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U.S.Department of Transportation

Federal Aviation Administration

Specification

DUAL MODE
HIGH INTENSITY APPROACH LIGHTING SYSTEM
(ALSF-2/SSALR)

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DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

SPECIFICATION

DUAL MODE HIGH INTENSITY APPROACH LIGHTING SYSTEM (ALSF-2/SSALR)

1. SCOPE

1.1 Scope.- This specification sets forth the integrated system equipment requirements for a Dual Mode High Intensity Approach Lighting System used to present visual approach lighting patterns to landing aircraft on selected Category II/III Runways. This system will have two operational modes, a High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) and a Simplified Short Approach Lighting System with Runway Alignment Indicator Lights (SSALR). This specification sets forth the integration requirements for the entire system, provides detailed requirements for the electrical equipment necessary to energize and remotely control the lighting patterns, provides requirements for remote maintenance monitoring, and provides brief descriptions and interface data for subelements of the system that are procured by other detailed specifications.

1.2 Classification.- Two types of dimmable sequenced flashing lights are covered by this specification.

Type I - Elevated flasher assembly (3.2.5.3)

Type II - Semiflush flasher assembly (3.2.5.4)

1.3 Definitions.- The following definitions apply for this specification.

1.3.1. Mode ALSF-2.- ALSF-2 is an abbreviation for the High Intensity Approach Lighting System with Sequenced Flashing Lights, Category II. In ALSF-2 mode, approximately 100 lamps of the 300 or 500 watt type (35 kilowatts (kw)) are connected in

series in each of five constant current loops. Actual number of lamps and lamp wattage may vary for each loop.

1.3.2 Mode SSALR.- SSALR is an abbreviation for the Simplified Short Approach Lighting System with Runway Alignment Indicator Lights.

1.3.3 Current loop.- A current loop is formed by electrically connecting lamp transformers and an approach lighting system (ALS) regulator in series such that the ALS regulator current has a single path through primary windings of all lamp transformers and hence produces equal illumination of all lamps connected to the respective secondary windings.

1.3.4 Discrimination ratio.- Discrimination ratio is the ratio of specified mean time between failures (MTBF) to the minimum acceptable MTBF.

1.3.5 Down-link.- Data transmission from the air traffic control tower to the substation.

1.3.6 Up-link.- Data transmission from the substation to the air traffic control tower.

1.3.7 Alternating current and voltage.- Unless otherwise specified, all alternating currents and voltages shall be understood to be root-mean-square (rms) values.

1.3.8 High voltage.- Any voltage above 500 volts (V) rms.

1.3.9 Equipment failures.- Equipment failures are black box, module, card, or part failures whose impact upon the system functions may vary from a minor maintenance action to catastrophic. For example, the failure of a power supply whose redundant unit takes over automatically with no system downtime is only an equipment failure.

1.3.10 Failure condition.- A failure condition exists when one or more steady burning lamps or flasher lamps fail after a caution condition.

1.3.11 Functional failures.- Failures which cause either the complete or partial loss of a function.

1.3.12 Caution condition.- A caution condition exists when two steady burning lamps fail while in the SSALR mode or five lamps fail while in the ALSF-2 mode, in any of five current loops. Caution also exists when one flasher fails in the SSALR mode or two flashers fail in the ALSF-2 mode.

1.3.13 TTL compatible.- TTL is an abbreviation for transistor-transistor logic. The input and output shall be either logic high or logic low.

1.3.13.1 Logic high.- Unless otherwise specified, logic high shall be voltage higher than 2.4 volts direct current (dc) but not greater than 5.5 volts dc. It may also be defined by the numeral "1" or "HI".

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1.3.13.2 Logic Low.- Unless otherwise specified, logic low shall be voltage higher than -0.6 volts dc but not to exceed 1 volt dc. It may also be defined by the numeral "0" or "LO".

1.3.14 Complementary metal-oxide semiconductor (CMOS) logic

1.3.14.1 Logic high.- Logic high shall be voltage higher than 5.0 volts dc but not greater than 15 volts dc. It may also be defined by the numeral "1" or "HI".

1.3.14.2 Logic low.- Logic low shall be voltage higher than -0.5 volts but not to exceed 3.6 volts dc. It may also be defined by the numeral"0" or "LO".

1.3.15 24-volt logic

1.3.15.1 Logic high.- Logic high shall be voltage equal or higher than 15 volts dc but not greater than 28 volts dc. It may also be defined by the numeral "1" or "HI".

1.3.15.2 Logic low.- Logic low shall be voltage equal or higher -0.5 volt dc but not to exceed 5 volts dc. It may also be defined by the numeral "0" or "LO".

1.3.16 Mean time between failures (MTBF).- MTBF is equal to the total operating hours of the equipment divided by the number of failures.

1.3.17 Mean time to repair (MTTR).- MTTR is the total corrective maintenance time divided by the total number of corrective maintenance actions.

1.3.18 Predicted MTBF.- The predicted MTBF is determined by reliability prediction methods based on the equipment design, the use environment, and the exponential distribution.

1.3.19 Predicted MTTR.- The predicted MTTR is determined by maintainability prediction methods based on the equipment design, configuration, fault detection, and fault isolation techniques.

1.3.20 Remote maintenance monitoring system.- The Remote Maintenance Monitor System (RMMS) consists of the various sensors, micro-computers, instrumentation, and other microcomputer controlled circuits and equipment necessary to remotely monitor, control, analyze, record engineering data, and certify proper operation of equipment comprising the ALSF-2/SSALR as well as the overall ALSF-2/SSALR system. RMMS includes the Remote Monitor Subsystem (RMS), Maintenance Data Terminals (MDT), Maintenance Processor Subsystem (MPS) and the software/firmware necessary to make the system function.

1.3.20.1 Remote monitoring subsystem.- The Remote Monitoring Subsystem (RMS) is a subsystem of RMMS to provide for the collection, processing, control, and transmission of ALSF-2/SSALR equipment and environmental performance parameters.

1.3.20.2 Maintenance processor subsystem.- The maintenance processor subsystem (MPS) (not part of this specification) serves as the central processor for a defined geographical area. It acts as a control point to collect, record, and analyze monitored data from the ALSF-2/SSALR RMS. The MPS also can process commands to control ALSF-2/SSALR system.

1.3.20.3 Maintenance data terminal.- The maintenance data terminal (MDT) (not part of this specification) is a commercially available IBM PC/AT compatible personal computer. The MDT contains a keyboard, processor, monitor, and RS-232 port for use by field technicians in support of on-site maintenance responsibilities.

1.3.21 Specified mean time between failures.- The specified MTBF is the minimum acceptable MTBF, times the discrimination ratio.

1.3.22 Line replaceable unit (LRU).- The lowest unit to be replaced within the system during site maintenance. It is a separate, installable, physical package performing a single function or a group of closely related functions.

2. APPLICABLE DOCUMENTS

2.1 FAA documents.- The following FAA specifications, drawings, and standards of the issues specified in the invitation-for-bids, or request-for-proposals form a part of this specification where specified herein:

FAA-D-2494	Technical Instruction Book Manuscript: Electronic, Electrical, and Mechanical Equipment, Requirements for Preparation of Manuscript and Production of Books
FAA-E-982	PAR-56 Lampholder

2.1.1 FAA specifications

FAA-E-1100	Photometric Test Procedures for Condenser Discharge Lamp
FAA-E-1315	Light Base and Transformer Housing
FAA-E-2408	Lamps, PAR-56 Incandescent, Aviation Services
FAA-E-2491	Approach Light, Semiflush, Steady Burning
FAA-E-2604	Low-Impact Resistance Structure for Medium Intensity Approach Lighting System (MALS)

FAA-E-2690	Isolation Transformer for Approach Lighting System (1500 Watt)
FAA-E-2702	Low Impact Resistance Structure
FAA-G-2100	Electronic Equipment, General Requirement
AC 150/5345-47	Isolation Transformers for Airport Lighting Systems
Order 6000.34A	Project Implementation Plan for the Remote Maintenance Monitoring System (RMMS) Maintenance Data Terminal (MDT)

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2.1.2 FAA drawings

C-6046 Frangible Coupling, Type 1 and lA, Details

D-5140-2 Type JB Junction BOX

D-6238-4 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2), Dual Mode Field Lighting Schematic Diagram

D-6038-6 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2), Semiflush Lighting Installation Details (Sheet 1 or 2).

D-6238-15 High Intensity Approach Lighting system With sequenced Flashing Lights (ALSF-2), PAR-56 Lampholder Flasher, and Maintenance Stand Installation Details

D-6238-17 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2), Regulator Substation Floor Plan

D-6238-18 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2), Regulator Substation/Reference Lamps and Mechanical Equipment Layout

D-6238-21 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2), Regulator Substation Conduits Routing Plan

D-6238-22 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2), Substation Schematic Diagram

D-6238-23 High Intensity Approach@ Lighting System with Sequenced Flashing Lights (ALSF-2), ATCT Control and Regulator Substation Schematic Diagram

D-6038-24 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage input Cabinet Assembly

D-6038-25 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Input Cabinet Assembly

D-6038-26 High Intensity Approach Lighting System with Sequenced Flashing Lights(ALSF-2) Regulator Substation, High Voltage Input Cabinet Assembly

D-6238-27 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Input Cabinet Details

D-6238-28 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Output Cabinet Assembly

D-6238-29 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Input Cabinet Assembly

D-6138-30 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Output Cabinet Assembly

D-6131-30 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Output Cabinet Assembly

D-6131-32 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Output Cabinet Assembly

D-6131-33 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Input/Output Cabinet Assembly

D-6131-34 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Output Cabinet Details

D-6131-35 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Output Cabinet Details

D-6131-36 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Output Cabinet Details

D-6131-37 High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2) Regulator Substation, High Voltage Output Cabinet Details

2.1.3 FAA standards

FAA-STD-013	Quality Control Program Requirements
FAA-STD-019	Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities
FAA-STD-020	Transient Protection, Grounding, Bonding, and Shielding Requirements for Equipment
FAA-STD-021	Configuration Management (Contractor Requirements)
FAA-STD-024	Preparation of Test and Evaluation Documentation
FAA-STD-025	Preparation of Interface Control Documents
FAA-STD-026	National Airspace System (NAS) Software Development
NAS-MD-790	Remote Maintenance Monitoring System Interface Control Document, Maintenance Processor Subsystem to Remote Monitoring Subsystems and Remote Monitoring Subsystem Concentrators dated June 10, 1986; Change Notice-1 dated September 10, 1991; Change Notice-2 dated November 5, 1991
NAS-MD-793	Remote Maintenance Monitoring System Functional Requirements for the Remote Monitoring Subsystem (RMS)
NAS-IR-5104 5100	Draft Interface Requirements Document, Maintenance Data Terminal (MDT)/Remote Monitoring Subsystem (RMS), dated October 9, 1989
FAA-AP-1990-4391	Draft Interface Control Document for the Terminal Control Computer Complex/Approach Lighting System (TCCC/ALS) 10/15/90

2.2 Federal publications. - The following federal publications, of the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of this specification and apply where specified herein.

2.2.1 Military standards

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-276	Impregnation of Porous, Nonferrous Metal castings
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility, Requirement for the Control of electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-470	Maintainability Program Requirements (For Systems and Equipments)
MIL-STD-471	Maintainability Verification, Demonstration, and Evaluation
MIL-STD-781	Reliability Tests, Exponential Distribution
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-810	Environmental Test Methods
MIL-STD-1521	Technical Reviews and Audits for Systems, Equipment and computer software
DOD-STD-2167	Defense System Software Development

2.2.2 Military publications

MIL-HDBK-217	Reliability Stress and Failure Rate Data for Electronic Equipment
MIL-HDBK-472	Maintainability Predictions
RADC-TR-75-22	Nonelectronic Reliability Notebook

2.2.3 Military specifications

MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-C-7989	Covers, Light Transmitting, for Aeronautical Lights, General Specification for
MIL-C-13924	Coating, Oxide, Black, for Ferrous Metals
MIL-C-22896	Contractors
MIL-C-24308	Connector, Electric, Rectangular, Miniature, Polarized Shell, Rack and Panel, General Specification for
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirement for
MIL-C-26482	Connectors, Electronic, Circular, Miniature, Quick Disconnect

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MIL-E-917	Electric Power Equipment, Basic Requirements
MIL-E-17555	Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts); Packing of
MIL-I-46058	Insulating Compounds, Electrical (for coating printed circuit assemblies)
MIL-M-38510	Microcircuits, General Specifications for
MIL-S-83731	Switch, Toggle, Unsealed and Sealed Toggle, General Specification for

2.2.4 Federal specifications

QQ-A-200/9	Aluminum Alloy Bar, Rod, Shapes, Tube and Wire Extruded, 6063
QQ-A-225	Aluminum and Aluminum Alloy Bar, Rod, Wire, or Special Shapes; Rolled, Drawn, or Cold Finished, General
QQ-A-250	Aluminum and Aluminum Alloy Plate and Sheet, General Specification for
QQ-A-591	Aluminum Alloy Die Castings
QQ-A-601	Aluminum Alloy Sand Castings
QQ-P-416	Plating, Cadmium (Electrodeposited)
QQ-Z-325	Zinc Coating, Electrodeposited, Requirements for

2.3 Other publications.- The following publications, of the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of the specification.

2.3.1 National Fire Protection Association document

NFPA No. 70	National Electrical Code
NFPA NO. 78	Lightning Protection Code

2.3.2 Occupational Safety and Health Act (OSHA)

National Standards Established by Occupational Safety and Health Act (OSHA)

2.3.3 National Electrical Manufacturers Association

NEMA 4X	Dusttight, Raintight, Corrosion/Ice Resistant-Outdoor Enclosure
NEMA 12	Industrial, Dust-Tight, Drop-Proof Enclosure
NEMA FA1-3.01	Vibration Testing

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2.3.4 American National Standards Institute

ANSI C37.90	IEEE Guide for Surge Withstand Capability (SWC) Tests
ANSI C39.1	American National Standard for Electrical Analog Indicating Instruments
ANSI C62.1	Quantities and Units Used in Electricity

2.3.5 American Iron and Steel Institute standard

AISI	Stain and Heat Resistant Steel, No. 13

2.3.6 Electronic industries association

EIA-RS-232	Interface Between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange

2.3.7 Institute of Electrical and Electronic Engineers

IEEE-P1014	Proposed Standard for Versatile Backplane Bus

(Copies of this specification and other applicable FAA documents may be obtained from the Contracting Officer in the office issuing the invitation-for-bids or request-for-proposals. The requests should fully identify material desired; i.e., standard, drawing, specification, and amendment numbers and dates. Request should cite the invitation-for-bids, request-for-proposal, or contract involved or other use to be made of the requested material.)

(Requests for copies of military specifications and standards should be addressed to Naval Publications and Forms Center, Attention: NPFC-105, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.)

(Information on obtaining copies of federal specifications and standards may be obtained from General Services Administration offices in Washington, DC.; Atlanta; Auburn, Washington; Boston; Chicago; Denver; Kansas City; New York; San Francisco; and Seattle.)

(Information on obtaining NFPA documents may be obtained from the National Fire Protection Association, Battery March Park, Quincy, Massachusetts 02269.)

(Information on obtaining OSHA standards may be obtained from Department of Labor, Occupational Safety and Health, Constitution Avenue & 14th Street, NW., Washington, DC.)

(Information on obtaining NEMA publications may be provided by the National Electrical Manufacturer's Association, 2101 L Street, NW., Washington, DC 20037)

(Information on obtaining ANSI standards will be provided by the American National Standards Institute, 70 East 45th Street, New York, New York.)

(Copies of the AISI standards can be obtained from the American Iron and Steel Institute, 1000 16th Street, NW., Washington, DC 20036)

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3. REQUIREMENTS

3.1 General.- The equipment furnished under this specification shall provide approach lighting for use on selected runways. The Approach Lighting System (ALS) shall be switchable from the High Intensity Approach Lighting System with Sequenced Flashing Lights, Category II (ALSF-2) mode, to the Simplified Short Approach Light System with Runway Alignment Indicator Lights (SSALR) mode. The patterns produced by these two lighting modes are shown in plan view by figures 1 and 2 respectively. The system shall be capable of providing the 3,000-foot (914 m) patterns as shown where glide slope angle restrictions require it, and also the shorter 2,400-foot (732 m) patterns for use on other domestic Category II Runways (without the last six stations). The steady burning approach lights will be connected in five constant current lighting loops as shown on FAA Drawing D-6238-4. Switching between the modes (ALSF-2/SSALR) will be locally controlled from the substation and remotely controlled from the airport traffic control tower (ATCT) via the control subsystem, which will activate/deactivate the constant current regulators. Operational modes of the flashing lights will be switched by selectively activating the appropriate trigger signals upon command from the ATCT. The approach lighting system will use low impact resistance structures, will employ constant current lighting techniques, and will have remotely indicated fault sensing equipment. The substation equipments (regulators, high voltage cabinets, Remote Monitoring Subsystem and control and monitor subsystems) will be installed in an environmentally controlled shelter that is generally located within the runway approach zone. This shelter is not a part of this specification; however, it will provide protection for some of the equipment. The shelter equipment arrangement and detailed mounting provisions are as shown on FAA Drawings D-6238-17 and D-6238-21. The system equipment and interconnection shall comply with the National Electrical Code (NEC) and Occupational Safety and Health Act (OSHA). The required system shall be as shown in the functional block diagram, figure 4. This specification also covers reliability and maintainability design and prediction requirements imposed on the contractor. The design shall include a requirement for a remote maintenance monitoring system capability. For each circuit card assembly type, the contractor shall provide one site spare.

3.1.1 Equipment to be supplied by the contractor.- The ALSF-2/SSALR systems shall be complete in accordance with all specification requirements and shall include the items listed below. Quantities shall be as specified in the contract schedule.

(a) 480 VAC input cabinet (3.2.1)
(b) High voltage output cabinet (3.2.2)
(c) Constant current regulators (3.2.3)
(d) Control and monitor subsystem (3.2.4)
(e) Reserved
(f) Elevated flasher assembly (Type 1) (3.2.5.3)
(g) Aiming device (3.2.5.3.1.9)
(h) Semiflush flasher assembly (Type II) (3.2.5.4)
(i) Flasher tester (3.2.5.5)
(j) Elevated PAR-56 lampholders (3.2.6)
(k) Site spare parts (3.2.7)
(m) Junction boxes (3.3.10)
(n) Instruction books (3.7)
(o) Remote monitoring subsystem (3.2.9)
(p) Substation Distribution Panel (3.2.8.1)
(q) Utility transformer (3.2.8.2)
(r) Safety Disconnect Switch (3.2.8.3)

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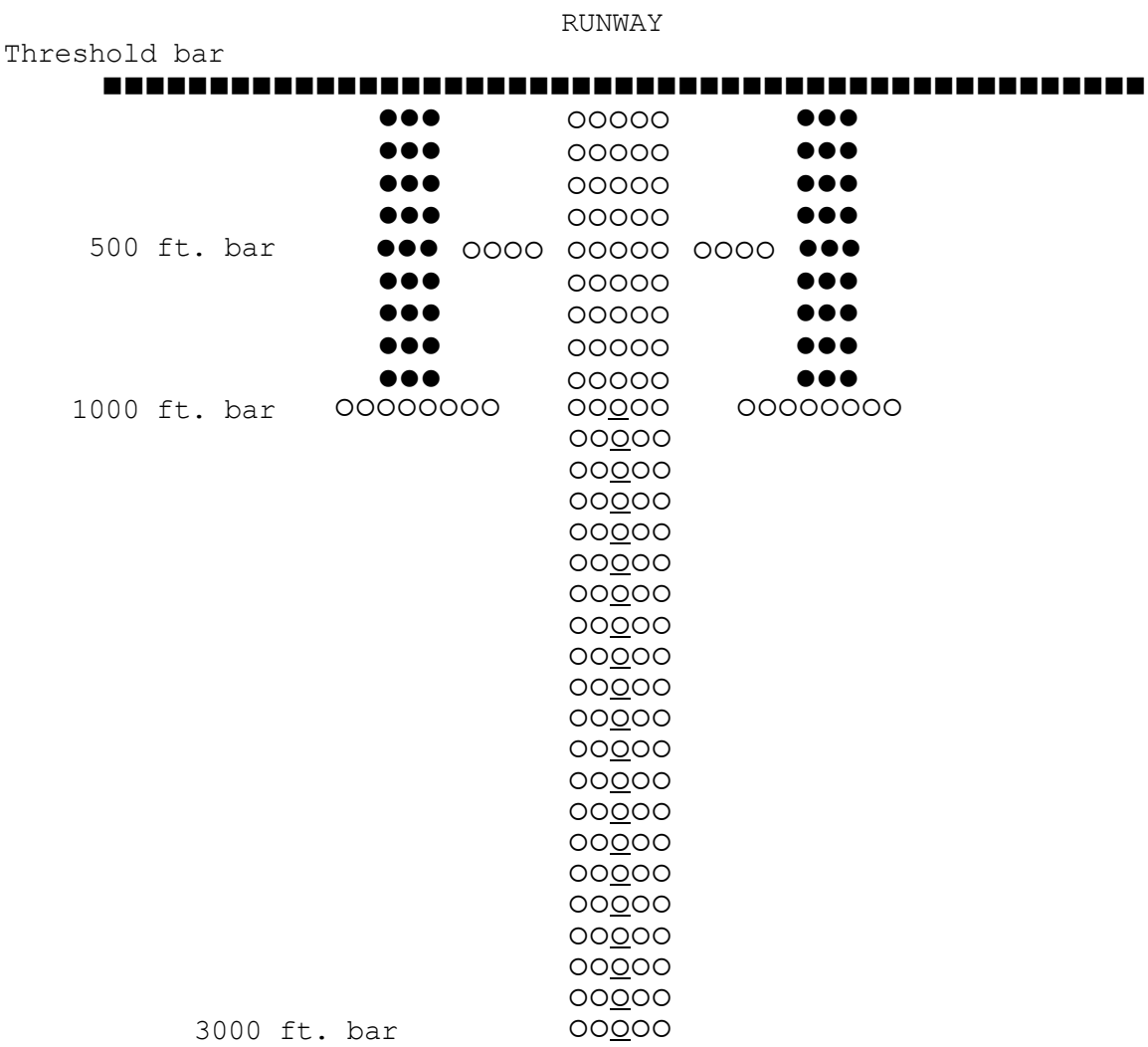
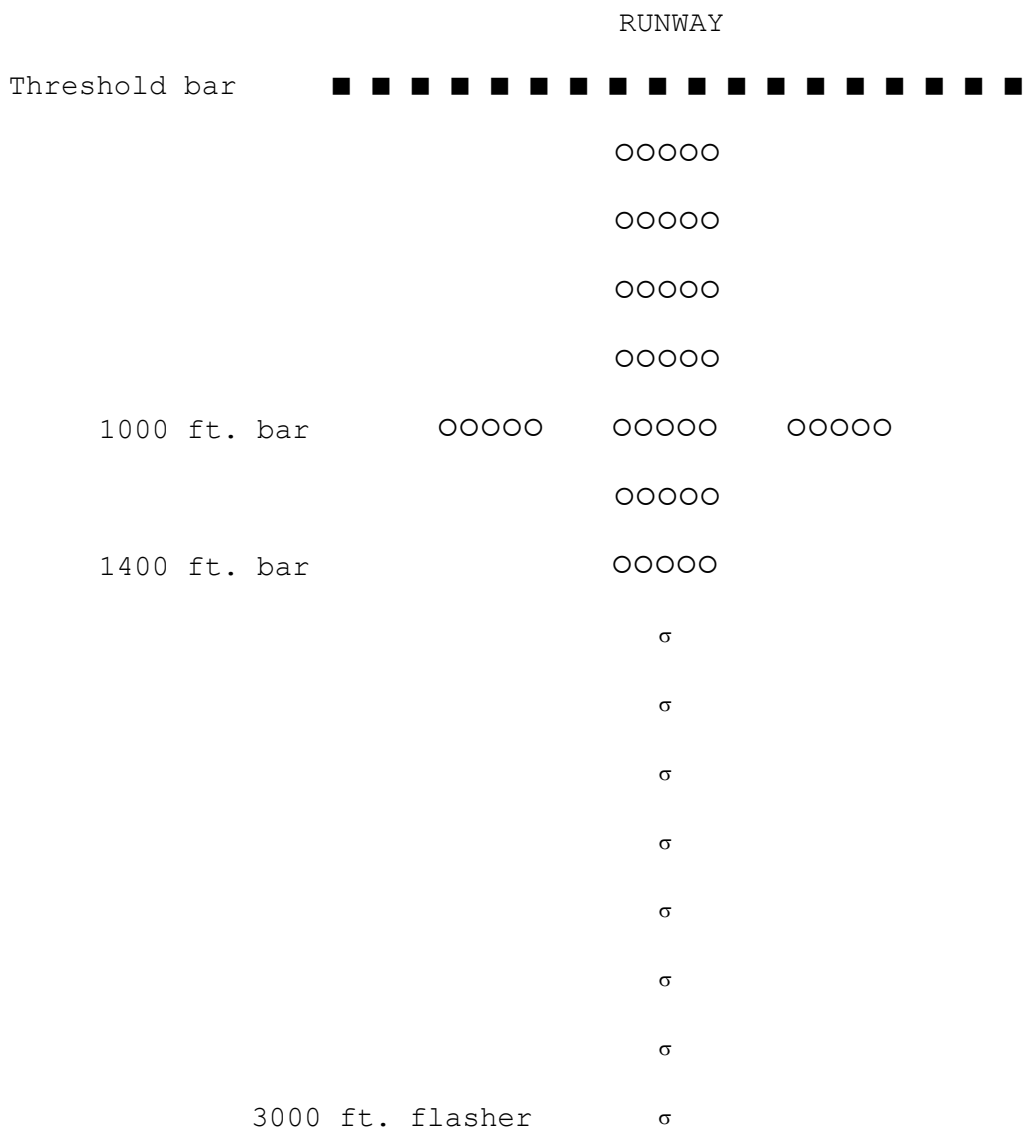


■ Green
● Red
O White
O̲ White with Flasher

Note: 2400 FT System same as above without the last six (6) light bars and last six (6) flashers. 49 lamp threshold bar shown. Can have up to 101 lamps.

Figure 1. ALSF-2 Lighting Pattern - 3000 FT System
(Not to Scale)



Note: 2400 FT System same as above without the last three (3) flashers.

Figure 2. SSALR Lighting Pattern - 3000 FT System
(Not to scale)

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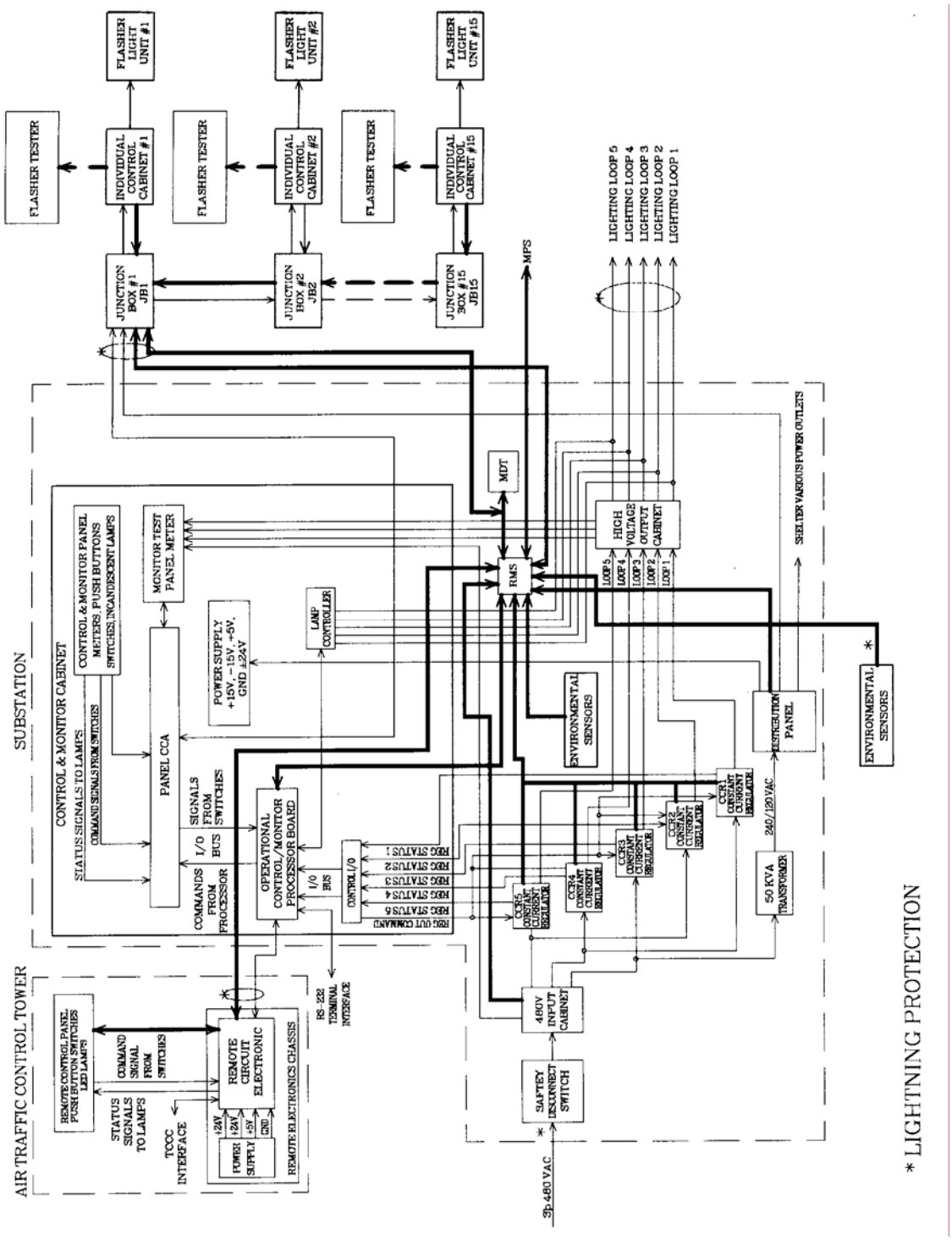

Figure 4. Functional Block Diagram

3.1.2 Other Equipment.- Other equipments required to make a complete approach lighting system are listed below. These items are not furnished or required under the specification, but are briefly described herein with detailed requirements being contained in the paragraphs or in the individual equipment specifications referenced below:

(a) Isolation transformers (3.2.11.1)

(1) 300 watt, 20 ampere (A) primary, 20 A secondary (AC 150/5345-47)

(2) 500 watt, 20 A primary, 20 A secondary (AC 150/5345-47)

(3) l500 watt, 20 A primary, 20 A secondary (FAA-E-2690)

(b) PAR-56 lamps (FAA-E-2408) (3.2.11.2)

(1) 300 watt

(2) 500 watt

(c) Low impact resistant structures (3.2.11.3)

(d) Substation shelter (3.2.11.4)

(e) Semiflush fixtures (FAA-E-2491)

3.2 Performance characteristics.- The units of the system shall have the performance characteristics shown in the following paragraphs.

