FAA-E-3037

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

PERFORMANCE SPECIFICATION

REMOTE RADIO CONTROL SYSTEM (RRCS)

Navigation Programs Lighting Systems Team
RRCS Product Team (AJM-3222)

February 17, 2016

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1 SCOPE

1.1 Scope

This performance specification establishes the performance, design and verification requirements for the Remote Radio Control System (RRCS).

1.2 System Overview

The RRCS is a service system consisting of hardware and software that is used by Air Traffic Controllers (ATC) to operate an airport's suitably equipped Visual Guidance Lighting Systems (VGLS). Only VGLS equipment interfaced with a Remote VGLS Interface Unit (RVIU) as part of the RRCS installation can be controlled. The RRCS enables ATC to turn VGLS systems on or off; change intensity levels on select equipment; and, have the ability to enable and disable control of VGLS equipment by airborne users.

The goal of this specification is to define requirements for a new generation of RRCS that: builds on the use of commercially available components; leverages experience with the current operational RRCS; and, greatly improves ATC control and situational awareness of an airport's VGLS systems. The next generation of RRCS is expected to reduce the number of individual and design-specific components.

2 APPLICABLE DOCUMENTS

2.1 General

The documents listed in this section are referenced and used in Sections 3 and 4 of this specification. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements in the documents cited in Sections 3 and 4 of this specification.

2.2 Government Documents

2.2.1 Specifications and handbooks

The following specifications and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues and revisions of these documents are those cited in the solicitation or contract.

2.2.1.1 FAA specifications

FAA-G-2100	Electronic Equipment, General Requirements

2.2.1.2 FAA handbooks

FAA Order 6050.19F	Radio Spectrum Planning

[Copies of specifications and other applicable FAA documents may be obtained from the Contracting Officer (CO) in the office issuing the invitation-for-bids or request-for-proposals. The request should fully identify material desired, i.e., standard, drawing, and/or specification plus amendment numbers and dates. Requests should cite this specification or the related Screening Information Request (SIR) for the RRCS. A number of the documents may be obtained at the following Web site: http://isddc.dot.gov/.]

2.2.2 Other Government documents, drawings, and publications

The following other Government documents, drawings and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues and revisions are those cited in the solicitation or contract.

2.2.2.1 FAA drawings

Not applicable.

2.2.2.2 Other FAA documents

DOT/FAA/CT-03/05 HF-STD-001	Human Factors Design Standard (HFDS)
FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding, And Shielding Requirements For Facilities And Electronic Equipment

2.2.2.3 External documents

External documents listed in this section are for reference purposes only, and may not be found within this specification.

EIA-STD-232	Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange
EIA-STD-485	Standard for Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multipoint Systems

2.2.3 Other Government documents

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
MIL-DTL-15024	Plates, Tags, and Bands For Identification Of Equipment
MIL-I-10	Insulating Compound, Electrical, Ceramic Class L
MIL-I-23264	Insulators, Ceramic, Electrical and Electronic, General Specification for
MIL-S-22473	Sealing, Locking and Retaining Compounds: (Single-Component)
MIL-S-46163	Sealing, Lubricating, and Wicking Compounds: Thread-Locking, Anaerobic, Single Component
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-T-22361	Thread Compound; Antiseize, Zinc Dust-Petrolatum

2.2.4 Non-Government documents

ANSI Standard C95.1	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz
ASTM G21-13	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
L-P-516	Plastic Sheet & Plastic Rod, Thermosetting, Cast

ICAO Annex 3	Meteorological Service for International Air Navigation, Annex 3
NFPA-70	National Electrical Code
NTIA Manual	NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management

Requests for copies of military documents should be addressed to Defense Automated Printing Service, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, website: http://www.documentservices.dla.mil/dso.html. ASTM documents may be obtained from the American Society for Testing Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, and NFPA documents from the National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471. ICAO documents may be obtained through the ICAO Web Site.

2.3 Order of precedence

In the event of conflict between the text in this document and the references cited, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3 REQUIREMENTS

The RRCS shall meet the requirements stipulated herein while operating over the full range of the operating environment defined herein.

3.1 System Definition

This section (3.1) provides narrative background and conceptual system definition information. It does not include functional performance requirements.

3.1.1 Functional layouts

Figure 1 provides a conceptual functional block diagram of the RRCS, its major components and externally interfaced systems. Simplified examples of RRCS and related VGLS equipment installations on an airport are shown in Figure 2 and Figure 3.

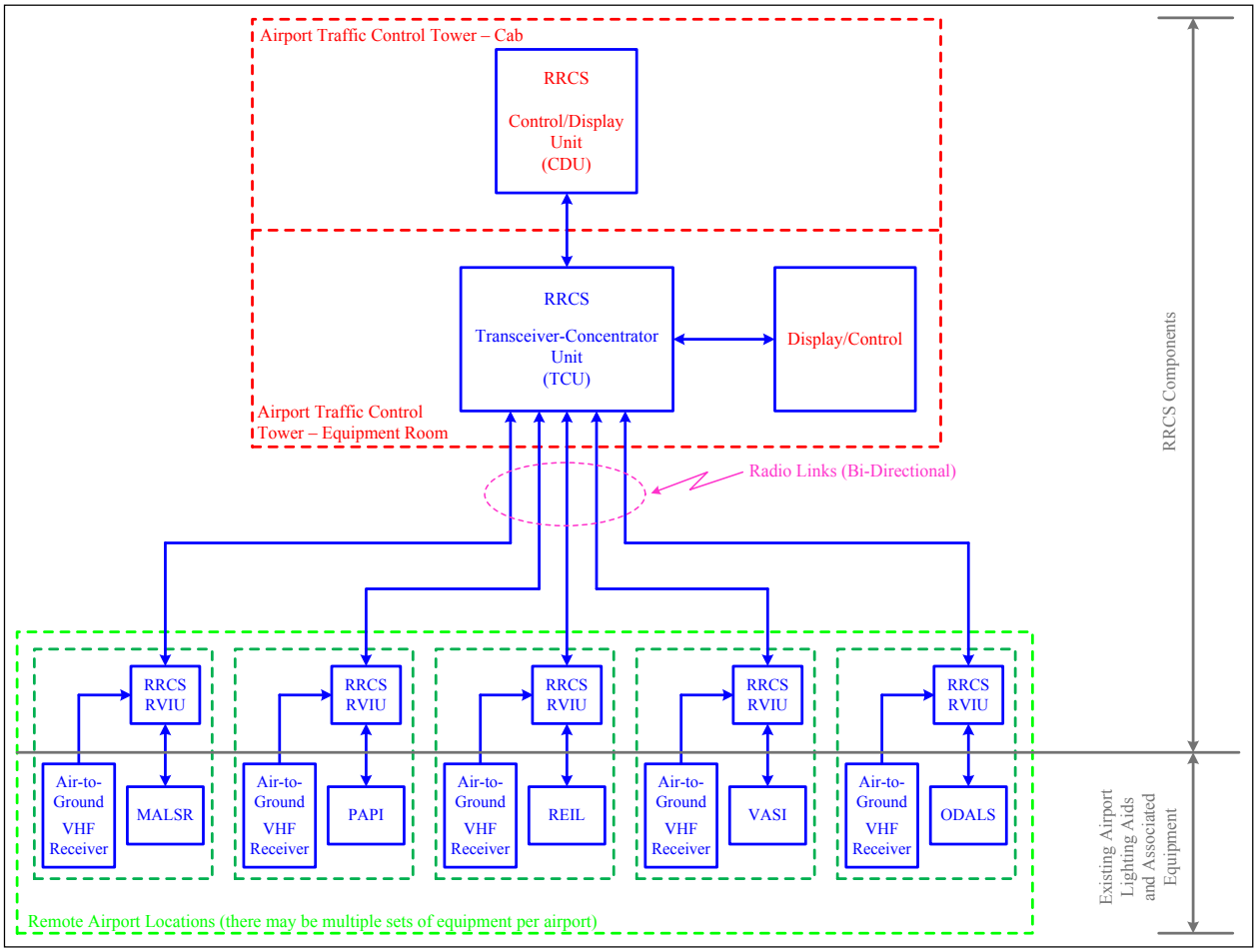

Figure 1. RRCS Functional Block Diagram - Conceptual

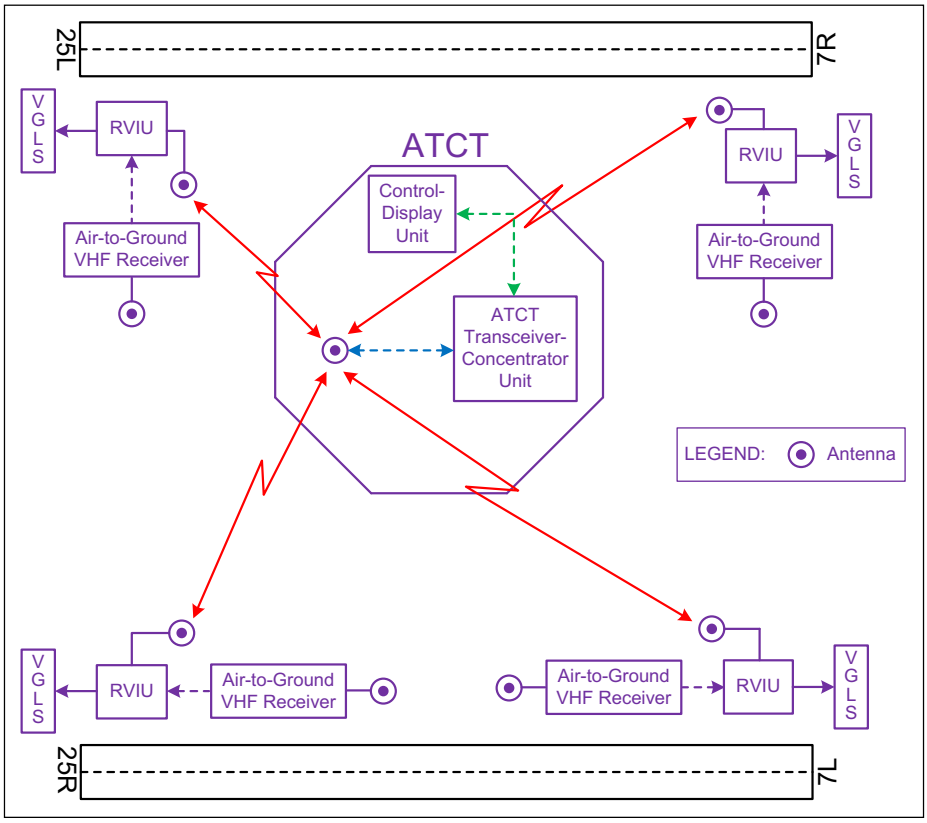

Figure 2. Plan View (Overhead) Of RRCS, VGLS, and VHF A/G Equipment - Example Locations

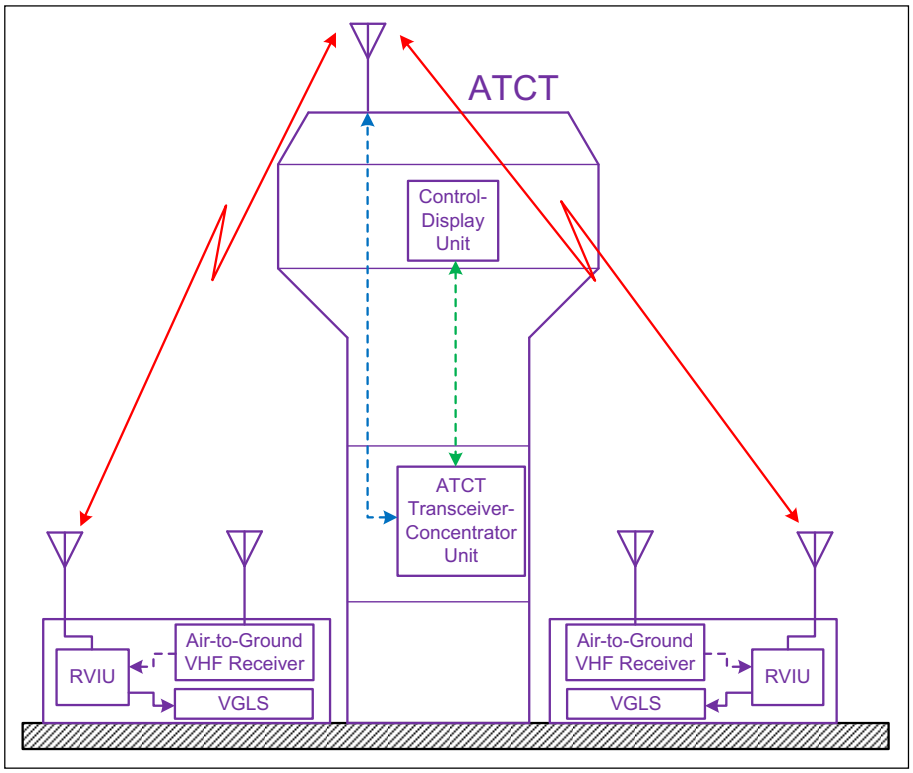

Figure 3. Plan View (Ground) Of RRCS, VGLS, and VHF A/G Equipment - Example Locations

3.1.2 Major components

Figure 4 provides a conceptual RRCS equipment unit breakdown. Each unit will be discussed in the remainder of Section 3. Note that the RVIU may be designed such that only one assembly is necessary to integrate with any VGLS interface.

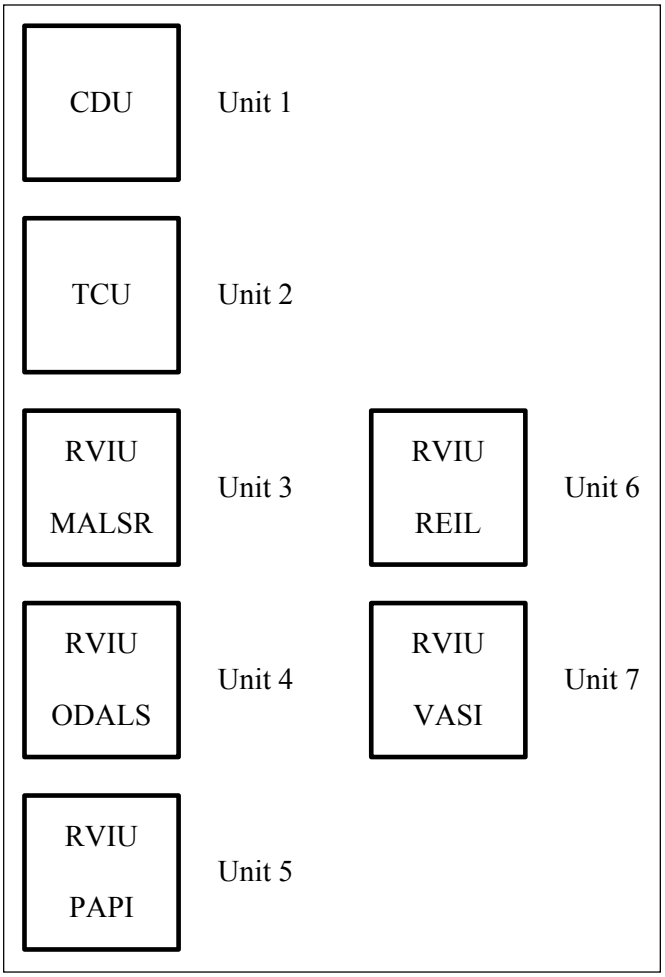

Figure 4. Conceptual RRCS Unit Designations

3.1.2.1 Airport Traffic Control Tower Installation

The ATCT installation has two major components, the CDU and the Transceiver-Concentrator Unit (TCU), which are shown in the data flow diagram provided Figure 5 and described in the following sections. These two components provide the ATC personnel interface and the primary control mechanism.

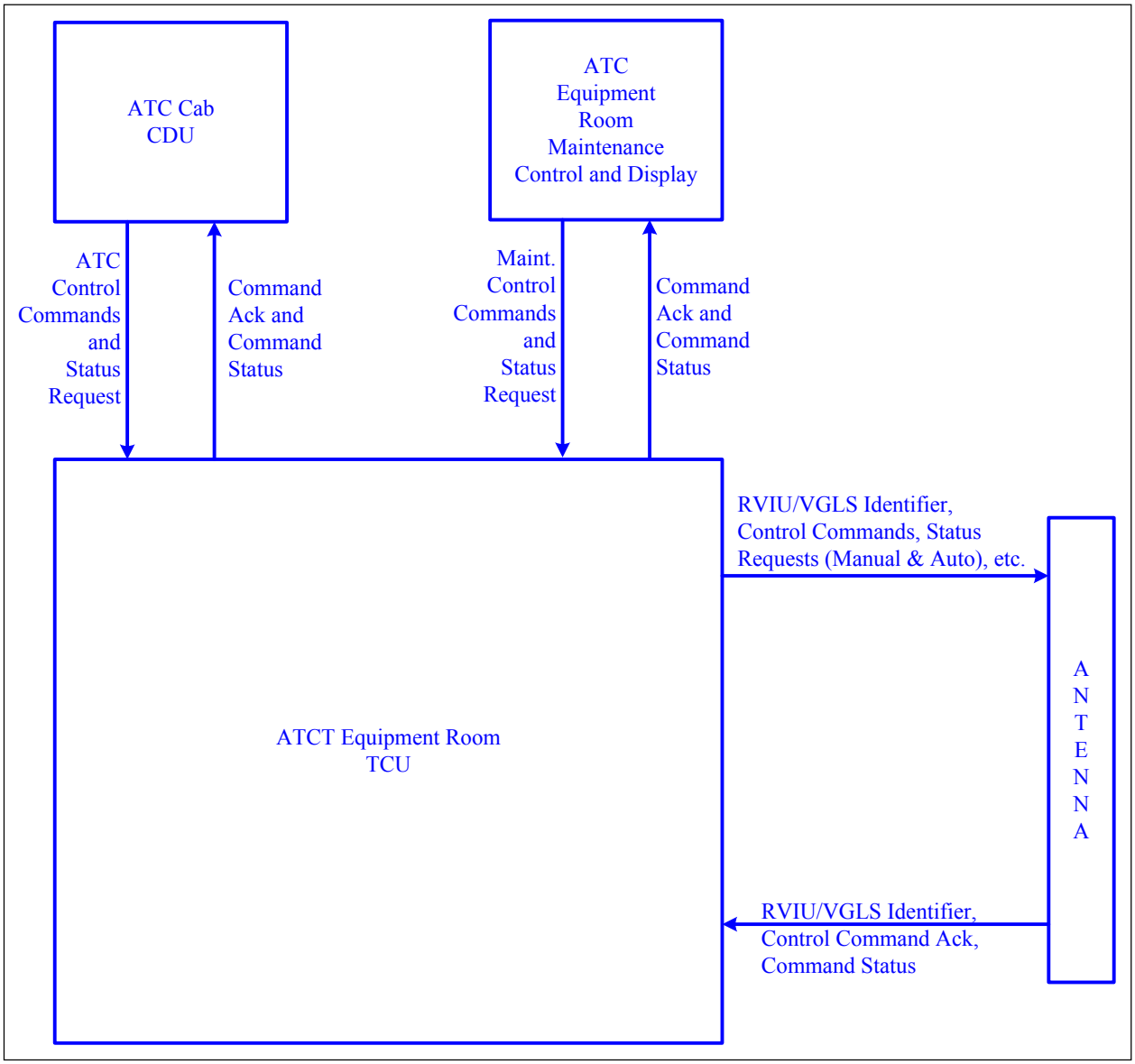

Figure 5. Data Flow Diagram of RRCS ATCT Components – Conceptual

3.1.2.1.1 Control-Display Unit (CDU)

ATC personnel interact with the RRCS through the CDU, which is designed in accordance with FAA Human Factors standards. An example basic layout is provided in Figure 6 below. This touch-sensitive display device is located in the ATCT cab and provides clear VGLS control and status information to ATC personnel. The VGLS control ribbon information is displayed in a manner consistent with the older RRCS units (see Figure 7 to Figure 11 below). Maintaining this layout philosophy reduces the amount of training and transition time when the new RRCS replaces existing units in ATCTs. Human factor requirements define the size, color, and alerts - both visual and aural - for the displays. The CDU is connected to the TCU through an interface, which in turn communicates with the RVIUs through a transceiver link.

