APPENDIX 12

DEN Architectural Program for Functional Area #19 – Central Monitoring Facility (CMF)

Denver International Airport
Architectural Program for a New Central Monitoring Facility (CMF)

DEN - CMF Program_r8.docx
04/19/2017

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Overview

This programming document is to provide a background for the detailed design of a Central Monitoring Facility (CMF) at Denver International Airport. The CMF is the primary location for all baggage system controls interfaces throughout the Airport. This includes, but is not limited to, baggage system controls, TSA operations, TSA On-Screen Resolution (OSR) procedures, and TSA Closed Circuit Television (CCTV) surveillance.

This program is based on the intent to effectively provide the same functionality that the TSA and the BHS operations currently have. Like for like. However, this is an opportunity to possibly correct areas where improvements are viable and cost effective. The facility needs to be relocated to make room for the remodeling of Level 6 of the Terminal building.

Currently the existing CMF is located on Level 6, MOD 3-East, in the Jeppesen Terminal. This room is to remain in operation until the new CMF is constructed, tested, and approved by the Airport. After which time the Airport will decide when the new CMF will be activated.

It should be noted that the CMF is also referred to as the On-Screen Resolution Area (OSR) by the TSA's Planning Guidelines & Design Standards (PGDS). The OSR functionality is specifically addressed in the PGDS in Chapter 10. The existing CMF is not compliant with the TSA PGDS nor is it necessary desirable to have this New CMF compliant. The PGDS is provided here for reference only to make the designer aware of some of the Human Machine Interface (HMI) requirements.

Logplan will support the design team and assist with the coordination of the local TSA, throughout the planning, design, construction process. Logplan will also provide the primary coordination for the installation and testing of the BHS equipment. In parallel with the CMF design process, Logplan will develop the phasing concept, equipment installation, and testing plan to be part of the construction drawings package.

Existing CMF

The existing facility was built in 2003-2005. Initially the size of the OSR portion of the space was to be much smaller. TSA required that the space be increased to accommodate more workstations per screening machines (34 multiplexed EDS machines). Over time, the TSA added functionality to the space such as CCTV camera visibility to the Checked Baggage Resolution Area (CBRA) rooms and some communications functions between the CMF and the CBRA locations.

There is a video wall in the main CMF space which displays the operating condition of the BHS system and is controlled by the BHS Control Room Operator. In addition to the BHS condition, the video wall also displays current Flight Departure information for the Airport IT system.

The initial supervisor's space was also increased to its present size today.

The heat generated by the equipment in the server rooms has been very difficult to overcome to the point that auxiliary cooling units have had to be added to the space. Over the years, this has been an annoyance and has caused occasional operational problems. During design, the proper design of HVAC

should be taken into consideration. Including an investigation into the benefits to have separate systems one for the TSA spaces and one for BHS and related equipment.

The City and County of Denver conducted an IT audit of the space and included in their report that the sprinkler system in the server room should be considered to be 'pre-action' or other system that would not accidently deluge the equipment with water.

Part of this space contains a cable/chase closet which served the project well. It allowed for the consolidation of all the required cabling to and from the CMF, Server room, CCTV monitors and all the devices in the field. A similar approach should be considered for the new CMF.

There is also a break room/locker room and conference room as part of the TSA CMF space.

For reference, Appendix "*Existing Terminal Central Monitoring Facility (CMF) Control Room*" is a floor plan and space allocation of the existing CMF space located on Level 6 of the Jeppesen Terminal.

Design

Below is a brief description of the space/rooms that are considered a part of the CMF.

Break Room/Locker Room

This is a break area with a small kitchenette and a refrigerator for the TSA employees. This area also includes lockers, water, garbage disposal, and a hook-up for a refrigerator and ice machine. There is no dishwasher. The TSA is to provide the refrigerator and lockers. The Locker Room is open to view (no door). Flooring is to be decided by the design team. The current flooring is VCT. The recommended new location for the CMF is slab on grade concrete. The design team should take this into consideration. The current Break Room was sized for approximately 10-12 people and has proven to be adequate in size. There is a live cable TV news feed in this location. TSA requires there be at least one in their space. The exact location needs to be coordinated with the TSA Conference Room.

The formal meeting area for TSA is to conduct operational readiness, training, or other meetings. The flooring is to be carpet. The space should have IT connections to the TSA IT system, and a DEN phone line. Other presentation materials should be coordinated with the TSA (white board, intelligent white board, large format screen with computer and internet connections should all be considered). The room size should be able to handle a meeting of 20 people.

Control Room

This is the primary area of the CMF for personnel and operations. This includes the video screen(s) showing flight information and the status of the BHS systems, workstations, communications, etc. The BHS portion of the room needs to be able to accommodate five (5) people. The current Control Room has a raised floor to accommodate all the communications and wiring required. The TSA occupies the majority of the space where they conduct their supervisory responsibilities, the OSR of checked bags and review on CCTV surveillance. The EDS machines can also be remotely reset from this room. The TSA will staff this space with no more than 12 people. The design team should coordinate with TSA for lighting requirements dimmable, task or both.

Electrical Room

The Electrical room contains the primary electrical supply to the associated spaces that are addressed in this program and associated with the CMF. In the current space, there is a UPS and transformer in the Electrical Room for this electrical equipment. The existing Electrical Room is wired to an auto-transfer switch so it can have power fed from two (2) different MOD's. Flooring is to be unfinished concrete or a resilient surface. The floor should be leveled if uneven.

TSA Data/Server Electronics Room

This room contains all TSA data racks and electronics to support equipment in the CMF and all server racks to operate the BHS. This room should accommodate space for two (2) desks for personal maintaining the BHS, or working on the TSA equipment. Flooring is to be a resilient surface, or similar (currently the space has VCT). This is the space that has been the environmental challenge noted above. Adequate electrical outlets for laptop computers and data connections should be considered, including wireless connection to the internet.

Supervisor Office

The TSA has requested that this is an enclosed office with a door. It is to contain a desk and two (2) guest chairs with carpet flooring.

Golf Cart Parking & Power

Identify parking spots for 2-4 golf carts adjacent to the CMF. Each parking space should be adjacent to a quadruple receptacle located on the wall adjacent to the cart for charging purposes.

Existing vs. Suggested Square Footage

Reference the Appendix "*Existing Terminal Central Monitoring Facility (CMF) Control Room*" for a plan view of the space.

Space/Room	Existing Approx. SF	Suggested Min. New Program SF	Spatial Adjacencies
BHS Server Room (SR)	260	**500**	Adjacent to TSA Data/Electronics (DAT), or combined with.
Electrical Room & UPS	108	110	
TSA Data/Electronics (DAT)	486	**260**	Adjacent to BHS Server Room, or combined with.
Wiring Closet	29	30	
Control Room (CR)	1,772	1,800	
Break Room/Locker Room (BR)	459	460	
Conference Room (CONF)	504	500	
Supervisor Office		**100**	This office can be a separate space or can be within the main Control Room.
Total	**3,575**	**3,760**	

Other Design Notables

New CMF Location

The new CMF room is to be located in the Jeppesen Terminal, MOD 1 East, Level 3. (See Appendix, "*Design Consideration: New CMF Alternative*" for location). Ceiling heights in all spaces shall not be less than 7 feet 6 inches.

Equipment & Furnishings

Existing equipment and furnishings in the CMF should be re-used wherever possible. Any new equipment or furnishings are to be approved by the DEN PM. Please refer to the Appendix "*CMF Existing Equipment Inventory Schedule*."

Security

The CMF area contains highly sensitive information and as a result, Security Identification Display Area (SIDA) badge readers are required at the main points of entry to the space. These security systems are to be linked to the existing security system at DEN. These card reader systems are to be coordinated and approved by the DEN Security Department. Note: Rooms within the CMF may need separate or additional security and will be addressed during the design process.

Circulation

Space should meet all ADA standards.

Equipment Access & Delivery

Identify a minimum 4' wide clear path for delivery and removal of equipment in spaces. Doors between primary rooms that do not require the movement of large equipment shall have at a minimum 36" door.

Acoustics: Noise Abatement

Provide adequate acoustical insulation so that the background noise levels shall not exceed 65 dBA throughout each room using a time-weighted average over an 8-hour shift (per PGDS Version 5.0). The designer is cautioned to consider the tug and cart traffic noise in the area.

Impact Protection

Due to the tug and cart activity in the area, impact protection should be considered for the wall facing the south and to the east where golf carts and carts are accessing and egressing the elevator. A mirror may be necessary for the elevator access.

ADA & Building Codes

The final design shall be in compliance with all ADA and applicable building codes.

Restrooms

The Architect will be responsible for analyzing and determining the number of fixtures associated with this space, per code. The Architect shall also determine whether utilization of the existing restrooms are possible.

Phasing

In coordination with DEN and Logplan, establish a suggested phasing plan for this work.

Installation/ Commissioning/ Testing/ Cut-over Plan

DEN, Logplan and TSA will develop the equipment installation, commissioning, and cut-over plan with the Architect. This will be included in the design drawings.

Cost Estimate

The Architect will be responsible for providing a cost estimate for this project.

Preliminary Construction Schedule

The Architect will provide a preliminary construction schedule.

Appendix

The following documents have been included for reference to aid in the location selection and the final design of the space.

- ☑ Existing Terminal Central Monitoring Facility (CMF) Control Room
- ☑ Design Consideration: New CMF Alternative
- ☑ CMF Existing Equipment Inventory Schedule
- ☑ PGDS, Version 5.0, Chapter 10

Chapter 10 from the Planning Guidelines & Design Standards (PGDS) has been extracted and included for reference.

