General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.

- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.

- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.

- This document is paginated as submitted by the original source.

- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

Produced by the NASA Center for Aerospace Information (CASI)

DRL No. 8
DRD No. SE-227T
JSC No. 10994-6

NASA CR-
147651

SMS
Instructor Operator Stations

CEI Part I, Detail Specification

"Preliminary" - NASA Approval Pending

NASA Contract NAS-9-14910
Type 1 Data

Date: 1 April 1976

(NASA-CR-147651) SMS INSTRUCTOR OPERATOR STATIONS. CE1 PART 1: DETAIL SPECIFICATION (Singer Co., Binghamtcn, N.Y.) 34 p HC $4.00 CSCL 14?

N76-22231

Unclas
G3/14 25343

NASA STI FACILITY
INPUT BRANCH

Singer
Simulation Products
Division
Binghamton, New York

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

Instructor/Operator Station

1.0 Scope

This part of this specification establishes the requirements for performance, design, test and qualification of one type of equipment identified as SMS Fixed and Moving Base Instructor - Operator - Observer Stations (IS/OS/OBS). This CEI is used to provide all hardware and wiring necessary for these stations and to define their interface with other SMS CEI's.

2.0 Applicable Documents

The following documents, of exact issue shown, form a part of this specification to the extent specified herein.

Standards

Singer Standard Engineering Practices

Specifications

Addendum "B" to Statement of Work for SMS	Data Management Specification for the SMS
Addendum "A" to Statement of Work for SMS	SMS Design Control Specification

Military

MIL-B-5087	Bonding, Electrical, and Lightning Protection for Aerospace Systems
MIL-D-1000	Drawings, Engineering and Associated Lists
MIL-E-5400	Electronics Equipment, Aircraft, General Specification for
MIL-I-8500	Interchangeability and Replaceability of Component Parts for Aircraft and Missiles
MIL-P-116	Methods of Preservation
MIL-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage

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

The IS/OS shall function as the central controlling locations for the Shuttle Mission Simulators. Each shall accommodate 4 instructors, 2 operators and up to 4 observers.

3.1 Performance

3.1.1 Performance Characteristics

The instructor operator stations shall provide the SMS instructors/operators the capability to control the overall operations of the simulators during training and check-out sessions. The IS/OS shall each:

a) Provide a simulator master control station for control of overall operations.

b) Provide simulation monitor capability of crew station controls and displays, and insertion of malfunctions including override capability of software indicator drive parameters where the indicators have a selectable crew station function.

c) Provide data recording devices

d) Provide visual scene repeaters

e) Provide capability in the cockpit for observing/controlling the simulation.

3.1.1.1 Simulator Unique Panels

Functions to be covered by these panels are as follows:

1) Simulator Mode

2) Simulator Control

3) Motion System (MBCS only)

4) Visual System

5) Aural Cue

6) Spe[illegible]

7) Light[illegible]

8) Master Power Control.

3.1.1.2 Simulaticn Control/Monitoring

The Graphic CRT system total through part of the interface including selector channel setup, switching from one graphic display system to another, and the transfer of command memory data blocks will be a maximum of 20,00 words/ second. Each word will consist of 16 bits. The update rate to be displayed image shall be a mximum of five (5) times/ second for instrument pictorial and one (1)/second for texts. The CRT useable screen dimensions of 12 inches high by 16 inches wide.

The A/N CRT system through part rate can be 600,000 bits per second or as limited by the selector channel. The maximum update rate for any dynamic information on all displays shall be once per second. The Instructors and Operators CRT's will have a rectangular dimension of 19 inches measured diagonally. The Observer CRT shall have a rectangular demension of 17 inches measured diagonally.

3.1.1.2.2 Simulator Controls

Operation of each of the Simulator complexes shall be controlled mainly from the Operator Station. Systems status indicators and controls shall be provided on the OS panels.

3.1.1.2.3 In-Cockpit Observer's Station

The in-cockpit observer's station shall be located behind the right hand crew member. It shall consist of one 17 inch A/N CRT and Keyboard and a control panel, to be shared between the FBCS and MBCS.

3.1.1.3 Data Recording Devices

The data recording devices shall consist of two X-YY recorders and three 8-track X-T recorders.

3.1.1.4 Visual Scene Repeaters

The visual scene repeaters shall consist of Black and White Monitor (3) for FBCSS and (2) for MBCSS.

3.1.2 Operability

3.1.2.1 Reliability

This CEI shall be designed such that reliability is maximized, 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 form 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

3.2.1 Interface Requirements

3.2.1.1 Power Cabinet (GFE)

Power for the IS/OS shall be provided from the PDU with adequate wire size and circuit breaker protection.

