Anomaly Resolution in the International Space Station

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Post Flight 2A Status

- Deferred maintenance items
  - Equipment upgrades
    - MIRT's
    - 3-way valves
  - Anomalies
    - ECOMM
    - Smoke detectors
    - MDM's
    - FGB air temperatures

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Groundrules

- Fault detection, isolation & recovery.
  - Primarily automated throughout the system, when the system is complete.
  - Until assembly is complete, redundancy is not always available.
- Manual fault isolation for maintenance.
  - When a redundant string is dead, isolation is manual and based on last telemetry available.

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Anomaly Resolution

- Potential Participants
  - Mission Evaluation Room (MER)
  - Engineering Support Rooms (ESR)
  - Engineering Support Centers (ESC)
  - Mission Control Center-Moscow (MCC-M)
  - Mission Control Center-Europe (MCC-E)
  - Mission Control Center-Houston (MCC-H)

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ECOMM Anomaly

The Early Communications Sub-system showed anomalous operation well after the crew had departed the station.

At first, the GN&C sustaining engineers identified the anomaly as possible antenna obscuration. Tests proved this was probably not the case, but the port side was suspect.

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Anomaly Resolution

Option 2 came from the EPS subsystem engineers (PHALCON). They believed that the failure involved a shorted circuit or damaged cable in the Radio Frequency Power Distribution Box (RFPDB).

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Anomaly Resolution

The Logistics & Maintenance MER Team informed the Increment Zero Flight Control Team that there had been no spares planned for the sub-system, because mission planners had only planned to use the ECOMM system once every two weeks, not continual operation for six months. The L&M Team had identified the lack of spares in 1997, as part of the Assembly Critical Failures Study, and recommended that qualification units be upgraded for flight. L&M presented a plan for resolution.

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L&M Plan

- Use source data provided during LSA
- Develop Manual Fault Isolation procedure based on last available telemetry
- Ensure qualification flight article for flight certification/qualification
- Manifest based on ambiguity group identified during MFI

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Case for Obscuration

- Current Station (Zarya-Unity combination) travels in an x-nadir spin
- Antenna is switched from port to starboard based on the spin rate
- The majority of the time, anomalous transmission and reception happened when the port antenna was supposed to be operating

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Case for Electrical Short

- Not all cases of anomalous behavior occurred on the port side antenna operation time
- A cable from the RFPDB to the antenna might have an intermittent short which would interrupt transmission/reception randomly
- During flight 2A, there were loose parts (a wedge, washer and bolt from the rack hardware) which might be the cause of a short

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Manual Fault Isolation

- Using FDIR data sheets provided by the manufacturer, an ambiguity group of two components and a cable was identified
- A logical flowchart was developed showing tests and decision points
- A procedure was developed to isolate the fault within the ambiguity group of 3

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Flight 2A.1

- The procedures were added to the crew timeline on ST-96/Flight 2A.1
- The tests were run, using the flowchart for Manual Fault Isolation
- A manual switch in the RFPDB was identified as being faulty, so the RFPDB was removed and replaced

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STS-96 / Flight 2A.1

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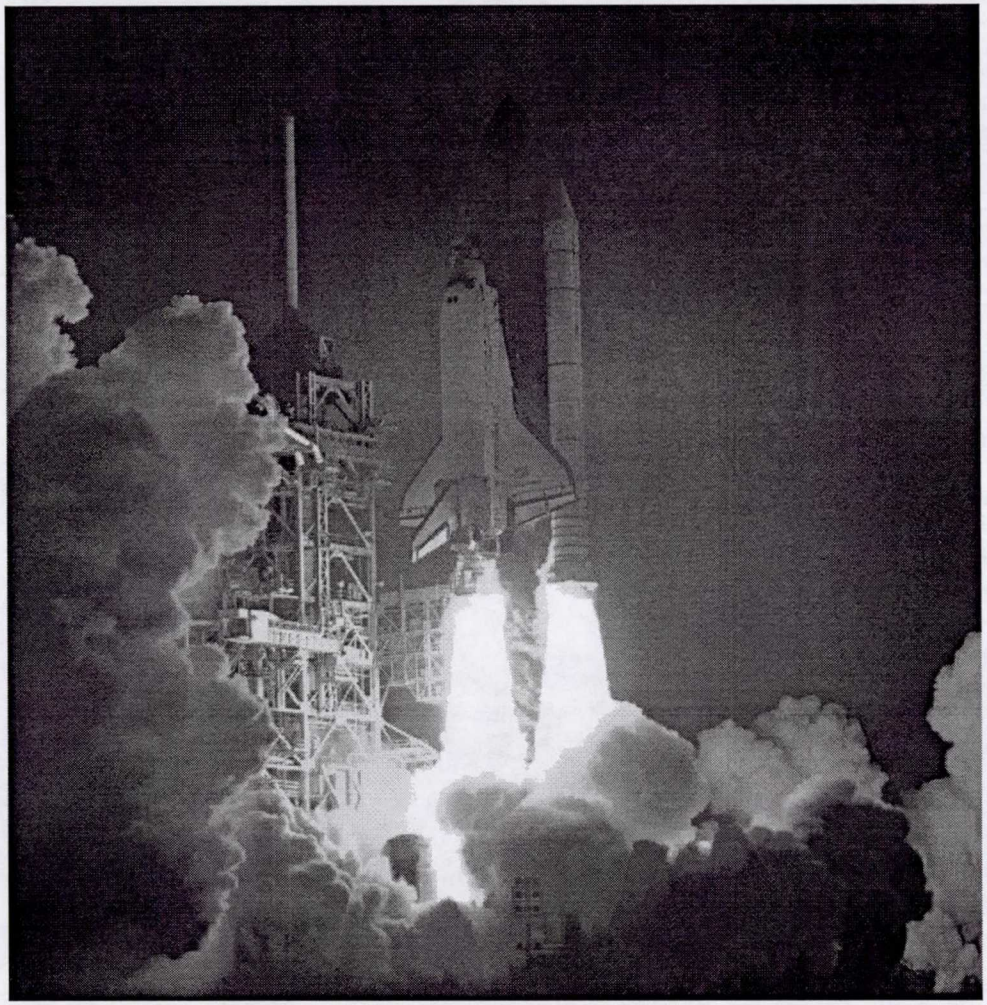

