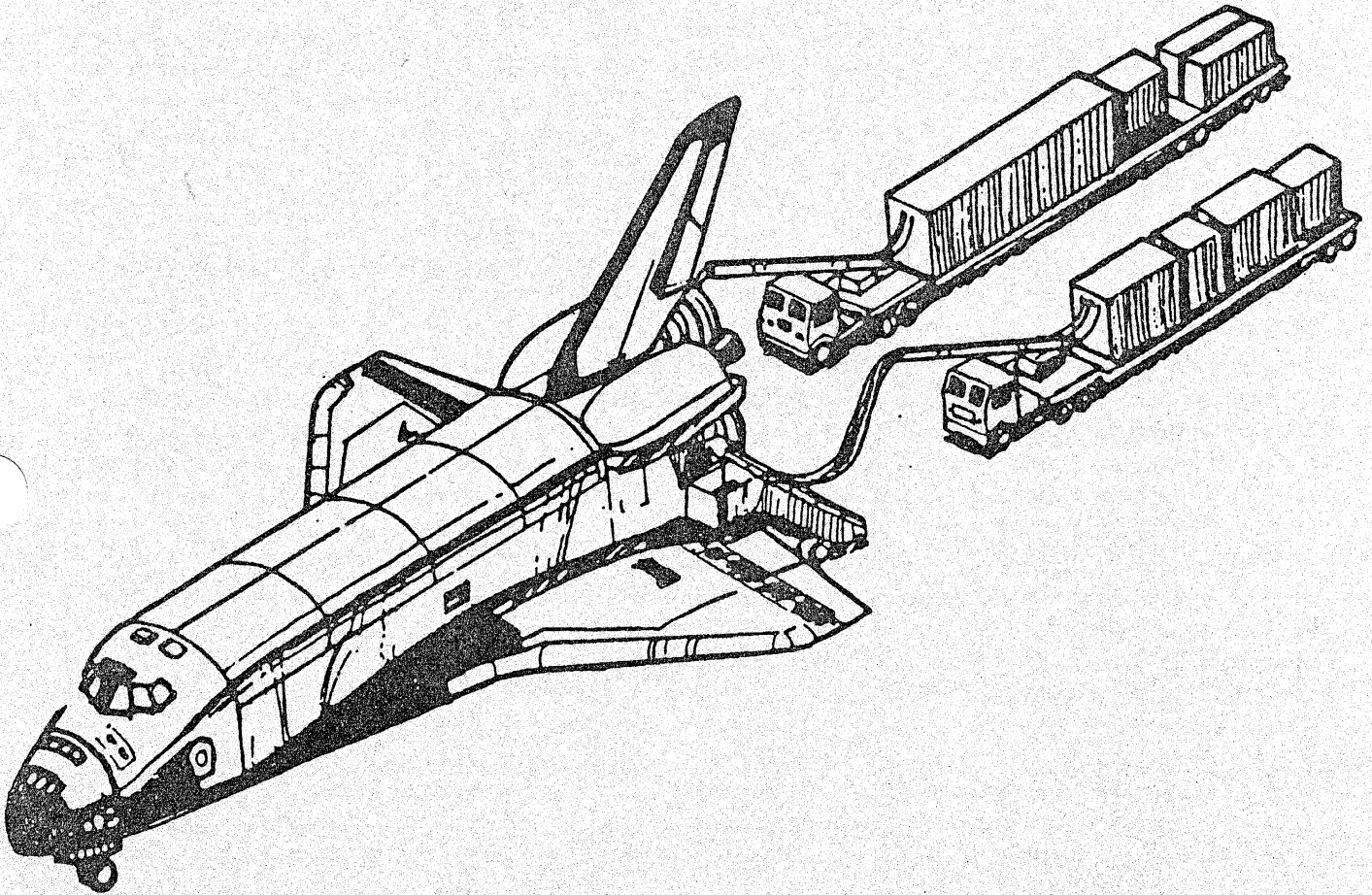


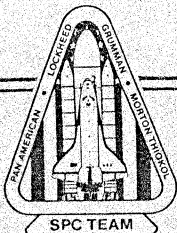
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ORBITER CONVOY OPERATIONS

8 JAN 1988



FOR TRAINING USE ONLY



SHUTTLE PROCESSING CONTRACT  
John F. Kennedy Space Center



# ORBITER CONVOY OPERATIONS

1. STS RECOVERY SITES
2. CONVOY RESPONSIBILITY
3. CONVOY MANAGEMENT
4. SIMULATIONS & TRAINING
5. CONVOY CAPABILITIES
6. VEHICLE/PERSONNEL COMPLEMENT
7. CONVOY COMMUNICATIONS
8. MISSION SUPPORT
9. TAL SITE OPERATIONS
10. ORBITER SYSTEMS & HAZARDS
11. SCHEDULE OF POST LANDING ACTIVITIES
12. CONTINGENCY OPERATIONS

## STS RECOVERY SITES

### CONUS SITES

1. EDWARDS AIR FORCE BASE, CA - Prime EOM & AOA (DOD)
2. WHITE SANDS SPACE HARBOR, N.M. - Alternate to EAFB (DOD)
3. KENNEDY SPACE CENTER, FL - Alternate & RTLS

### TAL SITES

1. BANJUL, GAMBIA
2. BEN GUERIR, MOROCCO -- BECOMES AUGMENTED ELS DURING MISSION
3. MORON AB, SPAIN (DOD)
4. ZARAGOZA AB, SPAIN (DOD)

### AUGMENTED ELS SITES

1. HICKAM AFB, HAWAII
2. ANDERSEN AFB, GUAM

## CONVOY RESPONSIBILITIES

- \* PROVIDE IMMEDIATE SERVICE TO ORBITER AFTER LANDING
- \* ASSIST FLIGHT CREW WITH EGRESS
- \* PREPARE ORBITER FOR TOWING
- \* TOW ORBITER TO DESERVICE AREA
- \* HAVE SKILLS, KNOWLEDGE & EQUIPMENT TO DEAL WITH ABNORMAL OR EMERGENCY SITUATION AND INITIATE APPROPRIATE ACTIONS

## NASA CONVOY COMMANDER

- \* RESPONSIBLE NASA INDIVIDUAL FOR ON-SITE CONTROL OF CONVOY OPERATIONS TO INCLUDE:
  1. ALL PERSONNEL AND ELEMENTS OF THE CONVOY
  2. ORBITER & FLIGHT CREW
  3. ALL PERSONNEL/EQUIPMENT WITHIN THE OPERATIONAL CONTROL AREA (1250 FT OF ORBITER).
- \* INTERFACES WITH GOM, LRD, JSC FLIGHT DIRECTOR, AIRFIELD SUPPORT COORDINATOR, DOD CARGO PERSONNEL & FLIGHT CREW.
- \* GIVES CONVOY PRETEST BRIEFING.
- \* BRIEFS FLIGHT CREW ON CONVOY OPS/POSTLANDING ACTIVITY.
- \* ESTABLISHES TRAINING & SIMULATION REQUIREMENTS.
- \* BECOMES CONTINGENCY OPERATIONS DIRECTOR IN EVENT OF INCIDENT OR CONTINGENCY ON RUNWAY.
- \* COORDINATES PLANNING FOR POSTLANDING EXPERIMENTS, CARGO AND SPACELAB REQUIRMENTS IN CONJUCTION WITH ORBITER OPERATIONS REPRESENTATIVE.

CONTRACTOR SUPPORT TEAM

\* ORBITER OPERATIONS REPRESENTATIVE

\* MOVE DIRECTOR

\* QUALITY ASSURANCE

\* SAFETY ASSESSMENT TEAM

\* LIFE SUPPORT TEAM

\* FLIGHT CREW SUPPORT TEAM

\* PHOTO/TV TEAM

\* CARGO SUPPORT TEAM

\* FIRE/CRASH/RESCUE FORCE

\* SECURITY

ORBITER OPERATIONS  
REPRESENTATIVE

- \* LSOC OPS MANAGER FOR POST LANDING ACTIVITIES.
- \* SENIOR LSOC OPERATIONS PERSONNEL.
- \* ON SCENE ADVISOR TO NASA CONVOY COMMANDER FOR ORBITER TECHNICAL MATTERS.
- \* LOCATED IN NASA CONVOY COMMANDERS VEHICLE.

MOVE DIRECTOR

- \* RESPONSIBLE FOR LSOC TECHS THROUGHOUT THE RECOVERY OPERATION.
- \* IN COORDINATION WITH ORBITER OPS REP, DIRECTS CONNECTING OF EQUIPMENT, TOWING OPERATIONS AND MOVEMENT OF CONVOY VEHICLES AND EQUIPMENT.



## QUALITY ASSURANCE (QA)

- \* MONITOR WORK FOR COMPLIANCE WITH OMI AND RECORD APPLICABLE DATA INTO OMI.
- \* SENIOR QA PERSONNEL LOCATED IN CONVOY COMMANDERS VEHICLE, OTHER QA PERSONNEL (NASA & LSOC) ON JOB SITE.

## SAFETY ASSESSMENT TEAM

### FORWARD ASSESSMENT TEAM

- \* CHECK FORWARD & HATCH AREA FOR TOXIC/EXPLOSIVE VAPORS.
- \* INSTALL NOSE GEAR DOWN LOCK PIN AND CHOCK NOSE GEAR.

### AFT ASSESSMENT TEAM

- \* CHECK AFT AREA FOR TOXIC/EXPLOSIVE VAPORS.
- \* PERFORM T-0 AREA SAFETY ASSESSMENT (AFTER APU SHUTDOWN & STAIRCASE VEHICLES ARE POSITIONED).
- \* CHECK HYDROGEN CONCENTRATIONS IN AFT/MIDBODY (AFTER LH2 CARRIER PLATE IS INSTALLED).

BOTH TEAMS CONTINUE TO MONITOR FOR EXPLOSIVE/TOXIC VAPORS THROUGHOUT THE RECOVERY OPERATION.

## LIFE SUPPORT TEAM

- \* PROVIDE SCAPE SUPPORT.
- \* TECH SUPERVISOR & ONE TECH PER EVERY 2-3 SCAPE SUITED PERSONNEL.
- \* SCAPE SUITED PERSONNEL FOR TYPICAL LANDING:
  1. T-0 ACCESS VEHICLES (2 PER VEHICLE).
  2. COOL TRANSPORTER (4)
  3. PURGE TRANSPORTER (4)
  4. EG&G LIFE SUPPORT (2)
  5. SAFETY ASSESSMENT TEAM (4)
  6. FAN VEHICLE (2)

## FLIGHT CREW SUPPORT TEAM

- \* JSC PERSONNEL NECESSARY TO PROVIDE FLIGHT CREW SUPPORT.
- \* LOCATED IN ASTRONAUT TRANSPORT VEHICLE.

## PHOTO/TV TEAM

- \* PROVIDE PHOTO SUPPORT FOR NASA PAO AND KSC ENGINEERING AND GROUND OPS TEAMS AS REQUIRED.

## CARGO SUPPORT TEAM

- \* PROVIDE CARGO SUPPORT FOR RETURNING PAYLOADS AS REQUIRED
- \* MAY BE DOD PERSONNEL DEPENDING UPON PAYLOAD.

## FIRE/CRASH/RESCUE FORCES

- \* PROVIDE FIRE SUPPRESSION SUPPORT AS REQUIRED.
- \* PROVIDE RESCUE TEAM IN EVENT OF FLIGHT CREW EMERGENCY EGRESS.
- \* PROVIDE SCAPE AND FLIGHT CREW DECONTAMINATION SUPPORT.
- \* DOD PERSONNEL AT EAFB & WSSH; EG&G PERSONNEL AT KSC.

SECURITY

- \* ESTABLISH OUTER & INNER SECURITY PERIMETER AFTER LANDING.
- \* CONTROL ACCESS TO VEHICLE DURING ALL CONVOY AND GROUND TURNAROUND OPERATIONS.
- \* HAZ BADGE OVERLAY AND BADGE EXCHANGE REQUIRED TO ENTER INNER PERIMETER.
- \* SECURITY VEHICLES FORWARD AND AFT OF VEHICLE.
- \* POINT OF CONTACT WITH FOREIGN GOVERNMENTS AT TAL SITES.
- \* PROVIDE THREAT BRIEFINGS WITH INFORMATION FROM THE STATE DEPARTMENT AND DIA *agency*

# SIMULATIONS AND TRAINING

## SIMULATIONS

- \* TRAINING SIMULATIONS CONDUCTED AT ALL CONUS AND OVERSEAS SITES.
  
- \* THESE SIMS INCLUDE PRACTICE FOR CONTINGENCIES.
  1. MODE V - LANDING, UNAIDED EMERGENCY EGRESS  
(NORMALLY PRIOR TO EACH MISSION)
  2. MODE VI - LANDING, AIDED EMERGENCY EGRESS  
(NORMALLY PRIOR TO EACH MISSION)
  3. MODE VII - OFF SITE LANDING, AIDED EMERGENCY EGRESS  
(CONUS ONLY)
  4. MODE VIII - CREW BAILOUT IN CONTROLLED GLIDED FLIGHT

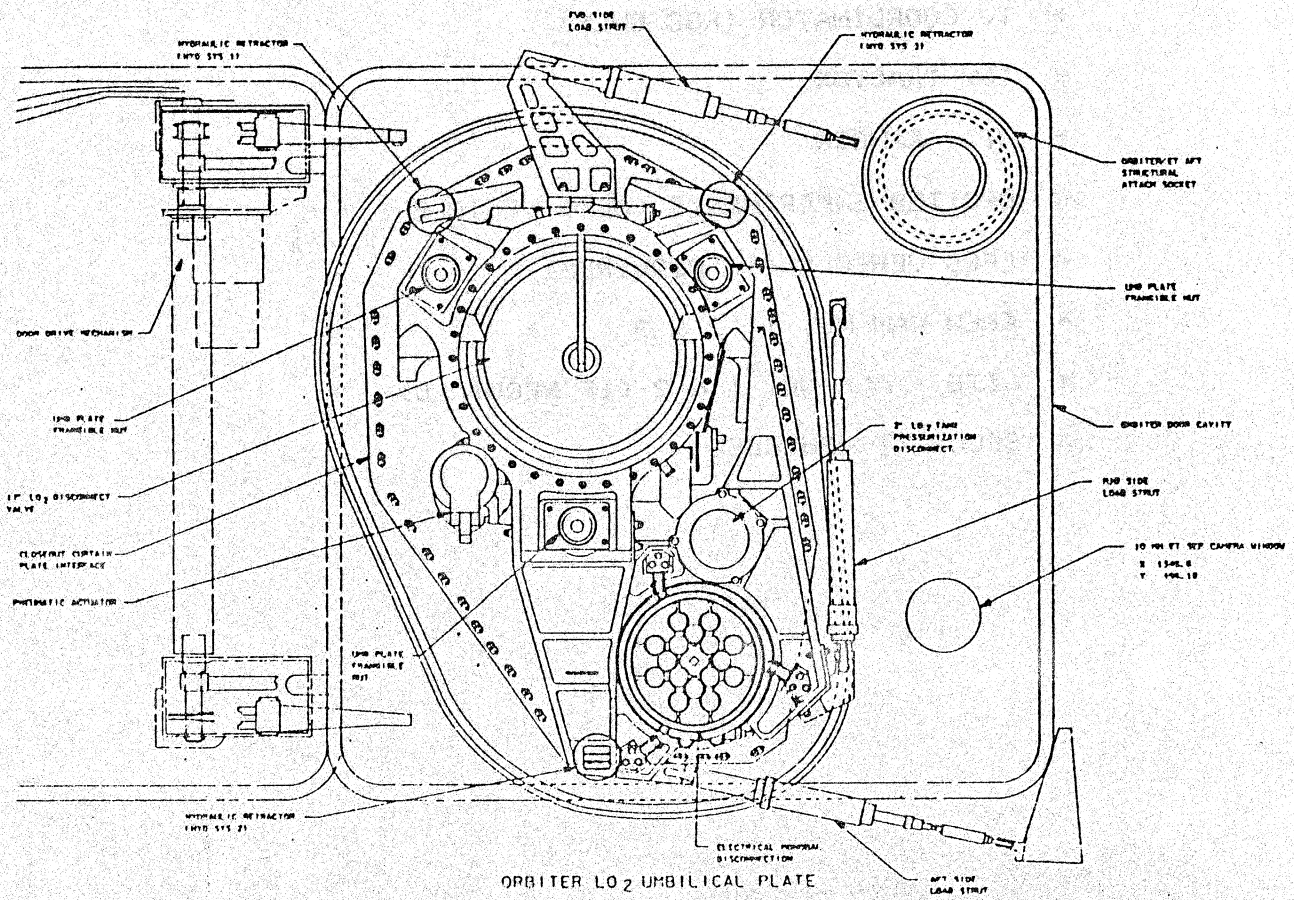
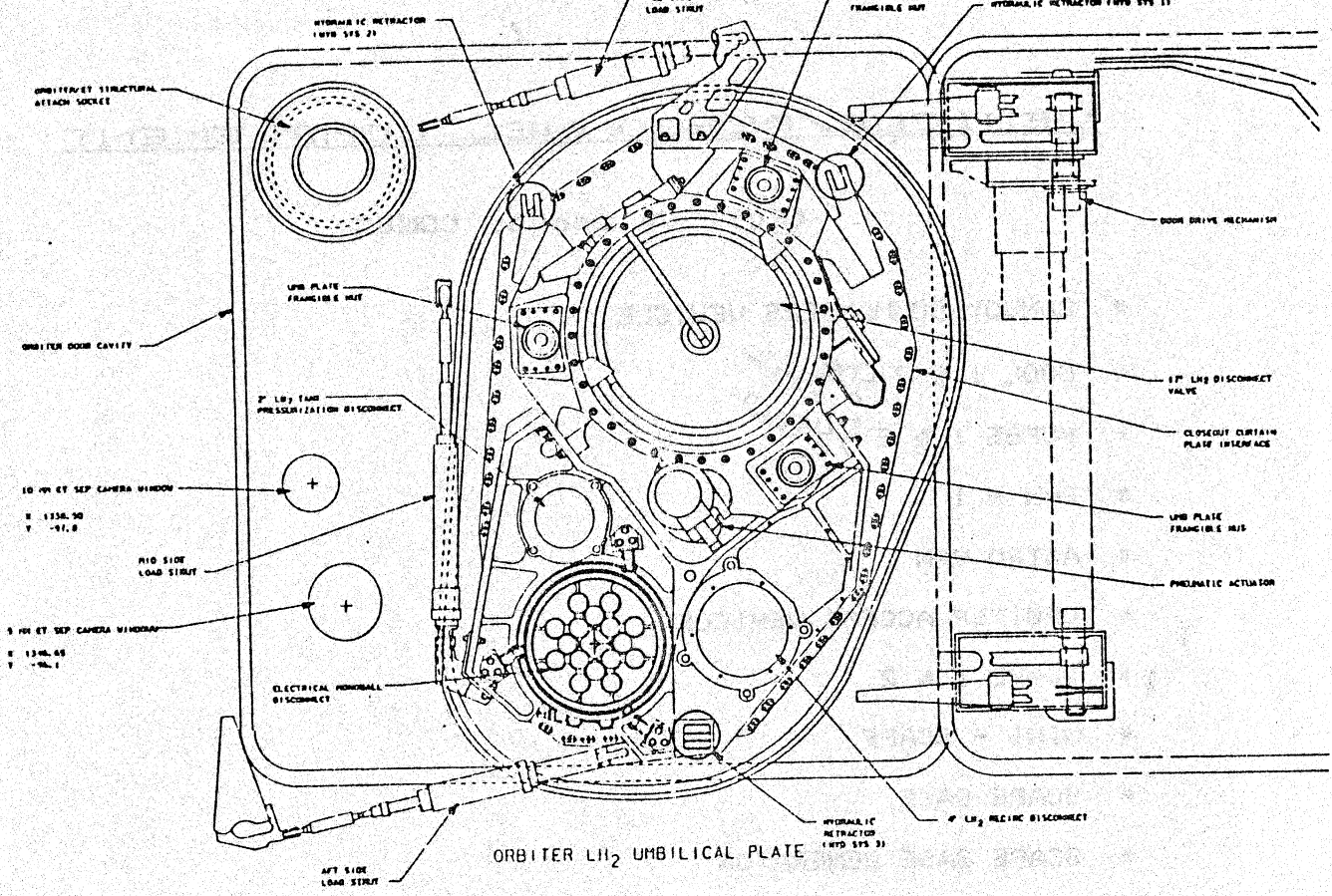
## TRAINING

- \* SOME SKILLS REQUIRE CERTIFICATION WHICH MAY INCLUDE:
  1. CLASSROOM TRAINING
  2. OJT
  3. STANDBOARD
  4. PHYSICAL
  5. PASSPORT (TAL SITES)

## CONVOY CAPABILITIES

### (EOM CONUS)

- \* PERFORM SAFETY ASSESSMENT.
- \* OPEN CREW MODULE HATCH AND ASSIST WITH FLIGHT CREW EGRESS.
- \* REMOVE/DESERVICE MIDDECK EXPERIMENTS.
- \* DESTOW FLIGHT CREW EQUIPMENT.
- \* PROVIDE GROUND COOLING BEFORE AMMONIA BOILER DEPLETION.
- \* PROVIDE PURGE FLOW WITHIN 45 MINUTES.
- \* REMOVE MAIN LANDING GEAR BRAKES.
- \* PERFORM TILE & DEBRIS INSPECTION.
- \* INSTALL SSME & OME THROAT PLUGS.
- \* INSTALL LANDING GEAR DOWNLOCK PINS & WHEEL WELL VENT PLUGS.
- \* NIGHT RECOVERY.
- \* INSTALL ET UMBILICAL DEBRIS TRAPS & COVER L02/LH2 ORB/ET DISCONNECTS
- \* POSTLANDING RUNWAY DEBRIS INSPECTION AND ROLLOUT MEASUREMENTS



# VEHICLE/PERSONNEL COMPLEMENT

(Full Up Convoy CONUS)

- \* CONVOY COMMANDERS VEHICLE
- \* COOL 1 & 2 *508 unit*
- \* PURGE 1 & 2 *534 unit*
- \* FAN - 1
- \* ASTRO VAN
- \* ORBITER ACCESS VEHICLE
- \* SCAPE 1 & 2
- \* MINI - SCAPE
- \* SCAPE BASE
- \* SCAPE BASE GENERATOR
- \* TV - 1 & 2
- \* TV COORDINATOR (KSC ONLY)
- \* TOW TRACTOR
- \* HI - RANGER
- \* ORBITER EXPERIMENTS (OEX) VEHICLE
- \* CFES VEHICLE (IF REQUIRED)
- \* CREW VAN NO. 1, 2 & 3
- \* LITE - ALL NO. 1 & 2 (IF REQUIRED)
- \* SECURITY VEHICLES



CONTINGENCY VEHICLES

- \* HE TUBE BANK
- \* HE PANEL PICKUP
- \* BACKUP GENERATOR
- \* C70-1115 MOBILE POWER UNIT
- \* KAMAN UNIT
- \* FIRE/CRASH/RESCUE VEHICLES
- \* MEDICAL VEHICLES
- \* IR CAMERA VAN (RTLS ONLY)

CONTINGENCY PLAN

\* THE TUBE BANK

\* THE PANEL FILTER

\* SPARKS OPERATOR

\* CYCLIC MOBILE POWER UNIT

\* POWER UNIT

\* FIVE-DIGIT REPLY VARIETY

\* TECHNICAL CENTER

\* IN CAMERA AND FILM UNIT

CONVOY COMMUNICATIONS

(CONUS)

COMMAND NET

- \* CONVOY COMMANDER
- \* LOCAL GOM COORD/STATUS (DFRF)
- \* LRD COORD/STATUS (KSC)
- \* JSC FLIGHT DIRECTOR
- \* LOCAL COORD/STATUS CONTINGENCY FORCES
- \* SAFETY COORD/STATUS
- \* TV/PHOTO COORD/STATUS
- \* LOCAL AIRFIELD CONTROL COORD/STATUS/CLEARANCE
- \* SUPPORT ELEMENTS STATUS

## PURGE NET

- \* MAJORITY OF CONTRACTOR GROUND TEAM
- \* ALL ACTIVITIES IN CONNECTION WITH ORBITER CONVOY OPERATIONS EXCEPT COOLING.
- \* INITIAL INSPECTION/ASSESSMENTS
- \* ORBITER AND EQUIPMENT CONTROL/POSITIONS
- \* COORDINATION OF INITIAL TASKS (Connections, etc.)
- \* PURGE ACTIVATION
- \* PROBLEM REPORTING/RESOLUTION

## COOLING NET

- \* COORDINATION OF COOLING GSE/ACTIVITIES
- \* LCC CONTACT (DFRC & KSC)
- \* BACKUP TO COMMAND NET

## UHF/VHF COMMUNICATIONS

- \* AVAILABLE IN CONVOY COMMANDERS VEHICLE FOR COMM WITH:
  - \* LRD/GOM (UHF)
  - \* AIRFIELD TOWER (UHF)
  - \* JSC/MCC (UHF)
  - \* KSC/LCC (UHF)
  - \* MEDICAL (UHF)
  - \* ORBITER AIR TO GROUND (UHF, FREQ. SELECTABLE)
  - \* SAFETY (VHF)
  - \* SECURITY (VHF)
  - \* FIRE/CRASH/RESCUE (VHF)

## DOD COMMUNICATIONS

DOD ON-SCENE COMMANDER AT EAFB & WSSH HAVE DOD COMMAND NETS (VHF/UHF/FM) TO CONTROL OR CALL UP ADDITIONAL CONTINGENCY FORCES.

MISSION SUPPORT

KSC - SLF CONVOY

IN READINESS FROM L-2 HRS THRU "NEG RETURN" FOR RTLS.

TAL CONVOY

IN READINESS UNTIL ORBITER IS CERTAIN TO ATTAIN ORBIT.

AOA CONVOY

IN READINESS UNTIL STABLE ORBIT IS ATTAINED.

LAUNCH DAY

ALL EQUIPMENT IN TWO HOUR READINESS STATE.

OTHER MISSION DAYS

READY TO RESPOND TO EARLY MISSION TERMINATION WITHIN 3 HRS.

# TAL SITE OPERATIONS

## MANAGEMENT

- \* GOM IS RESPONSIBLE NASA INDIVIDUAL FOR CONTROL OF ALL PERSONNEL AND ELEMENTS OF THE CONVOY.
- \* ORBITER OPS REP FUNCTIONS AS NCC AND ORBITER OPS REP
- \* ORBITER OPS REP BECOMES CONTINGENCY OPS DIRECTOR AT NON-DOD SITES.
- \* ON-SCENE COMMANDER BECOMES CONTINGENCY OPS DIRECTOR AT DOD SITES.

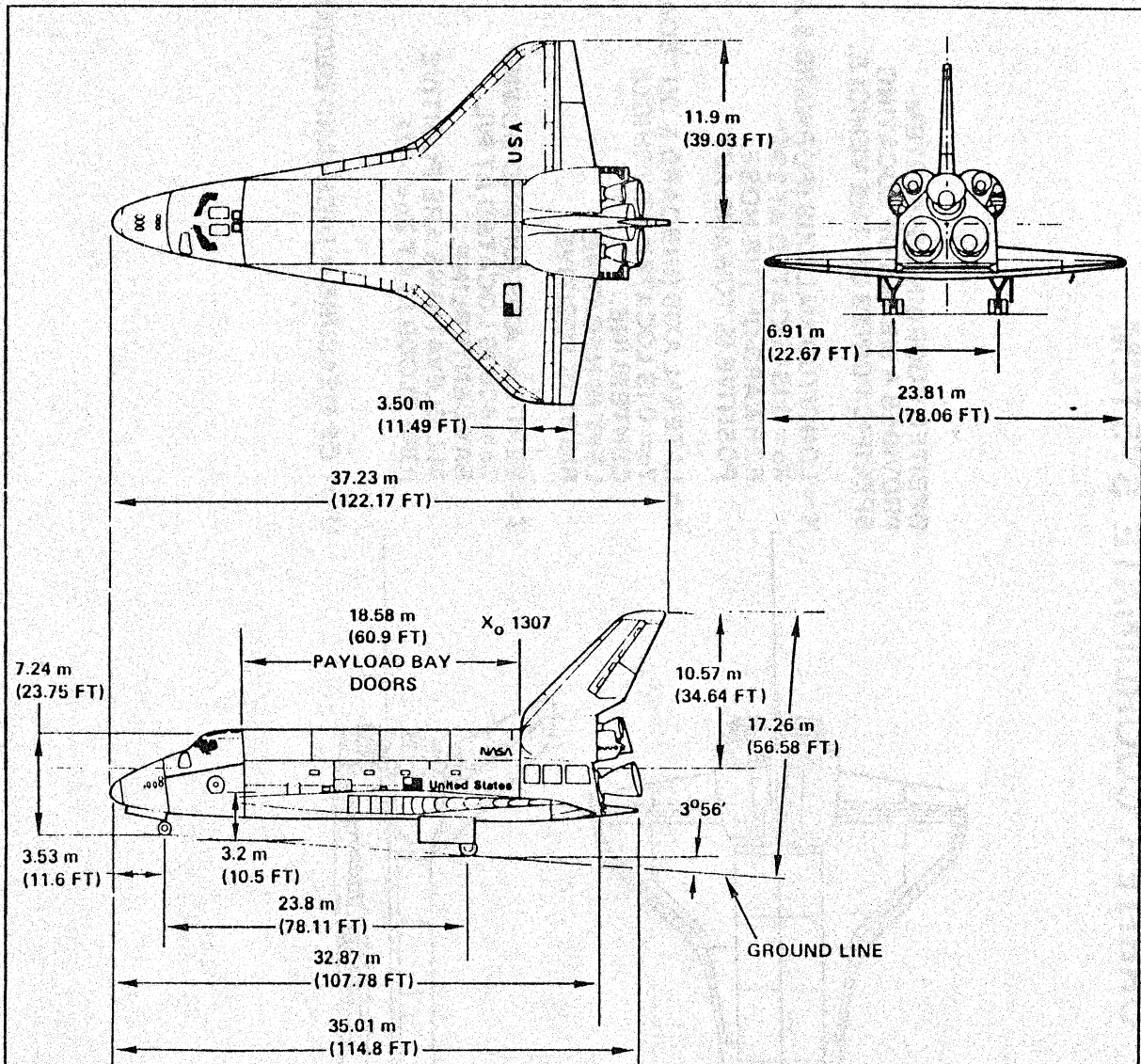
## COMMUNICATIONS

- \* LIMITED COMMUNICATIONS CAPABILITIES (i.e. no purge or cool nets).
  - \* CONVOY COMMANDER AND TOWER HAVE UHF COMM WITH ORBITER
  - \* AFTER ORBITER POWERDOWN FLIGHT CREW WILL USE HAND-HELD UHF RADIO.
  - \* LOCAL COMM IS VIA UHF HANDHELD RADIO. (6 CHANNELS)
  - \* VISUAL SIGNALS FOR LOSS OF COMM WITH FLIGHT CREW.
- \* THREE SATCOM SYSTEMS
- LF PRIME 1--GOM/LRD/LSO
  - WX AIRCRAFT/ORBITER - WX AIRCRAFT/CAPCOM
  - RATS WX DATA

## TAL SITE CAPABILITIES

- \* ONLY ONE SAFETY ASSESSMENT TEAM.
- \* BREATHING AIR UNITS ONLY, NO SCAPE.
- \* NO ORBITER SERVICING VEHICLES AVAILABLE (I.E. PURGE, COOL, FAN).
- \* NORMAL CREW EGRESS IS VIA AIRCRAFT ACCESS STAND.
- \* SHUTTLE ORBITER ARRESTING SYSTEM (SOAS) - ALL SITES EXCEPT BEN GUERIR.
- \* FIRE PROTECTION PROVIDED BY EG&G SUPPLEMENTED BY LOCAL PERSONNEL AT NON-DOD SITES.
- \* RESCUE PROVIDED BY EG&G AT NON-DOD SITES.
- \* FIRE/RESCUE PROVIDED BY USAF AT DOD SITES.





DIMENSIONS AND WEIGHT

WING SPAN .....	23.81 m	( 78.06 FT)
LENGTH .....	37.23 m	(122.17 FT)
HEIGHT .....	17.26 m	( 56.58 FT)
TREAD WIDTH .....	6.91 m	( 22.67 FT)
GROSS TAKE-OFF WEIGHT .....	VARIABLE	
GROSS LANDING WEIGHT .....	VARIABLE	
INERT WEIGHT (APPROX) .....	74,844 kg	(165,000 LB)

MINIMUM GROUND CLEARANCES

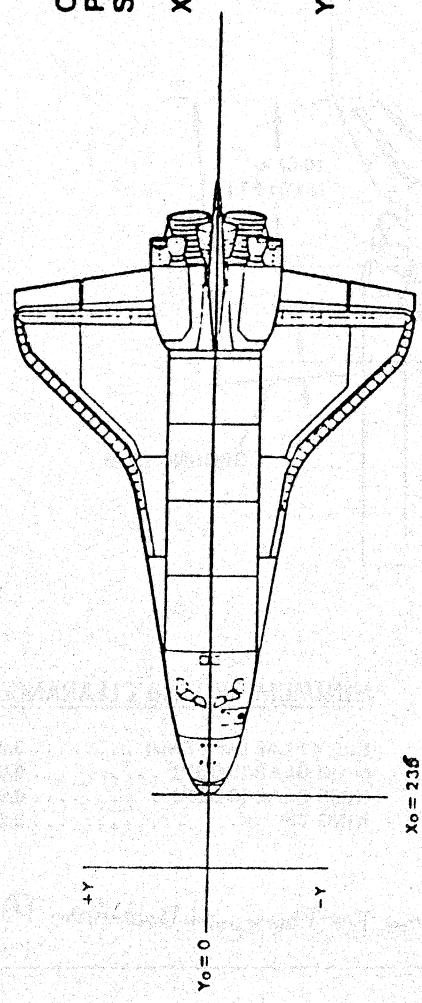
BODY FLAP (AFT END) .....	3.68 m	(12.07 FT)
MAIN GEAR (DOOR) .....	0.87 m	( 2.85 FT)
NOSE GEAR (DOOR) .....	0.90 m	( 2.95 FT)
WING TIP .....	3.64 m	(11.92 FT)

*154,000 LB max For Transport Back From TAL*

ORM-102-041C

Orbiter Dimensions and Weight.

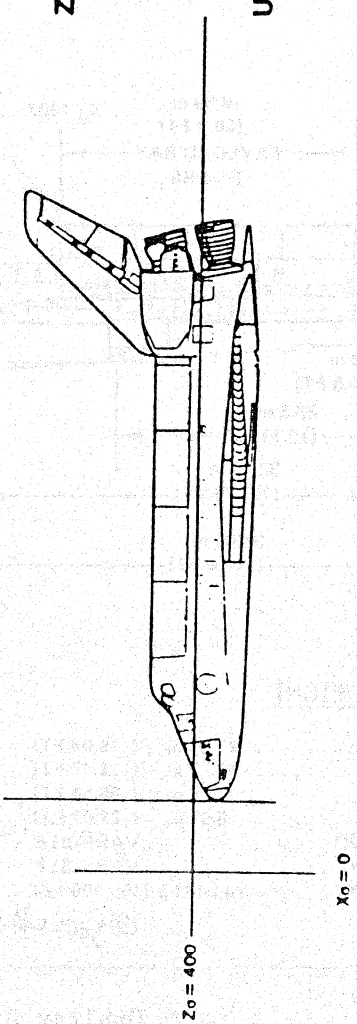
# ORBITER COORDINATE SYSTEM



ORBITER COORDINATE SYSTEM - PROVIDES A MEANS OF LOCATING SPECIFIC POINTS ON THE VEHICLE.

**X = LONGITUDINAL AXIS (FORWARD & AFT)**  
 $X_0 = 0$  IS LOCATED AT 236" FORWARD OF THE NOSE.  
 POSITIVE IS TOWARD AFT

**Y = LATERAL AXIS (INBOARD & OUTBOARD)**  
 $Y_0 = 0$  IS LOCATED AT VEHICLE CENTERLINE.  
 LEFT IS NEGATIVE.  
 RIGHT IS POSITIVE.

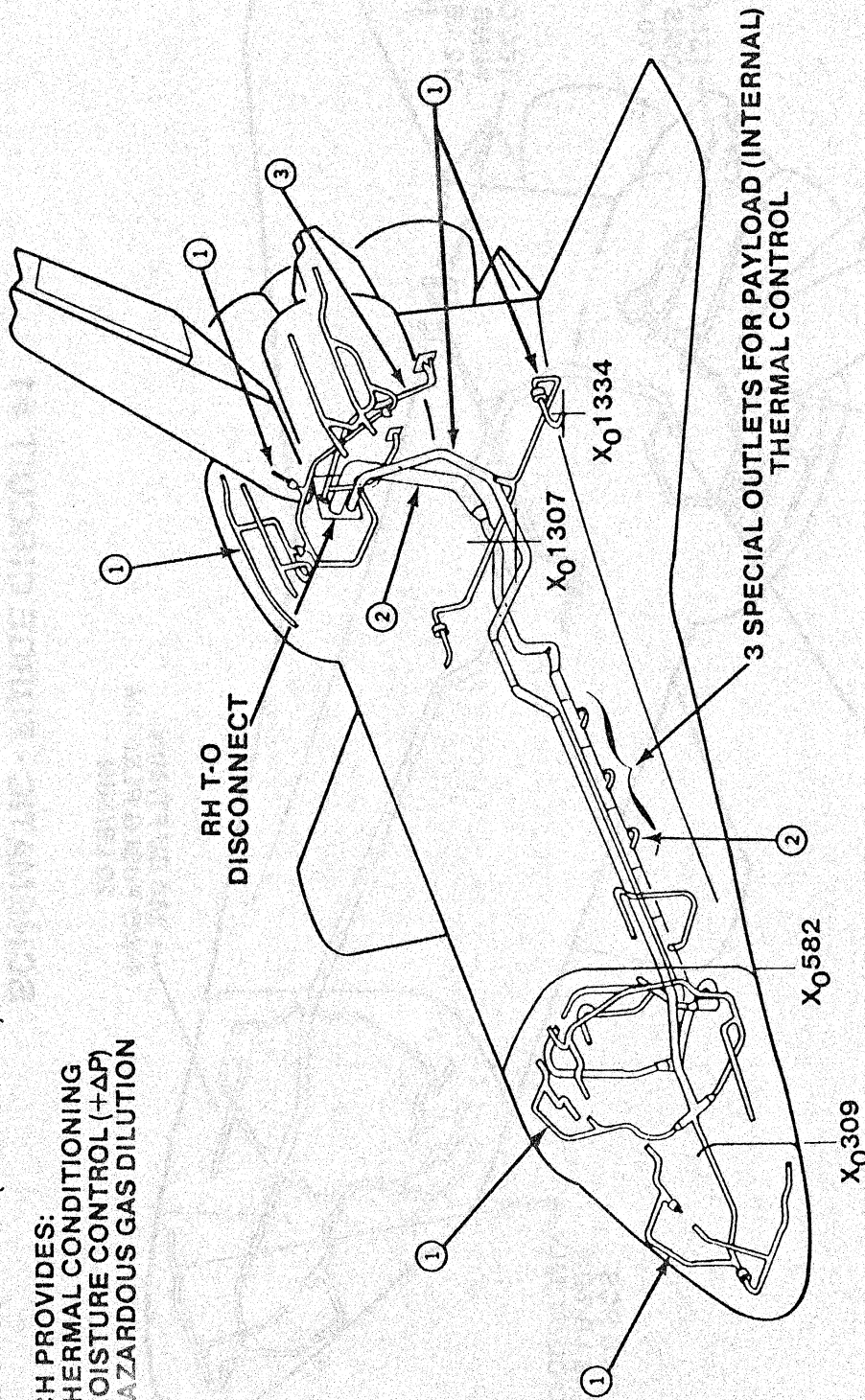


**Z = VERTICAL AXIS (UP AND DOWN)**  
 $Z_0 = 400$  IS LOCATED AT P/L BAY CENTERLINE.  
 ALL ELEVATIONS ARE POSITIVE.  
 (OPF FLOOR IS AT  $Z_0 = 147$ )

UNIT OF MEASURE = INCH (AND DECIMAL PLACES)

- THE SYSTEM CONSISTS OF 3 SEPARATE DEDICATED SYSTEMS:
  - 1) FWD FUSELAGE, FWD RCS/OMS PODS, WINGS, VERTICAL STABILIZER
  - 2) MID FUSELAGE (PAYLOAD BAY AND LOW EQUIPMENT BAY)
  - 3) AFT FUSELAGE (DEDICATED)

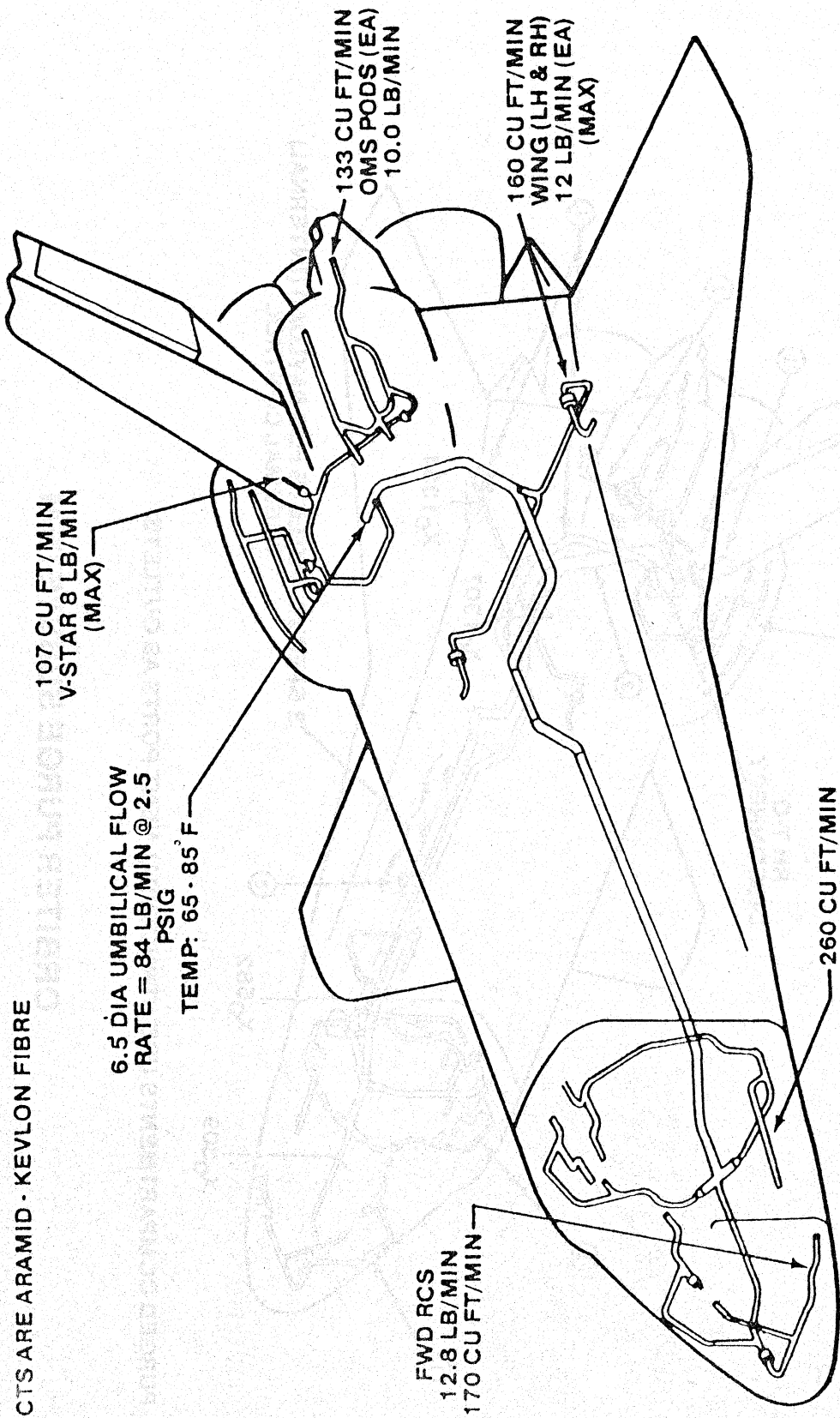
- EACH PROVIDES:
  - THERMAL CONDITIONING
  - MOISTURE CONTROL (+AP)
  - HAZARDOUS GAS DILUTION