3.2.1.2 Software

All IS repeaters of crew station controls/ displays shall be under software control via CRT pages.

3.2.2 Component Identification

3.2.2.1 Government Furnished Property List

The following items shall be furnished as GFE for the FBCSS:

1) 1-Keyboard (same as unit in C/S)
2) 3-DU's (same as units in C/S)
3) 7-Communications keysets, jacks and Headsets
4) 3-X-T Recorders

The following items shall be furnished as GFE for MBCSS:

1) 1-Keyboard (same as one in C/S0
2) 3-CRT's (TAC Units)
3) 7-ea.-Communications Keysets, Jacks & Headsets
4) 3-X-T Recorders
5) 2-X-YY' Recorders
6) IS/OS/OBS Consoles

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

3.3.1.1 IS Configuration

The SMS Instructor console is shown in Figures 3.1-1 through 3.1-3. The console is designed to accomodate 4 instructors.

The panels are wrapped both vertically and horizontally to facilitate visual and physical access to all panels. The console is comprised of seven straight sections and four wedge sections. The outer wedges are designed for a 45° wrap and the inner for a 15° wrap. The front of the console cross-section includes, from bottom to top:

1) A kick space

2) A 16-inch-deep shelf, 1.12 inches thick, whose bottom is 25 inches off the floor to provide adequate thigh clearance. Keyboards for each instructor are placed on this shelf.

3) A 10-inch-high lower panel, whose top is tilted backward at a 45° angle. Most controls, and all frequently used and critical controls, are placed here.

4) A 24-inch-high vertical panel. For mounting of A/N and Graphic CRT, DU or TAC units, and Comm Panels and CCTV monitor.

5) A 24-inch-high upper panel, whose top is tilted forward at a 30° angle. At this level are included the

visual system monitor CRT, and other A/N/Graphic CRT's.

3.3.1.2 OS Configuration

The SMS operator console is shown in Figures 3.1-4 thru 3.1-7. The console is designed to accomodate two operators. Other than the fact that the OS console is comprised only of straight sections, the physical description and general placement of controls and monitors of the IS console applies.

3.3.1.3 OBS Configuration

The OAS observer console is shown in Figures 3.1-8 thru 3.1-10.

The in-cockpit MBCS observer console has been designed to withstand the cockpit motion environment, to fit conveniently and unobtrusively into the cockpit, and to be readily removable from the cockpit.

The console profile features an eight inch shelf, a seven inch sloped (45°) control panel and a 24 inch vertical CRT panel. The console is 20 inches wide. Visual and reach access to both panels is very good.

The observer also has a communication keyset panel mounted on the pilot seat superstructure. The seat is positioned to permit trainee monitoring, console monitoring and control, and comm operation. The observer position can therefore be used beneficially with or without the console in position.

The In-cockpit FBCS observer console will be mounted via a pedestal that can be easily removed.

