ORBITAL MANEUVERING VEHICLE TELEOPERATION AND VIDEO DATA COMPRESSION

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ABSTRACT

This presentation describes the Orbital Maneuvering Vehicle (OMV) and concepts of teleoperation and video data compression as applied to OMV design and operation.

The OMV provides spacecraft delivery, retrieval, reboost, deboost and viewing services, with ground-control or Space Station operation, through autonomous navigation and pilot controlled maneuvers. The Flight Vehicle (FH) includes a payload/target grapple fixture and a three-point attach mechanism for spacecraft servicing. On-board propulsion is provided by control system (RCS) thrusters, and a cold-gas thruster system. The capability is provided for automatic, on-board attitude control and navigation functions. Communications systems are comprised of S-band RF command, telemetry, and compressed video data links through the TDRSS and GSTDN networks.

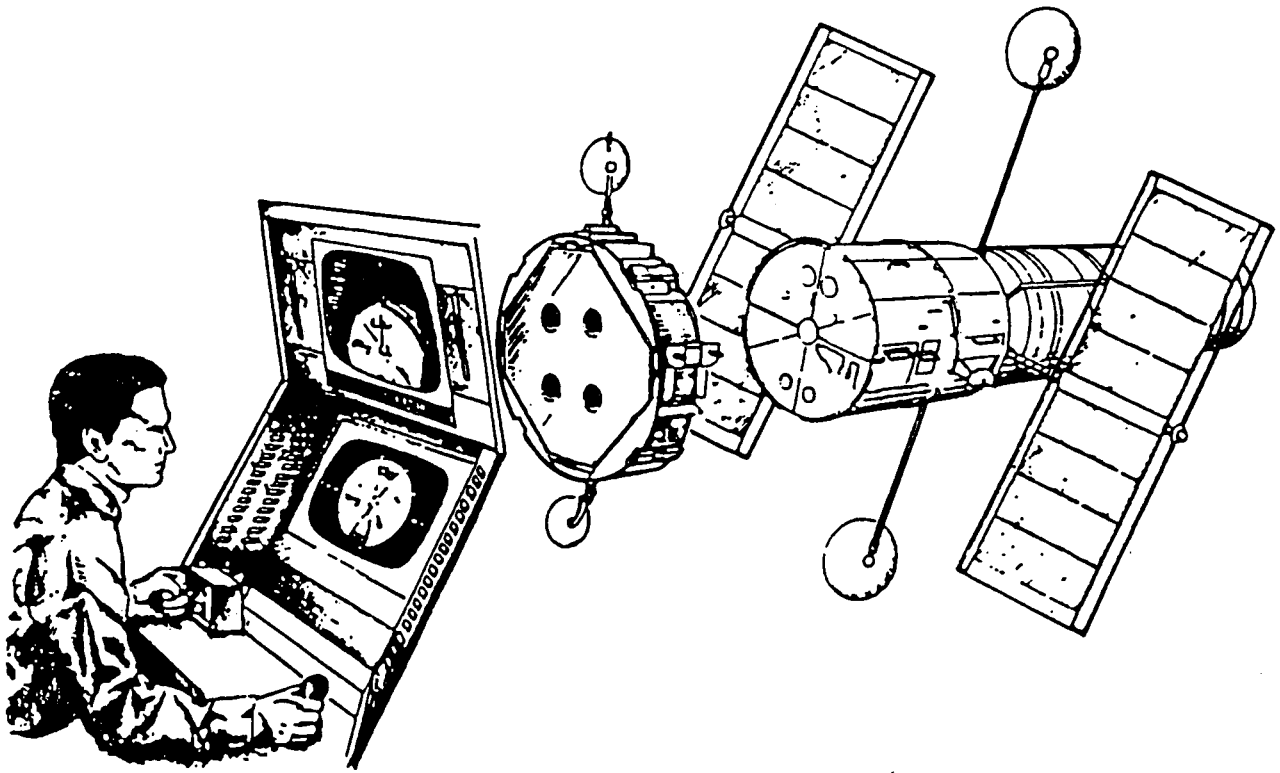
For target viewing and/or docking missions, the OMV navigates autonomously to the vicinity of the target vehicle. The pilot then assumes control of the FV for final maneuvers by observing control-console video monitors and commanding on-board thrusters, through the use of hand controllers at the console. The commands are routed to the FV through TDRSS (or GSTDN), and compressed video (from on-board cameras) is returned through the same network to the pilot. The total round-trip delay time is presently estimated to be 2-3 seconds.

The control console video monitors display a monochrome image at an update rate of five frames per second. Depending upon the mode of operation selected by the pilot, the video resolution is either 255 x

244 pixels, or 510 x 244 pixels. The system compresses the output of one camera into a digital data stream at a rate of 972 kbps (kilobits per second), or can interleave two camera outputs simultaneously into one data stream at 486 kbps per camera.

Since practically all video image redundancy is removed by the compression process, the video reconstruction is particularly sensitive to data transmission bit errors. Concatenated Reed-Solomon and convolution coding are used with helical data interleaving for error detection and correction, and an error-containment process minimizes the propagation of error effects throughout the video image. Video sub-frame replacement (using the appropriate sub-frame in the previous video frame) is used, in the case of a non-correctable error or error burst, to minimize the visual impact to the pilot.

ORBITAL MANEUVERING VEHICLE



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OMV REQUIREMENTS SUMMARY

- PROVIDE SPACECRAFT DELIVERY, RETRIEVAL, REBOOST, DEBOOST, AND VIEWING
- SHUTTLE BASED, (ETR & WTR), GROUND CONTROLLED
- SPACE STATION BASED, GROUND AND STATION CONTROL
- AUTOMATIC NAVIGATION & RENDEZVOUS
- MAN IN THE LOOP CONTROL FOR FINAL OPERATIONS
- LOW "G" TRAJECTORY WITH CONTINGENCY RETURNS
- PROVIDE LIMITED RESOURCES TO PAYLOADS
- END EFFECTOR AND 3-PT DOCKING SYSTEMS
- ACCOMMODATE VARIOUS MISSION KITS
- COLD GAS RCS FOR PROXIMITY OPERATIONS
- NINE MONTHS ON-ORBIT (SELF-CONTAINED STORAGE)
- CAPABLE OF ON-ORBIT MAINTENANCE
- TEN YEAR LIFE WITH REFURBISHMENT

