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Orbiter Processing Facility Payload Processing and Support Capabilities

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ORBITER PROCESSING FACILITY

PAYLOAD PROCESSING AND SUPPORT CAPABILITIES

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LIST OF EFFECTIVE PAGES

Revision D supersedes Revision C, dated December, 1991.

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LIST OF ABBREVIATIONS AND ACRONYMS

The following abbreviations and acronyms are used in this document. A more comprehensive listing is contained in NASA Reference Publication 1059 Revised, *Space Transporation System and Associated Payloads: Glossary, Acronyms, and Abbreviations*.

A	ampere
ac	alternating current
APS	Aft Propulsion System
ARCS	Aft Reaction Control System
bps	bits per second
^{o}C	degree Celsius
C&T	Communications and Tracking
CCTV	closed circuit television
CRT	Cathode-Ray Tube
dc	direct current
ECLSS	Environmental Control and Life Support System
^{o}F	degree Fahrenheit
f-c	foot-candle
FRCS	Forward Reaction Control System
GHe	Gaseous Helium
GN_2	Gaseous Nitrogen
GSE	ground support equipment
HEPA	High Efficiency Particle Air (filter)
HVAC	heating, ventilating, and air conditioning
Hz	hertz
ICD	Interface Control Document
I/O	input/output
kbps	kilobits per second
KSC	John F. Kennedy Space Center
LC	Launch Complex
LCC	Launch Control Center
lm	lumen
LPS	Launch Processing System
LSSM	launch site support manager
MHz	megahertz
NASA	National Aeronautics and Space Administration
NRZ-1	nonreturn to zero level

LIST OF ABBREVIATIONS AND ACRONYMS (Con't)

O&C	Operations and Checkout (Building)
OIC	Orbiter Integrity Clerk
OIS	Operational Intercommunication System
OIT	Orbital Interface Test
OMS	Orbital Maneuvering Subsystem
OPF	Orbiter Processing Facility
PHE	propellant handlers ensemble
PLB	payload bay
ppm	parts per million
PS	Protective Services (a KSC NASA directorate)
SID	Standard Interface Document
SLF	Shuttle Landing Facility
SPC	Shuttle Processing Contractor
SSME	Space Shuttle Main Engine
TACAN	Tactical Air Command and Navigation System
TPS	Thermal Protection System
V	volt
VAB	Vehicle Assembly Building
WBTS	Wideband Transmisison System

FOREWORD

Launch site payload processing facilities are described in three levels of documentation. These levels and their purposes are:

a. K-STSM-14.1, *Launch Site Accommodations Handbook for Payloads* - This document provides a brief summary of each facility and a general description of John F. Kennedy Space Center (KSC) launch and landing site operations.

b. Facility Handbooks - Each handbook provides a narrative description of the facility and its systems. Also, general operating rules, regulations, and safety systems are discussed in these handbooks. Handbooks available are:

K-STSM-14.1.1	*Facilities Handbook for Building AE*
K-STSM-14.1.2	*Facilities Handbook for Building AO*
K-STSM-14.1.3	*Facilities Handbook for Building AM*
K-STSM-14.1.4	*Facilities Handbook for Hangar S*
K-STSM-14.1.6	*Facilities Handbook for Explosive Safe Area 60A*
K-STSM-14.1.7	*Facilities Handbook for Spacecraft Assembly and Encapsulation Facility Number 2*
K-STSM-14.1.8	*Facilities Handbook for Radioisotope Thermoelectric Generator Storage Building*
K-STSM-14.1.9	*Facilities Handbook for Life Sciences Support Facility Hangar L*
K-STSM-14.1.10	**Payload Accommodations at the Rotating Service Structure*
K-STSM-14.1.12	*Facilities Handbook for Vertical Processing Facility*
K-STSM-14.1.13	**Orbiter Processing Facility Payload Processing and Support Capabilities*
K-STSM-14.1.14	**O&C Building Payload Processing and Support Capabilities*
K-STSM-14.1.15	*Facilities Handbook for Payload Hazardous Servicing Facility*

These facility handbooks are not under configuration control; however, they will be reissued as necessary in order to maintain usefulness to customers in their planning for launch site processing of their payloads.

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* These handbooks are titled differently because the facilities also serve functions other than payload support. Only the payload accommodations are described in these documents.

c. Standard Interface Documents (SID's) - These documents are intended to provide the payload-to-facility interface design details for these launch site payload processing facilities.

SID 79K12170	*Payload Ground Transportation Canister*
SID 79K16210	*Vertical Processing Facility*
SID 79K16211	*Horizontal Processing Facility (O&C Building)*
SID 79K17644	*Payload Strongback*
SID 79K18218	*Launch Pad 39A*
SID 79K28802	*Launch Pad 39B*
SID 79K18745	*Orbiter Processing Facility*
SID 82K00463	*Payload Environmental Transportation System Multiuse Container*

SID's are not available for all launch site payload processing facilities. In these cases, the facility handbooks must be used for design interface information and customers should ask for verification of any areas of concern. When SID's are available, they should be used as the official definition of the facility interfaces. There are some SID's for which there are no handbooks; e.g., the payload strongback and the Payload Environmental Transportation System (PETS) multiuse container. In these cases, the SID's must be used.

Customers may obtain copies of any of these documents through the assigned launch site support manager (LSSM).

SECTION I

INTRODUCTION

1.1 PURPOSE

The purpose of this handbook is to provide basic information regarding payload processing and support capabilities in the Orbiter Processing Facility (OPF) at the John F. Kennedy Space Center (KSC). The buildings and location are shown in figure 1-1.

1.2 SCOPE

This handbook is intended to be used by Space Shuttle customers as a guide for planning payload processing activities in the OPF. It describes general payload capabilities of the OPF. Detailed payload-oriented interfaces are contained in 79K18745, SID, Orbiter Processing Facility, which is referenced throughout the text for specific interfaces.

1.3 CUSTOMER CHARGE

Use of the OPF for payload integration is considered a standard service. Support for payload stand-alone testing or unique services could result in optional charges.

1.4 FACILITY ACCOMMODATIONS

Facility accommodations available to the customer as identified herein provide support to all payload elements of the mission manifest and to other payload elements being processed simultaneously. The customer must remain cognizant during his design development of the necessity to share these facilities with other payload elements. In cases where the facilities will be required for days as opposed to hours, or when required during major integrated tests, the designer should coordinate his requirements closely with the LSSM. An example of such a case would be shared ground support equipment (GSE) interfaces to the facility. These interfaces may be required for long periods of payload element testing.

Customers should be familiar with OMI No. S9908, *Orbiter Processing Facility (OPF), Emergency Procedures Document (EPD).*

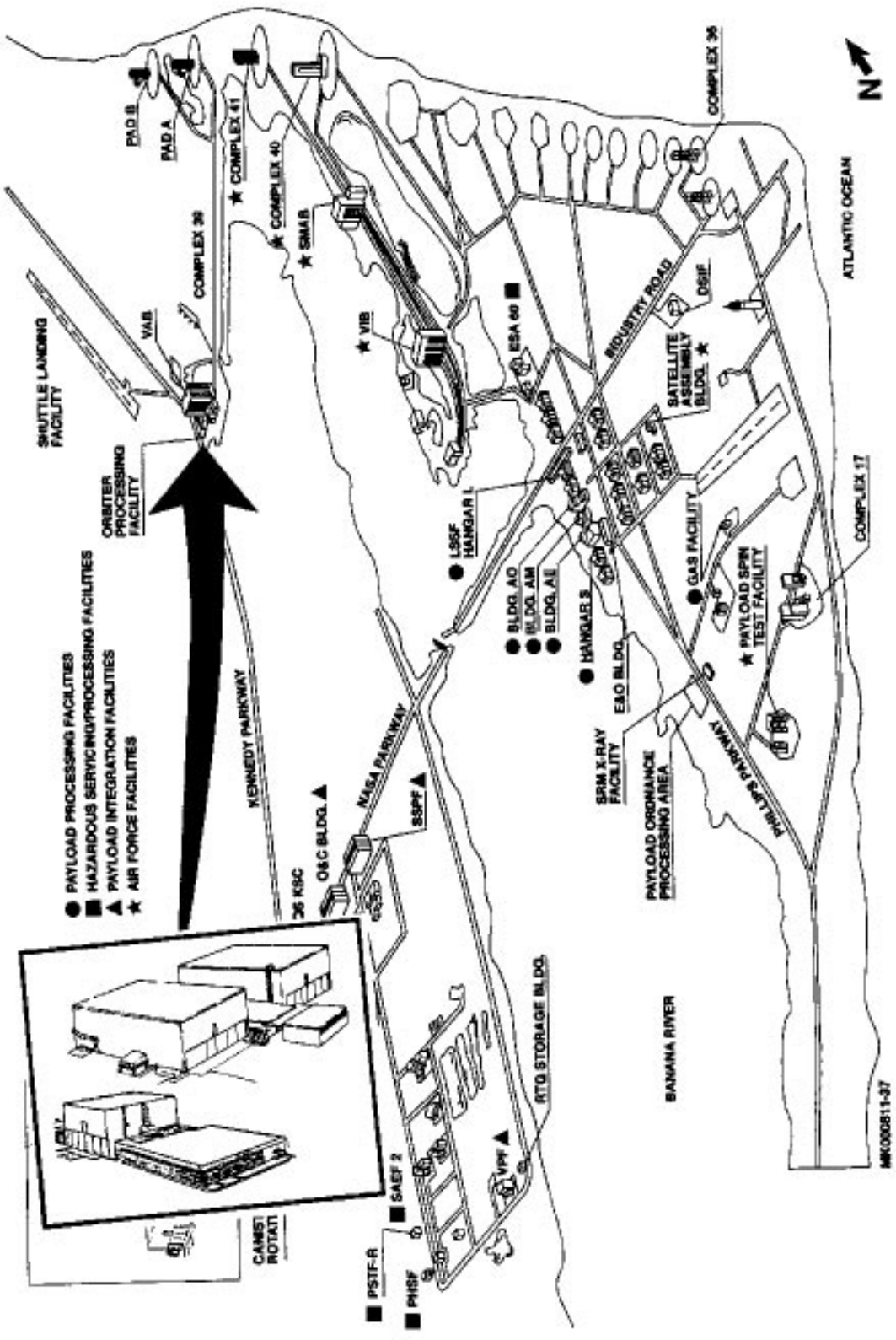


Figure 1-1. KSC/CCAFS Payload Processing Facilities

SECTION II

FACILITY DESCRIPTION

2.1 LOCATION AND DESCRIPTION

OPF facilities (Figure 2-1) are located to the west and to the north of the Vehicle Assembly Building (VAB) in part of the Launch Complex (LC) 39 area. The dual facility, to the west of the VAB, consists of two large concrete and steel high bay areas with access stands joined by a low bay. A service and support annex is on the north side. The three OPF's are approximately 71.9 meters (m) (236 feet (ft) long by 121.3 m (398 ft) wide. Each high bay is 60.0 m (197 ft) long by 45.7 m (150 ft) wide containing approximately 79,457 m^3 (2,806,000 cubic ft). The low bay area is 71.9 m (236 ft) long by 29.9 m (98 ft) wide. The single OPF located to the north of the VAB consists of a high bay area with access platforms and a low bay office and storage area attached to the east side.

The low bay area for high bay 3 is 57.6 m (189 ft) long by 70.1 m (230 ft) wide and is a two story 8,082.3 m^2 (87,000 square foot) support facility with the first floor housing processing shops, logistics, flight hardware storage, and the second floor office space for 180 personnel.

Also considered part of the OPF are the hypergolic fuel and oxidizer deservicing pads on the south side of the dual facility high and low bays, the OPF pumphouse, and the gaseous oxygen (GO_2) and gaseous hydrogen (GH_2) storage pads. The latter are well separated and placed well away from the main building. Figure 2-2 shows the OPF site plan.