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Radio Frequency Power Distribution Box (RFPDB)-Note wiring connections.

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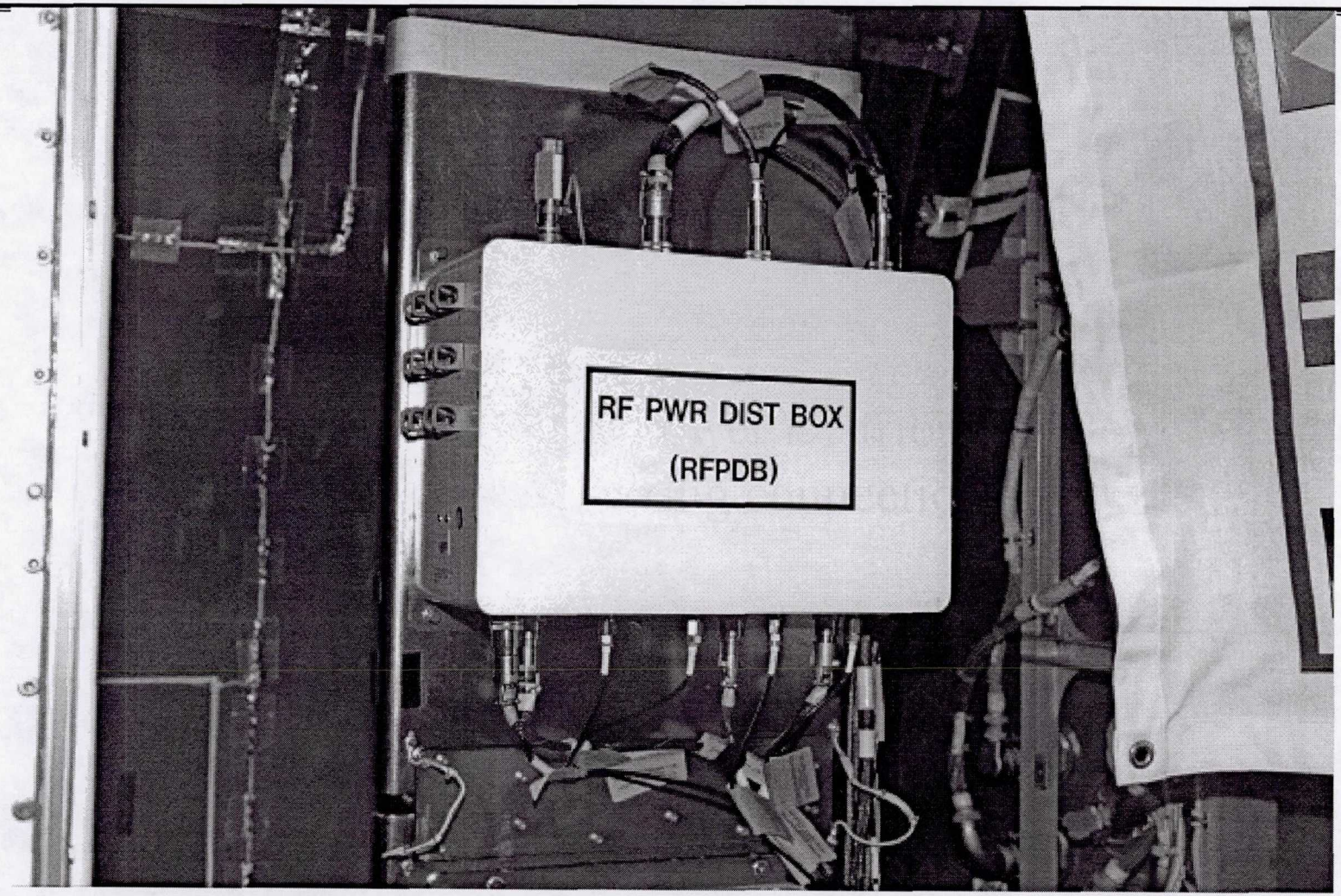