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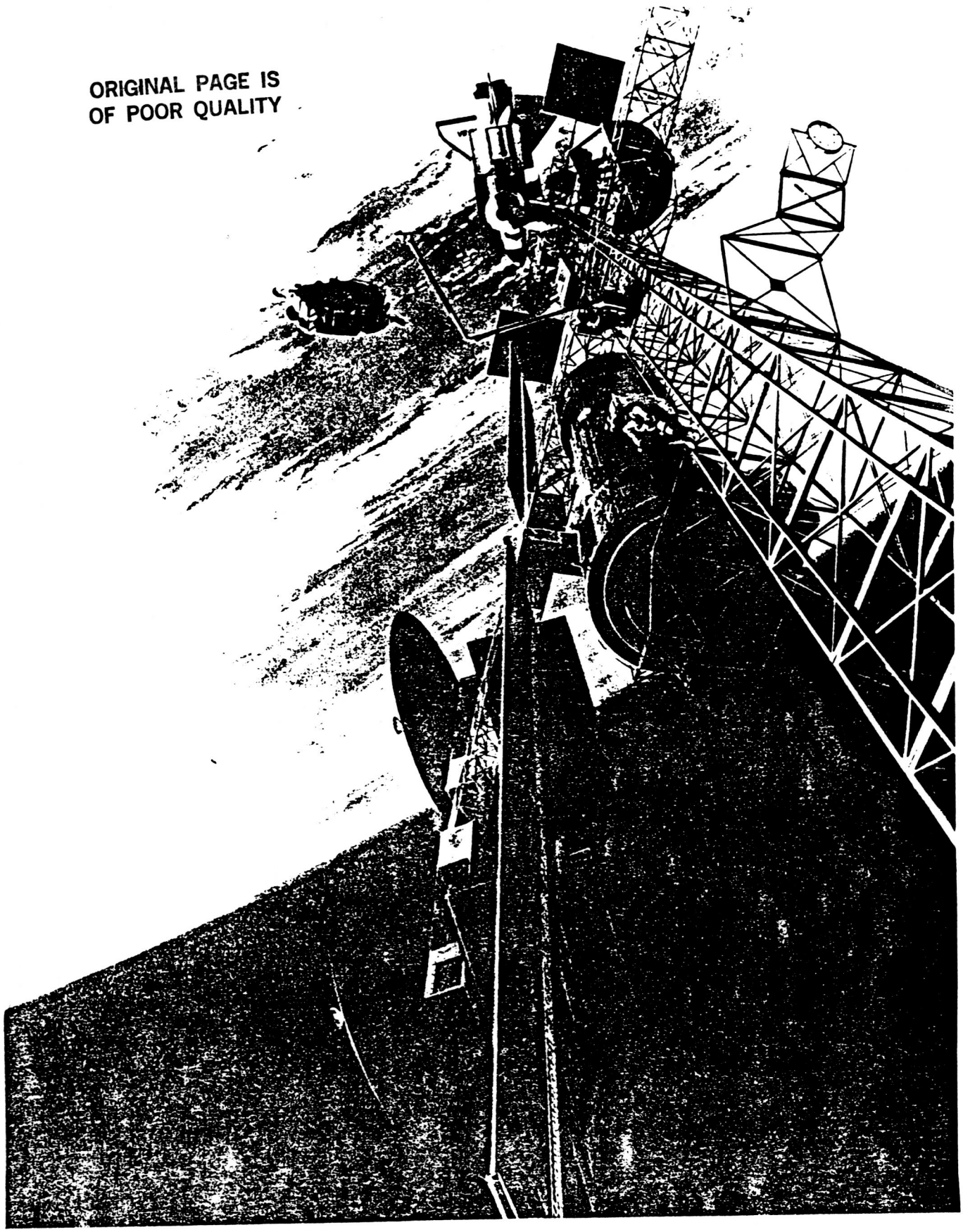