Figure 2-1. Orbiter Processing Facilities

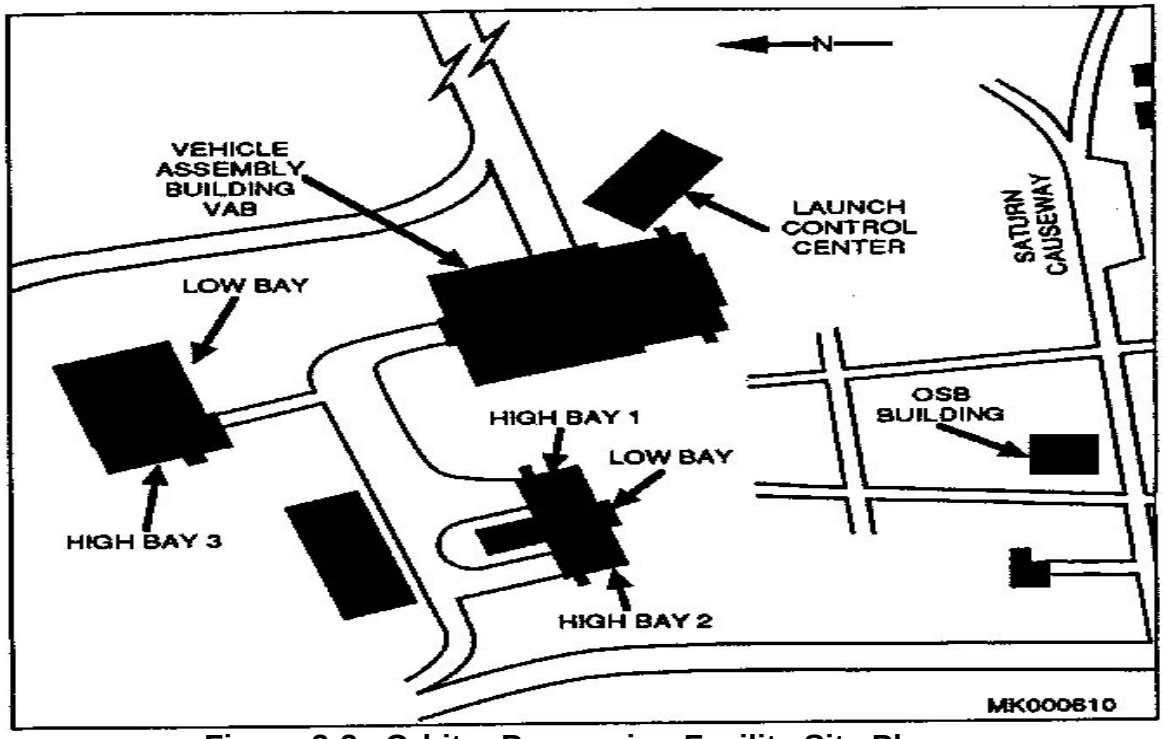


Figure 2-2. Orbiter Processing Facility Site Plan

2.2 FUNCTIONS

The OPF is used primarily for orbiter activities. It is the prime facility for orbiter processing preflight and postlanding. Access is provided to all external and limited internal surfaces of the orbiter to perform the following operations:

a. Draining and purging all fuel systems

b. Removing ordnance

c. Repairing and replacing damaged components

d. Inspecting and refurbishing the Thermal Protection System (TPS)

e. Inspecting and testing of orbiter systems such as landing gear, main and auxiliary propulsion, power units, flight instrumentation, communications and orbiter hydraulics

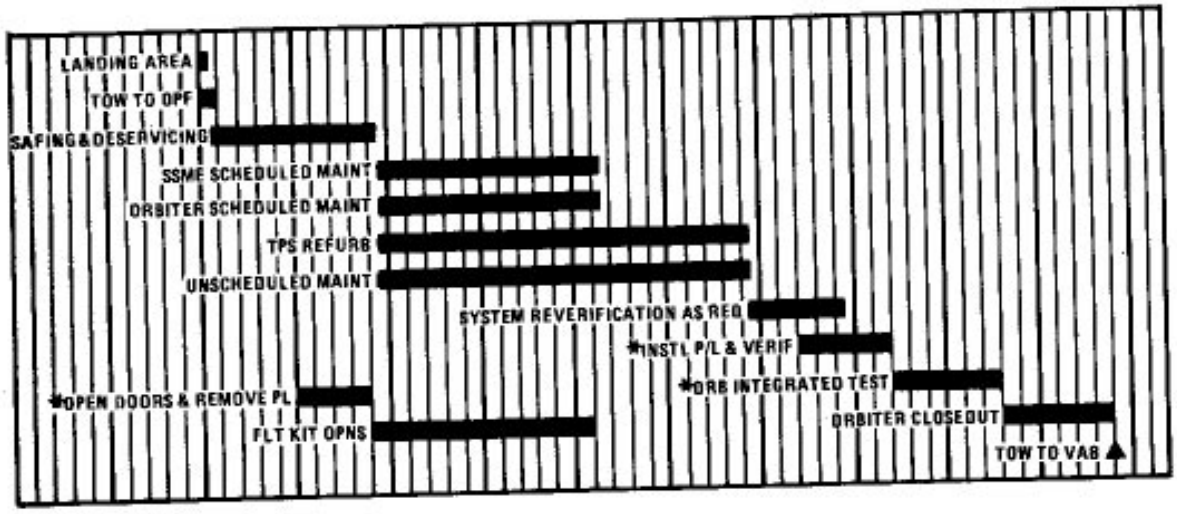
f. Payload bay configuration, testing

g. Payload installation, connection, and removal

Payload-related functions involve installation, connection, and removal of horizontally-processed payloads and flight kits, removal of support structures and cradles for deployed payloads, removal of aborted or returned payloads or elements, and checkout of orbiter-to-payload interface(s). Payloads can be located in the orbiter crew cabin in the middeck and in the payload bay. Orbiter activities are conducted in the OPF high bays with remote control functions performed from the Launch Control Center (LCC)

firing rooms. Figure 2-3 presents a summary flow of OPF orbiter/payload activities. Payload-related activities are indicated by an asterisk (*). Figure 2-4 shows a Space Shuttle scientific payload being lowered into the orbiter payload bay.

The orbiter is towed to one of the OPF high bays after landing at the Shuttle Landing Facility (SLF). Certain critical middeck experiments and Spacelab module experiments can be removed through the orbiter crew egress (side) hatch (through the Spacelab tunnel) shortly after landing at the SLF before towing. Deservicing of the orbiter and payload removal begin in the OPF shortly after the orbiter is jacked and leveled and the payload bay doors are opened. After refurbishment of the orbiter systems, installation of the payload and flight kits, and pre-closeout activities (such as mission/payload special tests, film canister loading, and cover removal), the payload doors are closed and the orbiter towed to the VAB for rotation to the vertical position and stacking with the Solid Rocket Boosters and External Tank.



* Payload Related Activities

Figure 2-3. Typical Flow of OPF Activities

2.3 FACILITY ACCESS

The OPF is surrounded by a chain link fence with access to the OPF dual facility gained through the north gate for personnel and equipment. There is a south gate that is locked except for payload transporter entry. High bay 3 is accessed from the south gate for personnel and equipment. Access is controlled by the KSC security force.

Figure 2-4. SLS-02 Payload Being Lowered Into Payload Bay in OPF

2.3.1 OPF ACCESS CONTROLS. Existing restrictions for OPF access will be strictly enforced and include:

a. All personnel requiring access must possess area permits 20, 21 and 22 for OPF bays 1 & 2; 23 & 24 for bay 3; and 70 & 73 for all three bays.

b. Access to the orbiter will be limited to essential personnel and controlled by the Orbiter Integrity Clerk (OIC).

c. Personnel access for the orbiter crew compartment is through a white room

d. Orbiter/level 13 platform clothing and activity requirements will be as outlined in KVT-PL-0024/0025. Clothing is issued in and returned to the OPF tool crib.

2.3.2 OPF WORK AREA CONTROLS. Anytime personnel go up from the OPF main floor, specific instructions control items such as personal items carried in pockets, eye glasses, watches, hard hats, etc. Examples of these controls are:

a. All personal items must be removed from upper pockets.

b. Badges must be worn below waist level.

c. Watches and rings must be removed or taped.

d. Eye glasses must be tethered.

e. All tools must be tethered.

f. Access is restricted within 0.9 m (3 ft) of orbiter. Orbiter Integrity Clerk (OIC) will provide specifics.

g. Flammable liquids must be approved.

2.3.3 PERSONNEL ACCESS. Personnel entrance to each high bay from the low bay is through an enclosed entryway with separate doors and passageways for entering and exiting. The clearance through these airlock-type doors is 1.1 m (3 ft 5 inches (in)) wide by 2.1 m (7 ft) high. See figures 2-5 and 2-6 for location of these and other doors to the high and low bays.

2.3.4 EQUIPMENT ACCESS. Small equipment can be brought in through personnel doors or on the north side of the dual facility from the low bay through the rollup doors 4.9 m (16 ft) wide by 3.1 m (10 ft) high. Larger equipment may enter through the north side orbiter entrance doors 28.4 m (93 ft 4 in) wide by 10.7 m (35 ft) high or through either of two south side high bay doors 3.7 m (12 ft) high and 9.1 m (30 ft) wide and 9.1 m (30 ft) wide by 9.1 m (30 ft) high (figure 2-5). High bay 3 (see figure 2-6) has similarly dimensioned doors with the personnel and roll-up doors on the east side and main orbiter doors on the south entrance. Payloads enter from the north doors approximately 9.1 m (30 ft) wide by 9.1 m (30 ft) high.

Whenever possible, GSE should be brought into the high bay through the personnel entry doors to prevent unnecessary opening of the larger doors.