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ECOMM wiring pass-through in hatch.

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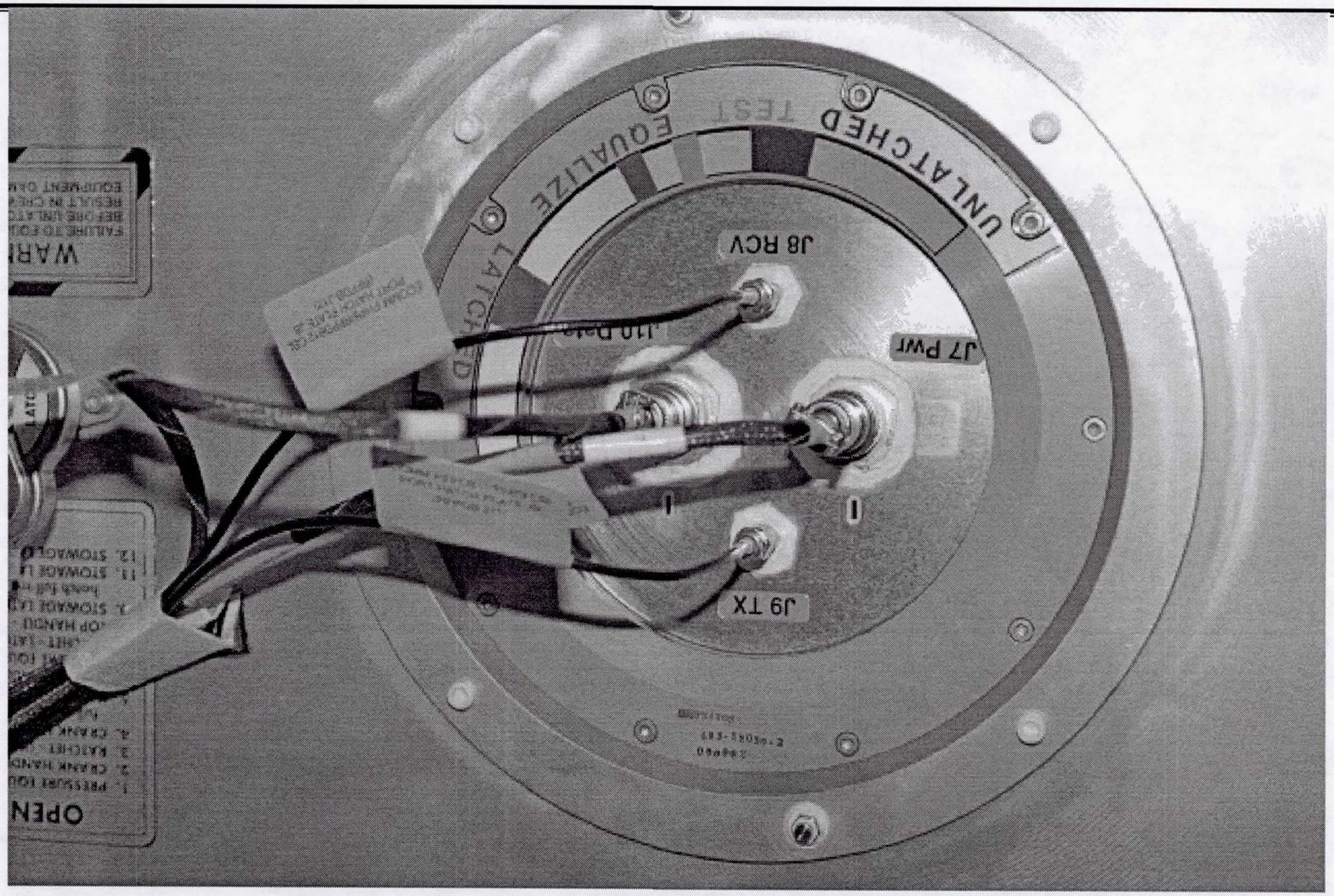

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ECOMM wiring run to portside.