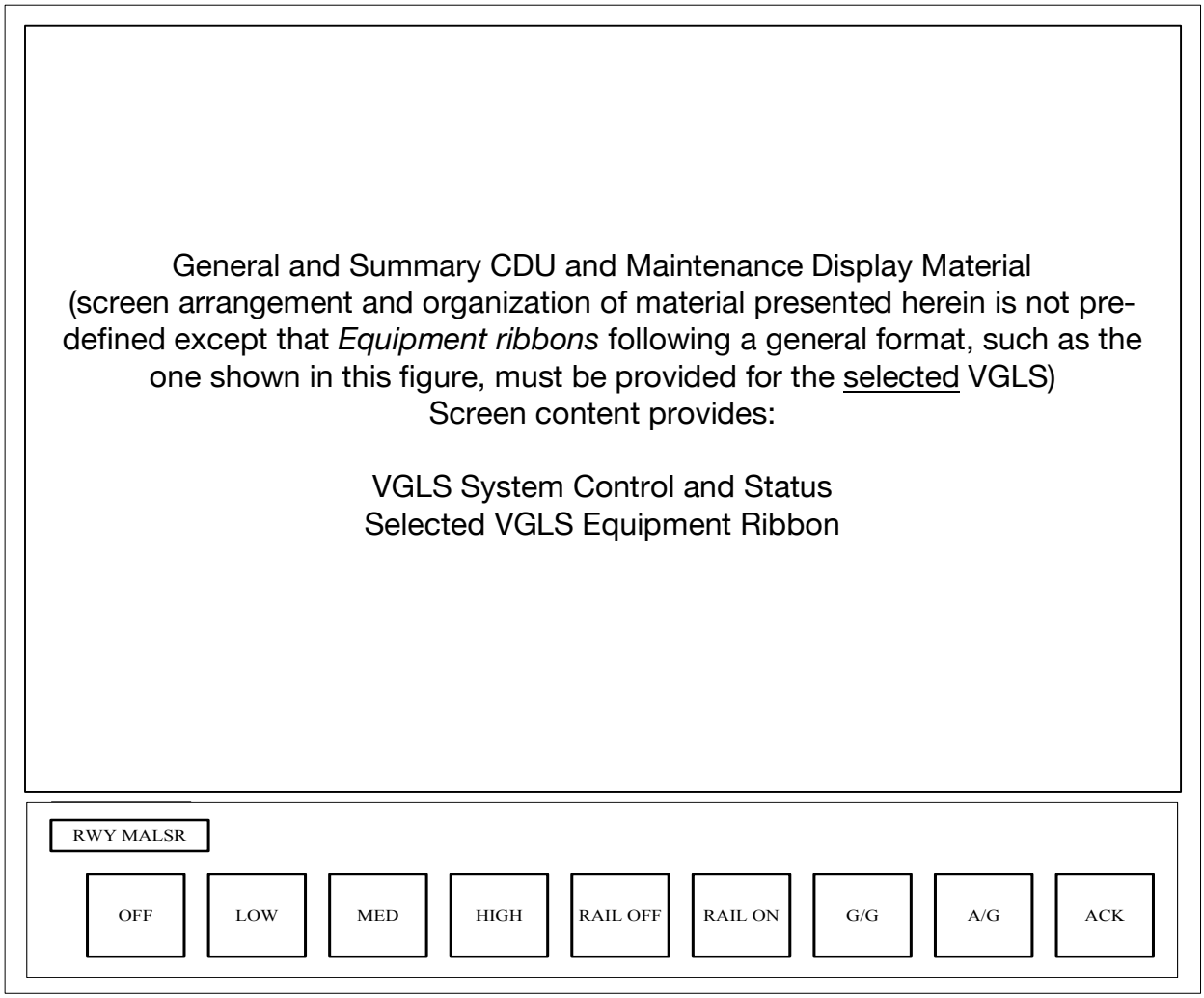

Figure 6. Conceptual CDU Display

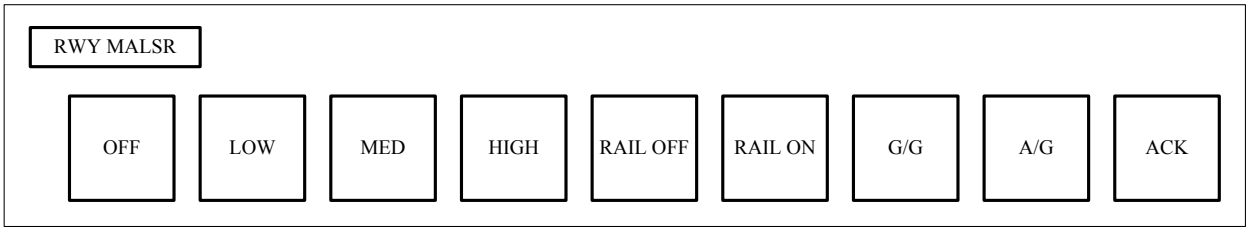

Figure 7. MALSR Ribbon Example

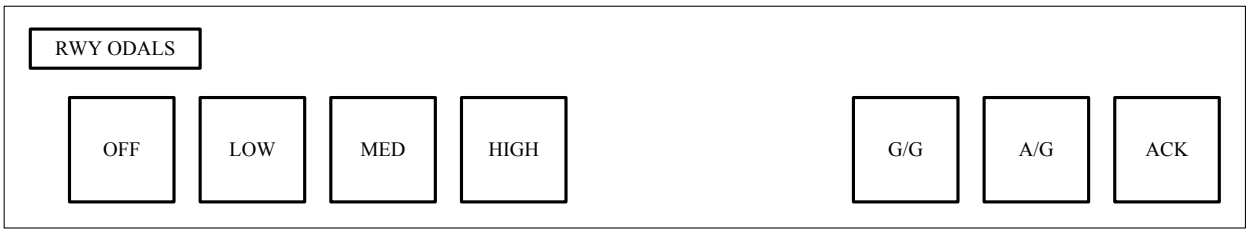

Figure 8. ODALS Ribbon Example

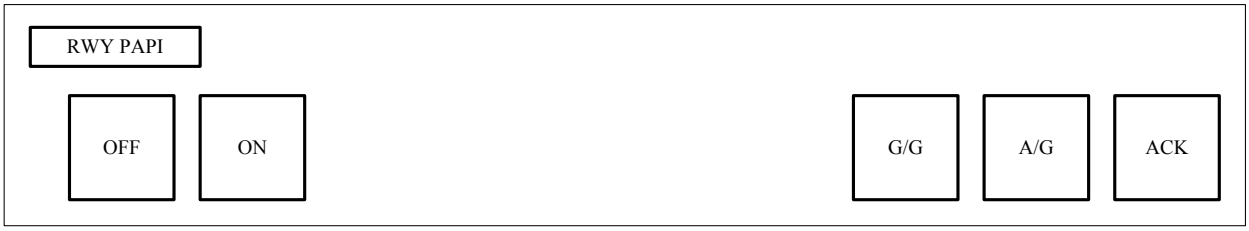

Figure 9. PAPI Ribbon Example

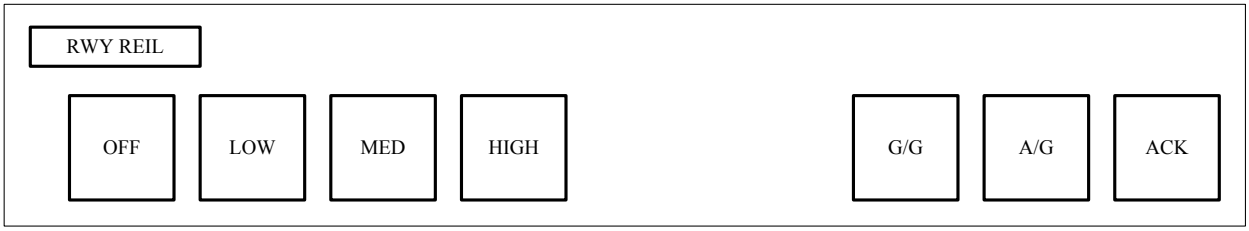

Figure 10. REIL Ribbon Example

Figure 11. VASI Ribbon Example

3.1.2.1.2 Transceiver-Concentrator Unit (TCU)

The TCU is the electronics assembly that is installed in the ATCT equipment room. The TCU may have a central processing unit or equivalent, operating system software (unsupported Operating System (OS) software is not permitted – that being OSs no longer supported by the creating company or organization), touchscreen display, interfaces that enables use of either a data radio and/or landline equipment, data radio for communication with remote equipment, antenna interface, and power supply. The TCU is responsible for executing the control and display functions used by the CDU that is located in the ATCT cab. The TCU may have added functions that provide system control, configuration, and RRCS operational status. For system

configuration and maintenance purposes, an integrated touchscreen display may be used in the TCU. An example TCU display is shown in Figure 12 below.

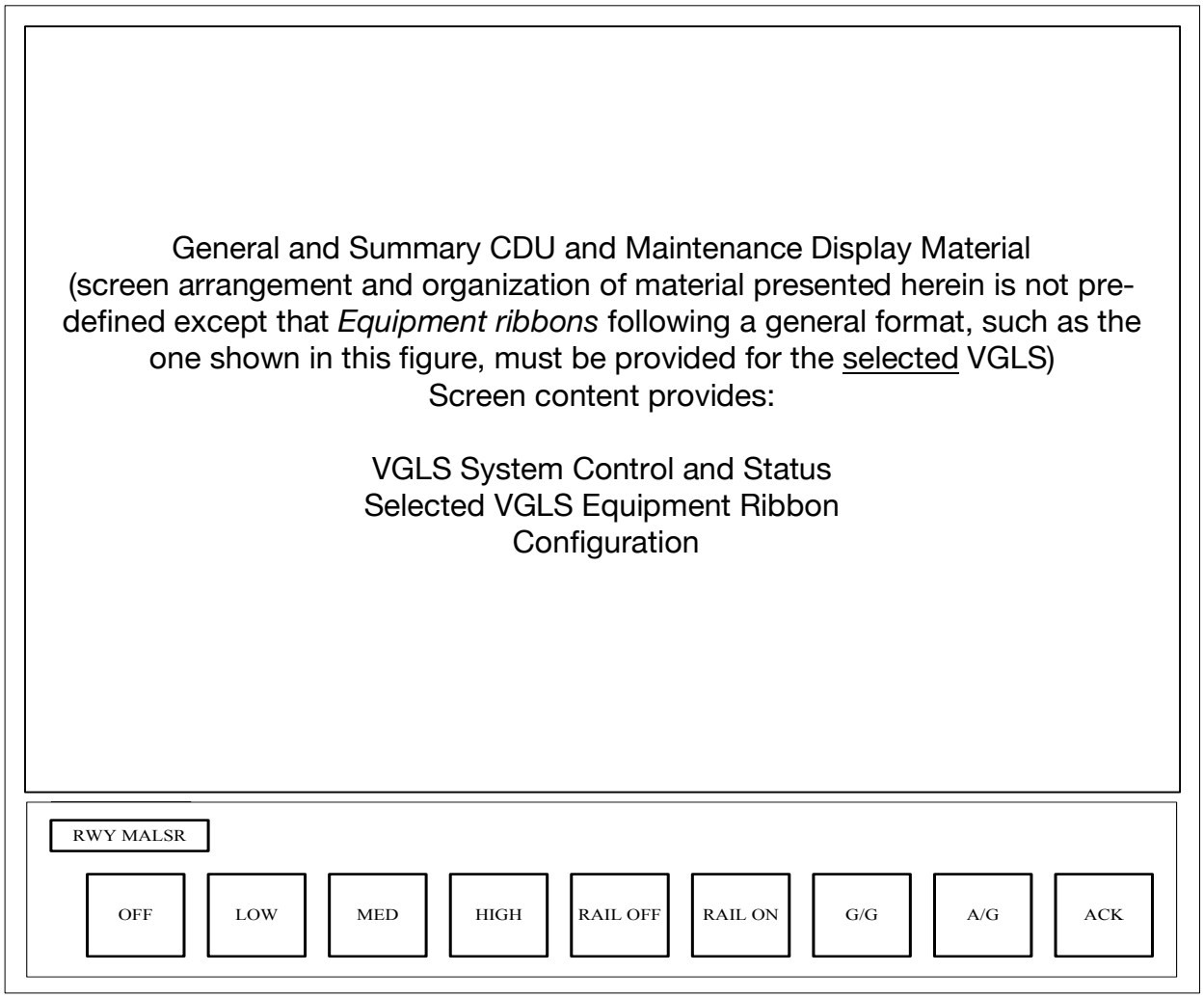

Figure 12. Conceptual TCU System Overview Screen

ATC control of the lighting systems by the TCU is accomplished using a wireless transceiver (or optional landline) as a data link to communicate with the RVIUs. Command execution status is defined as "Acknowledgement of the command (from either the TCU - G/G or VHF radio - A/G) execution by the RVIU." It is returned from the RVIUs via the same data link. The RRCS TCU will have a minimum RVIU interface capacity of 15 individual VGLS systems, but will not require all 15 interfaces to be utilized or connected to operate.

3.1.2.2 Remote VGLS interface unit (RVIU) equipment

The RVIU is described in the following section and its data flow diagram is shown in Figure 13. The RVIU provides the RRCS equipment interface to an individual VGLS. The RVIUs interface to the following VGLS equipment: Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR), Omnidirectional Approach Lighting System (ODALS), Runway End Identifier Lights (REIL), Precision Approach Path Indicator (PAPI), and Visual Approach Slope Indicator (VASI).

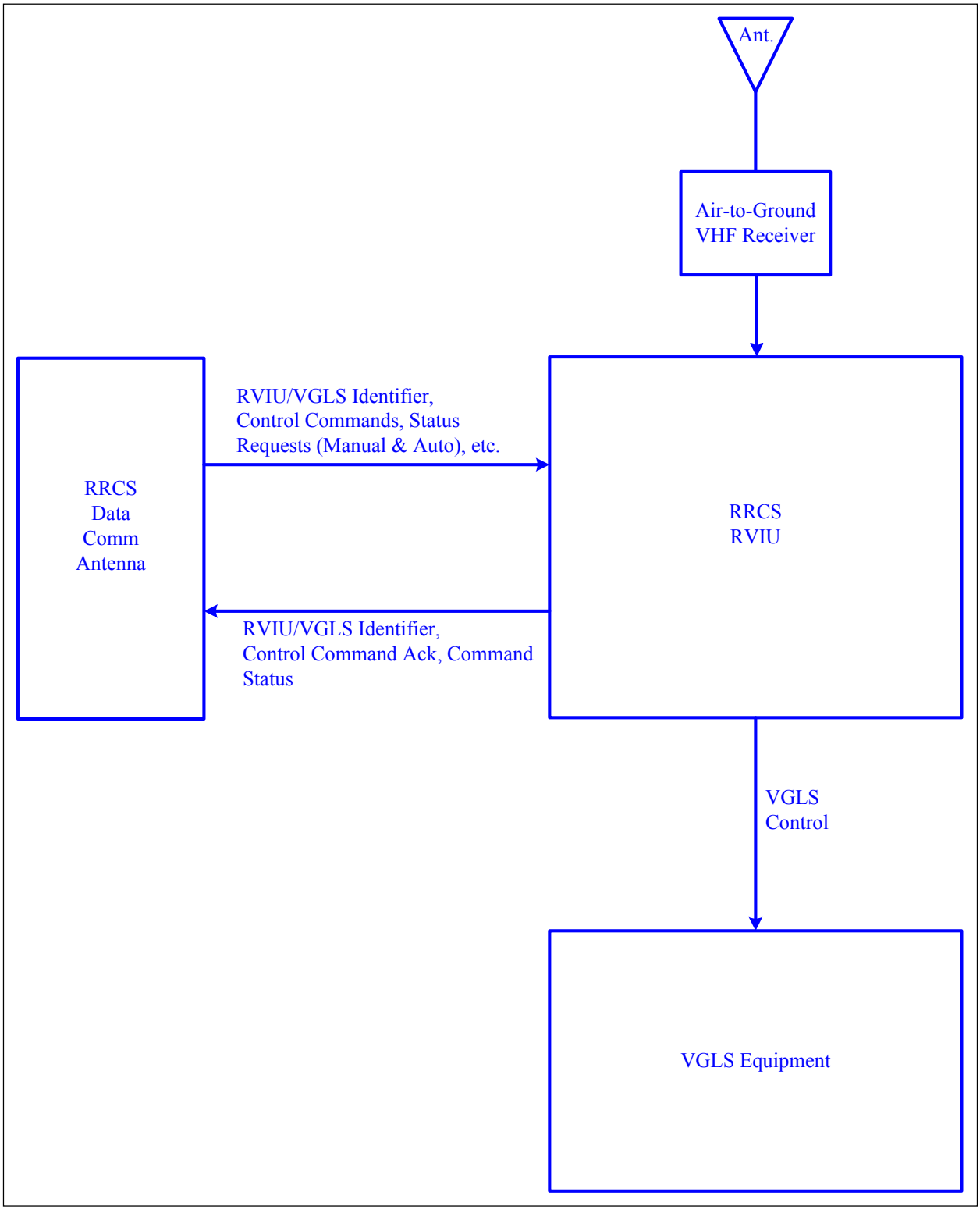

Figure 13. Data Flow Diagram of RRCS RVIU (remote site) Components – Conceptual

3.1.2.2.1 RVIU

The RRCS interfaces with new and existing visual lighting aids through the RVIU that is installed with each VGLS. The ATCT RRCS components (TCU/CDU) control and monitor the remote lighting systems using a wireless transceiver (or optional landline) for the data link between the TCU and RVIU. The RVIU receives commands for the associated lighting system from the TCU and controls the lighting system's operation through discrete 120VAC output control lines. The RVIU also monitors the lighting system's Air-to-Ground (A/G) command status, issues the received A/G commands to the VGLS when operating in A/G mode, and provides confirmation of command execution (both G/G and A/G commands) to the TCU. The RVIU must interface with VGLS equipment acquired using the equipment specifications provided in Table I.

Table I. Current VGLS Equipment Specifications

Equipment	Specification
MALS/MALSR	FAA-E-2980
ODALS	FAA-E-2651
PAPI	FAA-E-2756b
REIL	FAA-E-2159e
VASI	FAA-E-1328

3.2 Performance

3.2.1 RRCS product requirements

3.2.1.1 RRCS product definition

The RRCS provides control and control command execution status of airport VGLS equipment using a wireless transceiver and / or optional landline interface between equipment installed in the ATCT and the RVIU equipment.

3.2.2 System requirements

3.2.2.1 System components

The RRCS consists of the CDU, a TCU, and the number of RVIUs needed to control the designated VGLS equipment. The RRCS shall contain the necessary hardware and software to meet the requirements of this specification. Figure 1 illustrates the interfaces between the RRCS components and the set of the VGLS equipment identified in Table I. This specification requires that the RRCS interface with all of the VGLSs identified herein. The number of RVIUs for each RRCS will correspond to the number of controlled VGLSs for the airport. The RRCS base configuration shall consist of one CDU, a TCU, and RVIUs.

3.2.2.2 System design

The RRCS shall use a lowest replaceable unit (LRU) design to simplify maintenance and equipment upgrades.

3.2.2.3 Bi-directional communication

The ATCT TCU and RVIU RRCS shall be equipped with radio data communication equipment capable of transmitting "on-demand" data (i.e., not continuously) and receiving data.

3.2.2.4 Reliability and maintainability of electronic equipment

The reliability and maintainability requirements shall be as required below. The RRCS provides for a site and depot concept of maintenance. This concept assumes the use of LRU equipment that enables maintenance specialists to correct equipment failures by replacing the faulty LRU.

3.2.2.4.1 Maintenance checkout

All maintenance checkouts that will be performed in the field shall be capable of being performed with the standard tools in the list defined during the design review.

3.2.2.4.2 Reliability

Each RRCS component (CDU, TCU, and RVIU) shall have a point estimate Mean-Time-Between-Failure (MTBF) as shown in Table II.

Table II. RRCS Reliability and Maintainability Requirements

Subsystem	MTBF (Hours)	MTTR (Hours)
RRCS CDU	10,000	.5
RRCS TCU	30,000	.5
RRCS RVIU	30,000	.5

3.2.2.4.3 Maintainability

The RRCS CDU, TCU, and RVIUs shall be maintainable by one Maintenance Specialist, contain a minimum number of subsystems to meet the RRCS requirements, and enable the specialist to complete repairs without removing unaffected LRUs in accordance with the time requirement in paragraph 3.2.2.4.4.

3.2.2.4.4 Mean-Time-To-Repair

The Mean-Time-To-Repair (MTTR) of a single point failure of an RRCS shall be as shown in Table II or less, exclusive of time required to travel to the affected location. For purposes of this requirement, the RRCS consists of at least: the CDU, one TCU, and necessary RVIUs to communicate with one of each VGLS equipment type (MALSR, ODALS, REIL, PAPI, and VASI).

3.2.2.4.5 Periodic maintenance

3.2.2.4.5.1 RRCS CDU and TCU

3.2.2.4.5.1.1 RRCS operation interruption

RRCS operations shall not be interrupted for routine CDU or TCU periodic maintenance.

3.2.2.4.5.1.2 CDU and TCU periodic maintenance

Periodic maintenance for the CDU and TCU shall not be required more often than once every 90 days.

3.2.2.4.5.1.3 CDU and TCU mean periodic maintenance time

The mean periodic maintenance time (MPMT) shall not exceed 2 hours over a 90-day period for the CDU and TCU.

3.2.2.4.5.1.4 CDU and TCU personnel requirements

The periodic maintenance tasks for the ATCT components (CDU and TCU) shall require the services of only one person.

3.2.2.4.5.2 RRCS RVIU

3.2.2.4.5.2.1 RVIU periodic maintenance

Periodic maintenance on the RRCS RVIUs, performed at the RVIU's location, shall not be required more often than once every 90 days and may affect the operational status of the controlled VGLS.

3.2.2.4.5.2.2 RVIU mean periodic maintenance time

The MPMT shall not exceed 2 hours over a 90-day period for each RVIU.

3.2.2.4.5.2.3 RVIU personnel requirements

The periodic maintenance tasks for the RVIUs shall require the services of only one person.

3.2.2.4.6 Recoverability

3.2.2.4.6.1 Recovery

All system components of an operationally capable system shall recover automatically to normal operation from the loss of power (including power fluctuations), the loss of an interface, loss of any RRCS process and processor lock up.

3.2.2.4.6.2 Unit reset

Any unit that utilizes a microcontroller or microprocessor shall provide a method to manually reset the system.

3.2.2.4.6.3 RVIU recovery

3.2.2.4.6.3.1 RVIU power loss detection

The RVIU shall be capable of detecting RVIU system restarts due to power loss or power fluctuations exceeding the input power requirements defined in 3.2.4.2.1.

3.2.2.4.6.3.2 RVIU power loss status

The RVIU shall provide a status message identifying any RVIU restarts due to power loss or fluctuation.

3.2.2.4.6.3.3 RVIU power loss recovery

The TCU shall detect a single RVIU's recovery from power loss within 60 seconds based upon the RVIU's communicated status.

3.2.2.4.6.3.4 RVIU power loss recovery - initial state

When the TCU detects that an RVIU that had previously been commanded "ON" has recovered from a power loss, the RVIU shall be commanded to turn the associated VGLS "ON" to the highest intensity available (for systems with multiple intensities).

3.2.2.4.6.3.5 RVIU communication loss - state persistence

In the event of communication loss between the TCU and RVIU, the RVIU shall remain in the last commanded state until a new command is received.

3.2.2.4.7 Expandability

3.2.2.4.7.1 Hardware

The RRCS shall be capable of a 50% future growth in the size of the system (i.e., maximum average CPU time < 50% at initial delivery).

3.2.2.4.7.2 Software expandability

3.2.2.4.7.2.1 Software memory

The RRCS shall use no more than 50% of the available memory for all software and data storage at initial delivery.

3.2.2.4.7.2.2 Software upgrades

The RRCS component software shall be field upgradeable through an external communications port.

3.2.2.5 Subsystems controlled

The RRCS provides the indicated types of control for the following subsystems:

3.2.2.5.1 MALSR

The RRCS shall provide control for the following MALSR functions:

a.) Subsystem off;

b.) Select intensity (low, medium, or high);

c.) Runway alignment indicator lights (RAIL) on/off;

d.) Enable air-to-ground control; and,

e.) Enable ground-to-ground control.

3.2.2.5.2 ODALS

The RRCS shall provide control for the following ODALS functions:

a.) Subsystem off;

b.) Select intensity (low, medium, or high);

c.) Enable air-to-ground control; and,

d.) Enable ground-to-ground control.

3.2.2.5.3 REIL

The RRCS shall provide control for the following REIL functions:

a.) Subsystem off;

b.) Select intensity (low, medium, or high);

c.) Enable air-to-ground control; and,

d.) Enable ground-to-ground control.

3.2.2.5.4 PAPI

The RRCS shall provide control for the following PAPI functions:

a.) Subsystem on/off;

b.) Enable air-to-ground control; and,

c.) Enable ground-to-ground control.

3.2.2.5.5 VASI

The RRCS shall provide control for the following VASI functions:

a.) Subsystem on/off;

b.) Enable air-to-ground control; and,

c.) Enable ground-to-ground control.

3.2.2.6 RRCS Control-Display Unit (CDU)

The CDU shall display VGLS command status information selected by an ATC using a touch-screen display. The CDU is used by ATC to control and view command execution status for all RRCS-interfaced VGLS equipment (i.e., RVIU installed).

3.2.2.6.1 Physical CDU requirements

3.2.2.6.1.1 Typical installation

The RRCS CDU shall be console and/or articulated arm mountable.

3.2.2.6.1.2 CDU installation location and environment

The RRCS CDU shall be installed and operated in the ATCT cab under the “attended facility” (environment type I) conditions defined in Table XVIII.

3.2.2.6.1.3 Maintenance CDU installation location and environment

The RRCS maintenance CDU shall be installed and operated in the ATCT equipment room under the “attended facility” (environment type I) conditions defined in Table XVIII.

3.2.2.6.1.4 Maximum size

The maximum permissible dimensions of the RRCS CDU shall be 20” wide by 3” deep by 12” high.

3.2.2.6.1.5 Maximum weight

The maximum permissible weight of the CDU assembly shall be 15 lbs.

3.2.2.6.2 CDU data display and presentation

3.2.2.6.2.1 CDU display light control

The CDU display shall have independent brightness controls to permit manual adjustment of the display brightness in accordance with Section 5 of the FAA Human Factors Design Standard, HF-STD-001.

3.2.2.6.2.2 Readability

The ATCT RRCS display shall meet the requirements specified in Section 8 of the FAA Human Factors Design Standard, HF-STD-001.

3.2.2.6.3 Control state

3.2.2.6.3.1 System control status

The ATCT RRCS shall display the control command execution status of VGLS equipment when in air-to-ground and ground-to-ground mode.

3.2.2.6.3.2 Ground-to-ground status

ATCT RRCS system control status shall display “Ground-to-Ground” while under control of ATCT or Maintenance.

3.2.2.6.3.3 Air-to-ground status

ATCT RRCS system control status shall display “Air-to-Ground” while capable of control by aircraft.

3.2.2.6.3.4 RESERVED

3.2.2.6.3.5 Control indicator

The ATCT RRCS control indicator shall meet the requirements specified Section 8 of the FAA Human Factors Design Standard, HF-STD-001.

3.2.2.6.4 System status

3.2.2.6.4.1 System operational status

The ATCT RRCS shall display the commanded status of VGLS equipment in both ground-to-ground and air-to-ground modes.

3.2.2.6.4.2 Subsystem operational state indication

ATCT RRCS system status shall display the control command execution status “ON” or “OFF” state for VGLS equipment.

3.2.2.6.4.3 Subsystem intensity status

ATCT RRCS system status shall display the command execution state for VGLS intensity settings of “OFF”, “Low”, “Medium”, or “High” for those VGLSs with multiple intensity settings.

3.2.2.6.5 System alarms and indicators

3.2.2.6.5.1 Command execution fault display

The RRCS shall display VGLS command execution failures in accordance with the FAA Human Factors Design Standard, HF-STD-001.

3.2.2.6.5.2 Aural alarms

Aural alarms shall be provided to notify ATC of communication faults and command execution faults (RVIU) in accordance with Sections 6 and 7 of the FAA Human Factors Design Standard, HF-STD-001.

3.2.2.6.5.3 Aural alarm volume

Aural alarm volume shall be adjustable in accordance with Sections 6 and 7 of the FAA Human Factors Design Standard, HF-STD-001.

3.2.2.6.5.4 Visual status alarm

The RRCS visual status alarms shall be presented in accordance with Section 6 of the FAA Human Factors Design Standard, HF-STD-00, and be provided on all active control/display units.

