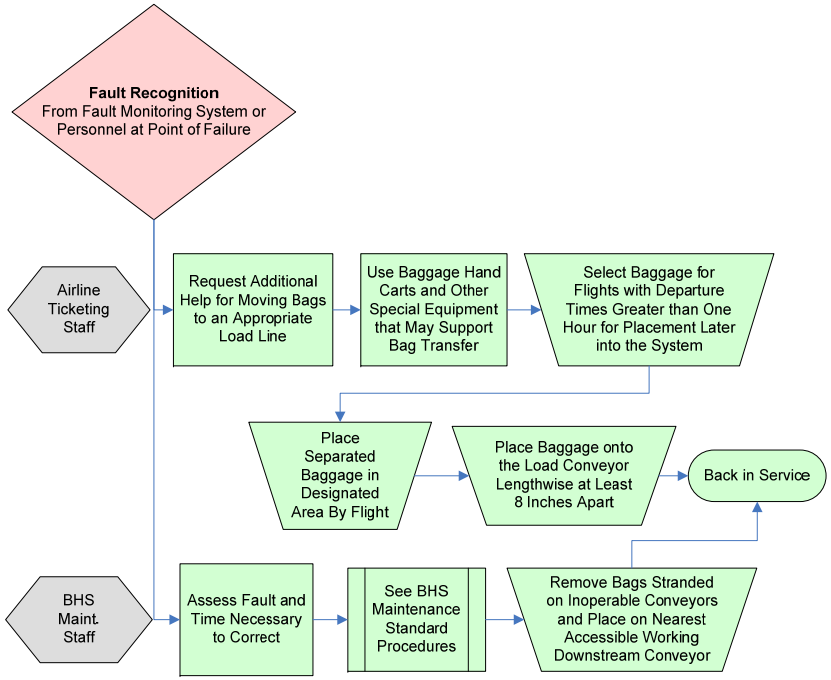
5. Carefully place bags lengthwise onto the conveyor and coordinate with all involved to ensure that the bags remain in intervals at least eight inches apart.

Procedures for BHS Maintenance Staff

1. Manually remove bags left stranded on any of the failed conveyors and load on the nearest and accessible operating conveyor either feeding or on the working line.

2. All efforts should be made to immediately correct the failure and return the conveyor to full operation.

Figure G-7
FAULTED TRANSPORT LINES



G.2.3.4 X3 and X4 Crossover Lines

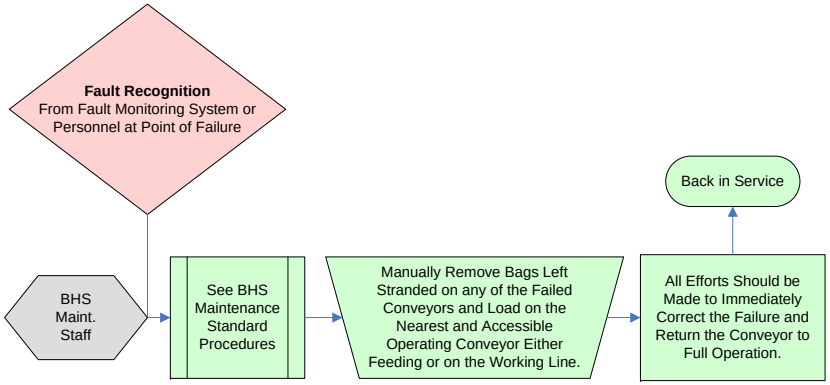
As these lines provide redundancy and load balancing capability for the Main Terminal EDS matrix in the event that conveyors downstream of the crossover lines become inoperable it is important to correct the failure promptly in order to maintain this important system feature.

Procedures for BHS Maintenance Staff

1. Manually remove bags left stranded on any of the failed conveyors and load on the nearest and accessible operating conveyor either feeding or on the working line.

2. All efforts should be made to immediately correct the failure and return the conveyor to full operation.

Figure G-8
FAULTED CROSSOVER LINE



G.2.3.5 EDS Matrix

G.2.3.5.1 SS1, SS2, SS3 and SS4 Failures

If one of the EDS machines becomes inoperable or the diverter or the conveyor line directly feeding the machine fails, the other operable machines will be responsible for all security scanning. This is accomplished automatically by monitoring software that shuts down the diverter feeding that line.

Bags already on the security shunt line prior to an EDS machine failure may be diverted onto the purge line for recirculation purposes if the conveyor within the EDS machine is still operable. If the conveyor is not working, the bags will need to be manually removed and, in most instances, taken to the CBRA.

The X3 and X4 crossover lines prior to the matrix may be utilized to balance the demand on EDS machine resources during failures associated with EDS machines or security shunt lines.

G.2.3.5.2 SF1 and SF2 Line and HSSD Failures

If any of the HSSDs on the two security feed lines (SF1 and SF2) fail then it should be possible, due to the redundancy of the conveyor design, to continue using the feed lines to direct bags to the operable security shunts lines (SS1, SS2, SS3 and SS4) and their EDS machines. This is also true regarding failures occurring on any of the security shunts lines or EDS machines.

The X3 and X4 crossover lines may be employed for load balancing purposes in this situation to reduce usage on the security feed line that has lost the use of one of its security shunt lines.

Procedures for TSA Staff

1. Move additional personnel to the CBRA for the extra demand on the ETD systems.

2. If the failure is with an EDS machine, procedures for securing service from the vendor should be implemented.

Procedures for Airline Baggage Handling Staff

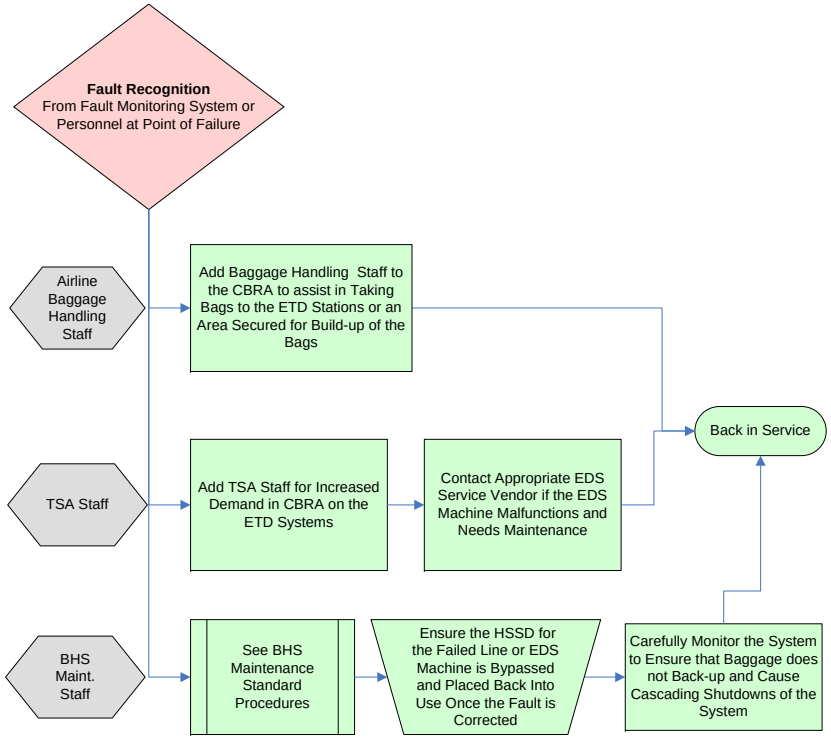
Move additional personnel to the CBRA to assist TSA personnel in unloading bags from the OG1 out-of-gauge line and taking them to the ETD stations or an area secured for build-up of the bags.

Procedures for BHS Maintenance Staff

1. The HSSD for the failed line or EDS machine should automatically be bypassed. It will be used again once the fault is corrected.

2. The system should be carefully monitored to ensure that baggage does not back-up and cause cascading shutdowns of the system.

Figure G-9
EDS MACHINE OR FEED LINE FAILURE



G.2.3.5.3 Baggage Measuring Array Failure

If the baggage measuring array fails, bags cannot be sized appropriately for the EDS machine, which means that none of the bags will be stopped from diverting to the machines. Personnel must be placed at the entrance to each of the machines to remove bags that jam or cannot enter the machines. These bags will need to be manually taken directly to the CBRA.

Bags that are able to enter and pass through the EDS machines, but are too large to produce a complete image will be sent to the CBRA for resolution with an errored or unknown status. If lines to the EDS machines are filled with bags and stopped, bags will continue onto the OG1 line into the CBRA.

During a BMA failure requiring a significant time duration to correct, ticket counter agents should apply greater attention to the size of the bags and attempt to ensure only bags that will pass through the EDS machines are placed on the ticket counter lines. These bags should be transported to the CBRA in much the same way as standard oversize bags.

Crossover Line Change

Bags intended for the EDS feed line with the disabled BMA may be diverted when possible to the line with a functional measuring array. This is should be the first line of action in response to such a failure until the two machines on the functional line reach a saturation point.

Procedures for TSA Staff

Prepare to move additional personnel to the CBRA in case of additional demand on the ETD systems.

Procedures for Airline Baggage Handling Staff

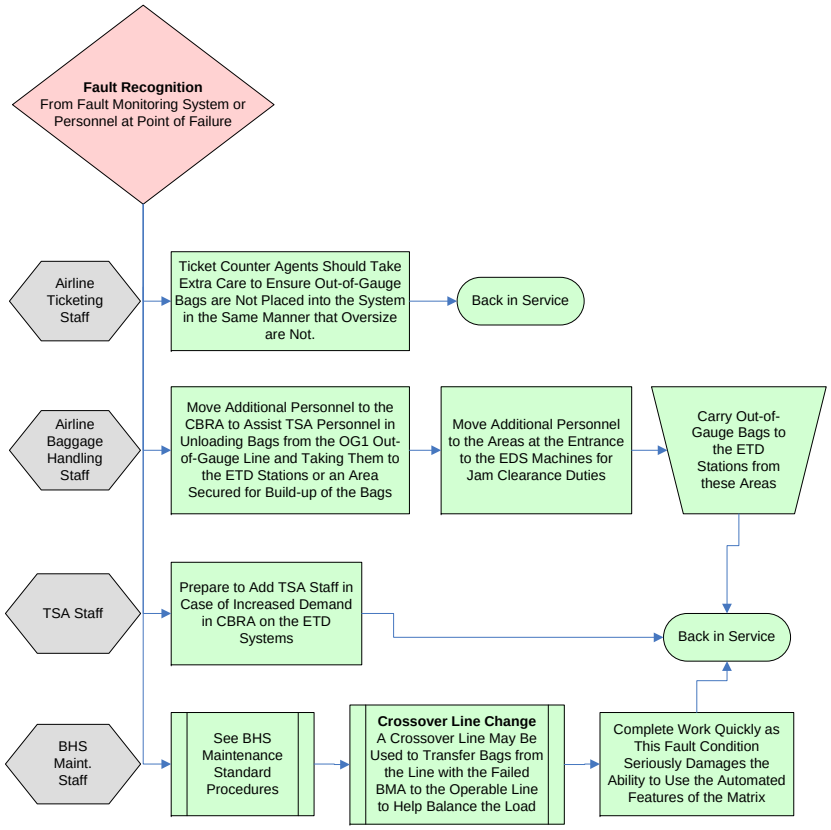
1. Move additional personnel to the CBRA to assist TSA personnel in unloading bags from the OG1 out-of-gauge line and taking them to the ETD stations or an area secured for build-up of the bags.

2. Move additional personnel to the areas at the entrance to the EDS machines for jam clearance duties. Bags too large may need to be carried to the ETD stations from these areas.

Procedures for BHS Maintenance Staff

Personnel should very quickly correct this failure. Replacement parts for these devices should always be kept on-site and trained personnel should always be available.

Figure G-10
BMA FAILURE



G.2.3.5.4 Out-of-Gauge (OG1) Line

It should be possible to take out-of-gauge bags from the SF1 line or the last operable OG1 line conveyor. It should also be possible to remove bags from the inoperable OG1 line as they slide off the tip chute from the SF2 line.

Procedures for Airline Baggage Handling Staff

Move additional personnel to the end of the SF1 line or last operable OG1 conveyor to assist TSA personnel in unloading bags and taking them to the ETD stations. Care must be taken to avoid tip chute action from the SF2 line.

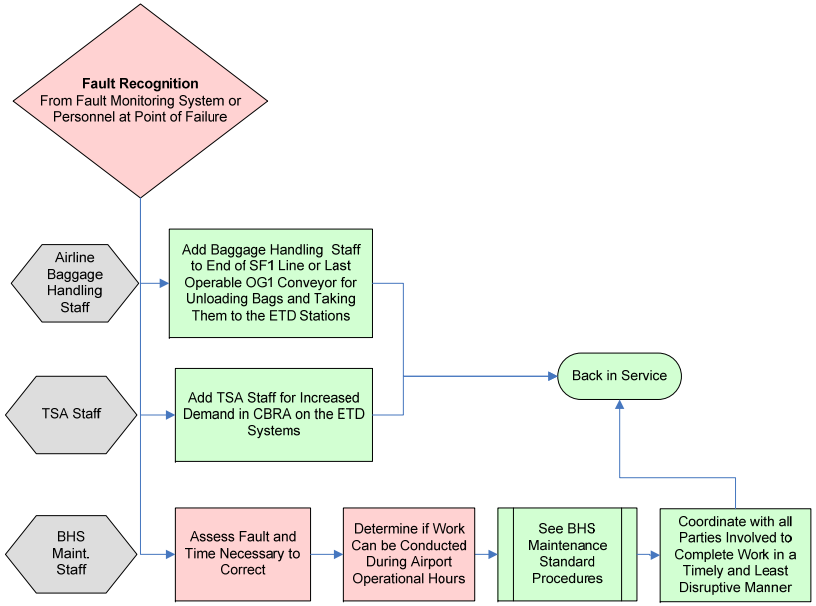
Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

Procedures for BHS Maintenance Staff

This fault condition should be treated in much the same manner as work at the ticket counter. If the work to repair the fault is more disruptive than the condition itself and if a suitable temporary fix can accommodate the TSA until the end of the work day, then work should be conducted during close-of-business hours to ensure that the problem is properly corrected before the next day's start of business. All should agree upon this solution, otherwise repair efforts should be conducted in earnest.

Figure G-11
OUT-OF-GAUGE LINE FAILURE



G.2.3.5.5 First Decision Point Vertical Sorter Failure

Failed first decision point sorter conditions will be treated much the same as for the failed security shunt line or EDS machine. Bags will not be diverted to the line with the failed sorter and will instead be diverted to operable lines. All bags currently on the line will be manually removed and taken directly to the CBRA for resolution.

Staff may place the stranded bags from the queues between to the EDS machine and the vertical sorter on the alarm line immediately downstream of the failed sorter. Staff can also lock the sorter in bypass mode in which it only feeds the alarm line in order to send these bags to the CBRA. Stranded bags located on the SS queues prior to the EDS machine may be placed on a queue, other than the entrance queue, on the nearest EDS machine with a functional sorter.

Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

Procedures for Airline Baggage Handling Staff

Move additional personnel to the CBRA to assist TSA personnel in unloading bags from the OG1 out-of-gauge line and taking them to the ETD stations or an area secured for build-up of the bags.

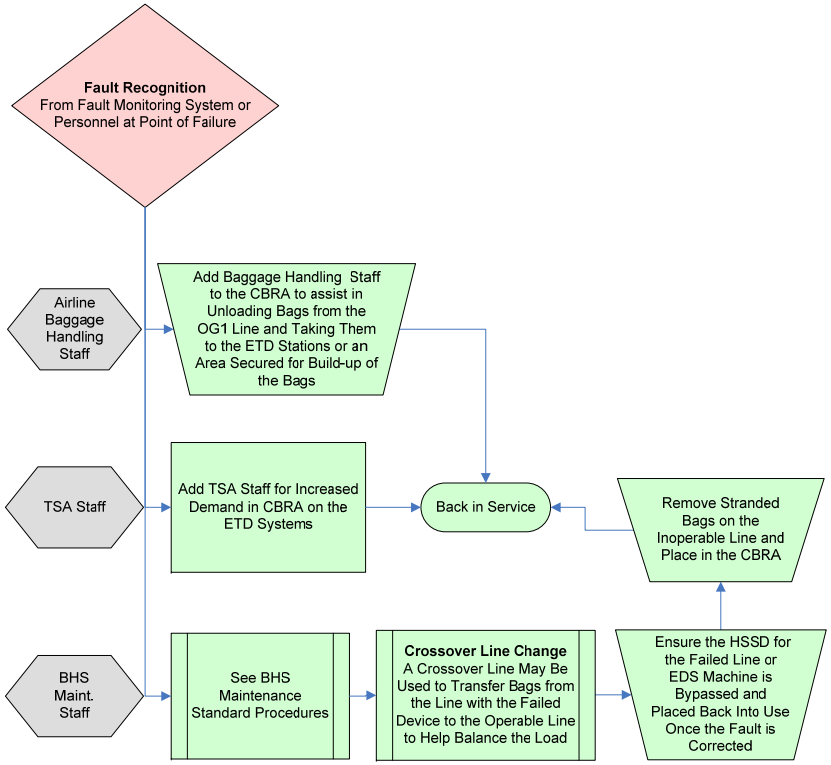
Procedures for BHS Maintenance Staff

1. Use crossover line to move bags and relieve pressure from the TC line associated with failed device to the line in full service.