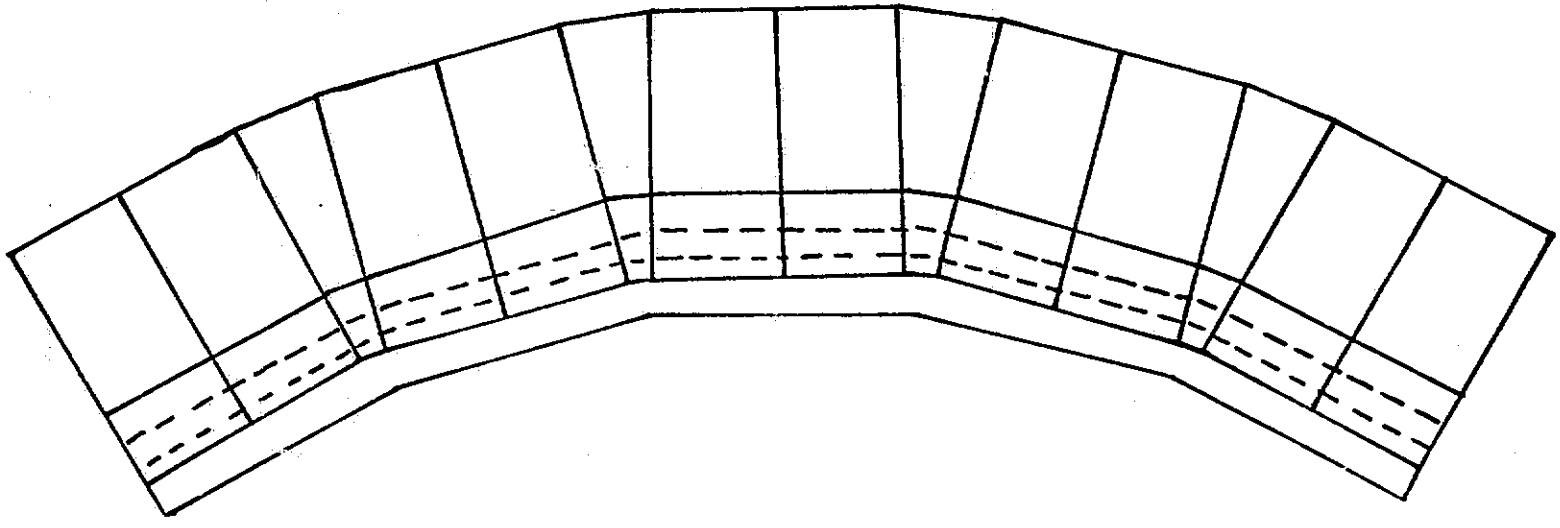

FIGURE 3.1-1 PLAN VIEW OF THE FBIS. AND MBIS CONSOLE

ORIGINAL PAGE IS
OF POOR QUALITY

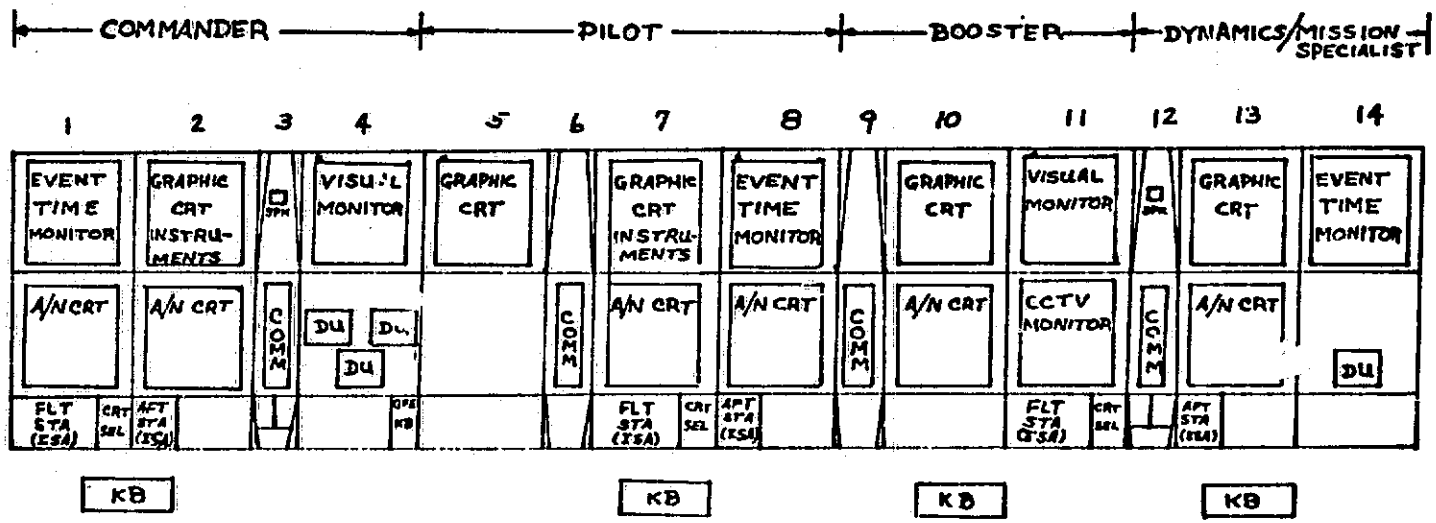

FIGURE 3.1-2 PANORAMIC VIEW OF THE FBIS CONSOLE

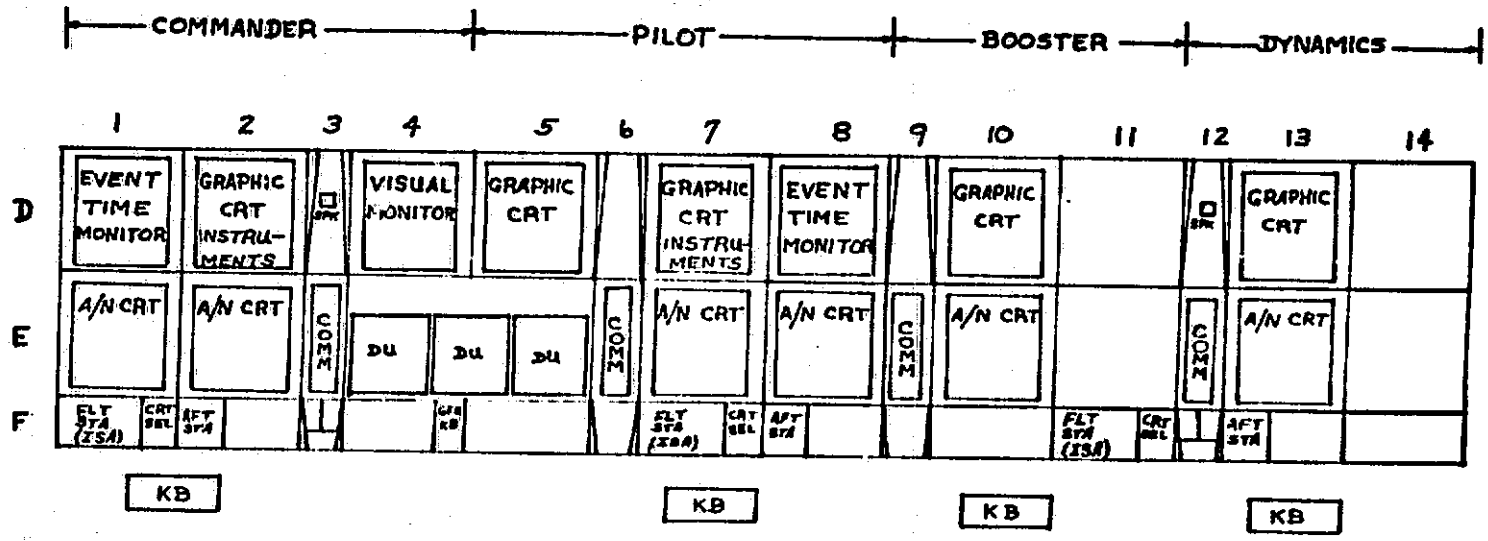

FIGURE 3.1-3 PANORAMIC VIEW OF THE MBIS CONSOLE

ORIGINAL PAGE IS OF POOR QUALITY

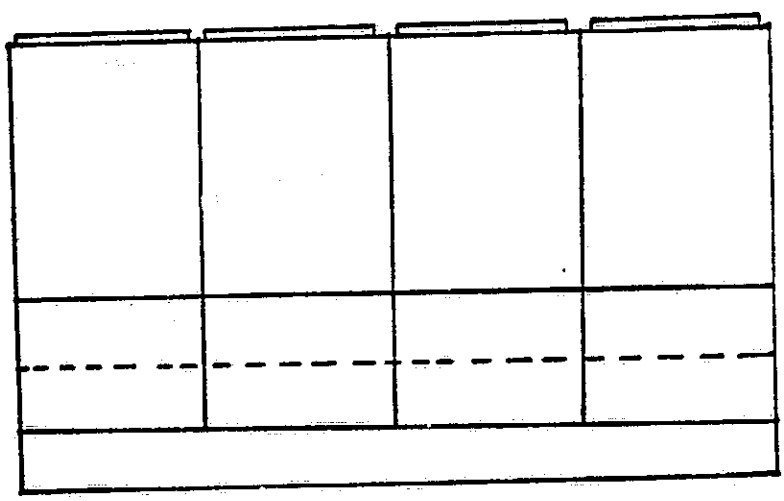

FIGURE 3.1-4 FBOS AND MBOS PLAN VIEW

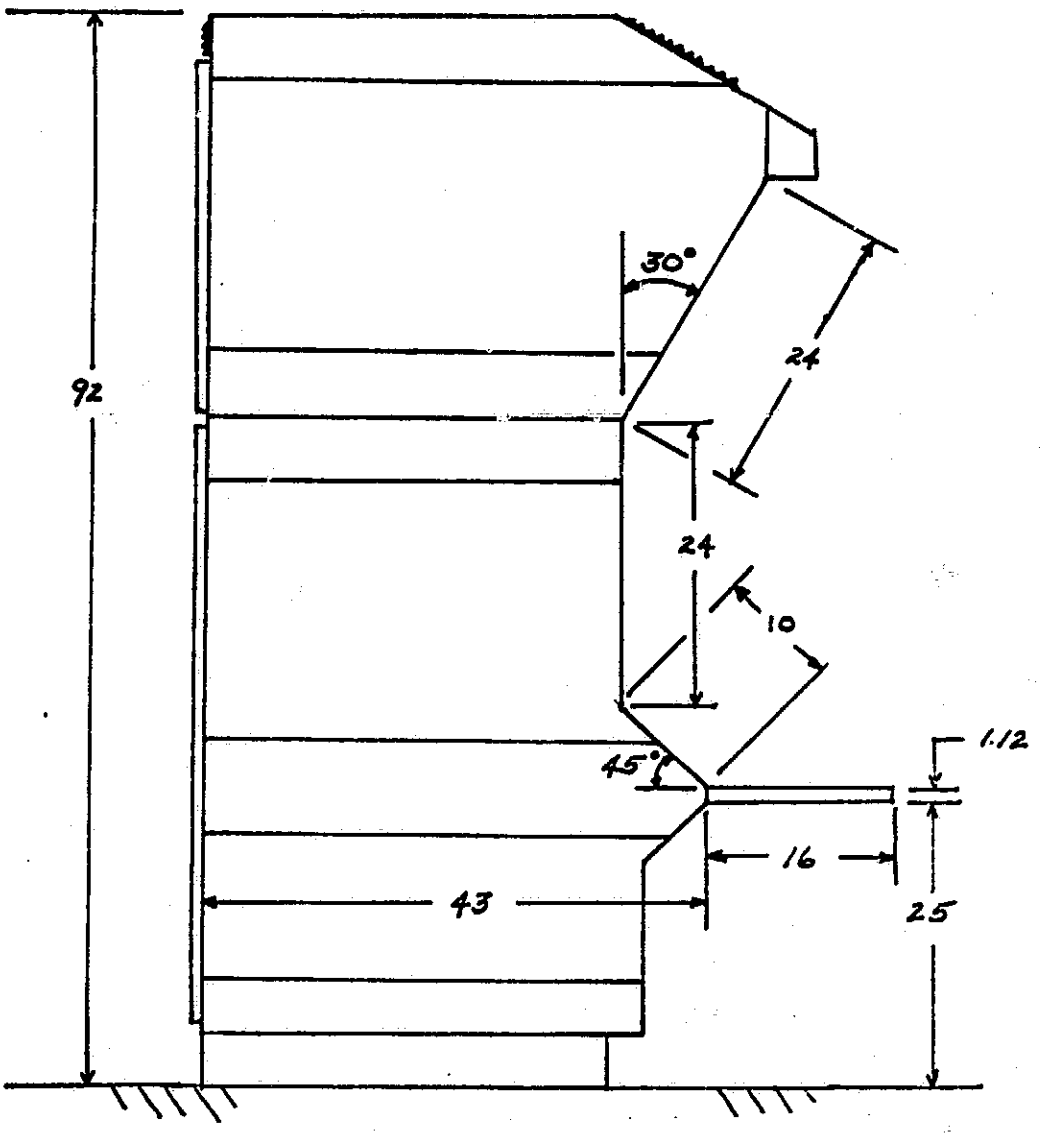

FIGURE 3.1-5 CROSS SECTION VIEW OF THE FBOS AND MBOS CONSOLES

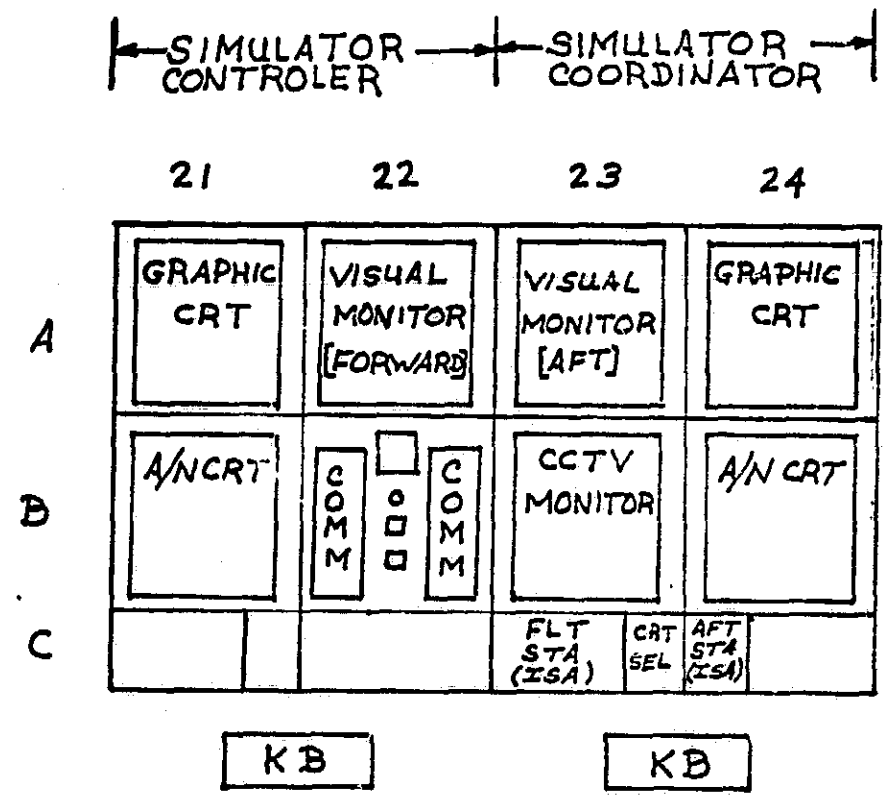

FIGURE 31-6 FBOS PANORAMIC VIEW

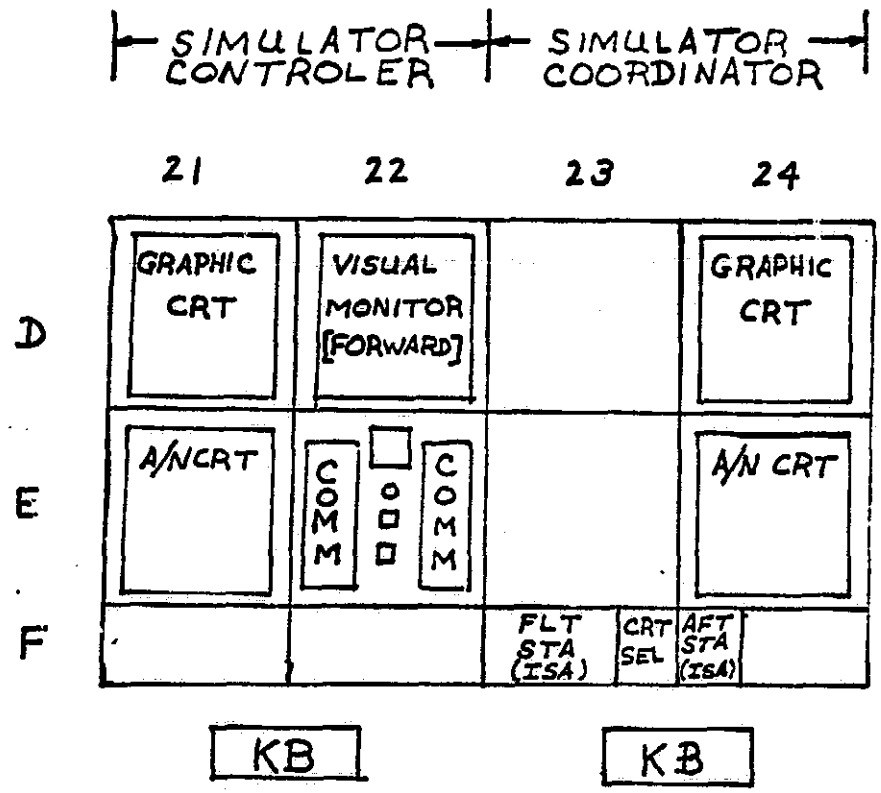

FIGURE 31-7 MBOS PANORAMIC VIEW

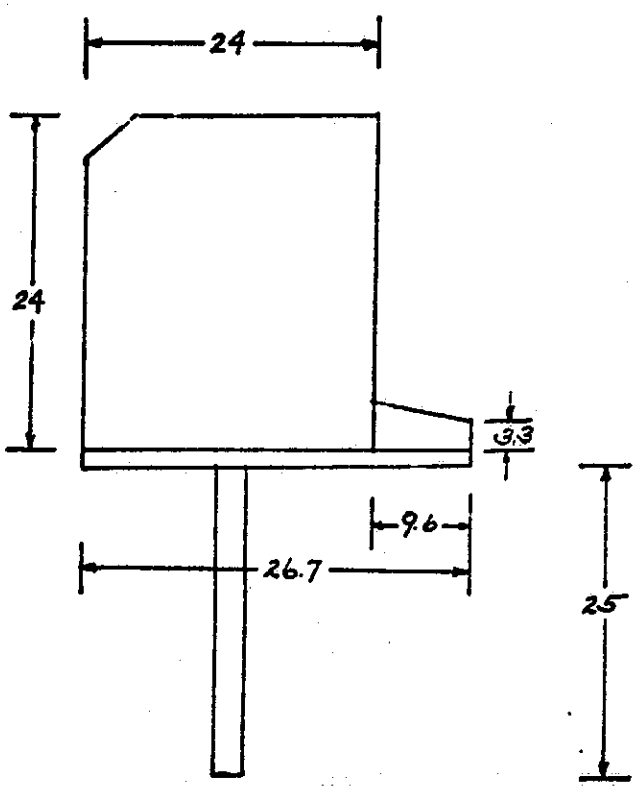

