

APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC-2000-001

TITLE Hoisting the Long Spacer Utilizing the Cargo Element Lifting Assembly (CELA)

DOCUMENT NUMBER/TITLE L5156 - Cargo Element Lifting Assembly (CELA)

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DATE May 12, 2000

REQUIRED APPROVAL

CONTRACTOR	<input type="checkbox"/> DESIGN	<input type="checkbox"/> R & QA	<input checked="" type="checkbox"/> OPERATIONS	<input checked="" type="checkbox"/> SAFETY
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**NASA SUSPENDED LOAD OPERATION
ANALYSIS/APPROVAL**

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OPERATIONS

To translate the Long Spacer to the Integrated Equipment Assembly (IEA) for mating in the Cargo Element Work Stands (CEWS) in the Space Station Processing Facility (SSPF).

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

- OMI L5166, Cargo Element Lifting Assembly (CELA) - O&C/SSPF
- SAA21CRS1-001, 30 Ton Highbay Bridge Cranes - Space Station Processing Facility (SSPF)

GENERAL DESCRIPTION

Translating the Long Spacer to the IEA for mating requires four (4) technicians and one (1) task leader to be under the suspended load.

This task is completed in the following OMI sequence:

- OMI L5166, Install Payload into TS (Test Stand), TSF (Trunnion Support Fixture), Canister, or Payload Transporter.

During ground processing of the Long Spacer and IEA, it is necessary to assume 80-90 percent of the weight of the long Spacer in the horizontal configuration using the CELA.

During the mating operation the CELA will be used to assume all the weight of the Long Spacer except 1000 pounds, enabling movement in the y-axis. Four (4) technicians and one (1) task leader will be required to work under the suspended load (CELA) to guide the Long Spacer to the mating location on the IEA. This is a precision mate requiring a tolerance of no more than .020 of an inch for the bolts to properly fit.

This task will be repeated once as a demonstration and once for each of the four (4)

Integrated Equipment Assemblies that will require mating operations on future missions.

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

Alternate Standard Requirement #1a

These operations cannot be conducted without placing personnel under the suspended load. The Long Spacer/IEA mating requires four (4) technicians and one (1) task leader to work directly under the suspended payload.

Long Spacer/IEA mating operations in SSPF have been evaluated for alternate methods to complete these tasks, and it has been determined that there are no design, operational, or procedural means to eliminate personnel exposure to a suspended load.

During mating operations, the technicians are required to be under the suspended load to guide the Long Spacer to the IEA for mating. There is no alternate access to the mating surfaces that is located underneath the payload. This physical limitation precludes any design, operational, or procedural changes that would eliminate personnel exposure to a suspended load.

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 CEWS.

Alternate Standard Requirement #1c

The maximum number of personnel permitted under the suspended load while guiding the Long Spacer to the IEA is four (4) technicians and one (1) task leader.

Alternate Standard Requirement #1d

Guiding the Long Spacer to the IEA will be accomplished as quickly and safely as possible to minimize exposure time. It will take four (4) technicians and one (1) task leader a maximum of 60 minutes to guide the Long Spacer to the IEA.

Alternate Standard Requirement #2:

Suspended load operations are reviewed and approved on a case-by-case/specific need basis - see General Description and Alternate Standard Requirement #1.

Alternate Standard Requirement #3:

Only those suspended load operations approved by the Center NASA Safety Assurance Director will be permitted. A list of approved suspended load operations will be maintained by the Center NASA Safety Assurance Directorate.

Alternate Standard Requirement #4

OMI L5166 has been revised to permit only the approved people under the suspended load. The OMI is available on site for inspection during the operation.

Alternate Standard Requirement #5:

A new suspended load operation not covered by this SLOAA, deemed necessary due to unusual or unforeseen circumstances where real time action is required, shall be documented and approved by the Center NASA Safety Assurance Director.

Alternate Standard Requirement #6

The suspended load operations addressed in this analysis involve one of the 30 ton SSPF bridge cranes. The cranes are designed, tested, inspected, maintained, and operated in accordance with the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9.

The SSPF 30 ton crane hoists are equipped with two magnetic holding brakes, each capable of holding the load up to the crane's rated capacity. Each brake's ability to hold the rated load (30 tons) is verified annually. The cranes are designed to meet a 5 to 1 safety factor based on ultimate strength for the hoist load bearing components. The 30 ton cranes are load tested annually at 100% of their rated capacities. Detailed preventive maintenance is performed monthly, quarterly, semiannually, and annually on the cranes 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.

The Cargo Element Lifting Assembly (CELA) is rated at 26,500 lbs. and is designed to meet a 5 to 1 safety factor based on ultimate strength. The combined weight of the CELA, Long Spacer, and miscellaneous hoisting equipment is approximately 33,000 lbs.

Alternate Standard Requirement #7 - An SAA has been completed on the 30 ton bridge cranes in the SSPF. The SAA includes a Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) and a hazard analysis (see supporting documents). No critical single failure points were identified during this analysis.

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 will be 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

potential hazards. 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 - The person 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.

APPROVAL: DATE:

Malcolm Glenn 5/15/00

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