

APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC- 1995-005

TITLE REMOVAL OR INSTALLATION OF PAYLOAD (IEH AND CAPL-2) FROM OR INTO THE SHIPPING CRADLE

DOCUMENT NUMBER/TITLE OMI E5669V3, IEH/CAPL-2 HANDLING - MPPF AND OMI E5669V4, WSF-2/IEH/CAPL-2 DEINTEGRATION - MPPF

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REQUIRED APPROVAL

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**NASA SUSPENDED LOAD OPERATION
ANALYSIS/APPROVAL**

**NUMBER: SLO-KSC-1995-005
PAGE 1 OF 4**

OPERATIONS

To remove or install the payloads, International Extreme Ultraviolet Hitchhiker (IEH) and Capillary Pumped Loop Experiment (CAPL-2), from or into the Shipping Cradle.

SUPPORTING DOCUMENTS - The associated operational procedure and System Assurance Analysis (SAA) are as follows:

- OMI E5669V3, IEH/CAPL-2 Handling - MPPF
- OMI E5669V4, WSF/IEH/CAPL-2 Deintegration - MPPF
- SAA21CRS2-001, 20 Ton Bridge Cranes - MPPF

GENERAL DESCRIPTION

Removal or installation of the payload (IEH or CAPL-2) from or into the shipping cradle requires two persons to work under the suspended load in order to install or remove the payload to cradle interface bolts (30 bolts for each payload).

These tasks are completed in the following OMI sequences:

- OMI E5669V3 sequence 10-000, CAPL-2 installation into canister
- OMI E5669V3 sequence 11-000, IEH installation into canister
- OMI E5669V4 sequence 08-000, CAPL-2 removal from canister
- OMI E5669V4 sequence 09-000, IEH removal from canister

These tasks require personnel to be in the area of increased hazard directly under the Integrated Partial Payload Lifting Assembly (IPPLA) hoist beam for IPPLA operations. OMI's E5669V3 and E5669V4 are the controlling procedures which are used in the Multiple Payload Processing Facility (MPPF).

RATIONALE/ANALYSIS - The suspended load tasks comply with the NASA Alternate Safety Standard as follows:

Alternate Standard Requirement #1a - These tasks cannot be conducted without placing personnel beneath the suspended IPPLA hoist beam because there is no other access to the hardware attach points.

The payload (IEH and CAPL-2) attaches to its cradle by a number of bolts, nuts and washers which must be installed/removed under and inboard of the IPPLA structure.

During all of these operations, the load must be hoisted above its appropriate holding fixture to provide access for hardware removal or installation. As a result, there are no operational or procedural means to eliminate personnel exposure to the suspended load because of lack of access to the attach points.

The design of additional support structures for the load is not feasible because access to the attach points would be blocked.

Alternate Standard Requirement #1b - The possible use of a secondary support system, to catch the load in the event of a crane failure, was analyzed. It was determined that the use of a secondary support system was not feasible because of positioning of the payload over the cradle.

Alternate Standard Requirement #1c - The maximum number of personnel allowed under the suspended IPPLA hoist beam during installation or removal of the payload to cradle interface bolts (for removal or installation of the payload from or into the cradle) is two.

Alternate Standard Requirement #1d - Removal or installation of the payload to cradle interface bolts will be accomplished as quickly and safely as possible to minimize exposure time. It will take two persons up to one hour to remove or install the bolts.

Alternate Standard Requirement #4 - OMI's E5669V3 and E5669V4 have been revised to permit only the approved number of persons under any of the suspended loads covered in this report. These OMI's are available on site for inspection during the operation.

Alternate Standard Requirement #6 - The suspended load operations covered by this report are conducted in the MPPF and involves the 20 ton bridge crane. The crane is designed, tested, inspected, maintained, and operated in accordance with the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9.

The 20 ton crane hoist is equipped with one holding brake and one mechanical load brake, each capable of holding the load up to the crane's rated capacity. Each brake's ability to hold the rated load (20 tons) is verified annually. The crane is designed to meet a 5 to 1 safety factor based on ultimate strength for the hoist load bearing components.

The 20 ton crane is being utilized for these tasks. IPPLA weighs 11,000 lbs. The weight of the IEH payload is 4,874 lbs, which in combination with the IPPLA is 39.7% of the crane's capacity. The weight of the CAPL-2 payload is 4,741 lbs., which in combination with the IPPLA is 39.4% of the crane's capacity.

The lifting sling is rated at 12,000 lbs and is designed to meet a 5 to 1 safety factor based on ultimate strength.

The 20 ton crane is load tested annually at 100% of its rated capacity. Detailed preventive maintenance is performed monthly, quarterly, semiannually, and annually on the crane to ensure proper operation. A detailed inspection of the lifting slings is performed annually. Nondestructive testing of the slings and crane hooks is performed annually.

Alternate Standard Requirement #7 - A System Assurance Analysis (SAA) has been completed on the 20 ton bridge crane in the MPPF. The SAA includes a Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) and a hazard analysis (see supporting documents).

The SAA identifies one Single Failure Point (SFP), the hoist gear reducer, which transmits power and reduces rotational speed from the hoist motor to the rope drum. Broken teeth downstream of the mechanical load brake, broken gear shafts or shaft to gear interface failure would cause interruption of the load path at the gearbox. This failure would result in the load dropping, which could cause loss of life and/or payload.

There is no history of failure with the SFP in the critical failure mode. A detailed inspection of the gear reducer is performed monthly, and gear reducer oil samples are verified annually. The use of high-quality, reliable components and a comprehensive maintenance, inspection, and test program (including preoperational checks) ensures that the crane systems operate properly. In addition, the crane was proof load tested at 125% prior to acceptance.

The associated SAA CIL Sheets identify all the rationale for accepting the risk of the SFP including design information, failure history, and the operational controls in effect to minimize the risks (maintenance, inspection, test, etc.).

Alternate Standard Requirement #8 - Visual inspections for cracks or other signs of damage or anomalies are performed on the hoist hooks, hoist beams, hoist cables,

hoist rod assemblies, and hoist fittings, and crane functional checks are performed before each operation per NSS/GO-1740.9.

Alternate Standard Requirement #9 - Trained and licensed crane operators shall remain at the hoist controls while personnel are under the load.

Alternate Standard Requirement #10 - Appropriate safety control areas are established before initiating operations. Only the minimum number of people (manloaded in the procedure) will be permitted in this area.

Alternate Standard Requirement #11 - A pretask briefing and a safety walkdown of the area are conducted prior to the lift to ensure that all systems and personnel are ready to support. All participants are instructed on their specific tasks and warned of any hazards involved. Following any crew change, the new personnel are instructed by the task leader on their specific tasks and warned of any hazards involved.

Alternate Standard Requirement #12 - Personnel beneath the suspended load will be in voice contact with the hoist operator and/or task leader. Upon loss of communication, the operation shall stop immediately, personnel shall clear the hazardous area, and the load shall be safed. Operations shall not continue until communications are restored.

Alternate Standard Requirement #13 - Personnel working beneath the load shall be in continuous sight of the hoist operator and/or task leader.

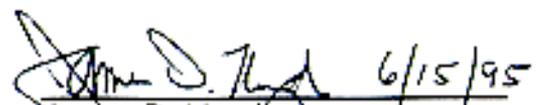
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