3.2.1 480 V ac input panel.- A 480 Vac input panel shall be supplied for each system and shall:

(a) Receive 480 volts alternating current (V ac), 3-phase, 3-wire, 60 hertz (Hz), ungrounded wye, 150 KW primary input power to the substation shelter.

(b) Provide power distribution to the substation in accordance with National Electrical Code (NEC) and OSHA requirements.

(c) Reserved.

(d) Contain potential and current transformers, as required to monitor the input voltage and power consumption at the control and monitor system.

(e) Provide high voltage warning and safety provisions.

The 480 V ac input panel shall provide 480 V ac, 1-phase, 2-wire power to each of the regulators in the substation and service transformer, and shall accommodate main power metering.

3.2.1.1 Reserved.

3.2.1.2 Reserved.

3.2.1.3 Disconnect switch.- Three-phase fused disconnect switch shall be provided to interrupt all phases of the primary power to the substation. The three phase disconnect switch shall be mechanically ganged so that all three blades are simultaneously disconnected with one lever motion.

3.2.1.4 Instrument potential transformers.- Potential transformers shall be provided to supply the required voltage monitoring signals to the input voltmeter and wattmeter located in the substation control and monitoring assembly. The transformers shall be equipped with fused primary windings to isolate high voltages in the event of transformer failure.

3.2.1.5 Instrument current transformers.- Current transformers having a ratio of 400 to 5 amperes shall be provided to supply current reference to the input power, 2-1/2 element, 3 phase wattmeter located in the substation control and monitor assembly. The current transformers shall be transient protected on secondary.

3.2.2 High voltage output cabinet.- A high voltage output cabinet shall be supplied for each system and shall:

(a) Receive constant current regulated power from the regulators for each of the five lighting loops.

(b) Provide service exit from the substation in accordance with NEC and OSHA requirements.

(c) Provide lightning protection for the output circuits and for the output monitoring circuits.

(d) Contain shorting disconnects for isolation of the light field during servicing and maintenance.

(e) Contain potential transformers as required to monitor output voltage level.

(f) Provide high voltage warning and safety provisions.

The high voltage output cabinet shall provide for distribution and switching of the current from five 30 KW constant current regulators to five output lighting loops in the ALS light field. The output cabinet shall be equipped with instrument potential transformers, shorting disconnects, and lightning protection circuitry. FAA Drawings D-6238-22 and D-6238-23 and D-6131-30 through D-6131-37 should be used as general guidance in designing the layout of the cabinet.

3.2.2.1 Lightning protection.- The output power lines from the cabinet shall be protected from lightning by installation of lightning arresters at each standoff feeding the light field circuits (see 3.6.6).

3.2.2.2 Standoff insulators.- All high voltage cable terminations and tie points shall be made on standoff insulators.

3.2.2.3 Shorting disconnect.- Shorting disconnects (Crouse-Hinds 30196, or equal) shall be connected in each output constant current loop. These plug cutouts shall isolate the load from the regulator and short both the regulator lines and the light field lines to provide safety to maintenance personnel and to prevent open circuit regulator outputs. The cable connecting lugs shall have pressure plates under the compression screws.

3.2.2.4 Instrument potential transformers.- Potential transformers (GE 643X87, or equal) shall be installed to allow monitoring of output loop voltages. Transformers shall have both legs of the primary circuits fused. The output of potential transformers shall be wired to the output terminal board as shown on FAA Drawings D-6238-22 and D-6238-23. The ratio of these transformers shall be 20:1. They shall provide inputs to both the light field monitoring circuits and the output voltage meter located in the substation control and monitor assembly.

3.2.2.5 Reserved.

3.2.2.6 Reserved.

3.2.3 Constant current regulator.- Five 30 KW constant current regulators shall be supplied for each system, one for each steady burning lighting loop. The regulators shall all be commanded simultaneously by the control subsystem and each shall:

(a) Operate from a 480 V ac, single phase, 2-wire, 60 Hz source.

(b) Provide output current monitoring meter.

(c) Have 24 V dc logic levels (see 1.3.15) for control and status signals.

(d) Provide regulated constant current to series lighting loops that is variable in 5 discrete steps as a function of selected brightness.

(e) Provide output taps for 15 KW, 20 KW, 25 KW and 30 KW.

Provisions shall be made for stepped-brightness selection without interrupting load current. The assembly shall have an isolation transformer, a current detecting system, transient suppressor, brightness selection control circuitry, open-circuit and over current protection, and an output current meter. Solid-state electronic circuitry and fixed winding transformers or reactors shall be used to accomplish regulation at the various brightness steps. (No moving coil or other mechanical apparatus shall be used for regulation.) Relays may be used for on/off control of the high voltage input but all control and monitoring interfaces shall be solid-state and shall have 24 V dc logic levels as defined in 1.3.15.

3.2.3.1 Input power.- The regulator shall operate without degraded performance with input voltages of 480 V ac ± 10%, 60 Hz ± 3%, single phase.

3.2.3.2 Output regulation.- The regulator shall automatically maintain its normal output current within the limits set forth in table I for all input voltages as specified in 3.2.3.1 and for all variations in output load from short circuit to full load (30 KW). The assembly shall meet these same requirements with 10 percent of the total load (3 KW) consisting of suitably loaded isolating transformers which are then open-circuited at their secondaries.

Table I. Regulator Output Requirements

Brightness Step	Output Current (Amperes)	Output Tolerance (Amperes)
5	20.0	+ 0.0, - 0.4
4	15.8	± 0.4
3	12.4	± 0.3
2	10.3	± 0.3
1	8.5	± 0.2

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3.2.3.3 Efficiency.- The efficiency of the regulator shall be greater than 92 percent at maximum brightness with an input voltage of 480 V ac, unity power factor load, and at an ambient temperature of 77 degrees F (25 degrees C). The efficiency shall be measured at rated load.

3.2.3.4 Power factor.- The regulator power factor shall be equal to or greater than O.95 at rated load (30 KW) in step 5 with a resistive load. The power factor shall always be lagging and shall not be less than 0.5 for any intensity step in the ALSF-2 mode or the SSALR mode, in which the power consumed by the load is equal to or greater than 10 percent of the full rated regulator capacity. Power factor correction, if needed, shall be internal to the regulator, and shall be switched as required to maintain a lagging power factor equal to or greater than 0.5 and less than 1 in step 5 for a resistive load of 3 KW to 30 KW.

3.2.3.5 Temperature rise.- The temperature rise for primary and secondary windings, as determined by the resistance method, shall not exceed 149 degrees F (65 degrees C) when operated at full load and unity power factor. The regulators shall have Type H insulation temperature characteristics in accordance with MIL-E-917.

3.2.3.6 Output isolation.- The regulator output shall be electrically isolated from the input and shall also be floating (not grounded).

3.2.3.7 Open-circuit protection.- An open-circuit protection feature shall be provided such that the regulator will be automatically switched off within 2 seconds after the output circuit is opened. Upon removal of the open circuit, the regulator shall not automatically restart. In order to restart the regulator, the regulator on/off control circuit (either local or remote) shall be cycled through the off position and returned to the on position to reset the open-circuit protection feature.

3.2.3.8 Open-circuit voltage.- In the event of failure of the open-circuit protection feature, or in the interim between where the open circuit occurs and the protection circuit operates, the peak open circuit voltage shall not exceed 4,500 volts, including transients or switching spikes.

3.2.3.9 Overcurrent protection.- An automatic overcurrent protection feature shall be provided such that the regulator will be automatically switched off if the output current exceeds 105 percent of its rated output (21 amperes). The feature shall have a time delay to prevent its activation on transients and other spurious signals such that activation shall occur between 0.5 and 2 seconds after overcurrent. Reset of this feature shall require intervention by maintenance personnel.

3.2.3.10 Output monitor.- An ac ammeter shall be provided on the front of the regulator to indicate the output current. This meter shall be at least 3.5 inches (89 mm) in diameter and shall have an accuracy of better than 1 percent without calibration cards or correction curves. The instrument shall be isolated from the output circuit by an instrument current transformer to remove the high voltage safety hazard. Full scale for the ammeter shall be 25 amperes.

3.2.3.11 Reserved.

3.2.3.12 Control.- Control of the regulator shall be possible from a front panel switch on the regulator and from the control subsystem. The local control switch shall be a 7 position rotary switch which has the following positions as it is rotated in the clockwise direction. REMOTE - OFF - B1 - B2- B3 - B4 - B5. In OFF the regulator shall be disconnected from the primary power source. In B1 through B5 the regulator shall connect to the primary and provide regulated output current for the brightness selected. In the REMOTE position all local commands shall be inactive and the unit shall be under the control of the control subsystem. Remote commands, when selected, shall be 24 V dc high logic. A terminal board that is conspicuously marked "CONTROL" shall have terminals labeled: COMMON, ON, B1, B2, B3, B4, and B5 for these respective functions. High voltage components shall be isolated from low voltage components by means of separate compartments. Components installed on the door shall not protrude into the high voltage compartment. All ungrounded metal shall be protected from personnel contact by insulated or grounded barriers.

3.2.3.13 Status.- Status monitoring signals (24 V dc high logic) shall be generated by the regulator control electronic circuitry that is indicative of the actual status of the regulator and that the command received (whether local or remote) has been, in fact, activated. These signals shall be available on a terminal board that is conspicuously marked "STATUS" and shall be labeled COMMON, ON, B1, B2, B3, B4, B5, and REMOTE (RMT).

3.2.3.14 Output current surge limitation.- Design of the regulator shall be such that switching the regulator on and off, changing brightness steps, or shorting the load shall not cause an output surge with (1) true rms amplitude greater than the next brightness step being switched; and (2) a time duration of longer than three 60 Hz cycles. Also, no surge shall cause the series connected incandescent lamps to flash or be damaged in any way. If power is continuously provided to the circuitry when the rotary switch is in the off position for surge limitation purposes, then a separate front panel switch labeled "internal control power" shall be provided to disconnect power from the printed circuit boards. Time delay, if incorporated, when switching the regulator on and off, shall not cause an interval of more than 2 seconds to elapse before the unit operates to deliver the current selected. Pulsation or hunting of output current shall be limited to 2 seconds or less under all conditions of switching.

3.2.4 Control and monitor subsystem.- A control and monitor subsystem shall be supplied with each system and shall consist of three major units.

(a) The substation control and monitor assembly

(b) The remote electronic chassis

(c) The remote control panel

3.2.4.1 Substation control and monitor assembly.- The substation control and monitor assembly shall:

(a) Operate from 120 V ac, 60 Hz power.

(b) Provide monitoring meters for input voltage, output voltage, and input power.

(c) Contain dc power supplies as required for the operation of the control and monitor electronic circuits and local panel indicator lamps.

(d) Provide lightning protection for the input power and the data transmissions link to the remote electronic chassis.

(e) Provide control signals to the flasher assemblies used in the ALSF-2/SSALR system. It shall also be capable of:

(1) Monitoring the operation of the flasher.

(2) Controlling the intensity of the flasher.

(f) Providing lightning protection for the output circuits.

(g) Receive monitoring signals from the individual control cabinet to determine the number of flasher light units that fail to flash.

(h) Control the flasher assemblies in accordance with the following:

ALSF-2 Mode- All flashers shall be active so that the sequence will begin with the flasher farthest from the threshold and proceed toward the flasher closest to the runway threshold. Each flasher shall flash twice per second (±2.5 percent)), in sequence. The time interval between flashes of a single sequence shall be 16.67 milliseconds (±2.5 percent).

SSALR Mode- Alternate flashers shall be active so that the sequence will begin with the flasher farthest from the runway threshold and proceed toward the flasher closest to the runway threshold ending with the flasher at the 1600ft bar. Each alternate flasher shall flash twice per second (±2.5 percent), in sequence. The time interval between flashes of a single sequence shall be 33.33 milliseconds (±2.5 percent).

(i) Monitor each flashing light unit for misfires accumulated over a 100 sample interval. When the number of misfires exceeds a pre-set value, the flasher light unit shall be considered failed, and a failure flag set. The misfire preset value shall be adjustable through the MDT/Flasher Tester in a range of one (1) to seven (7) misfires. When a flasher light unit misfires the selected number of times in the 100 sample period, it shall be registered as one (1) unit out for CAUTION/FAILURE determination by the system monitoring logic. The flasher light unit failure flag shall only be cleared by a command from the MDT/Flasher Tester. The flasher light unit shall continue to operate (if mechanically able) during this failure period.

(j) Contain the substation control panel (see figure 5) for controlling the operation of the system including:

(1) Power on*

(2) Power off

(3) Approach lights on

(4) Approach lights off

(5) Flashing lights on

(6) Flashing lights off

(7) Mode ALSF

(8) Mode SSALR

(9) Alarm status (caution, failure, communication fault)

(10) Control source maintenance (MAINT)

(11) Control source maintenance processor subsystem (MPS)

(12) Control source remote control panel (ATCT)

(13) Input voltage phase selectors
Note - Selectors may be replaced by meter(s) with multiple readout capability

(14) Output voltage loop selectors
Note - Selectors may be replaced by meter(s) with multiple readout capability

(15) Panel lamp test

(16) Brightness (1 - 5)

*The substation control panel power on switch/indicator (3.2.4.1 (j) (1), shall not be used to directly switch the 120 V ac power to the electronic circuits. Instead, a solid-state switch or relay controlled by the switch/indicator shall be used to switch the 120 V ac power. A master power switch that will disconnect the incoming 120 V ac power to the cabinet shall be installed in the cabinet, adjacent to the 120 V ac power fuse.

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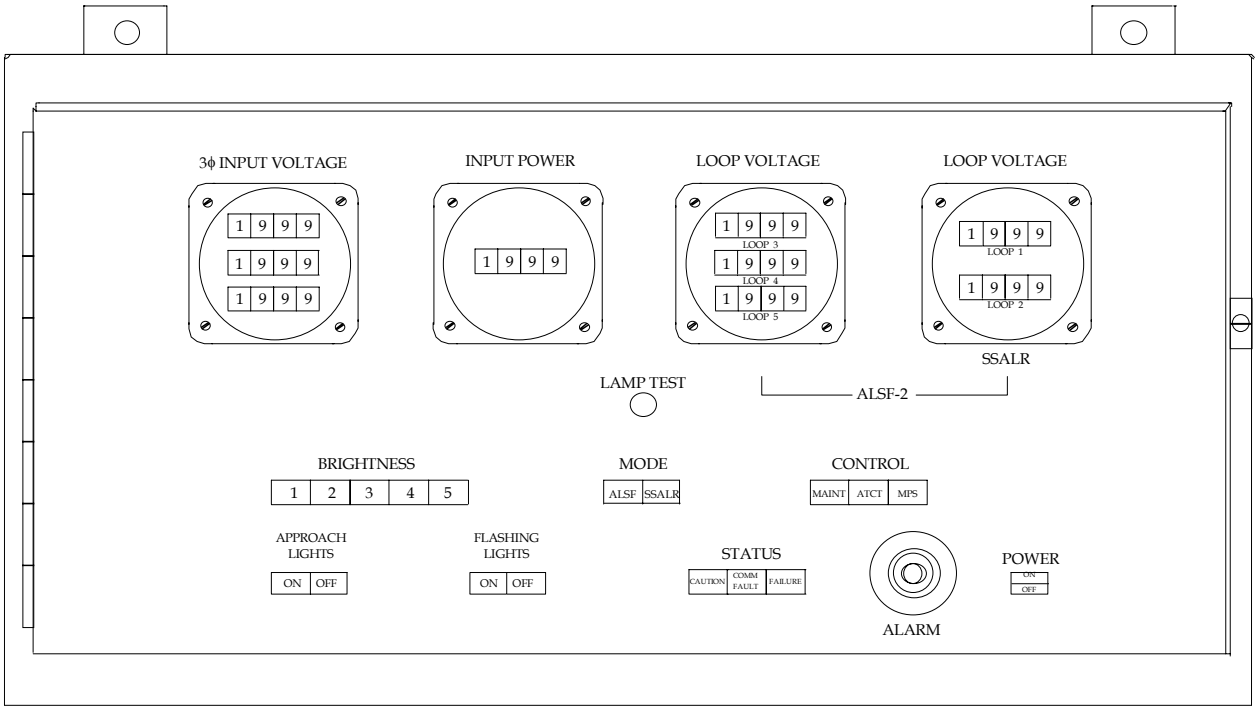

Figure 5. Typical Substation Control Panel

(k) Contain the electronic circuitry required to receive commands from the remote control panel, monitor control panel or RMS, solve the required control algorithms, format and distribute the commands to the output devices (regulators, flashers, RMS), and distribute status and alarm signals to monitoring and display devices.

(l) Contain the electronic circuitry required to detect the number of failed lamps in the five current loops in brightness level settings (B1 to B5) and both modes (ALSF-2 and SSALR). When a specified number/combination (adjustable) of failed lamps and/or flashers are detected (reference 3.2.4.5.2), the monitor shall transmit caution and failure alarms to the control electronics. (See 4.4.8.1.)

(m) Contain the electronic circuitry required to provide remote maintenance monitoring and control.

(n) Feature elapsed time indicator(s). The elapsed time indicators shall accumulate and display the total operating time for the following conditions (see 3.2.4.4.7):

(1) Brightness 1 or 2
(2) Brightness 3
(3) Brightness 4
(4) Brightness 5
(5) Flasher high intensity brightness

The stored totals shall be retained for five (5) years after loss of power.

(o) Contain electronic circuitry required to interface the ALSF-2/SSALR to the terminal control computer complex (TCCC). This function may be performed at the Remote Electronics Chassis.

(p) Contain logic to allow the Remote Control Panel to command flashing lights ON only when the approach lights (steady burning lights) are ON. This shall apply to all conditions except when in MDT Local Mode or the MAINT button is selected. Under MDT Local Mode or when the MAINT button is selected, the flashers shall be able to operate independent of the steady burning lights.

3.2.4.2 Remote electronic chassis.- The remote electronic chassis shall provide an interface function between the remote control panel and the substation control and monitor assembly. Its purpose is to perform those electronic functions required by the ATCT and the communications link without using ATCT control panel space. The tower control panel interface with the remote electronic chassis shall be a serial data interface. The operation of the system shall not be degraded by any length of cable up to a maximum of 300 feet (91.44 m). The remote electronic chassis shall contain the following functional hardware:

(a) Communication data modems, including clock generators

(b) Indicator lamp drivers (solid-state)

(c) Logic required to format data, interlock control functions, control and mute the audible alarms, and sense up-link communication failures

(d) Power supplies required for logic, communications, and display circuits (120 V ac input)

(e) Engine-generator (E/G) interface circuits

(f) RMS interface link to send and receive commands from the RMS unit in the substation shelter.

3.2.4.3 Remote control panel.- The remote control panel (see figure 6) shall:

(a) Have switch/indicators to control and display the status of the following functions.

(1) Brightness (1-5)

(2) Mode (ALSF-2/SSALR); and cause auxiliary contact closure in the remote electronics chassis for use with engine generator when ALSF-2 mode is selected.

(3) Approach lights (ON/OFF)

(4) Flashing lights (ON/OFF)

(5) alarm status (caution, failure, communication fault)

(6) Control status - (MAINT indicator only)

(7) Runway number

(8) Lamp test (part of runway number module)

(b) Have a control to dim the panel lights.

(c) Have an audible alarm to draw attention to indicated faults.

(d) Serial communications interface to the Remote Electronics Chassis.

3.2.4.4 Control subsystem.- The control subsystem shall be designed in three major assemblies as required in 3.2.4 and shall have the features specified herein.

3.2.4.4.1 Switch/indicators.- The switch/indicator modules used on the local and remote control panels shall be Korry Model 432 or equal and shall be grouped, labeled, and have legends as shown on figures 5 and 6. Momentary switch modules are acceptable in the remote control and substation control panels. Figure 5 is modified to require a single Power on/off switch with ON indicator Each module shall:

(a) Have at least two 28 V dc lamps per indicator (four lamps for split legend lenses).

(b) Allow relamping from the front.

(c) Provide compatible signals to control electronic circuitry.

(d) Have the legends in black letters, visible at all times on white background, which illuminates in color when energized.

(e) Reserved.

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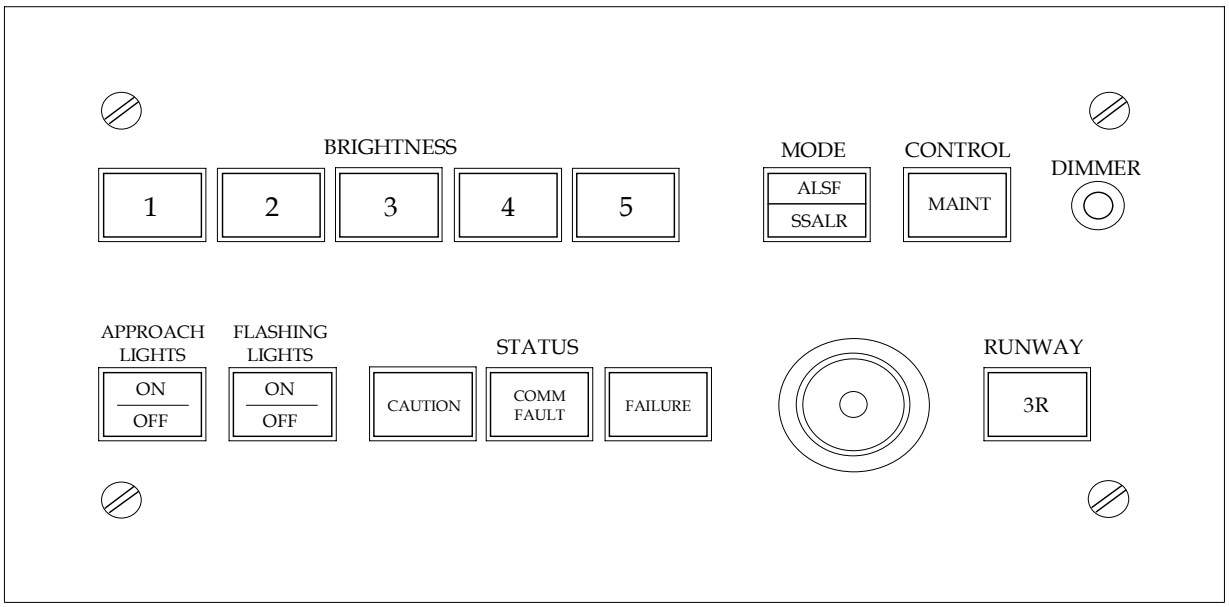

Figure 6. Typical Remote Control Panel

(f) Have switches that are electrically isolated from their indicators, such that the indication is a feedback from the controlled equipment which denotes that the requested action has, in fact, taken place. (Except meter selectors).

(g) Not lose switch command or require resetting in the event of power loss. (Brightness 5 is excepted.) Solenoid hold circuitry shall not be used.

3.2.4.4.1.1 Color.- All indicators shall illuminate in amber when activated except:

(a) ON indicators shall illuminate in green (OFF is amber).

(b) SSALR indicator shall illuminate in green (ALSF is amber).

(c) FAILURE indicator shall illuminate in red.

(d) MAINT indicator shall illuminate in red.

(e) ATCT indicator shall illuminate in green.

(f) MPS indicator shall illuminate in red.

3.2.4.4.1.2 Dimming.- A rotary control shall be provided on the remote control panel to adjust the intensity of the panel indicators from full voltage to 50 percent of full voltage. Maximum brightness shall occur when the control is in the clockwise position. Dimming is not required at the substation control panel.

3.2.4.4.1.3 Lamp test.- A lamp test feature shall be provided. Depressing the lamp test switch shall cause all lamps to illuminate and shall also cause the alarm buzzer to sound. This shall be a separate switch on the substation panel and shall utilize the runway identification (ID) switch in the remote panel.

3.2.4.4.1.4 Runway identification.- The runway identification switch/indicator (Legend 3R on figure 6) shall be provided with a blank lens. This module also serves as the lamp test pushbutton in the remote panel.

3.2.4.4.2 Control algorithms.- Electronic circuitry shall be provided as required to convert the requested commands (switch closures) into actual control signals for the various controlled equipments. Control algorithms shall primarily be solved in the substation control unit; however, circuitry shall be provided in the remote chassis as required to implement remote functions.

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3.2.4.4.2.1 MAINT/ATCT control.- For specification of MAINT/ATCT control see 3.4.16 and subsections. If any of the regulators are placed in a local control mode via its own independent (local/remote) switch when the substation (or tower) is in the ATCT mode, the air traffic control tower MAINT indicator shall be illuminated along with an audible alarm and the substation control panel MAINT indicator shall blink (see 3.2.4.4.2.8).

3.2.4.4.2.2 Brightness control.- Logic shall be provided to cause the selected brightness to be activated by the regulators, monitor, and flasher equipment. The flasher shall be commanded to LOW intensity for brightness steps 1 or 2, to MEDIUM for step 3, and to HIGH for steps 4 or 5.

3.2.4.4.2.3 Brightness 5 control logic.- Logic shall be provided to prevent brightness 5 from remaining active for more than 15 minutes ±10 seconds without reinitiating the command. Brightness 5 is a momentary signal and must be electronically latched. Once latched, the brightness 5 control shall be active for only 15 minutes, unless reinitiated during the 15 minute period. At 14.5 minutes ±10 seconds, an alert signal shall be generated and sent to the control panel to "beep" the alarm and cause the B5 indicator lamp to blink. At the end of 15 minutes, the B5 control latch shall be reset and B4 logic activated, causing the lighting system to switch into brightness 4. Until any brightness level is selected, the system shall remain in brightness 4 and the alert signal shall remain active, causing the B4 indicator to blink, indicating that the actual brightness is not as selected by the operator. When there is a power source transfer from commercial power to engine generator power, the brightness level will step from brightness 5 to brightness 4 for a period of 10 seconds after which it will return to brightness level 5. This is accomplished by 2 additional terminals connected to the engine generator "ON" switch. These two terminals shall be transient protected and identified as "engine generator set back." The voltage at these two terminals shall be 24 V dc and is provided by the engine generator. When 24 volts is at these terminals, logic is High and the engine generator is turned ON. When 0 volts is at these terminals, logic is Low and the engine generator is OFF.

3.2.4.4.2.4 Regulator control.- The logical control algorithm for the regulator on/off and brightness control functions shall be such that, when a regulator is turned on, it is turned on with B1 selected and after a 3.5 second time delay, the desired brightness is selected. The delay allows the steady burning lamps to come up to operating temperature before large energy output conditions are imposed on the system. After initial warm up, it shall be possible to select any brightness without additional delays. The 3.5 second time delay shall not be used when the regulator is turned off by input power interruption and then to on when input power returns, such as occurs when power is transferred from engine generator to commercial power using the E/G transfer switch.

3.2.4.4.2.5 Flashing light control.- Logic signals shall be provided to turn the flashing lights on/off, change modes, or change brightness upon command. No special timing considerations of these signals are required.

3.2.4.4.2.6 Mode change logic.- Logic shall be provided to turn the five regulators on when the system is commanded to be in the ALSF-2 mode. When the system is commanded to be in the SSALR mode, only the two regulators that feed the SSALR lighting loops shall stay on.

3.2.4.4.2.7 Alarm.- An electronic signal shall be provided and shall output a steady audible tone of 2000 Hz ±500 Hz with a sound pressure level measured at 1 meter of 55 to 70 decibels (dB). The sound level adjustment control shall be located inside the enclosure and behind the remote control panel. The alarm operates as follows:

(a) When a failure condition is received from either the strobe light (flasher) control system or the ALS operational monitor subsystem, it shall initiate a double beeping mode where the tone is emitted for 0.1 seconds, is off for 0.1 seconds, is emitted for 0.1 seconds, and is off for 0.7 seconds. The double tone shall stop after the FAILURE pushbutton is depressed until a new failure condition occurs. The failure indicator light shall remain lit until the failure condition is removed.

(b) When a communications fault occurs, the audible alarm shall initiate a beeping mode where the tone is emitted for 0.33 seconds and is off for 0.66 seconds. The beeping shall continue until the COMM FAULT pushbutton is depressed. It shall not reenter the continuous beep mode until after the fault condition is cleared and a new fault is detected. After the pushbutton is depressed the COMM FAULT light will remain lit until the fault condition is removed.

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(c) When a caution signal is received from either the flashing lighting system or the ALS monitor subsystem, the alarm shall emit a single 0.2 second tone. It shall emit this tone each time a caution condition occurs. The caution light shall remain lit until the condition is removed.

(d) Whenever a mode error is detected, when both the steady burning and the flashing lights are not in the same mode (ALSF/SSALR), a single 0.1 second tone shall be generated. The ALSF-SSALR status indicator shall blink until the steady burning and flashing lights have both switched to the mode selected. Detection of this error shall be inhibited for 1 second after a mode change is requested.

(e) Whenever the brightness 5 timer passes either the 14.5 minute warning, or switches to B4 at 15 minutes, a single 0.1 second tone shall be generated.

(f) The previously described modes shall operate independently. For example, if a communication fault and a failure condition existed simultaneously, the alarm would emit a continuous tone. If the FAILURE pushbutton was depressed, the audible alarm would start beeping until the COMM FAULT pushbutton is depressed. If a caution signal were to occur, the alarm would beep once. The substation control panel audible alarm shall not be active when the system is in ATCT mode nor shall the remote control panel audible alarm be active when the system is in MAINT mode.

(g) When the MPS, MDT, or Flasher Tester takes operational control of the ALSF-2 system refer to paragraph 3.4.16 and its subparagraphs.

3.2.4.4.2.8 Blinking.- An oscillator signal shall be provided for the blinking of indicator lights or the beeping of alarms. This signal shall have an on-time of 0.33 seconds and an off-time of 0.66 seconds.

