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DRL No. 8
DRD No. SE-227T
JSC No. 10994-8

NASA CR-

147597

SMS
Power and Grounding
CEI Part I, Detail Specification

"Preliminary" - NASA Approval Pending

NASA Contract NAS-9-14910
Type 1 Data

Date: 26 March 1976

(NASA-CR-147597) SMS POWER AND GROUNDING.
CEI PART 1: DETAIL SPECIFICATION, TYPE 1
DATA (Singer Co., Binghamton, N.Y.) 20 P
HC \$3.50 CSCL 14E

N76-22235

Unclas
25348
G3/14



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FOREWORD

This specification is submitted as part of a series of second level hardware contract end item specifications required for the Shuttle Mission Simulator (SMS). These specifications are for the following end items:

- 1 Mission Control Center Interface
- 2 Image Generation System
- 3 Image Display System
- 4 Image Processing and Control
- 5 Crew Station
- 6 Instructor Operator Stations
- 7 Digital Computer Complex
- 8 Power and Grounding
- 9 Voice Communication
- 10 Aural Cue/Caution and Warning
- 11 SCE
- 12 Central Timing Equipment

Contract End Item Specification - Part I

Power and Grounding

1.0 Scope

This specification establishes the requirements for performance, design, test, and qualification of the SMS total Power and Grounding System. This is defined as Designing a new PDU to be useable for SMS adding FBCS and Modifying and adding to the OAS power systems, the Emergency Off System and the Overheat Warning System. The above design considers all S.O.W. requirements.

Specifications (Con't)

Military (Con't)

MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Specification and Standards, Order of Procedures
MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipment
MIL-STD-681	Identification Coding and Application of Hookup and Lead Wire
MIL-STD-889	Dissimilar Metals
MIL-STD-1130	Connectors, Electrical, Solderless Connections, Wrapped
MIL-STD-1285	Marking of Electrical and Electronic Parts
MIL-STD-1310	Shipboard Bonding and Grounding Methods for Electromagnetic Compatibility
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-W-16878	Wiring, Electrical, Insulated, High Temperature
USAS Y32.2	Graphic Symbols for Electrical and Electronics Diagrams
USAS Y32.16	Reference Designations for Electrical and Electronics Parts and Equipments.

3.0 Requirements

3.1 Performance

3.1.1 Performance Characteristics

3.1.1.1 Primary Performance Characteristics of the CEI are to deliver power to the Singer supplied equipment in the SMS from the following types of power and grounds as required.

Power: 60 Hz 3Ø 120V/208V (Computer, Simulator)
 60 Hz 3Ø 277V/480V (Motion & Air Conditioner)
 400 Hz 1Ø 115V (Simulator)

Grounds: Neutral (Primary Power) Ground

Chassis Ground

Signal Ground

The Computer and Simulator capability shall be provided by a Power Distribution Unit, designed for SMS.

3.1.1.2 Secondary Performance Characteristics of the CEI are to provide overheat warning and emergency stop capability throughout the complex, power status indication for the OS station, and utility outlets for test equipment power during maintenance.

3.1.2 Operability

3.1.2.1 Reliability

This CEI shall be designed such that reliability is maximum, compatible with CEI design and performance requirements.

3.1.2.2 Maintainability

The equipment shall be designed for ease of maintenance, accessibility for installation and removal of components, safety of personnel during operation, and minimum time for training problem set-ups.

3.1.2.3 Useful Life

The equipment shall be designed to have a minimum useful life of 10 years when maintained in accordance with the manufacturer's supplied maintenance manual.

3.1.2.4 Natural Environment

The equipment shall be designed to be capable of satisfactory operation within the performance requirements of this specification and to sustain no damage from the following natural environment conditions:

- a) Temperature - Minus 20 degrees F minimum to plus 140 degrees F for two weeks.
- b) Altitude - Up to 35,000 feet for 5 hours.
- c) Humidity - 0 to 100 percent including condensation.

3.1.2.5 Transportability

The equipment shall be designed to minimize preparation procedures for handling and transport. Features shall be incorporated in the equipment design to permit handling by forklifts and cranes; no special equipment shall be required. Disassembly shall be held to the minimum required to provide adequate protection of the components, but shall not require the use of special tools or skills for reassembly. The largest piece of equipment which cannot be disassembled shall not exceed a crated width of 10 feet, height of 10 feet, length of 16 feet, and weight of 4,000 pounds.