2. The HSSD for the SS line with the failed vertical sorter should automatically be bypassed. It will be used again once the fault is corrected.

3. All bags stranded on the inoperable line should be removed and placed in the CBRA.

Figure G-12
FIRST DECISION POINT FAILURE



G.2.3.5.6 EDS Cleared Bag Lines

CL2 and CL4

EDS cleared bag lines face the same considerations as EDS machines and security shunt line failures; the line will not be used while the condition is in effect and alternative shunt lines will be used instead, and load balancing use of the crossover lines will be employed.

CL1 and CL3

This condition may be treated the same as described for CL2 and CL4, but when the failure in the line occurs downstream of other merge points, the situation becomes more critical.

If the CL1 line fails after the CL2 merge point then both lines will be down, if it occurs after the CL11 merge point then all three lines will be down. If the CL3 line fails after the CL4 merge point then both line will be down, if it occurs after the CL9 merge point the all three will be down. The CL9 line is the cleared line out of the CBRA, which creates its own contingency.

Personnel may be employed to move bags around the fault, but primarily the other two EDS lines (SS3 and SS4) must scan all bags unless excess demand requires alternative action. It may also be possible in a critical moment to force bags from these lines into the CBRA where TSA personnel can confirm the bags' cleared status and baggage handling personnel can then place the bags onto the CL9 line.

In a crisis, bags cleared out of the CBRA may need to be placed on the roller bed conveyors for oversize baggage. There, baggage handling personnel will place bags onto carts for the appropriate flights.

Obviously, this fault must be corrected quickly.

Procedures for TSA Staff

Move additional personnel to the CBRA.

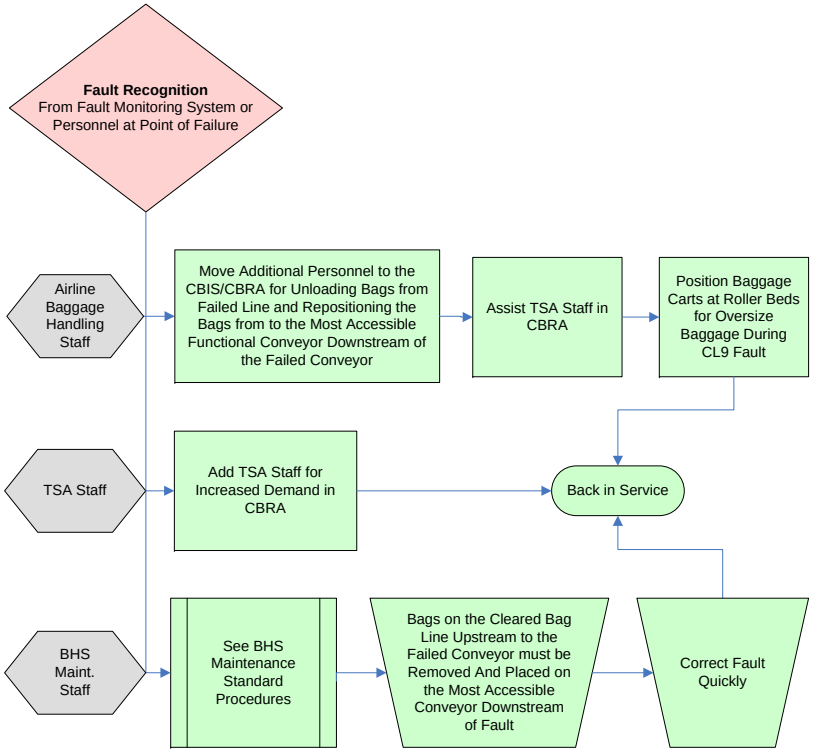
Procedures for Airline Baggage Handling Staff

1. Move additional personnel to the CBIS/CBRA.
2. Bags may need to be repositioned from the failed conveyor to the most accessible functional conveyor downstream of the failed conveyor.
3. Assist TSA officials in moving cleared bags.
4. For CL9 failure, position baggage carts at oversize roller bed load point.

Procedures for BHS Maintenance Staff

1. Bags on the cleared bag line upstream to the failed conveyor will need to be removed and placed on the most accessible conveyor leading to the sort area.
2. Quickly correct point of failure.

Figure G-13
EDS CLEARED BAG LINE FAILURE



G.2.3.5.7 Alarm Line Failure Prior to OSR Decision

EDS alarmed, suspect, errored or unknown (non-cleared) bag lines face the same considerations as EDS machines and security shunt line failures; the line will not be used while the condition is in effect and alternative shunt lines will be used instead.

Only the AL4 line after all the other AL lines have merged onto it creates a complete shutdown if it fails. If one of the other lines fails then that EDS subsystem should be avoided until it is corrected. The crossover lines may be employed for load balancing purposes in this instance.

Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

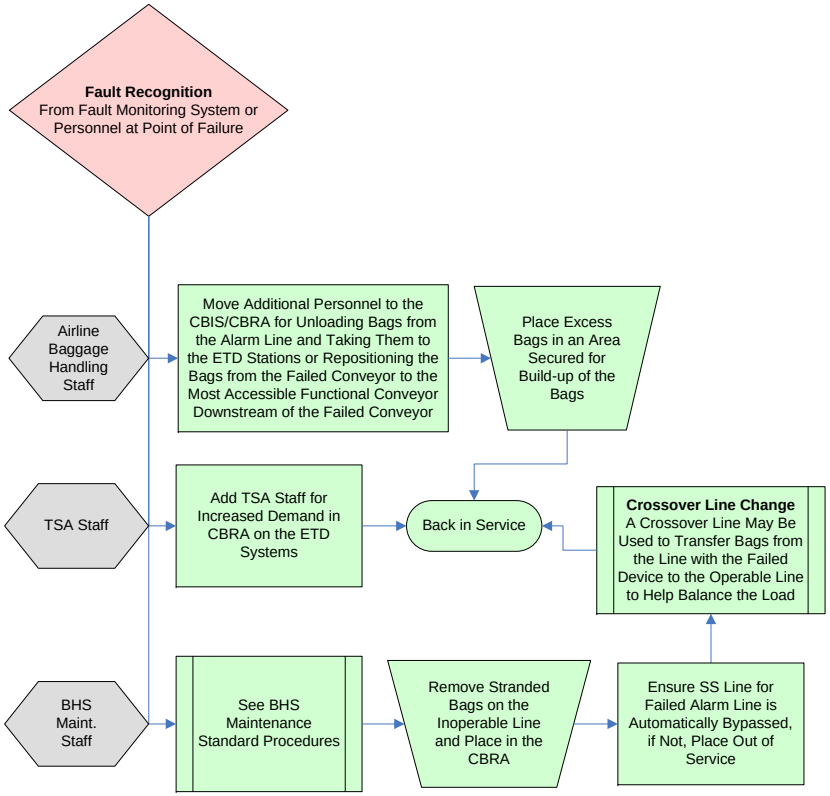
Procedures for Airline Baggage Handling Staff

1. Move additional personnel to the CBIS/CBRA for unloading bags from the alarm line and taking them to the ETD stations.
2. Bags may also be repositioned from the failed conveyor to the most accessible functional conveyor downstream of the failed conveyor. These bags would enter the CBRA with an unknown status.
3. Place excess bags in an area secured for build-up of the bags.

Procedures for BHS Maintenance Staff

1. All bags stranded on the inoperable line should be removed and placed in the CBRA.
2. Ensure SS line for failed alarm line is automatically bypassed, if not, place out of service.
3. Use load balancing techniques with the crossover lines if necessary.
4. The faulted conveyor should be repaired quickly.

Figure G-14
ALARM LINE FAILURE PRIOR TO OSR POINT



G.2.3.5.8 Second Decision Point Vertical Sorter Failure

If the OSR vertical sorter fails then all baggage not cleared and with an associated images from an EDS machine will continue to the CBRA for resolution if the sorter can be locked in the alarm line position. This would be a temporary fix until BHS maintenance is prepared to fix the sorter. This could also be accomplished during the airport's non-operational hours. TSA will need to provide extra staffing in the CBRA until the sorter is fixed.

If the sorter cannot be used, then BHS maintenance or baggage handling personnel will need to remove bags from the line prior to the sorter and place bags back on the alarm line after the sorter. Tracking will be lost and all related images will not be associated with the bags. An area may need to be set aside for the collection of bags awaiting resolution.

Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

Procedures for Airline Baggage Handling Staff

1. Move additional personnel to the CBRA to assist TSA personnel in unloading excess bags from the AL4 alarm line and taking them to an area secured for build-up of the bags.

2. Help BHS Maintenance staff remove stranded bags from the AL4 line upstream to the OCR divert point for placement back onto the downstream functional AL4 conveyors.

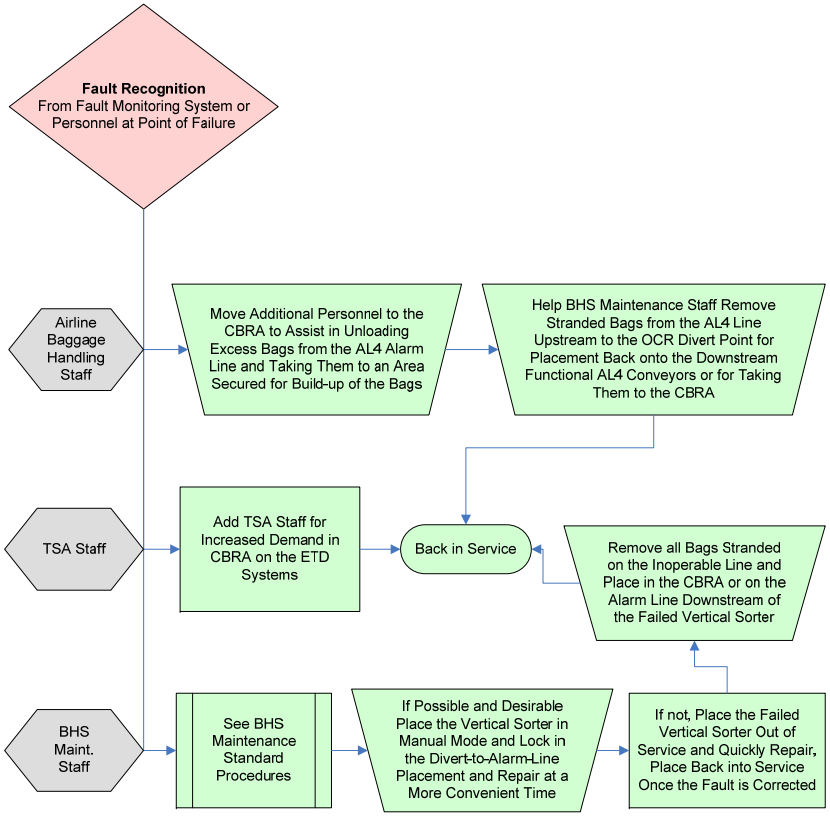
Procedures for BHS Maintenance Staff

1. If possible and desirable place the vertical sorter in manual mode and lock in the divert-to-alarm-line placement. Then repair at a more convenient time.

2. If not, the failed vertical sorter should be placed out of service and quickly repaired. It will be placed back into service once the fault is corrected.

3. All bags stranded on the inoperable line should be removed and placed in the CBRA or on the alarm line downstream of the failed vertical sorter.

Figure G-15
SECOND DECISION POINT VSU FAILURE



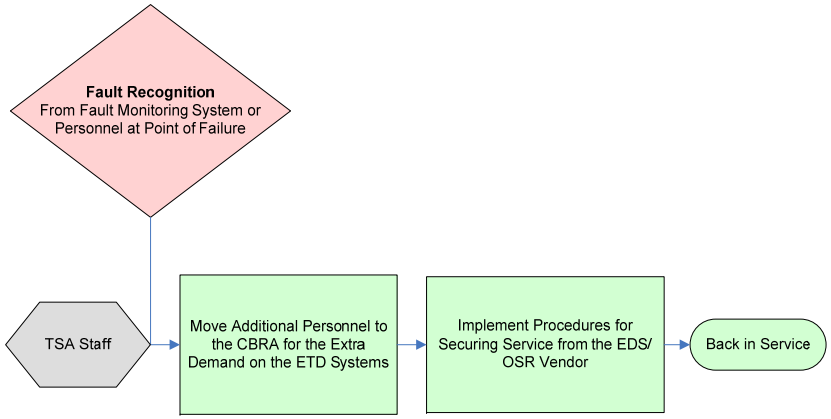
G.2.3.5.9 OSR Failure

If the ability to use the OSR services fails then all baggage on the AL4 line will continue to the CBRA for resolution.

Procedures for TSA Staff

1. Move additional personnel to the CBRA for the extra demand on the ETD systems.
2. Implement procedures for securing service from the EDS/OSR vendor.

Figure G-16
OSR FAILURE



G.2.3.5.10 Purge Line (RT1) Failure

If the purge line or the diverter for the purge line fails all bags that would have been diverted onto it will instead continue to the CBRA for resolution.

Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

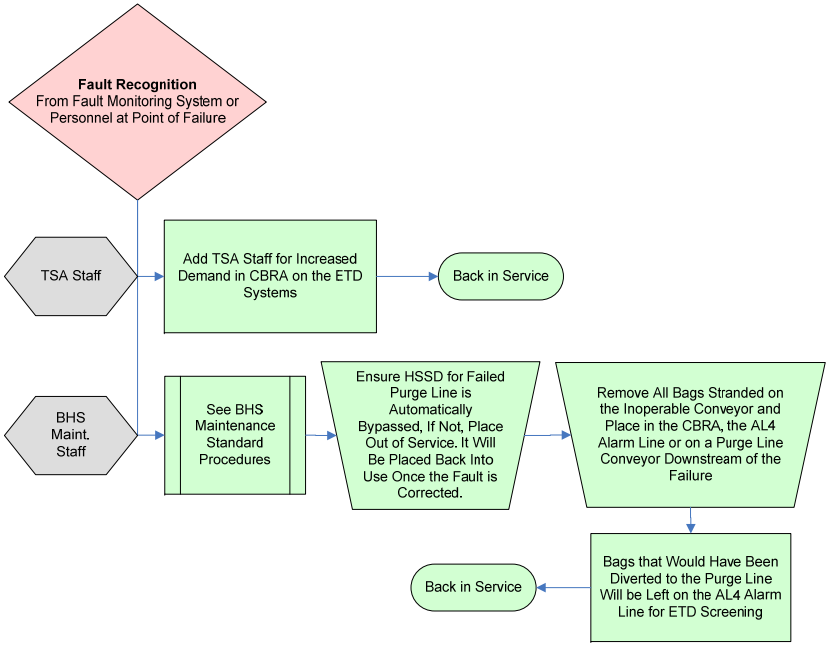
Procedures for BHS Maintenance Staff

1. Ensure HSSD for failed purge line is automatically bypassed, if not, place out of service. It will be placed back into use once the fault is corrected.

2. All bags stranded on the inoperable conveyor should be removed and placed on an operable purge line conveyor downstream to the failed conveyor, or on the AL4 alarm line, or taken to the CBRA.

3. Bags that would have been diverted to the purge line will be left on the AL4 alarm line for ETD screening.

Figure G-17
PURGE LINE FAILURE



G.2.3.5.11 Alarm Line Failure (AL4) Post OSR Decision

If an AL4 conveyor fails after the last decision point, bags will be manually removed and taken to the ETD stations for resolution. Tracking will be lost and related images will not be associated with the bags.

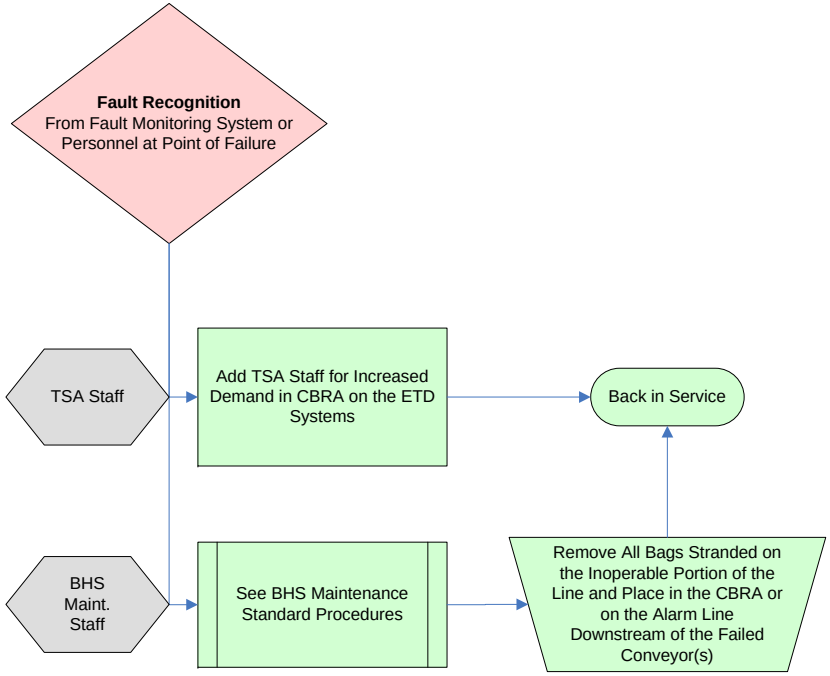
Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

Procedures for BHS Maintenance Staff

All bags stranded on the inoperable portion of the line should be removed and placed on an operable AL4 conveyor downstream of the failed conveyor or in the CBRA.