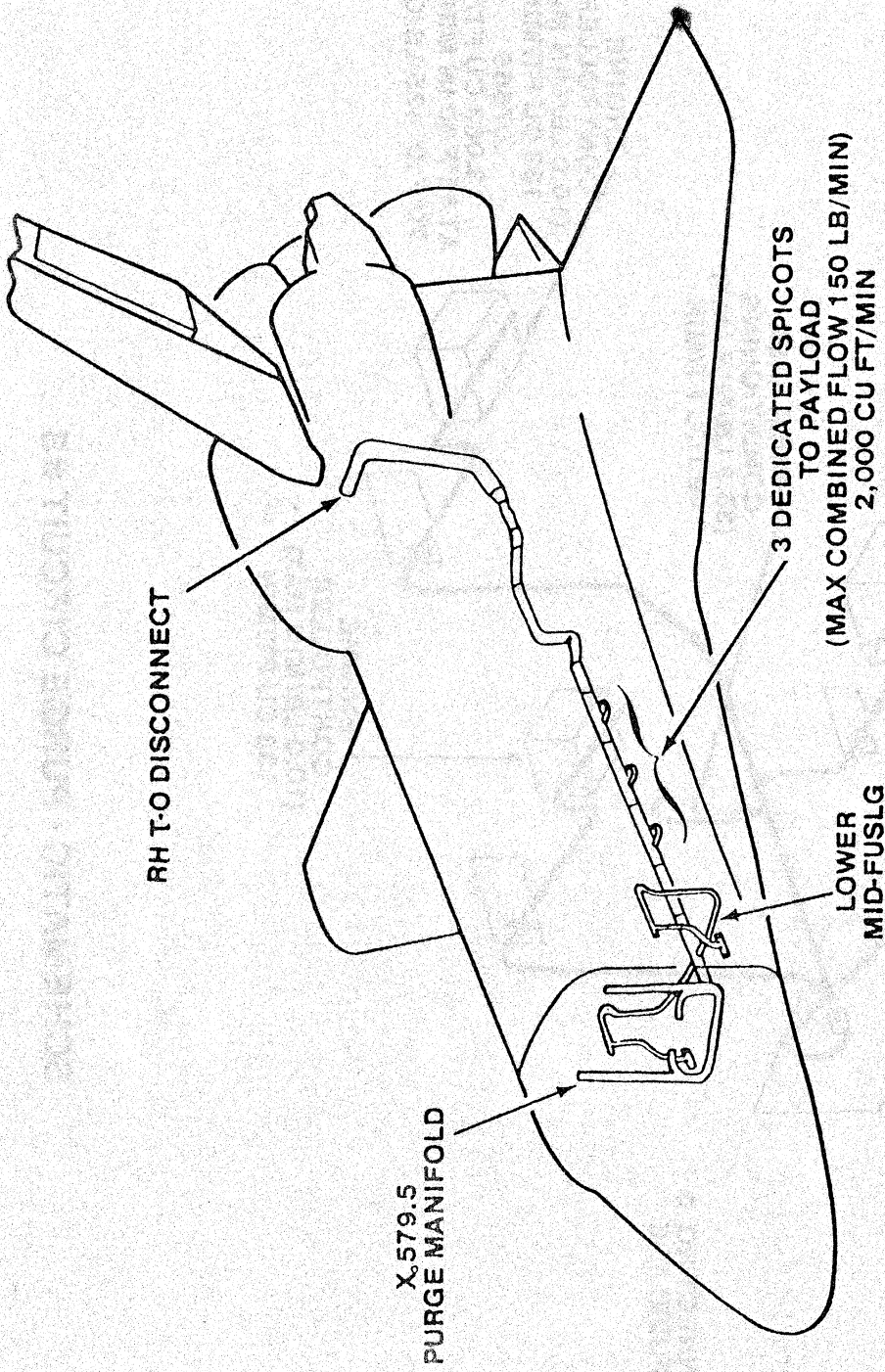
\*ALL PURGED COMPARTMENTS USE STRUCTURAL VENT PORTS AS OUTLETS

## ORBITER PURGE SUBSYSTEM

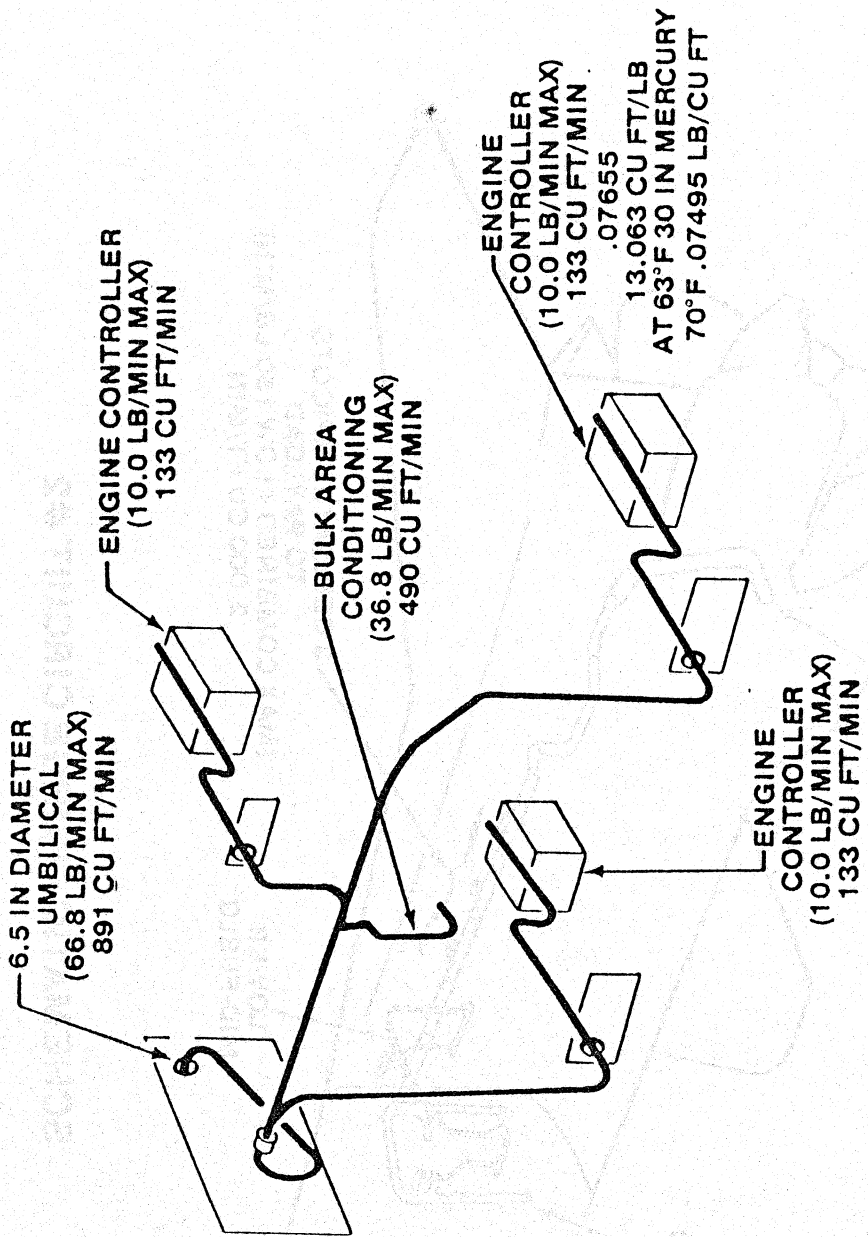
DUCTS ARE ARAMID - KEVLON FIBRE



SCHEMATIC - PURGE CIRCUIT #1

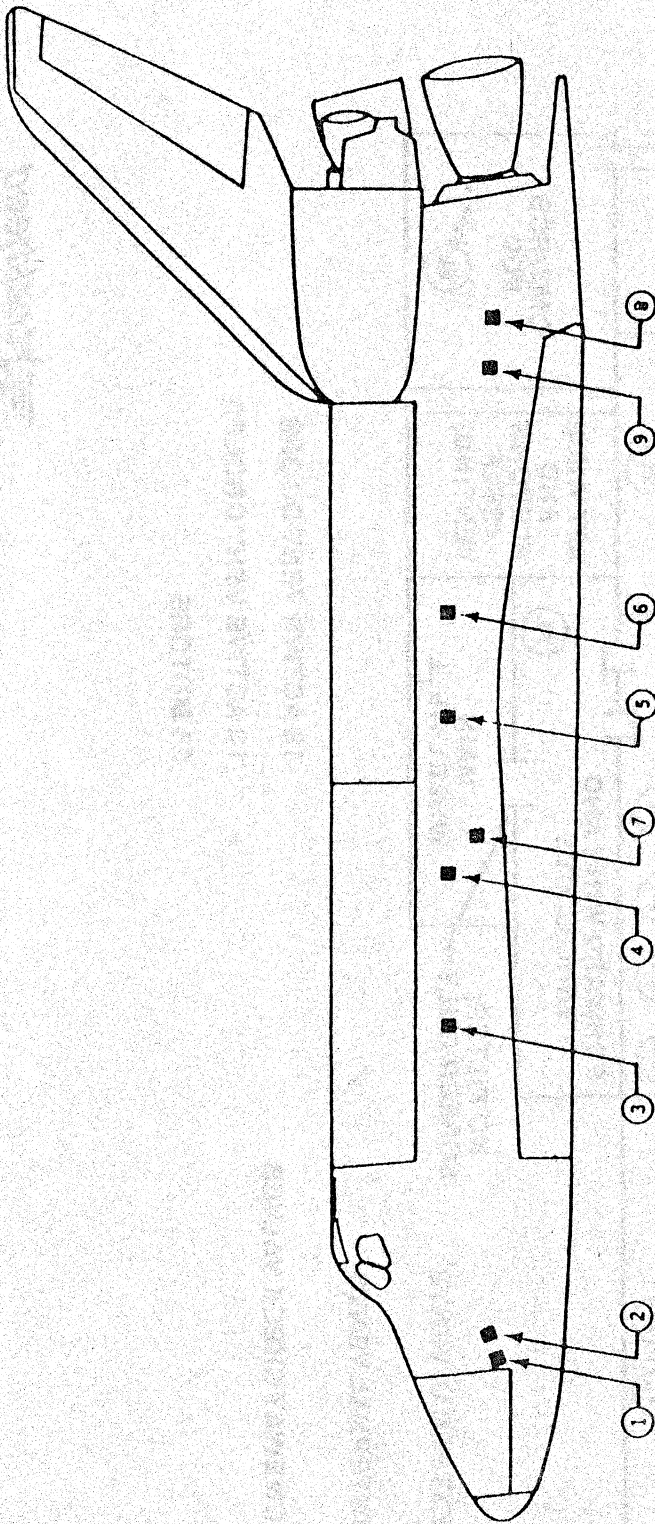


**SCHEMATIC - PURGE CIRCUIT #2**



DISCONNECT NO. 3  
AFT FUSELAGE

**SCHEMATIC - PURGE CIRCUIT #3**



● ALL VENTS SHOWN ARE LH AND RH

- VENTS 1 AND 2 ARE COUPLED
- VENTS 4 AND 7 ARE COUPLED
- VENTS 8 AND 9 ARE COUPLED
- 18 VENTS TOTAL
- TOTAL NET VENT AREA - 12.3 FT<sup>2</sup>

AREA 0.06 IN<sup>2</sup>/FT<sup>3</sup>  
VOLUME

● VENT POSITIONS

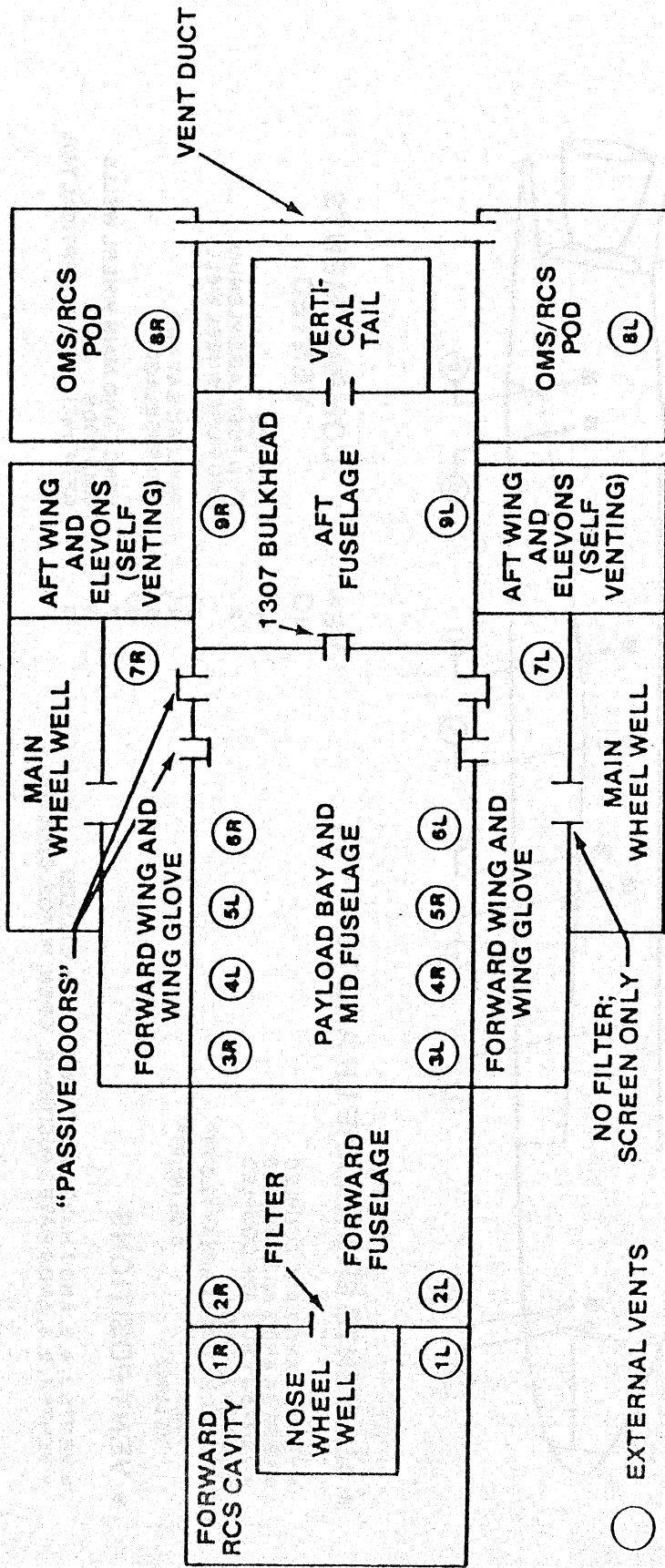
- VENTS 3, 4, 5, AND 7 HAVE 2 POSITIONS: OPEN, CLOSED
- VENTS 1, 2, 8, AND 9 HAVE 3 POSITIONS: OPEN, PURGE, CLOSED

VENT NO. COMPARTMENTS VENTED

- |   |   |
|---|---|
| 1 | FWD RCS                                 |
| 2 | FWD FUSELAGE PLENUM AND NOSE WHEEL WELL |
| 3 | PAYLOAD BAY AND MID FUSELAGE            |
| 4 |   |
| 5 | WINGS AND MAIN WHEEL WELLS              |
| 6 |   |
| 7 | OMS PODS                                |
| 8 | AFT FUSELAGE AND VERTICAL TAIL          |
| 9 |   |

VENT PORT IDENTIFICATION

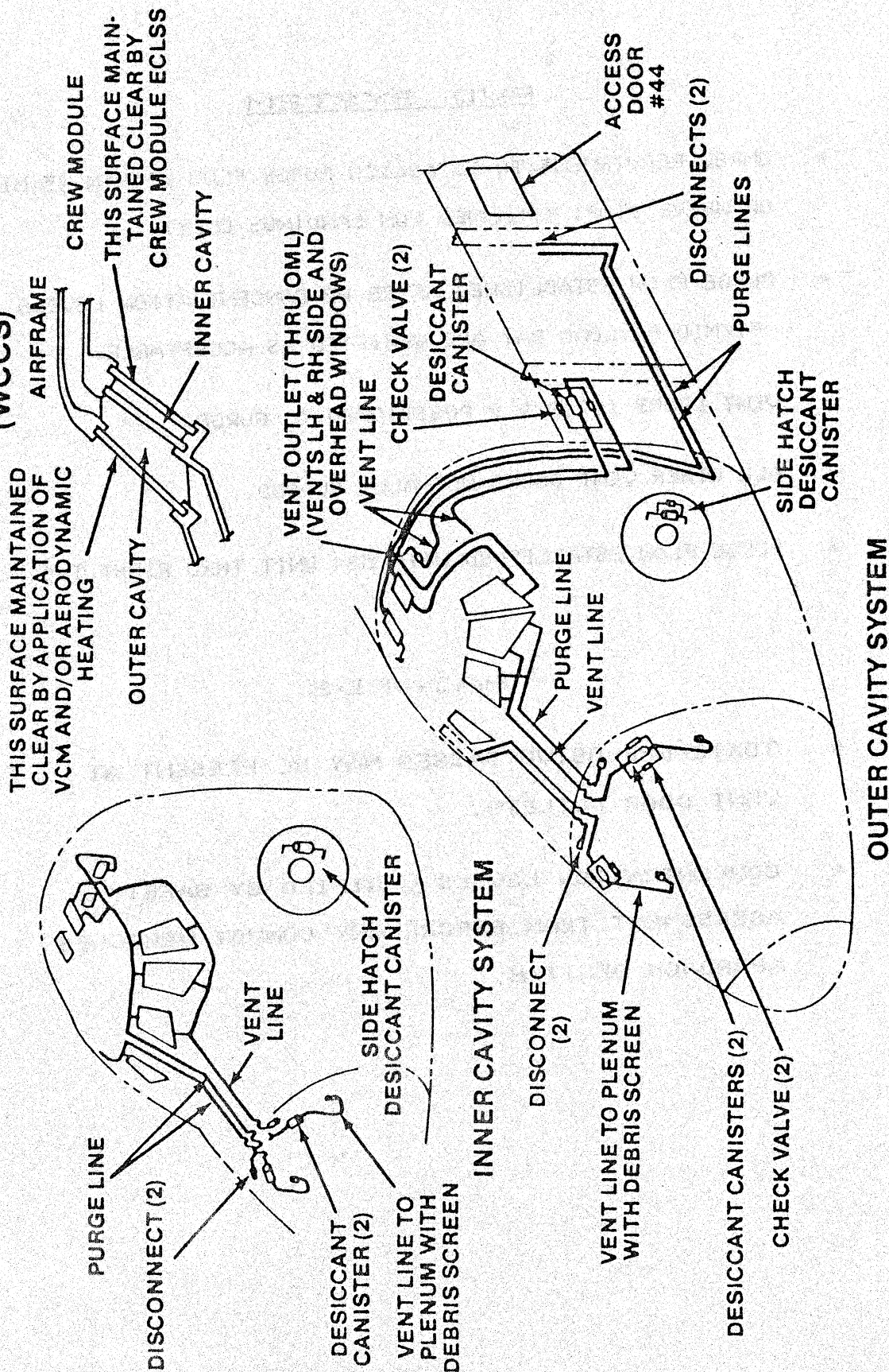
# VENTED ORBITER COMPARTMENTS



18 ACTIVE VENT DOORS  
 12 ACTIVE VENT GROUPS  
 24 MOTORS



# WINDOW CAVITY CONDITIONING SYSTEM (WCCS)



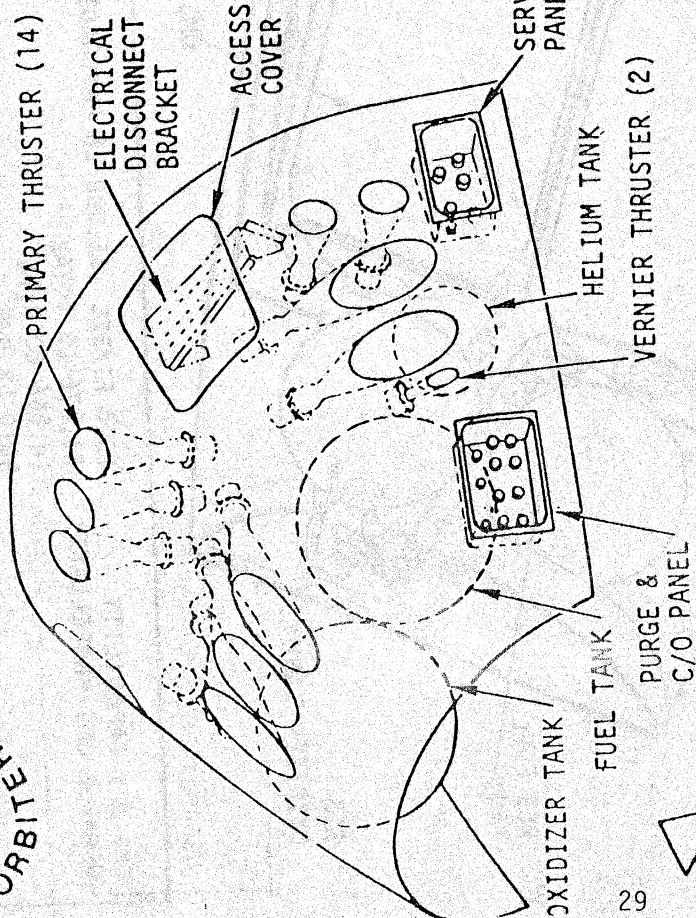
## PVD SYSTEM

- \* OMRSD REQUIREMENT TO ESTABLISH PURGE FLOW WITHIN 45 MIN. OF WHEEL STOP. (PLANNED EOM LANDINGS ONLY)
- \* PURGE FLOW ESTABLISHED AFTER H2 CONCENTRATION LEVELS IN AFT/MID/PAYLOAD BAY ARE VERIFIED AS ACCEPTABLE.
- \* VENT DOORS 1,2,8 & 9 POSITIONED TO PURGE.
- \* ALL OTHER VENT DOORS NORMALLY CLOSED.
- \* PURGE FLOW ESTABLISHED WITH 534 UNIT THRU RIGHT T-0.

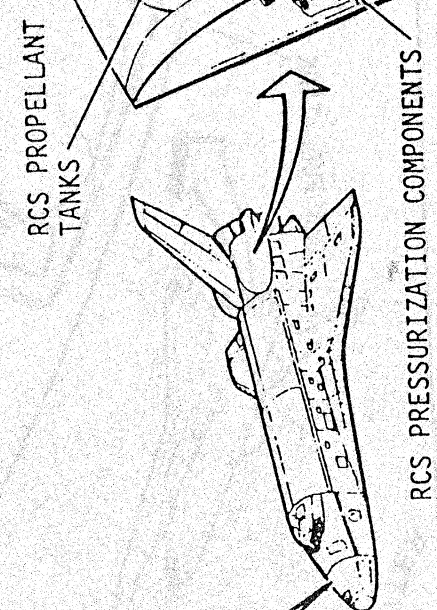
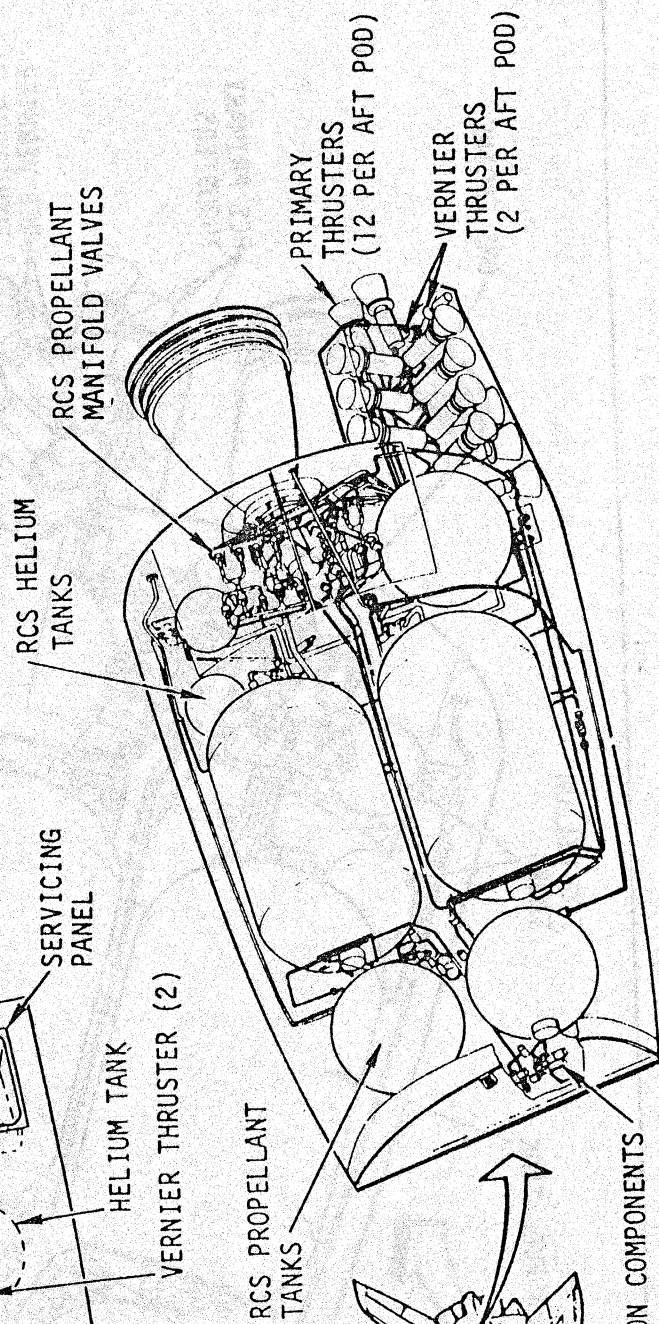
## HAZARDS

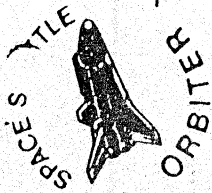
- \* TOXIC/EXPLOSIVE GASSES MAY BE PRESENT AT VENT DOOR OUTLETS.
- \* CONCENTRATION LEVELS VERIFIED BY SAFETY ASSESSMENT TEAM BEFORE ANY CONVOY VEHICLES APPROACH ORBITER.

REACTION CONTROL SUBSYSTEM

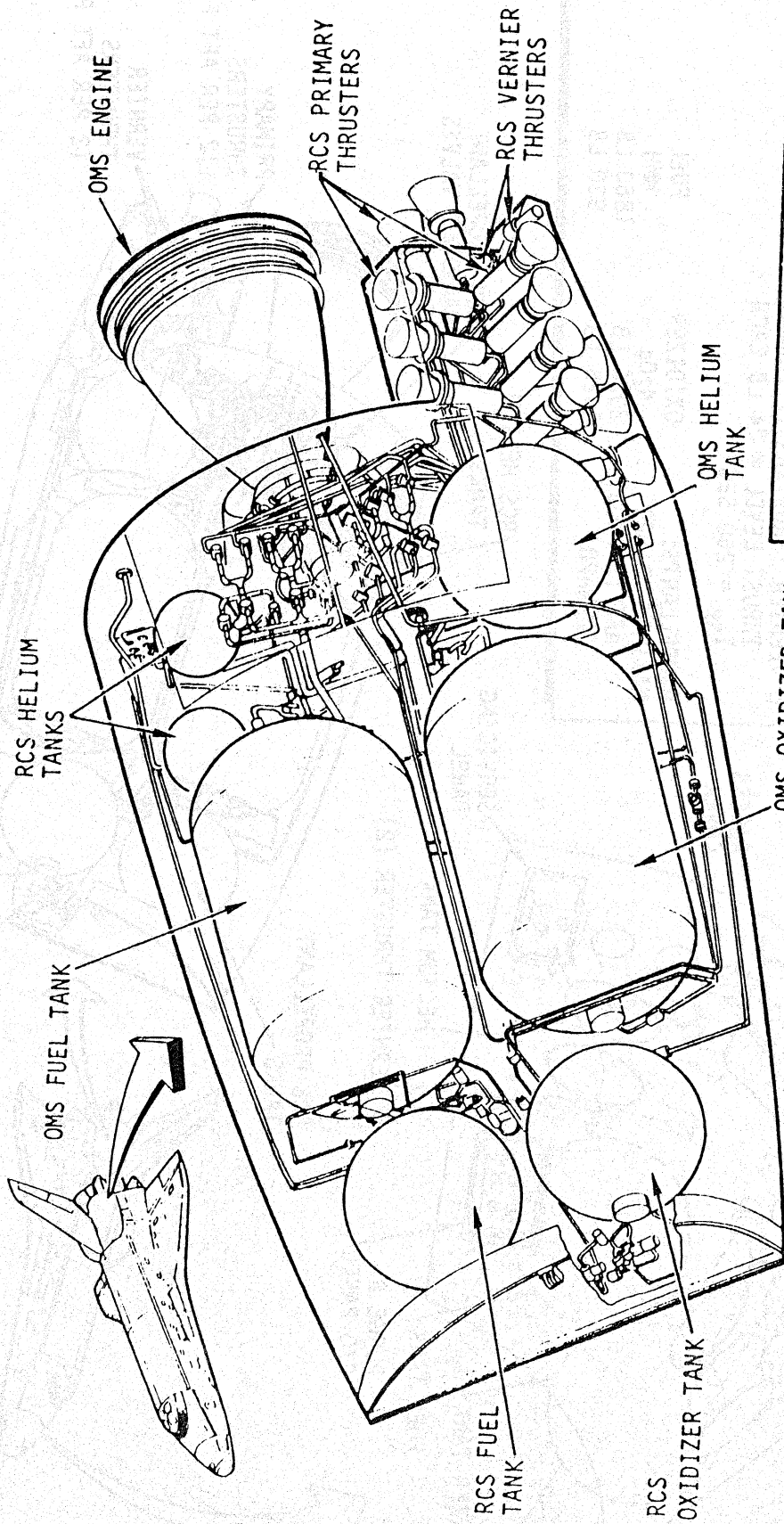


1 FORWARD RCS MODULE, 2 AFT RCS SUBSYSTEMS IN PODS			
38 MAIN THRUSTERS (14 FORWARD, 12 PER AFT POD)			
THRUST LEVEL = 870 LB (VACUUM) EACH			
Isp = 280 SEC			
6 VERNIER THRUSTERS (2 FORWARD & 4 AFT)			
THRUST LEVEL = 24 LB EACH			
Isp = 260 SEC			
PROPELLANTS:	OXIDIZER	FUEL	
MAXIMUM LOADED	N2O4	MMH	
AFT (2 PODS)	2976 LB	1860 LB	
FORWARD	1488 LB	930 LB	





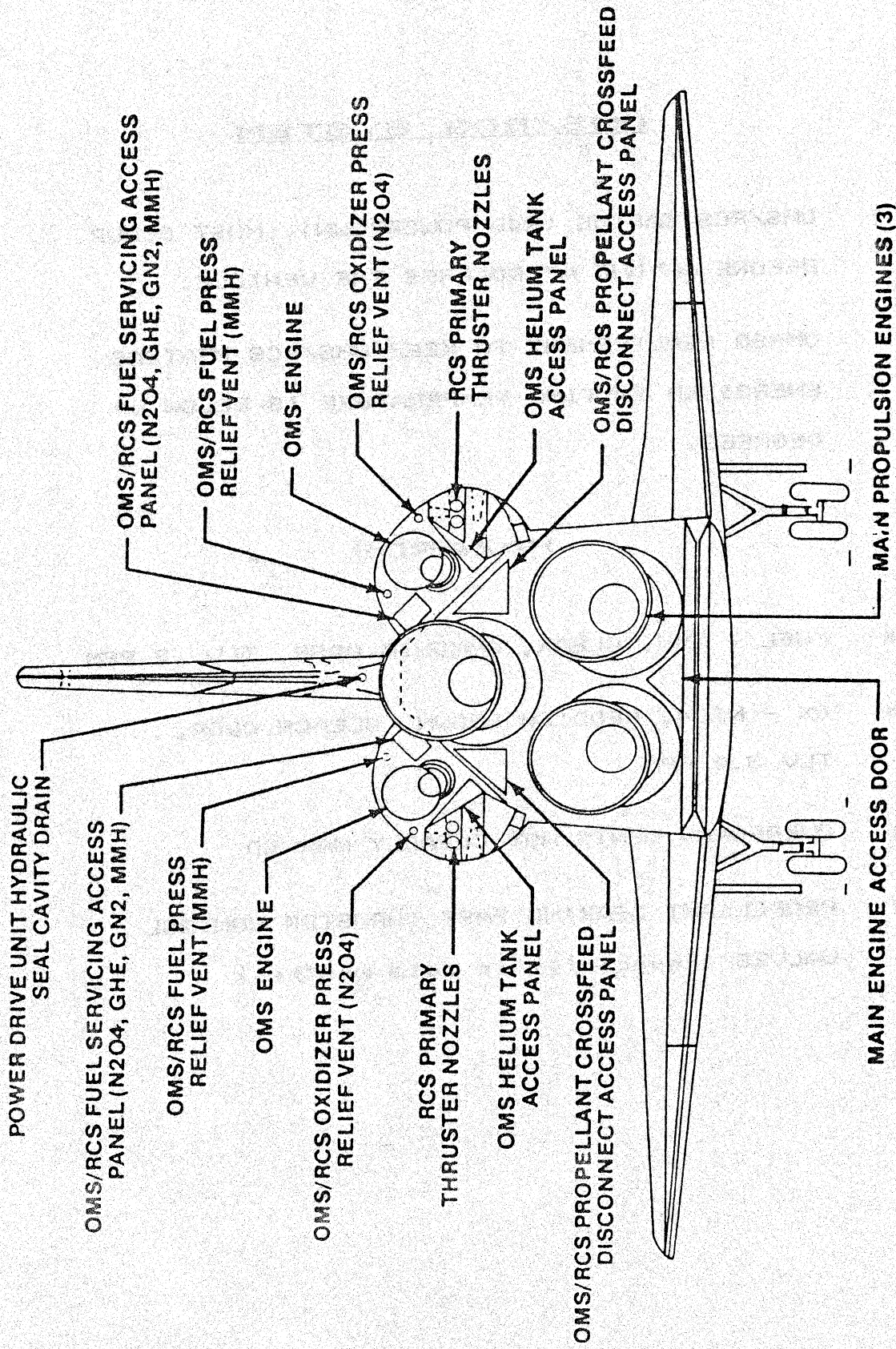
# ORBITAL MANEUVER SUBSYSTEM



OMS $\Delta V$ CAPABILITY	1000 FT/SEC
USEABLE OMS PROPELLANT:	23,876 LB TOTAL
	14,866 LB N <sub>2</sub> O <sub>4</sub>
	9010 LB MMH

OMS ENGINE CHARACTERISTICS	
THRUST	6000 LB (VACUUM)
SPECIFIC IMPULSE	313 SEC
CHAMBER PRESSURE	125 PSIA
MIXTURE RATIO	1.65
GIMBAL CAPABILITY	{ +6° PITCH
	{ +7° YAW

# MOLDLINE PENETRATIONS/ACCESS PANELS



## OMS/RCS SYSTEM

- \* OMS/RCS SAFING (RJD POWERDOWN), MUST OCCUR BEFORE ANYONE APPROACHES THE VEHICLE.
- \* OMRSD REQUIREMENT TO KEEP OMS/RCS HEATERS ENERGIZED ANYTIME TEMPERATURE IS BELOW 60 DEGREES.

## HAZARDS

- \* FUEL - MMH, CLEAR, AMMONIA ODOR, TLV .2 PPM
- \* OX - N2O4, REDDISH BROWN, BLEACH ODOR, TLV 3.0 PPM
- \* OVERBOARD VENTS NOT CLEARLY MARKED
- \* PROPELLANT LEAKING PAST THRUSTER CONTROL VALVES (Especially in cold weather)

ENVIRONMENTAL CONTROL LIFE  
SUPPORT SYSTEM (ECLSS)

ATMOSPHERE PRESSURIZATION SYSTEM

- \* O2/N2 STORAGE & DISTRIBUTION
- \* O2/N2 MIXTURE CONTROL
- \* CABIN PRESSURE REGULATION

AIR REVITALIZATION SYSTEM

- \* CABIN AIR CIRCULATION & TEMPERATURE CONTROL
- \* WATER COOLANT LOOPS

ACTIVE THERMAL CONTROL SYSTEM

- \* FREON LOOPS
- \* RADIATORS
- \* FLASH EVAPORATOR SYSTEM
- \* AMMONIA BOILER
- \* GSE HEAT EXCHANGER

CABIN HX & COLD PLATES

WATER

INTERCHANGER

FREON

MID/AFT HX & COLD PLATES

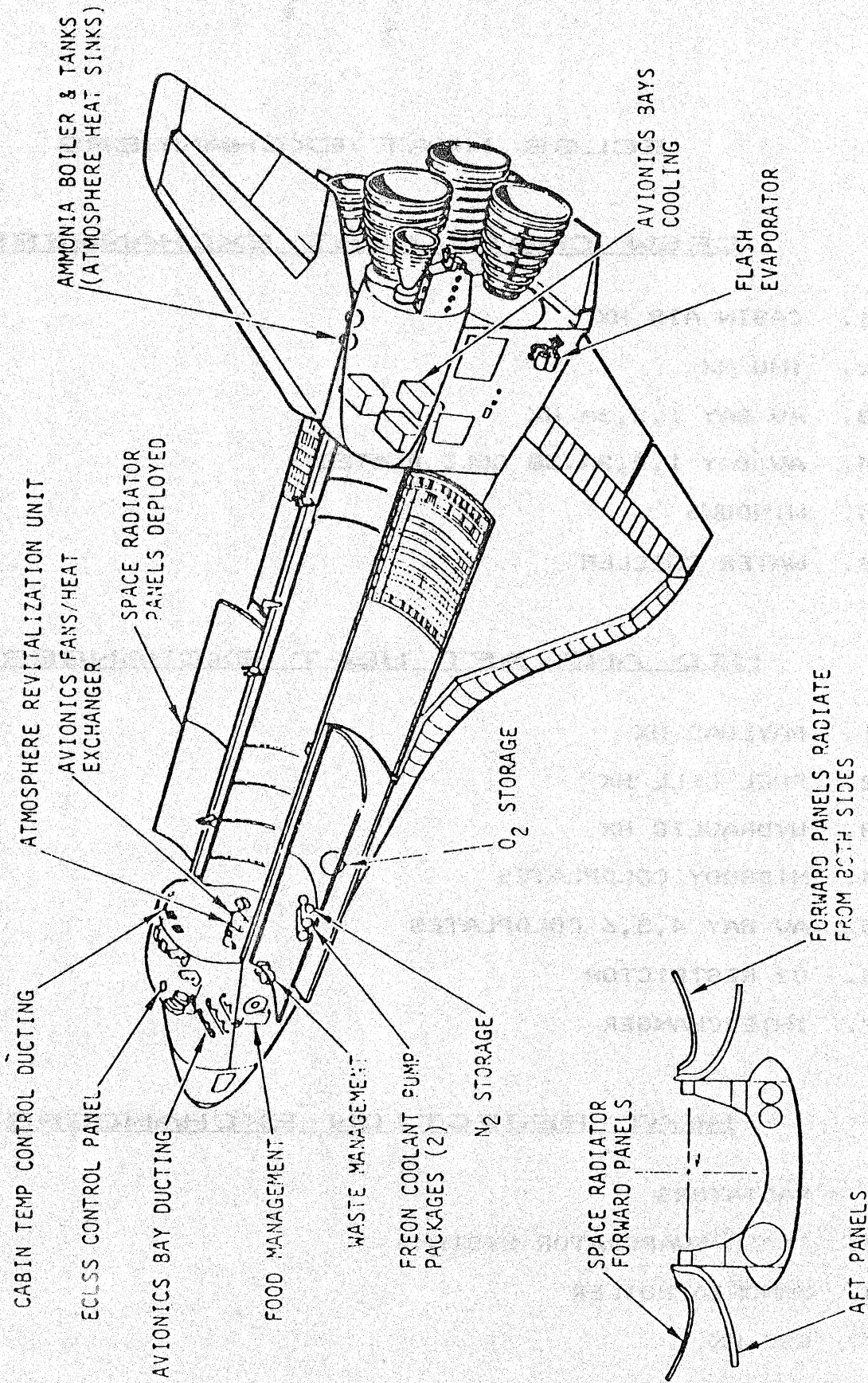
FREON

RADIATORS  
FES  
NH3 BOILER  
GSE HX

OUTSIDE ATMOSPHERE



# Environmental Control and Life Support Subsystem



## ECLSS HEAT EXCHANGERS

### CREW CABIN HEAT EXCHANGERS

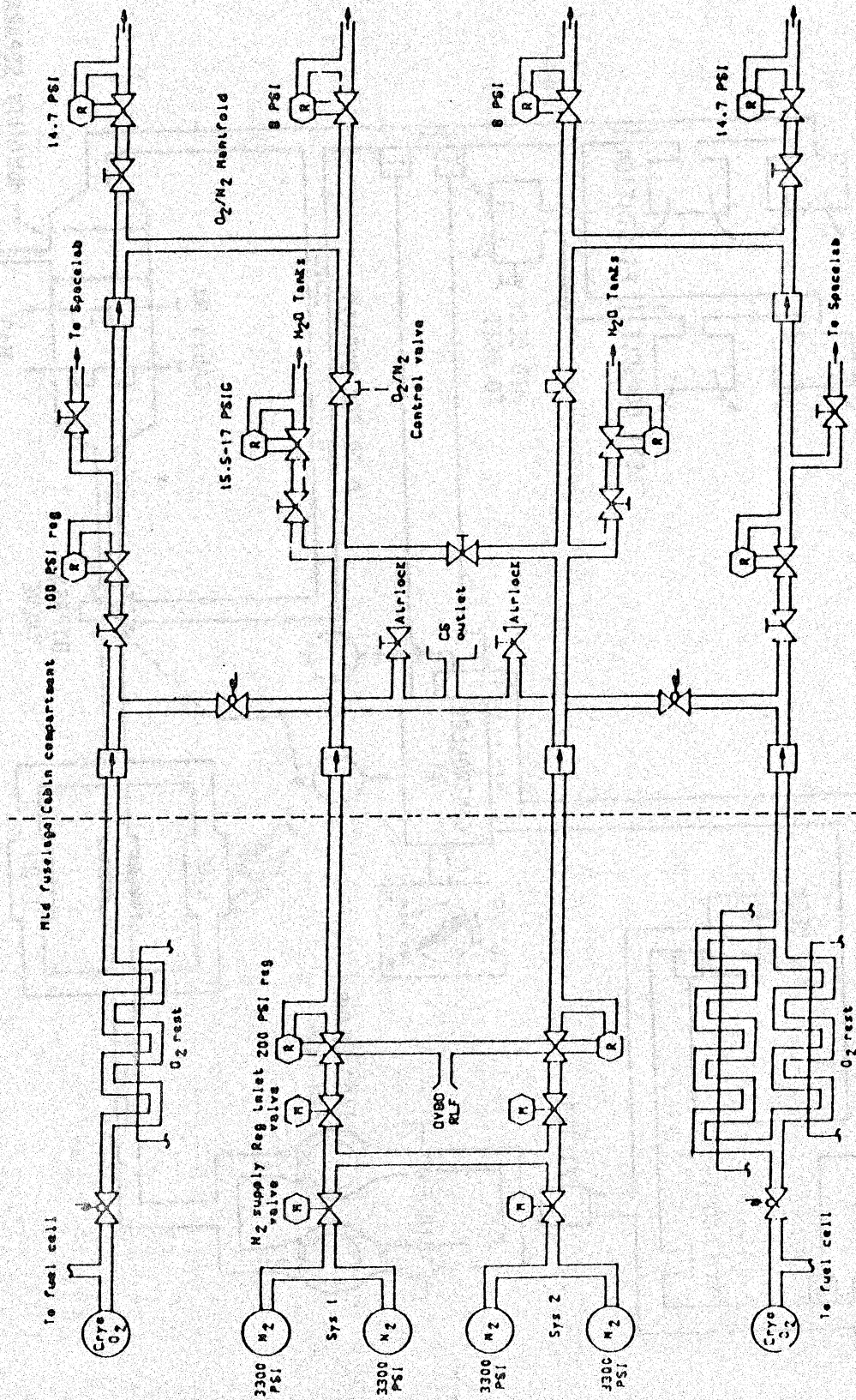
1. CABIN AIR HX
2. IMU HX
3. AV BAY 1,2,3A HX
4. AV BAY 1,2,3A,3B COLD PLATES
5. WINDOWS
6. WATER CHILLER