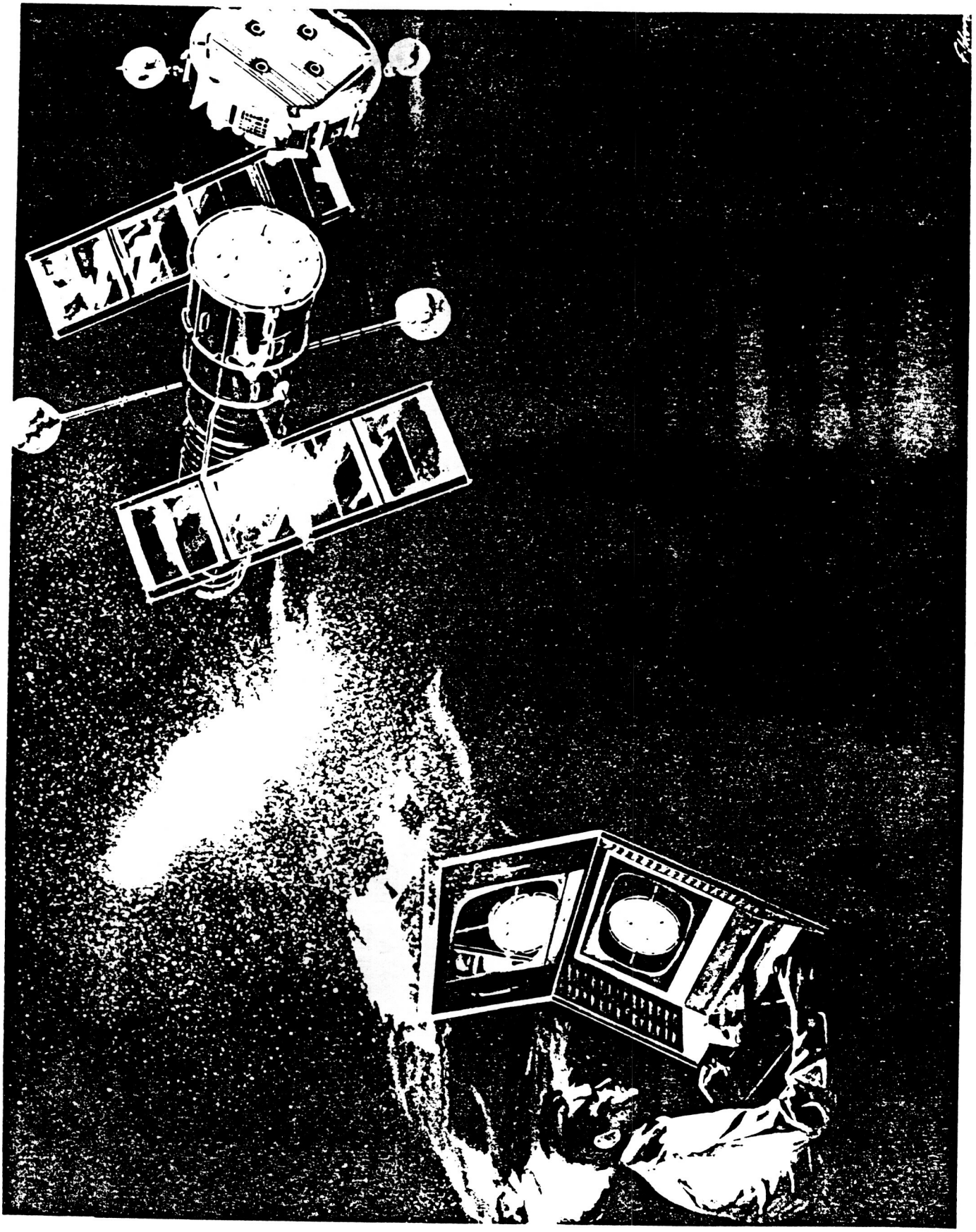
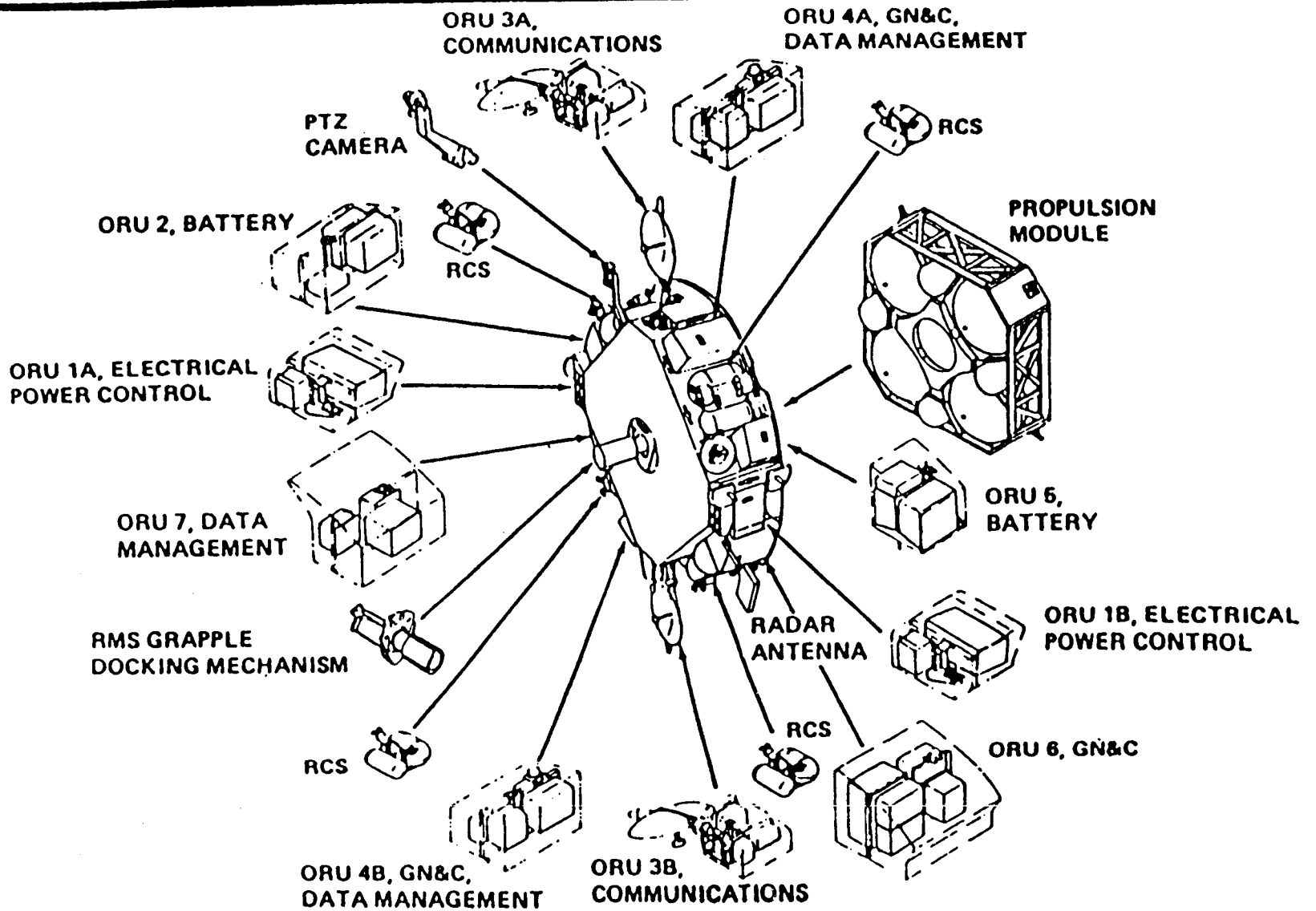
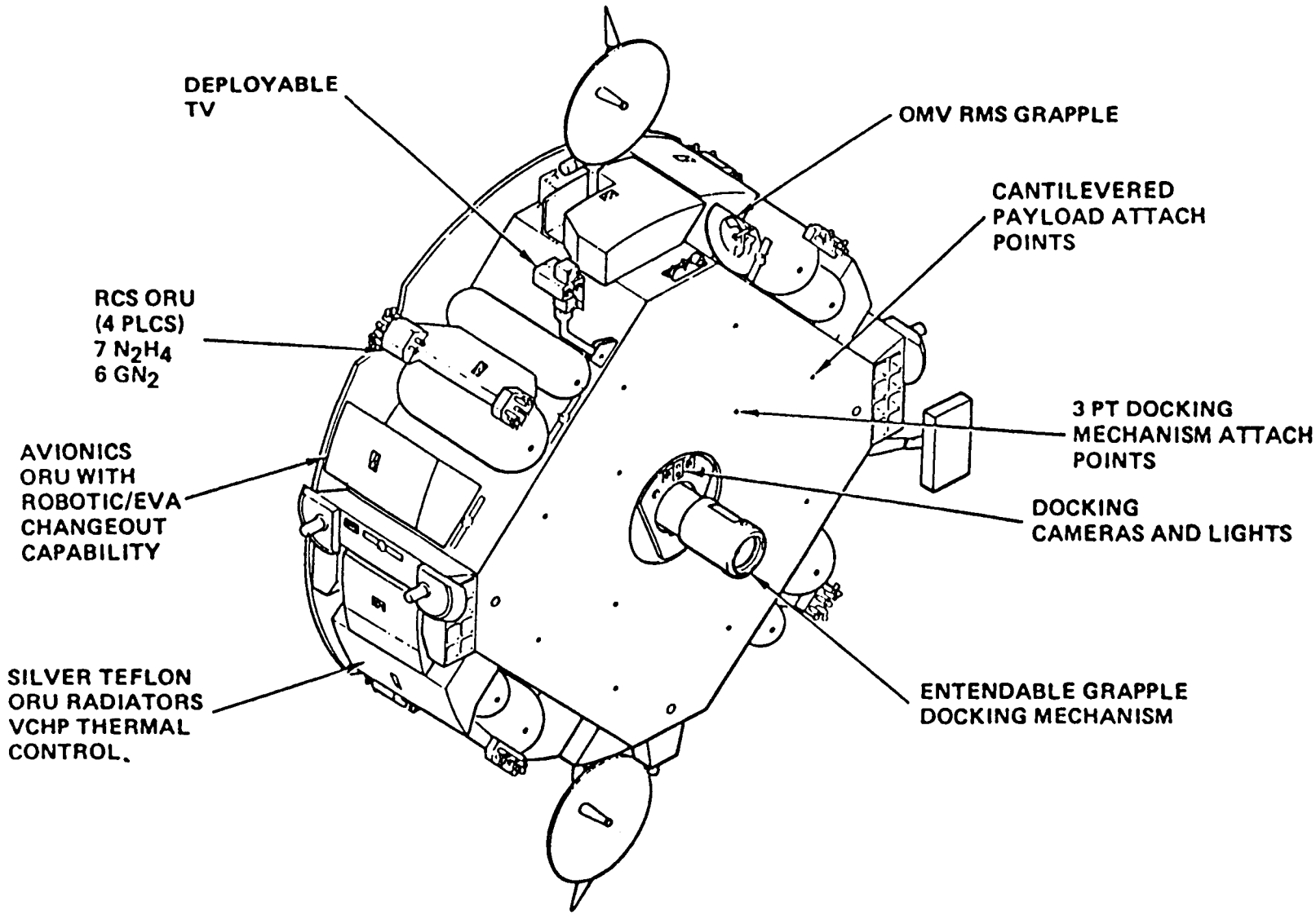