3.2.4.4.2.9 Transients.- All switching transients shall be suppressed using low pass filtering techniques as required. Switching at any point in the system shall not cause undesired action at any other point.

3.2.4.4.3 Data transmission.- The remote electronic chassis and the substation control and monitor assembly shall be connected together via a 2 wire, half duplex, phase coherent, frequency shift keyed (fsk) data link.

The transmission shall be asynchronous, serial binary, shall have the characteristics required in table II, and shall detect communications errors as required by 3.2.4.4.3.3. The transmission link is required to operate with at least an 8 dB signal-to-noise ratio over a distance of 10 miles (16 km) or more without intermediate boosters or line amplifiers. Loss of communications shall not cause the activation of erratic modes of operation. The two wire transmission lines shall terminate in the remote electronic chassis and the substation control and monitor assembly in differential amplifier input circuitry or equivalent that eliminates line noise from the transmitted and received signals.

Table II. Transmission Characteristics

Rate	10 words/sec. minimum
Frequency tolerance	0.5% max.
Output impedance	600 ohms
Transmitter output level	-12 dBm to 0 dBm ± 5% (Adjustable)
Receiver dynamic range	-50 dBm to 0 dBm ± 5%
Bit error rate (8 db S/N)	1 x 10-5 max
Peak-to-peak jitter	5% max
Carrier detect threshold	-50 dBm ± 5%

3.2.4.4.3.1 Frequencies.- The ATCT to substation communication link (downlink) shall transmit 1270 Hz and 1070 Hz for mark and space, respectively. The substation to tower link (up-link) shall transmit 2225 Hz and 2025 Hz for mark and space, respectively. ATCT and substation receiver frequencies shall be compatible.

3.2.4.4.3.2 Reserved.

3.2.4.4.3.3 Communications fault.- A communications fault (COMM FAULT) condition is defined as an up-link carrier loss, parity error, framing error, or overrun error. Upon detection of a communications fault, the control logic shall hold the last valid command. Four classes of errors shall be detected by the serial data interface and are defined as follows:

(a) Carrier loss - Generated if the carrier is not received.

(b) Parity error - Generated if parity bit is erroneous.

(c) Framing error - Generated if received data does not have a valid stop bit.

(d) Overrun error - Generated if data is not transferred to the receiver holding register before next character read.

3.2.4.4.3.4 Lightning protection.- Lightning protection, conforming to FAA-STD-019 and FAA-STD-020, shall be provided for all communication and power conductors and shall be installed as near as possible to their point of entrance into the housing. The arresters shall be properly combined, where necessary, to meet the circuit voltage requirements (see 3.6.6).

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3.2.4.4.4 Interfaces.- Interface signals (24 V dc logic levels) shall be provided to, and shall be received from, the regulators. Signals shall be terminated on terminal boards with terminals marked with the signal functional mnemonic term in accordance with table IV, or terminated with 25 pin, D type pin connectors. Each regulator shall have its own interface terminal board. Boards shall be labeled REG 1, REG 2, REG 3, REG 4 and REG 5 respectively. An intermediate terminal box shall be provided between the Control and Monitor Cabinet and the Constant Current Regulators as shown on drawing D-6290-033 and 034.

3.2.4.4.4.1 Reserved.

3.2.4.4.4.2 Terminal control computer complex (TCCC) interface.- A serial interface shall be provided for the TCCC in accordance with contractor's interface control document as agreed to by the government.

3.2.4.4.5 Power instrumentation.- Provisions shall be included in the substation control panel for metering substation Approach Lighting System (ALS) input power and voltage and regulator output voltage. Meters may be either analog or digital type. Digital display type meters shall be submitted for approval before use in the system. All meter terminals shall be insulated to prevent electrical shock hazards to the technicians. Analog meters shall have an accuracy of ± 2% or better of the full scale reading. Digital type meters shall have an accuracy of at least ± 1%.

Table IV. Regulator Interface

Commands		Status	
Signal	Logic HI	Signal	Logic HI
On/Off	On	On/Off	On
B1		B1	
B2		B2	
B3	HI in selected brightness	B3	HI in selected brightness
B4		B4	
B5		B5	
Command/ status return	COM	Local/ remote	Remote

3.2.4.4.5.1 Input power metering.- The input wattmeter shall be a 3 phase, 4-wire, 50/60 Hz, meter. The meter shall have a 300 kW capacity. Voltage inputs to the wattmeter are derived from three potential transformers located within the 480 volt input cabinet of the substation. Currents are derived from current transformers located within the 480 volt input cabinet.

3.2.4.4.5.2 Input voltage metering.- The input voltage meter shall be transformer rated (50/60 Hz). Full scale for the voltmeter shall be 600 volts. If an analog meter is used, the meter shall have a 50 degree scale of 6.9 inches (175 mm) in length. Voltage input to the meter may be derived from the potential transformers used with the wattmeter input. Pushbutton switches shall be provided to select phase A, B, or C voltages and to turn the voltmeter off.

3.2.4.4.5.3 Output voltage metering.- The output voltage meter shall be identical to the input meter and may be supplied from potential transformers located within the substation high voltage output cabinet. Inputs to the meter shall be through pushbutton switches to allow selection of loop 1, 2, 3, 4 or 5 and to turn the meter off.

3.2.4.4.6 Power requirements.- The system shall contain all power supplies required for operation and shall utilize 120 V ac, 60 Hz, single phase power input, both for the remote electronic chassis and the substation control and monitor assembly.

3.2.4.4.7 Elapsed time indicator(s).- The Elapsed time indicator(s) shall be installed behind the top front panel of the control and monitor cabinet to indicate the number of hours of operation of the approach lights. The indicator(s) shall indicate hours of operation in brightness 1 and 2. The indicator(s) shall indicate hours of operation in brightness 3. The indicator(s) shall indicate the hours of operation in brightness 4. The indicator(s) shall indicate the hours of operation in brightness 5. The indicator(s) shall indicate up to 99,999 hours and indicate the total time in hours and 10ths of hours. The indicator(s) shall be a recycling type(s). The total time shall be retained after loss of power. Time data derived from these indicator(s) shall be transmitted and be available to the remote monitoring subsystem.

3.2.4.5 Operational monitor subsystem.- The operational monitor subsystem shall monitor the ALSF-2 and SSALR modes and provide the substation control panel (figure 5) and the remote control panel (figure 6) with the operational status (indicator lights) of the system. The operational monitor subsystem shall provide an indication of the brightness level settings, B1 through B5. The input voltages, system power, the output voltages, and the current in each of the three current loops at each of the brightness levels shall be monitored. The monitor shall detect, at all brightness levels in each current loop, regulator failure,

lamp failure, over-current or over-voltage outputs, open or shorted loop conditions and provide caution or failure signals, as applicable. The operational monitor subsystem shall provide caution and failure signals suitable for combining with other system caution and failure signals for display on the substation control panel and remote control panels. When MPS or maintenance takes control of the system, the monitor caution and failure signals shall provide both an audible and visual indication in accordance with 3.2.4.4.2.7. If a central processing unit (CPU) or any device requiring programming is used, the device(s) shall automatically reset if it malfunctions or when a lock-up condition occurs. Complete removal of the operational monitor subsystem shall not affect the operation of the ALSF-2/SSALR system.

The operational monitor shall be able to monitor up to 101 steady burning lamps on the threshold bar. Note that the standard configuration is 49 lamps.

The operational monitor shall allow for the removal of any number of steady burning lamps and/or flasher stations from the lighting field. The intent of this requirement is to prevent the issuance of caution and failure alarms for lamps that are not physically configured in the system.

3.2.4.5.1 Monitor performance.- The operational monitor subsystem shall reliably detect and indicate when a 300 watt or a 500 watt lamp ceases to function. The monitor shall be capable of associating each failed lamp with lamp bars so the required generation of caution and failure signals as shown in table VI can be met. The detection of failed lamps or shorting devices shall not be affected by temperature and humidity caused circuit changes, lamp aging, and high resistance connections.

3.2.4.5.2 Caution and failure conditions.- The operational monitor subsystem shall be designed and delivered to produce caution and failure signals when any one or more of the standard conditions listed in table VI exist.

3.2.4.5.3 Caution and failure selection range.- The operational monitor subsystem shall permit selection of different caution and failure lamps out and bar quantities from the standard conditions described in Paragraph 3.2.4.5.2. The selection range shall be from 0 or at least 2 lamps less than the standard to twice the standard lamp quantities.

3.2.4.5.4 Failed lamp simulation.- The operational monitor subsystem shall provide a means to simulate failed lamps for all caution and failure conditions in order to verify correct operation of the subsystem.

Table VI. Caution and Failure Criteria

Parameter	Normal	Caution	Failure
ALSF-2 Mode			
1. Threshold bar	All lamps on	3 adjacent lamps out; or > 7 lamps out random.	≥ 4 adjacent lamps out; or ≥ 10 lamps out random.
2. Centerline inner 1500 ft	All lamps on	2 consecutive light bars out (≥ 3 lamps out in a 5 lamp bar); or ≥ 13 lamps out random.	≥ 3 consecutive bars out (≥ 3 lamps out in a 5 lamp bar); or ≥ 15 lamps out random.
3. Centerline outer 1500 ft	All lamps on	2 consecutive light bars out (≥ 3 lamps out in a 5 lamp bar); or ≥ 7 lamps out random (2400 ft); or ≥ 13 lamps out random (3000 ft).	≥ 3 consecutive bars out (≥ 3 lamps out in a 5 lamp bar); or ≥ 9 lamps out random (2400 ft); or ≥ 15 lamps out random (3000 ft).
4. Side row bar	All lamps on	2 consecutive light bars out (≥ 2 lamps out in a 3 lamp bar); or ≥ 9 lamps out random.	≥ 3 consecutive bars out (≥ 2 lamps out in a 3 lamp bar); or ≥ 10 lamps out random.
5. 500-foot bar (white lights only)	All Lamps on	3 lamps out.	≥ 4 lamps out.
6. 1,000-foot bar	All Lamps on	3 lamps out.	≥ 4 lamps out.
7. Flashers	All Flashers on	2 flashers out random.	≥ 2 flashers out consecutive; or ≥ 3 flashers out random.
8. Flasher	120 ±2 flashes per minute	N/A	> 122 flashes per minute; < 118 flashes per minute.

Table VI. Caution and Failure Criteria (Continued)

Parameter	Normal	Caution	Failure
9. Overall	All Lamps and Flashers on	27 lamps and flashers out random.	≥ 28 lamps and flashers out random.
SSALR Mode			
1. Threshold	All lamps on	3 lamps out.	≥ 4 lamps out.
2. Centerline	All lamps on	1 light bar out (≥ 3 lamps out in a 5 lamp bar).	≥ 2 light bars out (≥ 3 lamps out in a 5 lamp bar).
3. 1,000-foot bar	All Lamps on	3 lamps out.	≥ 4 lamps out.
4. Flashers	All Flashers on	1 flasher out.	≥ 2 flashers out random.
5. Overall	All Lamps and Flashers on	10 or 11 lamps and flashers out random.	≥ 12 lamps and flashers out random.
6. Flasher	120 ±2 flashes per minute	N/A	> 122 flashes per minute; < 118 flashes per minute.

3.2.4.5.5 Operational monitor interface.- The following monitor interfaces are discussed below:

(a) Loop voltage and currents

(b) Lamp bar/lamp failure detection

(c) Flasher light failure detection

(d) Control panel signals

3.2.4.5.5.1 Loop voltage and current monitoring.- If the operational monitor subsystem requires loop voltage sensing, it shall be obtained from the secondary of a 20 to 1 stepdown voltage transformer located in the high voltage output cabinet. If loop current sensing is needed, it shall be obtained using a current transformer located in the high voltage output cabinet.

3.2.4.5.5.2 Lamp/bar failure detection.- Monitoring shall be provided at each lamp bar to provide for the detection of a lamp failure in each of the light bars specified in 3.2.4.5.2. Any monitoring sensor components used at or near the lamp shall fit within the lamp holder. Lamps where power is supplied by 1500 watt transformers shall have shorting devices. Shorting devices are optional for single lamps where power is supplied by 300 watt or 500 watt transformers.

3.2.4.5.5.2.1 Reference lamps.- If reference lamps are used, they shall be connected into the system with a shorting device and an isolation transformer to provide consistency with the other lamp installations. The reference voltage input to monitor the circuitry shall be protected against the high voltage that will be applied to the input when the isolation transformer has a high impedance load or no load because of lamp and shorting device failure. Failure of the reference lamp(s) shall not affect the operation of the monitoring systems or the lighting system.

3.2.4.5.5.2.2 Lamp monitor wiring.- Only two (2) power wires from the isolation transformers' secondary to the lamp bar are allowed. Monitoring circuitry and wiring to the operational monitor in the substation are not limited. On lamps mounted on frangible couplings, two monitor wires are permitted provided the two monitor wires have a quick disconnect at the frangible coupling and fit into the frangible coupling along with the L-823 connector. The two monitor wires shall be a length of at least 8 feet. The monitor wires and connector shall be designed to operate in a wet, oily environment. Any monitor sensor component shall fit within the lamp holder. All terminations and termination enclosures shall be provided by the contractor.

3.2.4.5.5.3 Flasher light failure detection.- Flasher light caution and failure signals shall be provided to the operational monitor subsystem for integration with the caution and failure signals for both the substation and ATCT control panel indicators.

3.2.4.5.5.4 Control panel signals.- This paragraph is applicable if reference lamps are used. The ALS operational monitor subsystem shall be controlled by seven input control signals originating at the control subsystem. These signals provide system status information to the monitor as required to normalize the computations as a function of brightness and mode. The logic levels on input control signals shall be as specified in table VII.

3.2.4.5.6 Calibration.- Calibration of the monitor subsystem shall be automated as much as practical. A means to initiate calibration shall be provided at the substation. The operational monitor subsystem shall automatically compensate for temperature and humidity changes, lamp changes due to age, series loop impedance changes, and defective shorting devices. Calibration requiring human intervention shall not be required more often than quarterly. Calibration methods requiring the physical removal of lamp(s) are discouraged. Component selection and circuitry shall be designed for low long-term drift characteristics. The stability of the monitor shall be such that periodic adjustment shall not be required more often than every 3 months due to drift in the monitor circuit components. It shall take no longer than 30 minutes for one person to make the required adjustments or calibration.

Table VII. Monitor Interface

Commands			Status		
Signal	Logic HI	TB Mark	Signal	Logic HI	TB Mark
On/Off	On				
B1	HI in selected brightness	B1	Caution	CAUT	
B2		B2	Failure	FAIL	
B3		B3			
B4		B4			
B5		B5			
Mode	ALSF				

3.2.4.5.7 Non-volatile status.- The monitor subsystem shall maintain the status of failed lamps in each lamp bar in non-volatile memory. The operating times of the system in each mode and for each brightness level shall also be maintained in non-volatile memory. The memory shall be updated frequently enough during operation so that reasonably accurate status is recorded in the event of shutdown. When powered up, the operational monitor subsystem shall retrieve stored status and then be updated with current status.

3.2.4.5.8 Diagnostic program.- When a microprocessor is used in the ALSF-2 system to process the monitored signals, a diagnostic program shall be provided for testing the system's operational readiness. The diagnostics program shall test the addressing data output, data input, and the internal logic operation of the microprocessor. It shall also check the timing and data paths of the RAM, PROM, and PAL components located on the microprocessor board. As part of the request to perform diagnostics, the results shall be sent to the source of the diagnostics request.

3.2.4.5.9 Outputs to remote monitoring subsystem (RMS).- All of the data provided by table VI, status of caution and failure signals, and all data sensed by the operational monitoring subsystem shall be accessible to the RMS.

3.2.4.5.10 Reserved.

3.2.4.5.11 Lightning protection.- A lightning and surge protection system, meeting the requirements of FAA-STD-019 and FAA-STD-020, shall be employed to protect the monitor subsystem.

3.2.5 Flashing lights subsystem.- The flashing light section of the ALSF-2 system will consist of 21 flashers for a 3,000 feet (914 meters) ALS, and 15 flashers for a 2,400 feet (732 meters) ALS. The flashing light section of the SSALR system will consist of 8 flashers for a 3,000 feet (914 meters) ALS, and 5 flashers for a 2,400 feet (732 meters) ALS. The flasher subsystem shall consist of components in the control and monitor assembly, junction boxes, and flasher assemblies.

Flasher assemblies may be either elevated (Type I) or semiflush (Type II). Upon receiving a command either from the ATCT or the control and monitor assembly, the sequenced flasher light units shall produce a flashing light signal having the appearance of a flash traveling down the ALS from the flasher farthest from the runway threshold to the flasher closest to the runway threshold twice a second. The control and monitor assembly shall be capable of monitoring the status of the flasher light units, and reporting data on flashers performance to the control tower (3.2.4.1). The control and monitor assembly shall also be capable of controlling the intensity of the flasher light units. All lights shall be designed to operate at three intensity positions, in conjunction with the steady burning light portion of the system as described in 3.2.5.1.3. All intensity step changing of the flasher light units shall be done with the system operating. Complete instructions on accomplishing this change shall be included in the equipment instruction book. When necessary, in order to effectively switch flash capacitors, the control and monitor assembly may automatically interrupt power to the flasher light units for a period not to exceed 1.5 seconds during intensity step changing. Circuitry shall be provided to prevent simultaneous step changing and triggering. In the event of loss of intensity step control voltage, the flasher light units shall automatically revert to operation on the next lower intensity step. The design shall be such that no erratic arcing or relay operation will occur during any intensity step changing. Components used for intensity step changing shall be designed for a minimum life of 100,000 step changing operations.

3.2.5.1 Flashing lights subsystem, power, control and monitoring.- The flashing lights subsystem shall meet the power, control and monitoring stated in the following paragraphs.

3.2.5.1.1 Intensity control resistor cabinet.- If necessary, a resistor cabinet external to the master controller unit shall be provided with the required resistors, for adjusting the line current in high, medium, and low intensities.

3.2.5.1.2 Power.- The flashing lights subsystem input power shall be 120/240 V, 60 hertz, 3 wire, single phase and limited to no more than 53 amperes (rms) or 75 amperes (peak). The flashing lights subsystem shall load equally the positive and negative half cycles of the 60 hertz input power line. Unbalanced loading of positive or negative half cycles for half wave current by the flasher assemblies is not permitted. Only full wave current loading is permitted.

3.2.5.1.3 Control.- The three intensity levels of the flasher light units shall be controlled by the brightness level of the steady burning lights. In brightness levels 1 and 2, the intensity of the flasher light units shall be low. In brightness level 3, the flasher intensity shall be medium, and in brightness levels 4 and 5, the flasher intensity shall be high.

3.2.5.1.4 Remote control panel flasher monitoring capability.- Circuitry shall be provided to monitor the operational condition of the flasher system and to provide both an indication of impending failure (caution) and an indication of total fault (failure) to the remote control panel in the ATCT via the control and monitor subsystem. The initial fault detection criteria are outlined below for both the ALSF-2 and SSALR modes of operation.

	CAUTION	FAILURE
SSALR	One unit out. More than one intensity present.	Any two units out.
ALSF-2	Any two random units out. More than one intensity present.	Any two consecutive units out. Any three nonconsecutive units out.

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3.2.5.2 Flasher assemblies general requirements.- A flasher assembly shall consist of an individual control cabinet and a flasher light unit. Flasher assemblies shall be classified as follows:

(a) Elevated assembly (Type I)

(b) Semiflush assembly (Type II)

Each type of flasher assembly shall be controlled by the flashing lights subsystem (3.2.5.1) located in the monitor and control cabinet.

3.2.5.2.1 Individual control cabinet.- The triggering circuit of each flasher light unit shall be located in the individual control cabinet. The trigger transformer may be located in the flasher light unit. The flasher units shall operate satisfactorily when located up to 200 feet (60.96 meters) from the individual control cabinet. The design of the triggering circuits shall be such that failure of one or more flasher light units will not affect operation of the remaining units. Components used in the triggering circuit shall be designed for a minimum life of 50 million flasher operations. The individual control cabinet shall be equipped with a socket that will receive the flasher tester plug (3.2.5.2.1.5). The power transformer shall be placed with high voltage terminals toward the cabinet wall. A high voltage warning label shall be placed on the transformer or on a protective shield preventing access to the electrical shock hazards. The high voltage terminals shall be insulated or have a protective shield to prevent electrical shock hazards. The unused terminals on the high voltage capacitors shall be insulated or have a protective shield to prevent electrical shock hazards. All high voltage terminals shall have a protective shield to prevent electrical shock hazards. Printed circuit boards and associated components shall be designed so that no arcing will occur. A test button shall be provided to allow manual triggering of the flash lamp.

3.2.5.2.1.1 Input power.- The flasher assembly shall consume not more than 550 watts at 240 V ac when measured with a watt-hour meter or thermal meter giving a steady needle deflection. The assembly shall be capable of operating from an ungrounded 240 V ac source. The assembly shall be designed to operate reliably with a power input range of 210 to 250 V ac.

3.2.5.2.1.2 Input switch and fuse.- Input power shall be controlled by a 250 V ac double pole, single throw (DPST) toggle switch. The toggle switch shall be in accordance with MIL-S-83731. Circuit overload protection shall be accomplished by a suitably rated type 3AG fuse mounted in a fuse extractor post. The switch and fuse shall be located in the upper right quadrant of the cabinet.

3.2.5.2.1.3 Power and control circuitry.- Power and control signals between the control and monitor assembly and the individual control cabinet shall consist of the following:

(a) 120 V ac, 60 Hz, 1 phase

(b) Neutral

(c) 120 V

(d) Trigger, one signal for each flasher assembly

(e) Intensity step 1

(f) Intensity step 2

(g) Intensity step 3

(h) Monitor

Output power and control signals from the individual control cabinet to the flasher light unit shall be transferred through six wires designated as:

(a) Anode, No. 10 THWN (maximum)

(b) Cathode, No. 10 THWN (maximum)

(c) Neutral, No. 10 THWN (maximum)

(d) Trigger, No. 14 THWN (maximum)

(e) Interlock, No. 18

(f) Interlock return, No. 18

Forty feet (12.19 m) of the 200 feet (60.98 m) distance mentioned in 3.2.5.2.1 shall be restricted to the wire sizes listed above.

3.2.5.2.1.4 Lightning protection.- The input power terminals and control output lines of the individual control cabinet shall be protected from lightning by installing lightning arresters between each terminal or line and ground (see 3.6.6). Lightning arresters are required in the flasher light unit of the elevated assembly (Type I) only when the flasher light contains printed wiring boards or microelectronic devices (3.5.1.4) or semiconductor devices (3.5.1.5).

3.2.5.2.1.5 Flasher tester interface.- A serial interface shall be provided inside the Individual Control Cabinet. This interface shall give the maintenance personnel an access to perform diagnosis and troubleshooting of the ICC and the flashing light assembly. The interface shall be wired to a front panel mounted female MIL-C-24308 connector.

One 115/125 V ac, 15 Amp, GFI duplex receptacle shall be provided inside the individual control cabinet. The GFI duplex receptacle shall contain test and reset switches.

3.2.5.2.2 Photometric performance.- After 250 hours of flashing continuously twice per second, the lamp shall produce an effective intensity of no less than 70 percent of initial candlepower and consecutive misses shall be no more than 1 percent. Flash duration shall be not less than 250 nor more than 5,500 microseconds at 50 percent of the peak instantaneous candlepower. The optical system shall be as simple as possible and still meet all other pertinent requirements. The system may consist of reflectors, lenses, prisms, and other elements necessary to obtain the required light output. All optical elements shall be designed to assure a long life and consistency of photometrics. The lamp and all optical parts shall be firmly held in place to withstand shock and vibration, but shall permit convenient lamp replacement when required. The optical system shall be designed to prevent misalignment during maintenance operations.

3.2.5.3 Elevated flasher assembly (Type I).- The elevated flasher assembly shall consist of two parts, the individual control cabinet (3.2.5.2.1) and the flasher light unit. The flasher light unit may be installed next to the individual control cabinet on frangible couplings or on 2 inch (5.08 cm)electrical metallic tubing (emt), or on top of low impact resistant structures with a maximum vertical separation of 128 feet (39 meters) between the flasher light unit and the individual control cabinet.

3.2.5.3.1 Flasher light unit.- The flasher light unit shall be a single raintight assembly consisting of all items not mounted on or in the individual control cabinet. The lamp housing shall be constructed of stainless steel or aluminum or of a nonferrous material which is comparable in service life with that of a stainless steel or aluminum housing over the full range of environmental and operating parameters defined in this specification. The flasher light unit shall be provided with a means for continuous vertical adjustment of the light beam axis from horizontal to 25 degrees above horizontal. The horizontal beam axis shall be perpendicular to the lamp cover glass or window. All components in the lamp housing shall be accessible through a door or cover for maintenance purposes.

3.2.5.3.1.1 Intensities of the elevated flasher.- The flasher light unit (Type I) shall produce the intensities shown in table IX.

Table IX. Light Intensities (Type I)

Intensity Steps	Maximum Allowable Effective Intensity (candelas)	Minimum Effective Intensity (candelas)
High	20,000	8,000
Medium	2,000	800
Low	450	150

The effective intensity measurements shall be made over a rectangular pattern not less than 10 degrees vertically and 30 degrees horizontally. Corners may be rounded on a 5 degree radius to determine compliance with table IX values.

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3.2.5.3.1.2 Flash tube.- The flash tube shall be a plug-in type with a rated life of at least 1,000 hours when operated on the high intensity step. The effective intensity shall not decrease more than 30 percent during the minimum rated life and flash skipping (misfirings) shall be less than 1 percent with no skips occurring consecutively. If the flash tube used is the type which is enclosed in a PAR-56 bulb, then the window, reflector, and socket (3.2.5.3.1.3 through 3.2.5.3.1.5) are not required.

3.2.5.3.1.3 Window.- The flasher light unit shall have a glass window installed to permit the maximum amount of light transmission from the lamp and reflector. The glass shall be aviation white per MIL-C-25050 (ASG) and shall be Class A per MIL-C-7989. It shall be entirely free of bubbles, mold marks, or other imperfections, which might impair light transmission. The glass shall be 1/4 inch (6.35 mm) nominal thickness and shall be highly resistant to mechanical impact and abrasion. The gasket surface of all glass shall be either ground or molder to a sufficiently true surface to ensure a tight joint. The window shall be attached to the lamp housing by watertight gaskets made of material specified in 3.4.8.1 and mounted in such a manner that it can be easily removed or replaced.

3.2.5.3.1.4 Reflector.- A high quality metal reflector with long life reflective surface shall be enclosed in the lamp housing and shall be capable of providing the light output specified in table IX. The reflector shall have a minimum diameter of 7 inches (18 cm).

3.2.5.3.1.5 Socket.- The lamp socket shall be a plug-in type porcelain socket able to withstand the operating temperature of the flasher lamp. Insulating materials used in the socket shall be nonporous and nonabsorbent. Screw terminals shall be provided on the socket for required wire terminations. The socket shall be attached to the lamp housing with two or more screws in a manner facilitating easy removal or replacement of the socket. The socket receptacle of each lamp pin shall make surface connection on more than 180 degrees of the pin surface.

3.2.5.3.1.6 Mounting attachment.- Each flasher light unit shall be assembled to a mounting base. The mounting base shall have an internal wireway to accommodate the six wires mentioned in 3.2.5.2.1.3. The lampholder/mounting base interface shall permit passage of six wires regardless of the lampholder's vertical adjustment angle. The mounting base shall permit rigid mounting of the complete lampholder assembly in either of the following ways:

(a) Capping the open top of a frangible coupling (FAA Drawing C-6046) or a 2 inch (5.08 cm) electrical metallic tubing (emt) conduit (FAA Drawing D-6238-15). These equally spaced (120 degrees) 3/8-inch (0.95 cm) round head stainless steel screws (with slightly cupped tips) shall be provided for this method of attachment.

(b) Mounting into a lamp support as shown on FAA-Drawing D-6238-15.

3.2.5.3.1.7 Flasher assembly wire.- The flasher assembly design shall be such that all wires between the flasher individual control cabinet and the flasher light unit shall fit through a 1/2-inch (1.27 cm) conduit. All such wire shall be single conductor and a maximum of six wires shall be used between the flasher light unit and flasher individual control cabinet. If wire having an insulation rating greater than 600 volts is required, the contractor shall provide wires (60 feet (18.28 meters) to permit continuous runs from the individual control cabinet to a flasher light unit mounted on top of a 40 foot (12 meter) low impact resistance structure. The flasher light unit shall include a 1/2-inch liquid tight flexible conduit fitting on the bottom of the head through which wires from the flasher individual control cabinet will be routed.

3.2.5.3.1.8 Flasher light unit weight.- The maximum weight of the flasher light unit as defined in 3.2.5.3.1, including the mounting attachments required per 3.2.5.3.1.6, shall be 7.5 pounds (3.40 kilograms).

3.2.5.3.1.9 Aiming device.- The aiming device shall be designed for use with the flasher light unit and the PAR-56 lampholder. The aiming device shall fit onto the PAR-56 lampholder and flasher light unit without disassembly of the lampholder or removal of the lamp. The aiming device shall permit field aiming of the lamp axis perpendicular to the plane of the cover glass at any angle from 0 degrees to +25 degrees above the horizontal. The aiming device shall be constructed of a light weight non-corrosive metal and weigh no more than three pounds. The device shall have no loose parts, i.e., no pins. The device should have an enclosed dial and stop break to hold the reading. The device shall be capable of remotely measuring the alignment of the light unit when mounted on low impact resistant structures that conform to FAA-E-2604 or FAA-E-2702. The aiming device shall retain its reading when the tower is lowered. With the support structure in the elevated position, the aiming device shall permit an individual to accurately aim the light unit from the ground after lowering the structure a maximum of two times regardless of the tilting direction of the structure. The aiming device shall be capable of aiming the light unit mounted on a frangible coupling (FAA-Drawing C-6046). The aiming angle shall be indicated in 1 degree intervals and shall be accurate to within ± 1/2 degree of the actual aiming angle with the aiming device attached. If a digital display is used the indication shall be in degrees and in tenths of a degree of angle. The final aimed angle of the light unit with the aiming device unattached shall be accurate within 1 degree of the actual angle. The aiming device shall be designed to operate in any ambient

temperatures between -55 degrees Centigrade (C) (-67 degrees Fahrenheit (F) and +70 degrees C (158 degrees F).

