

APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC -2007-001A

TITLE Rack Turnover

DOCUMENT NUMBER/TITLE JDX-TOPK-#4R1403, JDX-TOPK-#4R1404, JDX-TOPK-#2R1403,
JTP-426112

PREPARED BY JAXA ISPR / JEM Development Project / S&MA DATE Mar. 2007

REQUIRED APPROVAL

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Suspended Load Operation Analysis / Approval

OPERATION:

1. To transfer #4Rack from Rack Stand to JEM system Rack Dolly
2. To transfer #4Rack from JEM system Rack Dolly to Rack Stand
3. To transfer ICS Rack from Rack Stand to JEM system Rack Dolly

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SUPPRTING DOCUMENT:

The associated operation procedure/systems assurance analyses are as follows:

1. Operation Instruction of
[Rack transfer from Rack Stand to JEM Dolly]
and [Rack transfer from JEM Dolly to Rack Stand]
(Appendix 3-1 and 3-2 of JDX-2006054)
2. JDX-TOPK-#4R1403, Rack Turnover to JEM System
JDX-TOPK-#4R1404, Rack Turnover from JEM System
JDX-TOPK-#2R1403, Rack Turnover to JEM System
3. SAA21CRS1-001, 30 Ton Highbay Bridge Cranes-Space Station
Processing Facility (SSPF)
4. SAA21CRS1-002, System Assurance Analysis of the 5-ton Bridge
Cranes located in the Intermediate Bay at SSPF.
5. JTP-426112 ICS-PM Separation from Rack Stand

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GENERAL DESCRIPTION:

1. When lifting Rack, two workers under Rack Lifting Device will adjust the turnbuckles to ensure that lifting is leveled in vertical position.
2. When lifting Rack, two workers under Rack Lifting Device will loose or fasten the bolts of Rack Stand.
3. When lifting Rack, one worker under Rack Lifting Device will loose or fasten the Drive Rod of Rack.

RATIONALE/ANALYSIS:

The suspended load tasks comply with the NASA Alternate Safety Standard for Suspended Load Operation as follows:

Alternate Standard Requirement #1a:

These operations cannot be conducted without placing personnel or hands under the Rack lifting Device during Rack transfer operations. Rack transfer operations at SSPF have been evaluated for alternate methods to complete this task, and it has been determined that there are no design, procedural, or operational means to eliminate personnel exposure to a suspended load, without exposing flight hardware to unacceptable damage.

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 use of a secondary support system was not feasible, because of vertical movement of suspended Rack Lifting Device.

Alternate Standard Requirement #1c:

1. The maximum number of personnel allowed under the Rack Lifting Device during adjusting turnbuckles is two workers: two workers are adjusting turnbuckles simultaneously to ensure balance of Rack.
2. The maximum number of personnel allowed under the Rack Lifting Device during loosening or fastening the bolts is two workers
3. The maximum number of personnel allowed under the Rack Lifting Device during loosening or fastening Drive Rod is one worker.

Alternate Standard Requirement #1d:

1. Adjusting turnbuckles will be accomplished as quickly and safely as possible to minimize exposure time. It will take up to 10 minutes under suspended Rack Lifting Device.
2. Loosening or fastening of the bolts of Rack Stand will be accomplished as quickly and safely as possible to minimize exposure time. It will take up to 20 minutes under suspended Rack Lifting Device.
3. Loosening or fastening of the Drive Rod of Rack will be accomplished as quickly and safely as possible to minimize exposure time. It will take up to 30 minutes under suspended Rack Lifting Device.

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 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 and 5 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. | A

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 SSPF 5 ton crane are equipped with emergency stop. Emergency stop ability is verified annually. | A

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 and 5 ton cranes | A

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.

Rack Lifting Device is utilized for each operation described in page 1.

Rack Lifting Device: A 30 ton and 5 ton cranes are utilized for these tasks. The maximum weight of the Rack Lifting Device is 551 lbs and the payload may weigh as much as 1786 lbs. The total load is 2337 lbs.

The Rack Lifting Device is rated at 2337 lbs and is designed to meet 8 or more to 1 safety factor based on ultimate strength.

Alternate Standard Requirement #7:

An SAA has been completed on the 30 ton and 5 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).

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. A sheared key or broken teeth 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 is 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.

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 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 pre-task briefing and a safety walk down 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 operator shall stop immediately, personnel shall clear the hazardous area, and the load shall be saved. 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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3/13/07

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