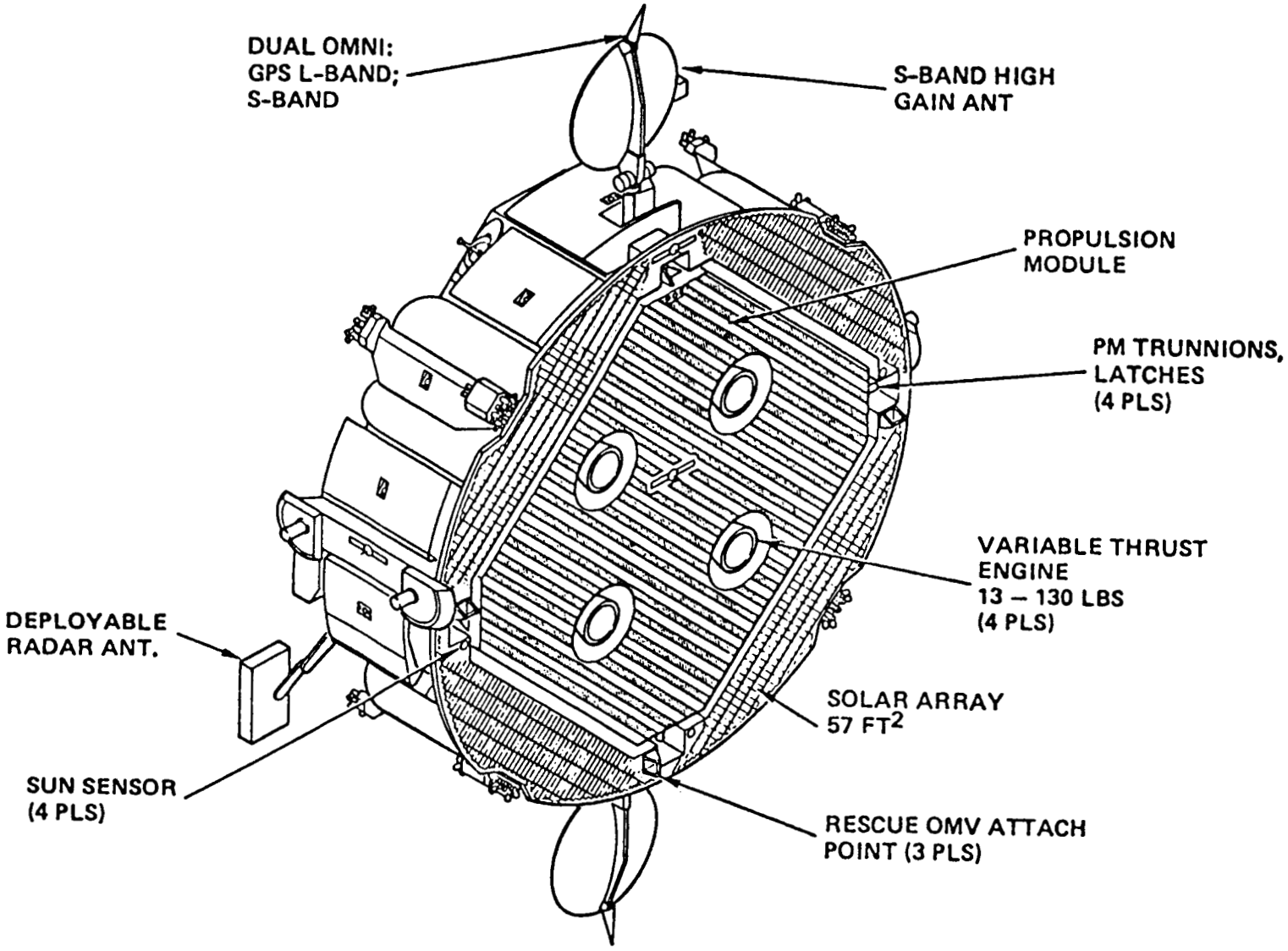
Fully Modular Design and Orbital Replacement Units (ORU's) Enable on Orbit Maintenance