Figure G-18
ALARM LINE FAILURE POST SECOND DECISION POINT



G.2.3.5.12 Cleared Bag Line (CL11) Failure Post OSR Decision

If a conveyor fails on the CL11 cleared bag line after the OSR decision point then the bags will need to be manually removed from the line and placed back on it downstream of the failed conveyor or placed on the CL1 or CL3 clear lines. If the line is inoperable for an extended period of time then the AL4 alarm line may be used instead and all OSR cleared bags will travel to the CBRA where they will be noted as cleared and placed on the CL9 clear lines.

Procedures for TSA Staff

Move additional personnel to the CBRA.

Procedures for Airline Baggage Handling Staff

1. Move additional personnel to the affected conveyors to assist BHS Maintenance personnel in unloading bags from the CL11 clear line upstream to the fault and placing them back on the line downstream of the fault.

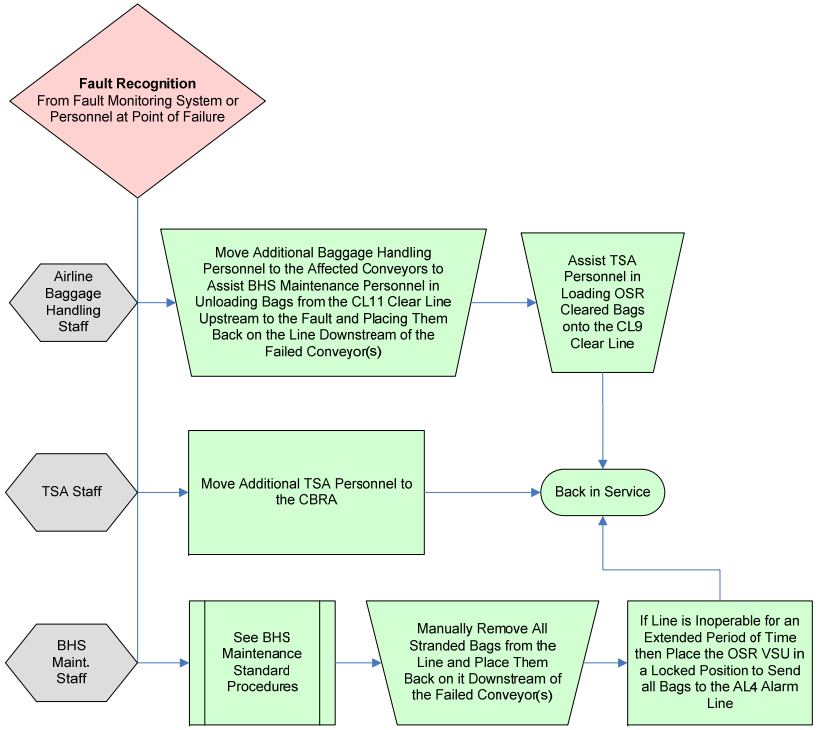
2. If bags remain on the alarm line and enter the CBRA then baggage handling personnel will need to assist TSA personnel in loading cleared bags onto the CL9 clear line.

Procedures for BHS Maintenance Staff

1. All stranded bags will need to be manually removed from the line and placed back on it downstream of the failed conveyor(s).

2. If line is inoperable for an extended period of time then place the OSR sorter in a locked position with all bags staying on the AL4 alarm line.

Figure G-19
CL11 LINE FAILURE



G.2.3.5.13 CBRA Cleared Bag Line (CL9) Failure

The system is designed with one cleared bag line originating in the CBRA. The roller beds intended for oversize baggage will be employed for CBRA cleared bags.

Procedures for TSA Staff

Place cleared bags in the CBRA on the oversize roller beds.

Procedures for Airline Baggage Handling Staff

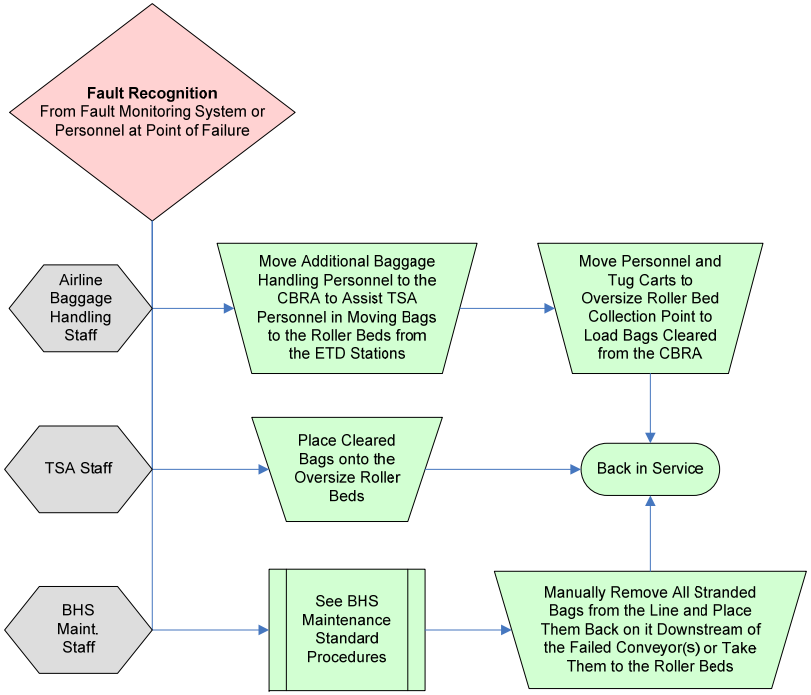
1. Move additional personnel to the CBRA to assist TSA staff in moving cleared bags to the roller beds.

2. Move personnel and baggage tub carts to oversize roller bed collection point for loading bags cleared in the CBRA.

Procedures for BHS Maintenance Staff

All stranded bags will need to be manually removed from the line and placed back on it downstream of the failed conveyor(s) or taken to the roller beds.

Figure G-20
CBRA CLEARED BAG LINE FAILURE



G.2.3.5.14 CBRA Equipment Failure

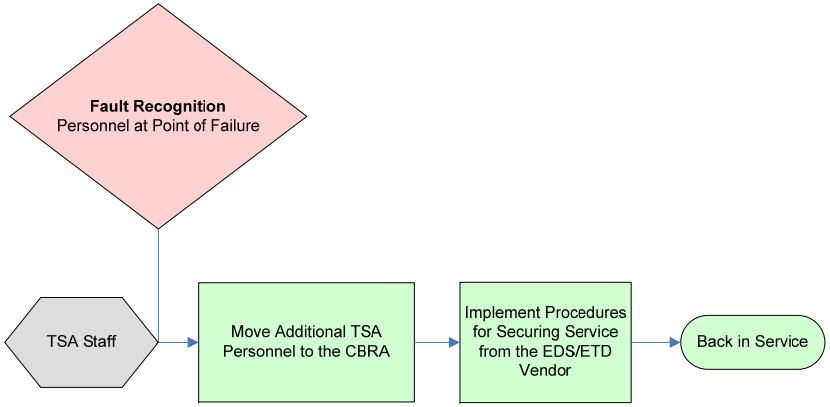
Alarmed bags entering the CBRA will need to be manually searched without direction if all HMIs fail. If trace detection fails then all bags will need to be manually searched.

Procedures for TSA Staff

1. Move additional personnel to the CBRA.

2. Contact appropriate sources/vendors for repairing failed devices.

Figure G-21
CBRA EQUIPMENT FAILURE



G.2.3.6 Sort Area

The Main Terminal sort area does not include redundant transport lines. This reduces some of the contingency possibilities when line and component failures occur. If the ML1 line fails all baggage sort points downstream of the failure may not be used in any significant manner. The RO line is the first divert point on the ML1 line and may be used to divert bags to the ramp level for baggage cart loading for all carriers. Sort piers with divert points prior to the

failure may also be utilized for bags until the line is brought back into full use. This will demand coordination between the affected carriers.

G.2.3.6.1 Sort Area ATR Failure

This is a potential disruption of some significance due to the lack of mainline redundancy. The ML1 runout pier would be typically considered the primary default pier for this contingency. This runout pier does not use a diverter, thus avoids potential missed diverts, subsequently all bags reach this point. The RO line is longer than the ML1 pier and may also be considered the default pier, although the MU10 make-up device may allow for more bag storage and presentation for the baggage carts. The HSSD for the selected pier may be placed in a divert-all position to send all bags to the pier. Either of these piers may be used as the default location for this event.

If demand is so great that the selected pier becomes overloaded, then an alternative default pier may be selected in the Control Room. It is possible to allow the default pier to build up large numbers of bags and then move to whole process to the other selected pier. This would require multiple pier locations for each flight. A great deal of coordination may be required by the airport and carriers in dealing with this condition.

It should be considered imperative that all necessary spare parts be on hand for the ATR devices, and that well-trained and experienced personnel be available to correct this failure in a very efficient and timely manner.

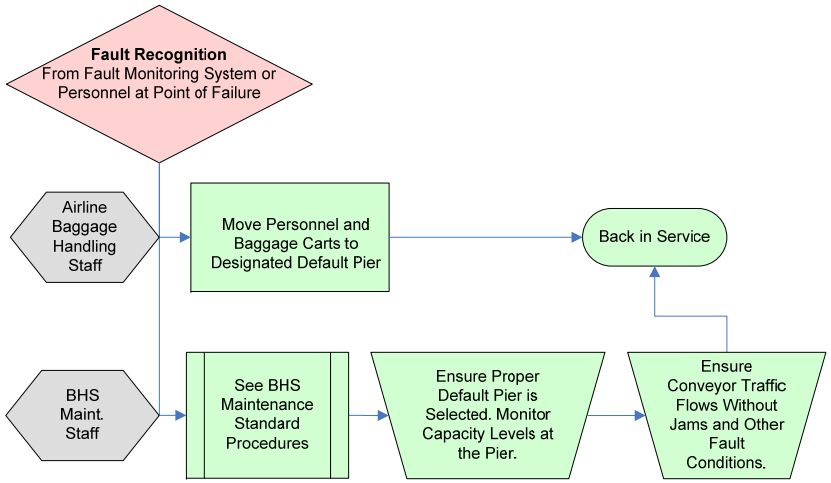
Procedures for Airline Baggage Handling Staff

Move personnel and baggage tub carts to designated default pier.

Procedures for BHS Maintenance Staff

1. Ensure proper default pier is selected.
2. Monitor capacity levels at the pier.
3. Ensure conveyor traffic flows without jams and other fault conditions.

Figure G-22
SORT AREA ATR FAILURE



G.2.3.6.2 Sort Device and Pier Failures

If the make-up device or a sort pier fails, baggage will need to be re-directed to an available sort destination for the make-up/pier. It is expected that the ML1 runout pier and the RO pier will be primarily used in this instance.

If other piers are used, coordination may be required between the affected carriers. Bags stranded on the failed device or line will need to be manually removed by maintenance/baggage handling personnel and taken to the appropriate location for bag placement onto the baggage carts.

Procedures for Airline Baggage Handling Staff

Move personnel and baggage tub carts to designated default pier or reassigned pier.

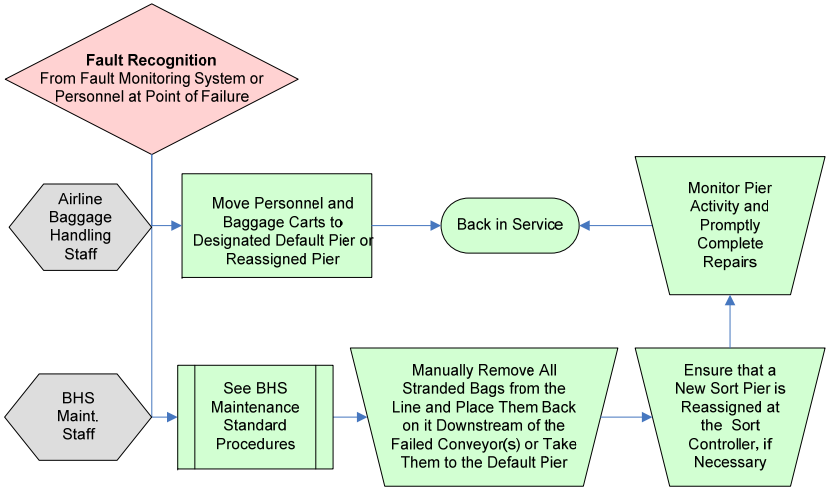
Procedures for BHS Maintenance Staff

1. All stranded bags will need to be manually removed from the line and placed back on it downstream of the failed conveyor(s) or taken to selected collection point.

2. Ensure that a new sort pier is reassigned at the sort controller, if necessary.

3. Monitor pier activity and promptly complete repairs.

Figure G-23
SORT DEVICE AND PIER FAILURE

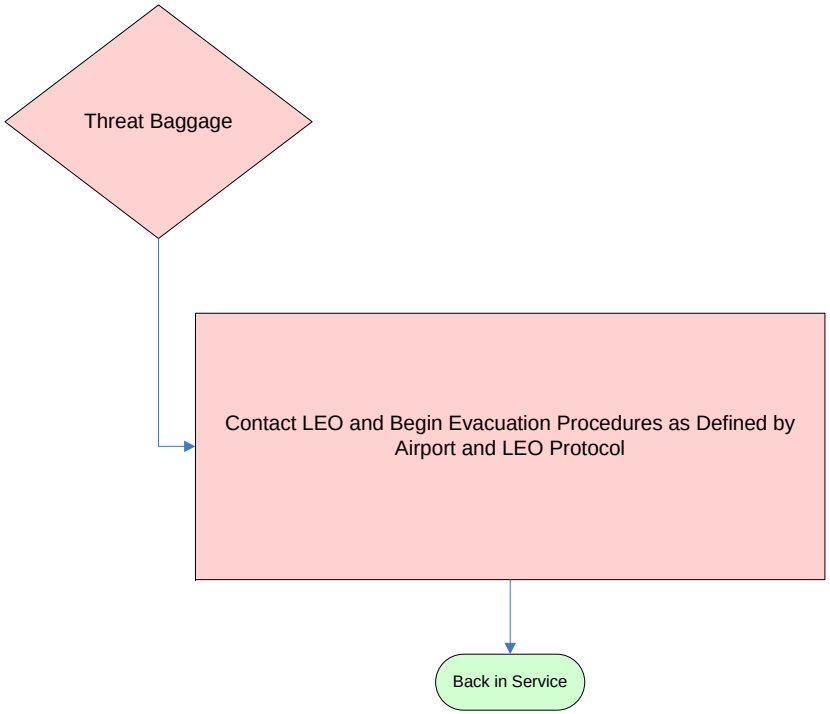


G.2.3.7 Threat Bags

If a bag is declared a threat through OSR procedures, the agents in the OSR room should inform agents working in the CBRA that a threat bag is in transit to the CBRA and evacuation procedures should be implemented. The bag should continue to the CBRA where it will be identified and resolved by LEO. Bags identified in the CBRA as a threat would require an immediate evacuation by staff. The airport must then be informed and all personnel must be evacuated to an appropriate location.

Responsible local law enforcement will establish protocol for procedures and evacuation routes in the event of the discovery of actual threat baggage. The LEO path would enter and exit the CBRA from the outside ramp area through the doorway near the oversize roller beds.

Figure G-24
THREAT BAGGAGE



G.2.4 Concourse C

G.2.4.1 System Overview

The Concourse C matrix is comprised of ticket counter lines T1 through T3, curbside lines CS1 through CS3, and the IL1 input line that merge into the two single feed lines (TC3 and TC4, and then SF3 and SF4) for the four L3 Communications eXaminer 3DX 6600D EDS machines (SS5 through SS8.

Two crossover lines are installed between TC3 and TC4 with crossover line X1 diverting from TC3 and merging onto TC4, and crossover line X2 diverting from TC4 and merging onto TC3. Both of these lines provide redundancy features for the Main Terminal EDS matrix in the event that conveyors downstream of the crossover lines become inoperable. The crossover lines also provide load balancing capability in the event that an individual EDS machine or feed line fails and bags accumulate too rapidly for the other EDS machine to scan without baggage backing up and causing system slowdown or shutdown

BMAs are placed on the TC3 and TC4 lines, at which point the lines are designated as SF3 and SF4, respectively. There are dual feed lines for the matrix of four EDS machines: two machines for each line. Upstream crossover lines provide the ability to move bags from one feed line to the other, thus providing redundancy and line balancing capability.