3.2.5.4 Semiflush flasher assembly (Type II).- The semiflush flasher assembly shall consist of an individual control cabinet (3.2.5.2.1) and a flasher light unit. The flasher light unit shall be designed for installation in paved areas and shall be capable of withstanding roll-over by aircraft without damage.

3.2.5.4.1 Semiflush light unit.- The semiflush light unit shall be designed for mounting on Type LB-4 bases, as specified in FAA-E-1315. Accessories for the light unit, excluding the light unit top assembly, shall be in accordance with FAA-E-2491. Electrical input shall be as specified in 3.2.5.2.1.3. An L-823 connector shall be used to connect the input cable to the flasher light unit (FAA Drawing D-6238-6).

3.2.5.4.1.1 Semiflush light unit top assembly.- The top assembly shall be fabricated from high strength metal which is inherently corrosion resistant. The top surface shall have a Brinell hardness of not less than 180, and shall be smooth and free of sharp projections. If not inherently corrosion-proof, the materials used shall be treated for effective, long-lasting corrosion resistance. Painting alone will not be considered a sufficient protective coating. Designs employing glass overall or a substantial portion of the top surface will not be accepted. The design shall permit pressure from tires, mechanical impact, thermal shock, and vibration without damage or loss of water tight seal. The top assembly shall be the minimum, size and weight consistent with good design and shall be in compliance with requirements of this description. It shall not have more than 400 square inches (0.25 square meter) of exposed area above the surface of pavement. The maximum lateral dimension of the top shall be no more than 26 inches (66 cm). No portion of the top assembly shall project more than 1 inch (2.54 cm) above pavement. The design shall provide for the outer edges of the top assembly to be flush with the pavement and provided with a watertight seal capable of withstanding an internal or external pressure of 10 pounds per square inch (psi). If the entire optical system is in a sealed module, this watertight requirement applies only to the module. The maximum temperature of the top assembly shall not be greater than 150 degrees C (302 degrees F) after an aircraft tire had been on the fixture for 10 minutes. The top surface shall have an average slope not exceeding 10 degrees in a direction parallel to beam axis, and not more than 12 degrees transverse to beam axis except for the light window and the sides of the light exit channel. All bolts in the top surface shall be recessed to the full depth of the head and shall permit the use of a standard thin wall socket wrench. The top assembly shall be held to the type LB-4 base with six bolts.

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The bolts shall be fabricated from stainless steel (3.5.2.2.2). A means for breaking the seal and lifting the top assembly shall be provided. If the optical system is attached to the top assembly, the optics protective device shall serve as a stand for the light unit when removed from its base.

3.2.5.4.2 Intensity of the semiflush light unit.- The inpavement flasher light unit shall produce the intensities shown in table X.

Table X. Light Intensities (Type II)

Intensity Setting	Maximum Allowable Effective Intensity (candelas)	Minimum Effective Intensity (candelas)
High	20,000	5,000
Medium	2,000	500
Low	600	150

The effective intensity measurements shall be made over a rectangular pattern not less than 10 degrees vertically and 30 degrees horizontally. The geometric center of this 10 degree by 30 degree pattern shall be 7 degrees ±1/2 degree above the horizontal. Corners may be rounded on a 5 degree radius to determine compliance with values in table X.

3.2.5.4.3 Static loading.- The light, when installed in a light base, shall be able to support the static loads of 4.4.9.2.

3.2.5.4.4 Window loading.- The window shall be able to support a load equal to 500 psi multiplied by the area of the opening.

3.2.5.5 Flasher Tester.- The flasher tester shall test the individual control cabinet and its associated flasher light unit through a test connector located inside the ICC. It shall isolate failures to the LRU level. It shall measure certified, key performance parameters and other critical electrical values and flag any that are out of tolerance. Linear electrical data and out of tolerance values shall be displayed in engineering units. LRU information shall be displayed in English language formats without the use of special codes or look-up tables. The

tester shall be powered by the GFI outlet (3.2.5.2.1.5) in the individual control cabinet.

3.2.5.5.1 Physical characteristics.- The tester shall be a single commercially available laptop or portable computer meeting the following minimal requirements:

a) Weigh not more than 15 pounds,
b) 83 key industry standard QWERTY keyboard,
c) Contain 4M RAM with expansion capability,
d) Contain 80MB hard drive,
e) Contain one (1) 3.5 inch 1.44MB disk drive,
f) Screen shall be monochromatic easily readable in bright sunlight, and backlit for visibility at night with 640 x 480 pixel resolution,
g) One (1) 9 pin RS-232 serial port,
h) One (1) 25 pin parallel port,
i) Hard or soft carrying case,
j) Operate on 110/120 Vac, 60 Hz power,
k) Include one (1) 6 ft AC power cord with ground,
l) One (1) 6 ft RS-232 interface cable,
m) All warranties, maintenance agreements, customer support agreements, etc.

3.2.5.5.2 Electrical measurements.- As a minimum, the following items shall be measured for normal and out of tolerance values:

a. input voltage, current and power
b. input control signals including timing criteria
c. triggering circuits including current and voltage magnitudes
d. output electrical values to the flasher light unit
e. flasher rate

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3.2.5.5.3 Operation.- The flasher tester shall be highly automated with no more than two operator actions to perform any tests. The LRU fault isolation shall be a single test. The tester shall isolate to the LRU level in accordance with paragraph 3.4.15.4.1.

3.2.5.5.4 Tester instructions.- Two types of instructions shall be provided, a portable set and detailed set.

3.2.5.5.4.1 Portable instructions.- Shall provide a simple description of how to connect the flasher tester to the individual control cabinets, log into the system, how to perform each function selected, and show sample results. It shall be in a portable format housed inside tester. These instructions shall be plasticized for weather resistance.

3.2.5.5.4.2 Flasher tester instruction books.- The flasher tester instruction books shall be that which is provided by the manufacturer of the flasher tester and the software identified in 3.2.5.5.5.

3.2.5.5.5 Flasher tester software.- The flasher tester shall be provided with the following software of the latest version at the time of contract award:

a) MS-DOS based operating system,
b) All software required for interface to the flasher subsystem,
c) All software licensing agreements, warranties, maintenance agreements, and customer support agreements.

3.2.5.5.5.1 Flasher tester developed software.- For any ALSF-2/SSALR contractor flasher tester developed software, a software user's manual shall be prepared in accordance with DOD-STD-2167a, Data Item Description (DID) DI-MCCR-80019A . This manual shall comply with all the requirements of this DID plus the requirements of paragraph 3.2.5.5.4.1.

3.2.6 Elevated PAR-56 lampholders.- Elevated PAR-56 lampholder shall support PAR-56 lamps and allow for angular adjustment. They interface mechanically to a supporting structure and electrically to the isolation transformers. Elevated PAR-56 lampholders shall be in accordance with FAA-E-982.

3.2.6.1 Aiming device for the PAR-56 lampholder.- The aiming device for PAR-56 lampholders shall be in accordance with 3.2.5.3.1.9.

3.2.7 Site spare parts.- Each unit of equipment (3.1.1(a) through (h), and (o)) shall include one spare printed circuit board assembly of each type used in each equipment, complete with all components, tested and operable. The material used to wrap or package spare parts shall be static free.

3.2.8 Power distribution equipment.- A substation distribution panel, a utility transformer and safety disconnect switch shall be provided for installation within the ALSF-2 substation shelter.

3.2.8.1 Substation Distribution Panel.- The substation distribution panel shall receive power from the 45 KVA transformer and provide 240/120 V ac input power to the substation facility, flasher master controller, ALSF-2 command and monitor subsystem, and the remote monitoring subsystem. The panel shall be rated at 240 V ac, 200 Amps and be furnished with a main power disconnect circuit breaker. The panel shall contain four 2 pole 20 Amp circuit breakers, and fourteen single pole 20 Amp circuit breakers.

3.2.8.2 Utility transformer.- The utility transformer receives 480 V ac, 60Hz, one phase power from the 480 V ac input panel, and provides input power (120/240 V, ±10 percent, 60 hertz) to the electrical and mechanical equipments in the substation shelter distribution panel (3.2.8.1) and the flasher system. The transformer will have the following characteristics: 50 KVA, one phase, 480/240-120 V ac.

3.2.8.3 ALSF-2 safety disconnect switch.- A fused safety disconnect switch, 600 V ac, 4 wire, 3 pole, with grounded neutral buss, NEMA 12 steel enclosure shall be provided. Main power input lightning protection shall be provided on the line side of the safety disconnect switch.

3.2.8.3.1 Lightning protection.- Lightning arresters shall be installed between each phase of the input to ground to protect primary apparatus and wiring from lightning (see 3.6.6).

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3.2.9 Remote monitoring subsystem (RMS).- A remote monitoring subsystem shall be supplied with the system and shall:

(a) provide lightning protection for the input AC power and data transmission link.

(b) contain sensors required for acquiring the data identified in paragraph 3.2.10 through 3.2.10.5.6.

(c) contain a versatile module eurocard (VME) backplane bus interface card cage containing all circuitry necessary to (1) accomplish management of the data link, (2) meet the modem requirements, (3) format equipment parameters, (4) transmit data at the proper times to the MPS, and (5) meet all input/output requirements.

(d) provide interfaces for the maintenance processor subsystem (MPS) and maintenance data terminal (MDT).

(e) provide the capability to monitor, control, and diagnose ALSF-2/SSALR equipment.

(f) contain initialization and self-testing capability.

3.2.9.1 General RMS requirements.- The ALSF-2/SSALR RMS shall include voltage and current sensors, cabling, connectors, and mounting hardware necessary to route required signals and control functions to the monitoring units of the ALSF-2/SSALR RMS, and shall include all circuitry necessary to buffer, condition data into engineering units, and preprocess sampled signals. The RMS shall transmit the data to the MPS in accordance with the formats and requirements of NAS-MD-790 (including Specification Change Notices 1 and 2) and shall execute control commands sent by the MPS and MDT.

3.2.9.1.1 MDT interface.- The ALSF-2/SSALR RMS shall be provided with a terminal interface as described in FAA Order 6000.34A. The interface shall be wired to a front panel mounted female MIL-C-24308 (MS-18275) connector.

3.2.9.1.2 MPS interface.- The ALSF-2/SSALR RMS shall be provided with an MPS interface in accordance with NAS-MD-790 (including Specification Change Notice 1 and 2).

3.2.9.1.2.1 Protocol.- The protocol used to control the MPS data interface shall be in accordance with ANSI X3.66 as specified in NAS-MD-790.

3.2.9.1.3 VME bus interface system.- The RMS equipment shall utilize printed wiring boards meeting all electrical and mechanical specifications contained in IEEE-P1014 for all RMS circuitry. The card cage and backplane shall be capable of accommodating the future addition of at least three VME double-height boards, physical configuration option NECP, without further modification. Backplane connectors provided for the purpose of accommodating the future addition of VME boards shall have user I/O pin assignments brought to individual solder terminals or connectors suitable for the future addition of wires.

3.2.9.1.4 Memory.- Memory shall consist of the appropriate combinations of read-only memory (ROM), programmable read-only memory (PROM), erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), logic arrays, and random-access memory (RAM). The basic PROM, EPROM, EEPROM, logic array, and RAM devices shall be available to the Government as a commercially available off-the-shelf item. The RMS shall have expansion capabilities as required by paragraph 3.2.9.1.5. and 3.4.14.6. Memory expansion techniques, i.e., hardware, firmware, or software changes shall be addressed in the equipment instruction book (see Paragraph 3.7).

3.2.9.1.4.1 Volatility.- All archived data (paragraph 3.2.9.1.4.2) shall be retained in non-volatile memory. This memory shall be protected from short or long term power failures for a period of not less than 15 days.

3.2.9.1.4.2 Data archiving.- The RMS subsystem shall continuously produce a historical data archive containing the following information:

a) Control settings originating from the RCP or MPS.
b) Alerts and Alarms. Control settings at time of the alert/alarm.
c) All monitored parameters in table Xa plus any additional paramaters dictated by the contractor's design, once every 12 hours.

This data shall be time tagged and stored in a 14 day rolling archive. For memory sizing purposes the following assumptions shall be made:

a) Five (5) control setting changes per day.
b) One (1) Alarm per seven days.
c) Six (6) Alerts per seven days.
d) Two (2) sets of monitored parameters per day.
e) 10% extra capacity over the total amount required for items (a) through (d).

Should the buffer become full before the end of the 14 day period, new data shall be stored by implementing a FIFO (first-in-first-out) priority. The archive shall meet the volatility requirements of paragraph 3.2.9.1.4.1.

3.2.9.1.5 RMS expansion.- In addition to all other requirements specified herein, the ALSF-2/SSALR RMS shall have, as a minimum, 20 spare analog input, 15 spare digital input, and 10 spare digital output lines. The capability for utilizing these input and output lines shall not be implemented; however, the original hardware, firmware, and software shall be designed for future utilization of these lines with minimal modification. The analog input shall be a differential input and shall enable the RMS to provide a digital output signal representing the input value. A signal comparator having two (2) sets of adjustable thresholds, one (1) for alarms and one (1) for alerts, shall be provided. These thresholds shall be programmable in 100 millivolt steps throughout the range of the voltage input. The RMS shall not introduce or cause an error in the true analog reading in excess of ±0.1 volt. The input impedance of the analog input shall be greater than one megohm.

3.2.9.1.6 Test points.- The RMS equipment design shall incorporate indicators, warning signals, test jacks, and test points to facilitate troubleshooting and malfunction isolation. Test points shall be provided to check critical timing waveforms, power supply output voltages, and for the injection of test signals. The test points shall be located for easy accessibility. Their locations shall be kept to a minimum, and each shall be labeled for easy identification and reference to maintenance data, and shall be designed for easy attachment of test probes and test equipment.

3.2.9.1.7 Indicator lights.- Indicator light(s) shall be provided, within the cabinet, to indicate application of power.

3.2.9.1.8 Reset switch.- Each unit employing microprocessors shall have, within the cabinet, a momentary contact switch labeled "reset". Activation of the reset switch shall cause all program variables and all software/firmware controlled hardware to be initialized to a predefined condition from which normal program execution can continue. The MPS shall be notified of a change of state in accordance with NAS-MD-790.

3.2.9.1.9 Environmental sensors.- The following sensors together with all necessary cabling, connectors, terminal boards, enclosures, mounting hardware, and installation and maintenance instructions shall be provided with each ALSF-2/SSALR equipment as specified below. Measurements from the sensors shall be processed by the RMS for transmission to the MPS at appropriate times and for output locally via the MDT interface.

(a) Intrusion detector (3 each)
- One for engine generator room
- Two for ALSF-2 shelter

(b) Smoke detector (2 each)
- One for engine generator room
- One for regulator room

(c) AC power

(d) E/G power

(e) Inside temperature (2 each)
- One for engine generator room
- One for regulator room

(f) Outside temperature

These sensors shall meet the requirements of paragraphs 3.2.10.5 through 3.2.10.5.6.

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3.2.9.1.10 Data communications failures.- When data communication failures between the RMS and the MPS occur, the retry and continuous polling procedures of paragraph 3.8 of NAS-MD-790 shall be implemented. Additionally, the ALSF-2/SSALR RMS shall have at least one (1) megabyte of storage to save Alarms, Alerts, Return-to-Normals, and State Change conditions respectively, that have accrued during RMS/MPS communications failures. When communications are reestablished, and a poll is received from the MPS, the RMS shall send (in order of priority stated above) the entire contents of the stored memory to the MPS. When the storage becomes full, the RMS shall implement a first-in-first-out and last-in-last-out procedure.

3.2.10 RMS performance parameter monitoring requirements.- The following performance parameters shall be monitored. The availability and use of these parameters shall be accomplished without interruption to normal operation.

3.2.10.1 System status parameters.- As a minimum, the status of the following ALSF-2/SSALR and environmental parameters shall be monitored: All the ALSF-2/SSALR monitored parameters of table Xa, and all system input voltages and currents, all cabinet, regulator, subsystem input and output voltages and currents, and all power supply input and output voltages and currents. See paragraph 3.4.15.3.2.2.

3.2.10.1.1 Sensors.- Sensors (transducers) and signal conditioning equipment shall be provided to allow the monitoring subsystem to reliably detect lamp or lamp bar malfunctions and compute the caution and failure signals required by table VI in 3.2.4.5.2.

3.2.10.2 Key equipment performance parameters.- ALSF-2/SSALR and associated equipment key performance parameters (also referred to as standards and tolerances) shall be available for automatic monitoring at the MPS interface and demand monitoring at both the MPS and MDT interfaces. Table VI identifies the minimum set of key performance parameters. Additional key performance parameters shall be added as dictated by contractor's design. Soft alarm (alert/caution) and hard alarm (failure) processing shall meet the requirements of paragraph 3.2.4.5.

3.2.10.3 ALSF-2/SSALR certification parameters.- The certification parameters as indicated in table Xb shall be available for automatic monitoring at the MPS interface and demand monitoring at both the MPS and MDT interfaces.

3.2.10.4 ALSF-2/SSALR key performance checks.- Performance checks (or equivalent measurements) required for the ALSF-2/SSALR in the instruction book shall be available for demand monitoring at the MPS and MDT interfaces.

TABLE Xa. ALSF-2/SSALR Monitored Parameters

Parameter	Normal	Alert (Soft Alarm)	Alarm
Software Version	Software Version Number	N/A	N/A
Date/Time	Date/Time	N/A	N/A
ALSF-2/SSALR System Status	All monitored parameters normal	One or more monitored parameters in Alert condition and no monitored parameters in alarm condition.	One or more monitored parameters in alarm condition.
System Operating Mode	ALSF-2/SSALR	N/A	N/A
System Control Mode	ATCT/MAINT/MPS/ MDT/Flasher Tester	N/A	N/A
ALSF-2 Mode			
1. Threshold bar	All lamps on	3 adjacent lamps out; or 8 to 9 lamps out random.	≥ 4 adjacent lamps out; or ≥ 10 lamps out random.
2. Centerline inner 1500 ft	All lamps on	2 consecutive light bars out (≥ 3 lamps out in a 5 lamp bar); or ≥ 13 lamps out random.	≥ 3 consecutive bars out (≥ 3 lamps out in a 5 lamp bar); or ≥ 15 lamps out random.
3. Centerline outer 1500 ft	All lamps on	2 consecutive light bars out (≥ 3 lamps out in a 5 lamp bar); or ≥ 7 lamps out random.	≥ 3 consecutive bars out (≥ 3 lamps out in a 5 lamp bar); or ≥ 9 lamps out random.

TABLE Xa. ALSF-2/SSALR MONITORED PARAMETERS (cont.)

Parameter	Normal	Alert (Soft Alarm)	Alarm
ALSF-2 Mode continued			
4. Side row bar	All lamps on	2 consecutive light bars out (≥ 2 lamps out in a 3 lamp bar); or ≥ 9 lamps out random.	≥ 3 consecutive bars out (≥ 2 lamps out in a 3 lamp bar); or ≥ 10 lamps out random.
5. 500-foot bar	All Lamps on	3 lamps out.	≥ 4 lamps out.
6. 1,000-foot bar	All Lamps on	3 lamps out.	≥ 4 lamps out.
7. Flashers	All Flashers on	2 flashers out random.	≥ 2 flashers out consecutive; or ≥ 3 flashers out random.
8. Flasher rate	120 ±2 flashes per minute	N/A	> 122 flashes per minute; < 118 flashes per minute.
9. Overall Flashers on	All Lamps and flashers out random.	27 lamps and flashers out random.	≥ 28 lamps and
SSALR Mode			
1. Threshold	All lamps on	3 lamps out.	≥ 4 lamps out.
2. Centerline	All lamps on	1 light bar out (≥ 3 lamps out in a 5 lamp bar).	≥ 2 light bars out (≥ 3 lamps out in a 5 lamp bar).
3. 1,000-foot bar	All Lamps on	3 lamps out.	≥ 4 lamps out.
4. Flashers	All Flashers on	1 flasher out.	≥ 2 flashers out random.

TABLE Xa. ALSF-2/SSALR MONITORED PARAMETERS (cont.)

Parameter	Normal	Alert (Soft Alarm)	Alarm
SSALR Mode continued.			
5. Overall	All Lamps and Flashers on	10 or 11 lamps and flashers out random.	≥ 12 lamps and flashers out random.
6. Flasher rate	120 ±2 flashes per minute	N/A	> 122 flashes per minute; < 118 flashes per minute.
Power Source	Commercial/ Engine Generator	N/A	N/A
Power Source Voltages (line side of engine generator transfer switch)			
a. Commercial			
1. Voltage			
(a) Phase A	Voltage present	N/A	No voltage present
(b) Phase B	Voltage present	N/A	No voltage present
(c) Phase C	Voltage present	N/A	No voltage present
b. Generator (when operating)			
1. Voltage			
(a) Phase A	Voltage present	N/A	No voltage present
(b) Phase B	Voltage present	N/A	No voltage present
(c) Phase C	Voltage present	N/A	No voltage present

TABLE Xa. ALSF-2/SSALR MONITORED PARAMETERS (cont.)

Parameter	Normal	Alert (Soft Alarm)	Alarm
480 Volt Input Cabinet Input Power			
a. Voltage			
1. Phase A	Specified voltage	Specified voltage ± X percent	Specified Voltage ± X percent
2. Phase B	Specified voltage	Specified voltage ± X percent	Specified Voltage ± X percent
3. Phase C	Specified voltage	Specified voltage ± X percent	Specified Voltage ± X percent
b. Current			
1. Phase A	Measured Amperage	N/A	N/A
2. Phase B	Measured Amperage	N/A	N/A
3. Phase C	Measured Amperage	N/A	N/A
c. Power			
1. Kilo Volt Amperes	Measured KVA	N/A	N/A
Steady Burning Lights			
a. Loop current for each of the 5 loops (represented by n below).			
1. Loop n	Specified loop current	Specified loop current ± X percent	Specified loop current ± X percent
b. Loop Voltage for each of the 5 loops.			
1. Loop n	Specified voltage	N/A	Over voltage; under voltage

TABLE Xa. ALSF-2/SSALR MONITORED PARAMETERS (cont.)

Parameter	Normal	Alert (Soft Alarm)	Alarm
Flasher Status	On/off	N/A	N/A
Flasher Intensity	Low/Medium/High	N/A	N/A
Steady Burning Light Status	On/off	N/A	N/A
Steady Burning Light Intensity	Brightness 1/2/3/4/5	N/A	N/A
Power supply inputs (When used, in accordance with paragraph 3.4.15.3.2.2)			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured Amperage	N/A	N/A
2. ac current	Measured Amperage	N/A	N/A
Power supply outputs (When used, in accordance with paragraph 3.4.15.3.2.2)			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent

TABLE Xa. ALSF-2/SSALR MONITORED PARAMETERS (cont.)

Parameter	Normal	Alert (Soft Alarm)	Alarm
b. Current			
1. dc current	Measured Amperage	N/A	Over current
2. ac current	Measured Amperage	N/A	Over current
Cabinet inputs (When used, in accordance with paragraph 3.4.15.3.2.2)			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured Amperage	N/A	Over current
2. ac current	Measured Amperage	N/A	Over current
Cabinet outputs (When used, in accordance with paragraph 3.4.15.3.2.2)			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured Amperage	N/A	Over current
2. ac current	Measured Amperage	N/A	Over current

TABLE Xa. ALSF-2/SSALR MONITORED PARAMETERS (cont.)

Parameter	Normal	Alert (Soft Alarm)	Alarm
Subsystem inputs (When used, in accordance with paragraph 3.4.15.3.2.2)			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured Amperage	N/A	Over current
2. ac current	Measured Amperage	N/A	Over current
Subsystem outputs (When used, in accordance with paragraph 3.4.15.3.2.2)			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured Amperage	N/A	Over current
2. ac current	Measured Amperage	N/A	Over current
ATCT/Substation Communications			
a. Receive Carrier	Carrier	N/A	No carrier
b. Transmit Carrier	Carrier	N/A	No carrier

TABLE Xa. ALSF-2/SSALR MONITORED PARAMETERS (cont.)

Parameter	Normal	Alert (Soft Alarm)	Alarm
c. Error Detection	No errors detected	> XX errors per hour	N/A
RMS CPU Status	Pass		Fail
Intrusion	No	N/A	Door open for more than 0.25 seconds and MDT not connected within 5 minutes.
Smoke Detector			
a. Equipment Shelter	Not Activated		Activated
b. Engine Generator Shelter	Not Activated		Activated
Inside Temperature	30° C nominal	XXX° C	≥70° C
Outside Temperature	XXX° C	N/A	N/A

3.2.10.5 Environmental parameters.- The following environmental parameters (also listed in paragraph 3.2.9.1.9) shall be monitored as specified for each parameter. Cable losses are based on a distance of 100 feet between the engine generator shelter and RMS equipment (located in the ALSF-2/SSALR shelter).

3.2.10.5.1 Intrusion detector.- The intrusion detector shall detect the opening of the ALSF-2/SSALR equipment shelter door and the ALSF-2/SSALR engine generator shelter door (the doors and shelters are not a part of this specification). The shelter security parameter shall be timed on when the detector senses that the door has been open for 0.25 seconds. A security alarm message shall be provided to the MPS interface if a portable terminal is not connected to the MDT interface within 5 minutes. The shelter security parameter shall return to normal if the MDT is connected to the terminal interface within 5 minutes. If after being connected, the MDT is disconnected from the terminal interface, the RMS shall inhibit sensing a shelter security alarm for a period of 5 minutes prior to resuming normal monitoring of the shelter security parameter. It shall be possible to bypass each of the intrusion detectors separately through commands from the MPS and MDT and manually at the RMS cabinet.

3.2.10.5.2 Smoke detector.- The ALSF-2/SSALR systems shall be furnished with an ionization type smoke detector for the ALSF-2/SSALR equipment shelter and a photoelectric type smoke detector for the engine generator shelter. The ionization type smoke detector shall meet the requirements of and bear the label of Underwriters Laboratories, Inc. Standard 268. The photoelectric type detector shall meet the requirements and bear the label of Underwriters Laboratories, Inc. Standard 217. A smoke detector alarm message shall be provided to the MPS interface upon activation of the smoke detector.

3.2.10.5.3 Commercial ac power.- Each ALSF-2/SSALR system shall be provided with a commercial ac power sensor. The commercial ac power sensor shall detect the presence/absence of specified commercial ac power applied to the ALSF-2/SSALR equipment. The commercial ac power alarm message shall be provided to the MPS interface if the commercial ac power fails.

3.2.10.5.4 Engine generator ac power.- Each ALSF-2/SSALR system shall be provided with an engine generator ac power sensor. The engine generator ac power sensor shall detect the presence of specified engine generator ac power applied to the ALSF-2/SSALR equipment. The engine generator failure alarm message shall be sent to the MPS interface if the engine generator fails to start due to loss of commercial ac power or a start command from the air traffic control tower; or failure of the engine generator after a successful start.

3.2.10.5.5 Inside temperature.- Each ALSF-2/SSALR system shall be furnished with two inside temperature sensors. The temperature sensors shall provide the temperature inside the ALSF-2/SSALR equipment shelter and inside the engine generator shelter (neither of the shelters is a part of this specification) to the RMS with an accuracy of ±2°C. The inside temperature shall be available for automatic and demand monitoring at the MPS and MDT interfaces.

3.2.10.5.6 Outside temperature.- Each ALSF-2/SSALR system shall be furnished with an outside temperature sensor. The temperature sensor shall provide the outside temperature to the RMS with an accuracy of ±2°C. The outside temperature shall be available for automatic and demand monitoring at the MPS and MDT interfaces.

3.2.11 Equipment required but not furnished.- The following items are not furnished under this contract but are required to make a complete approach lighting system.

3.2.11.1 Isolation transformers.- Isolation transformers isolate each lamp from the high voltage constant current loop and maintain loop integrity in the event of lamp failure. Transformers used will be in accordance with FAA Advisory Circular AC 150/5345-47, type L830-9 and L830-13, respectively. The 1500 watt transformers will be in accordance with FAA-E-2690.

3.2.11.2 PAR-56 lamps.- The lamps used in the ALS (steady burning) are of quartz halogen type and will be size PAR-56. Light output and beam shape will be in accordance with FAA-E-2408 for both the 300 watt and 500 watt lamps. Three hundred watt lamps are used for white illumination and 500 watt lamps are used in colored application (red or green). Both lamps require 20 amperes to produce full intensity.

3.2.11.3 Low impact resistant structures.- Low impact resistant (LIR) structures will be used to support the approach lighting system lighting fixtures. Low impact resistant structures shall be in accordance with FAA-E-2702.

3.2.11.4 Shelter.- The substation shelter provides environmental protection, work shop space, and storage for tools and spare parts. A typical shelter is shown on FAA Drawings D-6238-17 and D-6238-18.

3.2.11.5 Semiflush fixtures.- Semiflush fixtures used for the inpavement ALS lights are in accordance with FAA-E-2491.

3.3 Physical characteristics.- The enclosures to be supplied under this specification shall be as specified herein.

3.3.1 480 V ac input cabinet.- The 480 V ac input panel shall be a NEMA 12 enclosure. The steel enclosure shall be equipped with a lockable door. Warning signs shall be installed as specified in 3.4.12. The 480 V ac input panel shall comply with National Electric Code and National Standards established by the Occupational Safety and Health Act (OSHA). The contractor shall furnish preliminary drawings for approval. These drawings shall show the control wiring and terminations.

3.3.2 High voltage output cabinet.- The high voltage output cabinet shall be a NEMA 12 enclosure. The steel enclosure shall be equipped with a lockable door and with 1/4-inch transparent plexiglass enclosures, or equal, guarding all exposed voltage terminals. Warning signs shall be installed as specified in 3.4.12. The high voltage output cabinet shall comply with the National Safety and Health Act (OSHA). The control wiring terminal board shall be located to the front of the cabinet so that it will not be necessary to enter the high voltage areas to make measurements on the control wiring. The contractor shall furnish preliminary drawings for approval. These drawings shall show the control wiring and terminations.

3.3.3 Constant current regulators.- The 30 kilowatt (Kw) current regulators shall be contained in a steel enclosure not to exceed 70 inches high by 42 inches wide by 47 inches deep. The unit shall be mounted in such a way that forklift access is provided. Lifting eyes shall be provided on all four upper corners. Reactors, capacitors, and indoor transformers shall be provided with a steel enclosure. The input terminals shall be enclosed with steel.