3.2.2.6.5.5 Communication fault detection delay

The TCU and CDU shall display a visual indicator alarm, and enable an audible alarm on both, whenever communications to any RVIU has been lost for preset period of time.

3.2.2.6.5.6 Communication fault detection delay adjustment

The communication fault detection delay shall be adjustable from zero to 20 seconds.

3.2.2.6.5.7 Touchscreen display

3.2.2.6.5.7.1 Control and display groups

Each control and display group shall consist of the following: runway identifier, VGLS equipment type, equipment off, equipment on (if no intensity level options), intensity levels, ground-to-ground control enable, air-to-ground control enable, and equipment alarm acknowledge.

3.2.2.6.5.7.2 Data stream

The CDU shall send and receive data from the TCU.

3.2.2.6.5.7.3 Recovery

In case of AC power failure, when the power is restored the CDU shall reinitialize itself and restore all VGLS equipment to the state previously established by the Controller.

3.2.2.7 RRCS Transceiver-Concentrator Unit (TCU)

The TCU is responsible for executing the control and display functions used by the CDU. The TCU is also responsible for maintaining system control, configuration, and RRCS operational status. An integrated touchscreen display may be used in the TCU.

3.2.2.7.1 Physical TCU requirements

3.2.2.7.2 RRCS TCU design

The RRCS TCU components shall be integrated as one unit (processor, touchscreen display, power supply, transceiver, external communication port, etc.).

3.2.2.7.2.1 Typical installation

The RRCS TCU shall be rack mountable in an EIA/ECA-310-E compliant 19” rack.

3.2.2.7.2.2 Typical installation location and environment

The RRCS TCU is typically installed and operated in the ATCT equipment room under the “attended facility” (environment type I) conditions defined in Table XVIII.

3.2.2.7.2.3 Maximum size

The maximum permissible dimensions of the RRCS TCU shall be 19” wide by 21” deep by 12” high.

3.2.2.7.3 TCU – RVIU message receipt and processing

The TCU shall receive and process limited-periodic incoming RVIU responses and associated command execution status messages for all RVIUs installed at the associated airport.

3.2.2.7.4 TCU command message

When combined with the associated VGLS, each RVIU installation is unique. Each RVIU (and thus each VGLS) shall be individually addressable by the TCU.

3.2.2.7.5 VGLS configuration storage

The VGLS configurations (runway designation and equipment type) shall be stored in non-volatile memory and capable of backup and restoration via an external communication port.

3.2.2.8 RRCS Remote VGLS Interface Unit (RVIU)

3.2.2.8.1 Physical RVIU requirements

3.2.2.8.1.1 RVIU design

The RRCS RVIU components shall be integrated as a single NEMA 4X assembly (processor, power supply, transceiver, external communication port, etc.).

3.2.2.8.1.2 Typical installation and environment

The RRCS RVIU shall be mountable and operate under the “outdoor” (environment type III) conditions defined in Table XVIII.

3.2.2.8.1.3 Installation location

The RRCS RVIU shall be installed at the VGLS equipment location.

3.2.2.8.1.4 Minimum/maximum Size

The minimum permissible depth of the RVIU shall be 6” and the maximum permissible width and height of the RVIU are 24” wide by 24” high.

3.2.2.8.1.5 Maximum Weight

The maximum permissible weight of the RVIU assembly shall be 50 lbs.

3.2.2.8.2 RVIU-VGLS interface

The RVIU shall interface with all approved VGLS equipment types listed in the following subsections.

3.2.2.8.2.1 RVIU MALSR

The RVIU shall interface with equipment that meets the MALSR specification in Table I.

3.2.2.8.2.2 RVIU ODALS

The RVIU shall interface with equipment that meets the ODALS specification in Table I.

3.2.2.8.2.3 RVIU PAPI

The RVIU shall interface with equipment that meets the PAPI specification in Table I.

3.2.2.8.2.4 RVIU REIL

The RVIU shall interface with equipment that meets the REIL specification in Table I.

3.2.2.8.2.5 RVIU VASI

The RVIU shall interface with equipment that meets the VASI specification in Table I.

3.2.2.8.3 TCU – RVIU message receipt and processing

The RVIU shall receive and process incoming TCU commands and provide the associated command execution status in response.

3.2.2.8.4 RRCS remote equipment status message

The RVIU shall provide VGLS status messages within 10 seconds of receiving a request from the TCU.

3.2.2.9 Operational TCU and RVIU transceiver requirements

The transceiver must be capable of operation in accordance with the following requirements:

3.2.2.9.1 Transceiver – interface

The RVIU and TCU shall include a transceiver interface to provide for communication between the TCU and RVIUs using either radio frequency (RF) transceivers or optional landlines.

3.2.2.9.2 Transceiver – RF transceiver

The TCU and each RVIU shall include one (1) data RF transceiver per unit.

3.2.2.9.3 Transceiver – optional connectivity

The transceiver interface shall be designed such that the RF transceiver may be used simultaneously or replaced with an FAA-supplied landline interface that enables connectivity to FAA copper or fiber landlines for TCU/RVIU communications without additional RRCS hardware or software modifications.

3.2.2.9.4 Transceiver-antenna interface lightning protection

RRCS transceiver equipment shall interface with an antenna protected per FAA-STD-019.

3.2.2.9.5 Transceiver RF output frequency

The transceiver RF output frequency shall be programmable between 162-174 MHz or 406.1-420 MHz to accommodate site-specific frequency assignments.

3.2.2.9.6 Transceiver RF tolerance

The RRCS transceiver frequency tolerance shall not exceed 1.5 ppm (when operating in the 162-174 MHz band) or 1.0 ppm (when operating in the 406.1- 420 MHz band) per NTIA Manual 5.2.1.

3.2.2.9.7 Transceiver emission levels

Transceivers operating in the 406.1- 420 MHz band shall meet the wideband and narrowband emission levels to protect the Global Positioning System (GPS) per NTIA Manual 8.2.55.

3.2.2.9.8 Spurious response

The receiver shall meet the basic requirements for spurious response attenuation, adjacent channel selectivity, intermodulation rejection, and conducted spurious emissions per NTIA Manual 5.3.7A.

3.2.2.9.9 Transceiver tuning

3.2.2.9.9.1 162-174 MHz

Transceivers operating in the 162-174 MHz band shall adhere to the tuning and channel plan requirements per NTIA 4.3.7.

3.2.2.9.9.2 406.1-420 MHz

Transceivers operating in the 406.1- 420 MHz band shall adhere to the tuning and channel plan requirements per NTIA 4.3.9.

3.2.2.9.10 Transceiver channel spacing

Transceiver channel spacing shall be 12.5 kHz.

3.2.2.9.11 Transceiver bandwidth

Transceiver bandwidth shall not exceed 11 kHz (preferably 6.25 kHz or less if technically feasible) while providing sufficient data rates for control and status indication for the required minimum capacity of 15 RVIUs.

3.2.2.9.12 Programmable transceiver

TCU and RVIU transceiver RF output power shall be adjustable in increments of 0.1W up to 5 W (± 0.1 W) to accommodate worst-case, site-specific RF losses, but set to a default of the minimum RF output power required for proper operation of the installed system in a clean-site, typical-distance installation.

3.2.2.9.13 ATCT coaxial cable

All requirements shall be met with cable lengths equal to 500 feet from the ATCT RRCS TCU antenna to the transceiver.

3.2.2.9.14 VGLS site coaxial cable

All requirements shall be met with cable lengths equal to 300 feet from the VGLS RVIU antenna to the transceiver.

3.2.2.9.15 CDU-TCU communications cable

If a dedicated cable is used, all requirements shall be met with communication cable lengths equal to 500 feet to connect the CDU and the TCU.

3.2.2.9.16 Transceiver transmission distance

The TCU shall reliably demonstrate communication with an RVIU at an obstruction-free site located up to 7 nautical miles (nmi) from the TCU.

3.2.2.9.17 Frequency configuration

Both the RRCS and RVIU transceivers shall be tuned to the same frequency as a local, point-to-multipoint system. Use of frequency hopping techniques is prohibited.

3.2.2.9.18 Bi-Directional simplex system

The TCU and RVIU shall be equipped with data communication equipment capable of transmitting and receiving simplex data on a single frequency.

3.2.2.9.19 Single frequency

The RRCS transceivers shall use a single frequency for both the TCU and RVIU transceivers.

3.2.2.9.20 Voltage Standing Wave Ratio (VSWR)

VSWR shall meet the requirements in Table III.

Table III. VSWR Requirements

State	VSWR
Initial	Limits provided in Order JO-6650, Maintenance of Radio Control Equipment for Plant Facilities, paragraph 301(b)(5)
Operating	<= 2.0:1

3.2.2.9.21 Transceiver modulation type

The RRCS shall use a digital frequency modulation (FM) or pulse modulation (PM) scheme that conforms to the standards within Chapter 5.3.7 and Annex J of the NTIA Manual (47 CFR Part 300).

3.2.2.9.22 Transceiver security

The RRCS shall implement Identification and Authentication (IA) over the Radio Frequency (RF) links between one tower transceiver and the field receiving units. Whereby an airport's RRCS's field receivers only accept coded commands from its assigned tower.

3.2.2.10 Antenna requirements

3.2.2.10.1 Environmental conditions

Each antenna shall be compatible with the environmental operating requirements specified in Table IV.

Table IV. Antenna environmental requirements

Parameter	Characteristic
Temperature	-51° F to +158° F (-46° C to +70° C)
Relative Humidity	0% to 100% including seacoast salt spray environment
Wind and ice loading	Up to 85 knots with up to 1/2 inch of radial ice
Precipitation	Up to 7 inches of rainfall per hour

3.2.2.10.2 RRCS TCU antenna

3.2.2.10.2.1 Antenna type

The TCU shall utilize an antenna with characteristics as listed in Table V.

Table V. TCU antenna characteristics

Parameter	Characteristic
Gain	5.0dBi, maximum
Frequency Range	As required by transceiver
Connector Style	N-Type, Female

3.2.2.10.3 RRCS RVIU antenna

3.2.2.10.3.1 Antenna type

The RVIU shall utilize an antenna with characteristics as listed in Table VI.

Table VI. RVIU antenna characteristics

Parameter	Characteristic
Gain	5.0dBi, maximum
Frequency Range	As required by transceiver
Connector Style	N-Type, Female

3.2.3 RRCS Operational Requirements

3.2.3.1 Number of systems controlled

Each RRCS installation shall have the capacity to control a minimum of 15 VGLSs.

3.2.3.2 Operational functions

3.2.3.2.1 ATC CDU control

3.2.3.2.1.1 System control during normal mode

During Ground-to-Ground mode, the CDU shall be capable of controlling and monitoring the command execution status of the VGLSs from the ATCT cab.

3.2.3.2.1.2 System monitoring during VGLS maintenance mode

During VGLS maintenance, the CDU shall be capable of monitoring the command execution status of the VGLSs from the ATCT cab without generating audible alarms.

3.2.3.2.1.3 Field equipment fault detection

In accordance with Section 6 of HF-STD-001, the CDU shall display a visual alarm indication, with a corresponding audible alarm, whenever the command execution status of any RVIU has unexpectedly changed or when the actual equipment state does not reflect the last command state.

Note: Audible alarms are disabled at the CDU whenever the system is placed into Maintenance mode (i.e., when the system is controlled from the TCU).

3.2.3.2.1.4 Communication fault detection

The CDU shall display a visual alarm indication whenever communication to the TCU has been lost for more than the configured communication fault time period (zero to 20 seconds).

3.2.3.2.1.5 Visual alarm indication

A visual alarm indication shall be distinctively displayed on the CDU when the status of any VGLS requires immediate attention of the ATCT user in accordance with Section 6 of HF-STD-001.

3.2.3.2.1.6 Alarm indications

If a VGLS enters an “alarm” state it shall be presented on the currently visible CDU/TCU status display page.

3.2.3.2.1.7 Visual alarm button

The CDU System Overview screen shall include a System Status display button.

3.2.3.2.1.8 Visual alarm button characteristics

The CDU System Overview screen System Status button shall be an indicator for presenting alarm status in accordance with Sections 6 and 9 of FAA HF-STD-001 as well as a touch-sensitive control input for acknowledging alarm conditions.

3.2.3.2.1.9 Visual alarm button dimensions

The System Status button on the CDU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.1.10 Equipment fault visual alarm indication characteristics

In accordance with Section 6 of HF-STD-001, once a visual alarm condition is triggered, the visual alarm indication shall indefinitely toggle between two states until the visual alarm indication is acknowledged.

3.2.3.2.1.11 Communication fault visual indication

When a communication failure occurs between the TCU and an RVIU, all control buttons and status indicators for the respective RVIU on the CDU and TCU shall indicate controls are disabled and current status is unavailable in accordance with Section 6 of HF-STD-001.

3.2.3.2.1.12 Communication fault visual alarm indication acknowledgement

When the active communication fault visual alarm condition is acknowledged by the ATCT user, the steady alarm indication shall be in accordance with Section 6 of HF-STD-001.

3.2.3.2.1.13 Audible alarms - general

CDU audible alarms shall be enabled only when the system is in Ground-to-Ground mode and when the command execution state does not reflect the last command state (including communication errors), in accordance with HF-STD-001, Section 7.

Note: Audible alarms are disabled at the CDU whenever the system is placed into Maintenance mode (i.e., when the system is controlled from the TCU).

3.2.3.2.1.14 Audible alarm - duration

Once the alarm condition is triggered, the audible alarm “on” duration shall be a minimum of 500ms followed by an “off” duration of 500ms and cycled between “on” and “off” continuously thereafter until acknowledged by the ATCT user in accordance with HF-STD-001, Section 7.

3.2.3.2.1.15 Audible alarm - acknowledgement

When the active audible alarm condition is acknowledged by the ATCT user, the alarm shall be silenced in accordance with HF-STD-001, Section 7.

3.2.3.2.1.16 Screen overview legend

The CDU System Overview screen shall include a legend in accordance with HF-STD-001, Section 6.

3.2.3.2.1.17 Supported VGLS

The CDU System Overview screen shall support the minimum VGLS equipment capacity (15), using multiple pages if necessary.

3.2.3.2.1.18 Equipment ribbon display

The corresponding field equipment status and control ribbon shall be displayed in response to selecting a VGLS on the CDU System Overview screen.

3.2.3.2.1.19 Equipment status and control ribbon

The CDU System Overview screen shall display the status and available control features of a selected VGLS in the form of a ribbon.

3.2.3.2.1.20 Equipment status button dimensions

Each VGLS on the CDU System Overview screen shall be represented as a button in accordance with HF-STD-001, Section 9.

3.2.3.2.1.21 Equipment status button spacing

Each VGLS button on the CDU System Overview screen shall be spaced in accordance with HF-STD-001, Section 9.

3.2.3.2.1.22 Equipment status button adjacent object spacing

Each VGLS button on the CDU System Overview screen shall be spaced in accordance with HF-STD-001, Section 9.

3.2.3.2.1.23 Equipment status button characteristic

Each VGLS button on the CDU System Overview screen shall be a touch-sensitive control input as well as an indicator.

3.2.3.2.1.24 Runway label - defined runway

The CDU System Overview screen shall label each defined runway with an alphanumeric string in accordance with HF-STD-001, Section 8.

3.2.3.2.1.25 Runway label - defined equipment

The CDU System Overview screen shall label each defined runway equipment type with an alphanumeric string (e.g., “ODALS”) limited to five characters in accordance with HF-STD-001, Section 8.

3.2.3.2.1.26 Ribbon display - defined equipment

When manually selected, each defined VGLS button on the CDU System Overview screen shall cause the corresponding equipment status ribbon to be displayed on the bottom of the screen.

3.2.3.2.1.27 Ribbon display - undefined equipment

When manually selected, each undefined/unused VGLS button on the CDU System Overview screen shall not cause any system effect.

Note: There are no control ribbon touch buttons for undefined/unused VGLS.

3.2.3.2.1.28 Maintenance mode annunciation

When the RRCS is placed in Maintenance Mode the ATCT user shall be alerted by a visual indication on the CDU.

3.2.3.2.1.29 ATCT/MAINT mode indication

The CDU System Overview screen shall include a dedicated indicator for indicating the present ATCT/MAINT mode.

3.2.3.2.1.30 ATCT/MAINT mode indicator dimensions

The ATCT/MAINT indicator on the CDU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.1.31 ATCT/MAINT indicator formatting

The ATCT/MAINT indicator on the CDU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.1.32 Page control function

The CDU System Overview screen shall support a page control function to navigate between multiple separate screens if needed by screen design.

3.2.3.2.1.33 Page control button

If needed, the CDU System Overview screen shall include a dedicated page control button (previous/next page button) for the purpose of navigating to the next, or previous, System Overview screen.

3.2.3.2.1.34 Page control button type

If needed, the page control button (previous/next page button) on the CDU System Overview screen shall be a touch-sensitive control input as well as an indicator.

3.2.3.2.1.35 Page control button dimensions

If needed, the page control button (previous/next page button) on the CDU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.1.36 Page control button formatting

If needed, the page control button (previous/next page button) on the CDU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.1.37 Volume control up button

The CDU System Overview screen shall include a dedicated control input button for the purpose of increasing the audible alert volume in accordance with HF-STD-001, Section 7.

3.2.3.2.1.38 Volume control up button dimensions

The volume control "Up" button on the CDU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.1.39 Volume control up button formatting

The volume control "Up" button on the CDU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.1.40 Volume control down button

The CDU System Overview screen shall include a dedicated control input button for the purpose of decreasing the audible alert volume in accordance with HF-STD-001, Section 7.

3.2.3.2.1.41 Volume control down button dimensions

The volume control "Down" button on the standard System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.1.42 Volume control down button formatting

The volume control "Down" button on the CDU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.1.43 Volume test button

The CDU System Overview screen shall include a dedicated control input button for the purpose of testing the current volume level setting of the audible alert volume in accordance with HF-STD-001, Section 7.

3.2.3.2.1.44 Volume test button dimensions

The volume "Test" button on the CDU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.1.45 Volume test button formatting

The volume "Test" button on the CDU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.1.46 Volume test button response

Selecting the volume test button shall result in an audible pulse at the last set volume level in accordance with HF-STD-001, Section 7.

3.2.3.2.1.47 Display brighter button

The CDU System Overview screen shall include a dedicated control input button for the purpose of increasing the display luminance in accordance with HF-STD-001, Section 5.

3.2.3.2.1.48 Display brighter button dimensions

The backlight brighter button on the CDU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.1.49 Display brighter button formatting

The backlight brighter button on the CDU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.1.50 Display darker button

The CDU System Overview screen shall include a dedicated control input button for the purpose of decreasing the display luminance in accordance with HF-STD-001, Section 5.

3.2.3.2.1.51 Display darker button dimensions

The backlight darker button on the CDU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.1.52 Display darker button formatting

The backlight darker button on the CDU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.1.53 Equipment status button formatting

The most recent command execution status of each VGLS shall be formatted and displayed on the CDU System Overview screen in accordance with HF-STD-001, Section 8.

3.2.3.2.1.54 Equipment ribbon - button dimensions

Each ribbon button, either control or indicator, shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.1.55 Equipment ribbon - button spacing

Each ribbon button, either control or indicator, shall be spaced from all other button and label objects in accordance with HF-STD-001, Section 9.

3.2.3.2.1.56 Equipment ribbon - button adjacent object spacing

Each ribbon button, either control or indicator, shall be spaced from all other button and label objects in accordance with HF-STD-001, Section 9.

3.2.3.2.1.57 Equipment ribbon - control button characteristic

The functionality of each ribbon indicator/control button shall support being programmed as a touch-sensitive control input and indicator.

3.2.3.2.1.58 Equipment ribbon - indication button characteristic

The functionality of each ribbon indicator button shall support being programmed as an indicator-only (i.e., no control capability).

3.2.3.2.1.59 Equipment ribbon - button color assignments

The use of color on ribbon buttons shall be in accordance with HF-STD-001, Section 8 for the conditions given in Table VII.

Table VII. CDU equipment ribbon button conditions

System Condition
Normal, On
Transition, unknown condition
Off
Not Selected
Alarm

3.2.3.2.1.60 Equipment ribbon - equipment identifier

The CDU equipment ribbon shall include a display of the corresponding runway designator in combination with the type of equipment, with a blank character as a separator between them, as defined in Table VIII in accordance with HF-STD-001, Section 8.

Table VIII. CDU equipment ribbon - equipment identifier

Ribbon Equipment Identifier Formatting
Text **(Note 1, 2, 3)**
"RWY␣EQUIP"

Note 1: "RWY" represents the same 3-character alphanumeric string used on the CDU System Overview screen (e.g., 35L, 07R, ␣18, etc.).

Note 2: The character "␣" represents a blank space in the test string.

Note 3: "EQUIP" represents the same 5-character alpha string used on the CDU System Overview screen.

3.2.3.2.1.61 MALSR ribbon

The MALSR ribbon contains a combination of command execution status and control buttons. The conceptual display of the MALSR ribbon is illustrated in Figure 14.

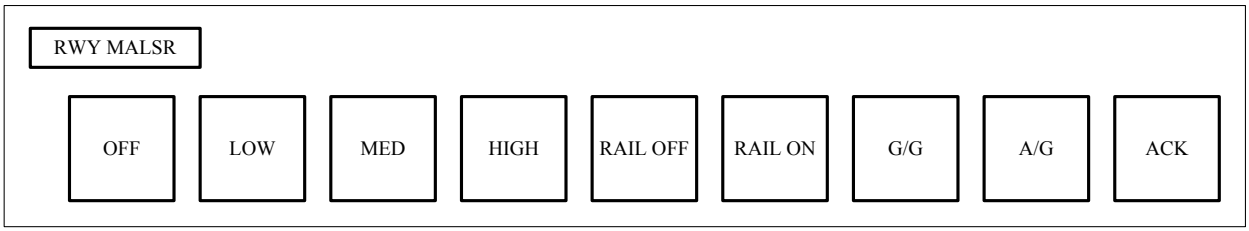

Figure 14. Conceptual MALSR ribbon display

3.2.3.2.1.62 MALSR ribbon - display and formatting

The information to be displayed on the MALSR equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.1.63 MALSR on selection

If the MALSR VGLS is currently off, then selecting the "LOW", "MED", or "HIGH" button shall command the MALSR to turn "ON" and to the corresponding intensity level (i.e., set to low, medium, or high intensity).

3.2.3.2.1.64 MALSR off selection

If the MALSR VGLS is currently set to "LOW", “MED”, or “HIGH” intensity, then selecting the "OFF" button shall command the MALSR and RAIL to turn “OFF”.

3.2.3.2.1.65 MALSR low intensity selection

If the MALSR VGLS is currently set to “OFF”, "MED" or “HIGH” intensity, then selecting the "LOW" button shall command low intensity to turn “ON” on the MALSR VGLS.

3.2.3.2.1.66 MALSR medium intensity selection

If the MALSR VGLS is currently set to “OFF”, "LOW" or "HIGH" intensity, then selecting the "MED" button shall command medium intensity to turn “ON” on the MALSR VGLS.

3.2.3.2.1.67 MALSR high intensity selection

If the MALSR VGLS is currently set to “OFF”, “LOW” or "MED" intensity, then selecting the "HIGH" button shall command high intensity to turn “ON” on the MALSR VGLS.

3.2.3.2.1.68 MALSR RAIL on selection

If the number of flashers installed for a MALSR is one or more, then the RAIL ON button shall be visible to the user, else it is not visible. If the MALSR VGLS is currently "ON" (Low, Med, or High), and the RAIL are currently "OFF", then selecting the "RAIL ON" button shall command the RAIL to turn “ON”, else it has no effect.

> Note: The RAIL “ON/OFF” is only enabled when MALSR is on Low/Medium/High Intensity.

3.2.3.2.1.69 MALSR RAIL off selection

If the number of flashers installed for a MALSR is one or more, then the RAIL OFF button shall be visible to the user, else it is not visible. If the MALSR VGLS is currently "ON" (Low, Med, or High), and the RAIL are currently "ON", then selecting the "RAIL OFF" button shall command the RAIL to turn "OFF", else it has no effect.

3.2.3.2.1.70 MALSR RAIL state

The command state of the MALSR RAIL selection shall persist through MALSR “OFF” commands (e.g., if the RAIL is ON when the MALSR is commanded OFF the RAIL will also be turned OFF, but when the MALSR is commanded ON again the RAIL will also turn ON).

3.2.3.2.1.71 MALSR ground-to-ground selection

If the MALSR is A/G equipped, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the MALSR lighting system to receive lighting control commands from the CDU. When going from A/G to G/G, the MALSR equipment shall keep its On/Off/Intensity settings currently selected by A/G.