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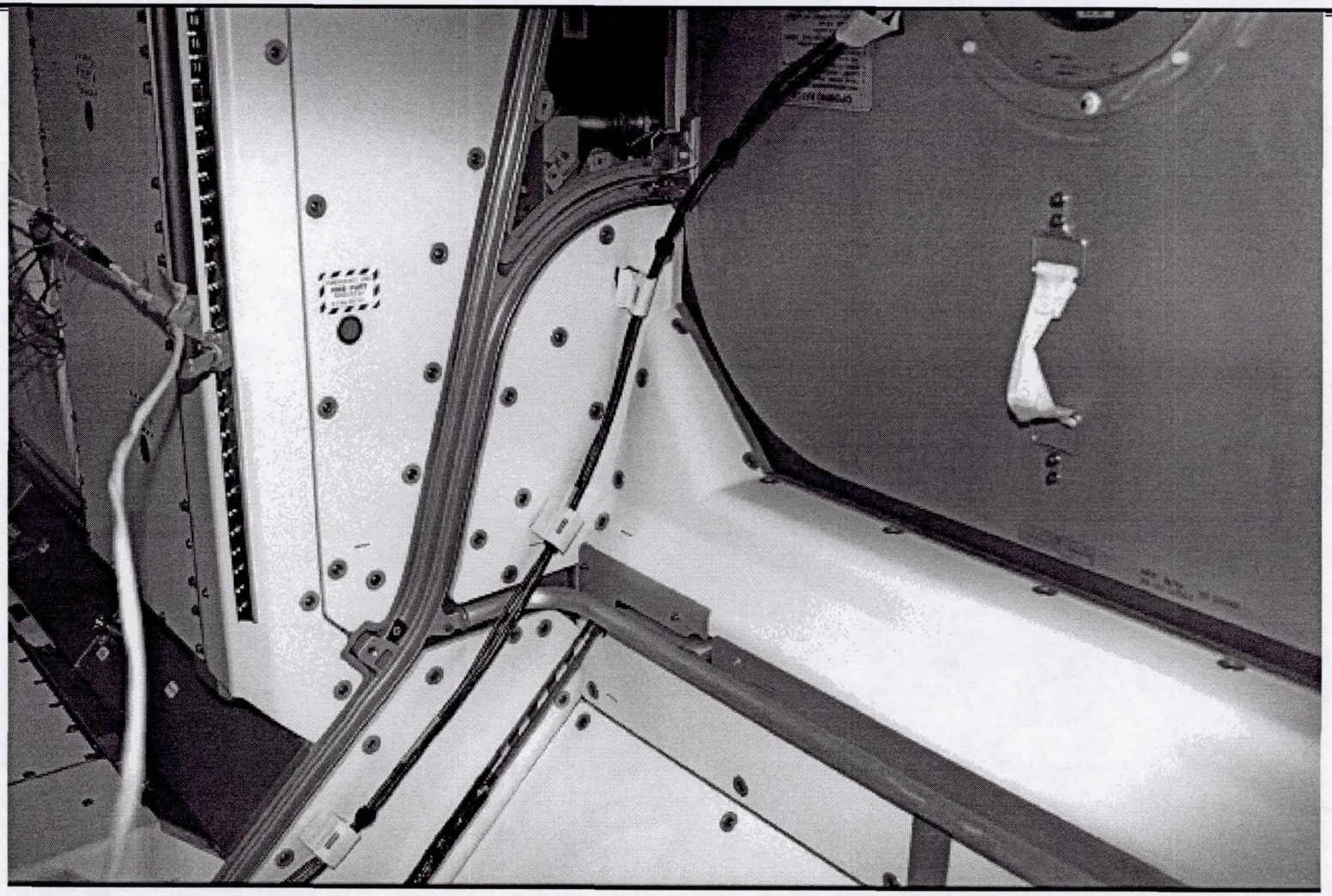

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ECOMM wiring run to port side