3.3.4 Substation control and monitor assembly.- The substation control and monitor assembly is shown in figure 7. The steel cabinet shall be a NEMA Type 12 enclosure. The cabinet shall have a split door. The upper door shall serve as the local control panel and the lower door shall provide access to the control and monitor electronic assemblies and interface wiring. Gasketing shall be provided for both doors such that the upper edge of the lower door will seal against the contoured lower edge of the upper door. Opening of the upper door shall not be possible without first opening the lower door, and locking provisions shall be provided on the lower door. The cabinet doors shall open from the right side and a door stop shall be provided to lock the door in a 120 degree open position.

3.3.5 Remote electronic chassis.- The remote electronic chassis shall be a NEMA Type 12 steel enclosure, 20 inches (508 mm) high by 16 inches (406.4 mm) wide by 10 inches (254 mm) deep. The unit shall be constructed such that it can be either wall mounted (up to 300 feet (91.44 m) from the tower control console) or placed on the floor directly below the console. The unit shall have a gasketed, lockable door, with right-hand opening. The chassis shall interface with the remote control panel via No. 19 AWG twisted pair cable. The remote electronics chassis shall have a serial data interface with the substation control and monitor assembly, and the remote monitoring subsystem via No. 19 AWG twisted pair using connectors conforming to MIL-C-26482.

3.3.6 Airport traffic control tower (ATCT) control panel.- The ATCT control panel shall be as shown in figure 6, and shall have a metal enclosure with the following dimensions: 10.5 inches (267 mm) wide by 5.25 inches (133 mm) high by 5 inches (127 mm) deep. It shall be supported in the tower console by a lip around the perimeter of the front panel. This lip shall not be less than 0.25 inches (6.3 mm) from the panel edge at any point. Power supplies shall not be mounted in or on the control panel. Interface to the remote electronic chassis shall be a serial data interface via No. 19 AWG twisted pair using connectors conforming to MIL-C-26482.

3.3.7 Reserved.

3.3.8 External resistor cabinet.- If required, the resistor cabinet shall be a waterproof, dust-tight enclosure. The cabinet shall be made of stainless steel or aluminum and shall have the following dimensions: 40 inches (1016 mm) by 20 inches (508 mm) by 13 inches (330 mm) (maximum).

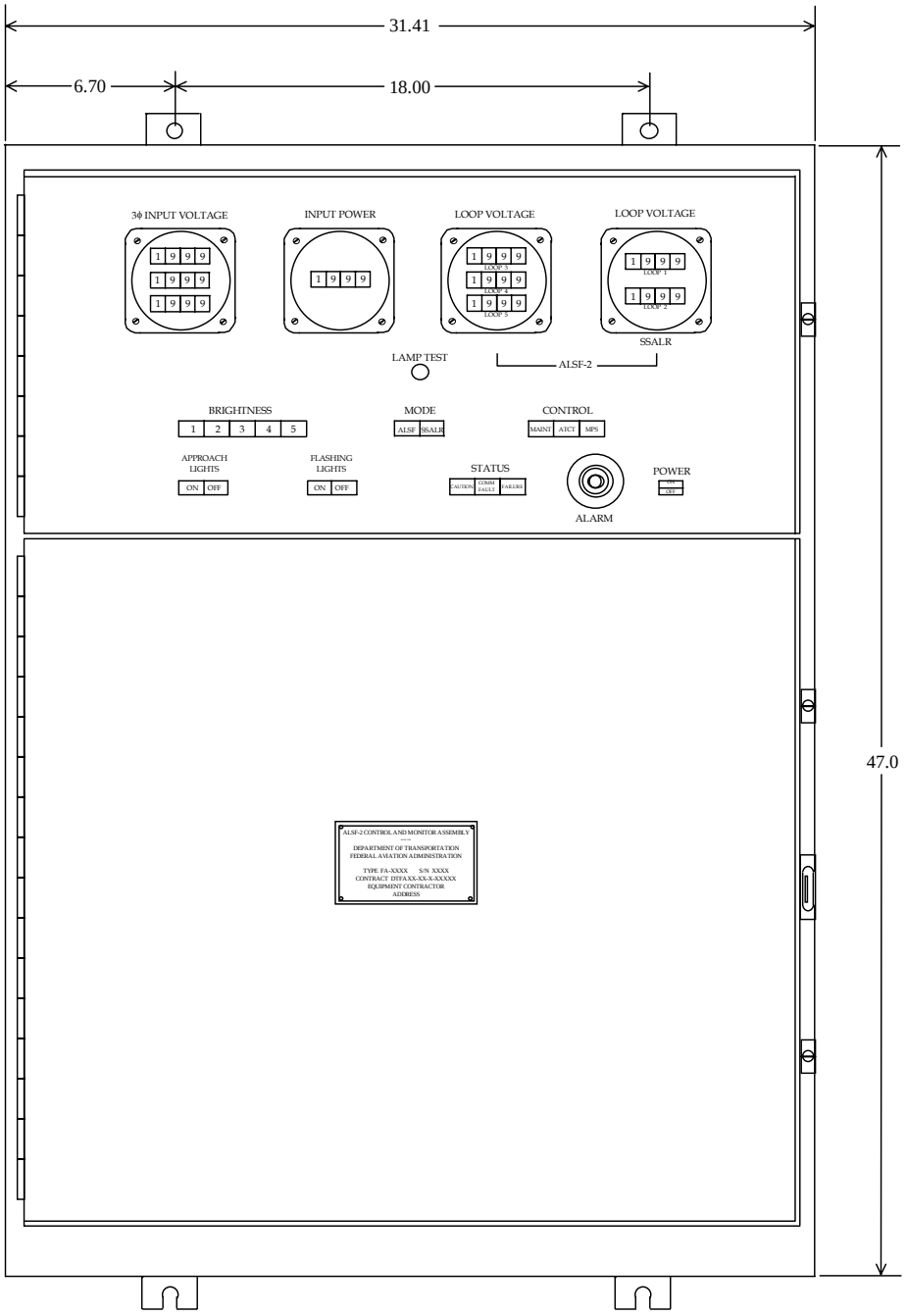

Figure 7. Typical Substation Control and Monitor Assembly

3.3.9 Individual control cabinet.- The cabinet shall be a NEMA 4X enclosure made of stainless steel, fiberglass, or anodized aluminum. It shall be of sufficient size to accommodate all of the necessary components and wiring and allow for easy field installation and maintenance. Mounting lugs or bolts shall be provided on the back of the cabinet to enhance the stability of the cabinet by using an additional mounting attachment when necessary. These mounting lugs shall be welded on all sides. Warning signs as specified in 3.4.12 shall be installed in the cabinet. The interface to the monitor and control subsystem, and remote monitoring subsystem shall be serial data via No. 19 AWG twisted pair cable with connectors conforming to MIL-C-26482 or terminal blocks.

3.3.10 Junction boxes.- Junction boxes shall be in accordance with FAA Drawing D-5140-2. However, the terminal block indicated in the above drawing shall be of the type specified in 3.5.1.8, and sized to accommodate the power and signal cables used in the system. The box shall be made of stainless steel or anodized aluminum. Conduit hubs shall not be installed on the junction box. Junction boxes will serve as convenient distribution points to interconnect cables from the substation to the individual control cabinets.

3.4 System requirements.- The system shall be designed using modular construction concepts for ease of maintenance, shall employ plug-in printed wiring boards where practical, have interchangeable parts between like systems, have readily accessible test points for all major signals, and have lightning and transient protection. All energized surfaces and points (except test points on printed circuit boards) shall be insulated or covered to prevent electrical shock.

3.4.1 Power quality requirements.- The interruption of primary power or voltage variations of up to ±10% either at the substation or the ATCT, for short or long durations, shall not cause the system to restart in an undefined state upon restoration of the power. Power variations shall not cause any damage to the equipment. All commands shall be permanently stored and shall not require intervention or reactivation from the operator upon restoration of power. Solenoid held devices shall not be employed. When a system is software controlled using microprocessors or similar devices, a battery driven power source shall be provided to maintain memory/logic in the circuitry for a minimum of two minutes during a power loss or a transfer of power source.

3.4.2 Modular construction.- All electronic, electrical, and mechanical components shall be designed and constructed to minimize skill, experience, and time necessary to disassemble, assemble, and maintain them. All electronics shall be designed using plug-in printed wiring boards except where high voltage or high power devices are utilized. Similar functions shall be performed using identical modules wherever practical, and preference shall be given to designs which afford component replaceability.

3.4.2.1 Module.- A module is defined as being two or more basic parts that form a functional assembly that is a portion of a larger assembly or unit. The module is easily removed intact and replaced by plug-in, unsoldering, quick-disconnect, fastener, or equivalent means. It may or may not contain printed circuitry and it may contain active or passive devices.

3.4.3 Interchangeability.- All like components of each system shall be interchangeable between systems, and identical units within each system shall be interchangeable. Identical components shall be identified with identical part numbers and unlike parts shall not have the same part number. This requirement does not prevent the readjustment or calibration of exchanged modules nor does it prohibit exchange of control panels due to the runway identification number. Interchangeability shall be in accordance with MIL-STD-454, Requirement 7.

3.4.4 Test points and controls.- Test points shall be provided on all signals that are required to be monitored during checkout, alignment, calibration, or during preventive maintenance procedures. Test points shall not be located in compartments with voltage points of 500 volts or more, and all test points shall be located so as to preclude accidental shock to personnel engaged in normal operating or maintenance activities. The removal of components, modules, or circuit cards shall not be required to gain access to test points or adjustments. Test point controls and indicators mounted on printed wiring boards shall be accessible from the front of the circuit cage assembly without the use of extender boards.

3.4.4.1 Remote maintenance monitoring test points.- Test points and controls shall be terminated in a central location within the equipment cabinet. The termination shall be in a female connector to allow easy connection to an external remote maintenance monitoring system and to be used during preventive maintenance procedures.

3.4.4.1.1 Remote electronic chassis RMM connector.- The connector use in the remote electronic chassis for remote maintenance monitoring purposes shall be MIL-C-24308 or a terminal block.

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3.4.4.1.2 Substation control and monitor RMM connector.- The connector used in the substation control and monitor subsystem for remote maintenance monitoring shall be MIL-C-24308 or a terminal block.

3.4.4.1.3 Reserved.

3.4.4.1.4 Individual control cabinet flasher tester connector.- The connector used in the individual control cabinet for interfacing the flasher tester shall be MIL-C-24308.

3.4.5 DC power supplies.- The dc power supplies shall be protected from overloads and short circuits, and shall provide the following regulated power.

(a) For control and monitor: 24 ±4 V dc with an output current of 3.5 A dc minimum and having a ripple of 50 Mv rms maximum; +15.0 ±0.5 V dc and -15 ±0.5 V dc with output tracking of ±1 percent maximum, 300mA dc output current, and 5 mV rms ripple maximum; 5 ±0.25 V dc with an output current of 3 A dc minimum and 10 mV rms ripple maximum.

3.4.6 Extender boards.- Extender boards shall be provided for all printed wiring boards that are in card cage assemblies. The use of extender boards shall be limited to corrective maintenance only and shall not be required for calibration, adjustment, or preventative maintenance activity.

3.4.7 Derating of electronic parts.- Derating of electronic parts and materials shall be in accordance with MIL-STD-454, requirement 18, and in accordance with FAA-G-2100 paragraph 3.5.2.2.

3.4.8 Enclosures.- Unless otherwise specified, all enclosures shall meet the following requirements. Enclosures shall be NEMA Type 12 cabinets and shall be rigidly constructed and shall not distort or bend during shipping, handling,and installation. Enclosures shall have mounting means external to the cabinet cavity, provisions for locking, and shall not have conduit hubs or knockouts. Space shall be provided in the cabinet for all external cable connections. Terminal blocks shall be located near the cable entrance to permit terminations of all external power and control wires feeding into the cabinet. Mounting lugs or bolts shall be provided on the back of the cabinets for mounting the cabinets vertically. Enclosures shall be stainless steel or aluminum sheet. Aluminum enclosures shall be anodized in accordance with MIL-A-8625.

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3.4.8.1 Door gasket.- Indoor cabinets shall have either continuous molded gaskets or strip gaskets. Outdoor cabinets shall have continuous molded gaskets. If strip gaskets are used; (a) the total number of strips used shall not exceed four, (b) the vertical and horizontal runs shall be continuous except where the vertical strips meet the horizontal strips, and (c) the horizontal strips shall overlap the vertical strips. The gaskets shall be neoprene and shall be resistant to deterioration such as cracking, hardening, or softening under the environmental conditions the equipment will operate in.

3.4.8.2 Cabinet door.- All cabinet doors shall open from the right side of the cabinets. The door hinge may be internally or externally mounted and shall be corrosion resistant. A doorstop shall be provided for locking the door in a 120 degree open position, except on Safety Disconnect Switch, 480 Volt Input Cabinet, High Voltage Output Cabinet, Constant Current Regulator and the Substation Distribution Panel.

3.4.8.3 Cabinet door handle.- The door handle lever shall have provision for padlocking it closed in the vertical position. The holes for the padlock shall be aligned such that a 3/8 inch (0.95 cm) diameter rod can be passed horizontally or vertically through the holes when the door handle is in a locked position. The handle shall activate a two-point shoot bolt to firmly secure the door in the closed position. The door handle shall be within 2 degrees of vertical when locked and shall keep the door completely closed regardless of what type or size of padlock is used.

3.4.8.4 Instruction book holder.- An instruction book holder shall be attached to the inside of cabinet doors larger than 2 square feet (0.37 square meter) (except for the individual control cabinet). The holder shall form a pocket for an 8-1/2-inch by 11-inch (216 by 279 mm) instruction book (3.7.2) and shall be made of the same material as the cabinet door.

3.4.8.5 Panel door cables.- Parts mounted on a hinged panel shall be wired to the other parts by means of a single cable, arranged to flex without being damaged when the panel is opened and closed.

3.4.9 Earth grounding.- The system covered by this specification shall meet all specification requirements when each unit of the complete system is connected to a good earth ground at the unit installation site. Equipment shall be provided with a grounding lug having a slotted, hexagonal, green-colored head suitable for a No. 6 bare copper ground wire.

3.4.10 Nameplates.- The ALS equipments shall have nameplates in accordance with FAA-G-2100, paragraph 3.10. Nameplates shall be attached to the outside surface of the equipment using type 430 or 18-8 stainless steel rivets or drive screws.

3.4.11 Assembly and marking.- All components shall be properly assembled and marked. Each electrical/electronic component or part thereof shall be identified by a reference designation marked adjacent to the physical location of the part of the equipment and readily visible to maintenance personnel. Such identification shall be identical to reference designations used in instruction books for the equipment. Marking shall be in accordance with FAA-G-2100, paragraph 3.9.

3.4.12 Warning signs.- All contacts, terminals, and parts having voltages in excess of 500 V (rms) shall be clearly marked "DANGER HIGH VOLTAGE". Warning signs shall be placed as close as possible to the point of danger. Markings shall have red letters (a minimum of 1/2 inch (12.7 cm) high) on a white or clear background.

3.4.13 High voltage insulation.- Insulation and insulating materials used in the high voltage input and output cabinets, and in the constant current regulator, shall be rated for at least 5,000 V ac service. Insulation resistance shall be greater than 50 megohms, when measured using 15 Kv dc. Designs shall be consistent with the surge withstand capability (SWC) of ANSI C37.90.

3.4.14 Software/firmware requirements.- Newly developed ALSF-2/SSALR software shall be implemented using a high order programming language as approved by the Government. The software shall be designed, developed, documented, and tested according to software development requirements specified by FAA-STD-026 and all requirements of DOD-STD-2167A except the following paragraphs which have been deleted in their entirety: 4.1.5, 4.2.2, 4.3.2, 4.4.2, 4.6.3, 4.6.4.b, 4.6.4.c, and 5.5.4.a. References to the source code have been deleted from the following paragraph of DOD-STD-2167A: 5.6.4.c, 5.7.4.b, and 5.8.4.

3.4.14.1 Operating system (OS) requirements.- If used, the operating system shall be a vendor supplied commercial-off-the-shelf software product.

3.4.14.2 Defensive coding.- The software shall be designed such that operator actions (i.e., inadvertently causing the system to halt, causing the system to stop performing the functions required by this specification, executing an incorrect command, executing out-of-limit parameters, and other operator-induced errors) shall not cause the incorrect operation of the system.
An incorrect input shall cause the system to respond with an error message and a prompt to aid the operator in providing a correct input. All such messages shall not require additional references or technical orders.

3.4.14.3 Operating parameters.- All operating parameter adaptations and limits, routing indicators and addresses, and priorities shall be changeable by the user/operator without a software change. Only minimal references will be required to make changes. Operators shall not be required to set up a database each time the system is initialized. All variables will have a default option that requires no operator intervention for selection.

3.4.14.3.1 Initialization/restart.- System initialization or restart shall be menu-driven with prompts.

3.4.14.3.2 Switch action.- Routine keyboard inputs shall only require a single key entry. Control key inputs shall be used only when necessary and for actions that could interrupt/halt the system or software. The desired method is a dual key entry with an operator prompt/response required.

3.4.14.4 Software utility services.- All processors that are software or firmware programmable shall be delivered with the necessary capability to develop and maintain the programmed logic. For firmware, this capability shall include a complete description of the logic and methodology and capability to modify the logic. All software and firmware provided shall be delivered with, and be reproducible from source materials. All delivered programs shall be capable of reconstruction on the delivered support configurations. This support software shall provide the following minimum capabilities:

(a) Compilation

(b) Assembly that produces relocatable object code

(c) Linking loader

(d) Generation, maintenance, and initialization of storage media for programs and data

(e) Diagnostics to support fault isolation

(f) Editing and debugging tools

(g) Test tools

3.4.14.5 System error messages.- System error messages concerning equipment, configuration, operator attention, and abnormal execution alarms shall be standardized. The generation of error/diagnostic messages shall make a distinction between the requirements for on-line messages (to facilitate real-time fault isolation required to maintain the system in operational status) and the logging of fault messages onto system files for the category of faults that require isolation and correction, but can be addressed off-line and do not degrade the system performance. The required processing time to identify and generate error/ diagnostic messages, either for immediate or off-line isolation and correction, shall not degrade the operational requirements of the system.

(a) Processor messages and advisory formats shall not require additional interpretation by the operator, such as table look-ups and references to documentation, with the exception of lengthy diagnostic procedures to be followed by the operator after an abnormal condition.

(b) No computer program shall generate a message or advisory identical to one generated by the OS or by another program operating in the ALSF-2/SSALR system.

(c) Off line error messages shall contain, as a minimum, the following information:

1 Time error was detected

2 The memory location from which the error routine was entered

3 Textual description of condition

4 Program identification

5 Required operator action, where applicable

6 Contents of instruction register and program counter at time of error

7 Identification of triggering module

8 Computer program or system execution status following the error

On-line error messages shall contain, as a minimum, the information in items 1, 3, and 5 above.

3.4.14.6 System growth capabilities.- The processing configuration (including microprocessors and microcomputers) shall provide the following capabilities for growth:

(a) Memory: The computer configuration shall include sufficient capacity to accommodate an increase of on-half in all computer program modules and data structures with no modifications in equipment, no restructuring of modules or data structures, and no resequencing of input/output operations.

(b) Central processing unit (CPU): Under worst-case CPU loading, the delivered CPU usage shall not be greater than 75 percent of capacity.

(c) Upward expandability: The delivered configuration shall either include, or permit by addition of units without induced change, modification, or redesign to the software/hardware components comprising the basic configuration a further 100 percent increase in the capacity of primary memory.

All of these margins for growth shall exist at the time of delivery. Analysis, proving that the requirements are met, shall be presented at PDR and CDR for Government approval.

3.4.15 RMS functional requirements.- The ALSF-2/SSALR RMS shall meet the functional requirements of NAS-MD-793 as augmented below and the requirements of NAS-MD-790. All data provided to the RMS interfaces (parameter values, measurements, standards, tolerances, and diagnostic test results) shall be conditioned and reported in the correct engineering units. The RMS data transmitted over the data link between the ATCT and the ALSF-2 substation shall utilize, as a maximum, one unshielded, twisted pair of 19 gauge wire.

3.4.15.1 Monitoring requirements.- All monitored data and reports shall be time stamped at the RMS. In addition, the RMS shall monitor environmental parameters to provide data on the ambient environmental and physical security conditions at the ALSF-2/SSALR equipment and engine generator shelters. Table XIVa lists the controlled functions of the monitoring system.

3.4.15.2 Alarm limits.- ALSF-2/SSALR and environmental equipment parameter values shall be collected on a regular and frequent basis (see 3.4.15.7.3). The RMS shall process the outputs of the sensors to determine hard and soft alarm status by comparing the monitored outputs with predetermined values. All hard and soft alarm thresholds shall be site adaptable. Thresholds for currents and voltages shall be adaptable to ± 40 percent of their specified values.

TABLE XIVa. ALSF-2/SSALR CONTROLLED FUNCTIONS

Controlled Function	Possible Status
ALSF-2/SSALR (available to both the local maintenance data terminal and the maintenance processor sub-system)	
RMS Diagnostics	(PASSED/FUNCTION "X" FAILED)
ALSF-2/SSALR Diagnostics	(PASSED/LRU, LIGHT BAR, and/or LAMP "X" FAILED)
Reset ALSF-2 RMS (SUCCESSFUL/UNSUCCESSFUL)	RESET
Reset ALSF-2 Microprocessors (SUCCESSFUL/UNSUCCESSFUL) (when used)[1]	RESET
ALSF-2/SSALR (available from local maintenance data terminal)	
a. Display Menu	-
b. Display System Status	-
c. Display Certification Parameters	-
d. Display Performance Checks	-
e. Display Key Equipment Performance Parameters	-
f. Display Status of a Parameter	-
g. Abort Command in Progress[2]	-
h. Time synchronization	-
i. ALS	(ON/OFF)
j. Establish System Parameters	PARAMETERS TEMPORARILY/ PERMANENTLY) INSTALLED
k. Alarm, Alert Enable/Disable	(ENABLE/DISABLE)

TABLE XIVa. ALSF-2/SSALR CONTROLLED FUNCTIONS (cont.)

Controlled Function	Possible Status
l. ALS Brightness	(1/2/3/4/5)
m. Flasher lights	(ON/OFF)
n. Mode	(ALSF-2/SSALR)
o. RMS Control Mode	MDT/MPS
o. Send Terminal Message	-
ALSF-2/SSALR (available from maintenance processor subsystem)	
a. ALS	(ON/OFF)
b. ALS Brightness	(1/2/3/4/5)
c. Flasher lights	(ON/OFF)
d. Mode	(ALSF-2/SSALR)

[1] Available to the MDT at anytime; available to the MPS only when the remote control panel is in ALARM.
[2] Available only for commands that take longer than 20 seconds to implement.

3.4.15.3 Control command requirements.- The RMS shall provide for the capability to assess performance parameters, diagnose, and change ALSF-2/SSALR equipment status from the MPS or MDT interfaces. Control commands shall be exercised within the following constraints:

a. The MPS shall not be capable of controlling ALSF-2 operational functions when the ALSF-2 has been turned on at the ATCT.

b. The MPS shall be capable of exercising any maintenance function that does not affect operational functions when the ALSF-2 has been turned on at the ATCT.

c. The MPS in MPS Control A Mode (3.4.16.1.2) shall have the capability to perform limited control (3.4.15.3.1) all ALSF-2 operational and maintenance functions when

the ALSF-2 has been turned off at the ATCT and the substation control panel control switch is in the ATCT position. Control of ALSF-2 operational functions under this scenario shall be limited to the time it takes the system to execute the command and the commanded action shall remain in affect for a period of 0 to twenty four hours. This time period shall be site adaptable in increments of one minute. A value of zero (0) shall disable MPS control commands. This time period shall be default set to 20 minutes and is restarted after each control command.

d. The RMS shall be capable of immediately returning operational control of the ALSF-2 system to the ATCT from the MPS when a function change is selected at the remote control panel.

e. An audible alarm and visible alarm shall be generated at the remote control panel and at the substation control panel whenever the MPS or the MDT take operational control of the ALSF-2. See paragraph 3.2.4.4.2.7(g).

f. The MPS shall have no control when the control MAINT button has been selected on the substation control panel.

g. The MDT shall have operational control of all ALSF-2 functions in accordance with paragraph 3.4.16 and subparagraphs.

h. The ALSF-2 RMS shall have two modes of operation: 1) a remote mode, and 2) a local mode. The capabilities and limitations of the MPS and the MDT in each mode (local and remote) and for each configuration (MDT logged in and MDT not logged in) shall be as described in table XIVb.

Table XIVb. RMS Operating Modes and Configurations

Modes and Configurations	Available Functions				
	RMS Status		RMS Control		Other
	MPS	MDT	MPS	MDT	
Remote Mode					
MDT not logged in	Yes	No	Yes	No	RMS provides Login Prompt to the Local Terminal Interface
MDT logged in	Yes	Yes	Yes	No	
Local Mode (MDT logged in)	No	Yes	No	Yes	
Substation Control Panel MAINT selected	No	Yes	No	No	

3.4.15.3.1 MPS interface commands.- In addition to the capability to respond to the polling requirements of NAS-MD-790, the following commands shall be incorporated into the RMS and shall be executed upon receipt of commands from the MPS interface.

(a) Diagnostic routine check (3.4.15.3.2.8)

(b) Turn approach lights ON (3.4.15.3.2.10)

(c) Brightness step (1-5) (3.4.15.3.2.11)

(d) Flasher lights ON/OFF (3.4.15.3.2.12)

(e) Reset (3.4.15.3.2.13)

(f) Time synchronization with MPS (3.4.15.3.2.14)

(g) Mode change (3.4.15.3.2.9)

3.4.15.3.2 MDT interface commands.- The following command shall be incorporated into the RMS and shall be executed upon receipt of commands from the MDT interface.

(a) Display menu (3.4.15.3.2.1)

(b) Display system status (3.4.15.3.2.2)

(c) Display certification parameters (3.4.15.3.2.3)

(d) Display performance checks (3.4.15.3.2.4)

(e) Display key equipment performance parameters (3.4.15.3.2.5)

(f) Display status of a parameter (3.4.15.3.2.6)

(g) Abort command in progress (3.4.15.3.2.7)

(h) Diagnostic routine check (3.4.15.3.2.8)

(i) ALSF-2/SSALR mode (3.4.15.3.2.9)

(j) Turn approach lights on/off (3.4.15.3.2.10)

(k) Brightness step (1-5) (3.4.15.3.2.11)

(l) Flasher lights on/off (3.4.15.3.2.12)

(m) Reset (3.4.15.3.2.13)

3.4.15.3.2.1 Display menu command.- The ALSF-2/SSALR RMS shall include a display menu command. Execution of the display menu command shall provide a listing of all menu items including the commands in 3.4.15.3.2 above.

3.4.15.3.2.2 Display system status.- The ALSF-2/SSALR RMS shall implement a display system status command. The display system status command shall be executed upon receipt of a unique command. Execution of the display system status command shall provide a report of the status of the ALSF-2/SSALR and environmental equipment including as a minimum the ALSF-2/SSALR monitored parameters of table Xa. The report shall also contain, all system input voltages and currents, all cabinet, regulator, subsystem input and output voltages and currents, and all power supply input and output voltages and currents. See paragraph 3.2.10.1.

3.4.15.3.2.3 Display certification parameters.- The AlSF-2/SSALR RMS shall implement a display certification parameters command. This command shall be executed upon receipt of a unique command and provide a report containing the date and time, the services provided, the certification parameters, standards and tolerances, and measured values as identified in paragraph 3.2.10.3.

3.4.4.15.3.2.4 Display performance checks.- The ALSF-2/SSALR RMS shall implement a display performance checks command. This command shall be executed upon receipt of a unique command and provide a report containing the date and time, periodicities of performance checks, performance checks, standards and tolerances, and measured values as identified in the instruction book (see paragraph 3.2.10.4).

3.4.15.3.2.5 Display key equipment performance parameters.- The ALSF-2/SSALR RMS shall implement a display key equipment performance parameter command. This command shall be executed upon receipt of a unique command and provide a report containing the date and time, inside temperature, outside temperature, parameters, standards and tolerances, alarm status, and measured value as identified in the instruction book (see paragraph 3.2.10.2).

3.4.15.3.2.6 Display status of a parameter command.- The ALSF-2/SSALR RMS shall implement a display status of a parameter command. The display status of a parameter command shall be executed upon receipt of a unique command. It shall be possible to separately specify each of the parameters of 3.4.15.3.2.2, 3.4.15.3.2.3, 3.4.15.3.24., and 3.4.15.3.2.5. The single line shall contain the parameter name, standard, the alarm status, and monitored value (as applicable) for that parameter exactly as the line for that parameter would be displayed in the reports specified.

3.4.15.3.2.7 Abort command in progress.- The ALSF-2/SSALR RMS shall implement an abort command in progress command. This command shall be available only for commands that take more than 20 seconds to implement. Execution of the abort command in progress command shall cause the RMS to cease execution of any interface command currently being executed.

3.4.15.3.2.8 Diagnostic routine check.- The ALSF-2/SSALR RMS shall implement the diagnostic routine check command. The command shall be executed upon receipt of a unique command from either the MDT or MPS interface. Execution of the diagnostic routine check shall cause the RMS to execute the diagnostic routine of 3.4.15.4. The results of the diagnostic shall be sent by the RMS to the requesting interface.

3.4.15.3.2.9 ALSF-2/SSALR mode.- The ALSF/SSALR RMS shall implement the ALSF-2/SSALR mode command. The command shall be executed upon receipt of a unique command from the MDT interface. Execution of the command from the MDT or the MPS shall cause the RMS to change from ALSF-2 mode of operation to SSALR mode or vice versa.

3.4.15.3.2.10 Turn approach lights on/off.- The ALSF/SSALR RMS shall implement the turn approach lights ON/OFF command. The ON/OFF command shall be executed upon receipt of a unique command from the MDT/Flasher Tester interface. Execution of the ON/OFF command shall cause the approach lights to be activated or deactivated. The MPS shall be able to turn the approach lights ON only when the remote control panel has turned the lights OFF. The MPS shall also be able to turn the approach lights ON/OFF in accordance with 3.4.16.1.6(c)(1).