3.2.3.2.1.72 MALSR air-to-ground selection

If the MALSR is A/G equipped, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the MALSR lighting system to receive lighting control commands from the appropriate radio frequency. When going from G/G to A/G, the MALSR equipment shall turn OFF.

> Note: When in A/G mode, the command execution status of the equipment is reported to the CDU/TCU equipment ribbon display.

3.2.3.2.1.73 MALSR alarm acknowledge

If the MALSR VGLS is currently "ON" with an active alarm condition (communications fault or RVIU command not executed/received) pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm if the system is in ATCT mode.

3.2.3.2.1.74 ODALS ribbon

The ODALS ribbon contains a combination of command execution status and control buttons. The conceptual display of the ODALS ribbon is illustrated in Figure 15.

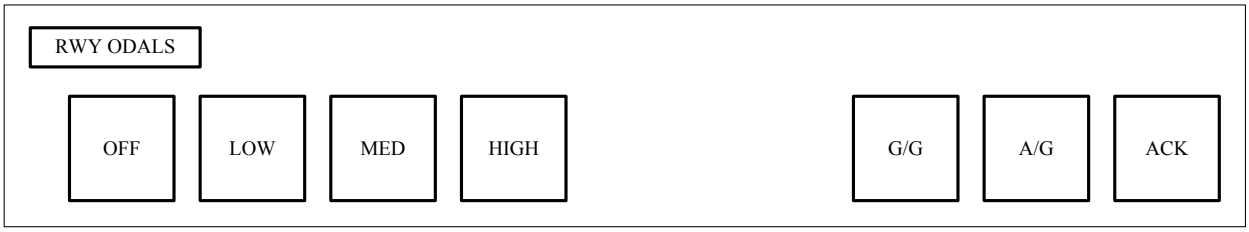

Figure 15. Conceptual ODALS ribbon display

3.2.3.2.1.75 ODALS ribbon display and formatting

The information to be displayed on the ODALS equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.1.76 ODALS on selection

If the ODALS VGLS is currently "OFF", then selecting the "LOW", "MED", or "HIGH" button shall command the ODALS VGLS to turn “ON” and to the corresponding intensity level (i.e., set to low, medium, or high intensity).

3.2.3.2.1.77 ODALS off selection

If the ODALS VGLS is currently set to "LOW", “MED”, or “HIGH” intensity, then selecting the “OFF” button shall command the ODALS VGLS to turn "OFF".

3.2.3.2.1.78 ODALS low intensity selection

If the ODALS VGLS is currently set to “OFF”, "MED" or “HIGH” intensity, then selecting the "LOW" button shall command low intensity to turn “ON” on the ODALS VGLS.

3.2.3.2.1.79 ODALS medium intensity selection

If the ODALS VGLS is currently set to “OFF”, "LOW" or "HIGH" intensity, then selecting the "MED" button shall command medium intensity to turn “ON” on the ODALS VGLS.

3.2.3.2.1.80 ODALS high intensity selection

If the ODALS VGLS is currently set to “OFF”, “LOW” or "MED" intensity, then selecting the "HIGH" button shall command high intensity to turn “ON” on the ODALS VGLS.

3.2.3.2.1.81 ODALS ground-to-ground selection

If the ODALS is A/G equipped, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the ODALS lighting system to receive control commands from the CDU. When going from A/G to G/G, the ODALS equipment shall keep its On/Off/Intensity settings currently selected by A/G.

3.2.3.2.1.82 ODALS air-to-ground selection

If the ODALS is A/G equipped, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the ODALS lighting system to receive control commands from the appropriate radio frequency. When going from G/G to A/G, the ODALS equipment shall turn Off.

Note: When in A/G mode, command execution status is reported to the CDU/TCU on the equipment ribbon display.

3.2.3.2.1.83 ODALS alarm acknowledge

If the ODALS VGLS is currently “ON” with an active alarm condition (communications fault or RVIU command not executed/not received) pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm if the system is in ATCT mode.

3.2.3.2.1.84 PAPI ribbon

The PAPI ribbon contains a combination of status and control buttons. The conceptual display of the PAPI ribbon is illustrated in Figure 16.

Figure 16. Conceptual PAPI ribbon display

3.2.3.2.1.85 PAPI ribbon display and formatting

The information to be displayed on the PAPI equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.1.86 PAPI on selection

If the PAPI VGLS is currently “OFF”, the selecting the “ON” button shall command the PAPI VGLS to turn “ON”.

3.2.3.2.1.87 PAPI off selection

If the PAPI VGLS is currently “ON”, then selecting the “OFF” button shall command the PAPI VGLS to turn "OFF", else it has no effect.

3.2.3.2.1.88 PAPI ground-to-ground selection

If the PAPI is A/G equipped, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the PAPI lighting system to receive control commands from the CDU. When going from A/G to G/G, the PAPI equipment shall keep its On/Off setting currently selected by A/G.

3.2.3.2.1.89 PAPI air-to-ground selection

If the PAPI is A/G equipped, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the PAPI lighting system to receive control commands from the appropriate radio frequency. When going from G/G to A/G, the PAPI equipment shall turn Off.

Note: When in A/G mode, command execution status is reported to the CDU/TCU on the equipment ribbon display.

3.2.3.2.1.90 PAPI alarm acknowledge

If the PAPI VGLS is currently “ON” with an active alarm condition (communications fault or RVIU command not executed/not received) pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm if the system is in ATCT mode.

3.2.3.2.1.91 REIL ribbon

The REIL ribbon contains a combination of status and control buttons. The conceptual display of the REIL ribbon is illustrated in Figure 17.

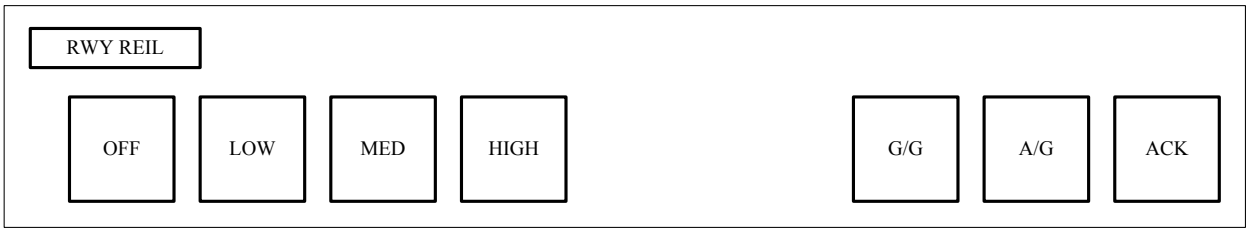

Figure 17. Conceptual REIL ribbon display

3.2.3.2.1.92 REIL ribbon display and formatting

The information to be displayed on the REIL equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.1.93 REIL ON selection

If the REIL VGLS is currently “OFF”, then selecting the “LOW”, “MED”, or “HIGH” button shall command the REIL VGLS to turn “ON” to the corresponding intensity level (i.e., set to low, medium, or high intensity).

3.2.3.2.1.94 REIL OFF selection

If the REIL VGLS is currently set to "LOW", “MED”, or “HIGH” intensity, then selecting the “OFF” button shall command the REIL VGLS to turn "OFF".

3.2.3.2.1.95 REIL low intensity selection

If the REIL VGLS is currently set to “OFF”, "MED" or “HIGH” intensity, then selecting the "LOW" button shall command low intensity to turn “ON” on the REIL VGLS.

3.2.3.2.1.96 REIL medium intensity selection

If the REIL VGLS is currently set to “OFF”, "LOW" or "HIGH" intensity, then selecting the "MED" button shall command medium intensity to turn “ON” on the REIL VGLS.

3.2.3.2.1.97 REIL high intensity selection

If the REIL VGLS is currently set to “OFF”, “LOW” or "MED" intensity, then selecting the "HIGH" button shall command high intensity to turn to “ON” on the REIL VGLS.

3.2.3.2.1.98 REIL ground-to-ground selection

If the REIL is A/G equipped, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the REIL lighting system to receive control commands from the CDU. When going from A/G to G/G, the REIL equipment shall keep its On/Off/Intensity setting currently selected by A/G.

3.2.3.2.1.99 REIL air-to-ground selection

If the REIL is A/G equipped, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the REIL lighting system to receive control commands from appropriate radio frequency. When going from G/G to A/G, the REIL equipment shall turn Off.

> Note: When in A/G mode, command execution status is reported to the CDU/TCU on the equipment ribbon display.

3.2.3.2.1.100 REIL alarm acknowledge

If the REIL VGLS is currently “ON” with an active alarm condition (communications fault or RVIU command not executed/not received) pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm if the system is in ATCT mode.

3.2.3.2.1.101 VASI ribbon

The VASI ribbon contains a combination of status and control buttons. The conceptual display of the VASI ribbon display is illustrated in Figure 18.

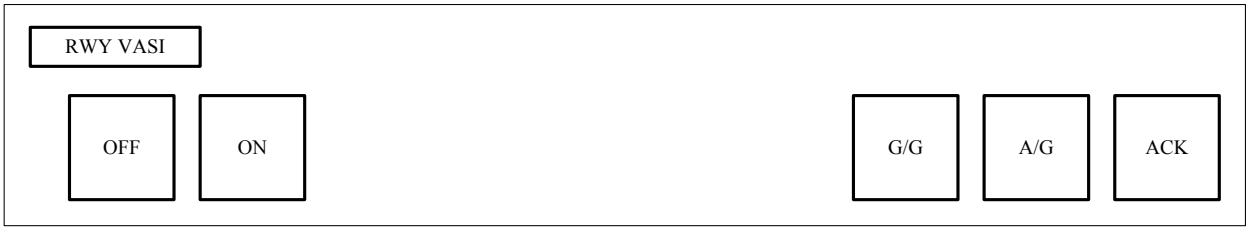

Figure 18. Conceptual VASI ribbon display

3.2.3.2.1.102 VASI ribbon display and formatting

The information to be displayed on the VASI equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.1.103 VASI on selection

If the VASI VGLS is currently “OFF”, then selecting the “ON” button shall command the VASI VGLS to turn "ON".

3.2.3.2.1.104 VASI off selection

If the VASI VGLS is currently “ON”, then selecting the “OFF” button shall command the VASI VGLS to turn "OFF", else it has no effect.

3.2.3.2.1.105 VASI ground-to-ground selection

If the VASI is A/G equipped, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the VASI lighting system to receive control commands from the CDU. When going from A/G to G/G, the VASI equipment shall keep its On/Off setting currently selected by A/G.

3.2.3.2.1.106 VASI air-to-ground selection

If the VASI is A/G equipped, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the VASI lighting system to receive control

commands from appropriate radio frequency. When going from G/G to A/G, the VASI equipment shall turn Off.

Note: When in A/G mode, command execution status is reported to the CDU/TCU on the equipment ribbon display.

3.2.3.2.1.107 VASI alarm acknowledge

If the VASI VGLS is currently “ON” with an active alarm condition (communications fault or RVIU command not executed/not received) pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm if the system is in ATCT mode.

3.2.3.2.2 Maintenance control (TCU)

3.2.3.2.2.1 Mode control

The TCU shall be capable of placing the RRCS in either ATCT mode or in Maintenance Mode.

3.2.3.2.2.2 System control during VGLS maintenance

During VGLS maintenance, the TCU shall be capable of monitoring the RVIUs and controlling the VGLSs from the tower equipment room.

3.2.3.2.2.3 System monitoring during ATCT mode

During ATCT mode, the TCU shall be capable of monitoring the RVIU command execution status from the tower equipment room.

3.2.3.2.2.4 Field equipment fault detection

In accordance with Section 6 of HF-STD-001, the TCU screen shall display a visual alarm indication with a corresponding audible alarm whenever the status of any RVIU has unexpectedly changed or when the actual equipment state does not reflect the last command state.

Note: Audible alarms are enabled at the TCU only when the system is placed into Maintenance mode (i.e., when the system is controlled from the TCU). Audible alarms are disabled at the CDU while in Maintenance mode.

3.2.3.2.2.5 Communication fault detection

The TCU shall display a visual alarm indication whenever communication to the TCU controller has been lost for more than the configured communication fault time period (zero to 20 seconds).

3.2.3.2.2.6 Visual alarm indication

A visual alarm indication shall be distinctively displayed on the TCU when the status of any VGLS requires immediate attention of the Maintenance User in accordance with Section 6 of HF-STD-001.

3.2.3.2.2.7 Visual alarm button

The TCU System Overview screen shall include a System Status button.

3.2.3.2.2.8 Visual alarm button characteristics

The TCU System Overview screen System Status button shall be an indicator for indicating fault conditions as well as a touch-sensitive control input for acknowledging fault conditions.

Note: The alarm ACK function only available in MAINT mode.

3.2.3.2.2.9 Visual alarm button dimensions

The System Status button on the TCU System Overview screen shall be in accordance with HF-STD-001, Section 9.

3.2.3.2.2.10 Equipment fault visual alarm indication characteristics

Once the visual alarm condition is triggered, in accordance with Section 6 of HF-STD-001, the visual alarm indication shall indefinitely toggle between two states until the visual alarm indication is acknowledged.

3.2.3.2.2.11 Communication fault visual indication

When a communication failure occurs between the TCU and the CDU all control buttons and status indicators on the TCU shall indicate controls are disabled and current status is unavailable, respectively, in accordance with Section 6 of HF-STD-001.

3.2.3.2.2.12 Communication fault visual alarm indication acknowledgement

When the active communication fault visual alarm condition is acknowledged by the Maintenance User, the steady alarm indication shall be displayed in accordance with Section 6 of HF-STD-001.

3.2.3.2.2.13 Audible alarms - general

TCU audible alarms shall be enabled only when the system is in the Maintenance mode, and when the command execution state does not reflect the last command state, in accordance with HF-STD-001, Section 7.

Note: Audible alarms are disabled at the TCU whenever the system is placed into the ATCT mode (i.e., when the system is controlled from the CDU).

3.2.3.2.2.14 Audible alarm - acknowledgement

When the active audible alarm condition is acknowledged by the Maintenance User the alarm shall be silenced in accordance with HF-STD-001, Section 7.

3.2.3.2.2.15 Screen overview label

The TCU System Overview screen shall include a legend formatted in accordance with HF-STD-001, Section 6.

3.2.3.2.2.16 Supported VGLS

The TCU System Overview screen shall support the minimum VGLS equipment capacity (15), using multiple pages if necessary.

3.2.3.2.2.17 Equipment ribbon display

The corresponding VGLS status and control ribbon shall be displayed in response to selecting an equipment button on the TCU System Overview screen.

3.2.3.2.2.18 Equipment status and control ribbon

The TCU System Overview screen shall display the status and available control features of a selected VGLS in the form of a "ribbon".

3.2.3.2.2.19 Equipment status button dimensions

Each VGLS on the TCU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.2.20 Equipment status button spacing

Each VGLS button on the TCU System Overview screen shall be spaced in accordance with HF-STD-001, Section 9.

3.2.3.2.2.21 Equipment status button adjacent object spacing

Each VGLS button on the TCU System Overview screen shall be spaced in accordance with HF-STD-001, Section 9.

3.2.3.2.2.22 Equipment status button characteristic

Each VGLS button on the TCU System Overview screen shall be a touch-sensitive control input as well as an indicator.

3.2.3.2.2.23 Runway label - defined runway

The TCU System Overview screen shall label each defined runway with an alphanumeric string in accordance with HF-STD-001, Section 8.

3.2.3.2.2.24 Runway label - defined equipment

The TCU System Overview screen shall label each defined runway equipment type with an alphanumeric string (e.g., “ODALS”) limited to five characters in accordance with HF-STD-001, Section 8.

3.2.3.2.2.25 Runway equipment label - undefined equipment

The TCU System Overview screen shall display undefined/unused runway equipment types in accordance with HF-STD-001, Section 8.

3.2.3.2.2.26 Ribbon display - defined equipment

When manually selected, each defined VGLS button on the TCU System Overview screen shall cause the corresponding equipment status ribbon to be displayed on the bottom of the screen.

3.2.3.2.2.27 Ribbon display - undefined equipment

When manually selected, each undefined/unused VGLS button on the TCU System Overview screen shall not cause any system effect.

3.2.3.2.2.28 ATCT/MAINT mode button

The TCU System Overview screen shall include a dedicated button for the purpose of both controlling and indicating the present ATCT/MAINT mode.

3.2.3.2.2.29 ATCT/MAINT mode indicator dimensions

The ATCT/MAINT indicator on the TCU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.2.30 ATCT/MAINT mode button formatting

The ATCT/MAINT button on the TCU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.2.31 Page control function

The TCU System Overview screen shall support a page control function to navigate between multiple screens, if needed.

3.2.3.2.2.32 Page control button

The TCU System Overview screen shall include a dedicated page direction "button" for the purpose of navigating to the next, or previous, System Overview screen, if needed.

3.2.3.2.2.33 Page control button type

The page direction button on the TCU System Overview screen shall be a touch-sensitive control input as well as an indicator, if needed.

3.2.3.2.2.34 Page control button dimensions

If needed, the page direction button on the TCU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.2.35 Page control button formatting

If needed, the page direction button on the TCU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.2.36 Volume control up button

The TCU System Overview screen shall include a dedicated control input button for the purpose of increasing the audible alert volume in accordance with HF-STD-001, Section 7.

3.2.3.2.2.37 Volume control up button dimensions

The volume control "Up" button on the TCU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.2.38 Volume control up button formatting

The volume control "Up" button on the TCU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.2.39 Volume control down button

The TCU System Overview screen shall include a dedicated control input button for the purpose of decreasing the audible alert volume in accordance with HF-STD-001, Section 7.

3.2.3.2.2.40 Volume control down button dimensions

The volume control "Down" button on the TCU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.2.41 Volume control down button formatting

The volume control "Down" button on the TCU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.2.42 Audible alarm - volume control response

Each time a change in volume control is commanded, either up or down, it shall result in an audible pulse at the next higher or lower step volume, respectively, in accordance with HF-STD-001, Section 7.

3.2.3.2.2.43 Volume test button

The TCU System Overview screen shall include a dedicated control input button for the purpose of testing the current volume level setting of the audible alert volume in accordance with HF-STD-001, Section 7.

3.2.3.2.2.44 Volume test button dimensions

The volume "Test" button on the TCU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.2.45 Volume test button formatting

The volume "Test" button on the TCU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.2.46 Volume test button response

Selecting the volume test button shall result in an audible pulse at the last set volume level in accordance with HF-STD-001, Section 7.

3.2.3.2.2.47 Display brighter button

The TCU System Overview screen shall include a dedicated control input button for the purpose of increasing the display luminance in accordance with HF-STD-001, Section 5.

3.2.3.2.2.48 Display brighter button dimensions

The backlight brighter button on the conceptual TCU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.2.49 Display brighter button formatting

The backlight brighter button on the TCU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.2.50 Display darker button

The TCU System Overview screen shall include a dedicated control input button for the purpose of decreasing the display luminance in accordance with HF-STD-001, Section 5.

3.2.3.2.2.51 Display darker button dimensions

The backlight darker button on the TCU System Overview screen shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.2.52 Display darker button formatting

The backlight darker button on the TCU System Overview screen shall be formatted in accordance with HF-STD-001, Section 8.

3.2.3.2.2.53 Equipment status button formatting

The most recent command execution status of each VGLS shall be formatted and displayed on the TCU System Overview screen in accordance with HF-STD-001, Section 8.

3.2.3.2.2.54 Equipment ribbon - button dimensions

Each ribbon button, either control or indicator, shall be represented as an indicator in accordance with HF-STD-001, Section 9.

3.2.3.2.2.55 Equipment ribbon - button spacing

Each ribbon button, either control or indicator, shall be spaced in accordance with HF-STD-001, Section 9.

3.2.3.2.2.56 Equipment ribbon - button adjacent object spacing

Each ribbon button, either control or indicator, shall be spaced in accordance with HF-STD-001, Section 9.

3.2.3.2.2.57 Equipment ribbon - control button characteristic

The functionality of each ribbon indicator/control button shall support being programmed as a touch-sensitive control input and indicator.

3.2.3.2.2.58 Equipment ribbon - indication button characteristic

The functionality of each ribbon indicator button shall support being programmed as an indicator-only (i.e., no control capability).

3.2.3.2.2.59 Equipment ribbon – button color assignments

The use of colors on ribbon buttons representing the conditions in Table IX shall be in accordance with HF-STD-001, Section 8.

Table IX. TCU equipment ribbon button conditions

System Condition
Normal, On
Transition, unknown condition
Off
Not Selected
Alarm

3.2.3.2.2.60 Equipment ribbon - equipment identifier

The TCU equipment ribbon shall include a display of the corresponding runway designator in combination with the type of equipment, with a blank character as a separator between them, as defined in Table X in accordance with HF-STD-001, Section 8.

Table X. TCU equipment - ribbon equipment identifier

Ribbon Equipment Identifier Formatting
Text (Note 1, 2, 3)
"RWY␣EQUIP"

Note 1: "RWY" represents the same 3-character alphanumeric string used on the TCU System Overview screen (e.g., 33R, 18L, ␣07, etc.).

Note 2: The character "␣" represents a blank space in the text string.

Note 3: "EQUIP" represents the same 5-character alpha string used on the TCU System Overview screen.

3.2.3.2.2.61 MALSR ribbon

The MALSR ribbon contains a combination of status and control buttons. The conceptual display of the MALSR ribbon is illustrated in Figure 19.

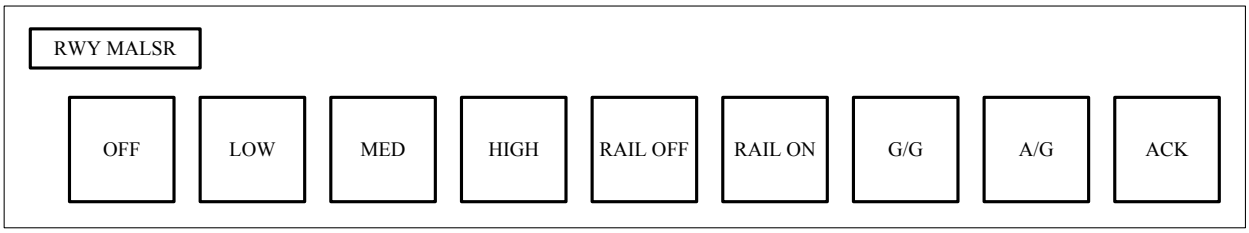

Figure 19. Conceptual TCU MALSR ribbon display

3.2.3.2.2.62 MALSR ribbon - display and formatting

The information to be displayed on the MALSR equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.2.63 MALSR on selection

If the MALSR VGLS is currently off, then selecting the "LOW", "MED", or "HIGH" button shall command the MALSR VGLS to turn "ON" to the corresponding intensity level (i.e., set to low, medium, or high intensity).

3.2.3.2.2.64 MALSR off selection

If the MALSR VGLS is currently set to "LOW", “MED”, or “HIGH” intensity, then selecting the "OFF" button shall command the MALSR VGLS to turn "OFF".

3.2.3.2.2.65 MALSR low intensity selection

If the MALSR VGLS is currently set to “OFF”, "MED" or “HIGH” intensity, then selecting the "LOW" button shall command low intensity to turn “ON” on the MALSR VGLS.

3.2.3.2.2.66 MALSR medium intensity selection

If the MALSR VGLS is currently set to “OFF”, "LOW" or "HIGH" intensity, then selecting the "MED" button shall command medium intensity to turn “ON” on the MALSR VGLS.

3.2.3.2.2.67 MALSR high intensity selection

If the MALSR VGLS is currently set to “OFF”, “LOW” or "MED" intensity, then selecting the "HIGH" button shall command high intensity to turn “ON” on the MALSR VGLS.

3.2.3.2.2.68 MALSR RAIL on selection

If the number of flashers installed for a MALSR is one or more, then the RAIL ON button shall be visible to the user, else it is not visible. If the MALSR VGLS is currently "ON" (Low, Med, or High), and the RAIL are currently "OFF", then selecting the "RAIL ON" button shall command the RAIL to turn ‘ON”, else it has no effect.

> Note: The RAIL “ON/OFF” is only enabled when MALSR is on Low/Medium/High Intensity.

3.2.3.2.2.69 MALSR RAIL off selection

If the number of flashers installed for a MALSR is one or more, then the RAIL OFF button shall be visible to the user, else it is not visible. If the MALSR VGLS is currently “ON” (Low, Med, or High), and the RAIL are currently “ON”, then selecting the "RAIL OFF" button shall command the Runway Alignment Indicator Lights to turn “OFF”, else it has no effect.