Once bags are placed into the system, they are conveyed past a BMA where the BHS Programmable Logic Controllers (PLC) track out-of-gauge bags to the out-of-gauge line into the CBRA. Bag IDs for tracking and assigning the status and image for each bag is assigned by the BHS PLCs at the BMA or the queue immediately prior to the EDS machines on the security shunt lines. These IDs are transferred between the EDS and BHS as the bag ID is handed-off to the EDS and returned back to the BHS.

Bags are conveyed into the CBIS onto either the SF3 or SF4 EDS matrix feed lines for security scanning. They are then diverted by a High Speed Sorting Device (HSSD) onto security shunts lines feeding the EDS machines. The SF3 line feeds the SS6 and SS8 lines and machines, and SS4 line feeds the SS5 and SS7 lines and machines.

Bags measured as too large to either fit into the EDS machines or be successfully imaged will continue on the SF3 and SF4 lines. The SF3 line becomes designated as the OG2 line prior to entering the CBRA. The SF4 line ends at a tip chute that drops bags onto the OG2 line. All out-of-gauge baggage is resolved using manual processes.

The lines for each EDS machine have a vertical sorting device after the exit of the machine. The sorting device separates machine cleared bags from those that are not. Cleared bags from the SS5 machine are diverted to the CL5 clear line, bags cleared by the SS6 machine are diverted to the CL6, the SS7 machine diverts cleared bags to the CL7 line, and the SS8 machine diverts cleared bags to the CL8 line.

Bags not cleared from the SS5, SS6, SS7 or SS8 lines are diverted to the AL5, AL6, AL7 and AL8 lines, respectively. The AL5, AL6 and AL7 alarm lines merge onto the AL8 line that travels to a second vertical sorting device for the second or OSR decision point.

Bags cleared by OSR are diverted to the CL10 cleared line. The CL5 and CL6 lines merge onto the CL2 line. The CL12 cleared bag line originates in the CBRA, travels to the sort area ATR used to reacquire bag tag information, and becomes the ML4 line that transports bags to the sort area. The CL8 line merges onto the CL7 line, travels through the sort area ATR used to reacquire bag tag information and becomes the ML3 line that transports bags to the sort area.

Bags not cleared by the OSR process continue on the AL8 line on into the CBRA.

The RT2 line is the designated purge line and is used to transport bags from the alarm line prior to the CBRA and back into the system prior to the EDS machines. It is used for bags that were not successfully scanned due to an EDS machine error. It is diverted from the AL8 line by a HSSD and merges onto the TC3 line prior to the matrix ATR.

Bags considered not cleared by an EDS machine or by OSR continue on the AL8 alarm line entering the CBRA for resolution. All bags cleared in the CBRA are placed on the CL12.

Oversize baggage will be manually transported to the CBRA and then placed on the roller beds between the CBRA and the sort area for baggage cart loading.

The two mainlines (ML2 and ML3) both feed cleared bags onto the two make-up devices (MU1 and MU2) where baggage handling personnel select bags for specific flights and place them on baggage carts. The ML3 line merges onto the ML2 line downstream of the last make-up device (MU2). The ML2 line then ends as a default runout belt for baggage cart loading.

Figure G-25
CONCOURSE C LAYOUT

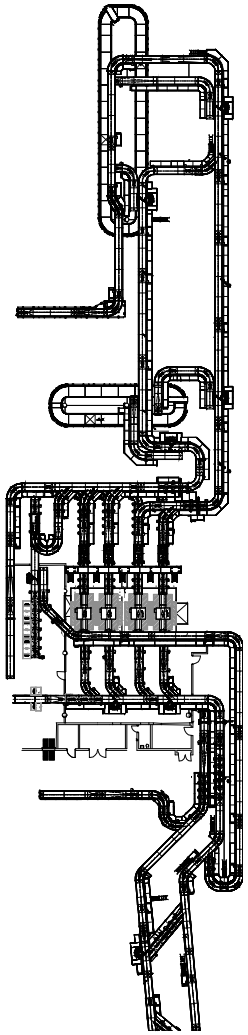


Figure G-26
CONCOURSE C CBIS

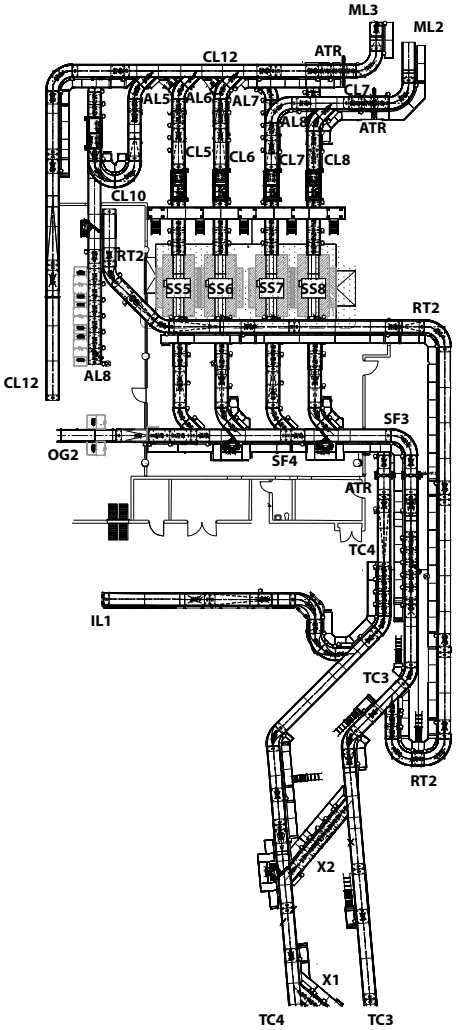
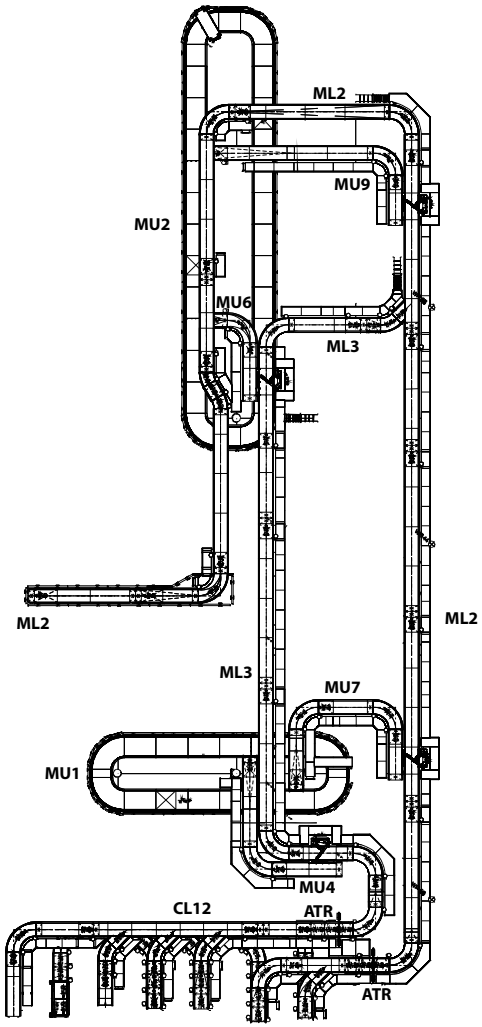


Figure G-27
CONCOURSE C SORT AREA



G.2.4.2 Ticket Counter and Curbside Lines

The ticket counter lines T1 through T3, curbside lines CS1 though CS3 and the IL1 input line merge onto the ticket counter transport lines TC3 and TC4: T1, CS1, CS2 and IL1 feed TC4, and T2, T3 and CS3 feed TC3.

G.2.4.2.1 Load Belts

If the loading take-away belt for ticket counter and curbside conveyors become inoperable a conveyor immediately downstream of the conveyor may, in some instances be used. For many of the ticket counter lines the power turn prior to the security/fire door separating the public area from the bag room may be used to place baggage onto the line.

Note: Certain fault conditions may exist that will not allow this approach.

Procedures for Airline Ticketing Staff

1. Determine that failed condition on the conveyor requires intervention from BHS Maintenance staff and inform proper personnel if the condition does.

2. Request additional help for ticket agents in moving baggage to the next operable conveyor from the ticket counter area.

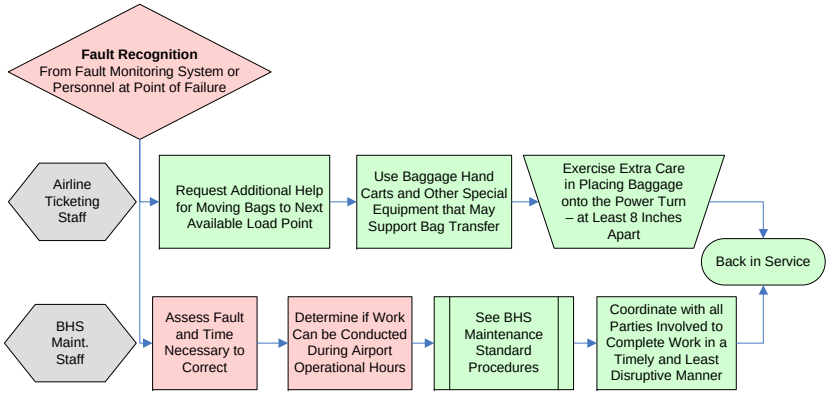
3. If necessary, especially during peak loading periods, use small cart to facilitate transfer of bags.

4. Carefully place bags lengthwise onto the conveyor in intervals at least eight inches apart.

Procedures for BHS Maintenance Staff

These fault conditions are like most in that they should be repaired as quickly as possible. As this work involves the public areas, it may be more convenient to create a suitable work-around for the problem during the active work day for the affected airline(s) and then work during close-of-business hours to ensure that the problem is corrected before the next day's start of business. This is a coordination issue that should be based upon the potential disruption of the fault and of the effort to correct the fault. The result should be agreeable to all parties involved.

Figure G-28
FAULTED LOAD BELTS



G.2.4.2.2 CS1 through CS3 and T1 through T3

If any of these conveyors fault and become inoperable, baggage intended for these subsystems will need to be moved to an associated line for loading onto the baggage system. Baggage already placed onto these conveyors will need to be removed and placed on the nearest downstream, operating conveyor; if this is not possible, the bags will be removed and taken to an associated ticket counter line for loading back into the baggage system.

Procedures for Airline Ticketing Staff

1. Determine that failed condition on the affected line requires intervention from BHS Maintenance staff and inform proper personnel if the condition does.

2. Request additional help for ticket agents in moving baggage to a nearby and available take-away load conveyor from the load area associated with the failed line.

3. Use small cart to facilitate transfer of bags to the most convenient working load conveyor.

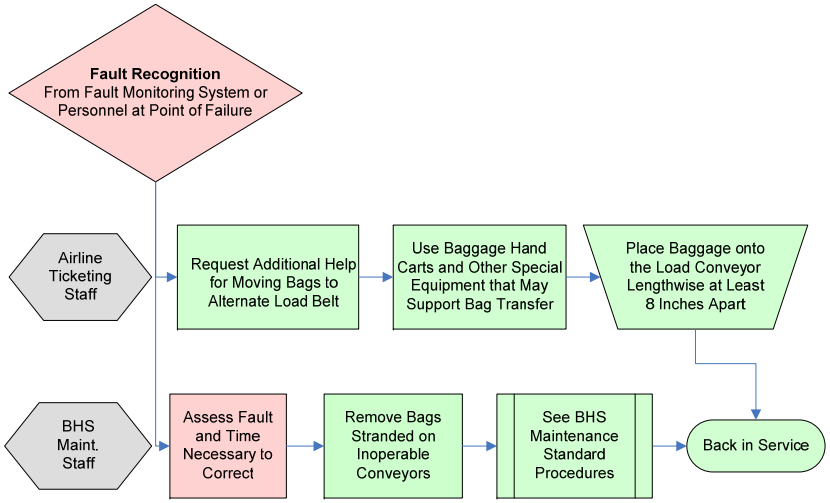
4. Carefully place bags lengthwise onto the conveyor and coordinate with all involved to ensure that the bags remain in intervals at least eight inches apart.

Procedures for BHS Maintenance Staff

1. Bags left stranded on any of the failed conveyors must be removed manually and loaded on the nearest and accessible operating conveyor either feeding or on the working line.

2. All efforts should be made to immediately correct the failure and return the conveyor to full operation.

Figure G-29
FAULTED TICKET COUNTER AND CURBSIDE LINE



G.2.4.3 TC3 and TC4 Transport Lines

These two transport lines accumulate and convey baggage from the ticket counter and curbside lines to the EDS matrix. The lines provide a redundant feature and increased load potential for the expected demand on the system.

If one of the lines becomes inoperable prior to the crossover lines, carriers using the ticket counter and curbside lines merging onto the line will need to use different input points. This is obviously an undesirable condition that may provide some relief but during peak periods would require significant coordination between the carriers. It is a high-priority condition that would need to be corrected very quickly.

Procedures for Airline Ticketing Staff

1. Determine that failed condition on the affected line requires intervention from BHS Maintenance staff and inform proper personnel if the condition does.

2. Request additional help for ticket agents in moving baggage load points feeding the operating transport line for the appropriate matrix and sort area. Use small cart to facilitate transfer of bags.

3. Select baggage for flights with departure times greater than one hour for placement later into the system.

4. Agents may place bags in a designated area by flight for this purpose.

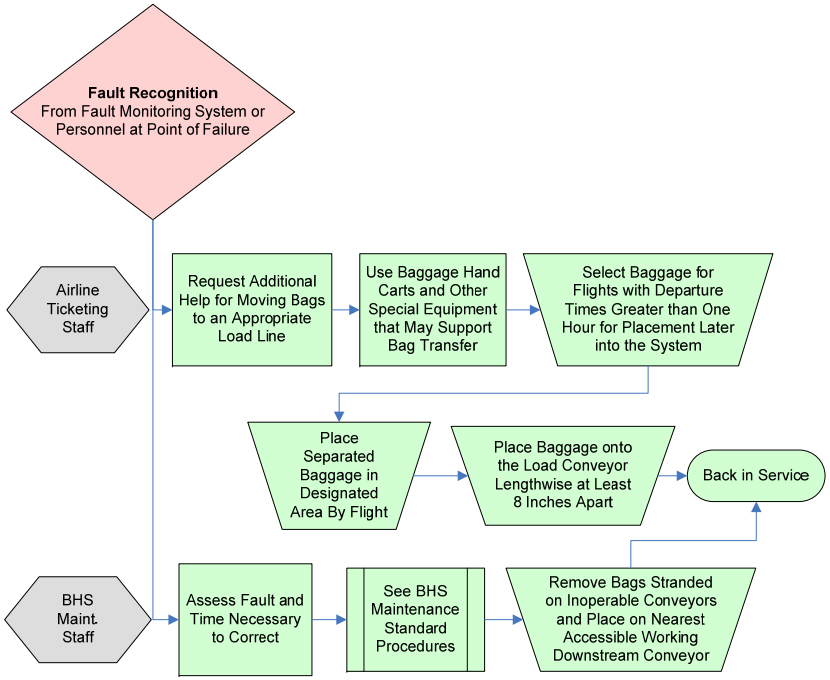
5. Carefully place bags lengthwise onto the conveyor and coordinate with all involved to ensure that bags remain in intervals at least eight inches apart.

Procedures for BHS Maintenance Staff

1. Manually remove bags left stranded on any of the failed conveyors and load on the nearest and accessible operating conveyor either feeding or on the working line.

2. All efforts should be made to immediately correct the failure and return the conveyor to full operation.

Figure G-30
FAULTED TRANSPORT LINES



G.2.4.4 X1 and X2 Crossover Lines

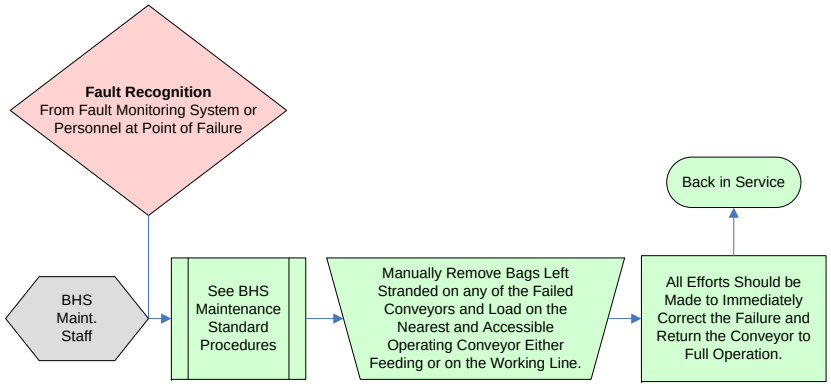
Two crossover lines are installed between TC3 and TC4 with crossover line X1 diverting from TC3 and merging onto TC4, and crossover line X2 diverting from TC4 and merging onto TC3. Both of these lines provide redundancy features for the Concourse C EDS matrix in the event that conveyors downstream of the crossover lines become inoperable. The crossover lines also provide load balancing capability in the event that an individual EDS machine or feed line fails and bags accumulate too rapidly for the other EDS machine to scan without baggage backing up and causing system slowdown or shutdown.

Procedures for BHS Maintenance Staff

1. Manually remove bags left stranded on any of the failed conveyors and load on the nearest and accessible operating conveyor either feeding or on the working line.