(Level 5 below)
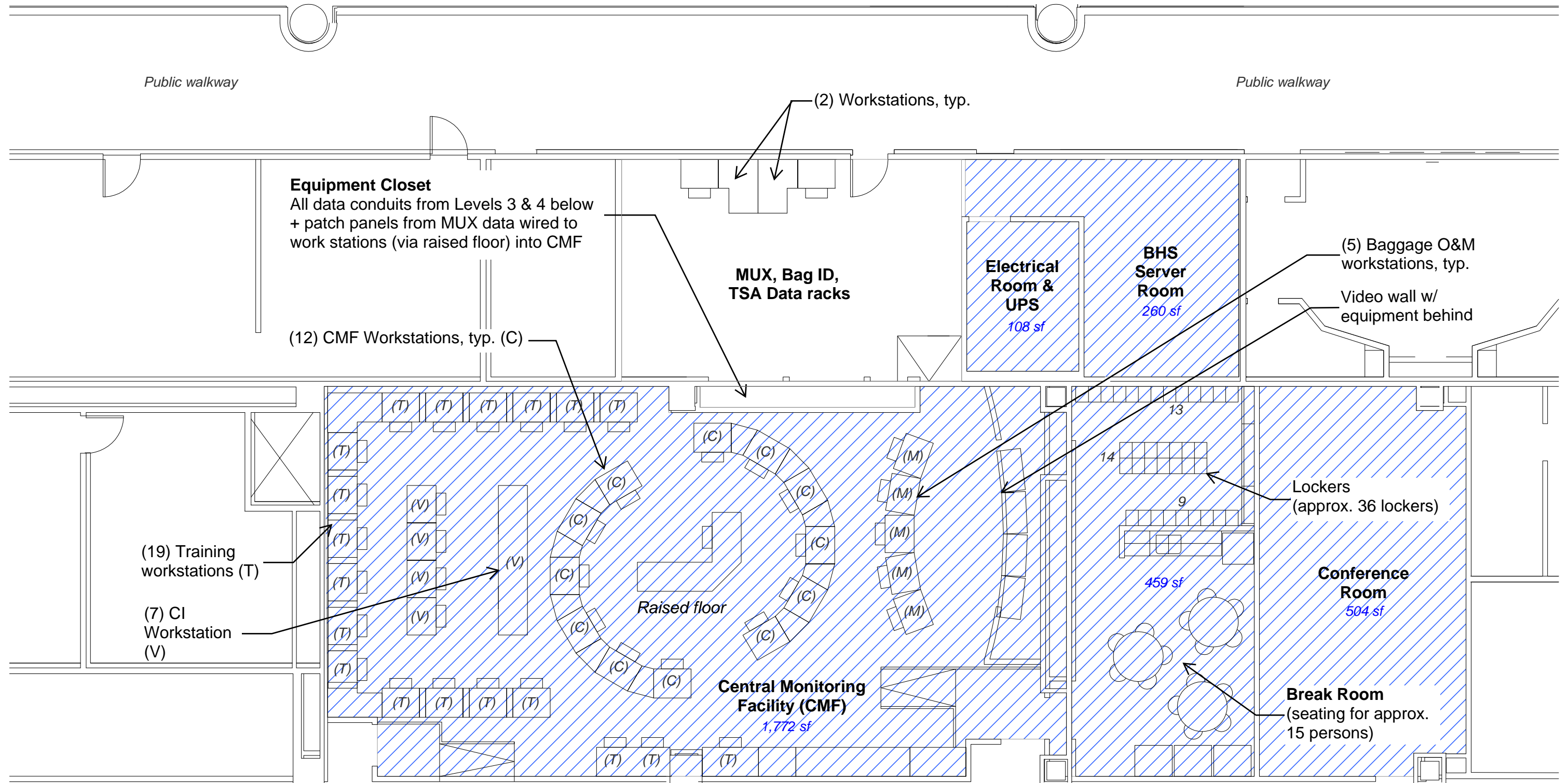
Public walkway

Public walkway

(2) Workstations, typ.

Equipment Closet
All data conduits from Levels 3 & 4 below
+ patch panels from MUX data wired to
work stations (via raised floor) into CMF

**MUX, Bag ID,
TSA Data racks**

**Electrical
Room &
UPS**
108 sf

**BHS
Server
Room**
260 sf

(5) Baggage O&M
workstations, typ.

Video wall w/
equipment behind

(12) CMF Workstations, typ. (C)

(T) (T) (T) (T) (T) (T)

(C)

(C)

(C)

(M)

13

(T)

(C)

(M)

14

(T)

(V)

(C)

(M)

9

Lockers
(approx. 36 lockers)

(19) Training
workstations (T)

(T)

(V)

(C)

(M)

459 sf

(T)

(V)

(V)

Raised floor

(C)

(M)

**Conference
Room**
504 sf

(7) CI
Workstation
(V)

(T)

(V)

(C)

(C)

(T)

(C)

**Central Monitoring
Facility (CMF)**
1,772 sf

Break Room
(seating for approx.
15 persons)

(T) (T) (T) (T)

(T) (T) (T)

N

Denver International Airport
Existing Terminal Central Monitoring Facility (CMF) Control Room
Jeppesen Terminal, Level 6, MOD 3E
Date: April 6, 2017

DEN

KEYPLAN

1	2a	2b	3
	5a	5b	
	5c	5d	
4			6
7	8a	8b	9
	8c	8d	
10	11a	11b	12
	11b	11d	
13	14a	14b	15
	14c	14d	

N
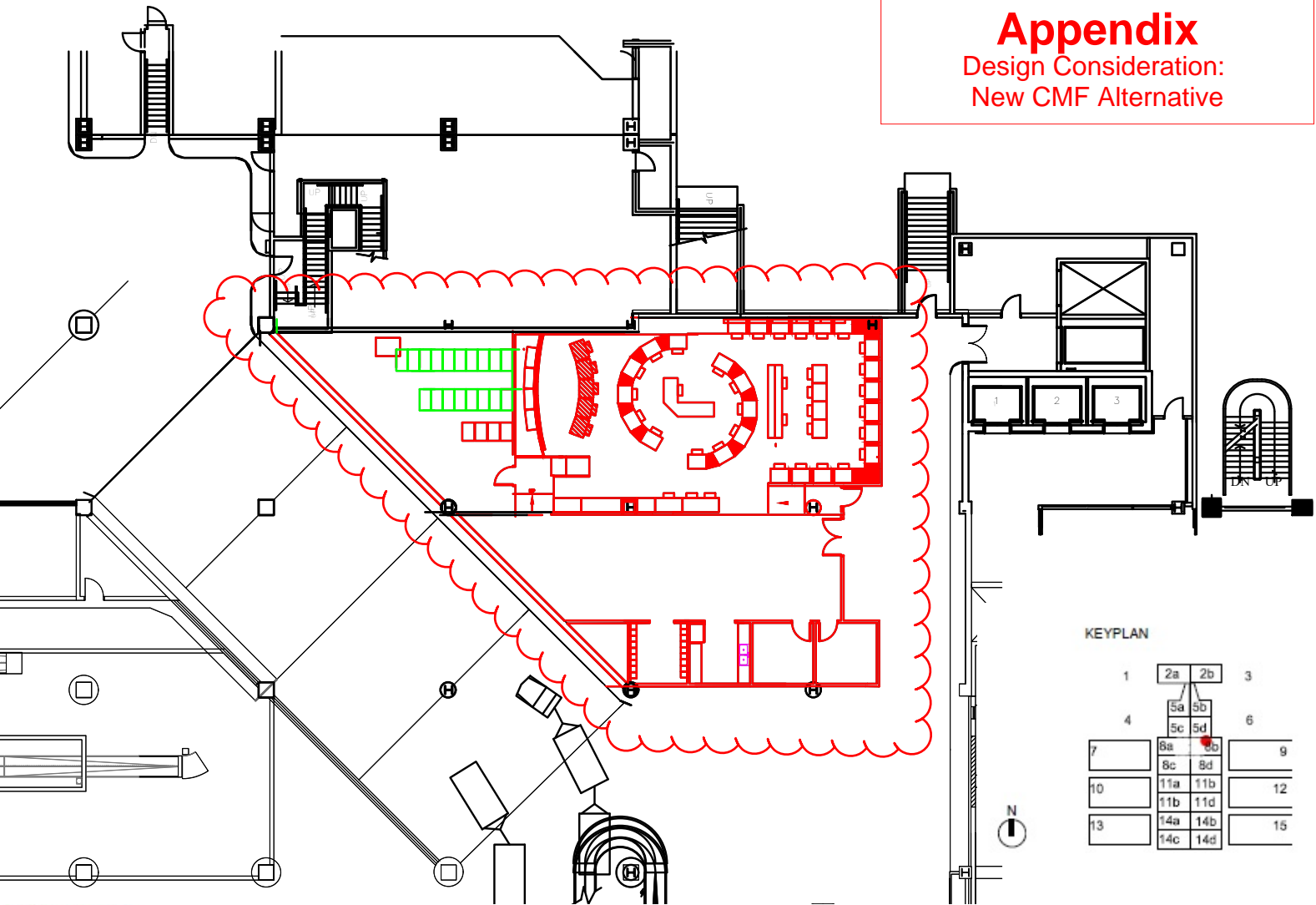
Note: Drawing NTS

Design Consideration: New CMF Alternative
Level 3, MOD 1E

Room	Equipment Name	Requirement	Quantity	Power	Data	Fiber	Details
CR	TSA Workstations	TSA	5	120vac 1 quad per workstation	(1) cat6 + spare each	N/A	TSA Internal Computers
CR	TSA TRI Training stations	TSA	2	120vac 1 quad per station	(1) cat6 + spare each	N/A	Cat 6 to MUX
CR	VOIP Phones	TSA	2	N/A	(2) cat6 + spare each to TSA phone system	N/A	VOIP IP connection to TSA phone System
CR	Land line Phones	TSA	3	N/A	(2) cat6 + spare each to DEN phone system	N/A	Standard DEN Phone connected to DEN phone system
CR	Fax machine	TSA	1	120vac 1 quad	(1) cat6 + spare each	N/A	Standard DEN Phone connected to DEN phone system
CR	CCTV monitors	TSA	2	120vac quad	(1) cat6 + spare each	N/A	Cat6 to TSA camera system
CR	TRI computers w/2 monitors each	TSA	32	120vac 1 quad each per computer	(1) cat6 + spare each	Fiber to MUX required	Cat 6 to MUX or fiber patch to mux with converters
CR	CI computer with 1 monitor	TSA	7	120vac 1 quad each per computer	(1) cat6 + spare each	Fiber to MUX required	1 CI for each mod data from CI to module MUX
CR	PUTTY PC with monitor	TSA	2	120vac 1quad each	(1) cat6 to BHS server each + (1) spare each	N/A	Sort controller interface for 3East and all other mods
CR	Kronos Timeclock	TSA	1	120vac duplex	(1) cat6 to TSA server + 1 spare	Fiber to DEN Comms Timeclock system required	TSA system Module 3 east level 6 DEN comms room existing. From there to Mod 1 West level 5 TSA server.
CR	Digital Clock	TSA	2	120vac duplex each	(1) cat6 to time synch server	Fiber to DEN Comms Timeclock system required	Originates from Mod 3 east level 6 DEN comms room
CR	Panic buttons Durress Recievers	TSA	9	120 Vac power to each reciever	Wired from CMF to DEN comms room to TSA server in Mod 1 West level 5.		Recievers in CMF from all three checkpoints and petshop. Must have wireless connectiveity to new CMF from all three areas
CR	Television with Cable	TSA	2	120vac duplex each	Supplied by DEN through DEN comms room level 6 mod 3 East.	N/A	Same as existing break area cable television and feed.
CR	Printer - TSA	TSA	6	120vac duplex each	Cat6 from TSA computers	N/A	Comms to TSA workstations
CR	Radio charger station - TSA	TSA	4	120vac quad each	N/A	N/A	Power and space for radio chargers 3' x 3'
CR	Fax machine - TSA	TSA	1	120vac duplex	Cat6 from DEN phone system	N/A	Not sure if TSA fax line is TSA phones or DEN.
CR	Workstation - TSA	TSA	51	N/A	N/A	N/A	workstations shall be comprised of 1 chair and 1- 42" x 36" desk area for each workstation
CR	OSR and BHS Operations shall be separated	TSA	N/A		N/A	N/A	General Changes: Required by PGDS v5.0 Chapter 10
CR	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 OSR and CBRA with a visual indicator in addition to an audio indicator.	TSA	N/A		N/A	N/A	General Changes: Required by PGDS v5.0 Chapter 10
CR	The lighting in the area shall include dimmers to allow for better screen viewing.	TSA	N/A		N/A	N/A	General Changes: Required by PGDS v5.0 Chapter 10
CR	Video wall	BHS	1	Video wall includes: (2)-30 amp 120 vac outlets for Video wall server (1) 2-plex 120 vac 20 amp service for each monitor (12) 50" monitors			
CR	Operations Phone for O&M	BHS	1	DEN phone number 303-342-4548 should be reused.			
CR	Workstation - MOD 3E Putty	BHS	1	120vac quad fed from dedicated UPS			
CR	Workstation - MOD 3E Graphics	BHS	1	120vac quad fed from dedicated UPS			
CR	Workstation - Primary putty, all other mods	BHS	1	120vac quad fed from dedicated UPS			
CR	Workstation - Primary Graphics, all other mods	BHS	1	120vac quad fed from dedicated UPS			
CR	Workstation - Secondary Graphics, all other mods	BHS	1	120vac quad fed from dedicated UPS			
CR	Workstation - Secondary putty, all other mods	BHS	1	120vac quad fed from dedicated UPS			
CR	Workstation - BHS	BHS	1	120vac quad fed from dedicated UPS			
CR	Workstation - ICS primary BHS	BHS	1	120vac quad fed from dedicated UPS			
CR	Workstation - ICS Secondary BHS	BHS	1	120vac quad fed from dedicated UPS			
CR	VOIP Phone Port - BHS	BHS	1	VOIP port			
CR	Printer - BHS	BHS	2	120vac quad fed from dedicated UPS	dedicated cat6	N/A	
CR	Radio - BHS	BHS	1	120vac quad fed from dedicated UPS			
CR	Filing cabinet - BHS	BHS	2	N/A	N/A	N/A	
CR	Operations Console - BHS	BHS	1	N/A	N/A	N/A	
CR/ SR	Switchgear auto-switch feed to CR & server room	BHS	1				Existing auto switch from 2E power and 3E power to remain as power feeds to the Control Room.
DAT/ PLC	Equipment Rack	Morpho/MUX	6	(2)-30 amp 120vac circuits each fed from separate source 6 racks with 2 30 amp circuits fed from separate sources each.	(30) cat6 cables each rack	N/A	19" x 42" rack with 42U capacity
DAT/ PLC	Patch panel	Morpho/MUX	1	(2)-30 amp 120vac circuits each fed from separate source 6 racks with 2 30 amp circuits fed from separate sources each.	(150) cat6 cables to CMF equipment and workstations	(60) fiber pairs single mode	Fiber connects CBRA located module specific MUX racks to Patch panel
DAT/ PLC	Equipment Rack	ARINC	4	(2)-30 amp 120vac circuits each fed from separate source 6 racks with 2 30 amp circuits fed from separate sources each.	(1)-3MPLS 3mb sprint connection (1)-BtoB circuit to Avinet (2)-CUS cat6 to DEN network	N/A	
ELC	UPS	BHS	1	Engineer to calculate			
GEN	Storage areas both on and off the workstation.	TSA	N/A		N/A	N/A	General Changes: Required by PGDS v5.0 Chapter 10

Room	Equipment Name	Requirement	Quantity	Power	Data	Fiber	Details
GEN	Receptacles	BHS	2 to 4	Quad receptacle (for golf cart charging)			should be located directly adjacent to parking spaces
GEN	Fiber converters	BHS	20	N/A			
GEN	Office Chair	BHS	8	N/A			
GEN	HVAC	BHS	2				Dedicated HVAC unit with backup to serve all TSA, Morpho, ARINC, and BHS space. Loads shall be calculated based on final design + 25%
GEN	LCP	BHS	1 Cabinet with 2 power circuits	(2)-30 amp 120vac circuits fed from separate sources			
GEN	LCP Switch	BHS	4	N/A			
SR	Workstation - BHS/VPN	BHS	2	(1)-120vac quad fed from dedicated UPS			
SR	Server Room printer	BHS	1	(1)-120vac quad fed from dedicated UPS			
SR	Desk - O&M Operator		1				
SR	Desk - (BHS Consultant)		2				
SR	Dial-in jacks for the Server network	VPN Network connection					

Acronyms

CCTV	Closed-Circuit Television
COMMS	Communications
CR	Control Room
BHS	Baggage Handling System
GEN	General
HVAC	Heating, ventilation, and air conditioning
LCP	Local Control Panel
MOD	Module
OSR	On-Screen Resolution
PC	Personal Computer
PGDS	Planning Guidelines & Design Standards
SR	Server Room
TRI	Threat Resolution Interface
TSA	Transportation Security Administration
UPS	Uninterruptible Power Supply
VPN	Virtual Private Network

Room Abbreviations

BR	Break Room/ Locker Room
CONF	Conference Room
CR	Control Room
DAT	TSA Data/ Electronics Room
ELC	Electrical Room
PLC	BHS PLC Room

Chapter 10

ON-SCREEN RESOLUTION AREA PLANNING STANDARDS

Transportation
Security
Administration

Planning Guidelines and Design Standards
for Checked Baggage Inspection Systems

10-1

Version 5.0
July 16, 2015

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Transportation
Security
Administration

Planning Guidelines and Design Standards
for Checked Baggage Inspection Systems

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10: ON-SCREEN RESOLUTION AREA PLANNING STANDARDS

REQUIREMENTS TABLE

Section	Requirement
10.1 Background	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.
10.3.2 Entrances/Exits	Door widths and access to space shall comply with applicable building codes and the American with Disabilities Act (ADA).
10.3.6.1 Multi-level floors	Where changes of floor level are introduced in conjunction with entrances or exits, proper physical "aids" shall be provided (such as guardrails, handrails, anti-slip surfaces, and appropriate signage, when indicated) to minimize potential workplace hazards.
10.3.7 Windows	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.
10.3.7 Windows	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, which are located on the left and/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.
10.3.8 Noise Abatement	The OSR Area 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.
10.4.3 OSR Room Layout	OSR layouts 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. This screen shall only show 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. • CCTV displays of EDS entrances and exits in order to enhance situational awareness and expedite responses to bag jams or machine fault events. • 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.

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10: ON-SCREEN RESOLUTION AREA PLANNING STANDARDS

Section	Requirement
	• 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 <u>shall</u> 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 and/or rooms may be necessary for devices that exceed 65 dBA at each workstation.
10.4.4 Workstation Arrangements and Ergonomic Considerations	Where confidential information is presented on display monitors and/or situated on desktops, it <u>shall</u> not be possible to see this information from the public viewing areas.
10.4.4.1 Plan Arrangements	Workstation arrangements <u>shall</u> take into account operations under normal and abnormal modes of system operation.
10.4.4.1 Plan Arrangements	Luminance <u>shall</u> be measured at the center of the monitor, and found to be in the range of 300 to 500 lux.
10.4.4.2 Control Workstations	A Supervisor/CI workstation <u>shall</u> include communications infrastructure for telephone and TSA network access.
Table 10-1 MONITOR/DESK/TASK CHAIR ERGONOMIC DESIGN REFERENCE– Monitors	Height: top of monitor <u>shall</u> be at or slightly below eye level <u>Distance: shall be 20-40-in. from the eye to the front surface of the monitor</u> <u>Position: shall 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</u> Size: 20-23-in. monitor shall be sufficient Glare: shall be positioned away from windows
Table 10-1 MONITOR/DESK/TASK CHAIR ERGONOMIC DESIGN REFERENCE,– Desks	Height: shall be adjustable between 20 in. and 28-in. Glare: desktops shall have a matte finish, avoid glass tops

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Planning Guidelines and Design Standards
for Checked Baggage Inspection Systems

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Section	Requirement
Table 10-1 MONITOR/DESK/TASK CHAIR ERGONOMIC DESIGN REFERENCE, Chairs	Height: shall be fully adjustable with a minimum range of 16-in. Backrest: at least 15-in. high and 12-in. wide, and should recline 15 degrees from vertical Chair Base and Rotation: 5-legged base; 360 degrees unrestricted rotation Seat Size: seat pan length shall be 15-in. to 17-in. and depth-adjustable Armrests: shall be removable, distance between them shall be at least 16-in. and adjustable
10.4.5 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 10.4.3).
10.4.5.1 Horizontal and Vertical Viewing Distances	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.
10.4.5.1 Horizontal and Vertical Viewing Distances	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.
10.4.5.1 Horizontal and Vertical Viewing Distances	H_e is the design-eye-position, measured from the floor to the outer corner of the eye; 5th percentile shall be applied
10.4.6 Personnel Circulation and Custodial Services 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.
10.4.6.1 Personnel Circulation	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 2 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.
10.4.6.2 Custodial Services Access	Inadvertent activation of any safety-critical controls shall not be possible during cleaning tasks.
10.5 Verification and Validation of OSRA Layout	In all cases, local, state, and Federal regulations regarding design and construction shall supersede the recommendations included in this chapter.

10.1 BACKGROUND

This chapter provides ergonomic requirements and recommendations for the layout of on-screen resolution areas (OSRAs), including workstation arrangements, the use of off-workstation visual displays, and OSRA maintenance. This chapter draws on provisions and other information provided in ISO 11064-1, ISO 11064-2, ISO 11064-3, Mil-STD-1472G, as well as the OSHA website (www.osha.gov) on computer workstations.

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 system 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, CCTV interface, and communications

- Individual workstations with PVS

- Administrative area that includes a printer

- Wall-mounted BHS display

- CCTV display of the CBRA

10.2 GENERAL ERGONOMIC RECOMMENDA-TIONS

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

10.3 ARCHITECTURAL CONSIDERATIONS

10.3.1 Traffic and Routing

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

- Distances should be minimized 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.

10.3.2 Entrances/Exits

Main entrances and exits should not form part of the working visual fields of the TSOs.

Entrances and exits should not be positioned behind 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/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.

- The ceiling height as an exit should be at least 7 feet 6 inches tall.

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

10.3.3 Equipment Requirements for Design Year

OSRA layouts should allow for expansion. As referenced in Section 5.3.1 the design year for equipment requirements is assumed to be 5 years after the initial operation startup for a given baggage screening system (i.e., DBU + 5 years). This is the time horizon which should be used when designing OSRAs.

10.3.4 Equipment Requirements for Future Growth

In order 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 Basis of Design Report, from DBU + 6 through DBU +15 years (including EDS machines, PVS, and SVS workstations) as stated in the requirement in Section 5.3.2.

10.3.5 Plan Space Provision

The selection of space for an OSRA should be consistent with the following guidelines:

- The selection of a space for an OSRA should be based on the usable area, not the gross area.

- Obstructions and structural features, such as pillars and awkward corners, 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 ft^2 to 49 ft^2 per working position with a minimum of not less than 29 ft^2. This has been found to be satisfactory for rooms with more than 1 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 ft^2 have been measured. These displays may include control interfaces and split displays showing various CCTV images from BHS and CBRAs.

- If additional staff, for example trainees, need to be accommodated during off-normal operations, within the OSRA, sufficient space should be allowed for these additional staff to be housed.

- Temporary positions should be provided alongside permanent TSO operator positions, where this additional staff is expected to be present during shift changes.

- Square, circular, and hexagonal spaces are preferred for the arrangement of functional groups, because they offer the potential of maximizing the number of links; long narrow spaces should be avoided since they can unduly reduce options.

- The information presented in Section 10.4.4 illustrates different ways in which workstations can be arranged. Some of the factors considered include views to shared off-workstation visual displays, operational links between TSO operators and contact between supervisors and operators. The diagrams are intended to highlight some of the advantages and disadvantages of alternative groupings of workstations. They are not intended to be exhaustive or prescriptive.

10.3.6   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.

- As a "rule of thumb," slab-to-slab heights should preferably be a minimum of 13 feet, to include false floors, false ceilings, indirect lighting systems and the accommodation of shared off-workstation visual displays. In practice, such a design would result in finished floor to finished ceiling heights of no less than 9 feet. This would accommodate the 99 percentile of the male population. NOTE: The appropriate user population data should be used.

- Uncluttered ceilings are preferred to avoid any distractions or stray reflections from luminaries; such as plain finishes, which are also recommended for walls and structural elements.

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- 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.

10.3.6.1 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" shall be provided (such as guardrails, handrails, anti-slip surfaces, and appropriate signage, when indicated) to minimize potential workplace hazards.

10.3.7 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, which are located on the left and/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.

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10.3.8   Noise Abatement

The OSR Area 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.

10.4   OPERATIONAL CONSIDERATIONS

10.4.1   General Recommendations

OSRA layouts should be based on an agreed set of principles derived from operational feedback (if available), task analysis and an understanding of the TSO population, including employees with disabilities. These underlying principles should be fully documented (see Section 10.5). The layout of OSRAs should:

- Facilitate team working 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 10.4.3).

10.4.2   OSRA Layout

In order 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 standards, 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.

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10.4.3   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 2 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 L-3 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 and/or rooms may be necessary for devices that exceed 65 dBA at each workstation.

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OSR Room personnel circulation is addressed in Section 10.4.6.

10.4.4 Workstation Arrangements and Ergonomic Considerations

The arrangement of workstations is closely linked to the ergonomic considerations of individual workstations, the positioning of supervisory workstations, vertical space usage and secondary workstations as all affect space and movement within the OSR room. Before going into details of each specific consideration there are a number of general aspects that deserve attention:

- OSR rooms which exhibit either overcrowding of work positions, or widely dispersed work positions, are not recommended. Layouts should allow, wherever practical, direct verbal communication between TSOs and avoid excessively short separations between adjacent TSOs (see Section 10.4.3).

- OSR rooms in the same terminal facility should adopt the same ergonomic principles of room layout to facilitate decision-making and teamwork.

- There are ergonomic benefits in varying postures during periods of work. Wherever practicable, it is recommended that TSO 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).

- <u>Where confidential information is presented on display monitors and/or situated on desktops, it shall not be possible to see this information from the public viewing areas.</u>
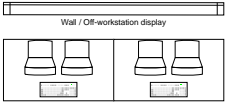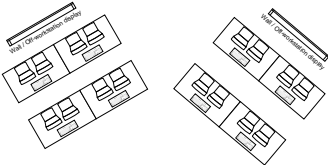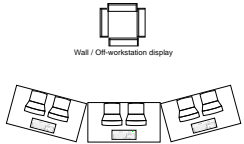
10.4.4.1 Plan Arrangements

Figure 10-1 illustrates the wide range of alternative workstation arrangements that can possibly be configured in the OSRA space. The most suitable layout should be determined through the conduct of a task analysis. When designing an arrangement plan the following elements should be considered:

- Operational links between TSOs, such as speech, sightlines or direct voice communication, should be documented using link association tables prior to developing workstation layouts. These should provide a benchmark against which alternative layouts can be assessed and detail primary and secondary operational means, including direct visual, message passing, or equipment sharing requirements.

- When considering alternative ways of laying out a number of workstations, the following factors should be considered:

  - Dedicated or shared workstations between TSOs.

  - Whether each workstation is identical.

  - Whether control operations and OSARP can be done from a single dual-use workstation or tasks are spread amongst a number of dedicated workstations.

NOTE: 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 (see Figure 10-1).

Figure 10-1
WORKSTATION LAYOUTS

Spatial layout	Layout description	Layout advantages/disadvantages
Wall / Off-workstation display	*Single 1-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
Wall / Off-workstation display	*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
Wall / Off-workstation display	*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.

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- 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

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10.4.4.2 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.

- <u>A Supervisor/CI workstation shall include communications infrastructure for telephone and TSA network access.</u>

- 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 and/or procedures. Additional space may be required for extra staff who may also need to be accommodated in this area.

10.4.4.3 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.

10.4.4.4 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 10-2 provides a visual reference, while Table 10-1 summarizes many of these points.

Figure 10-2
NEUTRAL BODY POSITION
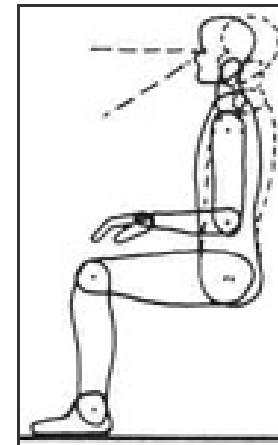
Source: United States Department of Labor, Occupational Safety & Health Administration available at www.osha.gov/SLTC/etools/computerworkstations/index.html

Table 10-1
MONITOR/DESK/TASK CHAIR ERGONOMIC DESIGN REFERENCE

Monitors	Desks	Chairs
Height: top of monitor shall be at or slightly below eye level	*Height:* shall be adjustable between 20-in. and 28-in.	*Height:* shall be fully adjustable with a minimum range of 16-in.
Size: 20-23-in. monitor shall be sufficient	*Clearance:* shall be 15-in. for knees and 24-in. for feet, width at least 20-in.	*Backrest:* shall be at least 15-in. high and 12-in. wide, and should recline 15 degrees from vertical
Distance: shall be 20-40-in. from the eye to the front surface of the monitor		*Chair Base and Rotation:* shall be 5-legged base; 360 degrees unrestricted rotation
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		*Seat Size:* seat pan length shall be 15-in. to 17-in. and depth adjustable
Glare: shall be positioned away from windows	*Glare:* desktops shall have a matte finish, avoid glass tops	*Armrests:* shall be removable, distance between them shall be at least 16-in. and adjustable

Source: United States Department of Labor, Occupational Safety and Health Administration available at www.osha.gov/SLTC/etools/computerworkstations/index.html

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 (refer to Table 10-1)

- 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 screen(s) should be located 15 to 20 degrees below the horizontal eye level of the TSO operators (see Figure 10-3).

- 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.

Figure 10-3
VIEWING DISTANCE
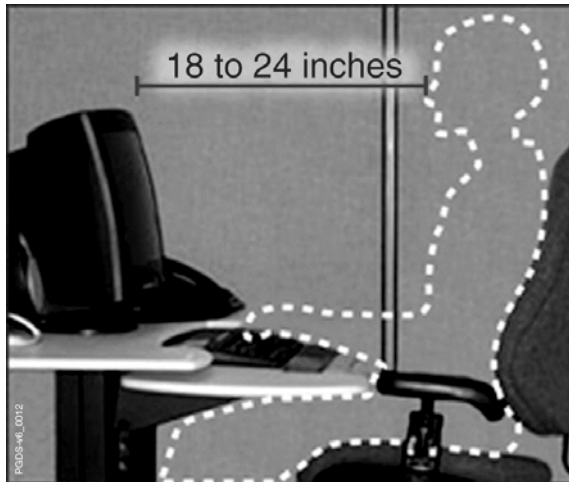
18 to 24 inches

Source: United States Department of Labor, Occupational Safety & Health Administration available at www.osha.gov/SLTC/etools/computerworkstations/index.html

- 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.

10.4.4.5 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 Chapter 5, Section 5.3.1).

- 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.

- 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 10-2.

- 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).

Table 10-2
CONTROL ROOM STORAGE—CLASSIFICATION OF TYPES

Storage requirement	Typical location	Example
Immediate access	Primary workstation	Operational procedures High-priority telephone numbers Emergency procedures Diagnostics
Secondary access	Secondary workstation	Internal telephone directory Secondary operating procedures
	Adjacent workstation	Architectural/engineering drawings
Occasional access	Library	Non-critical screening equipment failure procedures

Source: ISO 11064-3: 1999, Design of Control Centers. Part 3: Control room layout.

10.4.5   Off-workstation Shared Visual Displays

The layout of the OSRA shall ensure that all off-workstation shared visual displays, necessary for the TSO operator task, are visible from all relevant workstations (see 10.4.3).

The requirements presented in this section concern the location of shared visual displays within the OSRA. Many differing technologies can be used for overview visual displays, including banks of CCTV monitors, projected displays, hard-wired mimics and static maps/diagrams. When designing OSRA layouts for these differing solutions, the constraints imposed by the various solutions 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.

10.4.5.1 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 10-4).

Figure 10-4
PREFERRED LOCATION OF
OFF-WORKSTATION SHARED VISUAL DISPLAYS

Key

1   Operator
2   Horizontal visual field
3   Off-workstation visual display
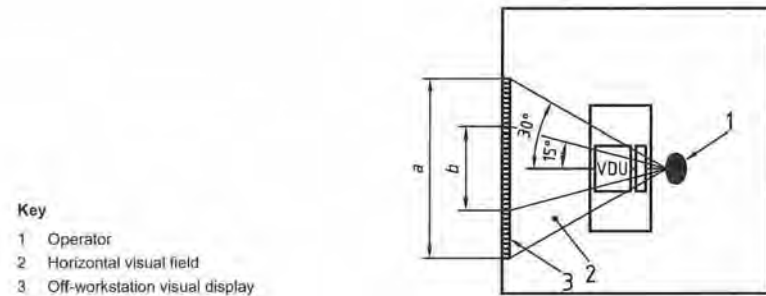
NOTE   This plan view is intended to show general principles.

Source: ISO 11064-3: 1999, Design of Control Centers.
             Part 3: Control room layout.

- Where the information presented on an off-workstation shared visual display does not have to be read while operating the console or provides secondary information, the displays can sometimes be mounted to one side of the workstation. Such displays should be positioned so that all information required can be reliably read from the TSO 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.

- <u>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.</u> 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.

- <u>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.</u> The following formula may be used to determine this measurement:

$$H_1 = H_c - (D + d) \; \frac{H_e - H_c}{D_c + d}$$

Where
H_1 is the lowest height at which the visual display can be seen;
$\underline{H_e}$ <u>is the design-eye-position, measured from the floor to the outer corner of the eye; 5th percentile shall be applied;</u>
NOTE: H_e is a combination of the adjusted seat height and the anthropometric data of "eye height, sitting."
H_C is the height of the console;
D is the horizontal distance between the front edge of the console and the surface of the wall panel;
D_c is the depth of the console;
d horizontal distance between the design-eye-position and the front edge of the console.

10.4.5.2 Relationship of Shared Visual Displays to Other Features

In particular, the following 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.

10.4.6   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 10.4.6.1).

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.

10.4.6.1 Personnel Circulation

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 2 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.

10.4.6.2 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.

10.5 VERIFICATION AND VALIDATION OF OSRA LAYOUT

Verification and validation should be integrated with the design process and should be performed in parallel with top-level design 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 chapter. This is especially relevant concerning the provision of allowances for the disabled as covered by the ADA.