3.2.3.2.2.70 MALSR ground-to-ground selection

If the A/G option is enabled, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the MALSR lighting system to receive lighting control commands from the TCU. When going from A/G to G/G, the MALSR equipment shall keep its On/Off/Intensity setting.

3.2.3.2.2.71 MALSR air-to-ground selection

If the A/G option is enabled, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the MALSR lighting system to receive lighting control commands from the appropriate radio frequency. When going from G/G to A/G, the MALSR equipment shall turn Off.

> Note: When in A/G mode, the command execution status of the RVIU is reported to the CDU/TCU equipment ribbon display.

3.2.3.2.2.72 MALSR alarm acknowledge

If the MALSR VGLS is currently “ON” with an active alarm condition pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm when the system is in MAINT mode.

3.2.3.2.2.73 ODALS ribbon

The ODALS ribbon contains a combination of status and control buttons. The conceptual display of the ODALS ribbon is illustrated in Figure 20.

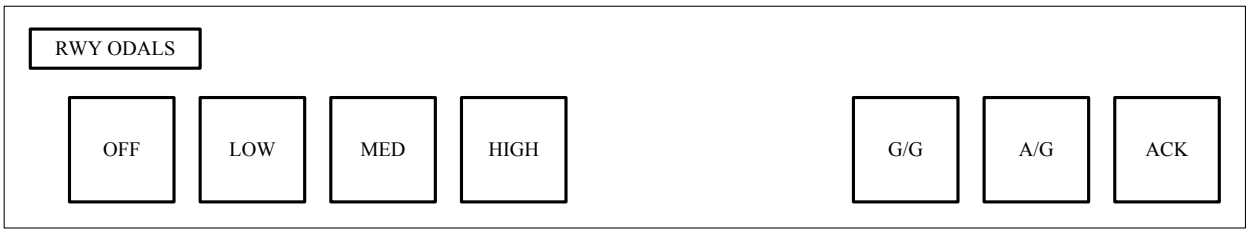

Figure 20. Conceptual TCU ODALS ribbon display

3.2.3.2.2.74 ODALS ribbon display and formatting

The information to be displayed on the ODALS equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.2.75 ODALS on selection

If the ODALS VGLS is currently “OFF”, then selecting the "LOW", "MED", or "HIGH" button shall command the ODALS VGLS to turn “ON” and to the corresponding intensity level (i.e., set to low, medium, or high intensity).

3.2.3.2.2.76 ODALS off selection

If the ODALS VGLS is currently set to "LOW", “MED”, or “HIGH” intensity, then selecting the “OFF” button shall command the ODALS VGLS to turn “OFF”.

3.2.3.2.2.77 ODALS low intensity selection

If the ODALS VGLS is currently set to “OFF”, "MED" or “HIGH” intensity, then selecting the "LOW" button shall command low intensity to turn “ON” on the ODALS VGLS.

3.2.3.2.2.78 ODALS medium intensity selection

If the ODALS VGLS is currently set to “OFF”, "LOW" or "HIGH" intensity, then selecting the "MED" button shall command medium intensity to turn “ON” on the ODALS VGLS.

3.2.3.2.2.79 ODALS high intensity selection

If the ODALS VGLS is currently set to “OFF”, “LOW” or "MED" intensity, then selecting the "HIGH" button shall command high intensity to turn “ON” on the ODALS VGLS.

3.2.3.2.2.80 ODALS ground-to-ground selection

If the A/G option is enabled, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the ODALS lighting system to receive control commands from the TCU. When going from A/G to G/G, the ODALS equipment shall keep its On/Off/Intensity setting.

3.2.3.2.2.81 ODALS air-to-ground selection

If the A/G option is enabled, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the ODALS lighting system to receive control commands from the appropriate radio frequency. When going from G/G to A/G, the ODALS equipment shall turn Off.

> Note: When in A/G mode, the command execution status of the RVIU is reported to the CDU equipment ribbon display.

3.2.3.2.2.82 ODALS alarm acknowledge

If the ODALS VGLS is currently “ON” with an active alarm condition pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm when the system is in MAINT mode.

3.2.3.2.2.83 PAPI ribbon

The PAPI ribbon contains a combination of status and control buttons. The conceptual display of the PAPI ribbon is illustrated in Figure 21.

Figure 21. Conceptual TCU PAPI ribbon display

3.2.3.2.2.84 PAPI ribbon display and formatting

The information to be displayed on the PAPI equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.2.85 PAPI on selection

If the PAPI VGLS is currently “OFF”, then selecting the “ON” button shall command the PAPI VGLS to turn “ON”.

3.2.3.2.2.86 PAPI off selection

If the PAPI VGLS is currently “ON”, then selecting the “OFF” button shall command the PAPI VGLS to turn “OFF”, else it has no effect.

3.2.3.2.2.87 PAPI ground-to-ground selection

If the A/G option is enabled, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the PAPI lighting system to receive control commands from the TCU. When going from A/G to G/G, the PAPI equipment shall keep its On/Off setting.

3.2.3.2.2.88 PAPI air-to-ground selection

If the A/G option is enabled, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the PAPI lighting system to receive control commands from the appropriate radio frequency. When going from G/G to A/G, the PAPI equipment shall turn Off.

Note: When in A/G mode, the command execution status of the RVIU is reported to the CDU on the equipment ribbon display.

3.2.3.2.2.89 PAPI alarm acknowledge

If the PAPI VGLS is currently “ON” with an active alarm condition pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm when the system is in MAINT mode.

3.2.3.2.2.90 REIL ribbon

The REIL ribbon contains a combination of status and control buttons. The conceptual display of the REIL ribbon is illustrated in Figure 22.

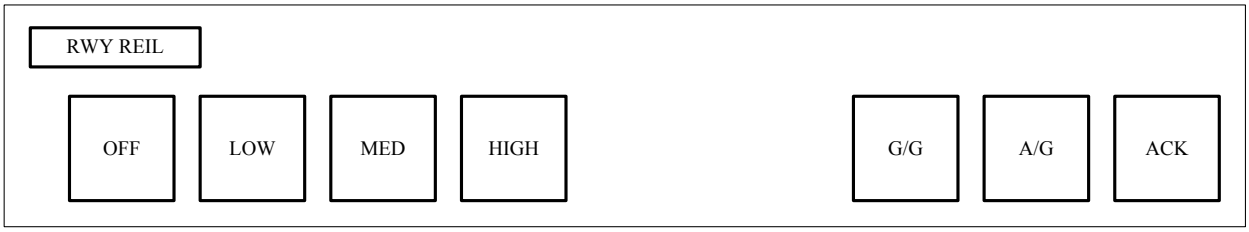

Figure 22. Conceptual TCU REIL ribbon display

3.2.3.2.2.91 REIL ribbon display and formatting

The information to be displayed on the REIL equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.2.92 REIL on selection

If the REIL VGLS is currently “OFF”, then selecting the "LOW", "MED", or "HIGH" button shall command the REIL VGLS to turn “ON” to the corresponding intensity level (i.e., set to low, medium, or high intensity).

3.2.3.2.2.93 REIL off selection

If the REIL VGLS is currently set to "LOW", “MED”, or “HIGH” intensity, then selecting the “OFF” button shall command the REIL VGLS to turn “OFF”.

3.2.3.2.2.94 REIL low intensity selection

If the REIL VGLS is currently set to “OFF”, "MED" or “HIGH” intensity, then selecting the "LOW" button shall command low intensity to turn “ON” on the REIL VGLS.

3.2.3.2.2.95 REIL medium intensity selection

If the REIL VGLS is currently set to “OFF”, "LOW" or "HIGH" intensity, then selecting the "MED" button shall command medium intensity to turn “ON” on the REIL VGLS.

3.2.3.2.2.96 REIL high intensity selection

If the REIL VGLS is currently set to “OFF”, “LOW” or "MED" intensity, then selecting the "HIGH" button shall command high intensity to turn “ON” on the REIL VGLS.

3.2.3.2.2.97 REIL ground-to-ground selection

If the A/G option is enabled, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the REIL lighting system to receive control commands from the TCU. When going from A/G to G/G, the REIL equipment shall keep its On/Off/Intensity setting.

3.2.3.2.2.98 REIL air-to-ground selection

If the A/G option is enabled, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the REIL lighting system to receive control commands from the appropriate radio frequency. When going from G/G/ to A/G, the REIL equipment shall turn Off.

Note: When in A/G mode, the command execution status of the RVIU is reported to the CDU on the equipment ribbon display.

3.2.3.2.2.99 REIL alarm acknowledge

If the REIL VGLS is currently “ON” with an active alarm condition pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm when the system is in MAINT mode.

3.2.3.2.2.100 VASI ribbon

The VASI ribbon contains a combination of status and control buttons. The conceptual display of the VASI ribbon display is illustrated in Figure 23.

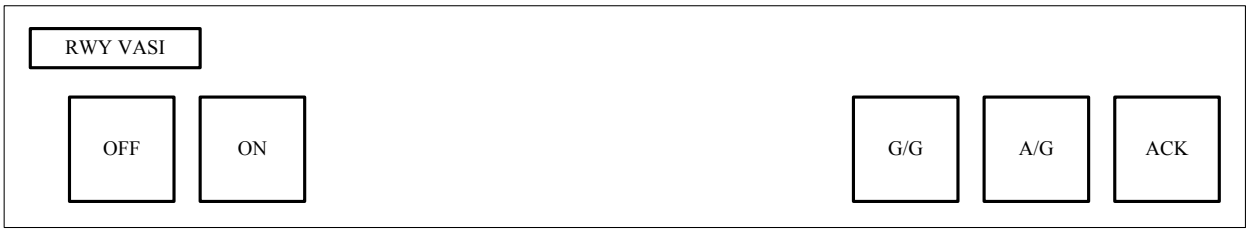

Figure 23. Conceptual TCU VASI ribbon display

3.2.3.2.2.101 VASI ribbon display and formatting

The information to be displayed on the VASI equipment ribbon shall be presented in accordance with HF-STD-001, Section 8.

3.2.3.2.2.102 VASI on selection

If the VASI VGLS is currently “OFF”, then selecting the “ON” button shall command the VASI VGLS to turn “ON”.

3.2.3.2.2.103 VASI off selection

If the VASI VGLS is currently “ON”, then selecting the “OFF” button shall command the VASI VGLS to turn “OFF”, else it has no effect.

3.2.3.2.2.104 VASI ground-to-ground selection

If the A/G option is installed, then the G/G button shall be visible to the user, else it is not visible. Selecting the "G/G" button shall command the VASI lighting system to receive control commands from the TCU. When going from A/G to G/G, the VASI equipment shall keep its On/Off setting.

3.2.3.2.2.105 VASI air-to-ground selection

If the A/G option is installed, then the A/G button shall be visible to the user, else it is not visible. Selecting the "A/G" button shall command the VASI lighting system to receive control commands from the appropriate radio frequency. When going from G/G to A/G, the VASI equipment shall turn Off.

Note: When in A/G mode, the command execution status of the RVIU is reported to the CDU on the equipment ribbon display.

3.2.3.2.2.106 VASI alarm acknowledge

If the VASI VGLS is currently “ON” with an active alarm condition pending, then selecting the "ACK" button shall have the effect of acknowledging the alarm and silencing the audible alarm when the system is in MAINT mode.

3.2.3.2.3 RVIU

The RRCS RVIU equipment may be designed as a single unit that meets all of the interfacing requirements for all VGLS equipment given herein or different units may be designed for interfacing with a single VGLS equipment type.

3.2.3.2.3.1 Common RVIU requirements – power and enclosure

3.2.3.2.3.1.1 RVIU input power interface

The RVIU shall operate on 120 VAC received from the associated VGLS.

3.2.3.2.3.1.2 RVIU design and construction

RVIU materials, processes, and parts shall be in accordance with FAA-G-2100.

3.2.3.2.3.1.3 RVIU enclosure - type

The RVIU enclosure shall be an aluminum NEMA 4X cabinet.

3.2.3.2.3.1.4 Reserved

3.2.3.2.3.1.5 RVIU enclosure - material

The RVIU enclosure material, including the door, shall be aluminum.

3.2.3.2.3.1.6 RVIU enclosure – corrosion prevention

The RVIU enclosure, including the door, shall be anodized in accordance with MIL-A-8625.

3.2.3.2.3.1.7 RVIU enclosure – volume

The RVIU enclosure shall accommodate all of the necessary components and wiring and provide clearance for field installation and maintenance per the current version of the National Electrical Code (NEC) specification.

3.2.3.2.3.1.8 RVIU enclosure – volume constraints

The RVIU shall provide a minimum clearance of 5 inches between the bottom of the enclosure and the lowest mounting plate for cable termination provisions, grounding and bonding, and maintenance access.

3.2.3.2.3.1.9 RVIU enclosure – knockouts

The RVIU enclosure shall not have pre-formed knockouts.

3.2.3.2.3.1.10 RVIU enclosure – external cable connections

Space shall be provided in the RVIU cabinet for all external cable connections.

3.2.3.2.3.1.11 RVIU enclosure – external electrical terminations

Terminal blocks shall be located near the cable entrance to permit terminations of all external power and control wires feeding into the RVIU cabinet.

3.2.3.2.3.1.12 RVIU enclosure – mounting provisions

The RVIU shall have a mounting means external to the cabinet cavity for mounting the cabinet vertically.

3.2.3.2.3.1.13 RVIU enclosure – mounting bolt protrusion

Internal or external mounting bolts shall not protrude though the RVIU cabinet.

3.2.3.2.3.1.14 RVIU enclosure – gasket method

RVIU enclosure door gaskets shall be either continuous or strip gaskets.

3.2.3.2.3.1.15 RVIU enclosure – strip gaskets

If strip gaskets are used on the RVIU enclosure the following shall apply.

3.2.3.2.3.1.15.1 Number of strips

The total number of strips used shall not exceed four.

3.2.3.2.3.1.15.2 Strip continuity

The vertical and horizontal runs shall be continuous except where the vertical strips meet the horizontal strips.

3.2.3.2.3.1.15.3 Strip overlap

The horizontal strips shall overlap the vertical strips.

3.2.3.2.3.1.15.4 Strip joining

The vertical strips shall be joined tightly against the horizontal strips.

3.2.3.2.3.1.16 RVIU enclosure – gasket material

RVIU enclosure gaskets shall be resistant to EMI and deterioration such as cracking, hardening, or softening under the environmental conditions the equipment will operate in.

3.2.3.2.3.1.17 RVIU enclosure – convenience outlet

3.2.3.2.3.1.17.1 Convenience outlet

A 120 volt, single phase, 15 amps, grounding type receptacle - with built-in ground fault interrupter fused at 15 amps - shall be installed in the RVIU for maintenance purposes.

3.2.3.2.3.1.17.2 Support power availability

The receptacle shall be usable even if the entrance switch is open.

3.2.3.2.3.1.18 RVIU enclosure – service lamp

3.2.3.2.3.1.18.1 Service lamp

The RVIU shall include a shatter-resistant-type service lamp for adequate illumination of the interior of the RVIU cabinet during both day and night service operations.

3.2.3.2.3.1.18.2 Service lamp protection

Means shall be provided to protect the lamp from accidental contact at all times and protect personnel vision during use at night.

3.2.3.2.3.1.18.3 Service lamp switch

The light shall have an on-off switch that is easily identifiable in the dark and is properly fused.

3.2.3.2.3.1.18.4 Service lamp availability

The light shall be usable even though the entrance switch is open.

3.2.3.2.3.1.19 RVIU enclosure – grounding lug

A grounding lug to provide for multiple ground interconnections, using #6 wire or smaller, shall be provided in the RVIU enclosure.

3.2.3.2.3.1.20 RVIU cabinet door - hinge direction

The RVIU cabinet door shall open from the right side of the cabinet.

3.2.3.2.3.1.21 RVIU cabinet door - hinge type

The RVIU cabinet door hinge shall be internally or externally mounted.

3.2.3.2.3.1.22 RVIU cabinet door - door stop

A door-stop shall be provided for locking the RVIU cabinet door in a 110-degree open position.

3.2.3.2.3.1.23 RVIU cabinet door - attachments

No electrical components or cables shall be attached to the RVIU cabinet door except for ground straps.

3.2.3.2.3.1.24 RVIU cabinet door - locking mechanism

The RVIU cabinet door shall be provided with a mechanism for locking the door closed with a padlock.

3.2.3.2.3.1.25 RVIU cabinet door - padlock size

The holes for the padlock shall be aligned such that a 7/16-inch diameter rod can be passed horizontally through the holes when the RVIU door is in a locked position.

3.2.3.2.3.1.26 RVIU equipment wiring diagram

A wiring diagram plate shall be provided with the RVIU cabinet that matches the wiring diagram figure provided in the instruction book manuscript.

3.2.3.2.3.1.27 RVIU equipment wiring diagram - location

The RVIU cabinet wiring diagram plate shall be mounted on the inside of the RVIU cabinet door.

3.2.3.2.3.1.28 RVIU equipment wiring diagram - plate type and color

The RVIU cabinet wiring diagram plate shall be a Type G, Adhesive backed plate, and the color style shall be IV, Natural, in accordance with MIL-DTL-15024.

3.2.3.2.3.2 Common RVIU requirements – control and transceiver

3.2.3.2.3.2.1 RVIU control input

The RVIU shall be controlled by a single TCU.

3.2.3.2.3.2.2 RVIU - VGLS equipment interface

The RVIU shall provide a functional interface to the VGLS lighting equipment.

3.2.3.2.3.2.3 RVIU - VGLS remote control

When the RVIU control selection switch is in the "REMOTE" position, the RVIU shall receive and execute light intensity-control (including “Off”) and Air/Ground mode-control commands from the TCU and send RVIU command execution status to the TCU.

3.2.3.2.3.2.4 RVIU - VGLS local control

When the RVIU control selection switch is in the "LOCAL" position, VGLS control shall be provided by the VGLS and “RVIU Local-control” command execution status is provided to the TCU.

3.2.3.2.3.2.5 RVIU initialization

The RVIU shall initialize and begin operation within 60 seconds after input power is initially applied.

3.2.3.2.3.2.6 Remote control logic

Remote control (A/G or G/G) logic outputs to the VGLS shall be as shown in Table XI.

Table XI. VGLS Remote Control (A/G and G/G)

Low Input	Medium Input	High Input	Flasher State / Intensity
*	*	*	Off
X	*	*	On - Low
X	X	*	On - Medium
X	X	X	On - High

X – 120VAC applied
* – No line voltage applied (e.g., grounded)
All other states (i.e., combinations of 120 VAC and ground) are not defined

3.2.3.2.3.3 MALSR RVIU specific requirements

Each MALSR RVIU is located near the existing MALSR lighting equipment. The MALSR RVIU includes the necessary electrical interfaces to support control of the MALSR equipment, including the MALSR lighting control cabinet and the MALSR air/ground control cabinet. The MALSR RVIU includes a transceiver data link interface to allow the TCU to remotely control the MALSR equipment.

The MALSR RVIU configuration includes:

a. RVIU equipment address (per the facility's RRCS control scheme).

The main functions of the MALSR RVIU include:

a. Receives MALSR lighting commands (off/low/medium/high) from the TCU or A/G radio.

b. Sends MALSR lighting commands (off/low/medium/high) to MALSR equipment.

c. Receives RAIL lighting commands (on/off) from the TCU.

d. Sends RAIL lighting commands (on/off) to MALSR equipment.

e. Receives MALSR G/G and A/G control commands from the TCU.

f. Sends A/G control command (Off/Low/Med/High) to MALSR equipment.

g. Sends RVIU MALSR command execution (G/G or A/G) status to the TCU.

3.2.3.2.3.3.1 MALSR RVIU external I/O support requirements

The MALSR RVIU shall include the external I/O capability as listed in Table XII.

Table XII. MALSR RVIU external I/O capability

External I/O Type	Characteristic (Note 1)	Purpose
Transceiver	One transceiver interface.	Supports communications with the TCU.
External communication	One external communication port.	Configuration backup and software upgrade.
120 VAC output	One latching 120 VAC output, MALSR low intensity control.	Selects MALSR low intensity lighting level.
120 VAC output	One latching 120 VAC output, MALSR medium intensity control. [MALSR Low output must also be enabled]	Selects MALSR medium intensity lighting level.
120 VAC output	One latching 120 VAC output, MALSR high intensity control. [MALSR Low and Medium outputs must also be enabled]	Selects MALSR high intensity lighting level.
120 VAC output	One latching 120 VAC output, RAIL On/Off control.	Selects RAIL lighting 'On' and 'Off'.
120 VAC input	One input, A/G low.	Control signal (low) from A/G radio.
120 VAC input	One input, A/G med.	Control signal (medium) from A/G radio.
120 VAC input	One input, A/G high.	Control signal (high) from A/G radio.
120 VAC input	MALSR RVIU input power.	Provides operational power from the facility to the MALSR RVIU.

Note 1: Latching 120 VAC outputs are required to control the MALSR equipment. Each latching output remains in its previous state if MALSR RVIU power should fail, thus the MALSR equipment always remains in its last commanded state.

3.2.3.2.3.4 ODALS RVIU specific requirements

Each ODALS RVIU is located near the existing ODALS lighting equipment. The ODALS RVIU includes the necessary electrical interfaces to support control of the ODALS equipment, including the ODALS lighting control cabinet and the ODALS air/ground control cabinet. The ODALS RVIU includes a transceiver data link interface to allow the TCU to remotely control the ODALS equipment.

The ODALS RVIU configuration includes:

a. RVIU equipment address (per the facility's RRCS control scheme).

The main functions of the ODALS RVIU include:

a. Receives ODALS lighting commands (off/low/medium/high) from the TCU or A/G radio.

b. Sends ODALS lighting commands (off/low/medium/high) to ODALS equipment.

c. Receives ODALS ground-to-ground and air-to-ground command from the TCU.

d. Sends A/G control command (Off/Low/Med/High) to ODALS equipment.

e. Sends RVIU ODALS command execution (G/G or A/G) status to the TCU.

3.2.3.2.3.4.1 ODALS RVIU external I/O support requirements

The ODALS RVIU shall include the external I/O capability as listed in Table XIII.

Table XIII. ODALS RVIU external I/O capability

External I/O Type	Characteristic (Note 1)	Purpose
Transceiver	One transceiver interface.	Supports communications with the TCU.
External communication	One external communication port.	Configuration backup and software upgrade.
120 VAC output	One latching 120 VAC output, ODALS low intensity control.	Selects ODALS low intensity lighting level.
120 VAC output	One latching 120 VAC output, ODALS medium intensity control. [ODALS Low output must also be enabled]	Selects ODALS medium intensity lighting level.
120 VAC output	One latching 120 VAC	Selects ODALS high intensity

External I/O Type	Characteristic (Note 1)	Purpose
	output, ODALS high intensity control. [ODALS Low and Medium outputs must also be enabled]	lighting level.
120 VAC input	One input, A/G low.	Control signal (low) from A/G radio.
120 VAC input	One input, A/G med.	Control signal (medium) from A/G radio.
120 VAC input	One input, A/G high.	Control signal (high) from A/G radio.
120 VAC input	ODALS RVIU input power.	Provides operational power from the facility to the ODALS RVIU.

Note 1: Latching 120 VAC outputs are required to control the ODALS equipment. Each latching output remains in its previous state if ODALS RVIU power should fail, thus the ODALS equipment always remains in its last commanded state.

3.2.3.2.3.5 PAPI RVIU specific requirements

Each PAPI RVIU is located near the existing PAPI lighting equipment. The PAPI RVIU includes the necessary electrical interfaces to support control of the PAPI equipment, including the PAPI lighting control cabinet and the PAPI air/ground control cabinet. The PAPI RVIU includes a transceiver data link interface to allow the TCU to remotely control the PAPI equipment.

The PAPI RVIU configuration includes:

a. RVIU equipment address (per the facility's RRCS control scheme).

The main functions of the PAPI RVIU include:

a. Receives PAPI lighting commands (on/off) from the TCU or A/G radio.

b. Sends PAPI lighting commands (on/off) to PAPI equipment.

c. Receives PAPI ground-to-ground and air-to-ground command from the TCU.

d. Sends A/G control command (On/Off) to PAPI equipment.

e. Sends RVIU PAPI command execution (G/G or A/G) status to the TCU.

3.2.3.2.3.5.1 PAPI RVIU external I/O support requirements

The PAPI RVIU shall include the external I/O capability as listed in Table XIV.