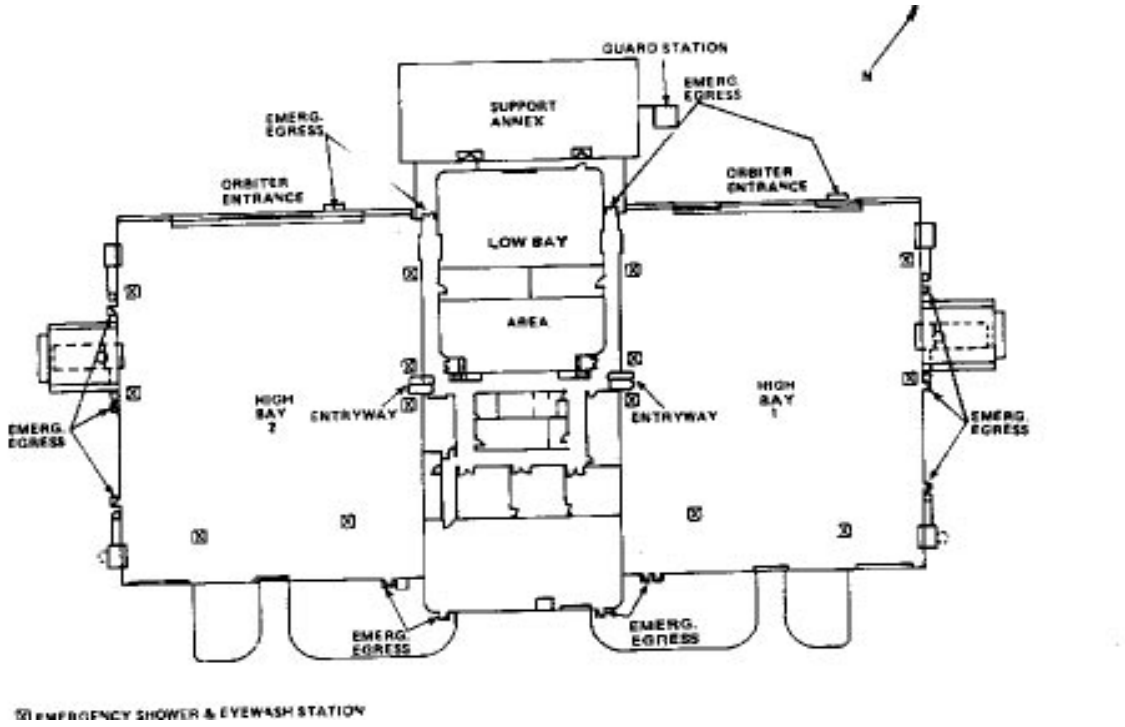


Figure 2-5. OPF General Layout Showing Access/Egress for High Bays 1 and 2

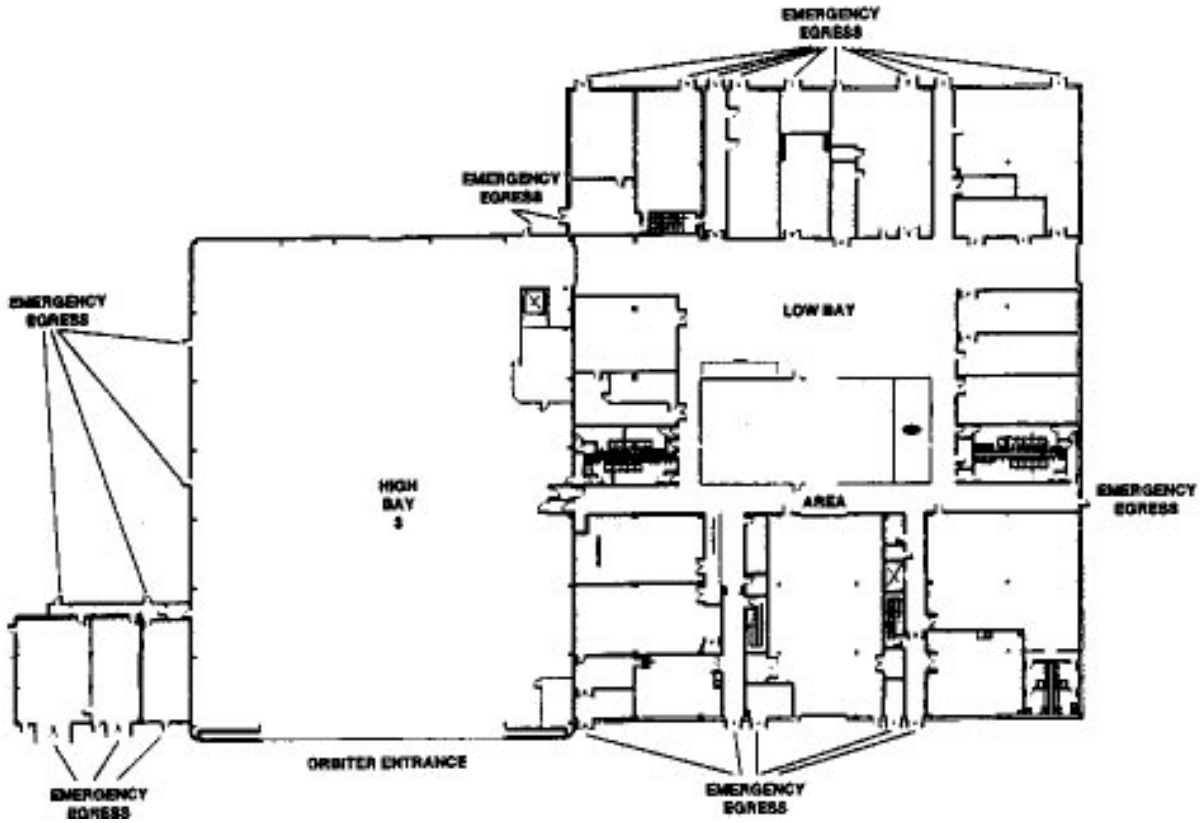


Figure 2-6. OPF General Layout Showing Access/Egress for High Bay 3

2.3.5 EMERGENCY EGRESS. The OPF's are designed to allow rapid egress from any part of the facility under emergency conditions. Emergency egress doors for the high bays are located on all walls and on the north and south walls of the low bay. All emergency egress doors, including the main personnel entry, are equipped with crash bars for emergency egress. Once outside, all personnel must proceed to the marshalling area as directed for headcount and further direction by safety.

2.4 ENVIRONMENT

The OPF's are defined as class 300,000 clean work areas with High Efficiency Particle Air (HEPA) filters providing a class 100, guaranteed class 5,000, non-laminar air flow to the OPF. The payload bay and OPF level 13 access platforms are class 100,000 work areas. OPF temperature is maintained at 21.1 +/- 2.8^{o} C (70 +/- 5^{o} F). Relative humidity is 50 percent maximum. Each OPF is continuously monitored by seven Environmental Monitoring Data System (EMDS) monitoring devices for particle counts and two also measure temperature and humidity. White rooms with air showers are used to access the orbiter crew compartment. Personnel entering the orbiter crew cabin and payload bay must wear clean room garments, including head and foot coverings. Clean room attire can be obtained at the logistics tool crib located in the low bay room 101 between high bays 1 and 2 and in low bay room 1121 in high bay 3.

2.5 SAFETY

2.5.1 GENERAL. Due to the type of work involved with processing an orbiter and payload, i.e., heavy equipment and hardware lifting, ordnance handling, working at heights, high pressure gases, and hazardous commodity servicing/deservicing, the facility is classified as a "Hazardous Facility". Therefore, the OPF is equipped with fire protection, hazardous chemical, and gas disposal equipment.

2.5.2 FIRE PROTECTION-HIGH BAY

a. Detection. Fire detection is accomplished automatically by the use of smoke and heat detectors and manually by fire alarm pull stations. Each bay is equipped with ceiling-mounted ionization-type smoke detectors that send an early warning signal to Protective Services (PS) Control but do not ring fire alarm bells.

Manual fire alarm pull stations are located at all exits and on access platforms; the platforms are also equipped with heat activated devices. Activation of either a pull station or heat detector will alert PS-Control and ring the fire alarm bells. In addition, the use of any high bay sprinkler fire suppression system will activate a flow indicating device that will alert PS-Control and ring the OPF fire alarm bells.

b. Suppression. Fire suppression in the OPF high bays consists of three major subsystems: a sprinkler system, hose reels, and dry chemical (Ansul) extinguishing systems. The sprinkler system is divided into seven zones, six for the orbiter and one for the access stands. Five of the orbiter zones have sprinkler nozzles located near the ceiling above the orbiter. The remaining zone provides fire protection and flushing at floor level beneath the orbiter and access stands. The zone for the access stands is divided into nine subzones designed to spray on various hazardous areas of the orbiter, access stands, and egress paths.

The access stand's nine subzones are activated by operating two 1/4-turn valves in series at one of nine locations. Activation of any sprinkler zone, electrically or manually, initiates a fire alarm for building evacuation.

Each bay is equipped with six water hose reels located in each corner and midway down each side. There are two hose reels on each high bay roof and hose reels on the access platforms. Hand-operated fire extinguishers are provided at convenient locations in the high bay.

Hydraulic control units in each high bay and hydraulic pump units outside of each bay are protected by dry chemical (Ansul) fire suppression units. Activation of these systems is accomplished automatically by a heat-activated device or manually by pull stations. Activation of either dry chemical system will alert PS-Control, but only the systems protecting the hydraulic control units inside the bay will ring the fire alarm bells.

2.5.3 HYPERGOLIC EXHAUST SYSTEM. The OPF is equipped with an emergency Hypergolic Exhaust System that works in conjunction with the normal building HVAC system. Accidental propellant spills are disposed of by means of the OPF hypergolic flush system, fire hoses, and the hypergolic drain; this protects the low bay from hypergolic fumes migrating from the high bay. The hypergolic exhaust system must be manually activated at stations located in the high bays (east, west, and south walls, and on the ground floor).

When activated, a sequence of several motor-operated dampers reposition, causing a change in direction of the airflow. Recirculation is prevented and the emergency exhaust stack blowers located on the south side of the high bays activate. Fumes are drawn out of the high bay, which is at negative pressure, and released to the atmosphere through the exhaust stack. Two air-handling units in each high bay bring in 100 percent outside air during draw-out of fumes.

2.5.4 OTHER SAFETY PROVISIONS. Hydrogen leak detectors (connected to the Launch Processing System (LPS)), a hydrogen vent fan in the ceiling of each high bay, hypergol leak detectors and spill removal equipment, hazardous gas detectors, and propellant handlers ensembles (PHE's) are provided for PHE-qualified personnel to protect personnel and equipment from hazardous gases and chemicals, when required. Hypergolic spill kits are located on the ground floor and platforms in hazardous areas. Each high bay is equipped with strategically located emergency showers and eyewash stations. These are shown in figure 2-5. A PA system with an aural warning device is also part of the OPF safety provisions.

2.6 OPERATING REGULATIONS

After passing the guard station, all personnel entering the high bays when the orbiter is present must check with the Operations Control Desk located just inside the high bay opposite the personnel entryway next to the middle of the main access stand. (Customers should check in through the adjacent Payload Operations Control Desk.) The Operations Control Desk controls orbiter testing and general operations in the high bay. Personnel must have appropriate OPF and orbiter training, must be properly

badged, or be escorted by authorized personnel in and around the orbiter. Hard hats are not worn, except as directed by Safety for lifting operations.

When entering the main access stands, personnel are instructed by posted notices that all personal items must be removed from the upper pockets, including badges or similar items; all jewelry should be removed or taped in place; and all tools and eyeglasses must be tethered. Contact lenses should not be worn during hazardous operations involving orbiter subsystems with toxic substances.

Employees working in or visiting the high bays must be properly attired with regard to feet and torso. Shoes must cover the entire foot, be low and wide heeled, and have soles heavy enough to afford adequate protection. In areas where hazardous liquids or fuels are located, canvas or cloth sneakers and nonporous shoes with breather holes are prohibited.

Full length trousers and slacks are required; short sleeved shirts and blouses are permitted. Tank tops, skirts, and/or shorts are not permitted.

SECTION III

ELECTRICAL SYSTEMS

3.1 ELECTRICAL SYSTEMS

The OPF's have alternating current (ac) and direct current (dc) electrical power available in the buildings.

3.1.1 AC ELECTRICAL POWER. The following types of ac electrical power are available on the platforms used for payload access and support equipment:

	Voltage	Phase	Amperage	Hertz	Receptacle Type
a.	115	single	20	60	CH FSQC-2320-GB-S4
b.	120	single	15	60	NEMA 5-15R Duplex
c.	120	single	15	60	CH B2120
d.	120	single	15	60	AP EFSCB 175-2023M
e.	120	single	15	60	DUPLEX
f.	120	single	15/20	60	NEMA5-15R,5-20R DUPLEX
g.	120	single	20	60	AP EFSCB175-2023
h.	120	single	20	60	FSQC 2320GB
i.	120	single	20	60	B21201 M3
j.	120	single	20	60	DUPLEX
k.	120	single	30	60	RS 3756
l.	120	single	20/30	60	NEMA L5-30
m.	120	single	30	60	CH FSQC 2320-GB-S4
n.	120	single	20	400	HU 23030
o.	120/208	three	30	60	CH RPE033-0235-01
p.	120/208	three	30	400	CH RPC-233-127-S02BR
q.	120/208	three	30	60	RS DF3516FRD
r.	480	three	20	60	RS 8031
s.	480	three	30	60	RS 7114
t.	480	three	30	60	CH BHRC 3482D
u.	480	three	60	60	RS 7124
v.	480	three	100	60	CH BHRC 10485D
w.	480	three	200	60	CH GBB-1728-31SL-BL

Receptacles used in the high bays consist of standard industrial, explosion proof, and weatherproof types depending on use. They are mounted on the workstands approximately
45.7 cm (18 in) above the platform. Locations and types are identified in SID 79K18745.

Standard 120-volt, single-phase, 20-ampere, 60-hertz ac power is available on the walls of the high bays. When diesel power is not acceptacle, 480-volt, three-phase, 200-ampere, 60-hertz power is available for use for transporter canister ingress and egress.

Emergency 120/208-volt, 60-hertz power is provided in an OPF for lighting and other selected circuits in the event of a facility power failure.

A rack-mounted GSE power unit that provides 60-hertz and 400-hertz, single phase and three phase, and 12 kVA can be made available for use in an OPF.

3.1.2 400-HERTZ ELECTRICAL POWER. There are five 30-ampere receptacles (CHRPC-233-127-S02BR) located at ground level on the west side of high bays 1 and 2 and three receptacles located on the east side of high bay 3. There are two 20-ampere receptacles (HU230230) at column PA-2B on the ground level. Use of these receptacles for payload activities must be scheduled.

3.1.3 DC ELECTRICAL POWER. 28-volt dc is provided through the orbiter for checkout of payloads in the orbiter bay.

3.1.4 GROUNDING SYSTEMS. All structural steel and other appropriate metallic components and equipment are connected to the facility grounding system.

Grounding points are contained on all platforms. Grounding for instrumentation or GSE is located on most of the platforms that provide ac power interfaces. The instrumentation system is single-point grounded. Instrumentation ground connections are provided on the platforms used for payload access and equipment. Locations of ground connections are provided in SID 79K18745.

3.1.5 ILLUMINATION. Lighting in an OPF is provided by fluorescent, incandescent, mercury-vapor, and high-pressure sodium lamps. Additional intensity may be provided by portable work lights.

3.2 TEST ACTIVITIES

For horizontally installed payloads, the payload-to-orbiter interface test is conducted in an OPF. It is performed under an integrated Operations and Maintenance Instruction (OMI). The objective is to verify all electrical interfaces between the orbiter and payload/pallet subsystem. During this interface test, ac and dc power is usually supplied from the orbiter, as are communications. There is only a limited T-O interface available in the OPF and no hardware interface module capabilities.

SECTION IV

MECHANICAL SYSTEMS

4.1 GENERAL

The OPF main areas presented in this document are the low bays, the support annex, and the high bays.

4.2 LOW BAYS

One low bay is located between the dual facility high bays and another to the east of OPF high bay 3. Their purpose is to provide support for orbiter operations. Figures 4-1 and 4-2 show the low bays and identify the main areas.

The dual facility low bay has a mezzanine above the southern portion of room 107 which houses the communications room and offices. The low bay corridor contains the water sprinkler control panels, pre-action sprinkler system and the fire alarm annunciator. Except for restroom facilities, there are no provisions for payload customer support in the OPF low bay.

4.3 SUPPORT ANNEX

The support annex is a two-story structure on the north side of the dual facility OPF low bay and is connected to the low bay by a covered walkway. It houses NASA and contractor personnel who directly support OPF operations and comprises offices and conference areas. The Payload Ground Operations Contractor has a permanent room (room 2109B) in OPF 3 annex, Building K6696.