3.1.2.6 Human Performance

Human performance criteria to support the equipment for optimum arrangement, lighting, colors, placarding, and equipment, shall be provided. Human factors requirements shall be applied to assure compatibility between man and the equipment. Unless otherwise specified herein, the human engineering requirements of the equipment shall be in accordance with the following engineering standards as applicable: MIL-STD-1472 and MSFC-STD-267A.

3.1.2.7 Safety

The equipment shall be designed to insure maximum safety to personnel and equipment during training periods and maintenance operations.

3.1.2.7.1 Personnel Safety

The equipment design shall provide for the adequate protection of personnel and crew members at all times. Protective devices shall be incorporated to prevent accidental contact with primary supply voltages or rotating parts.

3.1.2.7.2 Equipment Safety

The equipment shall be designed for optimum equipment safety throughout, as specified herein.

a) Overload Protection - Overload protective devices shall be provided within the equipment for primary circuits and such other circuits as required for protection of the equipment from damage due to overload. These protective devices shall be located in such a manner as to be readily replaceable from the front, either by direct location on the front panel or behind hinged doors or panels, except for power supply and computer complex equipment fuse and circuit breakers. Lamp indicators shall be used so that fuse failures are visually indicated except on the computer complex equipment and similar equipment. All overload protective devices shall be placed in the ungrounded side of the circuits.

b) Heat Dissipation - The design shall provide for the adequate positioning and spacing of components whose operation involves the release of heat at appreciable rates. Location and spacing shall be such as to permit sufficiently

rapid dissipation of heat to prevent excessive temperatures in their immediate environment. Such items shall be contained in cabinets or other suitable enclosures. Enclosure containing such heat dissipating components shall incorporate provisions for removal of heat energy released. Where the rate of dissipation is too high to warrant reliance upon natural convection for cooling, forced ventilation shall be provided.

3.1.2.8 Operating/Induced Environment

The equipment shall be capable of performing its intended functions within the specified performance requirements while operating under any combination of the environmental conditions specified below:

- a) Temperature - +60° F to 85° F.
- b) Altitude - Zero to 2,500 feet.
- c) Relative Humidity - 30 to 80 percent.

3.2 CEI Definition

The CEI will be designed to be compatible with the SMS Simulator and the GFE equipment with which it must operate.

3.2.1 Interface Requirements

The CEI will interface with other equipment and facilities in providing power and ground to these other devices, based on their specific requirements.

3.2.1.1 Schematic Arrangement

The relationships of this CEI to other systems/equipment is shown in Diagram 3.2.1.1-1.

3.2.1.2 Detailed Interface Definitions

This CEI requires 3Ø 60 Hz 120V/208V, 3Ø 60 Hz 277/480V and 115V 400 Hz 1Ø power from the building facility.

3.2.2 Component Identification

3.2.2.1 Government Furnished Property List

The Government-Furnished Property which the CEI must be designed to incorporate is listed below:

- 1) Interdata (MBCS)
- 2) SID's
- 3) OAS
- 4) X-T Recorders.

