

APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC- 2002-003

TITLE Installation and Check-out of the Japanese Experiment Module Remote Manipulator System

DOCUMENT NUMBER/TITLE JTP-323005, JTP-323007, JTP-361001

PREPARED BY NASDA JEM Project S&PA

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REQUIRED APPROVAL

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NASA SUSPENDED LOAD OPERATION ANALYSIS/APPROVAL (SLOAA)

OPERATION:

1. To remove / install JEMRMS (Japanese Experiment Module Remote Manipulator System) main arm for checking out of HRM (Hold & Release Mechanism) during the arm transfer from / to transportation container.
2. To remove / install JEMRMS main arm during the arm transfer from transportation container to the Main Arm/Turn Over Equipment I/F Equipment.
3. To remove / install JEMRMS main arm during the arm transfer from the Main Arm/Turn Over Equipment I/F Equipment to PM (Pressurized Module).

SUPPORTING DOCUMENTS: The associated operational procedure/systems assurance analyses are as follows:

1. JTP-323005 JEMRMS Main Arm Checkout
2. JTP-323007 JEMRMS Main Arm Installation
3. JTP-361001 FLT 1J Outfitting – RMS Main Arm Installation
4. SAA21CRS1-001, 30 Ton Highbay Bridge Cranes - Space Station Processing Facility (SSPF)

GENERAL DESCRIPTION:

1. Removal or installation of JEMRMS main arm for checking out of HRM requires four persons under the suspended JEMRMS Main Arm Lifting Equipment and payload (JEMRMS main arm) during the arm transfer from transportation container.
2. Removal or installation of JEMRMS main arm requires four persons under the suspended JEMRMS Main Arm Lifting Equipment and payload during the arm transfer from transportation container to Main Arm/Turn Over Equipment I/F Equipment.
3. Removal or installation of the structural bolts requires seven persons under the suspended JEMRMS Main Arm Lifting Equipment (in Arm install) and payload during the arm transfer from the Main Arm/Turn Over Equipment I/F Equipment to PM.

These tasks are completed in the following JTP-323005 sequences:

- Removal of the main arm (leaving HRM) from transportation container
- Installation of the main arm in Main Arm Assembly Adjustment Equipment
- Checking out of HRM
- Installation of the main arm in HRM based on transportation container

These tasks are completed in the following JTP-323007 sequences:

- Removal of the main arm from transportation container
- Installation of the main arm in Main Arm/Turn Over Equipment I/F Equipment.
- Installation of the main arm in PM (Pressurized Module)

These tasks require personnel to be in the area of increased hazard directly under the suspended JEMRMS Main Arm Lifting Equipment, JEMRMS Main Arm Lifting Equipment (in Arm install) and the payload.

RATIONALE/ANALYSIS: The suspended load tasks comply with the NASA Alternate Safety Standard for Suspended Load Operations as follows:

Alternate Standard Requirement #1a: These operations cannot be conducted without placing personnel under the suspended JEMRMS Main Arm Lifting Equipment, JEMRMS Main Arm Lifting Equipment (in Arm install) and the payload during payload transfer operations. These lifting operations at the SSPF have been evaluated for alternate methods to complete these tasks, and it has been determined that there are no design, procedural, or operational means to eliminate personnel exposure to a suspended load.

During these tasks, the payload has to be hoisted out of its respective support structure to gain access for the removal or installation of respective hardware.

These tasks place the technician beneath the JEMRMS Main Arm Lifting Equipment, JEMRMS Main Arm Lifting Equipment (in Arm install) and payload to remove or install the necessary hardware.

Because of the location of the structural bolts, which are beneath the payload, there is no other access for completing these tasks. These physical limitations preclude any operational or procedural work around.

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 use of a secondary support system was not feasible. Because there is no open space to set up a secondary support system for the reason that the operating area is limited

Alternate Standard Requirement #1c:

1. The maximum number of personnel allowed under the load during the main arm transfer from transportation container to Main Arm/Turn Over Equipment I/F Equipment is four.
2. The maximum number of personnel allowed under the load during removal or installation of the structural bolts is seven.

Alternate Standard Requirement #1d:

1. Removal or installation of the main arm for checking out of HRM will be accomplished as quickly and safely as possible to minimize exposure time. It will take four persons up to five hours to remove or install the main arm. (including return task after check out end)
2. Removal or installation of the main arm transfer from transportation container to support equipment will be accomplished as quickly and safely as possible to

minimize exposure time. It will take four persons up to three hours to remove or install the main arm.

3. Removal or installation of the structural bolts will be accomplished as quickly and safety as possible to minimize exposure. It will take seven persons up to five hours to remove or install the structural bolts.

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 NASA Safety and Mission Assurance Division Chief will be permitted. The NASA Safety and Mission Assurance Division will maintain a list of approved suspended load operations.

Alternate Standard Requirement #4: The work authorizing documents are written to allow only required personnel under the suspended load. The work authorizing documents are 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 NASA Safety and Mission Assurance Division Chief.

Alternate Standard Requirement #6: The suspended load operations addressed in this analysis involve the 30-ton SSPF bridge cranes. The cranes are designed, tested, inspected, maintained, and operated in accordance with the NASA Standard for Lifting Devices and Equipment, NASA-STD-8719.9.

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. Nondestructive testing of the crane hooks is performed annually.

A single 30-ton crane is utilized for these tasks. The maximum weight of the JEMRMS Main Arm Lifting Equipment or JEMRMS Main Arm Lifting Equipment (in Arm install) is 2,000 lbs and the payload may weigh as much as 2,200 lbs. The total load is 4,200 lbs.

The JEMRMS Main Arm Lifting Equipment and JEMRMS Main Arm Lifting Equipment (in Arm install) are rated at more than 2,200 lbs and are designed to meet 5 or more to 1 safety factor based on ultimate strength.

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 NASA-STD-8719.9.

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 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.

Alternate Standard Requirement #14: The NASA Safety and Mission Assurance Division shall conduct periodic reviews to ensure the continued safety of suspended load procedures.

Alternate Standard Requirement #15: The NASA Safety and Mission Assurance Division will provide copies of approved SLOAAs, a list of approved suspended load operations, a list of cranes/hoists used for suspended load operations and copies of the associated FMEA/CIL and hazards analyses to NASA Headquarters.

APPROVAL:

DATE:


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