3.4.15.3.2.11 Brightness step (1-5).- The ALSF/SSALR RMS shall implement the brightness step commands. The command shall be executed upon receipt of a unique command from either the MDT or MPS interface. Execution of the command shall cause the approach lights to be stepped from brightness steps one to two, two to three, three to four, and four to five as well as the reverse order. Execution of the reverse order of brightness steps from the MPS interface shall only be allowed in accordance with 3.4.16.1.6(c)(2).

3.4.15.3.2.12 Flashing lights on/off.- The ALSF/SSALR RMS shall implement the flashing lights ON/OFF command. The ON/OFF command shall be executed upon receipt of a unique command from either the MDT or MPS interface. Execution of the ON/OFF command shall cause the flashing lights to be activated or deactivated. The MPS shall be able to turn the flashing lights ON only when the steady burning lights are turned ON.

3.4.15.3.2.13 Reset.- The ALSF-2/SSALR RMS shall implement a reset command. Execution of the reset command shall cause the RMS to reset the RMS and initiate the time synchronization sequence of paragraph 3.4.15.3.2.14 below.

3.4.15.3.2.14 Clock sync request message.- The RMS shall provide a clock sync request message in accordance with NAS-MD-790, paragraph 3.5.4. The clock sync request message shall be automatically generated for transmission to the MPS at intervals frequent enough to maintain the RMS time to within six seconds of MPS time and at the following minimum intervals: once every 24 hours, whenever the RMS recovers from a power fault, and whenever the RMS is reset. Execution of this command shall cause a software routine to synchronize the RMS clock to within two (2) seconds of the MPS clock.

3.4.15.3.2.14.1 Clock sync command.- The RMS shall accept and execute a clock sync command from the MPS in accordance with NAS-MD-790, paragraph 3.7.9.

3.4.15.3.2.14.2 Clock delay adjustment.- The RMS shall be capable of incorporating a site adaptable, fixed time delta to account for transmission delays in the clock update routine. This clock delay shall be settable through the MDT from 0 to 120 seconds in 1 second intervals. The default shall be set to zero.

3.4.15.3.2.15 ATCT switch select.- The MPS shall be able to select or deselect the ATCT switch at the control and monitor panel in accordance with 3.4.16.1.6(c)(3).

3.4.15.4 Diagnostics requirements.- The RMS shall provide the capability for diagnosing ALSF-2/SSALR equipment faults to the LRU level. Diagnostics shall provide the identity of the failed LRU, light bar or lamp, and parameter values, and provide data reports when requested from the MPS and MDT interfaces.

3.4.15.4.1 Fault isolation.- The diagnostics shall isolate faults to a single LRU in 95% of diagnostic attempts. Faults shall be isolated to two or more LRUs in 98% of diagnostic attempts. Faulty LRUs shall be listed in order of most-likely to least-likely.

3.4.15.5 Physical security requirements.- The physical security function shall provide for the intrusion and smoke detection monitoring and reporting for the ALSF-2/SSALR and engine generator shelters (shelters are not a part of this specification).

3.4.15.6 MDT process security requirements.- The process security function shall control access to and use of the RMS display and control functions. The RMS shall sense for the connection of a MDT to its serial port, and offer a prompt for entry sign-on. A two-step sign-on command when correctly entered, shall cause the RMS to respond to subsequent commands. The two steps shall consist of entering a unique username and then a user password. The usernames and passwords shall be up to eight (8) alphanumeric characters each. Since the user password identifiers equate to various levels of security, each command entry shall validate against the applicable security level list before execution. Each sign-on command entry shall be reported to the MPS. At least 24 unique user password identifiers shall be provided. After replacement of memory devices which store security access data, the system shall reinitialize with a single default password identifier and security access level for each of the 24 addresses. Each password shall be able to be altered by its associated user. Security access to all usenames, passwords, and access levels shall be provided at the most restricted security level only.

3.4.15.6.1 Authority.- The first level password (highest) shall give access to all possible software adaptations, data displays (including calibration data), commands, and diagnostics. The second level shall be restricted to data displays, and diagnostics. The third level shall provide access to the ALSF-2/SSALR system status and key equipment performance parameter displays only.

3.4.15.6.2 Auto logoff.- The RMS shall contain an auto logoff feature for the MDT. This auto logoff shall log the user off the system due to inactivity of the MDT. This auto logoff shall be setable in one (1) minute intervals from 1 minute to 240 minutes. The timer shall be default set to 60 minutes.

3.4.15.7 RMS performance requirements.- The RMS performance function shall control the monitoring and recording of performance data on the hardware/software/firmware components of the RMS; and provide the means for detecting failures and unacceptable performance of the RMS.

3.4.15.7.1 Monitoring requirements.- In addition to the requirements of 3.2.10, the design of the ALSF-2/SSALR RMS shall include sensors and processes to monitor the performance of the RMS hardware, software, and firmware. The actual determination of a failure or impending failure of the RMS shall be accomplished as part of the alarm recognition processing described for the Alarm Function.

3.4.15.7.2 System integrity.- Failures of or in the RMS or associated telecommunications equipment shall not cause failures in, or in any way degrade the Air Traffic operational or Air Traffic Control Tower status and control capabilities of the ALSF-2/SSALR. The RMS shall be completely independent of the ALSF-2/SSALR operating system and the status and control functions of the Air Traffic Control Tower. Certain control functions (listed in paragraph 3.4.15.3.1) initiated from the MPS interface shall be limited to prevent accidental changes in operational status.

3.4.15.7.3 RMS sampling frequency.- The ALSF-2/SSALR RMS shall sense each key equipment performance (3.2.10.2) and certification parameter (3.2.10.3) no less than once every two (2) seconds.

3.4.15.7.4 Alert and alarm determination.- The RMS shall determine an alarm or alert condition and provide an indication of the condition to the local status file within an average time of two (2) seconds and a maximum time of ten (10) seconds.

3.4.15.7.5 Change of state determination.- The RMS shall determine a change of state and provide an indication of the state to the local status file within an average time of two (2) seconds and a maximum time of ten (10) seconds.

3.4.15.7.6 Performance parameter request.- The RMS shall gather performance parameter or diagnostics data for a single report and queue the data in the output buffer within an average time of fifty (50) seconds and a maximum time of four (4) minutes.

3.4.15.7.7 Command execution.- The RMS shall execute control commands (that cause a state change) or test commands within an average time of two (2) seconds and a maximum time of five (5) seconds where this time is measured from receipt of the last byte of the command in the input buffer of the RMS to the time the command is completely executed.

3.4.15.7.8 Communications requirements.- The RMS shall be capable of supporting the transfer of messages of up to 512 characters to the MPS within an average time of five (5) seconds and a maximum time of ten (10) seconds at a rate between 2400 and 9600 bits per second (bps). This time is measured from the acceptance of the first byte of the message by the communication subelement to receipt of the last byte of the message in the input buffer of the MPS.

3.4.15.8 System initialization requirements.- The system initialization function shall verify that the RMS is fully operational, and will load initial parameters from nonvolatile memory. The function shall then permit authorized system users to clear or set counters and registers to their starting values, and to load any necessary variable or constant values which have to be reloaded before an RMS can be started after an equipment or power failure, and to restart the RMS.

3.4.15.8.1 Startup.- Startup of the RMS shall be initiated from the MPS or MDT. Upon receipt of the startup command, the RMS shall execute required actions to restart the RMS, perform self-tests, clear registers, reset counters, etc.

3.4.15.9 MDT communications.- MDT communications support shall be in accordance with NAS-MD-793, paragraph 3.3.5.

3.4.16 ALSF-2 general control behavior.- Operational control of the ALSF-2/SSALR system shall be from only one point at a time: the remote control panel 3.2.4.1(j)(12), substation control panel 3.2.4.1(j)(10), MDT, flasher tester, or the MPS. The system shall respond to control commands from each of these points as defined in the following subparagraphs; as illustrated in figure 8. The system shall save 3.2.4.4.1(g), in non-volatile memory, the latest control settings for the approach lights (ON/OFF), ALSF-2/SSALR mode, brightness step setting, flashers (ON/OFF), from the remote control panel and substation control panel. Whenever control is taken from the remote control panel or substation control panel, and later returned, the system shall be restored to the panel settings previous to the control takeover 3.2.4.4.1(g). The one exception to the rule occur as follows: When the MPS has control (from remote control panel in the off state) and a switch selection is made at the remote control panel, the system shall immediately perform the action commanded by the remote control panel 3.4.15.3(d).

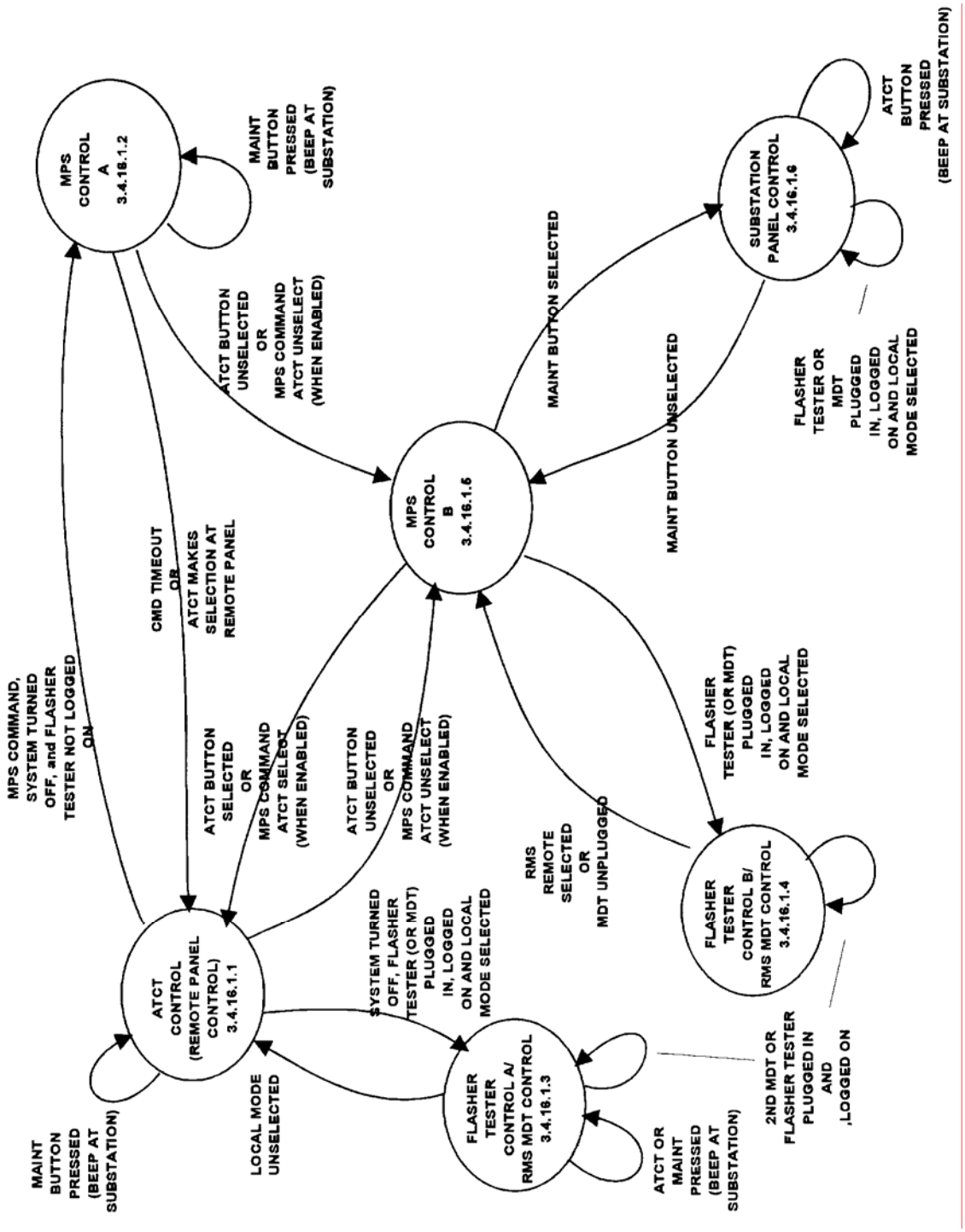

Figure 8. System Control Modes

Indicator lights on the remote control panel and substation control panel always reflect status of the system regardless of who has control 3.2.4.3(a). If a power loss of two minutes or less occurs the previous control state and system conditions are restored 3.2.4.4.1(g), 3.4.1. Only one MDT (attached to the RMS) or Flasher Tester (attached to an ICC) can be plugged in, logged on and in control at a time.

3.4.16.1 ALSF-2 control modes.- Figure 7 shows the ALSF-2 Control Modes. ALSF-2 shall have the following control modes 3.2.4.1, 3.2.4.3, 3.2.4.4.

3.4.16.1.1 ATCT control (Remote Panel Control).- The Air Traffic Controller shall be able to use all selectable functions on the remote control panel (3.2.4.3).

a. If the MAINT button on the substation control panel is selected, there will be a single 0.1 second beep audio alarm at the Substation Panel.

b. FLASHING LIGHTS shall not be selectable unless ALSF is selected ON.

3.4.16.1.1.1 ATCT control indicator lights.-

a. The remote control panel MAINT light shall be OFF 3.2.4.3(a)(6).

b. The substation control panel MAINT light shall be OFF 3.2.4.4.2.1.

c. The substation control panel ATCT light shall be ON 3.2.4.4.2.1.

d. The substation control panel MPS light shall be OFF 3.2.4.4.1.1(g).

3.4.16.1.1.2 Leaving ATCT control.- Remote control panel shall transfer control under the following three conditions:

3.4.16.1.1.2.1 ATCT control transfer to MPS Control A.- When the system is OFF and the MPS sends control command, the MPS can gain control 3.4.15.3 a. The MPS has the control described in paragraph 3.4.16.1.2.

a. There shall be a single 0.1 second beep audio alarm at the remote control panel.

b. The indicator lights after transfer are described in 3.4.16.1.2.1.

3.4.16.1.1.2.2 ATCT control transfer to MPS Control B.- When the ATCT button is unselected or a MPS ATCT unselect command is received, the MPS can gain control. The MPS unselect command is only valid when enabled by a MDT or Flasher Tester connected to the Control and Monitor system (3.4.16.1.6.c.3). MPS Control B is described in para 3.4.16.1.5.

a. There is a single 0.1 second beep audio alarm at the remote control panel.

b. The indicator lights after transfer are described in 3.4.16.1.5.1.

c. The system shall be turned OFF.

3.4.16.1.1.2.3 ATCT control transfer to flasher tester control A/RMS MDT Control A.- When the system is turned OFF and a Flasher Tester/MDT is plugged 3.4.15.3(h) in at an ICC and the user is logged in RMS local mode, the Flasher Tester/MDT shall have the control described in paragraph 3.4.16.1.3.

a. There is a single 0.1 second beep audio alarm at the remote control panel.

b. The indicator lights after transfer are described in 3.4.16.1.3.1.

3.4.16.1.2 MPS Control A.- The MPS shall be able to do the following with the constraints described in 3.4.15.3.c:

a. Turn the system ON but not OFF.

b. Increase intensity of lights.

c. Sequence flasher OFF or ON.

d. Change mode.

e. Selected options defined in 3.4.16.1.6(c).

3.4.16.1.2.1 MPS Control A Indicator Lights.-

a. The remote control panel MAINT light shall BLINK.

b. The substation control panel MAINT light shall be OFF.

c. The substation control panel ATCT light shall be ON.

d. The substation control panel MPS light shall BLINK.

3.4.16.1.2.2 MPS Control A transfer to ATCT control.- When MPS command timer expires after preset amount of time (0 min - 24 hours) or a user at the remote control panel makes a selection, the remote control panel is given control.

a. If the transfer is due to a remote control panel selection, the system condition as set by the MPS shall be retained except as modified by remote control panel selection (3.4.15.3.d).

b. If the transfer is due to a command timeout, the system shall be restored to the state (OFF) that existed before control was transferred to the MPS (3.4.15.3.c).

c. The indicator lights after transfer are described in 3.4.16.1.1.1.

3.4.16.1.2.3 MPS Control A transfer to MPS Control B.- When the ATCT button is unselected or a MPS ATCT unselect command is received, MPS Control B can have control as described in paragraph 3.4.16.1.6. The MPS unselect command is only valid when enabled by a MDT or Flasher Tester connected to the Control and Monitor system 3.4.16.1.6(c)(3).

a. The indicator lights after transfer are described in 3.4.16.1.5.1

3.4.16.1.3 Flasher Tester Control A/RMS MDT control.- The Flasher Tester shall have the capability to use all RMS local mode commands (3.4.15.3).

3.4.16.1.3.1 Flasher Tester Control A/RMS MDT control indicator lights.-

a. The remote control panel MAINT light shall be ON.

b. The substation control panel MAINT light shall BLINK.

c. The substation control panel ATCT light shall be ON.

d. The substation control panel MPS light shall be OFF.

3.4.16.1.3.2 Flasher Tester A transfer to ATCT control.- When the local mode is unselected, or logged off, or unplugged the remote control panel is given control described in paragraph 3.4.16.1.1.

a. The indicator lights after transfer are described in 3.4.16.1.1.1.

3.4.16.1.4 Flasher Tester/RMS MDT Control B.- The Flasher Tester or MDT shall have the capability to use all RMS local mode commands.

3.4.16.1.4.1 Flasher Tester/RMS MDT Control B indicator lights.-

a. The remote control panel MAINT light shall be ON.

b. The substation control panel MAINT light shall BLINK.

c. The substation control panel ATCT light shall be OFF.

d. The substation control panel MPS light shall be OFF.

3.4.16.1.4.2 Flasher Tester/RMS MDT Control B transfer to MPS Control B.- When the RMS Remote Mode is selected or the flasher tester/MDT is unplugged or logged off, the MPS can control as described in paragraph 3.4.16.1.5.

a. When this transfer occurs the lighting system goes OFF.

b. There is an single 0.1 second beep audio alarm at the substation.

c. The indicator lights after transfer are described in 3.4.16.1.5.1.

3.4.16.1.5 MPS Control B.- The MPS shall be able to do the following whenever in this mode:

a. Turn the system ON

b. Increase intensity on lights.

c. Sequence Flasher OFF or ON.

d. Mode selection.

The MPS shall be able to do the following when enabled by a MDT or Flasher Tester connected to the Control and Monitor system (3.4.16.1.6):

e. Turn the system OFF

f. Decrease the intensity on the lights

The command control constraints described in 3.4.15.3(c) do not apply to this mode of operation.

3.4.16.1.5.1 MPS Control B indicator lights.-

a. The remote control panel MAINT light shall be ON.

b. The substation control panel MAINT light shall be OFF.

c. The substation control panel ATCT light shall be OFF.

d. The substation control panel MPS light shall BLINK (when a MPS command is active) or OFF (When no MPS command is active).

3.4.16.1.5.2 Leaving MPS Control B.- This mode can transfer control under the following four conditions.

3.4.16.1.5.2.1 MPS Control B transfer to ATCT Control.- When the ATCT switch at the substation control panel is selected or a MPS ATCT select command is received, remote control panel is given control. The MPS ATCT select command is only valid when enabled by a MDT or Flasher Tester connected to the Control and Monitor subsystem 3.4.16.1.6(c)(3). Remote control panel control is described in paragraph 3.4.16.1.1.

a. The indicator lights after transfer are described in 3.4.16.1.1.1.

3.4.16.1.5.2.2 MPS Control B transfer to RMS MDT/Flasher Tester Control B.- When a RMS MDT/Flasher Tester is plugged in, logged on, and RMS local mode selected, the RMS MDT/Flasher Tester is given control. RMS MDT/Flasher Tester control is described in paragraph 3.4.16.1.4.

a. There is an single 0.1 second beep audio alarm at the substation control panel.

b. Existing MPS selected system conditions are retained.

c. The indicator lights after transfer are described in 3.4.16.1.4.1.

3.4.16.1.5.2.3 Reserved.

3.4.16.1.5.2.4 MPS Control B transfer to substation panel control.- When the MAINT button at the substation control panel is selected, the substation control panel is given control. Substation control panel control is described in paragraph 3.4.16.1.6.

a. The indicator lights after transfer are described in 3.4.16.1.6.1.

3.4.16.1.6 Substation Panel Control.- All selections from the substation control panel are active. When in this mode, the system will follow RMS local mode operations. If the Flasher Tester or MDT is connected to Control and Monitor Subsystem it can perform the following:

a. Reset the system

b. Diagnostics.

c. Enable or disable the following MPS commands (these options shall be default set to NO):

1. Turn the system OFF

2. Decrease intensity of lights

3. ATCT control select/deselect. When this command is disabled, system control is determined by the substation panel MAINT and ATCT buttons only. When the command is enabled, in addition to substation panel button selection, control is determined by MPS ATCT control select/unselect command.

4. Disable the MPS control timer.

5. Single selection of all the commands above (1, 2, 3 & 4)

3.4.16.1.6.1 Substation control panel indicator lights (see figure 5).

a. The remote control panel MAINT light shall be ON (see figure 6).

b. The substation control panel MAINT light shall be ON.

c. The substation control panel ATCT light shall be OFF.

d. The substation control panel MPS light shall be OFF.

3.4.16.1.6.2 Substation Control Panel Transfer to MPS Control B.- When the MAINT button is unselected at the substation control panel, the MPS can control the system. MPS control is described in 3.4.16.1.5.

a. The indicator lights after transfer are described in 3.4.16.1.5.1.

3.5 Parts, materials, and processes.- Parts, materials, and processes selected for use in this equipment shall be in conformity with specific requirements herein.

3.5.1 Parts.- Parts shall be as specified herein.

3.5.1.1 AC power connections.- AC line control circuits, parts, and protective devices shall meet the requirements of FAA-G-2100, paragraph 3.3.2.1.1 through 3.3.2.2.

3.5.1.2 Discrete components.- Discrete components shall be in accordance with the following requirements of MIL-STD-454.

(a)	Capacitors	Requirement 2
(b)	Connectors	Requirement 10
(c)	Controls	Requirement 28
(d)	Indicator lights	Requirement 50
(e)	Relays	Requirement 57
(f)	Resistors	Requirement 33
(g)	Switches	Requirement 58
(h)	Transformers, inductors	Requirement 14

(i) Contractors shall be in accordance with MIL-C-22896

3.5.1.2.1 Flasher assembly capacitors.- All flash capacitors shall be rated 25 percent above operating voltage and shall be designed for the intended application. They shall have a life expectancy of at least 1 year of continuous duty at a normal working voltage.

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3.5.1.3 Fuses.- Fuses shall be provided on the ac supply lines to protect the power supplies from overloading. Fuses and fuseholders shall be in accordance with MIL-STD-454, requirement 39, with limitations and additional requirements specified below.

(a) Fuseholders shall be extractor, indicating type and shall be mounted inside the front panels of the cabinets.

(b) All fuse positions shall be marked with the rated current capacity of the fuse to be employed therein. The marking shall be on the insertion side so as to be visible when replacing fuses.

(c) Fuses shall be designed for quick removal and replacement.

Two spare fuses shall be provided for each type of fuse used in the ALSF-2/SSALR equipment.

3.5.1.4 Microelectronic devices.- Only Class B product assurance level devices in accordance with MIL-M-38510 shall be used. All microelectronic devices shall be mounted by soldering techniques in accordance with MIL-STD-454, Requirement 5. The packaging style for microelectronic devices shall be selected from table XV. All devices shall be hermetically sealed; plastic encapsulation shall not be used.

3.5.1.5 Semiconductor devices.- Semiconductor devices, except integrated circuits, shall be as specified in FAA-C-2100, paragraph 3.5.5.20.

Table XV. Packaging Reference Selection

Packaging Preference Category	Selection Criteria
1 (Dual In-line)	Shall be used wherever required functions can be accomplished in accordance with good engineering practices. No approval is required for use of this category.
2 (Modified TO-5)	Shall be used only in those cases where selection of a suitable device from Category l is not possible. Selection from Category 2 does not require prior approval of the Contracting Officer; however, the contractor shall notify the Government in writing of the selection.

3 (Flat Pack)	Requires written Government approval before adoption for use in equipment. In requesting such approval, the contractor must present engineering proof satisfactory to the Government, that selection from Category 3, rather than from Category 1 and Category 2, is necessary and will be to the advantage of the Government.

3.5.1.6 Fastener hardware.- Fastener hardware shall conform to the requirements of FAA-G-2100, paragraph 3.5.10.

3.5.1.7 Interlock switches.- Interlock switches shall be incorporated in the flasher assembly so that opening the unit shall (a) disconnect all incoming power (except GFI receptacle) and (b) discharge all high voltage circuits. This requirement shall apply even if components which normally draw current from the high voltage circuits are removed. In addition, the design shall provide for permanently connected bleeder resistors to discharge the flasher to a maximum value of 50 volts within 1 minute after power is removed via the interlock switch or power ON/OFF switch. Means shall be provided to enable the interlock switch to be cheated with the door in the open position. Energized terminals on interlock switches shall be insulated with heat shrinkable tubing.

3.5.1.8 Terminal blocks.- Terminal blocks shall be the enclosed base type terminal blocks using pressure plate type terminal connectors and shall meet the requirements of FAA-G-2100, paragraph 3.5.5.15.4. Terminal blocks shall have 10 percent unused terminals, but not less than two extra terminals per terminal block. Power terminal blocks shall have a minimum of 6 inches (15.24 cm) clear space at the input and output terminals. Similarly, control terminal blocks shall have a minimum of 4 inches (10.16 cm) clear space.

3.5.1.9 Other parts.- Parts not otherwise specified shall be in accordance with industry standards. These parts, however, shall be first submitted to the Contracting Officer for approval.

3.5.2 Materials.- Materials shall be as specified herein. When materials are used for which no specification is provided, they shall be of commercial quality and suitable for the purpose.

3.5.2.1 Printed wiring boards (pwb).- All electronic components of the ALS system, except power devices, shall be mounted on printed wiring boards. Conformal coating of pwb's is required and shall be Type AR per MIL-I-46059.

3.5.2.2 Metals.- Metals shall withstand the mechanical stress involved and shall be inherently corrosion resistant, or suitably protected after fabrication, to prevent corrosion or oxidation under the service conditions. The use of dissimilar metals in contact with one another shall be avoided wherever practicable. However, if their use cannot be avoided, they shall be in accordance with MIL-STD-454, requirement 16. All sharp edges on all metal parts shall be filed. Where applicable, all exposed edges and corners shall be rounded to a minimum of .75 mm (.03 in) radius. Sharp edges and corners that present a personal safety hazard or potential damage to equipment during usage shall be protected or rounded to a minimum radius of 13 mm (1/2 in).

3.5.2.2.1 Ductile iron.- Heat-treated ductile iron, if used, shall have the proper tensile and yield strength to meet the requirements set forth herein. Particular attention shall be paid to the proper Brinell hardness and elongation of the material. Protection plating as specified in 3.5.3.2 shall be used on all cast and machined ductile iron surfaces.

3.5.2.2.2 Stainless steel.- type 18-8 stainless steel shall be used for all bolts, nuts, and washers not subject to high stress requirements. Bolts subject to direct stresses resulting from forces applied to the top surface of the Type II flasher light unit shall be high strength Type 410 stainless steel, heat-treated to Rockwell C-21 to C-23 (110,000 psi tensile strength), and given a black oxide coating per MIL-C-13924, Class 3, after heat treatment. At the Option of the contractor, stainless steel may be used for any purpose for which another material is not definitely specified elsewhere herein or elsewhere in the contract specifications, provided that all stainless steels are of the following types:

American Iron and Steel Institute (AISI) Type Numbers

301	305	316L
302	308	317
302B	309	321
303	310	322
304	314	322
304L	316	347

3.5.2.2.3 Aluminum.- Aluminum shall be in accordance with Federal Specifications QQ-A-200/9 and QQ-A-225. Aluminum alloy plate and sheet, aluminum alloy die castings, and aluminum alloy sand castings shall be in accordance with Federal Specifications QQ-A-250, QQ-A-591 and QQ-A-601, respectively. Aluminum alloy castings, if used, shall be impregnated in accordance with MIL-STD-276. All aluminum parts shall be anodized in accordance with MIL-A-8625.

3.5.3 Protective coatings.- Protective coatings used for prevention of corrosion shall be as specified herein.

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3.5.3.1 Anodizing.- Aluminum parts on the exterior of the Type II flasher light unit which would be exposed to continuous moisture, salt-laden atmosphere, or mechanical damage, shall be teflon penetrated, hardcoat anodized, and meet the requirements of MIL-A-8625, Type I or Type II, Class 1 or Class 2, as applicable.

3.5.3.2 Plating.- All iron and steel parts used outdoors shall be zinc or cadmium-plated in accordance with QQ-Z-325 or QQ-P-416.

3.5.4 Glass.- Glass used as an optical or structural part shall meet all requirements of this specification, which includes the requirements of MIL-C-7989 for Class B glass. Class C glass may be used if required for impact strength. The glass used shall be made of borosilicate glass having an average Young's Modules of 9.1 by 10 to the sixth power and a Poisson's ratio of 0.2, or equivalent. The glass shall be tempered to withstand thermal shock (3.6.2.8). Glass parts shall be supported in such a way that they will not be damaged by vibrations, shocks, or defection of any component part.

3.5.5 Gaskets.- Gaskets used in separable joints for cushioning and sealing purposes shall be capable of sustained operation at ambient temperatures of -55 C (-67 degrees F) to +70 degrees C (+158 degrees F). The gaskets shall be made of neoprene.

3.5.6 Adhesives.- Adhesives, if used, shall be in accordance with MIL-STD-454, requirement 23.

3.5.7 Processes.- All processes used in the assembly or manufacture of equipments used in this system shall be suitable for the intended purpose.

3.5.7.1 Brazing.- Brazing shall be in accordance with MIL-STD-454, requirement 59, except that electrical connections shall not be brazed.

3.5.7.2 Cabling.- Internal wiring practices shall be in accordance with MIL-STD-454, Requirement 69. Selection and application of cable and wire for interconnection between units shall be in accordance with MIL-STD-454, Requirement 71. All wire used in making circuit connections (other than RF) shall have a cross-section area to current ratio of not less than 500 circular mils per ampere.

(a) Electrical wire shall be in accordance with MIL-STD-454, Requirement 20.

(b) Coaxial radio frequency (RF) transmission cable shall be in accordance with MIL-STD-454, Requirement 65.

(c) Multiconductor cable shall be in accordance with MIL-STD-454, Requirement 66.