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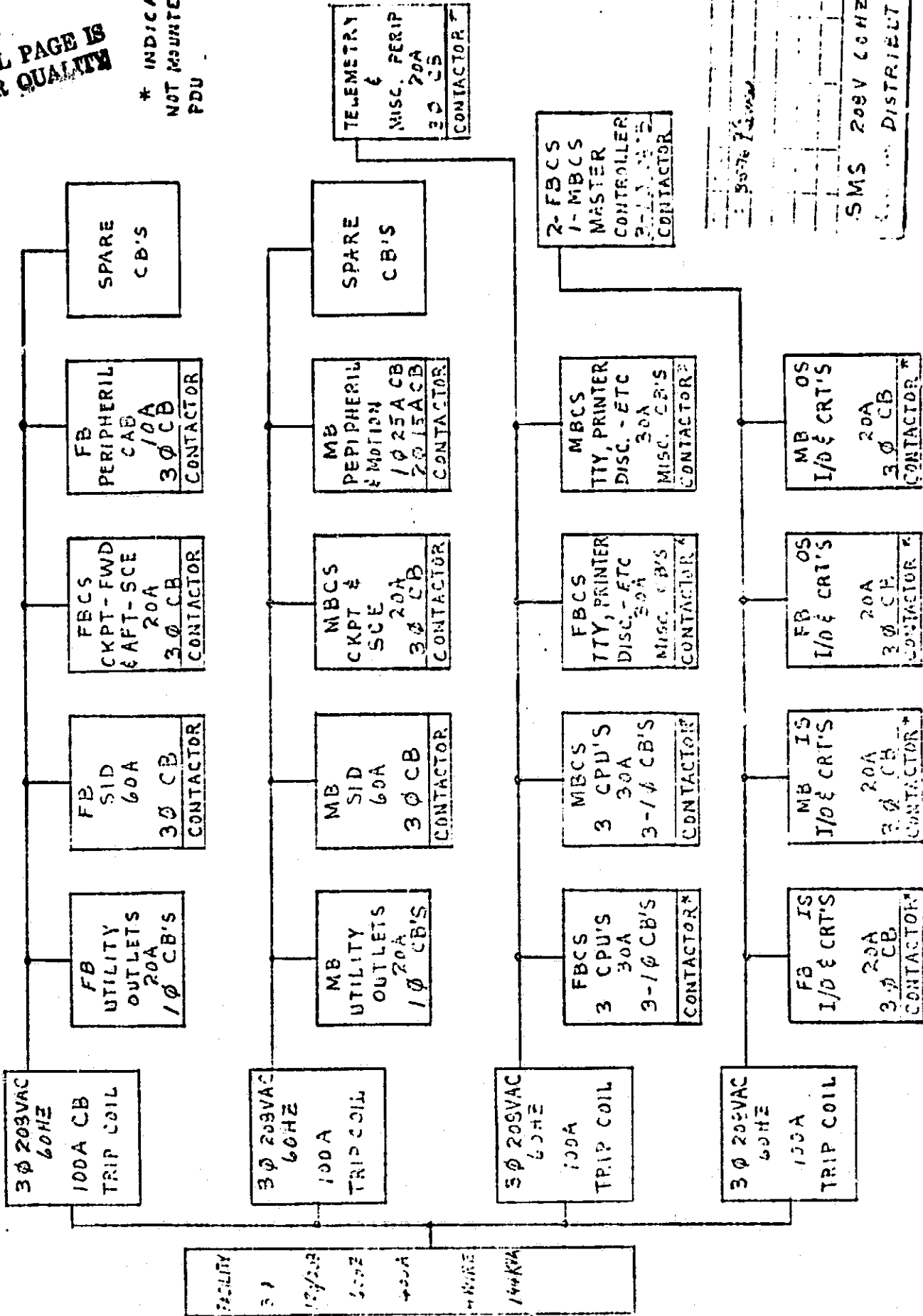


FIGURE 3.2.1.1-1

3.2.2.2 Engineering Critical Components List

Not Applicable

3.2.2.3 Logistics Critical Components List

Not Applicable

3.2.3 Technical Manuals

Information for maintenance and operation of this CEI shall be included in the SMS Maintenance Manual (DRL No. 17, JSC No. 11002) and Operations Manual (DRL No. 18, JSC No. 11003).

3.3 Design and Construction

3.3.1 General Design Features

Singer provided assemblies/components shall be easily accessible for maintenance and compatible with overall simulator maintenance procedures.

3.3.2 Selection of Specifications and Standards

Unless otherwise specified, specifications and standards for materials, parts, and processes shall be selected using Standard MIL-STD-143 as a guide.

3.3.3 Materials, Parts and Processes

The following requirements shall govern the selection of materials, parts, and processes in the design and production of the equipment covered by this specification:

a) Where covered by Government specification - Specifications and standards for materials, parts, and processes which are not specifically designated herein, will be selected in accordance with MIL-STD-143.

b) Where not covered by Government specifications - Where materials, parts, and processes are not covered by Government specifications, their selection will be at the option of the contractor with the restriction that selection shall meet the performance characteristics satisfactory for the intended use. As an example, connectors will be used exclusively to distribute the branch circuit 60Hz to the various user locations. These are Underwriters listed but not Mil. approved, plastic type standard shell with a separate pin size selection. There is a

cost saving in their use throughout the system.