2. All efforts should be made to immediately correct the failure and return the conveyor to full operation.

Figure G-31
FAULTED CROSSOVER LINE



G.2.4.5 EDS Matrix

G.2.4.5.1 SS5, SS6, SS7 and SS8 Failures

If one of the EDS machines becomes inoperable or the diverter or the conveyor line directly feeding it fails, the other operable machines will be responsible for all security scanning. This is accomplished automatically by monitoring software that shut down the diverter feeding that line.

Bags already on the security shunt line prior to an EDS machine failure may be diverted onto the purge line for recirculation purposes if the conveyor within the EDS machine is still operable.

If the conveyor is not working, the bags will need to be manually removed and, in most instances, taken to the CBRA

The X1 and X2 crossover lines prior to the matrix may be utilized to balance the demand on EDS machine resources during failures associated with EDS machines or security shunt lines.

G.2.4.5.2 SF3 and SF4 Line and HSSD Failures

If any of the HSSDs on the two security feed lines (SF3 and SF4) fail then it should be possible, due to the redundancy of the conveyor design, to continue using the feed lines to direct bags to the operable security shunts lines (SS5, SS6, SS7 and SS8) and their EDS machines. This is also true regarding failures occurring on any of the security shunts lines or EDS machines.

The X1 and X2 crossover lines may be employed for load balancing purposes in this situation to reduce usage on the security feed line that has lost the use of one of its security shunt lines.

Procedures for TSA Staff

1. Move additional personnel to the CBRA for the extra demand on the ETD systems.

2. If the failure is with an EDS machine, procedures for securing service from the vendor should be implemented.

Procedures for Airline Baggage Handling Staff

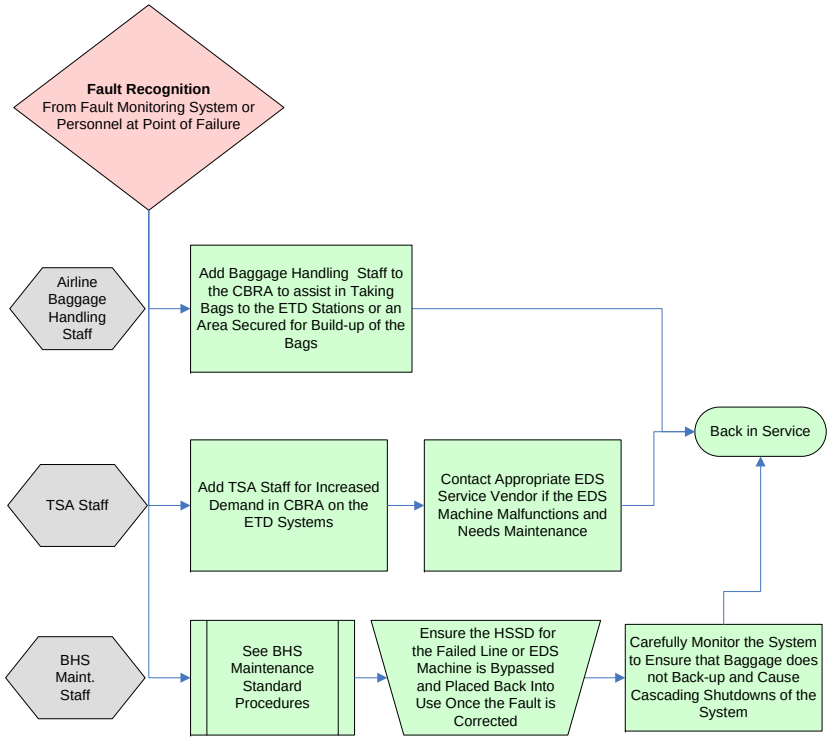
Move additional personnel to the CBRA to assist TSA personnel in unloading bags from the OG2 out-of-gauge line and taking them to the ETD stations or an area secured for build-up of the bags.

Procedures for BHS Maintenance Staff

1. The HSSD for the failed line or EDS machine should automatically be bypassed. It will be used again once the fault is corrected.

2. The system should be carefully monitored to ensure that baggage does not back-up and cause cascading shutdowns of the system.

Figure G-32
EDS MACHINE OR FEED LINE FAILURE



G.2.4.5.3 Baggage Measuring Array Failure

If the baggage measuring array fails, bags cannot be sized appropriately for the EDS machine, which means that none of the bags will be stopped from diverting to the machines. Personnel must be placed at the entrance to each of the machines to remove bags that jam or cannot enter the machines. These bags will need to be manually taken directly to the CBRA by BHS personnel.

Bags that are able to enter and pass through the EDS machines, but are too large to produce a complete image will be sent to the CBRA for resolution with an errored or unknown status. If lines to the EDS machines are filled with bags and stopped, bags will continue onto the OG2 line into the CBRA.

During a BMA failure requiring a significant time duration to correct, ticket counter agents should apply greater attention to the size of the bags and attempt to ensure only bags that will pass through the EDS machines are placed on the ticket counter lines. These bags should be transported to the CBRA in much the same way as standard oversize bags.

Crossover Line Change

Bags intended for the EDS feed line with the disabled BMA may be diverted when possible to the line with a functional measuring array. This is should be the first line of action in response to such a failure until the two machines on the functional line reach a saturation point.

Procedures for TSA Staff

Prepare to move additional personnel to the CBRA in case of additional demand on the ETD systems.

Procedures for Airline Baggage Handling Staff

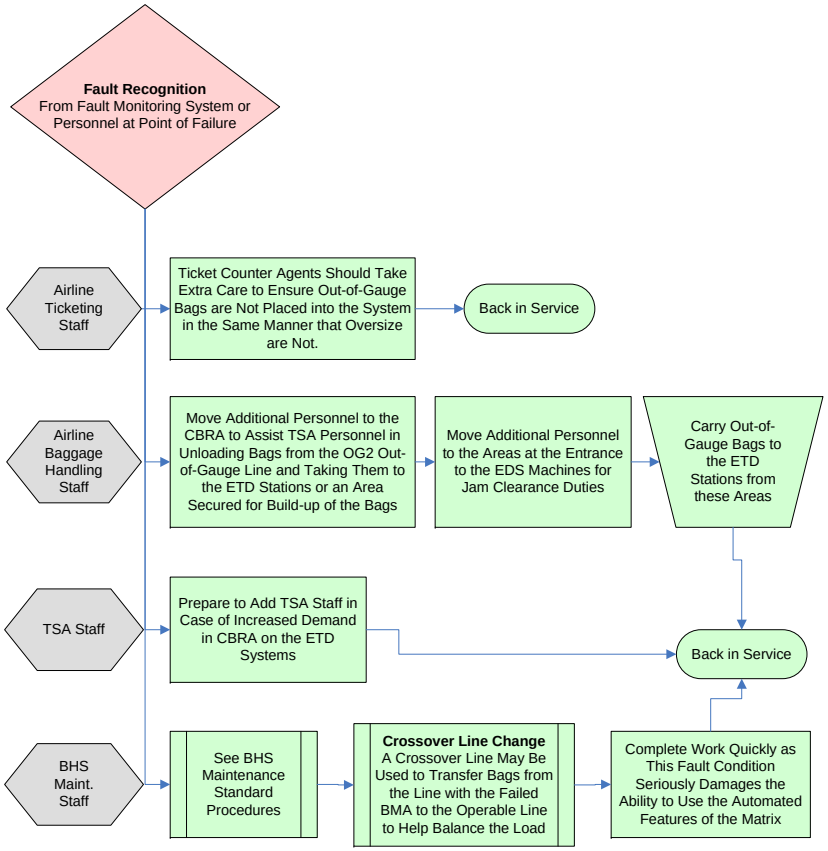
1. Move additional personnel to the CBRA to assist TSA personnel in unloading bags from the OG2 out-of-gauge line and taking them to the ETD stations or an area secured for build-up of the bags.

2. Move additional personnel to the areas at the entrance to the EDS machines for jam clearance duties. Bags too large may need to be carried to the ETD stations from these areas.

Procedures for BHS Maintenance Staff

Personnel should very quickly correct this failure. Replacement parts for these devices should always be kept on-site and trained personnel should always be available.

Figure G-33
BMA FAILURE



G.2.4.5.4 Out-of-Gauge (OG2) Line

It should be possible to take out-of-gauge bags from the SF3 line or the last operable OG2 line conveyor. It should also be possible to remove bags from the inoperable OG2 line as they slide off the tip chute from the SF4 line.

Procedures for Airline Baggage Handling Staff

Move additional personnel to the end of the SF3 line or last operable OG2 conveyor to assist TSA personnel in unloading bags and taking them to the ETD stations. Care must be taken to avoid tip chute action from the SF4 line.

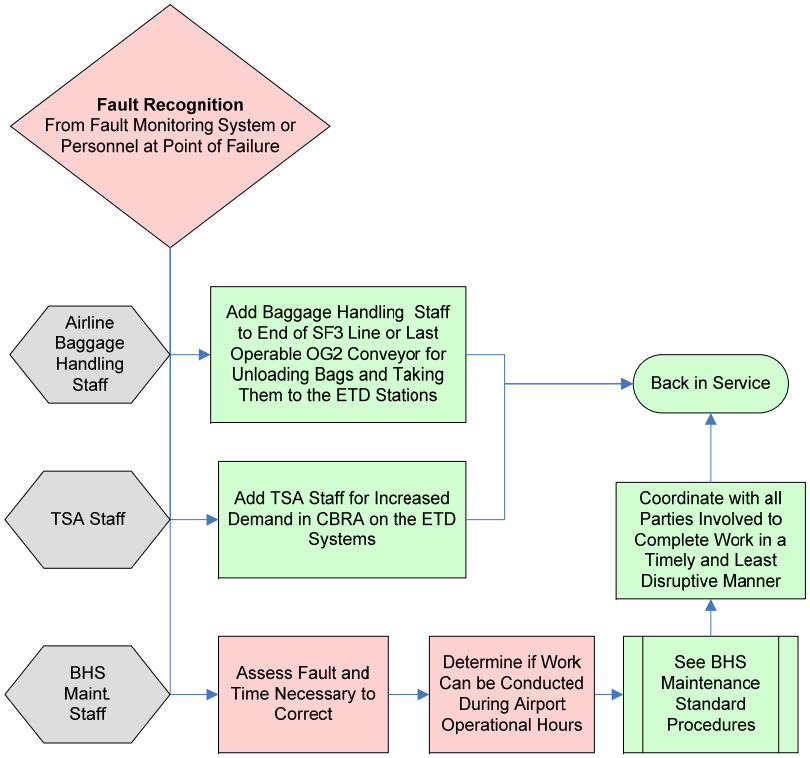
Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

Procedures for BHS Maintenance Staff

This fault condition should be treated in much the same manner as work at the ticket counter. If the work to repair the fault is more disruptive than the condition itself and if a suitable temporary fix can accommodate the TSA until the end of the work day, then work should be conducted during close-of-business hours to ensure that the problem is corrected before the next day's start of business. All should agree upon this solution, otherwise repair efforts should be conducted in earnest.

Figure G-34
OUT-OF-GAUGE LINE FAILURE



G.2.4.5.5 First Decision Point Vertical Sorter Failure

Failed first decision point sorter conditions will be treated much the same as for the failed security shunt line or EDS machine. Bags will not be diverted to the line with the failed sorter and will instead be diverted to operable lines. All stranded bags currently on the line will be manually removed and taken directly to the CBRA for resolution.

Staff may place the stranded bags from the queues between to the EDS machine and the vertical sorter on the alarm line immediately downstream of the failed sorter. Staff can also lock the sorter in bypass mode in which it only feeds the alarm line in order to send these bags to the CBRA. Stranded bags located on the SS queues prior to the EDS machine may be placed on a queue, other than the entrance queue, on the nearest EDS machine with a functional sorter.

Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

Procedures for Airline Baggage Handling Staff

Move additional personnel to the CBRA to assist TSA personnel in unloading bags from the OG2 out-of-gauge line and taking them to the ETD stations or an area secured for build-up of the bags.

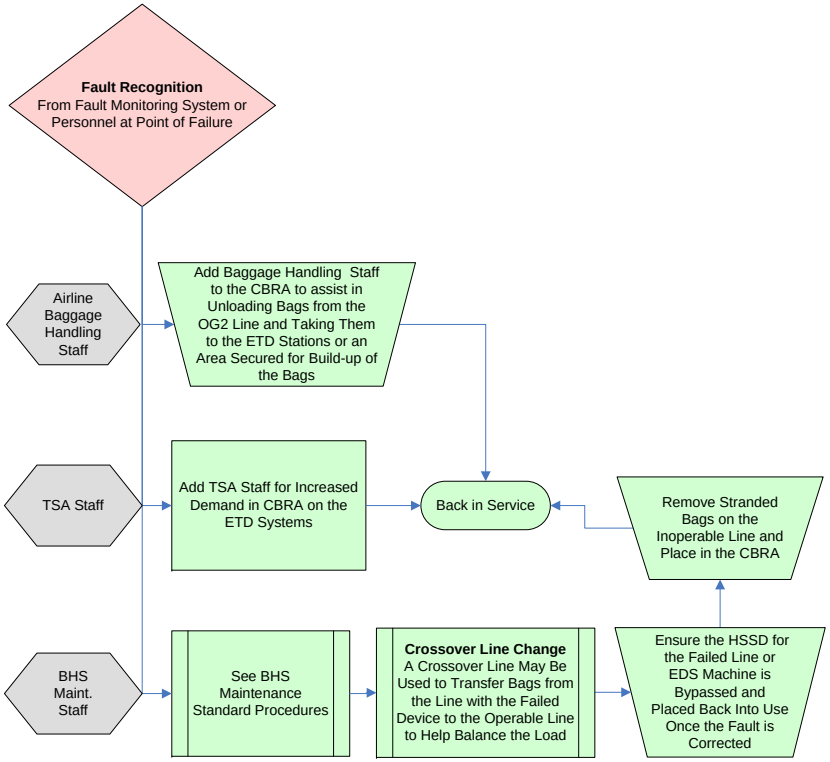
Procedures for BHS Maintenance Staff

1. Use crossover line to move bags and relieve pressure from the TC line associated with failed device to the line in full service.

2. The HSSD for the SS line with the failed vertical sorter should automatically be bypassed. It will be used again once the fault is corrected.

3. All bags stranded on the inoperable line should be removed and placed in the CBRA.

Figure G-35
FIRST DECISION POINT FAILURE



G.2.4.5.6 EDS Cleared Bag Lines

CL5, CL6 and CL8

EDS cleared bag lines face the same considerations as EDS machines and security shunt line failures; the line will not be used while the condition is in effect and alternative shunt lines will be used instead, and load balancing use of the crossover lines will be employed when necessary.

CL7

This condition may be treated the same as described for CL5, CL6 and CL8, but when the failure in the line occurs downstream of the CL8 merge point, both lines will be down.

CL12

The CL12 line is the cleared line out of the CBRA and continues to the ATR in the sort area where the line is re-designated as ML3. Both the CL5 and the CL6 EDS cleared bags lines merge onto CL12. If the CL12 line fails after the CL5 or CL6 merge points then both CL5 and CL6 will be down.

Personnel may be employed to move bags around the fault, but primarily the other two EDS lines (SS7 and SS8) must scan all bags unless excess demand requires alternative action. It may also be possible in a critical moment to force bags from these lines into the CBRA where TSA personnel can confirm the bags' cleared status and baggage handling personnel can then place the bags onto the CL12 line.

Since the CL12 line is the cleared line out of the CBRA, bags cleared out of the CBRA may need to be placed on the roller bed conveyors for oversize baggage. There, baggage handling personnel will place bags onto carts for the appropriate flights.

Obviously, this fault must be corrected quickly.

Procedures for TSA Staff

Move additional personnel to the CBRA.

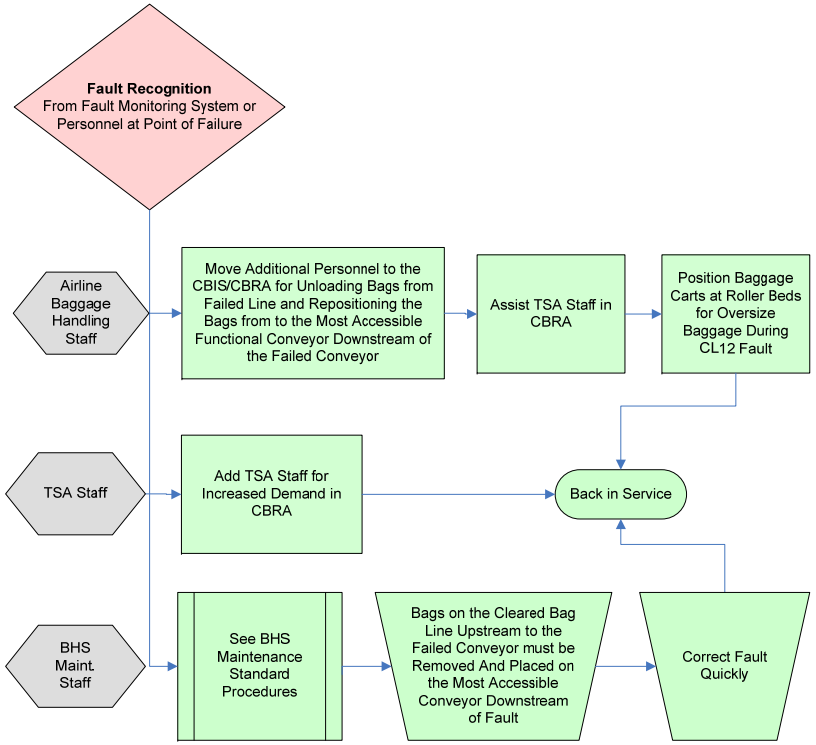
Procedures for Airline Baggage Handling Staff

1. Move additional personnel to the CBIS/CBRA.
2. Bags may need to be repositioned from the failed conveyor to the most accessible functional conveyor downstream of the failed conveyor.
3. Assist TSA officials in moving cleared bags.
4. For CL12 failure, position baggage carts at oversize roller bed load point.