Table XIV. PAPI RVIU external I/O capability

External I/O Type (Note 2)	Characteristic (Note 1)	Purpose
Transceiver	One transceiver interface.	Supports communications with the TCU.
External communication	One external communication port.	Configuration backup and software upgrade.
120 VAC output	One latching 120 VAC output, PAPI On/Off control.	Selects PAPI lighting 'On' and 'Off'.
120 VAC input	One input, A/G On.	Control signal (ON) from A/G radio.
120 VAC input	PAPI RVIU input power.	Provides operational power from the facility to the PAPI RVIU.

Note 1: Latching 120 VAC outputs are required to control the PAPI equipment. Each latching output remains in its previous state if PAPI RVIU power should fail, thus the PAPI equipment always remains in its last commanded state.

3.2.3.2.3.6 REIL RVIU specific requirements

Each REIL RVIU is located near the existing REIL lighting equipment. The REIL RVIU includes the necessary electrical interfaces to support control of the REIL equipment, including the REIL lighting control cabinet and the REIL air/ground control cabinet. The REIL RVIU includes a transceiver data link interface to allow the TCU to remotely control the REIL equipment.

The REIL RVIU configuration includes:

a. RVIU equipment address (per the facility's RRCS control scheme).

The main functions of the REIL RVIU include:

a. Receives REIL lighting commands (off/low/medium/high) from the TCU or A/G radio.

b. Sends REIL lighting commands (off/low/medium/high) to REIL equipment.

c. Receives REIL ground-to-ground and air-to-ground command from the TCU.

d. Sends A/G control command (Off/Low/Med/High) to REIL equipment.

e. Sends RVIU REIL command execution (G/G or A/G) status to the TCU.

3.2.3.2.3.6.1 REIL RVIU external I/O support requirements

The REIL RVIU shall include the external I/O capability as listed in Table XV.

Table XV. REIL RVIU external I/O capability

External I/O Type (Note 2)	Characteristic (Note 1)	Purpose
Transceiver	One transceiver interface.	Supports communications with the TCU.
External communication	One external communication port.	Configuration backup and software upgrade.
120 VAC output	One latching 120 VAC output, REIL low intensity control.	Selects REIL low intensity lighting level.
120 VAC output	One latching 120 VAC output, REIL medium intensity control. [REIL Low output must also be enabled]	Selects REIL medium intensity lighting level.
120 VAC output	One latching 120 VAC output, REIL high intensity control. [REIL Low and Medium outputs must also be enabled]	Selects REIL high intensity lighting level.
120 VAC input	One input, A/G low.	Control signal (low) from A/G radio.
120 VAC input	One input, A/G med.	Control signal (medium) from A/G radio.
120 VAC input	One input, A/G high.	Control signal (high) from A/G radio.
120 VAC input	REIL RVIU input power.	Provides operational power from the facility to the REIL RVIU.

Note 1: Latching 120 VAC outputs are required to control the REIL equipment. Each latching output remains in its previous state if REIL RVIU power should fail, thus the REIL equipment always remains in its last commanded state.

3.2.3.2.3.7 VASI RVIU specific requirements

Each VASI RVIU is located near the existing VASI lighting equipment. The VASI RVIU includes the necessary electrical interfaces to support control of the VASI equipment, including the VASI lighting control cabinet and the VASI air/ground control cabinet. The VASI RVIU

includes a transceiver data link interface to allow the TCU to remotely control the VASI equipment.

The VASI RVIU configuration includes:

a. RVIU equipment address (per the facility's RRCS control scheme).

The main functions of the VASI RVIU include:

a. Receives VASI lighting commands (on/off) from the TCU or A/G radio.

b. Sends VASI lighting commands (on/off) to VASI equipment.

c. Receives VASI ground-to-ground and air-to-ground command from the TCU.

d. Sends A/G control command (On/Off) to VASI equipment.

e. Sends RVIU VASI command execution (G/G or A/G) status to the TCU.

3.2.3.2.3.7.1 VASI RVIU external I/O support requirements

The VASI RVIU shall include the external I/O capability as listed in Table XVI.

Table XVI. VASI RVIU external I/O capability

External I/O Type (Note 2)	Characteristic (Note 1)	Purpose
Transceiver	One transceiver interface.	Supports communications with the TCU.
External communication	One external communication port.	Configuration backup and software upgrade.
120 VAC output	One latching 120 VAC output, VASI On/Off control.	Selects VASI lighting 'On' and 'Off'.
120 VAC input	One input, A/G On.	Control signal (ON) from A/G radio.
120 VAC input	VASI RVIU input power.	Provides operational power from the facility to the VASI RVIU.

Note 1: Latching 120 VAC outputs are required to control the VASI equipment. Each latching output remains in its previous state if VASI RVIU power should fail, thus the VASI equipment always remains in its last commanded state.

3.2.3.2.4 Intensity levels

The RRCS shall provide for the selection of the following intensity levels:

a.) MALSR (off, low, medium, or high);

b.) ODALS (off, low, medium, or high);

c.) PAPI (off, on);

d.) REIL (off, low, medium, or high); and,

e.) VASI (off, on).

3.2.3.2.5 Maintenance mode command processing

The RRCS RVIU shall respond to maintenance-related commands including the following:

a.) RVIU/VGLS control actions; and,

b.) RVIU status requests.

3.2.3.3 Failsafe

The RRCS ATCT and RVIU components shall fail in a way that is safe and ensures VGLS state-persistence (i.e., will not interfere with VGLS equipment operation).

3.2.3.4 Time-to-alarm

The RRCS shall generate an alarm within 60 seconds of detection of an RVIU command execution failure.

3.2.3.5 Test points

3.2.3.5.1 Test points

Test points shall be provided to monitor all signals used during checkout, alignment, calibration, or during preventive maintenance procedures.

3.2.3.5.2 Location

Test points shall not be located in compartments with exposed voltages of 24 DC volts or more.

3.2.3.5.3 Safety

All test points shall be located so as to preclude accidental shock to personnel engaged in normal operating or maintenance activities.

3.2.3.5.4 Accessibility

The removal of components, modules or circuit cards shall not be required to gain access to test points or adjustments.

3.2.3.5.5 Circuit card – test point front access

Test point controls and indicators mounted on printed wiring boards shall be accessible from the front of the circuit card assembly without the use of extender boards.

3.2.3.6 Interlock switches

3.2.3.6.1 Interlock switches

Interlock switches shall be in accordance with FAA-G-2100.

3.2.3.6.2 Locations

Interlock switches shall be incorporated in all outdoor enclosures.

3.2.3.6.3 Switch actions

When the units are opened, the interlock switches shall disconnect all incoming power and control circuits, except the incoming power to the maintenance light and convenience outlet.

3.2.3.6.4 Power discharge

The design shall provide for permanently discharging power within 1 minute when power is removed.

3.2.3.6.5 Bypass

Means shall be provided to enable the interlock switches to be bypassed when the units are opened.

3.2.4 Electronic equipment, general requirements

The RRCS shall meet the general navigational aid equipment requirements of this paragraph and Table XVII, which is tailored from FAA-G-2100.

Table XVII. General Navigational Aid electronic equipment requirements

FAA-G-2100 Requirements	Applicability Notes
Electrical Power, Wiring Arrangement	Applies in total.
Mechanical	Applies in total.
Software	Applies in total.
Operating Environmental Conditions	Applies with additional clarification in 3.2.4.3 and Table XVIII of this specification.
Physical Characteristics	Applies in total.
Reliability	Applies except where specified in 3.2.2.4.1 of this specification.
Maintainability	Maintainability requirements contained in 3.2.2.4.3 of this specification. Additional maintainability requirements of FAA-G-2100 apply.
[Failsafe] External Equipment Interfaces	Applies in total.
Electrostatic Discharge	Applies in total.
Transportability	Transportability requirements contained in paragraph 3.2.4.4 of this specification.

FAA-G-2100 Requirements	Applicability Notes
Materials, Processes and Parts	Applies in total. Additional materials design constraints are in paragraph 3.2.4.5 of this specification.
Electromagnetic Compatibility (EMI/EMC) and FCC Type Certification	Applies in total.
Nameplates and Marking	Applies in total.
Interchangeability	Applies in total.
Personal Safety and Health	Applies in total.
Human [Factors] Engineering	Applies in total.
Documentation	Applies as stated in the Statement of Work.
Personnel and Training	Applies as stated in the Statement of Work.
[Quality Assurance] Quality System Requirements	Applies as stated in the Statement of Work.
[Quality Assurance] Verification/Compliance to Requirements	Applies in Total except as modified for 4.2.2.2 and 4.2.2.4 in an issued Statement of Work.
FCC Type Acceptance and Registration Procedures	FCC Type Certification and Registration is modified per paragraph 3.X.5 of the Navigation Services Specifications Standard Practice Guide, Appendix 2.
Preparation for Delivery	Applies in total.

3.2.4.1 Workmanship

Workmanship shall be in accordance with MIL-HDBK-454, Requirement 9.

3.2.4.2 Power

3.2.4.2.1 General

All components of the RCCS shall use standard alternating-current (AC) commercial power, single phase, rated at 120 volts (V), (+10, -15 %), 60 Hertz (Hz) (± 3 Hz) per FAA-G-2100.

3.2.4.2.2 Power fluctuation response

In accordance with FAA-G-2100, all RRCS components shall recover in the event of input power fluctuations, deviations, and interruptions without affecting the state of the associated VGLS.

3.2.4.2.3 Internal wiring

All internal wiring to the equipment shall be in accordance with FAA-G-2100.

3.2.4.2.4 Building interface wiring

The equipment shall interface to building wiring in accordance with the latest revision of FAA-C-1217, FAA-STD-032, and NFPA 70 in that order of precedence.

3.2.4.2.5 Electronic equipment

All electronic equipment shall comply with power quality requirements for power factor, inrush current, and total current harmonics in accordance with FAA-G-2100.

3.2.4.2.6 Grounding and bonding

Equipment grounding and bonding shall be in accordance with the latest revision of FAA-STD-019.

3.2.4.3 Operating environmental requirements

The RRCS shall meet the requirements of FAA-G-2100 for operating environment requirements with the following clarifications.

3.2.4.3.1 Equipment environment classification

The equipment shall be capable of continuous operation based on the assigned indoor and outdoor classifications (summarized in Table XVIII). The equipment includes all enclosures, cables, connectors, and antennas associated with each component of the RRCS (CDU, TCU, and RVIU).

3.2.4.3.2 Attended facilities

RRCS equipment designed for use in attended facilities shall operate in the ambient conditions of Environment I in Table XVIII without active cooling.

3.2.4.3.3 Equipment shelters

RRCS equipment designed for use in unmanned facilities (e.g., equipment shelter) shall operate with the ambient conditions of Environment II listed in Table XVIII without active cooling.

3.2.4.3.4 Outdoor installations

Equipment not housed in equipment shelters shall operate in the ambient conditions of Environment III listed in Table XVIII without active cooling.

3.2.4.3.5 Temperature – indoor operating

All indoor equipment shall operate in the ambient temperature range of +55° to +85° F.

3.2.4.3.6 Temperature – outdoor operating

All outdoor equipment shall operate in an ambient temperature range of -50° to +153° F.

3.2.4.3.7 Altitude

All outdoor and indoor equipment shall operate from 0 (-0, +300 feet) to 10,000 feet (3,048 meters) Mean Sea Level (MSL).

3.2.4.3.8 Humidity – indoor operating

All indoor equipment shall operate in the humidity range of 30% to 80% in accordance with FAA-G-2100 for an attended facility.

3.2.4.3.9 Humidity – outdoor operating

All outdoor equipment shall operate in the humidity range of 0% to 100% (i.e., uncontrolled) in accordance with FAA-G-2100 for an unattended facility.

Table XVIII. Environmental Operating Conditions

Environment[1]	Equipment	Temperature (°F)	Relative Humidity[3] (%)	Altitude (Feet above sea level)	Wind (mph)	Ice Loading	Rain
I	TCU/CDU	+55 to +85	30 to 80	(-0, +300) to 10,000	--	--	--
II	N/A	0 to +100	Uncontrolled	(-0, +300) to 10,000	--	--	--
III[4]	RVIU	-50 to +153[2]	Uncontrolled	(-0, +300) to 10,000	0 to 100	Per ASCE Manual 74	2"/ hour

Notes: 1. *I: For equipment installed in an attended facility.*
II: For equipment installed in an unattended facility.
III: For equipment installed outdoors (RVIU, antennas).
2. *Includes 33°F for solar radiation.*
3. *Above 104°F, the relative humidity shall be based upon a dew point of 104°F.*
4. *Conformal coating is required.*

3.2.4.3.10 Sand and dust

All outdoor equipment shall operate while exposed to wind blown sand and dust particles (per Table XIX) in accordance with MIL-STD-810.

Table XIX. Sand and Dust Particle Sizes

Particle Classification[1]	Particle Size
Dust	< 150 µm
Sand	150 – 850 µm

[1]From MIL-STD-810G – Change 1, Method 510.6

3.2.4.3.11 Salt fog

All outdoor equipment shall operate while exposed to a salt-laden atmosphere of 5.0 ± 1% salt solution concentration for a minimum of four alternating 24-hour periods of salt fog exposure and drying conditions (two wet and two dry) in accordance with MIL-STD-810.

3.2.4.3.12 Rain

All outdoor equipment shall operate while exposed to wind-blown rain (per Table XX) in accordance with MIL-STD-810.

Table XX. Wind-blown Rain

Rain Rate	Droplet Size (diameter)	Wind Velocity
1.7 mm/min	0.5 mm	40 mph

[1]From MIL-STD-810G – Change 1, Method 506.6

3.2.4.3.13 Conducted emissions

For both indoor and outdoor equipment, the conducted interference levels on the power leads, control leads, signal leads, and interconnecting cables between parts shall not exceed the limits for CE102 as defined in MIL-STD-461 (Navy ground equipment class A3).

3.2.4.3.14 Radiated emissions

For both indoor and outdoor equipment, the radiated narrowband and broadband interference levels shall not exceed the limits for RE102 as defined in MIL-STD-461 (Navy ground equipment) over the frequency range from 14 kilohertz (kHz) to 10 Gigahertz (GHz) at a distance of 20 feet (6.1 meters) when TCU and RVIU transceivers are connected through a coaxial cable.

3.2.4.3.15 Conducted susceptibility

3.2.4.3.15.1 Conducted susceptibility

Conducted Susceptibility of the system shall be in compliance with CS114 of MIL-STD-461. The frequency range shall be 10 kHz to 200 MHz, and Curve #2 of Figure CS114-1 (MIL-STD-461) shall be used for the limit in accordance with Table III (MIL-STD-461) for Navy ground equipment.

3.2.4.3.15.2 Equipment recovery

The equipment shall restart and initialize to the last selected state automatically if an interruption or a shutdown is experienced.

3.2.4.3.16 Radiated susceptibility

3.2.4.3.16.1 Radiated susceptibility

For both indoor and outdoor equipment, the radiated susceptibility interference shall not exceed the limits for RS103 as defined in MIL-STD-461 (Navy ground equipment) over the frequency range from 1 MHz to 1 GHz.

3.2.4.3.16.2 Equipment recovery

The equipment shall restart and initialize to the last selected state automatically if an interruption or a shutdown is experienced.

3.2.4.3.17 Transient suppression

3.2.4.3.17.1 Input power voltage transients

The indoor equipment shall be designed to suppress switching transients and to withstand transient increases superimposed on the 120 VAC power line input voltage that reach a peak value of 500 V for as long as 50 milliseconds.

3.2.4.3.17.2 Input power and I/O control lines transients

The outdoor equipment shall be designed to withstand repeated transients applied at the power and control signal inputs, at the output lines, and characterized as an 8 by 20 microseconds current surge of 5,000 amps with the subsequent power-follow current and voltage surge of 10 kV, 1.2 by 50 microseconds.

3.2.4.3.17.3 Transient recovery

The equipment shall restart and initialize to the last selected state automatically if an interruption or a shutdown is experienced due to either type of transient (i.e., input power and I/O control lines).

3.2.4.3.17.4 Transparent operation

Equipment operational functions shall be unimpaired by the above transients (i.e., input power, I/O control lines) when each type of transient is imposed a minimum of 5 times each to the input terminals with a one-minute recovery period between successive transients.

3.2.4.3.18 Outdoor equipment

The RVIU shall be designed and constructed of outdoor, rainproof, dust-tight, and non-ventilated enclosures.

3.2.4.4 Transportability

The RRCS shall be capable of withstanding vibrations in the frequency range of 10 to 2,000 Hz. See paragraph 4.6.14 for limits.

3.2.4.5 Materials, processes and parts

The RRCS shall meet the requirements of FAA-G-2100 for materials, processes and parts. Navigational aids are subjected to environmental service conditions that have been found to be

detrimental to several types of material not identified in FAA-G-2100, so the following sub-paragraphs apply further restrictions to the use of such materials in the design of the equipment.

a. Iron and steel. Iron and steel shall be used only when necessary to comply with strength requirements. Outside equipment enclosures, exposed to Environment III (outside conditions), shall not be made of steel. When approved for use, iron and steel shall be treated to prevent corrosion.

b. Fibrous Material, Organic. Organic fibrous material shall not be used.

c. Fungus-inert Materials. Materials used shall be fungus-inert, except within a hermetically sealed assembly. Table XXI, Group I lists materials that are inherently fungus-inert, and Group II lists materials that are fungus nutrient in some configurations. Materials from Group I are preferred, but when materials from Group II must be used they shall be rendered fungus inert by compounding with a permanently effective fungicide or by suitable surface treatment. They shall pass the fungus test specified in ASTM G21-13, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi, with no visible growth of fungus after 28 days.

d. Insulating Materials, Electrical. Insulating materials shall be selected based on meeting or exceeding the use requirements of the following: temperature endurance, moisture absorption and penetration, fungus resistance, dielectric strength, dielectric constant, mechanical strength, dissipation factor, ozone resistance, and flammability. Polyvinyl chloride insulating materials for external cables shall be in accordance with NFPA-70. Ceramics shall conform to MIL-I-10 or equivalent. Ceramic insulators shall conform to MIL-I-23264A or equivalent. Sleeving shall provide adequate dielectric strength and leakage resistance under the designated service conditions. Cast thermosetting plastic used for electrical insulation shall be in accordance with L-P-516 Rev A or equivalent. Other electrical materials having moisture absorption of greater than 1% shall be impregnated with a suitable moisture barrier material.

e. Lubricants. Lubricants shall be suitable for the purpose intended. Low volatility lubricants shall be used. The lubricant shall be chemically inert with respect to the materials or other lubricants it contacts. Silicone and graphite-base lubricants shall not be used.

f. Rubber (natural). Natural rubber shall not be used.

g. Wood and Wood Products. Wood and wood products shall not be used inside equipment.

h. Thread Locking and Retaining Compounds. Thread locking and retaining compounds shall conform to the required operating conditions and MIL-S-22473 or MIL-S-46163 or equivalent, and be applied such that the required level of locking or retaining is achieved and maintained. Such compounds shall not impair electrical conductivity, cause or accelerate corrosion, or be used where failure would endanger personnel or damage equipment. Such compounds shall be compatible with the material to which they are bonded.

i. Conformal Coatings. Printed wiring boards shall be conformal coated in accordance with FAA-G-2100.

j. Anti-seize Compounds. Anti-seize compounds shall conform to MIL-T-22361 or equivalent. Graphite-base anti-seize compounds shall not be used.

Table XXI. Fungi susceptibility of material

GROUP I. Fungus-inert Materials	GROUP II. Not Fungus-inert
Acrylics	ABS (acrylonitrile-butadiene styrene)
Acrylonitrile-styrene	Acetal
Acrylonitrile-vinyl-chloride copolymer	Cellulose acetate
Ceramics	Epoxy-glass fiber laminates
Chlorinated polyether	Epoxy-resin
Fluorinated ethylenepropylene copolymer	Lubricants
(FEP)	Melamine-formaldehyde
Glass	Organic polysulphides
Metals	Phenor-formaldehyde
Plastic laminates:	Polydichlorostyrene
Silicone-glass fiber	Polyethylene, low and medium density
Phenolic-nylon fiber	(0.940 and below)
Diallylphthalate	Polymethyl methacrylate
Polyacrylonitrile	Polyurethane (the ester types are particularly susceptible)
Polyamide	Polyrichinoleates
Polycarbonate	Polyvinyl chloride
Polyester – glass fiber laminates	Polyvinyl chloride-acetate
Polyethylene, high density (above 0.940)	Polyvinyl fluoride
Polymonochlorotrifluoroethylene	Rubbers, natural and synthetic
Polypropylene	Urea-formaldehyde
Polystyrene	
Polysulfone	
Polytetrafluorethylene	
Polyvinylidene chloride	
Silicone resin	
Siloxane-polyolefin polymer	
Siloxane-polystyrene	

Note: Under certain conditions, selective microorganisms may attack polyamides.

3.3 System Characteristics

RRCS shall meet the requirements specified in 3.2 while in accordance with the system characteristics directed by 3.3.

3.3.1 Safety

The design and development of electronic equipment shall provide for the safety of personnel during the installation, operation, maintenance, repair and interchange of complete equipment assemblies or component parts. Equipment design for personnel safety shall be equal to or better than the requirements of the Occupational Safety and Health Agency (OSHA) as identified in CFR Title 29, Part 1910 and Part 1926.

3.3.1.1 High voltage protection

All points that have electrical potentials in excess of 24 VDC or 50 VAC shall be shielded by guards or barriers to prevent accidental contact by a service technician.

3.3.2 Security

3.3.2.1 Physical security

The RRCS shall be capable of installation without modification within an airport operations area in the proximity of runways, select FAA remote locations, the ATCT and the TRACON. RVIU enclosures near the runways and at remote locations shall be capable of being padlocked.

3.3.2.2 Information security

Reserved.

3.3.3 Human factors

The general and detailed design of the RRCS shall be in accordance with the requirements of DOT/FAA/CT-03/05 HF-STD-001.

Design of the display screens for maintenance and Air Traffic Operations personnel shall be engineered to ensure optimal: usability; efficiency and effectiveness of human performance; and safety.

4 VERIFICATION

This section addresses the system verification of the RRCS in support of the FAA Acquisition Management System. System tests are divided between Contractor testing and Government testing. FAA test and evaluation policy and guidelines may be found on the FAA Acquisition System Toolset (FAST) located at http://fast.faa.gov/.

4.1 Verification Requirements Traceability Matrix

Appendix A contains the Verification of Requirements Traceability Matrix (VRTM) for the RRCS equipment. Methods utilized to accomplish verification include:

a. Analysis (A). An element of verification that utilizes established technical or mathematical models or simulations, algorithms, charts, graphs, circuit diagrams, or other scientific principles and procedures to provide evidence that stated requirements were met.

b. Demonstration (D). An element of verification that generally denotes the actual operation, adjustment, or re-configuration of items to provide evidence that the designed functions were accomplished under specific scenarios. The demonstrations shall be itemized and instrumentally monitored to verify quantitative performance limits.

c. Inspection (I). An element of verification consisting of investigation, without the use of special laboratory appliances or procedures, of items to determine conformance to those specified requirements that can be determined by such investigations. Inspection is generally nondestructive and typically includes the use of sight, hearing, and touch; simple physical manipulation; mechanical and electrical gauging and measurement; and other forms of investigation.

d. Test (T). An element of verification that generally denotes the determination, by technical means, of the properties or elements of items, including functional operation, and involves the application of established scientific principles and procedures.

4.2 First Article Tests

The first phase of verification testing is Design Qualification Testing (DQT) to determine whether the design meets specified requirements. First article units will be used for performing the DQT of the product. If multiple first article units are required for initial DQT, then all members of that group will be referred to herein as part of the first article. The units that are produced for field installation will be referred to herein as “Production Units”.

4.3 OT&E

The Operational Test is conducted by the FAA Test Director to validate the RRCS functions that are stated in the Performance Specification Document. In addition, during the Operational Test, the equipment Technical Instruction Book will also be validated to verify all of the maintenance and installation procedures are accurate.

4.4 Requirements Testing

The relationship amongst Section 3 requirements, Table XXII, Table XXIII, and Appendix A, is as follows:

a) Section 3 of this specification lists the functional and performance requirements that the equipment must comply with; and,

b) Table XXII specifies the applicability of procedures defined in Section 4.6 to the DQT. Table XXIII specifies the applicability of procedures defined in Section 4.6 to the Production Acceptance Test (PAT) for the production units. The VRTM, in Appendix A, stipulates the method of verification (test, analysis, inspection, demonstration) for each “shall” required in Section 3 of this specification and identifies which test or tests in Section 4.6 verifies each requirement in Section 3.