FIGURE 3.1-8 OBS PEDESTAL MOUNT
CROSS SECTION VIEW

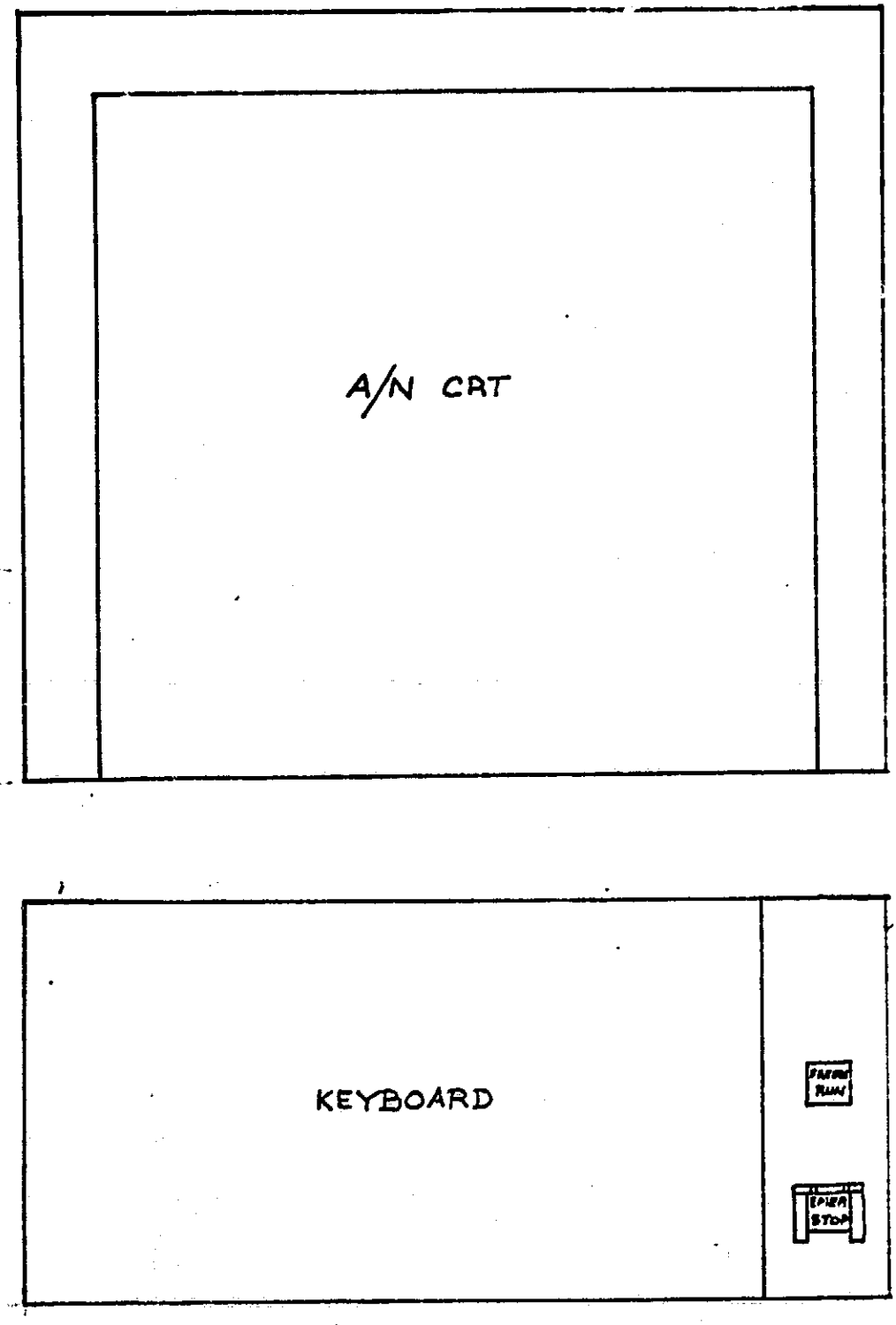

FIGURE 3.1-9 OBS PEDESTAL MOUNT
PANORAMIC VIEW

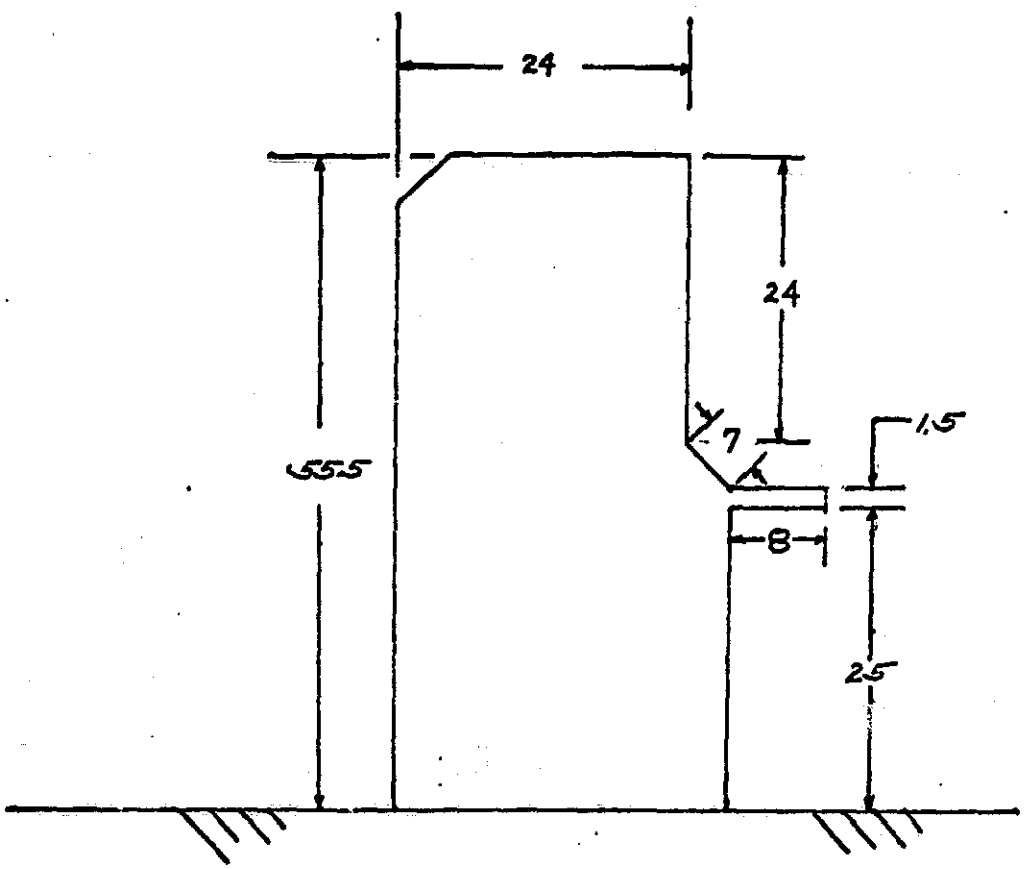

FIGURE 3.1-10 OBS CONSOLE MOUNT
CROSS SECTION VIEW

3.3.1.4 CRT Display System

The CRT system, both A/N and Graphic shall be built to accepted Commercial Standards and Practices.

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, wedling, brazing, painting, wiring and riveting.

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

e) The equipment shall be thcroughly 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

4.0 Quality Assurance Provisions

4.1 Phase I Test/Verification