4.4 HIGH BAYS

The OPF high bays house orbiters in both pre- and postflight status. Processing of the orbiter is the primary function of each high bay. To accomplish this, each high bay is equipped with a set of platforms that completely surround the orbiter to facilitate access and maintenance.

4.4.1 MAIN ACCESS PLATFORMS. The orbiter main access platforms, or workstands, provide personnel access to all external surfaces of the orbiter (except the bottom skin surfaces) and support the necessary equipment and systems involved in servicing, deservicing, safing, maintaining, and testing the orbiter. The platforms are part of a steel and aluminum structure supported by the building pile foundation system. Main access platforms are shown in figure 4-3 and 4-4.

4.4.1.1 Functional Description. The access platform structure includes three basic platform levels with additional movable platforms arranged to provide proper clearance for towing the orbiter (nose-in attitude) into position for jacking and leveling within the platforms and for varying clearances compatible with the subsequent maintenance and checkout operations. The platforms are designed to support GSE, test support equipment, personnel safety showers, Firex systems, elevator, and small hoists, and to provide for certain test support equipment ready storage.

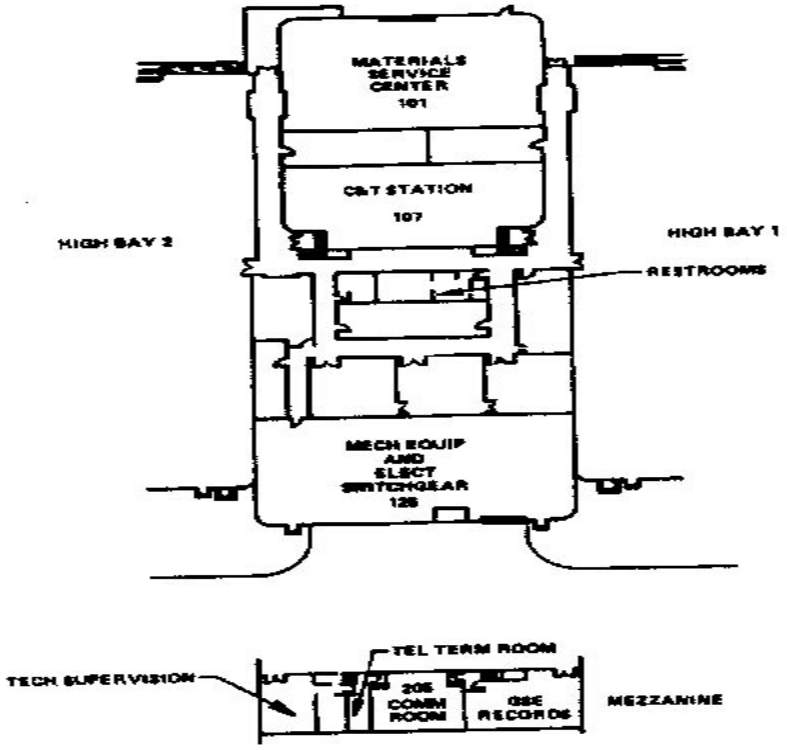


Figure 4-1. Dual Facility Orbiter Processing Low Bay

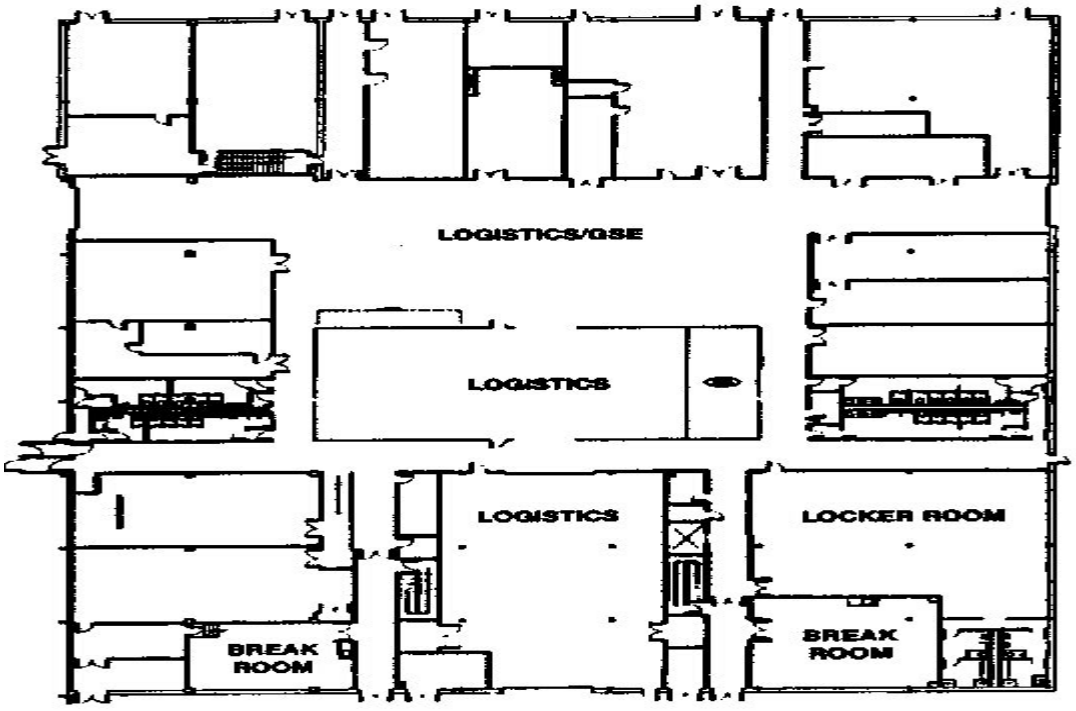


Figure 4-2. Single Facility Orbiter Processing Low Bay

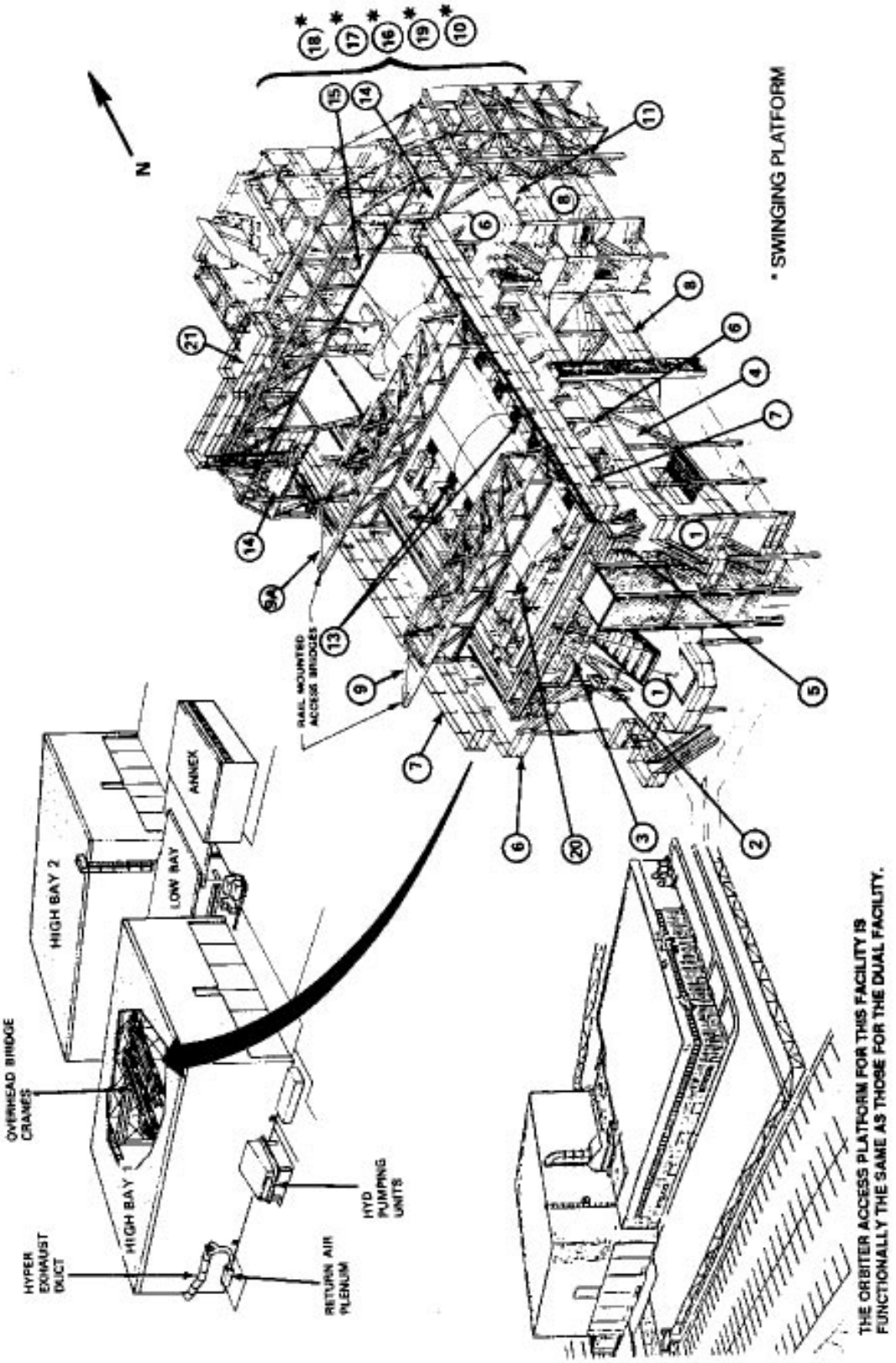


Figure 4-3. OPF High Bay Main Access Platforms

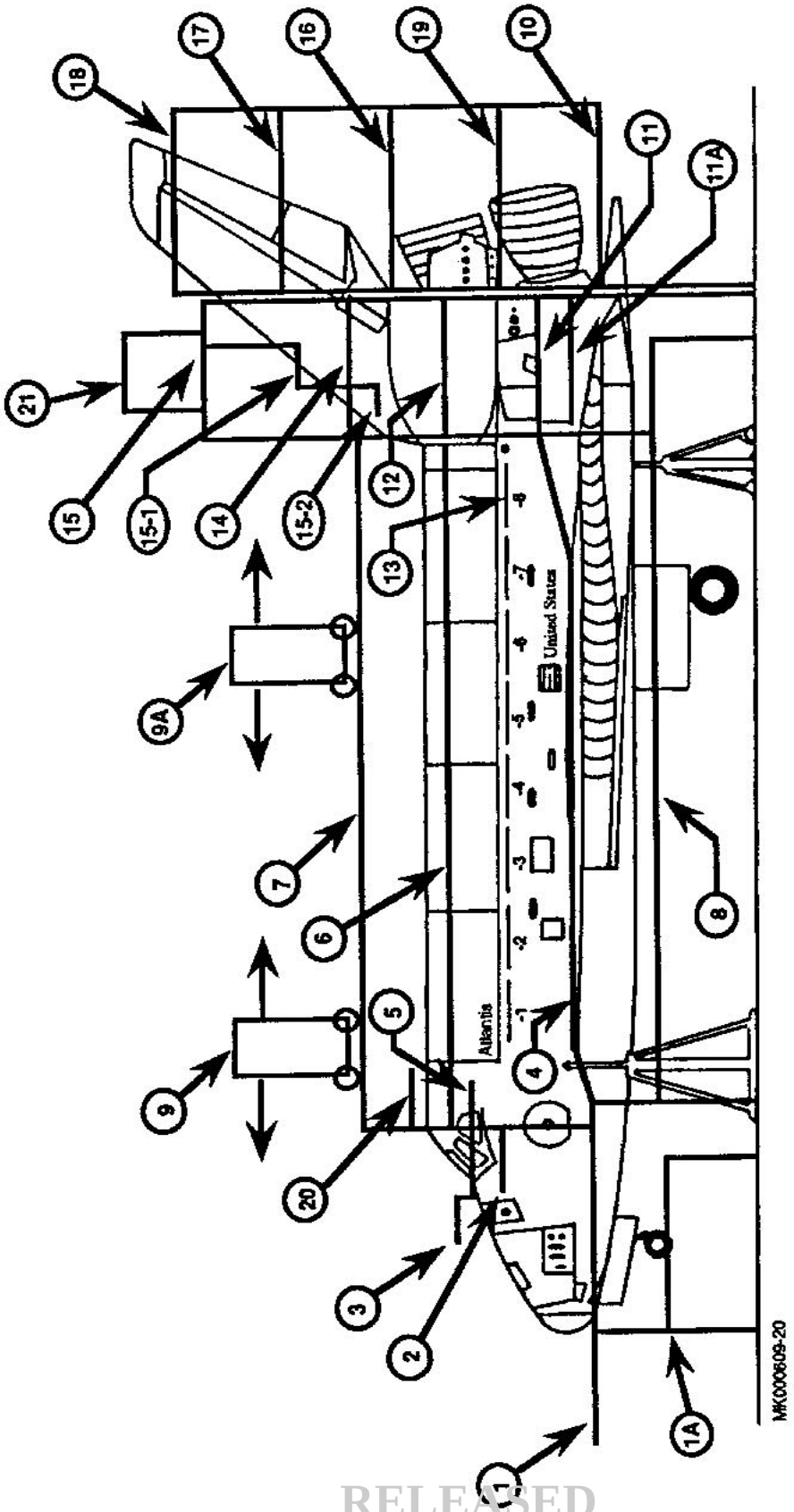


Figure 4-4. OPF High Bay Workstands

Platforms support the fluid and gas system lines and electrical signal and power cabling required to support vehicle operations within the OPF such as stowage and destowage of payloads in the crew compartment, the middeck area, and the payload bay. Other payload support functions include servicing, deservicing, safing, communication checkout, and electronic system checkout. Access is provided to the payload bay interior so that surfaces of the payload at the orbiter sill longerons can be reached.