Table XXII. Design Qualification Testing

Test	Para. Ref.	CDU	TCU	RVIU - MALSR	RVIU - ODALS	RVIU - PAPI	RVIU - REIL	RVIU - VASI	TRANSCEIVER
Visual Inspection	4.6.1	X	X	X	X	X	X	X	X[1]
Temperature	4.6.2	—	—	X	X	X	X	X	X[1]
Altitude	4.6.3	X	X	X	X	X	X	X	X[1]
Humidity	4.6.4	—	—	X	X	X	X	X	X[1]
Sand and Dust	4.6.5	—	—	X	X	X	X	X	X[1]
Salt Fog	4.6.6	—	—	X	X	X	X	X	X[1]
Rain	4.6.7	—	—	X	X	X	X	X	X[1]
Electromagnetic Interference	4.6.8	X	X	X	X	X	X	X	X[1]
Transient Suppression	4.6.9	—	—	X	X	X	X	X	—
Six-Hour	4.6.10	X	X	X	X	X	X	X	—
Transceiver Test	4.6.11	—	—	—	—	—	—	—	X
Electrical Safety	4.6.12	X	X	X	X	X	X	X	—
Fault Induction Test	4.6.13	X	X	X	X	X	X	X	—
Transportability and Vibration Test	4.6.14	X	X	X	X	X	X	X	—
Fail-safe Test	4.6.15	X	X	X	X	X	X	X	—

Note:

X = Required

X[1] = Required, understanding that the transceiver may be integrated with the RVIU and may not require separate testing.

— = Not required

4.5 Testing Methods

Testing of the equipment shall be performed as follows.

4.5.1 Design qualification test

4.5.1.1 Precondition

The Visual Inspection (see 4.6.1) must be performed prior to any other DQT.

4.5.1.2 Applicability

Any deformation, discoloration, deterioration, malfunction, or operation of the equipment outside of the prescribed conditions or limits of Section 3 during or after the conduct of each test shall be cause for rejection.

4.5.1.3 Required tests

The tests shown in Table XXII, as defined in 4.6, are required for DQT.

4.5.2 Production acceptance tests (PAT)

4.5.2.1 Applicability

The PAT will be performed on all RRCS units. First article units will be subjected to the PAT prior to performing DQT. All production units shall pass the PAT prior to delivery.

4.5.2.2 Required tests

The following tests shown in Table XXIII, as defined in Section 4.6, are required for all production units, site and depot spares.

Table XXIII. Production Acceptance Tests

Test	Para. Reference
Visual Inspection	4.6.1
6-hour	4.6.10
Electrical Safety	4.6.12

4.5.3 Type tests

4.5.3.1 Applicability

Tests shall be performed on regular production equipment or systems in accordance with the requirements in FAA-G-2100. The PAT will be performed on all RRCS units. All production units will be subjected to the PAT prior to performing Type Tests.

4.5.3.2 Required tests

The tests shown in Table XXIV, as defined in 4.6, are required for Type Tests.

Table XXIV. Type Tests

Test	Para. Ref.	CDU	TCU	RVIU - MALSR	RVIU - ODALS	RVIU - PAPI	RVIU - REIL	RVIU - VASI	TRANSCEIVER
Visual Inspection	4.6.1	X	X	X^2					X
Temperature	4.6.2	—	—	X^2					X
Humidity	4.6.4	—	—	X^2					X

Note:

X = Required

X^2 = Only one paring of RVIU-VGLS equipment is required for each test

— = Not required

4.6 Test Procedures

The equipment shall be tested in accordance with the tests specified herein and the failure criteria of paragraph 5.14 of MIL-STD-810G. Failure of a component during test, that requires replacement to restore the unit to "as-built" condition, constitutes a failure.

4.6.1 Visual inspection

The equipment shall be visually inspected for workmanship, fabrication, finishing, painting, and adequacy of selected parts.

4.6.2 Outdoor temperature test

The high temperature test shall be in accordance with Procedure II cycling method, Method 501.6 of MIL-STD-810G, except that the temperature shall be +153°F (+68°C). The low temperature test shall be in accordance with Procedure II, Method 502.5, of MIL-STD-810G, except that the temperature shall be -50°F (-46°C) and three 24 hour cycles (72 hours) shall be required.

4.6.3 Altitude test

The altitude test shall be in accordance with Procedure II, Method 500.6, of MIL-STD-810G. The equipment shall be tested at atmospheric pressures corresponding to zero feet (-0, +300 feet) and 10,000 feet (3,048 meters) altitude (MSL).

4.6.4 Humidity test

The humidity test shall be in accordance with Procedure II, Method 507.6, Figure 507.5-7, of MIL-STD-810G, except that a total of three 24 hour cycles (72 hours) will be required and the maximum temperature shall be +153°F (+68°C).

4.6.5 Sand and dust test

The sand and dust test shall be in accordance with Procedure I, Method 510.6, of MIL-STD-810G for Dust and Procedure II for Sand. Tests begin with the access door facing the source of sand or dust (orientation 0°). The RVIU is rotated 120° twice in the same direction, and after each rotation the feed is maintained for two hours for the dust test and 90 minutes for the sand, as provided in Table XXV. For blowing dust and sand, the test media particle sizes, mix, and wind speed are provided in Table XXVI.

Table XXV. Equipment Orientation

RVIU Orientation	**Test Duration**	
	Dust (hours)	**Sand (minutes)**
0° (equipment front)	2	90
120°	2	90
240°	2	90

Table XXVI. Sand and Dust Particles

Blowing Dust		
Mean % by weight	**Particle size**	**Wind Speed**
100%	Particles < 150µm (140 mesh silica flour or equivalent)	1750 feet/minute (8.9 meters/second)
Blowing Sand		
Mean % by weight	**Particle size**	**Wind Speed**
90 ± 5%	150µm < Particles < 600µm	3540 feet/minute (18 meters/second)
5%	600µm <= Particles < 850µm	3540 feet/minute (18 meters/second)

4.6.6 Salt fog test

The salt fog test shall be in accordance with Method 509.6, of MIL-STD-810G.The test shall consist of alternating 24 hour periods of salt fog exposure and drying conditions for a minimum of four 24-hour periods (two wet and two dry). The salt spray shall have a concentration of 5 ± 1 percent sodium chloride, by weight. Salt buildup as a result of the test may be removed with tap water.

4.6.7 Rain test

The rain test shall be in accordance with Procedure I, Method 506.6 of MIL-STD-810G. The wind velocity shall be 18 m/s (40 mph), and the rainfall rate shall be per MIL-STD-810. The exposure shall be on each of the four sides for 30 minutes. The temperature differential between the water and the equipment shall be more than 10°C at the beginning of each 30-minute

exposure period. The equipment shall be turned on for each exposure before starting rainfall and operated during the exposure.

4.6.8 Electromagnetic interference test

The equipment shall be tested for conformance to the electromagnetic interference control requirements defined in MIL-STD-461 (Navy Ground):

a. Conducted Emissions:
Conducted interference levels on incoming AC power leads, control leads, and signal leads shall not be greater than the limits for CE102 as defined in MIL-STD-461 using a frequency range of 10 kHz to 10 MHz.

b. Radiated Emissions:
Radiated emission shall not be greater than the limit for RE102 as defined in MIL-STD-461 using a frequency range of 2 MHz to 1 GHz.

c. Radiated Susceptibility:
Radiated susceptibility shall not be greater than the limit for RS103 as defined in MIL-STD-461 using a frequency range of 2 MHz to 1 GHz.

d. Conducted Susceptibility:
Conducted susceptibility shall not be greater than the limit for CS104 as defined in MIL-STD-461 using a frequency range of 10 kHz to 10 MHz.

4.6.9 Transient suppression test

A surge generator shall be used to superimpose each of the applicable types of transients specified in 3.2.4.3.17 at least five times on the 120 VAC input power lines. Transient surges shall be applied between each input power line and the grounded neutral. The preset transient control levels shall be verified by open-circuit and short-circuit tests prior to applying each test surge to the unit. Test surges shall be superimposed while operating the equipment. The time interval between successive superimposition of test surges shall be no more than 60 seconds. The equipment shall be continuously energized during the entire transient suppression test, which shall commence with the conduct of a performance test.

4.6.10 Six-hour operational test

The RRCS units and site spares shall be tested for 6 continuous hours at ambient temperature as a complete system (CDU, TCU, and at least one RVIU).

Note: The six-hour test will exercise all functions of the RRCS system. The test will cycle through all ATCT control functions, alternating between CDU and TCU, over the six-hour period to verify continuous operation as shown in Table XXVII below.

Table XXVII. Six-hour Operational Test Timing

Hour	Control Location	Input Voltage (CDU, TCU, and RVIU)
0	CDU and TCU	Nominal
2	TCU	+10% for five minutes
4	CDU	-15% for five minutes
6	CDU and TCU	Nominal

4.6.11 Transceiver test

Transceiver shall be NTIA certified.

4.6.12 Electrical safety

4.6.12.1 Dielectric test

A dielectric test shall be performed on power and remote control leads of the production models in accordance with MIL-STD-202. The test shall be performed using 60Hz VAC voltage applied for 1 minute between insulated leads and the chassis. All power switches must be set to the OFF position. Each unit of the RRCS system is tested independently for all power and interface wires. All power and interface conductors are tested separately. All lightning arrestor devices must be disconnected during the dielectric tests.

Table XXVIII. Dielectric Tests

All power wiring	1.5 kilovolts (kV) RMS
Interface Input / Output	0.5 kilovolt (kV) RMS

4.6.12.2 Grounding bonding test

A grounding-bonding test shall be performed on the TCU and RVIUs by passing a current of 25 amps through the chassis to a wire connected to the safety ground terminal. The measured impedance shall be 1 milliohm or less. This test may be performed using a manual or automatic tester.

4.6.13 Fault induction test

Fault(s) necessary to produce associated visual and aural alarms and related indications shall be induced.

4.6.13.1 VGLS state change

Operational status of the VGLSs used during the Fault Induction Test shall not be affected by the induced faults (i.e., the operational state of the VGLSs persist throughout the Fault Induction Test).

4.6.14 Transportability and vibration test

RRCS equipment packaged for shipment (i.e., not turned on) shall be tested to meet the requirements in 3.2.4.4.

4.6.14.1 Test description

The equipment shall be tested as described below.

(a) Vibration planes. The test assembly shall be vibrated in three planes or directions as follows:

1. In a direction perpendicular to the test table (vertically);
2. Horizontally, parallel to the access door axis; and,
3. Horizontally, at right angles to the access door axis.

(b) Frequencies. The test assembly shall be vibrated through a frequency range of 10 to 2,000 cycles per second (cps) in each plane until the acceleration shown in Table XXIX is reached. Duration of each sweep shall be 10 minutes. A sweep shall be defined as the vibration of the test assembly through a frequency range as shown in Table XXIX below.

Table XXIX. Vibration Test Data

Vibration Test Data	
Acceleration in G's	**Frequency (CPS)**
0.020 inch (.5mm) double amplitude (Peak to Peak displacement)	10-70
3	70-200
3	200-500
3	500-2,000

Following the vibration test, the equipment shall be thoroughly examined for mechanical failure of any component, loosening of any part, cracked or broken seals, continuity of electrical circuits, and possible damage to supports.

4.6.15 Fail-safe test

The vendor shall propose a Fail-Safe Test that covers the functional and failure modes and effects of the RRCS.

4.6.15.1 VGLS state change

Operational status of the VGLSs used during the Fail-Safe Test shall not be affected by the tests (i.e., the operational state of the VGLSs persist throughout the Fail-Safe Test).

4.6.16 Reliability

A reliability demonstration shall be conducted in accordance with MIL-HDBK-781A.

4.7 Maintainability Demonstration

The contractor shall provide support during the maintainability demonstration which is conducted in accordance with MIL-STD-470, Task 301 on the first unit of production (i.e., first article).

5 PACKAGING

Packaging requirements shall be as specified in the contract or order.

6 NOTES

6.1 Intended use

RRCS is intended to provide control of and status display for an airport's suitably interfaced VGLS equipment to FAA ATC personnel in the ATCT.

6.2 Acquisition requirements

The Government will conduct an operational capability test (OCT) of the RRCS as a part of the acquisition selection process. Requirements from the VRTM will be verified in order to determine the suitability of proposed system to support the specification requirements. The test will be conducted at an FAA test site. The data obtained during the OCT may be used to support portions of Operational Tests conducted after Contract award.

The Government will conduct an Operational Test and Evaluation of the RRCS as part of the acquisition process to validate the RRCS functions that are stated in the Performance Specification Document.

6.3 Definitions

The following definitions apply to the terms and acronyms used in this specification:

Availability	The probability that an item will perform its required function under given conditions at a stated instant of time. Alternatively, ability of an item to perform a required function under given conditions at a stated instant of time.
Diagnostics	Diagnostics refers to the Built-In Test (BIT) and Fault Isolation Test (FIT) features for the determination of subassemblies, boards, parts, etc., that perform below minimum acceptable levels.
Failsafe	The ability of the RRCS system to inhibit the output of erroneous data under System and Subsystem failure conditions.
Hard Alarm	An alarm issued when self-check finds a parameter outside the acceptable operation limits.

Lowest Replaceable Unit (LRU)	An LRU is the lowest possible unit to be replaced within the system component during site level maintenance activities. It is a separate, installable physical package performing a single function or group of closely related functions.
Mean Time Between Failures (MTBF)	MTBF is equal to the total operating hours of the RRCS system divided by the number of system failures.
Reliability	Reliability is the probability that an item will actually perform its intended function for a specified interval under specified conditions.
Soft Alarm	An alarm issued when self-check finds a parameter approaching the acceptable operational limit; in other words, a soft alarm alerts maintenance personnel that a hard alarm might occur in the near future.
Subsystem Failure	An RRCS subsystem failure occurs when: (a) there is a communication failure between an RVIU and the TCU, (b) there is a communication failure between a CDU and the TCU, (c) any transceiver fails or, or (d) a CDU fails. Any communication link failure external to the RRCS is not considered a subsystem or system failure.
System Failure	A system failure occurs when: (a) the system does not control the VGLS equipment, (b) the RRCS product output is not correct, or (c) there is a catastrophic failure.

6.4 Abbreviations and acronyms

A/G	Air-to-Ground
AC	Alternating Current
ACK	Acknowledge
Amps	Amperes
Ant	Antenna
ATC	Air Traffic Control
ATCT	Airport Traffic Control Tower
BIT	Built-in Test
C	Celsius
CDU	Control-Display Unit
CO	Contracting officer
CPU	Central Processing Unit

dB	decibel
DC	Direct current
DoDISS	Department of Defense Index of Specifications and Standards
DQT	Design Qualification Test
F	Fahrenheit
FAA	Federal Aviation Administration
FAST	FAA Acquisition System Toolset
FIT	Fault Isolation Test
G/G	Ground-to-Ground
GHz	gigahertz
GPS	Global Positioning System
HFDS	Human Factor Design Standard
Hz	Hertz
I/O	Input/Output
ICAO	International Civil Aviation Organization
kHz	kiloHertz
kV	kilovolt
LRU	Lowest Replaceable Unit
m/s	Meters per second
MAINT	Maintenance Mode
MALSR	Medium Intensity Approach Lighting System
MHz	MegaHertz
MPMT	Mean Periodic Maintenance Time
ms	millisecond
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NAS	National Airspace System
NEMA	National Electrical Manufacturers Association
nmi	Nautical Mile
NTIA	National Telecommunications and Information Administration
OCT	Operational Capabilities Test
ODALS	Omnidirectional Approach Lighting System

OSHA	Occupational Safety and Heath Administration
OT&E	Operational Test & Evaluation
PAPI	Precision Approach Path Indicator
PAT	Production Acceptance Test
ppm	Parts-per-million
Prev	Previous
RAIL	Runway Alignment Indicator Lights
REIL	Runway End Identifier Lights
Rev	Revision
RF	Radio Frequency
RMS	Root Mean Square
RRCS	Remote Radio Control System
RVIU	Remote Visual Guidance Lighting System (VGLS) Interface Unit
SIR	Screening Information Request
TBD	To be determined
TCU	Transceiver-Concentrator Unit
TIB	Technical Instruction Books
UPS	Uninterruptible Power Source
USB	Universal Serial Bus
V	Volt
VAC	Volts Alternating Current
VASI	Visual Approach Slope Indicator
VDC	Volts Direct Current
VGLS	Visual Guidance Lighting System
VHF	Very High Frequency
VRTM	Verification Requirement Traceability Matrix
W	Watt

6.5 ICAO Compliance

Not applicable for RRCS.

Appendix A

Verification Requirements Traceability Matrix (VRTM)

APPENDIX A. Verification Requirements Traceability Matrix (VRTM)

I= Inspection, D= Demonstration, A= Analysis, T= Test

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
1	3	Requirements					
2	3.2.2.1	System components	I	I	I		4.6.1
3	3.2.2.2	System design	I	I	I		4.6.1
4	3.2.2.3	Bi-directional communication	T	T	T		4.6.10, 4.6.11
5	3.2.2.4	Reliability and maintainability of electronic equipment		D	D		4.6.13
6	3.2.2.4.1	Maintenance checkout		D	D		
7	3.2.2.4.2	Reliability		A	D		4.6.16
8	3.2.2.4.3	Maintainability		D	D		4.6.13
9	3.2.2.4.4	Mean-Time-to-Repair		D	D		
10	3.2.2.4.5.1.1	RRCS operation interruption		A			
11	3.2.2.4.5.1.2	CDU and TCU periodic maintenance		A			
12	3.2.2.4.5.1.3	CDU and TCU mean periodic maintenance time		A			
13	3.2.2.4.5.1.4	CDU and TCU personnel requirements		A			
14	3.2.2.4.5.2.1	RVIU periodic maintenance		A			
15	3.2.2.4.5.2.2	RVIU mean periodic maintenance time		A			
16	3.2.2.4.5.2.3	RVIU personnel requirements		A	A		
17	3.2.2.4.6.1	Recovery		T	T		4.6.10
18	3.2.2.4.6.2	Unit reset		T			4.6.10
19	3.2.2.4.6.3.1	RVIU power loss detection	T	T	T		4.6.10
20	3.2.2.4.6.3.2	RVIU power loss status		T			4.6.10
21	3.2.2.4.6.3.3	RVIU power loss recovery	T	T	T		4.6.10

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
22	3.2.2.4.6.3.4	RVIU power loss recovery - initial state		D			
23	3.2.2.4.6.3.5	RVIU communications loss – state persistence	T	T	T		4.6.10
24	3.2.2.4.7.1	Hardware		A			
25	3.2.2.4.7.2.1	Software memory		A			
26	3.2.2.4.7.2.2	Software upgrades		T	T		4.6.10
27	3.2.2.5.1	MALSR	T	T	T		4.6.10
28	3.2.2.5.2	ODALS	T	T	T		4.6.10
29	3.2.2.5.3	REIL	T	T	T		4.6.10
30	3.2.2.5.4	PAPI	T	T	T		4.6.10
31	3.2.2.5.5	VASI	T	T	T		4.6.10
32	3.2.2.6	RRCS Control-Display Unit (CDU)	T	T	T		4.6.10
33	3.2.2.6.1.1	Typical installation		A			
34	3.2.2.6.1.2	CDU installation location and environment		A			
35	3.2.2.6.1.3	Maintenance CDU installation location and environment		A			
36	3.2.2.6.1.4	Maximum size		I			4.6.1
37	3.2.2.6.1.5	Maximum weight		I			4.6.1
38	3.2.2.6.2.1	CDU display light control		T			4.6.10
39	3.2.2.6.2.2	Readability		I			
40	3.2.2.6.3.1	System control status	T	T	T		4.6.10
41	3.2.2.6.3.2	Ground-to-ground status	T	T	T		4.6.10
42	3.2.2.6.3.3	Air-to-ground status	T	T	T		4.6.10
43	3.2.2.6.3.5	Control Indicator		A			
44	3.2.2.6.4.1	System operational status	T	T	T		4.6.10
45	3.2.2.6.4.2	Subsystem operational state indication	T	T	T		4.6.10

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
46	3.2.2.6.4.3	Subsystem intensity status	T	T	T		4.6.10
47	3.2.2.6.5.1	Command execution fault display	T	T	T		4.6.13
48	3.2.2.6.5.2	Aural alarms	T	T			4.6.13
49	3.2.2.6.5.3	Aural alarm volume		T			4.6.10
50	3.2.2.6.5.4	Visual status alarm	T	T			4.6.13
51	3.2.2.6.5.5	Communication fault detection delay		T	T		4.6.13
52	3.2.2.6.5.6	Communication fault detection delay adjustment		T			4.6.10
53	3.2.2.6.5.7.1	Control and display groups		A			
54	3.2.2.6.5.7.2	Data stream		T			4.6.10
55	3.2.2.6.5.7.3	Recovery	T	T	T		4.6.13
56	3.2.2.7.2	RRCS TCU design		A			
57	3.2.2.7.2.1	Typical installation		A			
58	3.2.2.7.2.2	Typical installation location and environment		A			
59	3.2.2.7.2.3	Maximum size		I			4.6.1
60	3.2.2.7.3	TCU – RVIU message receipt and processing	T	T			4.6.10
61	3.2.2.7.4	TCU command message		D			
62	3.2.2.7.5	VGLS configuration storage		T			4.6.10
63	3.2.2.8.1.1	RVIU design		A			
64	3.2.2.8.1.2	Typical installation and environment		A			
65	3.2.2.8.1.3	Installation location		A			
66	3.2.2.8.1.4	Minimum/maximum Size		A			
67	3.2.2.8.1.5	Maximum weight		A			
68	3.2.2.8.2	RVIU-VGLS interface		T			4.6.10
69	3.2.2.8.2.1	RVIU MALSR		T			4.6.10
70	3.2.2.8.2.2	RVIU ODALS		T			4.6.10

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
71	3.2.2.8.2.3	RVIU PAPI		T			4.6.10
72	3.2.2.8.2.4	RVIU REIL		T			4.6.10
73	3.2.2.8.2.5	RVIU VASI		T			4.6.10
74	3.2.2.8.3	TCU – RVIU message receipt and processing		T			4.6.10
75	3.2.2.8.4	RRCS remote equipment status message		T	T		4.6.10
76	3.2.2.9.1	Transceiver – interface		A			
77	3.2.2.9.2	Transceiver – RF transceiver		I			
78	3.2.2.9.3	Transceiver – optional connectivity		D			
79	3.2.2.9.4	Transceiver-antenna interface lightning protection	I	I			4.6.1
80	3.2.2.9.5	Transceiver RF output frequency		T			4.6.11
81	3.2.2.9.6	Transceiver RF tolerance		T			4.6.11
82	3.2.2.9.7	Transceiver emission levels		T			4.6.11
83	3.2.2.9.8	Spurious response		T			4.6.11
84	3.2.2.9.9.1	162-174 MHz		T			4.6.11
85	3.2.2.9.9.2	406.1-420 MHz		T			4.6.11
86	3.2.2.9.10	Transceiver channel spacing		A			
87	3.2.2.9.11	Transceiver bandwidth		T			4.6.11
88	3.2.2.9.12	Programmable transceiver	T	T			4.6.11
89	3.2.2.9.13	ATCT coaxial cable	T	T			4.6.10
90	3.2.2.9.14	VGLS site coaxial cable	T	T			4.6.10
91	3.2.2.9.15	CDU-TCU communications cable	T	T			4.6.10
92	3.2.2.9.16	Transceiver transmission distance		A			
93	3.2.2.9.17	Frequency configuration		A			
94	3.2.2.9.18	Bi-Directional simplex system		A			
95	3.2.2.9.19	Single frequency	T	T			4.6.10

