



Transportation
Security
Administration

Planning Guidelines and Design Standards for Checked Baggage Inspection Systems



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Planning Guidelines and Design Standards for Checked Baggage Inspection Systems

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FRONT MATTER

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
4.2	May 2, 2014	Update based on recommended follow-on studies and comments on Version 4.1
5.0	July 9, 2015	Update based on need for clear differentiation between requirements and best practices, follow-on studies and comments on Version 4.2
6.0	September 29, 2017	Update based on recommended follow-on studies and comments on Version 5.0
7.0	August 21, 2020	Update based on recommended follow-on studies and comments on Version 6.0
8.0	December 30, 2022	Update based on recommended follow-on studies and comments on Version 7.0

DISCLAIMER

The Planning Guidelines and Design Standards (PGDS) for Checked Baggage Inspection Systems (CBISs) 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.

The purpose of the document is to present TSA's requirements and documented best practices for implementing a high-performance and cost-effective CBIS. This document captures TSA's requirements for a CBIS project from the beginning stages of design through commissioning of the system. Best practices are meant to highlight practices that have proven successful during implementation and that TSA recommends for the Project Sponsor's consideration during the design and construction of a CBIS.

COMPLIANCE LANGUAGE DEFINITIONS

When used in the PGDS, the terms Requirement, Best Practice/Guidance, and Support statements shall be defined as follows:

Requirement – a statement of required, mandatory practice. All requirement statements are presented in underlined text. The verb “shall” is used. The verbs “should” and “will” are not used in requirement statements.

Best Practice and Guidance – a statement of recommended, but not mandatory, practice. These statements are generated from lessons learned. These statements are geared to inform the reader of known effective practices that have proven successful during implementation. Best practice and guidance statements can be identified within the document by the use of the verb “should”. The verbs “shall” and “will” are not used in best practice or guidance statements.

Support – an informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The verbs “shall” and “should” are not used in Support statements. The verb “will” can sometimes be used in support statements when referencing things that are the government's responsibility.

PGDS APPLICABILITY

CURRENT VERSION

Designs for new CBISs shall comply with the requirements set forth in this version of the PGDS. See Chapter 4 for other project types and their PGDS compliance.

All CBIS will be tested to requirements as established in the Commissioning and Evaluation Testing appendix 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

GENERAL INFORMATION

improvements to the system. For Operational Analysis Reports and CBIS that are being upgraded or changed, TSA reserves the right to evaluate the CBIS against the most current published PGDS version.

PRIOR VERSIONS

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. 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).

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 two years of TSA approval of the original 30% Detailed Design Package.

INDUSTRY COLLABORATION AND COMMENTS

TSA has been collaborating with an Industry Working Group (IWG) that represents airlines, Baggage Handling System (BHS) designers, manufacturers, and consultants to finalize recommended changes to PGDS Version 7.0.

The PGDS is updated regularly to ensure that its guidance and standards reflect the current technology and operating environment. The IWG will continue to meet with TSA to maintain the collaboration and consider potential changes for incorporation into the next version of PGDS.

The public and industry are invited to submit comments to TSA's [PGDS mailbox at pgds@tsa.dhs.gov](mailto:pgds@tsa.dhs.gov) from the date of PGDS publication. Comments, as well as TSA proposed changes, will be shared with the IWG prior to each meeting and will be reviewed and discussed during the sessions. Any additional comments provided through the IWG will also be considered during these sessions.

The TSA values all 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, Section A.11.

The comment form can be found at the [SAM.gov website](https://www.sam.gov) using the search term "PGDS".

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APPENDICES

The following appendices are considered part of the PGDS and are found in a separate PGDS Appendices document:

- Appendix A: Submittal Outlines, Form Templates, and Examples
- Appendix B: Generic Examples of CBISs
- Appendix C: Alternatives Analysis Report Case Study
- Appendix D: Commissioning and Evaluation Testing
- Appendix E: Contingency Plan Examples
- Appendix F: Risk Based Security Impacts for the Electronic Baggage Screening Program
- Appendix G: References
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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

ACWP	Actual Cost of Work Performed	BTT	Bag Travel Time	EVM	Earned Value Management
ADA	Americans with Disabilities Act	CAD	Computer-Assisted Design	FA	False Alarm
ADPM	Average Day of the Peak Month	CAGR	Compound Annual Growth Rate	FAA	Federal Aviation Administration
AIRS	Automatic Image Reconciliation System	CBIS	Checked Baggage Inspection Systems	FAQs	Frequently Asked Questions
APM	Acquisition Program Management	CBRA	Checked Baggage Resolution Area	FDRS	Field Data Reporting System
ASCII	American Standard Code Information Interchange	CBTD	Checked Baggage Technologies Division	FIFO	First In First Out
ASP	Advanced Surveillance Program	CCR	CBIS Change Request	FIS	Federal Inspection Service
ATR	Automatic Tag Reader	CCTV	Closed Circuit Television	FOV	Field of View
ATSA	Acceptance Testing and System Assessments	CI	Control Interface	FRM	Field Regional Manager
ACWP	Actual Cost of Work Performed	CM	Corrective Maintenance	FSA	Flight Schedule Analysis
BAC	Budget at Completion	CONOPS	Concept of Operations	FSD	Federal Security Director
BAM	Bag Allocation Methodology	CPI	Cost Performance Index	GFI	Government Furnished Information
BCWP	Budgeted Cost of Work Performed	CPU	Central Processing Unit	HAZMAT	Hazardous Materials
BCWS	Budgeted Cost of Work Scheduled	CRPG	Checkpoint Requirements and Planning Guide	HMI	Human-Machine Interface
BDR	Basis of Design Report	CSV	Comma-Separated Values	HQ	(TSA) Headquarters
BHS	Baggage Handling System	CWE	Current Working Estimate	HSD	High Speed Diverter
BHSC	Baggage Handling System Contractor	DBU	Date of Beneficial Use	HVAC	Heating, Ventilation, and Air Conditioning
BIS	Baggage Inspection Station	DHS	Department of Homeland Security	IAT	Independent Acceptance Testing
BMA	Baggage Measurement Array	DSD	Deployment and Sustainment Division	IATA	International Air Transport Association
BOE	Basis of Estimate	DSL	Deputy Site Lead	ICS	Individual Carrier System
bph	Bags per Hour	EAC	Estimate at Completion	ID	Identifier (or Identification)
BPT	Baggage Process Timer	EBSP	Electronic Baggage Screening Program	ILD	Integrated Local Design Team
BRP	Baggage Removal Point	EDS	Explosive Detection System	IMAC	Installation, Move, Add and Change
BSD	Bag Status Display	EDS-CP	EDS Competitive Procurement	IQT	Image Quality Test
BSIS	Baggage Screening Investment Study	ETD	Explosives Trace Detection	IRD	Interface Requirements Document
BST	Baggage Screening Timer			ISAT	Integrated Site Acceptance Test

ACRONYMS AND ABBREVIATIONS

ISO	International Organization for Standardization	OTA	Other Transactional Agreement	SOW	Scope of Work
IT	Information Technology	OTK	Operational Test Kit	SSCP	System Services Control Point
IWG	Industry Working Group	OVT	OSR Viewing Time	SSI	Sensitive Security Information
LCCA	Life-Cycle Cost Analysis	PDF	Portable Document Format	STIP	Security Technology Integrated Program
LCS	Life Cycle Support	PE	Photo Eye	STZ	Security Tracking Zone
LEO	Law Enforcement Officer	PEC	Photoelectric Cell	SV	Schedule Variance
LIT	Lost in Track	PGDS	Planning Guidelines and Design Standards	SVS	Secondary Viewing Station
MB	Megabytes	PLC	Programmable Logic Controller	TAF	Terminal Area Forecast
MCP	Motor Control Panel	PM	Preventive Maintenance	TIM	Technical Interchange Meeting
MCS	Master Control Station	PMB	Performance Management Baseline	TRC	Technical Review Committee
MIT	Mobile Inspection Table	PMIS	Performance Management Information System	TRN	Test Readiness Notification
MTCBF	Mean Time Between Critical Failures	PNR	Passenger Name Record	TRR	Test Readiness Review
NC	Non-Condensing	POC	Point of Contact	TSA	Transportation Security Administration
NEDS	Networked Explosive Detection Systems	PVS	Primary Viewing Station	TSIF	TSA Security Integration Facility
NFPA	National Fire Protection Association	QLR	Quick Look Report	TSL	Transportation Security Laboratory
O&M	Operating and Maintenance	RBS	Risk Based Security	TSM	Transportation Security Manager
OEM	Original Equipment Manufacturer	RDC	Regional Deployment Coordinator	TSO	Transportation Security Officer
OIT	Office of Information Technology	RFI	Request for Information	TSR	Test Summary Report
OOG	Out-of-Gauge	RFID	Radio Frequency Identification	UIC	Unique Identifier Cell
OS	Oversize	RFV	Request for Variance	UPS	Uninterruptible Power Supply
OSARP	On-Screen Alarm Resolution Protocol	ROM	Rough Order-of-Magnitude	UTP	Unshielded Twisted Pair
OSHA	Occupational Safety and Health Administration	SAT	Site Acceptance Test	VAC	Variance at Completion
OSR	On-Screen Resolution	ScTP	Screened Twisted Pair	VFD	Variable Frequency Drive
OSRA	On-Screen Resolution Area	SI	Site Integration	VSU	Vertical Sortation Unit
		SIDA	Security Identification Display Area	WBS	Work Breakdown Structure
		SL	Site Lead	WLAN	Wireless Local Area Network
		SOP	Standard Operating Procedure		

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SECTION I : CBIS CONCEPTS

CHAPTER 1: INTRODUCTION

CHAPTER 2: CHECKED BAGGAGE SCREENING PROCESS

CHAPTER 3: CBIS TYPES AND EQUIPMENT

CHAPTER 1: INTRODUCTION



1.1 Purpose

The purpose of the PGDS is to provide specific guidance on ways to implement a CBIS that (1) are less costly from both capital and life-cycle perspectives and (2) have higher performance than the previous generation of installed baggage screening systems. A BHS provides sortation and conveyance of checked baggage from airport inputs to baggage makeup areas. The CBIS, as part of the BHS, is the portion of the system located in the Security Tracking Zone (STZ). The STZ starts at the point at which the BHS acquires positive tracking of a bag prior to the Explosive Detection System (EDS) (normally at a Baggage Measurement Array (BMA), an Automatic Tag Reader (ATR), or a photocell where the BHS Tracking Identifier (ID) is assigned). The STZ extends to the Clear Line diversion points and to the Baggage Removal Points (BRPs) in the Checked Baggage Resolution Area (CBRA).

The PGDS also establishes design requirements clarifying the operational parameters that must be met. Additional best practice information is provided based on the lessons learned over years of designing and installing these systems.

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

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

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

- **Achieve the most cost-efficient solution** – Achieving long-term cost efficiency requires two key changes from typical past practices: (1) considering a wide range of alternatives rather than relying on a preconceived notion regarding which system would be best suited for a particular airport, and (2) 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.
- **Define design requirements and best practices** – Clearly delineating TSA's requirements for CBISs and presenting industry best practices have proven effective at making sure those requirements are met once the system is operational.
- **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-level of automation. Many different technologies for conveyance, tracking, and screening must all work together seamlessly to achieve an efficient and reliable CBIS. Lessons learned have been incorporated into this document as best practices and are intended to inform designers of effective elements of design which have proven successful during implementation.

- **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 TSA's approach for validating baggage screening demand and determining the equipment requirements for a given project.
- **Develop principles for providing equipment redundancy and establishing contingency operations** – Other important considerations for system sizing are EDS equipment redundancy and contingency operations. EDS equipment redundancy is designed into a system in an effort to attain the best operational availability from an EDS matrix. In addition, projects are required to create a project-specific contingency plan agreed upon by all key stakeholders, including local TSA, airport and airline personnel, that defines how the CBIS will operate when screening equipment is unavailable, demand exceeds capacity during extraordinary circumstances, or a catastrophic system failure occurs.
- **Develop principles for accommodating growth beyond initial system sizing** – Systems are designed to accommodate demand up to five years beyond the Date of Beneficial Use (DBU). Planning marginal additional upfront investments in conveyors or facilities can significantly reduce costs in 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. 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. DBU+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+5 years should be assessed using a 20-year life-cycle cost analysis.
- Use an integrated and participatory approach to the planning, design and implementation processes 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.
- **Upgrade the design review and approval process** – Utilizing lessons learned to improve the design review and approval process is important to support the objectives of cost management and increased quality for the screening systems.

The PGDS also addresses some aspects of the installation, testing, and commissioning of the CBIS. Requirements related to the operation and maintenance of CBISs are not within the scope of the PGDS but some best practice information is included. Reimbursable and nonreimbursable expense information related to the Electronic Baggage Screening Program (EBSP) are also not in the PGDS but are available in a separate policy memo called "Electronic Baggage Screening Program Policy – TSA Funding of Checked Baggage Inspection System Project Costs," which can be obtained at the [Sam.gov](https://www.sam.gov) website using the search term "PGDS".

1.2 Background

The PGDS was developed as an industry reference to develop cost-effective solutions and to define 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.

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 report. The EBSP framework was developed as the basis for the BSIS. The EBSP is a DHS acquisition program, under which the Checked Baggage Technologies Division (CBTD), within TSA's Acquisition Program Management (APM) receives funding for the execution of checked baggage screening projects.

As described in the EBSP Strategic Planning Framework submitted to Congress in February 2006, the primary goals of the EBSP Strategic Plan are to:

- Increase security through deploying EDS equipment to as many airports as practicable and implementing more labor-intensive Explosive Trace Detection (ETD) screening protocols at those locations where ETD will continue to be used for primary screening.
- Minimize EBSP life-cycle costs by deploying the best possible screening solutions at each airport, appropriately balancing capital investment and operating cost tradeoffs.
- Minimize impacts to TSA and airport and airline operations through well-designed and well-placed EDS solutions.
- 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.

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. Since then, TSA has completed several rounds of review processes in which industry comments and follow-on PGDS studies were incorporated into successive published PGDS versions.

Since publication of the PGDS V5.0 in 2015, the industry and TSA have made a consolidated effort to emphasize performance-based requirements in the PGDS and clearly identify and differentiate between requirements and best practices within the document. The TSA formed an internal stakeholder group from various offices, divisions and branches called the PGDS Technical Review Committee (TRC) to review and address internal and external stakeholder recommendations and govern the PGDS. Industry created the PGDS IWG in an effort to create a forum

for industry stakeholders to discuss relevant PGDS issues and collaborate with TSA. The result of the collaboration between these two groups and the updating, revision and review process is reflected in this version (V7.0) of the PGDS.

1.3 Organization

The PGDS is organized into three sections as follows:

- Section I: CBIS Concepts
 - Chapter 1, Document Purpose, Background, Organization and Key Changes from the previous version
 - Chapter 2, Checked Baggage Screening Process
 - Chapter 3, CBIS Types and Equipment
- Section II: CBIS Projects
 - Chapter 4, Project Planning and Initiation: project phases, stakeholder roles and responsibilities, the design review process, and TSA funding
 - Chapter 5, Pre-Design Phase, including methodologies for developing an evaluation of alternatives
 - Chapter 6, Schematic Design Phase
 - Chapter 7, Detailed Design Phase, including 30%, 70%, and 100% design reviews
 - Chapter 8, Construction Phase, including system change implementation
 - Chapter 9, Testing and Commissioning Phase
 - Chapter 10, Project Closeout Phase, including control configuration architecture documentation
 - Chapter 11, Life Cycle Cost Estimating
- Section III: CBIS Design Requirements and Industry Best Practices
 - Chapter 12, CBIS Design Requirements
 - Chapter 13, On-Screen Resolution Area Planning Standards
 - Chapter 14, Checked Baggage Resolution Area Planning Standards
 - Chapter 15, CBIS Operating and Maintenance Best Practices
 - Chapter 16, Information Technology Security

The PGDS also incorporates the following appendices in a separate document:

- Appendix A, Submittal Outlines, Form Templates, and Examples – Report submittal outlines for CBIS for the Pre-Design and Schematic Design phases and form templates, CBIS reporting examples, the Controls Configuration Architectural Overview, and an outline for TSA training documentation required for operation of the CBIS.
- Appendix B, Generic Examples of Checked Baggage Inspection Systems – Generic examples of linear CBIS design concepts and Individual Carrier System-based CBISs.
- Appendix C, Alternatives Analysis Report Case Study – Example of an Alternatives Analysis Report showing how the PGDS should be followed to develop and select viable CBIS alternatives.
- Appendix D, Commissioning and Evaluation Testing – Suite of tests that TSA has developed for the execution of the Testing and Commissioning Phase of a project and guidelines for developing an ILDT Test Plan used to test and commission the CBIS after installation.
- Appendix E, Contingency Plan Examples – Two examples of CBIS contingency plans to serve as reference for the development of this document.
- Appendix F, Risk Based Security Impacts for the Electronic Baggage Screening Program – Placeholder.
- Appendix G, References.
- Appendix H, Requirements Lists.

1.4 Key Changes from PGDS v7 to PGDS v8

Section	Section Title	Changes
General	Document Bifurcation	Separated Body and Appendices into two documents to reduce file size
3.2.1	In-Line CBIS	Removed Leidos 6700 EDS Model from PGDS
3.3.2	Stand-Alone CBIS	Added requirement prohibiting the use of Type II EDS in CBRAs or Oversize Screening Areas
3.5.1	Individual Carrier Systems	Added flexibility in determining a maximum average ICS carrier length
Chapters 4-10	Design Package Submittals, Phase Deliverables Lists	Consolidated deliverables list requirements by moving all lower-level deliverables requirements out of the deliverables lists and into appropriate existing document sections or new document sections and replacing with references to those sections in each phase deliverables list.
5.5.2.1	Field Data Reporting System Analysis Methodology	Replaced surged 85th Percentile FDRS 10-minute demand with unsurged 95th Percentile rate for FDRS Analysis Methodology
5.6.3	EDS Equipment Redundancy	Clarified definition of EDS grouping and added new requirement prohibiting any redundant EDS be shared between two EDS groupings

Section	Section Title	Changes
5.6.4	On-Screen Resolution Equipment Requirements	Replaced complex calculation with a simple allocation methodology
5.6.5	Baggage Inspection Station Requirements	Replaced complex calculation with simple allocation methodology
9.2	Pre-Commissioning Requirement	Created a maximum duration between ISAT testing and Go-Live Airport Operations
9.2	Pre-Commissioning Requirement	Created a RFV requirement for Phased ISATs and Combined testing phases
12.12.2	Environment	Revised Fire protection requirements to allow wet sprinkler systems in CBIS but restrict placement of sprinkler heads and supply piping from directly above the EDS machines
12.12.6	EDS Power Requirements	Removed UPS requirement, added new requirement to meet manufacturer power specifications
12.13, A.4	CBIS Reporting	Revised existing BHS reports to address stakeholder comments
14.2	CBRA Layout	Removed the single Alarm Line requirement
14.2	CBRA Layout	Removed the Larger CBRA's Optimal (Horseshoe) CBRA layout
14.5	CBRA Functionality	Removed Alternate Queuing Methodology(AQM) and replaced with a three-level Alarm Line Queuing method
14.6.5	Unique Identifier Cells	Added a fifth "Reinsert" UIC code on BSD design
14.5.6	Manual Reinsertion	Revised AQM BSD screens to accommodate any situation requiring manual reinsertion

CHAPTER 2: CHECKED BAGGAGE SCREENING PROCESS

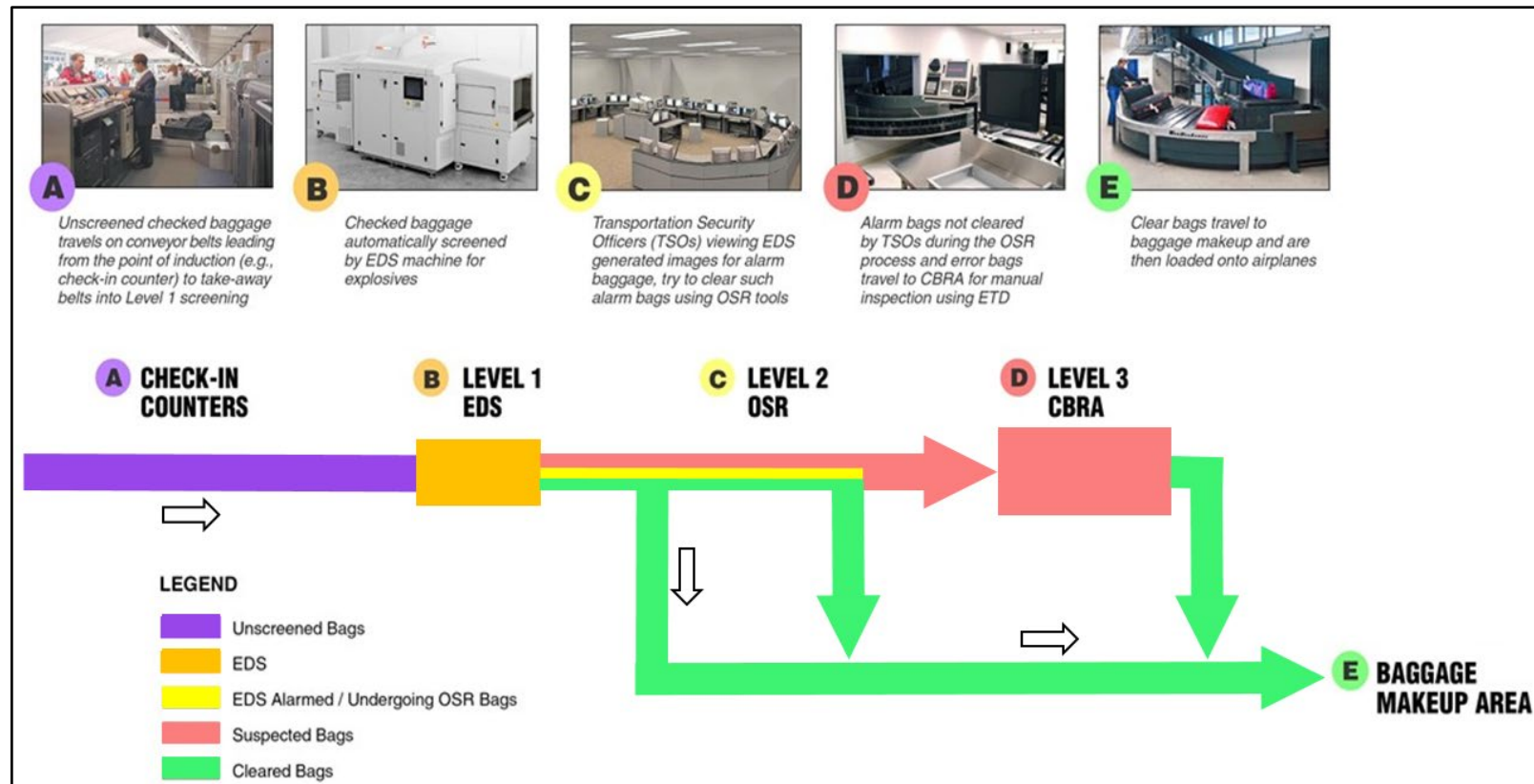


2.1 Screening Process Overview

The TSA utilizes a multi-level screening process to inspect checked baggage. This screening process is applicable to all CBIS types discussed later in this chapter except ETD-only screening.

In an in-line CBIS, screening operations are integrated with the outbound BHS, as shown in Figure 2.1.

Figure 2.1: Generic In-Line Checked Baggage Inspection System



2.2 Level 1 – EDS

Passenger baggage checked in at the airlines ticket counters, kiosks, curbsides, Federal Inspection Service (FIS) Recheck, or Group Check-ins (where applicable) is transported to a CBIS via conveyor systems for inspection. Once at the EDS, photo eyes collect bag data and the EDS generates an image used for security screening. The EDS unit assigns each bag exiting the scanner a Level 1 security status of Clear or Non-Clear. Clear bags are diverted to the make-up area, while Non-Clear bags continue to Level 2 screening.

2.3 Level 2 – On-Screen Resolution

In On-Screen Resolution (OSR), images of Non-Clear bags are inspected by a Transportation Security Officer (TSO) and assigned a Level 2 security screening status of Clear or Non-Clear. Clear bags are diverted to the make-up area, while Non-Clear bags continue to Level 3 screening.

The Level 2 screening typically takes place concurrently with baggage conveyance. BHS configurations are designed to allow for a minimum of 45 seconds of travel time for each bag between the exit of the EDS unit and the second decision point. If a Level 2 disposition isn't available before a bag reaches the second decision point, the bag is automatically deemed Non-Clear and continues onto the CBRA line.

2.4 Level 3 – Checked Baggage Resolution Area

Bags traveling on the CBRA line are sent to a Baggage Inspection Station (BIS). TSOs conduct a directed manual search on Non-Clear bags using the image generated at Level 1 and the OSR dispositions from Level 2 to target the objects of concern. When all objects have been inspected and cleared, the bag is assigned a Level 3 security status of Clear. The bag is transferred to the Clear Line and sent to the make-up area.

Bags that do not receive a Level 3 security status of Clear are considered Alarmed and must be processed by Law Enforcement Officers (LEOs).

CHAPTER 3: CBIS TYPES AND EQUIPMENT

3.1 CBIS Overview

This chapter provides information about CBIS types and their associated Concept of Operations (CONOPS), as well as screening equipment that can be used in the various system types.

CBIS designs use two types of EDS units for primary screening:

- EDS Type I:
 - Intended use case: integration of two or more EDS units with the same baggage conveyance system and providing resource balancing across the EDS units and shared network assets
 - Type I EDS units are capable of screening bags at a rate no less than 400 bags per hour (bph)
- EDS Type II:
 - Intended use case: screening with one EDS unit and dedicated assets
 - Type II EDS units are capable of screening bags at a rate no less than 150 bph when operated in accordance with approved staffing levels

A CBIS with very low throughput may be designed to accomplish primary screening using only ETDs (ETD CBIS).

Within each CBIS type, several acceptable screening equipment models may be available with similar throughput rates, false alarm (FA) rates, and OSR rates. TSA-qualified models are identified in this chapter. New CBIS designs shall not include legacy units.

The Project Sponsor shall coordinate with the TSA Project Coordinator for any needed Sensitive Security Information (SSI) and to make a final determination on the conveyable bag dimensions.

The tables at the beginning of each CBIS type subsection summarize the candidate screening equipment and throughput ranges for this screening equipment. Alarm rates and resolution rates for the listed scanner units are SSI and denoted as such. Environmental restrictions for all units include non-condensing (NC) levels of humidity.

More detailed examples of generic concepts of baggage screening systems, operational assumptions for the generic baggage screening concepts, and best practices captured in these generic concepts are found in Appendix B.

3.2 CBIS Using Type I EDS Units

3.2.1 In-Line CBIS

In-line systems have very high levels of integration and sophisticated in-line conveyor infrastructure, providing sufficient queuing capacity and OSR travel time while maintaining high throughput and accurate bag tracking. These systems have networked EDS technology (i.e., the capability to link multiple EDS units with multiple viewing stations), centralized control rooms, multiple baggage inputs, and one or more CBRAs. Type I EDS units used in this CBIS type are intended to provide solutions for airports that require fully integrated in-line systems designed to handle very high peak baggage screening demand.

The In-Line CBIS design is required to allow EDS listed in Table 3.1 to achieve the 95% Throughput indicated under test conditions (see Section 12.4). Throughput values used during design for system sizing shall be based on a site-specific bag sizes, which may differ from the assumed 28" average bag size used in Table 3.1.

Table 3.1: Type I EDS Units

Classification	Product	False Alarm Rate	OSR Clear Rate	Average OSR Time (sec)	Belt Speed (ft/min)	Idealized Throughput (28" bag with 12" spacing)	95% Throughput (bags/hour)	Current Status
EDS-CP	Leidos eXaminer 3DX 6700 ES	SSI	SSI	20	39.5	709	674	Qualified (EDS-CP)
EDS-CP	Smiths CTX-9800 DSi	SSI	SSI	20	39.5	709	674	Qualified (EDS-CP)

Notes:

- False Alarm Rate can vary from airport to airport, so the project sponsor should contact their TSA Project Coordinator for airport-specific alarm rate data.
- OSR Clear Rate can vary from airport to airport, so the project sponsor should contact their TSA Project Coordinator for airport-specific data.
- Idealized throughput is based on uniform 12" bag spacing and 28" test bags in a controlled testing environment. A blended domestic/international bag length should be used during CBIS design (see Section 5.6.2).
- 95% throughput value predicated on assumption that not all bags will be perfectly aligned when presented to the EDS units. Value is rounded to the nearest whole number.
- "Qualified (EDS-CP)" is defined as those systems that have successfully completed detection Certification, TSA Security Integration Facility (TSIF) Evaluation, and Operational Test and Evaluation against EDS Competitive Procurement (EDS-CP) requirements and may be available for procurement by TSA. Project sponsors should ask their TSA Project Coordinator to confirm availability of specific models with TSA's Checked Baggage Technology Division.
- The information included in this table is current as of the publication date of this document. To obtain the most up to date information on qualified EDS units, email PGDS@tsa.dhs.gov.

Figure 3.1 shows a schematic visualization of an In-Line CBIS with Type I EDS units.

Figure 3.1: Schematic Visualization of an In-Line CBIS Using Type I EDS Units

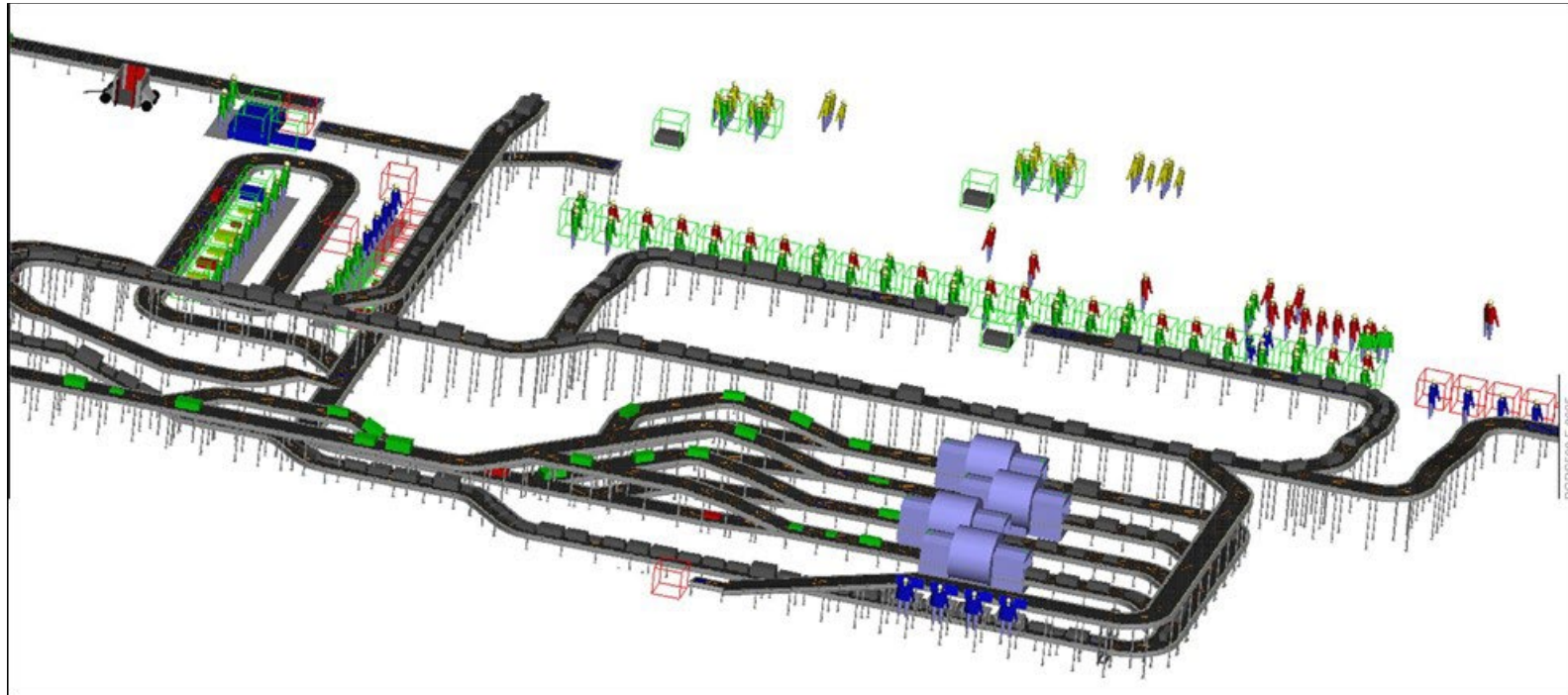
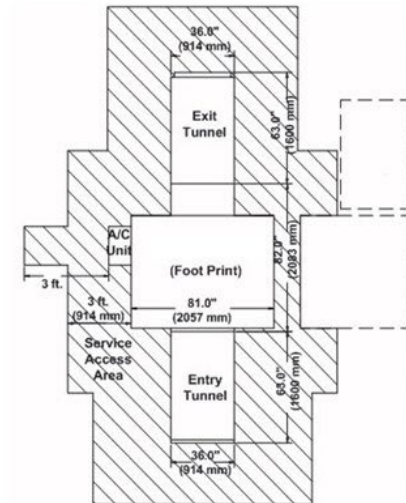
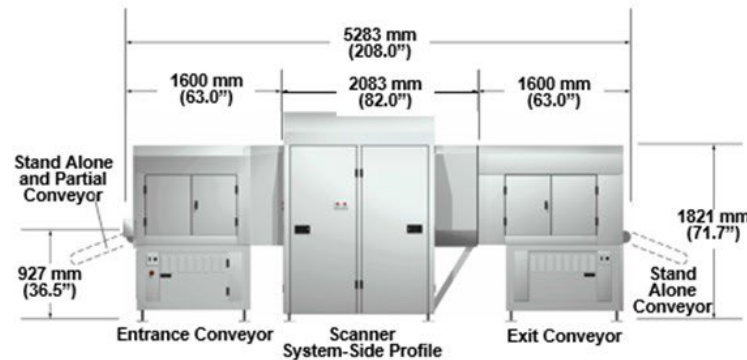


Figure 3.2 and Figure 3.3 provide graphical representations and summarize equipment assumptions for current qualified Type I EDS units.

Figure 3.2: Leidos eXaminer 3DX 6700 and eXaminer 3DX 6700 ES
Applicable System Type: In-line



SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 32-104°F/Humid. 10-85% NC
Weight (lb)	8,800
Floor loading (lb/sq ft)	158
Max bag size (L ₁ /L ₂ x W x H inch)	100/65 x 31 x 24.5 ¹
Current status	Qualified (EDS-CP) ²



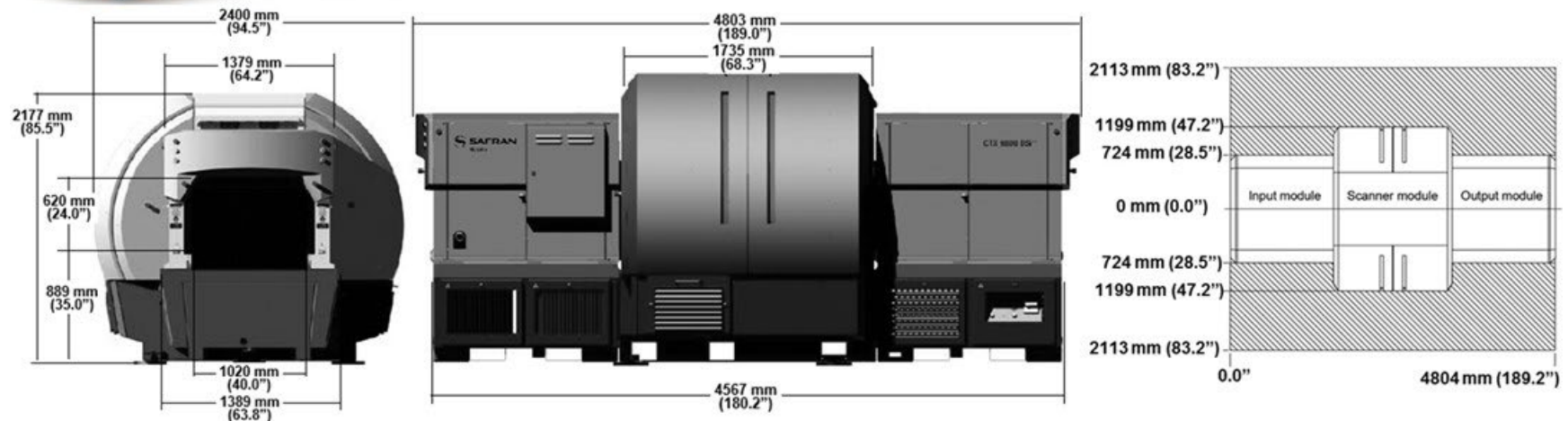
Notes:

1. Due to the shape of the unit's opening, the maximum height will drop with increasing bag width.
2. "Qualified (EDS-CP)" is defined as those systems that have successfully completed Detection Certification, TSIF Evaluation, and Operational Test and Evaluation against EDS-CP requirements and are available for procurement by TSA.
3. L₁ = Maximum bag length unit can scan
4. L₂ = Standard bag length unit can scan

Figure 3.3: Smiths CTX 9800 DSi (SEIO)
Applicable System Type: In-line



SPECIFICATIONS	
False alarm rate	SSI
OSR clear rate	SSI
Average OSR time (sec)	20
Environmental operating envelope	Temp. 19-120°F/Humid. 10-95% NC
Weight (lb)	15,700
Floor loading (lb/sq ft)	425
Max bag size (L x W x H inch)	98.4 x 39 x 23.6 ¹
Current status	Qualified (EDS-CP) ²



Notes:

1. Due to the shape of the unit's opening, the maximum height will drop with increasing bag width.
2. Qualified (EDS-CP)² is defined as those systems that have successfully completed Detection Certification, T SIF Evaluation, and Operational Test and Evaluation against EDS-CP requirements and are available for procurement by TSA.

3.2.2 EDS Multiplexed Network

TSA deploys fully-integrated EDSs in a multiplex network configuration for a CBIS size of three EDSs or more. This configuration allows two or more EDSs to communicate with two or more network elements such as viewing stations, a network Master Control Station (MCS), or a printer. A typical Multiplex Network consists of servers, racks, switches, cables, Uninterruptible Power Supplies (UPSs), EDS components, and various other hardware and software components that are required to establish the Multiplex Network configuration.

The EDS multiplexed network capabilities are critical to successful fully-integrated EDS operations and are verified prior to ISAT of a given CBIS. A multiplex network transmits bag images and threat data from EDS units to one of several viewing stations for Level 2 resolution and to one of several viewing stations for Level 3 resolution. Other EDS multiplexed network capabilities include server redundancy, network size scalability, utilization of TCP/IP, network fault monitoring, management of network configurations and settings, user database management, image archive and recall features, and access to Field Data Reporting System (FDRS) data.

The following list represents the potential EDS multiplex network configuration options for a fully-integrated and networked CBIS.

- **Dedicated OSR Area** – Can be used in new in-line, recapitalization, and existing multiple-CBIS zone projects where each screening zone is supported with a dedicated multiplexed network server physically located in separated OSR rooms.
- **Split OSR Area** – Can be used in CBIS expansions, recapitalization, and EDS upgrade projects where two separate networks are co-located together in the same physical OSR area (or room). This configuration will require dedicated network servers and MCS for each screening zone co-located within the OSR area (or room).
- **Consolidated OSR Area** – Can be used in CBIS expansions, recapitalization, and EDS upgrade projects where two or more dedicated OSR areas are networked together. This configuration may require EDS component upgrades and requires a split OSR area (or room) initially while the existing OSR network elements are transitioned to the new network.

Table 3.2 compares characteristics of the three networking types.

Table 3.2: EDS Networking Type Comparison

Factor	Dedicated OSR Area	Split OSR Area	Consolidated OSR Area
Staffing per EDS	Baseline	Higher Than Baseline	Lower Than Baseline
EDS network hardware requirements per EDS	Baseline	Higher Than Baseline	Baseline
Network infrastructure requirements per EDS	Baseline	Higher Than Baseline	Lower Than Baseline
Operational redundancy	Baseline	Baseline	Lower Than Baseline
Advantages	Separate operations for all zones	Separate operations, CBIS phasing, network reliability	Staffing savings per EDS, less hardware, network size scalability
Disadvantages	Increased staffing and dedicated infrastructure requirements	Increased staffing and dedicated infrastructure requirements	Redundant network fail-over fault

3.3 CBIS Using Type II EDS Units

Type II EDS units are designed for situations with lower throughput than those using Type I EDS systems. Two CBIS configurations use Type II EDSs: mini in-line and stand-alone.

3.3.1 Mini In-Line CBIS

A mini in-line design is a cost-effective solution for an airport or bag zone with low bag screening throughput needs. This CBIS type provides fully automated operations at a fraction of the cost of an in-line system. Other advantages include reduced space requirements, capital and operational costs, and construction time.

Mini in-line designs are tailored to site-specific needs, demographics, and operations, resulting a unique configuration for nearly every design.

The system's ability to queue bags is minimized because of its smaller footprint. As a result, system diebacks are expected to occur for short periods of time, but can be minimized with proper analysis and bag flow control.

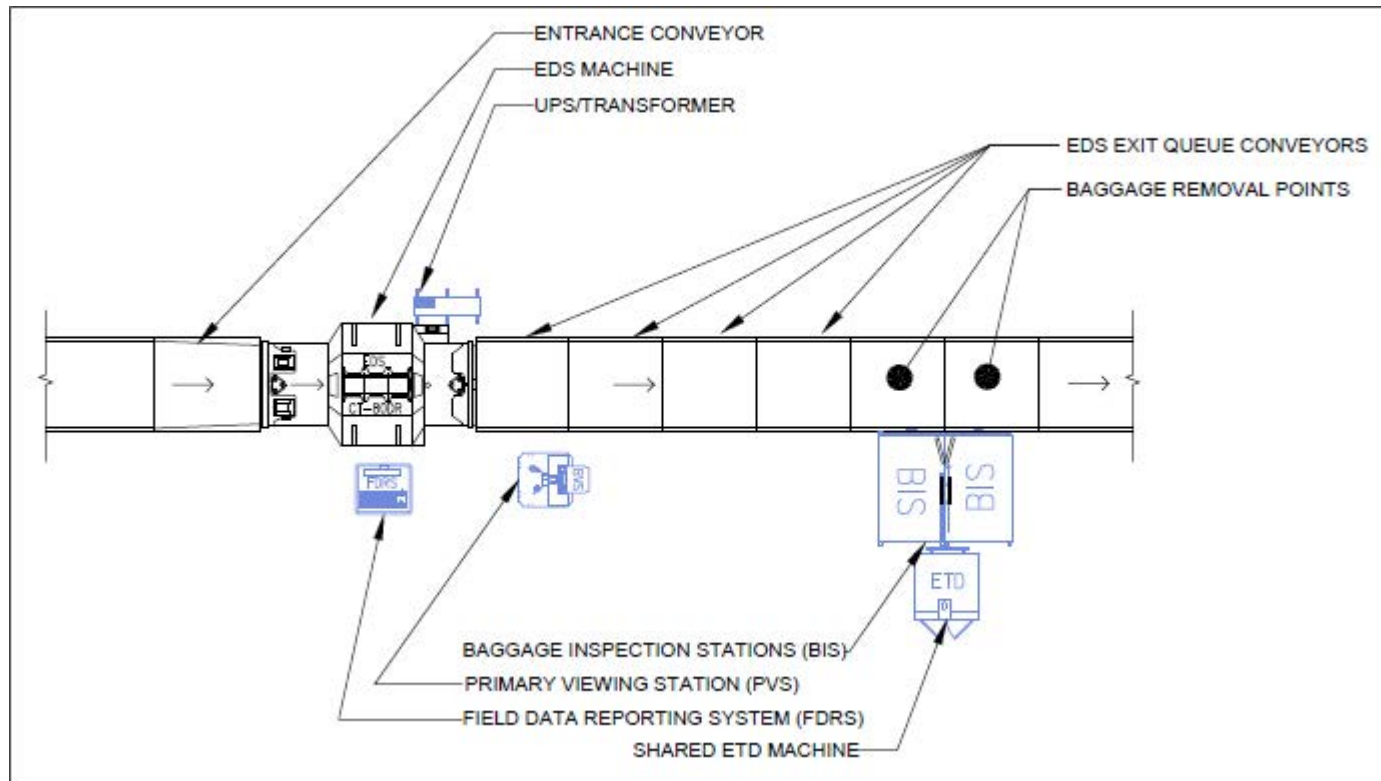
A mini in-line design is defined by the following criteria:

- Single Type II EDS configuration
- No redundant EDS

Contingency alternatives will be considered on a case by case basis and must be discussed with the TSA. Most airports have multiple mini in-line systems located near each other that may serve as redundant systems for each other in the event of an EDS or BHS failure. If other nearby systems aren't available, the TSA will analyze the baggage profile to determine other viable and cost-effective alternatives to ensure that operations continue during any system failures, such as additional ETDs, inspection stations, etc. There are currently no qualified EDS machines for use in a mini in-line solution.

Figure 3.4 shows an example of a mini in-line solution.

Figure 3.4: Example Mini In-Line Configuration



3.3.2 Stand-Alone EDS

In small airports or in specific zones with low baggage volumes at larger airports, stand-alone EDSs may be the most cost-effective option. Qualified Type II EDS units for stand-alone configurations are listed in Table 3.3. Type II EDS units are prohibited in Oversize screening areas unless approved with a Request for Variance (RFV).

Table 3.3: Type II EDS for Stand-Alone CBIS Configuration

Classification	Models	False Alarm Rate	OSR Clear Rate	Average OSR Time (sec)	Throughput (bags/hour)	Current Status
EDS-CP	Reveal CT-80DR+(S)	SSI	SSI	30	200-225	Qualified (EDS-CP)
EDS-CP	Reveal CT-80DR+(L)	SSI	SSI	30	180-200	Qualified (EDS-CP)
EDS-CP	Reveal CT-80DR+(XL)	SSI	SSI	30	160-180	Qualified (EDS-CP)
EDS-CP	Smiths CTX 5800	SSI	SSI	20	277	Qualified (EDS-CP)

Notes

1. False Alarm Rate based on System Evaluation Report or FDRS data from fielded systems and intended to be used as a national average. Airport-specific data may be available from the TSA Project Coordinator.
2. OSR Clear Rate based on values used for TSA staffing and intended to be used as a national average. Airport-specific data may be available from the TSA Project Coordinator.
3. Throughput value based on operational data analyzed from FDRS reports of fielded equipment.
4. "Qualified (EDS-CP)" is defined as those systems that have successfully completed Detection Certification, TSIF Evaluation, and Operational Test and Evaluation against EDS-CP requirements and may be available for procurement by TSA. Project sponsors should ask their TSA Project Coordinator to confirm availability of specific models with TSA's Checked Baggage Technology Division.
5. Given the limited available field data at the time of this publication, the CTX 5800 "as fielded" throughput value provided here is based on acquisition method (3D volumetric), belt speed and TSO staffing constraints in Standalone configuration.

The information included in this table is current as of the publication date of this document. To obtain the most up to date information on qualified EDS units, e-mail PGDS@tsa.dhs.gov.

As shown in Figure 3.5 and Figure 3.6, a stand-alone EDS operates in a manner similar to lobby screening nodes installed today at many Category X and Category I airports; however, stand-alone equipment should be installed in baggage makeup areas or other appropriate locations to reduce lobby congestion where possible. This CBIS type is relatively labor intensive, but minimal capital investment is required to install the system and support the operation. Note that no redundant stand-alone units will be provided by TSA.

Figure 3.5: Example Stand-Alone EDS Configuration

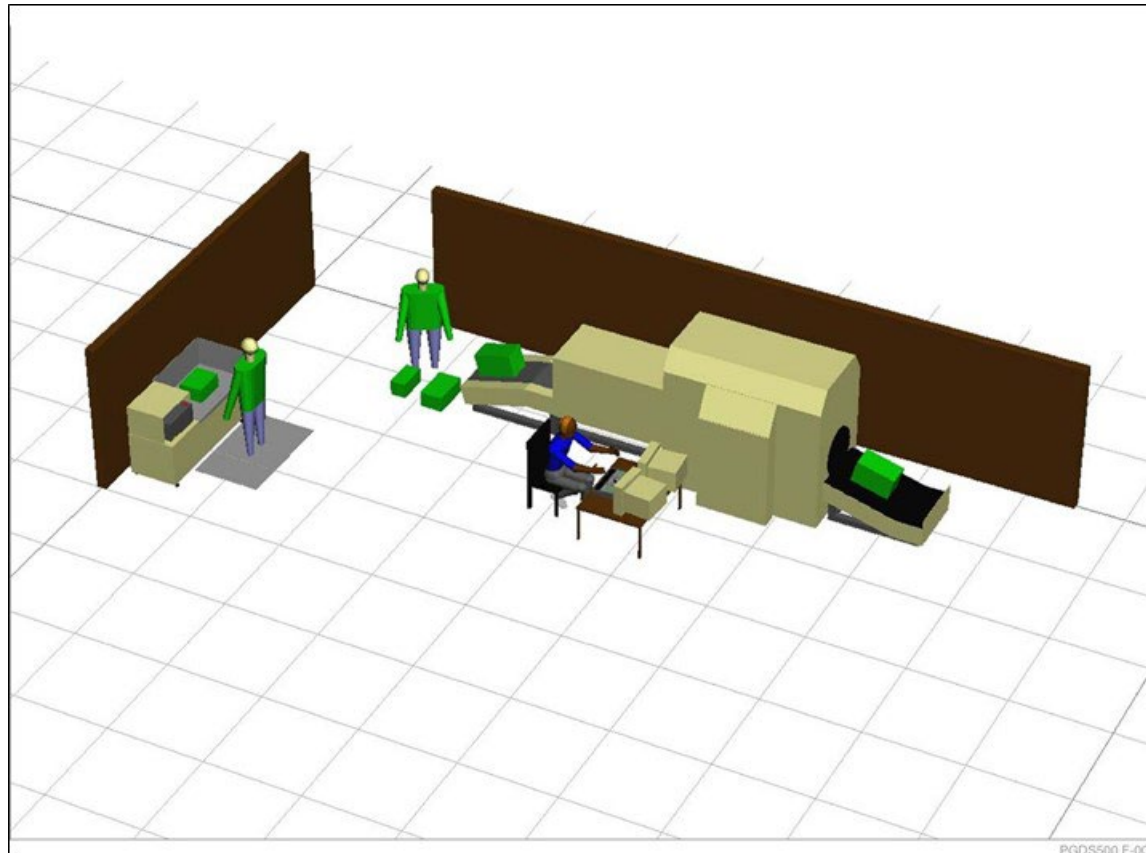
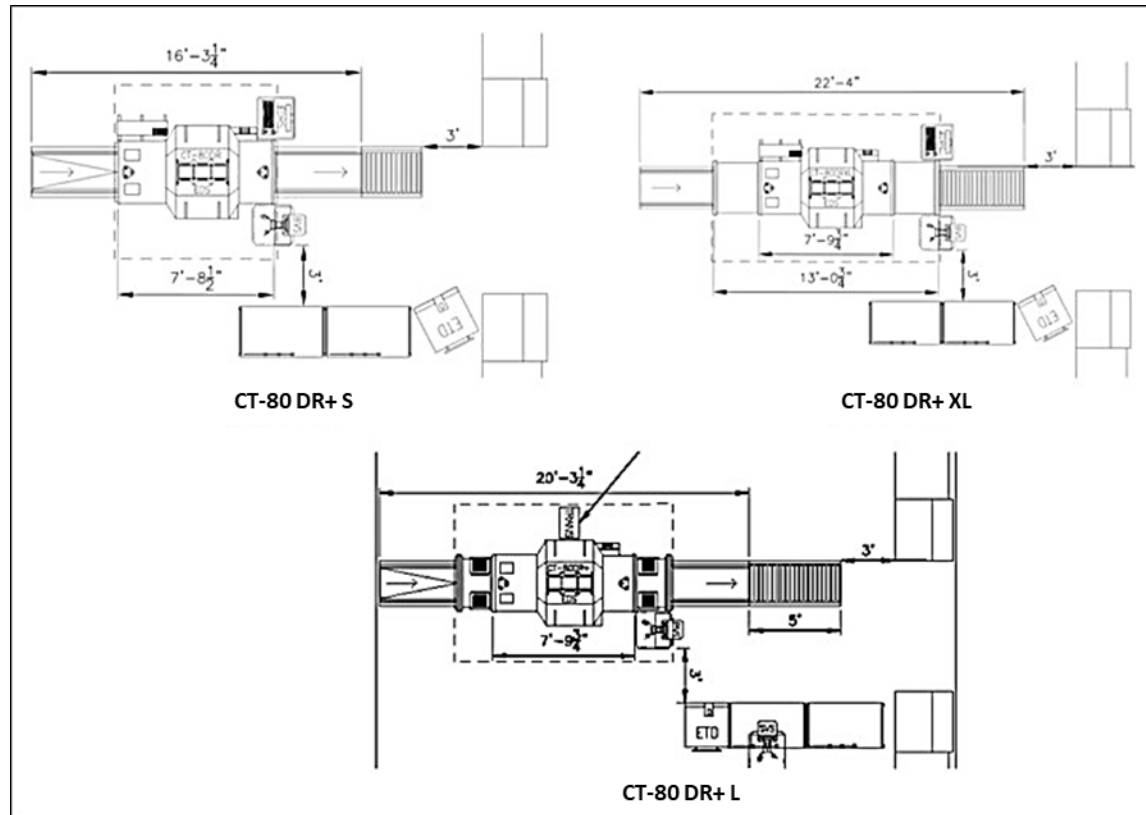


Figure 3.6: Schematic Visualization of Stand-Alone EDS Configurations



Stand-alone EDS layout designs shall ensure TSA personnel do not carry baggage more than 8 feet (as validated by the local Federal Security Director (FSD)) for the purposes of picking up a bag for screening or returning a screened bag to the aircraft operator.

A stand-alone system option would significantly reduce up-front capital costs by using currently available EDS units with throughputs of at least 100 bph in locations where no economic justification exists to design and implement an in-line system.

Most stand-alone EDSs may be installed with either flat or incline/decline conveyor belts at the entrance and exit of the unit. The preferred configuration of these belts may vary from site to site and the availability may vary from model to model. Refer to the EDS Original Equipment Manufacturer (OEM) Installation Guide for the available options associated with each model.

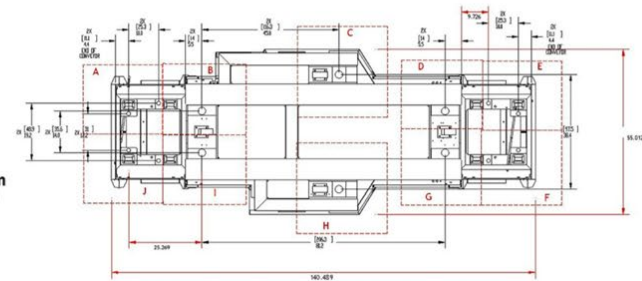
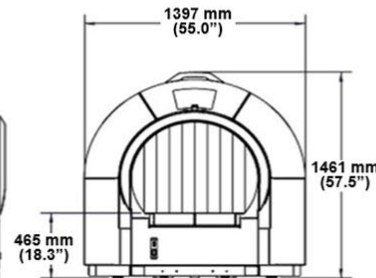
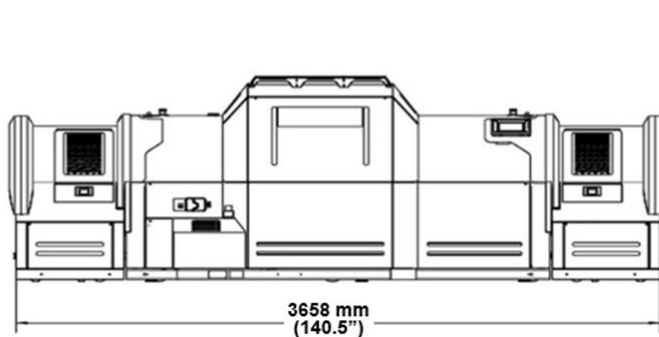
Level 3 screening operations for stand-alone EDS units will vary based on the type of EDS used. EDS-CP units all have the ability to recall bag images on Secondary Viewing Stations (SVSs) for Level 3 screening, and the CONOPS for these units may include the use of visual light indicators, conveyor functionality, search list criteria, and manual bag ID entry. Most legacy EDS units do not have dedicated SVS capability and TSOs will follow local procedures for alarm resolution with ETD. Accordingly, each deployment layout for legacy EDSs must accommodate the footprint required for alarm resolution dictated by local policy. A key consideration is the space necessary to support multiple TSOs assigned to the EDS traveling between the Primary Viewing Station (PVS) and alarm resolution work areas. Silent duress alarms shall be installed at all stand-alone EDS Checked Baggage screening areas located in the public space. Reference latest [Checkpoint Requirements and Planning Guide](#) (CRPG), Duress Alarm Requirements, for more details.

Figure 3.7 and Figure 3.8 provide graphical representations and summarize equipment assumptions for current and future stand-alone EDS units that are not already presented as part of the mini in-line CBIS type.

Figure 3.7: Reveal CT-80DR+
Applicable System Type: Stand-Alone



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)	3,635
Floor loading (lb/sq ft)	79.5
Max bag size (L x W x H inch)	63.0 x 24.5 x 19.8
Belt Speed	
Current status	Qualified (EDS-CP) ¹



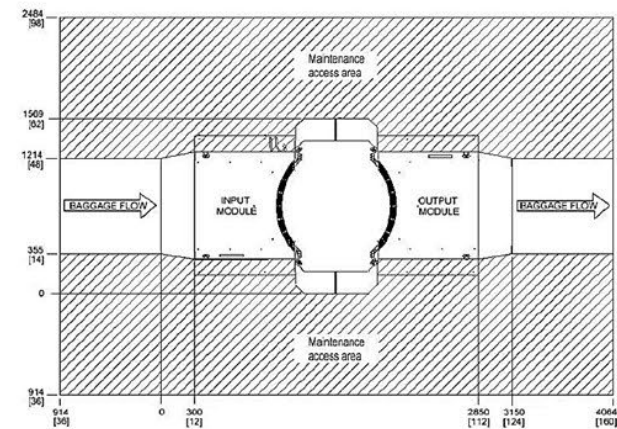
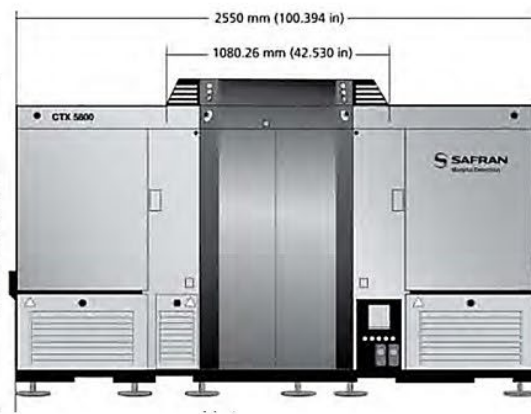
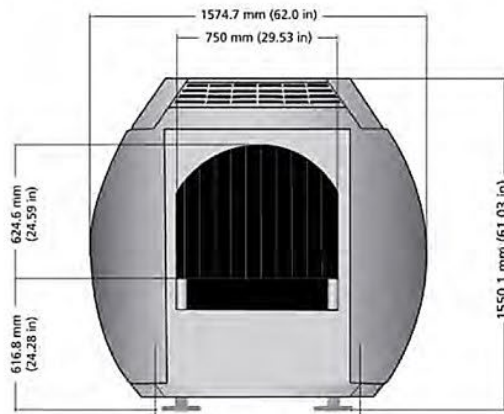
Notes:

1. Due to the shape of the unit's opening, the maximum height will drop with increasing bag width.
2. "Qualified (EDS-CP)" is defined as those systems that have successfully completed detection Certification, TSIF Evaluation, and Operational Test and Evaluation against EDS-CP requirements and are available for procurement by TSA.
3. L1 = Standard
4. L2 = Long
5. L3 = XL

Figure 3.8: Smiths Detection CTX 5800
Applicable System Type: Stand-alone



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 (L x W x H inch)	63.0 x 24.5 x 19.8
Belt Speed	27.5 ft/min (0.14 m/s)
Current status	Qualified (EDS-CP) ¹



Notes:

1. Due to the concave opening of the machine, the maximum height will drop with increasing bag width. System does not have a limitation on the allowable length of bags.
2. "Qualified (EDS-CP)" is defined as those systems that have successfully completed Detection Certification, TSIF Evaluation, and Operational Test and Evaluation against EDS-CP requirements and are available for procurement by TSA.

3.4 CBIS Using ETD Units

ETD equipment is currently used for primary screening and for resolution of EDS alarms. ETD systems qualified for both applications are listed in Table 3.4.

Table 3.4: ETD for Primary Screening and Alarm Resolution

Classification	Model	False Alarm Rate	Max Avg Analysis Time (sec)	Full Open Search Screening Method Throughput (bph)	Directed Search Screening Method Throughput (bph)	Oversize Screening Method Throughput (bph)	Current Status
Current	Smiths IONSCAN 500DT	SSI	8	Domestic: 22.5 International: 19.8	Domestic: 20.9 International: 18.7	Domestic: 19.5 International: 13.8	Qualified
Current	Leidos QS-B220	SSI	8	Domestic: 22.5 International: 19.8	Domestic: 20.9 International: 18.7	Domestic: 19.5 International: 13.8	Qualified

Notes:

1. Qualified = Certified to the 2012 Trace Detection Standard by the Transportation Security Laboratory (TSL) for use in Checkpoint and Checked Baggage screening.
2. The information included in this table is current as of the publication date of this document. To obtain the most up to date information on qualified ETDs, e-mail PGDS@tsa.dhs.gov.

3.4.1 Primary Screening

ETD equipment can currently be used for 100% checked baggage screening in lobbies, baggage makeup areas, or other appropriate locations when no EDS is present.

ETDs can also be used for primary screening of baggage that cannot be screened using an EDS, including out-of-gauge (OOG), oversize (OS), and fragile items. OOG is defined as exceeding the maximum baggage dimensions that can physically be screened by the EDS machine. OS is defined as exceeding the maximum conveyable baggage dimensions of the standard-width BHS conveyors.

As ETD screening is the most labor-intensive screening method and has the lowest throughput compared with all other screening methods, ETD primary screening is typically only appropriate in lieu of EDS screening at airport zones with low baggage volumes. Typical screening capacity for stand-alone ETD CBIS types is less than 100 bph. Silent duress alarms shall be installed at all ETD primary screening systems located in the public space. Reference latest [CRPG](#), Duress Alarm Requirements, for more details.

A schematic view of an ETD-only system for primary screening is shown in Figure 3.9.

Figure 3.9: Schematic Visualization of an ETD Primary Screening System

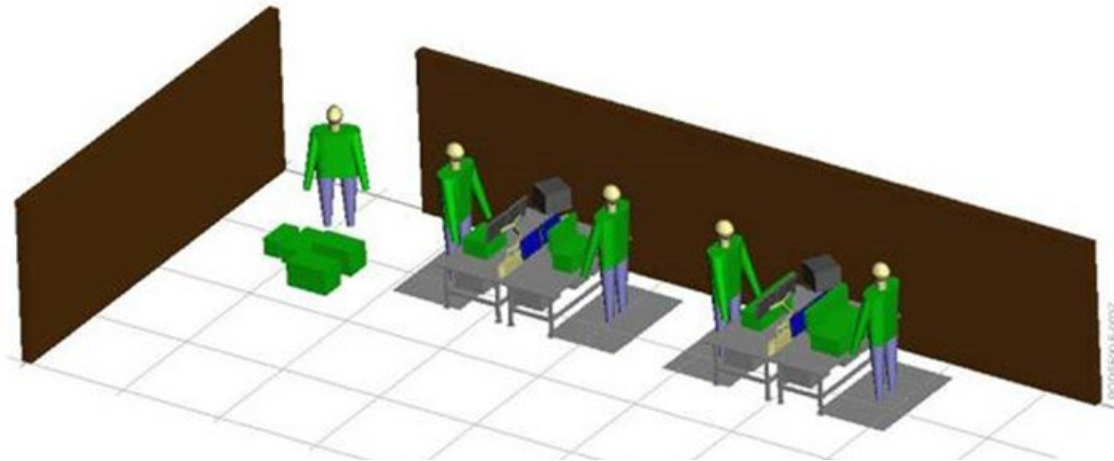
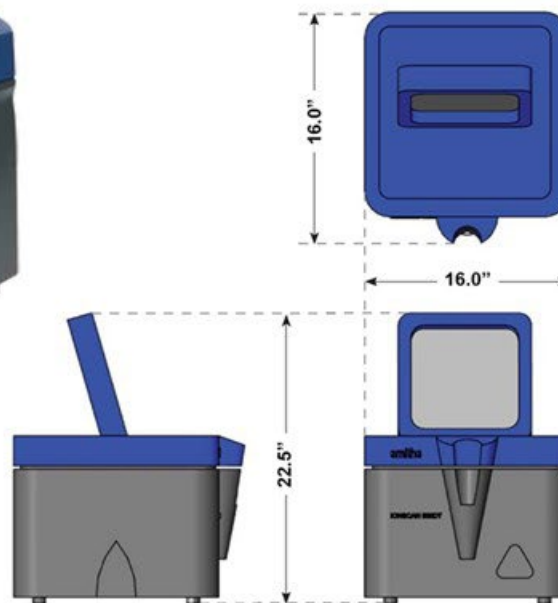


Figure 3.10 and Figure 3.11 provide graphical representations and summarize equipment assumptions for ETD machines.

Figure 3.10: Smiths IonScan 500DT
Applicable System Type: Stand-Alone ETD



SPECIFICATIONS	
False alarm rate	SSI
Environmental operating envelope	Temp. 32-104°F Humid. up to 95% NC
Weight (lb)	43.5
Current status	Qualified

Figure 3.11: Leidos QS-B220
Applicable System Type: Stand-Alone ETD



SPECIFICATIONS	
False alarm rate	SSI
Environmental operating envelope	Temp. 14-131°F Humid. up to 95% NC
Weight (lb)	32.1
Current status	Qualified

3.4.2 Alarm Resolution

ETD equipment is used in the Directed Search Screening Method to screen EDS-alarmed bags that have not been cleared by operators using an OSR protocol based on viewing bag images. This method is focused on identifying and locating objects within baggage that have triggered EDS alarms. In the event that a bag image is not available for an EDS-alarmed bag, a full open search may be employed by the TSA screener.

3.5 Other Baggage Conveying Systems

The previous discussions have assumed the traditional “friction belt on slider bed” baggage conveyance technology, but there are alternate types of baggage systems that utilize other means to accomplish the same goals.

3.5.1 Individual Carrier Systems

An Individual Carrier System (ICS)-based CBIS design concept typically uses individual carriers to move baggage through a transport and sortation system, which allows for the distribution of bags to the EDS units as well as to the CBRA, and if so designed, for the automated sortation of bags to multiple makeup devices. ICSs typically consist of a closed-loop conveying system on which special-purpose carriers, each accommodating a single bag and possessing a unique radio frequency identification (RFID) tag, are transported to the EDS. In this type of system, the bag remains on the carrier throughout the screening and sortation processes. Alarmed baggage is transported to the CBRA on the carrier while cleared baggage is conveyed to the sortation system. The ICS concept is presented to provide planners with a broad range of potential CBIS concepts for consideration during the Pre-Design Phase. More details on application of the ICS concept are found in Appendix B.

A key consideration in this type of design is that once loaded onto the ICS carrier, the bag must remain associated with that carrier throughout the screening process. Upon arrival into the CBRA, the bag cannot be removed from the carrier until an operator is available to screen the bag. Once the bag is removed from the carrier by sliding the bag (lifting should not be required), the carrier must remain at that location until the bag has been screened and loaded back onto the same carrier to maintain positive tracking. Depending on the CBRA design, bags may remain in the carrier during the physical inspection process.

ICS is most beneficial in a centralized screening operational design, where EDS and CBRA staff can be minimized without compromising time-in-system constraints. The Project Sponsor shall coordinate with TSA and OEMs to ensure the EDS-Carrier configuration is approved and an approval letter is obtained from the TSA program office prior to the 100% design phase. TSA will ensure prioritization is provided for detection impact validation testing of the EDS-Carrier configuration at TSA testing facilities. It is the responsibility of the ICS OEM to coordinate detection impact testing with the EDS OEM as part of their research and development process. The ICS OEM must provide the carriers associated with the EDS-Carrier configuration to the EDS OEM and TSL for detection impact validation testing.

The average ICS carrier size shall be no larger than two standard deviations above the airport-specific average bag length, using airport-specific data where possible, plus additional carrier length beyond maximum bag loading size required for operation specified by the ICS manufacturers

(typically 6").¹ TSA will consider slight variations from the calculated average carrier sizes due to standard carrier sizes available. ICS throughput shall be calculated based upon the carrier size and the minimum spacing requirements. No ICS carrier design shall restrict the processing rate of any EDS machine to less than 400 bph.

3.5.2 Mobile Inspection Tables

A Mobile Inspection Table (MIT) may be used to transport bags to the TSOs for inspection in the CBRA. The MIT consists of a table top integrated into an automated cart that transports bags along a path of magnetic tape affixed to the floor. Bags are loaded onto the MIT automatically and are delivered directly to the TSOs for inspection. The bag remains on the MIT during inspection and is positively tracked with the MIT. The MIT utilizes RFID transponders to positively update its position. After inspection the bag is automatically delivered to the clear line conveyor system for sortation or driven directly to the make-up area. Error bags can be sent to a reinsertion line.

3.6 Advanced Tracking Technology

This section describes enhanced tracking methodologies that may be implemented in a CBIS to improve system performance and security. The effectiveness of these technologies has been tested at the TSA Integration Facility and select U.S. airports.

If an Integrated Local Design Team (ILDT) proposes the use of any enhanced tracking methods, the methods must be reviewed and approved by TSA prior to implementing. Enhanced tracking methods shall have the ability to be disabled from the Human-Machine Interface (HMI). Technologies included in this section are just examples of possible techniques; other variations may exist. Any alternative innovative technologies may be submitted to TSA for consideration in future versions of PGDS.

3.6.1 Automatic Image Reconciliation System

Automatic Image Reconciliation System (AIRS) technology is an enhanced imaging, baggage identification, positive tracking and security enhancement system. AIRS has been installed within the baggage screening area at Dallas Love Field airport, the TSIF, and the SICK System Development Facility in Stoughton, MA. This applied technology is a major enhancement over current BHS tracking capabilities, allowing for a more secure and efficient CBIS. AIRS is not a trademark nor is this technology owned by any single manufacturer.

AIRS is designed to capture and positively match the unique exterior characteristics of each bag created by color image camera technology, similar to facial recognition. Additional layers of validation are integrated into AIRS with the capture of dimensional properties based on industry standard dimensioning systems and laser/matrix camera array technology for International Air Transport Association (IATA) bag tag identification.

¹ Based on national average bag lengths, the standard deviations are 5.3" for domestic and 4.7" for international.

The highly advanced bag matching algorithms developed for AIRS identify and track each bag in real time and store each image sequentially in a database. AIRS stores and associates multiple data points for each bag: the identity of a bag, its exact location in the CBIS (in conjunction with the information used by the BHS to track each bag), and recognition of exterior physical bag characteristics including color and dimensions. Lost-in-tracking errors are mitigated by reacquiring and validating the identity and security status of each bag.

AIRS also supports additional speed and efficiency in the CBRA when the technology is applied from the exit of each EDS to the CBRA divert point. A touch screen terminal in the CBRA allows TSOs to view the external characteristics of the bag to support locating it for screening.

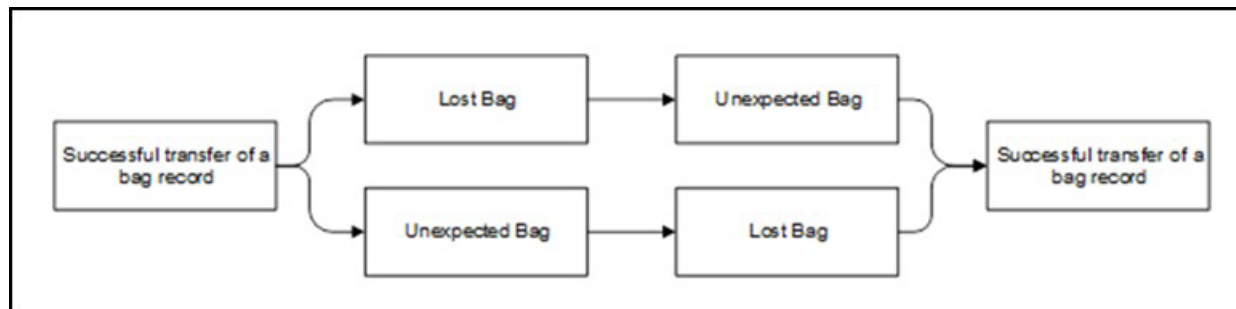
3.6.2 Reconstructive Tracking

Reconstructive tracking is a methodology applied to the Programmable Logic Controller (PLC) to positively track bags within the CBIS. This complex code is derived using a set of predefined programming rules that determine specific patterns of bags at specific locations within the CBIS where bags may become “lost in tracking.” The code has the ability to “reconstruct” tracking data.

For example, if bags 1,2,3,4, & 5 are positively tracked at photo cell AL-11, then based on various rules, if bags 1,2, xx, 4, & 5 are tracked at AL-12, based on the predefined rules, the PLC has the ability to assume that “xx” was in fact bag 3 and reassigns its data and the bag is then tracked with its original data.

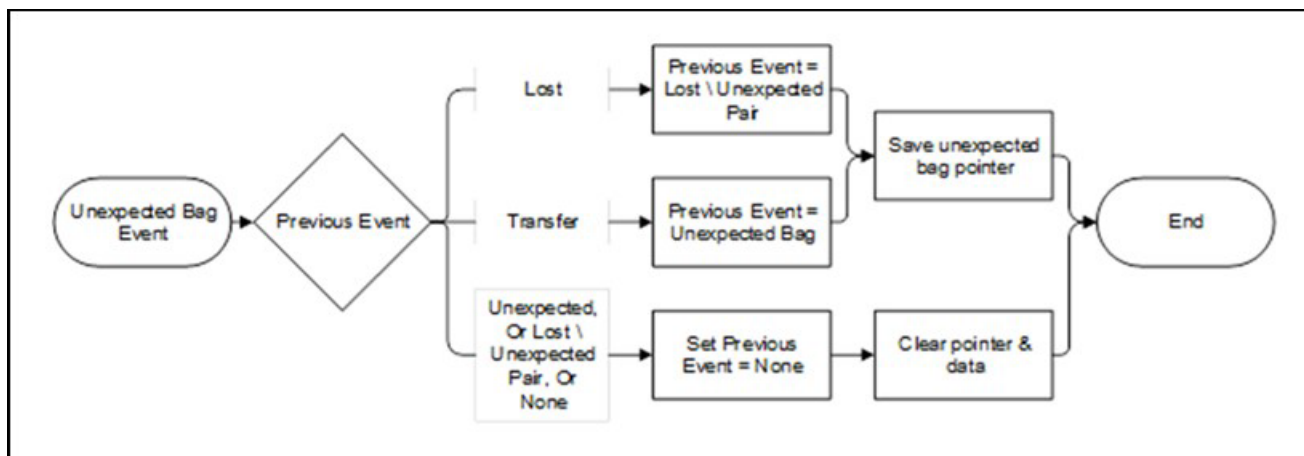
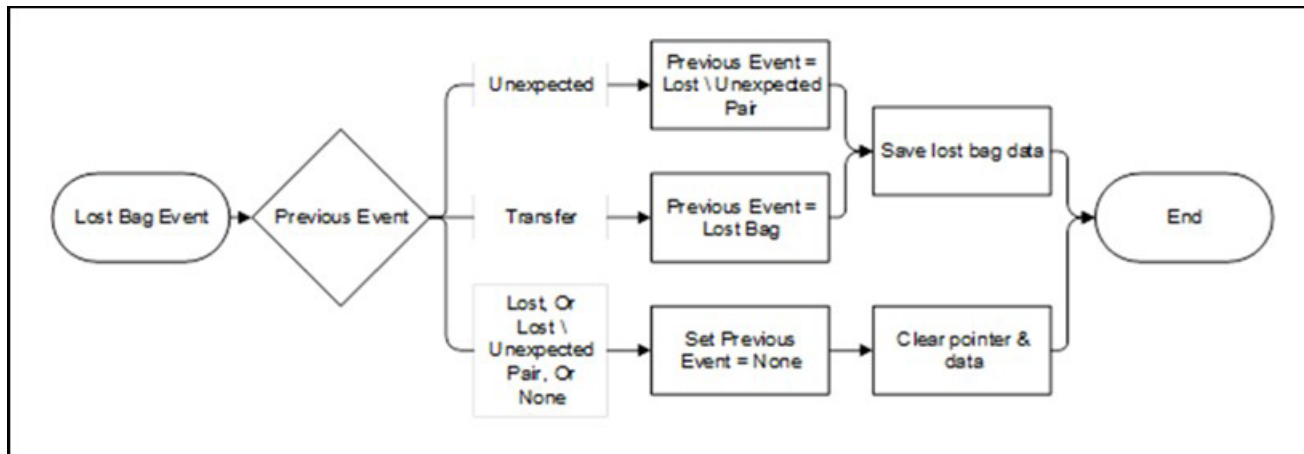
Conditions for Reconstruction

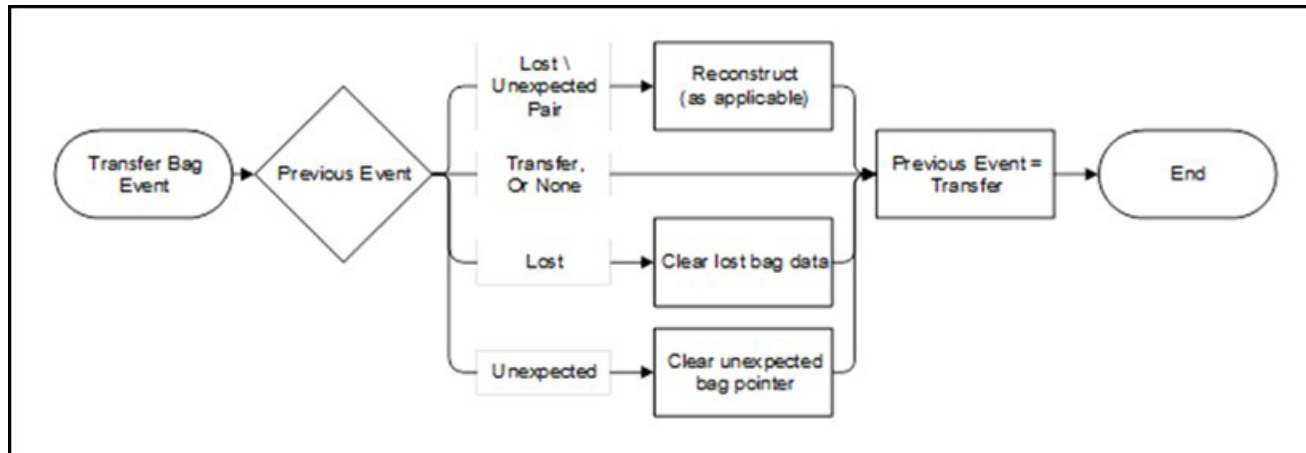
Bag reconstruction requires a predetermined number of successive events at single photocell in the correct order (2 possible):



The second successful transfer after the lost/unexpected triggers the reconstruction (i.e., associates the data of the lost bag to the unexpected bag), as well as the beginning of another possible reconstruction series).

This function can only be used at sector-to-sector transfers. At a tracking entrance photocell, bags cannot be lost because they are all “unexpected”; at tracking exit photocells, any bag that could be reconstructed has left tracking so there is nothing to reconstruct.





NOTE: Content provided courtesy of the Jervis B. Webb Company.

SECTION II: CBIS PROJECTS

CHAPTER 4: PROJECT PLANNING AND INITIATION

CHAPTER 5: PRE-DESIGN PHASE

CHAPTER 6: SCHEMATIC DESIGN PHASE

CHAPTER 7: DETAILED DESIGN PHASE

CHAPTER 8: CONSTRUCTION PHASE

CHAPTER 9: TESTING AND COMMISSIONING PHASE

CHAPTER 10: PROJECT CLOSEOUT PHASE

CHAPTER 11: LIFE CYCLE COST ESTIMATION

CHAPTER 4: PROJECT PLANNING AND INITIATION

4.1 CBIS Project Types

The majority of baggage screening projects fall into one of five categories – new system, recapitalization, optimization, PGDS upgrade, and expansion. The design requirements for the project are in part dependent on which type of project is being undertaken. Similarly, the ability for TSA to provide funding is also dependent on the type of project. The life cycle cost estimating process for CBIS has been included later in this section to guide the Integrated ILDT through understanding the total cost for CBIS construction and operation for the life of the system.

4.1.1 New CBIS Projects

New CBIS projects are any in-line screening systems that are built without needing to modify an existing CBIS. New CBIS projects are generally at greenfield sites (a new terminal, a newly created CBIS within an existing terminal, etc.) or can occur when an existing system is completely removed and replaced.

New CBIS projects are expected to fully comply with the design standards and requirements in the PGDS.

4.1.2 Recapitalization

Recapitalization projects are TSA-initiated and based on the expectation of existing screening equipment becoming technically obsolete. The scope of a recapitalization project is limited specifically to only those actions necessary to remove the existing screening equipment and integrate new screening equipment into an existing system.

Recapitalization projects are limited to the replacement of the screening equipment, while maintaining existing EDS throughput. The scope of recapitalization projects is defined by TSA in advance. Any additional work that an airport would like to conduct beyond the recapitalization scope is considered optimization activity.

A recapitalization project does not need to fully comply to PGDS requirements since it is not intended to fix known issues in the existing system. A recapitalization project must only comply with PGDS as it relates to installation and configuration of new screening equipment. Similarly, due to the reduced scope of a recapitalization project, the design process may not require all five phases of design.

4.1.3 Optimization

Optimization projects are airport-initiated modifications to an existing CBIS for any reason other than screening equipment recapitalization. Any changes made to the system as part of the optimization must comply with PGDS requirements. However, it is not required to bring the rest of the existing system (i.e., portions that are not receiving optimization) up to PGDS-compliance. PGDS applicability will be determined based on project's scope.

4.1.4 PGDS Upgrades

PGDS Upgrade projects are TSA-initiated efforts to close gaps between existing system capabilities and current PGDS requirements. Any changes made to the system as part of the PGDS upgrade must comply with PGDS requirements. However, it is not required to bring the rest of the existing system (i.e., portions that are not receiving upgrades) up to PGDS-compliance. PGDS applicability will be determined based on project's scope.

Required design submittals for a PGDS upgrade will depend on the scope and complexity of the upgrades to be done, but typically will not require all five phases of design.

4.1.5 Expansion

Expansion projects are limited to efforts that add screening equipment to an existing system that is designed to be expanded. This primarily refers to in-line systems originally built with additional shunts for future EDS installation. Expansion projects are generally not required to be compliant with current PGDS version, as the system may have been built to a previous version of the document.

The number of design phases required for an expansion project will be dependent on the scope and complexity of the expansion.

4.2 Stakeholder Roles and Responsibilities

4.2.1 Project Stakeholders

The project stakeholders list should be customized to reflect the relevant stakeholders at the specific airport, including external stakeholders associated with the project, and should include the following individuals representing primary functional areas:

- **Airport** – Engineering, Operations, Information Technology (IT), Maintenance, Planning and Design, Project Management, and others, as appropriate
- **Air Carriers** – Headquarters, Operations, Corporate Real Estate, IT, Maintenance, Engineering, Planning, Security Technology Officers, Station Managers, and others, as appropriate
- **TSA** – Local and National (Headquarters (HQ)) TSA

The following additional project stakeholders or designees will be included in some phases of the process:

- **Law Enforcement** – Local law enforcement (the entity responsible for procedures to handle alarmed bags not cleared at level 3 screening in the CBRA by ETD)
- **Technology Vendors** – EDS equipment providers and manufacturers

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

4.2.2 Integrated Local Design Team

As part of the design process, an ILDT that includes representatives 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, safety professionals and project managers. The design team is also likely to include specialty consultants, such as simulation analysts, on an as-needed basis.

Key benefits of the ILDT include:

- Facilitation of overall project coordination and information sharing between all project stakeholders throughout the life of the project
- Improved coordination of contingency plans and continuity of operations
- Representation of all project stakeholders in the decision making process
- A spirit of collaboration among stakeholders, which facilitates stakeholder buy-in from the early phases of the project

Responsibilities of the ILDT include:

- Development of alternative screening concepts, evaluation of those concepts, and generation of design drawings and submittals
- Development of RFVs. ILDTs assess specific local conditions affecting the CBIS design, as well as the requirements to be met by the CBIS design. If the ILDT concludes that any process, performance, or design requirement set forth in this PGDS cannot be met by the CBIS design due to local constraints, the ILDT can petition TSA via the Project Sponsor for an exemption. See Section 4.6.2 for requirements related to RFVs.
- Submission of CBIS Change Requests (CCRs). ILDTs submit a change request when a change to the system is required at the construction contractor level but does not change the Other Transactional Agreement (OTA) scope. The PGDS CCR Form is in Appendix A, Section A.6, and in the Submittals Checklist.

If Passenger Facility Charge funding is contemplated, regular communication with the local Federal Aviation Administration (FAA) Airports Office servicing the airport should be included in the ILDT planning process since TSA does not provide such communication or coordination.

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.

4.2.3 Project Sponsor

The Project Sponsor is assumed to be an airport owner or operator. 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. If an ILDT is not formed, the Project Sponsor shall assume the responsibilities of the ILDT.
- Application for TSA funding
- Identification of a point of contact who is responsible for stakeholder outreach during each phase of the project
- Submission of design packages to TSA and participation in design review meetings
- Submission of RFVs to TSA requesting exemption from any PGDS requirements that cannot be met
- Initiation and execution of construction, as well as testing and commissioning of the CBIS
- Operation and maintenance of the BHS portion of the CBIS

4.2.4 TSA Headquarters

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

Typical TSA Headquarters representatives include individuals from Acquisition Program Management, Requirements and Capabilities Analysis, and the Capabilities Management Division.

Key responsibilities of TSA Headquarters include:

- Creation of a regular forum for exchanging lessons learned as implementation moves forward and regularly updating the PGDS
- Reviews of technical and operational designs
- Assessment of the impact of potential screening protocol changes
- Communication of design best practices to the aviation industry
- EBSP management, including providing periodic updates to the Strategic Plan as warranted by technology or other critical changes and making best efforts to provide the TSA resources needed for the project

- Providing a stakeholder forum to brainstorm operation and policy issues as needed
- Providing Government Furnished Information (GFI) upon request

4.3 Project Phases

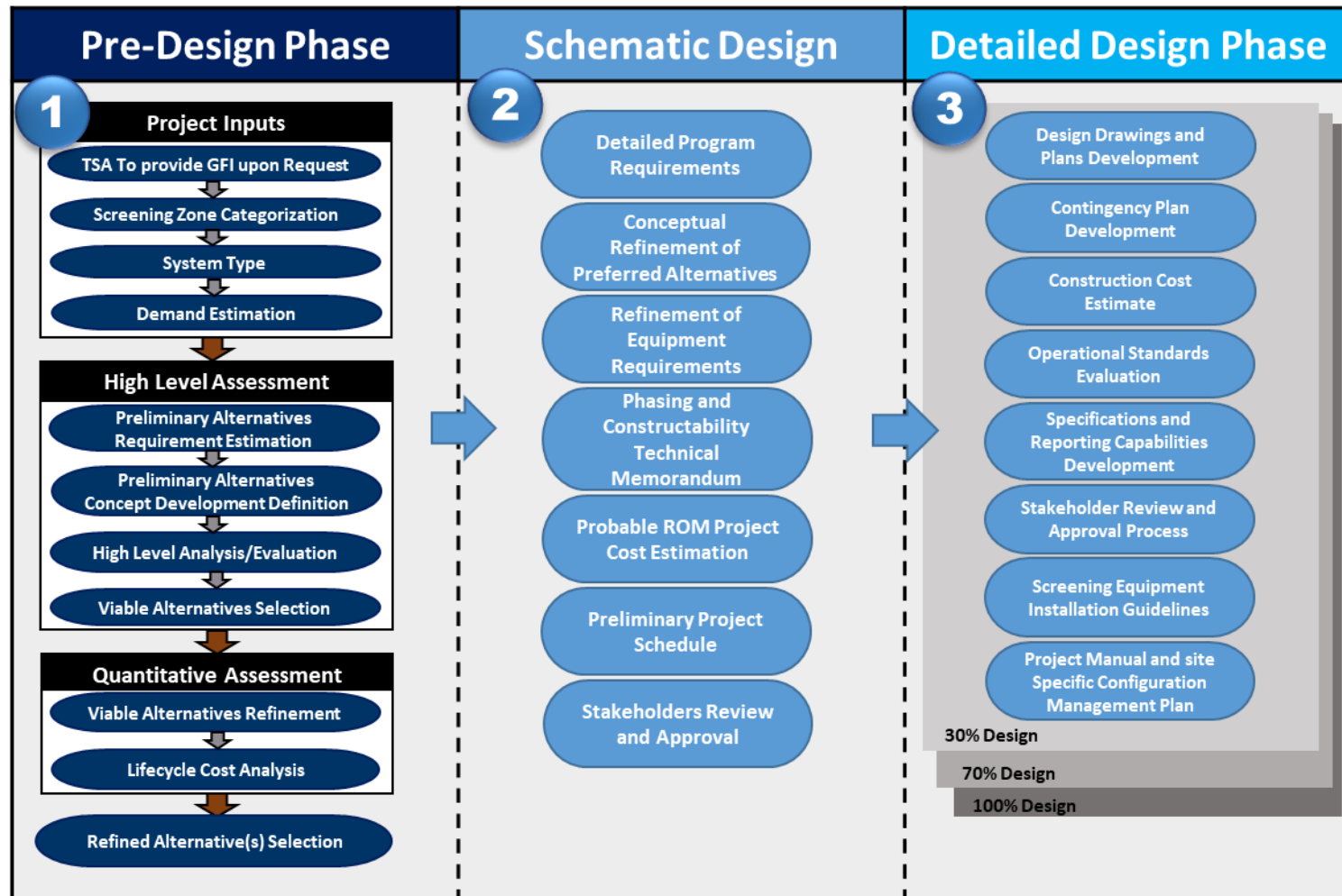
All projects shall follow the project phasing sequence Pre-Design Phase, Schematic Design Phase, Detailed Design Phase, Construction Phase, Testing and Commissioning Phase, and Project Closeout Phase. An overview of the activities occurring in each phase is below; Chapters 5-10 describe each phase's objectives, stakeholder responsibilities, activities, and deliverables in detail.

- **Pre-Design Phase** – The design-year baggage screening demand is estimated 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. Using the GFI request form found in Appendix A, the ILDT shall request airport-specific GFI from TSA, if available. TSA may provide a list of optimal preliminary alternatives for the Project Sponsor to consider.
- **Schematic Design Phase** – The work product of the Pre-Design Phase is used to further develop and refine the preferred alternatives, including initial development of design drawings, more detailed Rough-Order-of-Magnitude (ROM) construction cost estimates, and program schedules, resulting in an approved Basis of Design Report (BDR).
- **Detailed Design Phase** – The BDR is used to refine and finalize detailed design drawings, ROM construction cost estimates, and program schedules. Three sub-phases are used as milestones: 30%, 70%, and 100% design.
- **Construction Phase** – The CBIS is constructed following the 100% detailed design documents. Any changes to the approved documents are submitted to TSA for review and approval. Schedules for construction, equipment delivery, and testing are finalized. Training is also included in the construction phase prior to the testing and commissioning of the system.
- **Testing and Commissioning Phase** – All required tests are conducted before the system is commissioned.
- **Project Closeout Phase** – All final as-built documentation is submitted.

TSA may choose to allow the Project Sponsor to forgo certain project phase submissions at its discretion. The Project Sponsor may also request to forgo project phases through the RFV process explained in Section 4.6.2. Project Sponsor may request a combined Pre-Design and Schematic Design submittal at certain locations deemed applicable to the TSA Project Coordinator.

Figure 4.1 summarizes the pre-design, schematic design, and detailed design phases described in the PGDS.

Figure 4.1: CBIS Project Design Phases



4.4 Design-Build Projects

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 in the PGDS.

Documentation shall be provided in accordance with a schedule coordinated by the Project Sponsor and TSA to ensure applicability of the intended system to the guidelines and standards presented in the PGDS.

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

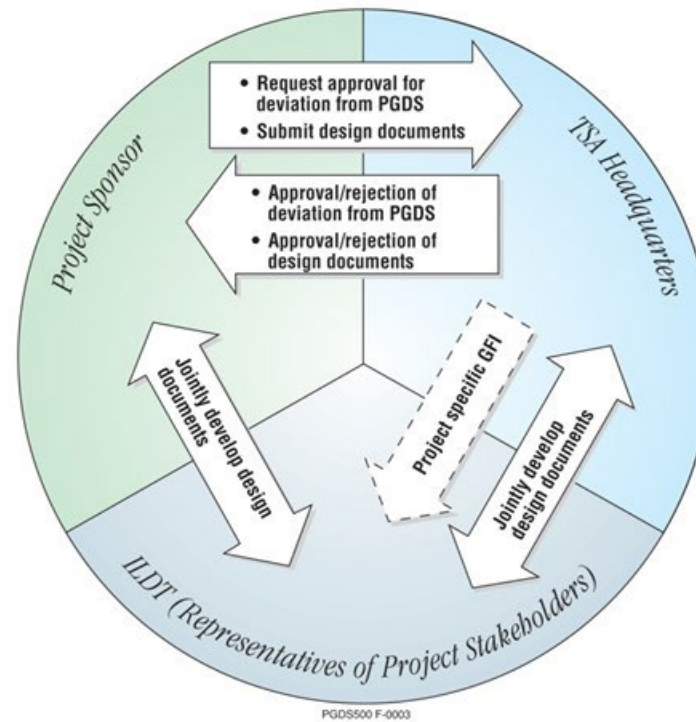
4.5 Design Review Process

The following TSA stakeholders are involved in the design review process: design reviewers, site leads, engineering staff, life-cycle support staff, and Project Coordinator. The design review process consists of the following steps for each design phase:

- The Project Sponsor submits the design submittals to the TSA.
- After reviewing the Project Sponsor's submittals, if TSA determines additional data is needed, the TSA instructs the Project Sponsor to provide any missing information to the TSA design review team.
- Following receipt of the requested data, TSA will complete the review process and provide the Project Sponsor with written review comments including either acceptance or rejection of the submittals. This may be followed by a meeting or teleconference between the TSA, the Project Sponsor, and the CBIS Designer to discuss TSA's comments, particularly if submittals are rejected.
- The Project Sponsor shall provide a written response to each TSA comment on the form and in the space provided.
- Based on the Project Sponsor's response to the comments and any subsequent discussions and clarifications, the TSA will accept or reject the submittals.

Figure 4.2 summarizes the interactions between the Project Sponsor, ILDT, and TSA Headquarters in the design review process.

Figure 4.2: Summary of Responsibilities During the Design Process



4.6 General Submittals Requirements

Requirements in this section apply to all CBIS project phase submittals.

4.6.1 Supporting Data

During the entirety of the CBIS project phases:

- All formulas and calculations for figures shall be submitted.
- All PGDS or other TSA-provided rates and numbers shall be used in all submittals unless a RFV is submitted to and approved by TSA.
- All rates and numbers supplied in submittals shall be accompanied by all the supporting numbers and calculations.

4.6.2 Requests for Variance

A RFV is required whenever the CBIS design cannot meet a PGDS requirement. The PGDS RFV Form is found in Appendix A, and on a tab in the Submittals Checklist and Comment Form. RFVs are submitted to TSA Planning branch at CBTPlanning@tsa.dhs.gov.

- The Project Sponsor shall submit a RFV for any PGDS requirement that cannot be met.
- The ILDT shall assess all implications of an exemption from any requirements set forth in the PGDS due to local constraints and supply full documentation supporting the RFV to the project sponsor.
- Design package submittals shall include documentation of all RFVs associated with the CBIS project.

In the event that CBIS design requirements described in Chapter 12 cannot be met, the TSA Design Review Team will notify the EBSP Program Manager and Life Cycle Support (LCS) Manager to determine the life cycle support impact on the EDS equipment.

4.6.3 Submittals Formatting

All submittals shall be made electronically in print-ready Portable Document Format (PDF) unless otherwise noted, and shall include the following:

- The front page and footer section shall include the title of the design and the applicable PGDS version.
- Each design package shall begin with a table of contents.
- All chapters/submittals shall be indexed electronically within the file.
- Each chapter shall be identified with an electronic PDF bookmark.
- PDF file size shall not exceed 20 megabytes (MB) for any individual submittal item.

4.6.4 Electronic File Naming Convention

The electronic file names shall conform to the following convention:

ABC_XXX_LOCATION_YYYYMMDD_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.
- YYYYYMMDD is the file date represented as year, month, and day, 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 Variable Frequency Drive (VFD) configuration
 - IDX is an index
 - HMI is a 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

4.6.5 Design Review Comment Form

TSA's Design Review Team provides comments on submittal items requiring additional information or correction to the Project Sponsor in the Design Review Comment Form. The Project Sponsor shall provide written responses to each TSA comment and shall include a reference to the submittals sections where changes were made to address comments. A copy of the Design Review Comment Form is included as a tab in the Submittals Checklist workbook.

4.6.6 Submittals Checklist

To support consistency and transparency in design package submittals and reviews, TSA has developed a Submittals Checklist. The Submittals Checklist is not required, but TSA recommends its use and inclusion with each design package submission.

The Submittals Checklist consolidates the requirements for submittal content and format from multiple locations in the PGDS into a single document to simplify verifying completeness, eliminate repetition, and more clearly illustrate the progression in level of detail through the project phase submittals. The checklist serves as a traceability matrix to document where information addressing requirements is located in the submittal to help design package developers and reviewers verify that all requirements for each phase submittal have been satisfied. The checklist also includes references to the relevant section of the PGDS for each content requirement to ensure that designers and reviewers are literally on the same page for design requirements and any questions that may arise.

The Submittals Checklist is an Excel workbook that is obtained by e-mailing PGDS@tsa.dhs.gov.

4.7 TSA Funding

4.7.1 Funding Application

Airports with an eligible in-line CBIS project may request TSA funding in support of the CBIS design and construction. The two-step application process consists of the submission of (1) a ReMAG request and (2) an application. Guidance and Frequently Asked Questions (FAQs) on the funding and application processes can be found on [TSA's Electronic Baggage Screening Program website](#). For more information on TSA's funding policy, see the Electronic Baggage Screening Program Policy Memo – TSA Funding of Checked Baggage Inspection System Project Costs at the [Sam.gov](#) website using the search term "PGDS".

4.7.2 Use of TSA-Approved Equipment

When TSA funds the design and construction of a CBIS project, the project sponsor shall design their CBIS for incorporation of TSA-qualified EDS and ETD units.

In the event that the airport is not using TSA funding for either the design or construction of a project, the airport may choose to design for a TSA-certified EDS, rather than a TSA-qualified unit throughout the design process. However, TSA will only approve a 100% design to move forward to construction if it is designed using TSA-qualified equipment identified in Chapter 3. The airport assumes the cost and schedule risk that if no qualified equipment exists or has been procured at that time, the airport may need to either redesign the system to use available qualified equipment or delay construction of the system until new qualified equipment becomes available.

4.7.3 Invoicing and Earned Value Management

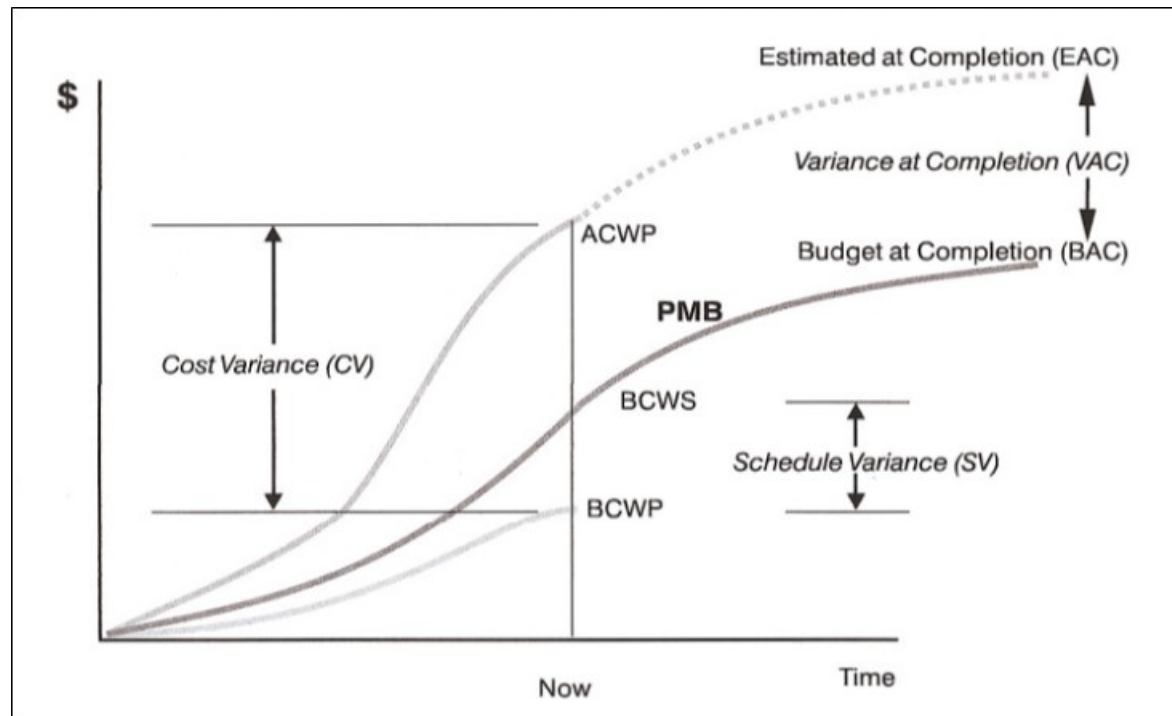
Invoices or requests for payment should include a summary page presented in the same format as the current working cost estimate (see Section 11.9) to allow for ease of tracking and comparing actual expenses to agreed-upon costs. For invoicing instructions, refer to the Project OTA.

Because the practice of Earned Value Management (EVM) and the equation's ability to measure cost performance are widely accepted, 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 Work Breakdown Structure (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 direct and 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)
- Performance Management Baseline (PMB)
- Schedule variance (SV)
- Variance at completion (VAC)
- Cost performance index (CPI) (which equals $BCWP \div ACWP$)

The BCWS, ACWP, and ACWS provide the mechanics for a full analysis of project progress and performance in the EVM environment. 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 calculated as $EAC = ((BAC - BCWP) \div CPI) + ACWP$. Note that $CPI = BCWP \div ACWP$; poor performance produces a CPI greater than 1. Figure 4.3 shows the relationship between the EVM variables and values.

Figure 4.3: Earned Value Management Graph



CHAPTER 5: PRE-DESIGN PHASE



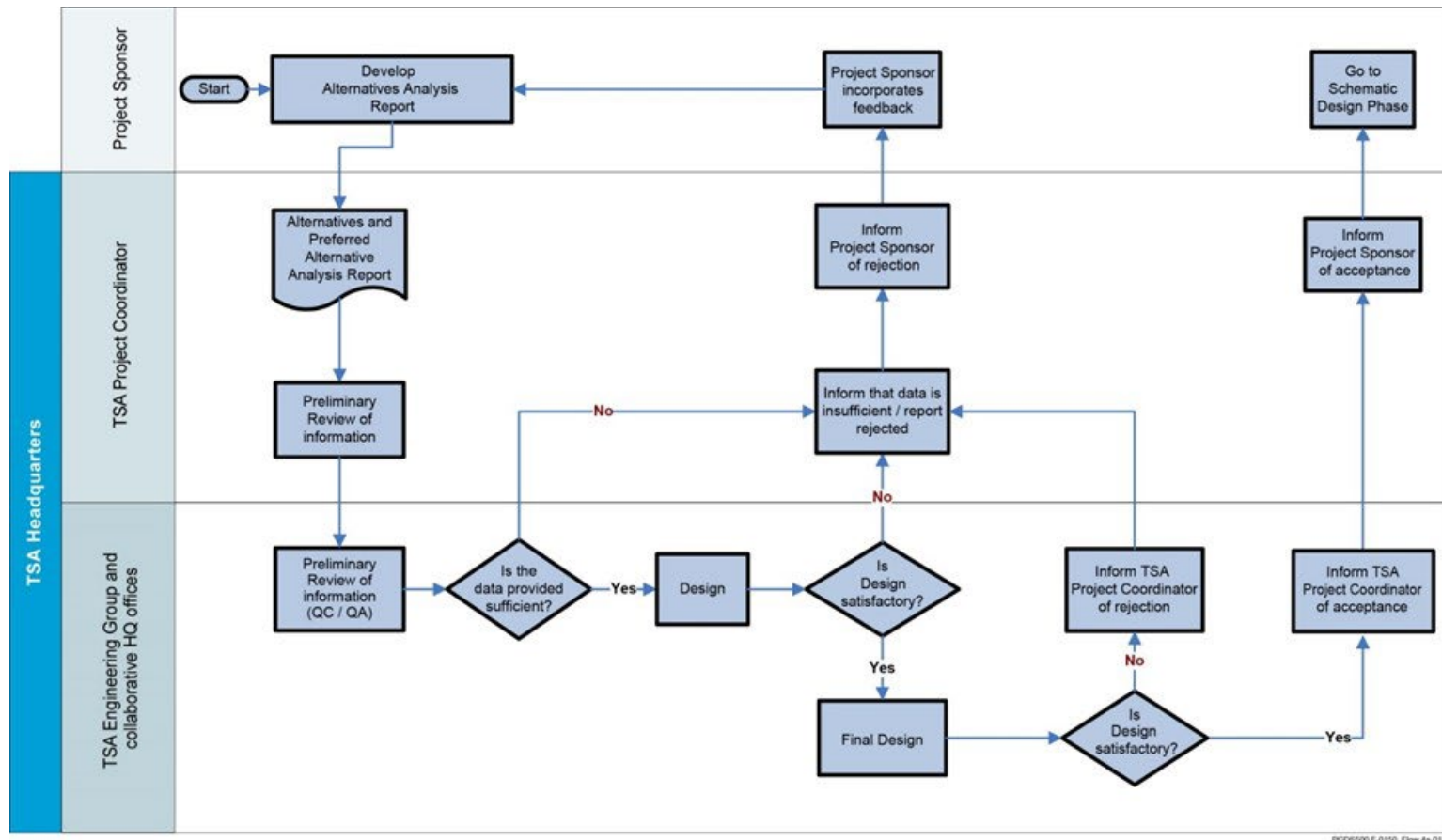
5.1 Pre-Design Phase Overview

The primary purpose of this phase is to identify a preferred 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 candidates. In each iterative cycle, alternatives are further refined and evaluated.

Every terminal at every airport is unique, with a particular set of zones and specific demand levels. All approved CBIS types should be considered to find the optimal 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 the capital, operating, and maintenance costs associated with each alternative for each zone—to determine the most cost-effective solution that is optimally-scaled for that airport or terminal.

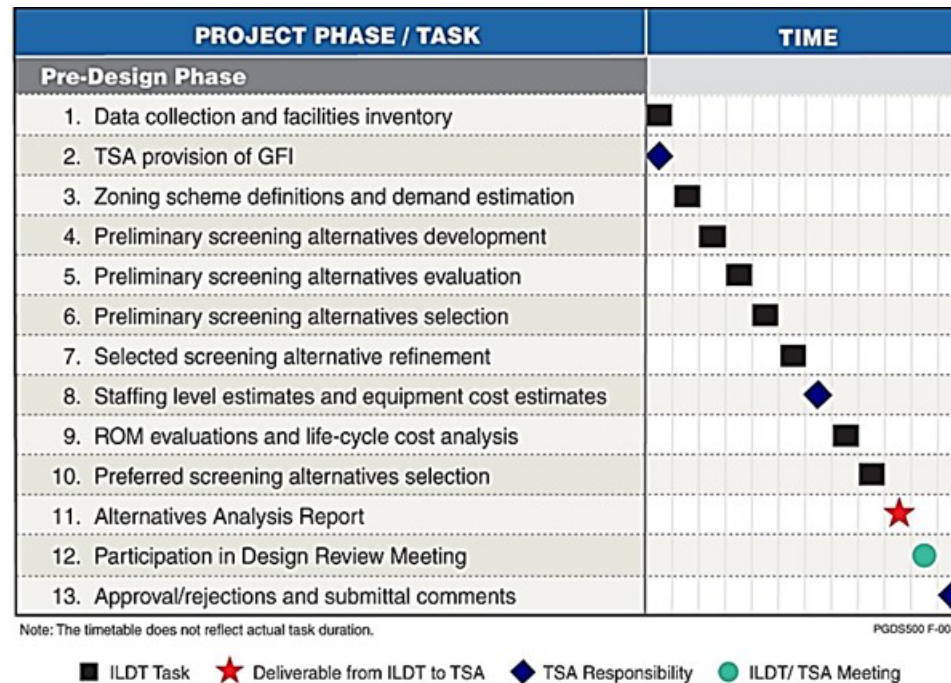
A process flow chart of the Pre-Design Phase is displayed in Figure 5.1.

Figure 5.1: Pre-Design Phase Process Flow



The end product of the Pre-Design Phase will be an Alternatives Analysis Report to be submitted to TSA describing the preferred alternative and the process and rationale used in its selection. To satisfy TSA requirements, the report should provide sufficient documentation to indicate 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 5.2 summarizes ILDT tasks and deliverables and TSA responsibilities for the Pre-Design Phase.

Figure 5.2: Summary of Pre-Design Phase



5.2 Project Sponsor and ILDT Pre-Design Phase Responsibilities

The tasks involved in the Pre-Design Phase that are the responsibility of the Project Sponsor and ILDT are outlined below:

- Collect necessary data, conduct a facilities inventory and participate in a project expectation meeting with TSA.
- Request, receive and review available GFI. Using the GFI as a starting point helps to shorten the design process and possibly nullify the need for a Flight Schedule Analysis (FSA) (see Section 5.5.2.2).
- Define the zoning scheme and estimate design-year baggage screening demand as described in Section 5.5.1. The TSA possesses information that is pertinent to the design review process, especially at the Pre Design level. The Project Sponsor should interact with the TSA to obtain realistic historical values for bags per passenger, peak values for passenger arrivals, passenger arrival curves, etc.

- Develop preliminary screening alternatives as described in Section 5.7. These screening alternatives should be similar to the system types described in Chapter 3.
- 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 Section 5.6). Appendix C contains an example of how a qualitative and high-level quantitative assessment of screening alternatives could be performed.
- Select the most promising alternatives for further development and evaluation.
- 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).
- Obtain TSA staff, equipment, and maintenance cost estimates to perform the life cycle cost analysis.
- Perform ROM evaluations, including 20-year life cycle cost analyses (see Chapter 11).
- Select the Preferred Alternative, which is the alternative that is operationally viable, meets the level-of-service requirements, and has the lowest present value life cycle costs. Other promising alternatives could be carried forward to the Schematic Design Phase at the discretion of the Project Sponsor.
- Submit Alternatives Analysis Report to TSA.
- Receive TSA comments on the Alternatives Analysis Report and formal approval or rejection.
- Participate in a meeting with the TSA Design Review Team in the event the Project Sponsor or ILDT requires clarification on the comments and disposition of the submittal.

5.3 Pre-Design Phase Deliverables

The Pre-Design package shall include the deliverables below:

- **Alternatives Analysis Report** (Sections 5.7 and 5.8)
- **Preliminary project schedule** (Section 6.6.2)
- **Preliminary contingency plan** (Section 7.5; only applicable to mini in-lines at this phase)

The Project Sponsor provides responses to submission comments from TSA's Design Review Team on the Design Review Comment Form, as appropriate (Section 4.6.5). The Submittals Checklist (Section 4.6.6) is recommended but not required.

5.4 TSA Pre-Design Phase Responsibilities

At the beginning of the Pre-Design Phase, TSA will initiate a project expectation meeting with the Project Sponsor and ILDT. If available, TSA will provide the following GFI:

- Historical data and the analysis required to render the baggage design 10-minute rate
- OOG percentage for current EDS units at site
- TSA Enhanced Staffing Model arrival curves and demand assumptions
- Performance Management Information System (PMIS) reports
- Estimates of staffing levels necessary to complete the life cycle cost analysis in preparing the Preferred Alternatives Analysis Report

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

- A Design Review Meeting with the Project Sponsor, ILDT, and TSA project coordinators
- Formal approval or rejection and comments on the report submittals

5.5 Baggage Screening Demand Determination

The intent of baggage screening demand analysis is to ensure that systems are designed to meet the baggage demands of at least 95% of the days as expressed by the peak 10 minutes of each day in the calendar year. Where designing for the 95th percentile does not provide sufficient capacity as determined by the TSA and Project Sponsor, alternative design days can be used with TSA approval.

This section documents the methodology used to determine the Design Demand required to size optimal screening systems within an airport. As explained in detail in the following paragraphs, the steps below summarize the methodology:

1. Categorize the airport into screening zones
2. Determine current checked baggage demand for each zone
3. Project future baggage demand for each zone

To aid the project sponsor in determining the baggage demand through this methodology, the TSA will provide GFI, when requested and available, for the given airport. This information may include data that will assist the project sponsor in determining the design day baggage rate (see Section 5.5.2) and equipment requirements (see Section 5.6). The Project Sponsor may choose to use this information as a guide throughout the analysis or as a justification to shorten the required analysis.

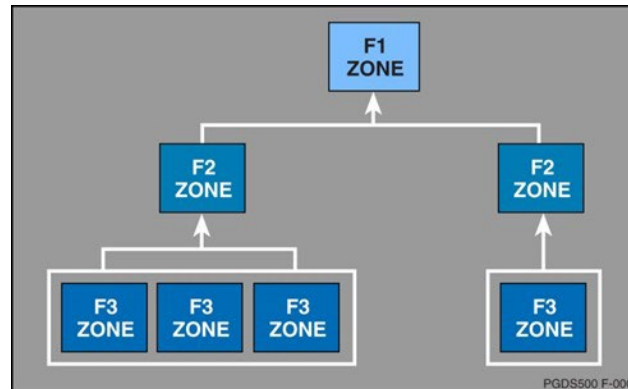
The case studies in Appendix C provide an example of how the steps in Sections 5.5.1 through 5.5.3 should be conducted.

5.5.1 Categorize the Airport 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. Figure 5.3 presents a sample scheme for a tri-level hierarchy (F1, F2, and F3).

Figure 5.3: Zone Hierarchy Representation



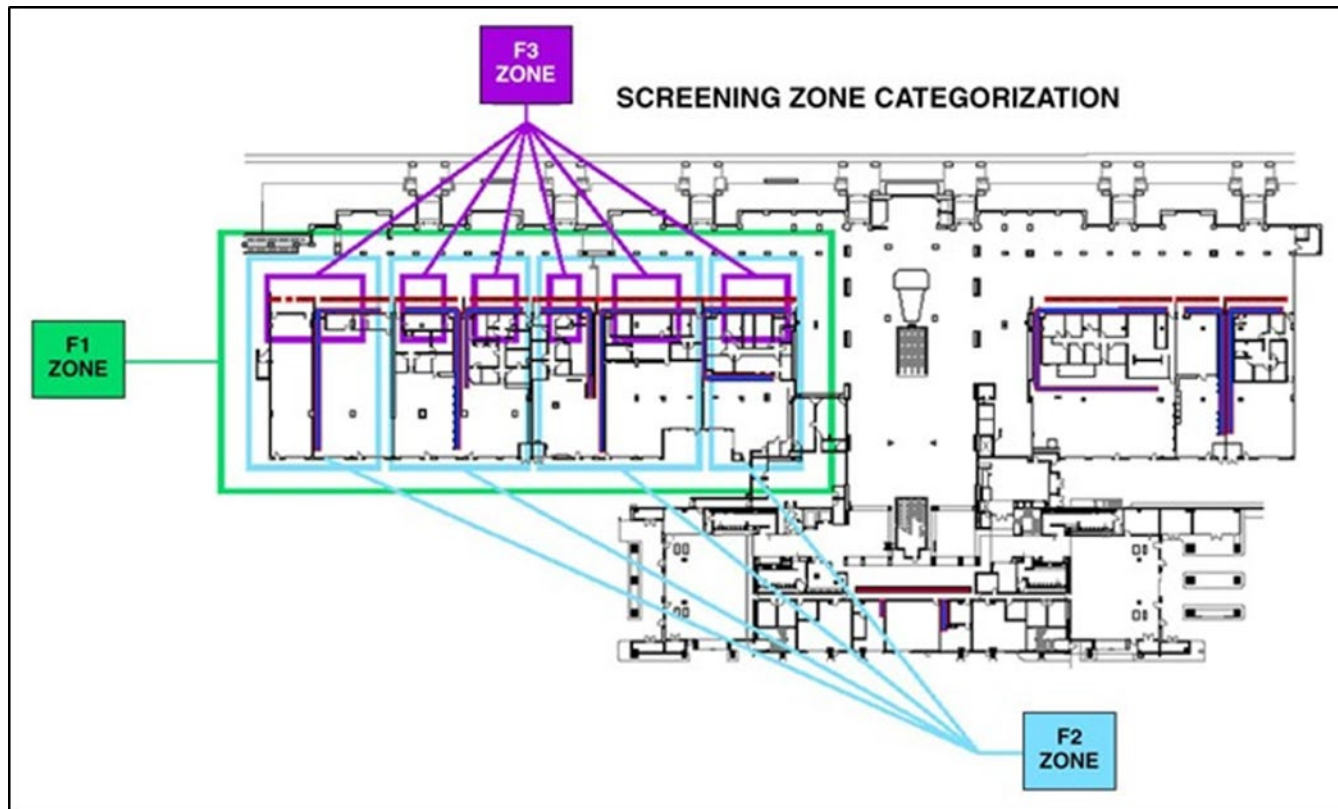
Each element in the hierarchy represents a spatially feasible zone for EDS screening, be it at a small, decentralized level or at a large, consolidated level:

- **F1 Zone** – An F1 zone is the largest feasible zone in an airport for installation of a centralized in-line system. This zone may accommodate multiple airlines that share 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 2 or more adjacent airlines sharing their screening and baggage handling facilities (e.g., a common baggage make-up area).

- **F3 Zone** – An F3 zone is the smallest feasible zone in a 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 5.4 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, and baggage make-up areas are all located on one contiguous level.

Figure 5.4: Assumed Screening Zones at Albuquerque International Sunport



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 an airport into zones is subjective, a detailed explanation of the reasons that a particular screening zone hierarchy was selected over another hierarchy should be provided as part of the Alternatives Analysis Report.

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

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

5.5.2 Determine Current Checked Baggage Demand

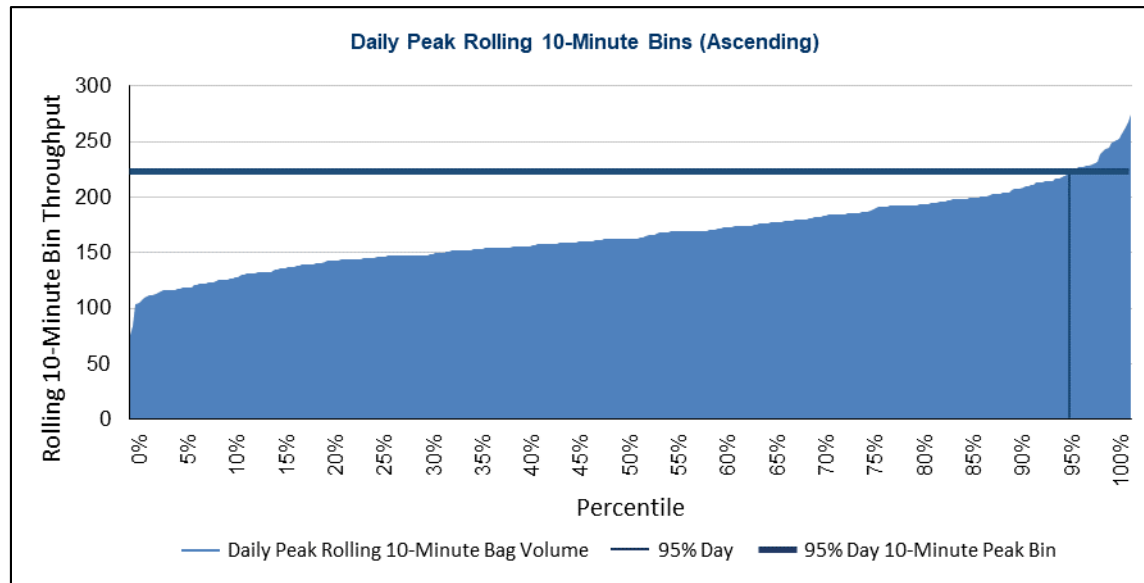
There are two methods for estimating current demand, one using FDRS data and the other based on the FSA. If available, the TSA will supply GFI to assist the ILDT in their determination of current baggage rate demands. This GFI data may consist of historical empirical FDRS data that has been cultivated to yield the peak 10 minutes of every day of the preceding year, individual EDS unit processing rates (by minute or 10-minute rolling bins), and Staff Allocation Model data (yielding some values for parameters such as bags/passenger/airline, hourly rates, etc.).

If available, FDRS data provided by TSA shall be used to determine the current 95th percentile peak 10-minute demand for each screening zone. If GFI is not available, the FSA methodology shall be used to derive the Average Day Peak Month (ADPM) peak 10-minute demand for each screening zone.

5.5.2.1 Field Data Reporting System Analysis Methodology

FDRS data provides an actual measure of current baggage demand. The peak 10-minute volume from each day is graphed from smallest to largest to identify the 95th percentile value for the screening zone, as illustrated in Figure 5.5. The 95th percentile value is used for the Current Demand design value.

Figure 5.5: Example 12-Month FDRS Peak 10-Minute Daily Volume, Ascending



The Current Demand value of 225 bags/10 minutes in the above example is used throughout the rest of this chapter in related example calculations.

No FSA is required when using the FDRS methodology. However, flight schedules (in Excel format) or another basis for deriving the Domestic-to-International ratio for each zone must be submitted.

5.5.2.2 Flight Schedule Analysis Methodology

The FSA method of estimating checked baggage demand analyzes the flight schedules on the ADPM to identify the peak hour demand associated with each screening zone. The FSA method should only be used if FDRS is unavailable or is found to be non-representative of actual baggage demand for some reason.

(1) Identify ADPM

The ADPM is determined from originating bags and international recheck bags for each zone. Historical flight schedules are typically used to determine ADPM; however, if enplanement growth is expected after CBIS construction, the ILDT can submit the planned future flight schedule to TSA for approval. Only validated and TSA-approved flight schedules shall be used to determine ADPM.

- For each screening zone, the total number of monthly originating bags and international recheck bags for all airlines in that zone in a 12-month period shall be obtained and the peak month identified. The month with the maximum combined number of originating and international recheck bags is referred to as the peak month.
- For each screening zone, the total number of daily originating and international recheck bags for all airlines in that zone during the peak month shall be calculated, and a mathematical average shall 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.

(2) Flight Schedule

Once the ADPM for each zone has been determined, that day's flight schedule for each screening zone shall be provided in MS Excel format. To identify outbound baggage demand, flight schedules shall only contain information on departing flights from the subject airport. Flight schedules shall specify for each flight: destination, flight departure time, flight number, published carrier, operator, aircraft type, and number of seats.

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

(3) 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. Because of the 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 if possible.

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

(4) Originating 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 screening 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. typically 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 if possible.

The percentage of passengers arriving on international flights and connecting to domestic flights shall be used to derive international recheck baggage demand.

The estimated number of **originating passengers** shall be calculated by multiplying the number of seats by the load factor and by the percentage of originating passengers assumptions for the ADPM.

$$\text{Originating Passengers} = \text{Number of Seats} \times \text{Load Factor} \times \text{Percentage of Originating Passengers}$$

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

$$\begin{aligned} \text{Connecting Passengers for International to Domestic Flights} \\ = \text{Number of Arriving Seats} \times \text{Load Factor} \times \text{Percentage of Connecting Passengers} \end{aligned}$$

(5) Passenger Arrival Distributions

Passenger arrival distributions specify the percentages of originating and international recheck passengers arriving at the airport a specific number of minutes prior to their flight departure. These distributions are used to determine the flow of passengers checking bags for each flight. The flows for each flight are added together to generate an overall passenger flow over the course of the Design Day.

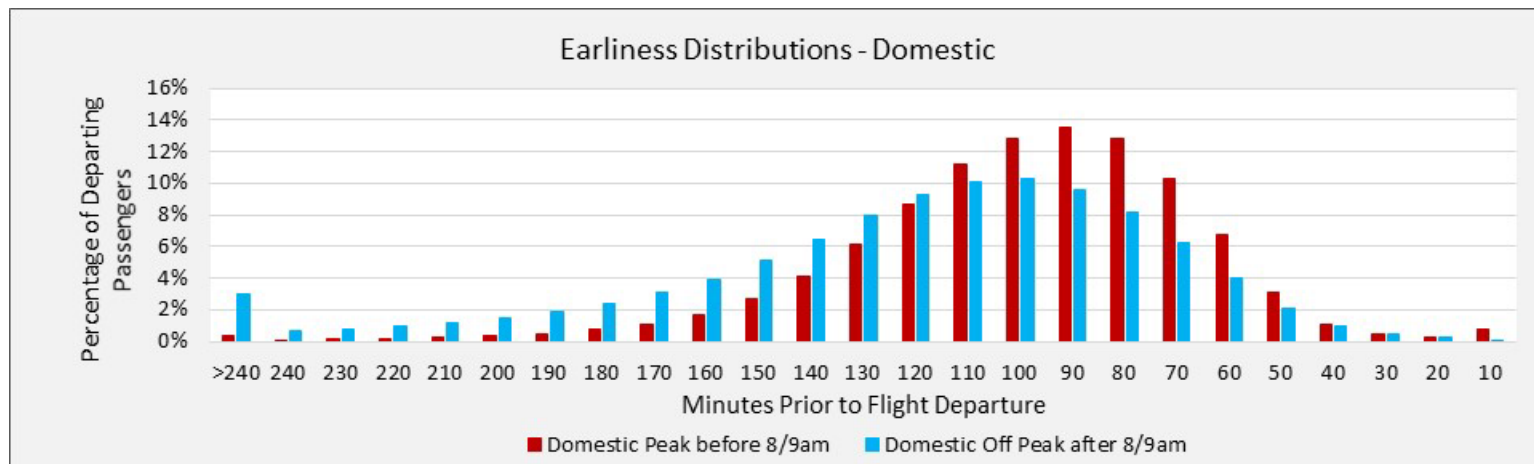
Where possible, and with TSA's concurrence, arrival distributions should be airport-specific, and obtained directly from the airlines. If airport-specific data is not available, the earliness distributions in this section should be used.

Domestic Earliness Distributions: Significant differences exist in the earliness distributions between passengers on Domestic flights departing before 8/9:00 a.m. and after 8/9:00 a.m. Earliness distributions for flights departing in the morning 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.

The distribution for flights departing before 8/9:00 a.m.(peak) hours exhibits higher peaking characteristics and has a much shorter duration than the distribution for flights departing after 8/9:00 a.m. (off-peak) hours.

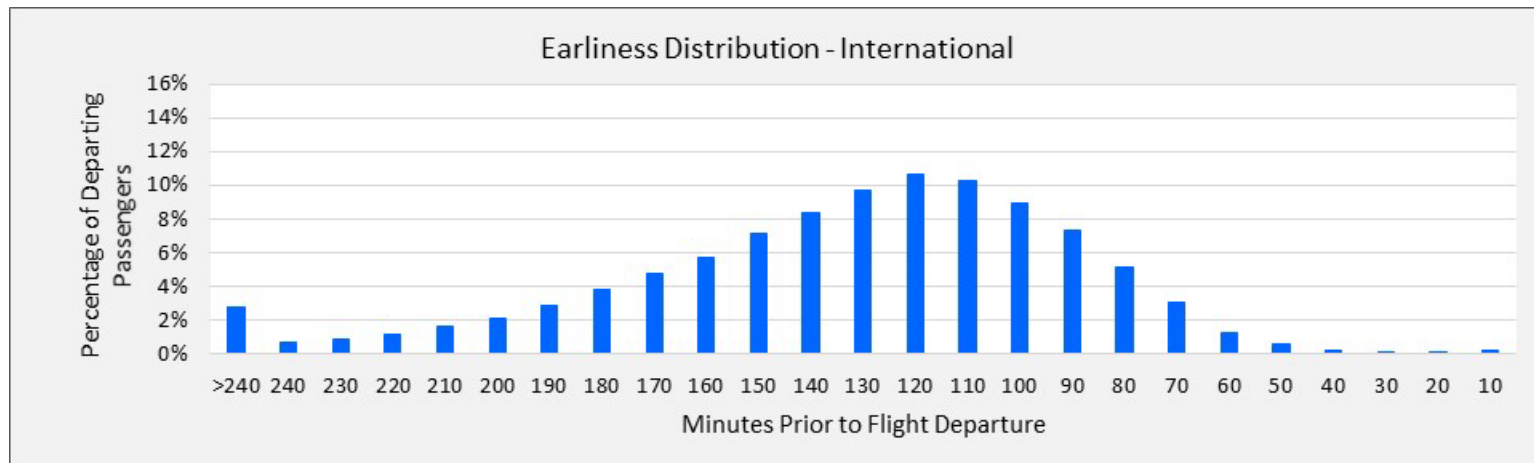
The Domestic earliness distributions are shown in Figure 5.6.

Figure 5.6: Earliness Distributions – Domestic Departures Before 8/9:00 A.M. and Off-Peak-After 8/9:00 AM



International Earliness Distributions: The distribution variance for international departures is higher than for domestic departures and a larger percentage of international passengers arrive at the airport earlier than for domestic flights. The International earliness distributions are shown in Figure 5.7.

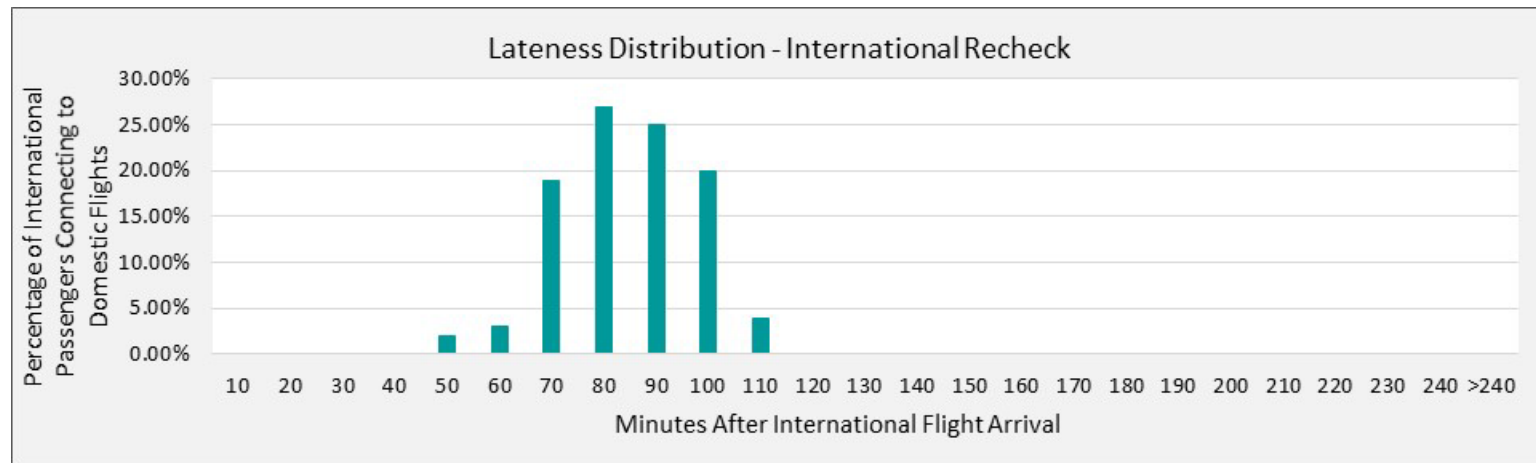
Figure 5.7: Earliness Distribution – International Departures



Lateness Distributions: A lateness distribution for international recheck passengers specifies the percentage of passengers that exit the Federal Inspection Services 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 Figure 5.8.

Figure 5.8: Lateness Distribution – International Recheck



The data underlying the passenger arrival distribution graphs in this section are compiled in Table 5.1. These values should only be used if airport-specific data is not available.

Table 5.1: Passenger Arrival Distributions

Minutes Before Departure/ After Arrival	Earliness Peak Domestic Before 8/9:00 a.m.	Earliness Off-peak Domestic After 8/9:00 a.m.	Earliness International	Lateness Federal Inspection Services Flight
0 to 10	0.80%	0.06%	0.22%	0.00%
10 to 20	0.26%	0.30%	0.11%	0.00%
20 to 30	0.42%	0.48%	0.15%	0.00%
30 to 40	1.10%	0.98%	0.28%	2.00%
40 to 50	3.08%	2.10%	0.61%	3.00%
50 to 60	6.71%	4.03%	1.32%	19.00%
60 to 70	10.34%	6.19%	3.08%	27.00%
70 to 80	12.87%	8.16%	5.13%	25.00%
80 to 90	13.54%	9.59%	7.37%	20.00%
90 to 100	12.79%	10.25%	8.93%	4.00%

Minutes Before Departure/ After Arrival	Earliness Peak Domestic Before 8/9:00 a.m.	Earliness Off-peak Domestic After 8/9:00 a.m.	Earliness International	Lateness Federal Inspection Services Flight
100 to 110	11.21%	10.08%	10.28%	0.00%
110 to 120	8.70%	9.25%	10.69%	0.00%
120 to 130	6.13%	7.95%	9.75%	0.00%
130 to 140	4.11%	6.44%	8.40%	0.00%
140 to 150	2.66%	5.09%	7.12%	0.00%
150 to 160	1.69%	3.94%	5.74%	0.00%
160 to 170	1.10%	3.06%	4.75%	0.00%
170 to 180	0.72%	2.36%	3.81%	0.00%
180 to 190	0.46%	1.83%	2.92%	0.00%
190 to 200	0.32%	1.43%	2.17%	0.00%
200 to 210	0.22%	1.14%	1.62%	0.00%
210 to 220	0.15%	0.92%	1.19%	0.00%
220 to 230	0.11%	0.74%	0.90%	0.00%
230 to 240	0.08%	0.62%	0.71%	0.00%
>240	0.41%	3.01%	2.77%	0.00%
Total	100%	100%	100%	100%

(6) 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 for a 2019 study demonstrate that the number of checked bags per passenger is:

- Average of 0.7 checked bags per originating passenger for domestic flights
- Average of 1.0 checked bags per originating passenger serving international markets
- Average of 1.0 recheck bags per international-to-domestic connecting passenger

These are very generic ranges, and planners should obtain and substantiate locally-collected specific values for the types of carriers and markets served. 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 shall be calculated by multiplying the estimated number of originating passengers by the number of checked bags per passenger assumptions for the ADPM.

$$\text{Originating Checked Bags} = \text{Number of Originating Passengers} \times \text{Number of Checked Bags per Originating Passenger}$$

The estimated number of international recheck bags shall be calculated by multiplying the estimated number of connecting passengers from international to domestic flights by the number of international recheck bags per passenger assumptions for the ADPM.

$$\begin{aligned} \text{International Recheck Bags} \\ = \text{Number of Connecting Passengers} \times \text{Number of International Recheck Bags per Connecting Passenger} \end{aligned}$$

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

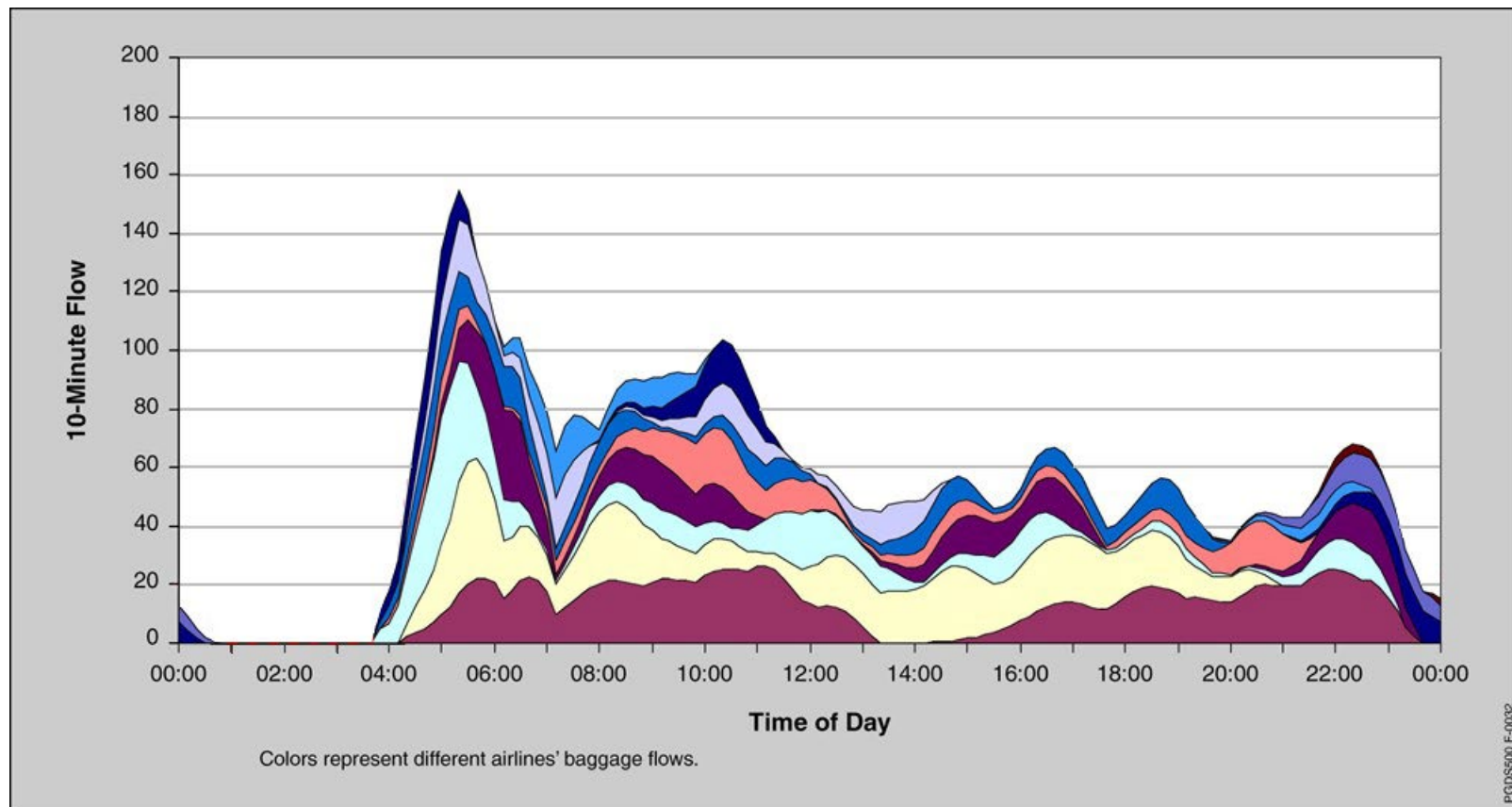
Data	Sources
Scheduled airline activity	Official Airline Guides, Inc. Seabury Airline Planning Group Database Airport sponsor Airlines
Charter airline activity	Airport sponsor Charter airlines
Airline boarding load factors	U.S. Department of Transportation Airlines
Percentage of originating passengers	U.S. Department of Transportation Airlines
Earliness and lateness distributions	Airlines In-field surveys
Checked bags per passenger	Airlines In-field surveys
Historical baggage data	TSA
Enhanced Staffing Model Data	TSA

(7) Identify Peak Demand

The final product of the Flight Schedule Analysis will show the combined baggage flow by 10-minute bin over the ADPM for all airlines in the screening zone. The highest 10-minute bin is used for the Current Demand design value. The ratio of International and Domestic bags in the peak 10-minutes shall be used in CBIS equipment calculations.

Figure 5.9 shows the 10-minute ADPM checked baggage flow by airline for an example airport. Each airline is represented by a different color in this figure. This figure is meant for reference only and is not meant to depict the actual curve smoothness developed using the ADPM process.

Figure 5.9: ADPM Checked Baggage Flow



(8) Calibration of Flight Schedule-Driven Demand

The FSA methodology should be calibrated with actual baggage counts for the relevant airlines. If a significant discrepancy in peak hour baggage demand (for the ADPM) is found between the two sources, then planners should consult with the Project Sponsor to resolve the discrepancy.

5.5.3 Project Future Baggage Demand

The Current Demand value identified through the FDRS or FSA methodology must be projected to reflect expected future growth in demand so that CBIS designs are sized adequately. There are two primary future demand values used in the CBIS design.

- **Design Year Demand** is the basis for CBIS equipment requirements calculations. Current baggage demand shall be projected to the Design Year to determine screening equipment requirements. The Design Year for equipment requirements shall be five years after the initial DBU 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 2023, the Design Year for that system will be 2028.
- **Space Planning Demand** is used to ensure there will be room in the CBIS if additional equipment will be needed to meet demand 15 years after DBU. Current Demand shall be projected to DBU+15 for space planning purposes. This planning includes space for EDSs (Section 5.6), OSR stations (Section 13.3.4), and CBRA stations (Section 14.3).

Baggage demand projections can be based on the FAA 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 demands. 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, they shall provide a revised forecast and detailed explanation of the reasons that the FAA-approved forecast is not acceptable to TSA for approval. The demand cannot be higher than the activity level that can be supported by the terminal gates for which the CBIS is designed.

The growth rate from the TAF or Master Plan forecast can be applied in one of two ways:

- directly applied across a growth period, or
- uniformly applied to the existing baggage demand.

In the event that actual yearly enplanement growth is not provided in the TAF or Master Plan data through DBU+15, a uniform growth rate or extrapolation can be used.

An example of uniform growth rate calculation is below.

The Compound Average Growth Rate (CAGR) is calculated using the following formula:

$$CAGR = \left(\left(\frac{\text{Future Year Enplanements}}{\text{Current Year Enplanements}} \right)^{\frac{1}{\text{Future Year} - \text{Current Year}}} \right) - 1$$

A growth rate calculation over an example date range is shown in Figure 5.10:

Figure 5.10: Example Growth Rate Calculation

Example TAF Enplanements			
Fiscal Year	Air Carrier	Commuter	Total
2018	36,753	208,569	245,322
2019	37,437	215,393	252,830
2020	38,233	222,732	260,965
2021	39,111	230,418	269,529
2022	40,056	238,371	278,427
2023	41,054	246,513	287,567
2024	42,094	254,794	296,888
2025	43,167	263,160	306,327
2026	44,270	271,599	315,869

Current

DBU

DBU+5

$$CAGR = \left(\left(\frac{315,869}{245,322} \right)^{\frac{1}{2026-2018}} \right) - 1$$

$$= 1.2876^{\frac{1}{8}} - 1 = 3.21\%$$

Applying the example growth rate starting with the current demand from the example FDRS chart in Section 5.5.2.1 through DBU+15 yields the Design Year Demand (DBU+5) and Space Planning Demand (DBU+15) shown in Table 5.3:

Table 5.3: Example Baggage Demand Projection

Fiscal Year	Compound Annual Growth Rate	Demand		Planning Year
		10 min	bph	
2018		225.00	1350.00	Current Year
2019	1.0321	232.22	1393.34	
2020	1.0321	239.68	1438.06	
2021	1.0321	247.37	1484.22	DBU
2022	1.0321	255.31	1531.87	DBU+1
2023	1.0321	263.51	1581.04	DBU+2
2024	1.0321	271.97	1631.79	DBU+3
2025	1.0321	280.70	1684.17	DBU+4
2026	1.0321	289.71	1738.23	DBU+5 Design Year
2027	1.0321	299.01	1794.03	DBU+6
...etc...	...etc...	...etc...	...etc...	...etc...
2035	1.0321	384.99	2309.96	DBU+14
2036	1.0321	397.35	2384.11	DBU+15 Space Planning Year

5.6 Baggage Screening Equipment Requirements Determination

During the Pre-Design Phase, the focus is on determining how many EDS units, OSR stations, and BISs are required, given a certain airline grouping, CBIS type, and EDS equipment type. Once all feasible screening zones 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.

The EDS, OSR, and CBRA equipment requirements and associated screening demand shall be listed in the Basis of Design Report, from DBU through DBU+15 years. These equipment requirements shall be shown in a chart with 1-year increments expressed as calculated values (to the nearest tenth of a decimal point) as well as the rounded values. The equipment requirements for 10 additional years past DBU+5 years shall be used to support space allocation planning in CBRA and OSR.

Equipment requirements shall be revalidated 12 months prior to equipment delivery. If EDS equipment type changes, the construction start date is delayed, or if the construction schedule causes delays more than 12 months beyond the expected DBU, then a revalidation of EDS and CBRA requirements shall be submitted.

5.6.1 Screening Equipment Parameters and Assumptions

5.6.1.1 False Alarm Rate and OSR Clear Rate

The range of expected annual average false alarm rates for EDS can vary 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.

5.6.1.1 Out-of-Gauge and Oversize Screened Baggage

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 Leidos eXaminer 3DX, at maximum width of 32 inches the maximum height of a bag is 14 inches and at a width of 21.5 inches the maximum height of the bag is 21.5 inches. Anything beyond the maximum dimensions of the EDS is considered to be out-of-gauge.

The OOG percentage is based on annual and national averages for domestic and international flights with varying bag sizes and on maximum bag dimensions specified by BHS designers and EDS manufacturers. The OOG percentage is based on the EDS model 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.

OS bags are items that are too large to be conveyed by the standard width conveyors. These are generally delivered to the CBRA through a separate larger wider conveyor line or hand-delivered to a screening location.

5.6.1.2 EDS Error and Lost-In-Track Baggage

EDS error bags are items that errored in the EDS and tracked to the CBRA with an EDS Error status. These bags can either be reinserted or manually screened as determined by the TSO.

Lost-In-Track (LIT) bags are bags that are not tracked properly post-EDS. These bags may have received a decision by the EDS, but are sent to CBRA because the original tracking ID association is lost. Depending on the screening system, these bags may be reconciled in the CBRA using the IATA bag tag and a hand scanner.

5.6.1.3 Design Values

Site-specific design values are always preferred over assumed values for EDS system sizing. The use of the assumed values in Table 5.4 is allowed only in the absence of site-specific data and when accompanied by supporting data deemed acceptable to the Project Coordinator.

Table 5.4: Assumed Design Values

Design Parameter	Assumed Values
EDS Errored Rate	1%
Lost-In-Track Rate	2% with connected Reinsertion Line or 1% without
Oversize Rate	2%
Out-of-Gauge Rate	2%
Average Bag Length	Domestic 29.3", International 30.2"

5.6.2 EDS Equipment Requirements

The following key inputs are needed to determine EDS equipment requirements:

- Design Year Demand, calculated as described in Section 5.5.3
- Adjustment percentages and formulas
 - OOG and OS bag percentages
 - Reinserted bag percentage
 - Surge factor (only applicable to FSA-derived Design Year Demand)
- Ratio of domestic to international flights
- CBIS type and EDS equipment type (a list of system types, EDS equipment types, and EDS throughputs is provided in Chapter 3)

The following steps to calculate EDS requirements are described in detail in this section:

1. Adjust the Design Year Demand to determine EDS Demand
2. Calculate EDS throughput
3. Calculate number of EDS required to meet EDS Demand at the EDS throughput rate

In determining EDS equipment requirements, the 10-minute demand of the Design Year (DBU+5) shall be used.

5.6.2.1 Determine EDS Demand

Design Day Demand does not always equal EDS Demand. EDS Demand is determined using one of the three conditions below:

- **If FDRS data from an in-line system is being used to derive demand for a new in-line system**, EDS Demand is equal to Design Day Demand.
- **If the Design Year Demand was derived using the FSA methodology**, EDS Demand equals (Design Year Demand minus OS minus OOG plus Reinsert bags) multiplied by a surge factor.
 1. Subtract bags that will not pass through the EDS (OS and OOG), then add Reinsert bags to find the Adjusted Design Year Demand.
 2. Calculate a surge factor to account for random variability in the expected average demand and 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 surge factor is derived from an assumed arrival Poisson process distribution. The surge factor accounts for random variability in the expected average 10-minute-based demand and ensures 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 each zone-specific surge factor:

$$\text{Surge Factor} = \frac{\text{Adjusted Design Year Demand} + 2\sqrt{\text{Adjusted Design Year Demand}}}{\text{Adjusted Design Year Demand}}$$

3. Multiply the Adjusted Design Year Demand by the Surge Factor to find the EDS Demand.
- **If FDRS data from a standalone system is being used to derive demand for a new in-line system**, EDS Demand equals Design Year Demand plus Reinsert bags.

5.6.2.2 Calculate EDS Throughput

Throughput is a function of the expected EDS model data and applicable domestic/international blended average bag length, reduced by 5% to account for denigration from skewed bags. EDS throughput rates shall be calculated using the following formula:

$$\text{Throughput}_{EDS} = \left(\frac{\text{EDS Belt Speed}}{(29.3" \times \% \text{ Domestic}) + (30.2" \times \% \text{ International}) + \text{bag spacing}} \right) \times 95\%$$

where **Throughput_{EDS}** = Number of bags screened per hour by the EDS.

An example of the EDS throughput calculation for the Leidos eXaminer 6700 ES with a 70%/30% ratio of Domestic to International bags is shown in Figure 5.11.

Figure 5.11: Example EDS Throughput Calculation

Assumptions EDS Belt Speed = 39.5 fpm for eXaminer 6700 ES % Domestic = .70 % International = .30 Avg Domestic Bag Length = 29.3 in Avg International Bag Length = 30.2 in Bag Spacing = 12 in	$\begin{aligned} \text{Throughput}_{EDS} &= \frac{\text{EDS Belt Speed} \times 60}{(29.3 \text{ in} \times \% \text{ Domestic}) + (30.2 \text{ in} \times \% \text{ International}) + \text{Bag Spacing}} \times 95\% \\ &= \frac{39.5 \text{ fpm} \times 60}{(2.4 \text{ ft} \times .70) + (2.5 \text{ ft} \times .30) + 1 \text{ ft}} \times 95\% \\ &= 649.94 \text{ bph} \end{aligned}$
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5.6.2.3 Calculate Number of EDS Required

The number of EDS units required shall be calculated as follows:

$$N_{EDS} = \frac{\text{EDS Demand} \times 6}{\text{Throughput}_{EDS}}$$

where:

N_{EDS} = Number of EDS units

EDS Demand = 10-minute demand that will be screened by EDS units

Throughput_{EDS} = Number of bags screened bags per hour by the EDS.

The resulting number is rounded up to the next whole number of EDS. If the calculated EDS value yields less than or equal to X1 of an EDS, a Technical Interchange Meeting (TIM) will be scheduled to determine the most appropriate rounding conditions.

Continuing the example with projected demand from Section 5.5.3 and EDS throughput from Section 5.6.2.2, the number of EDS machines required would be calculated as shown in Figure 5.12.

Figure 5.12: Example EDS Requirements Calculation

Assumptions	Number of EDSs for Design Year (DBU+5)	Number of EDSs for Space Planning (DBU+15)
Design Year EDS Demand = 289.71 bags/10 min Space Planning EDS Demand = 397.35 bags/10 min EDS Throughput = 649.94	$N_{EDS} = \frac{EDS\ Demand \times 6}{Throughput_{EDS}}$ $= \frac{289.71 \times 6}{649.94}$ $= 2.67 \text{ rounds to } \mathbf{3\ EDS\ machines}$	$N_{EDS} = \frac{EDS\ Demand \times 6}{Throughput_{EDS}}$ $= \frac{397.35 \times 6}{649.94}$ $= 3.67 \text{ rounds to } \mathbf{4\ EDS\ machines}$

As screening systems are sized to meet demand 95% of the time, 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.

5.6.3 EDS Equipment Redundancy

Estimating EDS equipment requirements based on surged peak-hour baggage demand 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.

To attain the best possible values for operational availability, an additional EDS unit will be supplied per EDS unit grouping. A grouping is defined as a quantity of EDS units situated together and fed from a single or dual mainline. A single redundant EDS machine shall not be shared between two EDS groupings.

The quantity of mainlines, as well as the quantity of EDS units in a CBIS should be minimized. This increases efficiency, improves operational availability, and reduces cost.

The redundant EDS units are intended to provide replacement capacity in the event that some of the nonredundant EDS units are out-of-service for a period of time.

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 or ETD screening protocols. It is expected that redundant equipment will only be cost-effective for In-line CBIS types, where unit downtime can have a significant effect on system performance.

TSA will endorse the CBIS right of way 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.

5.6.4 OSR Station Requirements

For certain system types, the 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 IT infrastructure requirements.

Thus, to select the best OSR system type and location, it is recommended that OSR options be evaluated by assessing OSR staffing needs, capital costs of IT infrastructure and building modifications, and Operations and Maintenance (O&M) costs associated with each option.

The number of OSR stations (N_{OSR}) required shall be equal to the number of EDS machines including any redundant machines.

Continuing our example from earlier, assuming the system qualifies for a redundant EDS machine, four OSR stations will be required for a CBIS with three non-redundant EDS machines and one redundant EDS machine; however, the OSR area should be designed to accommodate five OSR stations, since four non-redundant EDS machines are projected to be required to meet EDS demand at DBU+15.

5.6.5 Baggage Inspection Station Requirements

The total number of BISs required for screening is divided into two categories: BISs required for the processing of Alarmed, OOG, and Reinserted bags, and BISs required to screen Oversized bags. These values are combined for total BIS required, as shown in the formula below.

$$N_{BIS} = (N_{Alarmed} + N_{OOG} + N_{Reinsert}) + N_{OS}$$

5.6.5.1 Baggage Inspection Stations for Alarmed, Reinsert, and OOG Processing

The number of BISs to be installed shall be based on the number of non-redundant EDS machines.

For systems processing Alarmed+Reinsert+OOG bags on the same lines, the number of BISs to meet demand shall be calculated as follows:

- For a strictly Domestic operation, 4 BISs are allocated per non-redundant EDS machine.
- For a strictly International operation, 4.5 BISs are allocated per non-redundant EDS machine.
- For operations that include a percentage of International destinations in the peak hour, the number of BISs per non-redundant EDS machine is pro-rated between 4 and 4.5 according to the Domestic/International ratio.
- The calculated number of BISs is half-rounded, where greater than or equal to 0.5 rounds up, and less than 0.5 rounds down.

For systems with separate Alarmed+Reinsert lines and OOG lines, the number of BISs to meet demand shall be calculated as follows:

- For a strictly Domestic operation, 3.3 BISs are allocated per non-redundant EDS machine for Alarmed+Reinsert bag processing and 0.7 BISs are allocated per non-redundant EDS machine for OOG bag processing.
- For a strictly International operation, 3.6 BISs are allocated per non-redundant EDS machine for Alarmed+Reinsert bag processing and 0.9 BISs are allocated per non-redundant EDS machine for OOG bag processing.
- For operations that include a percentage of International destinations in the peak hour, the number of BISs per non-redundant EDS machine for each group of lines is pro-rated between the values above according to the Domestic/International ratio.
- Rounding for the two groups of lines is as follows:
 - For Alarmed+Reinsert bag processing, the calculated number of BISs is half-rounded, where greater than or equal to 0.5 rounds up, and less than 0.5 rounds down.
 - For the OOG bag processing, the calculated number of BISs is rounded similar to the EDS rounding methodology; greater than or equal to 0.1 rounds up, and less than 0.1 rounds down.

For systems that do not use default average bag lengths as specified in Table 5.4, an RFV shall be submitted to deviate from the BIS-per-EDS requirement specified in this section.

An example calculation for the number of BISs needed in a system processing Alarmed+Reinsert+OOG bags on the same lines is illustrated in Table 5.5.

Table 5.5: Required BIS for Systems Without a Separate OOG Line

Non-Redundant EDS Qty	100 % Domestic / 0% International	70 % Domestic / 30% International	0 % Domestic / 100% International
1	4	4.2 (rounds to 4)	4.5 (rounds to 5)
2	8	8.3 (rounds to 8)	9
3	12	12.5 (rounds to 13)	13.5 (rounds to 14)
4	16	16.6 (rounds to 17)	18
5	20	20.8 (rounds to 21)	22.5 (rounds to 23)

Continuing our example from earlier, 13 BISs are required to process Design Year Alarmed+Reinsert+OOG bags for a CBIS with 3 non-redundant EDS machines and a 70%/30% Domestic-to-International ratio. For space planning purposes, with 4 EDS machines projected to meet EDS Demand at DBU+15, the CBRA should be designed to accommodate up to 17 non-oversize BISs.

Table 5.6 illustrates calculations for systems with a separate OOG line, where the BIS allocation is separated into Alarmed+Reinsert BIS and OOG BIS.

Table 5.6: Required BIS for Systems With a Separate OOG Line

Non-Redundant EDS Qty	Alarmed+Reinsert 100 % Domestic / 0% International	Alarmed+Reinsert 70 % Domestic / 30% International	Alarmed+Reinsert 0 % Domestic / 100% International	OOG 100 % Domestic / 0% International	OOG 70 % Domestic / 30% International	OOG 0 % Domestic / 100% International
1	3.3 (rounds to 3)	3.5 (rounds to 4)	3.6 (rounds to 4)	0.7 (rounds to 1)	0.7 (rounds to 1)	0.9 (rounds to 1)
2	6.7 (rounds to 7)	6.8 (rounds to 7)	7.2 (rounds to 7)	1.3 (rounds to 2)	1.5 (rounds to 2)	1.8 (rounds to 2)
3	10.0 (rounds to 10)	10.3 (rounds to 10)	10.7 (rounds to 11)	2.0 (rounds to 2)	2.2 (rounds to 3)	2.8 (rounds to 3)
4	13.3 (rounds to 13)	13.7 (rounds to 14)	14.3 (rounds to 14)	2.7 (rounds to 3)	2.9 (rounds to 3)	3.7 (rounds to 4)
5	16.6 (rounds to 17)	17.1 (rounds to 17)	17.9 (rounds to 18)	3.4 (rounds to 3)	3.7 (rounds to 4)	4.6 (rounds to 5)

Returning to our example, if the system had separate Alarmed+Reinsert lines and OOG lines with 3 non-redundant EDS machines, 10 BISs would be allocated for Alarmed+Reinsert bag processing and 3 BISs would be allocated for OOG bag processing. For space planning purposes, with 4 EDS machines projected to meet EDS Demand at DBU+15, the CBRA should be designed to accommodate 14 BISs for Alarmed+Reinsert bag processing and 3 BISs for OOG bag processing.

EDS machines projected to meet EDS Demand at DBU+15, the CBRA should be designed to accommodate 14 BISs for Alarmed+Reinsert bag processing and 3 BISs for OOG bag processing.

The BIS allocation design values include risk mitigation against future changes in the EDS false alarm rate, OSR clear rate, or both that could increase bags to CBRA. TSA may approve a design with a higher ratio of BIS to EDS if the airport determines that their CBRA demand is unusually high and submits a RFV.

5.6.5.2 Oversize Baggage Inspection Station Requirements

The number of BIS required to process Oversize bags shall be calculated using the following equation:

$$N_{OS} = \frac{N_{EDS} \times \text{Throughput}_{EDS} \times \% OS}{(Rate_{OS Domestic} \times \% Domestic) + (Rate_{OS International} \times \% International)}$$

Where:

N_{EDS} = number of non-redundant EDS

Throughput_{EDS} = throughput of the EDS

% OS = percentage of OS bags

$Rate_{OS Domestic}$ = rate at which TSOs resolve domestic OS baggage via OS search

$Rate_{OS International}$ = rate at which TSOs resolve international OS baggage via OS search

The OS requirement value is rounded up and then added to the rounded Alarmed+Reinsert+OOG value if OS screening is performed in CBRA, or treated separately if OS screening is performed outside of CBRA.

Figure 5.13 shows example Oversize BIS requirement calculations using the values from the example equipment calculations throughout this section.

Figure 5.13: Example Oversize BIS Calculation

Assumptions

Design Year # EDS = 3
 Space Planning # EDS = 4
 EDS Throughput = 649.94
 % OS bags = .02
 % Domestic = .70
 % International = .30
 Domestic OS Bag
 Processing Rate = 19.5 bph
 International OS Bag
 Processing Rate = 13.8 bph

Number of OS BISs for Design Year (DBU+5)

$$\begin{aligned}
 N_{os} &= \frac{N_{EDS} \times \text{Throughput}_{EDS} \times \% OS}{(\text{Rate}_{OS Domestic} \times \% Domestic) + (\text{Rate}_{OS International} \times \% International)} \\
 &= \left(\frac{3 \times 649.94 \times .02}{(19.5 \times .70) + (13.8 \times .30)} \right) \text{rounded up} \\
 &= 2.19 \text{ rounds up to 3 OS BISs}
 \end{aligned}$$

Number of OS BISs for Space Planning (DBU+15)

$$\begin{aligned}
 N_{os} &= \frac{N_{EDS} \times \text{Throughput}_{EDS} \times \% OS}{(\text{Rate}_{OS Domestic} \times \% Domestic) + (\text{Rate}_{OS International} \times \% International)} \\
 &= \left(\frac{4 \times 649.94 \times .02}{(19.5 \times .70) + (13.8 \times .30)} \right) \text{rounded up} \\
 &= 2.92 \text{ rounds up to 3 OS BISs}
 \end{aligned}$$

A CBIS with 3 non-redundant EDS machines and a 70%/30% ratio of Domestic to International bags would require 3 BISs for processing Oversize bags in addition to the 13 for non-oversize bag processing in the Design Year. For space planning purposes, the number of OS BISs remains 3 even when the number of EDS increases to four at DBU+15.

5.6.6 ETD Machine Requirements

BISs for Alarmed, OOG, and Reinsert bags are located in the CBRA. BISs for Oversize bag screening can be located outside of the CBRA, e.g., in the lobby. In general, an ETD machine is shared between two BISs 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 BISs to ETD equipment is typically two to one. If OS bag screening is conducted outside of the CBRA, the ETD requirements are calculated separately for CBRA and the OS screening area.

The number of ETD machines required shall be calculated as the number of BISs divided by two; fractional results are rounded up to the next whole number. Calculations using the example values from the previous section are shown in Figure 5.14.

Figure 5.14: Example ETD Calculations

Number of ETDs for Design Year (DBU+5)		
All BISs in CBRA	OS Screening Outside of CBRA	
$N_{ETD} = \frac{(N_{Alarmed} + N_{Reinsert} + N_{OOG}) + N_{OS}}{2}$ $= (13 + 3)/2$ $= 8 \text{ ETDs}$	$N_{ETD} = \frac{(N_{Alarmed} + N_{Reinsert}) + N_{OOG}}{2}$ $= (10 + 3)/2$ $= 6.5$ rounds to 7 ETDs	$N_{ETD} = \frac{N_{OS}}{2}$ $= 3/2$ $= 1.5$ rounds to 2 ETDs
PLUS		

Number of ETDs for Space Planning (DBU+15)		
All BISs in CBRA	OS Screening Outside of CBRA	
$N_{ETD} = \frac{(N_{Alarmed} + N_{Reinsert} + N_{OOG}) + N_{OS}}{2}$ $= (17 + 3)/2$ $= 10 \text{ ETDs}$	$N_{ETD} = \frac{(N_{Alarmed} + N_{Reinsert}) + N_{OOG}}{2}$ $= (14 + 3)/2$ $= 8.5$ rounds to 9 ETDs	$N_{ETD} = \frac{N_{OS}}{2}$ $= 3/2$ $= 1.5$ rounds to 2 ETDs
PLUS		

Continuing the example from the preceding section, the number of ETDs required for this CBIS in the Design Year would be $(13+3) \div 2 = 8$ ETDs if all BISs are located in the CBRA. If there is a separate OS screening area outside of CBRA, the number of ETDs required would be 9: $13 \div 2 = 6.5$, rounds to 7, for the CBRA and $3 \div 2 = 1.5$, rounds to 2, for the OS screening area.

In determining ETD TSO throughput rates for remote OSR, it is assumed that each TSO has a dedicated viewing station.

5.6.7 Accommodating Traffic Growth after the Design Year

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

For future planning, the ILDT needs to consider the space required for future growth.

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:

- Upgraded software, hardware, or both to improve throughputs of installed equipment.
- Replacement of installed equipment with higher-throughput units and necessary modifications to the BHS to support these units (including providing access to and from the equipment).
- Addition of 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.

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

- **In-Line CBIS** – These systems could be designed with sufficient queuing capacity, variable frequency drives, and other components to support replacement of EDS units 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 units. 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 units 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 an in-line system.
- **Stand-Alone CBIS** – Software and hardware improvements may increase system throughput (assuming that bags can be loaded into the EDS units at a fast enough rate to fully utilize the unit). However, it is expected that additional units 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 11, 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.

While CBIS screening equipment may be replaced during the 20 year life cycle to meet operational needs, 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.

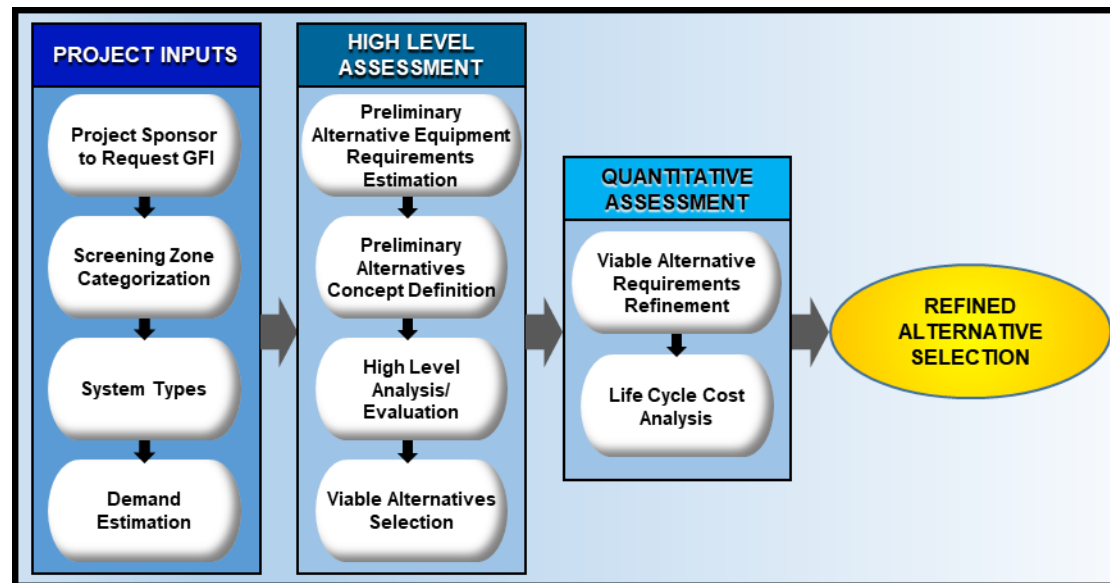
5.7 Alternatives Development and Evaluation

5.7.1 Alternatives Development

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

Figure 5.15 summarizes the alternatives development and evaluation process to be carried out during the Pre-Design and Schematic Phases.

Figure 5.15: Pre-Design Phase Alternatives Development And Evaluation



When developing the Alternatives Analysis Report as stated in the requirements for Pre-Design Phase in Chapter 4, planners shall follow the requirements listed in Sections 5.2 (Project Sponsor and ILDT Responsibilities), 5.6 (Baggage Screening Equipment Requirements Determination), and Chapter 11 (Life Cycle Cost Estimating). 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 Section 5.5.1).
- **CBIS Capacity Data** – Data related to the number and type of screening systems and screening equipment (see Section 5.6).
- **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 Section 5.2).
- **Cost Data** – Equipment, infrastructure, O&M, and staffing costs (see Chapter 11).

Planners are encouraged to develop various alternatives based on conditions at the specific airport. An initial high-level assessment identifies spatially and operationally feasible alternatives. Spatially and operationally feasible alternatives shall be evaluated on the basis of a 20-year life cycle cost analysis detailed in Chapter 11 for implementing, maintaining, and replacing the screening system.

The methodology for developing alternatives, assumptions for assessing the cost effectiveness of the alternatives, and the evaluation process for selecting the preferred alternatives are discussed in this section. Appendix C provides a case study of an airport installation where this methodology was applied.

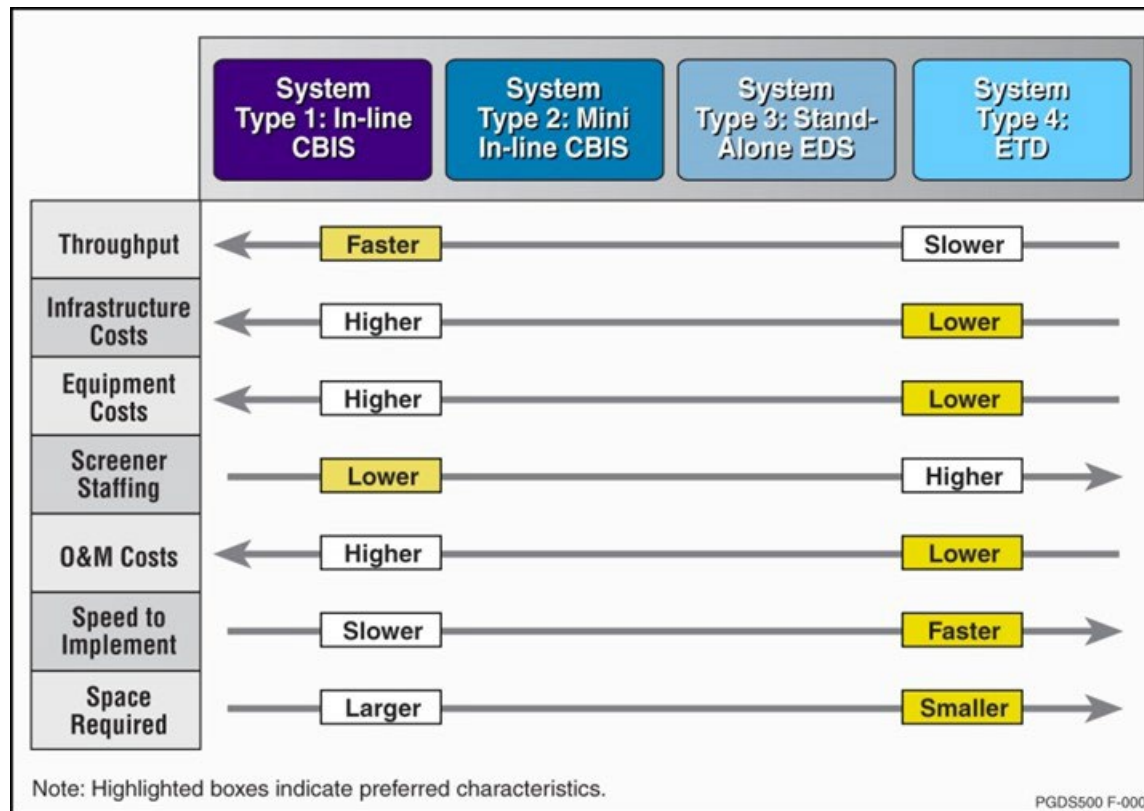
5.7.1.1 Screening Zone Categorization

When defining the set of screening alternatives, planners should compare screening solutions for different combinations of baggage flows. Whenever possible, at least two different combinations of baggage flows should be analyzed to provide a meaningful comparison (e.g., centralized zones vs. airline-specific zones).

5.7.1.2 CBIS Type Selection

Several screening system types could serve demand in each screening zone. The CBIS types defined in Chapter 2 provide different tradeoffs between upfront capital costs and recurring staffing and O&M costs, as illustrated in Figure 5.16 and summarized below:

Figure 5.16: System Type Comparison



- In-Line CBIS.** In-line systems are likely to be used in centralizing screening zones that serve one or more airlines. They are generally the most efficient from the perspectives of EDS unit and staff utilization. However, the centralized nature of these systems may require more complex conveyor arrangements and extensive building modifications, therefore, associated upfront capital investment and O&M costs may be high. These systems may contain extensive buffering space and sections of conveyor allowing for sufficient OSR time.

This system type corresponds to the Qualified Type I EDS as specified in the TSA Procurement Specification (see Section 3.2.1).

- 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 thus 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 an In-Line system 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 In-Line CBIS types (see Section 3.2.2).

- **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 unit (see Chapter 3 for a list of stand-alone EDS units) may be the most economical. A conveyor infrastructure is not required with a stand-alone 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 unit utilization than System Type 2 (see Section 3.3.2).
- **Stand-Alone ETD Systems.** Primary screening with ETD should only be used to screen OOG, OS, fragile, and other baggage that cannot be screened using EDS or at airports with very low bag volume that cannot justify an EDS unit. 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 (see Section 3.4).

Centralized screening zones require a fully automated in-line system (System Type 1). 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.

5.7.1.3 Alternatives Baggage Screening Demand Estimation

Once the screening zones are defined, planners estimate baggage screening demand for each screening zone as explained in detail in Section 5.5.

5.7.1.4 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 Section 5.6.

For each alternative proposed, planners shall determine the CBIS type (e.g., in-line, mini in-line, stand-alone) and number of units required for each screening zone.

5.7.1.5 Alternatives Concept Definition

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

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.

- 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 of 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 units.
 - 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 shall be 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 would 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.
- Contingency Planning
 - Even though a contingency plan is required only for mini-inlines at the Pre-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 of the contingency planning process, contingency plan development, and evaluation of contingency alternatives is included in Section 7.5.

5.7.2 Alternatives Evaluation and Selection

Once 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 alternatives selected.

5.7.2.1 Qualitative 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 unit were inoperative during a peak period, as well as the effect that the alternative would have on the airlines
- **Economic Considerations** – These costs will include those to be borne by TSA as well as airport operators and airlines. The costs associated with TSA staff salaries as well as 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, expanded, and commissioned
- **Ergonomic Considerations** – The accessibility of the system to personnel; inclusive of stairs, ladders, spatial considerations, egresses, and when the manual transport of baggage is required

Based on criteria similar to those listed above, planners and stakeholders 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.7.1. The remaining alternatives should be further refined before analyzing life cycle costs.

Once the number of feasible alternatives has been reduced and those remaining feasible alternatives compared based on life cycle cost, detailed flow modeling is used to further evaluate the alternatives, refine equipment requirements, and evaluate CBIS performance. Flow modeling (Section 6.5.3) helps planners, architects, and CBIS designers transition from high-level concepts to more detailed design. It can also serve as a feedback loop between designers and the Baggage Handling System Contractor (BHSC) regarding the system parameters needed for effective operation of the CBIS. More advanced dynamic modeling is optional and is discussed in Section 7.2.4.

5.7.2.2 Quantitative Evaluation Based on Life Cycle Cost Analysis

Life cycle costs are analyzed for the viable alternatives identified in the high-level assessment to select the preferred alternative (or alternatives). The requirements and details regarding how to conduct a life cycle cost analysis are presented in Chapter 11.

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

5.7.2.3 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. 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, planners shall use the 20-year Real Interest Rate on Treasury Notes and Bonds of Specified Maturities found in the latest version of the Office of Management and Budget Circular No.A-94, Appendix C, as the real discount rate. This discount rate corresponds to guidance from the Office of Management and Budget for projects that accrue costs 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.

$$PV = \left(\frac{C1}{(1+r)^1} \right) + \left(\frac{C2}{(1+r)^2} \right) + \dots + \left(\frac{C20}{(1+r)^{20}} \right)$$

where C1 is the total cost in year 1 and r is the real discount rate.

The total cost (C1) includes (but is not limited to) the following cost categories:

- EDS machine capital costs.
- BHS equipment (Vertical Sortation Units (VSUs), High Speed Diverters (HSDs), conveyors etc.) capital costs.
- BHS maintenance costs.
- TSA staffing costs.
- Overall energy consumption costs.
- Inbound and outbound baggage handling costs.

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.

The least expensive design may not be the most efficient for all concerned. The ILDT should present their position as to why a particular alternative is more efficient compared with another.

5.8 Alternatives Analysis Report

The Alternatives Analysis Report is the primary deliverable in the Pre-Design Phase. This report documents 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.
- This report also documents the life cycle cost analysis and basis for selection of the preferred alternatives to be further developed in the Schematic Design Phase.

This report will be incorporated into the Basis of Design Report in the Schematic Design Phase. An example Alternatives Analysis Report can be found in Appendix C.

The Alternatives Analysis Report shall include, at minimum:

- Background information, including
 - Current airport layout and airlines
 - Objectives for new CBIS
 - Growth potential and limitations
- Alternatives Development (Section 5.7.1)
 - Zoning Schemes
 - System Types
 - Preliminary Alternatives
 - Feasible Alternatives
- For each feasible alternative:
 - Baggage Screening Demand Determination (Section 5.5)
 - Baggage Demand Assumptions
 - Current Year Demand Determination
 - FDRS analysis (Section 5.5.2.1) OR
 - FSA (Section 5.5.2.2)

- Design Year Demand Determination (Section 5.5.3)
 - Growth Methodology Substantiation
 - Growth Calculations
- Screening equipment quantity requirements (Section 5.6)
- Quantitative Evaluation (Section 5.7.2.2, Chapter 11)
 - Life-cycle cost analysis assumptions
 - Life-cycle costs calculations for each alternative
- Qualitative Evaluation (Section 5.7.2.1)
- Selection of Preferred Alternative (Section 5.7.2.3)

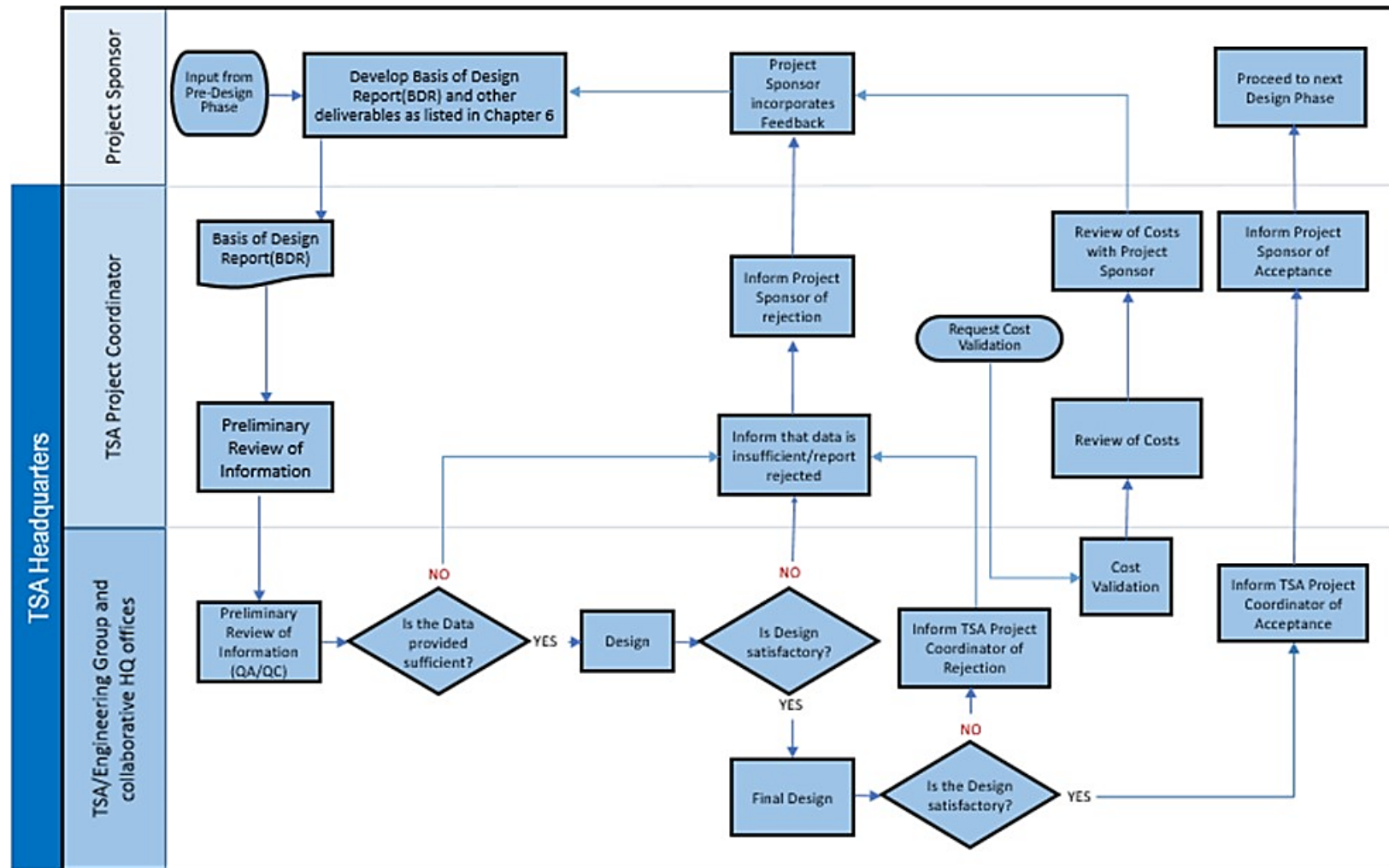
CHAPTER 6: SCHEMATIC DESIGN PHASE



6.1 Schematic Design Phase Overview

During the Schematic Design Phase, the work product of the Pre-Design Phase is used to further develop and refine the Preferred Alternative, including initial development of concept-level design drawings and a program schedule, as well as more detailed ROM construction cost estimates. The BDR is the end product of the Schematic Phase. In the design packages that must be submitted during this phase, increased emphasis is placed on economic analysis, contingency operations plan, and conformance with operational performance standards. A process flow chart of this phase is displayed in Figure 6.1.

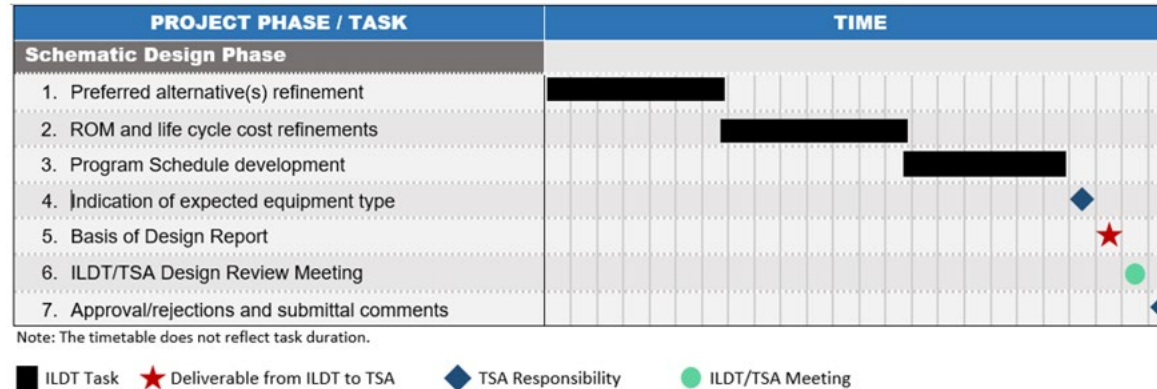
Figure 6.1: Schematic Design Phase Design Process Flow



Footnote: A cost validation may be requested at the TSA Project Coordinator's discretion at any time during the design process

ILDT tasks, deliverables, TSA responsibilities, and meetings during the Schematic Design Phase are addressed in the following paragraphs and summarized in Figure 6.2.

Figure 6.2: Summary of Schematic Design Phase



6.2 Project Sponsor and ILDT Schematic Design Phase Responsibilities

The tasks that are the responsibility of the Project Sponsor and ILDT involved in the Schematic Design Phase are outlined below:

- Further develop and refine the preferred alternatives, including the initial development of design drawings.
- Develop a more detailed ROM construction cost estimate to be incorporated into the life cycle cost analysis performed in the Pre-Design Phase.
- Develop a program schedule.
- Obtain a preliminary indication of expected equipment types from TSA. EDS unit availability and characteristics are subject to the outcome of TSA's competitive procurement.
- Submit the BDR (see below).
- Participate in a meeting with the TSA Design Review Team in the event the Project Sponsor/ILDT requires clarification on the comments and disposition of the submittal. Receive comments on the BDR and formal approval or rejection.

6.3 Schematic Design Phase Deliverables

Detailed requirements for deliverables are in the PGDS sections referenced at the end of each list item below.

The Schematic Design package shall include:

- **Basis of Design Report** (Section 6.5), which adds the following elements to the approved Alternatives Analysis Report:
 - Detailed project requirements (Section 6.5.1)
 - EDS equipment make, model, and quantity that will be provided by TSA (Sections 6.2, 6.4)
 - Preliminary description of operations (Section 6.5.2)
 - Flow-based modeling assumptions and results (Section 6.5.3)
 - List of legacy EDS to be decommissioned (Section 6.5.4)
- **Preliminary layout drawings of the CBIS** (Section 6.6.1)
- **Preliminary phasing plan** (Section 6.6.3)
- **Updated preliminary project schedule** (Section 6.6.2)
- **ROM preliminary Basis of Estimate document** (Chapter 11)
- **ROM estimate of probable construction costs** (Chapter 11)
- **EDS Maintenance and Environment Assessment** of environmental conditions that will exist in the designed CBIS and environmental requirements of EDS units (Section 12.12.2)
- **Contingency plan** (Section 7.5, only applicable to mini in-lines at this phase)
- **Stakeholder notification documentation** (Section 6.6.8)
- **Approved and in-process RFVs** (Section 4.6.2)

The Project Sponsor provides responses to submission comments from TSA's Design Review Team on the Design Review Comment Form, as appropriate (Section 4.6.5). The Submittals Checklist (Section 4.6.6) is recommended but not required.

6.4 TSA Schematic Design Phase 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

- A Design Review Meeting with the Project Sponsor, ILDT, and TSA project coordinators
- Formal approval or rejection and comments on the BDR and supporting submittal documents

6.5 Basis of Design Report

The BDR builds on the Alternatives Analysis Report to provide increasing levels of detail as the CBIS design progresses through the design phases. Refer to the PGDS sections indicated for detailed requirements.

The BDR shall include, as designated for each phase:

- Approved Alternatives Analysis Report (Sections 5.7, 5.8)
- Detailed project requirements (Section 6.5.1)
- EDS equipment make, model, and quantity that will be provided by TSA (Sections 6.2, 6.4)
- Description of Operations (Section 6.5.2)
- Flow-based modeling assumptions and results, including time-in-system and Bag Travel Time (BTT) analyses (Section 6.5.3)
- List of legacy EDS to be decommissioned (Section 6.5.4)

6.5.1 Project Requirements

Project requirements expand on the Background section of the Alternatives Analysis Report to describe detailed information specific to the approved alternative and factors affecting its construction and operation.

The project requirements discussion shall include, at minimum:

- Planning assumptions
- A system evaluation of the approved alternative
- Specific reference to the EDS type that TSA approved in the Alternatives Analysis Report to perform the screening function
- Indication of preferred equipment model and quantity at Schematic Design and specific reference to equipment TSA has committed to provide in subsequent phases
- Constructability technical memoranda documenting project-specific issues for each discipline, including CBIS design and architectural, structural, mechanical, plumbing, electrical, and communications considerations
- Demolition requirements describing what will need to be removed in order for the CBIS project to move forward

6.5.2 Description of Operations

The description of operations discusses how the CBIS and its component parts work and how the system integrates with the airport BHS.

At the Schematic Design Phase, the description of operations shall describe the preliminary operational concept.

At the 30% Detailed Design Phase, the Description of Operations shall describe, at a high level:

- How the overall CBIS is intended to work, with references to how requirements in Chapter 12 will be met
- How OSR is intended to work, with references to how requirements in Chapter 13 will be met
- How CBRA is intended to work, with references to how requirements in Chapter 14 will be met
- How the CBIS integrates with the airport BHS, including contrasting baggage rates and controls methodology

At the 70% Detailed Design Phase, the Description of Operations shall describe:

- Refinements to the 30% design Description of Operations
- Detailed OS and OOG Description of Operations
- Operational description of how the “no-lift” policy will be met in the CBRA

At the 100% Detailed Design Phase, the Description of Operations shall include final refinements to all topics covered in the 70% design Description of Operations.

6.5.3 Flow-Based Modeling

In the Pre-Design Phase, flow-based modeling is used to support the assessment of viable alternatives. From the Schematic Design Phase forward, flow-based modeling is used to validate planning assumptions, justify design elements such as the number of mainlines, analyze bag time in system, and confirm sufficient bag travel time for OSR.

The flow-based modeling discussion shall:

- Identify the paths used for the high-level flow-based modeling calculations on plan view drawings
- Identify the assumptions used for the flow modeling
- Provide time-in-system analysis results including maximum baggage time in system by calculating the shortest and longest times that

- An in-gauge bag will travel through the system as measured from the natural points of bag induction through an EDS, into and out of the CBRA
- An OOG bag will travel from natural induction into and out of the CBRA
- Provide bag travel time analysis results to demonstrate adequate time for OSR

For these calculations, planners should assume constant bag flow based on the design speeds from induction to CBRA with no provision for jams, faults, or halting for merging or diverting.

For complicated system designs, dynamic modeling may prove beneficial and can be performed at the Project Sponsor's discretion. Dynamic modeling is discussed in Section 7.2.4.

6.5.4 EDS to be Decommissioned

The project sponsor shall submit a list of EDS equipment, by make, model, and serial number, that will be decommissioned after the proposed in line system is operational.

6.6 Other Design Package Documents

Requirements for other documents submitted as part of the design package and not described elsewhere in the PGDS are provided in the sections below.

6.6.1 Schematic Drawings

Schematic drawings are submitted during the design, construction, and closout project phases that illustrate detailed structural, mechanical, electrical, and other engineering aspects of the CBIS design.

- All drawing packages shall begin with a cover sheet and index.
- Each drawing shall have a title box. The drawing title box shall be clearly labeled with a construction phase number, where applicable.
- Each drawing shall include a legend.
- Each drawing shall show standard details for the drawing type (structural, mechanical, electrical, etc.)
- Each drawing shall label conveyors and components, if known.
- Each drawing shall show dimension of points of intersection.
- Each drawing package submittal shall include an enlarged single-sheet plan view of the CBIS and an enlarged single-sheet plan view of the CBRA.

Prior to the closeout phase, schematic drawings are submitted in PDF format. Closeout phase schematic drawings are submitted in both PDF and native format (e.g., AutoCad). Closeout phase as-built drawings shall be 1/4" scale for elevation views and 1/8" scale for plan views, except for the BIS plan view, which shall be enlarged to 1/2" scale.

Schematic drawings are refined and updated in each design phase. Failure to properly update drawings to reflect changes from one phase submittal to the next will result in the design package being rejected by the TSA review team and returned to the project sponsor for correction.

In the Construction Phase, TSA shall be provided with 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.

Schematic Design Phase, Detailed Design Phase, and Closeout Phase drawings shall include the elements in Table 6.1 marked as "Required" for the indicated project phase.

Table 6.1: Required Drawing Elements for Specified Project Phases

Drawing Element	Related PGDS Section	Schematic Design	30% Design	70% Design	100% Design	Closeout
CBIS plan views, showing at minimum:	(See below)	(See below)	(See below)	(See below)	(See below)	(See below)
EDS locations	Chapter 14, Appendix B	Required	Required	Required	Required	Required
OSR Area (OSRA) location and spatial dimensions	13.3	Required	Required	Required	Required	Required
CBRA location and spatial dimensions	14.6	Required	Required	Required	Required	Required
IT cabinets and closets	16.8.3	Required	Required	Required	Required	Required
BHS control room or control center location	13.4.3	Optional	Optional	Required	Required	Required
Outlined conveyors and right of ways	12.8	Required	Required	Required	Required	Required
Conveyor delineations, especially near the EDS units	12.8	Optional	Required	Required	Required	Required
Conveyor ID labels	12.8	Optional	Required	Required	Required	Required
Inclines and declines	12.8.5.2	Optional	Required	Required	Required	Required
EDS pedestals, if needed	3.3.1	Optional	Required	Required	Required	Required
EDS unit removal route	12.12.4	Required	Required	Required	Required	Required

Drawing Element	Related PGDS Section	Schematic Design	30% Design	70% Design	100% Design	Closeout
Locations of quick disconnect conveyors	12.12.5	Optional	Required	Required	Required	Required
ATRs, BMAs	12.7.1.1	Required	Required	Required	Required	Required
O&M-related access	12.12.1	Required	Required	Required	Required	Required
Storage for spare parts and tools	12.12.3	Required	Required	Required	Required	Required
Catwalks, platforms, and ladders	14.6.11	Optional	Optional	Required	Required	Required
Stairways intended for TSA personnel	14.6.11	Optional	Optional	Required	Required	Required
Motor Control Panel (MCP) locations	10.3.2	Optional	Required	Required	Required	Required
Motor and drive package locations	14.6.13	Optional	Optional	Required	Required	Required
CBIS/OSRA/CBRA egress plan	13.3.2, 14.6.3	Optional	Optional	Required	Required	Required
Notable interference issues	Chapters 12-15	Optional	Optional	Required	Required	Required
OSRA plan views, including at minimum:	(See below)	(See below)	(See below)	(See below)	(See below)	(See below)
OSRA layout	13.4.2	Required	Required	Required	Required	Required
Entrances and exits	13.3.2	Optional	Required	Required	Required	Required
Windows, if provided	13.3.7	Optional	Required	Required	Required	Required
Workstation arrangement	13.4.4.1	Optional	Required	Required	Required	Required
Shared displays	13.4.5	Optional	Required	Required	Required	Required
Printers	13.1	Optional	Required	Required	Required	Required
CBRA plan views, including at minimum:	(See below)	(See below)	(See below)	(See below)	(See below)	(See below)
Conveyor delineations	12.8	Optional	Required	Required	Required	Required
Design prints indicating how the “no lift” policy is to be met	14.2	Optional	Required	Required	Required	Required
BRPs and insertion positions in relation to workstations and TSO movement space	14.3.2	Required	Required	Required	Required	Required

CBIS PROJECTS

6: SCHEMATIC DESIGN PHASE

Drawing Element	Related PGDS Section	Schematic Design	30% Design	70% Design	100% Design	Closeout
Layout for OS and OOG bags	12.8.11, 12.8.12	Required	Required	Required	Required	Required
Shrouding materials	14.6.13	Optional	Required	Required	Required	Required
Flooring material	14.6.2	Optional	Required	Required	Required	Required
Lighting design	14.6.5	Optional	Required	Required	Required	Required
Noise reduction design	14.6.9	Optional	Required	Required	Required	Required
Bag Inspection Stations (level 3 alarm resolution stations)	14.3	Required	Required	Required	Required	Required
ETD locations and mounting options	14.3	Optional	Required	Required	Required	Required
Bag Viewing Stations, Remote Resolution Station, FDRS locations	14.2	Required	Required	Required	Required	Required
Footprints for proper installation of stairs and ladders	14.6.11	Optional	Required	Required	Required	Required
Elevation views, showing at minimum:	(See below)	(See below)	(See below)	(See below)	(See below)	(See below)
Floor and wall penetrations	14.6.2	Optional	Required	Required	Required	Required
Steep gradients	12.8.5.2, 13.3.6	Optional	Required	Required	Required	Required
Congested areas	Chapters 12-15	Optional	Required	Required	Required	Required
Top of Bed approximate elevations	12.8, 14.3.2	Optional	Required	Required	Required	Required
Multi-level floors	13.3.6	Optional	Required	Required	Required	Required
Vertical dimensions of the CBIS (cross section)	12.12.1	Optional	Required	Required	Required	Required
OSRA vertical space provisions	13.3.6	Optional	Required	Required	Required	Required
CBRA vertical space provisions	14.2, 14.6	Optional	Required	Required	Required	Required
CBRA BISs	14.3	Optional	Required	Required	Required	Required
Electrical	(See below)	(See below)	(See below)	(See below)	(See below)	(See below)
Power pole locations	12.12.6	Optional	Required	Required	Required	Required

Drawing Element	Related PGDS Section	Schematic Design	30% Design	70% Design	100% Design	Closeout
E-stops near the EDSs with associated zones and control stations	12.7.1.2	Optional	Optional	Required	Required	Required
E-stops in CBRA with associated zones and control stations	14.3.1	Optional	Optional	Required	Required	Required
Device locations (photo eRequired, shaft encoders, audio and visual alarms, VFDs)	10.3.3	Optional	Optional	Required	Required	Required
Control station locations	10.3.3	Optional	Optional	Required	Required	Required
Control device details	10.3.3	Optional	Optional	Required	Required	Required
Other drawings, including:	(See below)	(See below)	(See below)	(See below)	(See below)	(See below)
Plan view of existing structures and conditions prior to construction of the new CBIS	n/a	n/a	Required	Required	Required	Required
Heating, Ventilation, and Air Conditioning (HVAC)	13.3.5, 16.8.3	Optional	Required	Required	Required	Required
Fire suppression	12.12.2	Optional	Required	Required	Required	Required
Special systems (e.g., camera system, access control)	16.8.4	Optional	Required	Required	Required	Required
Phasing drawings	6.6.3	Optional	Optional	Required	Required	Required
Plans for demolition of existing BHS	6.6.3	Optional	Optional	Required	Required	Required
Control system architecture drawing	10.3.3	Optional	Optional	Required	Required	Required
Plan view PDF drawing of the entire system from baggage infeed to make up device	Chapters 12-15	Optional	Optional	Optional	Required	Required

6.6.2 Project Schedule

The project schedule shall include, at a minimum, the following milestones:

- Design OTA Period of Performance Start
- Design Consultant Notice to Proceed
- Pre-Design delivery to TSA for review
- Pre-Design – TSA Review

- Schematic design delivery to TSA for review
- Schematic design – TSA review
- 30% design delivery to TSA for review
- 30% design – TSA review
- 70% design delivery to TSA for review
- 70% design – TSA review
- 100% design delivery to TSA for review
- 100% design – TSA review
- RFP release
- Bid selection process completion
- Design OTA Period of Performance end
- EDS Delivery (if phased delivery is planned, provide delivery dates per phase)
- EDS Installation (if phased installation is planned, provide installation dates per phase)
- Testing (Site Acceptance Test (SAT), Owner testing, Test Readiness Review (TRR), ISAT, Live Operations, and Run-In period)
- EDS decommission dates

Additional detailed construction phase milestones are listed in Section 8.6.

6.6.3 Phasing Plan

Phasing refers to the grouping and timing of CBIS construction activities. Well-planned phasing ensures that construction activities occur in an efficient order and avoids conflicts between activities that cannot occur at the same time. Effective phasing helps airports mitigate operational impacts during construction. Phasing can also support putting the new CBIS into operation in increments.

Phasing plans shall include:

- Plan view drawing package showing conveyor layout and BHS/EDS components of the CBIS (i.e., ATRs, BMAs, EDS, CBRA BRPs) at each construction phase
- Brief description of the state of the system represented in each phase drawing, including:
 - The major functional changes of the CBIS in each phase (e.g., what components are removed/replaced, what major additions are made to the network or subsystems)
 - Whether the CBIS will be used operationally following each phase, and a brief description of how operations would be conducted (e.g., which induct points, which screening lines, is CBRA temporary or final configuration, etc.)
 - Number and type of each EDS populating screening lines in each phase

- Schedule showing when each phase is anticipated amongst other major activities impacting the system state by the BHSC and EDS OEM (e.g., high level of demolition and construction, networking and integration work, etc.)

6.6.4 Screening Equipment Installation Guideline References

Submittals shall reference manufacturer's site-installation and integration guides (including document name, date, and revisions) and describe how requirements for the satisfactory accommodation of the selected screening equipment will be met, including requirements for EDS ancillary equipment and their respective spaces.

HVAC requirements (EDS, CBRA, OSR, IT closets, etc.) associated with spaces housing screening equipment and associate ancillary equipment shall also be confirmed.

6.6.5 Conveyor Manifest

Starting at the 30% Design Phase, the conveyor manifest shall list, for each planned conveyor in the system:

- Conveyor identifier
- Approximate conveyor length
- Conveyor speed

Starting at the 70% Design Phase, the conveyor manifest shall include:

- Conveyor motor sizing
- Conveyor motor amperage
- Total amperage requirements

6.6.6 Specifications

Project specifications provide contractual work and workmanship requirements for contractors building the CBIS. Specifications describe the scope of the work to be performed, as well as materials, installation methods, and quality control measures to be used in performing the work.

- Project specifications shall make explicit reference to TSA-specified CBIS design performance requirements in Chapters 12-14.
- Project specifications shall reference current commissioning requirements outlined in Chapter 12 and Appendix D.
- Project specifications shall include detailed BIS requirements.

6.6.7 Bid Documents

Bid documents are submitted at the 100% Design Phase and shall include:

- Cover sheet with noted stakeholders, project locale, title, dates, revision block
- Drawing index
- Legend sheet
- Mechanical
 - Conveyor manifest sheets
 - Plan views, including catwalk, stairs, and 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 unit removal route as well as all other O&M-related access
- CBRA plans

6.6.8 Stakeholder Notification

Project sponsors are responsible for ensuring that stakeholders are notified of the project status and any significant developments. Design package submittals shall include documentation that project stakeholders have been periodically briefed on the progress of the planning and design effort.

CHAPTER 7: DETAILED DESIGN PHASE



7.1 Detailed Design Phase Overview

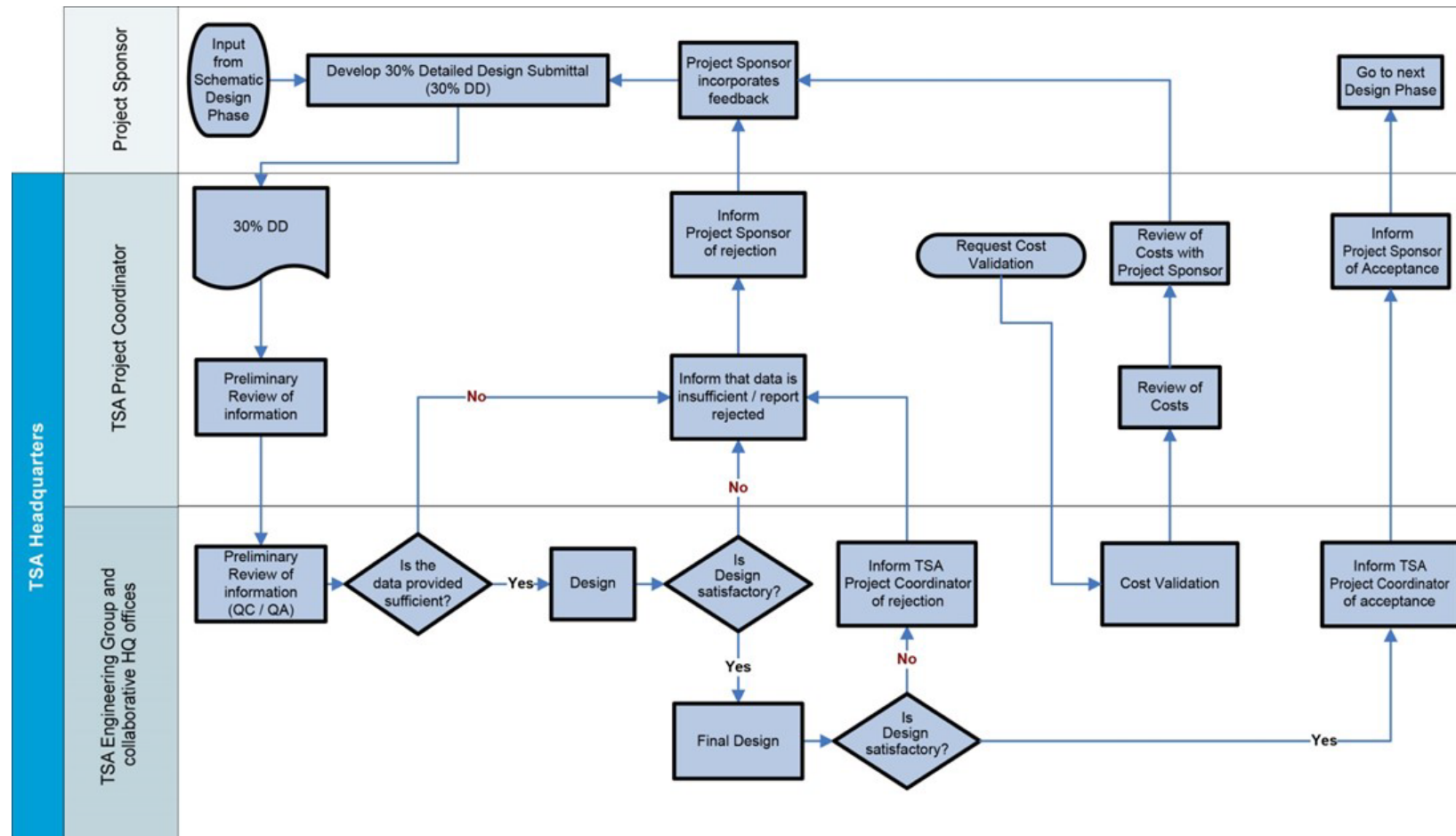
During the Detailed Design Phase, the BDR is used to refine and finalize detailed design drawings, contingency plans, ROM construction cost estimates, and the program schedule. Three sub-phases are to be used as milestones: 30% design, 70% design, and 100% Construction Documents.

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

7.2 30% Design

A process flow chart of the 30% Design Phase is displayed in Figure 7.1.

Figure 7.1: Detailed Design Phase, 30% Design Process Flow

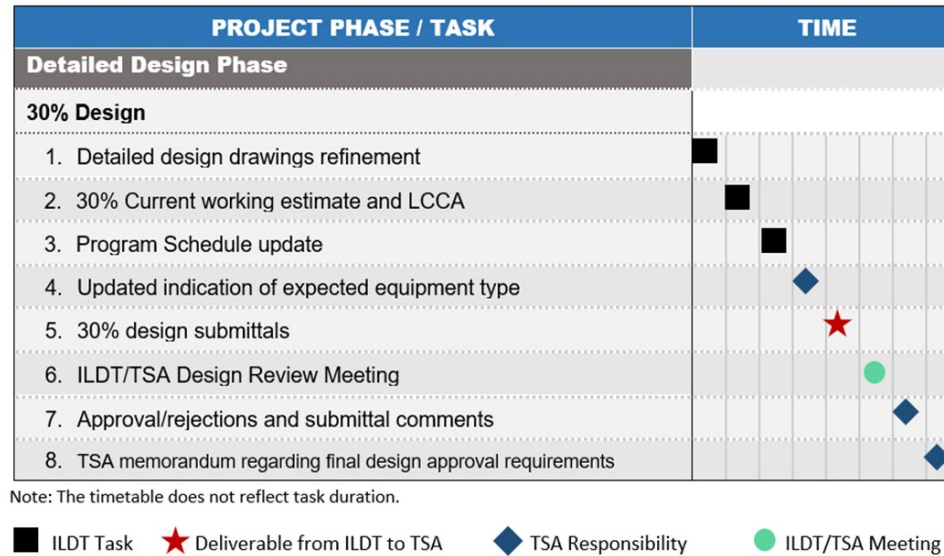


Footnote: A cost validation may be requested at the TSA Project Coordinator's discretion at any time during the design process.

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Figure 7.2 summarizes ILDT tasks, deliverables, TSA responsibilities and meetings for the 30% Detailed Design Phase.

Figure 7.2: Summary of 30% Detailed Design Phase



7.2.1 Project Sponsor and ILDT 30% Design Responsibilities

The tasks that are the responsibility of the Project Sponsor and ILDT involved in the 30% Detailed Design sub-phase are outlined below:

- Create the detailed design based on the TSA-approved BDR.
- Develop 30% level current working estimate and Life-Cycle Cost Analysis (LCCA).
- Update the preliminary program schedule developed in the Schematic Design Phase.
- Obtain an updated indication of expected EDS equipment types from TSA.
- Submit the 30% design deliverables specified below.
- Participate in a meeting with the TSA Design Review Team in the event the Project Sponsor/ILDT requires clarification on the comments and disposition of the submittal.

- Receive comments on the 30% design submittals and formal approval/rejection from TSA.

7.2.2 30% Design Deliverables

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

- **Updated BDR** (Section 6.5) with emphasis on:
 - Updated project requirements (Section 6.5.1)
 - Refined flow-based modeling assumptions and results (Section 6.5.3)
 - Detailed discussion of operations (Section 6.5.2)
- **Preliminary Drawings** for mechanical, electrical, plumbing, fire protection, and special systems (Section 6.6.1)
- **Updated preliminary phasing plan** (Section 6.6.3)
- **Updated project schedule** (Section 6.6.2)
- **Basis of Estimate, 30% Current Working Estimate, and, if applicable, updated LCCA** (Chapter 11)
- **Contingency plan** (Section 7.5; only applicable to mini in-lines at this phase)
- **Baggage and data flow charts** (detailed data flow and examples are in Appendix A, Section A.3)
- **Conveyor manifest** (Section 6.6.5)
- **Screening Equipment Installation Guideline References** (Section 6.6.4)
- **Outline of Reporting Capabilities** to be provided by the CBIS (12.13) (see Appendix A, Section A.4 for examples of detailed reports)
- **National Environmental Policy Act form** (Section IV of TSA form 2601-1)
- **Stakeholder notification documentation** (Section 6.6.8)
- **Approved and in-process RFVs** (Section 4.6.2)

The Project Sponsor provides responses to submission comments from TSA's Design Review Team on the Design Review Comment Form, as appropriate (Section 4.6.5). The Submittals Checklist (Section 4.6.6) is recommended but not required.

7.2.3 TSA 30% Design 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 types and quantities to be delivered
- A Design Review Meeting with the TSA project coordinators
- Formal approval or rejection and comments on the 30% design submittals
- A memorandum from TSA stating that TSA issues must be addressed (if appropriate) and that the CBIS design cannot be bid until after TSA approval of the 100% design submittal

NOTE: Ad hoc meetings should be convened as soon as possible with all affected parties to resolve safety-related issues that arise during the 30% design phase.

7.2.4 Dynamic Modeling

Dynamic modeling is not required in the BDR. However, it can be very helpful in the Detailed Design Phase for larger systems, providing designers with the ability to:

- 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)
- Assist baggage designers with PLC specifications and requirements
- Refine the evaluation of system performance
- Visualize the final design to assist with stakeholder review and approval

Commercial and proprietary modeling packages can be used for the Detailed Design Phase.

If dynamic modeling is used, the modeling provider shall submit to the Project Sponsor and the TSA Project Coordinator all programming parameters that may be used to adjust the model including but not limited to:

- Bag distribution methodology
- Belt speeds

- Merge windows
- Spacer/bag gap timers
- Jam timer
- Space programmed between bags for diverting
- Bag spacing at vertical sortation units
- All statistical distributions used

The Project Sponsor should share all dynamic modeling parameters used with the BHSC once contracted to ensure that the BHSC is using the same programming parameters used in the modeling and the CBIS will perform as shown in the modeling.

If any parameters are changed as a result of the construction process, an updated modeling should be performed and the results submitted to the TSA Project Coordinator to confirm CBIS performance still meets the established requirements.

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

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

The following standards and methodology should be used during the development of any modeling:

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. Use the design day flight schedule and other assumptions (load factors, earliness distributions, etc.) developed during the Pre-Design phase regarding the flight schedule to determine baggage demand input to the flow-based model for the specific airport.
4. In a modeling effort, if the baggage rate is sampled in 1-minute intervals, no surge factor should be applied. Since the surge factor is a correction to offset the averaging incurred over 10-minute intervals during the ADPM process, it is not relevant if the sampling is done in 1-minute increments.
5. Assume that the redundant EDS unit (see Section 5.6.3) is operational for the entire modeling period.
6. Multiple flow-based models should be developed for the design day to explore the sensitivity of the modeling to variables which may change randomly.

7. For systems using laser scanners, assume a no-read or misread rate of 2.0%. For systems using RFID scanners, assume a no-read or misread rate of 1.0%.
8. Identify potential locations for jams throughout the system and program realistic jam rates. If historical data is available on jam rates by system location, then that information should be used. For new systems, an overall 0.5% jam rate can be applied to occur randomly at baggage transition points within the system

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 normal distribution where the mean is 20.0 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 oversize bags – Use a gamma distribution. Distribution parameters are considered SSI. Please contact TSA to obtain required information.
- **ETD** directed search of EDS alarmed bag – Use a gamma distribution. Distribution parameters are considered SSI. Please contact TSA to obtain site specific 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, the national average design values in Section 5.6.1.3 should be used.
- 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.

7.3 70% Design

A process flow chart of this 70% Detailed Design Phase is displayed in Figure 7.3.

Figure 7.3: Detailed Design Phase, 70% Design Process Flow

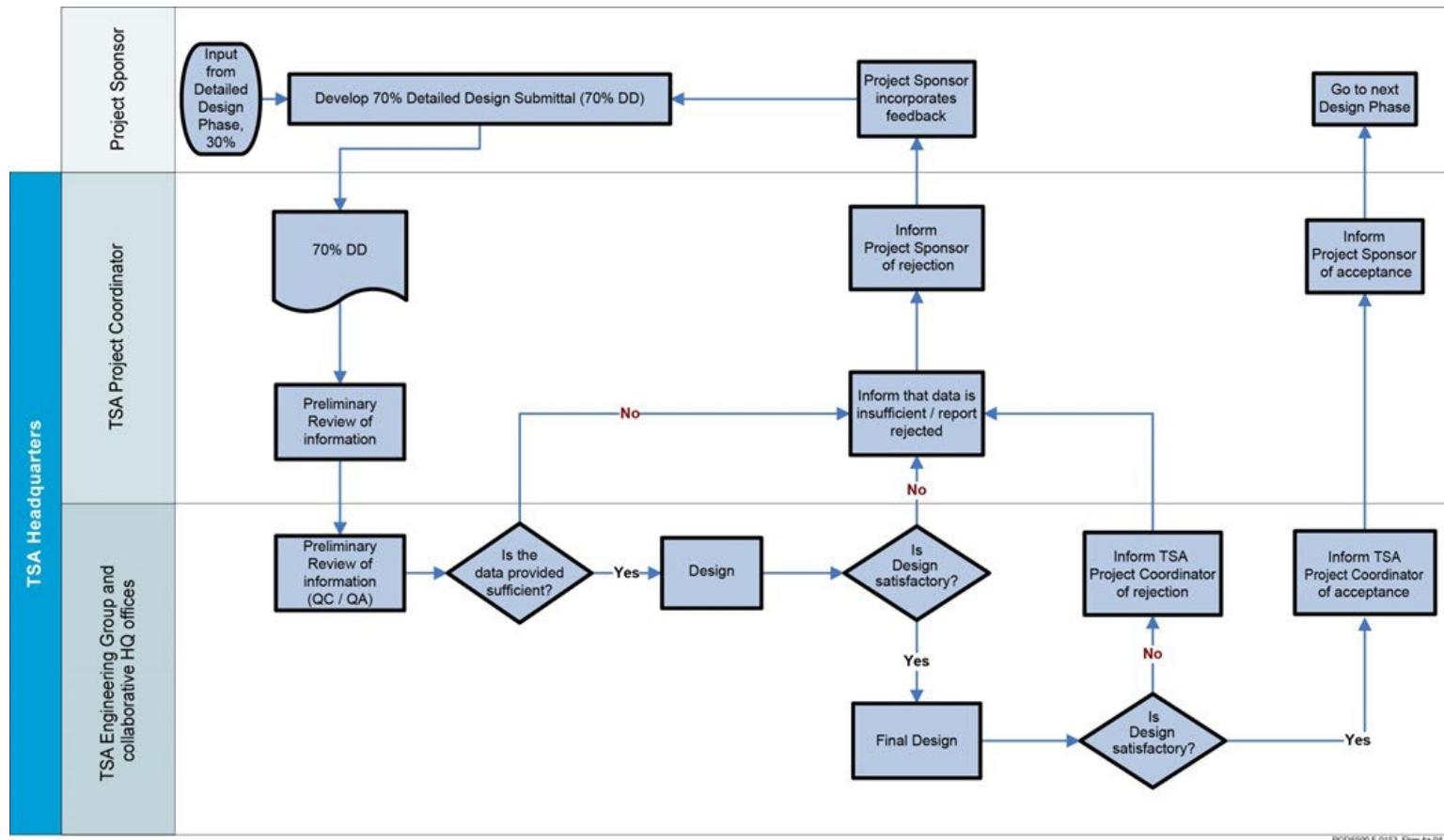
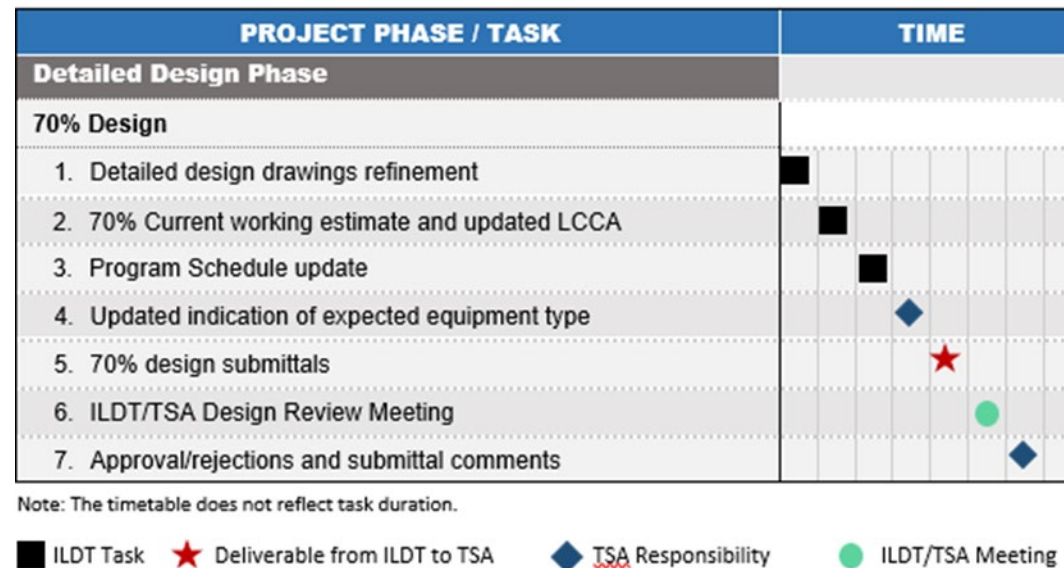


Figure 7.4 summarizes ILDT tasks, deliverables, TSA responsibilities and meetings for the 70% Detailed Design Phase.

Figure 7.4: Summary of 70% Detailed Design Phase



7.3.1 Project Sponsor and ILDT 70% Design Responsibilities

The tasks that are the responsibility of the Project Sponsor and ILDT involved in the 70% Detailed Design sub-phase are outlined below:

- Refine detailed design drawings based on TSA comments on the 30% design submittals
- Refine current working estimate and update LCCA
- Update the preliminary program schedule developed in the 30% design sub-phase
- Obtain an updated indication of expected equipment type from TSA
- Submit the 70% design deliverables specified below
- Participate in a meeting TSA Design Review Team in the event the Project Sponsor or ILDT requires clarification on the comments and disposition of the submittal

- Receive TSA comments on the 70% design submittals and formal approval or rejection from TSA

7.3.2 70% Design 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 BDR** (Section 6.5) with emphasis on:
 - Updated project requirements (Section 6.5.1)
 - Refined flow-based modeling assumptions and results (Section 6.5.3)
 - Refined detailed discussion of operations (Section 6.5.2)
- **70% Design Drawings** for mechanical, electrical, plumbing, fire protection, and special systems (Section 6.6.1)
- **Updated phasing plan** (Section 6.6.3)
- **Updated project schedule** (Section 6.6.2)
- **Basis of Estimate, 70% Current Working Estimate, and, if applicable, updated LCCA** (Chapter 11)
- **Preliminary contingency plan** (see Section 7.5)
- **Baggage and data flow charts** (detailed data flow and examples are in Appendix A, Section A.3)
- **Updated conveyor manifest** (Section 6.6.5)
- **Screening Equipment Installation Guideline References** (Section 6.6.4)
- **Outline of Reporting Capabilities** to be provided by the CBIS (12.13) (see Appendix A, Section A.4 for examples of detailed reports generated)
- **National Environmental Policy Act form** (Section IV of TSA form 2601-1)
- **Draft Site-Specific Configuration Management Plan** (Section 7.3.4)
- **70% Specifications** (Section 6.6.6)
- **Stakeholder notification documentation** (Section 6.6.8)
- **Approved and in-process RFVs** (Section 4.6.2)

The Project Sponsor provides responses to submission comments from TSA's Design Review Team on the Design Review Comment Form, as appropriate (Section 4.6.5). The Submittals Checklist (Section 4.6.6) is recommended but not required.

7.3.3 TSA 70% Design 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:

- A Design Review Meeting with the Project Sponsor, ILDT, and TSA project coordinators
- Formal approval or rejection and comments on the 70% design submittals
- Confirmation of exact equipment to be delivered and approximate delivery schedule

NOTE: Ad hoc meetings should be convened as soon as possible with all affected parties to resolve safety-related issues that arise during the 70% design phase.

7.3.4 Configuration Management

The Site-Specific Configuration Management Plan includes documentation of the screening system boundaries; delineated areas of responsibility between 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 to the TSA.

The Configuration Management Plan shall follow 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

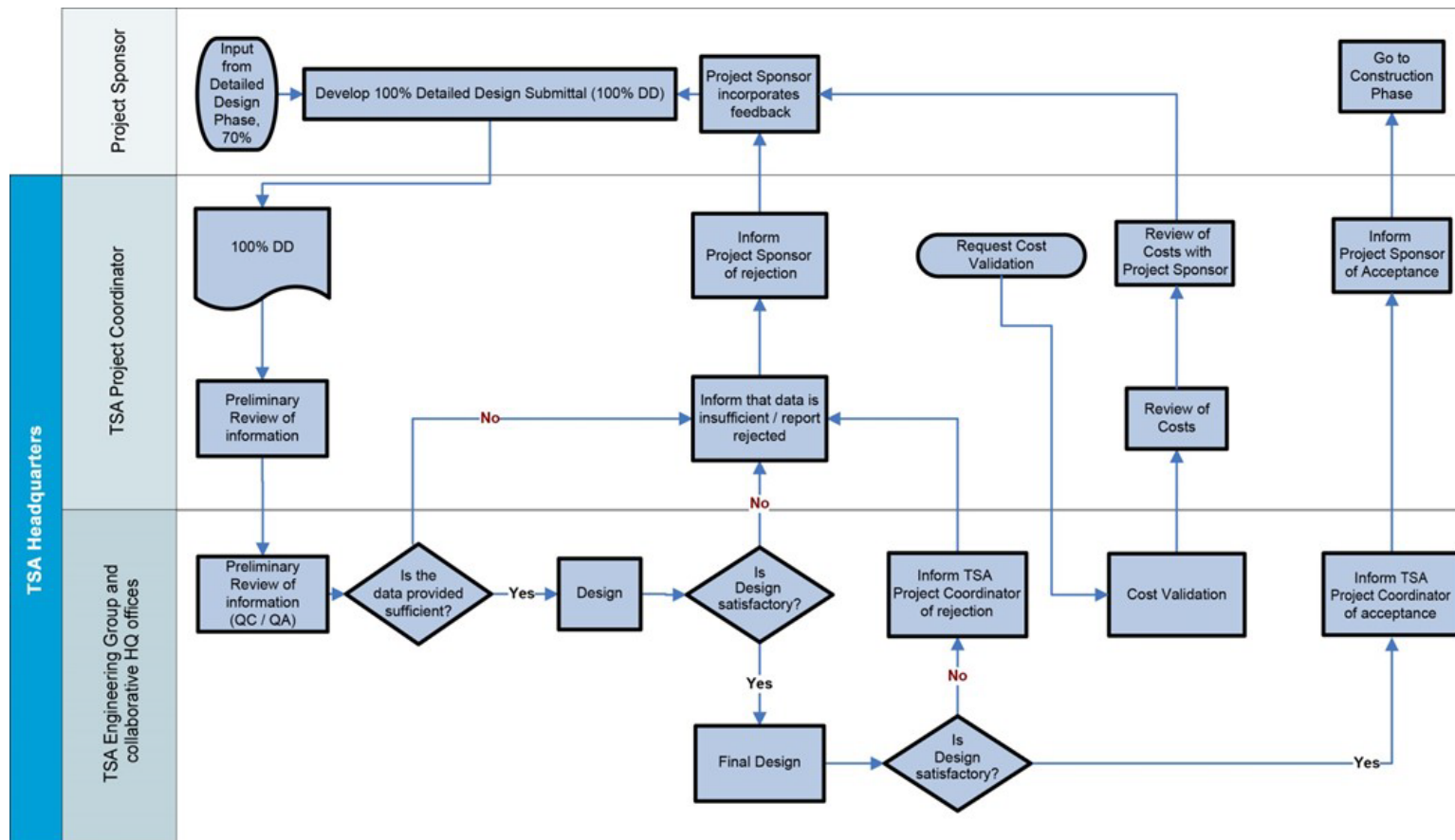
4.4.1 Post Commissioning Change Management

4.4.2 Documentation and Audit

7.4 100% Design

A process flow chart of the 100% Detailed Design Phase is displayed in Figure 7.5.

Figure 7.5: Detailed Design Phase, 100% Design Process Flow

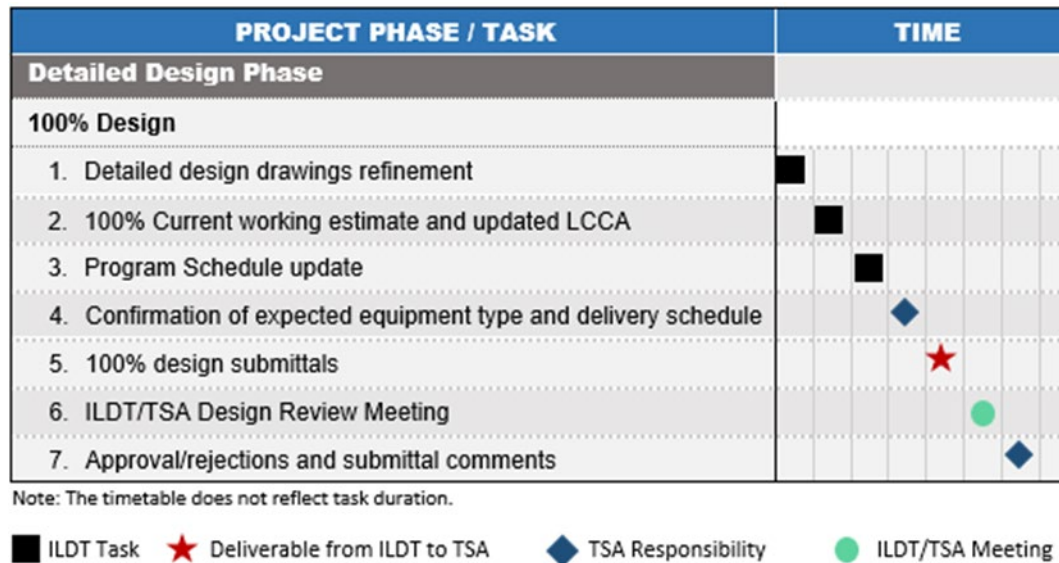


Footnote: A cost validation may be requested at the TSA Project Coordinator's discretion at any time during the design process.

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Figure 7.6 summarizes tasks, deliverables, TSA responsibilities and meetings for the 100% Detailed Design Phase.

Figure 7.6: Summary Of 100% Detailed Design Phase



7.4.1 Project Sponsor and ILDT 100% Design Responsibilities

The tasks that are the responsibility of the Project Sponsor and ILDT involved in the 100% Detailed Design sub-phase are outlined below:

- Refine and finalize detailed design drawings based on TSA comments on the 70% design submittals.
- Refine and finalize 100% level current working estimate and LCCA.
- Update the preliminary program schedule developed in the 70% design sub-phase.
- Confirm with TSA the exact equipment to be delivered and expected delivery schedule.
- Submit the 100% design deliverables specified below.
- Participate in a meeting with the TSA Design Review Team in the event the Project Sponsor or ILDT requires clarification on the comments and disposition of the submittal.
- Receive TSA comments on the 100% design submittals and formal approval/rejection from TSA.

- Provide a final report detailing the life cycle support impacts for airport facilities that do not meet the Chapter 12 Design Best Practices and Standards.

7.4.2 100% Design Deliverables

The 100% design package shall include the following documents:

- **Final BDR** (Section 6.5) with emphasis on
 - Final project requirements (Section 6.5.1)
 - Final flow-based modeling assumptions and results (Section 6.5.3)
 - Final detailed discussion of operations (Section 6.5.2)
- **100% Design Drawings** for mechanical, electrical, plumbing, fire protection, and special systems (Section 6.6.1)
- **Final phasing plan** (Section 6.6.3)
- **Updated project schedule** (Section 6.6.2)
- **Final Basis of Estimate, 100% Current Working Estimate, and, if applicable, updated LCCA** (Chapter 11)
- **Final contingency plan** (Section 7.5)
- **Baggage and data flow charts** (detailed data flow and examples are in Appendix A, Section A.3)
- **Final conveyor manifest** (Section 6.6.5)
- **Screening Equipment Installation Guideline References** (Section 6.6.4)
- **Outline of Reporting Capabilities** to be provided by the CBIS (12.13)
- **National Environmental Policy Act form** (Section IV of TSA form 2601-1)
- **Final Site-Specific Configuration Management Plan** (Section 7.3.4)
- **100% Specifications** (Section 6.6.6)
- **Bid Documents** (Section 6.6.7)
- **Stakeholder notification documentation** (Section 6.6.8)
- **Approved RFVs** (Section 4.6.2)

The Project Sponsor provides responses to submission comments from TSA's Design Review Team on the Design Review Comment Form, as appropriate (Section 4.6.5). The Submittals Checklist (Section 4.6.6) is recommended but not required.

7.4.3 TSA 100% Design 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
- A Design Review Meeting with the Project Sponsor, ILDT, and TSA project coordinators
- Formal approval or rejection and comments on the 100% design submittals

NOTE: Ad hoc meetings should be convened as soon as possible with all affected parties to resolve safety-related issues that arise during the 100% design phase.

7.5 Contingency Planning

Contingency alternatives for a CBIS are critical to sustaining baggage operations at the airport and include provisions incorporated into the CBIS during the design process. Operational contingencies for sustaining baggage operations include the development of written Contingency Plans by the local stakeholders that focus on alternate methodologies for continuing baggage operations and may include portering of bags to another input belt in the event of a localized bag belt failure.

This section provides requirements for contingency plan contents and summarizes the contingency planning process, contingency plan development, and an evaluation of contingency alternatives. Appendix E provides two sample contingency plans that illustrates how contingency design principles are applied during the CBIS design process.

7.5.1 Contingency Planning Requirements

The Project Sponsor, 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.

Preliminary contingency plans shall include, at minimum:

- Mitigation for short-, medium-, and long-term screening equipment failure
- Mitigation for short-, medium-, and long-term conveyance equipment failure
- Mitigation for short-, medium-, and long-term loss of utility power
- Mitigation for unplanned surges in system demand

Final contingency plans shall include, in addition to the requirements for preliminary contingency plans:

- Diagrammatic depictions of baggage screening contingencies and mitigation methods
- Description of the conditions that would trigger mitigation measures
- Protocols for operation
- A directory of all project stakeholders with direct responsibilities for operation of the CBIS

The Project Sponsor shall include contingency plans for extraordinary circumstances when baggage demand exceeds CBIS capacity, whether as the result of the failure of CBIS (EDS or BHS) components or peak baggage flow that exceeds the maximum capacity of the CBIS.

The Project Sponsor shall include contingency plans for instances where alarm bags at the CBRA that cannot be cleared using directed search with ETD need to be transferred for further inspection by law enforcement (typically a bomb disposal squad).

The preliminary contingency plan needs to be reviewed by the full ILDT and included in the Pre-Design Phase submittal for mini in-line systems and the 70% Design Phase submittal for all other systems as stated in the requirements for Chapter 4. The contingency plan will be reviewed by TSA as part of the overall design review and approval process for that CBIS design.

7.5.2 Contingency Planning Considerations

When developing a contingency plan, the ILDT should consider the following elements:

- Roles and responsibilities of the various stakeholders regarding system operation during potential contingency scenarios (e.g., approval of various mitigation measures 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 95th percentile day, peak month flow).
- Set of eligible mitigation measures 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 mission critical failures of EDS or BHS components 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 or supersede checked baggage operations, such as the Airport Operations Emergency Response Plan, local Standard Operating Procedures (SOPs) for transportation security incidents, Airport Emergency/Incident Response Plan, and Airport Emergency/Incident Recovery Plan.
- Temporary alternative screening location for checked baggage.
- Procedures for manual handling unscreened bags in the event conveyors pre-CBIS are down. Procedures for handling screened/unclear bags pre-CBRA.
- Threat evacuation and associated impact on baggage screening.
- Natural disaster impact on the screening operation.

7.5.3 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.

7.5.3.1 Programming Logic

One example of a design phase contingency plan that can be implemented into the CBIS may be that in the event of a failure of a component on the Clear Line between the EDS units and the CBRA, all bags can be sent down the Alarm Line and then cleared bags are diverted at the 2nd chance divert point.

Designers should specify programming scenarios for specific conditions that will automatically activate within the control system program to divert baggage to other locations as required to maintain throughput and avoid dieback. If programming logic is used for contingency operations, the control system should provide a visual alert to the operator when the diversion of bags is activated so that this function can be communicated to the TSA at both the OSR and CBRA locations.

The CBIS may have a bypass feature to allow clear bags to bypass all diverters during fault conditions and be sent to the CBRA. The bypass feature shall be enabled and disabled via an operator's workstation in the BHS control room.

The Project Sponsor may consider employing a Recovery Mode which allows for a temporary increase of the mainline rate to the total EDS capacity (including redundant EDS). This mode should only be used for periods of extraordinary demand, such as the clearing of an EDS or BHS Downtime event, to allow the system to more quickly process an excess accumulation of bags and limit Airline impact.

If a Recovery Mode is created, the following requirements apply:

- The Project Sponsor shall obtain a TSA-approved RFV (during design) to operate the mainline above the non-redundant EDS capacity requirement. (See Section 12.3.1.)
- A Memorandum of Understanding (MOU) shall be created by the Project Sponsor during the 30% Design Phase and signed by the Project Sponsor, Major airlines involved and the FSD, which specifies an agreement by all parties regarding how the Recovery Mode will operate, how it is activated, who is notified of activation, etc.
- Recovery Mode shall be automatically deactivated once it is no longer needed, according to triggers defined during design (e.g., imminent dieback in CBRA or post-EDS, sustained reduced demand for a pre-determined amount of time, etc.)
- Any system operating with a Recovery Mode shall report metrics about the frequency and duration of usage in the BHS reporting.
- Any system operating with a Recovery Mode shall be tested against the Total EDS Throughput Rate (including redundant EDS) during System Throughput testing.
- Definition of Recovery Mode details and testing and validation plans shall be thoroughly presented in the BDR.

7.5.3.2 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 the CBRA for manual screening.

In the event that conveying or screening equipment failures occur down-line of the OOG diverter, the OOG diverter may be manually set to operate in a “limited operation” mode in which all baggage is conveyed directly to the CBRA for manual screening. Engaging the “limited operation” mode shall only occur with concurrence from local TSA.

7.5.3.3 Provision for Manual Conveyance of Baggage

CBIS design should allow for a clear, securable path for manual conveyance of baggage from the ticket lobby to the CBRA. As much as possible, designs should make use of dedicated conveyors, 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.

7.5.3.4 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 at CBRA using ETD with bags being portered to CBRA from the ticketing lobby and from CBRA to a nearby point for handoff to airline personnel for bag make-up operations. This only applies if the Airport intends to operate fully and process passengers and baggage during a power failure.

7.5.4 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. The Project Sponsor 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.

7.5.5 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 a CBIS: (1) power failures produced by external events and (2) conveyance 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 or manual methods (for example additional conveyers to allow appropriate transfer of baggage or backup power sources for BHS components). In addition, as a last resort, alternative screening measures can be used with TSA approval to mitigate CBIS failures.

7.5.5.1 Short-Duration Failures

Short-duration failures are failures lasting less than 10 minutes. Typically, during this class of failure, a CBIS cannot perform its intended function, but the failure can be cured without maintenance personnel being called in. 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 restart 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.

7.5.5.2 Medium-Duration Failures

Medium-duration 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 the 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 are sent to another EDS unit in a separate CBIS (if possible) or manually conveyed to an area designated by TSA for manual 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 or another area designated by TSA for manual screening (e.g., OOG conveyors and oversize conveyors). 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 unit within a separate CBIS (if possible) or the CBRA. Unscreened baggage is conveyed to another EDS unit in a separate CBIS (if possible) or to an area designated by TSA for manual or alternative screening.

7.5.5.3 Long-Duration Failures

Long-duration 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. Long-Duration 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 systems 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.

7.5.6 Evaluation of Contingency Alternatives

When evaluating mitigation measures, planners, stakeholders, and designers should consider a broad range 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.

7.5.6.1 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 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 should list the range of mitigation measures and the conditions that trigger those measures.

7.5.6.2 Mini In-Line System Example

As an example of the tradeoffs and options that should be evaluated, consider two mini in-line systems in close proximity to each other. 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 unit, however, could be mitigated by manually carrying bags to the in-feed belt serving the remaining operational EDS unit. Additionally, unscreened bags may be sent directly to the CBRA. In this manner, bags are screened by ETD, with the possibility that some level of mitigation may be applied.

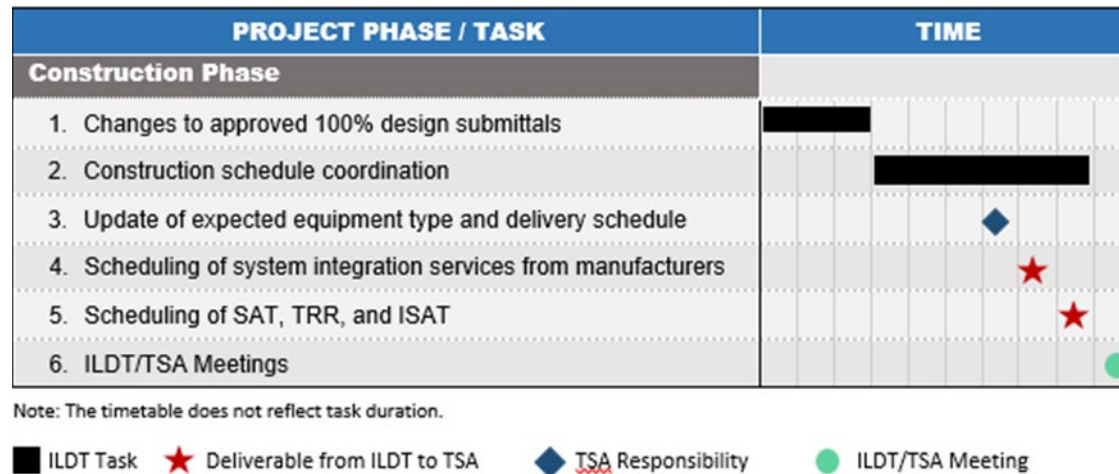
In the event that both EDS units experience medium-duration failures simultaneously, sending bags to the CBRA would be the most effective option. A long-duration failure of the entire CBIS would require yet another mitigation process, such as increasing the number of ETD screenings and the number of screening personnel in the lobby or bag rooms prior to bag make-up for individual flights.

CHAPTER 8: CONSTRUCTION PHASE

8.1 Construction Phase Overview

Tasks, deliverables, TSA responsibilities, and meetings for the Construction Phase are shown in Figure 8.1.

Figure 8.1: Summary of Construction Phase



The duration of the Construction Phase will vary significantly based on the complexity and size of the approved CBIS.

8.2 Project Sponsor and ILDT Construction Phase Responsibilities

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

- To ensure TSA's complete understanding and acceptance of the projected system performance, any changes or amendments to the approved 100% design, including contract document addenda, change requests and Requests for Information (RFIs), that affect the functionality of the CBIS shall be presented for approval to TSA. Any variation from the 100% approved design will not be funded without prior TSA approval of the changes.
- TSA Deployment, through its contractor, distributes the uncompleted Pre-ISAT Project Portfolio Checklist to the Project Sponsor at no less than 120 calendar days before the planned start of ISAT testing, and the project sponsor shall provide Acceptance Testing this completed checklist and the site documentation it defines no less than 90 calendar days before the planned start of ISAT testing.

- The Project Sponsor shall submit an updated Construction Schedule to TSA stakeholders at a minimum of every 30 calendar days after construction award. Most projects conduct a weekly meeting to review project status and shall invite a TSA Deployment representative.
- The project sponsor shall request an update of the availability of equipment and equipment upgrades.
- The Project Sponsor shall consult with the TSA Project Coordinator and their TSA Acceptance Testing representative no later than 90 calendar days prior to ISAT to refine projected commissioning durations.

8.3 Construction Phase Deliverables

The Construction Phase deliverables shall include the following documents:

- **Any changes or amendments to the approved 100% design package** including contract document addenda, change requests and RFIs
- **Courtesy copies of shop and installation drawings** (Section 6.6.1) to ensure the original intent of the design as reviewed up to and including the 100% design review submittal process
- **Updated project schedule with construction milestones** (Section 8.6)
- **Power System Engineering Analysis** (Section 12.12.6)
- **Cybersecurity plan** (Section 16.2.2)
- **Cybersecurity Incident handling plan** (Section 16.2.3).

The Project Sponsor provides responses to submission comments from TSA's Design Review Team on the Design Review Comment Form, as appropriate (Section 4.6.5). The Submittals Checklist (Section 4.6.6) is recommended but not required.

Requirements for concurrent Training Phase deliverables are in Section 8.8.

8.4 TSA Construction Phase Responsibilities

During the Construction Phase, based on the construction schedule, TSA Headquarters will confirm the availability of equipment and equipment upgrades and the schedule for delivery of specific equipment. TSA will also deliver and install TSA-furnished equipment.

8.5 Meetings

Regular meetings shall be conducted with the Project Sponsor/ILDT and TSA to monitor system construction.

NOTE: Ad hoc meetings should be convened as soon as possible with all affected parties to resolve safety-related issues that arise during the construction phase.

8.6 Construction Schedule

- Key construction milestones for project completion shall be included in the Project Schedule such as:
 - Construction notice to proceed
 - CBIS construction prior to EDS delivery and post-EDS delivery
 - EDS delivery
 - EDS power readiness and installation
 - EDS SAT complete
 - EDS integration and network installation
 - Project Portfolio Checklist received and completed
 - Pre-ISAT
 - IRR
 - ISAT (see Chapter 9)
 - Live bag screening
 - 30-day run-in
 - Completion of all required deficiency corrections
 - Substantial completion
 - Project closeout
- At a minimum, the following ISAT durations shall be used as initial inputs to the construction schedule with the type of ISAT test being conducted (single-phase or multi-phase):
 - Single-Phase ISAT:
 - One business day for mobilization to site
 - One business day per EDS spur line

- Three business days for system testing (one business day each for System Mixed Bag, System Full Load, and System Throughput tests)
- One business day for outbrief and demobilization
- Multi-Phase ISATs, each phase (except for final phase):
 - One business day for mobilization to site
 - One business day per EDS spur line not tested in previous phase
 - Two business days for system testing (System Mixed Bag and System Full Load)
 - One business day for outbrief and demobilization
- Final Phase:
 - One business day for mobilization to site
 - One business day per EDS spur line not tested in previous phase
 - Three business days for system testing (System Mixed Bag, System Full Load and System Throughput) conducted across all EDS in final form
 - One business day for outbrief and demobilization

8.7 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 shall include at a minimum the items listed in this section.

8.7.1 CBIS Change Requests

Any changes made to the CBIS from the TRR forward must be approved by the TSA prior to implementation. TSA's CCR form shall be used for all pre- and post-ISAT change requests. All requests for changes shall be submitted to TSA Acceptance Testing and System Acceptance (ATSA) Branch at BASEteam@TSA.DHS.gov. The CCR form is found in Appendix A and in the Submittals Checklist.

When any change to the CBIS is required during the TRR, a change request shall be submitted to and approved by TSA's Site Integration (SI) contractor prior to implementation.

When any change to the CBIS is required post-Test Readiness Notification (TRN), between the TRR and the completion of ISAT, a change request shall be submitted to and approved by TSA's Acceptance Testing contractor prior to implementation. The only difference for changes

made during this part of commissioning is that the CCR form is to be submitted to the Acceptance Testing Contractor Site Lead in addition to TSA ATSA Branch.

When any change to the CBIS is required post-ISAT, a change request shall be submitted to and approved by TSA ATSA Branch prior to implementation.

Upon completion of the approved CCR, all required documentation and updated PLC code as required in the CCR shall be submitted to ATSA Branch at BASEteam@TSA.DHS.gov.

8.7.2 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 persons 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

8.7.3 TSA Approval

In response to the change request submittal, the TSA will provide direction on the request. The proposed change shall 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 five business days upon the completion of testing.

8.7.4 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

8.7.5 Test Results

Empirical data shall be recorded during testing. A summary of the data shall be provided explaining how the collected data met (or did not meet) the expected results.

8.8 Training

8.8.1 Training Deliverables

Training materials and documentation to be presented shall be submitted to TSA for review 60 days prior to the first scheduled training session.

8.8.2 CBIS Use and Logistics Training

CBIS use and logistics training, distinct from maintenance training, shall be provided by the Project Sponsor to TSA for mechanical, electrical, and computer functions required to properly operate the staffed portions of the system including, but not be limited to:

- Any BHS-provided equipment in the CBRA
- Bag induction and handling procedures

- Any BHS-provided equipment in the OSRA
- BHS control interface provided to conduct the Image Quality Test (IQT) procedures
- CBIS orientation and layout
- CBIS fail-safe procedures and layout
- System safety
- Bag jam and fault clearing procedures
- BHS reporting system

The BHSC shall provide training on how to access and download BHS reports as well as SSI training for any BHS reports classified as SSI; training must comply with Federal Government SSI guidelines. SSI Best Practices and Quick Reference Guides for more information on SSI handling, sharing, and destroying procedures can be found on the [TSA.gov SSI webpage](https://www.tsa.gov/ssi).

See Appendix A, Section A.1 for an example training documentation outline. All operators or individuals with access to either viewing or printing reports shall have completed SSI procedures training prior to operation. The training sessions shall be conducted prior to the operational startup of the respective BHS.

8.8.3 TSA Training

8.8.3.1 EDS Training

Local TSA management must coordinate with the TSA Training and Workforce Engagement to schedule training on the EDS equipment for TSOs and TSA management to be concurrent with CBIS Use and Logistics Training. The training must be specific to the EDS and ETD models utilized in the CBIS and completed prior to the established commission date.

8.8.3.2 Procedural Training

Local TSA management must coordinate with the TSA Training and Workforce Engagement (or a local TSA trainer) to schedule training on the current Checked Baggage SOP as it is associated with the On-Screen Alarm Resolution Protocol (OSARP) and CBRA application to ensure qualified TSOs are available to properly staff the OSARP and CBRA functions. This training must be completed (as needed) prior to the established CBIS commission date.

CHAPTER 9: TESTING AND COMMISSIONING PHASE

9.1 Testing and Commissioning Phase Overview

ILDT Tasks and TSA responsibilities for the Testing and Commissioning phases are addressed in the following paragraphs and shown in Figure 9.1.

Figure 9.1: Summary of Commissioning And Testing Phase

Project Phase / Task	Time			
Testing and Commissioning Phase				
1. SAT	◆			
2. Pre-ISAT		★		
3. TRR			◆	
4. ISAT				◆

★ Deliverable from ILDT to TSA
◆ TSA Responsibility

9.2 Pre-Commissioning Requirements

Prior to the CBIS being approved and used for security screening operations, at a minimum, the activities listed below must be completed. All IATA tags for all phases of BHS testing. Pre-ISAT, TRR, and ISAT shall be provided by the airport or airline tenant.

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

The **Pre-ISAT** (for in-line CBIS only), which is commonly referred to as Owner's Testing, is a series of independent checks and confidence tests conducted by the Project Sponsor. The tests conducted during the Pre-ISAT may be witnessed by a representative of TSA Deployment and Sustainment Division (DSD) and counted toward completion of the TRR, if approved by TSA. This will be considered a combined Pre-ISAT/TRR testing phase and will require a TSA approved RFV. If combined Pre-ISAT/TRR testing occurs, no tests conducted during this testing may be counted toward the ISAT and a full independent ISAT must be conducted. The Pre-ISAT is intended to independently evaluate CBIS performance and capability to meet the design standards and performance requirements defined in Chapter 12. These tests shall be conducted in accordance with the requirements set forth in Appendix D. In the case of an independently conducted Pre-ISAT, the project sponsor shall provide a TRR Readiness confirmation letter documenting the successful demonstration and acceptance of Pre-ISAT test results to the TSA DSD following the completion of Pre-ISAT testing and prior to the start of TRR Testing. ISAT will not start unless the TRR Readiness confirmation letter has been

delivered to DSD. If a combined Pre-ISAT/TRR is conducted, the delivery of the TRR Readiness confirmation letter need not apply. The project sponsor shall also provide copies of all unlocked PLC code to DSD prior to ISAT testing.

From the TRR forward, the Project Sponsor shall ensure that change management processes are stringently adhered to. Section 8.7 details the conditions under which change requests must be initiated. In addition to the process outlined in Appendix D, a benchmarked copy of the PLC program controlling CBIS components from induction points to the cleared bag sortation ATR shall be submitted at the following points:

- Post-ISAT
- Post-Operational Run-In

PLC code representing the CBIS under test shall be provided to TSA's Acceptance Testing Contractor at ISAT, and PLC code representing the post-operational run-in state shall be provided to TSA's Acceptance Testing Contractor during on-site observations for the run-in period or be submitted remotely upon successful completion of the run-in period if observations are not made. Passwords for any and all portions of "locked" PLC code shall be provided along with the code.

The **TRR** is a series of independent tests defined in Appendix D to ensure that the CBIS is ready for ISAT in the Testing and Commissioning phase. The TRR is conducted by the TSA DSD testing representative. The Pre-ISAT and TRR are separate testing phases, but may be combined with the approval of TSA DSD. As stated previously, if combined Pre-ISAT/TRR testing occurs, no tests conducted during this testing may be counted toward the ISAT and a full independent ISAT must be conducted. Following the completion of TRR or combined Pre-ISAT/TRR, the TRN report outlining the successful completion of TRR testing results with a recommendation to proceed to ISAT must be submitted to TSA Acceptance Testing no later than close of business on the Wednesday prior to the week of the ISAT. If the CBIS fails the TRR, subsequent testing shall be conducted at intervals of no less than 14 calendar days.

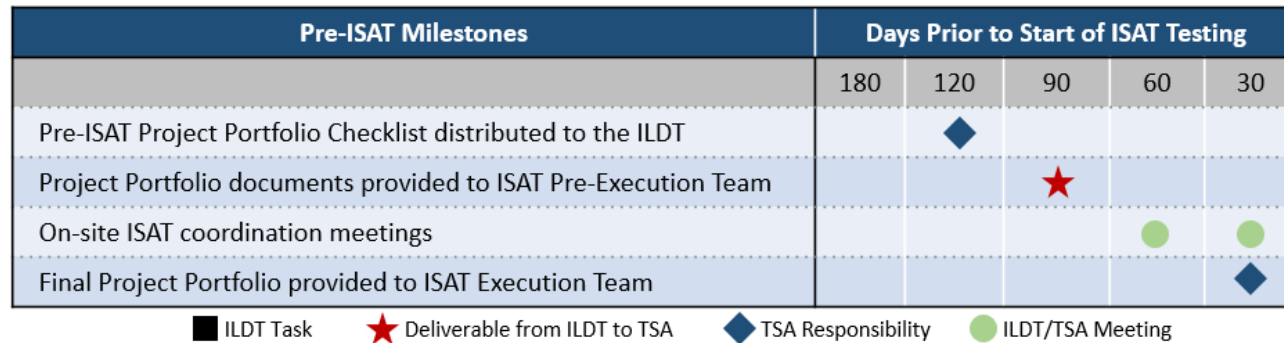
The following guidelines will be used to assist the Project Sponsor with projecting testing schedules for phased recapitalization and optimization projects only:

- The Pre-ISAT (Owner's Testing) and TRR will be scheduled as separate testing phases, unless approval has been obtained from TSA DSD to conduct a combined Pre-ISAT/TRR. If a combined Pre-ISAT/TRR is approved and conducted, a TSA DSD testing representative must be present to record and witness all testing. The results of the combined Pre-ISAT/TRR will be recorded in a TRN and submitted to TSA ATSA NLT COB on the Wednesday prior to the week of the ISAT..
- A single EDS unit (defined as from spur line divert to Level 1 Decision point) is phased into the existing CBIS – A combined TRR/ISAT may be conducted provided only the EDS line is being modified.
- If changes upstream of the spur line divert and downstream of the Level 1 decision point (including CBRA) are implemented and able to be tested with the first single EDS replacement, a combined TRR/ISAT can still be conducted.

- Testing duration is expected to be no more than three business days if provided a six-hour test window. This would cover line testing and a Full Load Test, depending on the changes to the CBIS. Any throughput testing would be conducted after the entire CBIS is complete.
- A combined pre-ISAT/TRR shall be conducted with the ISAT scheduled separately when there are multiple EDS, multiple changes to the in-feed or out-feed, or changes to the OSR or CBRA subsystems.
- TSA testing will be conducted based on the total changes made to the system.
- Questions on ISAT schedules should be directed to the Acceptance Test Lead.

The **ISAT** (for in-line CBIS only) is conducted by TSA following the completion of all pre-requisite milestones shown in Figure 9.2 with logistical and labor support from the Project Sponsor.

Figure 9.2: ISAT Pre-Requisite Milestones



Logistical and labor support shall include at minimum:

- Operational EDS Network Printers to print EDS images
- Operational BHS network printers to print BHS reports
- 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 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 12. 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.

TSA test bag dimensions are included in Appendix D.

ISAT testing shall occur not more than 30 Calendar days prior to the commencement of Live bag screening (Run-In-Period). If the CBIS fails the ISAT conducted by TSA, subsequent testing shall be conducted at intervals of no less than 30 calendar days.

The Run-In Period shall consist of an initial 14-day period to collect operational data (BHS and EDS) to support a thorough analysis that accurately depicts the system performance. If during the 14-day period there are anomalies in the data, an additional 14-day run-in period may be performed. This determination will be coordinated with the Regional Deployment Coordinator (RDC) and Acceptance Test Team. 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. For multi-phased projects, incremental 1-2-week data collection periods may be conducted until the final phase of ISAT.

During the Run-In period, the Project Sponsor or its designees shall submit weekly data reports in electronic format, preferably in PDF or native Comma-Separated Values (CSV) file format to the TSA Acceptance Testing Contractor. Should native CSV format not allow correct separation of tabular data, especially for event reports where locations and events are listed, reports should be available in Microsoft Excel (.xlsx) format. These reports shall include all BHS reports required by PGDS Section 12.13 (CBIS Reporting Requirements) as well as select EDS reports. Prior to the Run-In period, the TSA Acceptance Testing Contractor will provide a Data Collection Plan that will include points of contact for delivery, delivery dates, report format, report time-frames, submission method, specific report names, and other Run-In data collection details.

The Post-ISAT Audit will be directed by TSA on a periodic recurring basis or as the result of reported system performance anomalies.

Upon notification from TSA APM that a Post-ISAT Audit has been directed, the authority with jurisdiction at the airport (along with local TSA) shall submit to the TSA Acceptance Testing Contractor and the TSA ATSA Branch, the immediate past 30 days of BHS and EDS reports in electronic format, preferably in native CSV or PDF format. Should native CSV format not allow correct separation of tabular data, especially for event reports where locations and events are listed, reports should be available in MS Excel (.xlsx) format. These reports shall include all BHS reports required by PGDS Section 12.13 (CBIS Reporting Requirements) as well as select EDS Reports. Prior to the Post-ISAT Audit, the TSA Acceptance Testing Contractor or the TSA Engineering Team will provide points of contact for delivery, delivery dates, report format, report time-frames, submission method, specific report names, and other Run-In data collection details.

TSA does not test a partial or incomplete CBIS. The system must be in final configuration for ISAT as defined below. Any CBIS components not in final configuration, or any situation requiring phased commissioning shall be submitted to TSA for approval using the Request for PGDS Variance (RFV) Template prior to the start of TRR testing. The template is found in Appendix A, Section A.7. The ILDT must demonstrate an operational

impact for said RFV to be considered. Final configuration is defined as when the physical, programming, networking, and reporting capabilities of the entire CBIS are in final operational state. More specifically, this includes (except by approved RFV):

- All induction points are tied in (unless phased and approved by RFV);
- All BHS conveyors, pathways, and components are operational (CBRA lines, OOG/OS lines, Re-insert lines, clear outbound paths, BMAs, ATRs, etc.) including legacy BHS components delivering bags to and taking bags away from the CBIS;
- All BHS interfaces are operational (including manual encode stations, image quality, E-stops, BIS Bag Status Displays (BSDs), jam control stations, etc.);
- All BHS functionality (e.g., bag allocation, load leveling, merge logic, purge logic, and other conditional performance programming) is complete;
- All EDS components (EDS, Control Interface (CI), PVS, SVS, printers) are installed and networked in final - not temporary - configuration, to include redundancy if applicable;
- BHS network is in final configuration accessible via the BHS control room and its interfaces, including redundancy if applicable; and
- Complete BHS/CBIS reports are available.

9.3 Testing and Commissioning Phase Deliverables

Testing and Commissioning Phase deliverables are not submitted for review by TSA's design review team, but are instead coordinated with TSA ATSA and will depend on the nature of the project. The Testing and Commissioning Phase deliverables shall include the following:

- **Pre-ISAT documentation**, which may include the BDR, CONOPS Documents, Project Schedule, Bag Hygiene Policy, Jam and Fail-Safe Clearing Procedures, Integration Specifications, System Drawings, and Phasing Plan.
- **Run-in and Closeout documentation**, which may include a Data Analysis Plan and requested BHS and EDS reports.

9.4 TSA Testing and Commissioning Phase Responsibilities

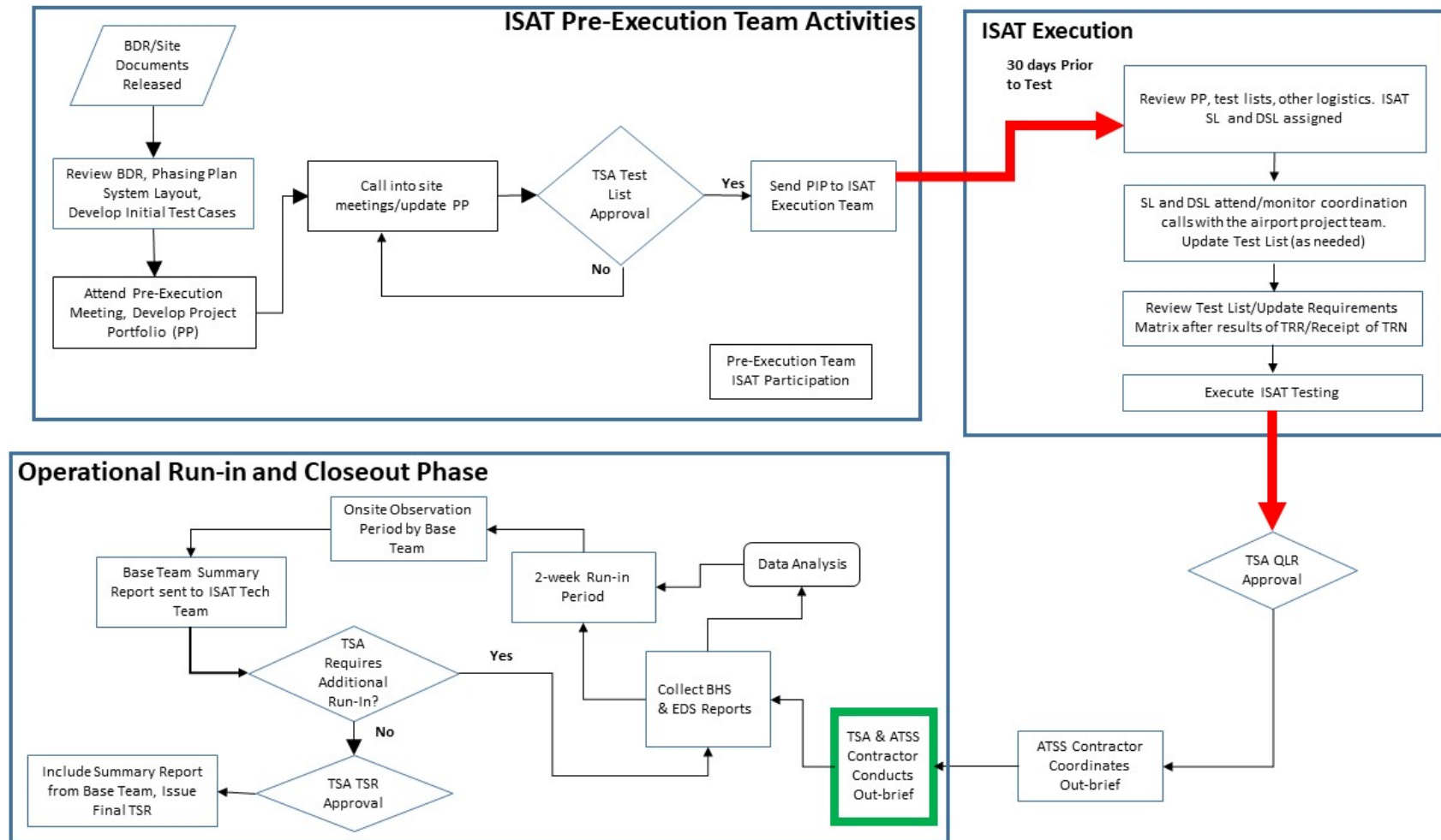
- Conducting SAT
- Conducting the TRR or, if a combined Pre-ISAT/TRR, witnessing and recording tests and results
- Conducting the ISAT

9.4.1 Integrated Site Acceptance Testing

An ISAT is required to be performed after each major phase of a multi-phase project or at the end of construction for a completely new CBIS. Prior to commencing an ISAT, Pre-ISAT (Owner's testing) and the TRR must be successfully completed. If Pre-ISAT and TRR are conducted separately, the TRR Readiness confirmation letter must have been submitted by the Project Sponsor to the TSA DSD and the TRN must have been submitted by TSA DSD to TSA ATSA within the required timeframe before the ISAT can be commenced. If a combined Pre-ISAT/TRR is conducted, the TRN must have been submitted by TSA DSD to TSA ATSA within the required timeframe before the ISAT can be commenced. The ISAT must be completed and successfully passed prior to screening of live operational baggage.