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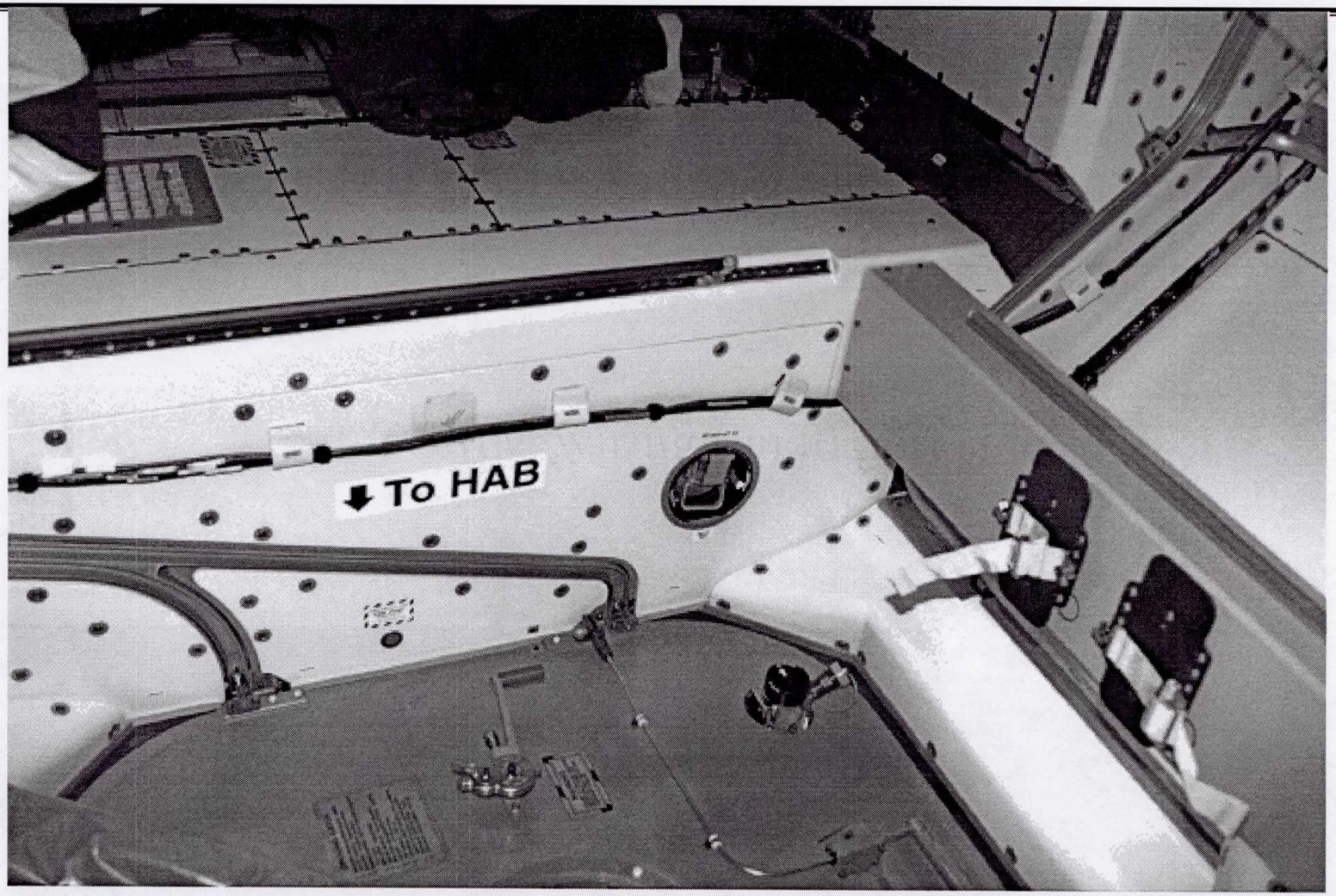

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STS-88 Crew inspects ECOMM wiring on installation of the system.

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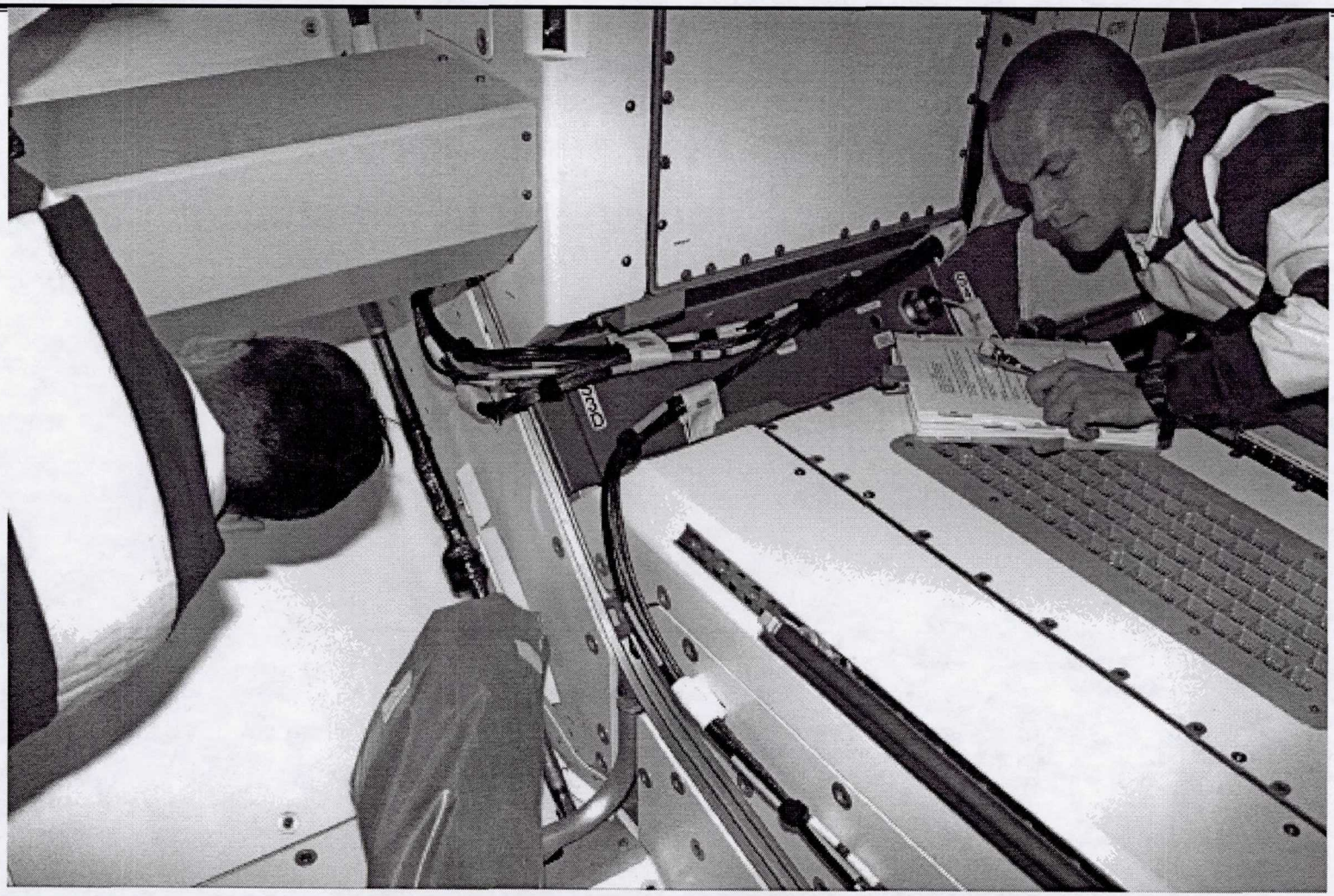

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Portcom Transceiver (XCVR)

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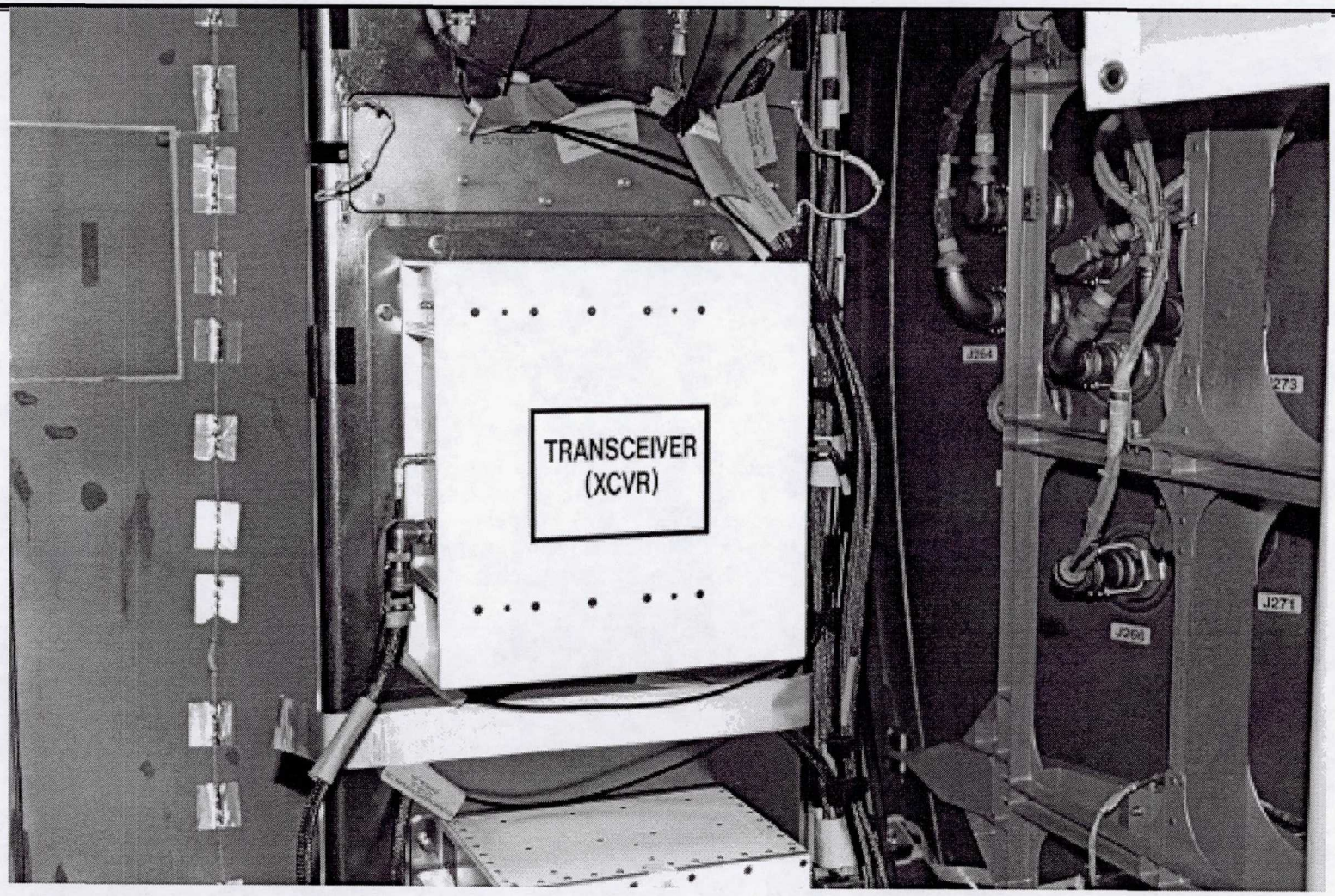

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Command & Telemetry Processor (CTP)

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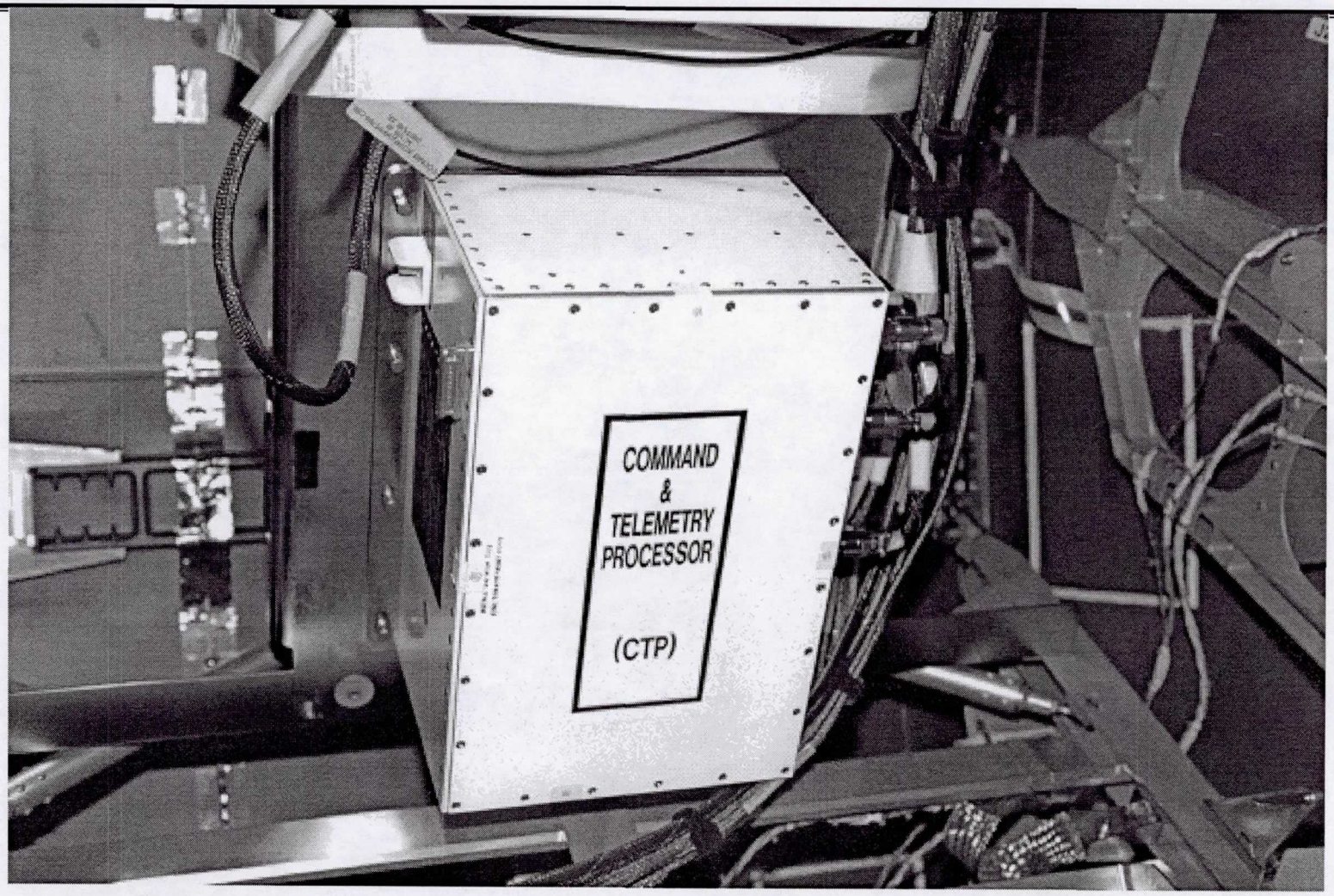