Materials that are not specified herein shall be sound, of uniform quality and conditions, and free from cracks, seams or defects which may adversely affect the appearance, strength, endurance or wear resistance of the finished part. Wherever practival, non-critical materials shall be used in construction of the equipment. All nonmetals such as wood, plastic, and fabric used in construction of the equipment shall be of the moisture and temperature resistant type.

3.3.3.1 Flame-Resistant Materials

Where practicable, flame-resistant materials shall be used. Where necessary to use flammable materials, they shall be of such characteristics that neither toxic nor corrosive fumes will be liberated if the material should burn. All flammable materials shall be brought to Program Office attention prior to design approval.

3.3.4 Standard and Commercial Parts

Standard parts such as Air Force-Navy (AN), National Aircraft Standard (NAS), Military Standards (MS) parts shall be used where practicable when they suit the purpose, and shall be identified on the drawing by their part number. Commercial parts having suitable properties may be used where there are no suitable AN, NAS, or MS standard parts.

3.3.5 Moisture and Fungus Resistance

Materials that are susceptible to damage or deterioration due to moisture or salt spray shall be avoided.

Materials that are nutrients for fungi shall not be used where it is practical to avoid them. Where nutrient materials are used and not hermitically sealed, they shall be treated with an acceptable fungicidal agent.

3.3.6 Corrosion of Metal Parts

Corrosion-resistant metals shall be used in the construction of the equipment wherever protective finishing is not practical. Where necessary to use ferrous materials to obtain certain functional or magnetic properties, such ferrous materials shall be protected against corrosion.

3.3.7 Interchangeability and Replaceability

Mechanical and structural interchangeability and replaceability shall conform to the requirements of Specification MIL-I-8500. Electrical and electronic interchangeability and replaceability shall conform to the requirements of MIL-E-5400. All parts having the same suppliers part numbers shall be governed by the drawing number requirements of MIL-D-1000.

3.3.8 Workmanship

The equipment shall be constructed and finished in accordance with the best commercial practice. Particular attention shall be given to the following:

a) Freedom from objectionable blemishes, defects, burrs, and sharp edges.

b) Accuracy of dimensions, radii of fillets, and marking of parts and assemblies.

c) Thoroughness of soldering, welding, brazing, painting, wiring and riveting.

d) Alignment of parts and rightness of assemblies, screws, and bolts.

e) The equipment shall be thoroughly cleaned. Loose, spattered or excess solder, metal chips, and other foreign materials shall be removed during and after final assembly.

3.3.9 Electromagnetic Interference

Equipment design to prevent generation of electromagnetic interference or the vulnerability of the equipment to interference shall be in accordance with MIL-STD-461 and MIL-STD-1310.

3.3.10 Identification and Markings

The major items of the equipment shall be durably and legibly marked in accordance with the requirements of Standard MIL-STD-130 and shall include the following information:

Part Name and Number

Manufacturer's type or part number

Quantity this package; lot number (if applicable)

Serial Number (if applicable)

Manufacturer

Date of Manufacturer

Contract Number

In all instances where parts, subassemblies, assemblies and units of the spacecraft equipment are used in the simulator such parts shall be permanently marked with the following precautionary markings in a plainly visible position:

CAUTION: For Use Only in Training Equipment

3.3.11 Storage

Not Applicable

4.0 Quality Assurance Provisions

4.1 Phase I Test/Verification

4.1.1 Engineering Test and Evaluation

4.1.1.1 Using a volt meter establish that the facility has available for delivery to Singer equipment the sources of power specified in para. 3.1.1.1.

4.1.1.2 Using visual inspection and a volt meter, as necessary to ensure that the power status light and utility outlets power are available.

4.1.2 Reliability Tests and Analyses

The contractor shall maintain a log of all failures which occur during all test period. This log shall include:

- 1) Part No. of failed part
- 2) Location of failed part
- 3) Short narrative explaining failure
- 4) Number of hours on unit at time of failure
- 5) Number of manhours required to correct failure

4.1.3 Engineering Critical Components

Not Applicable

4.2 Phase II Integrated Tests

Performance of the SMS Power CEI shall be demonstrated

by observation of proper operation of SMS systems/equipment
in an integrated mode.

5.0 Preparation for Delivery
 Not Applicable