3.5.7.3 Cable breakout wires.- Each individual breakout wire lead which emerges from a cable shall be longer than necessary for its termination with approximately 1 inch (25 mm) of slack wire neatly formed adjacent to its termination.

3.5.7.4 Soldering.- Soldering shall be in accordance with FAA-G-2100 or better.

3.5.7.5 Lugs connected to screw terminals.- Where wires are connected to solderless or solder lugs which are clamped under screw terminals so as to be removable by loosening or removing the screws, not more than one wire shall be attached to each lug, so that each wire can be removed individually from the screw terminals. Not more than three lugs shall be attached to each screw terminal.

3.5.7.6 Cable connector wiring.- Not more than one wire shall be attached to each contact to each connector, except that two wires may be attached to a crimp-type contact. The two wires connected together shall not exceed the size of the connector pin.

3.5.7.7 Splices.- Wires and cables shall not be spliced.

3.5.7.8 Finishes.- Finishes for indoor enclosures shall be in accordance with FAA-G-2lOO paragraph 3.7.6.

3.5.7.9 Workmanship.- Workmanship shall be in accordance with MIL-STD-454, requirement 9.

3.6 Environmental requirements.- The equipment shall be designed for continuous operation under the environmental conditions specified in the following paragraphs. RMS equipment mounted indoors and outdoors shall meet the requirements of 3.6.1 and 3.6.2 respectively.

3.6.1 Indoor equipment.- Indoor equipment shall operate in the ambient conditions specified as environment II in Table III of FAA-G-2100, except that the relative humidity shall be 100 percent. Indoor equipments are identified in paragraphs 3.1.1(a), 3.1.1(b), 3.1.1(c), 3.1.1(d), indoor components of 3.1.1(o), 3.1.1(p), 3.1.1(q) and 3.1.1(r). All other equipments are to be considered outdoor equipment.

3.6.2 Outdoor equipment.- The equipments to be installed as part of the outdoor unattended facilities shall operate in the following environments:

3.6.2.1 Temperature.- An ambient temperature range from -55° C (-67° F) to +70° C (158° F)

3.6.2.2 Altitude.- Sea level to 10,000 feet (3,048 meters) mean sea level (msl).

3.6.2.3 Humidity.- Up to 95 percent relative humidity from sea

level to 10,000 feet (3,048 meters) (msl) and +70° C (+158° F) ambient temperature.

3.6.2.4 Sand and dust.- Exposure to wind blown sand and dust particles as may be encountered in arid regions.

3.6.2.5 Salt fog.- Exposure to salt-laden atmosphere.

3.6.2.6 Rain.- Exposure to wind-blown rain.

3.6.2.7 Solar radiation (sunshine).- Exposure to sunshine with ambient temperature as stated in 3.6.2.1.

3.6.2.8 Temperature shock.- Exposure of exposed surfaces (including light windows) to sudden application of cold water when the lights reach stable temperatures. (See 4.4.3.1 and 4.4.9.5).

3.6.2.9 Vibration.- The flasher light units types I and II shall be capable of withstanding vibrations in the frequency range of 10 to 2,000 hertz in accordance with NEMA Standard FA1-3.01.

3.6.3 Impact.- Semiflush flasher light units shall be capable of sustaining impact loads (see 4.4.9.3).

3.6.4 Hydraulic impact.- The inpavement flasher light units shall be designed to withstand, without damage, hydraulic pressures which may be formed by aircraft tires moving at high speeds on the fixture during operations in wet weather.

3.6.5 Snowplow impact.- The semiflush flasher light units shall be designed to withstand, without functional damage, impact by steel blade of snowplows at speeds up to 30 miles per hour (mph) (48.2 kilometer per hour (kmph) (see 4.4.9.7).

3.6.6 Transient suppression.- The equipment shall be designed to withstand transient increases superimposed on the 120/240 V ac (rms) power line input that reach a peak value of 500 V for as long as 50 milliseconds. The indoor equipment shall be designed to withstand lightning transients, applied at the equipment input and output terminals that interface with outdoor equipment. These lightning transients shall be characterized as 8 by 20 microseconds current surges of 3,000 amperes with the subsequent power-follow current, and 1.2 by 50 microseconds voltage surges of 6 Kv. The current and voltage waveforms are defined in ANSI standard C37.90. In addition, the outdoor equipment shall be designed to withstand lightning transients superimposed on the ac input and output power lines (excluding remote maintenance monitoring) characterized as 8 by 20 microseconds current surge of 5,000 amperes with the subsequent power-follow current and voltage surge of 10 Kv/microsecond minimum. The equipment shall resume normal operation automatically when an interruption or a shutdown is experienced due to a transient. Equipment performance and operational functions shall be unimpaired by the above transients

after each type of transient is imposed a minimum of 5 times to each ac input and output terminal while the equipment is energized. Lightning protectors shall be provided in accordance with FAA-STD-019 and FAA-STD-020 and the NFPA #78, Lightning Protection Code for all power lines at their first point of entry into the equipment, and at their exit from the equipment. The return terminal of the lightning protector shall be connected to earth ground via a separate dedicated conductor no less than a No. 6 American Wire Gage (AWG).

3.6.7 Interference requirements.- Conducted interference levels on the power leads, control leads, signal leads, and interconnecting cables between parts, shall not exceed the limits for CEO3, as defined in MIL-STD-461 (equipment class A3). Similarly, radiated narrowband and broadband interference levels shall not exceed the limits for REO2 of MIL-STD-461 over the frequency range from 14 kilohertz (kHz) to 10 gigahertz (GHz) at a distance of 20 feet (6.1 meters).

3.7 Instruction books.- Draft manuscript and camera ready reproducible copies of the instruction books in accordance with the requirements of specification FAA-D-2494 shall be furnished. The Government will reproduce instruction books and furnish copies to the contractor for shipment with the equipment. Two instruction books shall be included with each set of equipment comprising a system.

3.8 Reliability

3.8.1 Reliability design criteria.- The following equipment shall meet the listed reliability requirements:

	Equipment	Specified MTBF
(a)	480 Volt Input Cabinet	2,500 hours
(b)	High voltage output cabinet	None specified
(c)	Constant current regulators	12,000 hours
(d)	Control and monitor system	2,800 hours
(e)	Flashing lights subsystem	2,500 hours
(f)	Remote Monitoring Subsystem	30,000 hours

3.8.2 Reliability program

3.8.2.1 Organization.- The head of the reliability management organization shall have the necessary authority, resources, and access to higher management to implement and enforce the requirements specified herein.

3.8.2.2 Subcontractor and supplier reliability program control.- Subcontractors and suppliers shall be bound by the same reliability requirements as the contractor and monitored and controlled in accordance with MIL-STD-785, Task 102.

3.8.2.3 Reliability predictions.- Reliability predictions shall be based on the proposed design and mathematics model of the system element for each mission profile and mode of operation. Predictions shall conform to the requirements for predictions in accordance with MIL-STD-785, Task 203 and the following:

(a) Apportion required system probability of mission success to each function.

(b) Determine the reliability of hardware items and other system elements executing or supporting each function.

(c) Reliability estimates and predictions shall be made relating to the mathematical model such as those contained in MIL-HDBK-217. Current estimates and predictions shall be made for each mission or mode of operation. Where other equipments (Government or contractor furnished) are to be integrated, data furnished by the Government on known or estimated values of reliability shall be used as applicable in the contractor's judgment.

(d) The reliability of the equipment shall be predicted based on the stresses experienced by the parts using the failure rate information contained in MIL-HDBK-217 and in the Nonelectronic Reliability Notebook, RADC-TR-75-22. No other source of part failure rates shall be used unless specifically approved by the procuring activity. The prediction techniques in the following paragraphs shall be implemented by the contractor.

3.8.2.3.1 Average stress prediction.- The reliability of the system shall be predicted using average part failure rates in conjunction with generalized part application assumptions. The prediction shall be submitted in accordance with the contract schedule.

3.8.2.3.2 Detailed stress prediction.- The reliability for the system shall be predicted based on failure rates determined from either measured or computed stress for each part used in the system. Detailed reliability stress analysis shall be performed in accordance with MIL-HDBK-217. The predictions shall be based upon the (maximum temperature rise) specified in the detailed specification. An initial stress analysis prediction shall be submitted 15 days prior to the Critical Design Review (CDR). The prediction shall be revised, as necessary, during the course of the system development and production effort to reflect any design changes and part substitutions.

3.8.2.4 Parts control task.- All reliability requirements placed upon the contractor are equally applicable to subcontractors/vendors. The reliability manager shall be responsible for assuring compliance and for assuring that the appropriate requirements are placed in subcontractor specifications.

3.8.2.5 Reliability development/growth testing.- The contractor shall implement a reliability development/growth testing program in accordance with MIL-STD-785, Task 302. The requirements of the Failure Reporting, Analysis, and Corrective Action System in accordance with MIL-STD-785, Tasks 104.1 and 104.2 shall be applied in the event of a problem that causes operation other than that prescribed in this specification.

3.8.2.6 System Integrity Demonstration.- The Contractor shall conduct a system integrity demonstration in accordance with paragraph 4.4.14. The demonstration shall verify that malfunction of the RMS does not affect the operation of the ALSF-2/SSALR.

3.9 Maintainability

3.9.1 Maintainability design criteria.- The following equipment shall meet the listed maintainability requirements:

	Equipment	MTTR	Maximum Repair Time
(a)	480 volt input cabinet	0.5 hours	8 hours
(b)	High voltage output cabinet	None specified	None specified
(c)	Constant current regulators	0.5 hours	8 hours

(d)	Control and monitor system	0.5 hours	8 hours
(e)	Flasher lights	0.5 hours	4 hours
(f)	Remote Monitoring	0.5 hours	4 hours

3.9.2 Maintainability program

3.9.2.1 Maintainability program management.- The contractor shall have one clearly identified organizational element which shall be responsible for planning, implementing, controlling, and reporting all maintainability tasks required by this specification.

3.9.2.2 Organization.- The head of the maintainability management organization shall have the necessary authority and resources and access to higher management to enable him to implement and enforce the requirements specified herein. The maintainability management organization may be part of the reliability management organization.

3.9.2.3 Maintainability predictions.- The contractor shall predict maintainability values for the system/equipment in accordance with MIL-STD-470, Task 203. The prediction technique specified shall be used. The prediction technique shall estimate quantitatively the maintainability system/equipment parameter value for the planned design configuration. The quantitative estimates shall be used to judge the adequacy of the proposed design to meet the maintainability quantitative requirements and identify design features requiring corrective action.

3.9.2.4 Maintainability Demonstration.- The contractor shall conduct a maintainability demonstration on the production model in accordance with paragraph 4.4.15.

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3.10 Configuration management.- The contractor shall implement a configuration management program in accordance with FAA-STD-021. As a minimum, the contractor shall submit, within 30 days after receipt of contract, a configuration management plan for review and approval by the Government.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General.- The contractor shall provide and maintain a quality control program which fulfills the requirements of FAA-STD-013, Quality Control Programs. Unless otherwise specified in this specification or in the contract, all tests and inspections to determine compliance with the requirements of the contract specifications shall be made by the contractor or his subcontractor and shall be subject to Government inspection. The term "Government inspection" as used in this specification, means that an FAA representative will witness the contractor's or subcontractor's testing and inspection, and will carry out such visual and other inspections and tests required by the contract specification. The test data must demonstrate that the equipment meets contract requirements, and shall include the statement, "This certifies that this unit fully meets all technical requirements of the contract," and be dated and signed by a responsible official of the contractor or testing agency. Certified test data shall be furnished by the contractor or testing agency to the Contracting Officer. Shipment shall not be made until the contractor receives written Government approval of the test data.

4.1.1 System component quality assurance.- All subsystems and components procured under this specification shall meet the Quality Assurance and Testing provisions (section 4) of their respective specifications.

4.1.2 Data certification.- Prior to the system inspection, the contractor shall submit to the FAA representative certified data covering shipment of each item from the supplier's plant to that of the prime contractor. Each document shall carry the vendor's certification that each item furnished meets the requirements of this specification. The certification shall be traceable to the manufacturer's quantitative test data pertaining to the specific subsystem or component. Vendor certification does not constitute FAA acceptance of any part of unit of equipment provided under this specification or release that part of unit from acceptance testing by the contractor.

4.1.3 System,subsystem, and equipment testing requirements.- The contractor shall furnish a master test plan (MTP) in accordance with FAA-STD-024 to the Government for review and approval. The MTP and its associated test plans must identify the testing and testing methods proposed by the contractor to demonstrate that the equipment to be furnished complies with all of the requirements of this specification and as a minimum, includes the tests specified in the Verification Requirements Traceability Matrix (VRTM) contained in Table XVIII and those requirements

specified in Qualification and Production Tests contained in Table XVI.

4.1.4 VRTM definitions.- The following definitions are provided to clarify terms in the VRTM. This information is to be used by the contractor for the preparation of test and evaluation procedures defined in paragraphs 4.1.3. and 4.4.

(a) Test.- Test is a method of verifying performance requirements of system/subsystem/equipment items by quantitative measurement of controlled functional or environmental stimuli. These dynamic measurements are made using standardized laboratory equipment, procedures or other services, then analyzed to determine their compliance.

(b) Demonstration.- Demonstration is a method of verifying system/subsystem/equipment item requirements by observing their functional response to dynamic exercising. This qualitative evaluation is made using criteria from technical procedure, including measurements. Acceptance is based on pass/fail results.

(c) Inspection.- Inspection is a method of verifying acceptability of hardware, software, or technical documentation by determining compliance to requirements by visual examination of condition or content. The criteria for examination is obtained from standards, inventories, or conformance features. The success criteria is pass/fail.

(d) Analysis.- Analysis is a method of verifying requirements for hardware or software design by comparing it mathematically (modeling) or otherwise with known scientific and technical principles, procedures, or practices. Results of the comparison are used to estimate the capability of the design to meet system and mission requirements. Justification for analysis includes impractical or impossible access to measurements, determining statistical probabilities and percentiles; and as proposed by the VRTM.

4.2 Notification of readiness for inspection.- After receipt of approval of the master test plan, test procedures (4.1) and test data forms (FAA-STD-013), the contractor shall notify the Contracting Officer in writing that he is ready for Government inspection. Such notification shall be given in time to reach the Contracting Officer not less than 5 work days before the contractor desires inspection to start. All testing described herein shall be performed at the contractor's expense at the contractor's facility or at an FAA approved location.

4.3. Test methods.- Testing of the system shall be performed as follows:

4.3.1 Design qualification test.- The first unit of production is designated as the production model. The production model shall be subjected to the tests specified in tables XVI and XVIII. The production model(s) after passing the design qualification tests, shall be deliverable items under the contract.

4.3.2 Production unit tests.- Testing of the production units shall start after acceptance of the production model. Tests on production units shall be as specified in Table XVI and Table XVIII.

4.3.3 Operational testing.- For all testing which requires the use of the entire system, including 150 hour functional and 24 hour functional tests, the components which will be part of a particular system provided under this specification shall be connected together in accordance with FAA Drawings D-6238-22 and D-6238-23. The components shall include the Remote Monitoring Subsystem. Test lamps, distribution transformers, and transmission lines shall be provided to produce a configuration equivalent to an operational ALS as shown on FAA Drawing D-6238-4. Test lamps shall be used in all 5 loops. Test lamps shall also be used when testing the flashing light subsystem. A method shall also be provided to simulate at least 10 failed lamps (either open or shorted in any combination) in any one of the 5 current loops and at least 3 failed lamps (open) in the flashing light circuit for the purpose of testing the monitor circuitry. At least 10 percent of any current loop simulation shall be composed of actual ALS isolation transformers.

4.4 Tests

4.4.1 Visual inspection.- The systems shall be visually inspected for workmanship, safety, fabrication, finish, painting, and compliance of selected parts.

4.4.2 Twenty-four hour test.- Each deliverable system (including the remote monitoring subsystem) shall be connected together in accordance with paragraph 4.3.3 and tested as a system for a minimum of 24 hours (at an ambient temperature of 30 degrees C ± 10 degrees C (86 degrees ± 18 degrees F). Each functional control, brightness selector, mode control, status indicator, alarm circuit, monitor channel, and timing and triggering shall be exercised to demonstrate full compliance with the specification. Any erratic switching, loss of control, or operation outside of the prescribed limits shall be cause for rejection. Each function shall be exercised each 4 hours (at least 6 times) during the 24 hour test period. During this test, a transfer switch shall switch all incoming power to the ALSF-2 system to demonstrate a power transfer from engine generator to commercial power. At least 20 transfers shall be made at brightness B5. One power interruption of two minutes shall be used to demonstrate compliance with paragraph 3.4.1. A power transfer shall be performed at each brightness step.

4.4.3 Environmental tests.- Environmental tests shall be as specified herein.

4.4.3.1 Temperature.- Temperature testing shall be performed to demonstrate compliance to the requirements of 3.6. Testing shall be as specified by MIL-STD-810, Procedure I, Method 502.3, for cold temperatures, and Procedure II, Method 501.3, for high temperatures.

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4.4.3.2 Humidity.- Humidity testing in accordance with MIL-STD-810, Procedure I, Method 507.3, shall be performed to demonstrate compliance with the humidity requirements of 3.6.

4.4.3.3 Altitude.- Altitude testing in accordance with MIL-STD-810, Procedure I, Method 500.3, shall be perform to demonstrate compliance with the altitude requirement of 3.6.

4.4.3.4 Transient suppression test.- The system shall be connected as described in 4.3.3. A surge generator shall be set to superimpose transient levels described in 3.6.6, on the energized ac power line and control signals output line (excluding remote maintenance monitoring output terminals) of the equipments that interface with outdoor equipment. These levels shall be verified by open-circuit and short-circuit tests prior to testing the equipment. The surge generator, with a preset transient control level, shall then be connected to the input power line and output line of the energized equipment. A minimum of five test surges for each transient control level, shall be superimposed on the power and output lines of the energized equipment. Test surges shall be applied between each input terminal and ground and each output terminal and ground, as well as between the input terminals of a circuit pair and the output terminals of a circuit pair. At the conclusion of the test, the equipment shall be tested in accordance with 4.4.2.

4.4.3.5 Rain test.- The test shall be in accordance with Procedure I, Method 506.3, of MIL-STD-810.

4.4.3.6 Salt fog test.- The test shall be in accordance with Procedure I, Method 509.3, of MIL-STD-810, for not less than 168 hours except that the relative humidity shall be up to 95 percent. Salt buildup as a result of the test may be removed with tap water. Deterioration of any part preventing the fixture from meeting function, service, and maintenance requirements shall be cause for rejection.

4.4.3.7 Interference test.- The equipment shall be connected as described in 4.3.3 and tested to verify conformance with the interference requirements of 3.6. Measurement of the electromagnetic emissions shall be in accordance with test method CE03 of MIL-STD-462. Measurement of the radiated emission shall be in accordance with test method RE02 of MIL-STD-462.

4.4.3.8 Sand and dust test.- The test shall be in accordance with Procedures I and II, Method 510.3, of MIL-STD-810. Rotate the equipment 120 degrees two times. Air velocity shall be 2,500 ±500 feet (762 ±152 meters) per minute.

4.4.3.9 Solar radiation (sunshine) test.- The test shall be conducted in accordance with Procedures I and II, Method 505.3, of MIL-STD-810. The equipment shall be operated for 1 hour during the third cycle when the test item has reached its peak temperature.

4.4.4 Insulation resistance test.- Insulation resistance shall be tested to demonstrate compliance with the requirements of 3.4.13. Surge withstand capacity (SWC) testing is not required.

4.4.5 150-hour test.- The system shall be connected together in accordance with 4.3.3 and tested as a system for a minimum of 150 hours at an ambient temperature of 30 degrees ± 10 degrees C (86 degrees ± 18 degrees F). Each functional control, brightness selector, mode control, status indicator, alarm circuit, and monitor channel shall be exercised to demonstrate full compliance with the specification. Any erratic switching, loss of control, or operation outside of the prescribed limits shall be cause for rejection. Operation of the monitor subsystem for each loop shall be tested with the shorting devices installed in the PAR-56 lampholders. The following steps shall be performed during the test period:

(a) Each function (brightness and mode changes) shall be exercised at least once each hour during the test period.

(b) Each brightness level settings (B1 through B5) shall be activated for 3.5 minutes in each mode (ALSF/SSALR) every 10 hours.

(c) The system shall operate on each brightness level setting (B1 through B5) and each mode (ALSF/SSALR) for 10 hours, except for the hourly interruption mentioned in step (a).

(d) The proper operation of the alarm circuit shall be demonstrated by removing 10 lamps in each loop of the ALSF and SSALR circuits, and 3 lamps in the flashing light circuit. The test shall be done at the end of the 10 hour test (step (c)), and at the conclusion of the 150 hour test.

4.4.5.1 RMS operational test.- The ALSF-2/SSALR RMS functional requirements shall be tested using an MPS simulator. The synchronous MPS communications simulator, hereinafter referred to as the simulator, provides a means of simulating the communication functions, as defined below, of a single channel of an MPS. The data communications protocol between the simulator and RMS is as defined by the Remote Maintenance Monitoring Subsystem (RMMS) Interface Control Document, NAS-MD-790. The simulator is designed to run on an IBM or an IBM-compatible personal computer (PC) with MS-DOS release 2.0 or higher and a minimum of 320K bytes of random access memory (RAM) with government furnished software that simulates an MPS interface to the RMS. The simulator hardware shall be provided by the contractor. The PC must also have an IBM synchronous data link control (SDLC) communications adapter card, an external clock with a baud rate of 2400 at RS-232 level, and a parallel printer port.

4.4.6 Regulator tests.- The tests as specified herein shall be performed on the regulators.

4.4.6.1 Regulation.- The regulators shall be tested to demonstrate full compliance with the requirements of 3.2.3.2. For production units, regulation need only be tested at nominal input voltage. Regulation testing shall also demonstrate compliance with the local and remote control and monitor requirements of 3.2.3.12 and 3.2.3.13.

4.4.6.2 Temperature rise.- Temperature rise testing as required by 3.2.3.5 shall be performed using the resistance method.

4.4.6.3 Efficiency.- The regulator shall be tested to demonstrate the efficiency requirement of paragraph 3.2.3.3.

4.4.6.4 Power factor.- The regulator shall be tested to demonstrate the power factor requirements of paragraph 3.2.3.4.

4.4.6.5 Open circuit, over current, and surge protection.- Testing shall be provided to demonstrate compliance with the requirements of 3.2.3.7, 3.2.3.8, 3.2.3.9, and 3.2.3.14.

4.4.7 Control functions tests.- Testing shall be provide for the control subsystem as required herein.

4.4.7.1 Control testing.- A test shall be provided which exercises each control on both substation control panel and the remote control panel, reads the status of each indicator, verifies proper timing relation, and demonstrates compliance with the functional requirements of 3.2.4.4.

4.4.7.2 Data transmission.- The output level and carrier detect specifications of the data transmission link shall be verified by testing. The transmission line loss may be simulated by an attenuator pad in lieu of having an actual 10 mile (16.1 km) transmission line. The mark and space trans-mitting frequencies shall be verified.

4.4.8 Operational monitor tests.- Tests shall be performed on the operational monitor subsystem as specified herein.

4.4.8.1 Operational monitor operation.- The ability of the operational monitor to detect the number of failed lamps (either open or shorted) in each loop within one lamp shall be verified by tests. The ability shall be tested in all brightness levels and in both modes (ALSF-2/SSALR). The system shall be able to detect from 1 to 10 failed lamps in ALSF-2 and from 1 to 5 in SSALR.

4.4.8.2 Operational monitor calibration.- Procedures shall be provided and demonstrated to verify that calibration of the operational monitor subsystem can be accomplished by one person within 30 minutes.

4.4.9 Flasher assembly tests.- The tests as specified herein shall be performed on the flasher assembly.

4.4.9.1 Photometric tests.- Photometric and like tests shall be conducted on the production model to determine compliance with the requirements as specified. Photometric tests shall be conducted in accordance with FAA-E-1100, Photometric Test Procedures for Condenser Discharge Lamps. A flash lamp of the type used in this system shall be calibrated by the National Bureau of Standards and used as a calibration standard for the tests. The photometric tests may be conducted with a Module 580-20 Radiometer System as manufactured by EG&G. Test results shall include a graph showing the effective isocandela curve for each intensity setting and oscilloscope photographs of the pulse shape and deviation. Production units shall be checked at the beam center, +15 degrees horizontally from the beam axis and ±5 degrees vertically from the beam axis. Photometric tests shall be conducted on the semiflush production model before and after the static load, impact, vibration, and snowplow tests to determine the capability of the semiflush approach light assembly to comply with the requirements as specified when submitted to the tests.

4.4.9.2 Static load tests.- The semiflush production model shall be subjected to the load tests of 4.4.9.2.1 and 4.4.9.2.2 and show no evidence of cracking or breaking of the top assembly or of any other component which would cause leaks. There shall be no permanent distortion to cause shifting of the light output.

4.4.9.2.1 Distributed load test.- The semiflush production model shall be mounted in a test machine on a supporting ring equivalent to the LB-4 light assembly through a rubber pad having a Shore A hardness of 55 to 65. The rubber pad shall have a diameter equal to the diameter of the top assembly and thickness of 1-1/2 inches (38.1 mm). No filling material or support shall be used in the light output window cavity. A load of 160,000 pounds (72,574.7 kilograms (kg)) shall be applied to the rubber pad through a flat steel plate at least 1-inch (25.4 mm) thick and a diameter equal to the top assembly. The load shall be applied at the rate of 20,000 pounds (9,071.8 kg) per minute and held at the computed load for 5 minutes.

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4.4.9.2.2 Concentrated load test.- The semiflush production model shall be mounted on a light base flange as in paragraph 4.4.9.2.1 above. A compression load shall be applied to the center of the top surface of the light assembly through a 6 inch (152 mm) diameter by 1-1/4 inch (31.1 mm) steel plate. The steel plate will be directly in contact with the light assembly. A pad between the steel plate and the light assembly will not be permitted. The load shall be applied at a rate of 20,000 pounds (9,071.8 kg) per minute to a total of 250,000 pounds (113,398 kg). The total load shall be held for 5 minutes.

4.4.9.3 Impact test.- The semiflush light unit, complete with all parts shall be installed in an LB-4 light base imbedded in concrete. A 5 pound (2.26 kg) ball shall be dropped from a height of 6 feet (1.82 meters) on the top of the light unit at various locations. Impact drops at not less than six different locations, including one directly over the light output window, shall be made. The ball shall be steel and case hardened to Rockwell C50-C53. There shall be no cracking or breaking of parts which could cause leaks or shift the light output pattern.

4.4.9.4 Window loading test.- The semiflush production model light output window shall be subjected to a uniformly distributed load of 500 pounds per square inch (psi) of the area of the window opening. Either a static load or a hydrostatic pressure test may be used. The static load, if used, shall be applied through a 1-inch (25.4 mm) thick rubber pad having a Shore A hardness of 55 to 65. A contour of the rubber block shall be similar to but not larger than the exposed glass window. The test load shall be applied to the rubber pad and window through a steel plate 1-inch thick with a shape similar to but not larger than the rubber pad. The load shall be applied perpendicular to the exposed window face at a rate of 1,000 pounds (453.5 kg) per minute and the total load maintained for not less than 2 minutes. The hydrostatic pressure test, when used, shall require a compartment to enclose the window and a section of the top of the light. The compartment shall have sufficient height to contain not less than 1-inch (25.4 mm) depth of the test fluid above any enclosed part of the light unit. The test pressure shall be applied at a rate not to exceed 200 psi per minute and the total pressure shall be maintained for not less than 2 minutes. The window shall not crack or be permanently displaced or damaged by the test.

4.4.9.5 Thermal shock test.- The production model shall be installed as in normal use and operated at maximum intensity until the temperatures have stabilized. At least three gallons of water at a temperature of 0° ± 5° C (32° ± 9° F) shall be sprayed on the top surface. There shall be no cracking of glass or metal.

4.4.9.6 Vibration test.- The Type I and Type II flashers shall be vibration tested as described below to meet the requirements of 3.6.2.9. The Type II semiflush production model light unit, complete with all parts and lamp, shall be installed on an LB-4 lightbase and mounted securely on the test machine in a manner to simulate installed conditions.

(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 light beam axis.
(3) Horizontally, at right angles to the light beam axis.

(b) Frequencies.- The test assembly shall be vibrated through a frequency range of 10 to 2,000 cycles per second, in each plane, until the accelerations shown in Table XVII are reached. Duration of each sweep shall be 10 minutes. Electrical continuity through the lamp shall be continuously monitored under full load conditions. If the gas tube or lamp envelope fails at any point in the range of frequencies, the test shall be continued and completed on the fixture alone. Then a new lamp shall be installed and the fixture assembly shall again be vibrated in three planes through the frequencies of 55 to 2,000 cycles at 3 gravities (g). Failure to meet these requirements shall be cause for rejection of the fixture or the lamp mounting method or both.

After the vibration test, the fixture shall be thoroughly examined for mechanical failure of any component, loosening of any part, cracked or broken seals, continuity of electrical circuits, possible damage to the lamp envelope, supports, etc.

4.4.9.7 Snow plow test.- The Type II semiflush light unit shall be installed in pavement and traversed five times, at speeds up to 30 mph, by a Walters snow fighter, Model FBCS, or similar vehicle, with its blade set to scrape the pavement. The blade shall pass over the unit from different directions five times. There shall be no damage which would render the fixture unfit for service.

4.4.9.8 Leakage test.- This test shall be conducted only on the Type II semiflush production model after successfully passing the vibration test, load tests, and impact test. The optical assembly shall be submerged in water at least 3 inches (76.2 mm) below the surface and subjected to an internal air pressure of 10 psi and maintained for a period of 10 minutes. There shall be no evidence of leakage. Leakage tests on production units may be accomplished by using a mass spectrometer, freon leak detector, or other acceptable leak checking method.

4.4.9.9 Aiming device test.- The contractor shall provide an aiming platform for mounting the PAR-56 lampholder assembly and the flasher remote optical head to test each remote aiming device. The platform shall be calibrated to the some tolerances specified for the aiming devices and shall permit verification of the angular readings taken from the mounted aiming devices from 0° to 25° in 2° increments.

4.4.10 Flasher tester operational test.- The test shall demonstrate the operation of all the test functions provided in the flasher tester (3.2.5.5). The test shall show that the flasher tester is calibrated.