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
96	3.2.2.9.20	Voltage Standing Wave Ratio (VSWR)	T	T			4.6.10
97	3.2.2.9.21	Transceiver modulation type	T	T			4.6.10
98	3.2.2.9.22	Transceiver security		T			4.6.10
99	3.2.2.10.1	Environmental conditions		T			4.6.2 - 4.6.7
100	3.2.2.10.2.1	Antenna type		I			4.6.1
101	3.2.2.10.3.1	Antenna type		I			4.6.1
102	3.2.3.1	Number of systems controlled		T/A			4.6.10
103	3.2.3.2.1.1	System control during normal mode	T	T	T		4.6.10
104	3.2.3.2.1.2	System monitoring during VGLS maintenance mode	T	T	T		4.6.10
105	3.2.3.2.1.3	Field equipment fault detection	T	T	T		4.6.13
106	3.2.3.2.1.4	Communication fault detection	T	T	T		4.6.13
107	3.2.3.2.1.5	Visual alarm indication	T	T	T		4.6.13
108	3.2.3.2.1.6	Alarm indications	T	T	T		4.6.13
109	3.2.3.2.1.7	Visual alarm button	T	T	T		4.6.13
110	3.2.3.2.1.8	Visual alarm button characteristics		T			4.6.13
111	3.2.3.2.1.9	Visual alarm button dimensions		A			
112	3.2.3.2.1.10	Equipment fault visual alarm indication characteristics	T	T	T		4.6.13
113	3.2.3.2.1.11	Communication fault visual indication	T	T	T		4.6.13
114	3.2.3.2.1.12	Communication fault visual alarm indication acknowledgement	T	T	T		4.6.13
115	3.2.3.2.1.13	Audible alarms - general	T	T	T		4.6.13
116	3.2.3.2.1.14	Audible alarm - duration		T			4.6.13
117	3.2.3.2.1.15	Audible alarm - acknowledgement	T	T			4.6.13
118	3.2.3.2.1.16	Screen overview legend		D			
119	3.2.3.2.1.17	Supported VGLS		T			4.6.10

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
120	3.2.3.2.1.18	Equipment ribbon display		T			4.6.10
121	3.2.3.2.1.19	Equipment status and control ribbon	T	T			4.6.10
122	3.2.3.2.1.20	Equipment status button dimensions		A			
123	3.2.3.2.1.21	Equipment status button spacing		A			
124	3.2.3.2.1.22	Equipment status button adjacent object spacing		A			
125	3.2.3.2.1.23	Equipment status button characteristic		T			4.6.10
126	3.2.3.2.1.24	Runway label - defined runway		T			4.6.10
127	3.2.3.2.1.25	Runway label - defined equipment		T			4.6.10
128	3.2.3.2.1.26	Ribbon display - defined equipment		T			4.6.10
129	3.2.3.2.1.27	Ribbon display - undefined equipment		T			4.6.10
130	3.2.3.2.1.28	Maintenance mode annunciation		T			4.6.10
131	3.2.3.2.1.29	ATCT/MAINT mode indication		T			4.6.10
132	3.2.3.2.1.30	ATCT/MAINT mode indicator dimensions		A			
133	3.2.3.2.1.31	ATCT/MAINT indicator formatting		A			
134	3.2.3.2.1.32	Page control function		T			4.6.10
135	3.2.3.2.1.33	Page control button		T			4.6.10
136	3.2.3.2.1.34	Page control button type		T			4.6.10
137	3.2.3.2.1.35	Page control button dimensions		A			
138	3.2.3.2.1.36	Page control button formatting		A			
139	3.2.3.2.1.37	Volume control up button		T			4.6.10
140	3.2.3.2.1.38	Volume control up button dimensions		A			

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
141	3.2.3.2.1.39	Volume control up button formatting		A			
142	3.2.3.2.1.40	Volume control down button		T			4.6.10
143	3.2.3.2.1.41	Volume control down button dimensions		A			
144	3.2.3.2.1.42	Volume control down button formatting		A			
145	3.2.3.2.1.43	Volume test button		T			4.6.10
146	3.2.3.2.1.44	Volume test button dimensions		A			
147	3.2.3.2.1.45	Volume test button formatting		A			
148	3.2.3.2.1.46	Volume test button response		T			4.6.10
149	3.2.3.2.1.47	Display brighter button		T			4.6.10
150	3.2.3.2.1.48	Display brighter button dimensions		A			
151	3.2.3.2.1.49	Display brighter button formatting		A			
152	3.2.3.2.1.50	Display darker button		T			4.6.10
153	3.2.3.2.1.51	Display darker button dimensions		A			
154	3.2.3.2.1.52	Display darker button formatting		A			
155	3.2.3.2.1.53	Equipment status button formatting		A			
156	3.2.3.2.1.54	Equipment ribbon - button dimensions		A			
157	3.2.3.2.1.55	Equipment ribbon - button spacing		A			
158	3.2.3.2.1.56	Equipment ribbon - button adjacent object spacing		A			
159	3.2.3.2.1.57	Equipment ribbon - control button characteristic		T			4.6.10
160	3.2.3.2.1.58	Equipment ribbon - indication button characteristic		T			4.6.10

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
161	3.2.3.2.1.59	Equipment ribbon - button color assignments		A			
162	3.2.3.2.1.60	Equipment ribbon - equipment identifier		A			
163	3.2.3.2.1.62	MALSR ribbon - display and formatting		T/A			4.6.10
164	3.2.3.2.1.63	MALSR on selection	T	T/A	T		4.6.10
165	3.2.3.2.1.64	MALSR off selection	T	T/A	T		4.6.10
166	3.2.3.2.1.65	MALSR low intensity selection	T	T/A	T		4.6.10
167	3.2.3.2.1.66	MALSR medium intensity selection	T	T/A	T		4.6.10
168	3.2.3.2.1.67	MALSR high intensity selection	T	T/A	T		4.6.10
169	3.2.3.2.1.68	MALSR RAIL on selection	T	T/A	T		4.6.10
170	3.2.3.2.1.69	MALSR RAIL off selection	T	T/A	T		4.6.10
171	3.2.3.2.1.70	MALSR RAIL state	T	T/A	T		4.6.10
172	3.2.3.2.1.71	MALSR ground-to-ground selection	T	T/A	T		4.6.10
173	3.2.3.2.1.72	MALSR air-to-ground selection	T	T/A	T		4.6.10
174	3.2.3.2.1.73	MALSR alarm acknowledge	T	T/A	T		4.6.13
175	3.2.3.2.1.75	ODALS ribbon display and formatting	T	T/A	T		4.6.10
176	3.2.3.2.1.76	ODALS on selection	T	T	T		4.6.10
177	3.2.3.2.1.77	ODALS off selection	T	T	T		4.6.10
178	3.2.3.2.1.78	ODALS low intensity selection	T	T	T		4.6.10
179	3.2.3.2.1.79	ODALS medium intensity selection	T	T	T		4.6.10
180	3.2.3.2.1.80	ODALS high intensity selection	T	T	T		4.6.10
181	3.2.3.2.1.81	ODALS ground-to-ground selection	T	T	T		4.6.10
182	3.2.3.2.1.82	ODALS air-to-ground selection	T	T	T		4.6.10

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
183	3.2.3.2.1.83	ODALS alarm acknowledge	T	T	T		4.6.13
184	3.2.3.2.1.85	PAPI ribbon display and formatting	T	T/A	T		4.6.10
185	3.2.3.2.1.86	PAPI on selection	T	T/A	T		4.6.10
186	3.2.3.2.1.87	PAPI off selection	T	T	T		4.6.10
187	3.2.3.2.1.88	PAPI ground-to-ground selection	T	T	T		4.6.10
188	3.2.3.2.1.89	PAPI air-to-ground selection	T	T	T		4.6.10
189	3.2.3.2.1.90	PAPI alarm acknowledge	T	T	T		4.6.13
190	3.2.3.2.1.92	REIL ribbon display and formatting	T	T/A	T		4.6.10
191	3.2.3.2.1.93	REIL ON selection	T	T/A	T		4.6.10
192	3.2.3.2.1.94	REIL OFF selection	T	T	T		4.6.10
193	3.2.3.2.1.95	REIL low intensity selection	T	T	T		4.6.10
194	3.2.3.2.1.96	REIL medium intensity selection	T	T	T		4.6.10
195	3.2.3.2.1.97	REIL high intensity selection	T	T	T		4.6.10
196	3.2.3.2.1.98	REIL ground-to-ground selection	T	T	T		4.6.10
197	3.2.3.2.1.99	REIL air-to-ground selection	T	T	T		4.6.10
198	3.2.3.2.1.100	REIL alarm acknowledge	T	T	T		4.6.13
199	3.2.3.2.1.102	VASI ribbon display and formatting	T	T/A	T		4.6.10
200	3.2.3.2.1.103	VASI on selection	T	T/A	T		4.6.10
201	3.2.3.2.1.104	VASI off selection	T	T	T		4.6.10
202	3.2.3.2.1.105	VASI ground-to-ground selection	T	T	T		4.6.10
203	3.2.3.2.1.106	VASI air-to-ground selection	T	T	T		4.6.10
204	3.2.3.2.1.107	VASI alarm acknowledge	T	T	T		4.6.13
205	3.2.3.2.2.1	Mode control	T	T	T		4.6.10
206	3.2.3.2.2.2	System control during VGLS maintenance	T	T	T		4.6.10
207	3.2.3.2.2.3	System monitoring during ATCT mode	T	T	T		4.6.10

VRTM #	Section 3 Reference #	Heading	PAT	DQT	OT&E	Type Test	Section 4 Reference #
208	3.2.3.2.2.4	Field equipment fault detection	T	T	T		4.6.13
209	3.2.3.2.2.5	Communication fault detection	T	T	T		4.6.13
210	3.2.3.2.2.6	Visual alarm indication	T	T	T		4.6.13
211	3.2.3.2.2.7	Visual alarm button		I			4.6.1
212	3.2.3.2.2.8	Visual alarm button characteristics	T	T	T		4.6.13
213	3.2.3.2.2.9	Visual alarm button dimensions		A			
214	3.2.3.2.2.10	Equipment fault visual alarm indication characteristics	T	T	T		4.6.13
215	3.2.3.2.2.11	Communication fault visual indication	T	T	T		4.6.13
216	3.2.3.2.2.12	Communication fault visual alarm indication acknowledgement	T	T	T		4.6.13
217	3.2.3.2.2.13	Audible alarms - general	T	T	T		4.6.13
218	3.2.3.2.2.14	Audible alarm - acknowledgement	T	T	T		4.6.13
219	3.2.3.2.2.15	Screen overview label		A			
220	3.2.3.2.2.16	Supported VGLS		A			
221	3.2.3.2.2.17	Equipment ribbon display	T	T	T		4.6.10
222	3.2.3.2.2.18	Equipment status and control ribbon	T	T	T		4.6.10
223	3.2.3.2.2.19	Equipment status button dimensions		A			
224	3.2.3.2.2.20	Equipment status button spacing		A			
225	3.2.3.2.2.21	Equipment status button adjacent object spacing		A			
226	3.2.3.2.2.22	Equipment status button characteristic		T			4.6.10
227	3.2.3.2.2.23	Runway label - defined runway		A			
228	3.2.3.2.2.24	Runway label - defined equipment		T/A			4.6.10
229	3.2.3.2.2.25	Runway equipment label - undefined equipment		A			

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230	3.2.3.2.2.26	Ribbon display - defined equipment		T			4.6.10
231	3.2.3.2.2.27	Ribbon display - undefined equipment	T	T	T		4.6.10
232	3.2.3.2.2.28	ATCT/MAINT mode button	T	T	T		4.6.10
233	3.2.3.2.2.29	ATCT/MAINT mode indicator dimensions		A			
234	3.2.3.2.2.30	ATCT/MAINT mode button formatting		D/A			
235	3.2.3.2.2.31	Page control function	T	T	T		4.6.10
236	3.2.3.2.2.32	Page control button	T	T	T		4.6.10
237	3.2.3.2.2.33	Page control button type	T	T	T		4.6.10
238	3.2.3.2.2.34	Page control button dimensions		A			
239	3.2.3.2.2.35	Page control button formatting		D/A			
240	3.2.3.2.2.36	Volume control up button	T	T	T		4.6.10
241	3.2.3.2.2.37	Volume control up button dimensions		A			
242	3.2.3.2.2.38	Volume control up button formatting		D/A			
243	3.2.3.2.2.39	Volume control down button	T	T	T		4.6.10
244	3.2.3.2.2.40	Volume control down button dimensions		A			
245	3.2.3.2.2.41	Volume control down button formatting		D/A			
246	3.2.3.2.2.42	Audible alarm - volume control response		T			4.6.13
247	3.2.3.2.2.43	Volume test button		T			4.6.10
248	3.2.3.2.2.44	Volume test button dimensions		A			
249	3.2.3.2.2.45	Volume test button formatting		D/A			
250	3.2.3.2.2.46	Volume test button response		T			4.6.10

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251	3.2.3.2.2.47	Display brighter button		T			4.6.10
252	3.2.3.2.2.48	Display brighter button dimensions		A			
253	3.2.3.2.2.49	Display brighter button formatting		D/A			
254	3.2.3.2.2.50	Display darker button		T			4.6.10
255	3.2.3.2.2.51	Display darker button dimensions		A			
256	3.2.3.2.2.52	Display darker button formatting		D/A			
257	3.2.3.2.2.53	Equipment status button formatting		D/A			
258	3.2.3.2.2.54	Equipment ribbon - button dimensions		A			
259	3.2.3.2.2.55	Equipment ribbon - button spacing		A			
260	3.2.3.2.2.56	Equipment ribbon - button adjacent object spacing		A			
261	3.2.3.2.2.57	Equipment ribbon - control button characteristic		T			4.6.10
262	3.2.3.2.2.58	Equipment ribbon - indication button characteristic		T			4.6.10
263	3.2.3.2.2.59	Equipment ribbon - button color assignments		T/A			4.6.10
264	3.2.3.2.2.60	Equipment ribbon - equipment identifier		T/A			4.6.10
265	3.2.3.2.2.62	MALSR ribbon - display and formatting	T	T	T		4.6.10
266	3.2.3.2.2.63	MALSR on selection	T	T	T		4.6.10
267	3.2.3.2.2.64	MALSR off selection	T	T	T		4.6.10
268	3.2.3.2.2.65	MALSR low intensity selection	T	T	T		4.6.10
269	3.2.3.2.2.66	MALSR medium intensity selection	T	T	T		4.6.10
270	3.2.3.2.2.67	MALSR high intensity selection	T	T	T		4.6.10

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271	3.2.3.2.2.68	MALSR RAIL on selection	T	T	T		4.6.10
272	3.2.3.2.2.69	MALSR RAIL off selection	T	T	T		4.6.10
273	3.2.3.2.2.70	MALSR ground-to-ground selection	T	T	T		4.6.10
274	3.2.3.2.2.71	MALSR air-to-ground selection	T	T	T		4.6.10
275	3.2.3.2.2.72	MALSR alarm acknowledge	T	T	T		4.6.13
276	3.2.3.2.2.74	ODALS ribbon display and formatting	T	T	T		4.6.10
277	3.2.3.2.2.75	ODALS on selection	T	T	T		4.6.10
278	3.2.3.2.2.76	ODALS off selection	T	T	T		4.6.10
279	3.2.3.2.2.77	ODALS low intensity selection	T	T	T		4.6.10
280	3.2.3.2.2.78	ODALS medium intensity selection	T	T	T		4.6.10
281	3.2.3.2.2.79	ODALS high intensity selection	T	T	T		4.6.10
282	3.2.3.2.2.80	ODALS ground-to-ground selection	T	T	T		4.6.10
283	3.2.3.2.2.81	ODALS air-to-ground selection	T	T	T		4.6.10
284	3.2.3.2.2.82	ODALS alarm acknowledge	T	T	T		4.6.13
285	3.2.3.2.2.84	PAPI ribbon display and formatting	T	T	T		4.6.10
286	3.2.3.2.2.85	PAPI on selection	T	T	T		4.6.10
287	3.2.3.2.2.86	PAPI off selection	T	T	T		4.6.10
288	3.2.3.2.2.87	PAPI ground-to-ground selection	T	T	T		4.6.10
289	3.2.3.2.2.88	PAPI air-to-ground selection	T	T	T		4.6.10
290	3.2.3.2.2.89	PAPI alarm acknowledge	T	T	T		4.6.13
291	3.2.3.2.2.91	REIL ribbon display and formatting	T	T	T		4.6.10
292	3.2.3.2.2.92	REIL on selection	T	T	T		4.6.10
293	3.2.3.2.2.93	REIL off selection	T	T	T		4.6.10
294	3.2.3.2.2.94	REIL low intensity selection	T	T	T		4.6.10

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295	3.2.3.2.2.95	REIL medium intensity selection	T	T	T		4.6.10
296	3.2.3.2.2.96	REIL high intensity selection	T	T	T		4.6.10
297	3.2.3.2.2.97	REIL ground-to-ground selection	T	T	T		4.6.10
298	3.2.3.2.2.98	REIL air-to-ground selection	T	T	T		4.6.10
299	3.2.3.2.2.99	REIL alarm acknowledge	T	T	T		4.6.13
300	3.2.3.2.2.101	VASI ribbon display and formatting	T	T	T		4.6.10
301	3.2.3.2.2.102	VASI on selection	T	T	T		4.6.10
302	3.2.3.2.2.103	VASI off selection	T	T	T		4.6.10
303	3.2.3.2.2.104	VASI ground-to-ground selection	T	T	T		4.6.10
304	3.2.3.2.2.105	VASI air-to-ground selection	T	T	T		4.6.10
305	3.2.3.2.2.106	VASI alarm acknowledge	T	T	T		4.6.13
306	3.2.3.2.3.1.1	RVIU input power interface		A			
307	3.2.3.2.3.1.2	RVIU design and construction		A			
308	3.2.3.2.3.1.3	RVIU enclosure - type		A			
309	3.2.3.2.3.1.5	RVIU enclosure - material		I			4.6.1
310	3.2.3.2.3.1.6	RVIU enclosure – corrosion prevention		I			4.6.1
311	3.2.3.2.3.1.7	RVIU enclosure – volume		I			4.6.1
312	3.2.3.2.3.1.8	RVIU enclosure – volume constraints		I			4.6.1
313	3.2.3.2.3.1.9	RVIU enclosure – knockouts		I			4.6.1
314	3.2.3.2.3.1.10	RVIU enclosure – external cable connections		I			4.6.1, 4.6.12.1
315	3.2.3.2.3.1.11	RVIU enclosure – external electrical terminations		I			4.6.1, 4.6.12.1
316	3.2.3.2.3.1.12	RVIU enclosure – mounting provisions		I			4.6.1
317	3.2.3.2.3.1.13	RVIU enclosure – mounting bolt protrusion		I			4.6.1

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318	3.2.3.2.3.1.14	RVIU enclosure – gasket method		I			4.6.1
319	3.2.3.2.3.1.15	RVIU enclosure – strip gaskets		I			4.6.1
320	3.2.3.2.3.1.15.1	Number of strips		I			4.6.1
321	3.2.3.2.3.1.15.2	Strip continuity		I			4.6.1
322	3.2.3.2.3.1.15.3	Strip overlap		I			4.6.1
323	3.2.3.2.3.1.15.4	Strip joining		I			4.6.1
324	3.2.3.2.3.1.16	RVIU enclosure – gasket material		I			4.6.1
325	3.2.3.2.3.1.17.1	Convenience outlet		I			4.6.1
326	3.2.3.2.3.1.17.2	Support power availability		I			4.6.1
327	3.2.3.2.3.1.18.1	Service lamp		I			4.6.1
328	3.2.3.2.3.1.18.2	Service lamp protection		I			4.6.1
329	3.2.3.2.3.1.18.3	Service lamp switch		I			4.6.1
330	3.2.3.2.3.1.18.4	Service lamp availability		I			4.6.1
331	3.2.3.2.3.1.19	RVIU enclosure – grounding lug		I			4.6.1
332	3.2.3.2.3.1.20	RVIU cabinet door - hinge direction		I			4.6.1
333	3.2.3.2.3.1.21	RVIU cabinet door - hinge type		I			4.6.1
334	3.2.3.2.3.1.22	RVIU cabinet door - door stop		I			4.6.1
335	3.2.3.2.3.1.23	RVIU cabinet door - attachments		I			4.6.1
336	3.2.3.2.3.1.24	RVIU cabinet door - locking mechanism		I			4.6.1
337	3.2.3.2.3.1.25	RVIU cabinet door - padlock size		I			4.6.1
338	3.2.3.2.3.1.26	RVIU equipment wiring diagram		I			4.6.1
339	3.2.3.2.3.1.27	RVIU equipment wiring diagram - location		I			4.6.1
340	3.2.3.2.3.1.28	RVIU equipment wiring diagram - plate type and color		I			4.6.1
341	3.2.3.2.3.2.1	RVIU control input		A			
342	3.2.3.2.3.2.2	RVIU - VGLS equipment interface		A			

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343	3.2.3.2.3.2.3	RVIU - VGLS remote control	T	T	T		4.6.10
344	3.2.3.2.3.2.4	RVIU - VGLS local control	T	T	T		4.6.10
345	3.2.3.2.3.2.5	RVIU initialization	T	T	T		4.6.10
346	3.2.3.2.3.2.6	Remote control logic		T			4.6.10
347	3.2.3.2.3.3.1	MALSR RVIU external I/O support requirements		T			4.6.10
348	3.2.3.2.3.4.1	ODALS RVIU external I/O support requirements		T			4.6.10
349	3.2.3.2.3.5.1	PAPI RVIU external I/O support requirements		T			4.6.10
350	3.2.3.2.3.6.1	REIL RVIU external I/O support requirements		T			4.6.10
351	3.2.3.2.3.7.1	VASI RVIU external I/O support requirements		T			4.6.10
352	3.2.3.2.4	Intensity levels	T	T	T		4.6.10
353	3.2.3.2.5	Maintenance mode command processing	T	T	T		4.6.10
354	3.2.3.3	Failsafe		T	I		4.6.15
355	3.2.3.4	Time-to-alarm		T			4.6.13
356	3.2.3.5.1	Test points		T			4.6.1
357	3.2.3.5.2	Location		I			4.6.1
358	3.2.3.5.3	Safety		I			4.6.1
359	3.2.3.5.4	Accessibility		I			4.6.1
360	3.2.3.5.5	Circuit card – test point front access		I			4.6.1
361	3.2.3.6.1	Interlock switches		A			
362	3.2.3.6.2	Locations		I			4.6.1
363	3.2.3.6.3	Switch actions		T			4.6.1
364	3.2.3.6.4	Power discharge		T			4.6.1
365	3.2.3.6.5	Bypass		T			4.6.1

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366	3.2.4	Electronic equipment, general requirements		T/A/I			4.6.1
367	3.2.4.1	Workmanship		I			4.6.1
368	3.2.4.2.1	General		A			
369	3.2.4.2.2	Power fluctuation response		T			4.6.1
370	3.2.4.2.3	Internal wiring		I			
371	3.2.4.2.4	Building interface wiring		I			4.6.1
372	3.2.4.2.5	Electronic equipment		I			4.6.1
373	3.2.4.2.6	Grounding and bonding		T			4.6.12.2
374	3.2.4.3	Operating environmental requirements		I			4.6.1
375	3.2.4.3.1	Equipment environment classification		A			
376	3.2.4.3.2	Attended facilities		A			
377	3.2.4.3.3	Equipment shelters		A			
378	3.2.4.3.4	Outdoor installations		A			
379	3.2.4.3.5	Temperature – indoor operating		D			
380	3.2.4.3.6	Temperature – outdoor operating		T			4.6.2
381	3.2.4.3.7	Altitude		T			4.6.3
382	3.2.4.3.8	Humidity – indoor operating		D			
383	3.2.4.3.9	Humidity – outdoor operating		T			4.6.4
384	3.2.4.3.10	Sand and dust		T			4.6.5
385	3.2.4.3.11	Salt fog		T			4.6.6
386	3.2.4.3.12	Rain		T			4.6.7
387	3.2.4.3.13	Conducted emissions		T			4.6.8
388	3.2.4.3.14	Radiated emissions		T			4.6.8
389	3.2.4.3.15.1	Conducted susceptibility		T			4.6.8
390	3.2.4.3.15.2	Equipment recovery		T			4.6.8
391	3.2.4.3.16.1	Radiated susceptibility		T			4.6.8

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392	3.2.4.3.16.2	Equipment recovery		T			4.6.8
393	3.2.4.3.17.1	Input power voltage transients		T			4.6.9
394	3.2.4.3.17.2	Input power and I/O control lines transients		T			4.6.9
395	3.2.4.3.17.3	Transient recovery		T			4.6.9
396	3.2.4.3.17.4	Transparent operation		T			4.6.9
397	3.2.4.3.18	Outdoor equipment		T		T	4.6.2 - 4.6.7
398	3.2.4.4	Transportability		T		T	4.6.14
399	3.2.4.5	Materials, processes and parts		A/I			4.6.1
400	3.3	System Characteristics		A			
401	3.3.1	Safety		A			
402	3.3.1.1	High voltage protection		A			
403	3.3.2.1	Physical security		A			
404	3.3.3	Human factors		A/I			4.6.1