The platforms also provide for all types of scheduled and unscheduled maintenance operations on the orbiter.

4.4.1.2 Types of Platforms. There are various types of platforms, fixed and movable. Several fixed platforms have flip-down segments, hydraulic scissor platforms, extendibles, and bolt-on additions to allow further access. The platforms are numbered, painted, and joined by ramps, stairs, and ladders. The ramps, stairs, and ladders have non-slip surfaces. The platforms for bays 1 & 2 have east and west, generally mirror -imaged portions identical except for the few orbiter-specific access platforms that are one of a kind. Table 4-1 identifies major platforms by number, sides, types, orbiter coordinate location, and primary use. High bay 3 platforms are numbered the same as those in high bay 1 and 2.

4.4.1.3 Payload Bay Access Platforms. Normal access to the payload bay is by orbiter door 44, platform 13's, and platforms 9 and 9A by telescoping buckets. Platforms are placarded with loading restrictions. Access to the midbody is by special permission and is controlled by a monitor at the desk by the white room entrance on platform 1.

Platform 13's provide personnel access to the orbiter sill area of the payload bay. These platforms are reached from platform 6. Each side has pivoting/flip-down platforms that are positioned at an elevation of Zo 425 and provide access to +/- Yo 103. Each flip-down platform is rated to support a live load of 244.1 kg/m^2 (50 lb/ft^2). There is an extensible portion at the end of each flip-down section (body harnesses are required for all personnel on extensible platforms at all times). The only facility services provided on platform 13's are vacuum cleaner lines, OIS communication, and power available through the use of extension cords. See figures 4-5 and 4-6 for platform 13's plan view and elevation and figure 4-7 for a photograph of the platform in use. A clothing changeout room is provided on platform 6 for donning clean room garments before proceeding to platform 13's.

Additionally, there are portable access stands and and platforms available for internal work in the orbiter payload bay.

Table 4-1. Main Access Platform Identification

No./ Sides	Orbiter Coordinate Location*	Type	Primary Use
1	Zo 318	Fixed	Access to crew cabin, nose FRCS
1A	Zo 318	Fixed	Contains ECLSS unit & hypers
2	Zo 384	Fixed, with extensions	Orbiter servicing - side of nose

Table 4-1. Main Access Platform Identification (Cont.)

No./ Sides	Orbiter Coordinate Location*	Type	Primary Use
3	Zo 465.5	Fixed	Crossover, forward
4	Zo 330	Fixed	Access to mid orbiter fuselage near wing
5	Zo 444	Fixed	Forward
6	Zo 478	Fixed	Access to platform 13
7	Zo 574.5	Fixed	Access to 9 & 9A
8 (A&B)	Zo 242	Fixed, with flip-down sections	Wing access
9 & 9A	Zo 629.375	Rolling	Access to telescoping buckets
10	Zo 316 to Zo 365	Swinging/bay 3 retractable	OMS/ARCS/SSME servicing
11	Zo 380	Fixed, with extensions	Orbiter servicing, aft entry
12	Zo 478 Zo 461	Fixed, with flip-downs	OMS pod
13	Zo 440 Zo 425	Flip down (8 each side bays 1 and 2 -2 each side in bay 3)	PLB sill access - runs entire length of sill area of PLB
14	Zo 588	Fixed	Access to 7
15	Zo 698	Fixed	Crossover
16	Zo 535	Swinging/Bay 3 Retractable	Orbiter tail servicing
17	Zo 650	Swinging	Orbiter tail servicing
18	Zo 745	Swinging	Orbiter tail servicing
19	Zo 436	Swinging	APS, SSME servicing
20	Zo 525.5	Movable	Over cabin
21	Zo 828.125	Fixed	Communication equipment