4.4.11 Site spare parts test.- Spare parts shall be visually inspected and placed in the appropriate equipment units. The equipment units shall be connected together in accordance with 4.3.3 and tested as described in 4.4.2.

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Table XVII. Vibration Test Data

Acceleration in G's	Frequency Hertz
0.020 inch double amplitude	10-70
5	70-200
10	200-500
15	500-2,000

4.4.12 Frequency test.- The ATCT to substation link (down-link) and the substation to tower link (up-link) frequencies shall be measured to verify conformance with the requirements of 3.2.4.4.3.1.

4.4.13 Meter calibration.- The accuracy of all voltage and current meters on the system shall be verified by test data or certified calibration stickers. Data obtained by comparison to another instrument that has a current calibration, traceable back to a secondary standard, shall be acceptable. The reference instrument shall be at least 5 times more accurate than the instrument being verified.

4.4.14 System integrity demonstration.- The Contractor shall demonstrate that the failsafe provisions of the ALSF-2/SSALR RMS equipment comply with the requirements of paragraph 3.4.15.7.2 of this specification.

4.4.15 Maintainability demonstration.- The contractor shall perform a maintainability demonstration in accordance with MIL-STD-470, Task 301 on the first unit of production (first article). The tests shall be conducted to verify all quantitative maintenance values required by this specification. Maintenance task sampling shall be in accordance with Appendix A of MIL-STD-471. Accept/reject criteria shall be based on MIL-STD-471, Table 2, Test Method 8.

4.5 Test instruments.- The manufacturer or the testing laboratory performing preproduction tests shall provide adequate instrumentation for these tests. All instruments shall have calibration labels indicating that the instruments have been calibrated by a reliable laboratory within a period of 6 months prior to the beginning of tests on the flasher equipments. Oscilloscopes and photometric equipment shall be calibrated prior to performing the first test, and if necessary, every 3 months after completion of the first test. Indicating instruments, voltmeters, and ammeters shall be of the 1/2 of 1 percent classification or better. Alternating current instruments shall be true types. Temperature sensing elements shall be thermocouples. Each thermocouple shall be pretested by inserting it in a chamber of known temperature. The thermocouples shall be installed at points determined by the FAA representative.The thermocouples shall be secured in place with high temperature

cement manufactured for this purpose (Sauereisen cement or equal).

4.6 Test performance.- All tests described above shall be performed at the contractor's expense at the contractor's facility or at an FAA approved independent testing laboratory.

5. PREPARATION FOR DELIVERY

5.1 General.- All components that form a part of a particular system and are tested together shall be shipped together. Each system shall be prepared for domestic shipment in accordance with the following subparagraphs:

5.1.1 Packaging.- Preservation and Packaging shall be in accordance with Specification MIL-E-17555, Level A, for equipments of this classification. All loose items shall be securely fastened prior to shipment.

5.1.2 Packing.- Packing shall be in accordance with specification MIL-E-17555, Level B.

5.1.3 Marking.- All shipments and packages shall be durably and legibly marked with the following instructions:

Quantity_____
Type_____
Style_____
Specification Number_____
Contract Number_____
National Stock Number_____
Manufacturing Name or Trademark_____
Serial Number_____
Gross Weight of the Container_____

Each package and/or shipping container shall be marked with bar codes in accordance with MIL-STD-129.

6. Note.- Deliverable items such as ALSF-2/SSALR equipment, spare parts, documentation, software, services, reviews, audits, etc. are to be called out in the contract schedule.

Table Xb. ALSF-2/SSALR Certification Parameters

Service	Certification Parameters	Standard	Actual	Initial Tolerance	Operating Tolerance
1. Light plane	Light bar lamps illuminated	All lamps on	(value)	Same as standard	27 random lamps and flashers out
2. Light intensity	Vertical angular alignment	Locally established vertical angle of the lighted beam axis of light. All flashers aimed at 6° or as installed	N/A at RMS	Standard ±1°	Standard ±2°
	Horizontal angular alignment	Parallel to centerline of runway	N/A at RMS	Standard ±1°	Standard ±2°
	Regulator output				
	step 1	8.5A	(value)	±0.2A	±0.2A
	step 2	10.3A	(value)	±0.3A	±0.3A
	step 3	12.4A	(value)	±0.3A	±0.3A
	step 4	15.8A	(value)	±0.4A	±0.4A
	step 5	20.0A	(value)	+0.0A, -0.4A	+0.0A, -0.4A

Table Xb. ALSF-2/SSALR Certification Parameters (Continued)

Service	Certification Parameters	Standard	Actual	Initial Tolerance	Operating Tolerance
3. Brightness control capability	Brightness step changing time: Change time from step 1 to step 2 (from initial turn on)	See instruction book	(value)	Same as standard	Same as standard
	Change time between steps (after initial turn on)	No delay	(value)	Same as standard	Same as standard
4. Identify threshold	ALSF-2 Threshold bar	All lamps on	(value)	Same as standard	< 4 adjacent lamps out; or < 9 random lamps out.
	Green filters	All in place	Filter status N/A at RMS	Same as standard	Same as standard
	SSALR Threshold bar	All lamps on	(value)	Same as standard	< 4 lamps out
	Green filters	All in place	Filter status N/A at RMS	Same as standard	Same as standard

Table Xb. ALSF-2/SSALR Certification Parameters (Continued)

Service	Certification Parameters	Standard	Actual	Initial Tolerance	Operating Tolerance
5. Identify 500 feet from threshold	500 foot bar	All lamps on	(value)	Same as standard	< 4 lamps out
6. Identify area from threshold to 1000 foot bar	Side row bar	All lamps on	(value)	Same as standard	< 2 consecutive light bars out; or <10 lamps out random
	Red filters	All in place	Filter status N/A at RMS	Same as standard	Same as standard
7. Identify 1000 feet from threshold	1000 foot bar	All lamps on	(value)	Same as standard	< 4 lamps out
8. Identify approach path	Sequenced flashing lights operation ALSF-2	All lamps on	(value)	Same as standard	< 2 flashers out consecutive; or 2 out random

Table Xb. ALSF-2/SSALR Certification Parameters (Continued)

Service	Certification Parameters	Standard	Actual	Initial Tolerance	Operating Tolerance
8. Identify approach path (cont'd)	Sequenced flashing lights operation SSALR	All lamps on	(value)	Same as standard	1 flasher out
	Flashing rate. ALSF-2/SSALR	120 per minute	(value)	±2 per minute	Same as standard
9. Visibility	Obstructions	No obstruction	N/A at RMS	Same as standard	Same as standard

10. Monitoring: All monitored parameters not in ALARM condition.

NORMAL CERTIFICATION INTERVAL: Monthly
MAXIMUM CERTIFICATION INTERVAL: 90 days
PERSON RESPONSIBLE FOR CERTIFICATION: Maintenance person at lighted navigational aid.
CERTIFICATION ENTRY IN FACILITY MAINTENANCE LOG: ALSF-2/SSALR certified.
CERTIFICATION ENTRY (WITH EXCEPTION)
IN FACILITY MAINTENANCE LOG: ALSF-2/SSALR certified except:

1. ALSF-2 Out of Tolerance/Limit
2. Flasher Out of Tolerance/Limit
3. Monitor Out of Tolerance/Limit
4. Light Bar (Number) Out of Tolerance/Limit

Table XVI. Qualification and Production Tests

Equipment (test)	480 Volt Input & High Voltage Output Cabinets	Regulator	Monitor and Control	Remote Monitor Subsystem	Flasher Assembly Type I/II	Aiming Device/ Flasher Tester
Visual (4.4.1)	X*	X*	X*	X*	X*	X*
Twenty-four hour (4.4.2)	*	*	*	*	*	
Temperature (4.4.3.1)	X	X		X	X	
Humidity (4.4.3.2)	X	X	X	X	X	
Altitude (4.4.3.3)	X	X	X	X	X	
Transient Suppression (4.4.3.4)	X	X	X	X	X	
Rain (4.4.3.5)					X	
Salt fog (4.4.3.6)					X	X (Aiming Device only)

X = Design qualification tests (production model)

* = Production unit tests.

Table XVI. Qualification and Production Tests

Equipment (test)	480 Volt Input & High Voltage Output Cabinets	Regulator	Monitor and Control	Remote Monitor Subsystem	Flasher Assembly Type I/II	Aiming Device/ Flasher Tester
Interference (4.4.3.7)		X	X	X	X	
Sand and dust (4.4.3.8)					X	
Solar radiation (4.4.3.9)					X	
Insulation resistance (4.4.4)	X*	X*				
150 hour test (4.4.5)	X	X	X	X	X	
Regulation (4.4.2.1)		X*				
Temperature (4.4.6.2)		X				
Efficiency (4.4.6.3)		X				

X = Design qualification tests (production model)

* = Production unit tests.

Table XVI. Qualification and Production Tests

Equipment (test)	480 Volt Input & High Voltage Output Cabinets	Regulator	Monitor and Control	Remote Monitor Subsystem	Flasher Assembly Type I/II	Aiming Device/ Flasher Tester
Power Factor (4.4.6.4)		X				
Open circuit, over current, and surge protection (4.4.6.5)		X*				
Control functions (4.4.7.1)			X*			
Data transmissions (4.4.7.2)			X*			
Monitor calibration (4.4.8.2)			X*			
Photometric (4.4.9.1)					X*	
Static load (4.4.9.2)					X (Type II)	
Impact (4.4.9.3)					X (Type II)	

X = Design qualification tests (production model)

* = Production unit tests.

Table XVI. Qualification and Production Tests

Equipment (test)	480 Volt Input & High Voltage Output Cabinets	Regulator	Monitor and Control	Remote Monitor Subsystem	Flasher Assembly Type I/II	Aiming Device/ Flasher Tester
Window loading (4.4.9.4)					X (Type II)	
Thermal shock (4.4.9.5)					X	
Vibration (4.4.9.6)					X	
Snowplow (4.4.9.7)					X (Type II)	
Leakage (4.4.9.8)					X* (Type II)	
Aiming device (4.4.9.9)						X* (Aiming device)
Meter calibration (4.4.10)		X*	X*			
Flasher tester operational (4.4.10)						X* (Flasher tester)

X = Design qualification tests (production model)

* = Production unit tests.

Table XVI. Qualification and Production Tests

Equipment (test)	480 Volt Input & High Voltage Output Cabinets	Regulator	Monitor and Control	Remote Monitor Subsystem	Flasher Assembly Type I/II	Aiming Device/ Flasher Tester
Integrity demonstration (4.4.14)				X		
Maintainability demonstration (4.4.15)				X		
RMS operational test (4.4.5.1)				X		

X = Design qualification tests (production model)

* = Production unit tests.

TABLE XVIII
ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.1	480 V ac input cabinet					Lower level test requirements apply
3.2.1(a)	480 VAC, 4 wire, 60 Hz, ungrounded wye, 150KW primary input power	IA	I	X		
3.2.1(b)	Service entrance, NEC/OSHA	IA	I	X		
3.2.1(c)	Lightning protection					Lower level test requirements apply
3.2.1(d)	Potential and current transformers					Lower level test requirements apply
3.2.1(e)	Provide warning and safety provisions	IAT	D	X		
No number	Input cabinet provisions	IAT	D	X		
3.2.1.1	Reserved					
3.2.1.2	Reserved					

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	REMARKS
3.2.1.3	Disconnect switch	IAT	ID	X		
3.2.1.4	Instrument potential transformers	IA	I	X		
3.2.1.5	Instrument current transformers	IA	I	X		
3.2.2	High voltage output cabinet					Lower level test requirements apply
3.2.2(a)	Receive regulated power	IAT		X		
3.2.2(b)	Provide service exit	IA	I	X		
3.2.2(c)	Provide lightning protection					Lower level test requirements apply
3.2.2(d)	Contain shorting disconnects					Lower test level requirements apply
3.2.2(e)	Contain transformers to monitor output	IA	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.2(f)	Provide warning and safety provisions	IAT	D	X		
No number	Provide current distribution	IT	I	X		
No number	Output cabinet lighting protection circuitry	IA	I	X		
3.2.2.1	Lightning protection	IA	I	X		3.6.6, 4.4.3.4
3.2.2.2	Standoff insulators	IA	I	X		
3.2.2.3	Shorting disconnect	IA	IT	X		
3.2.2.4	Instrument potential transformers	IA	I	X		
3.2.2.5	Reserved					
3.2.2.6	Reserved					
3.2.3	Constant current regulators	IA	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.3(a), (b), (c), (d), (e)	480 volt, single phase, 2 wire, 60 Hz; provide meter; 24 V dc logic; Provide regulated constant current; provide 15 KW, 20 KW and 25 KW taps.	IA	I	X		Lower level test requirements apply
No number	Provisions for stepped brightness	IA	I	X		
No number	Isolation transformer, current detection system, transient suppressors, circuitry protection, and meter	IA	I	X		
No number	Prohibition of moving coil and mechanical apparatus	IA	I	X		
No number	Use of relays; control and monitoring interf.	IA	I	X		
3.2.3.1	Input Power	IAT	T	X		4.4.6.1

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.3.2	Output Regulation	IAT	T	X		4.4.6.1
3.2.3.3	Efficiency	IAT		X		4.4.6.3
3.2.3.4	Power factor	IAT		X		4.4.6.4
3.2.3.5	Temperature rise	IAT		X		4.4.6.2
3.2.3.6	Output isolation	IAT	I	X		
3.2.3.7	Open-circuit protection	IAT	T	X		4.4.6.5
3.2.3.8	Open-circuit voltage	IAT	T	X		4.4.6.5
3.2.3.9	Overcurrent protection	IAT	T	X		4.4.6.5
3.2.3.10	Output monitor	IAT	I	X		4.4.13
3.2.3.11	Reserved					
3.2.3.12	Control	IAT	IT	X		4.4.6.1
3.2.3.13	Status	IAT	IT	X		4.4.6.1

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	REMARKS
3.2.3.14	Output current surge limitation	IAT	IT	X		4.4.6.5
3.2.4(a), (b), and (c)	Control and monitor subsystem					Lower level requirements apply
3.2.4.1(b,c,e, j,k,m,o)	Substation control and monitor assembly	IA	I	X		
3.2.4.1(a,d,f, g,h,i,l,n,p)	Substation control and monitor assembly	IAT	ID	X		
3.2.4.2	Remote electronics chassis	IAT	I	X		
3.2.4.2(a) thru (f)	Remote electronics chassis	IAT	I	X		
3.2.4.3(a) thru (d)	Remote control panel					Lower level requirements apply
3.2.4.4	Control subsystem					Lower level requirements apply
3.2.4.4.1	Switch/indicators	IA	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.4.4.1(a) thru (g)	Switch/indicators	IAT	ID	X		4.4.7.1
3.2.4.4.1.1	Color	IT	ID	X		4.4.7.1
3.2.4.4.1.2	Dimming	IT	ID	X		4.4.7.1
3.2.4.4.1.3	Lamp test	T	ID	X		4.4.7.1
3.2.4.4.1.4	Runway identification	I	ID	X		4.4.7.1
3.2.4.4.2 thru 3.2.4.4.2.8	Control algorithms	IAT	ID	X		4.4.7.1
3.2.4.4.2.9	Transients	IAT		X		4.3.3, 4.4.3.4
3.2.4.4.3 thru 3.2.4.4.3.3	Data transmission	IAT	IT	X		4.4.7.2, 4.4.12
3.2.4.4.3.4	Lightning protection	IAT	I	X		3.6.6, 4.4.3.4
3.2.4.4.4	Interfaces	IAT	IT	X		4.4.7.1, 4.4.7.2

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.4.4.4.2	TCCC interface	IAT	ID	X		
3.2.4.4.5	Power instrumentation					Lower level requirements apply
3.2.4.4.5.1	Input power metering	IA	I	X		4.4.13
3.2.4.4.5.2	Input voltage metering	IAT	ID	X		4.4.13
3.2.4.4.5.3	Output voltage metering	IAT	ID	X		4.4.13
3.2.4.4.6	Power requirements	IA	I	X		
3.2.4.4.7	Elapsed time indicators	IAT	I	X		
3.2.4.5	Operational monitor subsystem	IAT	ID	X		4.4.8.1
3.2.4.5.1	Monitor performance	IAT	ID	X		4.4.8.1, 4.4.11
3.2.4.5.2	Caution and failure conditions	IAT	ID	X		4.4.8.1
3.2.4.5.3	Caution and failure selection range	IAT	D	X		4.4.8.1

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.4.5.4	Failed lamp simulation	IAT	D	X		4.4.8.1
3.2.4.5.5 thru 3.2.4.5.5.4	Operational monitor interface	IAT	ID	X		4.4.8.1
3.2.4.5.6	Calibration	IAD	ID	X	X	4.4.8.2, 4.4.11
3.2.4.5.7	Non-volatile status	IAT	ID	X		4.4.8.1
3.2.4.5.8	Diagnostic Program	IA	I	X		
3.2.4.5.9	Monitored parameter data	IAT	ID	X		
3.2.4.5.9	Outputs to RMS	IA		X		
3.2.4.5.10	Data archiving	IAD	ID	X		
3.2.4.5.11	Lightning protection	IA		X		
3.2.5	Flashing lights subsystem	IAT	ID	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.5.1	Flashing lights subsystem, power, control & monitoring	IAT	ID	X		
3.2.5.1.1	Intensity control resistor cabinet	IAT	I	X		
3.2.5.1.2	Power	IAT	I	X		
3.2.5.1.3	Control	IAT	IT	X		
3.2.5.1.4	Master controller timing requirements	IAT	T	X		
3.2.5.2	Flasher assemblies general requirements	IA	I	X		
3.2.5.2.1	Individual control cabinet	IAT	ID	X		
3.2.5.2.1.1	Input power	IAT	ID	X		
3.2.5.2.1.2	Input switch and fuse	IA	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.5.2.1.3	Power and control circuitry	IA	I	X		
3.2.5.2.1.4	Lightning protection	IA	I	X		3.6.6, 4.4.3.4
3.2.5.2.1.5	Flasher tester interface	IAT	IT	X		
3.2.5.2.2	Photometric performance	IAT	IT	X		4.4.9.1
3.2.5.3	Elevated flasher assembly (Type I)					Lower level test requirements apply
3.2.5.3.1	Flasher light unit	IAT	IT	X		
3.2.5.3.1.1	Intensities of the elevated flasher	IA	I	X		
3.2.5.3.1.2	Flash tube	IA	I	X		
3.2.5.3.1.3	Window	IA	I	X		
3.2.5.3.1.4	Reflector	AT	I	X		
3.2.5.3.1.5	Socket	IA	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.5.3.1.6	Mounting attachments	IA	I	X		
3.2.5.3.1.7	Flasher assembly wire	IA	I	X		
3.2.5.3.1.8	Flasher light unit weight	IA	I	X		
3.2.5.3.1.9	Aiming device for the flasher light unit	IAT	IT	X		4.4.9.9
3.2.5.4	Semiflush flasher assembly (Type II)					Lower level test requirements apply
3.2.5.4.1	Semiflush light unit	IA	I	X		
3.2.5.4.1.1	Semiflush light unit top assembly	IAT	IT	X		4.4.9.8
3.2.5.4.2	Intensity of the semiflush light unit	AT		X		
3.2.5.4.3	Static loading	AT		X		4.4.9.2
3.2.5.4.4	Window loading	AT		X		4.4.9.4

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.5.5	Flasher tester	IAD	IT	X		4.4.10
3.2.5.5.1	Physical characteristics	I		X		
3.2.5.5.2	Electrical measurements	ID	D	X		
3.2.5.5.3	Operation	D		X		
3.2.5.5.4	Tester instructions	ID	I	X		
3.2.5.5.4.1	Portable instructions	ID	I	X		
3.2.5.5.4.2	Flasher tester instruction book	ID	I	X		
3.2.5.5.5	Flasher tester software	IAT	IT	X		
3.2.5.5.5.1	Flasher tester development software	IAT	IT	X		
3.2.6	PAR-56 lampholder	IAT	I	X		
3.2.6.1	Aiming device for the PAR-56 lampholder	IT	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.7	Site spare parts	IAT	IT	X		4.4.9.9, 3.2.5.3.1.9
3.2.8	Power distribution equipment	IAT	IT	X		Subparagraph requirements apply
3.2.8.1	Substation distribution panel	IAT	IT	X		
3.2.8.2	Utility transformer	IAT	IT	X		
3.2.8.3	ALSF-2 safety disconnect switch	IAT	IT	X		
3.2.8.3.1	Lightning protection	IA	I	X		3.6.6, 4.4.3.4
3.2.9	Remote monitoring subsystem (RMS)					Subparagraph requirements apply
3.2.9(a)	Lightning protection	IA	I	X		
3.2.9(b)	Sensors	IA	I	X		
3.2.9(c)	VME card cage	IAT	ID	X		
3.2.9(d)	Interfaces	IA	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.9(e)	Capability	IAD	ID	X		
3.2.9(f)	Initialization / self-testing capability	IA	I	X		
3.2.9.1	General RMS requirements	IA	I	X		
3.2.9.1.1	MDT interface	IAD	ID	X		
3.2.9.1.2	MPS interface	IAD	ID	X		
3.2.9.1.2.1	Protocol					
3.2.9.1.3	VME bus interface system	IAD	ID	X		
3.2.9.1.4	Memory	IA	I	X		
3.2.9.1.4.1	Volatility	IAD	ID	X		
3.2.9.1.5	RMS expansion	IAT	ID	X		
3.2.9.1.6	Test points	IAD	I	X		
3.2.9.1.7	Indicator lights	IAD	ID	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	REMARKS
3.2.9.1.8	Reset switch	IAD	ID	X		
3.2.9.1.9	Environmental sensors	IAD	ID	X		
3.2.9.1.10	Data communications failures	IAD	ID	X		
3.2.10	RMS performance parameter monitoring requirements	IAD	ID	X		
3.2.10.1	System status parameters	IAT	ID	X		
3.2.10.1.1	Sensors	IAT	ID	X		
3.2.10.2	Key equipment performance parameters	IAT	ID	X		
3.2.10.3	ALSF-2/SSALR certification parameters	IAT	ID	X		
3.2.10.4	Performance checks	IAT	ID	X		
3.2.10.5	Environmental parameters	IAT	ID	X		Subparagraph requirements apply

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.2.10.5.1	Intrusion detector	IAD	ID	X		
3.2.10.5.2	Smoke detector	IAD	ID	X		
3.2.10.5.3	Commercial AC power	IAT	IT	X		
3.2.10.5.4	Engine generator ac power	IAT	ID	X		
3.2.10.5.5	Inside temperature	IAT	ID	X		
3.2.10.5.6	Outside temperature	IAT	ID	X		
3.2.11 through 3.2.11.5	Equipment required but not furnished					No test requirements
3.3 thru 3.3.10	Physical characteristics	IA	I	X		
3.4	System requirements					Lower level requirements apply
3.4.1	Power quality requirements	IT	ID	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.4.2 and 3.4.2.1	Modular construction	IA	I	X		
3.4.3	Interchangeability	IA	I	X		
3.4.4 and 3.4.4.1	Test points and controls Remote maintenance monitoring test points	IA	I	X		
3.4.4.1.1 thru 3.4.4.1.4	Test connectors	IAT	IT	X		
3.4.5(a)	DC power supplies	IAT	IT	X		
3.4.6	Extender boards	IA	ID	X		
3.4.7	Derating electronic parts	A		X		
3.4.8 thru 3.4.8.5	Enclosures	IA	I	X		
3.4.9	Earth grounding	IAT	ID	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.4.10	Nameplates	IA	I	X		
3.4.11	Assembly and marking	IA	I	X		
3.4.12	Warning signs	IA	I	X		
3.4.13	High voltage insulation	IAT	IT	X		4.4.4
3.4.14	Software/firmware requirements	IA		X		
3.4.14.1	Operating system requirements	IA	ID	X		Subparagraph requirements apply
3.4.14.2	Defensive coding	IAD	ID	X		
3.4.14.3	Operating parameters	IAD	ID	X		
3.4.14.3.1	Initialization / restart	IAD	D	X		
3.4.14.3.2	Switch action	IAD	D	X		
3.4.14.4 and 3.4.14.4(a) thru (g)	Software utility services	IA	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.4.14.5 thru 3.4.14.5(c)8	System error messages	IAD	ID	X		
No number	Sentence below 3.4.14.5(c)8	IAD	ID	X		
3.4.14.6	System growth capabilities					Subparagraph requirements apply
3.4.14.6(a) thru (c)	System growth	IAD	ID	X		
3.4.15	RMS functional requirements	IAD	ID	X		
3.4.15.1	Monitoring requirements	IAD	ID	X		
3.4.15.2	Alarm limits	AD	D	X		
3.4.15.3	Control command requirements	AD	D	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.4.15.3.1 and 3.4.15.3.1 (a) thru (h)	MPS interface commands	AD	D	X		
3.4.15.3.2 and 3.4.15.3.2.1 thru 3.4.15.3.2.14	MDT interface commands	AD	D	X		
3.4.15.4	Diagnostic requirements	AD	D	X		
3.4.15.4.1	Fault isolation	AD	D	X		
3.4.15.5	Physical security requirements	AD	D	X		
3.4.15.6	MDT process security requirements	AD	D	X		
3.4.15.6.1	Authority	AD	D	X		
3.4.15.6.2	Auto log-off	DT	D	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.4.15.7	RMS performance requirements	AD	D	X		
3.4.15.7.1	Monitoring requirements	AD	D	X		
3.4.15.7.2	System integrity	IAD	ID	X		
3.4.15.7.3	RMS sampling frequency	IAT	ID	X		
3.4.15.7.4	Alert and alarm determination	IAT	ID	X		
3.4.15.7.5	Change of state determination	IAT	ID	X		
3.4.15.7.6	Performance parameter request	IAT	ID	X		
3.4.15.7.7	Command execution	IAT	ID	X		
3.4.15.7.8	Communications requirements	IAT	ID	X		
3.4.15.8	System initialization requirements	IAD	ID	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	REMARKS
3.4.15.8.1	Startup	IAD	ID	X		
3.4.15.9	MDT communications	IAD	ID	X		
3.4.16	ALSF-2 General control behavior	IAD	ID	X		
3.5 and 3.5.1	Parts					Lower level test requirements apply
3.5.1.1	AC power connectors	IA		X		
3.5.1.2	Discrete components	IA		X		
3.5.1.2.1	Flasher assembly capacitors	IA		X		
3.5.1.3	Fuses	IA	I	X		
3.5.1.4 and 3.5.1.5	Devices	IA	I	X		
3.5.1.6	Fastener hardware	IA	I	X		
3.5.1.7	Interlock switches	IAT	IT	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	REMARKS
3.5.1.8	Terminal blocks	IA	I	X		
3.5.1.9	Other parts	IA	I	X		
3.5.2 thru 3.5.7.9	Materials	IA	I	X		
3.6	Environmental requirements					Lower level requirements apply

Note 1: When the equipment design has previously passed design qualification testing to the environmental and other requirements herein, redundant design qualification testing need not be accomplished. In such cases, mandatory testing as designated by a "T" shall be replaced by an "A" indicating a requirement for analysis of previous design qualification test data. Paragraphs 3.6.1 thru 3.6.7 are candidates for such a change.

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD	TEST LOC	CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU PRO	FAC FLD	REMARKS
3.6.1	Indoor equipment	T	X	3.2.1 thru 3.2.4, 3.2.5.1, 3.2.7
3.6.2.1	Temperature	T	X	3.2.1 thru 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4, 3.2.7, 4.4.3.1
3.6.2.2	Altitude	T	X	3.2.1 thru 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4, 3.2.7, 4.4.3.3
3.6.2.3	Humidity	T	X	3.2.1 thru 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4, 3.2.7, 4.4.3.2
3.6.2.4	Sand and dust	T	X	3.2.5.3, 3.2.5.4, 4.4.3.8
3.6.2.5	Salt fog	T	X	3.2.5.3, 3.2.5.4, 3.2.5.3.1.9, 3.2.5.5, 4.4.3.6
3.6.2.6	Rain	T	X	3.2.5.3, 3.2.5.4, 3.2.5.3.1.9, 3.2.5.5, 4.4.3.5
3.6.2.7	Solar radiation (sunshine)	T	X	3.2.5.3, 3.2.5.4, 4.4.3.9

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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REQUIREMENTS		TEST LEVEL AND METHOD	TEST LOC	CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU PRO	FAC FLD	REMARKS
3.6.2.8	Temperature shock	T	X	3.2.5.3, 3.2.5.4, 4.4.3.1, 4.4.9.5
3.6.2.9	Vibration	T	X	3.2.5.3, 3.2.5.4, 4.4.9.6
3.6.3	Impact	T	X	3.2.5.4, 4.4.9.3
3.6.4	Hydraulic impact	T	X	3.2.5.4, 4.4.9.4
3.6.5	Snowplow test	T	X	3.2.5.4, 4.4.9.7
3.6.6	Transient suppression	T	X	3.2.1 thru 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4, 3.2.7, 4.4.3.4
3.6.7	Interference requirements	T	X	3.2.3, 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4, 4.4.3.7
3.7 thru 3.7.2	Instruction book			Other test requirements apply
3.8	Reliability			Lower level test requirements apply

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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REQUIREMENTS		TEST LEVEL AND METHOD	TEST LOC	CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU PRO	FAC FLD	REMARKS
3.8.1(b)	Reliability design criteria			No test requirements apply
3.8.1(a) and (c) thru (f)	Reliability design requirements	A	X	
3.8.2 thru 3.8.2.4	Reliability program			Other test requirements apply
3.8.2.5	Reliability Growth Testing	T	X	
3.9	Maintainability			Lower level test requirements apply
3.9.1(a) and (b)	Maintainability design criteria			No test requirements
3.9.1(c) thru (f)	Maintainability design criteria	AD	X	
3.9.2 thru 3.9.2.3	Maintainability program			Other test requirements apply

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

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ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD	TEST LOC	CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU PRO	FAC FLD	
3.9.2.4	Maintainability demonstration	AD	X	
3.10	Configuration management			No test requirements

Note 2: Overall visual inspection requirements per Paragraph 4.4.1 are contained in Table XVI.

Note 3: Overall system twenty four hour test requirements per paragraph 4.4.2 are contained in Table XVI.

Note 4: Overall system 150 hour test requirements per paragraph 4.4.5 are contained in Table XVI.

Note 5: All test measurements shall be made using calibrated test instruments per paragraph 4.5.

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AN METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD