

	EQUIPMENT SPECIFICATION SHEET	ESS No.: 032 Revision No.: 1 Page 1 of 7
Equipment: Kuosheng ISFSI Gantry Crane Lift Booms and Trolley Beam Side Shift Assemblies		
Equipment Identification No.: 630075-012-7 and -31	Quality Category: B	Master Quality Category Assessment ID: CAS-009 per 91150-Q-01
Prepared by/Date: <i>Kenneth C. Woodman</i> 4/28/14		Checked by/Date: <i>[Signature]</i> 29 APR 14
Quality Assurance/Date: <i>BFB</i> 4/30/14		Project Manager/Date: <i>alaw</i> 4/30/14

1. APPLICATION OF EQUIPMENT OR ITEM:

The self-propelled Kuosheng ISFSI gantry crane is utilized to vertically lift the loaded MAGNASTOR[®] transfer cask off the transfer cask dolly and set it on top of the Vertical Concrete Cask (VCC).

The hydraulic gantry crane, using slings and lifting links, will engage the transfer cask lifting trunnions at the top of the transfer cask, lift the transfer cask off the deck of the transfer cask dolly, and move the transfer cask to the top of the designated VCC, where the spent fuel storage canister will be lowered into the VCC using an air operated chain hoist. The gantry crane will remain engaged with the transfer cask while lowering of the canister into the VCC.

2. CRITICAL PHYSICAL CHARACTERISTICS OF EQUIPMENT OR ITEM:

The gantry crane is required to have the following critical physical capabilities and attributes:

- The gantry crane shall meet all applicable design, materials, fabrication and testing requirements of ASME NOG-1, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)".
- Welding shall be in accordance with AWS D1.1, "Structural Welding Code". All welds shall be completed by qualified/certified welders using qualified procedures. Procedure qualifications shall include impact tests when required by ASME NOG-1, Paragraph 4251.2 (for welds with a nominal effective throat greater than 5/8 inch).
- Welding materials shall be in accordance with ASME NOG-1, Section 4230.
- All structural welds shall be 100% visually inspected in accordance with AWS D1.1. All full penetration butt welds, if any, shall be volumetrically examined using ultrasonic inspection. All welds with effective throats exceeding 3/8 inch shall be magnetic particle examined in accordance with ASME NOG-1 Section 4251.4 (10% of the length of welds). Inspectors, procedures, acceptance criteria and repairs shall be performed in accordance with AWS D1.1.

- Raw materials for structural members shall be in accordance with ASTM, AISI or ASME standards. Material Test Reports with actual chemical and physical values shall be supplied for all structural components. Such items shall be procured from appropriately qualified category B suppliers (US NRC Regulatory Guide 7.10). In accordance with Section 4210 in ASME NOG-1, Charpy testing shall be performed for the materials and conform to the acceptance criteria shown in Table 4212-1 in ASME NOG-1 (for structural materials greater than 5/8 inch). Structural fastener materials shall conform to Section 4220 in ASME NOG-1. Heat/Lot traceability shall be established and maintained to the extent that the supplier can provide fabrication records demonstrating that only acceptable items were used in the component (traceability to the specific location is not required).
- Quality Category B items and services shall only be procured from sub-suppliers found to be acceptable in accordance with the Supplier's QA program using at least one of the following methods
 1. Use of sub-supplier who has been audited and approved by the Supplier, the purchaser or the purchaser's representative.
 2. Use of sub-supplier who has appropriate ASME accreditation.
 3. Re-performance of specified (critical) chemical and physical testing as required by the appropriate material specification using an approved testing organization.
 4. Procurement from a sub-supplier for whom a documented history has been established and maintained such that sub-supplier's capability to provide high quality materials can be objectively assessed by interested third parties.
- The gantry crane shall be provided with a durable coating system consisting of an epoxy base coat/primer and a polyurethane top coat, or approved equivalent, meeting the requirements of coating service level II, as defined by Section 3000 of ASME NOG-1.
- The four post hydraulic gantry crane telescoping booms, working together as a set of four, shall have an extended rated capacity of at least 500 tons total, which is more than four times the weight of the transfer cask, loaded spent fuel canister, canister lifting adapter and associated rigging.
- Lift booms shall be provided in accordance with ASME B30.1, "Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries."
- Each gantry crane hydraulic lifting cylinder shall be factory pressure tested to at least 110% of the individual cylinder rated capacity.
- A prototype of the gantry crane wedge locks (single failure proof feature) shall be tested to demonstrate that the set of four wedge locks will hold a load of at least 200 tons (a pair of two wedge locks may be tested to 100 tons to satisfy this requirement). The wedge lock test shall be performed with the boom sections in the inverted configuration (outer boom stage on top).
- The lift boom shall have the capability to lift the transfer cask at least 21'-0". The height of the VCC with the transfer adapter installed is approximately 20'-2". The

height of the transfer cask is 16'- 7". The minimum head room required for the canister lift chain hoist is 9'- 6", bottom of trolley beam to bottom of hoist sister hook.

- The lift booms will run on W14x109 wide flange beams embedded in the concrete ISFSI storage pad. Center to center spacing of the beams is 54 inches. The concrete is recessed 5" between the beams. Eight uplift restraint brackets, mounted on the boom base module, shall be provided to resist seismic uplift.
- Structural load carrying material shall be ASTM A572 Grade 50 or higher strength ASME NOG-1 approved material. Lift boom minimum section properties are provided in the following table. The Hydraulic Gantry Crane Vendor shall collaborate with NAC International to optimize the design.

Boom Part	Area (in ²)	Moment of Inertia (in ⁴)	
		X-X axis	Y-Y axis
Lower stage	92	9,800	13,600
Middle stage	104	14,100	25,900
Fixed upper stage	101	20,300	28,000

X-X axis is parallel to gantry track axis and longitudinal direction of ISFSI pad

3. CRITICAL PERFORMANCE CHARACTERISTICS OF EQUIPMENT OR ITEM:

The gantry crane shall meet the following critical performance characteristics:

- Capable of operating in rain or snow at a temperature range of 32°F to 106°F at 0% to 100% humidity.
- Fracture toughness criteria of ASME NOG-1, paragraph 4212 applies to ferritic plates in the load path (material greater than 5/8 inch thick) for operations down to 32°F. The Charpy V-notch test temperature shall be 2°F or lower.
- The gantry crane booms shall be provided with a wedge lock system (2 pairs of wedges per each moving section) which automatically locks all power sections if the hydraulic cylinder seals or hydraulic locking valves malfunction and pressure cannot be held in the cylinder. The wedge lock system must remain functional during a design basis seismic event. Through prototype testing, it shall be demonstrated that the wedge locks (set of four) can support at least 200 tons per boom, in an extreme environmental loading condition (seismic event under load).
- The lift housings shall be a three stage telescopic boom assembly with two stage power up and down cylinders with hydraulic counterbalance locking valves. The lift and lower speeds for the crane booms shall be limited to 1 foot/minute. The lift system must include a hydraulic limiting feature that will not allow lifting in excess of rated load.
- If the primary diesel engine malfunctions, operation of the lift cylinders shall be possible by using a redundant electric motor and hydraulic pump in each control module.

- The lift base housings shall have a planetary self-propelled direct drive to loaded wheels with a motion control brake and mechanically released freewheel design. The brake system must be able to hold the crane during a seismic design basis event. The horizontal travel speed shall be two to three feet per minute.
- The lift boom shall be provided with a radio remote control lifting system. An emergency stop switch shall be provided on each control module and on the radio remote control.
- The radio remote control shall display the lift extension for each lift housing and synchronize all lift movement. An exact load indication shall be provided, with overload warning and operator over-ride controls. The display shall be in traditional Chinese, as used in Taiwan.
- A 125 ton side shift assembly shall be mounted on each lifting beam to center the trolley beam precisely over the centerline of the VCC (lifting and trolley beams by others). The side shift travel speed shall be less than four inches per minute.

4. DESCRIPTION OF OTHER RELATED SERVICES THAT ARE NEEDED:

A field service representative from the Hydraulic Gantry Crane Vendor shall participate in the assembly, installation, and acceptance testing of the gantry crane in Taiwan. During performance and load testing in Taiwan, the field service representative shall provide training of personnel in the safe operation and normal maintenance of the gantry crane lift booms and associated ancillary equipment (provided on time and materials basis).

The gantry crane support track, lift beams, trolley beam, lifting links and pins, rigging slings, shackles and lifting plates, and seismic restraint sway rods, struts, dampers and rings will be supplied by others.

5. SCOPE OF SUPPLY:

5.1 Hydraulic Gantry Crane Vendor:

- Four lift booms (500 ton combined capacity) designed and supplied in accordance with ASME B30.1 and fabricated and tested in accordance with ASME NOG-1, with pin connection plates and stiffeners welded to the upper boom sections for lift beam connection, cross bracing, struts and the transfer cask seismic restraint ring system. The cylinder bench testing shall confirm that the hydraulic lifting cylinder physical stops will prevent vertical over travel of the boom if any hydraulic cutout switches are bypassed and the hydraulic system continues to try to lift the lift beams (essentially this is mimicking a two-block test for the hydraulic booms).
- Two 125 ton side shifting assemblies to center the trolley beam over the VCC.
- Two diesel powered control modules with hydraulic oil reservoir, with back-up electrical motor, with each control module operating two lift booms.
- Radio remote control synchronized lift system for operating all four booms together.

- Spare parts for two years of crane operation, about 100 lifting cycles (provided on time and materials basis).
- Technical support in Taiwan at the CTCIM shop and at the Kuosheng site for crane assembly, testing, and operations and maintenance training (provided on time and materials basis). Optionally, CTCIM may send technicians to the Hydraulic Crane Vendor's shop for training.

5.2 NAC International and CTCIM:

- NAC analysis of the gantry crane structure for site specific design basis seismic events under fully loaded conditions of operation with a maximum design basis critical load (MCL) of 100 metric tons and demonstration that the gantry crane meets all load case stress allowables of ASME NOG-1.
- NAC QA oversight of the Hydraulic Gantry Crane Vendor fabrication and testing to confirm compliance with this Equipment Specification Sheet.
- Design, analysis and supply of the rigging between the gantry crane and the transfer cask (slings, shackles, lift plates).
- Design, analysis and supply of the chain hoist and associated hardware used to lower the canister into the VCC (chain hoist, canister lift adapter, chain hoist top bracket).
- Design, analysis and supply of two lifting beams, connecting pins and trolley beam.
- Design, analysis and supply of six lifting links and connecting pins on the trolley beam (used to lift the transfer cask and canister chain hoist).
- Design, analysis and supply of the transfer cask seismic restraint ring, connecting pins and connecting slings to the gantry booms.
- Design, analysis and supply of the upper boom section cross bracing sway rods, struts, connecting pins and seismic dampers.
- Overseas packing, shipping and freight forwarding of fabricated lift booms, side shifting assemblies, radio remote control and control modules.
- Assembly of the gantry crane with the CTCIM supplied lift beams, trolley beam, lifting links and seismic restraint system at the CTCIM shop in Kaohsiung and crane assembly load testing in accordance with ASME NOG-1 Section 7423.
- After the assembled gantry crane load test at the CTCIM shop, it shall be disassembled, transported to Kuosheng, re-assembled and then functionally tested.