*OPF Floor: Zo 147; Orbiter coordinate system; refer to JSC-07700, Volume XIV

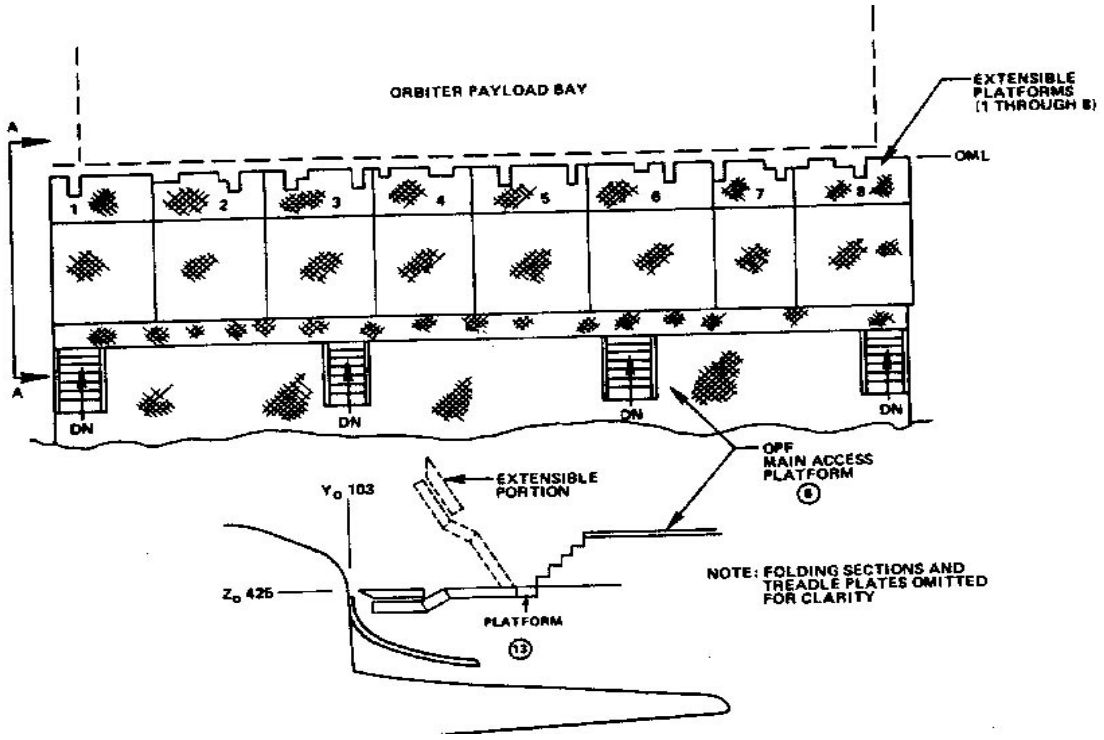


Figure 4-5. OPF Payload Access Platform 13, High Bays 1 and 2

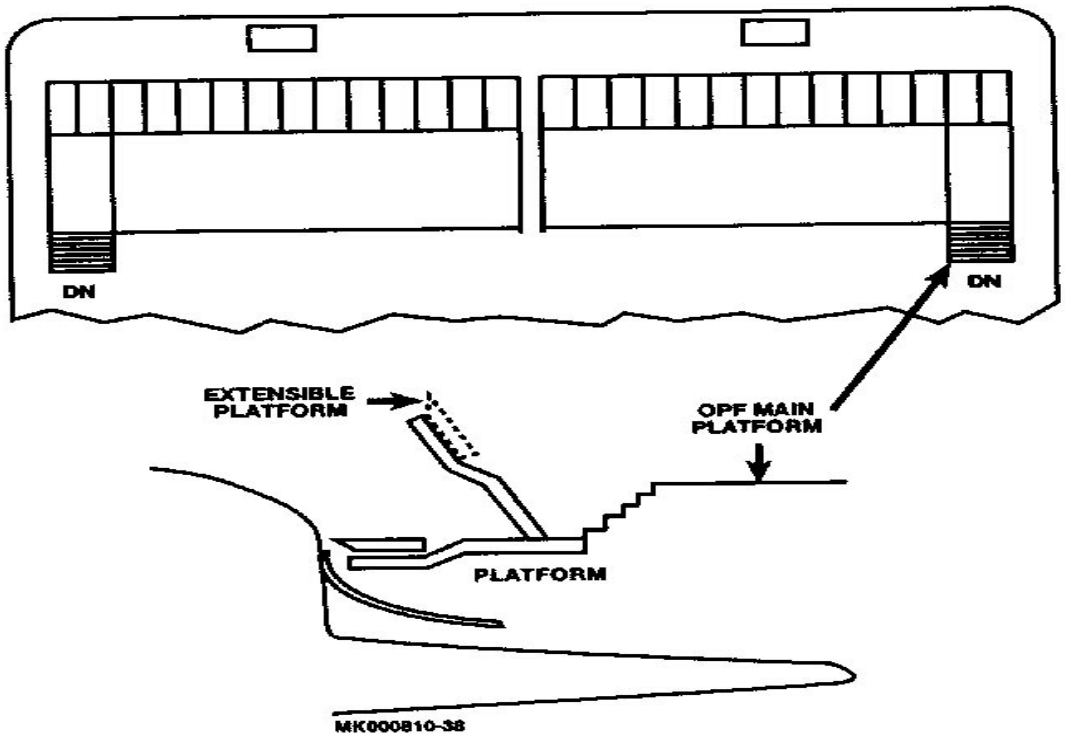


Figure 4-6. OPF Payload Access Platform 13, High Bay 3

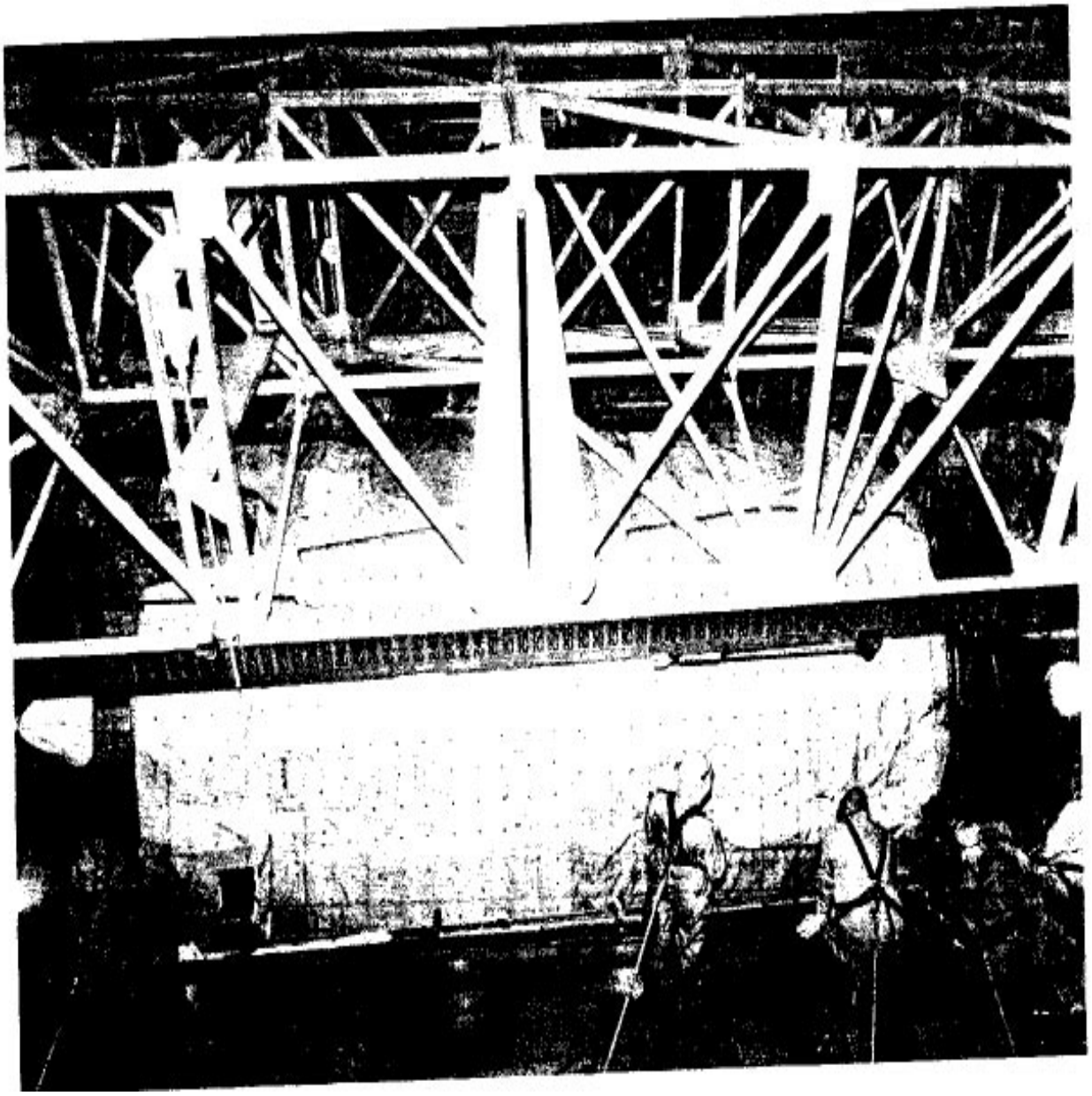


Figure 4-7. Access to Payloads from Platform 13

4.4.1.4 Access Bridges and Telescoping Buckets. Each main access platform structure contains two rail-mounted access bridges, platforms 9 and 9A (as shown in figure 4-2), that span the orbiter from one side to the other. They are powered to any Xo position over the payload bay. Each bridge supports two buckets mounted on telescoping supports, which provide a work platform 0.9 m (3 ft) wide and up to 2.7 m (9 ft) long (figure 4-8). Horizontal north-south travel bridge speed is 2.7 or 0.9 m/min (9 or 3 feet per minute); horizontal east-west travel bridge speed is 3.1 or 1.0 m/min (10 or 3 feet 4 inches per minute). The vertical speeds of the access buckets are 6.1 and 2.0 m/min (20 or 6 feet 6 inches per minute).

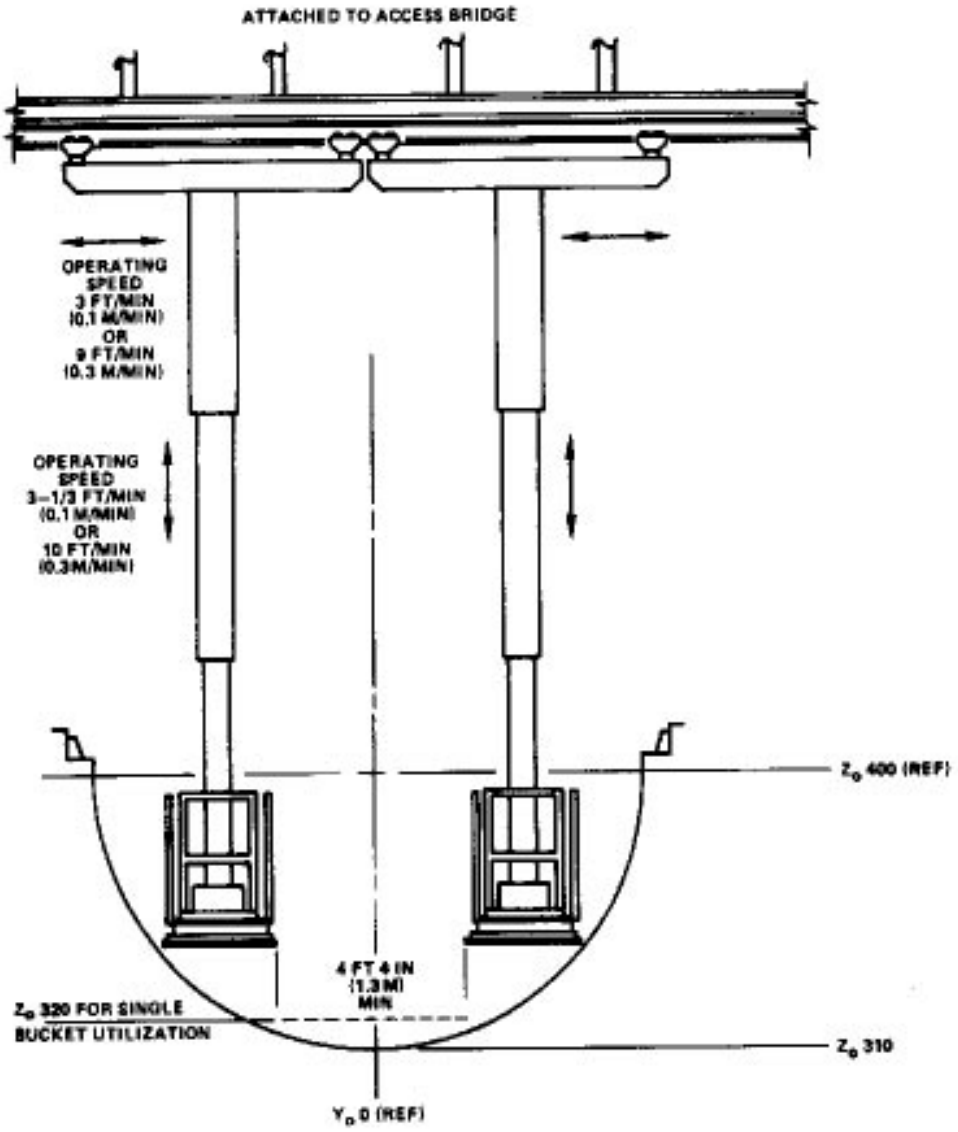


Figure 4-8. Telescoping Buckets

The buckets are motor-driven and are operated by the Shuttle Processing Contractor (SPC) for the payload organization. The buckets are stowed in a fully retracted position just under platforms 9 and 9A. Figure 4-9 shows a telescoping bucket in use in the orbiter payload bay. Figure 4-10 shows the plan view of the bucket.

These buckets can be placed in any position within the payload bay, and each bucket can traverse the bridge to clear the orbiter entirely. They can be retracted to elevation Zo 563, extended downward to elevation Zo 320, and rotated 360 degrees in a clockwise direction. The telescoping bucket platforms are designed to support a maximum live load of 1200 pounds (544.3 kg) each and no lateral loads. Each bucket can be operated from movable controls in the bucket and/or from platform 7.

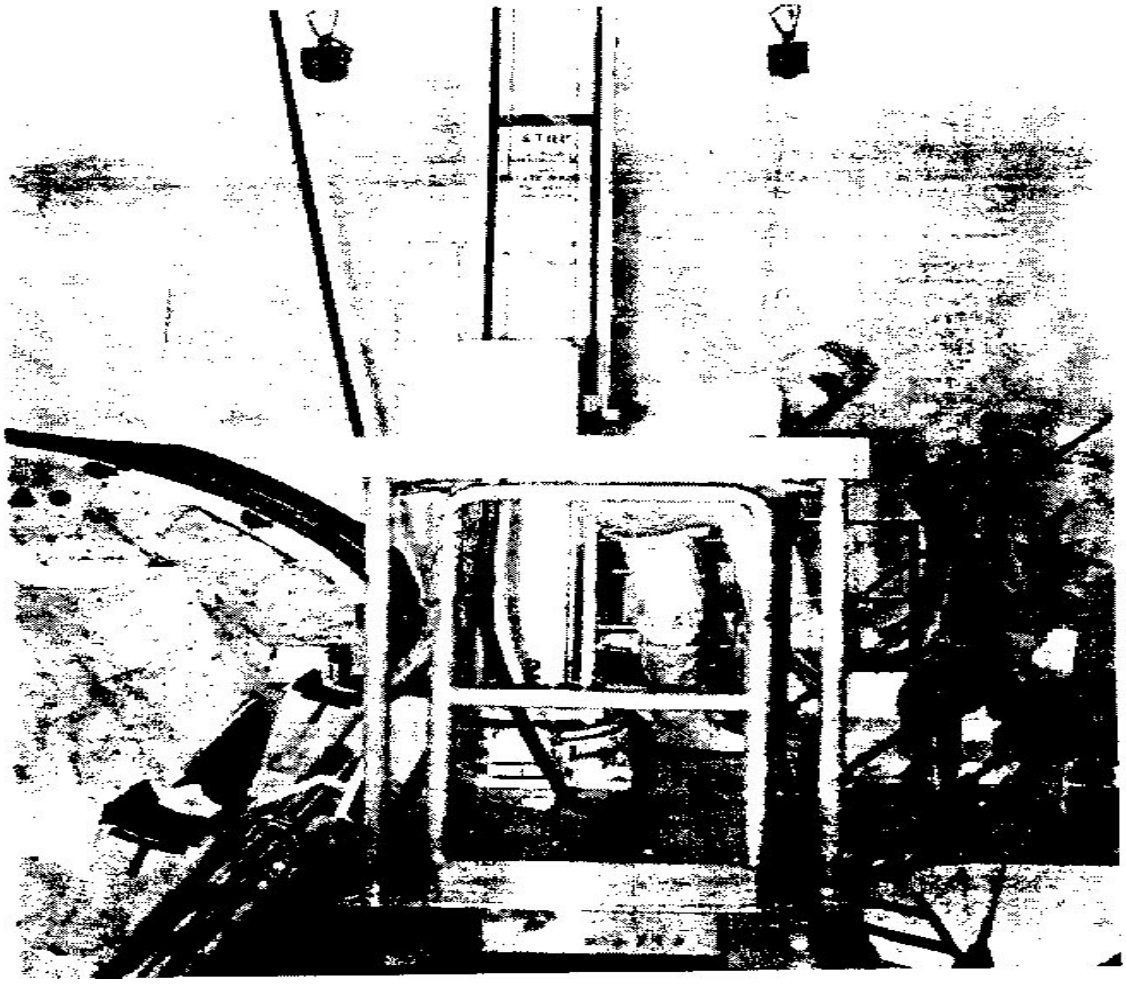


Figure 4-9. Servicing Payload Pallet from Telescoping Bucket

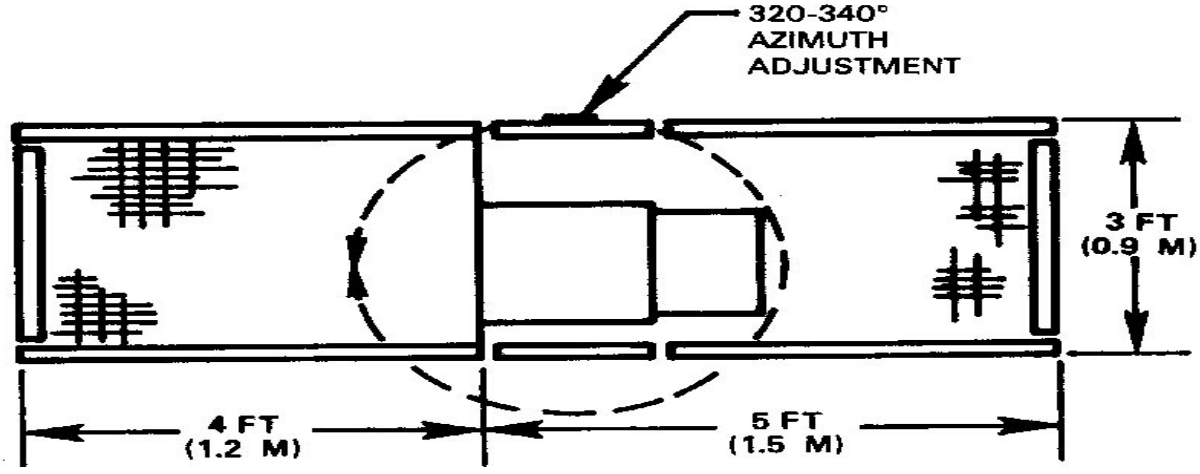


Figure 4-10. Telescoping Bucket Plan View

4.4.1.5 Experiment Access Kits. Experiment access platforms (referred to as spikes) have been designed to attach to the existing telescoping platforms by means of extension tubes. There is one extension tube provided for each bucket. Two standing access platforms 0.4 m (1 ft 5 in) wide and 0.5 m (1 ft 7-1/2 in) long will be provided. Two kneeling access platforms 0.6 m (2 ft) wide by 0.7 m (2 ft 5 in) long will be available. Each bay has a kit.

Each experiment access platform is designed to hold one man standing or kneeling or a 113.4-kg (250 pound) live load. With the experiment access platform in place, the live load of the existing telescoping bucket is decreased from 544.3 kg (1200 pounds) to 430.9 kg (950). Figure 4-11 shows a concept of the kneeling platform and extension tube.