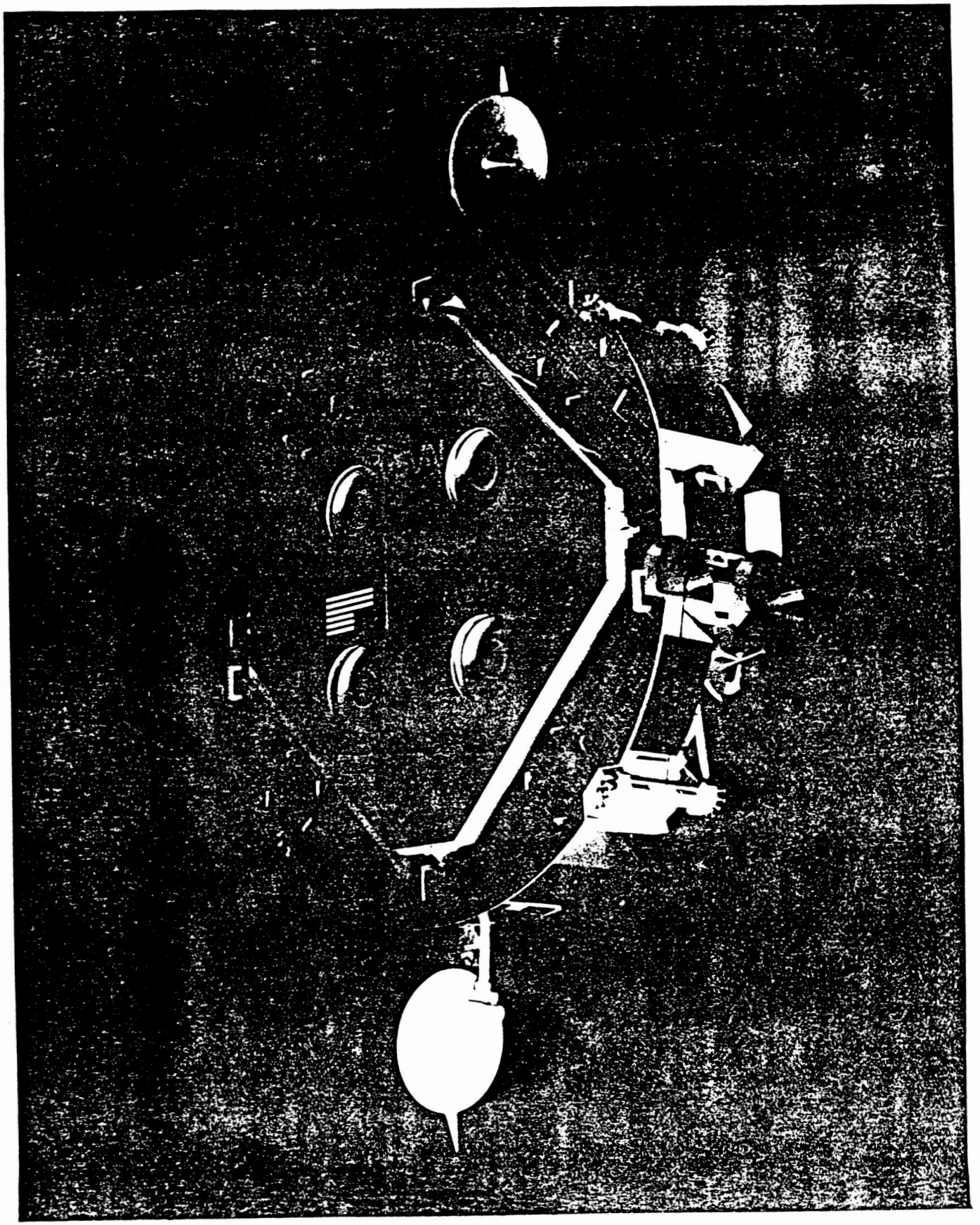


Vehicle – Front Side



Vehicle – Back Side





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