### MID AND AFT HEAT EXCHANGERS

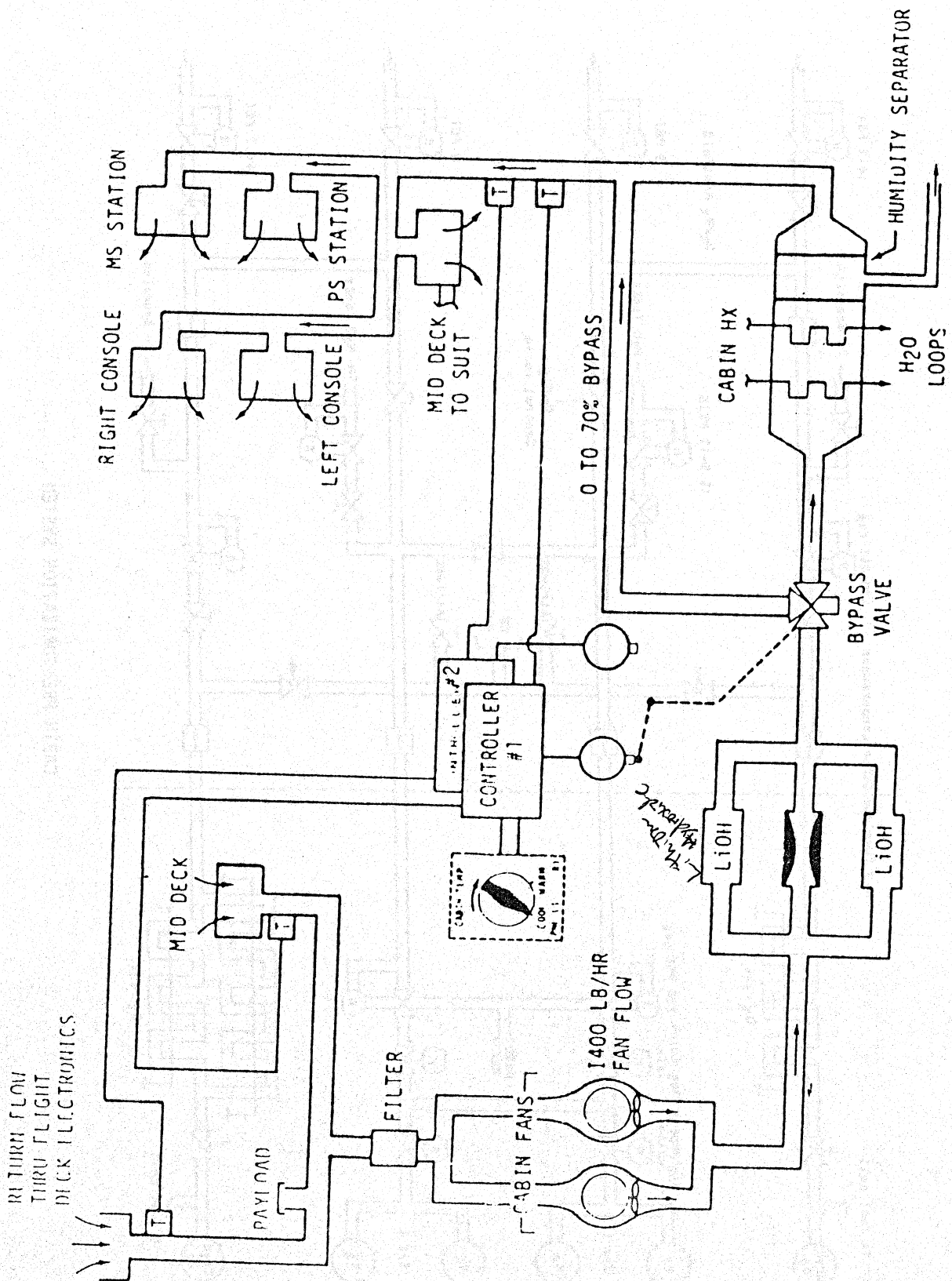
1. PAYLOAD HX
2. FUEL CELL HX
3. HYDRAULIC HX
4. MIDBODY COLDPLATES
5. AV BAY 4,5,6 COLDPLATES
6. O2 RESTRICTOR
7. INTERCHANGER

### HEAT REJECTION EXCHANGERS

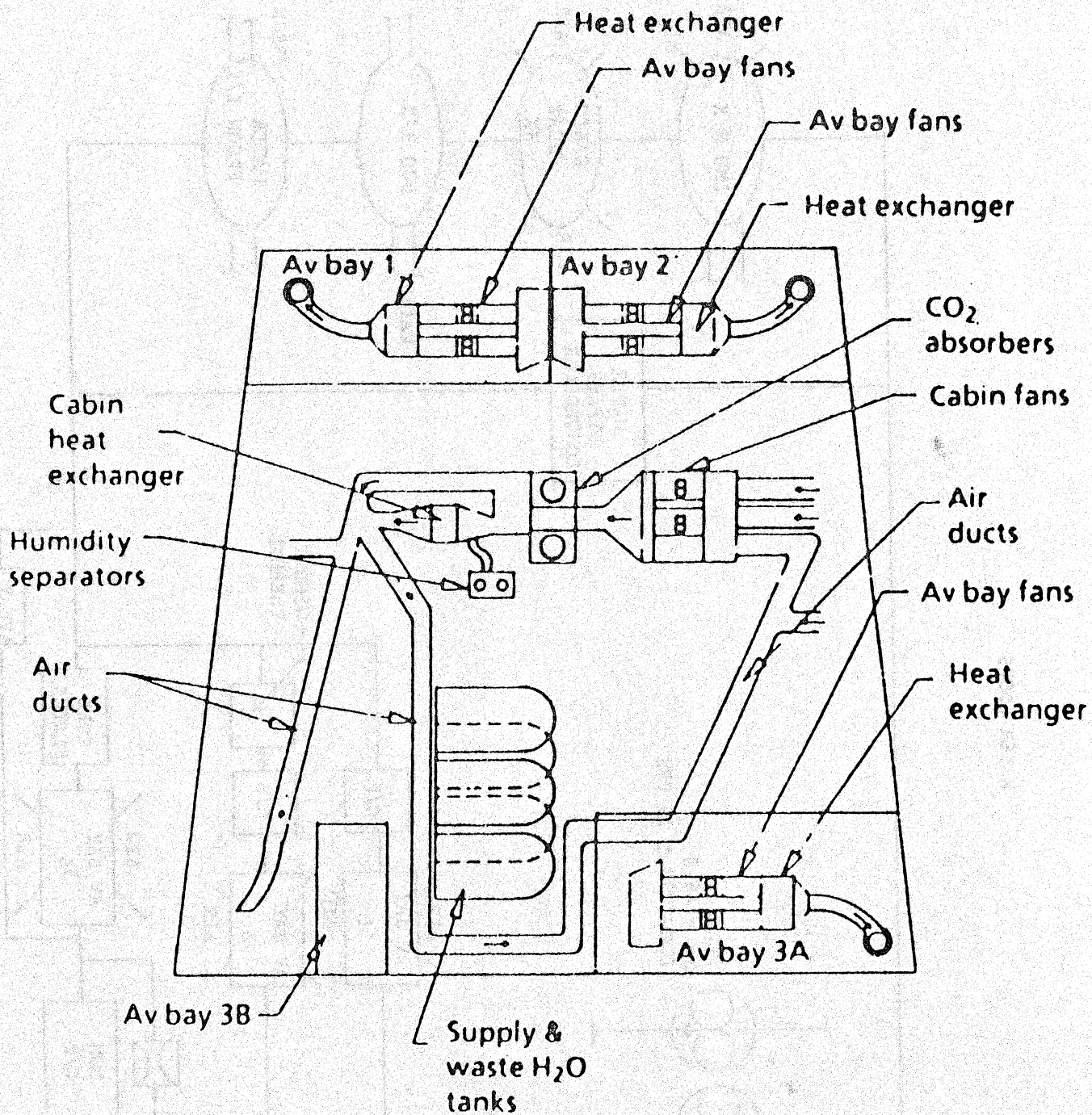
1. RADIATORS
2. FLASH EVAPORATOR SYSTEM
3. AMMONIA BOILER
4. GSE HX



CABIN PRESSURIZATION SYSTEM

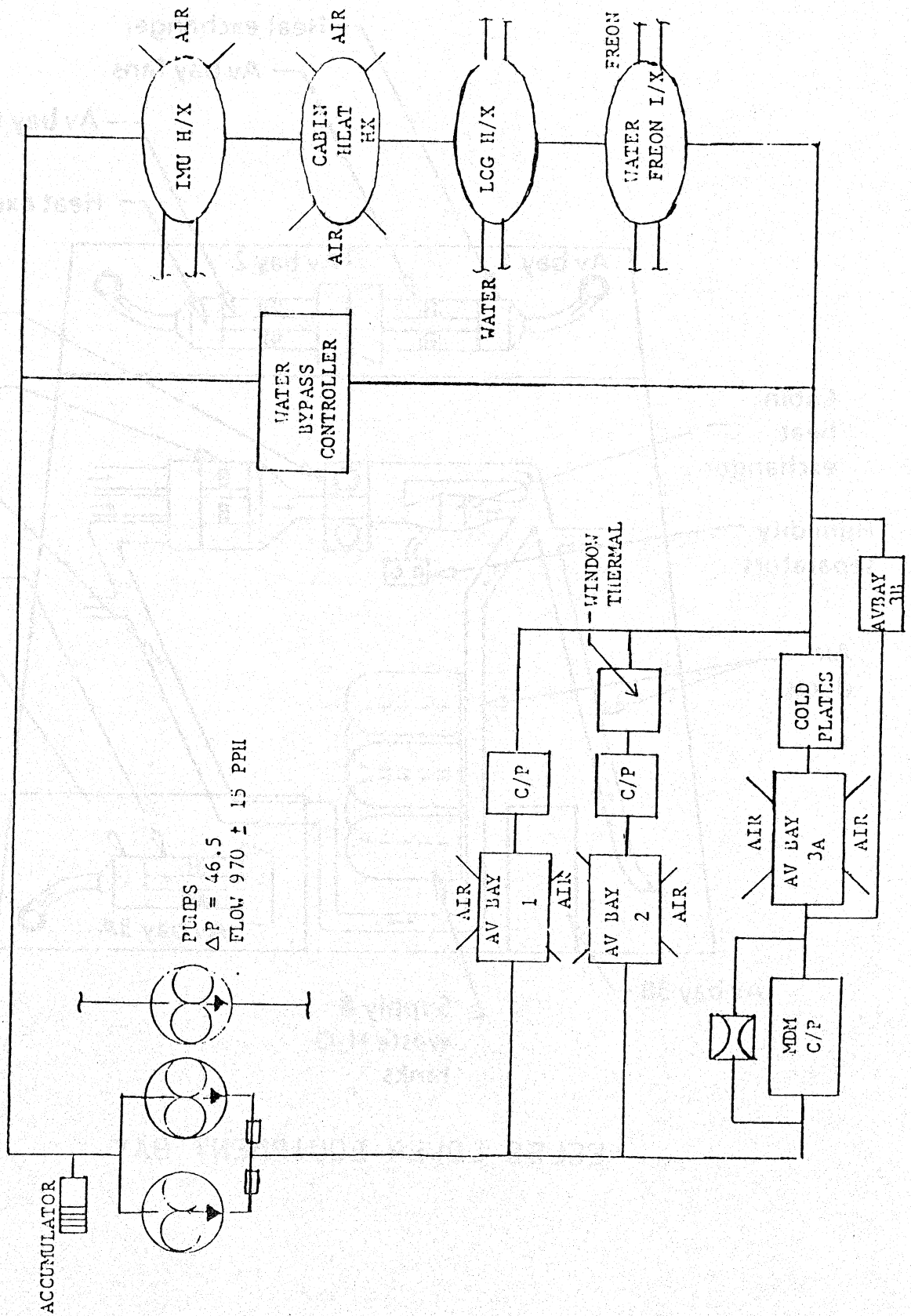


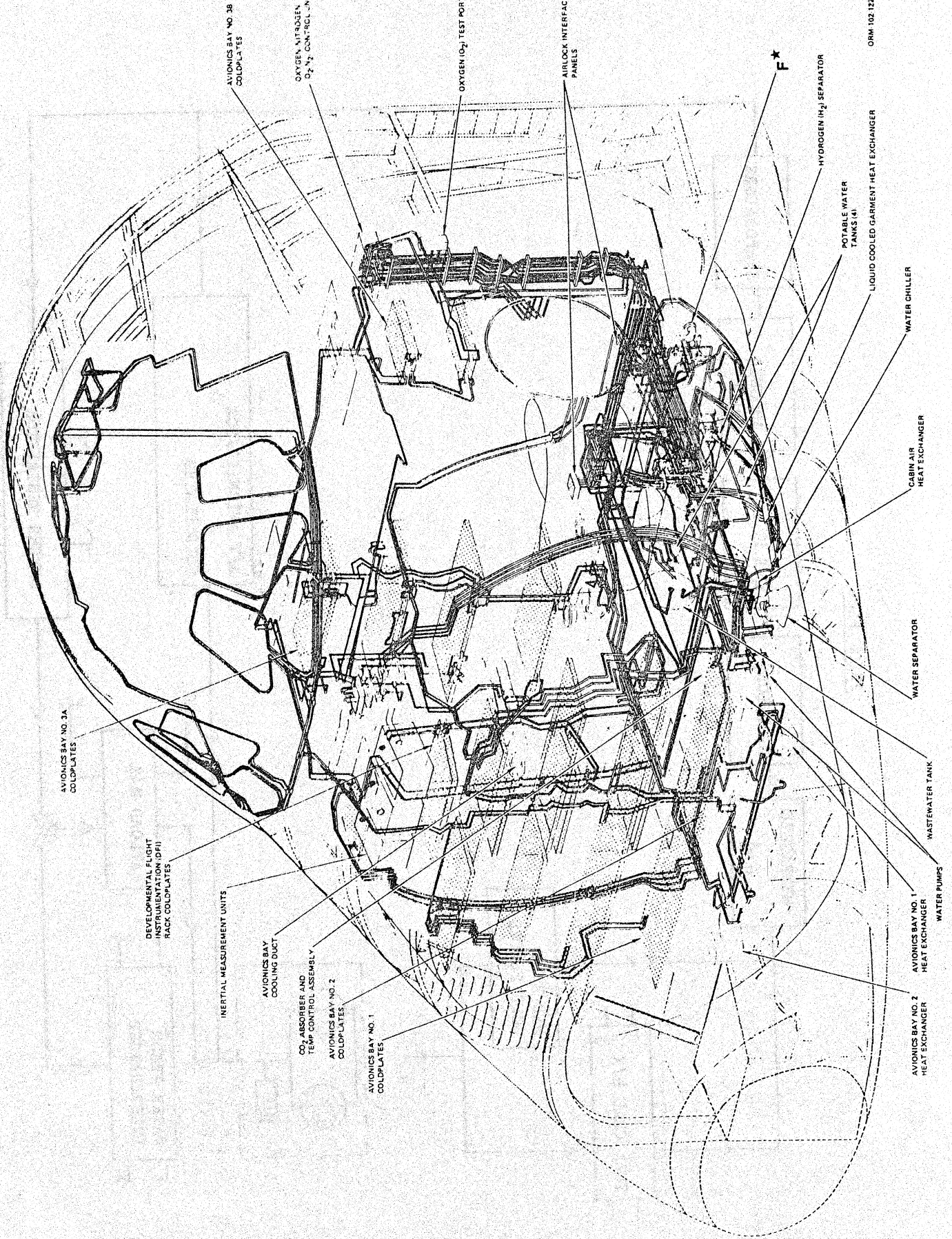
Air circulation.



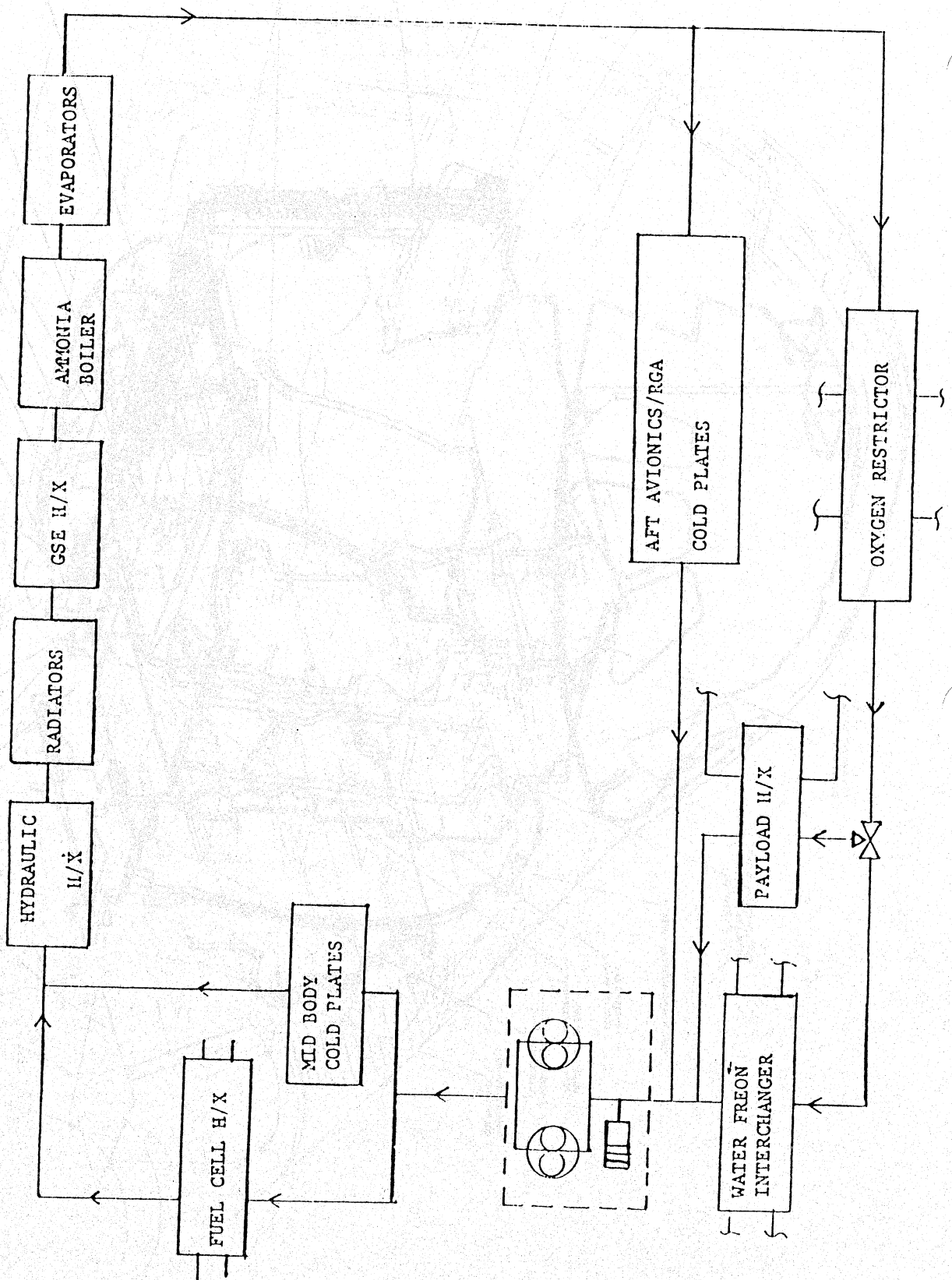
ECLSS LOWER EQUIPMENT BAY

WATER LOOPS





FREON FLOW





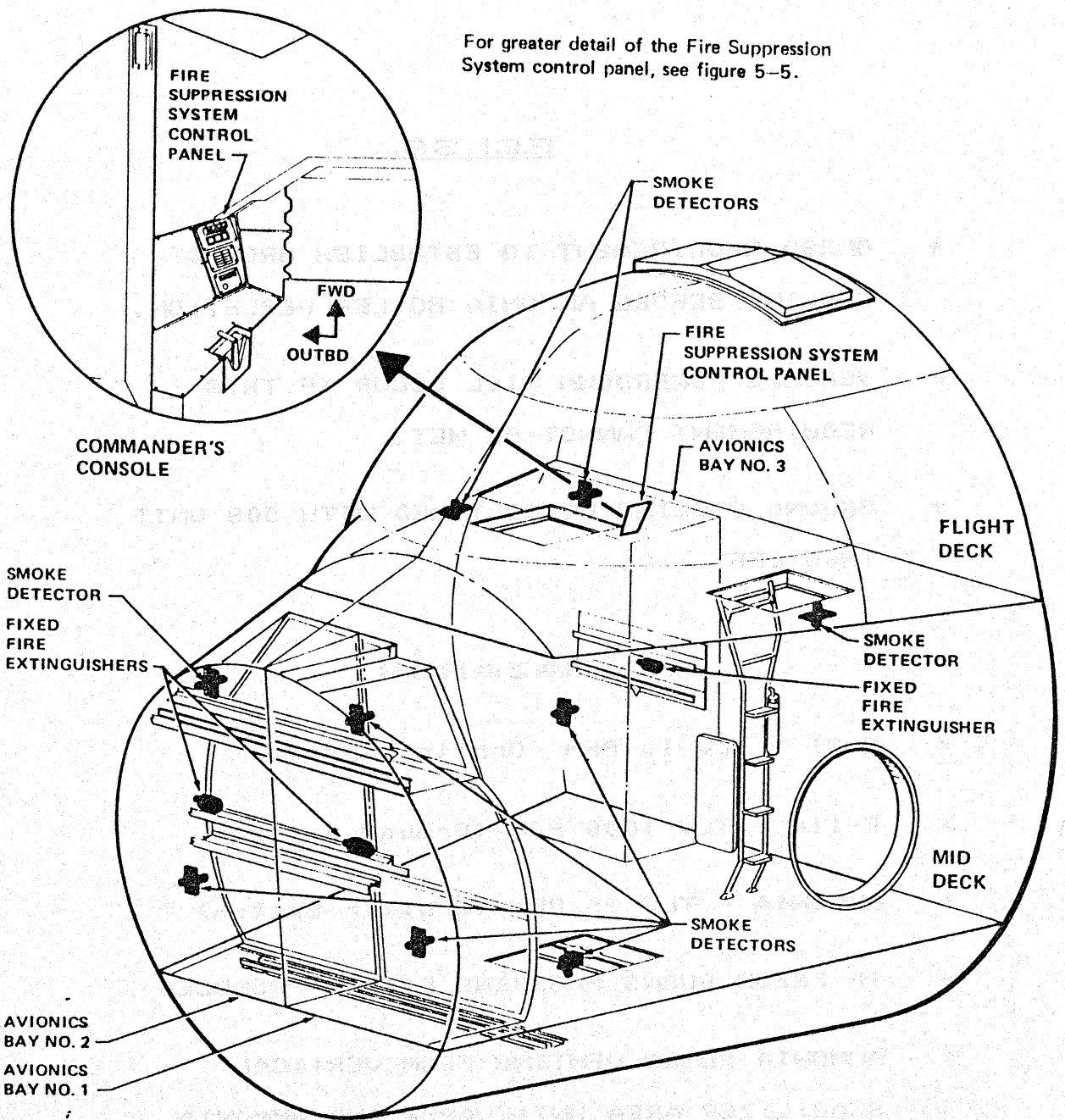
## ECLSS

- \* OMRSD REQUIREMENT TO ESTABLISH GROUND COOLING BEFORE AMMONIA BOILER DEPLETION.
- \* VEHICLE POWERDOWN WILL OCCUR IF THIS REQUIREMENT CANNOT BE MET.
- \* GROUND COOLING ESTABLISHED WITH 508 UNIT THRU LEFT T-0.

## HAZARDS

- \* F-21 - TLV 10 PPM (Orbiter System)
- \* F-114 - TLV 1000 PPM (Ground System)
- \* AMMONIA - TLV 25 PPM (Orbiter System)
- \* IF FREON BURNS PHOSGENE GAS IS PRODUCED
- \* AMMONIA FUMES VENTING FROM VERTICAL STABILIZER AREA UNTIL APUs AND AMMONIA BOILER SHUTDOWN OCCURS. (MAY REQUIRE BREATHING AIR/FAN MACHINE)

For greater detail of the Fire Suppression System control panel, see figure 5-5.

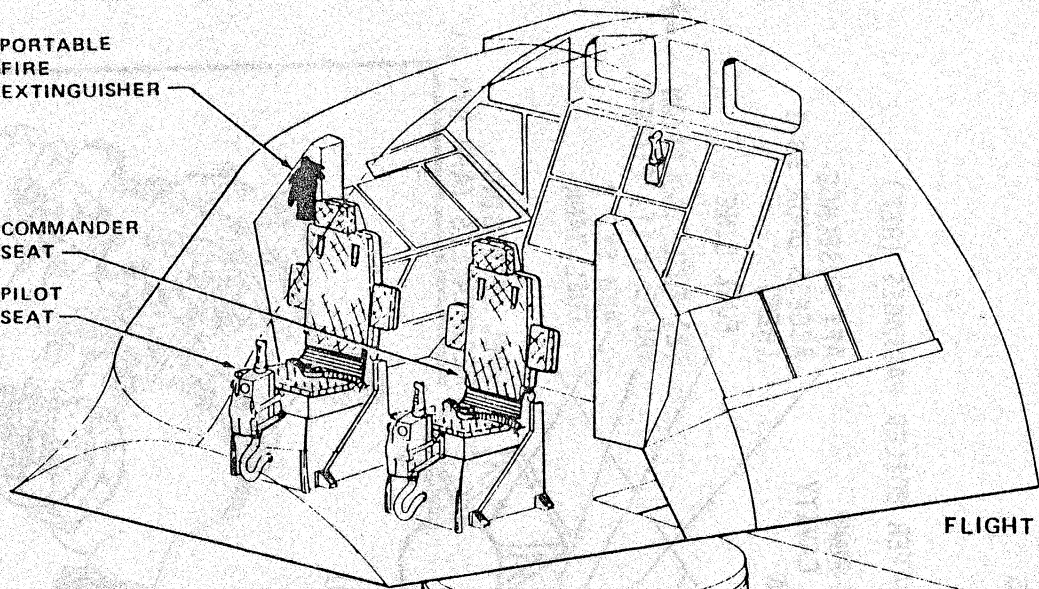


Fire detection and suppression components.

PORTABLE  
FIRE  
EXTINGUISHER

COMMANDER  
SEAT

PILOT  
SEAT

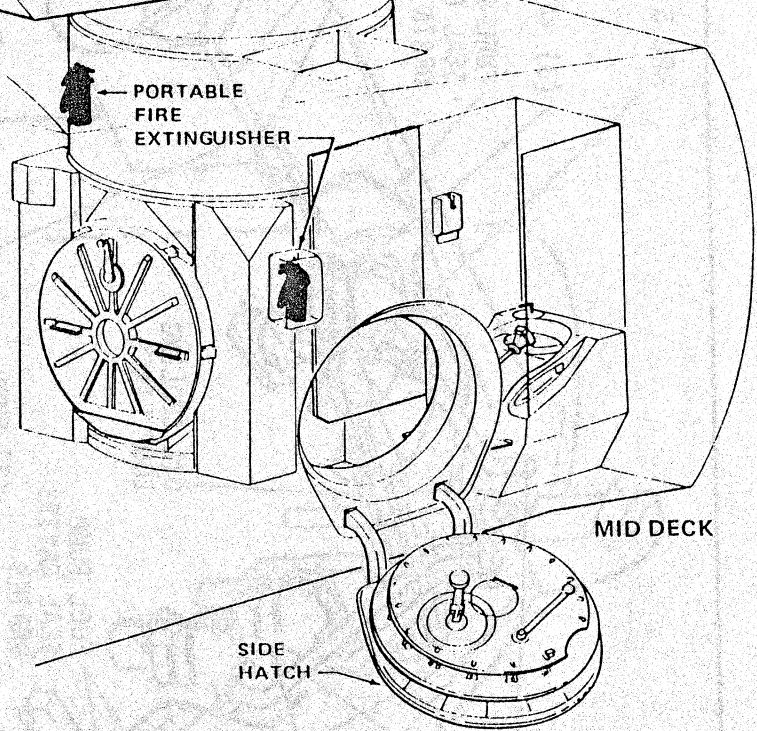


FLIGHT DECK



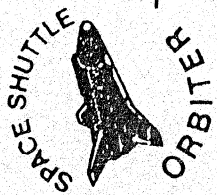
PORTABLE FIRE EXTINGUISHER

PORTABLE  
FIRE  
EXTINGUISHER

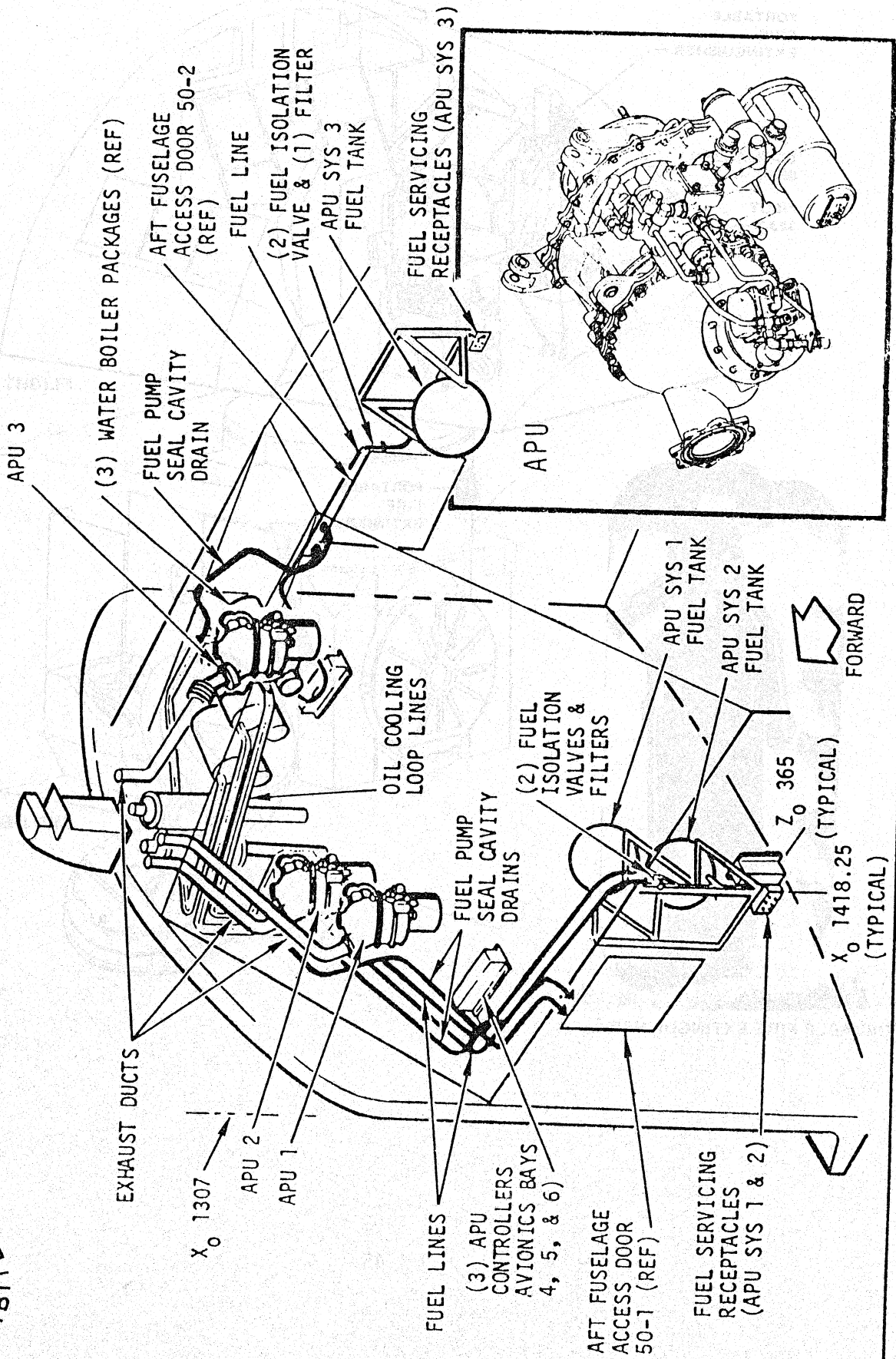


MID DECK

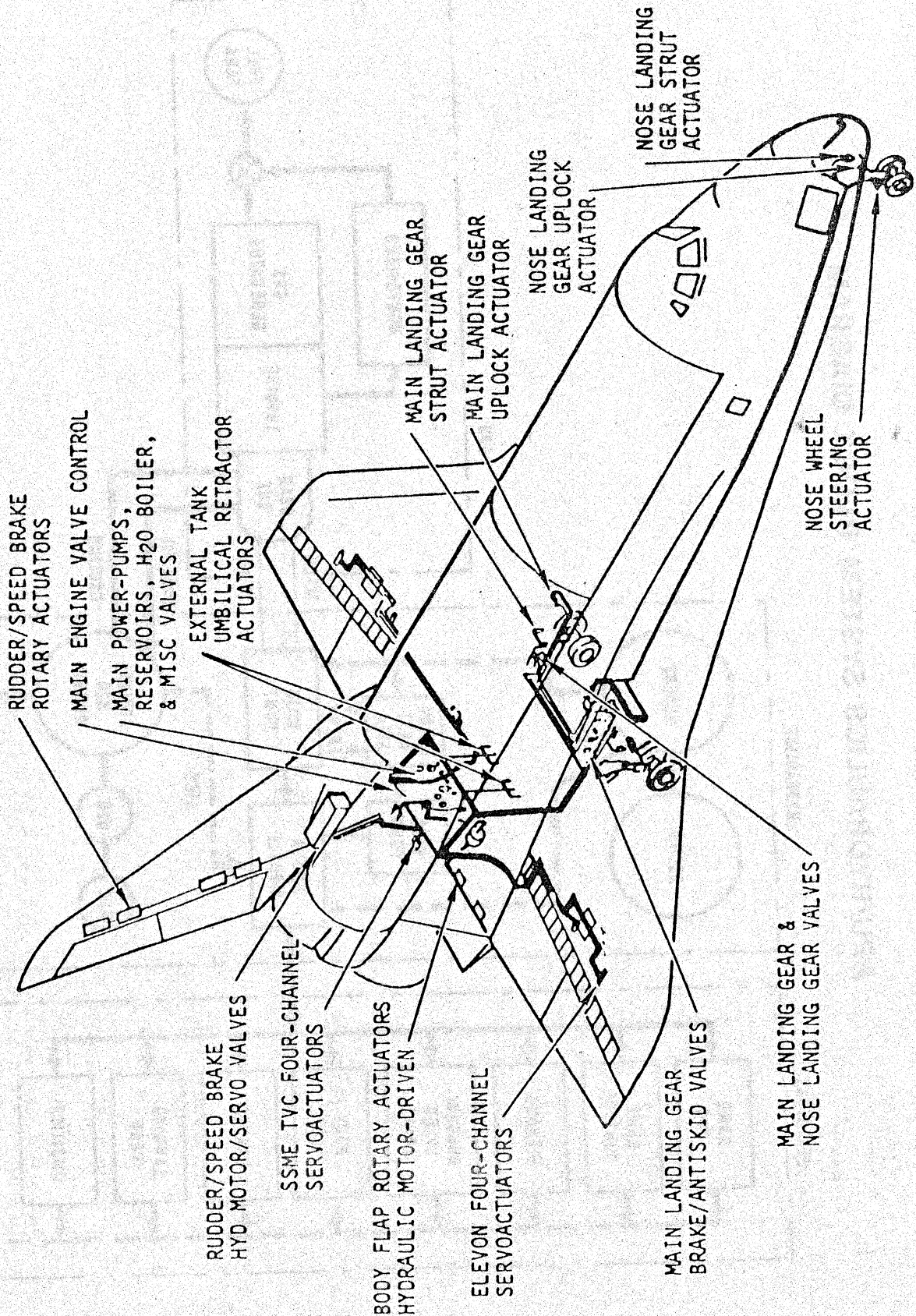
SIDE  
HATCH



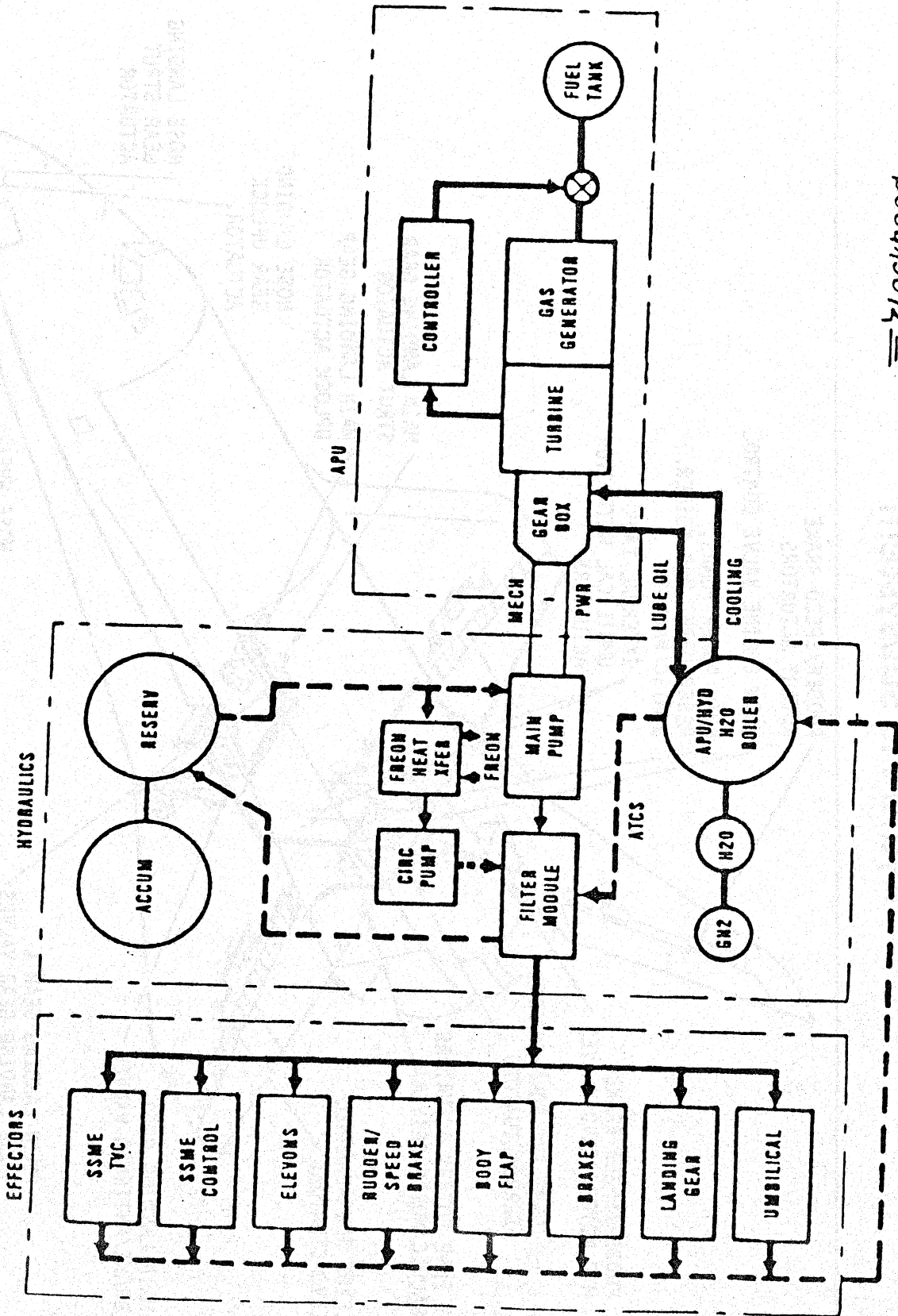
# AUXILIARY POWER UNIT SUBSYSTEM



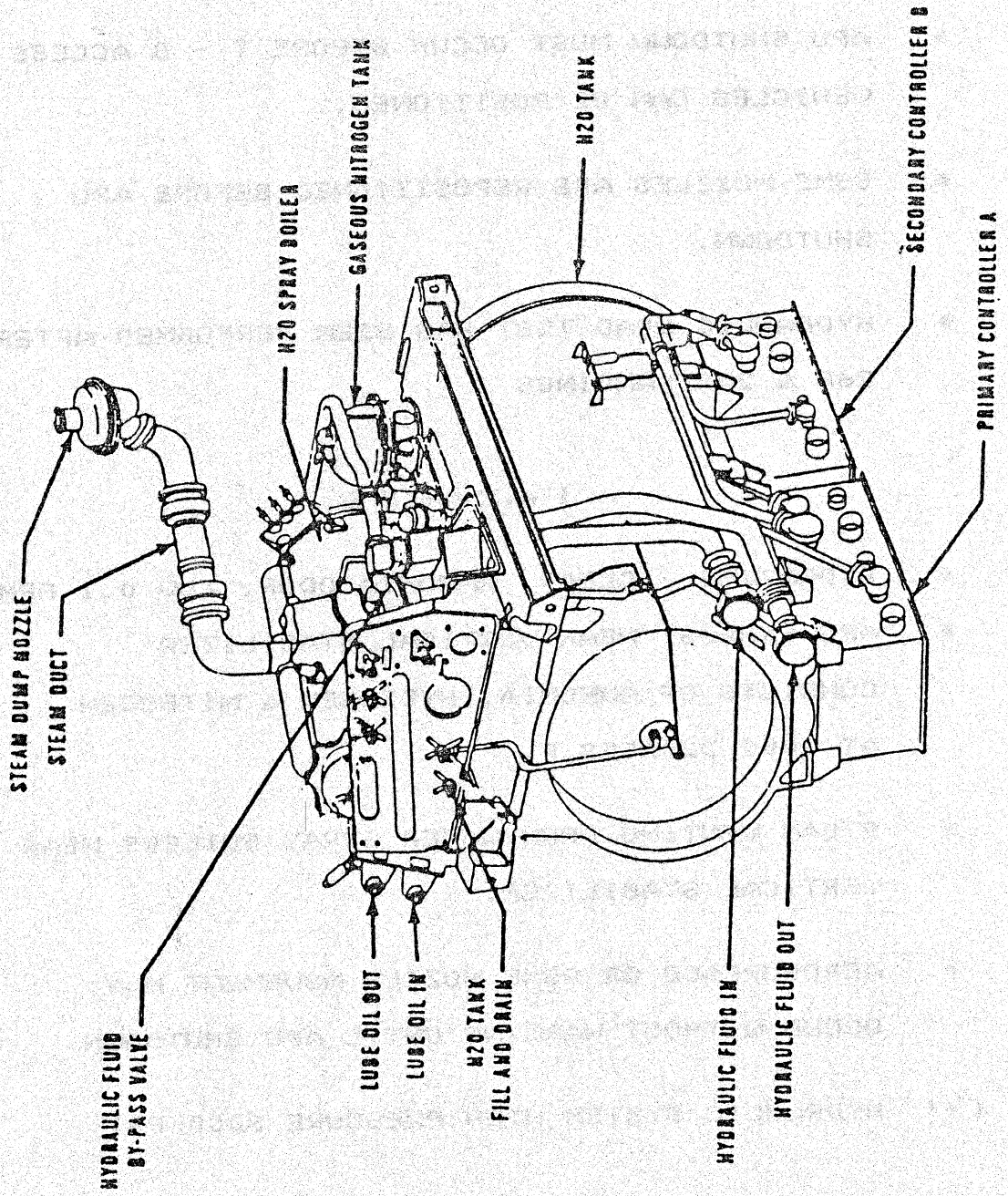
# Hydraulic subsystem



# APU/HYDRAULICS SYSTEM BLOCK DIAGRAM



# WATER SPRAY BOILER



## APU/HYDRAULIC SYSTEMS

- \* APU SHUTDOWN MUST OCCUR BEFORE T - 0 ACCESS VEHICLES CAN BE POSITIONED.
- \* SSME NOZZLES ARE REPOSITIONED BEFORE APU SHUTDOWN.
- \* HYDRAULIC LOAD TEST HAS BEEN PERFORMED AFTER 26R & 27R LANDINGS

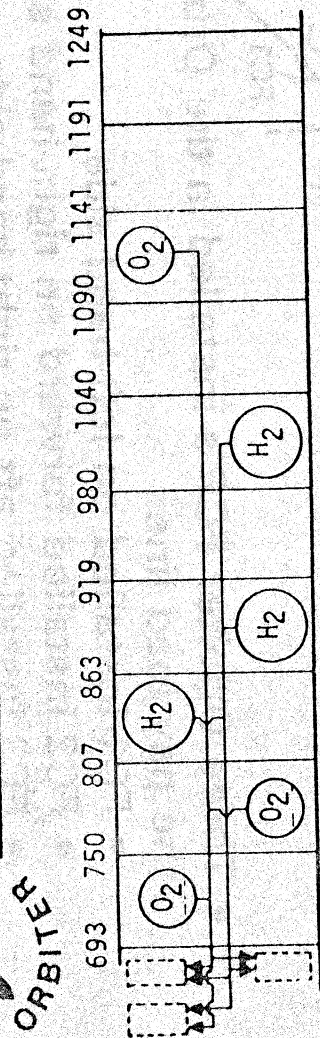
## HAZARDS

- \* HYDRAZINE - CLEAR, AMMONIA ODOR, TLV 0.1 PPM
- \* APU EXHAUST NEAR VERTICAL STABILIZER CONSISTS OF AMMONIA, HYDROGEN & NITROGEN AT 1000 DEGREES F.
- \* STEAM VENTING FROM WATER SPRAY BOILERS NEAR VERTICAL STABILIZER.
- \* AEROSURFACE OR SSME NOZZLE MOVEMENT MAY OCCUR WITHOUT WARNING UNTIL APU SHUTDOWN.
- \* HYDRAULIC SYSTEM HIGH PRESSURE 3000 PSI.