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ECOMM port/starboard antenna wiring split

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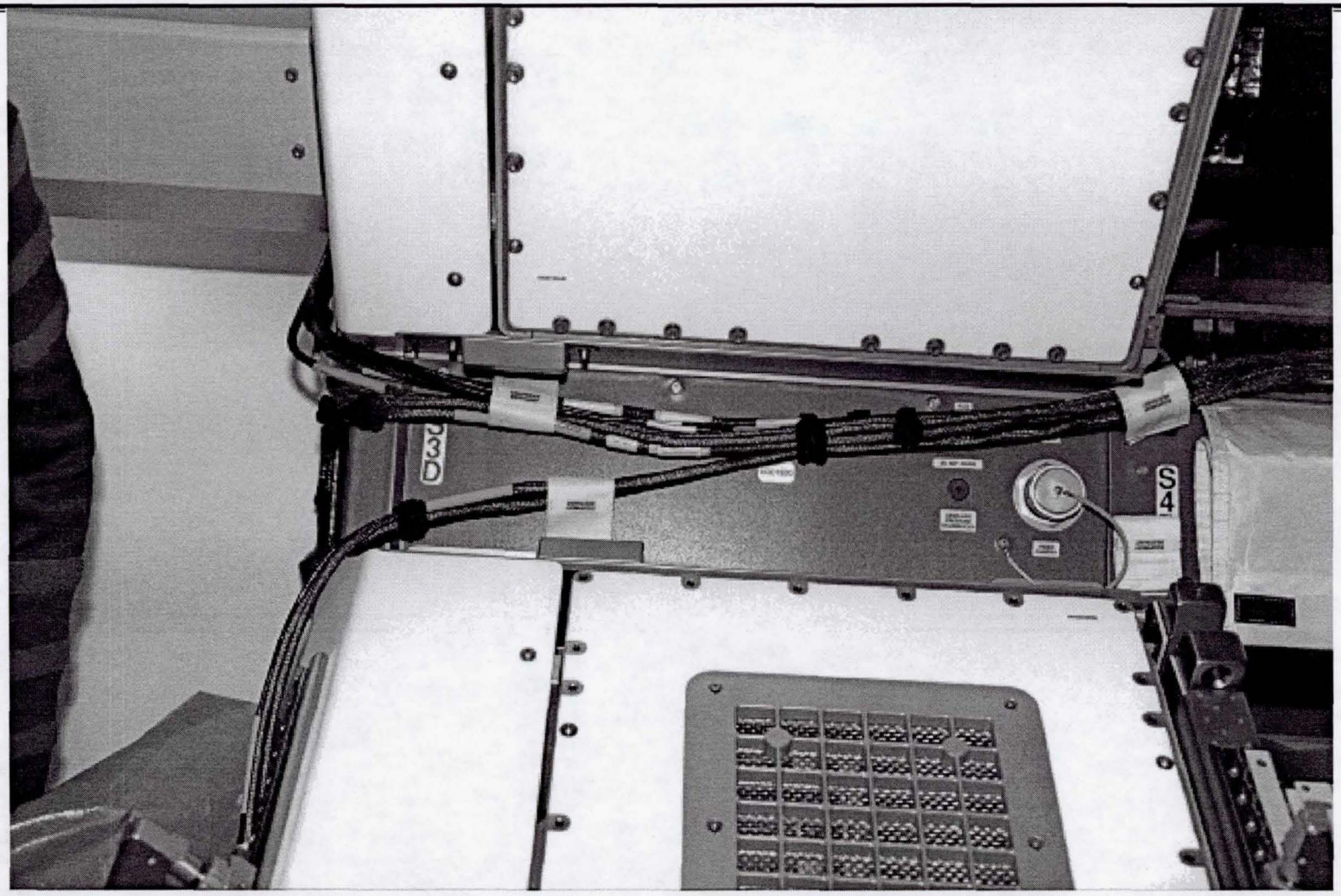

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Mission Accomplished

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Post-mission

- After Flight 2A.1, the installed RFPDB was redesigned to take care of the faulty switch. The ECOMM system was used less often on orbit until on Flight 2A.2a, the redesigned RFPDB was reinstalled. At that time, the port antenna was also replaced so that it could be examined more closely
- The ECOMM System is still operating without anomaly
- Early Communications will be replaced after flight 5A.1, when the US Lab is in place and the KU Band system has been installed.