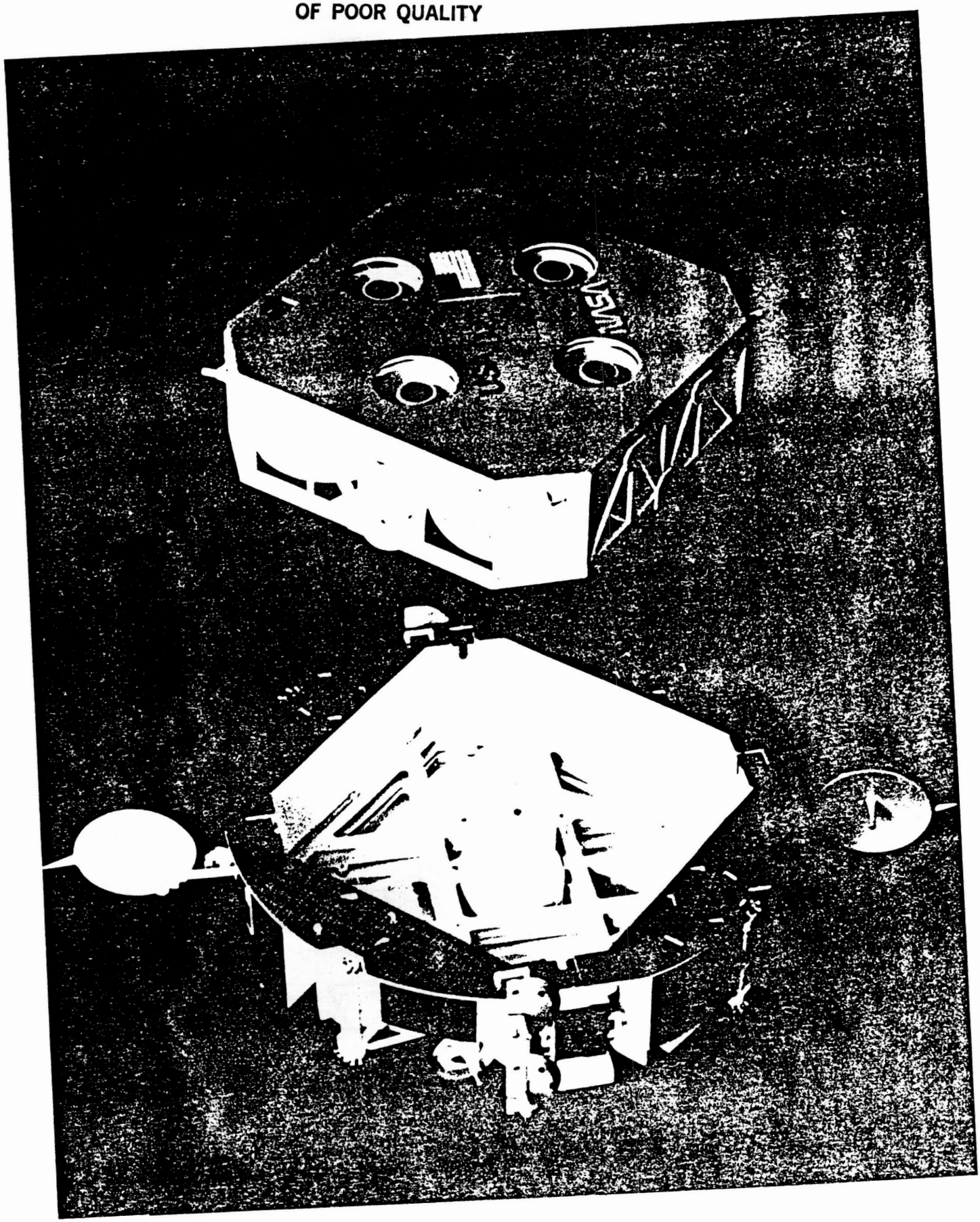
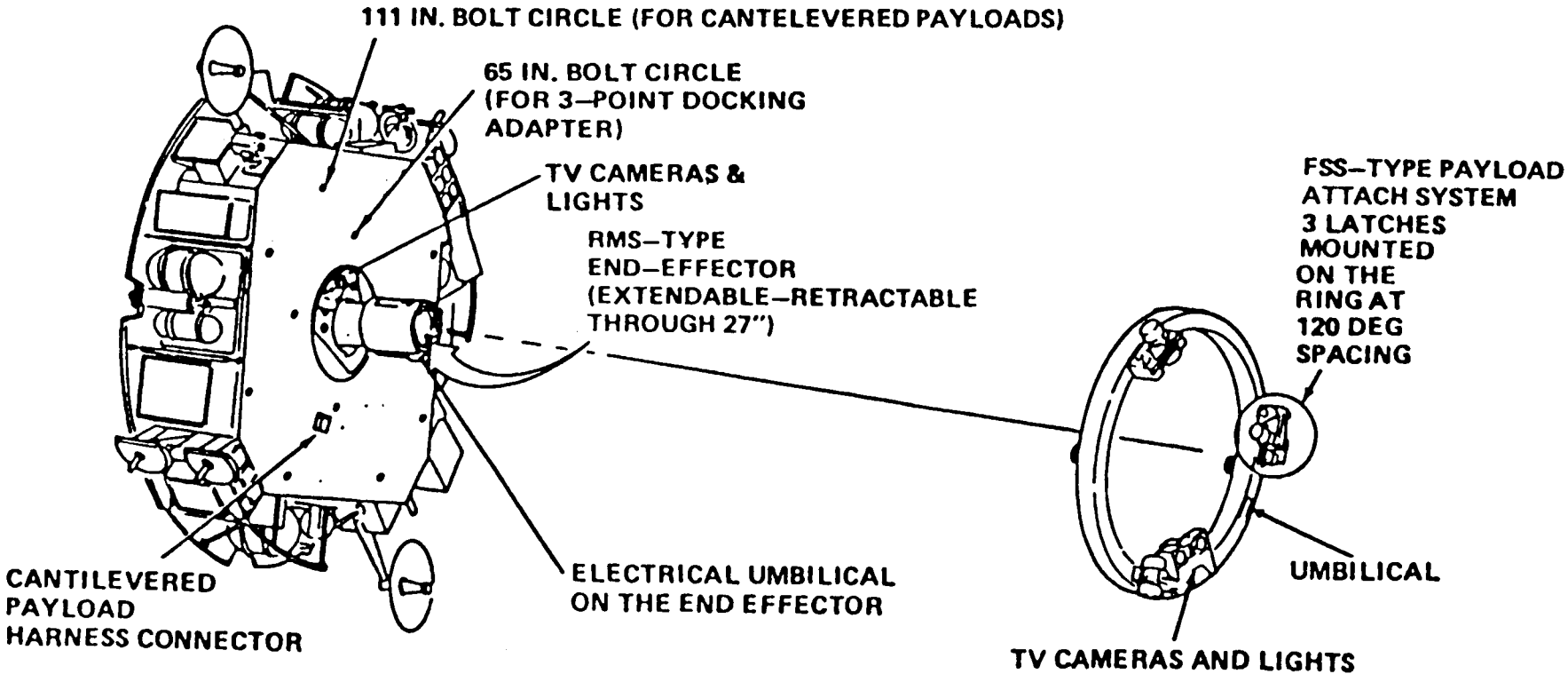
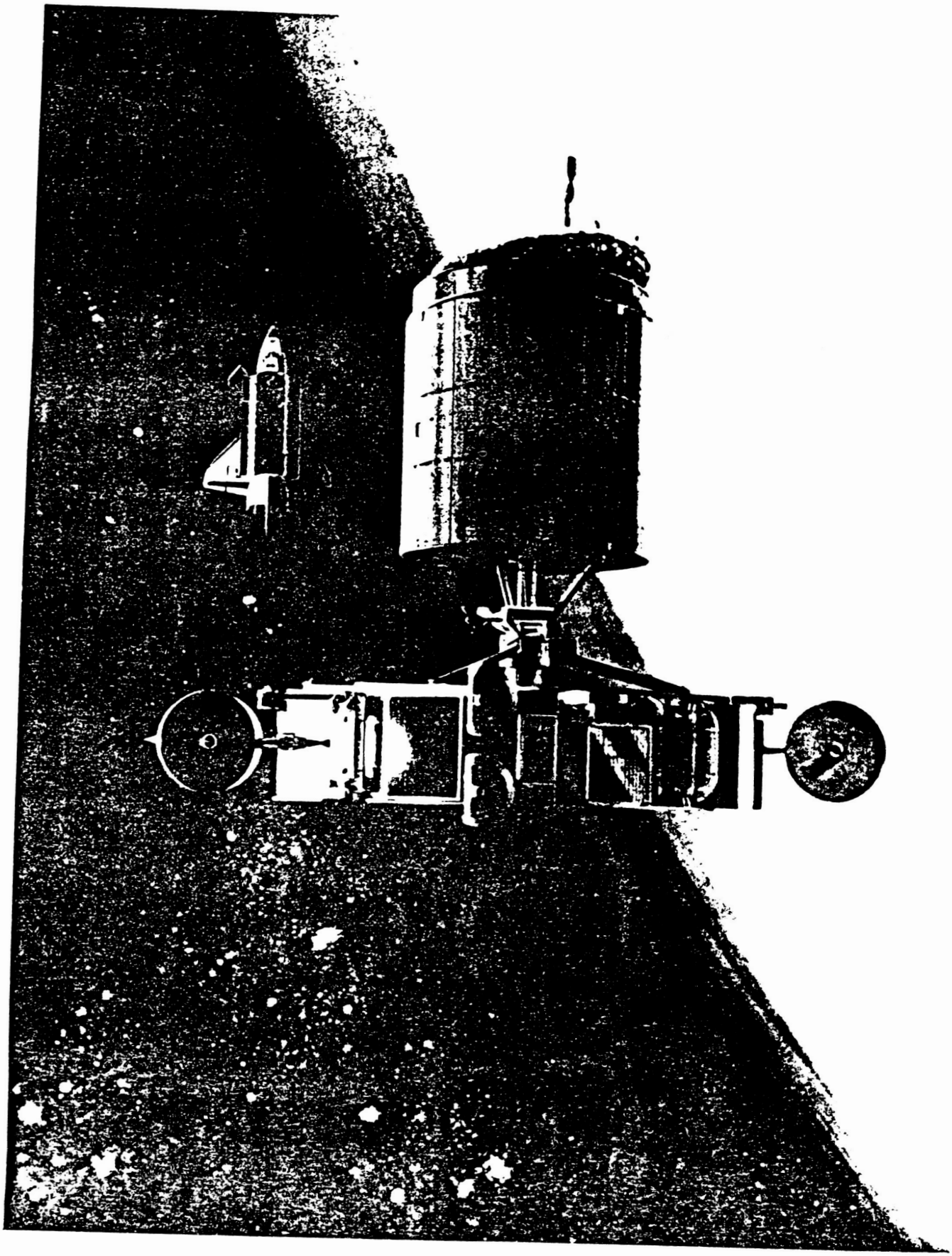


PAYLOAD DOCKING PROVISIONS

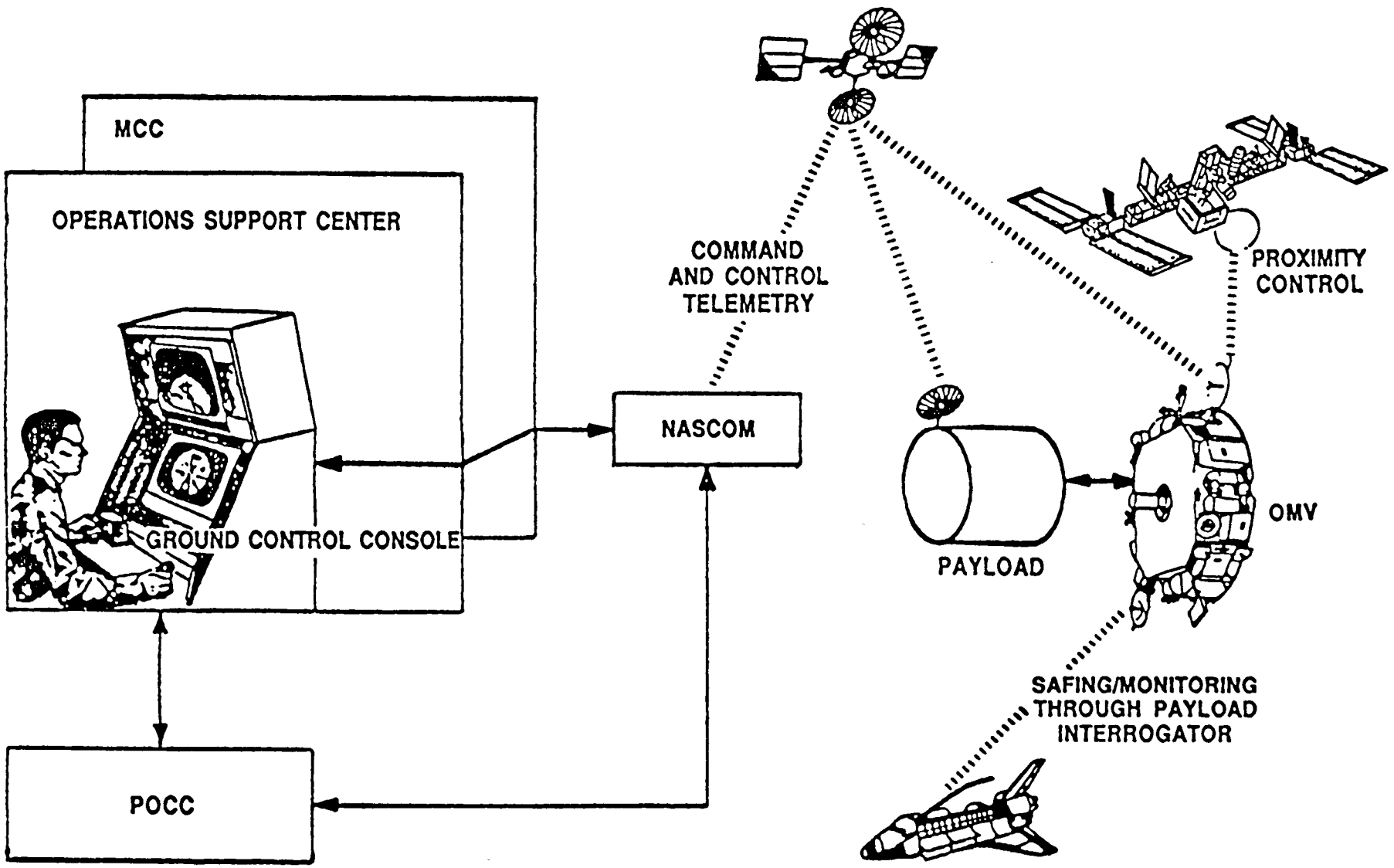


DESIGN CHARACTERISTICS

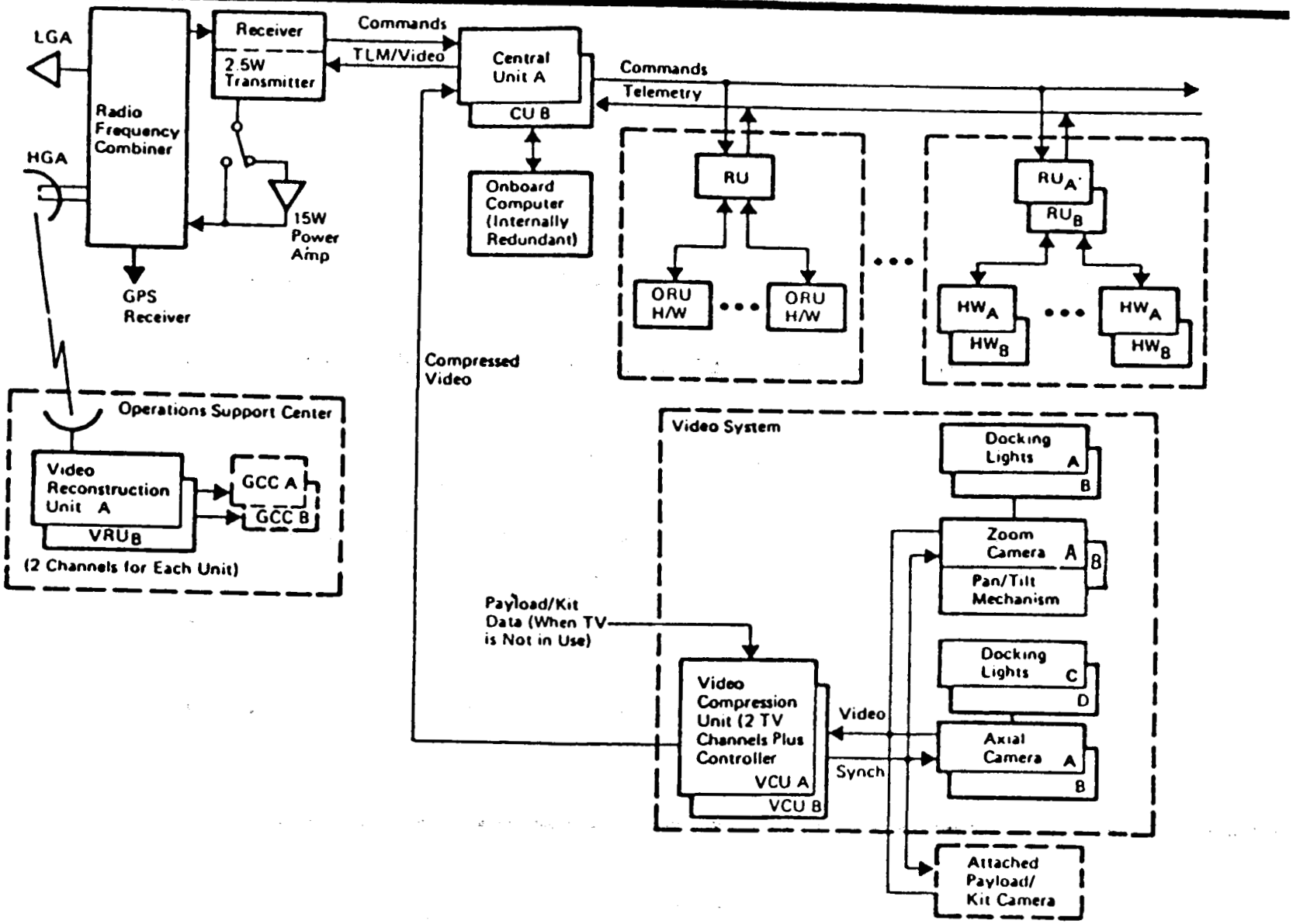
Width		71 inches	
Diameter		176 inches (14'8")	
Weight Summary (pounds)	**OMV**	**PM**	**SRV**
Empty (with RGDM)	7340	2125	5215
Burnout (with max. residuals)	7720	2405	5315
Mission Weight			
Minimum	11065	4405	6660
Full	18065	11405	6660
Max. Propellant (Bipropellant/Monopropellant/GN_2)	9000/1180/165	9000	1180/165



OMV OPERATIONAL COMMUNICATIONS



C&DM SUBSYSTEM



OMV VIDEO COMPRESSION

- COMPRESSED DATA DOWNLINK RATE = 972 KBPS
- MULTIMODE OPERATION
  - TWO CAMERA OUTPUTS INTERLEAVED INTO DATA STREAM
    VIDEO RESOLUTION: 255 X 244 PIXELS (EACH CAMERA)
  - SINGLE CAMERA OUTPUT
    510 X 244 PIXELS VIDEO RESOLUTION
- ON-BOARD TIMING DATA INTERLEAVED INTO DOWNLINK
- RECONSTRUCTED VIDEO IMAGE UPDATED AT 5 FRAMES/SECOND
- ERROR DETECTION/CORRECTION
  - REED - SOLOMON CODING/HELICAL INTERLEAVING
  - CONVOLUTIONAL ENCODING
  - ERROR CONTAINMENT THROUGH VIDEO SUB-FRAME REPLACEMENT