# ELECTRICAL POWER SUBSYSTEM

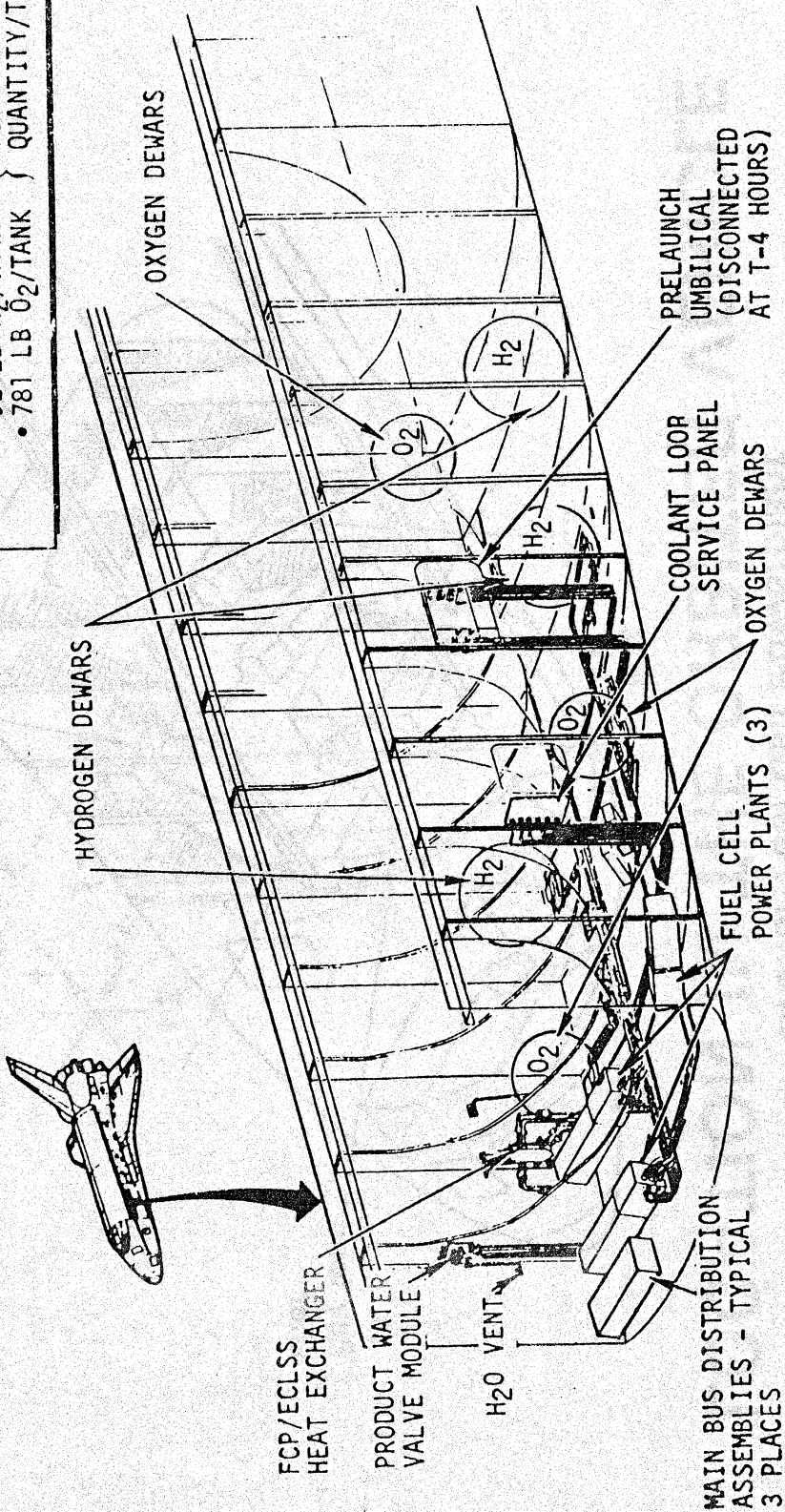


## FCP SUBSYSTEM

- 12.5  
16
- 14 KW CONTINUOUS/24 KW PEAK
  - 27.5 TO 32.5 VDC

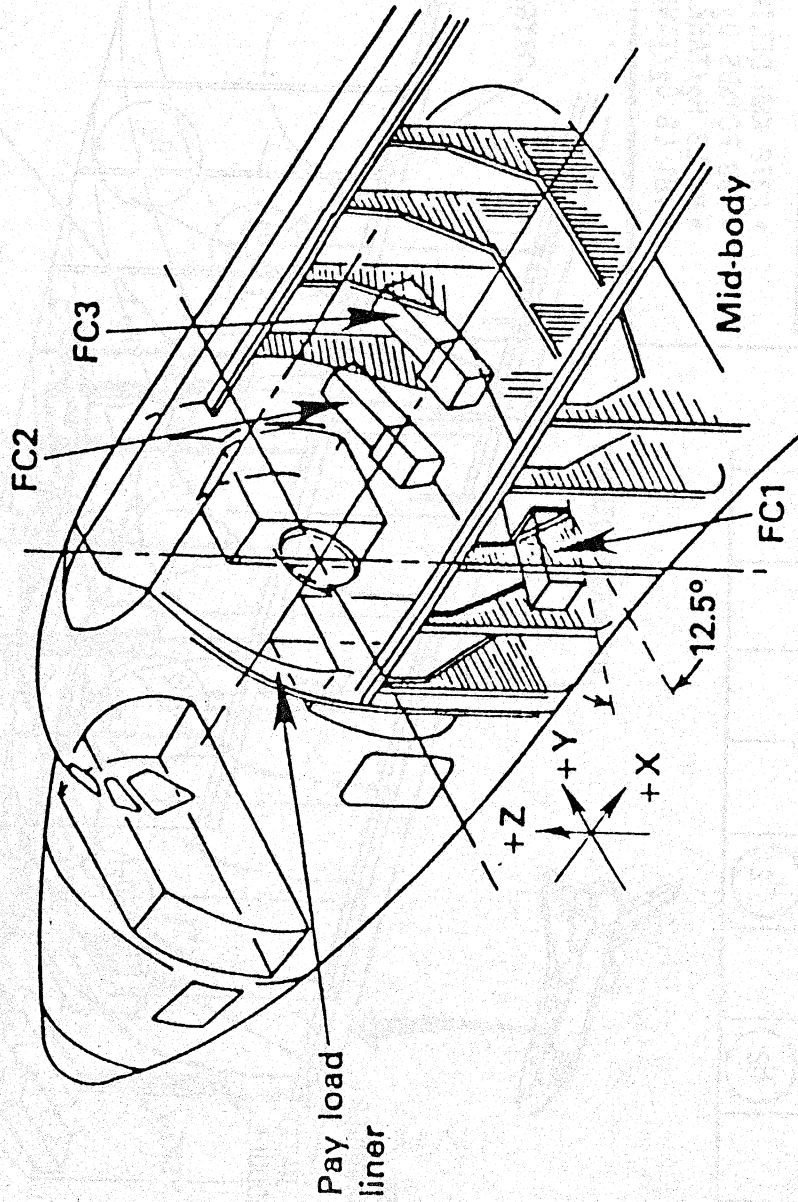
## REACTANT STORAGE

- 2370 KWH DELIVERED ENERGY
- 168 POUNDS O<sub>2</sub> FOR ECLSS
- 92 LB H<sub>2</sub>/TANK } TOTAL LOADED QUANTITY/TANK
- 781 LB O<sub>2</sub>/TANK }



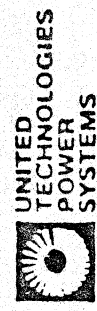
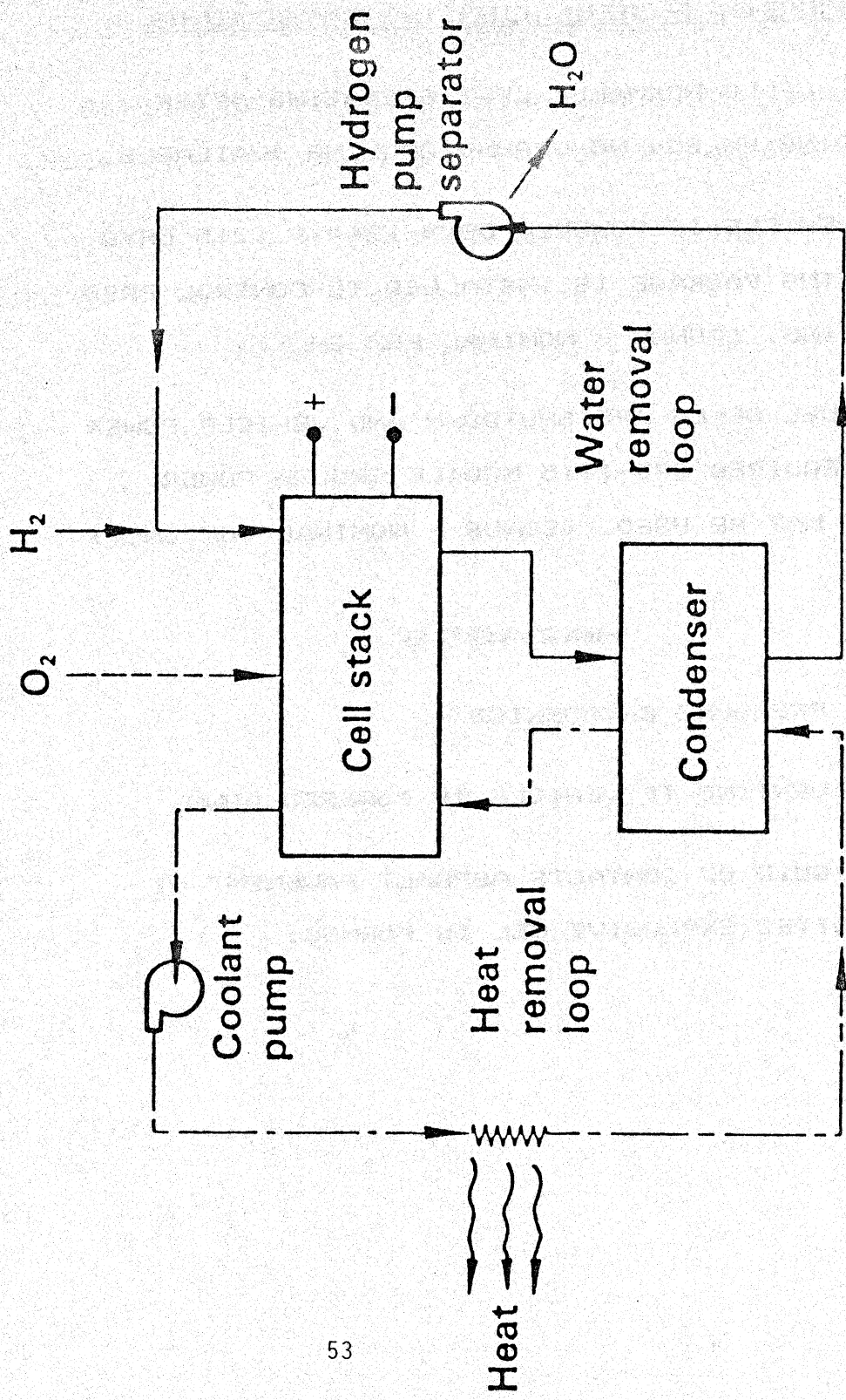
## Orbiter Fuel Cell Powerplant

# LOCATION IN THE ORBITER VEHICLE



- Three Orbiter FCP's installed in the Orbiter vehicle mid-body behind the pay load liner
  - FC1 installed on left-hand side
  - FC2 installed forward on right-hand side
  - FC3 installed aft on right-hand side

# TYPICAL ALKALINE FUEL CELL POWERPLANT SCHEMATIC

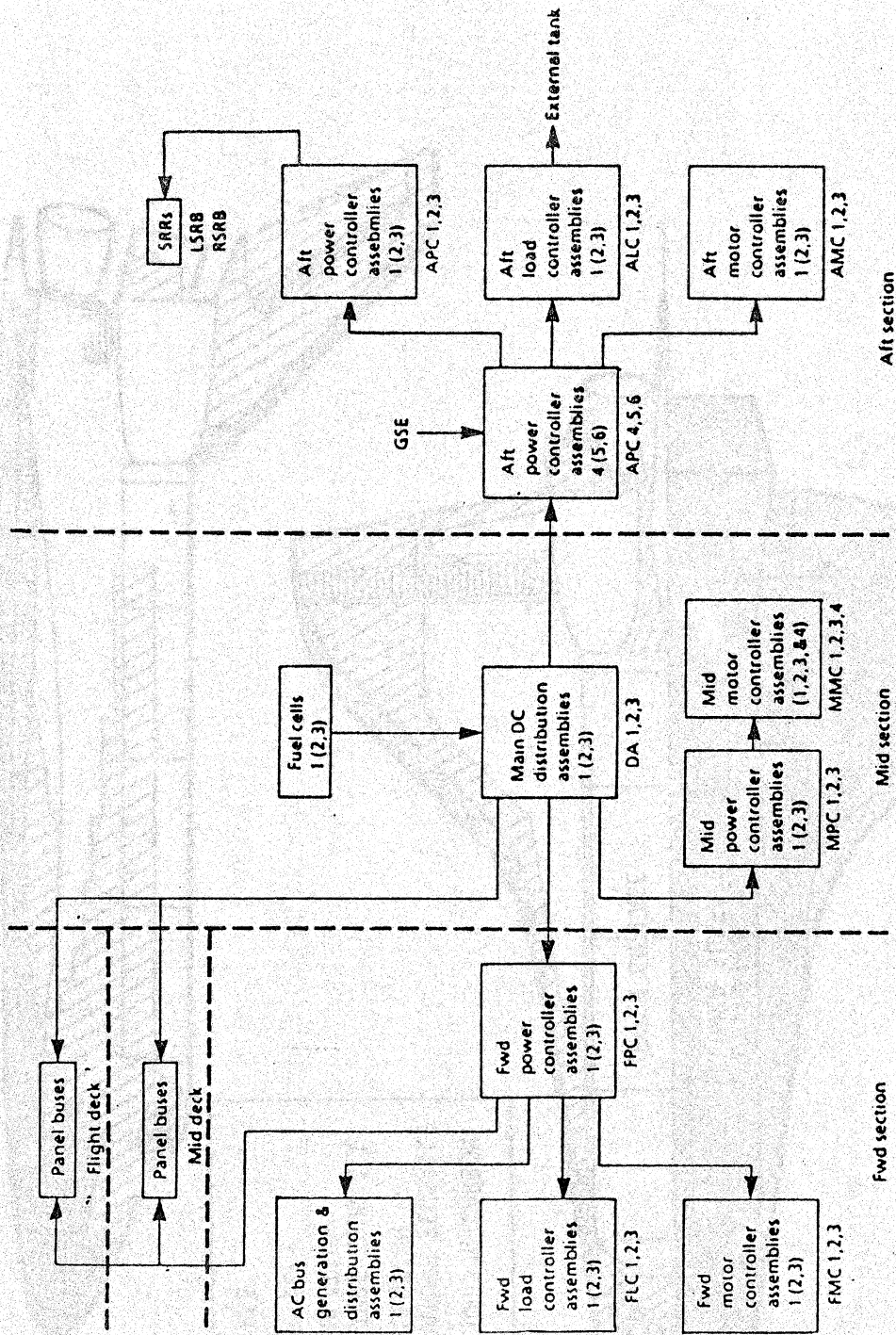


## PRSD/FUEL CELL SYSTEMS

- \* FUEL CELLS NORMALLY LEFT OPERATING AFTER LANDING UNLESS NO GROUND COOLING AVAILABLE.
- \* IF VEHICLE IS POWERED DOWN 1214 & 1215 CRYO VENTING PACKAGE IS INSTALLED TO CONTROL PRSD VENTING. (CONUS - NOMINAL EOM ONLY)
- \* IF FUEL CELLS ARE SHUTDOWN AND VEHICLE POWER IS REQUIRED C70-1115 MOBILE GROUND POWER UNIT MAY BE USED. (CONUS - NOMINAL EOM ONLY)

### HAZARDS

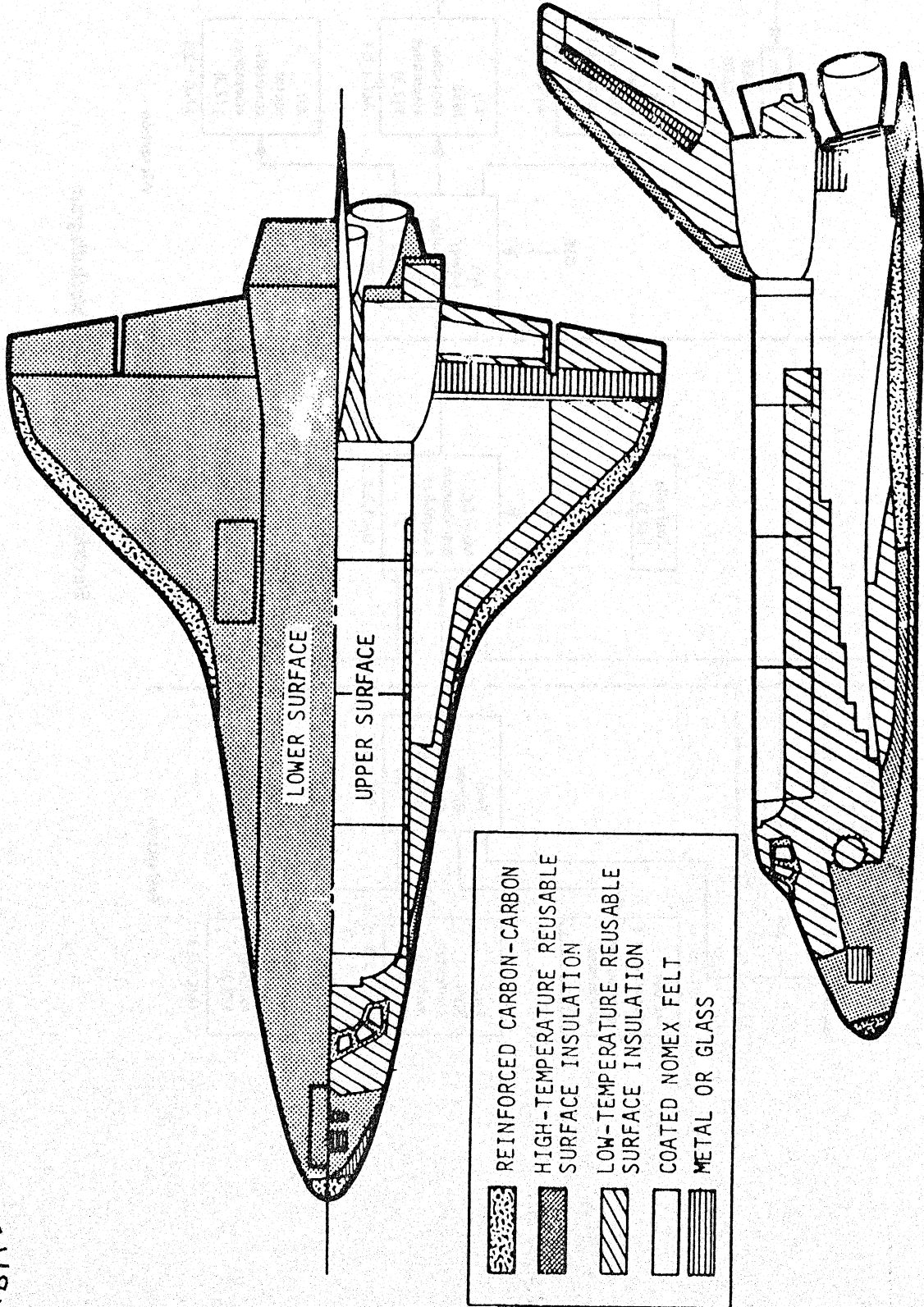
- \* HIGH PRESSURE CRYOGENICS
- \* CRYO VENTING IF VEHICLE IS POWERED DOWN
- \* IF LIQUID O2 CONTACTS ASPHALT PAVEMENT AT TAL SITES EXPLOSIVE GEL IS FORMED.



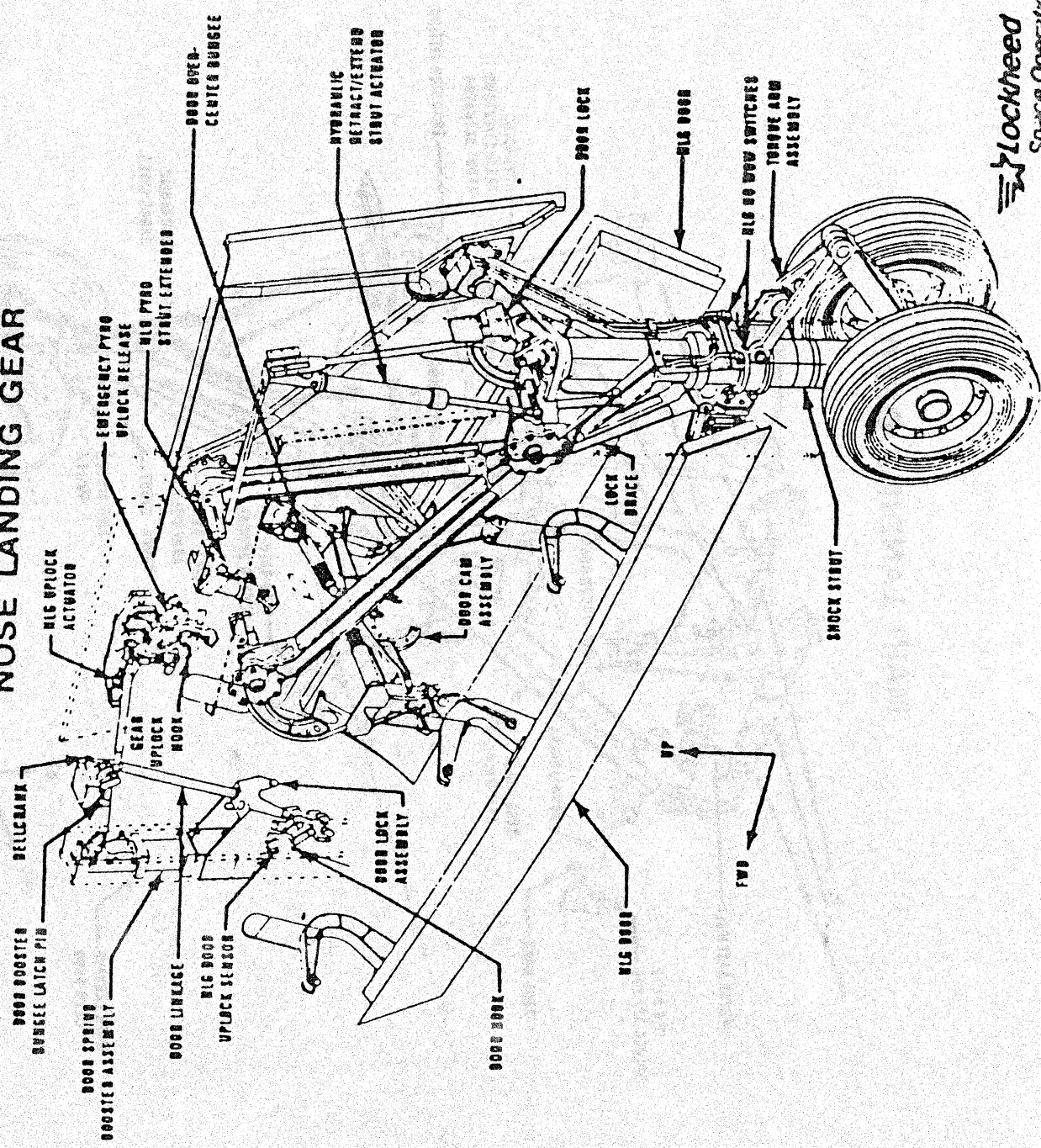
Electrical power distribution block diagram.



THERMAL PROTECTION SUBSYSTEM



# NOSE LANDING GEAR

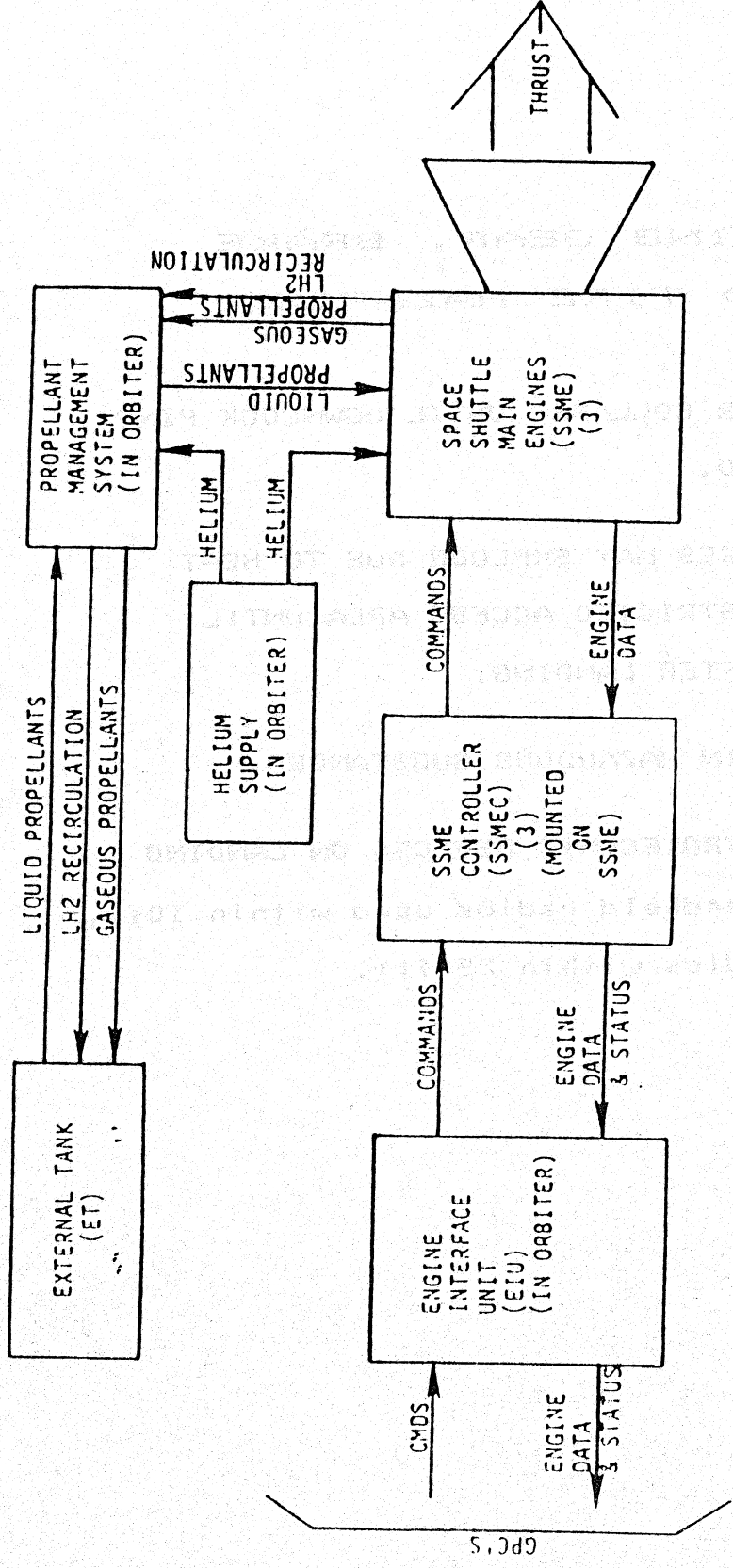




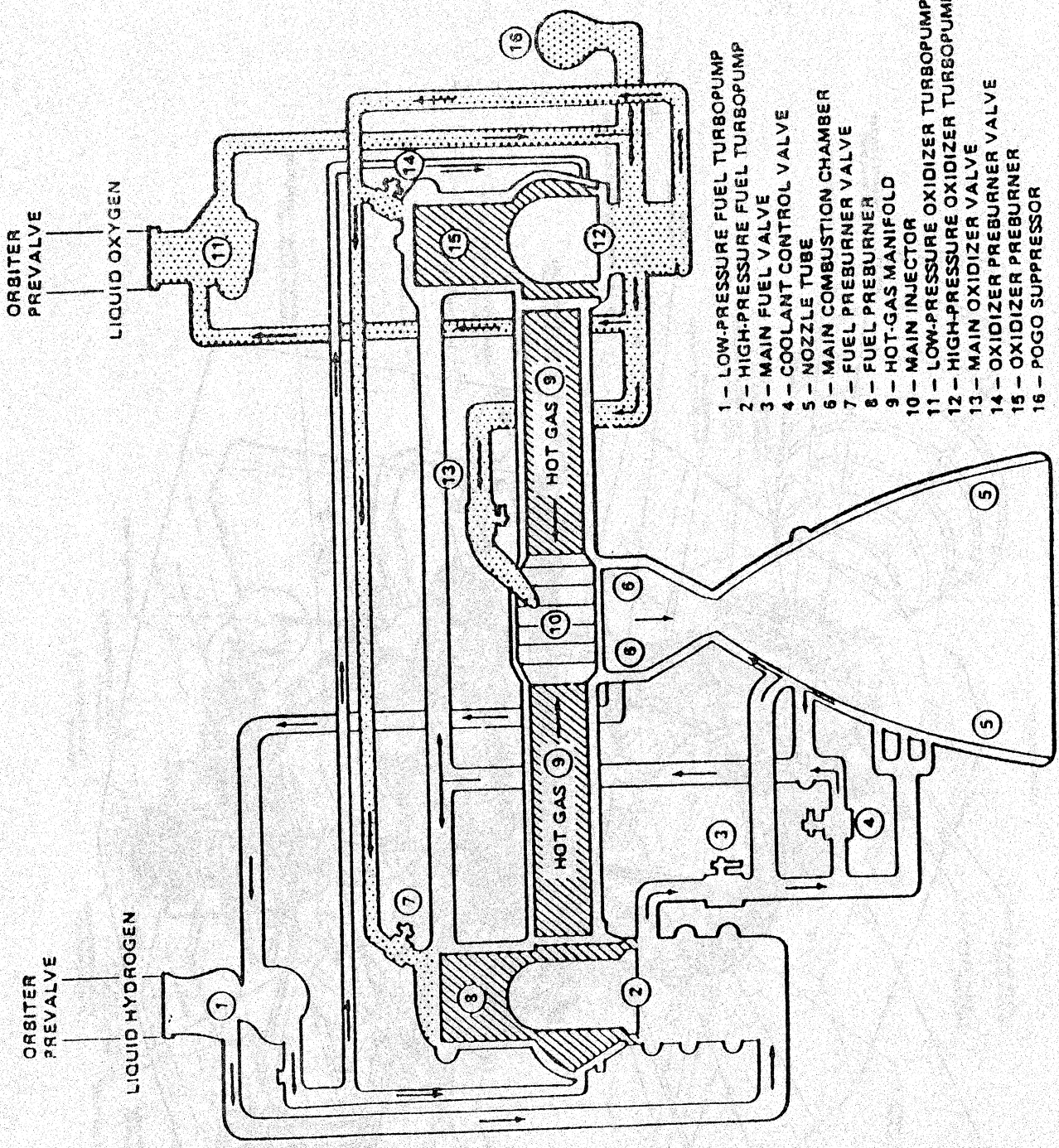


## LANDING GEAR, BRAKE AND TIRE HAZARDS

- \* POSSIBLE GEAR COLLAPSE UNTIL DOWNLOCK PINS ARE INSTALLED.
- \* MAIN GEAR TIRES MAY EXPLODE DUE TO HEAT SOAKBACK, RESTRICTED ACCESS AREA UNTIL 45 MINUTES AFTER LANDING.
- \* BRAKES CONTAIN HAZARDOUS SUBSTANCES.
- \* UNEXPENDED PYROTECHNIC DEVICES ON LANDING GEAR. (No handheld radios used within 10ft, no mobile radios within 35 ft).



The MPS subsystem interface.



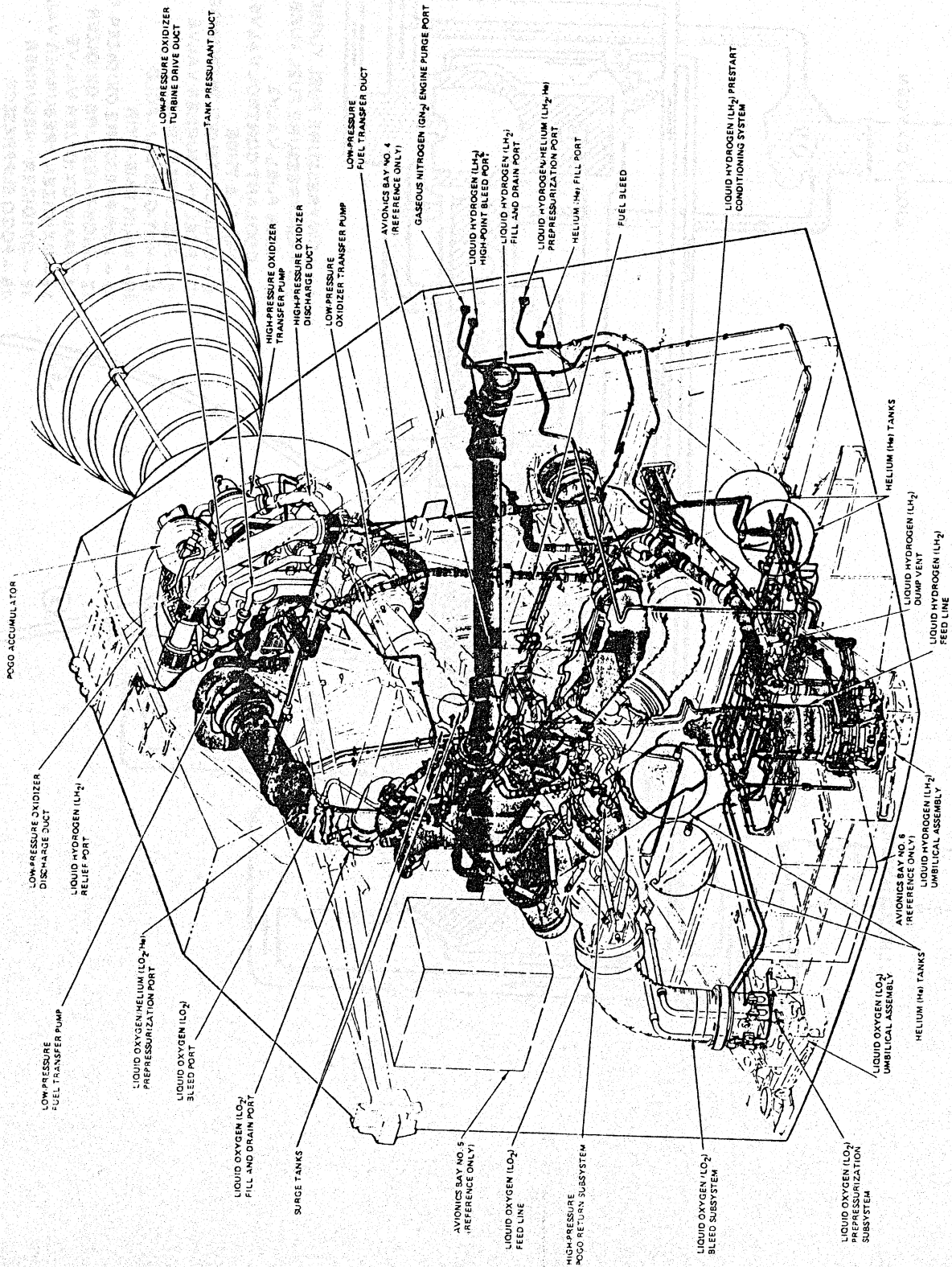
ORBITER  
PREVALVE

LIQUID OXYGEN

ORBITER  
PREVALVE

LIQUID HYDROGEN

- 1 - LOW-PRESSURE FUEL TURBOPUMP
- 2 - HIGH-PRESSURE FUEL TURBOPUMP
- 3 - MAIN FUEL VALVE
- 4 - COOLANT CONTROL VALVE
- 5 - NOZZLE TUBE
- 6 - MAIN COMBUSTION CHAMBER
- 7 - FUEL PREBURNER VALVE
- 8 - FUEL PREBURNER
- 9 - HOT-GAS MANIFOLD
- 10 - MAIN INJECTOR
- 11 - LOW-PRESSURE OXIDIZER TURBOPUMP
- 12 - HIGH-PRESSURE OXIDIZER TURBOPUMP
- 13 - MAIN OXIDIZER VALVE
- 14 - OXIDIZER PREBURNER
- 15 - OXIDIZER PREBURNER
- 16 - POGO SUPPRESSOR



## SSME/MPS HAZARDS

- \* HIGH PRESSURE, HIGH VOLUME HELIUM IN MID/AFT TANKS AND MPS LINES.
- \* SSME NOZZLE MOVEMENT MAY OCCUR WITHOUT WARNING UNTIL APU SHUTDOWN.
- \* RESIDUAL H<sub>2</sub> OR O<sub>2</sub> IN MPS LINES OR ENGINE COMPONENTS.

## RF RADIATION HAZARDS

- \* MAINTAIN FOLLOWING MINIMUM CLEARANCES FROM ORBITER RADIATING ANTENNAS.
  