Procedures for BHS Maintenance Staff

1. Bags on the cleared bag line upstream to the failed conveyor will need to be removed and placed on the most accessible conveyor leading to the sort area.
2. Quickly correct point of failure.

Figure G-36
EDS CLEARED BAG LINE FAILURE



G.2.4.5.7 Alarm Line Failure Prior to OSR Decision

EDS alarmed, suspect, errored or unknown (non-cleared) bag lines face the same considerations as EDS machines and security shunt line failures; the line will not be used while the condition is in effect and alternative shunt lines will be used instead.

Only the AL8 line after all the other AL lines have merged onto it creates a complete shutdown if it fails. If one of the other lines fails then that EDS subsystem should be avoided until it is corrected. The crossover lines may be employed for load balancing purposes in this instance.

Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

Procedures for Airline Baggage Handling Staff

1. Move additional personnel to the CBIS/CBRA for unloading bags from the alarm line and taking them to the ETD stations.

2. Bags may also be repositioned from the failed conveyor to the most accessible functional conveyor downstream of the failed conveyor. These bags would enter the CBRA with an unknown status.

3. Place excess bags in an area secured for build-up of the bags.

Procedures for BHS Maintenance Staff

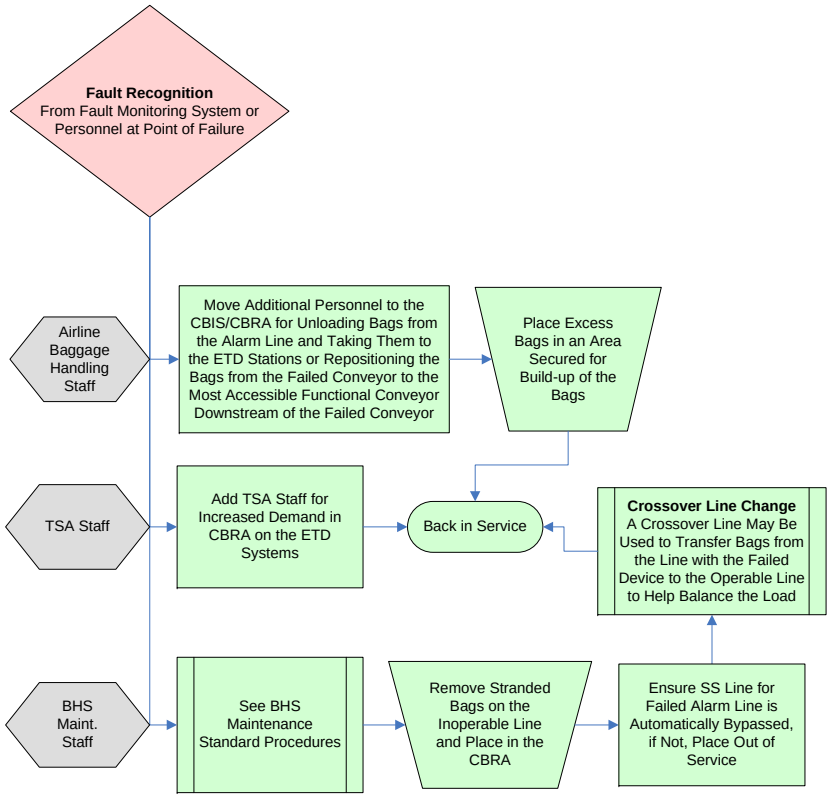
1. All bags stranded on the inoperable line should be removed and placed in the CBRA.

2. Ensure SS line for failed alarm line is automatically bypassed, if not, place out of service.

3. Use load balancing techniques with the crossover lines if necessary.

4. The faulted conveyor should be repaired quickly.

Figure G-37
ALARM Line Failure Prior to OSR Point



G.2.4.5.8 Second Decision Point Vertical Sorter Failure

If the OSR vertical sorter fails then all baggage not cleared and with an associated images from an EDS machine will continue to the CBRA for resolution if the sorter can be locked in the alarm line position. This would be a temporary fix until BHS maintenance is prepared to quickly fix the sorter. This could also be accomplished during the airport's non-operational hours. TSA will need to provide extra staffing in the CBRA until the sorter is fixed.

If the sorter cannot be used, then BHS maintenance or baggage handling personnel will need to remove bags from the line prior to the sorter and place bags back on the alarm line after the sorter. Tracking will be lost and all related images will not be associated with the bags. An area may need to be set aside for the collection of bags awaiting resolution.

Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

Procedures for Airline Baggage Handling Staff

1. Move additional personnel to the CBRA to assist TSA personnel in unloading excess bags from the AL8 alarm line and taking them to an area secured for build-up of the bags.

2. Help BHS Maintenance staff remove stranded bags from the AL8 line upstream to the OCR divert point for placement back onto the downstream functional AL4 conveyors.

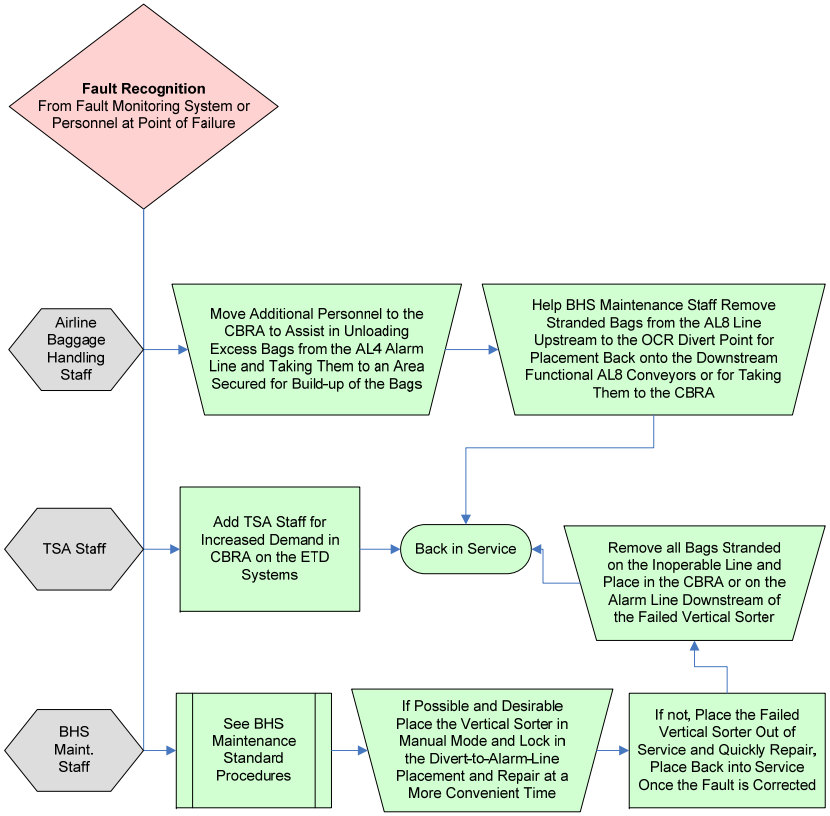
Procedures for BHS Maintenance Staff

1. If possible and desirable place the vertical sorter in manual mode and lock in the divert-to-alarm-line placement. Then repair at a more convenient time.

2. If not, the failed vertical sorter should be placed out of service and quickly repaired. It will be placed back into service once the fault is corrected.

3. All bags stranded on the inoperable line should be removed and placed in the CBRA or on the alarm line downstream of the failed vertical sorter.

Figure G-38
SECOND DECISION POINT VSU FAILURE



G.2.4.5.9 OSR Failure

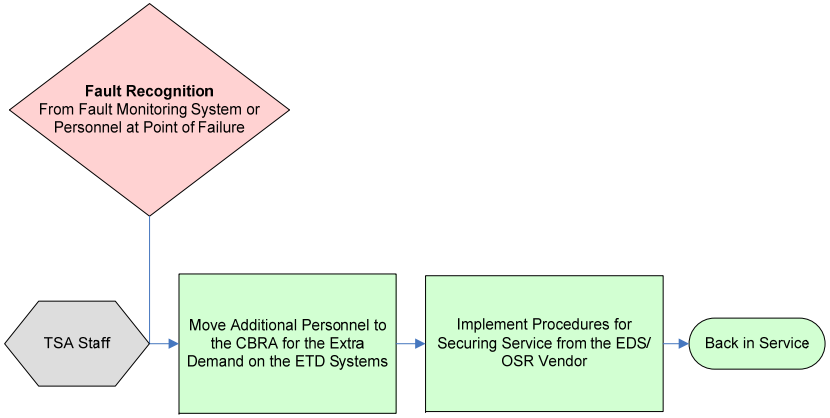
If the ability to use the OSR services fails then all baggage on the line will continue to the CBRA for resolution.

Procedures for TSA Staff

1. Move additional personnel to the CBRA for the extra demand on the ETD systems.

2. Implement procedures for securing service from the EDS/OSR vendor.

Figure G-39
OSR FAILURE



G.2.4.5.10 Purge Line (RT2) Failure

If the purge line or the diverter for the purge line fails all bags that would have been diverted onto it will instead continue to the CBRA for resolution.

Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

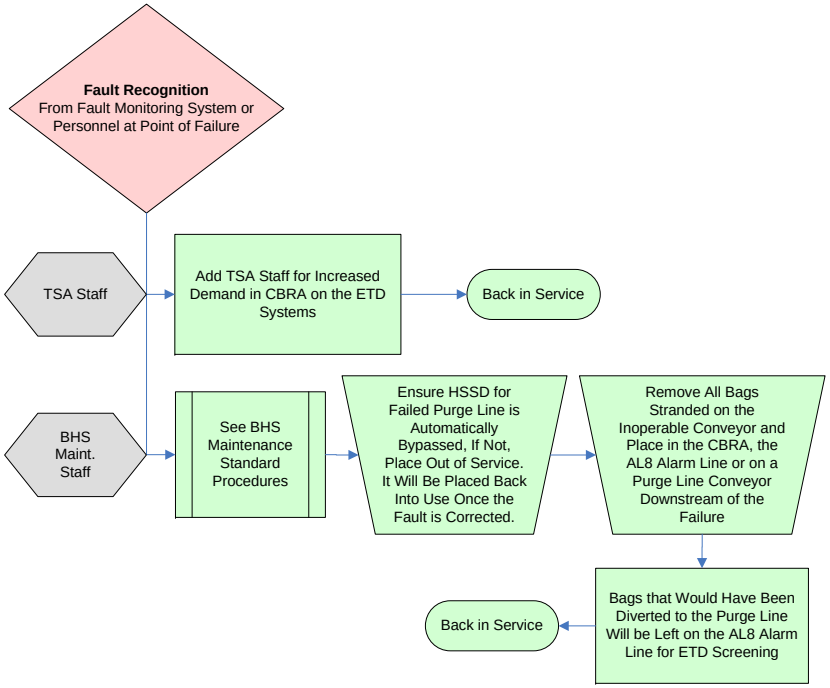
Procedures for BHS Maintenance Staff

1. Ensure HSSD for failed purge line is automatically bypassed, if not, place out of service. It will be placed back into use once the fault is corrected.

2. All bags stranded on the inoperable conveyor should be removed and placed on an operable purge line conveyor downstream to the failed conveyor, or on the AL4 alarm line, or taken to the CBRA.

3. Bags that would have been diverted to the purge line will be left on the AL4 alarm line for ETD screening.

Figure G-40
PURGE LINE FAILURE



G.2.4.5.11 Alarm Line Failure (AL8) Post OSR Decision

If an AL8 conveyor fails after the last decision point, bags will be manually removed and taken to the ETD stations for resolution. Tracking will be lost and related images will not be associated with the bags.

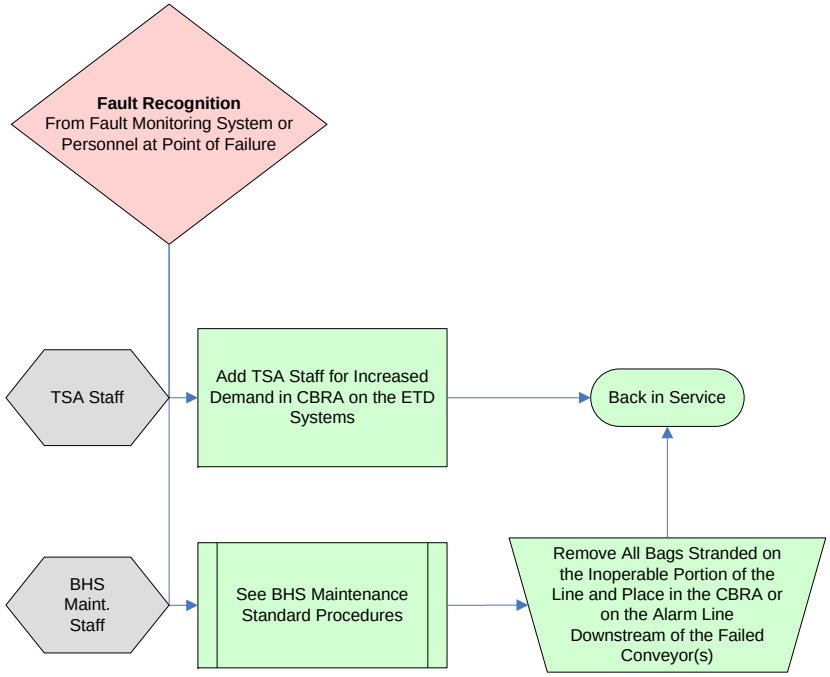
Procedures for TSA Staff

Move additional personnel to the CBRA for the extra demand on the ETD systems.

Procedures for BHS Maintenance Staff

All bags stranded on the inoperable portion of the line should be removed and placed on an operable AL8 conveyor downstream of the failed conveyor or in the CBRA.

Figure G-41
ALARM LINE FAILURE POST SECOND DECISION POINT



G.2.4.5.12 Cleared Bag Line (CL10) Failure Post OSR Decision

If a conveyor fails on the cleared bag line after the OSR decision point then the bags will need to be manually removed from the line and placed back on it downstream of the failed conveyor or placed on the CL12 line. If the line is inoperable for an extended period of time then the AL8 alarm line may be used instead and all OSR cleared bags will travel to the CBRA where they will be noted as cleared and placed on the CL12 clear lines.

Procedures for TSA Staff

Move additional personnel to the CBRA.

Procedures for Airline Baggage Handling Staff

1. Move additional personnel to the affected conveyors to assist BHS Maintenance personnel in unloading bags from the CL10 clear line upstream to the fault and placing them back on the line downstream of the fault.

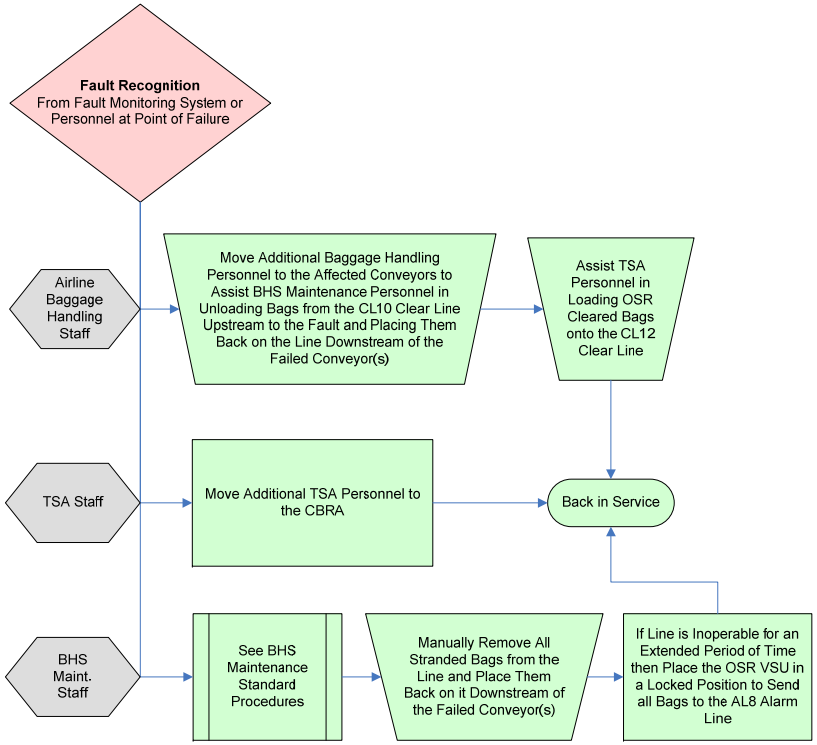
2. If bags remain on the alarm line and enter the CBRA then baggage handling personnel will need to assist TSA personnel in loading cleared bags onto the CL12 clear line.