4.1.1 Engineering Test and Evaluation

This phase of test and verification consists of the quality assurance tests which will be given this CEI during and after the manufacturing process and will be in accordance with requirements given in the approved SMS Quality Assurance Plan.

4.1.2 Preliminary Qualification Tests

Each item of the equipment shall be subjected to visual inspection of product to verify workmanship and Q. C. standards in accordance with the approved OAS Quality Assurance Plan.

4.1.3 Formal Qualification Test

Not applicable

4.1.4 Reliability Tests and Analyses

The contractor shall maintain a log of all failures which occur during all test periods. 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.

4.2 Phase II Integrated Tests

These tests should be performed on this CEI after it has been integrated with the rest of the SMS. At that time each device identified in Section 3 of this spec should be operated and it should be ascertained that the device gives the correct cue or cause the correct effect. The CRT System will be tested using a diagnostic program. All items that interface with the SCE will be tested with the using system.

5.0 Preparation for Delivery

5.1 General

Preservation, packaging, and packing shall be designed to provide necessary protection to all items to prevent damage or deterioration.

5.2 Preservation

Items subject to deterioration or corrosion from exposure to the elements shall be preserved by methods necessary to insure adequate protection.

5.3 Packaging and Packing

Packing and packaging where specified herein shall be designed to protect the item from damage during transit from the point of manufacture to the receiving activity and during subsequent short-term storage.

5.4 Marking

Marking of interior and exterior containers shall comply with the requirements of MIL-STD-129 and all applicable local or federal regulations and shall insure safe arrival and ready identification at destination.

5.4.1 Unit Container

Wherever containers are used, they shall be durably marked in a legible manner in such a way that the markings shall not become damaged when the containers are opened. The markings shall provide the following information:

a) Part name and number

b) Manufacturer type or part number

c) Quantity this package; lot number (if applicable)

d) Serial number (only if serialized for control)

e) Manufacturer; date of manufacture

f) Contract number

5.4.2 Shipping Container

Whenever shipping containers are used, they shall be packed with single or more like items. The shipping containers shall be marked in accordance with paragraph 5.4.1 above, and the supplier's standard marking for address and precautionary handling. Shipping containers packed with unlike items shall be marked with the supplier's marking for address and precautionary handling.