- \* S - BAND PM - 5 FT
  
- \* UHF, RADAR ALT, MSBLS,  
S - BAND FM & TACAN - 2 FT
  
- \* UHF (AIRLOCK) - 1 FT

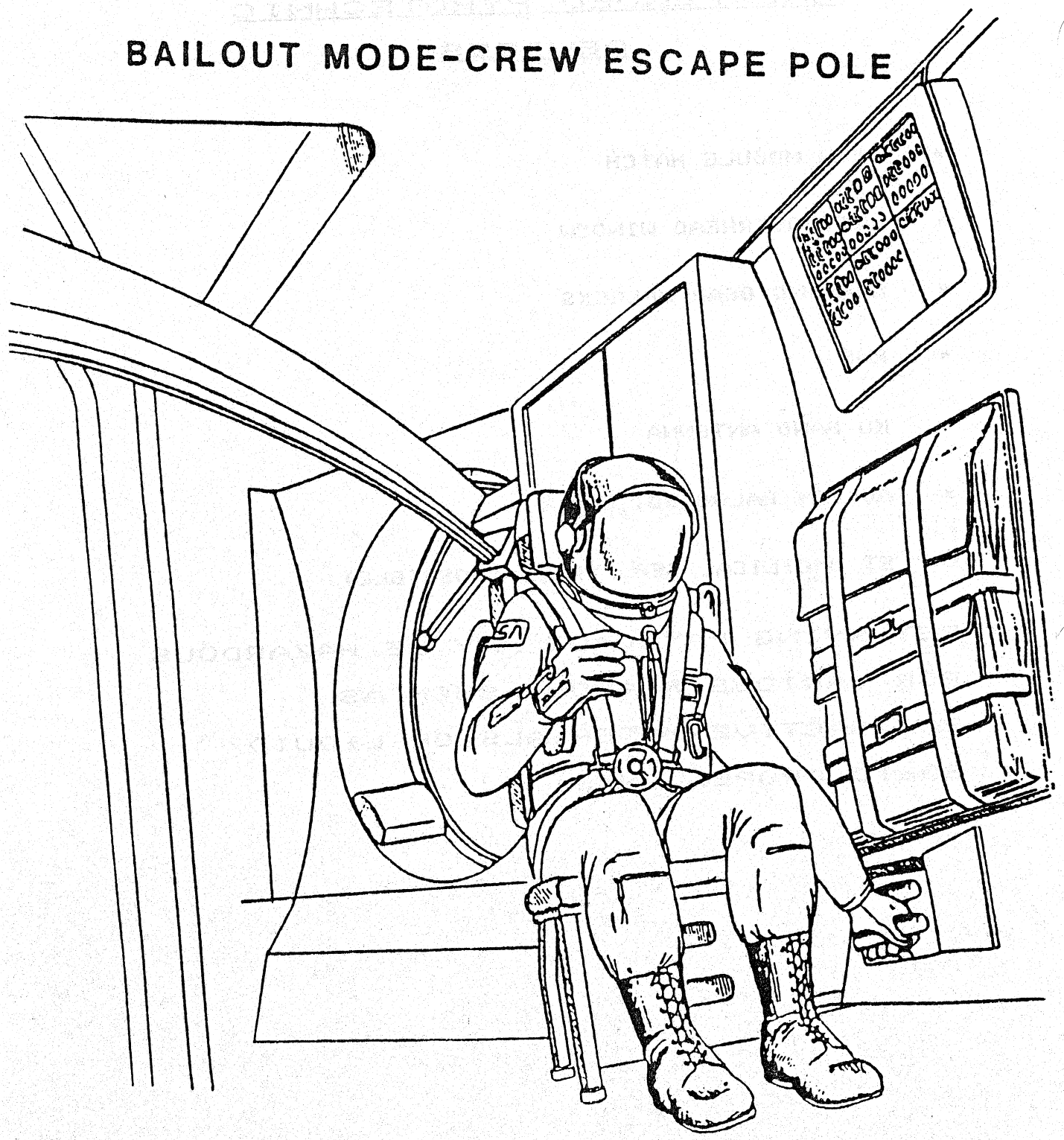
UNEXPENDED PYROTECHNIC

DEVICES

- \* CREW MODULE HATCH
- \* LEFT OVERHEAD WINDOW
- \* LANDING GEAR UPLOCKS
- \* RMS
- \* KU BAND ANTENNA
- \* AV BAY HALON BOTTLES
- \* ET UMBILICAL SEP PYROS (POSSIBLE)

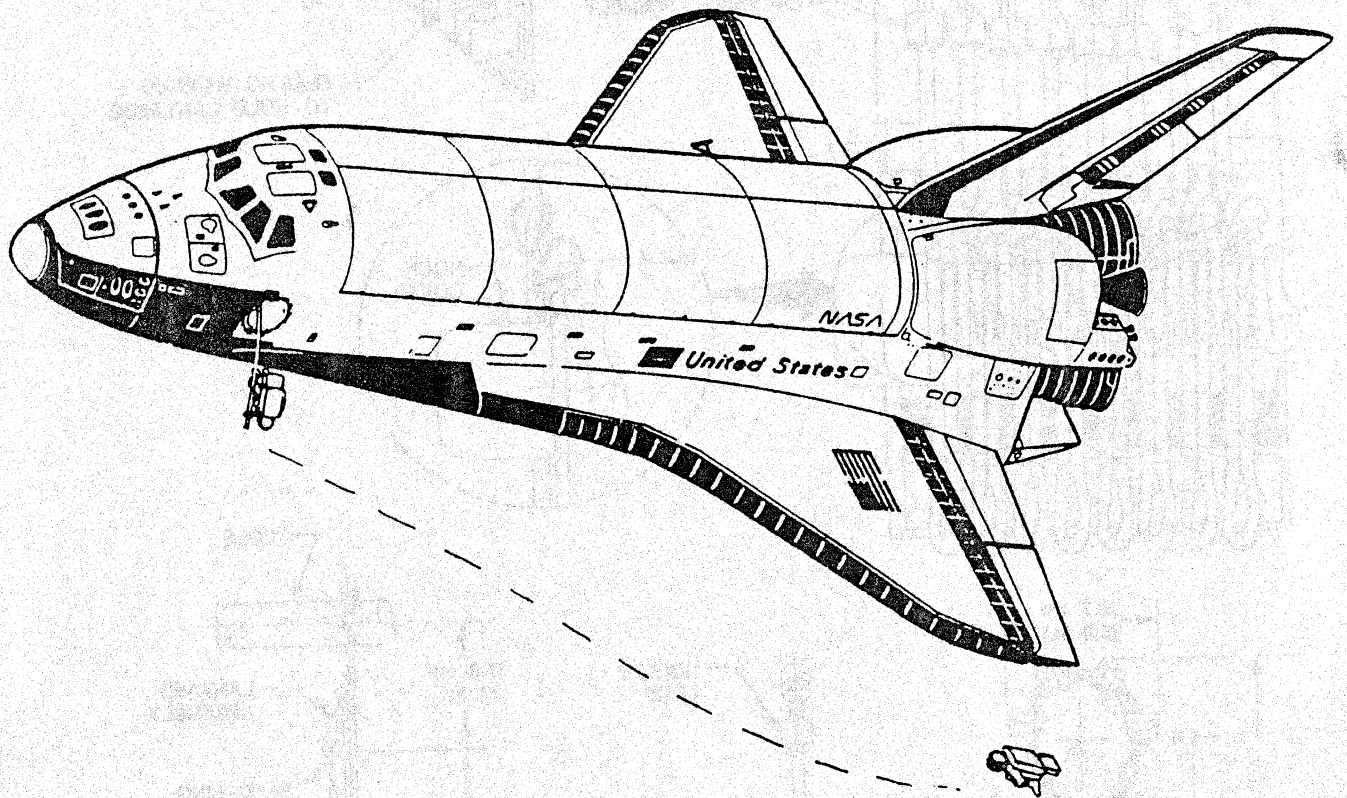
RETURNING PAYLOADS MAY BE HAZARDOUS  
FOR VARIOUS REASONS SUCH AS  
RADIOACTIVE MATERIALS OR LIQUID/  
SOLID PROPELLANTS.

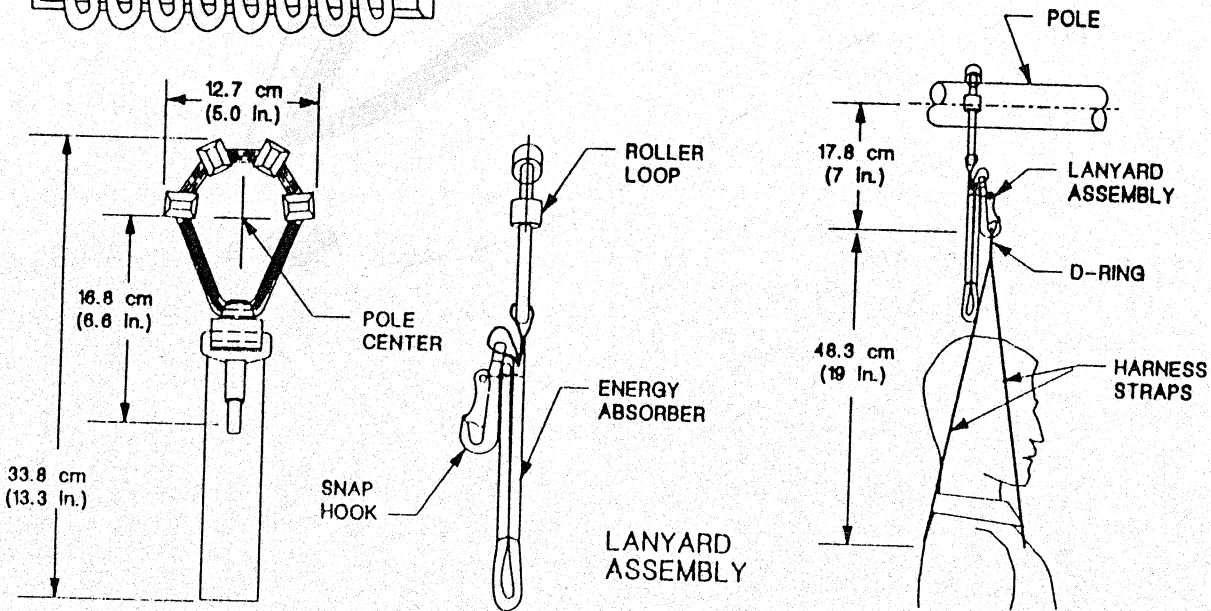
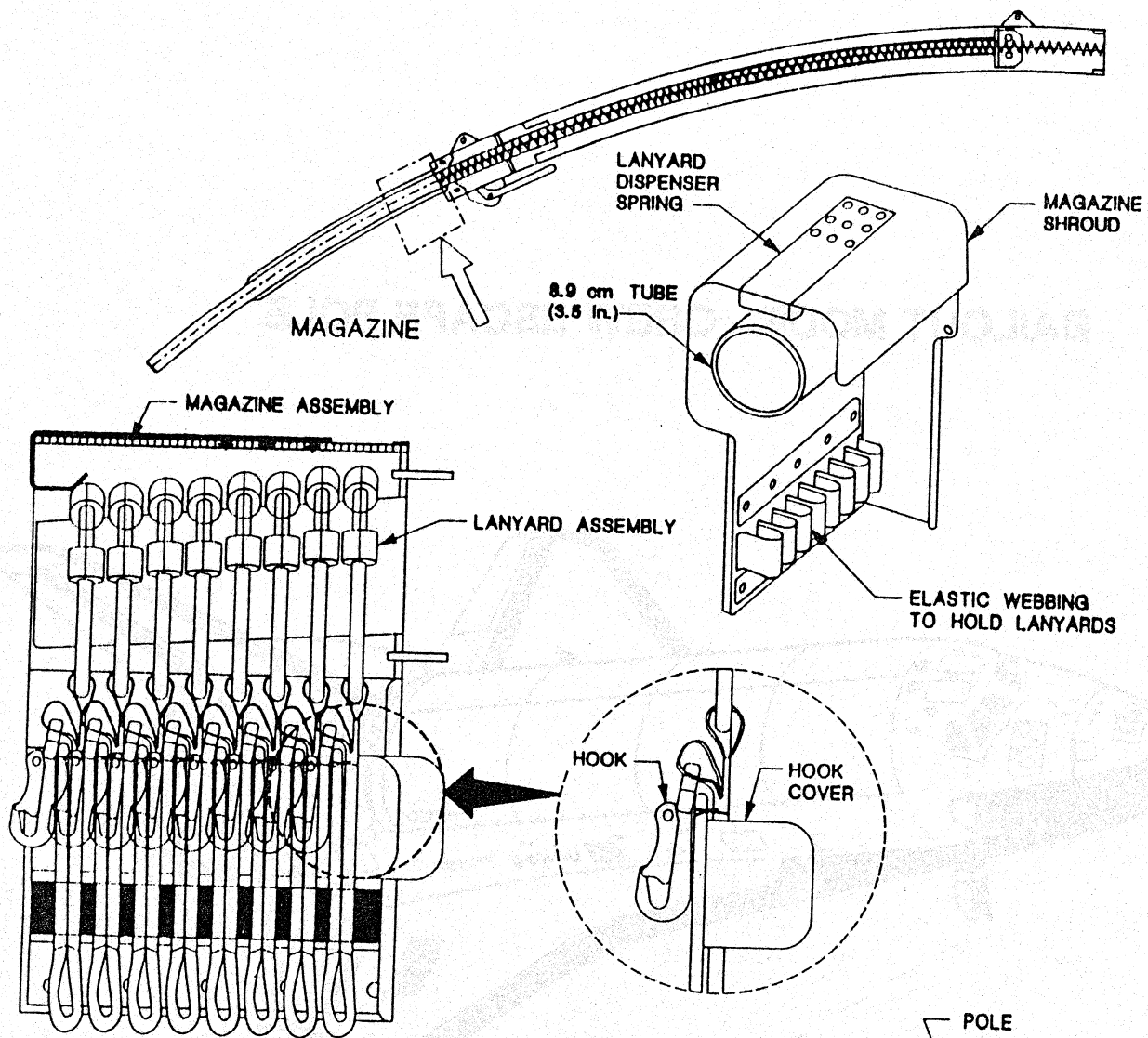
# BAILOUT MODE-CREW ESCAPE POLE





# BAILOUT MODE - CREW ESCAPE POLE



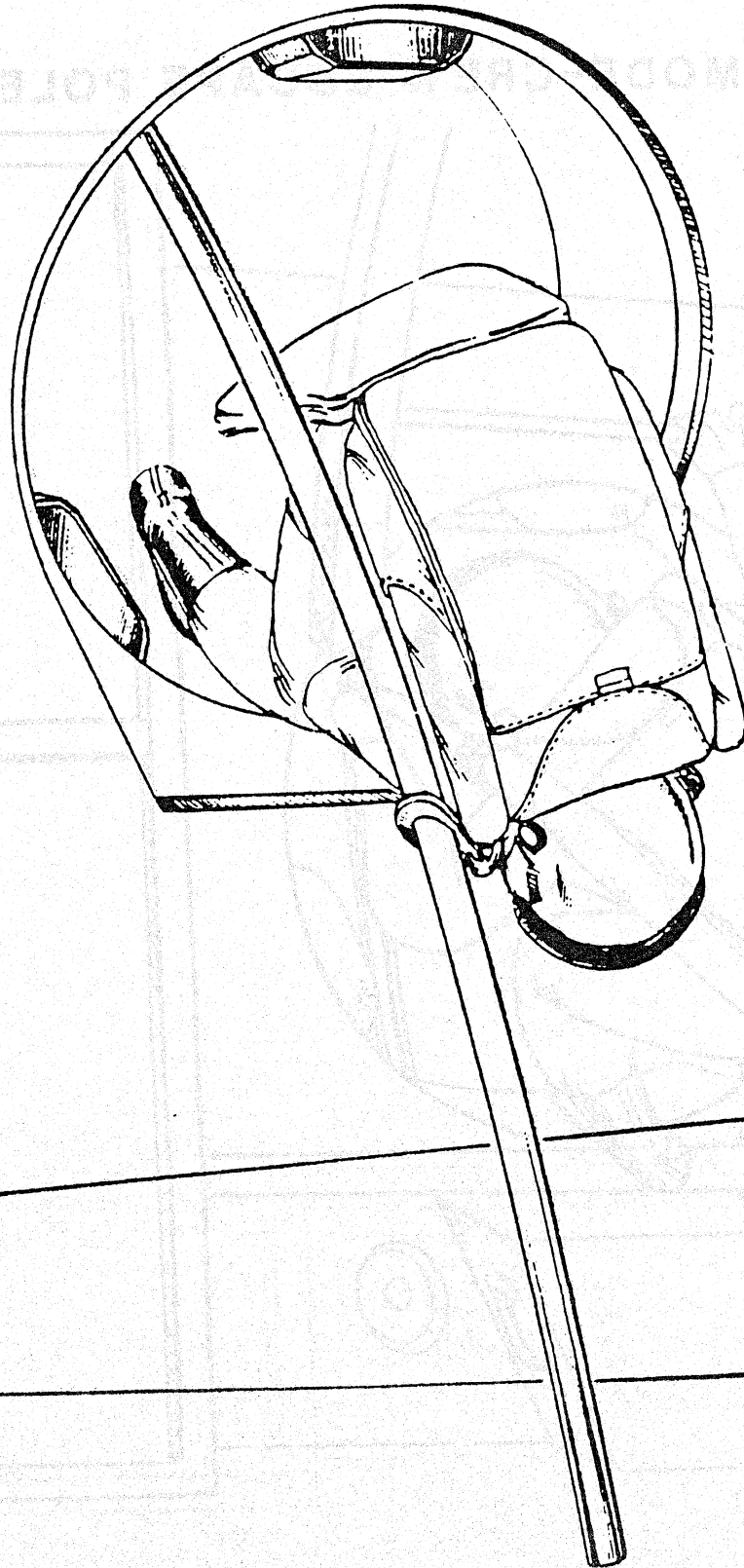


Method of attachment to the PCES.

# BAILOUT MODE-CREW ESCAPE POLE



# BAILOUT MODE - CREW ESCAPE POLE



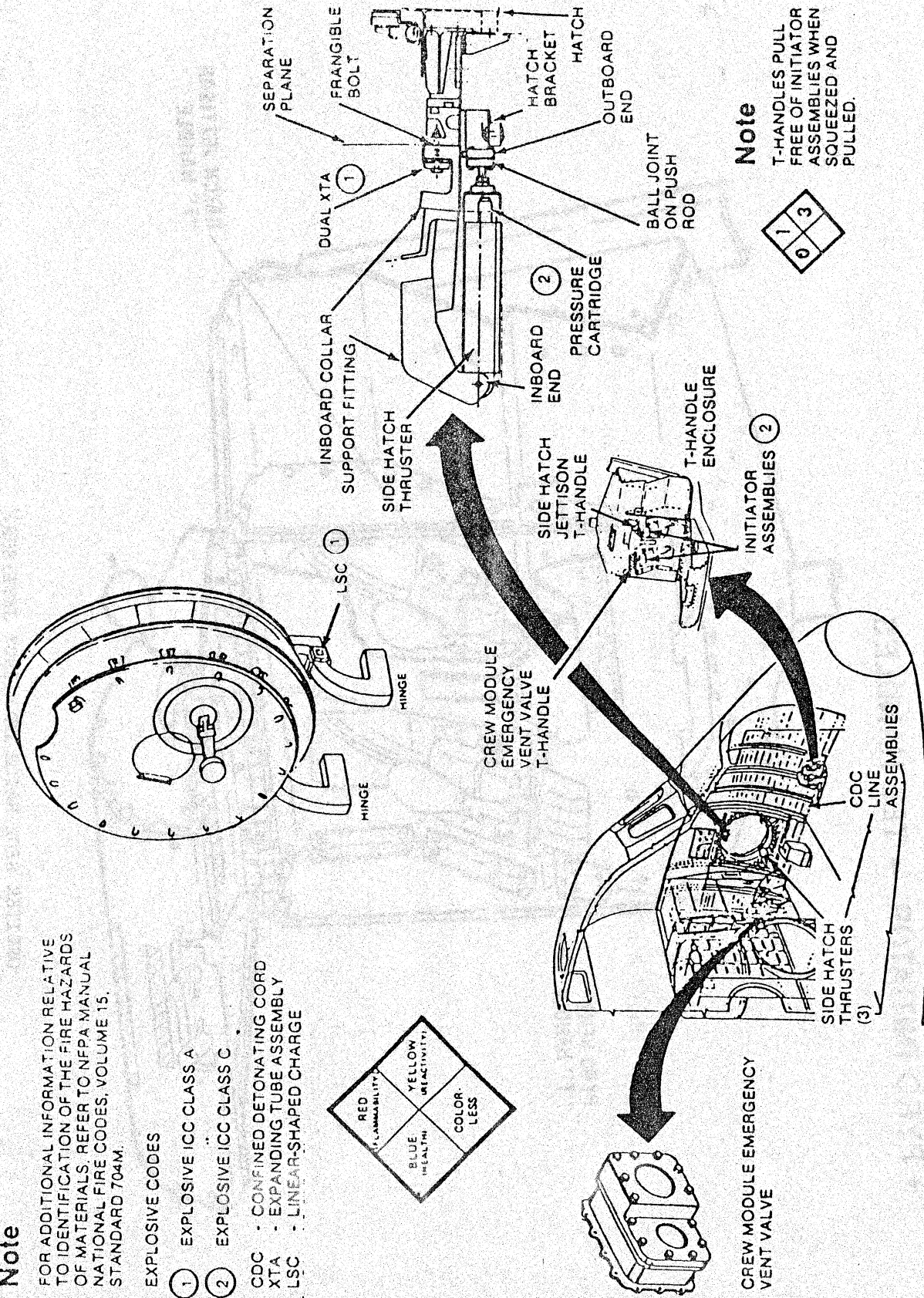
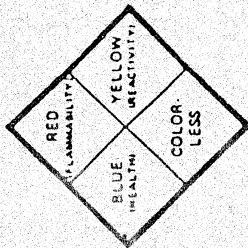
**Note**

FOR ADDITIONAL INFORMATION RELATIVE TO IDENTIFICATION OF THE FIRE HAZARDS OF MATERIALS, REFER TO NFPA MANUAL NATIONAL FIRE CODES, VOLUME 15, STANDARD 704M.

**EXPLOSIVE CODES**

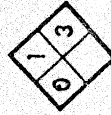
- ① EXPLOSIVE ICC CLASS A
- ② EXPLOSIVE ICC CLASS C

CDC - CONFINED DETONATING CORD  
 XTA - EXPANDING TUBE ASSEMBLY  
 LSC - LINEAR-SHAPED CHARGE

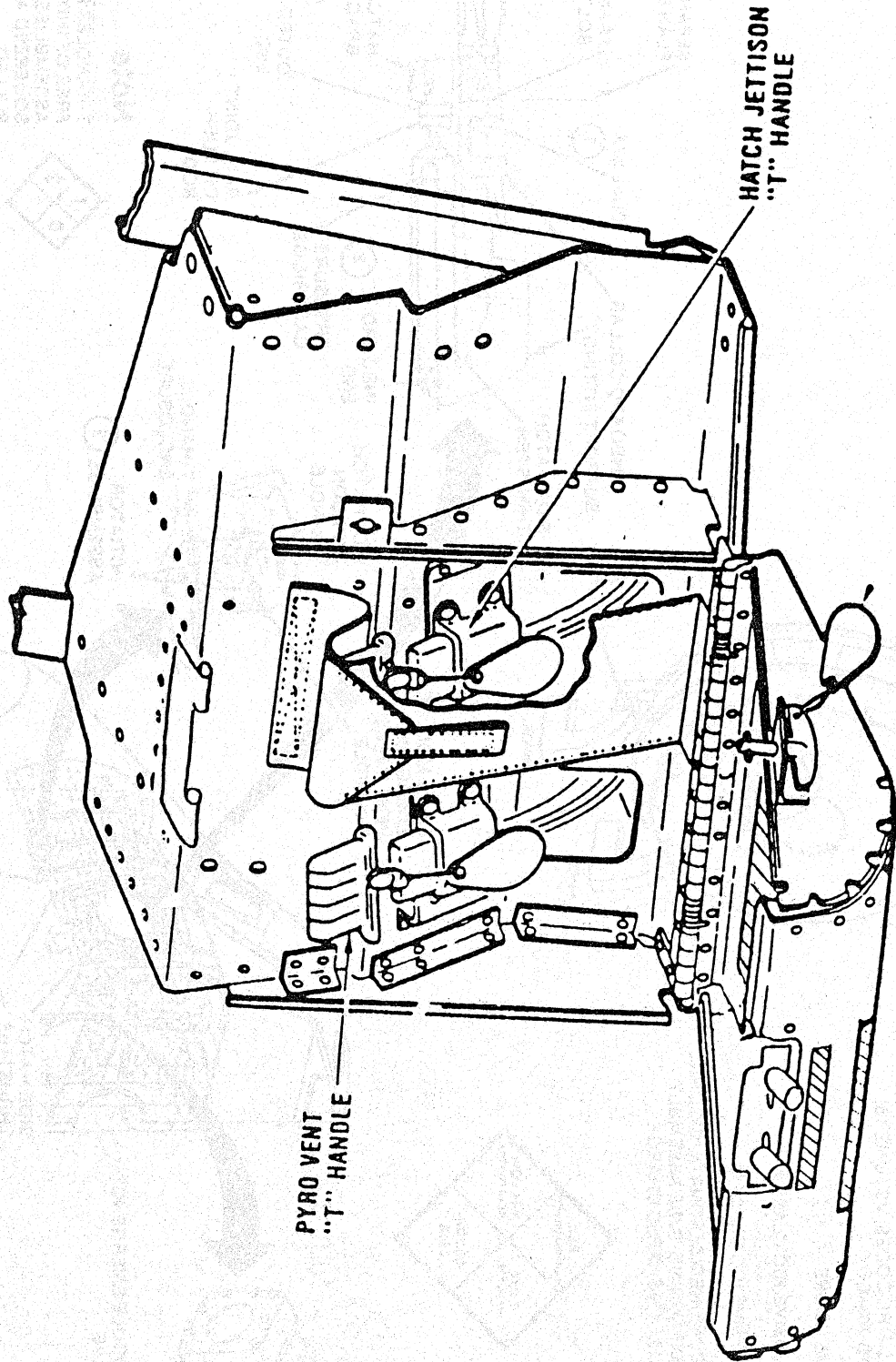


**Note**

T-HANDLES PULL FREE OF INITIATOR ASSEMBLIES WHEN SQUEEZED AND PULLED.



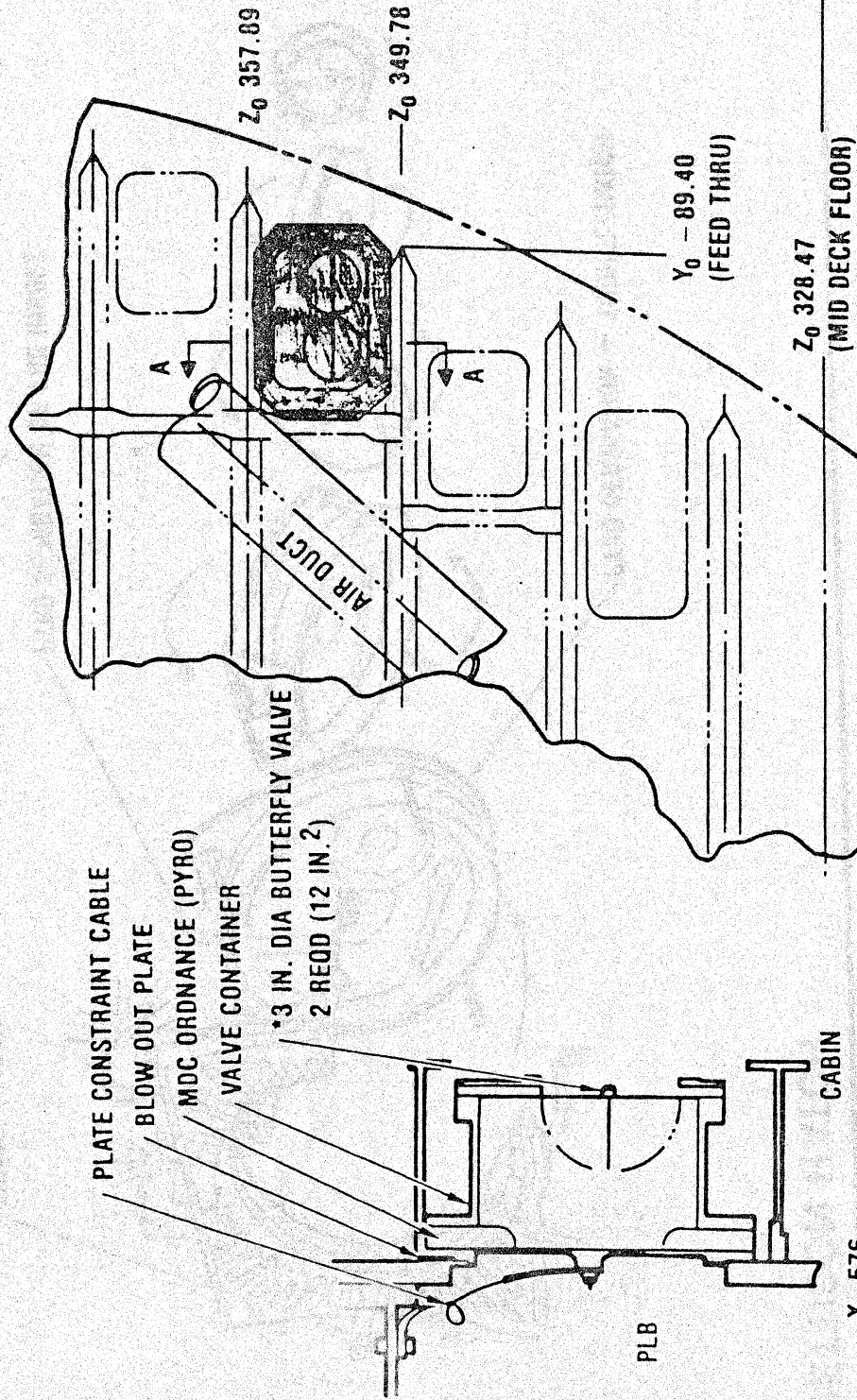
• PYRO INITIATOR — TEE HANDLES



ORBITER SIDE HATCH EMERGENCY JETTISON

# Technical Overview

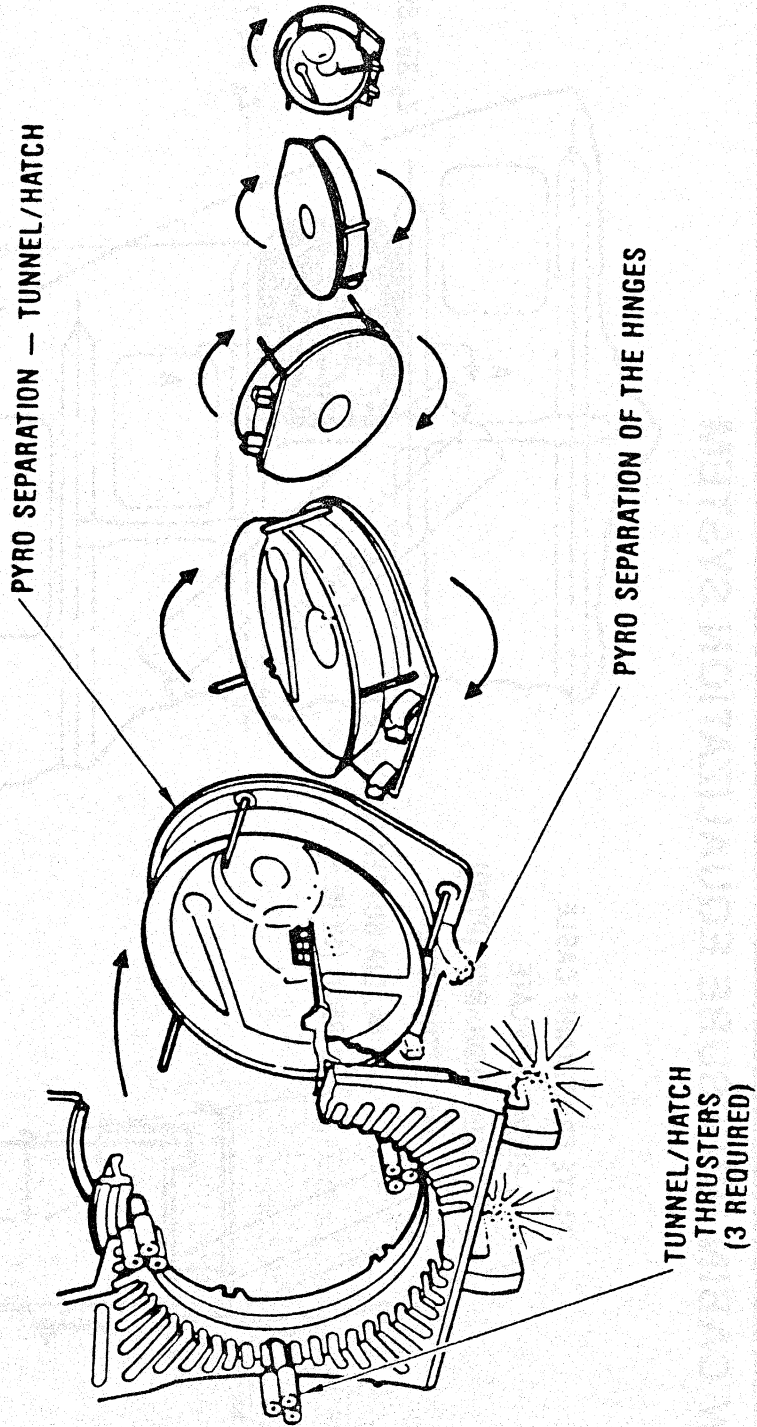
## CREW CABIN PRESSURE EQUALIZATION SYSTEM



\*PAYLOAD BAY HAZARDOUS FLUID INGRESS PREVENTION

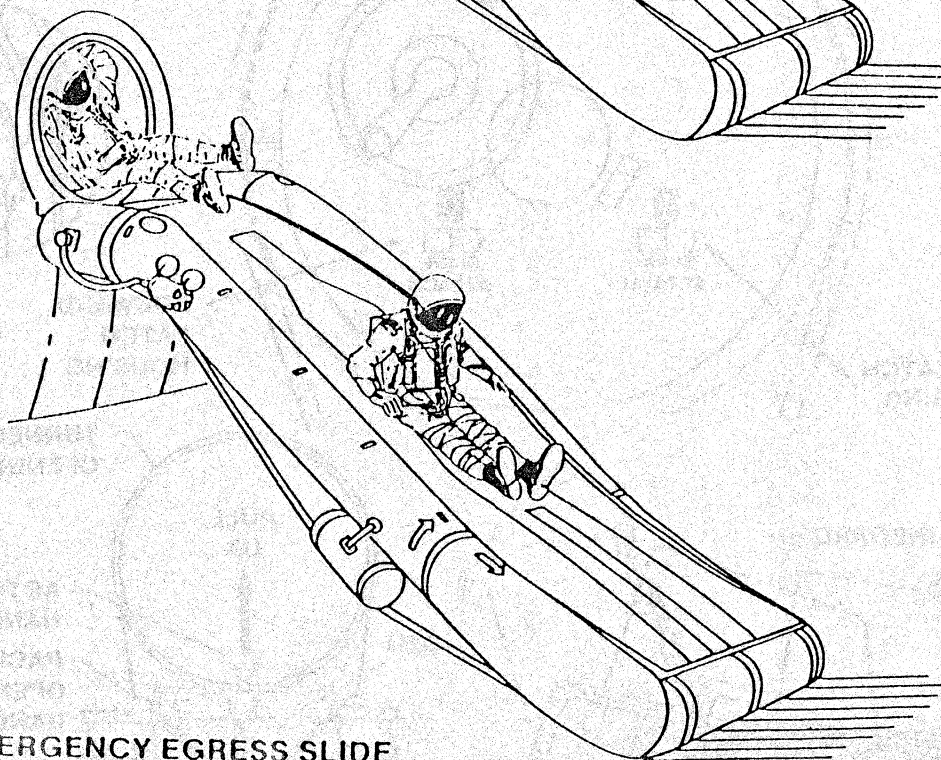
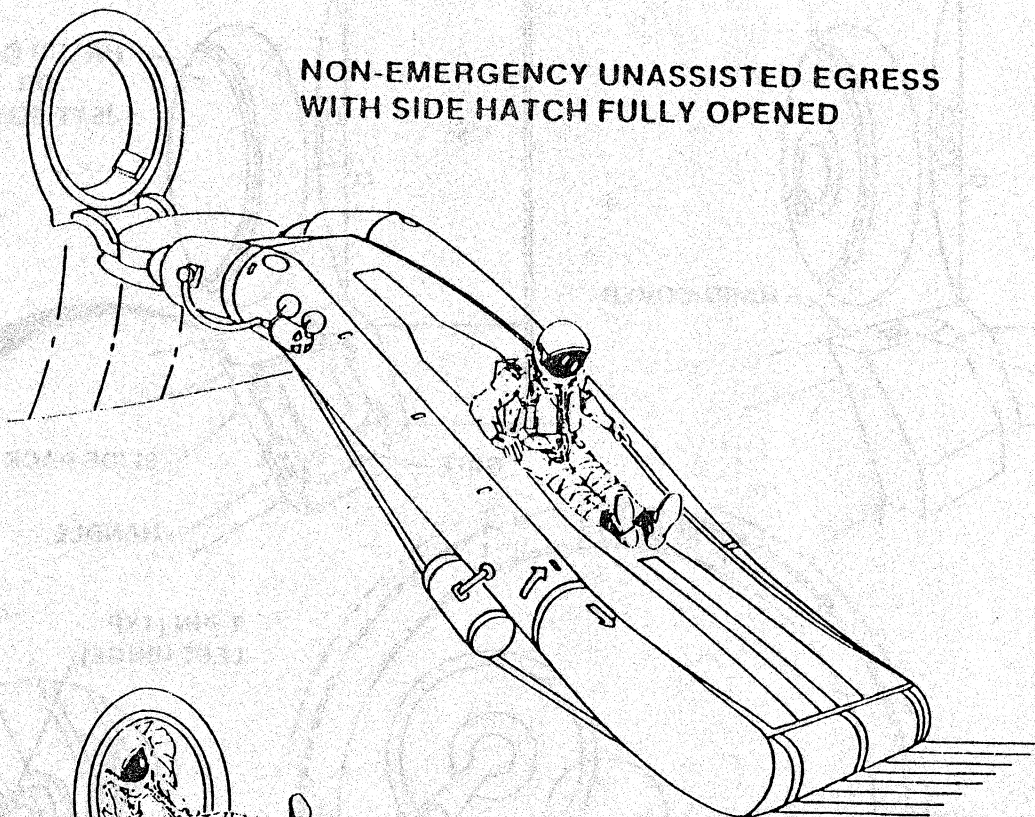
# Technical Overview

## JETTISON HATCH

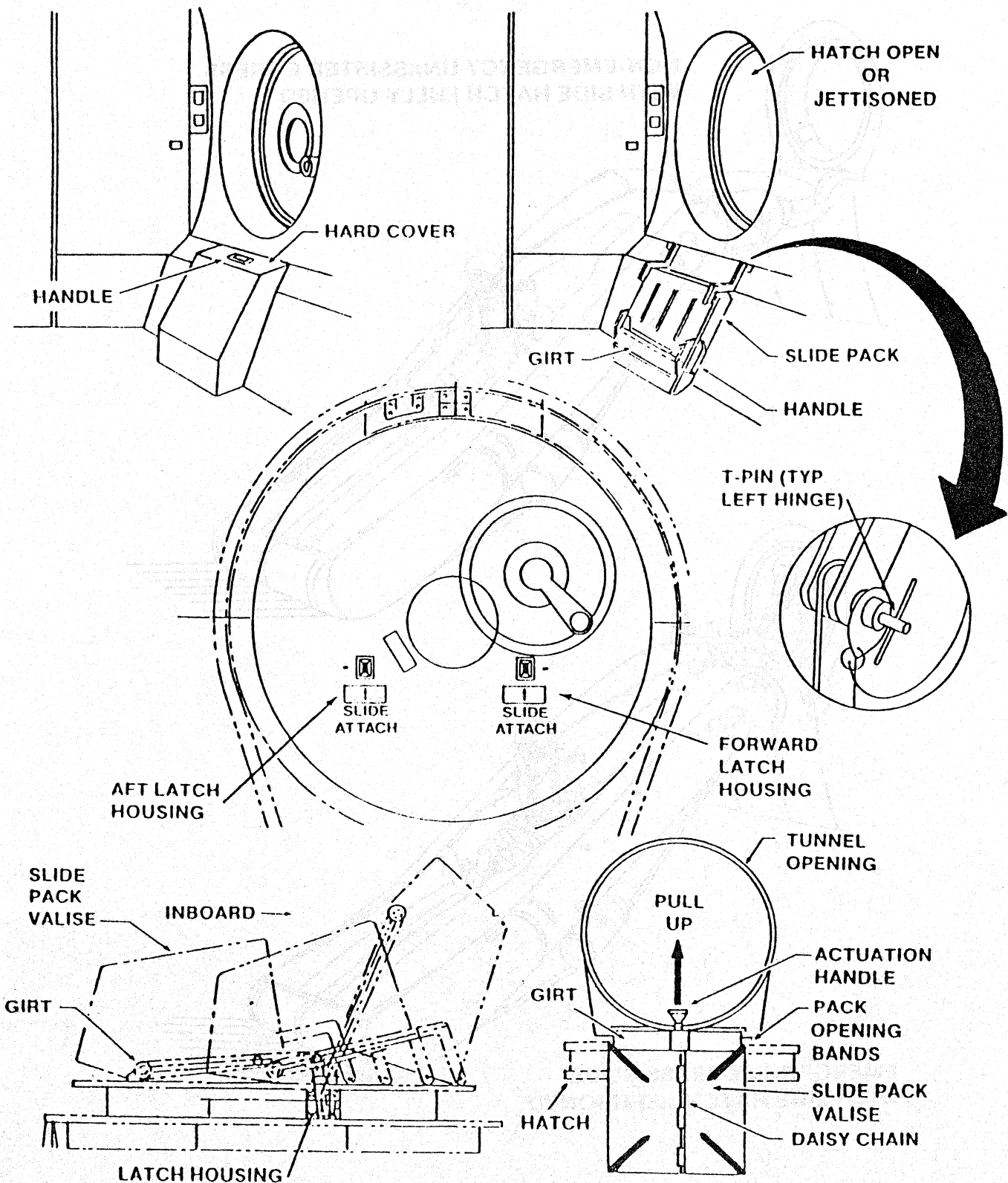




**NON-EMERGENCY UNASSISTED EGRESS  
WITH SIDE HATCH FULLY OPENED**



**EMERGENCY EGRESS SLIDE  
WITH SIDE HATCH JETTISONED**



Emergency egress slide deployment with hatch open.

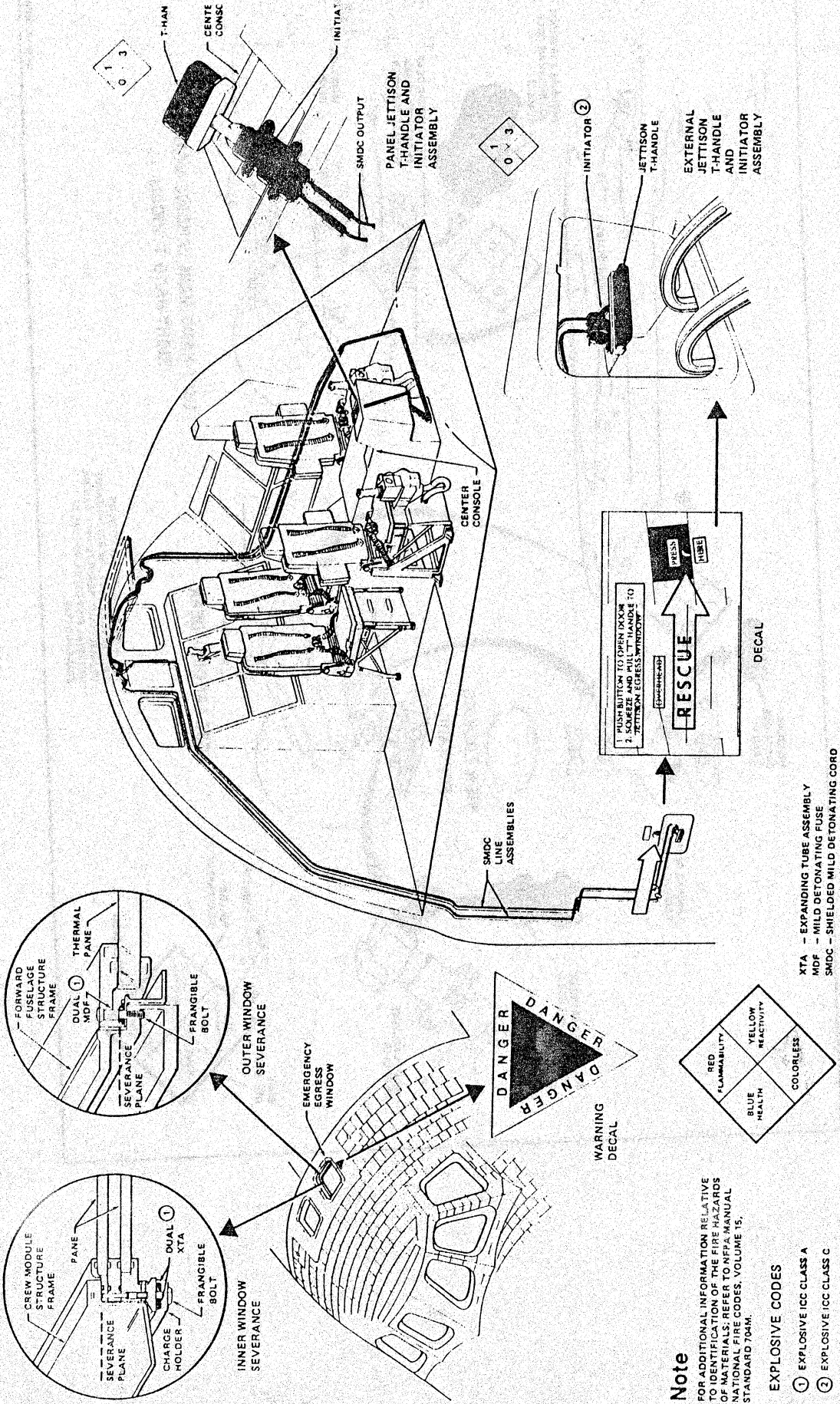


Figure 2-18. — Escape system pyrotechnics — OPS 010599.

Revised March 1983 2-87

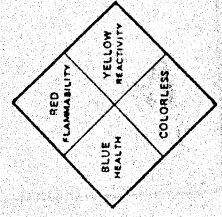
XTA — EXPANDING TUBE ASSEMBLY  
MDF — MILD DETONATING FUSE  
SMDC — SHIELDED MILD DETONATING CORD

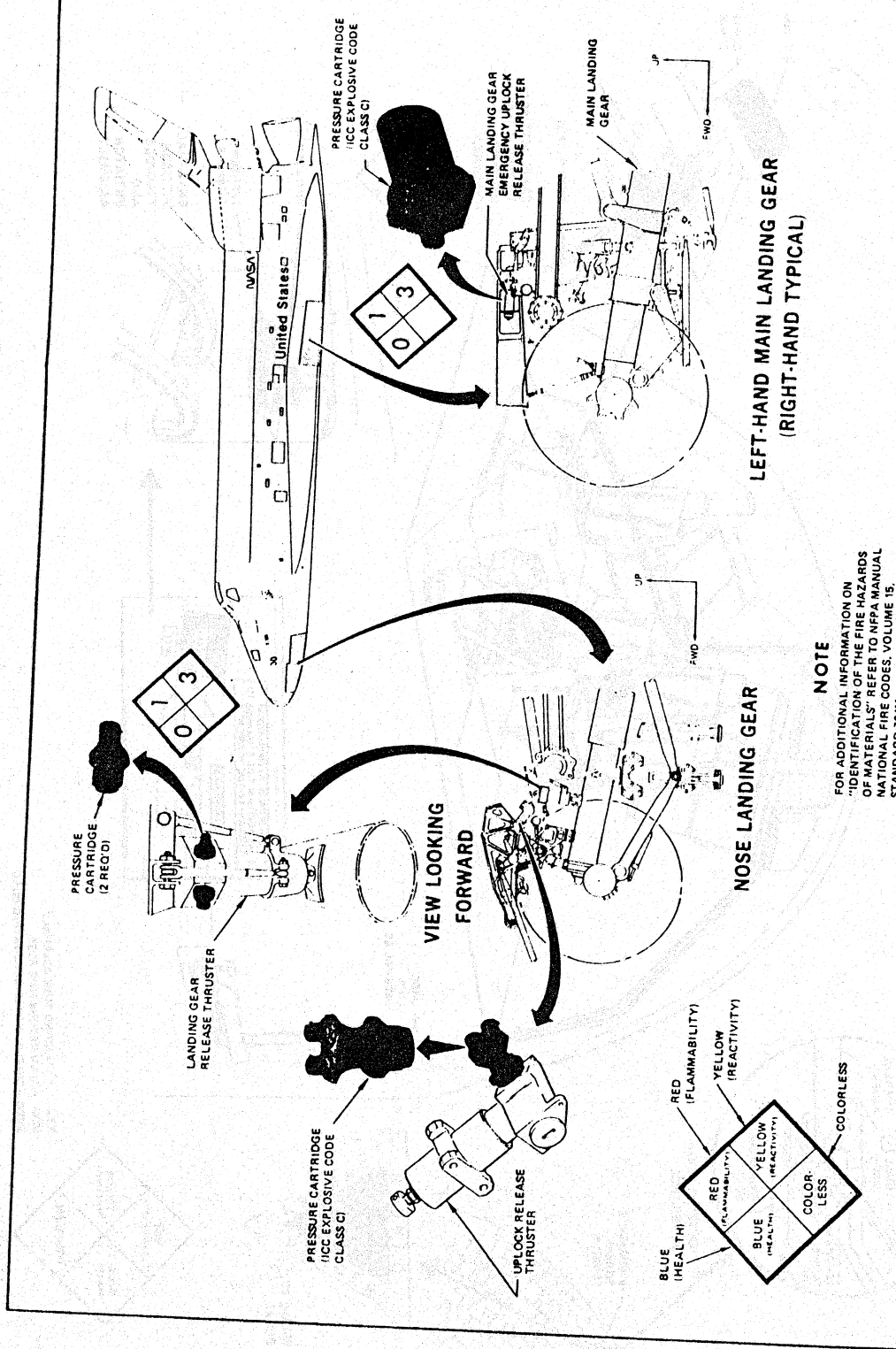
**Note**

FOR ADDITIONAL INFORMATION RELATIVE TO IDENTIFICATION OF THE FIRE HAZARDS OF MATERIALS REFER TO NFPA MANUAL NATIONAL CODES, VOLUME 15, STANDARD 704H.

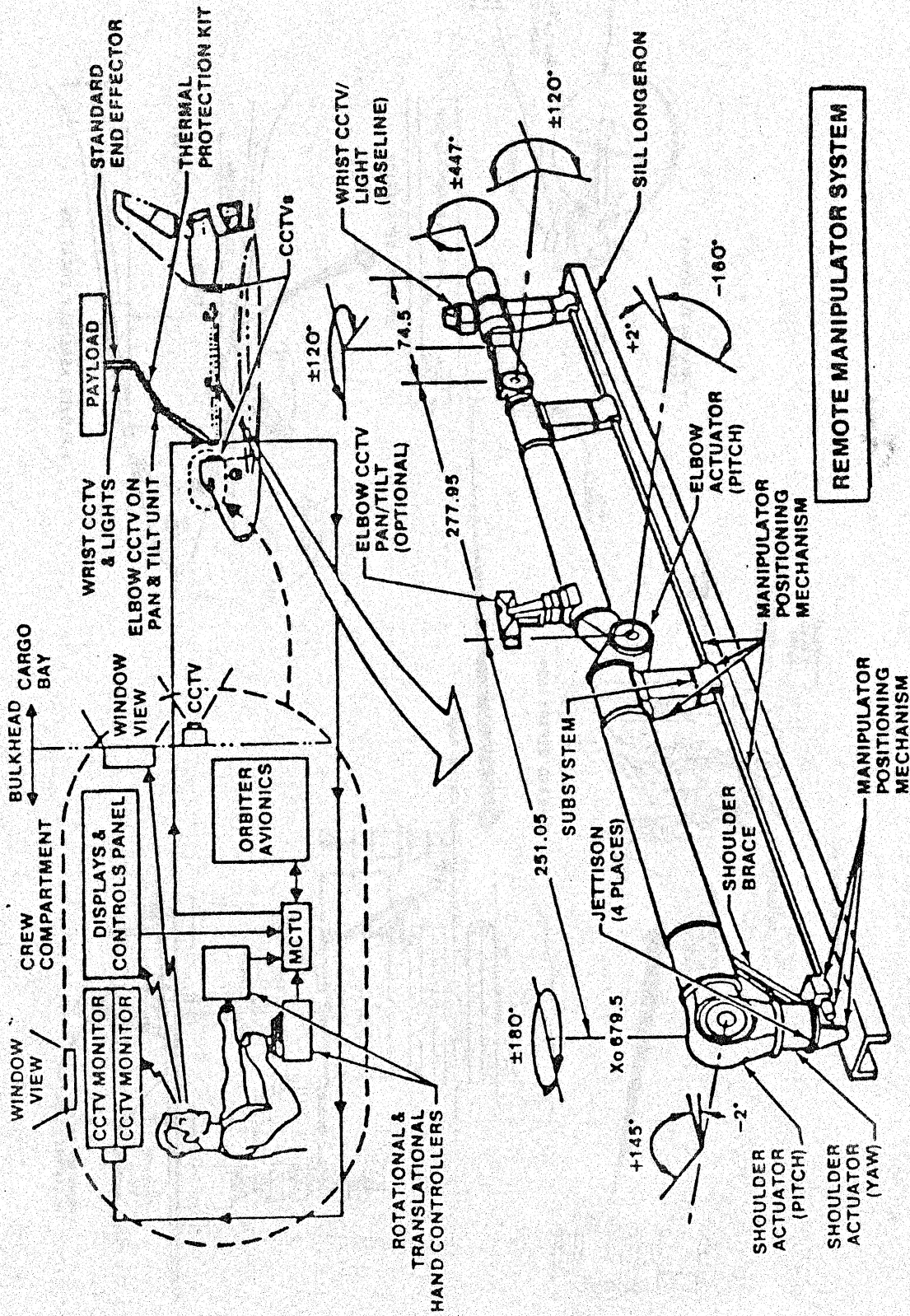
**EXPLOSIVE CODES**

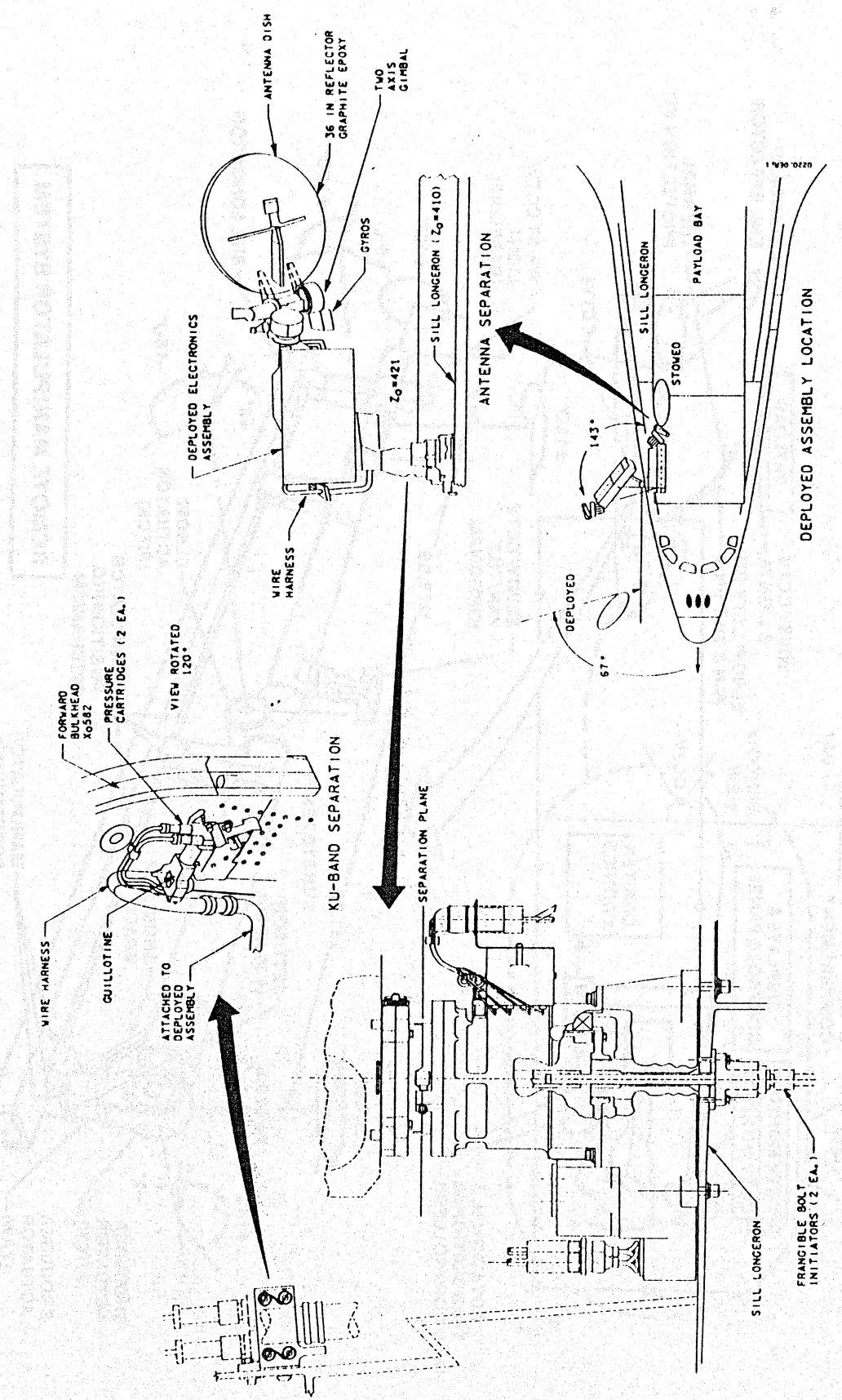
- ① EXPLOSIVE ICC CLASS A
- ② EXPLOSIVE ICC CLASS C



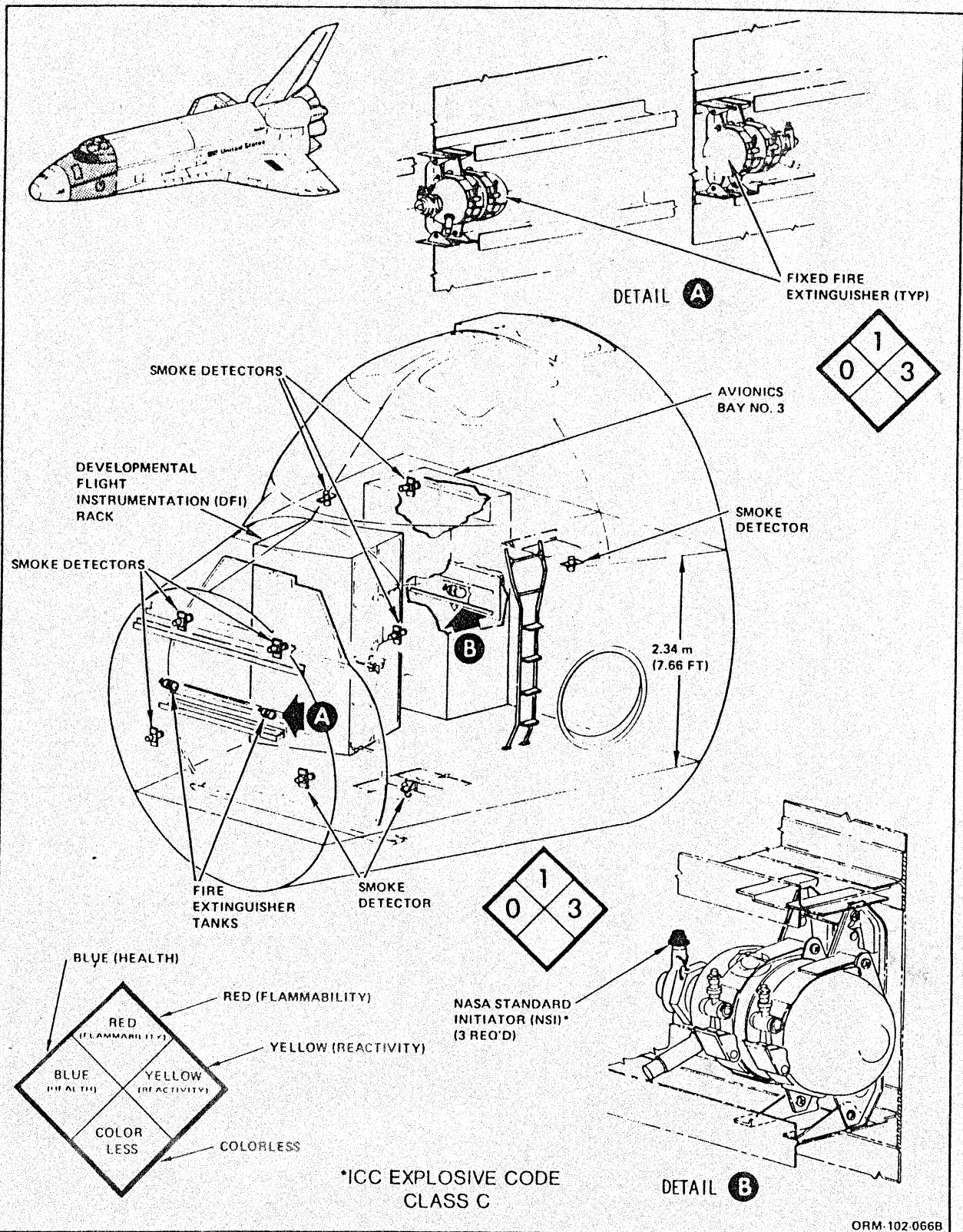


# PAYLOAD DEPLOYMENT AND RETRIEVAL SYSTEM





External antenna emergency release  
 system operational.



Fire Extinguisher Pyrotechnics.

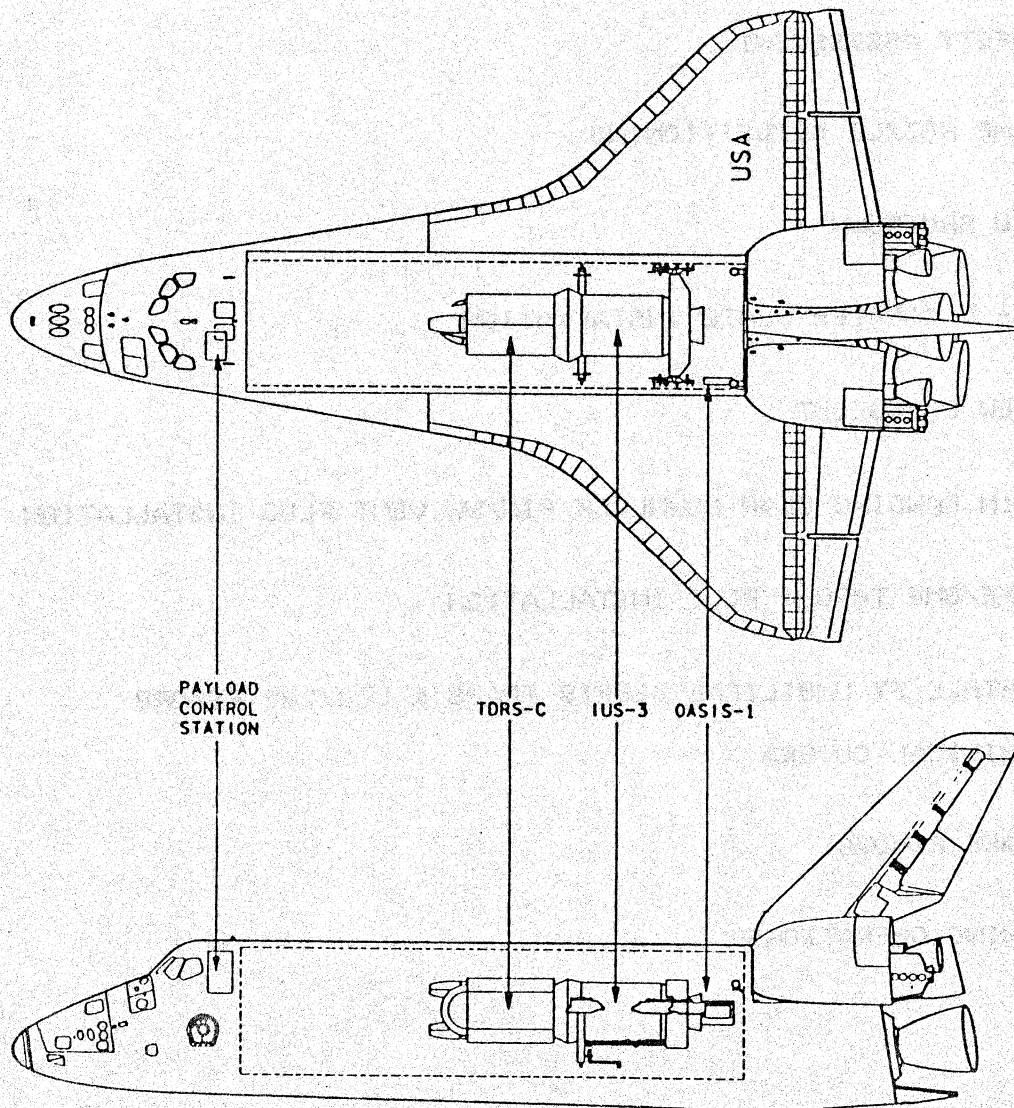




## ORBITER PAYLOADS

STS-26 (OV103 flight 7) payload locations are shown in figures 7-1 to 7-4.

- IUS-3 - INERTIAL UPPER STAGE
- TDRS-C - TRACKING AND DATA RELAY SATELLITE
- OASIS-I - ORBITER EXPERIMENT (OEX) AUTONOMOUS SUPPORTING INSTRUMENTATION SYSTEM



Payload location.

SCHEDULE OF POSTLANDING

ACTIVITIES

- \* OMS/RCS & HATCH PYRO SAFING
- \* ET DOOR POSITIONING
- \* SAFETY ASSESSMENT
- \* SSME NOZZLE REPOSITIONING
- \* APU SHUTDOWN
- \* T - 0 CARRIER PLATE INSTALLATION
- \* CREW CHANGEOUT
- \* MAIN LANDING GEAR DOWNLOCK PIN/WW VENT PLUG INSTALLATION
- \* SSME/OME THROAT PLUG INSTALLATION
- \* INSTALL ET UMBILICAL DEBRIS TRAPS & LO2/LH2 ET/ORB  
UMBILICAL COVERS
- \* BRAKE REMOVAL
- \* TOWING OPERATIONS

## OMS/RCS & HATCH PYRO SAFING

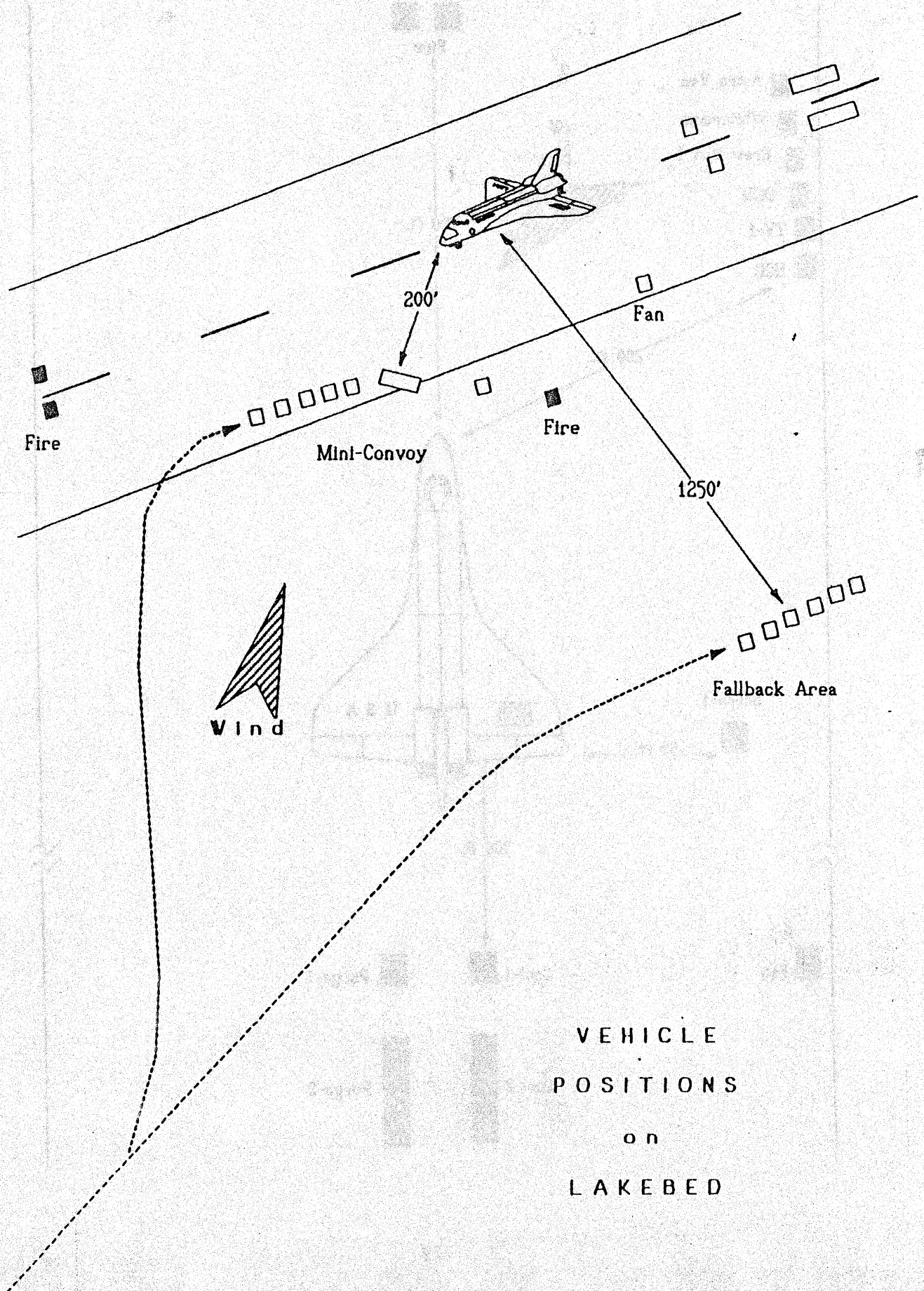
- \* ACCOMPLISHED BY FLIGHT CREW
- \* REMOVES POWER FROM RJDs TO PREVENT ACCIDENTAL FIRING OF RCS THRUSTERS
- \* ASSURES GROUND CREW THAT HATCH PYROS ARE SAFED
- \* NO APPROACH TO VEHICLE UNTIL COMPLETE

## ET DOOR POSITIONING

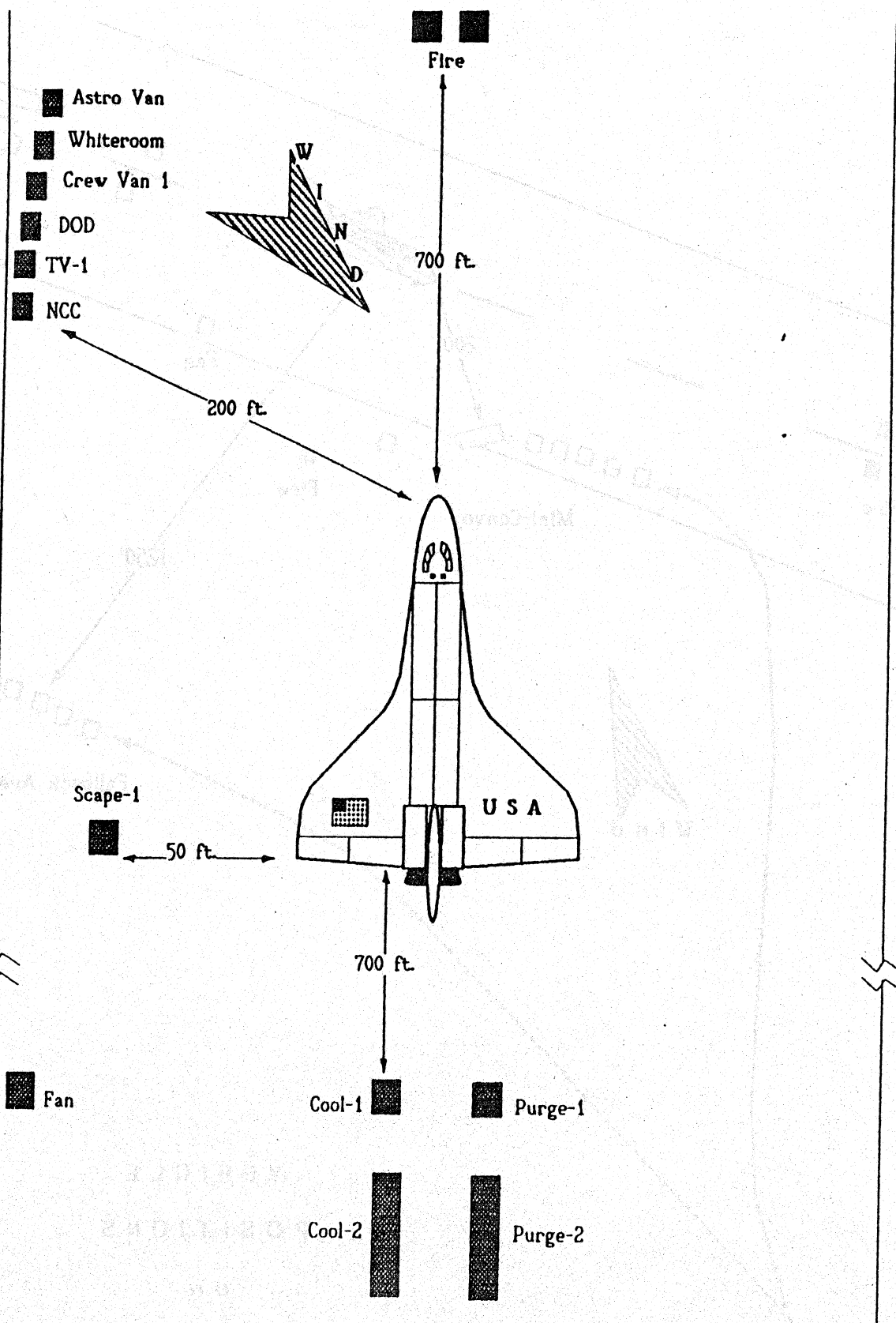
- \* POSITIONED TO VERTICAL AFTER WHEELSTOP
- \* CREW HAS NO VISUAL INDICATION OF POSITION
- \* DOORS POSITIONED TO 90 DEGREES  $\pm$  10 BEFORE TOWING
- \* VEHICLE POWER REQUIRED TO REPOSITION DOORS
- \* REMAIN CLEAR OF DOORS DURING MOVEMENT

## SAFETY ASSESSMENT

- \* AFTER OMS/RCS AND HATCH SAFING IS VERIFIED FWD AND AFT ASSESSMENT TEAMS MOVE TO ORBITER.
- \* APPROACH TO ORBITER WILL VARY DEPENDING UPON WINDS & PROTECTIVE CLOTHING USED.
- \* VEHICLE MOVES TO 50 FT OFF WING TIP DROPS OFF TEAM--RETURNS TO 1250' FROM ORBITER
- \* FWD TEAM
  - \* CHECKS FWD AREA FOR TOXIC/EXPLOSIVE VAPORS
  - \* INSTALLS NOSE GEAR DOWNLOCK PIN
  - \* CHOCKS NOSE GEAR TIRES
- \* AFT TEAM
  - \* CHECKS AFT AREA FOR TOXIC/EXPLOSIVE VAPORS--H2 CONCENTRATIONS MEASURED IN AFT/MID/PAYLOAD BAY USING SAMPLE LINES ON LEFT T-0.



VEHICLE  
POSITIONS  
on  
LAKEBED



## SSME NOZZLE REPOSITIONING

- \* MUST BE PERFORMED PRIOR TO APU SHUTDOWN.

## RAIN DRAIN

- \* POSITION USED FOR LANDING SITES OTHER THAN KSC.
- \* ALLOWS POSITIONING OF A70-1201 ACCESS STAND IN DESERVICING AREA.

## NULL + 2

- \* POSITION USED FOR KSC LANDINGS.
- \* ALLOWS CLEARANCE FOR OPF WORK PLATFORMS.

## APU SHUTDOWN

- \* ALLOWS STAIRCASE VEHICLES & PURGE TRANSPORTER TO MOVE INTO POSITION AT ORBITER T-0.
- \* ONCE STAIRCASE VEHICLES ARE IN POSITION, AFT SAFETY ASSESSMENT TEAM CHECKS AFT RCS THRUSTERS AND T-0 AREA FOR TOXIC/EXPLOSIVE VAPORS.

## T-0 CARRIER PLATE

### INSTALLATION

- \* AREA MAY BE DOWNGRADED TO COVERALLS AFTER AFT SAFETY ASSESSMENT.
- \* COOLING VEHICLE MOVES TO ORBITER.
- \* 508 UNIT CONNECTED TO LEFT T-0 ALLOWING AMMONIA BOILER TO BE SHUTDOWN.
- \* H2 CONCENTRATIONS MEASURED IN AFT/MID/PAYLOAD BAY USING SAMPLE LINES ON LEFT T-0.
- \* IF CONCENTRATIONS ARE WITHIN LIMITS VENT DOORS ARE REPOSITIONED AND PURGE FLOW IS ESTABLISHED.

### CREW CHANGEOUT

- \* ONCE FORWARD ASSESSMENT TEAM HAS CLEARED FORWARD AREA, CREW MODULE ACCESS VEHICLE MOVES INTO POSITION.
- \* CREW MODULE HATCH IS OPENED AND AFTER APPROXIMATELY 35-45 MINUTES FLIGHT CREW WILL EGRESS.
- \* VEHICLE CONTROL IS PASSED TO JSC ASP OR LSOC SCO.
- \* KSC ASSUMES VEHICLE RESPONSIBILITY AT FLIGHT CREW EGRESS OR VEHICLE POWERDOWN.



## MAIN LANDING GEAR DOWNLOCK

### PIN INSTALLATION

- \* AFTER 45 MINUTE COOLING PERIOD IS ELAPSED, DOWNLOCK PINS ARE INSTALLED.
- \* WHEEL WELL VENT PLUGS ARE INSTALLED AT THIS TIME.

## SSME/QMS THROAT PLUG

### INSTALLATION

- \* REQUIRES HI - RANGER.
- \* INSTALLED TO PREVENT CONTAMINATION.

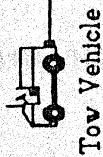
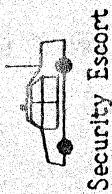
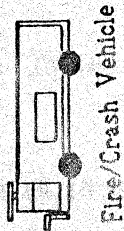
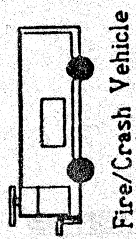
## BRAKE REMOVAL

- \* MUST BE ACCOMPLISHED BEFORE VEHICLE IS TOWED.
- \* REQUIRES USE OF PROTECTIVE RESPIRATOR & GARMENTS

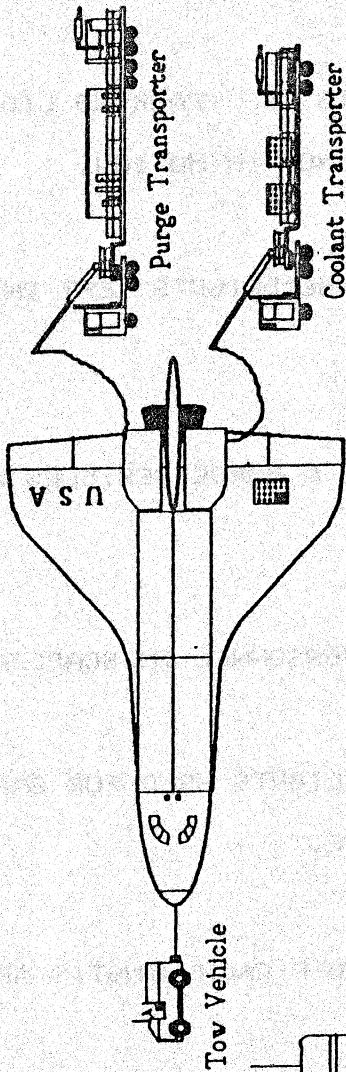
TOWING OPERATIONS

- \* NOSE GEAR DRAG LINK DISCONNECTED.
- \* TOW BAR CONNECTED.
- \* TOWING OPERATIONS COMMENCE UNDER CONTROL OF MOVE DIRECTOR.
- \* PURGE & COOL VEHICLES MOVE IN UNISON.
- \* RADIO CONTACT MAINTAINED AT ALL TIMES.

TYPICAL CONVOY TOW CONFIGURATION



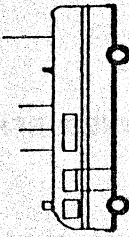
Maintenance Vehicle  
(DFRF Only)



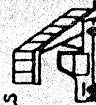
Purge Transporter

Coolant Transporter

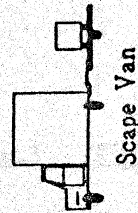
Convoy Commander Vehicle



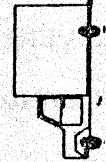
T-O Umbilical  
Access Trucks



Hatch Access Vehicle



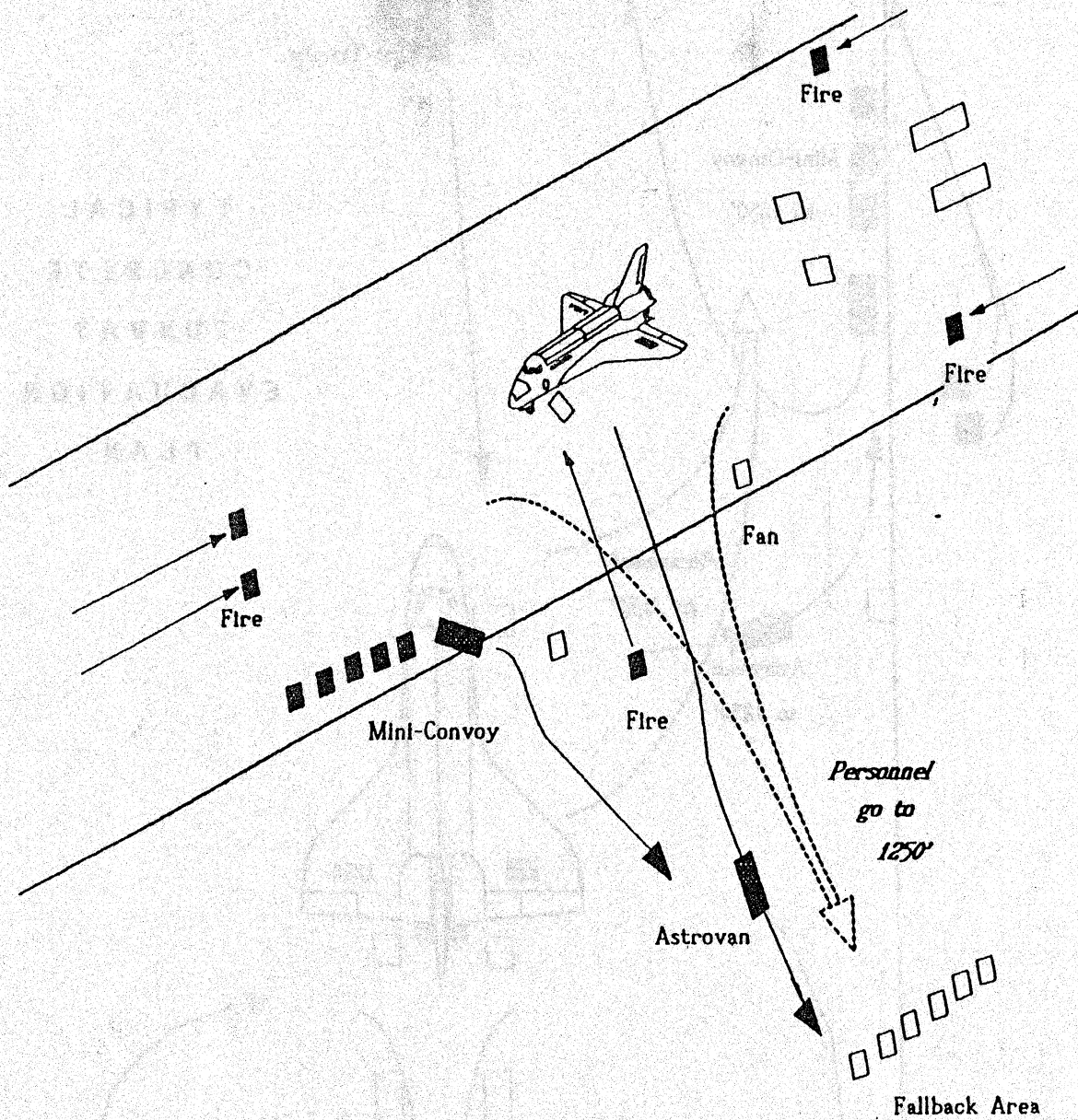
Scape Van



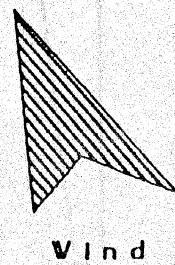
Crew Support Van

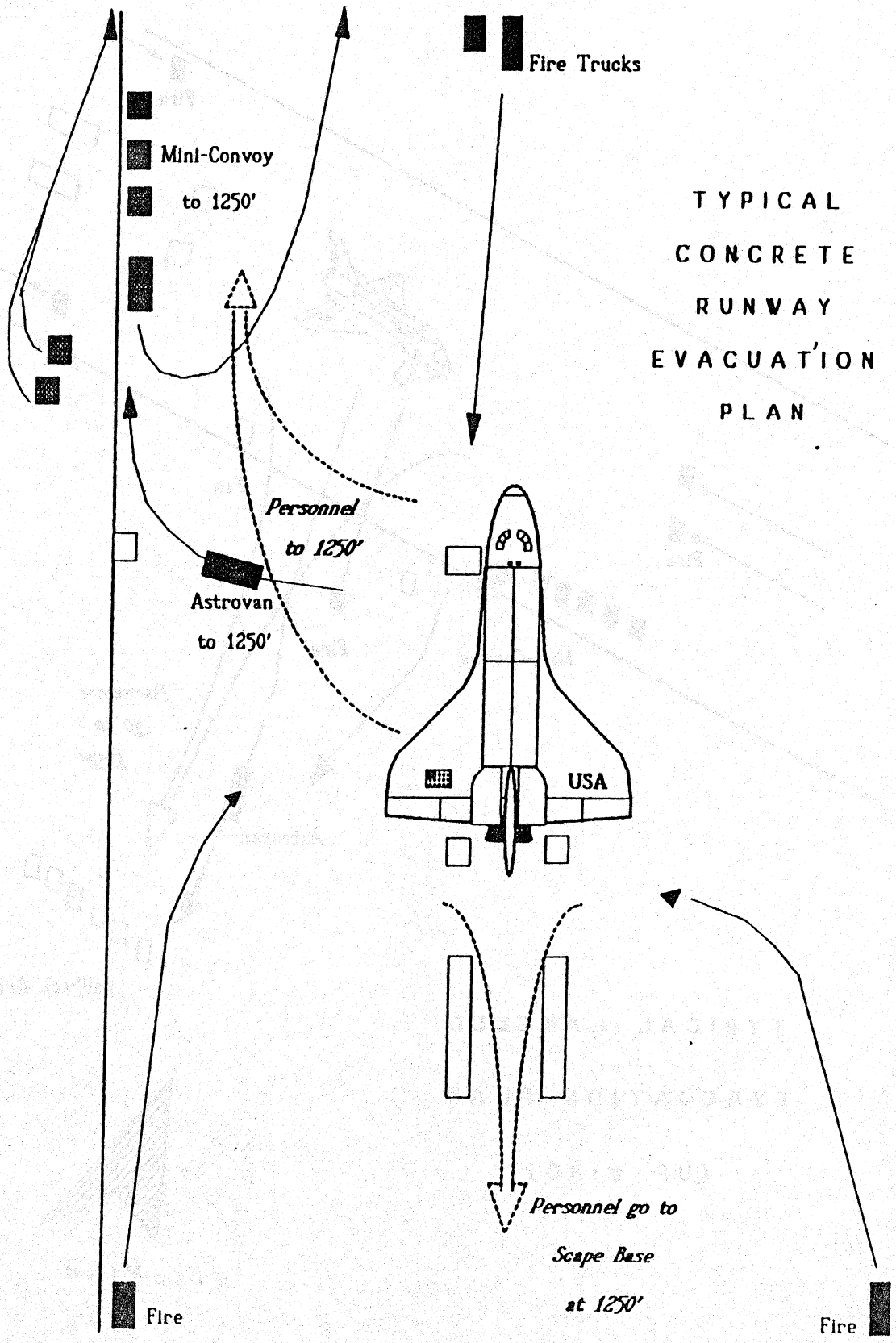
## NIGHT LANDING OPERATIONS

- \* ALL VEHICLE HEADLIGHTS OFF (PARKING LIGHTS ON), FOR LANDING AND WHEN NOT IN MOTION.
- \* COOL & PURGE VEHICLE HEADLIGHTS LEFT ON TO AID GROUND CREW.
- \* "BOOM" LIGHTS ON COOL & PURGE VEHICLES NOT USED UNLESS REQUIRED.
- \* CHEM-LITES TAPED TO PERSONNEL IN SCAPE/AIR PACKS.
- \* EXPLOSION-PROOF FLASHLIGHTS USED FOR SAFETY AND VISUAL INSPECTIONS OF VEHICLE.
- \* LITE-ALLS POSITIONED OFF EACH WINGTIP AFTER SAFETY ASSESSMENT.
- \* ALL XENON LIGHTS TURNED OFF AFTER ORBITER WHEEL STOP.
- \* XENON LIGHTS TURNED BACK ON ONLY UPON DIRECTION FROM CONVOY COMMANDER OR LSOC OPS.