Procedures for BHS Maintenance Staff

1. All stranded bags will need to be manually removed from the line and placed back on it downstream of the failed conveyor(s).

2. If line is inoperable for an extended period of time then place the OSR sorter in a locked position with all bags staying on the AL8 alarm line.

Figure G-42
CL10 LINE FAILURE



G.2.4.5.13 CBRA Cleared Bag Line (CL12) Failure

The system is designed with one cleared bag line originating in the CBRA. The roller beds intended for oversize baggage will be employed for CBRA cleared bags.

Procedures for TSA Staff

Place cleared bags in the CBRA on the oversize roller beds.

Procedures for Airline Baggage Handling Staff

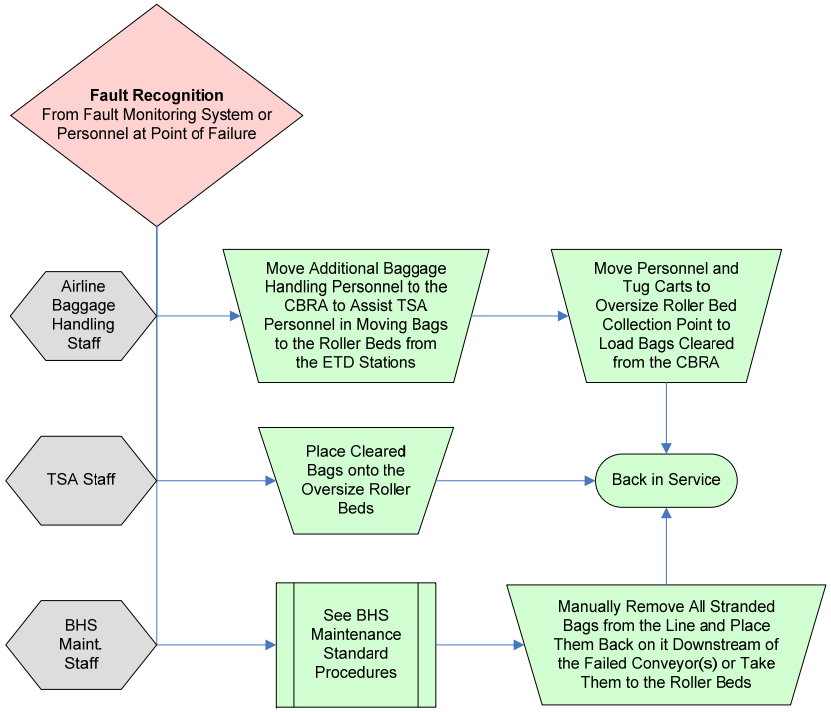
1. Move additional personnel to the CBRA to assist TSA staff in moving cleared bags to the roller beds.

2. Move personnel and baggage tub carts to oversize roller bed collection point for loading bags cleared in the CBRA.

Procedures for BHS Maintenance Staff

All stranded bags will need to be manually removed from the line and placed back on it downstream of the failed conveyor(s) or taken to the roller beds.

Figure G-43
CBRA CLEARED LINE FAILURE



G.2.4.5.14 CBRA Equipment Failure

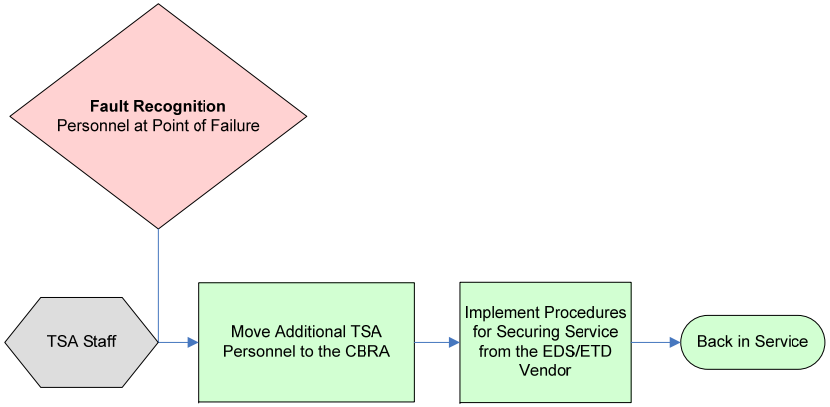
Alarmed bags entering the CBRA will need to be manually searched without direction if all HMIs fail. If trace detection fails then all bags will need to be manually searched.

Procedures for TSA Staff

1. Move additional personnel to the CBRA.

2. Contact appropriate sources/vendors for repairing failed devices.

Figure G-44
CBRA EQUIPMENT FAILURE



G.2.4.6 Sort Area

The Concourse C sort area includes redundant transport lines ML2 and ML3. Bags cleared by the SS7 and SS8 EDS machines travel to the sort area on the ML2 line. Bags cleared by the SS5 and SS6 EDS machines, by the OSR process, and from the CBRA all travel to the sort area on the ML3 line.

Controls will be implemented to send bags to EDS machines that do not feed a disabled mainline if a fault were to develop on that line. Stranded bags would need to be manually removed from the disabled line and placed on a functioning conveyor leading to the sort area. There is no redundancy to the sort area out of the CBRA.

G.2.4.6.1 Sort Area ATR Failure

The failure of an ATR on the ML2 or ML3 lines will automatically send bags on the mainline with the failed ATR to the default runout pier for ML2.

Procedures for Airline Baggage Handling Staff

Move personnel and baggage tub carts to the default pier.

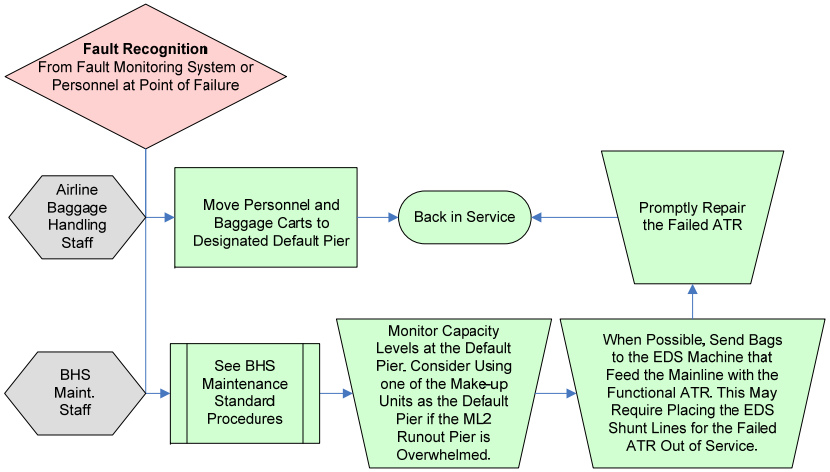
Procedures for BHS Maintenance Staff

1. Monitor capacity levels at the default pier. Consider using one of the make-up units as the default pier if the ML2 runout pier is overwhelmed.

2. When possible, send bags to the EDS machines that feed the mainline with the functional ATR. This may require placing the EDS shunt lines for the failed ATR out of service.

3. Promptly repair the failed ATR.

Figure G-45
SORT AREA ATR FAILURE



G.2.4.6.2 Make-up Device and Sort Pier Failures

If a make-up device fails (MU1 or MU2), baggage intended for the device will be directed to the ML2 default runout pier. If the diverter for the device from either the ML2 or ML3 lines fails, bags intended for the device from that line will be directed to the runout pier. If the pier fails, bags will need to be manually removed from the point of failure by maintenance/baggage handling personnel and taken to the appropriate location for bag placement onto the baggage carts and one of the make-up devices will be selected at the sort controller/PLC as the default pier.

Procedures for Airline Baggage Handling Staff

Move personnel and baggage tub carts to ML2 default runout pier.

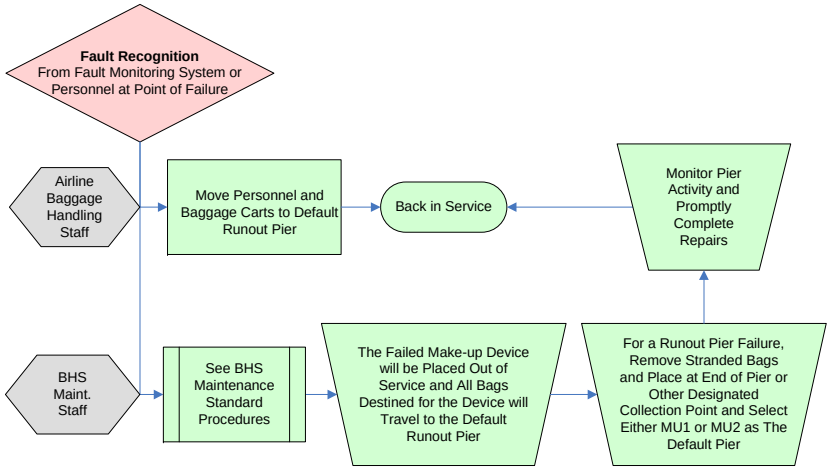
Procedures for BHS Maintenance Staff

1. The failed make-up device will be placed out of service and all bags destined for the device will travel to the default runout pier.

2. For a runout pier failure, remove stranded bags and place at end of pier or other designated collection point and select either MU1 or MU2 as the default pier.

3. Monitor pier activity and promptly complete repairs.

Figure G-46
SORT DEVICE AND PIER FAILURE

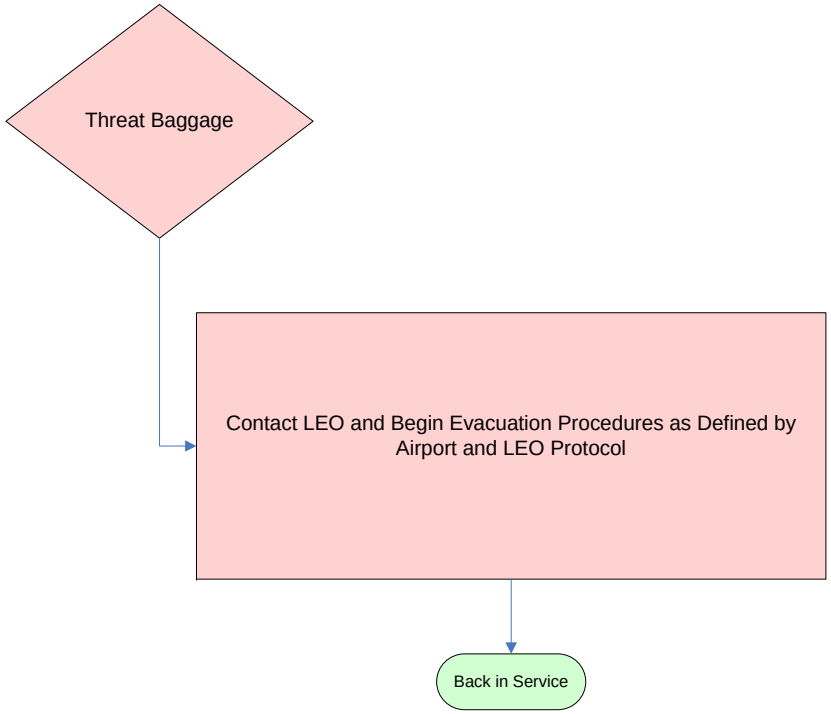


G.2.4.5 Threat Bags

If a bag is declared a threat through OSR procedures, the agents in the OSR room should inform agents working in the CBRA that a threat bag is in transit to the CBRA and evacuation procedures should be implemented. The bag should continue to the CBRA where it will be identified and resolved by LEO. Bags identified in the CBRA as a threat would require an immediate evacuation by staff. The airport must then be informed and all personnel must be evacuated to an appropriate location.

Responsible local law enforcement will establish protocol for procedures and evacuation routes in the event of the discovery of actual threat baggage. The LEO path would enter and exit the CBRA through the doorway near the OG2 line.

Figure G-47
THREAT BAGGAGE



Appendix H

CHECKED BAGGAGE SCREENING EQUIPMENT SENSITIVE SECURITY INFORMATION IDENTIFICATION GUIDE

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TRANSPORTATION SECURITY ADMINISTRATION

CHECKED BAGGAGE SCREENING EQUIPMENT

SENSITIVE SECURITY INFORMATION

IDENTIFICATION GUIDE

SSIIDG 0062 Version 2.0

August 2008

Issued and Approved By:

Andrew Colsky
Director, SSI Office
Transportation Security Administration

August 13, 2008

SCOPE AND APPLICABILITY

This document provides guidance identifying which information associated with checked baggag screening equipment is and is not Sensitive Security Information (SSI), under 49 CFR 1520 (Title 49 part 1520 of the Code of Federal Regulations), associated with checked baggage screening equipment. This guide shall be cited as the basis for interpretations of the SSI regulation regarding the protection and release of information and materials related to checked baggage screening equipment. Users of this guide include the following: Transportation Security Administration (TSA) employees, contractors, and grantees; other Department of Homeland Security (DHS) and Department of Transportation (DOT) components and agencies that use information covered in this guide; vendors; and, any other covered persons (as defined in 49 CFR 1520.7) that use or access information covered in this guide.

This guide also has an SSI Annex containing further guidance on which information is and is not SSI related to this subject area. The Annex provides guidance on those topics where the guidance itself must be written at an SSI level.

GENERAL INFORMATION ON CHECKED BAGGAGE SCREENING EQUIPMENT

Following the terrorist attacks on September 11, Congress passed, and the President signed, the Aviation and Transportation Security Act (ATSA), which created the Transportation Security Administration (TSA) and mandated, among other items, that TSA screen 100 percent of all checked baggage for explosives by December 31, 2002. TSA worked with its private industry partners to deploy checked baggage screening equipment to all the approximately 440 commercial airports regulated by 49 CFR 1542.

TSA has approved or certified two different equipment types to screen checked baggage for explosives: Explosives Detection System (EDS) and Explosives Trace Detection (ETD). EDS equipment is larger and employs technology similar to a medical CAT scan, whereas ETD equipment is much smaller, about the size of a printer. EDS equipment may be deployed as stand-alone machines in airport lobbies or baggage handling areas, or integrated into the airport's baggage handling conveyor systems, called "in-line" systems. Transportation Security Officers (TSOs) working with the ETD equipment use a swab on a piece of luggage; the swab is then analyzed for traces of explosives. TSA continues to work with industry to enhance existing technology to screen checked baggage for explosives and develop new technologies that may be used in the future.

FOR FURTHER INFORMATION

Please contact us at the SSI Office via telephone at 571-227-3513 or e-mail at SSI@DHS.gov.

www.tsa.gov

Sensitive Security Information

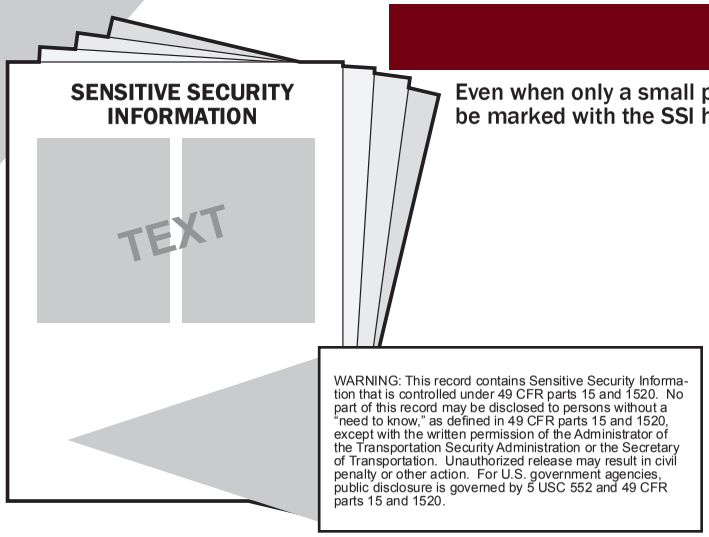
SSI Quick Reference Guide for DHS Employees and Contractors

What is SSI?

Sensitive Security Information (SSI) is information that, if publicly released, would be *detrimental to transportation security*, as defined by Federal regulation 49 C.F.R. part 1520.

Although SSI is not classified information, there are specific policies and procedures for recognizing, marking, protecting, safely sharing, and destroying SSI. This guidance is required of all DHS and component organization employees and contractors.

Marking SSI



Even when only a small portion of a document contains SSI, every page of the document must be marked with the SSI header and footer.

Recognizing SSI

SSI is information about transportation security activities. The following information constitutes SSI (as defined in 49 CFR part 1520):

1. Security programs and contingency plans
2. Security Directives
3. Information Circulars
4. Performance specifications
5. Vulnerability assessments
6. Security inspections or investigative information
7. Threat information
8. Security measures
9. Security screening information
10. Security training materials
11. Identifying information of certain transportation security personnel
12. Critical infrastructure asset information
13. Systems security information
14. Confidential business information
15. Research and development
16. Other information as determined in writing by the TSA Administrator

Destroying SSI

- ★ Shred with a cross-cut shredder.
- ★ Cut manually into squares smaller than ½-inch.
- ★ Where available, place SSI in designated and clearly marked SSI bins.
- ★ Destroy electronic SSI using any method that will preclude recognition or reconstruction of the information.

Don't...

- ★ Don't leave SSI unattended. Leave it in a locked drawer or locked file cabinet.
- ★ Don't post SSI on any Internet web site. Only post SSI on Intranet web sites with prior approval.
- ★ Don't take SSI home without permission from your supervisor(s).
- ★ Don't share SSI with individuals who do not have a need to know.
- ★ Don't put SSI in the body of an email—send it as a password-protected attachment.
- ★ Don't download SSI onto personal computers or other personal data storage devices.

Do...

- ★ Make sure all SSI is properly marked.
- ★ Use an SSI cover sheet on all SSI materials.
- ★ Protect SSI according to the SSI regulation and report any unauthorized disclosures or poor security practices to your SSI Coordinator and supervisor.
- ★ Lock up all notes, draft documents, electronic media, and other material containing SSI.
- ★ Turn off or lock your computer whenever you leave your desk to ensure that no SSI is compromised.
- ★ Transmit SSI via email only in a password protected attachment, not in the body of the email. Send the password without identifying information in a separate email or by phone.
- ★ Personally hand-deliver SSI to the intended recipient; never leave SSI unattended in the recipient's work space.
- ★ Destroy all SSI in your possession when no longer needed.
- ★ Be conscious of your surroundings when discussing SSI. Protect verbal communications with the same heightened awareness that you would apply to SSI on paper or email.
- ★ Use encrypted portable devices (i.e. thumb drives) or password-protect SSI on electronic media.
- ★ Mail SSI by U.S. First Class mail or other traceable delivery service using an opaque envelope or wrapping. The outside wrapping (i.e. box or envelope) should not be marked as SSI.

www.tsa.gov

Sensitive Security Information

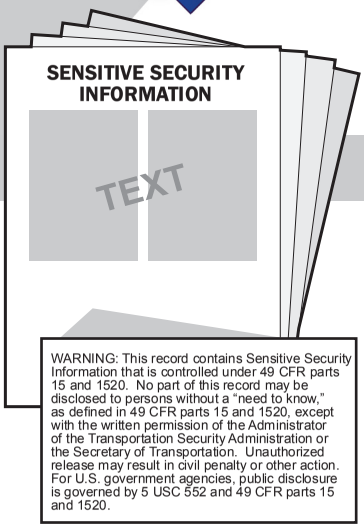
Best Practices Guide for Non-DHS Employees

The purpose of this hand-out is to provide *transportation security stakeholders and non-DHS government employees and contractors* with best practices for handling SSI. Best practices are not to be construed as legally binding requirements of, or official implementing guidance for, the SSI regulation.

What is SSI?

Sensitive Security Information (SSI) is information that, if publicly released, would be *detrimental to transportation security*, as defined by Federal regulation 49 C.F.R. part 1520.

Although SSI is not classified information, there are specific procedures for recognizing, marking, protecting, safely sharing, and destroying SSI. As persons receiving SSI in order to carry out responsibilities related to transportation security, you are considered "covered persons" under the SSI regulation and have special obligations to protect this information from unauthorized disclosure.



SSI Requirements

The SSI regulation mandates specific and general requirements for handling and protecting SSI.

You Must – Lock Up All SSI: Store SSI in a secure container such as a locked file cabinet or drawer (as defined by Federal regulation 49 C.F.R. part 1520.9 (a)(1)).

You Must – When No Longer Needed, Destroy SSI: Destruction of SSI must be complete to preclude recognition or reconstruction of the information (as defined by Federal regulation 49 C.F.R. part 1520.19).

You Must – Mark SSI: The regulation requires that even when only a small portion of a paper document contains SSI, every page of the document must be marked with the SSI header and footer shown at left (as defined by Federal regulation 49 C.F.R. part 1520.13). Alteration of the footer is not authorized.

Best Practices Guide

Reasonable steps must be taken to safeguard SSI. While the regulation does not define reasonable steps, the TSA SSI Branch offers these best practices as examples of reasonable steps:

- Use an SSI cover sheet on all SSI materials.
- Electronic presentations (e.g., PowerPoint) should be marked with the SSI header on all pages and the SSI footer on the first and last pages of the presentation.
- Spreadsheets should be marked with the SSI header on every page and the SSI footer on every page or at the end of the document.
- Video and audio should be marked with the SSI header and footer on the protective cover when able and the header and footer should be shown and/or read at the beginning and end of the program.
- CDs/DVDs should be encrypted or password-protected and the header and footer should be affixed to the CD/DVD.
- Portable drives including "flash" or "thumb" drives should not themselves be marked, but the drive itself should be encrypted or all SSI documents stored on it should be password protected.
- When leaving your computer or desk you must lock up all SSI and you should lock or turn off your computer.
- Taking SSI home is not recommended. If necessary, get permission from a supervisor and lock up all SSI at home.
- Don't handle SSI on computers that have peer-to-peer software installed on them or on your home computer.
- Transmit SSI via email only in a password protected attachment, not in the body of the email. Send the password without identifying information in a separate email or by phone.
- Passwords for SSI documents should contain at least eight characters, have at least one uppercase and one lowercase letter, contain at least one number, one special character and not be a word in the dictionary.
- Faxing of SSI should be done by first verifying the fax number and that the intended recipient will be available promptly to retrieve the SSI.
- SSI should be mailed by U.S. First Class mail or other traceable delivery service using an opaque envelope or wrapping. The outside wrapping (i.e. box or envelope) should not be marked as SSI.
- Interoffice mail should be sent using an unmarked, opaque, sealed envelope so that the SSI cannot be read through the envelope.
- SSI stored in network folders should either require a password to open or the network should limit access to the folder to only those with a need to know.
- Properly destroy SSI using a cross-cut shredder or by cutting manually into less than ½ inch squares.
- Properly destroy electronic records using any method that will preclude recognition or recontruction.

Transportation Security Administration

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0062 CHECKED BAGGAGE SCREENING EQUIPMENT GUIDANCE

0062 Checked Baggage Screening Equipment Guidance		
Topic Area/Subtopic	**Not SSI**	**SSI and Citation(s) within 49 CFR 1520.5(b)**
0062.01 Applies to Both EDS and ETD Equipment		
0062.01.01 Tests and comparisons of EDS and ETD equipment	TSA deploys a combination of both EDS and ETD equipment to screen all checked baggage by electronic means. The two types of equipment are equally effective when operated correctly. The automated EDS is able to process baggage at a faster rate than the manual ETD, and is therefore more efficient, particularly in in-line systems. Because it is more efficient, this can reduce crowding in areas where passengers must line up to provide their checked bags to TSA for screening in the airport lobbies; such crowded lobbies can be a terrorist target, so there is also a security benefit to broader use of EDS versus ETD.	Any comparison of EDS and ETD equipment by TSA or vendors in a laboratory setting is SSI under (15), and is SSI under both (5) and (9)(v) in an operational airport environment. EDS and ETD operational covert testing results are classified in accordance with DHS Security Classification Guide (SCG) TSA-011, Covert Testing. Certain EDS detection data is classified in accordance with DHS SCG TSA-002, Explosives Detection Systems Information and Data.
0062.01.02 Current testing and pilot performance data for individual machines, airports, vendors/manufacturers, and nationwide	Throughput information for any machine (bags screened per hour) and in any configuration, checkpoint or airport.	All other current and historical performance data for each machine, for each airport, each manufacturer (only for TSA configurations), and collectively nationwide at TSA locations is SSI under (9)(v).

0062 Checked Baggage Screening Equipment Guidance		
Topic Area/Subtopic	**Not SSI**	**SSI and Citation(s) within 49 CFR 1520.5(b)**
0062.01.03 False alarm rates for each type of equipment	The national average for the false alarm rate for EDS equipment is between 15-20 percent. The national average for the false alarm rate for ETD equipment is approximately 1 percent. TSA continues to work with manufacturers to reduce the false alarm rates. The Transportation Security Officers (TSOs) that screen passengers and their baggage create a record each time an EDS/ETD alarms, including false alarms.	Completed alarm forms created by TSOs reveal items and substances that cause false alarms and are SSI under both (4)(i) and (9)(v). The false alarm rates based on actual TSA operational experience for ETDs and EDS for individual machines, individual airports, or to compare different vendors' equipment is protected under both (4)(i) and (9)(v). This includes data collected by vendors prior to certification, which is SSI under (15). Procedures and techniques for clearing alarms are SSI under (9)(i).
0062.01.04 Equipment maintenance information: • Mean down time (MDT) • Mean time between failures (MTBF) • Mean time between critical failures (MTBCF) • Mean time to repair (MTR) • Mean time between maintenance actions (MTBMA)	Contractual target and national averages for equipment presented by type (e.g., all EDS or all ETD). Equipment maintenance performance information on specific airports or equipment types, e.g., the MTBCF for all equipment at LaGuardia is no longer SSI.	Any document indicating that maintenance issues at a specific airport are reducing the effectiveness of screening (as distinct from efficiency of screening) are SSI under (5).
0062.01.05 Maintenance procedures and schedules	Procedures, methods, techniques, schedules, supplies, suppliers are not SSI.	Any analysis linking a particular maintenance problem or procedure to the equipment's detection capability, to a security vulnerability, or to data on the performance (frequency, etc.) of alternative procedures is SSI under (9)(v).

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Topic Area/Subtopic	**Not SSI**	**SSI and Citation(s) within 49 CFR 1520.5(b)**
0062.01.06 Information technology (IT)	EDS and ETD systems use IT (software and hardware).	IT information on the EDS and ETD equipment as used by TSA and distinct from manufacturers' standards that would provide opportunity to a malefactor to surreptitiously defeat the system is SSI under (4)(i). This includes technical information on IT components, interfaces, system architecture, design, network configurations, and technical descriptions of IT operations, including connectivity or other functionality for equipment, airports, manufacturer products, and nationwide.
0062.01.07 Daily calibration	TSA frequently uses calibration test objects and procedures to test the checked baggage screening equipment to ensure that it is working as specified. Manufacturers' standard recommendations are not SSI.	The calibration of TSA owned or operated equipment is SSI under (4)(i). For example, TSA's use of a step wedge to calibrate its X-ray machines is not SSI, but what gauge wire the machines must detect is SSI under (4)(i). TSA uses a verific strip for ETD calibration but does not reveal the substance(s) present on the types of strips it purchases. The explosive simulants used to calibrate ETDP & EDS machines. The degree to which TSA calibration and standards differs from manufacturers' standards is SSI. In addition, any other calibration test objects that TSA uses are SSI under (4)(i); calibration test procedures are also SSI under (4)(i).

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Topic Area/Subtopic	**Not SSI**	**SSI and Citation(s) within 49 CFR 1520.5(b)**
0062.01.08 Standard operating procedures (SOPs) for using EDS or ETD equipment	TSA screens checked baggage using EDS and ETD equipment. TSOs may perform On-Screen Resolution (OSR) to clear bags screened using EDS equipment, or ETD is used to resolve EDS alarms.	Language that describes specific TSA-approved screening techniques, e.g., procedures documented in TSA's screening SOPs and SOP-related Operations Directives (ODs), is SSI under (9)(i). Often the basic procedure is known and it is the technique that is SSI, e.g. it is a known procedure that TSA swabs bags and items in bags; the information that is SSI relates to the circumstances requiring different types of bag clearances and the specifics of where on/in a bag swabbing takes place and the types of items within the bag selected for swabbing.

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Topic Area/Subtopic	**Not SSI**	**SSI and Citation(s) within 49 CFR 1520.5(b)**
0062.01.09 Alternative procedures	TSA has approved alternative procedures that it uses to screen checked baggage when circumstances, such as an out-of-service EDS machine, makes it necessary. The Aviation and Transportation Security Act of 2001 (ATSA) outlines the approved alternative screening procedures, such as using explosive detection canines, physical searches, and positive passenger bag matching. National rate for the total number of bags screened using alternative procedures.	Identification of specific alternative procedures at an airport and data related to such usage, e.g., Airport X uses K9s canines to screen checked baggage when its EDS equipment requires repair and when (schedules, anticipated uses, etc.) it uses explosives detection canines is SSI under (9)(i). Alternative protocols or procedures TSA uses to screen checked baggage that are not specifically listed in the Aviation and Transportation Security Act of 2001 (ATSA) are also SSI under (9)(i). Information on specific airports, regions or categories of airports use of alternative procedures (percentages, etc.) any alternative procedure is used, its operational impact, or other performance data or trend analysis is SSI under (9)(v).
0062.01.010 Safety issues and standards for safe operation of equipment	The safety standards for safe operation of equipment, including TSO safety training, are not SSI. This includes OSHA requirements for ambient radiation. That CT based EDS systems are not film save and that other radiation damage can occur to some items.	Specific levels of radiation that penetrate a bag is SSI under (4)(i).

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Topic Area/Subtopic	**Not SSI**	**SSI and Citation(s) within 49 CFR 1520.5(b)**
0062.01.011 The number of EDS/ETD machines in each airport and which airport has which vendors' equipment	The number and type of EDS/ETD machines per airport is not SSI. TSA currently has certified three vendors to produced EDS equipment to screen checked baggage The total award of each of these contracts and the amount of equipment purchased are not SSI.	NA
0062.01.012 Images on EDS and ETD screens	TSOs use EDS and ETD equipment screens during checked baggage screening. The colors displayed by EDS screens to represent organic, non-organic, explosive, or metallic items in baggage are not SSI.	The screens that show images on the EDS or ETD equipment are SSI under (9)(vi). All possible efforts should be made to protect the images from public viewing. Descriptions of actual threat items and how they are detected or missed are SSI under both (4)(i) and (9)(vi).
0062.02 Applies to Deployment of New EDS/ETD Equipment or Deployment of an In-Line System		
0062.02.01 Justification for new equipment	The various criteria used in justifying the priority used for the purchasing of new equipment for individual airports.	The particular justification used for funding additional equipment for a particular airport are SSI under (5) and (9)(v).
0062.02.02 When TSA will be deploying new equipment	Schedules for deployment are not SSI.	N/A
0062.02.03 The number and location of new EDS and ETD machines that will be deployed in each airport	The amount of funding, the number of new machines, where those new machines will be located, and the names of the manufacturers of the equipment that various airports will be receiving with funds this fiscal year.	N/A

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Topic Area/Subtopic	**Not SSI**	**SSI and Citation(s) within 49 CFR 1520.5(b)**
0062.03 Applies to EDS Equipment Only		
0062.03.01 The amount and/or type of explosives, the set percentages for false alarm rates, and other performance goals that the EDS equipment meets to be certified, prior to deployment	EDS equipment is certified at the Transportation Security Laboratory (TSL) prior to deployment. TSL tests a vendor's technology prior to deploying it an airport. .	Most of the certification standards for EDS equipment are classified, including the amount and/or type of explosives used to certify EDS prior to deployment, the amount and/or type of explosives used during the Site Acceptance Test performed once the equipment is in place at an airport, and the false alarm rate and other performance goals that the EDS equipment must meet to be certified. For more information on which EDS information is classified national security information, please see DHS SCG TSA-002.
0062.03.02 EDS On-Screen Resolution (OSR) clearance rate	TSA continues to work with manufacturers to improve on-screen image quality for EDS equipment.	Current OSR clearance rates for TSA-operated EDS equipment, nationwide or broken down by manufacturer are SSI under both (4)(i) and (9)(v).
0062.03.03 Deployment of the Threat Image Projection System (TIPS) for EDS equipment, and TIPS images	TSA continues to work on deploying a TIPS library for all EDS equipment.	The schedule for EDS TIPS library deployment, broken down by airport or for a specific airport, is SSI under (8)(i). Any TIPS images, and any general or specific descriptions of TIPS images, generated by TSA or used on TSA-deployed equipment, are SSI under (9)(vi).

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Topic Area/Subtopic	**Not SSI**	**SSI and Citation(s) within 49 CFR 1520.5(b)**
0062.04 Applies to New Technology under Development or under Contract/Grant as a Research and Development (R&D) Project		
0062.04.01 New technology under development or under contract/grant as an R&D project	TSA continues to work with the private sector to develop new technologies to screen for explosives. Current programs include Cambria, Phoenix, and Manhattan II. The names of the vendors, and the amounts of grants (or contracts), their purpose, and the equipment/technology that are being developed/tested.	The test results and other information related to the various technologies under development are SSI under (15). The complete, detailed list describing detection capabilities of all TSA R&D projects for aviation or maritime transportation security, and the status and schedule of each is also SSI under (15). Certain EDS R&D information is classified in accordance with DHS SCG TSA-002. Contact the SSI Office if you access or generate R&D information related to land-mode (non-aviation or maritime) transportation that would be detrimental to security if publicly released. The SSI Office will consider the use of 1520.5(b)(16) to protect such information.

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