The ISAT process consists of three phases: ISAT Pre-Execution, ISAT Execution, and Operational Run-in & Closeout. Following is a description of the events in each phase with the required documentation and expected output for each phase. The process flowchart in Figure 9.3 provides the tasks and a high-level overview of the ISAT Process through all three phases. This process is notional and there are instances where steps are combined within a phase, but the functions will not transfer between phases.

Figure 9.3: ISAT Process Flow



9.4.1.1 ISAT Pre-Execution

Description: The ISAT Pre-Execution phase is designed to get the test team involved with the ILDT/Airport Team early in the project to ensure there is a continuous dialog within the team about scheduling, conduct, and expectations of testing. At the discretion of the RDC, the Independent Acceptance Testing (IAT) team will be invited to the normal ILDT/Airport meetings to begin the discussion about testing logistics and coordination. It is expected that the involvement of the IAT in these early planning meetings will greatly enhance the successful completion of the overall project. During this phase a Pre-ISAT checklist of required CBIS information will be provided to the ILDT/Airport Team by the IAT Pre-ISAT Execution Team. The ILDT/Airport Team will review this checklist and, through a designated Point of Contact (POC), provide feedback to IAT. This checklist and the subsequent feedback will be used to generate a Project Portfolio which includes, but is not limited to, an overall project contact list, system descriptions, drawings, equipment serial numbers, expected throughput, an expected test list, and any approved RFVs and CCRs. The Project Portfolio will be handed off to the ISAT Execution Team at least 30 days prior to the commencement of the ISAT. The designated POC will continue to be the primary contact between the ILDT/Airport Team and the IAT throughout the completion of the project to ensure continuity of communication and a smooth testing transition throughout.

Required Documents: BDR, CONOPS Documents, Project Schedule, Bag Hygiene Policy, Jam and Fail-Safe Clearing Procedures, Integration Specifications, System Drawings, and Phasing Plan (if applicable).

Outputs: At the end of the Pre-Execution phase a Project Portfolio will be provided to the ISAT Execution Team at least 30 days prior to the commencement of the ISAT. This Project Portfolio is an internal IAT document that will direct the ISAT Execution team in performing all required tests as well as provide a system overview, coordination activities, and test strategies.

9.4.1.2 ISAT Execution

Description: ISAT Execution is the testing and certification of the CBIS. Thirty days prior to commencement of the ISAT, the IAT Site Lead (SL) and Deputy Site Lead (DSL) will take over the coordination of the ISAT from the Pre-Execution Team. From this point forward, they will participate in the ILDT/Airport Team meetings and will coordinate with the ILDT/Airport Team to monitor and potentially participate in the testing phase of the TRR. The actual execution of the ISAT will normally take place over, but not be limited to, a one-week period:

- Monday: the test team travels to the site
- Tuesday – Thursday: conduct the ISAT
- Friday: used as a backup testing day if necessary, or the test team departs the site) per phase

The duration of the ISAT is dependent on the complexity of the changes made to the CBIS and the amount of testing time available each day. Testing duration is expected to be, but will not be limited to, no more than three business days if provided a six-hour test window each day.

During the ISAT, various test protocols will be utilized to determine if the system is “secure” and “efficient” for TSA Operations. All tests performed will be based on the tests included in Appendix D. Based on results of data gathered and testing conducted during ISAT, a recommendation will be provided to the TSA DSD RDC as to whether or not the system is secure and efficient enough to be utilized for live baggage screening operations. Based on the findings of Suitability and Efficiency, a recommendation will be provided to the RDC as to whether the system is capable and secure enough to be utilized in live screening operations. The RDC will provide the Go Live notification at their discretion.

Required Documents: None.

Outputs: Quick Look Report (QLR) will be submitted to TSA within five days following the completion of the ISAT.

9.4.2 Operational Run-in & Closeout

Description: The Operational Run-in will commence two weeks after the completion of the ISAT. The Operational Run-in will normally last for two weeks. The IAT Data Analysis team will forward a data analysis plan to the site upon completion of the ISAT which provides a list of items that are required for the analysis. During the run-in period, TSA expects that the airport and the BHS and EDS teams will provide the requested reports to support the data analysis effort. If the system is shown to be performing adequately and within established efficiency requirements, the run-in will stop and the Test Summary Report (TSR) will be drafted. If performance is not within the established efficiency requirements, or at the discretion of the RDC, another two weeks of data collection and run-in will be performed prior to the drafting of the TSR.

Upon completion of the two week (or as prescribed) run-in period, the Data Analysis team will perform an analysis of the submitted reports. Upon completion of their analysis, the TSR will be drafted and issued to the RDC. The RDC will then provide the TSR to the ILDT/Airport Team.

Required Documents: Data Analysis Plan and requested BHS and EDS reports.

Outputs: Verbal confirmation of the ISAT results and the TSR.

In order to have a successful ISAT, both Owner's and TRR testing should be robust enough to ensure that the system performs in accordance with the requirements outlined in this document. If during testing, the tests outlined in Appendix D of this document are completed successfully then the system should pass the ISAT.

9.5 EDS Recapitalization Baseline ISAT Testing

Prior to the start of construction at EDS recapitalization sites, TSA may choose to conduct a Baseline ISAT testing to document the current status of the CBIS as it relates to safety, security and efficiency. The extent of the Baseline ISAT testing may include any test found in Appendix D as well as additional testing as deemed necessary by TSA.

CHAPTER 10: PROJECT CLOSEOUT PHASE

10.1 Project Closeout Phase Overview

Deliverables and TSA responsibilities for the Project Closeout Phase are listed below and shown in Figure 10.1.

Figure 10.1: Summary of Project Closeout Phase

PROJECT PHASE / TASK	TIME			
Project Closeout Phase				
1. Official TSA Approval of system for beneficial use	◆			
2. As-built CBIS documentation submittal		★		
3. Final copy of the PLC program with drawings			★	
4. Final copy of disaster recovery procedures				★

Note: The timetable does not reflect task duration.

ILDT Task
 Deliverable from ILDT to TSA
 TSA Responsibility
 ILDT/TSA Meeting

Once the CBIS has been allowed to proceed to Live Bag Screening operations and all CBIS deficiencies have been corrected, TSA will provide official approval of the CBIS for beneficial use and the following actions are the responsibility of the Project Sponsor and ILDT to close out the project. Please see a complete list of configuration information in Section 10.3.

10.2 Project Closeout Phase Deliverables

The Project Closeout Phase deliverables shall include the following:

- **As-built CBIS documentation** shall be submitted to TSA, in both Computer-Assisted Design (CAD) and PDF file format, as follows:
 - Final Description of Operations (Section 6.5.2)
 - A complete set of BHS as-built mechanical, electrical, plumbing, fire protection, and special systems drawings (Section 6.6.1)
 - Final conveyor manifest (Section 6.6.5)
- **Control System Architecture Documentation** (Section 10.3)
- **The PLC program** (Section 10.3.3)

10.3 Control Configuration Architecture Documentation

The TSA requires that all configuration information be submitted at various stages of the system life-cycle for each and every CBIS. The requirements of these submittals are described in this section.

10.3.1 Closeout Submittal Format

The submittal data described in this section shall be submitted to the TSA as follows:

- **30-Day Post DBU Submission:** Within 30 days following DBU, the initial submittal, as defined in Section 10.2, shall be made.
- **Submission Procedure:** Submission of all data shall be coordinated with the FSD or designee. All data shall be submitted via electronic files – paper copies will not be accepted.

10.3.1.1 Summary

A descriptive summary narrative of the submittal shall be included in Microsoft Word and PDF format. 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 units
 - 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 and sub-systems and their controller equipment. At a minimum, the following information shall be provided:
 - List of each PLC and the conveyors and sub-systems it controls
 - List of each MCP and the conveyors and sub-systems it controls
- Contact information for:
 - Airport director, engineering manager or other primary contact point responsible for this CBIS
 - Airlines primary contact for this CBIS

- Operation and maintenance contractor (if applicable) primary point of contact
- Point of contact responsible for follow-up submittals

10.3.1.2 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.

10.3.2 Control System Architecture Drawing

A control system architecture drawing shall be submitted 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 MCP or PLC chassis level for high-level networks. Detail shall be down to the photoelectric cell (PEC) or control devices 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.

10.3.3 PLC Code and Associated Configuration Information

The low level, or PLC control, submission shall include the following at a minimum.

- **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. The PLC program submission 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. The PLC program submittal shall include all PLC and software disaster recovery procedures, including software applications.
- **Network Configuration:** A copy of all network configuration files shall be submitted in its native format. The network configuration submittal shall include any redundant networks that may exist.
- **VFD Configuration:** A copy of the configuration of each VFD (including any firmware information) in the CBIS shall be submitted in its native format. The configuration submittal shall include all parameters including unchanged or default settings.
- **Communication and Other Controllers:** A copy of the configuration and code for all other devices as a part of the control system shall be submitted in its native format. An example of these devices might be co-processors or multi-vendor interfaces.
- **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, Input/Output modules, Network modules, Communication modules and VFDs.

10.3.4 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 10.3.6 for configuration software requirements.

Soft copies of these programs shall also be provided, including any portion that is required to operate the system. This includes applications such as those residing in touch screens or other types of dedicated displays or interfaces.

10.3.5 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 computers or PLCs that control 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.

10.3.6 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.

10.3.7 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 on the PLC, where deterministic networks with set update times are used provide all settings and times.

10.3.8 Change Summary Log

A log of all changes made to the CBIS post-ISAT shall be maintained and controlled by the Owner of the CBIS. 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

CHAPTER 11: LIFE CYCLE COST ANALYSIS

11.1 Cost Analysis Overview

There are three key cost analysis documents required over the course of a CBIS project: the Life Cycle Cost Analysis, Basis of Estimate (BOE), and Current Working Estimate. The LCCA is a long-term planning document that primarily supports the selection of the preferred alternative. The BOE builds on the preferred alternative LCCA and is a detailed breakdown of the project construction costs that identifies costs borne entirely by the project owner and costs eligible for TSA funding. The Current Working Estimate (CWE) rolls up the information in the BOE into a summary report.

11.2 Life Cycle Cost Analysis

The design principles prescribed in the PGDS emphasize the need to define and implement the most cost-efficient 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. Life cycle cost is estimated early in the design process and is refined as the design process progresses. These costs establish the basis for return on investment analysis.

It is expected that the life cycle cost will initially be completed as part of the pre-design phase to help identify a preferred alternative and then continually refined during the rest of the design phases. The estimated cost of the project is reviewed by TSA during the design review.

11.3 Analysis Assumptions

Life cycle cost analysis assumptions include the following:

- Life cycle cost analysis period
- Equipment life cycle
- Construction period
- Real dollar cost

11.3.1 Life Cycle Cost Analysis Period

To provide a standardized period for assessing life cycle costs, a 20-year total timeframe shall be assumed based on an EBSP Acquisition Decision Memorandum 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 accommodating traffic growth beyond the initial project Design Year (DBU+5 years).

11.3.2 Equipment Life Cycle

For the purposes of this analysis, equipment life cycle assumptions are as follows (see Chapter 2 for details by equipment model):

- **EDS Equipment:** The useful life of an EDS unit is assumed to be 15 years. Actual EDS useful life is determined by maintenance records and technical obsolescence.
- **ETD Equipment:** The useful life of an ETD unit is assumed to be 10 years.
- **Baggage Handling System:** The useful life of a BHS is assumed to be 20 years. Mechanical and control modifications to systems may be required to accommodate the latest technology and EDS unit throughput rates.

11.3.3 Construction Period

It is expected that the construction period will be, on average, about two years for in-line systems and one year or less for mini in-line and stand-alone systems. The exact construction period will be project-specific and depend on the complexity of design and contracting requirements. Therefore, planners should estimate appropriate construction periods for the particular project in question.

11.3.4 Real Dollar Cost

Real values shall be used to estimate all costs considered in the life cycle analysis to provide a consistent comparison of costs over time. These costs are based on the year in which the analysis is conducted. Therefore, no assumptions regarding cost escalation or inflation are necessary for this analysis. For an estimate of the present day value of project costs, a discount rate will be applied (see Section 11.8). 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 unit costs \$1.0 million today and is expected to cost \$1.1 million in 2020, \$1.1 million is the nominal cost of the unit in 2020. Real (or constant) values are adjusted to eliminate the effect of inflation. In the example above, the real value of the unit is \$1.0 million, whether purchased today or in the future.

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.

11.4 Capital Costs

Capital costs to be considered include:

- Screening equipment acquisition costs

- Screening equipment direct installation costs
- Screening equipment upgrade costs
- EDS removal costs
- EDS residual value and disposal costs
- Required building and BHS infrastructure modification costs

11.4.1 Screening Equipment Acquisition Costs

The cost to acquire screening equipment including ancillary equipment needed for a CBIS installation is seen summarized below in Table 11.1.

Table 11.1: Estimated EDS/SVS/PVS/Network Procurement and Installation Costs

EDS Type	Procurement and Installation Cost per EDS Unit (including ancillary equipment)
Type I	\$1,700,000
Type II	\$700,000

11.4.2 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 11.2.

Table 11.2: Components of Direct Installation Costs

Equipment	Labor	Logistics	Onsite Installation
• Auxiliary equipment (including hardware and software) • Initial spares/repair parts and consumables	• Program management (on-site and TSA Headquarters), including technical contracts • Systems engineering personnel • Initial training	• Warehousing • Shipping and handling • Data (training manuals, maintenance manuals, operations manuals) • Travel • Other	• Site preparation • Facility modifications (construction) and design (see note) • Integration and multiplexing • Testing and evaluation

Note: Includes any onsite modifications required to install screening equipment. Does not cover expenses related to BHS design and associated facility modifications. Facility modifications, construction and design are part of the overall project by the project sponsor. Electrical for screening equipment should also be included by the project sponsor. Integration, testing and evaluation are activities that will have both direct and project-sponsored costs.

Direct installation costs vary significantly among configurations of the same model of EDS unit. For example, the installation of a Reveal CT-80DR 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 Reveal CT-80DR equipment compared to one using Reveal CT-80DRXL equipment should be assumed, as the Reveal CT-80DR EDS is capable of operating at higher throughput rates.

11.4.3 Screening Equipment Upgrade Costs

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.

11.4.4 Similar Screening Equipment Replacement Costs

Whenever it is necessary to replace screening equipment with new screening equipment of similar performance, it may be necessary to modify the BHS so that it can support the new unit types if the BHS is not already designed to support the new type of screening equipment. However, due to unpredictable variability in EDS equipment life spans, equipment replacement costs are not to be considered in the LCCE.

11.4.5 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 units require significant facility design and construction costs because of their size and weight and the need to integrate these units 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 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.

Facility modification costs shall be adjusted to account for regional differences in construction costs based on the latest *RS Means Construction Cost Data Indexes* published by Reed Construction Data or by other industry-standard cost adjustment practices.

11.5 Soft Costs

Project management, construction management, escalation, design fees, and other so-called “soft costs”, many of which are undefined, can vary greatly depending on project delivery methods.

Project management as discussed in the PGDS refers solely to the airport, project sponsor or project sponsor’s existing Program Management Office 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 or BHSC to construct and install the CBIS solution (whether in-line, stand-alone, or otherwise).

Soft costs to be considered may include the following:

- Project management
- Construction management
- Construction administration
- Design contingencies
- Construction contingencies
- Escalation

For more information on soft costs as they relate to TSA funding, please reference the latest TSA-issued Funding Policy Memo located on the [Sam.gov](https://www.sam.gov) website using the search term “PGDS”.

11.6 O&M Costs

O&M costs refer to any expenses incurred by the airport or TSA to operate and maintain the baggage screening system. 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

Screening equipment O&M is generally funded by TSA while BHS O&M is the responsibility of the airport.

11.6.1 Screening Equipment Maintenance Costs

Screening equipment maintenance costs include costs for preventive and corrective maintenance, related program management, replenishment of spares, repair parts, shipping and handling, technical update training, data manuals, other direct expenses. Maintenance costs for new technology equipment are assumed to also be on a fixed price per unit basis, equal to 10% annually of the purchase price. EDS annual maintenance costs for planning purposes are provide in Table 11.3.

Table 11.3: EDS Annual Maintenance Costs

EDS Type	Cost per EDS unit
Type I	\$160,000
Type II	\$80,000

All EDS vendors provide 2-year warranty periods, so the first 2 years of maintenance costs are 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.

11.6.2 Screening Equipment Operating Costs

The largest operating cost for screening equipment is the electrical consumption of the EDS equipment. Typically, electrical consumption per unit can be estimated from equipment specifications and duration of use (which can be estimated based on baggage flow). Table 11.4 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 11.4: Screening Equipment Electrical Consumption

Screening equipment	Consumption (kW)
Leidos eXaminer 3DX 6700	6.2
Leidos eXaminer 3DX 6700 ES	6.2
Leidos eXaminer 3DX 6600	6.2
Leidos eXaminer 3DX 6600 ES	6.2
Smiths CTX 9800 DSi (Classic)	10.3
Smiths CTX 9800 DSi (SEIO)	10.3
Smiths CTX 5800	2.1
Reveal CT-80DR+	4.4
Reveal CT-80DR	4.4
Reveal CT-80DRXL	4.4

Sources: TSA and screening equipment manufacturers, 2014.

11.6.3 Incremental BHS Maintenance Costs

Planners should account for incremental costs for BHS maintenance directly related to the CBIS. 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, planners shall only consider the incremental cost of BHS maintenance which is calculated by subtracting the existing maintenance cost of the current BHS (with or without a CBIS) from the total estimated maintenance cost of the new BHS with the proposed CBIS.

For the most part, BHS repair costs without the CBIS are negligible, except in airports that have large sortation systems. The overall annual cost of O&M for the full CBIS shall be estimated at 10% of the initial overall cost of the system. As the system ages, a reduction in this cost may occur if proper preventative and corrective maintenance is performed.

Table 11.5 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 11.5: Estimated Annual Incremental BHS Maintenance Costs for Systems Without Existing CBIS

Screening system type	Incremental BHS maintenance cost per EDS unit
In-line	\$290,000
Mini in-line (all equipment types)	\$38,000
Stand-alone	\$0

Source: Existing in-line systems data, May 2006, escalated to Federal Fiscal Year 2013 dollars.

11.6.4 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 (with or without a CBIS) from the total estimated operating cost of the new BHS with the proposed CBIS.

11.7 Staffing Costs

Staffing costs to be considered include:

- TSA TSO 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 staffing costs are expected, such costs should be included in staffing or O&M costs as applicable.

11.7.1 TSA Personnel Costs

TSA will assess staffing costs for TSA TSOs and supervisors. Planners shall request staffing cost estimates for the screening alternatives 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
- Descriptions of the screening system type and equipment for each screening zone assumed in the concept
- Estimated baggage flow for the Design Day in 10-minute bins
- Assumed annual growth rate based on the forecasts used to determine equipment requirements
- TSA will provide assistance as needed in estimating the total screening cost by year for each alternative under consideration.

11.7.2 Incremental Costs for Baggage Porters and Other Airport/Airline Staff

Any increase or decrease in costs for baggage porters or other airport/airline staff shall be included in the life cycle cost analysis. Planners shall include only incremental costs for baggage porters or other airport/airline staff.

11.8 Basis of Estimate Document

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 ROM costs, the 30% through 100% designs require detailed cost estimates based on the BDR.

Estimates submitted at each project phase from 30% Design forward shall include a BOE document which includes, at a minimum, the following elements:

- Purpose
- Executive summary
- Project scope description
- Methodology used to prepare the estimate
 - Work breakdown structure
 - Tools and data sources
 - Major cost components: labor, equipment, and material
 - Subcontractor and prime contractor markups and fees
 - Allowances
 - Other factors
 - Schedule requirements
 - Assumptions, exclusions, and exemptions
 - Areas of risks

The BOE documentation should clearly indicate that the estimate is reflective of current market conditions. The BOE submitted at each design phase should provide a level of detail commensurate with the level of design. Further explanation of each section of the BOE is provided below.

11.8.1 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.

11.8.2 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. The Executive Summary section shall include, not necessarily in this order, discussions of:

- Where the project sponsor is in the bid and construction contract award process, if applicable
- Whether construction has already begun and, if so, how much of the construction has been completed, if applicable
- If the airport sponsor has awarded the construction contract, the type of construction contract instrument (firm fixed price, time and materials, design-build, etc.), if applicable
- 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 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
- Statement regarding whether the airport sponsor's estimate is reflective of current market conditions that addresses:
 - 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.

11.8.3 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.

11.8.4 Methodology Used to Prepare the Estimate

11.8.4.1 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 shall be presented. A sample WBS is provided in Figure 11.1.

Figure 11.1: Sample Work Breakdown Structure

TSA CBIS Project Sample Work Breakdown Structure	
010000 General Requirements	
020000 Existing Conditions	
022000 Measurements	144000 Lites
024000 Construction Investigation	147000 Scaffolding
024000 Demolition and Structure Moving	148000 Other Conveying Equipment
025000 Site Removal	210000 Material-Based Fire Suppression Systems
026000 Contaminated Site Material Removal	211000 Water-Based Fire Suppression Systems
027000 Water Remediation	212000 Fire-Extinguishing Systems
028000 Facility Remediation	213000 Fire Pumps
030000 Concrete	214000 Fire-Suppression Water Storage
031000 Concrete Forming and Accessories (Typically not allocable)	220000 Plumbing
032000 Concrete Reinforcing (Typically not allocable)	221000 Plumbing Piping and Pumps
033000 Cast-in-Place Concrete (Typically not allocable)	222000 Plumbing Equipment
034000 Precast Concrete (Typically not allocable)	224000 Plumbing Features
035000 Cast Decks and Underlayment (Typically not allocable)	230000 Heating Ventilating and Air-Conditioning (HVAC)
036000 Grouting	231000 HVAC Fuel Systems
037000 Mass Concrete (Typically not allocable)	232000 HVAC Piping and Pumps
038000 Concrete Cutting and Boring	233000 HVAC Air Distribution
040000 Masonry	234000 HVAC Air Cleaning Devices
042000 Unit Masonry	235000 Central Heating Equipment
044000 Stone Assemblies	236000 Central Cooling Equipment
045000 Refractory Masonry	237000 Central HVAC Equipment
046000 Corrosion-Resistant Masonry	238000 Decentralized HVAC Equipment
047000 Manufactured Masonry	250000 Integrated Automation
050000 Metals	251000 Integrated Automation Network Equipment
051000 Structural Metal Framing (Typically not allocable)	252000 Integrated Automation Instrumentation and Terminal Devices
052000 Metal Joists (Typically not allocable)	253000 Integrated Automation Facility Controls
053000 Metal Decking (Typically not allocable)	259000 Integrated Automation Control Sequences
054000 Cold-Formed Metal Framing (Typically not allocable)	260000 Electrical
055000 Metal Fabrications	261000 Medium-Voltage Electrical Distribution
057000 Decorative Metal (Not allocable)	262000 Low-Voltage Electrical Transmission
060000 Wood, Plastics, and Composites	263000 Facility Electrical Power Generating and Storing Equipment
061000 Rough Carpentry	264000 Electrical and Cathodic Protection
062000 Finish Carpentry	265000 Lighting
064000 Architectural Woodwork	270000 Communications
065000 Structural Plastics	271000 Structured Cabling
066000 Plaste Fabrications	272000 Data Communications
067000 Structural Composites	273000 Voice Communications
068000 Composite Fabrications	274000 Audio-Video Communications
070000 Thermal and Moisture Protection	275000 Distributed Communications and Monitoring Systems
071000 Damp proofing and Waterproofing	280000 Electronic Safety and Security
072000 Thermal Protection	281000 Electronic Access Control and Intrusion Detection
073000 Slope Slope Retention (Typically not allocable)	282000 Electronic Surveillance
074000 Roofing and Siding Retention (Typically not allocable)	283000 Electronic Detection and Alarm
075000 Membrane Roofing (Typically not allocable)	284000 Electronic Monitoring and Control
076000 Flashing and Sheet Metal	310000 Site Clearing
077000 Roof and Wall Specialties and Accessories	312000 Earth Moving
078000 Fire and Smoke Protection	313000 Earthwork Methods
080000 Joint Protection	314000 Shoring and Underpinning
081000 Doors and Frames	315000 Excavation Support and Protection
083000 Specialty Doors and Frames	316000 Special Foundations and Load-Bearing Elements
084000 Entrances, Storefronts, and Curtain Walls (Typically not allocable)	317000 Tunneling and Mining
085000 Windows (Typically interior only)	320000 Exterior Improvements (Typically not allocable)
086000 Roof Windows and Skylights (Typically not allocable)	321000 Bases, Ballasts, and Paving
087000 Hardware	322000 Site Improvements
088000 Glazing (Typically interior only)	327000 Wetlands
089000 Louvers and Vents	328000 Irrigation
090000 Finishes	329000 Planting
090000 Painting and Coating	330000 Utilities
092000 Plaster and Gypsum Board	331000 Water Utilities
093000 Tiling	332000 Walls
094000 Ceilings	333000 Sanitary Sewerage Utilities
095000 Flooring	334000 Storm Drainage Utilities
097000 Wall Finishes	335000 Fuel Distribution Utilities
098000 Acoustic Treatment	336000 Hydraulic and Steam Energy Utilities
100000 Specialties	337000 Electrical Utilities
101000 Information Specialties	338000 Communications Utilities
102000 Interior Specialties	340000 Transportation
104000 Safety Specialties	340000 Baggage Handling Systems
105000 Storage Specialists	Project/Size Management – The costs associated with the baggage contractor's project management, site supervision, administration and support infrastructure associated with the project
108000 Other Specialties	Equipment – The costs for the conveyor components excluding motor control panels, PLCs and other control equipment
110000 Equipment	Installation – The costs for the mawright's and electrician's labor associated with the installation of the baggage system
120000 Furnishings	Engineering – The cost for the baggage system contractor to prepare shop drawings for the baggage system
121000 Art (Not Allocable)	Controls (linked 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
122000 Window Treatments (Typically not allocable)	Testing – Labor for labor associated with testing the motors and testing the labor to support the ISAT process
123000 Casework	350000 Waterway and Marine Construction (Typically not allocable)
124000 Furnishings and Accessories	400000 Process Integration (Typically not allocable)
125000 Furniture	410000 Material Processing and Handling Equipment (Typically not allocable)
126000 Halls Seating (Typically not allocable)	420000 Process Heating, Cooling, and Drying Equipment (Typically not allocable)
129000 Other Furnishings	430000 Process Gas and Liquid Handling, Purification and Storage Equipment (Typically not allocable)
130000 Special Facility Components	440000 Pollution Control Equipment (Typically not allocable)
131000 Special Purpose Rooms	450000 Industry-Specific Manufacturing Equipment (Typically not allocable)
132000 Special Structures	460000 Electrical Power Generation
134000 Integrated Construction	
135000 Special Instrumentation	
140000 Conveying Equipment	
142000 Elevators	
143000 Escalators and Moving Walks (Typically not allocable)	

11.8.4.2 Tools and Data Sources

The BOE shall indicate the primary estimating methodology used in preparing the cost estimate, including that used for cost resources, historical data, and estimating tools and documents.

11.8.4.3 Major Cost Components: Labor, Equipment, Material

Sources for labor, equipment and material cost elements used in preparing the BOE shall 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."

11.8.4.4 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.

11.8.4.5 Allowances

Allowances used in the estimate and the reason they were used shall 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."

11.8.4.6 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.

11.8.4.7 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.

Section 8.3 requires the Project Sponsor to submit an updated Construction Schedule to TSA stakeholders at a minimum of every 30 days after construction award for construction of the BHS/CBIS identified/agreed to in the Letter of Intent or OTA. The schedule should be submitted in both hard and soft (i.e., Microsoft Project) 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 EVM information required when submitting invoices to TSA (see Section 4.7.3).

11.8.4.8 Assumptions, Exclusions, and Exemptions

The BOE shall 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.

11.8.4.9 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

11.9 Current Working Estimate Submissions

A summary of the Basis of Estimate costs shall be submitted at each phase of design. The Current Working Estimate (CWE) summary form in Figure 11.2 shows the level of detail that should be in the detailed cost summary.

If the project sponsor is requesting TSA funding, TSA must be able to verify that it is only funding that portion of a project that is necessary to implement a CBIS. The current working estimate summary form in Figure 11.2 clearly identifies which costs are allocable for TSA funding and those that are not. Airport sponsors requesting funding support from TSA shall provide a detailed breakout of allocable versus non-allocable costs at each phase of design.

Figure 11.2: Current Working Estimate Summary

CURRENT WORKING ESTIMATE SUMMARY				Prepared by:					
AIRPORT IDENTIFIER:									
PROJECT NAME:									
ESTIMATED PROJECT COMPLETION DATE:									
Current Working Estimate - Effective Pricing Date:									
Current Working Estimate - Level of Design:									
Currency:				US					
HARD COSTS (IECCA)									
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 Covering 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 Gases and Liquid Handling, Purification and Storage Exp.									
Div 44 Pollution Control Equipment									
Div 45 Industry Specific Manufacturing Equipment									
Div 46 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)					\$	-	\$	-	\$

11.9.1 Cost Estimate Breakouts

Estimates should, at a minimum, include the elements shown in Figure 11.2 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 the most recent version of the Construction Specifications Institute Division Summary Master Format.

- The CWE includes the following contractor markups:
 - Insurance and Bond
 - Home office overhead
 - Profit
 - Sales tax
- The CWE includes the following soft costs:
 - Construction contingency
 - Design and programming
 - Project/construction management
 - Escalation
- The CWE includes BHS estimates listed separately under Construction Standards Institute division 34 “Transportation,” and includes as separate items each of the following:
 - Project management
 - Equipment
 - Installation
 - Engineering
 - Controls
 - Testing

11.9.2 Cost Estimate Pricing Substantiation

All CWE pricing shall be effective as of the date of the submittal.

Estimates submitted for funding request purposes shall 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

11.9.3 Allocable Costs

The CWE can contain both costs that are allowable under the terms of the OTA and allocable to the CBIS portion of the project and those that are not. TSA non-allowable/allocable costs are segregated in a separate column of the CWE. The Project Sponsor shall include both allowable/allocable and non-allowable/allocable costs in the appropriate CWE column. All allowable/allocable costs associated with the CBIS, CBRA, and OSR room should be included in the appropriate column (see example in Figure 11.3). TSA will only reimburse the airport or project sponsor for those costs that are considered allowable, allocable and reasonable under Federal grant rules and guidance and are properly identified as such on the CWE.

Figure 11.3: 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

For more information on TSA's funding policy, see the Electronic Baggage Screening Program Policy Memo – TSA Funding of Checked Baggage Inspection System Project Costs at the SAM.gov website using the search term "PGDS".

11.10 Estimate Reconciliation

It is common practice for two independent estimates to be prepared; one by the Project Sponsor and one by the TSA 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 Project Sponsor's estimate and TSA allowable costs, the approach to reconcile the estimates will proceed with the following ground rules:

- Estimate summaries will strictly adhere to the CWE format illustrated in Figure 11.2. As a rule of thumb, variances in excess of 10% for each division will be reconciled further. The rationale for the reconciliation will be documented to provide an understanding of the reconciled value.

- The formats for the estimate will strictly adhere to a WBS to evaluate the scope of the project. A sample WBS is provided in Section 11.8.4.1. Scope variance will be reconciled prior to review of pricing. Once scope differences are resolved, updated estimate summaries will be generated.
- The “reconciled” estimate will be used as the go-forward estimate.

11.11 Estimate Trending

As each subsequent design level is completed, the CWE should be compared with the prior design phase CWE. Any changes to scope or design shall be identified, documented, and submitted to the TSA Project Coordinator for approval. Once a project budget has been established, changes in cost should be added or deducted from the design contingencies with Contracting Officer approval.

REQUIREMENTS AND BEST PRACTICES

SECTION III : CBIS DESIGN REQUIREMENTS AND INDUSTRY BEST PRACTICES

CHAPTER 12: CBIS DESIGN REQUIREMENTS

CHAPTER 13: ON-SCREEN RESOLUTION AREA PLANNING STANDARDS

CHAPTER 14: CHECKED BAGGAGE RESOLUTION AREA

CHAPTER 15 CBIS OPERATING AND MAINTENANCE BEST PRACTICES

CHAPTER 16: INFORMATION TECHNOLOGY SECURITY

CHAPTER 12: CBIS DESIGN REQUIREMENTS



12.1 CBIS Design Principles

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

- Overall CBIS design principles related to security, efficiency, customer service level, cost-effectiveness, and safety.
- Specific design best practices and standards to assist designers and planners in developing CBIS designs in accordance with the PGDS.

The design performance to be achieved by the CBIS designs are described in detail in this section. The requirements will be used by the CBIS designers in developing CBIS plans and specifications.

- **Security:** When designing a CBIS, security is a top priority. The CBIS design principles in this section describe key security-related requirements and best practices to be met in planning and designing a CBIS.
- **Efficiency:** 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 as Lost in Track or Unknown 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.
- **Customer Service Level:** A CBIS must meet TSA security requirements 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.
- **Cost Effectiveness:** Alternative system types, if properly sized, will offer equivalent levels of security, efficiency, and customer service. Therefore, selection of the preferred alternative will 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 Section 5.7.
- **Operational Considerations:** 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 that must accompany the 30% design submission to TSA. A CBIS concept of operation outline is provided in Appendix A, Section A.2, 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 as stated in the requirements for Chapter 2. 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.
- **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 the customer service level. Separate chapters and sections of this PGDS are devoted to the key steps involved in proper system selection and sizing:

- Chapter 2 describes the range of system types and screening equipment to be considered.
- Section 5.5 describes the process for determining baggage screening demand.
- Section 5.6 describes the methodology for determining baggage screening equipment requirements.
- Section 5.7 describes the process used in developing and evaluating alternatives.
- **Safety:** In planning and throughout the construction of a CBIS, safety standards and ergonomic design principles will be applied as early as possible to reduce the potential for injuries caused by improper ergonomic designs. Applicable safety standards and ergonomic design principles will be applied in conjunction with other security parameters during the planning phase to avoid future costly retro-fitting solutions to reduce injuries.

12.2 CBIS Planning Standards

Performance requirements specify key operational parameters that a CBIS must meet or exceed. This section identifies those requirements and describes additional planning considerations to assist Project Sponsors in successfully passing the design review process and the commissioning of the system.

A CBIS will be evaluated during the design, construction, testing, and commissioning phases to ensure compliance with specific design standards.

- **Design Phases:** Before receiving approval from TSA, proposed in-line CBIS designs will be evaluated to demonstrate compliance with the requirements described in this chapter.
- **Construction, Testing, and Commissioning Phases:** Before final TSA acceptance, a number of system and component tests will be performed on an installed CBIS as part of the commissioning process. See Appendix D for a description of how the ISAT and Site Specific Test Plan will be developed.

12.3 BHS Capacity

For new systems, no component of the CBIS shall constrain the maximum qualified capacity of each EDS unit. For recapitalization projects, the existing capacity of the CBIS shall not be reduced.

Legacy BHS components shall not affect the performance of the CBIS. To ensure the legacy BHS does not affect the new 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 units. Please contact the TSA Project Coordinator or go to

TSA's EBSP web page to obtain a copy of the EBSP Policy Memo – *TSA Funding for Checked Baggage Inspection System Project Costs*. The Project Sponsor shall ensure compliance with the EDS OEM's site planning and installation guidelines.

12.3.1 Mainline Requirements

Mainlines shall be capable of delivering bags to the EDS units to equal the capacity of the total non-redundant EDS units. Prior to entering the STZ, the BHS shall regulate baggage flow to not exceed the capacity of the non-redundant EDS machines. Mainlines taking bags away from the EDS unit shall be capable of transporting bags equal to or greater than the capacity of the non-redundant EDS units.

A redundant mainline will not be allowed when it will:

- Defeat the purpose of redundant EDS units
- Reduce the efficiency of the CBIS
- Add unnecessary cost
- Impose unnecessary spatial constraints
- Add unnecessary complexity to the system

12.3.2 Tail-to-Head Bag Spacing Requirement

For slider bed conveyors, the space between bags as measured from the trailing edge of leading bag to the leading edge of the trailing bag, or "tail-to-head spacing" shall be no less than 12 inches prior to entering the EDS unit.

- Bag Spacing shall be measured on the queue conveyor immediately upstream of the EDS machine and shall be adjustable.
- Adjustments to bag spacing shall be done via the main BHS Operator interface (HMI) in the BHS control room.
- Adjustments to bag spacing are allowed only at TSA's request and through use of the CCR process.
- Adjustment ranges will be fixed with a minimum of 12 inches and a maximum of 36 inches.
- BHS Bag Spacing reporting shall:
 - Maintain spacing data for last 100 bags
 - Omit spacing greater than 36 inches when creating averages
 - Maintain a column in the "Bag Spacing Report" that shows bag spacing/averages
 - Trigger an event record when spacing is changed that will include time, date of change, and new spacing setting

The speed of the queue belt immediately before and after the EDS unit (as bags transition into and out of the EDS) shall comply with the EDS Integration manual. For ICS, the space between carriers shall be as determined by the EDS manufacturer and their ability to clearly delineate between carriers. The ICS must also be able to maintain positive tracking.

12.4 Screening Throughput Capacity Requirement

A CBIS needs to provide adequate screening throughput capacity and meet the throughput and capacity standards set in this section. The following are the corresponding screening throughput capacity standards.

The actual screening throughput capacity of the CBIS as tested in accordance with the information presented in Appendix D shall meet or exceed the EDS throughput rate listed in the 100% approved BDR. If the average bag length used in the BDR differs from the average bag length of the ISAT test bag set, the tested throughput capacity will be adjusted from the BDR rate to be based on the ISAT test bag set average length. If this rate is greater than the maximum screening capacity of CBRA, the tested capacity of the CBIS shall not exceed the CBRA capacity.

Note: The actual EDS screening throughput is the overall baggage rate with the OS and OOG percentages subtracted.

- As part of the pre-ISAT testing described in Chapter 9, the average screening throughput capacity per EDS unit will be confirmed by the Project Sponsor.
- If the design cannot meet the required screening throughput capacity, the Project Sponsor must justify the designed screening throughput capacity to TSA.

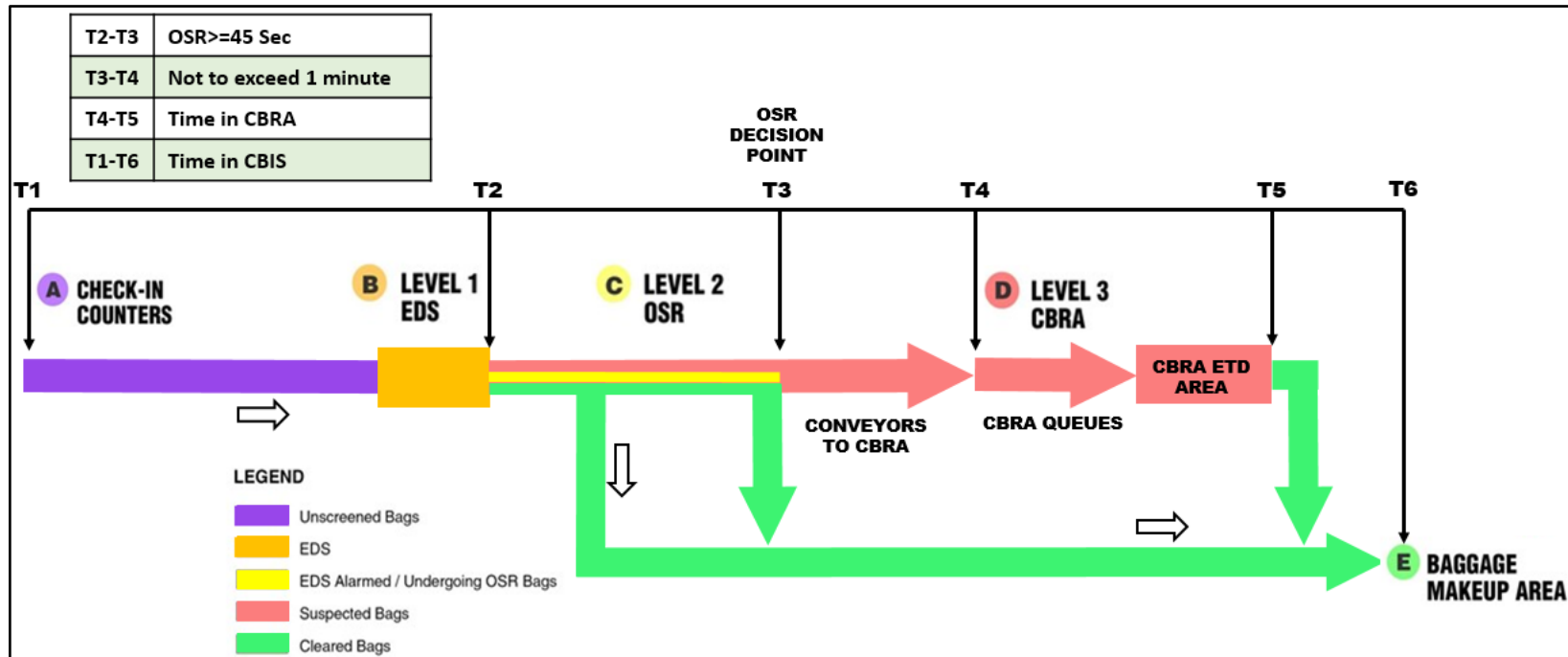
12.5 Bag Time-in-System

When designing the CBIS, the amount of time a bag is in the system needs to be considered. The proposed CBIS should be designed to minimize delay to bags processed during normal operations.

12.5.1 Time-in-System Static Calculations

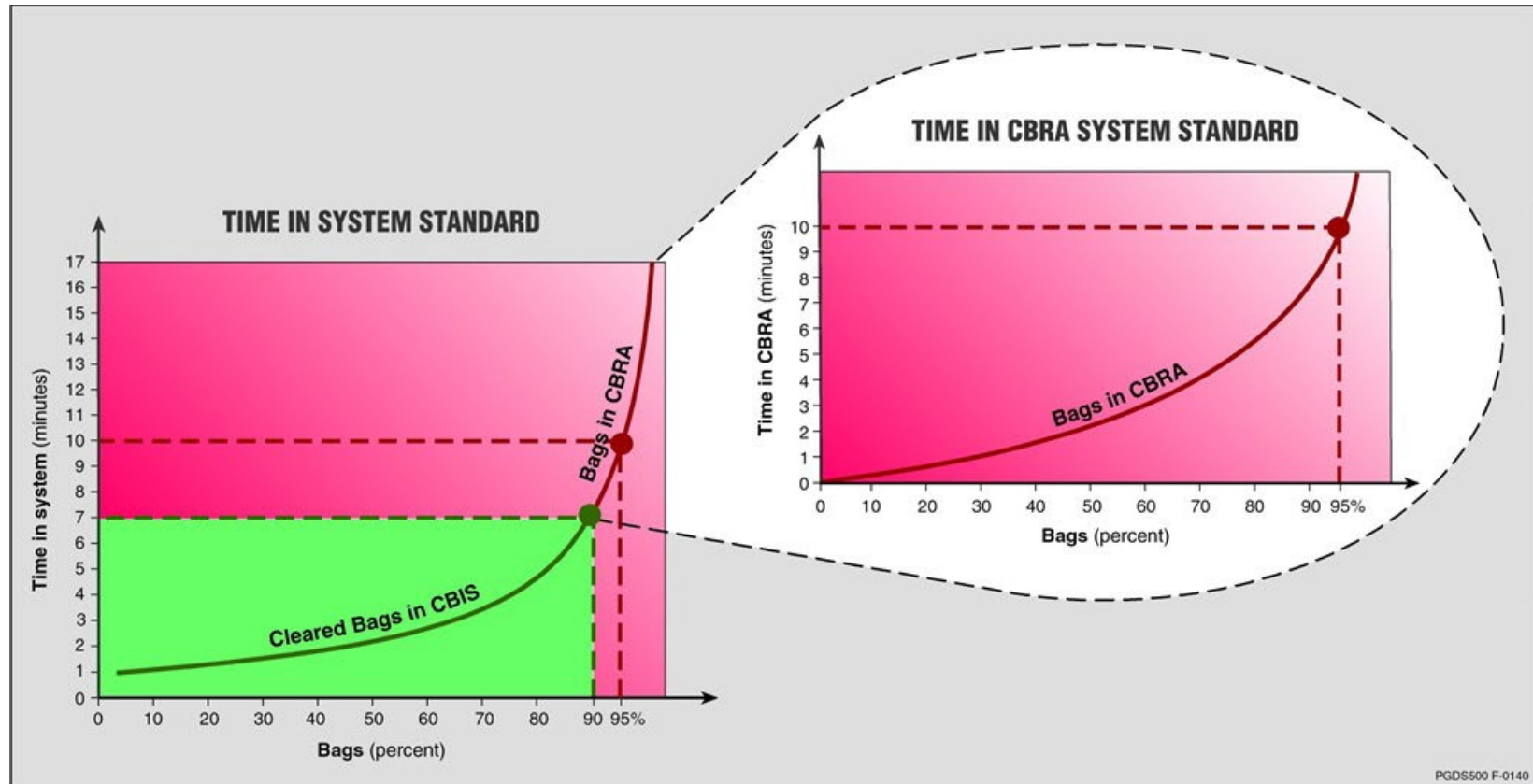
Industry best practice is that the bag time-in-system from insertion at the furthest load point, through the CBIS, to arrival at the sortation system mainlines that feed the baggage makeup area should be no more than 10 minutes for 95% of peak hour bags during normal operations (shown as T1-T6 in Figure 12.1).

Figure 12.1: Bag Time In System and Bag Time In CBRA



The time includes all screening time (i.e., including alarm resolution in the CBRA). Since the vast majority of bags bypass the CBRA by being cleared by the EDS or the OSR operator, only a small percentage of bags should ever exceed the 10-minute threshold as shown in Figure 12.2.

Figure 12.2: Time In System and Time In CBRA Standards



The travel time calculations will be provided as part of the Schematic and Detailed Design Phases as referenced in Chapter 2 and Section 5.7.

12.5.2 Time-in-System Modeling Calculations

When flow-based modeling of the CBIS is performed, the time-in-system calculations should be verified by averaging across a sufficient number of modeling runs to provide reliable results (industry best practice is commonly 10 or more).

However, for specific CBISs with especially long delivery lines from check-in areas to a centralized CBIS or CBIS with legacy EDS units that typically have higher false alarms rates, bag time-in-system calculations could result in values longer than 10 minutes for 95% of the bags. In these cases, the Project Sponsor should engage with the project stakeholders to determine a mutually acceptable solution.

See Section 7.2.4 for additional best practices regarding dynamic modeling programming parameters.

12.6 Bag Travel Time Requirements

The Bag Travel Time (BTT) is the time it takes a bag to travel from the exit of the EDS to the last decision point photo eye.

12.6.1 In-Line Systems

For in-line systems, the CBIS shall allow a minimum of 45 seconds of BTT without holding bags. This minimum BTT allows for sufficient OSR Viewing Time (OVT) and is the minimum time an operator has to conduct OSR protocols at Level 2. It is critical to ensure adequate OVT when dealing with consecutive alarm bags to minimize timed out bags going into the CBRA.

12.6.2 Mini In-Line Systems

For mini in-line systems, the minimum BTT shall be 60 seconds. However, designers are encouraged to maximize it further whenever possible. This higher BTT can be achieved without impacting EDS rates, using a combination of:

- Slower belt speeds downstream of the EDS
- Additional queues downstream of the EDS
- Holding of alarm bags downstream of the EDS to take advantage of lag times in between the bags (due to bag flow control upstream of the EDS)
- For mini in-line systems, the minimum design OVT shall be 25 seconds for each alarm bag, for up to 3 consecutive alarm bags.

12.7 BHS Tracking

This section defines the BHS baggage tracking requirements and corresponding best practices to achieve optimal performance. A key requirement 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.

12.7.1 CBIS Positive Bag Tracking Requirements

- The CBIS shall be capable of maintaining positive bag tracking in the STZ during events (e.g., diebacks, merging, decision point transitions, etc.) that are typical of situations which may occur in BHSs.
- The STZ starts at the point at which the BHS acquires positive tracking of a bag prior to the EDS (normally at a BMA, an ATR, or a Photocell where the BHS Tracking ID is assigned). The STZ extends to the Clear Line diversion points and to the BRPs in the CBRA.
- The CBIS will be designed with sufficient control functions so that bags stop on the appropriate conveyor and no part of the bag drifts onto the next downstream conveyor.

12.7.1.1 Pre-EDS Requirements

- The BHS shall assign a unique tracking ID (BHS Pseudo ID) to each bag once the bag enters the STZ within the CBIS for the purposes of positive bag tracking.
- The CBIS shall incorporate an ATR upstream of the EDS matrix. ATRs shall not be located on an incline or decline. ATRs shall be a minimum of 6' away from a power turn.
- ATR read rates shall be no less than 98% for laser arrays and 99% for RFID applications for valid reads for that system during controlled testing.
- All systems utilizing an ATR shall maintain a relation between the BHS tracking ID and the 10-digit IATA bag tag ID for all bags that are successfully read.
- The BHS Pseudo ID shall be used as the Primary ID passed from the BHS to the EDS. In all systems where an ATR is present, the 10-digit IATA bag tag data shall also be passed from the BHS to the EDS.
- CBIS tracking shall in no way be controlled or constrained by a sort controller where the relation is maintained within the PLC.
- The BHS Pseudo ID and, if available, the 10-digit IATA bag tag data shall be transferred between BHS and EDS equipment as defined by each EDS manufacturer's interface requirements document or integration guide. If the EDS does not accept both a BHS Pseudo ID and a 10-digit IATA bag tag ID, then the 10-digit IATA bag tag ID shall be transferred to the EDS as the primary ID.
- Upstream IATA tracking accuracy: The upstream IATA tracking accuracy shall be calculated and reported in the CBIS Executive Summary Report by summing the quantity of the 10-digit IATA bag tags that are successfully handed off to the EDS units, R_{EDS} , with the quantity of 10-digit IATA bag tags that are seen by the photo eye (PE) just past the OOG divert location, $R_{OOG @ PE}$, all divided by the quantity of 10-digit IATA bag tags that are successfully read by the ATR and supplied to the BHS, R . This value shall be displayed as a percentage and shall be at least 97%. The formula used to calculate Upstream IATA Tracking Accuracy is shown below:

$$\text{Upstream IATA Tracking Accuracy} = \left(\frac{R_{\text{OOG @ PE}} + R_{\text{EDS}}}{R} \right) \times 100$$

- IATA Handoff Accuracy: The IATA Handoff Accuracy shall be equal to the total number of 10-digit IATA bag tags sent back at the exit of the EDS machine divided by the total valid (non-OOG) ATR reads. This measurement shall be displayed in the CBIS Performance report. (See Appendix A, Section A.4.10.)
- If the BHS Pseudo ID becomes unknown or unavailable, the BHS will generate a new BHS Pseudo ID or the EDS will generate an EDS Pseudo ID for tracking purposes. This format and EDS Bag ID range is specified in the OEM's integration guide. The BHS OEM shall ensure EDS Bag ID overlap does not occur between any EDS unit within any matrix.
- BHS Pseudo IDs and EDS Pseudo IDs shall not overlap with IATA requirements for bag tag IDs or repeat themselves within 24 hours (i.e., unique BHS/EDS IDs are required for a duration of 24 hours).
- OOG tracking accuracy (absolute): The OOG tracking accuracy (absolute) shall be calculated by dividing the quantity of successfully tracked OOG bags just after the OOG divert location by the total OOG bags detected at the BMA. This value shall be displayed as a percentage in the CBIS Executive Summary Report and shall be at least 97%. The equation used to calculate this value is shown below, where $R_{\text{OOG @ PE}}$ is the quantity of positively read, OOG bags at the OOG divert point; $R_{\text{NR, OOG @ PE}}$ is the no-reads at the OOG divert; R_{OOG} is the positively read OOG bags at the BMA; and $R_{\text{NR, OOG}}$ is the OOG no-reads at the BMA.

$$\text{OOG Tracking Accuracy (absolute)} = \left(\frac{R_{\text{OOG @ PE}} + R_{\text{NR, OOG @ PE}}}{R_{\text{OOG}} + R_{\text{NR, OOG}}} \right) \times 100$$

- Invalid Arrivals at the OOG Line: The Invalid OOG Arrival percentage shall be measured just after the OOG divert location and calculated by subtracting the known OOG bags, $R_{\text{OOG @ PE}} + R_{\text{NR, OOG @ PE}}$, from the total quantity of bags at the same location, all divided by the total quantity of bags at the same location. This value shall be displayed as a percentage in the Daily CBIS Summary Report. The equation used to calculate the percentage is shown below:

$$\text{Invalid Arrivals at the OOG Line} = \left(\frac{\text{Total Bags at OOG PE} - (R_{\text{OOG @ PE}} + R_{\text{NR, OOG @ PE}})}{\text{Total Bags at OOG PE}} \right) \times 100$$

12.7.1.2 Post-EDS Requirements

- When the EDS passes a decision to the BHS, the BHS shall retain this status throughout the tracking process for each bag and never override the EDS decision.

- If a decision is not received from the EDS, the BHS shall assign a Communication Error status for tracking purposes.
- At no time shall the system swap or transfer BHS tracking IDs on or between bags, nor swap or transfer security screening decisions on or between bags.
- 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.
- Invalid arrivals at CBRA shall be monitored and logged via the BHS reporting system. Whether or not a bag arrival is considered Valid at CBRA will be based on the status displayed on the BSD as the bag initially arrives to the BRP (i.e., not following secondary retrieval methods that may be available, such as hand scanners).
 - The ONLY valid bag arrival statuses displayed in CBRA during controlled testing or live operations, provided the status appropriately conveys the bag disposition as defined in Section 14.5.2, are:
 - Alarmed bags
 - OOG bags
 - OS bags (if applicable)
 - SEL-CLEAR (if applicable)
 - During controlled testing, EDS Error and Timeout arrivals are excluded from the Invalid CBRA Arrival Rate calculation. During live operations, EDS Error and Timeout arrivals are included in the Invalid CBRA Arrival Rate calculation and shall be separately tracked, as any of these arrivals represent a system deficiency.
 - Reported statuses should either match the displayed status or further delineate the reason for, and uniquely represent, the displayed CBRA arrival status (e.g., Unknown bags may be displayed for lost bags as well as security re-reroute conditions detected such as bags too close or bag length change; EDS errors may be the result of bag spacing errors as presented by the BHS, if delineated by the EDS disposition code, or due to various EDS fault conditions; Timeout bags can be queue or screen timeouts, provided this distinction is provided by the EDS disposition code).
- The Invalid CBRA Arrival rate during controlled testing is measured by dividing the Number of Invalid CBRA Arrivals (per above) by Total Bags Inducted. The Invalid CBRA Arrival rate during live operations is measured by dividing the Number of Invalid CBRA Arrivals (per above) by Total Bags Inducted during both the Daily Peak Hour and 24-hour Calendar Day. The Daily CBIS Summary Report may be used to determine the Invalid CBRA Arrival rate during live operations. The Invalid CBRA Arrival rate allowed for controlled testing and live operations shall not exceed 3% in a CBRA designed with a Bag Reinsertion Line, and not exceed 2% in a CBRA designed without a Reinsertion Line.

- In the event of a BHS or EDS emergency stop (e-stop) activation, the system shall:
 - Maintain tracking of all bags screened by the EDS and
 - Maintain the security status of all bags that have been screened by the EDS and
 - Maintain the security decision transmitted from the EDS to the BHS prior to or after activation of either a BHS or EDS 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.
- When dieback beyond the last chance divert is inevitable, non-Clear bags should be held at the merges prior to the common OSR line while Clear bags should continue to be processed through the first chance divert. (As the majority of bags are Clear, this method will allow OSR Clear bags to be released, potentially minimizing dieback). The non-clear bags should be released as queuing space becomes available beyond the last chance divert. The release of the non-Clear bags should occur on equal priority basis per lane while not causing starvation at any CBRA removal point. A non-Clear bag held on a merge as a result of dieback, and is subsequently OSR Cleared, that bag should immediately be released if the second chance divert is clear.

12.7.1.3 CBIS Bag Detection Requirements

- 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.
 - Any bag with a conveyable dimension less than 12 inches should be placed in a tub.
 - The minimum conveyable bag should measure at least 12 inches in any dimension.
- The CBIS shall be capable of detecting when a bag has been delayed or accelerated in accordance with Appendix D. Delaying or accelerating a bag beyond the configured tracking tolerance shall result in application of one of the following solutions:
 - Upstream of EDS (single bag): The CBIS shall reacquire the bag and continue tracking.
 - 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. For ICS, if the identification of the carrier can be reacquired prior to the last divert point and the status of the bag is clear, the carrier can be rerouted to the sortation area.
 - 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. For ICS, if the identification of the carrier can be reacquired prior to the last divert point and the status of the bag is clear, the carrier can be rerouted to the sortation area.

- 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, or directly beside another bag.
 - Upstream of EDS (single bag): The CBIS shall acquire the bag and continue tracking.
 - 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 Appendix D for testing standards related to added bags.

12.7.2 Bag Tag Identification Best Practices

Bag tag identification is a method in which a tag or chip with a unique readable Bag Tag 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 based on either optical or RFID, as long as the technology does not affect CBIS throughput performance.

Best practices can critically influence the read rate of ATRs and the association rate of ATR ID to bag image in live stream of commerce operations. Best practices to optimize ATR read rates include the following:

- ATR maintenance and adjustments should be performed periodically to ensure optimal reader performance. This includes periodically cleaning ATR reader heads, realigning and calibrating reader heads, and ensuring ATR to BHS communication performance occurs reliably. The need for periodic maintenance and adjustments may be planned in accordance with ATR OEM guidelines and historical operational need. Recognizing the need for unplanned maintenance and adjustments may be determined by periodic physical inspection and review of ATR performance as reported via ATR or CBIS reports.
- Airline bag tag print quality should be maintained to ensure optimal read performance. Airlines should periodically inspect printed 10-digit IATA bag tags for print quality and readability (i.e., misalignment, inadequate contrast, streaking, bleed), and maintain tag printers accordingly. Bag tag printer OEM documentation should be reviewed for performing maintenance procedures properly.
- Bag induction procedures and practice should be inclusive of tactics for optimizing bag tag read performance, including:
 - Bag tag placement relative to bag orientation should be considered (i.e., tags should not be placed on a part of a bag that will challenge readability such as under an extendable handle or on the underside of a bag in its induction orientation, and if the bag will be inducted within a tub tags should not be positioned on bag such that the tag will be hidden from the reader by the tub sides or bottom).
 - Previously used bag tags and bingo tags should be removed prior to bag tag placement to avoid multi-tag reads.

- Care should be taken not to bend, wrinkle, smudge, or otherwise distort bag tags and their printed bar codes during tag application.
- Bag tags should be applied such that bar code information on each side of the applied tag has a reasonable opportunity to be read.
- Care should be taken to avoid covering the bag tag bar code in any way, Stickers should not be placed on bag tags. Occluding markers or pens should not be used to write on bag tags; only highlight markers should be used to mark bag tags before reinserting bags on re-induction lines.

12.7.3 Bag Length

Bag length shall be measured at a photo eye no more than two queue conveyors upstream of the EDS unit. This measurement shall be established as the bag's baseline length. The use of a dual belt speed conveyor shall not negatively affect this measurement in any way.

Bag length shall be re-measured upstream of the diverter and the measurement shall be compared to the bag's baseline length. Any bag that has increased in length by 12 inches or more upstream of the diverter shall be conveyed to the CBRA with a status of "Length Change".

12.8 Conveyor System Design

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

12.8.1 CBIS Conveyor Subsystem Nomenclature

All lines should be given a standard, two- or three-letter designation. The 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)
- Out-of-Gauge: OOG
- OSR Line: OSR
- Clear Line: CL
- Alarm Line: AL
- Re-Insert Line: RL
- Oversize: OS
- Crossovers: XO

12.8.2 Conveyor Inputs

Checked bags typically 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.

A BMA is typically used to identify bags that are too large to fit into the EDS (defined as OOG bags) for downstream diversion to a separate conveyor that transfers the bags directly to Level 3 screening in the CBRA to be screened manually using ETD equipment.

12.8.3 Divert and Merge Requirements

- Bags exiting the EDS machine shall be properly spaced via increases in belt speeds on subsequent conveyors to allow for continuous flow (no less than the minimum diverter processing rate) through the level 1 divert point.
- Bags exiting each EDS unit shall be separated by their clear or non-clear screening status prior to merging onto the post-EDS mainline or OSR line. ICS carriers shall be separated by their clear or non-clear status at the first opportunity but may travel on the OSR line.
- After clear and non-clear bags have been separated, they shall not be commingled.
- Only clear bags shall be diverted at horizontal diverters; non-clear bags shall pass through. At vertical diverters, clear bags shall divert up and non-clear bags shall divert down.
- The following requirements apply to diverters in the STZ downstream of the EDS units:
 - For systems with two decision point diverters, at the first decision point diverter, if the system is unable to divert a clear bag, the bag shall bypass the diverter on the Alarm Line.
 - For systems with two decision point diverters, at the second chance diverter, if the system is unable to divert a clear bag, the bag shall cascade stop and NOT bypass the diverter on the Alarm Line.
 - For systems with a single decision point diverter, if the system is unable to divert a clear bag, the bag shall cascade stop and NOT bypass the diverter on the Alarm Line.
 - The CBIS may have a bypass feature to allow clear bags to bypass all diverters during fault conditions and be sent to the CBRA. The bypass feature shall be enabled and disabled via an operator's workstation in the BHS control room. Enabling the bypass feature is to be coordinated with local TSA. Bypass features that send non-clear bags to the outbound system shall not be allowed.

12.8.4 Baggage Allocation Methodology

Bag allocation methodology (BAM) refers to the logic used to distribute bags between the EDS units. All new CBIS designs shall incorporate a round-robin BAM, in which bags are routed singularly and consecutively to each available SS line. Deviations from round-robin BAM shall be submitted through an RFV for review and approval by TSA.

Round-robin allocation is typically accomplished by assigning an ID for each SS line to bags upstream of the screening matrix. For example, if a matrix has four SS lines, as bags leave the upstream scanning array, SS_1 is assigned to bag 1, SS_2 to bag 2, SS_3 to bag 3, SS_4 and so on. Under normal conditions, bags are diverted to the corresponding SS lines. If the corresponding SS line cannot accept the bag (shunt or EDS unavailable), the PLC logic dynamically adjusts to allow another SS line to accept the bag. In the case where an SS line is not available, the system is expected to maintain that ID in the round-robin count.

12.8.5 Conveyor System Design Best Practices

A CBIS that does not follow the following industry best practices may introduce a high risk of testing failure which could delay the project and incur additional cost. Historical testing has shown that tracking failures can often be correlated to tracking issues caused by non-adherence to the below best practices.

12.8.5.1 Gradual Conveyor Speed Transitions Best Practices

The transitions in conveyor belt speeds between any two consecutive conveyor belts should not exceed 30 feet per minute or a 50% difference of belt speeds, whichever is less, so as not to affect the stability, orientation, or spacing of bags while still maintaining accurate bag tracking.

12.8.5.2 Avoidance of Steep Conveyor Slopes Best Practices

The CBIS should 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).

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

NOTE: Acute turns in the BHS with adjacent inclines or declines may also cause avoidable tracking errors and bag jams. Consult with EDS and BHS manufacturers to ensure such configurations are acceptable when indicated due to space constraints.

12.8.5.3 Divert and Merge Requirements and Best Practices

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

- Static ploughs and roller diverters should not be used.
- Directly opposing diverters should not be used.
- Pushers should not be used in the CBIS.

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

Designers shall not utilize pre-EDS 90 Degree diverter-takeaway configurations on diverters feeding the security shunt lines.

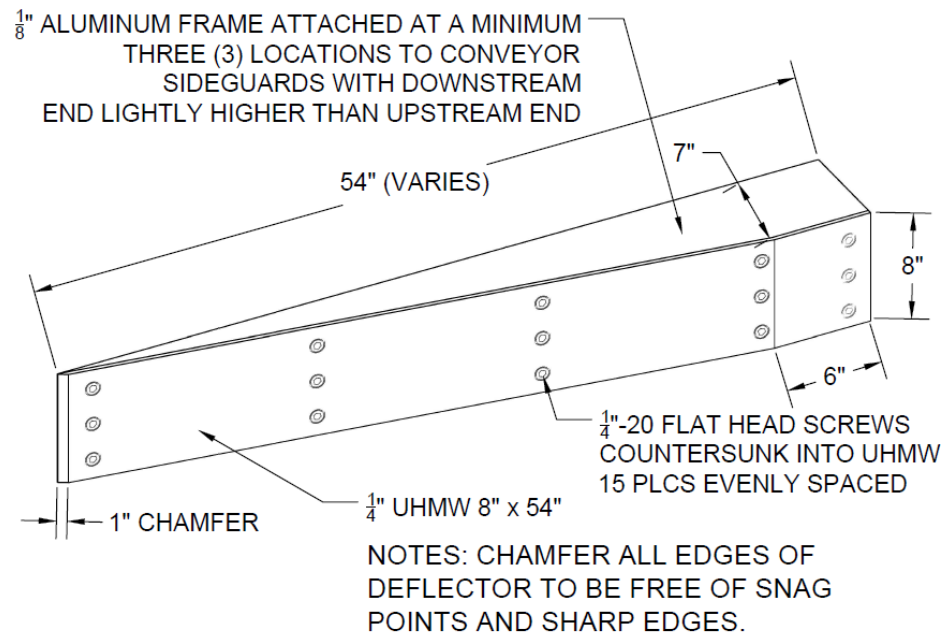
12.8.5.4 Bag Orientation Requirements and Best Practices

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

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.

Pre-EDS bag centering devices shall be used on the security shunt lines to optimize bag presentation to the EDS. For static deflectors to work efficiently and effectively, a low coefficient of friction belt under the static deflectors should be used. The EDS in-feed and exit conveyors are typically high coefficient of friction belting. An example of a bag centering solution used at the TSA's TSIF is illustrated below in Figure 12.3.

Figure 12.3: Example Bag Centering Wedge



12.8.5.5 Conveyor Transition Best Practices

- Physical transitions within mechanical equipment should be aligned to ensure smooth transitions.
- Ensure the correct belt riding surface is used in each application. For example, a high friction belt is recommended for applications including inclines and declines 7 degrees and higher and on queue conveyors with frequent cycling to reduce bag slippage at higher speeds.
- In tracked zones, minimize (or avoid if possible) spiral turns, consecutive power turns, and turns in an "S" configuration.
- Allow room for bag stabilization between changes in direction to improve tracking accuracy, e.g., adding a queue between a power turn and an incline or decline conveyor, or using radial break-overs for steep inclines and declines.
- Avoid the use of vertical waterfalls.
- Merge and divert transitions should adhere to the manufacturers recommended conveyor heights, belt types, and belt speeds.

12.8.5.6 Conveyor System Maintenance Best Practices

- Photo eyes, light curtains and scanning array heads should be cleaned regularly to avoid build-up of dust and debris that can obstruct the sensors and reduce accuracy.
- Shaft encoder connections should be checked to reduce slippage and ensure proper readings.
- Belt tension tracking should be regularly inspected and corrected to avoid slippage and reduce bag jams.
- Faulty equipment should be repaired or replaced immediately to avoid further degradation of the system.
- Outdated tracking equipment and programming should be updated to ensure the system operates as efficiently as possible.
- BHS-to-EDS and EDS-to-BHS handoffs should be monitored and any increase in errors evaluated

12.8.5.7 Non-Powered Rollers Best Practices

Non-powered rollers should be avoided 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.

The only exception is non-powered rollers that are an integral part of the transition plates for HSDs.

12.8.6 Recirculation Loop Requirement

The automatic recirculation of bags shall not be designed, either pre-EDS screening or post-EDS screening, except for connected reinsertion lines in the CBRA. (See Section 14.4.6.)

12.8.7 Reinsertion Line Requirement

Non-cleared bags shall only be reinserted upstream of the STZ. (See also Section 14.4.6.)

12.8.8 Draft Curtains Requirement

All PECs shall be clear of obstructions, including draft curtains.

12.8.9 Stack Light Requirements

Stack lights used at decision points in the CBIS shall adhere to the following color designations:

- Green = Cleared
- Red = Alarm
- Blue = Fail-safe
- White = All others (Unknown, EDS Errored, Pending, etc.)

12.8.10 System Conveyable Items

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.

Site-specific characteristic of the stream of commerce bag size distribution should always be considered during CBIS design. In unique cases where an airport sees an unusually large percentage of long bags or other large non-conveyable items, designers should consider employing wider conveyors and wider-radius power turns to maximize the EDS usage and minimize bags sent to Oversize screening areas.

12.8.11 Oversize Bag Conveyance

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

12.8.12 Out-Of-Gauge Bag Conveyance

OOG bags are those bags that can be transported by the BHS, but are too large to be screened by the EDS units deployed for that CBIS. The CBIS shall transport OOG bags directly to the CBRA. OOG bags should be routed to the CBRA on the Alarm Line. If space or design limitations exist and routing OOG bags on the Alarm Line is not cost-effective or feasible, then OOG bags should be routed directly to the CBRA on separate conveyors. OOG bags shall be diverted upstream of the EDS lines. OOG diversion is shown in the Generic CBIS examples of Appendix B. The most effective way to filter OOG is to locate BMAs queues upstream of the EDS lines. To minimize bags on the OOG line, bags that do not have dimension information or that may have been lost in tracking after the BMA shall be transported to an EDS shunt, not the OOG line. An over-height protective device shall be installed two queues in front of each EDS unit, e.g., an over-height photo eye, light curtain, headache bar or other similar device to ensure over height bags are stopped prior to the EDS unit.

12.9 Fail-Safe Operation

A fail-safe operation is one that prevents the conveyance of any non-clear bag to airside locations where they would be loaded onto a flight. The requirements in this section apply to fail-safe operation.

12.9.1 Fail-Safe Operation General Requirements

- In the event of a fail-safe activation, the default path for any non-clear bag shall be to a secure location. Non-clear bags shall never be sent to an airside location.
- Fail-safe activations shall not exceed 0.5% of bag volume for each system test in controlled testing as measured by dividing the number of fail-safe activations at all Decision Diversion Points by Total Bags Inducted.
- Fail-safe activations shall not exceed 0.5% of bag volume during the Daily Peak Hour and 24-Hour Calendar Day as measured by dividing the number of fail-safe activations at all Decision Points by Total Bags Inducted using the Daily CBIS Summary Report.
- The sidewalls of all conveyors or portions of conveyors associated with the fail-safe zone shall be clearly marked or identified to support appropriate bag removal.
- Fail-safe alarms shall be distinct from all other types of system event alarms.

12.9.2 Fail-Safe Operation Requirements for In-Line CBIS

The following fail-safe requirements apply to in-line CBISs:

- Bags shall be tracked through each diverter downstream of the EDS units prior to the CBRA. A single bag failing to track from the decision photo eye upstream of the diverter to the fail-safe photo eye on the Alarm Line downstream of the diverter shall activate a fail-safe condition.
- Upon activation of a fail-safe:
 - The appropriate number of conveyors on the clear bag line, as calculated in Item 4 below, shall stop; and
 - Audible and visible fail-safe alarms shall be activated.
- The length of clear bag line conveyors to stop shall be calculated as follows:
 1. Measure the distance (D) from the tracking/decision point photo eye before the diverter to the fail-safe photo eye after the diverter.
 2. Add five additional feet. This distance (D+5) is the portion of the Clear Line identified as the fail-safe zone.

3. All conveyors in the fail-safe zone must be stopped during a fail-safe event.
4. To account for unique project requirements, additional conveyors may be identified and stopped as a part of the fail-safe zone. However, under no circumstances shall fewer conveyors be identified and stopped as the fail-safe zone.
- For systems with more than one diverter between the EDS units and the CBRA, during a fail-safe activation at the first chance diverter, clear bags shall pass the diverter on the Alarm Line to be diverted at the second chance diverter.

For systems with a single diverter, during a fail-safe activation at this diverter, clear bags shall not pass the diverter and shall cascade stop upstream of the diverter. Figure 12.4 illustrates a typical In-line fail-safe CBIS design.

Figure 12.4: In-Line Fail-Safe Designs

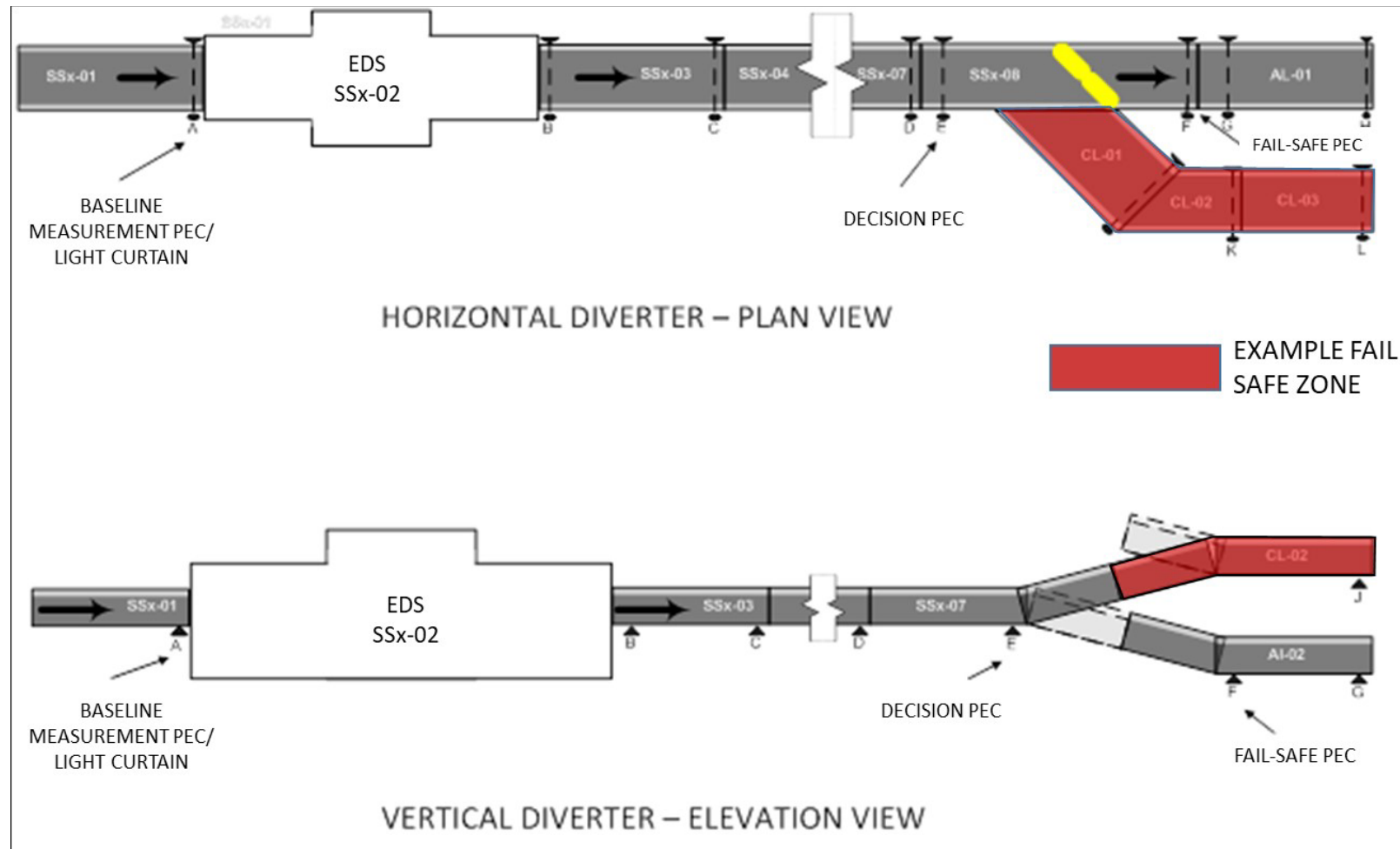
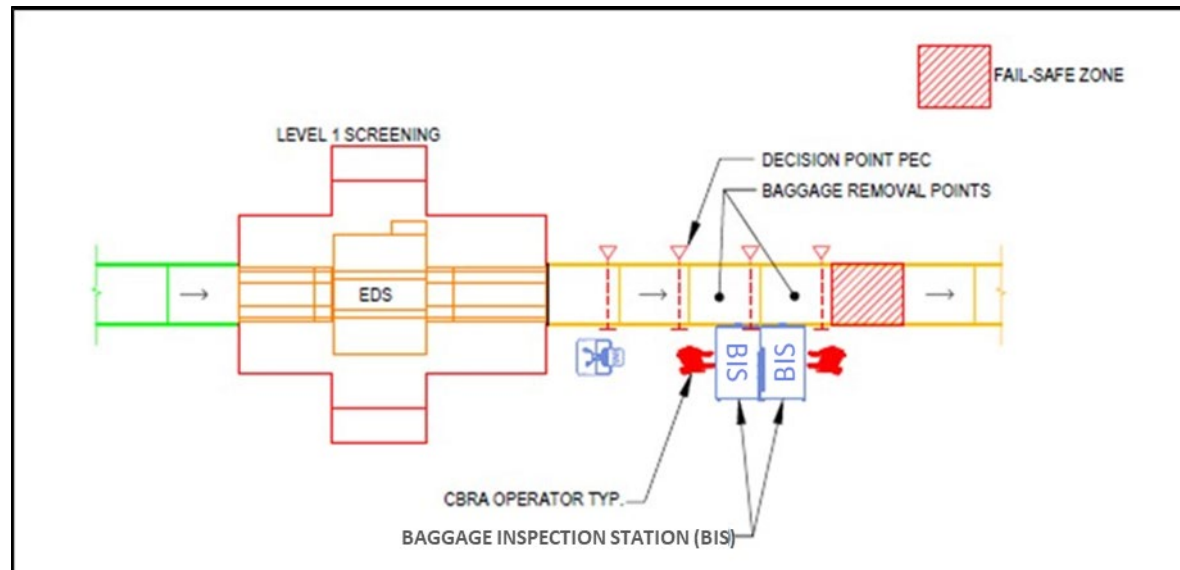


Figure 12.5 illustrates typical fail-safe designs for a Mini In-Line CBIS.

Figure 12.5: Mini In-Line Fail-Safe Designs



12.9.3 Fail-Safe Operation Requirements for a Manually Operated Mini In-Line Decision Point CBIS

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

- 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
- Activate audible and visible fail-safe alarms.

12.10 Operational Test Kit

Design of Operational Test Kit (OTK) bag insertion and removal locations (such as conveyor sideguards, EDS and BHS e-stops) need to properly address applicable safety standards and ergonomic design principles. The following are design requirements for the OTK test.

Specific OTK Test controls shall be built into the CBIS in coordination with the EDS and BHS vendors and their integration documentation. The OTK testing controls shall be appropriately located to control the OTK Test with minimal walking between the controls, OTK load point and OTK unload point, and between adjacent units so that two units can be tested from one location. The conveyors between the OTK load and unload points shall be straight with a maximum angle of 0 degrees. Emphasis should be on coordinating in advance with the BHS vendors to optimize the layout for quick and efficient conduct of the daily OTK Test.

OKT Test controls shall enable an operator to:

- Stop the normal flow of bags into the EDS without losing track of bags already in the system.
- Allow the OTK bag to be placed safely and properly onto the EDS entrance conveyor or immediately adjacent conveyor. The sideguard height at this interface point shall not exceed 4 inches and have no protrusions or sharp edges. For safety purposes, the conveyor belt immediately upstream of the OTK load point shall stop when OTK Mode is activated to prevent a pinch point.
- Restart the EDS entrance conveyor to feed the OTK bag into the EDS.
- Stop the OTK bag on the EDS exit conveyor or immediately adjacent conveyor to allow removal of the IQT bag. The sideguard height at this removal point shall not exceed 4 inches and have no protrusions or shape edges.
- Allow for repeat of OTK Tests as necessary.
- Return the system to normal screening operation.

All of the OTK processes shall be supported without requiring a shutdown and restart of the CBIS from a MCP or other location. The OTK control station shall consist of a keyless, selector type switch or HMI graphics to enable the OTK test mode. The OTK test activation signal shall be annunciated in the BHS control room.

12.11 Bag Jam Rate

There are two types of bag jams. 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. 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.

- 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.

- CBIS designs will allow for safe, quick, and effective clearing of any bag jam.
- When a bag jam does occur, adequate and proper bag jam clearing procedures are required to ensure safe and secure operations throughout the CBIS.

The bag jam rate is calculated by dividing the number of jam events (hard and missing) from the ATRs of the SF line through all EDS shunt lines to the entrance of the EDS by the total bags inducted. The Jam Rate shall be less than 1%.

- During controlled testing, the bag jam rate for each system test shall be less than 1% of inducted bag volume is calculated by dividing the number of jam events (hard and missing) from the ATRs of the SF line through all EDS shunts to the entrance of the EDS by the total bags inducted during the test.
- During live bag operations, the bag jam rate shall be less than 1% of bag volume during the Daily Peak Hour and 24-hour Calendar Day as measured using the Daily CBIS Summary Report. The bag jam rate is calculated by dividing the number of jam events (hard and missing) from the ATRs of the SF line through all EDS shunt lines to the entrance of the EDS by the total bags inducted during the peak hour and averaging across each daily peak hour measured during the 30-day run-in.

Written bag jam resolution procedures will be developed for all areas within the CBIS, including tracked, non-tracked, and fail-safe zones as referenced in the requirements listed in Chapter 2 for CBIS Use and Logistics Training. 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.

Please refer to Appendix A, Section A.2 for an outline of the bag jam resolution procedures that should be provided.

12.12 EDS Maintainability Requirements

12.12.1 Service Access

CBIS designers will provide sufficient access to the EDS units for the following purposes:

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

A minimum service area shall be provided of 3 feet around all four sides of the equipment and 3 feet vertical clearance above the highest point of the EDS. 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 that is rated and approved for such lifting purposes 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.

12.12.2 Environment

The Project Sponsor shall ensure that all operating environmental and maintenance requirements as set in the OEM's integration guidelines 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 HVAC systems are necessary to ensure acceptable performance of the CBIS.

Designers shall not locate wet-type fire protection sprinklers or associated supply piping directly above the EDS machines.

Designers shall use the EDS Maintenance and Environment Assessment displayed in Figure 12.6 to ensure that the required environmental standards described in this section are met.

Figure 12.6: EDS Maintenance and Environment Assessment

EDS Maintenance and Environment Assessment								
Airport:								
Location/Terminal:								
Completed by:								
Date:								
Service Access								
Does the EDS area provide 3 feet or more around all four sides and above the units? (yes or no)								
Provide the measured area around all four sides and overhead for each EDS unit. Add more columns if necessary.								
	EDS 1	EDS 2	EDS 3	EDS 4	EDS 5	EDS 6	EDS 7	EDS 8
Entrance								
Right side								
Exit								
Left side								
Overhead								
Heating, Ventilation, and Air Conditioning (HVAC) Systems								
Does the EDS area provide for consistent warmed, cooled, and dehumidified air flows? (yes or no)								
Provide the model and make of the HVAC system:								
Temperature								
Does the temperature of the EDS area maintain a consistent range between 50 F and 80 F? (yes or no)								
Provide the measured humidity range in the EDS area:								
Secure Storage and Spare Parts Access								
Is there a secure storage space for spare parts and tools with an area of 150 square feet or more within close proximity of the EDS units? (yes or no)								
Describe the secure storage space:								
Provide the distance from the secure storage area to the closest EDS unit:								
Heavy Equipment Lifting								
Is there a heavy equipment lifting system available for use in maintaining the EDS units? (yes or no)								
Describe the lifting equipment or system that is in place:								
Quick Disconnect Standard								
Are the EDS conveyor components readily removable through the use of available hand or power tools?								
Comments:								

12.12.3 Storage and Spare Parts Access

Secure storage space shall be provided close to the EDS units for spare parts and tools. This space should be approximately 150 square feet per CBIS.

12.12.4 EDS Replacement

The Project Sponsor shall include access routes for EDS equipment replacement in the CBIS design.

12.12.5 Quick Disconnect Standard

CBIS designers shall identify the appropriate number of conveyor components in the Detailed Design phase immediately before and after the EDS unit 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 units to allow for easy access to the EDS units for maintenance, removal or replacement.

12.12.6 EDS Power Requirements

The Project Sponsor shall provide power to the EDS machines that complies with the requirements in the most current OEM installation and integration manual at the time of design. A Power System Engineering Analysis shall be conducted during the construction phase to demonstrate that power requirements are met. The analysis shall include:

- Visitation of the facility during normal working hours for the purpose of performing power quality monitoring of specified equipment during routine operations
- Collection of information relevant to power system engineering analysis as it relates to the utility source (i.e., airport mains power)
- Recording of data for the duration of 30 calendar days, as measured on a Line Voltage basis (i.e., Line-to-Line, 480 volts nominal), to capture data elements that include, at minimum:
 - Key Evaluation Parameters
 - PF: Power Factor
 - Steady State Voltage (Line to Neutral)
 - Voltage Unbalance
 - VTHD: Voltage Total Harmonic Distortion
 - TDD: Total Demand DistortionMax Circuit Loading
 - Voltage Distortion Events

- Voltage Transients
 - o Voltage Sags
 - o Voltage Swells
 - o Voltage Interruptions
- Voltage Tolerance Curve Results
 - o (e.g., Information Technology Industrial Curve – ITIC)

The Project Sponsor shall issue a written compliance report within 20 calendar days of the end of the data collection that presents the findings of the power system engineering analysis and any recommendations for remediation of documented utility source problems. Such recommendations may include suggested equipment changes or system changes for the Airport Authority and TSA's consideration. An outline for the Power System Engineering Analysis Report is provided to the ILDT with OTA documents.

The Project Sponsor is responsible for:

- All coordination with power engineering company personnel necessary in supporting the performance of the Power System Engineering Analysis, to include familiarization with onsite safety practices and regulations
- Providing a key point of contact for all matters pertaining to the planning and execution of the Power System Engineering Analysis.
- Providing electrician resources to direct and facilitate power engineering company personnel to the power distribution system to be evaluated, to include supply of a single-line (i.e., one-line) diagram to said personnel
- Any airport infrastructure modifications necessary to allow the movement and placement of monitoring equipment controlled by power engineering company personnel, within the airport.
- Rescheduling work or prohibiting other trades or vendors from working in the affected areas while the power engineering company's monitoring equipment is being installed, configured, or removed.

A follow-on analysis may be required after the system is installed and connected to power.

12.12.7 EDS Network

EDS PLC shall communicate to the BHS PLC via Ethernet/IP Protocol.

12.13 CBIS Reporting

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 requirements.

12.13.1 Reporting Frequency Requirement

The CBIS reporting system shall be capable of providing data in real time (± 1 minute) and in hourly, daily, weekly, monthly, quarterly, annual, and manually entered time periods.

12.13.2 Reporting Detail Requirements

- The CBIS reporting system shall be capable of providing detailed data by Bag ID number and EDS unit and will be provided by the BHS Vendor.
- At a minimum, the reporting system shall be capable of providing the following features in 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 unit)
 - Bag type (OS, OOG, In-gauge)
 - Time stamped when bag enters the EDS unit or time stamped when OOG bags are diverted to OOG Line
 - SSI - Level 1 screening status
 - SSI - 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 (NOTE: This is not a report for a given PE, but rather the status of a given bag at critical PEs in the system):
 - Bag ID
 - SSI - Bag screening status
 - BHS Faults
 - Fault type (NOTE: A "fault" is defined as a "cause" such as lost in track, motor overload, PEC failure, encoder failure)

- 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, or jams, or the "effect" of human interaction on the system, such as via HMI or control station, e.g., pushing an e-stop or OTK activation)
 - Event location
 - Event time
 - Total event time
- EDS Statistics (if data to support these statistics is available from the EDS OEM being installed)
 - SSI – Number of bags alarmed by specific EDS unit
 - SSI – Number of bags cleared by specific EDS unit
 - EDS unit faults (if known)
 - Start time of fault
 - End time of fault
- ATR Performance
 - ATR Name
 - ATR Description (i.e., Tracking or Sortation)
 - Total number of bags seen
 - Total number of tags read
 - Number of problem tag reads (this can be provided as a single total count or ideally as a set of constituent counts plus a total count and should be representative of the number of unreadable/missing tags, number of invalid tag reads, number of conflict/multi-tag reads, etc.)
 - Number of associated tag reads (i.e., number of 10-digit IATA bag tag IDs read and associated with the bag's BHS tracking ID)
 - Total number of 10-digit IATA bag tags that are read at the ATR and passed to the EDS
 - Total number of 10-digit IATA bag tags sent back at the EDS exit
 - Upstream IATA Tracking Accuracy
 - IATA Handoff Accuracy

- BMA Statistics
 - o Total number of bags through the BMA
 - o Total number of OS bags
 - o Total number of OOG bags
- System Baggage Volumes
 - o By input conveyors (ticket counter conveyors, curbside conveyors, oversize conveyors)
 - o By screening area (including EDS unit and CBRA)
- CBRA Statistics – CBRA statistics shall be presented and considered SSI
 - o Cleared
 - Cleared (CLR)
 - PRE-Clear (P-CLR)
 - SEL-Clear (S-CLR)
 - o Alarmed
 - Alarmed (ALM)
 - PRE-Alarmed (P-ALM)
 - SEL-Alarmed (S-ALM)
 - No Decision
 - Purged
 - Queue Time Out (Q-TimeOut)
 - Operator Time Out (O-TimeOut)
 - o Lost in Tracking
 - Mistracked
 - Bag Length Tracking
 - Following Lost Bag
 - Too Close
 - Security Re-route
 - o Unscreened
 - OS

- OOG
 - OOG (absolute) Tracking Accuracy
 - Reinsert Line
 - Reinserted bags
- PEC Tracking Statistics
 - Total number of bags seen at each PEC
 - Total number of purged bags 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
- Baggage Process Timer (BPT) Statistics (see Section 14.4.5)
 - Total number of bags seen
 - Average processing time for each bag
 - By BIS position
- At the Project Sponsor’s discretion, the reporting system may contain the capability to perform database queries.
- The reporting system shall provide BHS Reports which should be within 5% difference or accuracy compared to the EDS Counts per screening line. When analyzing this data, the point of Bag ID acquisition at the EDS must be taken into consideration, i.e., if the ID is generated at the in-feed and passed to the EDS, the ID may be processed and logged in the FDRS. However, if the unit faults, that ID and decision may not be passed back to the BHS for logging.
- For MITs and ICS systems, all CBRA reports shall be generated based on bag status upon arrival at the inspection station location.

12.13.3 Daily Reporting Requirements

At a minimum, the following daily reports in the format shown in Appendix A, Section A.4, shall be available to the local TSA representative via auto-download and auto-transmittal capabilities to a specified existing e-mail address or secure storage location:

- Daily CBIS Summary Report
- Daily CBIS Summary Report – Peak Hour

- Daily CBIS Bag Volume Report
- CBIS Executive Summary Report – SSI
- CBRA Executive Summary Report – SSI
- PEC Tracking Reports for all PECs within a tracking zone
- BPT Summary Report
- CBRA Bag Report
- CBIS Hourly Throughput Report – SSI
- CBIS Bag Spacing Report
- CBIS Performance Report – SSI

12.13.4 BHS ID Log Report Requirements

A report of the last 1000 BHS IDs shall be provided as defined below:

- The BHS ID LOG shall be considered a First-In-First-Out (FIFO). The FIFO shall capture the last 1,000 Pseudo IDs, associated decisions and a flag indicating whether the bag has been processed by a TSO (including re-inserted for screening) for each EDS.
- This data shall consist of three elements:
 - Pseudo ID
 - Decision
 - Processed
- The report shall be provided in both a PDF format and an importable CSV file.

Refer to OEM integration manuals for additional guidance.

12.13.5 BHS Reporting During Maintenance

BHS Reporting capabilities shall be designed such that logging of photo eye activity (i.e., total, missing, unknown, etc.) is disabled on conveyors not running or operating in a manual override mode. The BHS shall only log photo eye activity when conveyors are running in a fully automated mode. Analysis of operational run-in data has been thrown off and skewed when maintenance activities occur while the system was live or logging events.

CHAPTER 13: ON-SCREEN RESOLUTION AREA PLANNING STANDARDS



13.1 OSR Overview

This section provides ergonomic requirements and recommendations for the layout of OSRAs, including workstation arrangements, the use of off-workstation visual displays, and OSRA maintenance. This chapter draws on provisions and other information provided in International Organization for Standardization (ISO) 11064-1, ISO 11064-2, ISO 11064-3, Mil-STD-1472G, as well as the [Occupational Safety and Health Administration \(OSHA\) website](#).

Additionally, National Fire Protection Association (NFPA) 70, National Electrical Code and NFPA 101, Life Safety Code or similar standards adopted by the authority having jurisdiction, shall be used, as appropriate, in the design of OSRAs.

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 as bag decision status determinations 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 and components:

- Control/supervisor workstation with a CI, closed circuit television (CCTV) interface, and communications
- Individual workstations with PVS
- Administrative area that includes a printer
- Wall-mounted BHS display
- CCTV display of the CBRA

13.2 General Ergonomic Recommendations

Several high-level ergonomic considerations are listed below which should be used to guide the design process:

- TSO population
- TSO attributes
- Work organization and process flow
- Job aids and work practices
- Shift rotation system
- Personnel qualification

- Training program
- Technology transfer
- Cross-cultural aspects

13.3 Architectural Considerations

13.3.1 Traffic and Routing

When designing OSRAs it is important to take into account the flow of both people and equipment:

- Distances should be minimized while taking 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.

13.3.2 Entrances and 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 TSOs.

NFPA 101, Life Safety Code or similar standards adopted by the authority having jurisdiction must be considered when locating entrances/exits in light of mean of egress from OSRAs.

Door widths and access to space shall comply with applicable building codes and the American with Disabilities Act (ADA). Access is required for typical office furniture and computer equipment.

Due to the specific requirements of OSRAs, the design of exits, entrances, and walkways should 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, including routes of egress from 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 restrooms, relaxation areas, supervisors, and offices.
- The sizes of entrances and 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 needing wheelchair access.
- Entrance and exit heights should be at least 7 feet 6 inches tall.

Emergency egress paths should be considered when positioning entrances and exits.

13.3.3 Equipment Requirements for Design Year

OSRA layouts should allow for expansion. As referenced in Section 5.5, 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.

13.3.4 Equipment Requirements for Future Growth

To plan for future baggage growth, the OSR Station equipment requirements for 10 additional years past DBU+5 years are to be listed in 1-year increments in a separate chart in the BDR, from DBU+6 through DBU+15 years (including EDS units, PVS, and SVS workstations) as stated in the requirement in Section 5.6.7.

13.3.5 Plan Space Provision

While the number of OSR stations installed is based on DBU+5 design values, OSRA space planning is based on DBU+15 values to ensure adequate space for growth, if needed. For space allocation purposes, the size of the OSRA shall be based on the number of OSR stations derived based on the DBU+ 15 checked baggage demand projections and respective EDS requirements.

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, and overhead obstacles (for example, structural and HVAC components) 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 ft² to 49 ft² per working position with a minimum of not less than 29 ft². 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 should 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 ft² 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, needs 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.
- Workstations can be arranged in different way to meet local needs. Some of the factors considered include views to shared off-workstation visual displays, operational links between TSO operators and contact between supervisors and operators. The diagrams presented in Section 13.4.4 are intended to highlight some of the advantages and disadvantages of alternative groupings of workstations. They are not intended to be exhaustive or prescriptive.

13.3.6 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.
- Slab-to-slab heights should preferably be a minimum of 13 feet, to accommodate false floors, false ceilings, indirect lighting systems and shared off-workstation visual displays. In practice, such a design would result in finished floor to finished ceiling heights of no less than 9 feet.
- Uncluttered ceilings are preferred to avoid any distractions or stray reflections from luminaries. Plain finishes are recommended for walls and structural elements.
- Differing finished floor heights can sometimes offer advantages for viewing areas, supervisory overviews and a means of keeping a “public area” segregated. To avoid potential safety hazards, including trip hazards, ramps should be considered for movement of equipment and personnel between floor heights.

NOTE: 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.

Multi-level Floors: 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 the adoption of a solution based on varying floor levels in an OSRA, the following drawbacks 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 encumbered or restricted.
- Future changes in room layout can be more difficult and flexibility can be limited.
- Variation in workstation heights and locations of TSO operators can require additional measures to ensure proper lighting and HVAC control.
- Wheelchair access shall be provided by ramps, which require additional floor space, or wheelchair lifts.

Where changes of floor level are introduced in conjunction with entrances or exits, proper physical aids such as guardrails, handrails, anti-slip surfaces, and appropriate signage, when indicated, shall be provided to minimize potential workplace hazards.

13.3.7 Windows

Windows, if provided, require solar glare control and adjustable block-out treatments. Windows should be provided in OSRAs whenever possible 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, need to be avoided. The ratio of luminances for task areas that are frequently viewed in sequence (for example, screen, document and windows) shall be lower than 10:1 as referenced in Mil-STD-1472G 5.2.1.3.8. Within a static visual field, a significantly higher ratio of luminance's can be tolerated between the task area and its surrounds (for example, display housing and walls) and should not have any adverse effect. Displays shall be free from glare.

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 shall not be located behind the OSR monitors.

- Windows located on the left or right side of a workstation shall have a minimum distance of 9 feet to that workstation.
- Windows shall be included in meeting and relaxation areas and offer an alternative visual environment to that of the OSRA.

13.3.8 OSR Noise Abatement

The OSRA shall be provided in an environment that minimizes noise as much as possible. Because of the likely proximity to the BHS bag room, the walls and ceiling of the CBRA require adequate acoustical insulation so that the background noise levels shall not exceed 65 dBA as measured at the natural TSO sitting points at each screening station using a time-weighted average over an 8-hour shift.

13.3.9 Heating, Ventilation, and Air Conditioning

The OSRA shall be a climate-controlled space. Temperature and humidity control shall be supplied commensurate with the locale. A separate temperature control thermostat shall be provided for the OSRA.

If forced-air ventilation is provided, fresh outside air shall be delivered to the OSRA at rates specified by the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) Standard 62.1-2016 Ventilation for Acceptable Indoor Air Quality. The OSRA shall be under positive pressure relative to ambient BHS areas to minimize the migration of contaminants (e.g., products of combustion from tugs and vehicles, as well as outside dirt, dust, and debris) from entering into the OSRA.

13.4 OSRA Operational Requirements

13.4.1 General OSRA 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 employees with disabilities. These underlying principles should be fully documented (see Section 13.5). The layout of OSRAs should:

- Facilitate teamwork opportunities for TSOs.
- Reflect the allocation of responsibilities and the requirements for supervision.
- Optimize key operational links, including sightlines between OSRA staff, or direct speech communication between OSRA as well as between OSRA and CBRA staff (see Section 13.4.3).

13.4.2 OSRA Layout

To develop design specifications for an OSRA arrangement, the following activities should be performed:

- Confirm the functional areas making up the OSRA and what may already exist in other TSA support areas.
- Estimate the space requirements for each functional area, e.g., administration areas, rest areas and provision for visitors.
- Confirm suitability of the planned location within the terminal, for example space restrictions, local hazards, and environmental impacts.
- Acquire current copies of all pertinent standard building codes, user building policies, and the like.
- Verify the availability of necessary utilities and associated services and determine if their current capacity will meet projected requirements, as well as the future needs of the OSRA.

Determination of the operational links between the functional areas and the development of a preliminary OSRA layout should have been performed during the Schematic Design Phase.

Functional entities to be included are:

- OSR room
- Meeting room
- Training facilities
- Office
- Break room with a potable water source
- Locker rooms and toilets

NOTE: The proposed design specifications should facilitate the smooth transition between all the activities in the OSRA.

13.4.3 OSR Room Layout

The following tasks have to be undertaken in order to properly design an OSR room layout:

- Determine the usable space
- Identify the furniture, equipment, and workstation components 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 and custodial services requirements

OSR Rooms shall 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 that only shows the CBIS area as related to TSA operations
- A centralized location for remote stop/start devices in order to minimize delays in re-setting EDS in faulted conditions (NOTE: Not available with Leidos equipment)
- 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 lighting in the area shall include dimmers to allow for better screen viewing
- Equipment racks
- Storage both on and off the workstation
- Notice board
- 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 and should accommodate organizational bins and file cabinets
- Clear Line of sight to enable supervision of the entrances/exit points
- Access to electrical panel boxes (including disconnecting means)
- Access to first aid equipment, emergency equipment and emergency exits
- Primary workstations shall be shielded from windows present in non-operational areas of the OSR room
- Shared off-workstation displays
- Desks
- Printer stands, photocopying machines and other office equipment, as necessary. NOTE: Isolation cabinets or rooms may be necessary for devices that exceed 65 dBA at each workstation.

OSR Room personnel circulation is addressed in Section 13.4.6.

A secondary passive CBIS display shall be added to provide real-time performance metrics identical to that required in Section 14.3.3. The display shall be installed on the supervisor's desk. The exact location shall be coordinated between TSA and the ILDT during the project submittal phase.

13.4.4 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 are a number of general aspects that deserve attention:

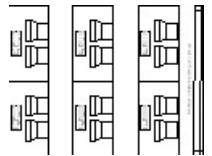
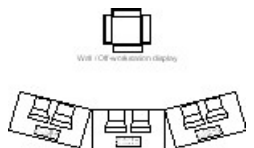
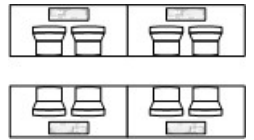
- OSR rooms that exhibit either overcrowding of work positions or widely dispersed work positions are not recommended. Layouts should allow, wherever practical, direct verbal communication between TSOs and avoid excessively short separations between adjacent TSOs (see Section 13.4.3).
- OSR rooms in 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 operator 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).
- Where confidential information is presented on display monitors, it shall not be possible to see this information from the public viewing areas.

13.4.4.1 Floor Plan Arrangements

A wide range of alternative workstation arrangements can be configured in the OSRA space. The most suitable layout should be determined through the conduct of a task analysis. Where clusters of workstations are grouped together to form a single unit, the way in which TSO operators are arranged around the workstation can offer different advantages.

Some of the possible layouts are summarized in Table 13.1.

Table 13.1: 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 angles). 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 an 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.

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 between a number of dedicated workstations.
- Where a number of OSRAs operating on the same CBIS are needed, but located at various sites throughout the airport, each OSRA should have a similar layout. 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, fallback arrangements for information transmission by paper or other non-electronic means.
- Where ventilation systems, light fixtures, and windows have already been installed, positioning of workstations should take into account these existing conditions to avoid draughts, and glare and reflections on visual display screens.
- Luminance shall be measured at the center of the monitor, and found to be in the range of 300 to 500 lux.
- 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 TSO operators require to access as part of their duties, as well as items which can be required in operational emergencies.
- Where workstations are grouped together, the minimum distances between adjacent positions should not result in individuals sitting within each other's personal space. While occasional close working relationships may be necessary and acceptable, working positions adopted for extended periods should avoid TSO operators having to intrude within each other's personal space.
- Spacing between TSO operators should take account of shared equipment, where consideration of common reach zones or potential problems of interference due to noise need to be applied.

- Approximate workstation sizing for initial room layout purposes should take into account such factors as equipment size, flat worktop provision, and the requirements for on-workstation storage and accommodation of employees 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 TSO operators, for example, additional space for equipment adjacent to a normal operator's position or a separate, discrete training workstation.
- Layouts should take into account maintenance requirements and access space for technicians and equipment removal, particularly where this involves bulky components.
- 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

13.4.4.2 Control Workstations

OSRAs will have an area designated as the Supervisory/CI workstation and additional requirements can be associated with their location in the OSRA:

- The Supervisory/CI workstation should take full account of the additional reference material which is sometimes required to be stored, displayed, and used at these workstations.
- In arranging Supervisory/CI layouts, it should be considered that the person at this workstation 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 OSR workstations.
- A Supervisor/CI workstation shall include communications infrastructure for telephone and TSA network access.
- Layouts should allow for additional circulation around Supervisory/CI area and for the temporary accommodation of visitors.
- Where major screening incidents are handled from the Supervisory/CI area, the provision of extra vertical display surfaces needs to be considered for the presentation of additional images or procedures. Additional space may be required for extra staff who may also need to be accommodated in this area.

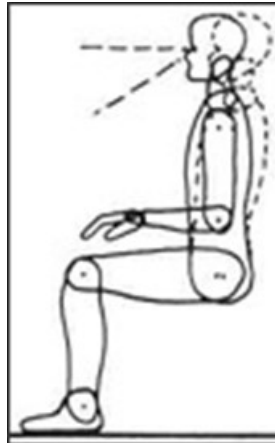
13.4.4.3 Secondary Workstations

Where it is impractical to store all equipment or reference material at the workstation (or at another workstation that 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.

13.4.4.4 Specific Ergonomic Considerations

When designing workstations, the following specific ergonomic considerations should be taken into account in order to achieve a neutral body position that reduces strain on muscles, tendons, and the skeletal systems and allows TSO operators to vary their postures throughout the day. Figure 13.1 provides a visual reference, while Table 13.2 summarizes many of these points.

Figure 13.1: Neutral Body Position



Source: United States Department of Labor, Occupational Safety & Health Administration
available at [OSHA's computer workstation webpage](#).

Table 13.2: Monitor/Desk/Task Chair Ergonomic Design Reference

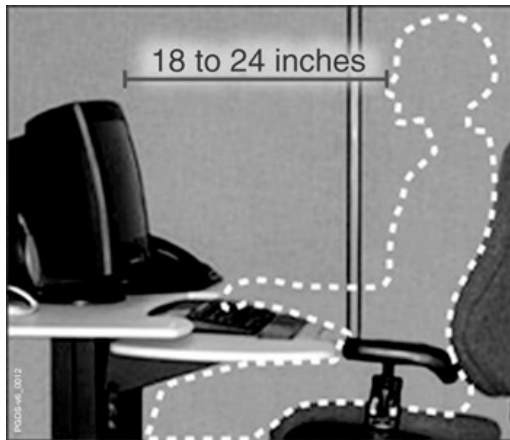
Monitors	Desks	Chairs
- Height: top of monitor <u>shall</u> be at or slightly below eye level - Size: 20-23-in. monitor <u>shall</u> be sufficient - Distance: <u>shall</u> be 20-40-in. from the eye to the front surface of the monitor - Position: <u>shall</u> be directly in front of you, so your head, neck and torso face forward when viewing the screen. Monitors should not be farther than 35 degrees to the left or right - Glare: <u>shall</u> be positioned away from windows	- Height: <u>shall</u> be adjustable between 20-in. and 28-in. - Clearance: <u>shall</u> be 15-in. for knees and 24-in. for feet, width at least 20-in. - Glare: desktops <u>shall</u> have a matte finish, avoid glass tops	- Height: <u>shall</u> be fully adjustable with a minimum range of 16-in. - Backrest: <u>shall</u> be at least 15-in. high and 12-in. wide, and should recline 15 degrees from vertical - Seat Size: seat pan length <u>shall</u> be 15-in. to 17-in. and depth adjustable - Chair Base and Rotation: <u>shall</u> be 5-legged base; 360 degrees unrestricted rotation - Armrests: <u>shall</u> be removable, distance between them <u>shall</u> be at least 16-in. and adjustable

Source: United States Department of Labor, Occupational Safety and Health Administration available at [OSHA's computer workstation web page](#).

NOTE: Where physically disadvantaged TSO operators or visitors (those exhibiting a physical disability) are expected to use the OSRA, these measurements will differ. Please refer to any local or national regulations that would be applicable in these circumstances.

- Workstations should be designed to allow the hands, wrists, and forearms to be in-line and parallel to the floor.
- Workstations should be designed to allow the TSO's head to be 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 110 degrees.
- Accommodations should be made so that while TSOs are seated at their workstations in an ergonomic task chair their backs are fully supported 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 TSOs to their monitors should be between 18 and 24 inches and the center of the monitor screens should be located 15 to 20 degrees below the horizontal eye level of the TSO operators (see Figure 13.2).

Figure 13.2: Viewing Distance



Source: United States Department of Labor, Occupational Safety & Health Administration
available at [OSHA's computer workstation webpage](https://www.osha-slc.computerworkstationwebpage).

- Adequate desk space should be provided to allow the placement of monitors within the viewing range of 18 to 24 inches to TSO operators, as well as to provide adequate room for the placement of any reference materials/other equipment which may be needed.
- Desks should have a leg clearance of between 20 and 28 inches. Ideally, height-adjustable desktops should be provided to afford maximum flexibility within the TSO population.
- Task chairs should have proper lumbar support that allow the TSO operators to recline up to 15 degrees from vertical, and which are height-adjustable.
- OSR room dimensions and workstation layout dimensions and features for which end-user sizes are relevant, for example, seated view over workstations, should take into account the range of TSO operators for which these items are being provided.

13.4.4.5 Additional Considerations

In particular, the following must be considered:

- The OSRA workstation layout should take into account the requirements that are likely to be in place at the end of the planned life span of the OSRA (refer to Section 5.6).
- The needs of persons with disabilities should be considered during the layout of the OSRA, for example, by allowing additional circulation spaces and introducing ramps for wheelchair access.

- Adequate provisions should be made for the storage of personal items at workstations (briefcases and purses) or outside the OSRA in adjacent locker rooms (for clothing and other personal effects).
- Hard-copy information storage should be classified such that the most appropriate provisions can be made within the OSRA such as storage in a lockable drawer. An appropriate classification is suggested in Table 13.3.

Table 13.3: 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
Secondary access	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.

13.4.5 Off-Workstation Shared Visual Displays

The layout of the OSRA shall ensure that all off-workstation shared visual displays necessary for the TSO operator task are visible from all relevant workstations (see Section 13.4.3).

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 should be considered. Such constraints include limitations on viewing angle, contrast ratios, and image construction.

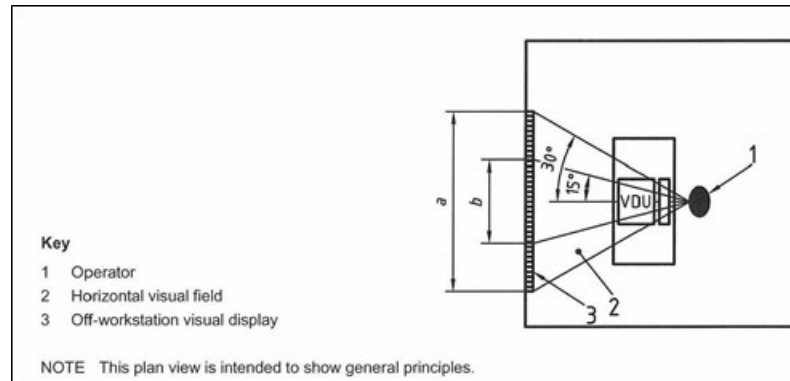
As an alternative to large shared displays, the option of presenting this information on the workstation, with smaller schematics, should be considered.

13.4.5.1 Horizontal and Vertical Viewing Distances

In particular, the following has to be taken into account:

- Where off-workstation shared visual displays need to be used on a regular or continuous basis, the preferred position is directly in front of the TSO operator where they can easily be seen when looking over the workstation or can be scanned by eye-movement alone (see Figure 13.3).

Figure 13.3: Preferred Location of Off-Workstation Shared Visual Displays



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 operator's normal position, by a simple rotation of their task chair.
- For very large off-workstation shared visual displays which need to be monitored on a continual or regular basis, it is recommended that TSO operators 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 TSO operators, the design of the visual display and the layout of the OSRA should ensure that all of the information that needs to be used by a TSO operator 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 operator 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 shared visual display shall be visible to a 5th percentile, seated, non-upright TSO operator. The following formula may be used to determine this measurement:

$$H1 = Hc - (D + d) \frac{He - Hc}{Dc + d}$$

Where

- H1 is the lowest height at which the visual display can be seen;
- He 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.”
- Hc 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;
- Dc is the depth of the console;
- d is the horizontal distance between the design-eye-position and the front edge of the console.

13.4.5.2 Relationship of Shared Visual Displays to Other Features

In particular, the following should be taken into account:

- Windows should not be located adjacent to off-workstation shared 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 shared visual displays.

13.4.6 Personnel Circulation and Custodial Services Access

The requirements and recommendations presented in this section concern the provision of appropriate space for general circulation.

Circulation of OSRA staff, maintenance staff, and all visitors should be achieved with minimum disruption to the work of TSO operators (see Section 13.4.6.1).

Where it is anticipated that the Supervisory/CI positions will give rise to additional circulation from outside the OSRA, it is recommended that these positions be located close to main entrances.

OSRA designs should incorporate a means of restricting thoroughfare access.

All aspects of OSRA layout shall take into account the requirements for maintenance and custodial services access as stated in Mil Standard 1472G Section 5.9.

13.4.6.1 Personnel Circulation Planning

Planning for the circulation of personnel throughout the OSRA shall include the following:

- Adequate general circulation, such that OSRA operations are not interrupted by either visual or auditory distraction.
- Adequate circulation areas where shift changeover is protracted and two shifts are present in the OSRA at the same time.
- Orderly evacuation of the area via easily identifiable routes of egress in the event of an emergency, such as a fire alarm.
- OSRA circulation routes arranged to avoid cross-circulation.
- Restricted ceiling heights, where present, be indicated using ceiling-mounted warning.

13.4.6.2 Custodial Services Access

As with maintenance, the ability of custodial services 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 tasks.
- An adequate number of power outlets should be provided which will enable cleaning appliances to be used without causing electrical interference or disturbing OSRA operations.
- Where gaps occur between items of equipment or furniture, adequate clearances should be allowed for proper cleaning task to be executed.
- Special provision is sometimes required where food and beverage are permitted to be consumed in the OSRA.
- The OSRA layout should not give rise to unsuitable working conditions or working movements or postures for cleaning staff.

13.5 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 and detailed design. It is recommended that verification and validation be an iterative process during the development of the design. This process should give feedback to the designer in moving towards the best possible solution and 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 coordination
- 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, state, and Federal regulations regarding design and construction shall supersede the recommendations included in this section. This is especially relevant concerning the provision of allowances for the disabled as covered by the ADA.

CHAPTER 14: CHECKED BAGGAGE RESOLUTION AREA PLANNING STANDARDS

14.1 CBRA Overview

The CBRA provides the space and equipment needed by TSOs to conduct bag inspection per the Checked Baggage SOP as mandated by the TSA. The proper layout and furnishing of the CBRA are essential to ensuring that TSOs can effectively, efficiently, and safely perform their duties. Careful consideration needs to be given to the operational controls, environmental and ergonomic configuration, and equipment specified for the CBRA.

Although each airport is different and the available space may differ, all CBRAs need to follow the same layout concept, BIS configuration, functionality, and BSD operations. This standardizes training and improves personnel utilization across multiple CBRAs within an airport. The following sections provide details in these four aspects of the CBRA design. Deviations from Chapter 14 requirements shall be submitted through an RFV for review and approval by TSA.

14.2 CBRA Layout

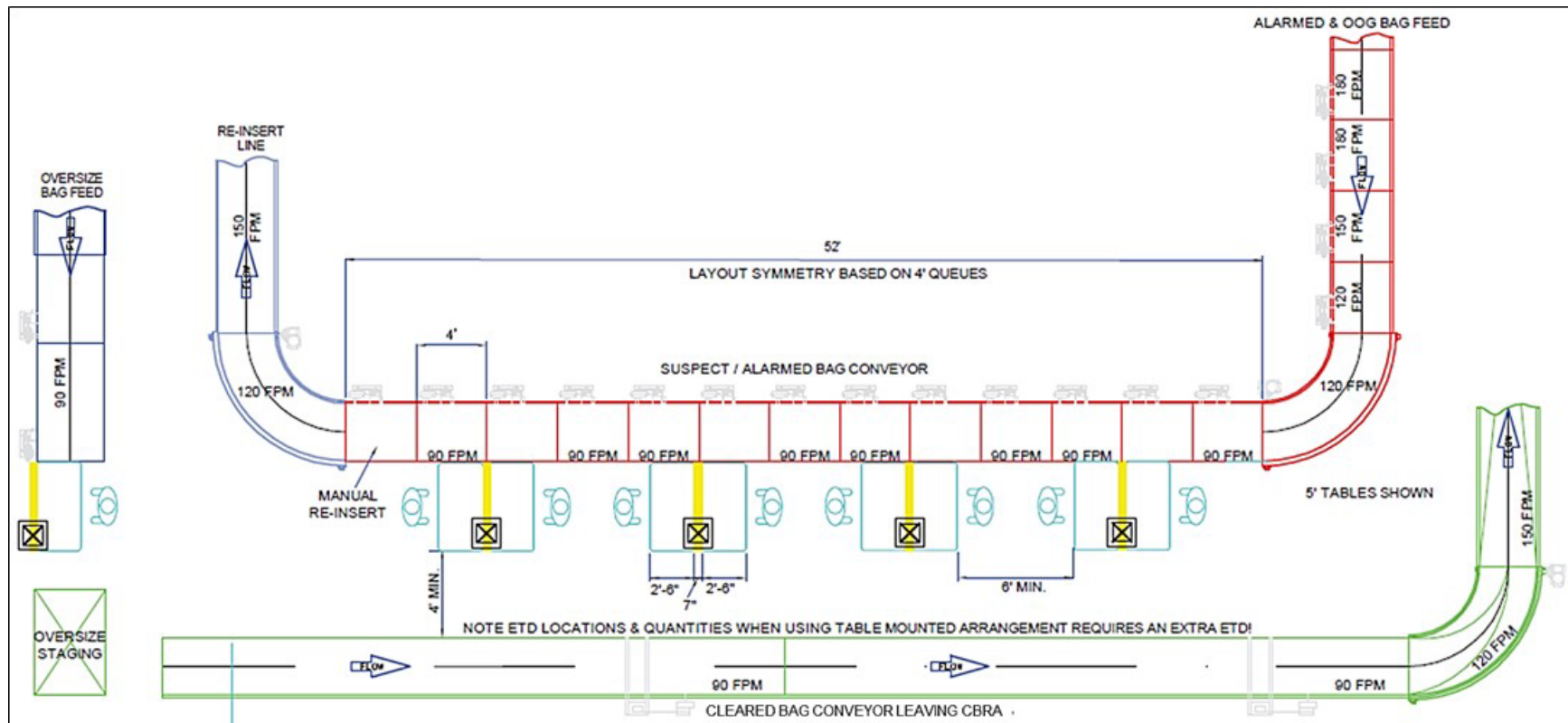
The CBRA layout shall be designed to optimize TSO utilization, avoid bag lifting, and reduce equipment costs. The CBRA layout shall be centralized and incorporate the following:

- Multiple Alarm Lines may be used for larger CBRAs
- Connected to the end of the Alarm Line, a Reinsert Line with no side guard (at beginning of the Reinsert Line) to ease bag placement during manual reinsertion
- Transport of OOG bags via the Alarm Line (or separately, as required) and leave via the Clear Line
- Clear Lines shall be shared among multiple Alarm Lines where possible
- Transport of OS bags via a dedicated conveyor line

The CBRA layout should include a single Clear Line unless physical constraints require additional lines.

For smaller configurations, the optimal layout shall include a straight Alarm Line and a parallel Clear Line as shown in Figure 14.1. For configurations with multiple Alarm Lines, a description of operations discussing Alarm Line balancing and prioritization schemes is expected.

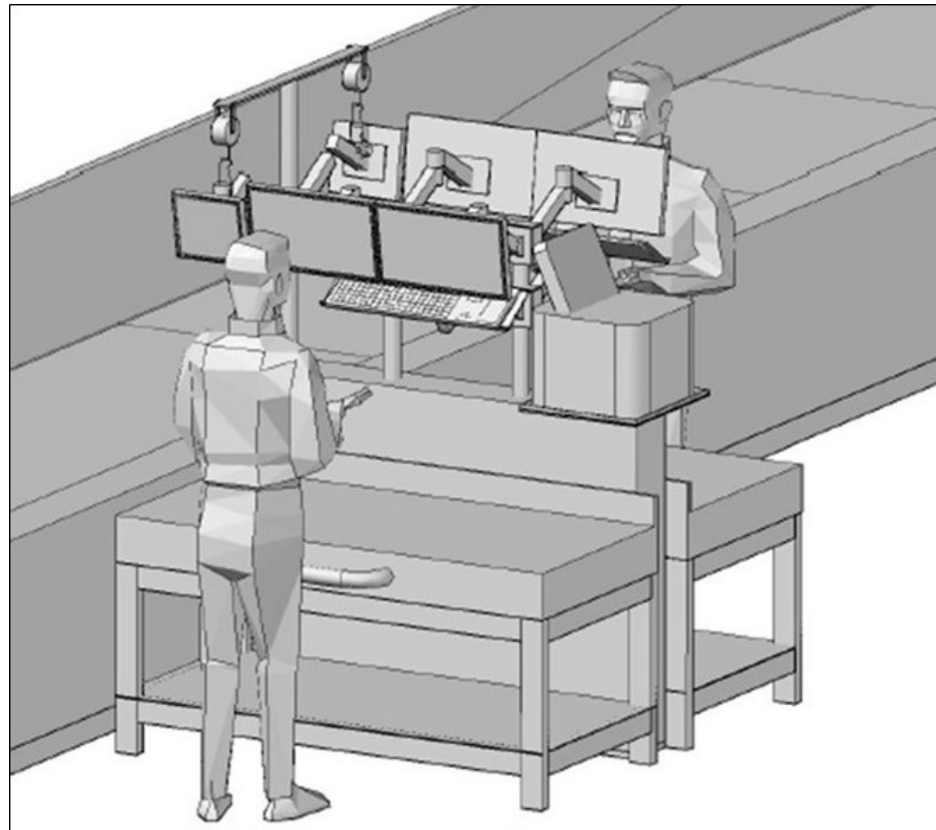
Figure 14.1: Optimal CBRA Layout for Smaller Systems



14.3 Baggage Inspection Stations

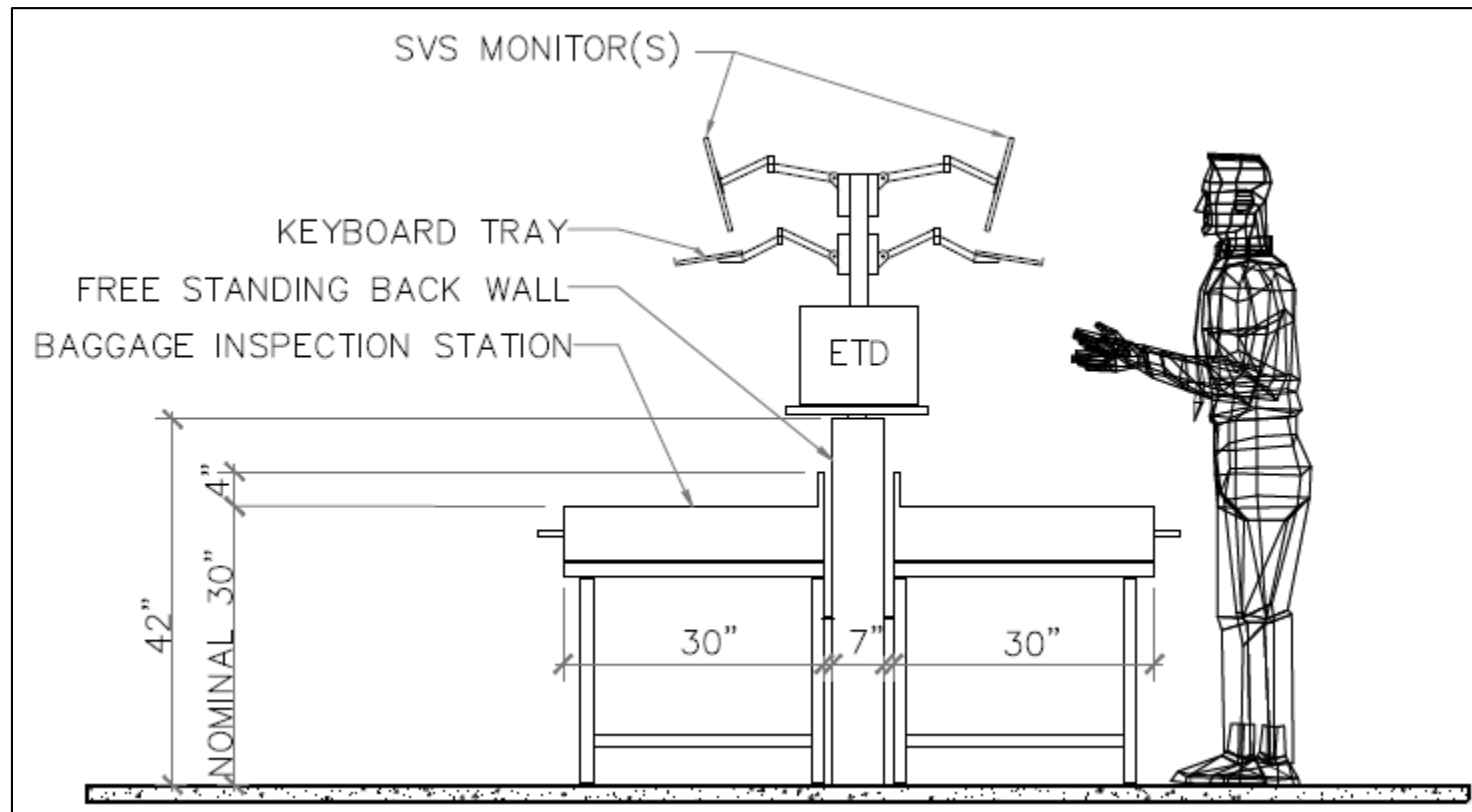
The BIS is a workstation that provides the TSO with all the tools needed and an ergonomically sound space for inspecting bags. In previous versions of the PGDS, the BIS included a back wall and a sliding-top, stainless steel table. However, in order to promote innovation, new designs and technologies for the BIS will be considered. An example BIS is shown in Figure 14.2 and a BIS cross section in Figure 14.3.

Figure 14.2: Example Baggage Inspection Station



Note: The table shown in the figure is only for reference. Other baggage inspection worksurface solutions may be used.

Figure 14.3: CBRA Workstation Cross Section



Note: The table shown in the figure is only for reference. Other baggage inspection worksurface solutions may be used.

The BIS shall include a flat work surface for the TSO to place the bag and remove any objects inside the bag as needed. The work surface shall be made of a non-porous material that can withstand isopropyl alcohol decontamination. The BIS work surface shall be 30" W x 60" L and be placed at 30" high above the finished floor.

The BIS shall be capable of processing bags year-round in an environment with a temperature range of 50-100°F and a humidity of 30-70%. The baggage to be screened may weigh up to 125 pounds. The BIS shall provide a 36" W x 60" L workspace in front of the working surface for the TSO to move freely. In addition, the BIS shall allow maintenance access to all components and shall accommodate all the CBRA ancillary equipment listed in Section 14.3.1.

Kick panels shall be installed at all locations where a bag is opened along the Alarm Line and Clear Line.

The BISs for the OS line do not require the SVS, scan gun, or BSD, as these bags were not screened by the EDS.

The bag inspection process requires the use of certain tools that will vary depending on the bag. The BIS shall provide a storage system for these tools to increase TSO efficiency, prevent theft, and avoid leaving tools inside passenger luggage after the inspection. The tool storage system shall be:

- Organized for easy inventory checks at the end of each shift by the Transportation Security Manager (TSM)
- Visually trackable for quick inventory checks after each bag inspection by the TSO

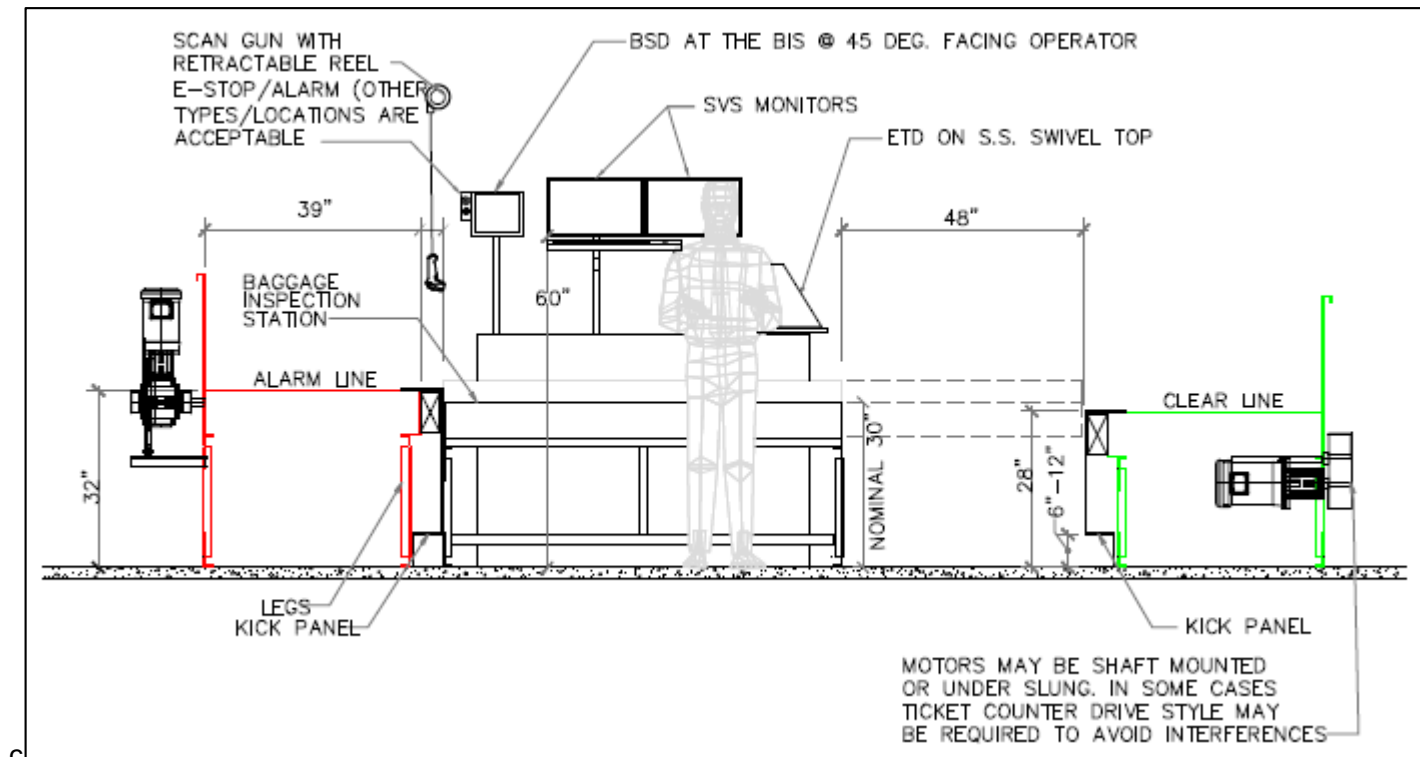
The storage system shall allow quicker access to primary and secondary tools as these are the most used, while the special tools may require more time to obtain since they are only used occasionally. A list of primary, secondary, and special tools to be stored can be found in Table 14.1.

Table 14.1: List of Tools Needed for the Bag Inspection Process

Primary	Secondary	Special
Lock Keys TSA note ETD wand ETD disks	Alcohol bottle Paper towel Gloves box Hand sanitizer Marker Bolt cutter	Screw driver Pry-bar HAZMAT note Scissor Box cutter Tape gun

Figure 14.4 illustrates the BIS position between the alarm and clear lines and the positioning of ancillary equipment with respect to the BIS and the standing position of the TSO.

Figure 14.4: CBRA Workstation Elevation



Note: The table shown in the figure is only for reference. Other baggage inspection worksurface solutions may be used.

14.3.1 BIS Ancillary Equipment

The BIS shall include all the supports needed to mount the ancillary equipment listed in this section.

- The **BSD** is the interface between the TSO and the BHS. It displays specific baggage information and allows the TSO to take action on a given bag. One BSD shall be installed per BIS. The BSD shall be color and touch capable with a 12" minimum diagonal display size. The bezel of the BSD shall not exceed 1" in any direction and shall be located near the BRP at a 45-degree angle. The BSD mounting solution shall be adjustable in X, Y, Z dimensions without the use of tools.

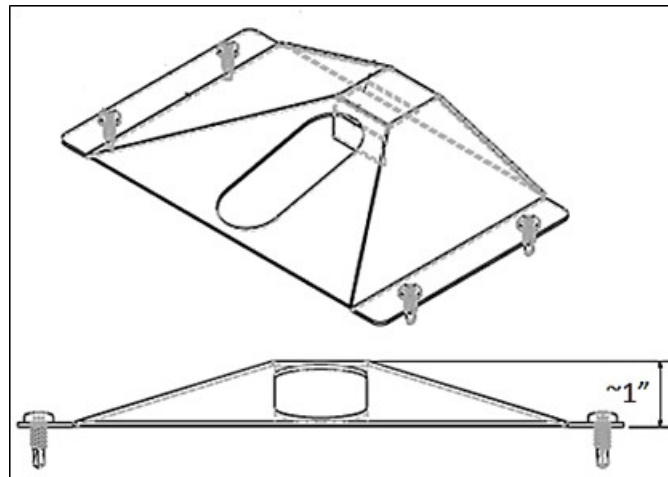
- The **SVS** is the interface between the TSO and the EDS. It permits the TSO to conduct searches using the bag ID and image of the bag. The SVS is provided by the EDS OEM and may include one or two monitors, a keyboard, a mouse, and a computer Central Processing Unit (CPU). The SVS monitors, keyboard and mouse shall be located towards the middle of the BIS and shall be adjustable in X, Y, Z dimensions without the use of tools. The SVS CPU shall be located in a lockable compartment where it will not interfere with the screening process.
- The **Scan Guns** are devices that read the 10-digit IATA bag tag and transfer the information to the BSD, which then sends the information to the SVS for image retrieval. The scan gun shall include a shock absorbing protector (rubber or similar) and be located near the adjacent BRP on a retractable reel. Scan guns shall be corded with stationary mounting solutions.
- The **ETD** is a device used to screen a bag for explosives. The CBRA design shall provide means to place and share an ETD between two adjacent BISs. The ETDs are provided by the TSA.
- The **Emergency Stop (E-stop)** shall stop all conveyors in a contiguous line when pressed during an emergency. Each BIS shall have an accessible E-stop. An E-stop lanyard the length of the alarm line or a control station-type E-stop can be utilized. E-stop stations at other locations (such as the Clear Line or an OS line) are also encouraged. A single start push button per E-stop zone shall be installed to ensure the system can only be started (reset) from one location within the zone after an E-stop has been activated.
- The **UPS** is a device capable of temporarily providing power to the TSA-provided BIS equipment whenever power outages occur. The BIS shall provide a place to locate the UPS.

14.3.2 Baggage Removal Point

The **BRP** is the queue conveyor where bags stop for removal and processing by the TSO.

- The BRP shall be 48" L and 32" H (floor to the conveyor bed). The PE location and programing of the BRP shall ensure that arriving bags are centered (with respect to the width of the conveyor) and stop next to the corresponding BIS. In addition, the photo eye reflector cover shall be of a slim design no more than 1" H that allows bags to be slid over it. Refer to Figure 14.5 for an example.

Figure 14.5: Photo Eye Reflector Cover



- The queue conveyors situated between the BRPs are termed “Intermediate Queues” and shall be a minimum of 48” long and 32 inches high. Intermediate queues shall be installed in the space between BIS pairs adjacent to the workspace for the TSOs.

14.3.3 CBRA BHS Displays

The CBRA shall be equipped with a display of additional BHS information that is useful for the TSA to effectively respond to system issues or bag surges. This information shall be visually available as follows:

- BHS Status Display – A visual representation of the conveyor belt design shall be included that uses industry-wide standard color codes to communicate real-time equipment status.
- BHS Remote Reporting Workstation – A remote thin client BHS workstation shall be provided to TSA in OSR/CBRA at supervisor’s desk depending on system size and TSA needs.
- The BHS Remote Reporting Workstation display of all reports shall include an optional setting that refreshes the information on the display at a selected interval so that the report can be left open on the display and show current operational data.

The number, locations, and size of displays will depend upon the BHS design, TSM desk location, and CBRA layout. Smaller airports may require one to two smaller displays (22” to 27”), while bigger airports may require one to three larger displays (42” to 60”). The exact configuration of CBRA BHS displays shall be coordinated between TSA and the ILDT during the project submittal phase.

14.4 CBRA Functionality

This section provides a description of the functionality and controls required by the equipment in CBRA.

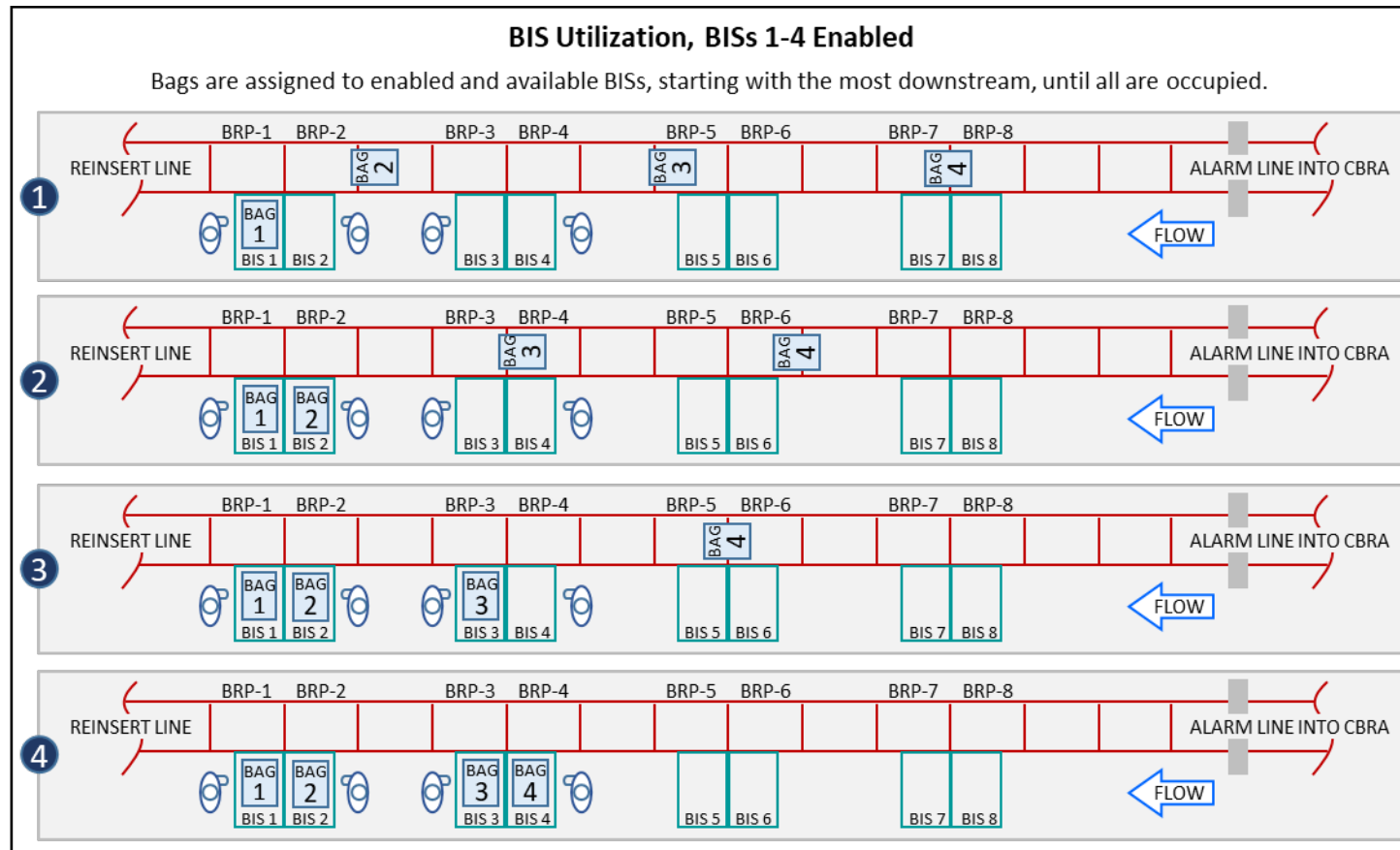
14.4.1 BIS Utilization

A BIS is considered enabled when an operator is logged in. BISs shall be enabled in upstream sequence only, beginning with the furthest downstream station. The BHS shall inhibit an upstream station from being enabled if downstream BISs are disabled. This applies to conventional conveyor and other baggage conveying system CBRA layouts.

An enabled BIS is considered available when it is not occupied with a bag for screening. When there is more than one available BIS, bags arriving on the Alarm Line shall be assigned to the BIS that has been available for the longest period of time. When a bag is assigned by the BHS to an available BIS, the bag cannot be reassigned to another BIS unless the BIS is disabled (i.e., the operator logs out).

An example of BIS utilization is illustrated in Figure 14.6.

Figure 14.6: BIS Utilization Example



14.4.2 Alarm Line Queuing

Queuing methodology refers to the logic used to determine the order in which Alarm Line conveyors in the CBRA are filled with bags waiting to be screened.

If there are no enabled BISs, bags arriving on the Alarm Line shall queue at the second most downstream BRP.

When BISs are enabled but none are available, a three-level queuing methodology has been found to be appropriate for most CBRA designs. The CBRA shall be programmed to queue bags waiting for an available BIS in the following order:

- Level 1: Enabled BRPs, starting from the most upstream
- Level 2: CBRA queue conveyors (except intermediate queues), upstream of the enabled BISs
- Level 3: Intermediate queues starting from the most upstream

The three queuing levels are described in detail later in this section.

TSA understands that, for some CBRAs, other queuing methodologies could be considered.

14.4.2.1 Level 1 Queuing

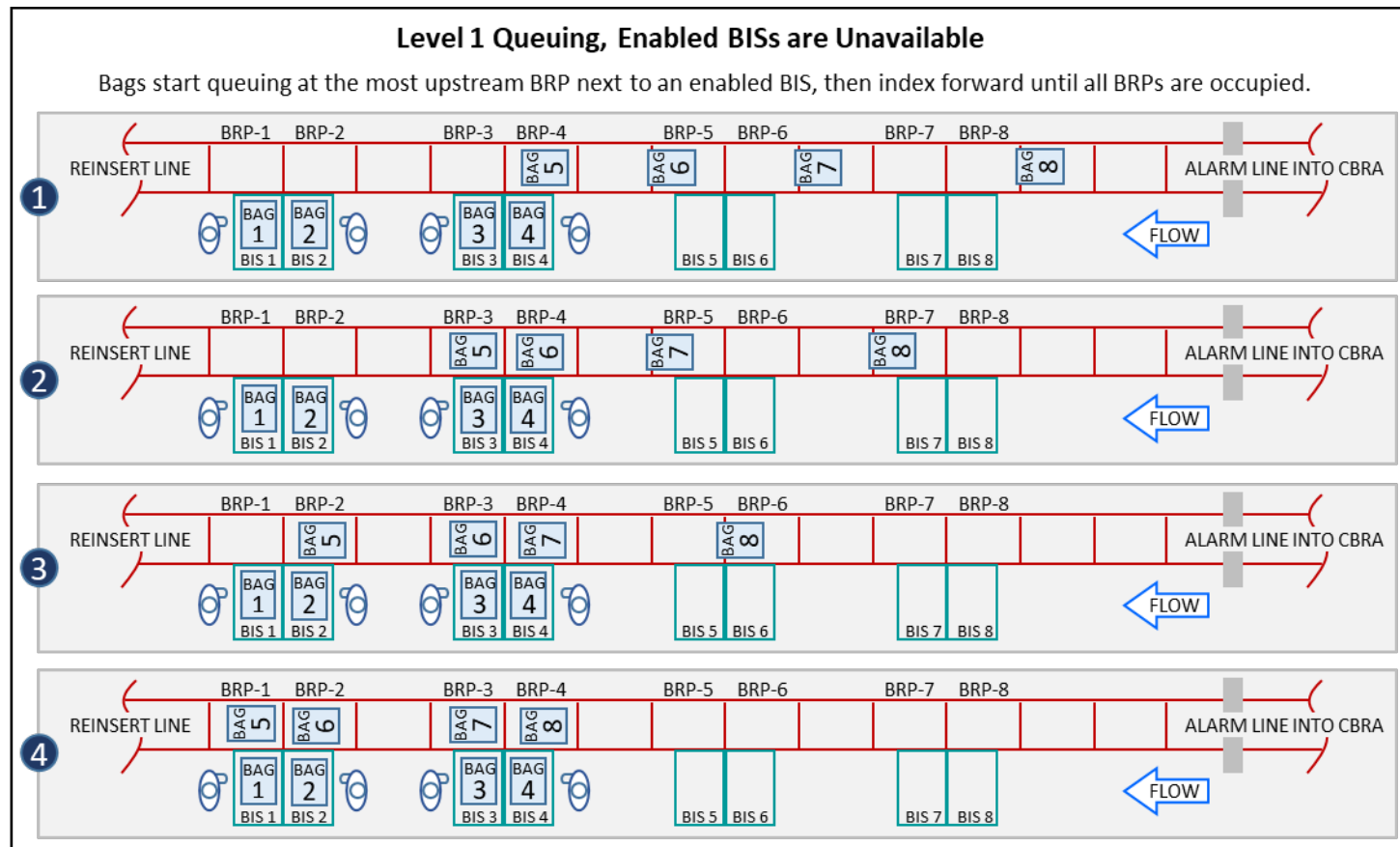
Level 1 queuing is shown in Figure 14.7 and applies when all enabled BISs are screening bags and unavailable. Each additional bag entering CBRA indexes forward onto the BRP next to an enabled BIS, beginning with the most upstream BRP, leaving the intermediate queues vacant.

Figure 14.7 assumes that BIS-1, BIS-2, BIS-3, and BIS-4 are enabled and available and eight bags arrive in the CBRA consecutively. Following Level 1 queuing logic:

1. Bag 5 queues at BRP-4.
2. When Bag 6 arrives on the conveyor immediately upstream of BRP-4 and no BIS has become available, Bag 5 indexes forward to BRP-3 and Bag 6 indexes forward to BRP-4.
3. When Bag 7 arrives on the conveyor immediately upstream of BRP-4 and no BIS has become available, Bag 5 indexes forward to BRP-2, Bag 6 indexes forward to BRP-3, and Bag 7 indexes forward to BRP-4.
4. When Bag 8 arrives on the conveyor immediately upstream of BRP-4 and no BIS has become available, Bag 5 indexes forward to BRP-1, Bag 6 indexes forward to BRP-2, Bag 7 indexes forward to BRP-3, and Bag 8 occupies BRP-4.

When a BIS becomes available, the upstream bags index forward using the same logic to keep all BRPs next to enabled BISs occupied.

Figure 14.7: Level 1 Queuing

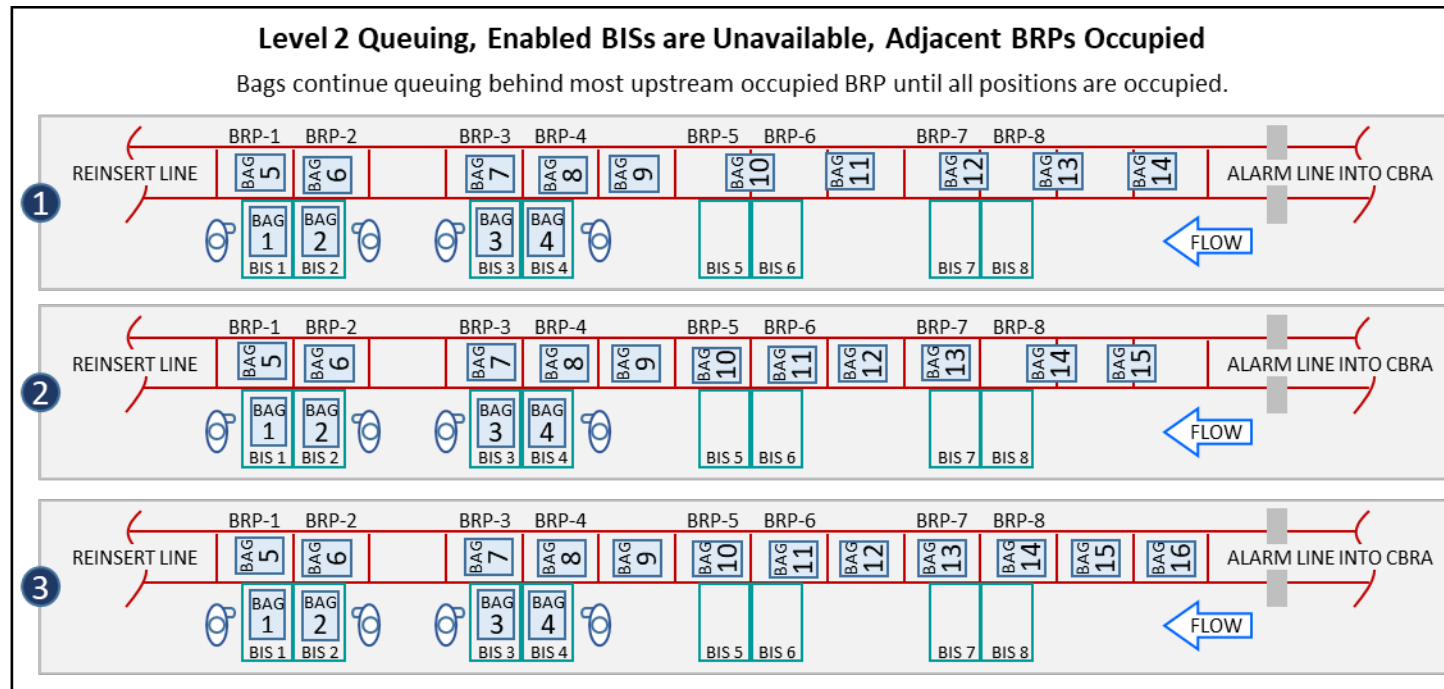


14.4.2.2 Level 2 Queuing

When all enabled BIS and adjacent BRPs are occupied, queuing begins at the queue position immediately upstream of the most upstream enabled BRP and then indexes bags backwards as more bags enter the CBRA. Figure 14.8 illustrates bags indexing until all the upstream CBRA queues positions are occupied. Intermediate queues are left open until all BIS are occupied and bags cascade to fill all the upstream queue

positions in CBRA. The only exception is that bags en route to the reinsertion line may occupy intermediate queues. Note that intermediate queues exist only between enabled back-to-back BISs.

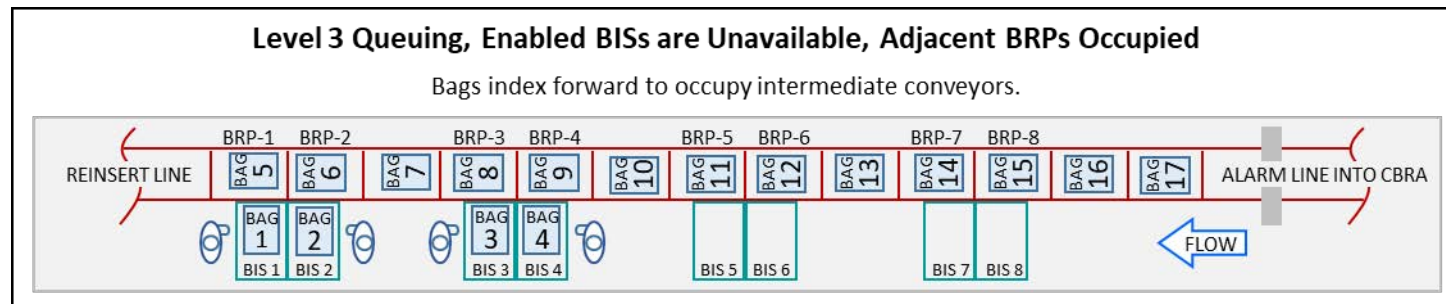
Figure 14.8: Level 2 Queuing



14.4.2.3 Level 3 Queuing

In Level 3, bags will index forward to occupy the intermediate queues, as illustrated in Figure 14.9. Any required queuing beyond Level 3 will take place outside of the CBRA.

Figure 14.9: Level 3 Queuing



14.4.3 Baggage Removal Point Lag Timer

After a bag has been removed from a BRP and an action button has been selected on the BSD (the chronological order is irrelevant, but both conditions must be met), the system controls shall have an adjustable lag timer for the BRP belt to resume operations (i.e., advance other bags). The default value shall be 3 seconds.

14.4.4 Scan Guns

The scan guns shall be connected to the BSD so data is passed from the BHS to the SVS via a predefined communication port.

14.4.5 Baggage Process and Screening Timers

The BHS shall use a BPT to record every bag processing time at each BIS using the arrival of a bag at the BRP as the start signal for the timer. BPT information is considered SSI and requires SSI training to access. The BHS shall also use a Baggage Screening Timer (BST) to record the bag screening time at each BIS using the SEARCH button on the BSD as the start signal for the timer. Both BPT and BST use the CLEARED button for the stop signal and are recorded in the CBRA Bag Process report. Example reports are provided in Appendix A, Section A.4.

14.4.6 Reinsert Line

The Reinsert Line conveyor shall automatically start when a reinserted bag is detected on the upstream queue conveyor and the bag is automatically transferred onto the Reinsert Line for rescreening.

Bags eligible for either automatic or manual reinsertion shall be assigned a new unique BHS tracking ID prior to rescreening.

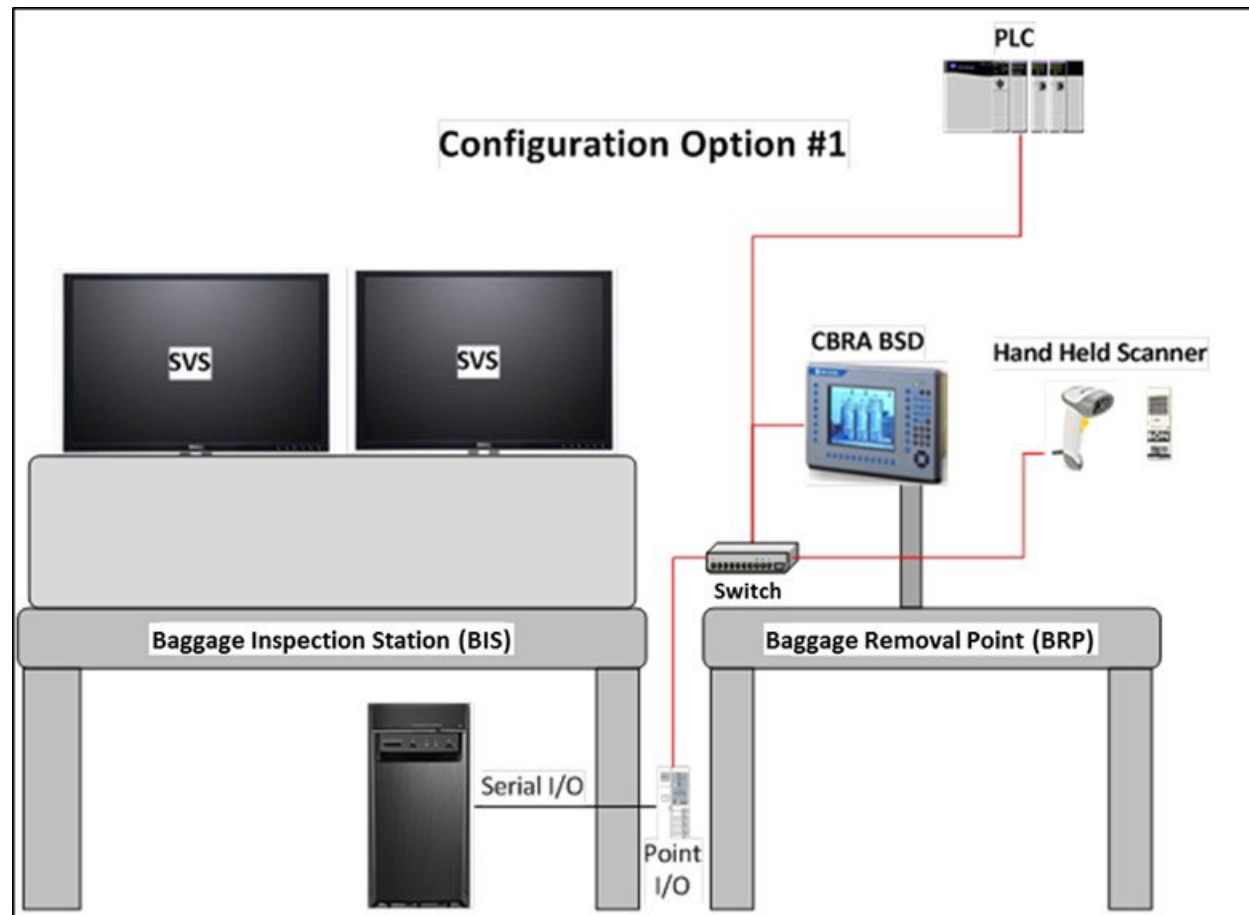
A control station shall be provided to operate the Reinsert Line conveyor and allow for the manual placement of a bag. At the manual reinsert points, the design shall incorporate a control station with the functionality of “Insert Bag” which will stop the conveyor and queue bags upstream to allow a bag to be manually placed on the conveyor (manual reinsert process). Manual reinsert points located in optimal layouts are shown in Figure 14.1. After the bag is placed on the conveyor, pressing a “dispatch” button shall send the bag downstream tracked with a status of “REINSERTED”. Reinserted bags shall not stop at enabled BRPs if the path to the Reinsert Line is clear and will be advanced directly to the Reinsert Line.

14.4.7 Serial Communication Requirements

BSD to SVS serial communication requirements are being refined by the TSA to include, in part, two-way communications. This section details information pertaining to the serial communications between the BSD, controlled by the BHS, and the SVS, controlled by the EDS network. Projects based on this version of the PGDS shall include provisions for these requirements to be incorporated during the project or as defined by the EDS Integration Documentation at the time of installation.

Figure 14.10 depicts one option to accomplish the serial interface as outlined.

Figure 14.10: Serial Communications Configuration Option



Note: The BSD is shown over the conveyor for clarity in the figure but is normally installed over the baggage inspection workspace.

When the operator logs into the SVS, a heartbeat will be sent from the SVS and used by the BHS to automatically enable the BSD/BRP for bag processing.

When a bag arrives in the CBRA, the BSD will send the associated ID to the SVS based upon the options available to the operator as described below. This data will be used by the FDRS to log the time an image was sent to the screen to the time a final disposition was rendered by the CBRA operator.

After each bag has been processed by the TSO, the SVS will send back the associated ID string in addition to the bag's disposition to the BSD based upon the actions taken at the SVS. For example, if the operator renders a clear disposition on a given bag, that information will be sent back to the BHS. This will in turn be used by the BHS to declare that position available.

14.4.7.1 Communication Port Parameters

The SVS serial communications port shall be configured for two-way communications send and receive, with the following parameters:

- Baud Rate – 9600
- Data Bit – 8
- Parity – 0
- Stop Bits – 1

14.4.7.2 Communications Data Format

Data formatting between the BSD and SVS shall comply with the American Standard Code Information Interchange (ASCII) standards.

For any instance where either no BHS Pseudo ID or IATA ID is available from the BHS to the SVS or SVS to the BHS, the 10 digits shall be populated with “?” marks (where a “?” is equivalent to an ASCII 63).

Note: Numbers below within “()” indicate the ASCII equivalent value.

14.4.7.3 BSD to SVS

Data format is <<STX,Pseudo,IATA,ETX>> where

- STX (02) = Start of Text
- . (44)
- Pseudo = BHS generated ID for tracking purposes and displayed on the BSD
- , (44)

- IATA = IATA ID Displayed on BSD
- . (44)
- ETX (03) = End of Text

14.4.7.4 Order of Bag ID Lookup

1. The SVS will use the BHS Pseudo ID as the primary ID to recall the associated image.
2. Where a bag cannot be recalled due to BHS issues such as lost in tracking, the EDS will use the IATA as a secondary means to recall the image.
3. Where no ID is found, either BHS Pseudo or IATA, the SVS will provide a positive response that no image was found associated with the IDs provided. This will be indicated as a “popup” message on the SVS monitors.

14.4.7.5 SVS to BSD Heartbeat

When the operator has logged into the SVS, a heartbeat will be sent from the SVS to the BSD denoting it is active and available to process bags.

When the BHS detects the heartbeat from the SVS, the BSD shall automatically be enabled and the active screen will be “Waiting For Bag”.

This data will be a toggle between two separate ASCII values and shall be as follows every two seconds:

Data format is <<STX,HB,ETX>> where

- STX (02) = Start of Text
- . (44)
- HB = Toggles between H (72) and h (104)
- . (44)
- ETX (03) = End of Text

Note: The BHS is expected to monitor this data for a change of state. If a change of state is not detected within 10 seconds, the BHS is expected to automatically log out of the BRP and declare the BRP unavailable.

14.4.7.6 Bag ID and Disposition String Format

Data format is <<STX,IATA,Pseudo,Disposition,ETX>> where

- STX (02) = Start of Text
- , (44)
- IATA = IATA ID Displayed on BSD
- , (44)
- Pseudo = BHS generated ID for tracking purposes and displayed on the BSD
- , (44)
- Disposition
 - Clear = C (67)
 - Alarm = A (65)
 - No Image Found = F (70)
- , (44)
- ETX (03) = End of Text

14.5 BSD Operations

14.5.1 BSD Screens Design

The BSD Interface comprises different elements and specific visual characteristics that shall be replicated on every design. The visual design shall include:

- Font style: The font shall be a web-safe sans-serif typeface such as Arial, Verdana, or Calibri.
- All Capital Letters: Bag statuses, Unique Identifier Cells (UICs), and operator messages shall be displayed in all capital letters. Everything else will follow the typical format of the first capital letter only.
- The elements to screen size ratio shall be maintained regardless of the display size. For instance, when determining the width of the elements:
 - Data fields – 10% each (or 40% total)
 - Operator Message – 10%

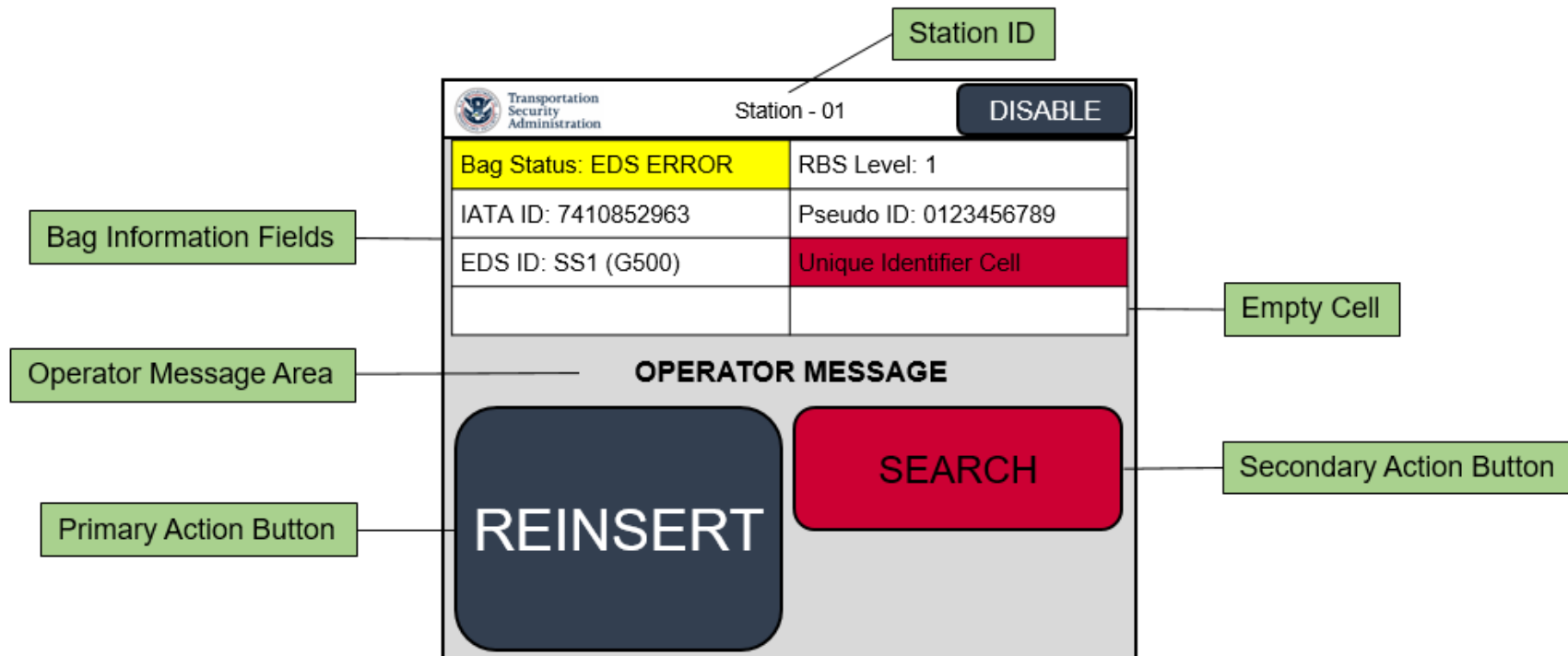
- Primary Buttons – 40%
- Secondary buttons – 20%
- All colors used throughout the displays shall follow the colors in Table 14.2:

Table 14.2: BSD Color Requirements

Color	Pantone	R	G	B
Blue	2955 C	0	51	102
Gray	Cool Gray 6 C	176	177	179
Red	187 C	204	0	51
Light Blue	307 C	0	102	153
Green	370 C	51	153	0
Orange	159	191	87	0
Yellow	102 C	246	229	0

The BSD structure shall include the following key elements, illustrated in Figure 14.11:

Figure 14.11: Elements of Bag Status Display Screen



- **Station ID:** Numbering convention in the format of "STATION -XX", which correlates to the BIS number in which it is mounted.
- **Bag Information Fields:**
 - **Bag Status:** Disposition of the bag as indicated by designator and color listed in Section 14.5.2
 - **RBS Level:** The EDS algorithm used to screen the bag. The EDS algorithm used to screen the bag. The ".X" field should be supplied by the Baggage Source Message (BSM) to the upper level, which determines the Risk-Based Security (RBS) level.
 - **IATA ID or RFID:** If an ATR is being used upstream of the EDS units, the IATA number shall be populated here. If an RFID system is being used, the RFID ID shall be displayed.

- **PSEUDO ID:** The generated pseudo ID (either by the BHS or the EDS) shall be shown.
- **EDS ID:** EDS screening line and EDS serial number used to process the current bag in the format of SS8 (G500)
- **UIC:** Used to identify when any of the following scenarios occur:
 - o Duplicate IATA
 - o Timeout
 - o Communication Error
 - o Length Change
 - o Reinsert
 - o Others may be added with an approved RFV
- **Found at PE:** Photo eye ID that correlates to the location where bags that have been lost in tracking were “found”.
- **Operator Message Area:** Used to display any messages for the operator.
- **Primary Buttons:** These represent the primary action typically taken by the operator. These also work as a trigger for the Bag Auto ID Transfer functionality when needed, as referenced in TSA’s Integration Requirements Document (IRD).
- **Secondary Action Buttons:** These provide an optional action for the operator under certain circumstances.

Throughout the following sections, multiple BSD screens will be presented to show the desired results from each processing step. The ILDT is required to match every aspect of each screen including colors, font style, button location and size, messages displayed, and others. If the ILDT desires additional functionality, or would like to propose changes to improve operations, an RFV could be submitted to start the dialogue.

14.5.2 BSD Statuses and High-level Processing Procedures

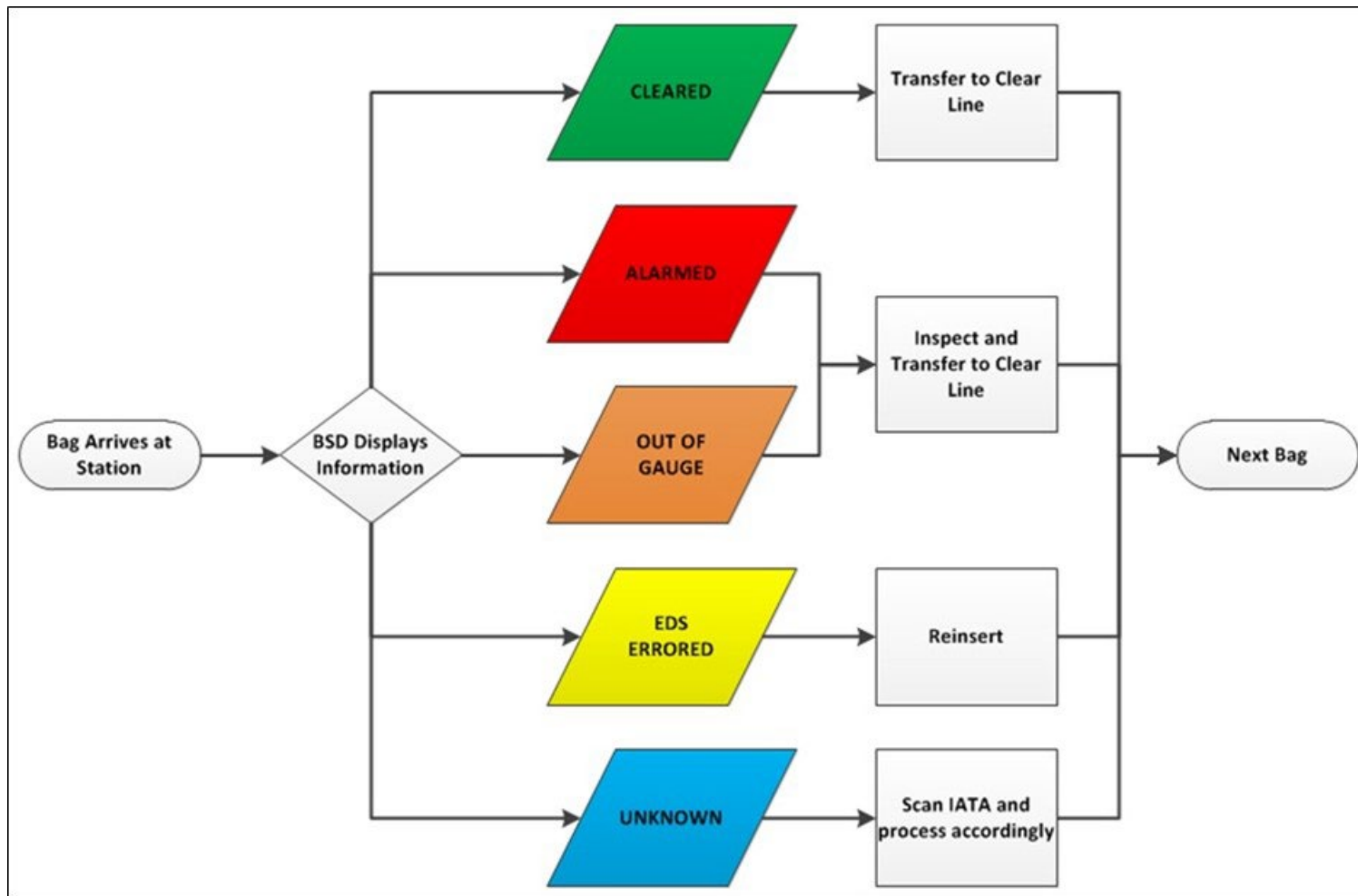
Baggage that arrives in the CBRA shall be limited to the following five statuses with their corresponding designator codes, color, and RBS level.

- **CLEARED (Green)** – Bags that received a clear status from the EDS or OSR. Cleared bags include:
 - Clear – Standard bag with RBS level - 0
 - PRE-Clear – Pre-Check bag with RBS level - P
 - SEL-Clear – Selectee bag with RBS level - S
- **ALARMED (Red)** – Bags that generate an automatic alarm on an EDS unit and were viewed but not cleared by the Level 2 OSR Operator. Alarmed bags include:

- Alarmed – Standard bag with RBS level - 0
- PRE-Alarmed – Pre-Check bag with RBS level - P
- SEL-Alarmed – Selectee bag with RBS level – S
- Timeout – Bags that received an alarm status from the EDS but timed out during OSR or didn't make it to the OSR at all. RBS level can be 0, P, or S.
- **OUT OF GAUGE** (Orange) – Bags that do not fit into EDS units. RBS level - UNK
- **EDS ERRORED** (Yellow) – Bags that received an error status from the EDS. RBS level – UNK
- **UNKNOWN** (Blue) – Bags that have become lost in tracking between the exit of the EDS and the BRP or forced unknown for security reasons. RBS level – UNK
 - Communication Error – BHS will assign this status in scenarios where a disposition has not been received by the BHS from the EDS. This status is NOT an indication of an EDS or BHS error, but indicates a possible communications error. Where the status is persistent, the BHS and EDS engineers should review the possible condition causing the error. RBS level – UNK
 - Length Change – BHS will assign this status to bags that are believed to have “changed” their length. RBS level – UNK
 - Reinsert- BHS will assign this status to bags which are destined for the reinsertion line. Operators will have the option to screen the bag, manually reinsert the bag or take no action where the bag will continue towards the reinsertion line. In the case of a non-connected reinsertion line, the options will be to screen or manually reinsert the bag.

These five statuses will be processed primarily utilizing five operator sub processes as shown in Figure 14.12. These sub processes are discussed in greater detail in the next sections utilizing diagrams to illustrate multiple tasks happening simultaneously throughout each bag status resolution.

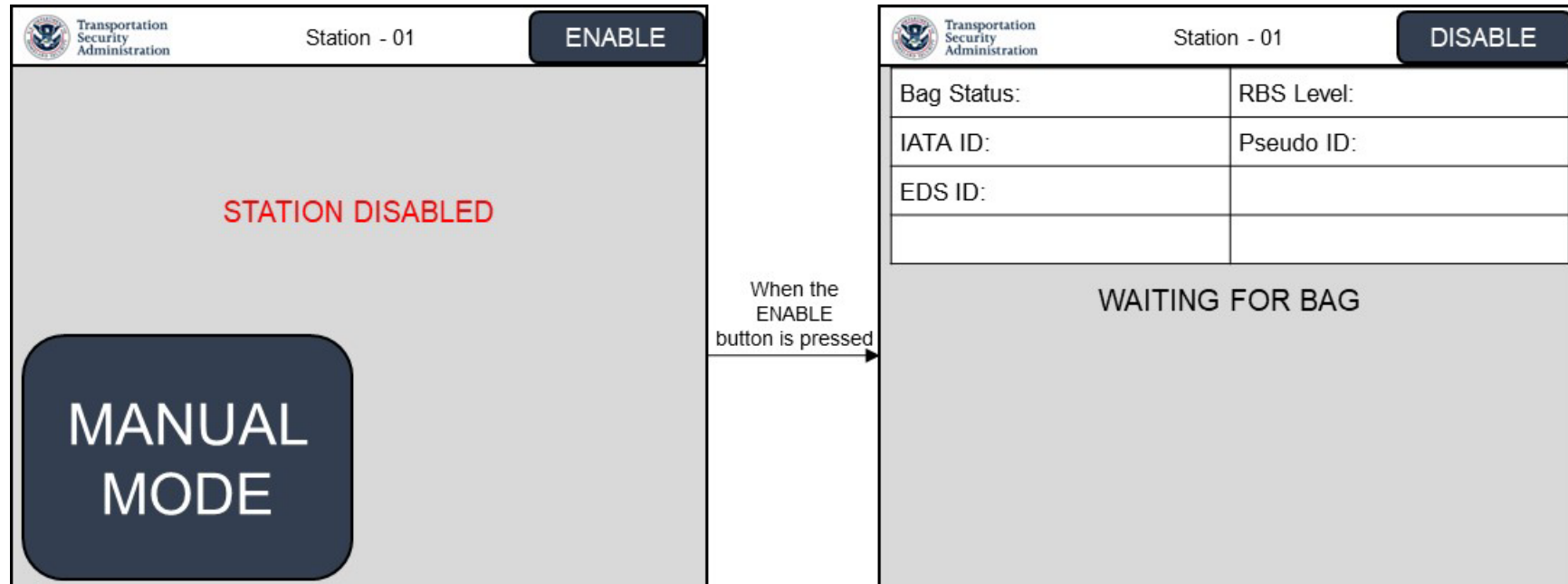
Figure 14.12: High-level Procedure Per Bag Status



14.5.3 Station Disabled and Waiting for Bag Screens

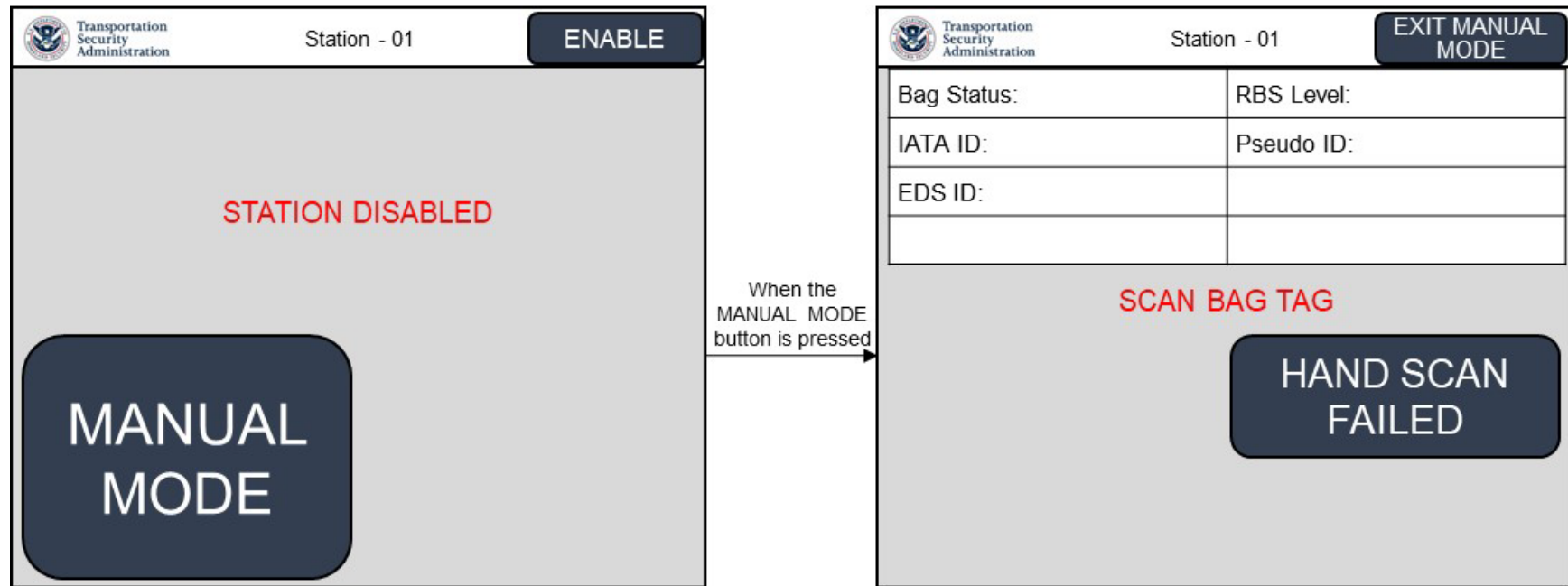
After the BHS startup procedures are completed, the BSD shall remain DISABLED until an operator presses the ENABLE button shown in Figure 14.13 or logs on to the SVS with two-way communication.

Figure 14.13: Station Disabled (left side) and Station Enabled (right side) Screens



MANUAL MODE allows for processing of bags hand carried to a BIS. MANUAL MODE can only be entered from a “DISABLED” BSD. While in MANUAL MODE, the BHS will not queue bags on the associated BRP and the BSD will assume that every bag has an “UNKNOWN” status in order to allow for a tag scan. The processing of bags while in MANUAL MODE follows the sequence for UNKNOWN bags shown in Section 14.5.4.5. The MANUAL MODE BSD screen is shown in Figure 14.14.

Figure 14.14: Station Disabled (left side) and Manual Mode Activated (right side) Screens



14.5.4 Bag Processing by Status

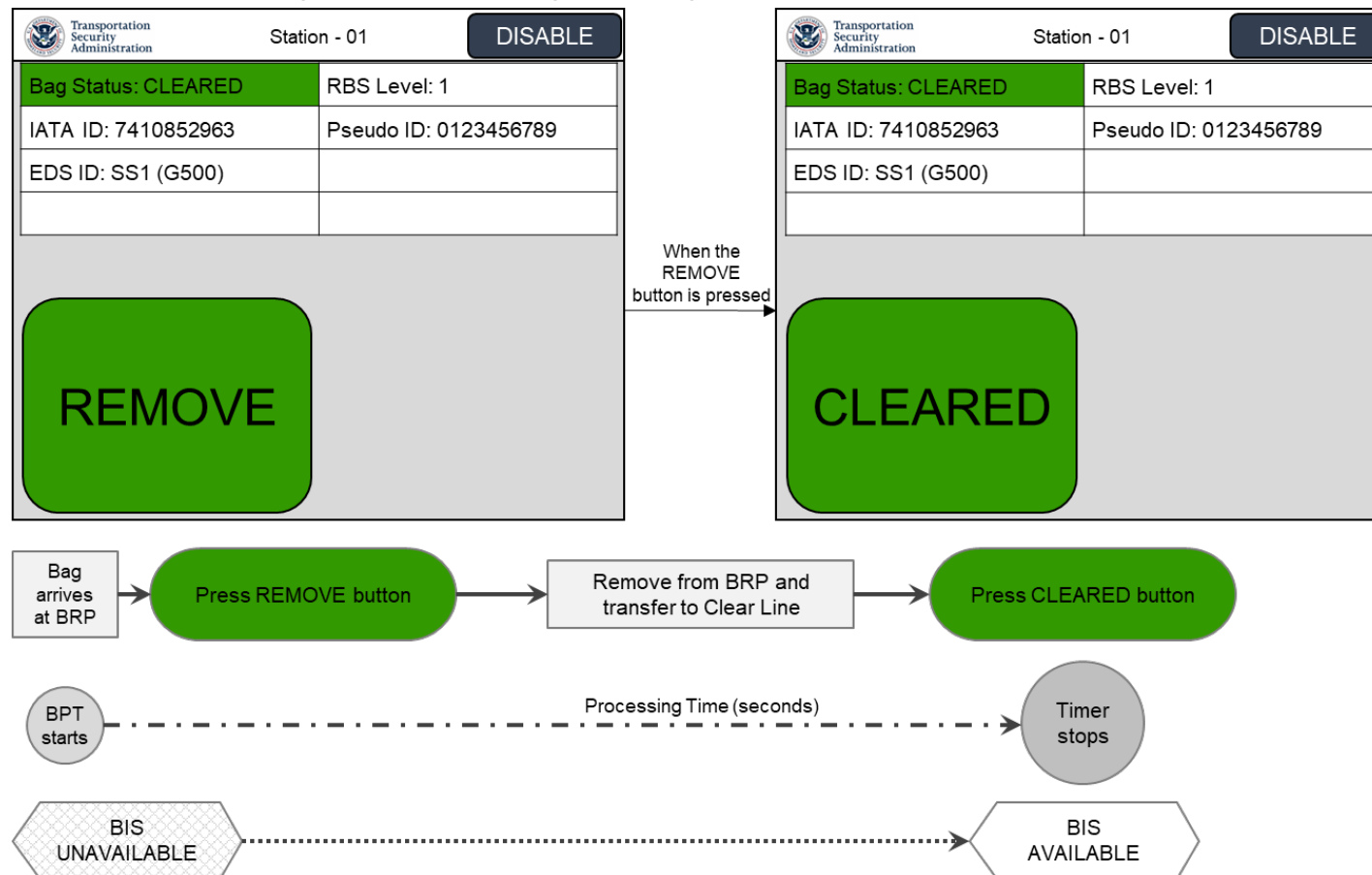
The figures in this section depict the following information regarding bag processing:

- The BSD screens required for processing all five bag statuses
- The physical sequence of operations required by the operator to complete the process, and;
- The controls requirements throughout the process

14.5.4.1 Cleared Bag Processing

The BPT starts and the BIS becomes unavailable when the bag arrives at the BRP. The bag status, IATA ID, EDS ID, RBS level, and Pseudo ID information cells are populated. The bag status cell is green and displays the status **CLEARED**. The primary action button is green and displays **REMOVE**. The TSO presses the primary button, which then changes to display **CLEARED**. The TSO transfers the bag to the clear line, and presses the primary button again to stop the BPT and make the BIS available again.

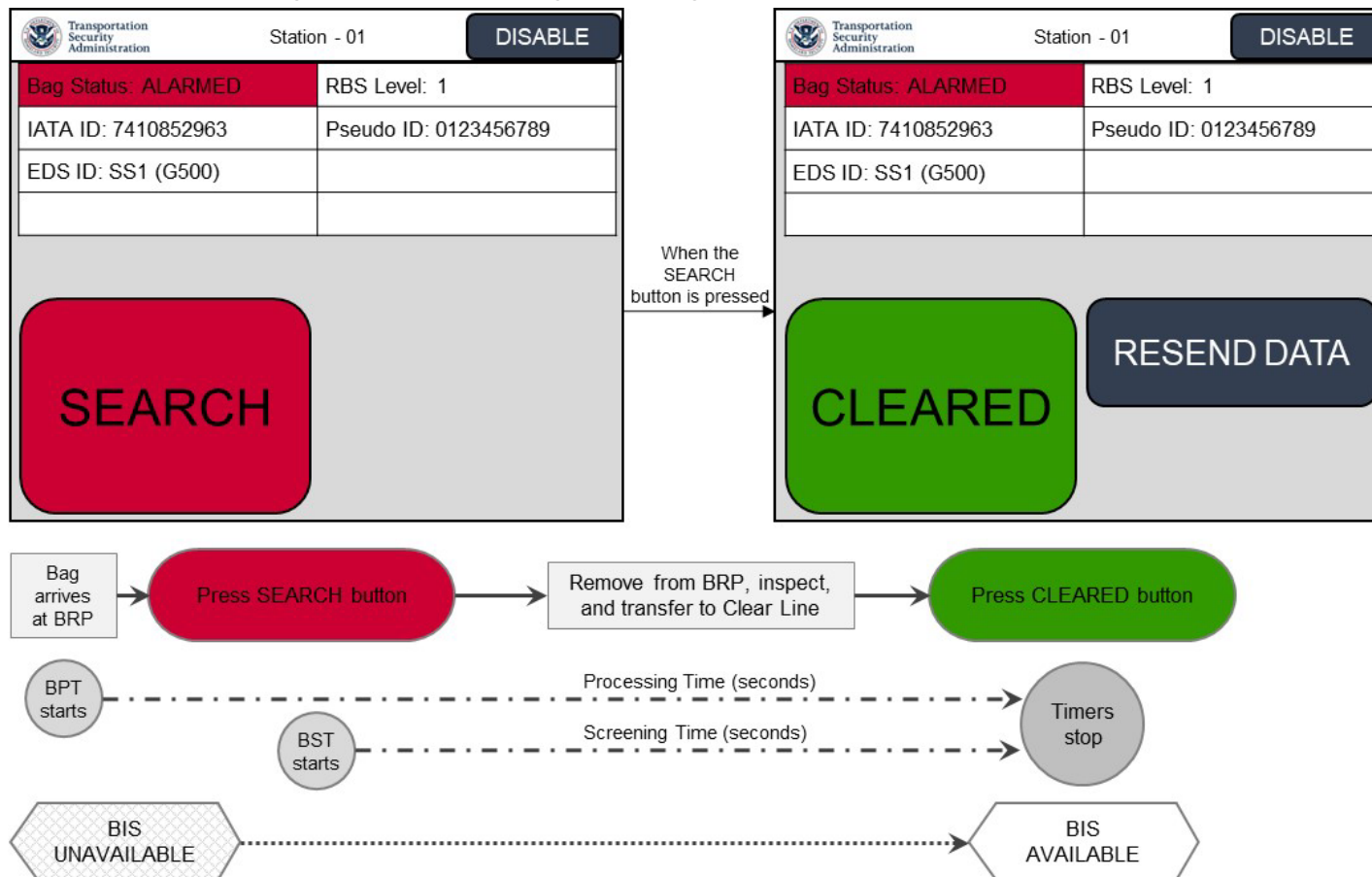
Figure 14.15: Cleared Bag Processing Screens and Sequence of Operations



14.5.4.2 Alarmed Bag Processing

The BPT starts and the BIS becomes unavailable when the bag arrives at the BRP. The bag status cell is red and displays the status ALARMED. The IATA ID, EDS ID, RBS level, and Pseudo ID information cells are populated. The primary action button is red and displays SEARCH. The TSO presses the primary button, which then changes to green and displays CLEARED. The TSO inspects the bag, transfers it to the clear line, and presses the primary button again to stop the BPT and make the BIS available again.

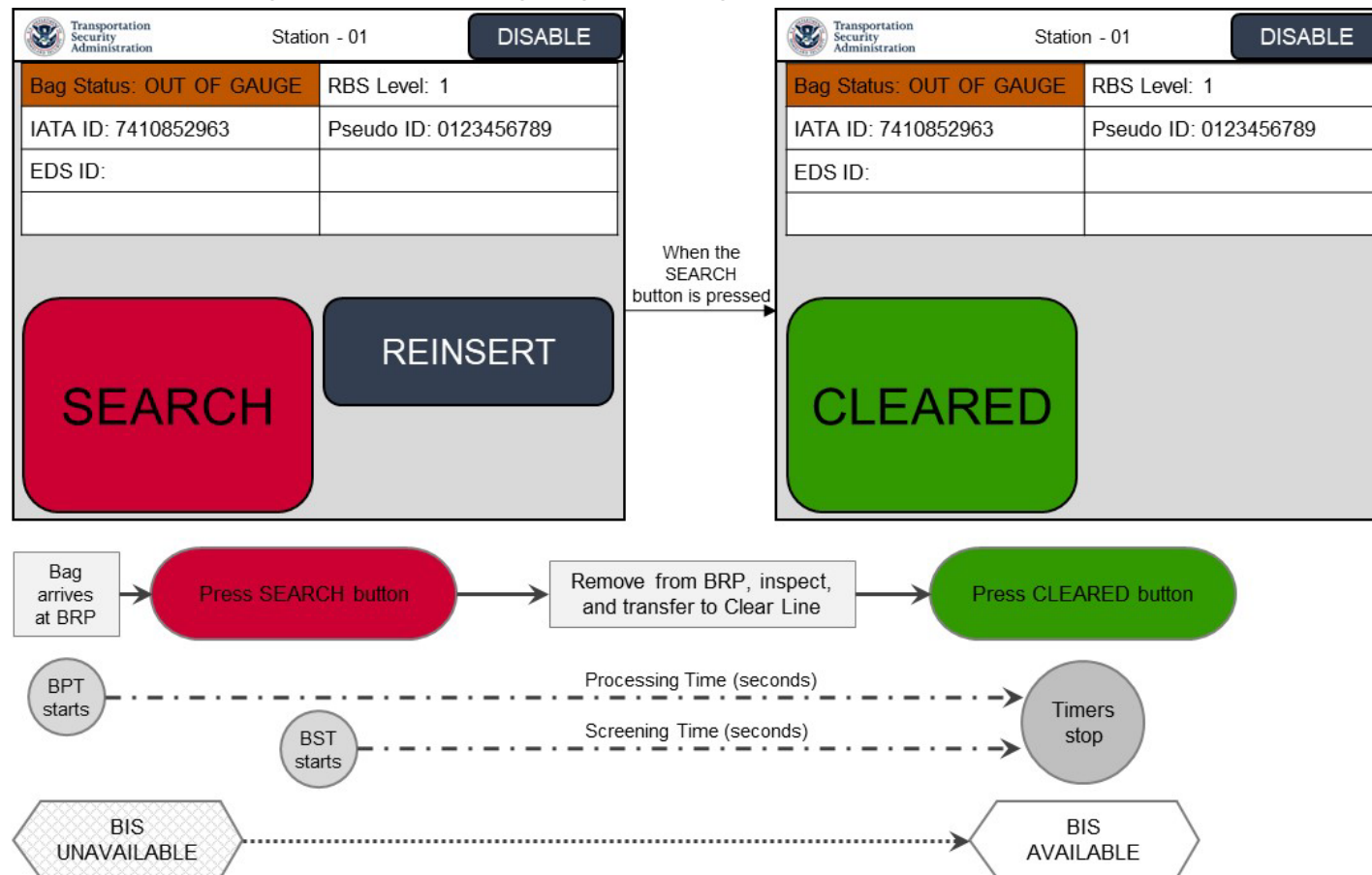
Figure 14.16: Alarmed Bag Processing Screens and Sequence of Operations



14.5.4.3 Out of Gauge Bag Processing

The BPT starts and the BIS becomes unavailable when the bag arrives at the BRP. The bag status cell is brown and displays the status OUT OF GAUGE. The IATA ID, EDS ID, RBS level, and Pseudo ID information cells are populated. The primary action button is red and displays SEARCH. The TSO presses the primary button, which then changes to green and displays CLEARED. The TSO inspects the bag, transfers it to the clear line, and presses the primary button again to stop the BPT and make the BIS available again.

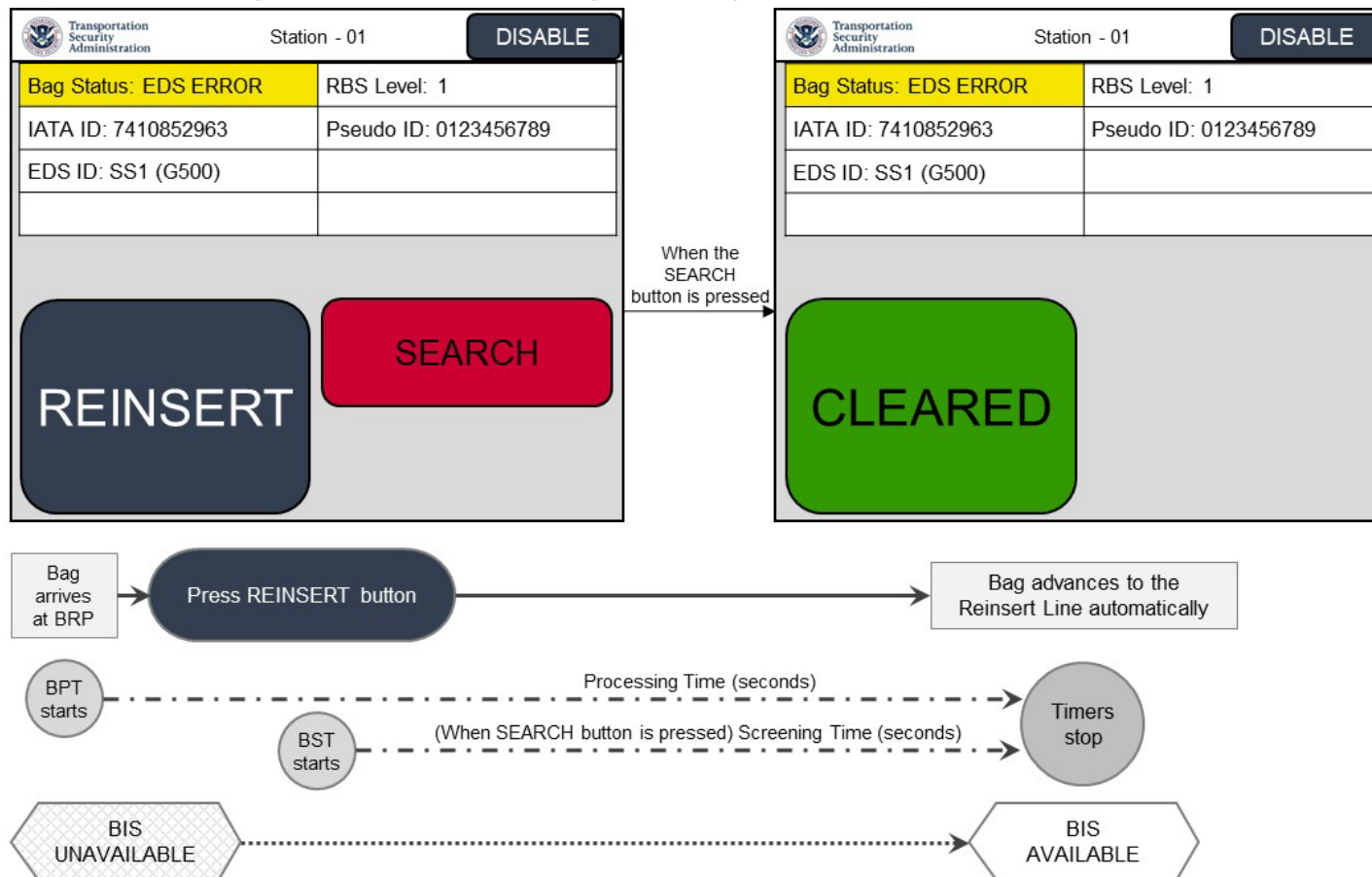
Figure 14.17: Out of Gauge Bag Processing Screens and Sequence of Operations



14.5.4.4 EDS Errored Bag Processing

The BPT starts and the BIS becomes unavailable when the bag arrives at the BRP. The bag status cell is yellow and displays the status EDS ERROR. The IATA ID, EDS ID, RBS level, and Pseudo ID information cells are populated. The primary action button is dark blue and displays REINSERT. The TSO presses the primary button, which then changes to green and displays CLEARED. The bag automatically advances to the reinsert line. The TSO presses the primary button again to stop the BPT and make the BIS available again.

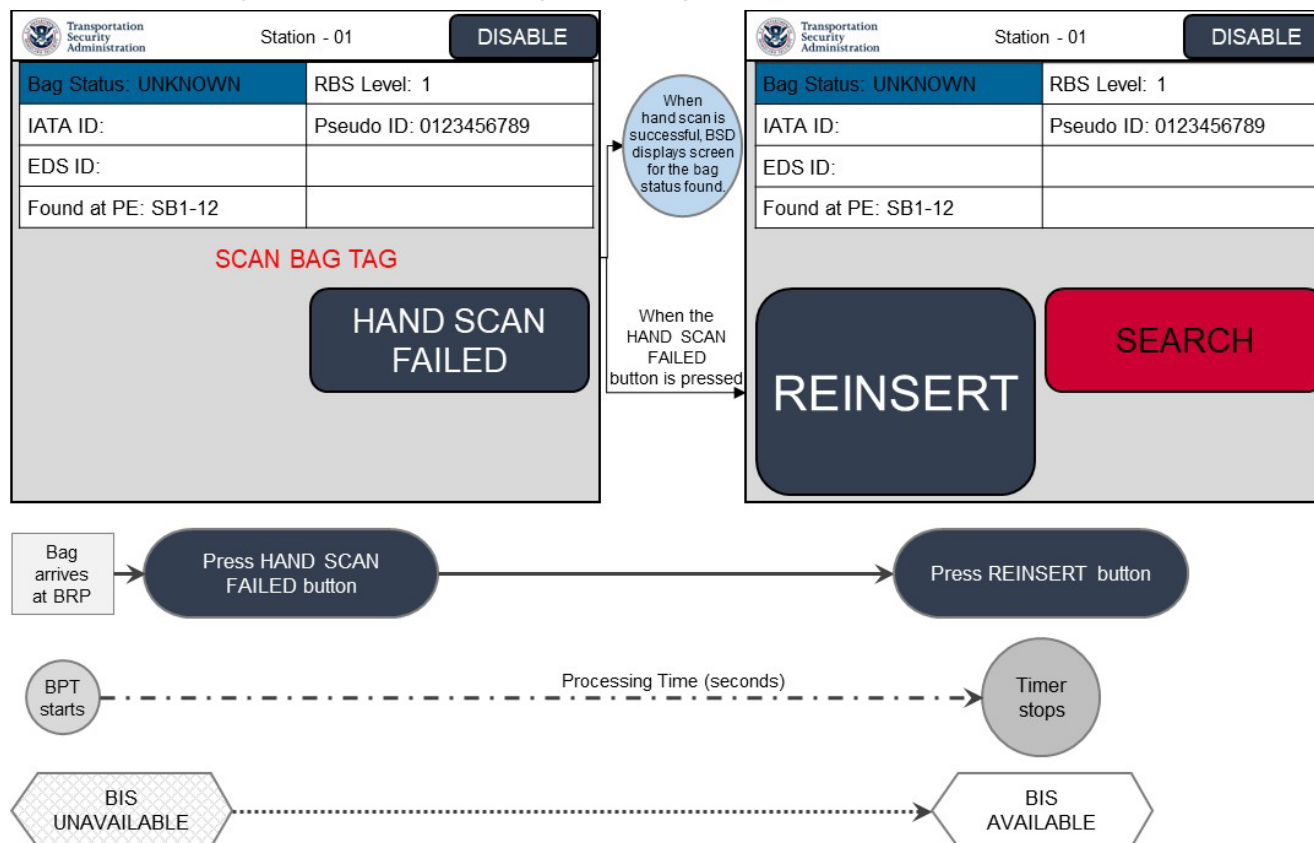
Figure 14.18: EDS ERRORED Bag Processing Screens and Sequence of Operations



14.5.4.5 Unknown Bag Processing

The BPT starts and the BIS becomes unavailable when the bag arrives at the BRP. The bag status cell is blue and displays the status UNKNOWN. The IATA ID and EDS ID information cells are blank. The RBS level and Pseudo ID information cells are populated. A normally empty information cell displays the words “found at” and the photo eye ID. The primary action button is not displayed. The secondary action button is dark blue and displays HAND SCAN FAILED. If the scan fails to retrieve the bag information, the TSO presses the secondary button. The screen changes to display a dark blue primary button that says RE-INSERT and a red secondary button that says SEARCH. Whichever button the TSO presses, the screen changes to the corresponding reinsert or search screen.

Figure 14.19: UNKNOWN Bag Processing Screens and Sequence of Operations



14.5.5 Unique Identifiers Cell

There are five messages that may be displayed in the UIC: Reinsert, Comm Error, Length Change, Timeout, and Duplicate IATA; these shall be displayed as shown in Figure 14.20. These messages are used mostly for troubleshooting purposes. Additional UIC messages may be used if submitted through an RFV and approved by the TSA.

Figure 14.20: Unique Identifier Cell Messages

The figure displays four screenshots of the Unique Identifier Cell (UIC) interface, each showing a different error message. Each screenshot includes a header with the Transportation Security Administration logo, 'Station - 01', and a 'DISABLE' button. The interface is divided into a top section for data entry and a bottom section for action buttons.

Message	Bag Status	RBS Level	IATA ID	Pseudo ID	EDS ID	Action Buttons
COMM ERROR	UNKNOWN	1		0123456789	SS1 (G500)	SCAN BAG TAG, HAND SCAN FAILED
LENGTH CHANGE	UNKNOWN	1		0123456789	SB1-12	SCAN BAG TAG, HAND SCAN FAILED
REINSERT	UNKNOWN	1	7410852963	0123456789	SS1 (G500)	REINSERT-NO ACTION NEEDED, SEARCH, MANUALLY REINSERT
TIMEOUT	ALARMED	1	7410852963	0123456789	SS1 (G500)	SEARCH
DUPLICATE IATA	ALARMED	1	7410852963	0123456789	SS1 (G500)	SEARCH

When a positively tracked bag arrives in CBRA with a Duplicate IATA message in the UIC, the system shall process the bag according to the bag status. In the event that a Duplicate IATA is retrieved following the hand scanning of a Unknown bag arrival, the unknown bag screen shown below in Figure 14.21 is used and search function is limited to recalling images using the BHS Pseudo ID.

Figure 14.21 : Unknown Bag Duplicate IATA

 Transportation Security Administration		Station - 01	DISABLE
Bag Status: UNKNOWN	RBS Level: 1		
IATA ID: 7410852963	Pseudo ID: 0123456789		
EDS ID: SS1 (G500)	DUPLICATE IATA		
Found At PE:			
REINSERT		SEARCH	

14.5.6 Manual Reinsertion

When the Alarm line queues in CBRA are full (cascaded), any operator working on a bag requiring reinsertion at an affected BIS will notified by the BSD to reinsert the bag manually. This slightly different process applies only to OOG, EDS ERRORED, and UNKNOWN statuses. The associated BSD screens shown in Figure 14.22, Figure 14.23, and Figure 14.24.

Figure 14.22: Manual Reinsert – Out of Gauge Bag Screen

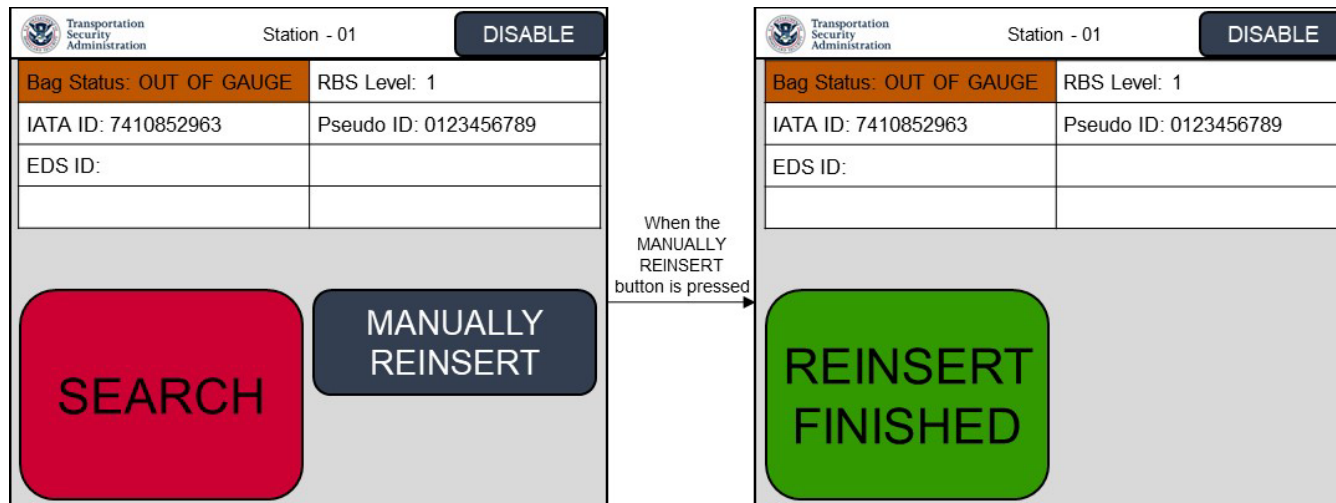


Figure 14.23: Manual Reinsert – EDS ERROR Bag Screen

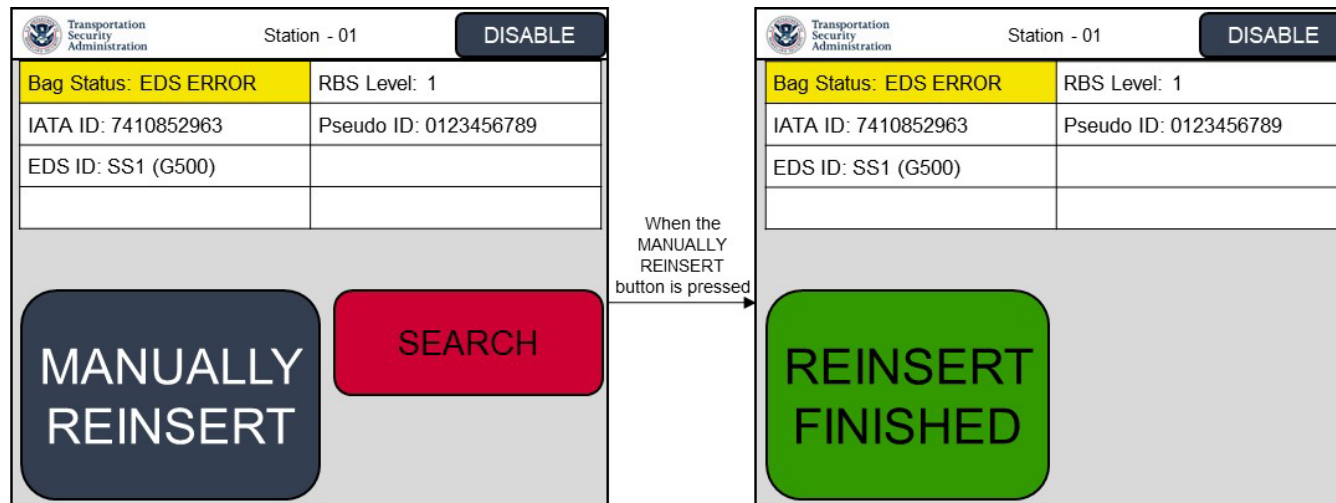
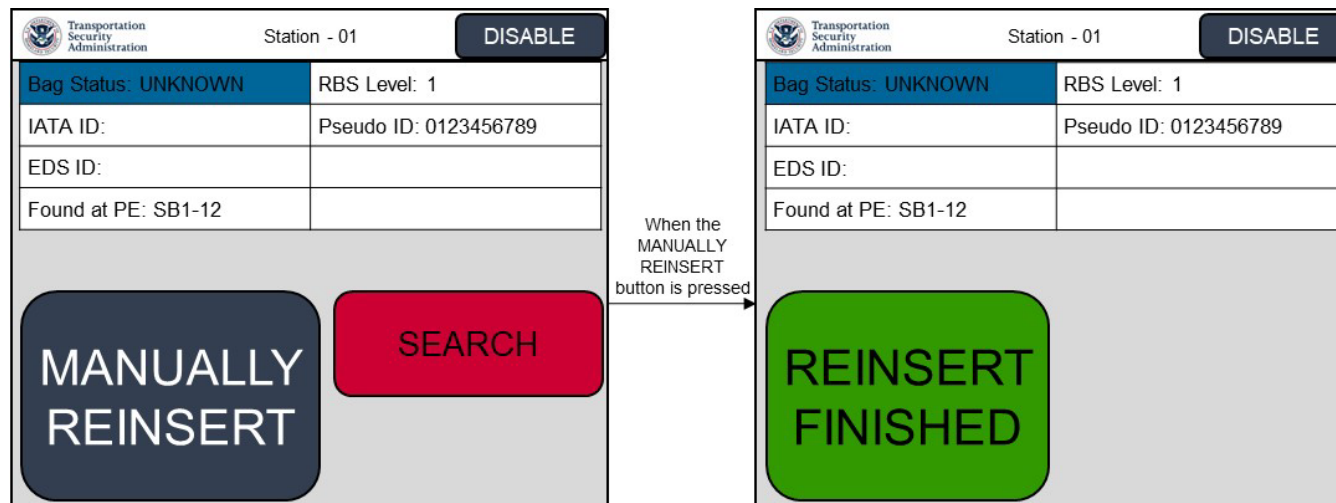


Figure 14.24: Manual Reinsert – Unknown Bag Screen



14.5.7 Bag Waiting Alerts

In an attempt to mitigate unnecessary dieback in the CBRA, a flashing visual alarm shall alert operators to a condition where manual intervention is required.

The following conditions shall trigger the Bag Waiting Alert on the BSD:

- If the BIS is available and a bag requiring manual intervention (i.e., pressing a button) is queued at the adjacent BRP, a bag waiting timer shall start.
- If the bag is left unattended for 15 seconds the BSD shall display a flashing BAG WAITING TOO LONG message in red until an action is taken on the bag as shown in the example in Figure 14.25. This applies to all bag type screens.
- If the bag is left unattended for 45 seconds the bag shall advance to an available downstream BRP.
- After the 45 seconds time has expired the BHS shall lock out the search bag button for 3 seconds before the bag departs to the next available Downstream BIS.

Figure 14.25: Example of Bag Waiting Alert for Alarm Bag Screen

 Transportation Security Administration		Station - 01	DISABLE
Bag Status: ALARMED		RBS Level: 1	
IATA ID: 7410852963		Pseudo ID: 0123456789	
EDS ID:			
BAG WAITING TOO LONG!			
SEARCH		REINSERT	

14.6 General CBRA Design Considerations

The following sections describe general design considerations for CBRA including Architectural, Mechanical, Electrical and Spatial design.

14.6.1 Bag Storage Capacity

The TSA staffing methodology allows for 10 minutes of bag processing in CBRA per TSO. Therefore, the CBIS design shall be capable of storing the proper quantity of bags needed to avoid system diebacks. The following equations shall be used to determine the bag storage needed to meet this requirement:

$$Total\ Bags_{to\ accommodate} = \frac{10\ min}{Average_{screening\ time}(min)} \times Quantity\ of\ BISs_{Alarmed/OOG}$$

$$Bag\ Storage\ Capacity = Total\ bags_{to\ accommodate} - Quantity\ of\ BISs_{Alarmed/OOG}$$

For example, Table 14.3 shows how the storage capacity changes based upon the number of BISs and the average processing times.

Table 14.3: Example of CBRA Accumulation

# of BISs	Default BRPs/ Intermediate Queue	Bag Storage Capacity Needed for Domestic @ 2.87 min/bag	Bag Storage Capacity Needed for INTL @ 3.2 min/bag
4	6	10	9
8	12	20	17
12	18	30	26
16	24	40	34
20	30	50	43
30	45	75	64
40	60	100	85

When analyzing the bag storage capacity needed for a particular design, the ILDT shall consider the third and fourth column from Table 14.3.

For instance, using a CBRA with four BISs and a 2.87-minute average screening time, the conveyor system will need to accommodate up to 10 bags. Since the layout will include four BRPs and two intermediate queues, another four bags will need to be stored somewhere else.

The bag storage capacity shall be achieved using a combination of queues, inch and store conveyor belts, or other cost-effective means between the OSR 2nd/last chance divert point and the entrance to the CBRA as well as BRPs and Intermediate Queues within CBRA.

14.6.2 Architectural Features

The CBRA shall be fully enclosed with segregating partitions extending to the structural deck to allow for the security and comfort of the TSOs. Conveyor wall penetrations in CBRA shall be equipped with security doors to completely secure the CBRA when the conveyor system is not running. The CBRA shall be provided with finished horizontal and vertical surfaces as follows:

- **Flooring** shall be composed of a safety/anti-fatigue material configured for a continuous installation under all TSO work and movement areas except for MIT pathways with a service-life of no less than seven years. Flooring shall extend at least 12" beneath stationary table edges on all work and movement sides.
- **Walls** shall have durable, impervious surfaces, such as painted masonry, plastic laminate or drywall that is taped, bedded, and textured with epoxy or enamel paint.
- **Ceilings** shall include the use of painted suspended drywall, or suspended, lay-in acoustical tile at a minimum height of 9 feet. An acceptable design can include exposed structure with no ceiling. See Section 14.6.9 below for noise abatement recommendations.
- **Access** shall be provided with at least one set of double doors (or a rollup door) for access for equipment movement into and out of the area.

Designers shall consult with local authorities to determine the proper protocols and routing for the removal of threat bags from the CBRA including 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.

14.6.3 CBRA Physical Space Requirements

The size of the CBRA is dictated by the number of queues and BISs required to adequately meet the screening demands of the CBIS and is based on DBU+15 values to ensure room for growth is available if needed. For space allocation planning, the CBRA shall be sized to accommodate the number of BISs that would be allocated based on the number of non-redundant EDS machines required at DBU+15.

The space requirements for the staging room for OS bags shall be based on the individual airport handling of OS bags. For instance, if the OS screening area is located at the lobby it is unlikely that many bags will arrive in CBRA at the same time. If the OS bag screening is performed in the CBRA, the airlines may send multiple bags via carts or tugs.

Space shall to be allocated for the storing of hazardous materials outside of the CBRA. The hazardous materials storage space requirement shall be based on the historical accumulation of these materials and the frequency with which the airport collects them.

The only equipment installed in the CBRA shall be directly required for the operations in that space, e.g., SVSs, BISs, and BSDs. No other equipment such as motor control panels, UPSs for EDS equipment, IT racks or any other equipment not directly related to CBRA operations shall be installed in the CBRA.

Designers shall verify with local authorities that routes of egress within and external to the CBRA comply with applicable life safety codes. Additionally, sufficient clearance for utilization of bomb disposal robots shall also be taken into account.

14.6.4 Horizontal Clearances

The following horizontal dimensions shall be maintained in the CBRA:

- The work space at the workstation and visual acuity ranges for off-station displays shall conform to the following ISO standards:
 - 11064-01:2000 Ergonomic design of control centres – Part 1: Principles for the design of control centres
 - 11064-02:2000 Ergonomic design of control centres – Part 2: Principles for the arrangement of control suites
 - 11064-03:1999 Ergonomic design of control centres – Part 3: Control room layout

14.6.5 Lighting

Proper illumination is required in the CBRA to allow the TSOs to perform their duties without unnecessary fatigue and eye strain. Luminance shall be measured at the surface of the BIS and found to be in the range of 500 to 750 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. Color corrected and full spectrum lighting lamps shall be used and fluorescent lights are preferred.

14.6.6 Heating, Ventilation, and Air Conditioning

The CBRA shall be a climate-controlled space. Temperature and humidity control shall be supplied commensurate with the locale. A separate temperature control thermostat shall be provided for the CBRA.

If forced-air ventilation is provided, fresh outside air shall be delivered to the CBRA at rates specified by the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) Standard 62.1-2016 *Ventilation for Acceptable Indoor Air Quality*. The CBRA shall be under positive pressure relative to ambient BHS areas to minimize the migration of contaminants (e.g., products of combustion from tugs and vehicles, as well as outside dirt, dust, and debris) from entering into the CBRA.

14.6.7 Power and Communications

Power shall be provided to the CBRA to support TSA- and airport operator-provided equipment. The Project Sponsor shall coordinate the final requirements based on the actual equipment list and layout, but as a minimum:

- Two quad receptacles (120V/20A) shall be provided for each BIS to support screening operations and ancillary equipment.
- One duplex outlet shall be provided on the side of the back wall between the two BISs for access by cleaning personnel.
- Convenience outlets shall 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 at a minimum:

- A telephone shall be provided for use by TSOs, with access to the airport communication network, and for placing outside calls.
- The network cabling shall be provided to support the BHS, EDS, and TSA workstations.
- All cabling and associated outlets shall be installed in a location where they cannot be damaged by BISs or cause a safety hazard.

14.6.8 Connectivity to TSA Network

The connection of the CBRA ETD equipment to the TSA Network (TSANet) shall be provided via a “Dual Drop” consisting of 2 RJ45 Cat5e/Cat6 connections terminated at a wall or floor box.

This connectivity allows TSA to collect valuable information on the screening performance of the equipment in place within each CBIS. Please also refer to the Security Technology Integrated Program (STIP) Data Requirements listed in Section 16.8.

In addition, the following requirements shall be met:

- All core drilling shall support a minimum of 4 “Dual Drops”
- All new fiber installations shall be single 6-strand bundles enclosed in innerduct
- All cabinet installations require 2 110v 20A service
- All cabinet installations shall meet the local seismic rating requirements and can be floor/bracket mounted

14.6.9 CBRA Noise Abatement

The CBRA shall have adequate acoustical insulation so that the background noise levels do not exceed 70dBA as measured at the natural TSO standing points at each screening station using a time-weighted average over an 8-hour shift.

14.6.10 Ergonomic Design Dimensions

Peripheral equipment stations shall have sturdy and durable mounting systems that are adjustable to 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.

14.6.11 Conveyor System Crossovers and Catwalks

CBRA conveyor system crossovers shall consist of up and down treaded stairs, a full railing system, and a toe-boarded catwalk. Crossover configurations can be straight, L-shaped, U-shaped, or Z-shaped to conform to existing immovable structures within the CBRA footprint. TSA access stairs and handrails in and around CBRA used on a routine basis shall be compliant with the current OSHA 1910. 25 or IBC 1011 code, whichever is more stringent.

14.6.12 Conveyor Belt End Points on Alarm Line

End points of in-bound conveyor belts shall have a photo eye installed across the conveyor belt to stop baggage from falling off the end. Termination photo eyes shall be located sufficiently upstream to prevent baggage straps from becoming entangled in the conveyor belt at the end point.

14.6.13 Design for Safety

The Alarm Line conveyor belt surfaces shall be smooth or semi-smooth to facilitate easier baggage retrieval. Such surfaces minimize the amount of exertion required by TSOs to remove bags from in-bound belts.

All motor drives and associated tracking devices shall not be intrusive to the screening workspace. The design shall use motor drives mounted on the opposite side of the inbound and outbound lines from screening personnel or, if this is not feasible, the designers shall ensure that all hazardous moving parts (e.g., drive shafts, roller spindles, bearings, bearing components etc.) are guarded and free from sharp or pointed edges to prevent accidental contact.

End caps shall be installed on conveyor shaft bearing assemblies within TSO-occupied spaces to avoid operational hazards. End caps shall be attached to conveyor shaft bearing assemblies via mounting hardware. Press fit end caps or caps retained by tabs shall not be used.

Any moving part located in any area of the CBRA where TSOs are required to perform their duties shall be shielded to avoid injury.

The CBRA shall be designed to comply with TSA's "no-lift" policy.

All aspects of the CBRA layout shall take into account the requirements for maintenance and custodial services access as stated in Mil Standard 1472G Section 5.9.

CHAPTER 15: CBIS OPERATING AND MAINTENANCE BEST PRACTICES

15.1 CBIS Operating Best Practices

During the Operations and Maintenance stage, the ILDT and TSA operate the CBIS and monitor its performance. TSA's ATSA Team and Baggage Assessment and System Evaluation (BASE) Team are available to support local stakeholders in CBIS troubleshooting and improvements when needed. However, many potential operational issues can be avoided by heeding the collective lessons learned of the industry.

Designing an optimal CBIS should include implementation of design practices that will ensure optimal CBIS 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 identify corrective maintenance and schedule preventive maintenance actions to improve the overall operations.

This section discusses CBIS O&M best practices that designers should be cognizant of during the CBIS design phase. Optimal CBIS design allows for implementation of O&M best practices when the CBIS is operational to ensure a high-quality and cost-effective CBIS operation.

15.1.1 CBIS Remote Reporting Workstation

A CBIS Remote Reporting Workstation (a real-time display of key CBIS statistics and data) in the BHS control room is important to facilitate cost-effective monitoring and quick detection of any CBIS performance degradation or malfunction.

One recommended method of designing and implementing a CBIS Remote Reporting Workstation is to use a separate thin client 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.

15.1.2 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:

- Increase in CBRA error percentages – The error rate established when the system was commissioned should remain within a relatively constant range. 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).
- 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 degradation in the CBIS or EDS performance.

15.1.3 CBIS Testing

The most valuable CBIS tests are often the most difficult, and costly, 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 OTK 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. An example of such design principles is: 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).

15.1.4 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.

15.1.5 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:

- Ensuring that the proper communication can occur between EDS units and the BHS control room.
- Improved communications between TSA and the BHS operator (e.g., BHS operators should be notified by TSA of any EDS failure).
- 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 or airlines are usually responsible for BHS maintenance, TSA is responsible for the maintenance of EDS units, which are owned by TSA. As such, non-TSA personnel clearing bag jams from EDS units may create contractually challenging situations. Therefore, only authorized TSA personnel or other TSA designees are allowed to clear bag jams from EDS units.

15.2 Maintenance Best Practices

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

15.2.1 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. Table 15.1 identifies the equipment types which are procured, delivered, installed and maintained by the TSA. All other equipment is the responsibility of the Project Sponsor.

Table 15.1: TSA Procurement and Maintenance Responsibility Matrix

Category	Equipment Type	TSA Procured	TSA Maintained
Screening Equipment	EDS, ETD	Yes	Yes
Ancillary Equipment	SVS, PVS, MCS, Network Server	Yes	Yes
Furniture	OSR Chairs	No	No

15.2.2 Operator Training

Operator 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 or smell of burning rubber/ plastic 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 Section 15.2.5).

15.2.3 Frequency of Preventive Maintenance

PM helps improve the reliability of the CBIS. There are two levels of PM for screening equipment. Level 1 PM consists of user-level activities such as inspecting and cleaning filters or replacing consumables at intervals specified in the OEM user manual. Level 2 PM is performed by trained service technicians every month, quarter or year according to the OEM guidelines. Level 2 PM is conducted by the OEM during the warranty period and thereafter under TSA's Contractor Logistics Support contract.

BHS preventive maintenance should be performed daily, weekly, monthly, and semi-annually in accordance with the airport Project Sponsor maintenance contract.

15.2.4 CBIS Environment

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

15.2.5 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

Safety EDS maintenance best practices, that when implemented, have led to significant improvements in operating time and MTBCF of EDS units include:

- Ensuring that work environments are safe for all personnel who work in the area.
- Providing and using appropriately personal protective equipment to service personnel
- Immediately reporting any injuries that occur on site

15.2.6 BHS Maintenance Best Practice

BHS maintenance such as the cleaning of photo eyes should not be performed during live bag operations.

CHAPTER 16: INFORMATION TECHNOLOGY SECURITY



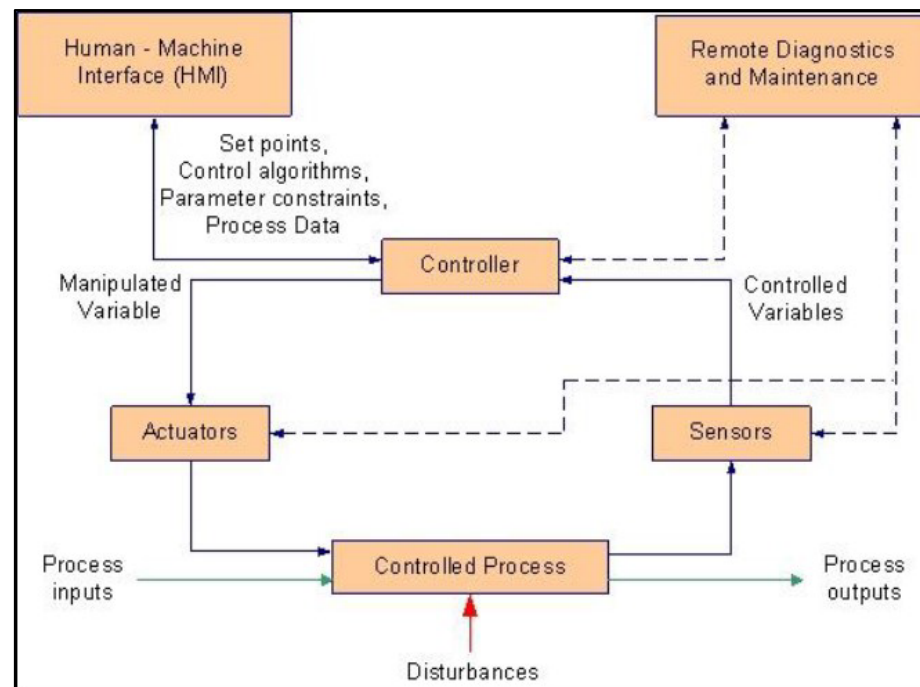
16.1 Cybersecurity Demonstration

A cybersecurity plan and cybersecurity incident plan are required deliverables during the construction phase as outlined in Section 8.3. At TSA's request, cybersecurity measures shall be demonstrated to TSA.

16.2 Cybersecurity Requirement Assumptions

This section assumes the CBIS has an Industrial Control System with discrete components similar to the model in Figure 16.1.

Figure 16.1: Industrial Control System High-level View



Source: National Institute of Standards and Technology, 2015

Industrial control systems of this type are often the target of cyber-attacks at both the computer and controller level. These cybersecurity requirements are set forth to ensure ongoing system integrity throughout the project lifecycle.

The CBIS control system shall have appropriate cybersecurity measures to ensure the system:

- Does not allow unauthorized access to any portion of the CBIS networks, controls systems or components
- Does not allow unauthorized access to data or unauthorized data extraction from the control system, inclusive of both SSI and non-SSI data
- Employs appropriate equipment and systems to isolate networks
- Has appropriate updates and patches applied throughout its lifecycle to ensure ongoing security

As every project is unique, it is incumbent upon the ILDT to develop the appropriate cybersecurity procedures and processes.

16.2.1 User Accounts

Individual user accounts shall be employed and the use of generic or multi-user accounts shall be prohibited. User accounts shall be terminated within 24 hours for those no longer requiring access. User accounts shall be audited on a monthly basis to ensure only required accounts are active. These requirements shall apply to remote access users as well.

16.2.2 Cybersecurity Plan

Cybersecurity plans shall be specific to the CBIS and shall include the following sections, where applicable (not all sections apply to all systems, e.g., not all systems have remote access capabilities):

- System architecture drawings
- User and account management controls
- Remote access policy and procedures
- Access log retention policy and procedures
- External network connections and access controls
- Disaster recovery plans and procedures

16.2.3 Incident Handling

The ILDT shall prepare an incident handling plan to deal with cybersecurity related attacks. Figure 16.2 provides a basic framework for incidental handling and stakeholder engagement and communication.

Figure 16.2: Cybersecurity Incident Response Framework



Source: National Institute of Standards and Technology, 2012

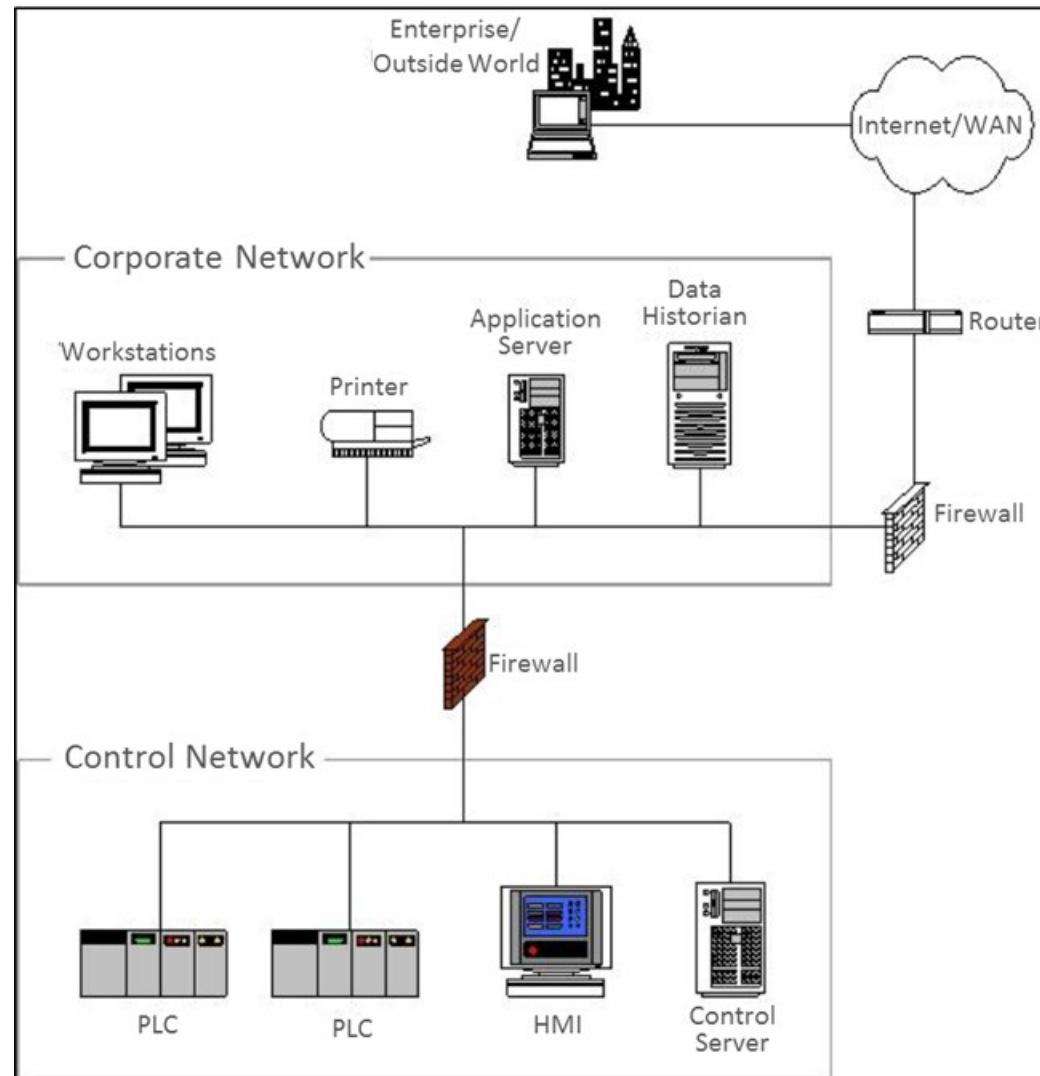
The ILDT should consult the National Institute of Standards and Technology Special Publication 800-61R2, *Computer Security Incident Handling Guide, Recommendations of the National Institute of Standards and Technology*, when preparing the plan. TSA on both a local and national level should be included in the Incident Response Team.

16.3 Firewalls

Network firewalls to control the flow of network traffic shall be employed. The firewalls shall restrict connectivity to and from internal and external networks to those with a need-to-know. It is recommended that additional firewalls be employed to further restrict inter-subnetwork communications between functional security subnets and devices. Figure 16.3 represents a firewall separation of a control network at the most basic level. Additional guidance on firewalls can be obtained from:

- [NIST Special Publication SP 800-82 Rev.2 May 2015 Guide to Industrial Control Systems \(ICS\) Security](#)
- [NIST Special Publication SP 800-41 Rev.1 Sep 2009 Guidelines on Firewalls and Firewall Policy](#)

Figure 16.3: Firewall Example

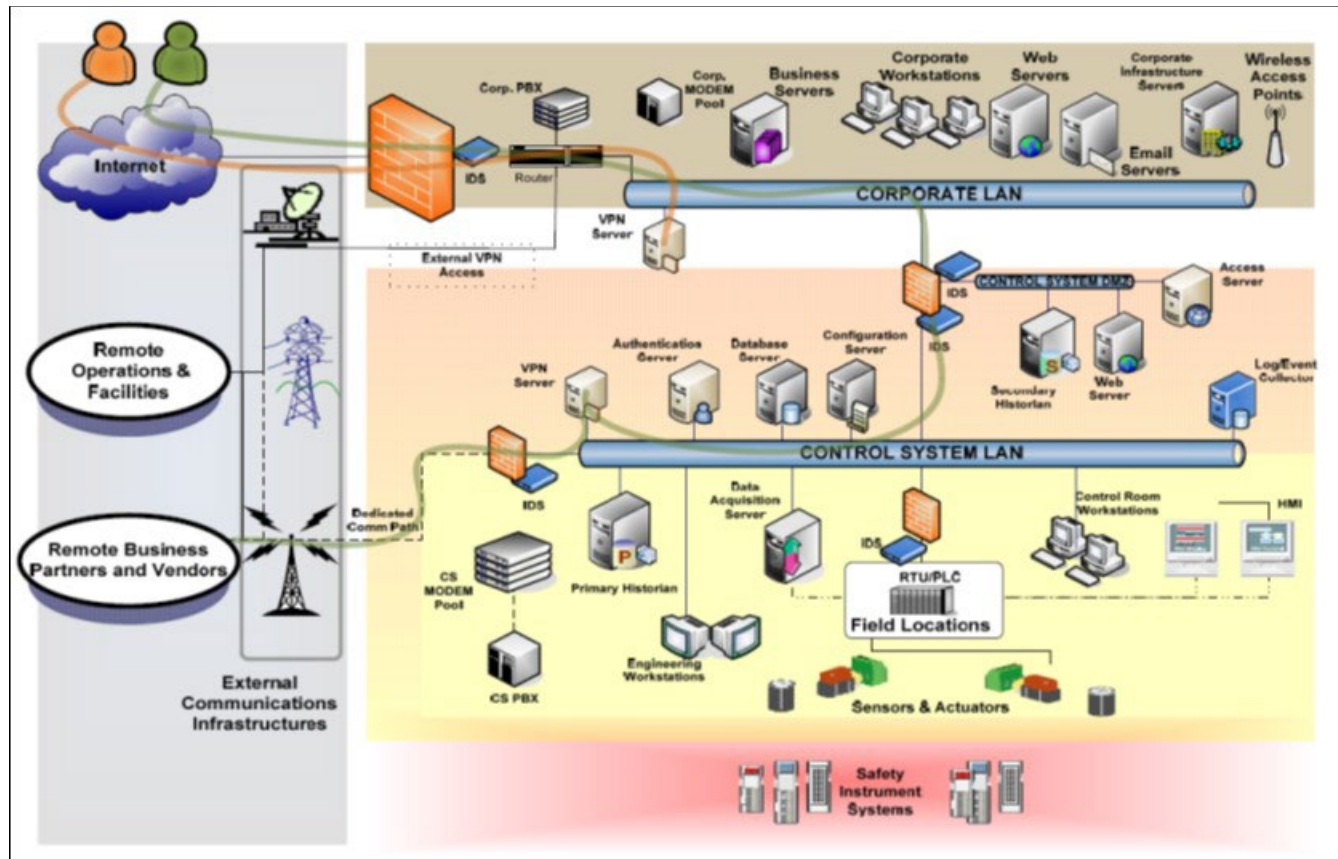


Source: National Institute of Standards and Technology, 2015

16.4 Remote Access

Systems allowing remote access need to employ appropriate security measures. At a minimum, the system shall be secured as noted in Configuring and Managing Remote Access for Industrial Control Systems, April 2011, Centre for the Protection of National Infrastructure and the United States Department of Homeland Security. Figure 16.4 represents a secure remote access example at the most basic level.

Figure 16.4:Secure Remote Access Example



Source: United States Department of Homeland Security and Centre for the Protection of National Infrastructure, 2011

16.4.1 Remote Access Logs

Remote access activities shall be logged and reviewed to ensure all access is by authorized personnel. At TSA's request, access logs shall be submitted to TSA within seven calendar days.

16.4.2 External Connections

Remote access shall be enabled only when required. Normal users may require on-demand remote access, but vendor support may only require remote access rarely. Therefore, vendor user IDs should be disabled until they are required to be enabled and then disable them once again when they have completed their task. This technique can be applied to any group of users who require only intermittent access. Alternatively, external network connections can be physically disconnected or otherwise made inaccessible when not needed. The cybersecurity plan will document all external connections and both physical and logical access controls.

16.5 Software Maintenance and Updates

NIST Special Publication SP800-40R3, "Guide to Enterprise Patch Management Technologies," notes the following:

"Patch management is the process for identifying, acquiring, installing, and verifying patches for products and systems. Patches correct security and functionality problems in software and firmware. From a security perspective, patches are most often of interest because they are mitigating software flaw vulnerabilities; applying patches to eliminate these vulnerabilities significantly reduces the opportunities for exploitation. Patches serve other purposes than just fixing software flaws; they can also add new features to software and firmware, including security capabilities."

Appropriate software maintenance and patch management programs shall be employed to maintain the system security.

16.6 Network Segregation

A typical in-line CBIS will have several network layers including some of the following:

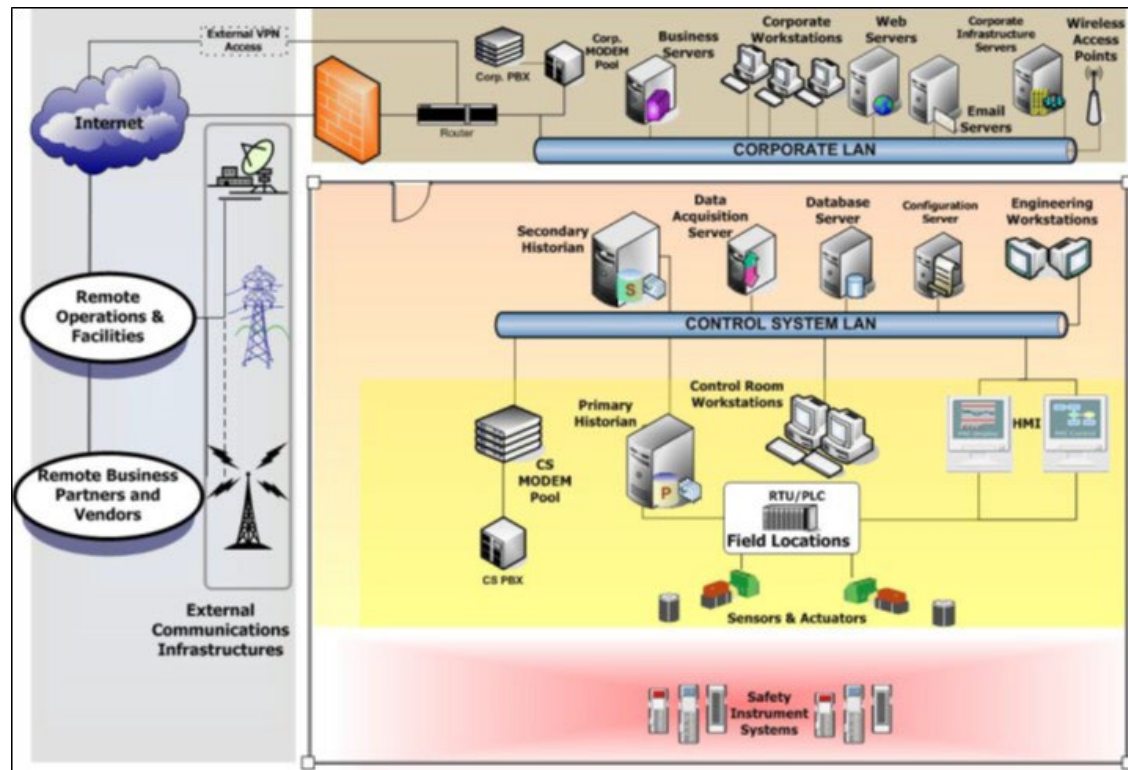
- Device level networks such as DeviceNet or Actuator Sensor Interface.
- Industrial control networks such as Ethernet IP, ControlNet or Profibus.
- High-level networks such as Ethernet.

Each network should include only the equipment necessary for that network. The following networks shall be segregated, or "air-gapped" from all other networks:

- **EDS image networks.** Neither the BHS nor any other airport network shall be connected to the network used by the EDS for transmission of images, e.g., the Smiths MUX or Leidos NEDS.
- **TSA data network.** Neither the BHS nor any other airport network shall be connected to the TSA data network unless specifically directed and authorized by TSA.

Figure 16.5 shows an example of network segregation.

Figure 16.5: Network Segregation



Source: United States Department of Homeland Security and Centre for the Protection Of National Infrastructure, 2011

Wireless networks, whether part of the CBIS or its control system, shall adhere to the guidelines as noted in NIST Special Publication SP 800-153 Feb 2012 *Guidelines for Securing Wireless Local Area Networks (WLANs)*.

16.7 Cybersecurity Best Practices

- Be aware of new and evolving threats. Ensure security updates are installed on a regular basis.
- Audit the system on a regular basis to ensure unauthorized changes have not been made.
- Maintain multiple backups in multiple locations.
- Utilize a defense-in-depth security approach, as shown in Figure 16.6.

Figure 16.6: Strategic Framework for Cyber Defense-In-Depth



Source: United States Department of Homeland Security, 2009

16.8 Security Technology Integrated Program Data Requirements for Checked Baggage Systems

The TSA HQ Office of Information Technology (OIT) and STIP require STIP-enabled transportation security equipment to have specific connections to securely and reliably network the equipment. Multiple parties play a role in this portion of CBIS specification and execution.

The TSA Project Coordinator will provide the Project Sponsor with the latest copy of the STIP data requirements.

16.8.1 Roles and Responsibilities for Implementing STIP

As a CBIS is modified as part of a TSA-funded project, the Project Sponsor's contractor will provide new telecommunications outlets and cables as needed to support new technology. If a CBIS reconfiguration is initiated as part of a recapitalization/optimization, safety effort, new technology deployment or any other CBIS redesign initiative, the CBIS contractor will be responsible for restoring the previous state of connectivity ("make whole"), including development of the scope of work (SOW). Implementation in the field will occur via the CBIS contractor. A working group, must be formed by the Project Sponsor consisting of representatives from the Airport Authority, FSD staff, APM, OIT and STIP. The group should meet immediately via conference call once it has been determined that a CBIS is going to be recapitalized or optimized. This action will ensure that ALL aspects of the CBIS redesign have been identified and assigned to a specific group for action and funding. The Project Sponsor will organize the working group members, develop, review and approve the SOW. The OIT Field Regional Manager (FRM) will always be consulted when a CBIS redesign is initiated and will provide the necessary routing information to ensure the checked baggage systems are appropriately cabled to a networked TSA IT cabinet.

16.8.2 The IMAC Process

The Installation, Move, Add and Change (IMAC) Process is the mechanism by which TSA OIT will procure and install IT hardware (e.g., network switch) following the IT infrastructure build-out of a CBIS contractor. The TSA Project Coordinator will be responsible for engaging OIT at project initiation and including the respective regional FRM throughout the construction process.

The IMAC process takes between 30 and 45 days and needs to be initiated to complete the following tasks:

- Procurement, configuration and shipment of IT hardware
- Installation of IT hardware
- Patch cabling of checked baggage equipment
- Validation of network connectivity for checked baggage equipment
- Validations of STIP Enterprise Manager server registration for checked baggage equipment.

It is imperative to engage each team member as early as possible in order to avoid any gaps in IT services.

16.8.3 Specific STIP Design Requirements

Two modular jacks consisting of a flush-mounted telecommunications outlet box plus/minus 10 feet from the equipment are required. Even though one is redundant, both terminations should be connected using Cat5e or Cat6 4-pair 100 ohm unshielded twisted pair (UTP) or screened twisted pair (ScTP) cable and terminated on the patch panel in the closest TSA IT cabinet. The data cable type should be based on the existing conditions at the CBIS. The purpose of this connectivity is so that TSA HQ can review statistical data over the network from screening equipment for a particular airport and time period without having to go to the site.

Installation or relocation of Cat5e/Cat6 data cabling will meet or exceed the specifications listed in the TSA Structured Cabling System Guidelines dated April 2018. This document will be provided by the TSA to the Project Sponsor or requested through the TSA OIT.

The following STIP requirements shall be met:

- All ETDs and stand-alone EDSs shall have one “dual telecommunications outlet”.
- When a multiplex server is present, connectivity to TSANet shall terminate at the multiplex server cabinet, therefore connectivity to TSANet for each EDS is not required.
- All core drilling shall support a minimum of four “modular jacks”.
- All new fiber installations shall be multimode fibers, either multimode fiber, either 50/125 or 62.5/125 micron fibers r 50/125 or 62.5/125 micron fibers, 6-strand bundles enclosed in inner duct.
- All cabinet installations shall have 2 110v 20A service.
- All cabinet installations shall meet the local seismic rating requirements and can be floor/bracket mounted.
- All newly installed and existing data jacks and associated patch panels shall comply with TSA’s approved scheme (see *TSA Structured Cabling System Guidelines* dated July 2012).
- Completed Data Capture Sheet and cable certification paperwork shall be provided to TSA prior to established ISAT date.
- All IT cabinet installations shall include a temperature and humidity gauge for monitoring purposes. HVAC requirements in IT cabinet spaces shall comply with all applicable OEM documentation.

Figure 16.7 illustrates all of the equipment that must be connected to the Main Distribution Frame/Intermediate Distribution Frame IT cabinet for a stand-alone CBIS configuration. When the EDS are in a stand-alone configuration, each EDS must be connected to the patch panel.

Figure 16.7: Stand-Alone CBIS Configuration

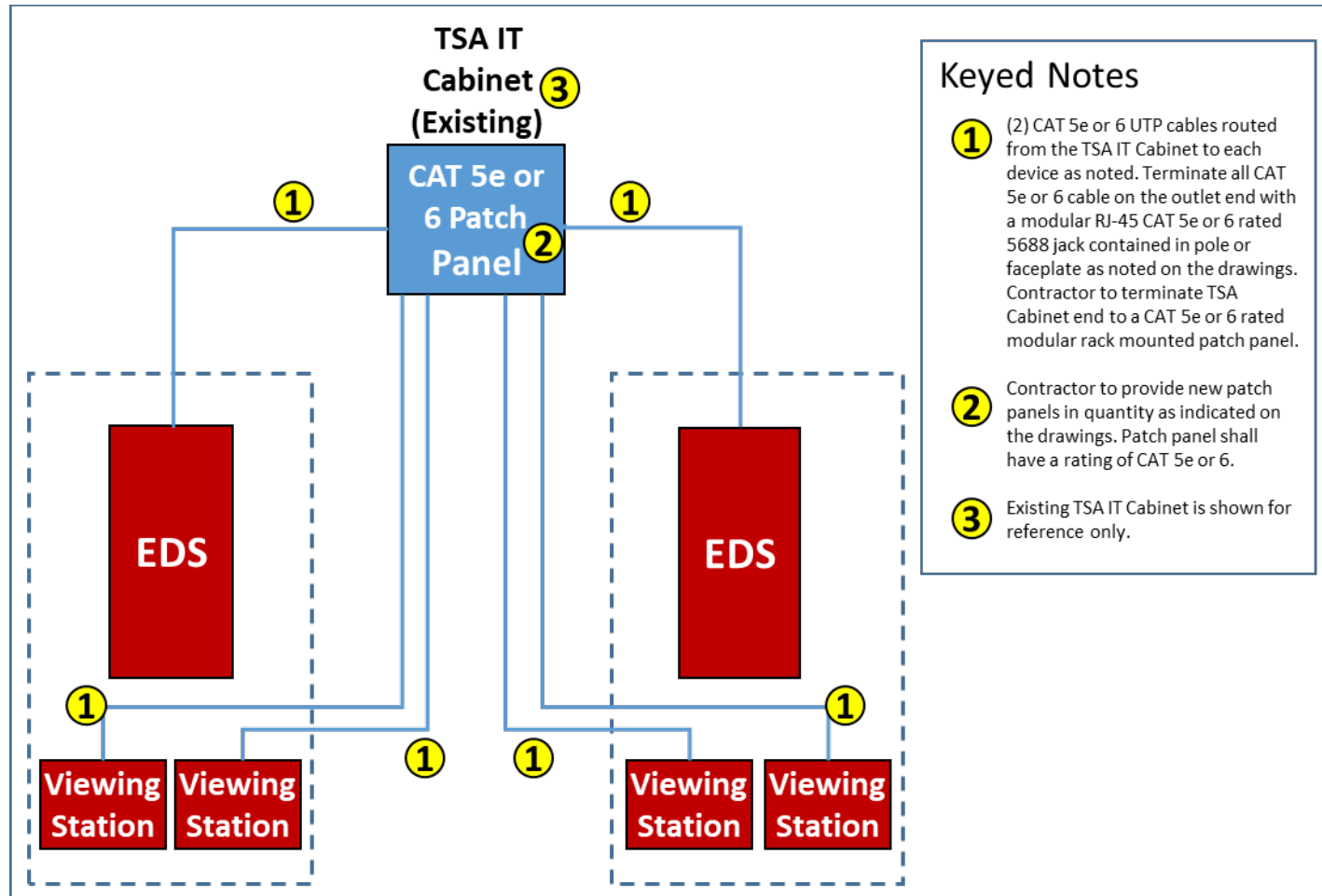
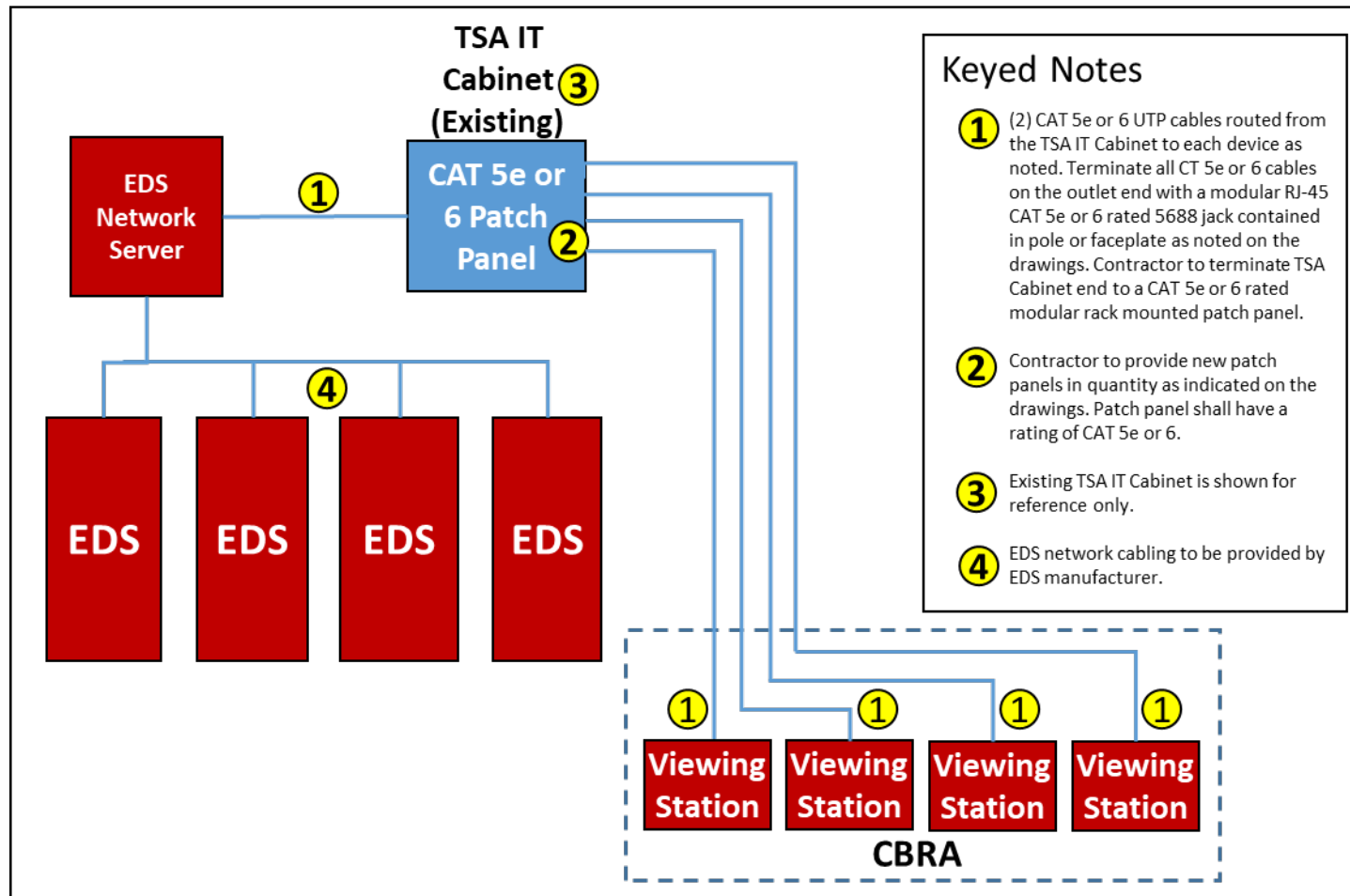


Figure 16.8 illustrates all of the equipment that must be connected to the Intermediate Distribution Frame IT cabinet for a CBIS where the EDS units are already networked together. When the EDS units are networked together (e.g., MUX and NEDS), the connection only needs to be made to the EDS Network Servers.

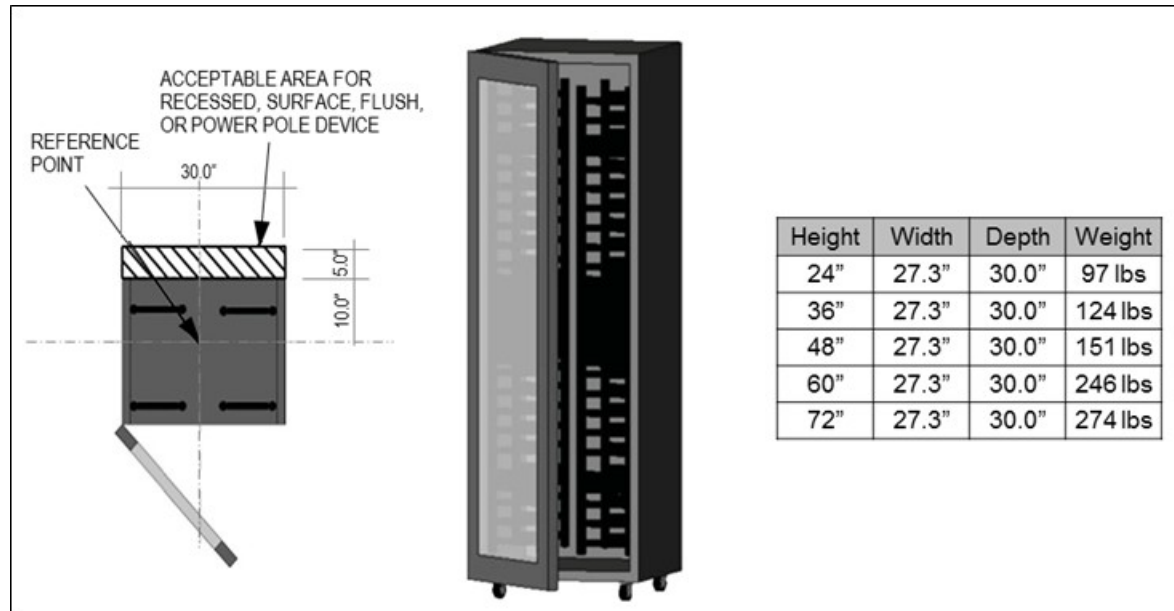
Figure 16.8: Networked CBIS Configuration



At a minimum, the following guidelines should be considered when designing a new CBIS or reconfiguring an existing CBIS.

- If an existing TSA IT cabinet is within 295 feet of the CBIS:
 - Verify that the existing switches have sufficient open ports to accommodate the required number of drops.
 - Notify TSA OIT FRM if the existing switch capacity will not accommodate the required number of drops so that additional equipment can be procured.
 - Punch down cabling from the individual CBIS devices in the patch panel of the IT cabinet.
- If there is no IT cabinet within 295 feet of the CBIS:
 - Install an appropriate IT cabinet. Refer to for the IT cabinet specifications below.
 - Run fiber optic cable from the IT cabinet to an existing TSA IT cabinet.
 - Punch down cabling from the individual CBIS devices in the patch panel of the IT cabinet.
 - Initiate IMAC group to install jumper cables from the patch panel to the switch and activate port.

Figure 16.9: IT Cabinet



IT Cabinet Specifications:

- Cabinet size: See Figure 16.9.
- Quantity: One or more per checkpoint, depending on size
- Power requirements
 - For 24H, 36H and 48H:
 - Dedicated
 - 20A, 125V, 3KVA/Cabinet
 - 2-Pole, 3-Wire Grounding
 - NEMA L5-30R Receptacle
 - 3KVA UPS
 - 6' power cord from the IT cabinet to the receptacle

- For 60H and 72H:
 - Dedicated
 - 30A, 208V, 6KVA/Cabinet
 - 2-Pole, 3-Wire Grounding
 - NEMA L6-30R Receptacle
 - 6KVA UPS
 - 8' power cord from the IT cabinet to the receptacle
- IT Requirements
 - Size patch panels to accommodate all TSA data outlets at the checkpoint plus 100% spares, minimum.
 - Size giga bit network switch to accommodate all data outlets in checkpoint plus 10%.
 - Provide a minimum of four pair single mode fiber optic cable from IT cabinet to the TSA main distribution frame.
- Additional information
 - 30" front and rear access is required.
 - These cabinets will receive all data communication lines from the System Services Control Point (SSCP), so the cabinet should be located as close to the SSCP as possible, but in a secure location. Careful consideration needs to be given to the IT cabinet location because the exhaust fan for cooling can be loud when located in a confined space with TSA or airport personnel.
 - Equipment racks can be loaded into the cabinet from the front or the back at the location where the cabinet is installed. Although not required, side access would improve rack accessibility and TSA personnel mobility around the cabinet.
 - Refer to Program of Requirements dated July 2005, Section III-D for labeling, cable management and administration of IT cabinet.
 - Refer to Program of Requirements dated July 2005, Section III-D for acceptance testing of IT circuits.
 - Wall-mounted cabinets are an option in some instances, but must adhere to all applicable local codes and standards. Recommend consultation with the Field Regional Manager when considering a wall-mounted alternative.

16.8.4 Advanced Surveillance Program Video Surveillance

TSA's Advanced Surveillance Program (ASP) recommends the following best practices for all video surveillance systems:

- The system installed should be configurable, expandable, and have a hierarchy of access levels, user IDs and passwords.

- All recorded video should be able to be stored for a minimum of 30 days; airports may choose to increase the length of storage based on local considerations.
- Cameras and displays should be positioned to minimize any impact on the quality or performance of the video displayed due to light glare.
- Video data should be in a format suitable for use by all airport stake holders (e.g. local TSA, local law enforcement, airport authority, etc.).
- Video surveillance workstations should be provided at reasonable locations.

Table 16.1 shows the recommended minimum Fields of View (FOVs) to be captured using any number of devices.

Table 16.1: ASP Recommended Fields of View

Field of View	Summary	Capability
EDS Entrance	FOV is the baggage entering the EDS unit.	FOV enables effective situational monitoring of this area; specifically, the view enables identification of baggage by shape ,color, and - if applicable - identification of the EDS operator.
EDS Exit	FOV is baggage exiting the EDS unit.	FOV enables effective situational monitoring of this area; specifically, the view enables identification of baggage by shape, color, and - if applicable - identification of the EDS operator.
OSRA	FOV is OSR alarm resolution area.	FOV enables effective situational monitoring of this area; specifically, the view enables identification of personnel performing screening and monitoring of primary viewing station in OSR.
Overhead View of CBRA	FOV is overhead view of CBRA.	FOV enables effective situational monitoring of this area; specifically, the view enables monitoring of the baggage as it is taken to the bag inspection table.
CBRA Baggage Entrance	FOV is baggage entering CBRA.	FOV enables effective situational monitoring of this area; specifically, the view enables identification of baggage by shape and color.
CBRA Baggage Inspection Tables	FOV is bag contents screening and ETD Sampling.	FOV enables effective situational monitoring of this area; specifically, the view enables identification of baggage by shape and color; view includes screeners handling any items from the passenger property; identification of individual items removed from and returned to baggage should also be included in the view .
CBRA ETD Machine	FOV is screener collecting sample to be placed into ETD, screener placing sample into ETD machine, and results from ETD machine.	FOV enables effective situational monitoring of this area; specifically, the view enables identification of screener and identifies if ETD machine alarmed.
CBRA Exit to Reintroduction / Reinsertion Belt	FOV is baggage exiting CBRA for EDS re-screening.	FOV enables effective situational monitoring of this area; specifically, the view enables identification of baggage by shape and color; view also enables identification of personnel placing baggage onto belt.

Field of View	Summary	Capability
CBRA Exit to Cleared Belt	FOV is baggage exiting CBRA for entry into Cleared Belt.	FOV enables effective situational monitoring of this area; specifically, the view includes belt and enables identification of baggage by shape and color and identification of personnel placing baggage onto Cleared Belt.
Personnel Entrance to CBRA	FOV is personnel entrance to CBRA.	FOV enables effective situational monitoring of this area; specifically, the view enables identification of any persons entering the CBRA along with identification of baggage entering CBRA in their possession.
CBRA Personnel Exit	FOV is personnel exit from CBRA.	FOV enables effective situational monitoring of this area; specifically, the view enables identification of any persons exiting the CBRA along with identification of baggage leaving the area in their possession.
OS / OOG	FOV is baggage entering OS / OOG belt and then entering the CBRA.	FOV enables effective situational monitoring of this area; specifically, it enables identification of baggage by shape and color; if applicable, allows the identification of the EDS operator. View enables monitoring of the baggage as it is transferred to CBRA. Coverage is sufficient to enable review of baggage screening procedures.

APPENDICES

SECTION IV: APPENDICES

The following PGDS Appendices are in a separate document:

- Appendix A: Submittal Outlines, Form Templates, and Examples
- Appendix B: Generic Examples of CBISs
- Appendix C: Alternatives Analysis Report Case Study
- Appendix D: Commissioning and Evaluation Testing
- Appendix E: Contingency Plan Examples
- Appendix F: Risk Based Security Impacts for the Electronic Baggage Screening Program
- Appendix G: References
- Appendix H: Requirements Lists