TYPICAL LAKEBED  
 EVACUATION PLAN  
 (UP-WIND)





# CONTINGENCY OPERATIONS

## EVACUATION ROUTES

- \* EVACUATE TO MINIMUM OF 1250 FT (UPWIND IF POSSIBLE).
- \* ALL PERSONNEL EVACUATE ON FOOT EXCEPT VEHICLES SPECIFICALLY PREBRIEFED.

## COLLAPSED GEAR/OBVIOUS

### STRUCTURAL DAMAGE

- \* NO RESPONSE FROM CREW, (VISUALLY OR ON NET), MODE VI EMERGENCY EGRESS INITIATED.

CAUTION ! IF IN DOUBT ABOUT CREW CONDITION REMAIN CLEAR OF CREW MODULE HATCH, MAY BLOW WITHOUT WARNING!

- \* CREW OK, AND NO SIGNS OF LEAKS, SMOKE OR FIRE; EMERGENCY POWERDOWN AND MODE V EGRESS.

## BLOWN TIRE

- \* CONTINUE NORMAL CHECKLIST, BUT BE PREPARED FOR EMERGENCY EGRESS.
- \* GROUND ACCESS RESTRICTED WITHIN 20 FT RADIUS OF GOOD TIRE FOR 1 HOUR MINIMUM.

SMOKE OR FIRE IN FWD/MID/AFT

- \* PERFORM EMERGENCY POWERDOWN EVACUATE 1250 FT MINIMUM.

BRAKES/TIRES ON FIRE

- \* ALERT CREW, INITIATE EMERGENCY EGRESS IF FLAMES ARE GOING INTO WHEEL WELL.

EXTERNAL LIQUID LEAKAGE

- \* CONTINUE CHECKLIST, BE PREPARED FOR EMERGENCY EGRESS.

HYPERGOLIC VAPOR RELEASE

- \* CONTINUE CHECKLIST BE PREPARED FOR EMERGENCY EGRESS.
- \* AREA MONITORED BY SAFETY TEAM IF IN SCAPE.
- \* ALL OTHERS NOT IN SCAPE EVACUATE TO 1250 FT MINIMUM.

H2/HYDRAZINE CONCENTRATIONS ABOVE 3%

- \* PERFORM EMERGENCY POWERDOWN EGRESS TO 1250 FT MINIMUM.

NO MPS VACUUM INERT

- \* EXPEDITED POWERDOWN & MODE V EGRESS



## SCAPE MALFUNCTIONS

### INCAPACITATION/LOSS OF AIR

- \* EXIT STATION & REPORT CONDITION
- \* REMOVE PERSON FROM TOXIC AREA
- \* WASHDOWN SUIT IF REQUIRED
- \* IF INJURY CAUSED BY LIQUID AIR CONTACT, REMOVE SUIT IMMEDIATELY AND WASHDOWN INDIVIDUAL

### LOSS OF COMMUNICATIONS

- \* NOTIFY OPERATIONS VIA BUDDY OR OTHER SIGNAL
- \* REMOVE PERSON FROM AREA, WASHDOWN & OPEN SUIT
- \* SEND IN BACKUP, IF AVAILABLE

POSSIBLE TO HAVE SCAPE SUITED PERSONNEL IN TWO DIFFERENT LOCATIONS (FWD & AFT) IF EVACUATION OCCURS ON CONCRETE RUNWAY.

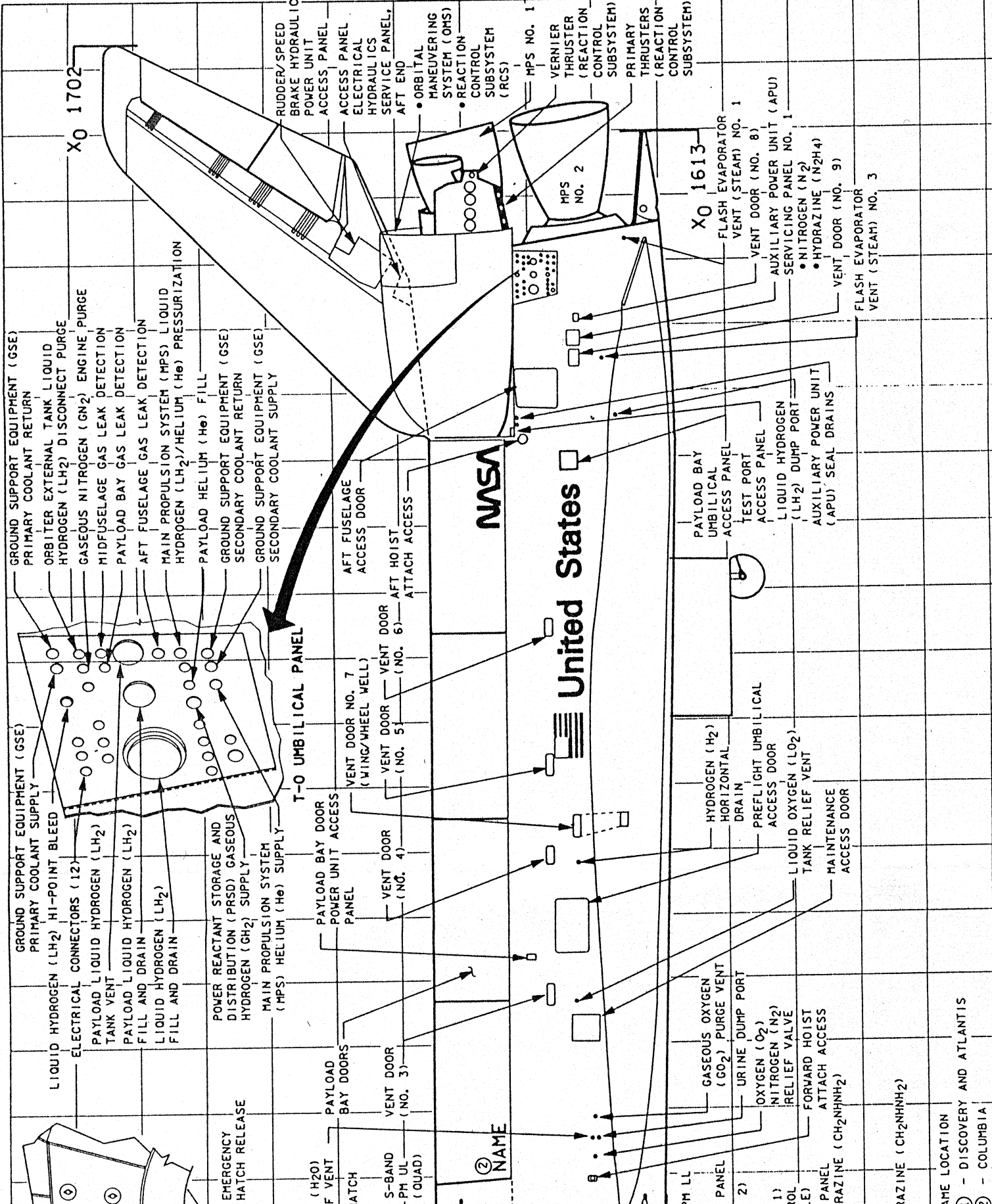
EMERGENCY PROCEDURES

EMERGENCY PROCEDURES

- \* EXIT STATION & REPORT LOCATION
- \* REMOVE PERSON FROM THE AREA
- \* MANAGER MUST BE ADVISED
- \* IF INJURY CAUSED BY LOSS OF AIR CONTACT, REMOVE SOON
- \* IMMEDIATELY AND MANAGER INSTRUCTED

EMERGENCY PROCEDURES

- \* NOT TO OPERATE VIA WALK OR OTHER MEANS
- \* REMOVE PERSON FROM AREA, MANAGER MUST BE ADVISED
- \* IF INJURY CAUSED BY LOSS OF AIR CONTACT, REMOVE SOON
- \* IMMEDIATELY AND MANAGER INSTRUCTED



XO 1702

XO 1613

NASA

United States

② NAME

NAME LOCATION  
 ① - DISCOVERY AND ATLANTIS  
 ② - COLUMBIA

GROUND SUPPORT EQUIPMENT (GSE)  
 PRIMARY COOLANT RETURN  
 ORBITER EXTERNAL TANK LIQUID HYDROGEN (LH<sub>2</sub>) DISCONNECT PURGE  
 GASEOUS NITROGEN (GN<sub>2</sub>) ENGINE PURGE  
 MIDFUSELAGE GAS LEAK DETECTION  
 PAYLOAD BAY GAS LEAK DETECTION  
 AFT FUSELAGE GAS LEAK DETECTION  
 MAIN PROPULSION SYSTEM (MPS) LIQUID HYDROGEN (LH<sub>2</sub>)/HELIUM (He) PRESSURIZATION  
 PAYLOAD HELIUM (He) FILL  
 GROUND SUPPORT EQUIPMENT (GSE)  
 SECONDARY COOLANT RETURN  
 GROUND SUPPORT EQUIPMENT (GSE)  
 SECONDARY COOLANT SUPPLY

GROUND SUPPORT EQUIPMENT (GSE)  
 PRIMARY COOLANT SUPPLY  
 LIQUID HYDROGEN (LH<sub>2</sub>) HI-POINT BLEED  
 ELECTRICAL CONNECTORS (12)  
 PAYLOAD LIQUID HYDROGEN (LH<sub>2</sub>) TANK VENT  
 PAYLOAD LIQUID HYDROGEN (LH<sub>2</sub>) FILL AND DRAIN  
 LIQUID HYDROGEN (LH<sub>2</sub>) FILL AND DRAIN  
 POWER REACTANT STORAGE AND DISTRIBUTION (PRSD) GASEOUS HYDROGEN (GH<sub>2</sub>) SUPPLY  
 MAIN PROPULSION SYSTEM (MPS) HELIUM (He) SUPPLY

T-O UMBILICAL PANEL  
 PAYLOAD BAY DOOR  
 PAYLOAD BAY DOOR POWER UNIT ACCESS PANEL  
 VENT DOOR (NO. 3)  
 VENT DOOR (NO. 4)  
 VENT DOOR (NO. 5)  
 VENT DOOR (NO. 6)  
 AFT FUSELAGE ACCESS DOOR  
 AFT HOIST ATTACH ACCESS  
 RUDDER/SPEED BRAKE HYDRAULIC POWER UNIT ACCESS PANEL  
 ACCESS PANEL ELECTRICALS HYDRAULICS SERVICE PANEL, AFT END  
 • ORBITAL MANEUVERING SYSTEM (OMS)  
 • REACTION CONTROL SUBSYSTEM (RCS)  
 MPS NO. 1  
 VERNIER THRUSTER (REACTION CONTROL SUBSYSTEM)  
 PRIMARY THRUSTERS (REACTION CONTROL SUBSYSTEM)  
 PAYLOAD BAY UMBILICAL ACCESS PANEL  
 TEST PORT ACCESS PANEL  
 LIQUID HYDROGEN (LH<sub>2</sub>) DUMP PORT  
 AUXILIARY POWER UNIT (APU) SEAL DRAINS  
 PAYLOAD BAY UMBILICAL ACCESS PANEL  
 FLASH EVAPORATOR VENT (STEAM) NO. 1  
 VENT DOOR (NO. 8)  
 AUXILIARY POWER UNIT (APU) SERVICING PANEL NO. 1  
 • NITROGEN (N<sub>2</sub>)  
 • HYDRAZINE (N<sub>2</sub>H<sub>4</sub>)  
 VENT DOOR (NO. 9)  
 FLASH EVAPORATOR VENT (STEAM) NO. 3

HYDROGEN (H<sub>2</sub>) HORIZONTAL DRAIN  
 PREFLIGHT UMBILICAL ACCESS DOOR  
 LIQUID OXYGEN (LO<sub>2</sub>) TANK RELIEF VENT  
 MAINTENANCE ACCESS DOOR  
 GASEOUS OXYGEN (GO<sub>2</sub>) PURGE VENT  
 URINE DUMP PORT  
 OXYGEN (O<sub>2</sub>) NITROGEN (N<sub>2</sub>) RELIEF VALVE  
 FORWARD HOIST ATTACH ACCESS  
 DRAZINE (CH<sub>2</sub>NHNH<sub>2</sub>)  
 DRAZINE (CH<sub>2</sub>NHNH<sub>2</sub>)

Z0908.299

Z0844.252

Z0780.205

Z0716.158

Z0652.111

Z0588.064

Z0524.017

Z0500.000

Z0459.970

HINGE E

Z0395.923

Z0331.876

Z0267.829

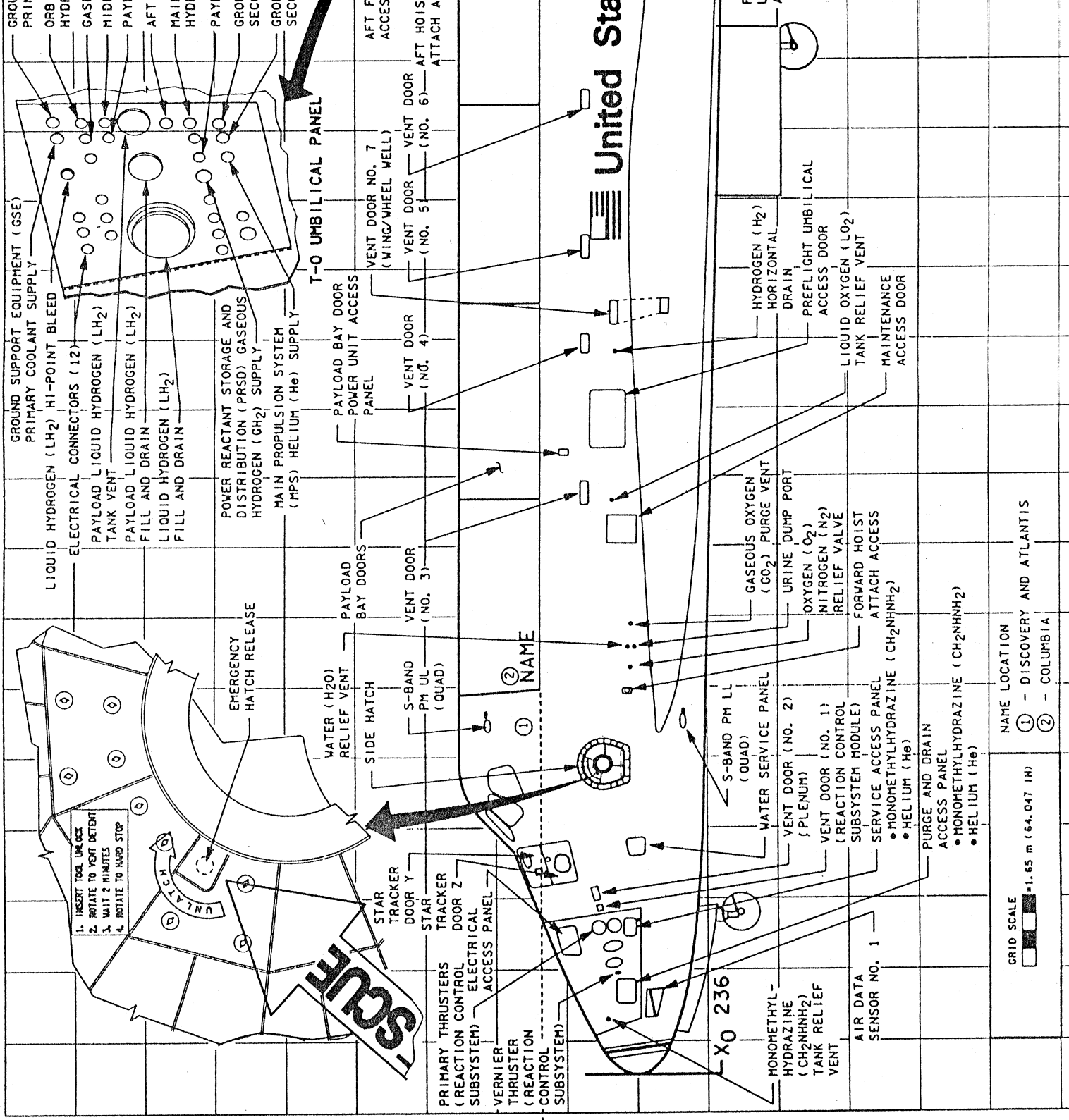
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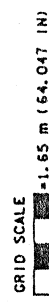
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1. INSERT TOOL UNLOCK
2. ROTATE TO YOUT DETENT
3. WAIT 2 MINUTES
4. ROTATE TO HARD STOP

**SC-37**

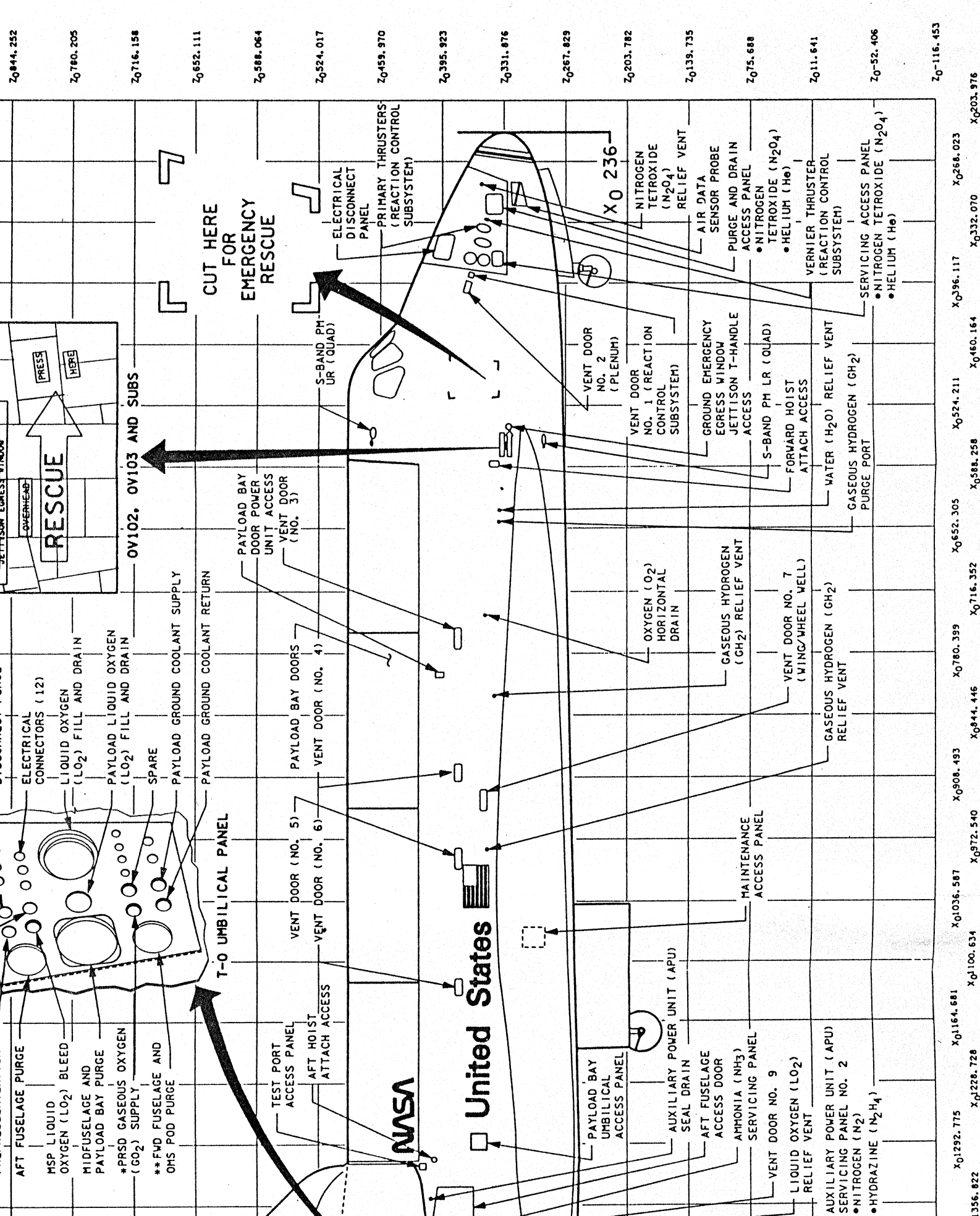
① NAME



NAME LOCATION

① - DISCOVERY AND ATLANTIS

② - COLUMBIA



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 Z0182.002

RESCUE

OV102, OV103 AND SUBS

CUT HERE FOR EMERGENCY RESCUE

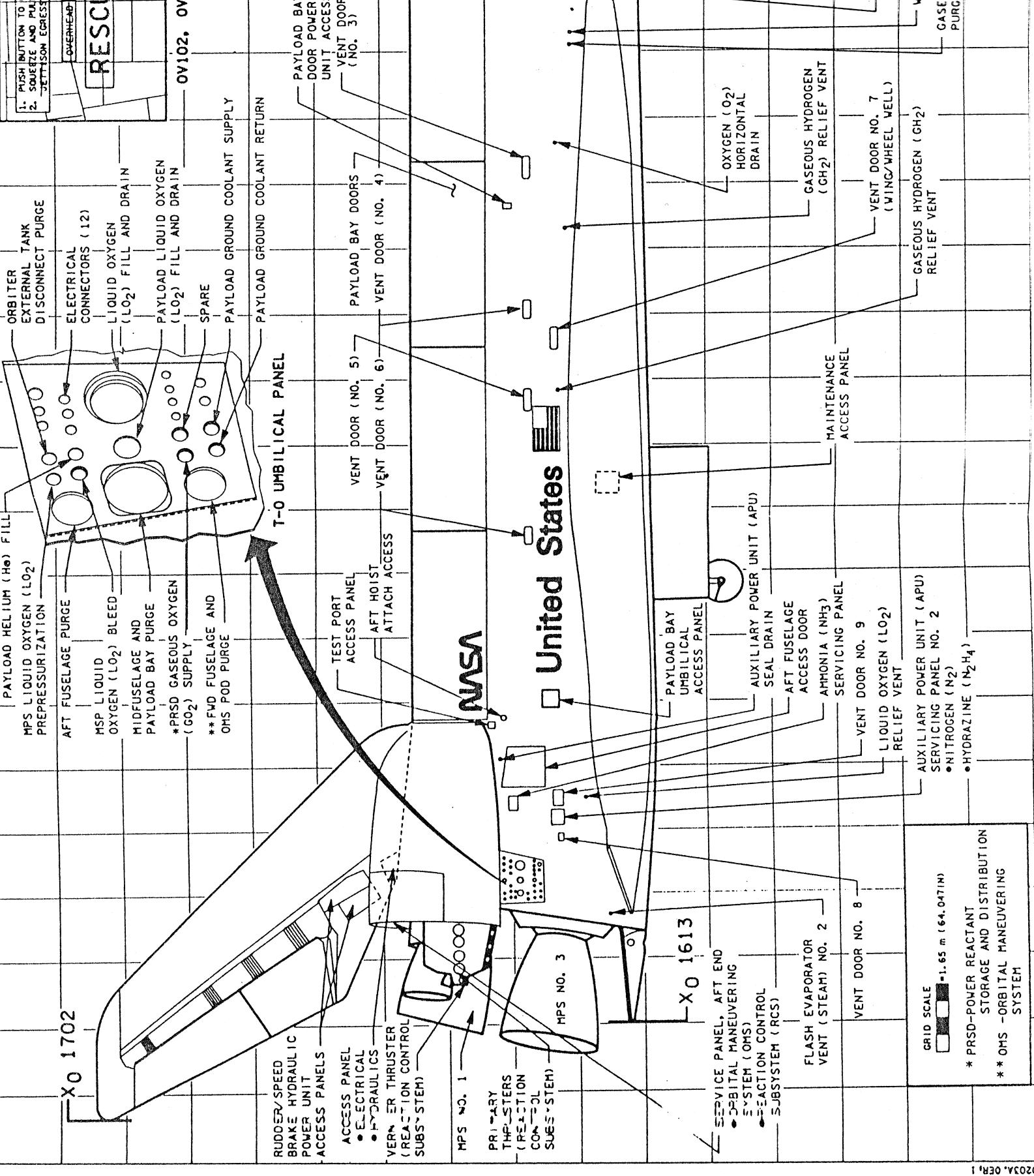
T-O UMBILICAL PANEL



United States

X 0 236

X0122.775 X0164.681 X01036.587 X01036.593 X0780.399 X0524.211 X0396.117 X0268.023  
 X01228.728 X01228.734 X0972.540 X0944.446 X0568.258 X0460.164 X0332.070 X0203.976  
 56.822



1. PUSH BUTTON TO  
2. SQUEEZE AND PULL  
"JETTISON EGGS"  
OVERHEAD  
**RESCUE**

OV102, OV

XO 1702

- PAYLOAD HELIUM (He) FILL
- MPS LIQUID OXYGEN (LO<sub>2</sub>) PREPRESSURIZATION
- AFT FUSELAGE PURGE
- MSP LIQUID OXYGEN (LO<sub>2</sub>) BLEED
- MIDFUSELAGE AND PAYLOAD BAY PURGE
- \* PRSD GASEOUS OXYGEN (GO<sub>2</sub>) SUPPLY
- \*\* FWD FUSELAGE AND OMS POD PURGE
- ORBITER EXTERNAL TANK DISCONNECT PURGE
- ELECTRICAL CONNECTORS (12)
- LIQUID OXYGEN (LO<sub>2</sub>) FILL AND DRAIN
- PAYLOAD LIQUID OXYGEN (LO<sub>2</sub>) FILL AND DRAIN
- SPARE
- PAYLOAD GROUND COOLANT SUPPLY
- PAYLOAD GROUND COOLANT RETURN

T-O UMBILICAL PANEL

- RUDDER/SPEED BRAKE HYDRAULIC POWER UNIT ACCESS PANELS
- ACCESS PANEL
  - ELECTRICAL
  - HYDRAULICS
- VERNER THRUSTER (REACTION CONTROL SUBSYSTEM)

MPS NO. 1

- PRIMARY THRUSTERS (REACTION CONTROL SUBSYSTEM)

United States

NASA

MPS NO. 3

XO 1613

- SERVICE PANEL, AFT END
- ORBITAL MANEUVERING SYSTEM (OMS)
- REACTION CONTROL SUBSYSTEM (RCS)

FLASH EVAPORATOR VENT (STEAM) NO. 2

VENT DOOR NO. 8

GRID SCALE  
-1.65 m (64.047 IN)

- \* PRSD-POWER REACTANT STORAGE AND DISTRIBUTION SYSTEM
- \*\* OMS -ORBITAL MANEUVERING SYSTEM

PAYLOAD BAY DOOR POWER UNIT ACCESS VENT DOOR (NO. 3)

PAYLOAD BAY DOORS VENT DOOR (NO. 4)

VENT DOOR (NO. 5) VENT DOOR (NO. 6)

TEST PORT ACCESS PANEL AFT HOIST ATTACH ACCESS

OXYGEN (O<sub>2</sub>) HORIZONTAL DRAIN

GASEOUS HYDROGEN (GH<sub>2</sub>) RELIEF VENT

VENT DOOR NO. 7 (WING/WHEEL WELL)

GASEOUS HYDROGEN (GH<sub>2</sub>) RELIEF VENT

GASE PURG

PAYLOAD BAY UMBILICAL ACCESS PANEL

AUXILIARY POWER UNIT (APU) SEAL DRAIN

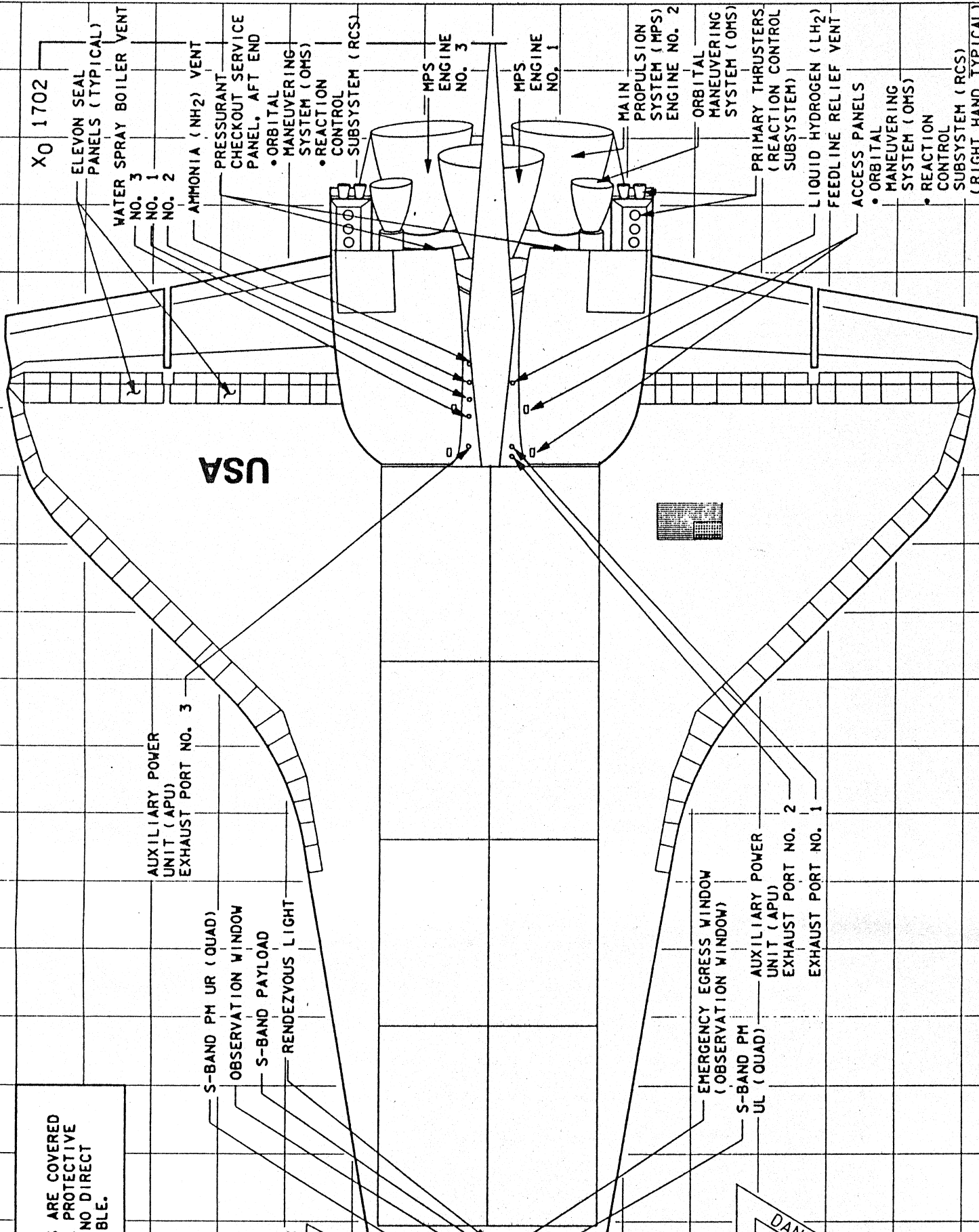
AFT FUSELAGE ACCESS DOOR AMMONIA (NH<sub>3</sub>) SERVICING PANEL

VENT DOOR NO. 9 LIQUID OXYGEN (LO<sub>2</sub>) RELIEF VENT

AUXILIARY POWER UNIT (APU) SERVICING PANEL NO. 2

- NITROGEN (N<sub>2</sub>)
- HYDRAZINE (N<sub>2</sub>H<sub>4</sub>)

MAINTENANCE ACCESS PANEL



S ARE COVERED  
L PROTECTIVE  
NO DIRECT  
IBLE.

DANG

**Note**

ALL ANTENNAS ARE COVERED WITH THERMAL PROTECTIVE INSULATION. NO DIRECT ACCESS POSSIBLE.

AUXILIARY POWER UNIT (APU) EXHAUST PORT NO. 3

S-BAND PM UR (QUAD)

OBSERVATION WINDOW

S-BAND PAYLOAD

RENDEZVOUS LIGHT

S-BAND FM UPPER (HEMI)

TACAN 2 UPPER

TACAN 3 UPPER

ELECTRICAL DISCONNECT ACCESS PANEL

PRIMARY THRUSTERS (REACTION CONTROL SUBSYSTEM)

KUBAND MSBLS 2

KUBAND MSBLS 1

KUBAND MSBLS 3

ELECTRICAL DISCONNECT ACCESS PANEL

XO 236 TACAN 1 UPPER

STAR TRACKER DOOR Y

STAR TRACKER DOOR Z

DANGER

DANGER

DANGER

EMERGENCY EGRESS WINDOW (OBSERVATION WINDOW)

S-BAND PM UL (QUAD)

AUXILIARY POWER UNIT (APU) EXHAUST PORT NO. 2

AUXILIARY POWER UNIT (APU) EXHAUST PORT NO. 1

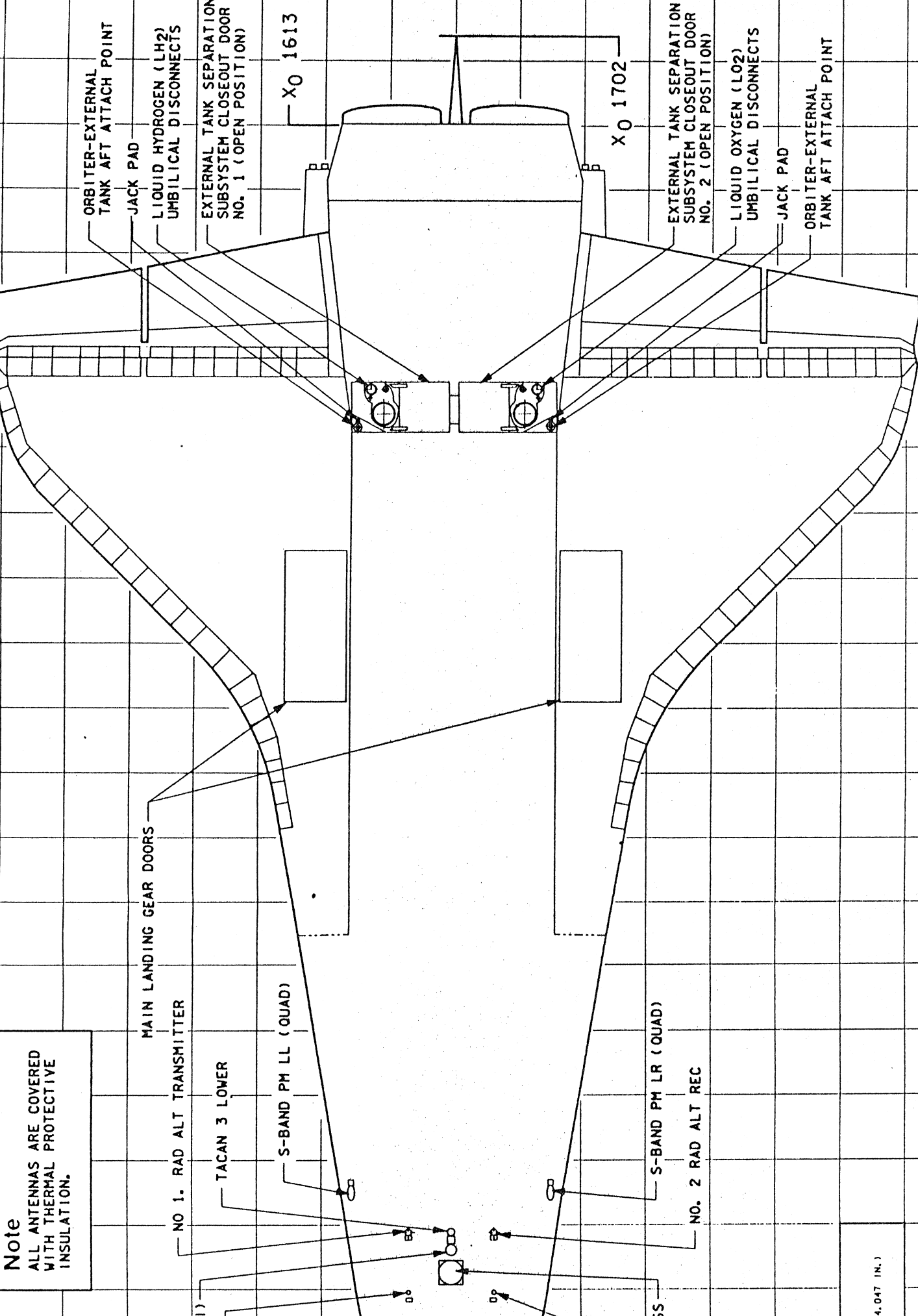
GRID SCALE

1.55 m (64.047 IN.)

USA

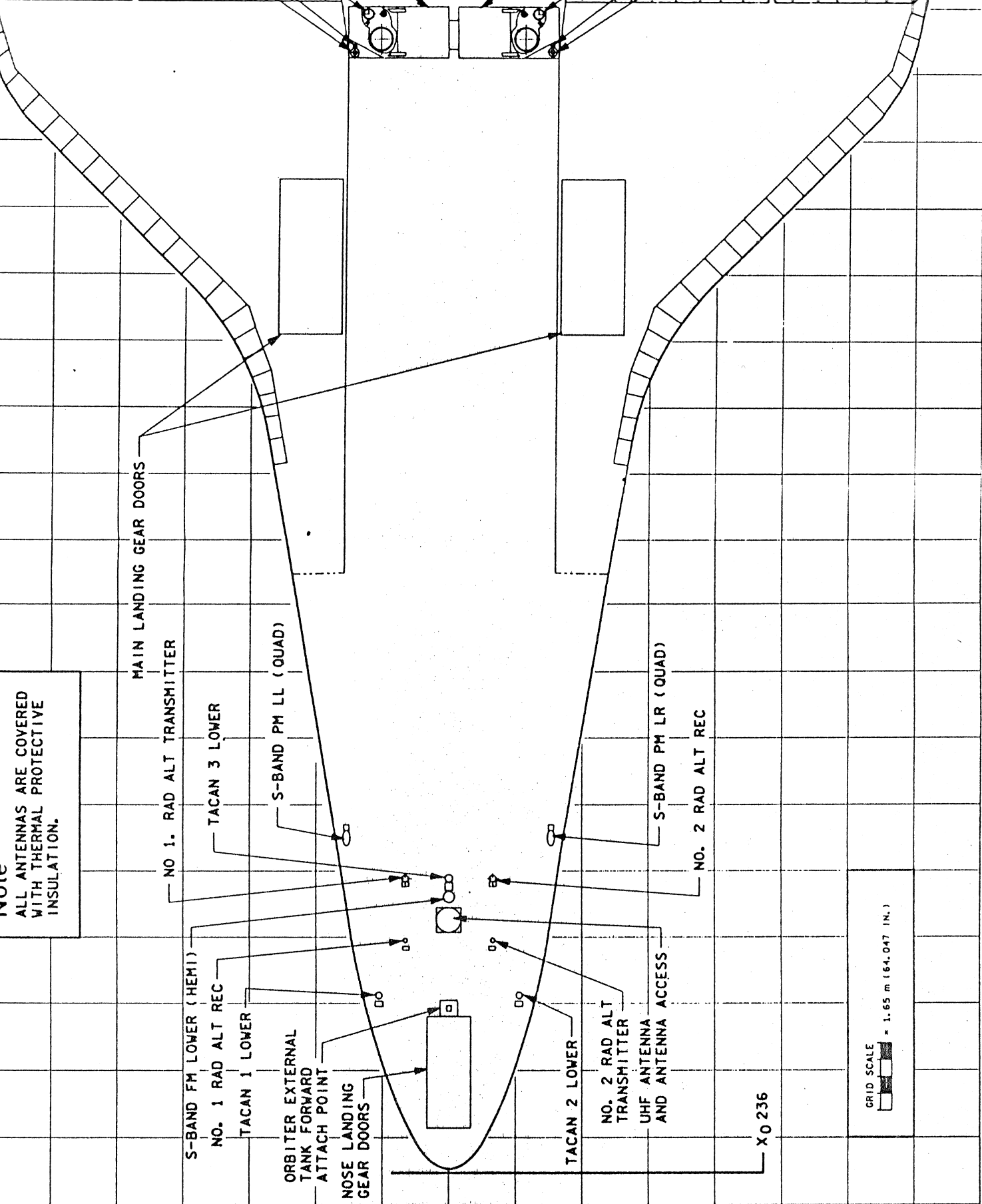


Note  
ALL ANTENNAS ARE COVERED  
WITH THERMAL PROTECTIVE  
INSULATION.



X0524.211 X0552.305 X0760.399 X0844.446 X0908.493 X0972.540 X1036.587 X1100.634 X1164.681 X1228.728 X1292.775 X1356.822 X1484.916 X1548.963 X1613.010 X1677.057 X0160.164 X0588.258 X0716.352 X0844.446 X0908.493 X0972.540 X1036.587 X1100.634 X1164.681 X1228.728 X1292.775 X1356.822 X1484.916 X1548.963 X1613.010 X1677.057 X01741.10

(64.047 IN.)

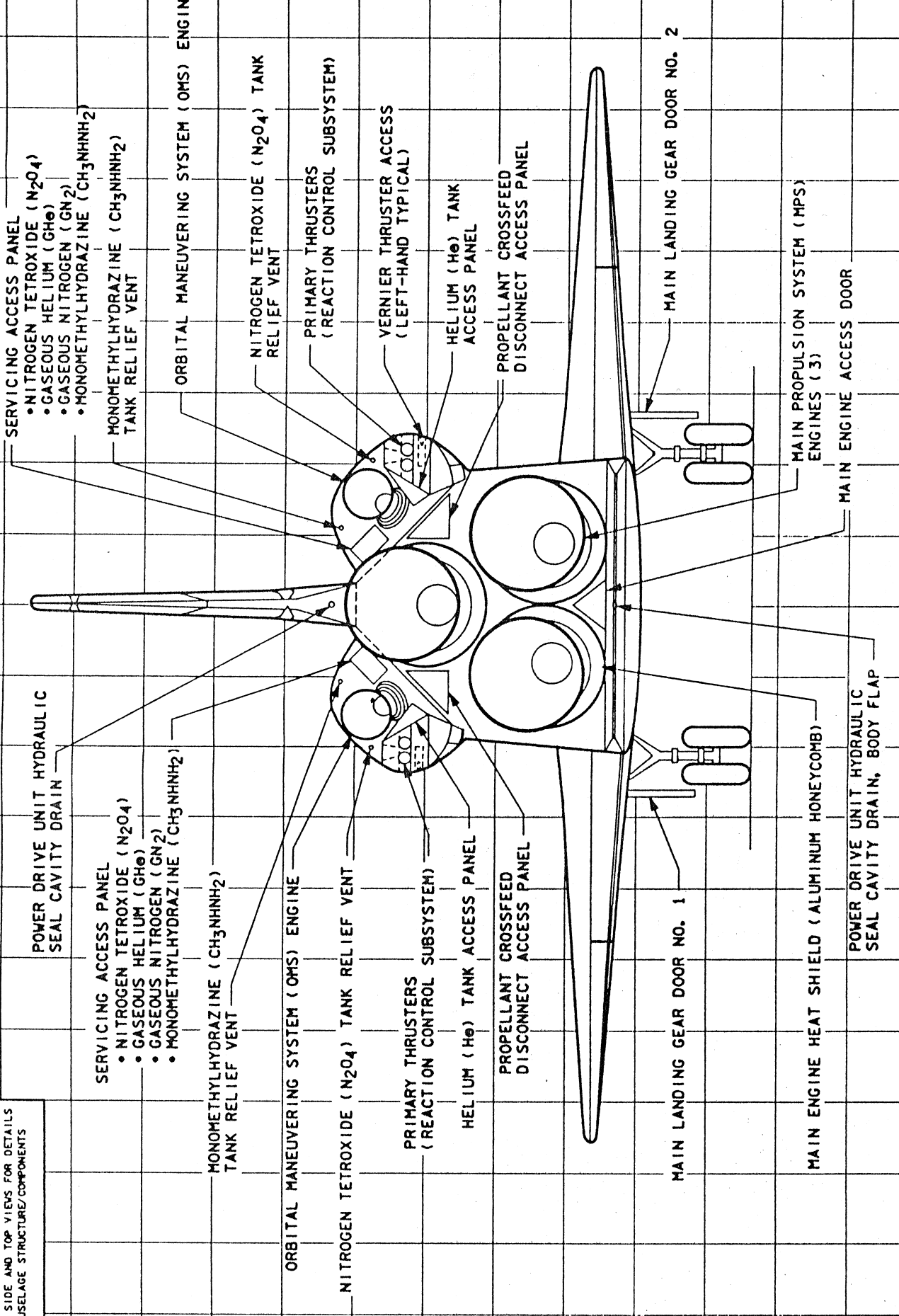


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 Y0-320.235  
 Y0-256.188  
 Y0-192.141  
 Y0-128.094  
 Y0-64.047  
 Y0 0.000  
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 Y0 128.094  
 Y0 192.141  
 Y0 256.188  
 Y0 320.235  
 Y0 384.282  
 Y0 448.329  
 Y0 512.376

X0 203.976  
 X0 268.023  
 X0 332.070  
 X0 396.117  
 X0 460.164  
 X0 524.211  
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 X0 908.493  
 X0 972.540  
 X0 1036.587  
 X0 1100.634  
 X0 1164.681  
 X0 1228.728  
 X0 1292.775  
 X0 1356

**Note**

REFER TO SIDE AND TOP VIEWS FOR DETAILS OF AFT FUSELAGE STRUCTURE/COMPONENTS



SERVICING ACCESS PANEL  
 • NITROGEN TETROXIDE (N<sub>2</sub>O<sub>4</sub>)  
 • GASEOUS HELIUM (GH<sub>0</sub>)  
 • GASEOUS NITROGEN (GN<sub>2</sub>)  
 • MONOMETHYLHYDRAZINE (CH<sub>3</sub>NHNH<sub>2</sub>)  
 MONOMETHYLHYDRAZINE (CH<sub>3</sub>NHNH<sub>2</sub>)  
 TANK RELIEF VENT

POWER DRIVE UNIT HYDRAULIC SEAL CAVITY DRAIN  
 SERVICING ACCESS PANEL  
 • NITROGEN TETROXIDE (N<sub>2</sub>O<sub>4</sub>)  
 • GASEOUS HELIUM (GH<sub>0</sub>)  
 • GASEOUS NITROGEN (GN<sub>2</sub>)  
 • MONOMETHYLHYDRAZINE (CH<sub>3</sub>NHNH<sub>2</sub>)  
 MONOMETHYLHYDRAZINE (CH<sub>3</sub>NHNH<sub>2</sub>)  
 TANK RELIEF VENT

ORBITAL MANEUVERING SYSTEM (OMS) ENGINE  
 NITROGEN TETROXIDE (N<sub>2</sub>O<sub>4</sub>) TANK RELIEF VENT  
 PRIMARY THRUSTERS (REACTION CONTROL SUBSYSTEM)

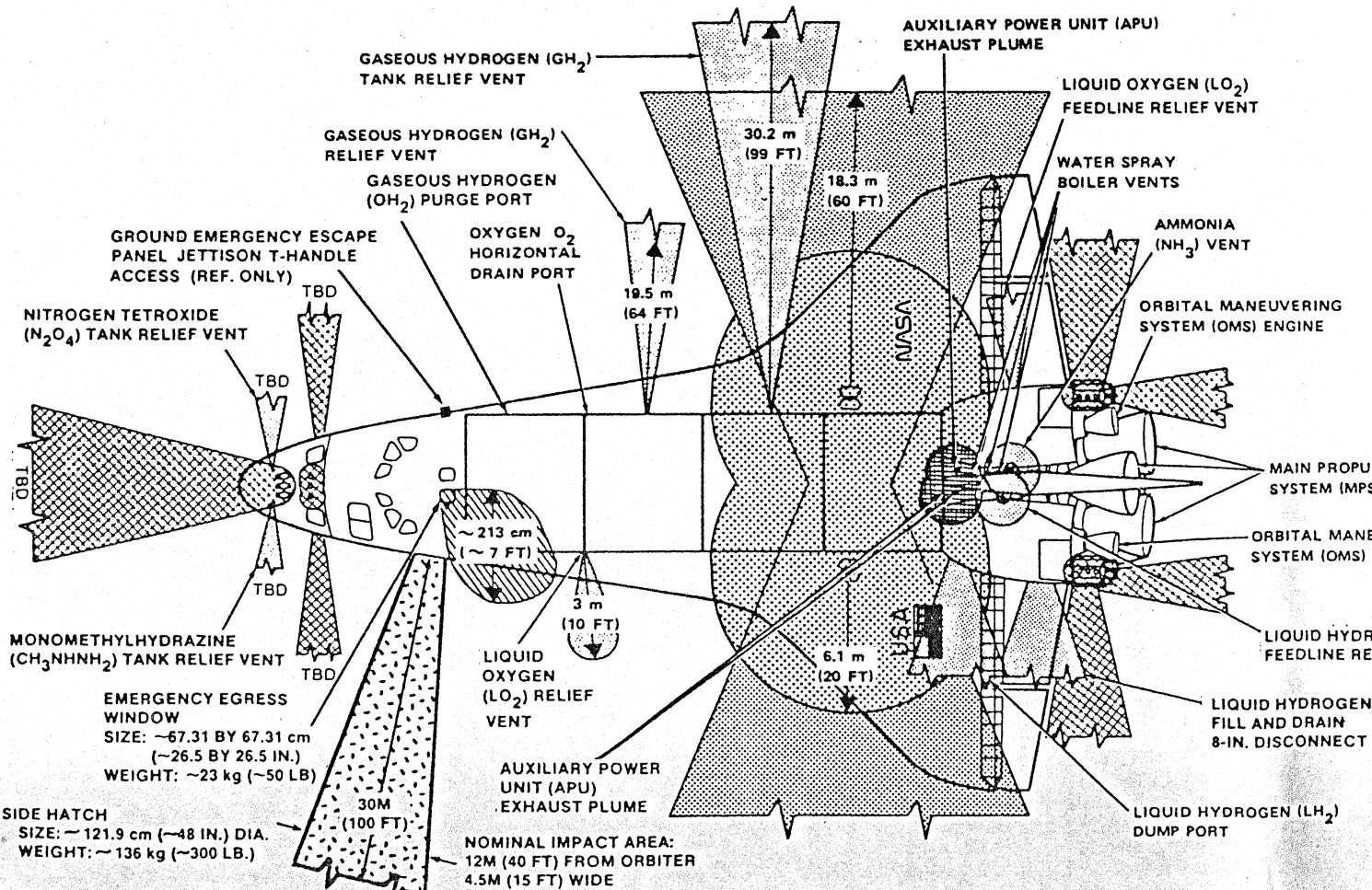
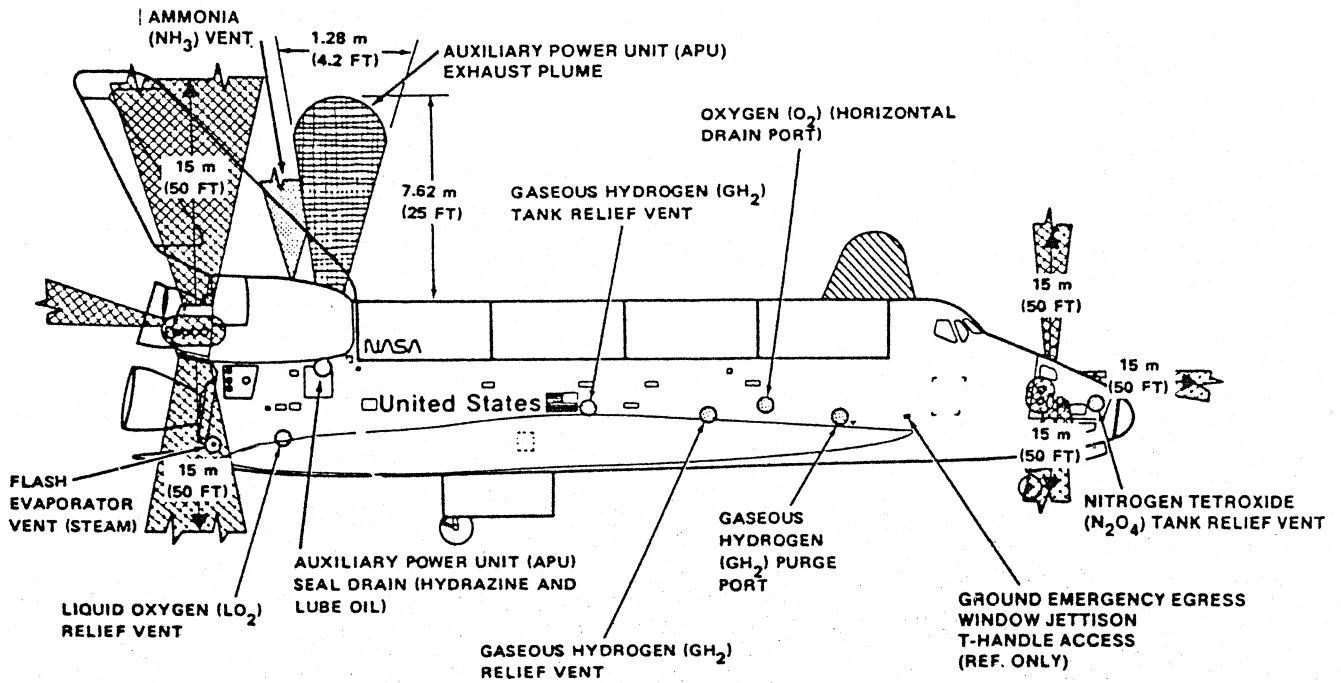
ORBITAL MANEUVERING SYSTEM (OMS) ENGINE  
 NITROGEN TETROXIDE (N<sub>2</sub>O<sub>4</sub>) TANK RELIEF VENT  
 PRIMARY THRUSTERS (REACTION CONTROL SUBSYSTEM)

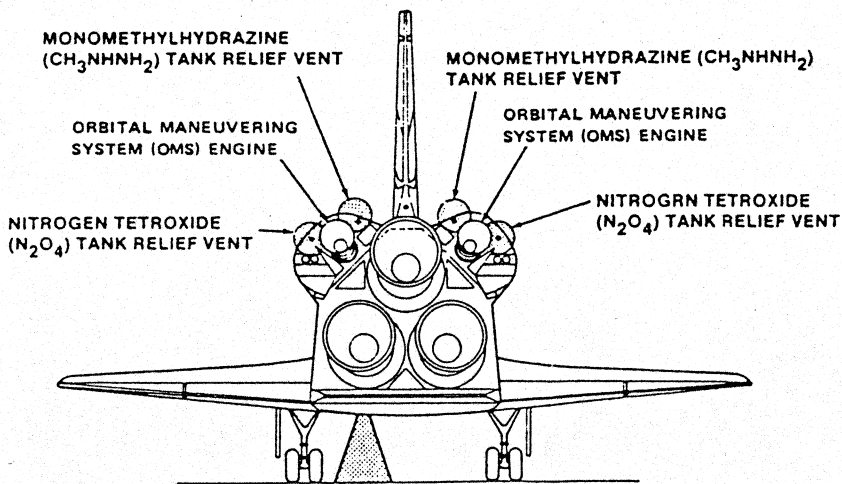
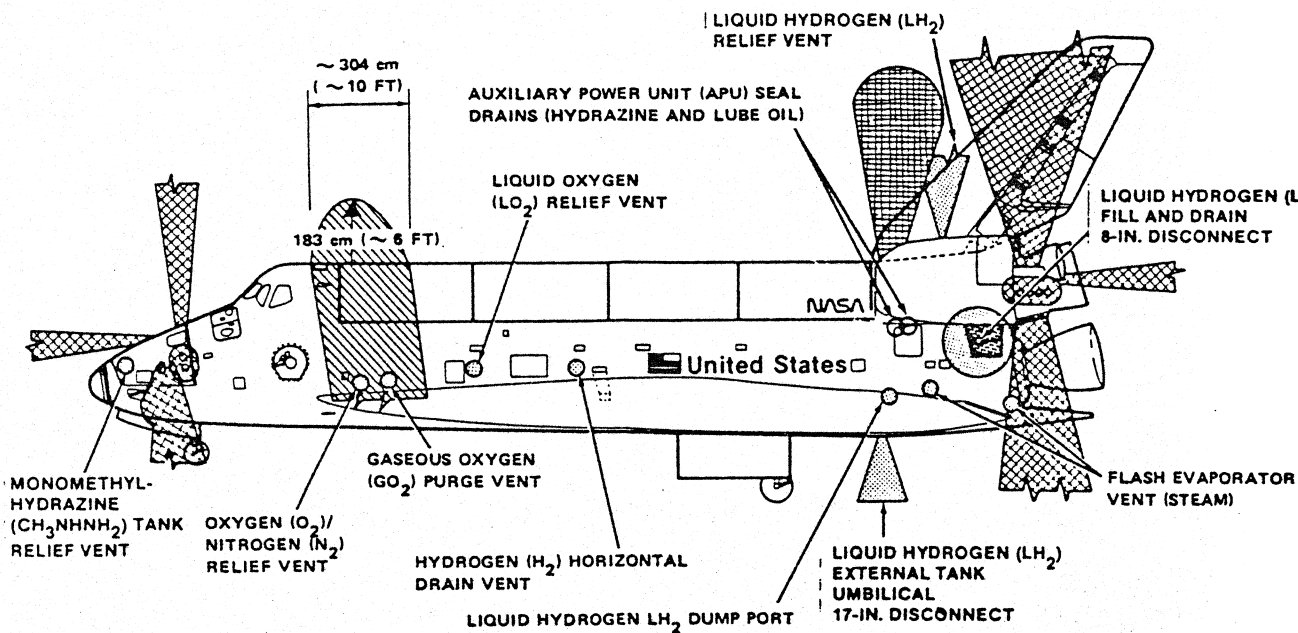
VERNIER THRUSTER ACCESS (LEFT-HAND TYPICAL)  
 HELIUM (He) TANK ACCESS PANEL  
 PROPELLANT CROSSFEED DISCONNECT ACCESS PANEL

HELIUM (He) TANK ACCESS PANEL  
 PROPELLANT CROSSFEED DISCONNECT ACCESS PANEL








MAIN LANDING GEAR DOOR NO. 2  
 MAIN PROPULSION SYSTEM (MPS) ENGINES (3)  
 MAIN ENGINE ACCESS DOOR

MAIN LANDING GEAR DOOR NO. 1  
 MAIN ENGINE HEAT SHIELD (ALUMINUM HONEYCOMB)  
 POWER DRIVE UNIT HYDRAULIC SEAL CAVITY DRAIN, BODY FLAP





## DANGER AREAS

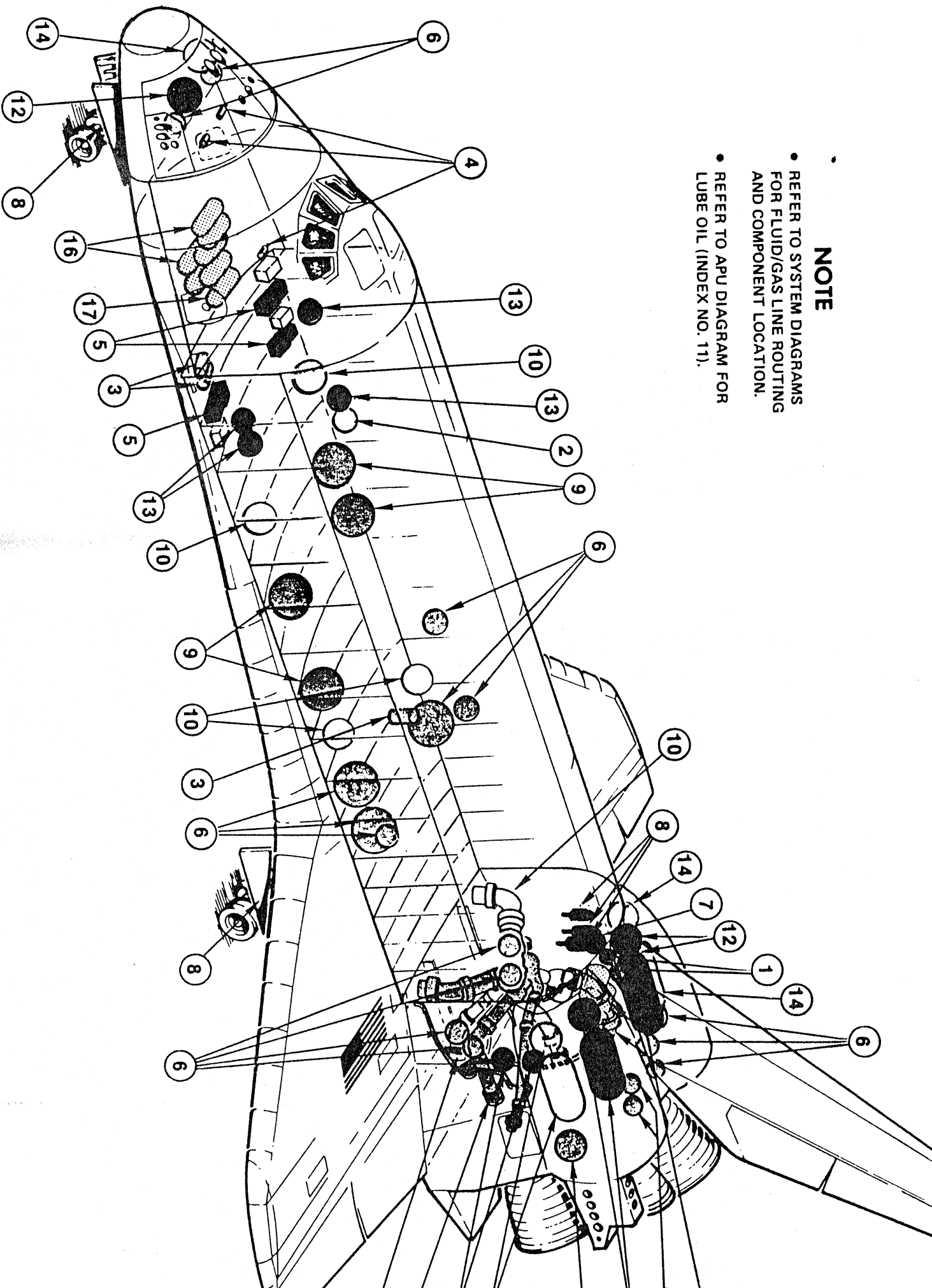
-  WHEEL/TIRE FRAGMENTATION
-  HOT BRAKES/WHEEL
-  AUXILIARY POWER UNIT (APU) EXHAUST PLUMES
-  REACTION CONTROL SUBSYSTEM (RCS) EXHAUST PLUMES
-  EMERGENCY EGRESS WINDOW HAZARD AREA
-  SIDE HATCH JETTISON HAZARD AREA
-  FLUIDS/GASES

## Warning

- THE REACTION CONTROL SUBSYSTEM (RCS) EXHAUST PLUMES IDENTIFY THOSE AREAS THAT SHOULD BE AVOIDED. DO NOT APPROACH THE ORBITER IN-LINE OF ANY THRUSTER EXHAUST. DO NOT STAND IN-LINE WITH OR WITHIN 15.24 m (50 FT) OF THRUSTER LINE.
- THE TRAJECTORY OF THE OUTER EGRESS WINDOW AND SIDE HATCH MAY VARY FROM ENVELOPE SHOWN — DEPENDING ON ATTITUDE OF ORBITER AND WIND CONDITIONS.
- PERSONNEL AND VEHICLES SHOULD STAY OUT OF THE POSSIBLE WHEEL/TIRE FRAGMENTATION AREA FOR 45 MIN. POSTLANDING.
- THE TRAJECTORY OF THE OUTER EGRESS WINDOW MAY VARY FROM ENVELOPE SHOWN DEPENDING ON ATTITUDE OF ORBITER AND WIND CONDITIONS.

# NOTE

- REFER TO SYSTEM DIAGRAMS FOR FLUID/GAS LINE ROUTING AND COMPONENT LOCATION.
- REFER TO APU DIAGRAM FOR LUBE OIL (INDEX NO. 11).



**NOTE**

REFER TO SYSTEM DIAGRAMS  
FOR FLUID/GAS LINE ROUTING  
AND COMPONENT LOCATION.

REFER TO APU DIAGRAM FOR  
LUBE OIL (INDEX NO. 11).

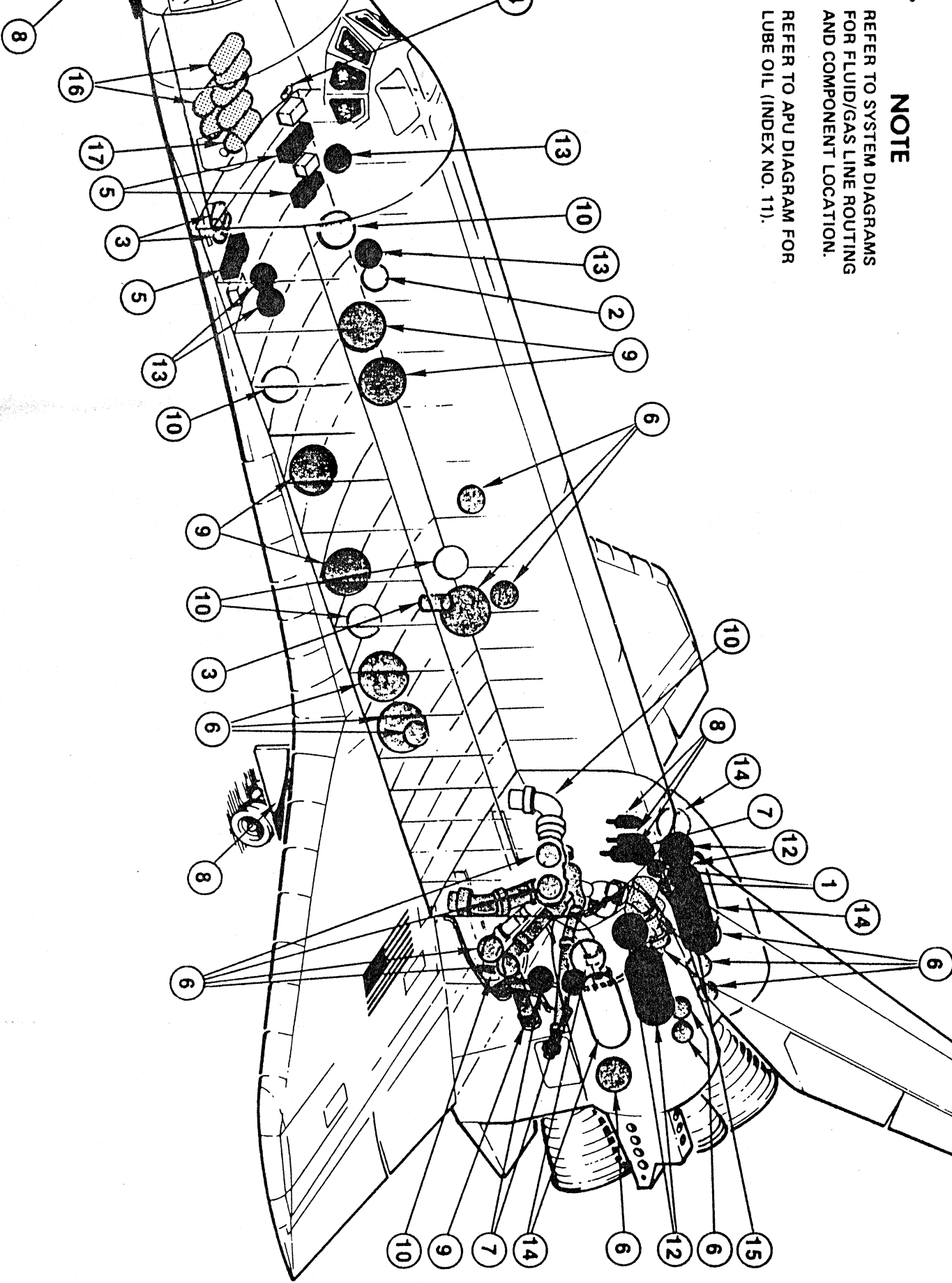


Figure 2-1.- Location of Fluid and Gas Tanks.

ORM-102-031B

6-00000A

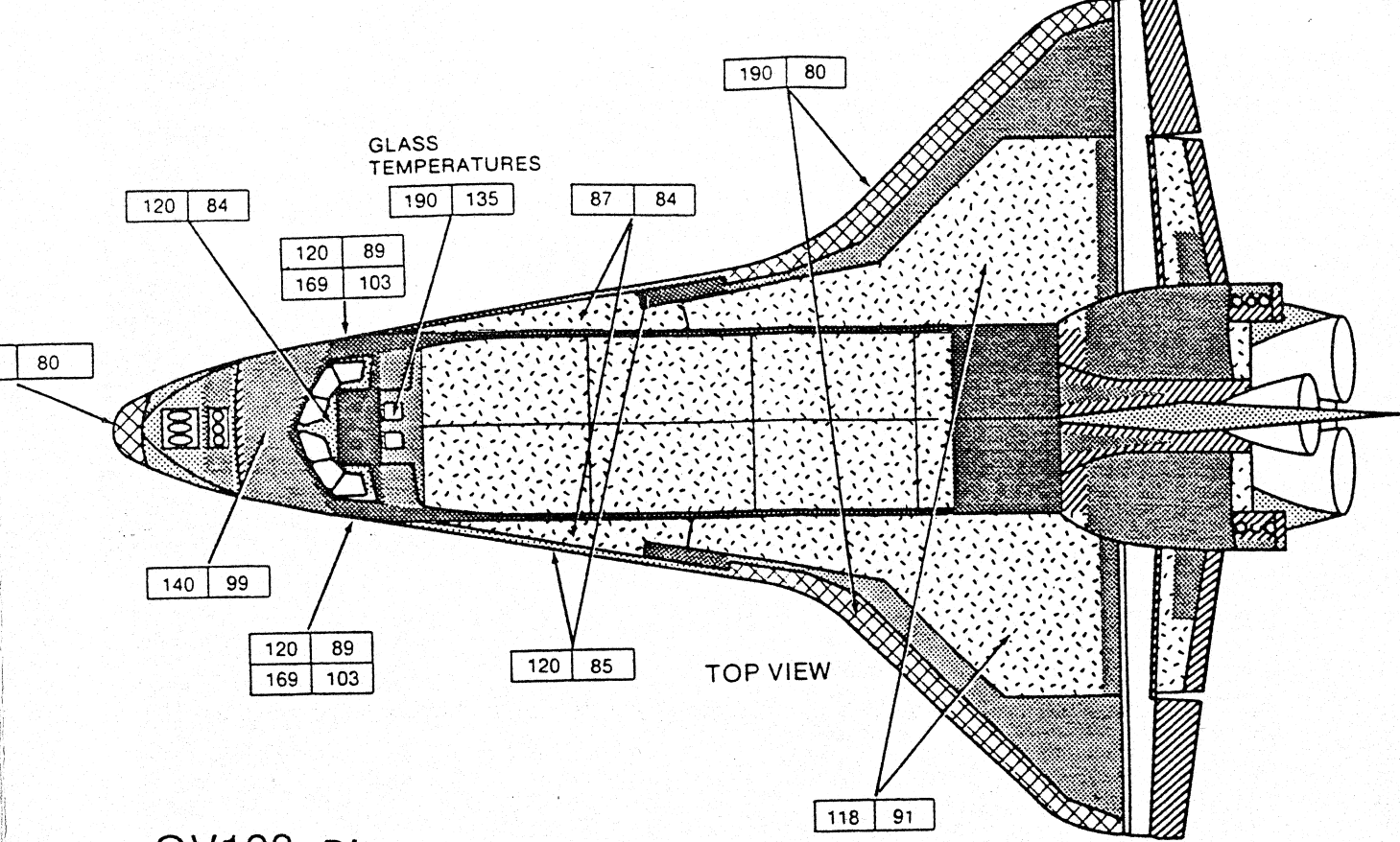
TABLE 2-I.- FLUIDS AND GASES

File number code	Fluid/gas	Specification	Location	System	Approximate total tank capacities kg (lbs)	Lower explosive limit (LEL)	Upper explosive limit (UEL)	Threshold limit value (TLV) ppm	Description (ft <sup>3</sup> , m <sup>3</sup> )
1	Ammonia (NH <sub>3</sub> )	MIL-P-27406	Aft fuselage	ECLSS	44.45 (98)	16 percent	25 percent	50	Two tanks 0.051 (1.8)
2	Breathing oxygen (GO <sub>2</sub> )	MIL-O-27210D amendment 1, type 1	Midfuselage	ECLSS (LSS)	32.21 (71)	(b)	(c)	(c)	One tank 0.134 (4.73) (mission kit only)
3	Freon-21 Dichloromono-fluoromethane (CHCl <sub>2</sub> F)	BB-F-1421A type 21	Mid- and aft fuselage	ECLSS	272.16 (600)	(b)		1000 (TWA)	System
4	Halon 1301 Bromotri-fluoromethane	MIL-M-122188	Crew module fire extinguishers	Fixed	5.17 (11.4)	(b)		1000 (TWA)	Three tanks
				Portable	3.6 (8.4)	(b)		1000 (TWA)	Three bottles
5	Fluorinert FC-40	SE-S-0073 (MB0110-012)	Midfuselage	EPS	35.11 (77)	(b)		(d)	Fuel cell coolant loops
6	Helium (He)	MIL-P-27407 amendment 1	Fwd RCS module	Fwd RCS	3.63 (8)	(b)		(e)	Two tanks 0.049 (1.73)
			OMS/RCS modules	OMS	44.91 (99)				Two tanks 0.490 (17.3)
			Aft RCS	Aft RCS	7.26 (16)				Four tanks 0.049 (1.73)
			Aft fuselage	MPS	22.68 (50)				Four tanks 0.134 (4.73) Two tanks 0.008 (0.29)
			Midfuselage	MPS	77.56 (171)				Three tanks 0.049 (17.3) Three tanks 0.134 (4.73)
7	Hydrazine (N <sub>2</sub> H <sub>4</sub> )	MIL-P-26536C amendment 1	Aft fuselage	APU	476.28 (1050)	4.7 percent	100 percent at 212° F	0.1	Three tanks 0.187 (6.6)
8	Hydraulic fluid	MIL-H-83282A	Fwd, mid- and aft fuselages, and wings	Hydraulic	382.3(f) (101)	204° C (400° F)		(d)	Three systems
			Landing gear struts	Landing gear	13.6 (30)	110° C (230° F)		(d)	Nose & main gear
			Aft fuselage	MPS	160.19 (373)	4 percent	75 percent	(e)	Feedlines &

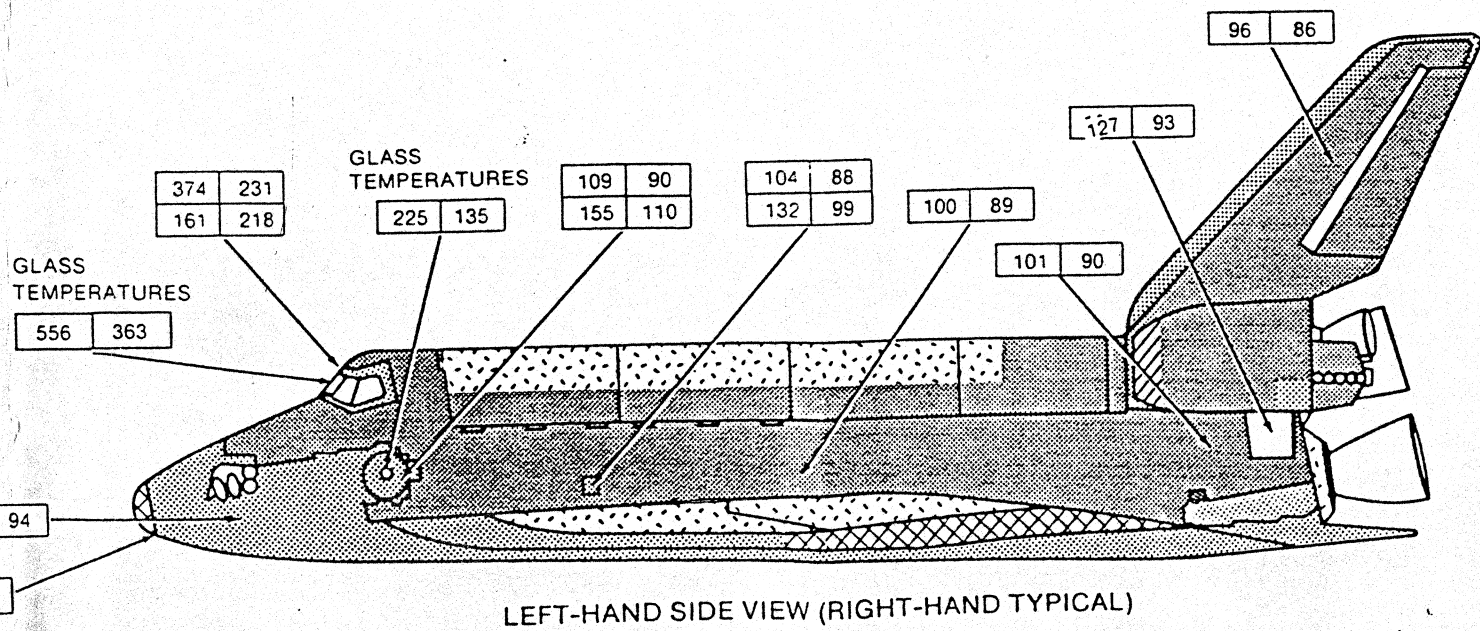


9	Liquid hydrogen (LH <sub>2</sub> )	MIL-P-27201B type II	Aft fuselage	MPS	169.19	(373)	4 percent	75 percent at 68° F	(e)	Feedlines & SSM
		MIL-P-27201C grade A	Midfuselage	EPS	166.92	(368)			(d)	Four tanks 0.606 (21.4)
		type I or II								
10	Liquid oxygen (LO <sub>2</sub> )	MIL-P-25508E type II grade F	Aft fuselage	MPS	2220.8	(4896)			(b)	Feedlines & SSM
		MIL-P-25508E type II grade F	Midfuselage	EPS & LSS	1417.05	(3124)			(c)	Four tanks 0.318 (11.24)
11	Lube oil	MIL-L-23699C	Aft fuselage	APU	8.16	(18)	246° C (475° F)		(d)	Three systems (cooling loops)
12	Monomethyl-hydrazine (CH <sub>3</sub> NHNH <sub>2</sub> )	MIL-P-27404A amendment 2	Fwd RCS module	Fwd RCS	428.2	(944)	2.5 percent	98 percent at 1 atmosphere	0.2	One tank 0.506 (17.88)
			OMS/RCS modules	Aft RCS	872.73	(1924)				Two tanks 0.506 (17.88)
				OMS	4297.86	(9475)				Two tanks 2.547 (90)
13	Nitrogen (N <sub>2</sub> )	MIL-P-27401C grade B	Midfuselage	ECLSS	103.42	(228)			(e)	Four tanks 0.134 (4.73)
14	Nitrogen tetroxide (N <sub>2</sub> O <sub>4</sub> )	MIL-P-26539C amendment 2	Fwd RCS module	Fwd RCS	692.19	(1526)			2.5	One tank 0.506 (17.88)
			OMS/RCS modules	Aft RCS	1403.44	(3094)				Two tanks 0.506 (17.88)
				OMS	7071.17	(15589)				Two tanks 2.547 (90)
15	Water (deionized)	JSC-SPEC-C-20	Crew module	ECLSS	60.33	(133)			None	Two cooling loops
			Aft fuselage	Hydraulic	192.33	(424)				Three tanks 4.002 (141.4)
					6.8	(15)				Three water spray boilers
16	Water (potable and waste)		Lower equipment bay, crew module	LSS	381.0	(840)			None	Five tanks 0.761 (2.69)

(Measurement in liters (gallons) for hydraulic fluid



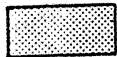
OV103 *Discovery*  
and  
OV104 *Atlantis*



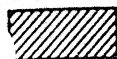
(b) OV103 *Discovery* and OV104 *Atlantis*.



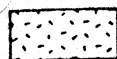
RCC — REINFORCED CARBON-CARBON



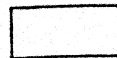
HRSI — HIGH-TEMPERATURE REUSABLE SURFACE INSULATION



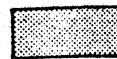
LRSI — LOW-TEMPERATURE REUSABLE SURFACE INSULATION



FRSI — FRSI-NOMEX FELT REUSABLE SURFACE INSULATION



METAL OR GLASS



FI — FLEXIBLE INSULATION

# Caution

IF EGRESS WINDOW RESCUE IS REQUIRED, THERMAL BLANKETS SHOULD BE USED TO PREVENT INJURY TO RESCUE PERSONNEL.

# Note

- REFER TO SECTION 2 FOR GENERAL DETAILS AND SPECIFIC THICKNESS DATA RELATED TO PRESELECTED PENETRATION AND CUT-IN AREAS.
- POST-TOUCHDOWN TEMPERATURES OF THE ORBITER ARE INDICATED IN DEGREES FAHRENHEIT IN THE FOLLOWING MANNER.

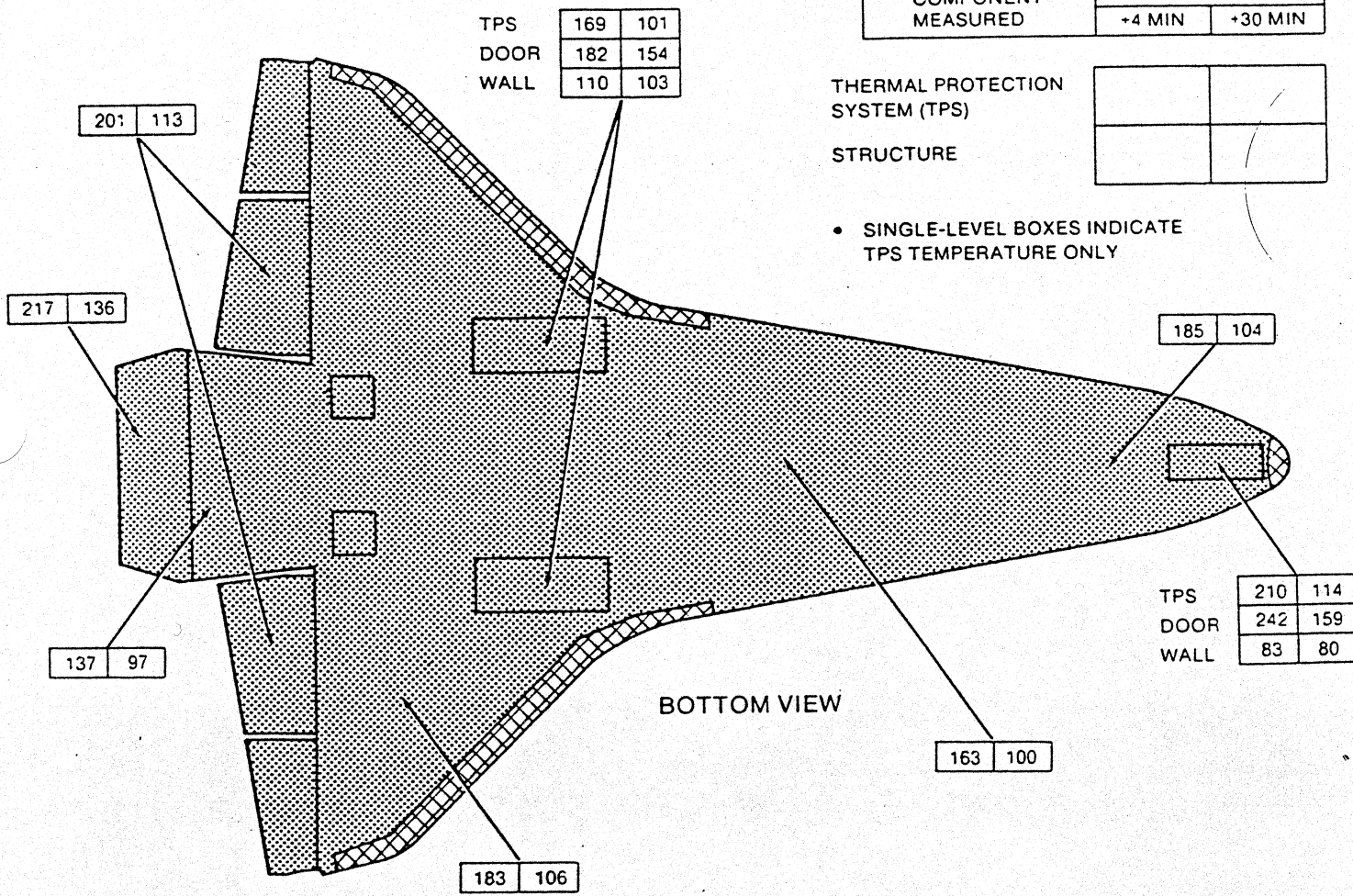
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COMPONENT MEASURED	TOUCHDOWN	
	+4 MIN	+30 MIN

THERMAL PROTECTION SYSTEM (TPS)


STRUCTURE

- SINGLE-LEVEL BOXES INDICATE TPS TEMPERATURE ONLY



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335 201