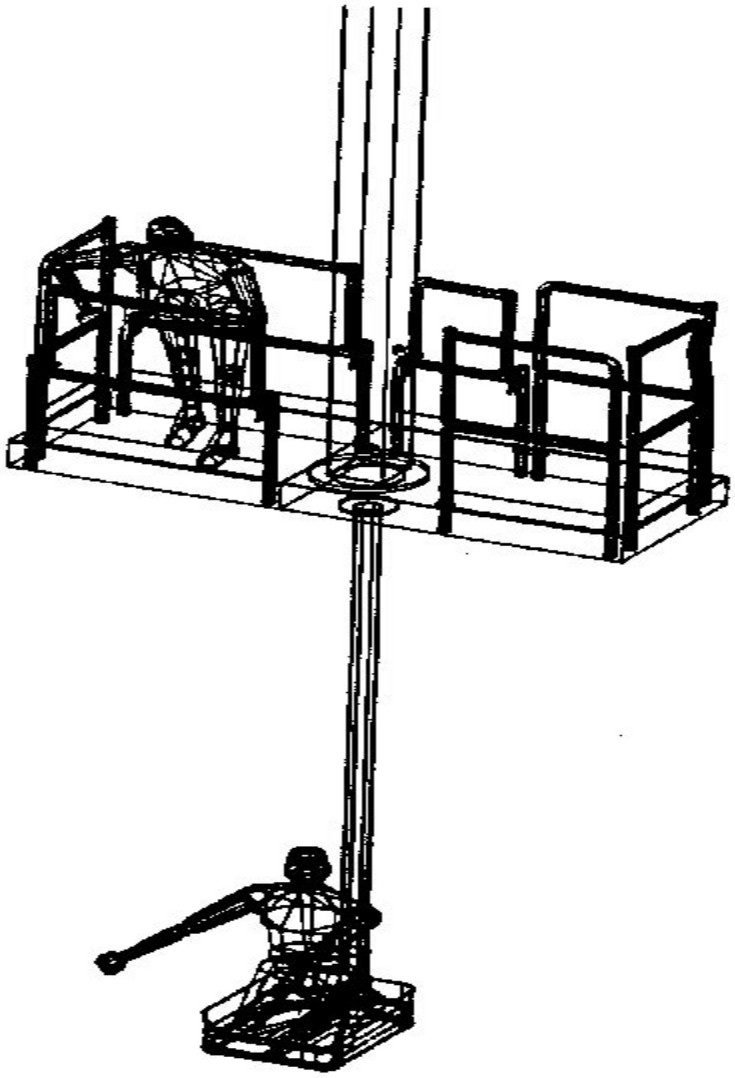


Figure 4-11. Concept of Experiment Access Kneeling Platform

4.4.2 HOISTING CAPABILITY. Each high bay has two 27.2-metric ton (30-ton) bridge cranes that travel on the same set of rails in a north-south direction. See figure 4-12 for the coverage area of these cranes. The cranes, which provide coverage of the entire high bay, are used to handle the payload during installation into and removal from the payload bay. Crane details are given in table 4-2.

The effective travel for the 30 ton high bay cranes is referenced in SID 79K18745.

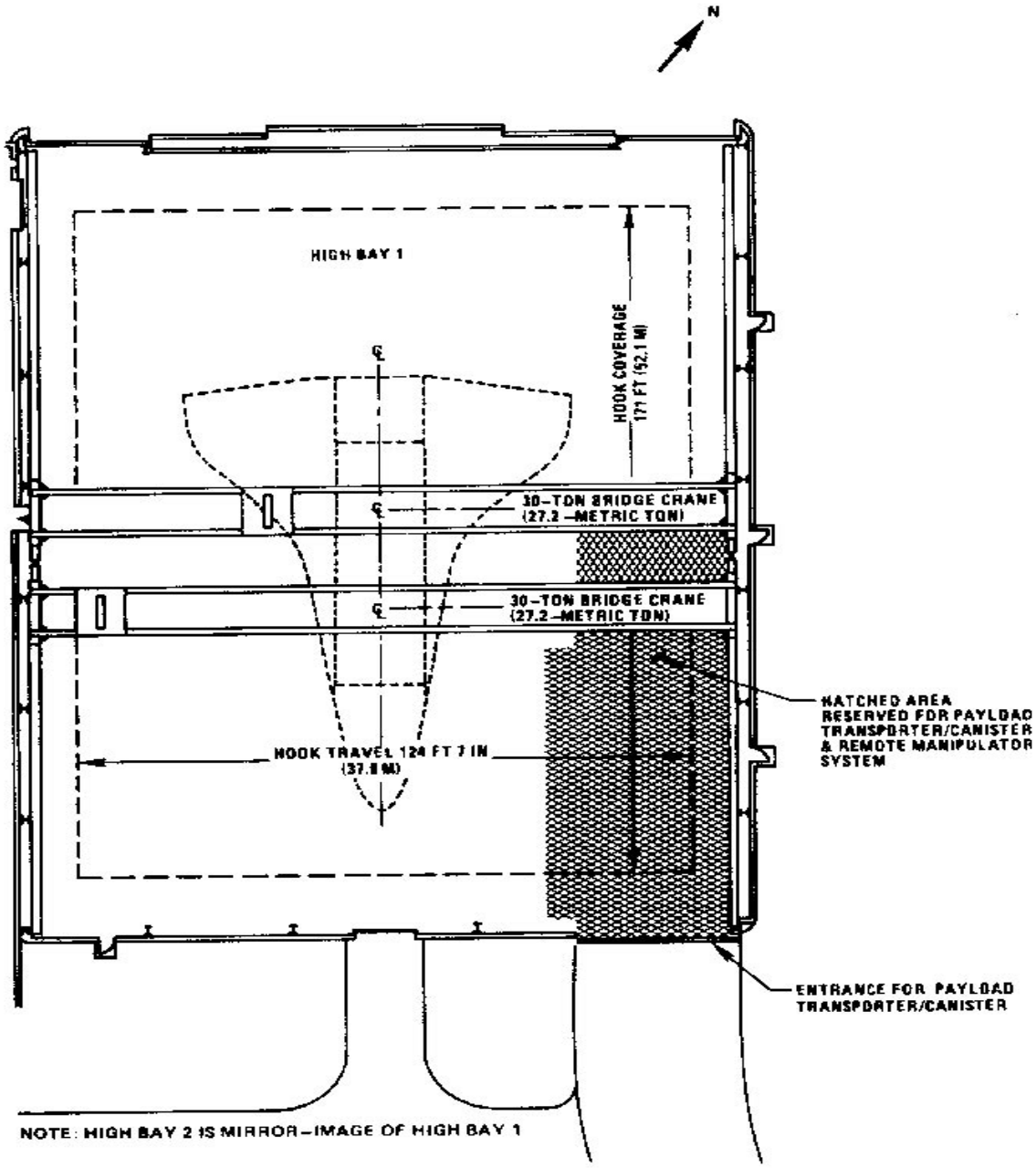


Figure 4-12. High Bay Crane Coverage

Table 4-2. OPF High Bay Crane Details

Metric ton (capacity ton)	Hook Height m (ft)	Speeds Lift	Trolley m/min (ft/min)	Bridge
27.2 (30)	20.1 (66)	0.1 to 3.9 (0.5 to 12.9)	0.3 to 8.9 (0.9 to 29.4)	0.3 to 9.1 (0.9 to 29.8)

On the port side of each main access platform structure in high bays 1 and 2 is a 1-ton (0.9-metric ton) jib hoist for lifting GSE form the ground floor to platform 1 near the crew compartment side hatch. On the transfer aisle side near the aft stairwell of the main access platforms is a 1-ton (.9-metric ton) jib hoist for lifting GSE from the ground floor to platform 11. These two hoists rotate 90 degrees each way. Handrails close to these hoists are removable, instead of fixed like the remainder of the outside rails. Crane hook details are presented in figure 4-13.

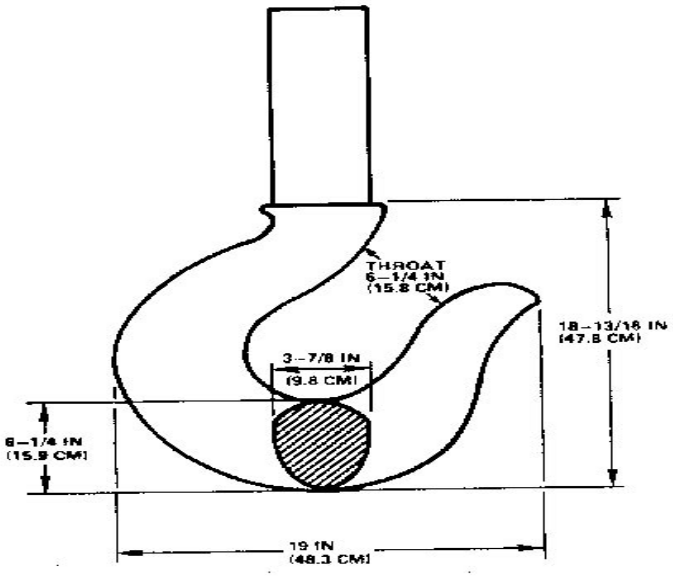


Figure 4-13. OPF Hook Details

4.4.3 ELEVATOR. Each high bay contains a freight elevator that is part of the main access platform structure. The elevator is located on the port side of the orbiter near the crew compartment side hatch in the dual facility and on the starboard side of the orbiter in high bay 3. The elevator is designed to carry small to medium GSE from the ground floor of the OPF high bay to platforms 1 and 6. The elevator cage is 1.7 m (5 ft 8 in) deep, 1.9 m (6 ft) wide, and 2.1 m (7 ft) high. The elevator door is 2.1 m (7 ft) high by 1.0 m (3 ft 4 in) wide. There is a 30.5 cm (12-inch) by 10.2 cm (4-in) obstruction at the top of the elevator door on the left as you face the elevator from the ground level. Allowable elevator cargo weight is 1360.8 kg (3,000 pounds).

4.4.4 FLUIDS AND GASES. The high bays and main access platforms contain compressed air, gaseous helium (GHe), gaseous nitrogen (GN_2), conditioned air, water, and vacuum cleaning.

4.4.4.1 Compressed Air. Nonregulated compressed air with an operating pressure of 8.6 bars (125 pounds per square inch) is provided on the high bay ground floors; the walls; and platforms 1, 2, 4, 5, 6, and 11. The compressed air outlets are fitted with Hansen, Wake Forest, and KC 124 series quick-disconnect sockets located conveniently on the access platforms approximately 0.6 m (2 ft) above the steel deck. Specific locations, type, and size of outlets are identified in OPF SID 79K18745.

4.4.4.2 Gaseous Helium. GHe (regulated) is provided under operating pressures of 206.7 bars (3,000 pounds per square inch) and 413.4 bars (6,000 pounds per square inch) on platform 4. GHe under 206.7 bars (3,000 pounds per square inch) operating pressure is provided on the ground floors and on platform 1. KC 124 type, quick-disconnect fittings are used. Additionally, GHe at 413.4 bars (6,000 pounds per square inch) and 51.7 bars (750 pounds per square inch) is available on the ground floors. OPF panel S70-1246 has an inlet pressure of 413.4 bars (6,000 pounds per square inch). SID 79K18745 contains the locations and specific fittings.

4.4.4.3 Gaseous Nitrogen. GN_2, also regulated, under an operating pressure of 206.7 bars (3,000 pounds per square inch) is provided to the ground floors and platforms 1 and 4. 413.4 bars (6,000 pounds per square inch), 51.7 bars (750 pounds per square inch), and 3.5 bars (50 pounds per square inch) operating pressure is provided to the ground floors. OPF panel S70-1246 has three GN_2 inlet pressures of 413.4, 206.7, and 51.7 bars (6,000, 3,000, and 750 pounds per square inch). Nonregulated capped GN_2 with 3.4 bars (50 pounds per square inch) operating pressure is provided to various potential spark-producing enclosures in the high bays. KC 124 type, quick-disconnect fittings are the facility interface for the GN_2 supply. See SID 79K18745 for locations and sizes.

4.4.4.4 Vacuum System. There is a vacuum system in each bay designed to clean the area in and around the payload bay. Each system consists of piping and hoses on platforms 6 and 7 and a large vacuum pump behind the high bay.

4.4.5 SAFETY SYSTEMS/EQUIPMENT. The high bays are protected by fire protection systems described in paragraph 2.5.2. Fire extinguishers rated for operations in the high bays and on the platforms are placed on or near the fixed portions of the platform handrails or near the work areas on the ground floor.

Boxes 0.5 m by 0.3 m by 0.6 m (18 inches by 12 inches by 24 inches) high marked by green and white stripes contain emergency breathing air packs; these are placed regularly about the platforms and on the ground floor.