6. EVALUATION TO DETERMINE ACCEPTABILITY OF VENDOR EQUIPMENT:

- Verify interface dimensions with components to be supplied by CTCIM (verify pin plate thickness and alignment and size and location of pin holes; verify base module wheel spacing and space for guide bar on track).
- Witness shop proof load testing of the four gantry crane booms per ASME B30.1 and wedge lock prototype testing.
- Witness operation and functional testing of the hydraulic and electrical control systems, including side shifting assemblies.

- Inspection and testing requirements shall comply with ASME B30.1 and ASME NOG-1, Section 7000.

Representatives of Taiwan Power Company and the Taiwan regulator may wish to visit the fabrication shop prior to the start of fabrication. Additionally, they may wish to witness material verification, welding, non-destructive examination, shop testing of the lift booms, and surface preparation and coating.

7. IDENTIFICATION OF REQUIRED SPARE PARTS AND MAINTENANCE REQUIREMENTS FOR THE EQUIPMENT:

An Operations and Maintenance Manual shall be provided with detailed equipment set-up, operations and storage procedures; periodic and annual maintenance and inspection requirements; and a listing of recommended spare parts.

8. PROCUREMENT AND SHIPPING:

The hydraulic four post gantry crane will be used at the Kuosheng Nuclear Power Station (Kuosheng) in Taiwan. NAC International (NAC) and CTCI Machinery Corporation (CTCIM) have a teaming relationship to provide equipment for handling dry spent nuclear fuel containers at Kuosheng. NAC is responsible for project engineering and will witness the testing at the Hydraulic Gantry Crane Vendor's facility. CTCIM is responsible for hardware procurement and installation in Taiwan. Equipment shall be supplied ex works with CTCIM responsible for packing, shipping and freight forwarding. After shop testing and inspection, the four hydraulic booms, two control modules, radio remote control and two side shifting systems shall be shipped to:

CTCI Machinery Corporation
No. 5, Hsin-Kung Road, Ta-She Area
Kaohsiung City, Taiwan

9. DOCUMENT SUBMITTAL REQUIREMENTS:

The following documents shall be submitted for approval prior to use:

- Manufacturing schedule, indicating material procurement, fabrication, component assembly, testing, and preparation for shipment.
- Material Suppliers List prior to procurement
- Services (testing, NDE, etc.) Suppliers List
- Manufacturing design drawings, plans and procedures (including shop travelers)
- Cutting and forming procedures, if applicable
- Cleaning and painting procedures
- Material CMTRs, including Charpy test results as required
- Welding and weld repair procedures and weld procedure qualification records
- Personnel qualification reports (welder, NDE inspectors)
- Burr removal procedure, if applicable
- Non-destructive examination procedures (VT, MT and pressure tests, as applicable)

- Assembled component weight measurement procedure
- Dimensional and surface inspection procedure
- Functional and proof load test procedures
- Operation and maintenance manual

Shop manufacturing documents shall be submitted for approval at least eight weeks prior to the start of manufacturing. Shop inspection and testing procedures shall be submitted for approval at least eight weeks prior to inspection or testing. Two paper and two electronic copies of the operation and maintenance manual shall be supplied no later than four weeks after shipment.

10. EQUIPMENT OPERATIONS AND MAINTENANCE TRAINING:

At the time of the testing in Taiwan, instructions shall be available for storage, installation and maintenance.

11. RIGHT OF ACCESS:

NAC, CTCIM and NAC/CTCIM customer personnel shall be given free access to areas where the testing is performed.

12. CERTIFICATE OF CONFORMANCE:

The Vendor shall provide a Certificate of Conformance, signed by the person responsible for the Vendor's QA function, certifying that the component was supplied in accordance with the purchase order and this equipment procurement specification.

13. REFERENCES:

- 13.1 ASME B30.1-2009, "Jacks, Industrial Rollers, Air Casters, and Hydraulic Gentries".
- 13.2 ASME NOG-1-2010, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)".
- 13.3 AWS D1.1-2010, "Structural Welding Code".