Payload personnel planning frequent access to the main platforms should familiarize themselves with the locations of the safety equipment and the egress route(s) from the particular work station(s).

Other safety procedures/operating regulations are presented in paragraph 2.6.

4.4.6 ORBITER CREW COMPARTMENT ENTRANCE. A clothing changeout room surrounds the side hatch entrance to the crew compartment to provide a controlled, clean access to the crew compartment. This white room is located on platform 1, orbiter port side, in the high bays. Access to the crew compartment is by special permission and is controlled by a monitor at the desk by the white room entrance on platform 1. Personnel must pass through an air shower upon entering the room to don their clean room garments. When properly attired, they may proceed through the extendible passageway to the orbiter crew access hatch. (Personnel entering the crew compartment or midbody must be certified or accompanied by a certified escort. Any tools carried into the crew compartment will be accounted for in accordance with LSOC SP004, *Work Area Rules and Access Controls for SSV and Associated Processing Areas.)*

4.4.7 GSE. The majority of GSE items are orbiter dedicated, such as portable water fill units, freon and water servicers, movable access stands, and lighting and power panels on the ground floor.

Any GSE that the payload requires must be customer supplied or arranged through the LSSM. Location on the platforms of any GSE must be coordinated/scheduled through the LSSM, the OPF Site Manager, and the Payload Operations Control Desk.

As stated in section I, use of OPF systems and GSE will be on a timeshared basis. Most systems have multiple uses, and the time frame for the use must be coordinated with the OPF Site Manager.

SECTION V

COMMUNICATIONS AND DATA HANDLING

5.1 COMMUNICATIONS

The OPF provides Operational Intercommunication System (OIS), OTV, telephone, and paging and area warning communications.

5.1.1 OIS. The OIS is a multi-channel voice communication network interconnecting operational areas required for Space Shuttle payload processing at KSC and CCAFS. OIS-D is installed in high bays 1, 2, and 3. OIS-D rackmounted end instruments are used in the low bays. Approximately 60 OIS-D end instruments are conveniently located in each high bay throughout the platforms and ground floor, (see figure 5-1). These end instruments interface with group processor assemblies in the OPF which are linked to the central summing network in the LCC. This allows users in the OPF to talk with the control rooms in the LCC. Twelve OIS-D channels are reserved for payload voice links per mission. An operational training course is provided by SPC or PGOC customers familiarization with the equipment.

5.1.2 OTV. OTV is a closed-circuit system providing video monitoring and recording of payload and orbiter processing from operational areas like the OPF to control and monitor areas in the LCC and payload processing facilities at CCAFS. Areas under surveillance of TV cameras include the payload bay. Two portable TV cameras provide coverage of payload bay activities. In addition, orbiter TV cameras are available during the payload-to-orbiter integrated test. TV cameras in the OPF are remotely controlled from the LCC, room 1P2, by technicians who can pan, tilt, and zoom the cameras on command. An OTV monitor is located across from the operations desk. Use of the TV system is not considered a standard service.

5.1.3 TELEPHONES. The OPF provides KSC administrative telephone system in the low bays and on the ground floor of each high bay, plus a few units on the work platforms. Point-to-point communication is also available at the Operations Control Desk and just outside the white room on platform 1. As stated in paragraph 5.1.2, major voice communication of the high bay platforms is conducted through the OIS-D.

5.1.4 PAGING AND AREA WARNING. The OPF is equipped with a paging and area warning system that serves the high bays, the low bays, the service and support annex, and immediate areas surrounding the OPF. Speakers are positioned for full facility coverage, inside and outside. The paging system is part of LC-39 area warning system.

5.2 DATA HANDLING

The following data handling systems are used at the OPF for Space Shuttle requirements. The payload LSSM should be contacted for current data handling capabilities.

5.2.1 FIBER OPTIC WIDEBAND. The Fiber Optic Wideband System supports analog signals with bandwidths to 12 MHz or digital signals to 8MB/s. The customer interface is 75 ohm unbalanced or 124 ohm balanced, 1.0 Vp-p. This system will be used to phase out the copper based wideband system. System performance details are documented in 80K54096, *Wideband Fiber Optic Transmission System Centerwide Operations; Operations and Maintainance Specifications.*

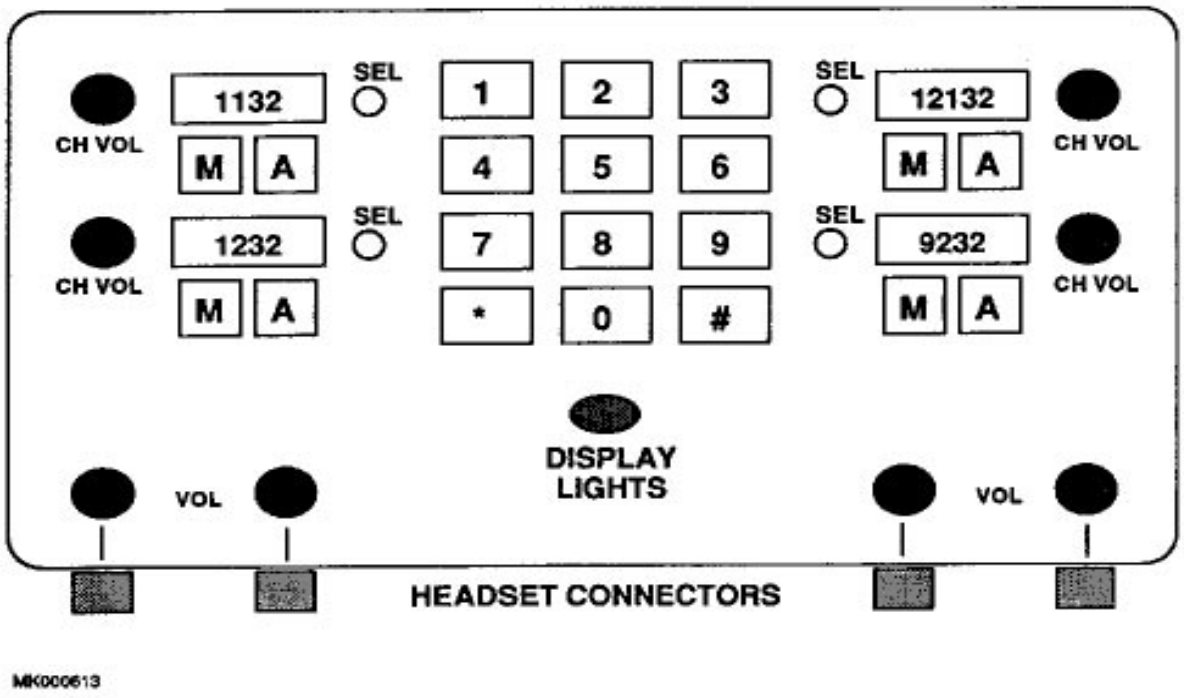


Figure 5-1. OIS-D Type 53-D End Instrument

5.2.2 WIDEBAND TRANSMISSION SYSTEM (WBTS). The WBTS is a telecommunication system which provides analog links within a band pass up to 4.5-Mhz. WBTS links are used to support RS-170 television, multiplexed carriers, timing, data signals and other complex waveform signals. Clamping, to restore the DC signal component, is provided for television signals only. Clamping circuits are disabled when links are used for other purposes. The WBTS band pass frequency response is within +/- .2 db from 30-Hz to 4.5 Mhz and provides a signal to noise ratio better than 60-db. Customer interfaces may be either 124 ohms balanced or 75 ohms unbalanced. Both operate with a signal level of 1.0 Vp-p. The WBTS systems will not be modified to accommodate nonstandard and unique requirements. Each customer is responsible for interface adaptors such as impedance matching transformers, attenuators, or amplifiers. Links provide unity gain and are nearly transparent to users. A more detailed description of the WBTS may be found in Operations and Maintenance Documentation (OMD) 79K14984.

5.2.3 DIGITAL TRANSMISSION SYSTEM (DTS). The DTS provides data links between selected KSC and CCAFS facilities. Asynchronous data rates, between 100 bps and 256 bps in NRZ-L format (128 KBPS, BIO-L) are accommodated with a bit error rate better than 10^{-9}. Customers are provided a balanced access to links which comply with RS-422 standards (124 ohms). Unbalanced, RS-232 interfaces which are not readily available may be established when requirements warrant.

5.2.4 FREQUENCY DIVISION MULTIPLEX SYSTEM (FDM). The Frequency Division Multiplexing System supports digital signals to 512KB/s. Voltage levels conform EIA RS422 or RS423 specifications. A 1.0 Vp-p output option is also supported. Interfaces are selectable for 75 ohm unbalanced or 124 ohm balanced.

5.2.5 RADIATING SYSTEM CAPABILITY. The OPF provides antennas on the roof for radiating S-band PM and FM, Ku-band, ultra-high frequency, TACAN, and Range Safety frequencies to KSC and CCAFS facilities/areas. The S-band payload interrogator antenna is rotatable. Signals are sent through the OPF avionics ground station from the antenna hat couplers on each high bay. All antennas have lightning rods installed for protection. An omnidirectional (discone) S-band antenna is mounted just inside the main access door of each OPF high bay. These antennas provide S-band coverage during the final portion of the orbiter tow from the SLF to the OPF. The antennas are positioned to optimize coverage during the time when the orbiter is on the OPF parking apron and while it is being moved into the high bay work platforms. This capability supplements the coverage from the Merritt Island Launch Area tracking station, which may be marginal at the time of movement.

SECTION VI

FACILITY DESCRIPTION SUMMARY

6.1	**FLOOR SPACE**		
	a.	High bays 1 & 2 (each)	2,745.2 m^2 (29,550 ft)
	b.	High bay 3	2,563.5 m^2 (27,594 ft^2)
6.2	**CLEAR VERTICAL HEIGHT**		
	a.	High bays	20.1 m (66 ft)
	b.	Dual facility low bay	Variable 2.4m (8 ft) to 7.0 m (23 ft)
6.3	**EQUIPMENT ENTRY**		
	a.	High bays 1 & 2, north side	28.4 m wide x 10.7 m high (93 ft 4 in x 35 ft)
	b.	High bays 1 & 2, south side	3.7 m x 3.7 m (12 ft x 12 ft)
			9.1 m x 9.1 m (30 ft x 30 ft)
	c.	Low bays	Small equipment through personnel door, 3.1 m x 4.9 m (10 ft x 16 ft) roll-up door
	d.	High bay 3, north side	9.1 m x 9.1 m (30 ft x 30 ft)
	e.	High bay 3, south side	28.4 m wide x 10.7 m high (93 ft 4 in x 35 ft)
6.4	**CRANES/HOISTS**		
	High bays		Two 27.2-metric ton (30-ton) bridge cranes each bay
6.5	**HOOK HEIGHT**		20.1 m (66 ft)
6.6	**SYSTEMS/EQUIPMENT**		
	a.	High bays	
		(1) Workstands	For orbiter access

		(2) GHe	413.4 bars (6,000 lb/in^2) 206.7 bars (3,000 lb/in^2) 51.7 bars (750 lb/in^2)
		(3) GN_2	413.4 bars (6,000 lb/in^2) 206.7 bars (3,000 lb/in^2) 51.7 bars (750 lb/in^2) 3.5 bars (50 lb/in^2)
		(4) Compressed air	8.6 bars (125 lb/in^2)
		(5) Vacuum	Two systems on access platforms
		(6) LO_2, LH_2, Freon, hydraulic fluid	Available on access platforms (not for payload use)
		(7) Vents and Drains	High bay floors/stands
		(8) Potable water	High bay floors/stands
		(9) Fuel cell detanking and servicing	High bays
	b.	Low bays	
		(1) Compressed air	8.6 bars (125 lb/in^2)
		(2) Potable water	Restrooms, water fountains
	c.	Fire protection equipment	Automatic/manual fire detection systems (smoke, heat, manual pull-stations) in all areas, Firex sprinkler systems in high bays, automatic sprinkler system in low bay areas and annex, dry chemical systems for hydraulic pump and control units, and automatic/ manual hypergolic exhaust system
6.7	**TEMPERATURE/RELATIVE HUMIDITY**		21.1 to 2.8^o C (70 +/- 5^o F)/50 percent max R.H.
6.8	**CLEANLINESS**		Supply air class 100 nominal, class 5,000 guaranteed, hydrocarbon content -15 ppm maximum

6.9 ELECTRICAL POWER

High and Low bays	120V/15 A/1 phase/60 Hz 120/208V/30 A/3 phase/60 Hz 480V/30 A/3 phase/60 Hz (crane operations) 400 Hz/30 and 20A

6.10 SAFETY

Operations	Hazardous payload operations conducted only after contingency landing. Normally, only orbiter hazardous operations are accommodated.
Equipment	Emergency showers, eyewash fountains, audio-visual warning alarms, gas masks/air packs, fire extinguishers