11.0 PLANT SYSTEMS
11.10 HEAVY LIFT CRANES

11.10.1 Conduct of Review

This chapter of the SER contains the staff's review of the heavy lift cranes described by the applicant in CAR Chapter 11.0. The objective of this review is to determine whether heavy lift crane PSSCs and their design bases identified by the applicant provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents. The staff evaluated the information provided by the applicant for heavy lift cranes by reviewing Chapter 11.0 of the CAR, other sections of the CAR, supplementary information provided by the applicant, and relevant documents available at the applicant's offices but not submitted by the applicant. The review of heavy lift cranes design bases and strategies was closely coordinated with the review of fire protection in Section 7.0 of this SER, the review of chemical safety in Section 8.0 of this SER, and the review of accident sequences described in the Safety Assessment of the Design Bases (see Chapter 5 of this safety evaluation), and the review of other plant systems.

The staff reviewed how the information in the CAR addresses the following regulations:

- Section 70.23(b) of 10 CFR states, as a prerequisite to construction approval, that the design bases of the PSSCs and the quality assurance program be found to provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents.

- 10 CFR Part 70.64 requires that baseline design criteria (BDC) and defense-in-depth practices be incorporated into the design of new facilities. It specifically addresses quality standards; natural phenomena hazards; fire protection; environmental conditions and dynamic effects; emergency capability; inspection, testing and maintenance; criticality control; and instrumentation and controls.

The review for this construction approval focused on the design basis of heavy lift cranes, their components, and other related information. For heavy lift cranes, the staff reviewed information provided by the applicant for the safety function, system description, and safety analysis. The review also encompassed proposed design basis considerations such as redundancy, independence, reliability, and quality. The staff used Section 11.4.8 in NUREG-1718 as guidance in performing the review of heavy lift cranes.

As stated in the 10 CFR Part 70 Subpart H rulemaking, IROFS may be described at the systems level, provided that there is enough detail to understand the function of the system in relation to the performance requirements. Accordingly, as discussed in DSER below, the staff finds it acceptable to identify PSSCs at the systems level.

In the DSER discussions that follow, the system descriptions are provided as well as function, major components, control concepts, and system interfaces. These discussions include, but are not limited to, PSSCs, to provide an understanding of the system. Design bases of PSSCs are provided in Section 11.9.1.2.

Regarding the proposed MOX FFF use of heavy lift cranes, specific design considerations given in the CAR should demonstrate the following:

- The equipment is designed in accordance with the American National Standard for Overhead and Gantry Cranes (Top Running Bridge, Single of Multiple Girder, Top Running Hoist), American National Standards Institute/American Society of Mechanical Engineers ASME B30.2-1983 and the American National Standard for Overhead Hoists, ASME B30.16-1987.

- The purchase of equipment and materials is based on codes and standards that represent a level of capability to meet the design requirements specified in American National Standard Lightning Protection Code, American National Standards Institute/National Fire Protection Association NFPA 78-1986, and the Specifications for Overhead Traveling Cranes, Crane Manufacturers Association of America CMAA Specification 70.

- Cranes capable of carrying heavy loads are prevented, preferably by design rather than by interlocks, from moving over safety and containment systems.

- Cranes are designed to provide single failure-proof handling of heavy loads, so that a single failure will not result in loss of capability of the crane-handling system to perform its safety function.

- The cranes, structures, and their support equipment are designed to withstand all design loads while remaining in place.

- The crane system design is based on an analysis that considers the confinement of radioactive material under conditions of system failure and mis-operation.

- Heavy lift cranes are adequately designed to maintain functionality when subjected to tornadoes, tornado missiles, earthquakes, floods, and any other severe natural phenomena deemed to be credible as further established in the ISA to be performed by DCS.

As stated in the 10 CFR Part 70 Subpart H rulemaking, IROFS may be described at the systems level, provided that there is enough detail to understand the function of the system in relation to the performance requirements. Accordingly, as discussed in DSER below, the staff finds it acceptable to identify PSSCs at the systems level, provided that there is enough detail to understand the function of the system in relation to the performance requirements.

In the DSER discussions that follow, the system descriptions are provided as well as function, major components, control concepts, and system interfaces. These discussions include, but are not limited to, PSSCs, to provide an understanding of the system. Design bases of PSSCs are provided in Section 11.8.1.3.

11.10.1.1 System Description

DCS has not identified cranes, heavy-lift or otherwise, as PSSCs in the MFFF CAR. However, material handling equipment and controls has been identified as PSSCs. IROFS will be identified by DCS in its ISA summary to be submitted as part of its application for a 10 CFR Part 70 operating license.

For the MFFF, heavy lift cranes are designated as those cranes designed to lift greater than 816 Kg. [1,800 lbs]. This load definition limits, to a very few, the number of cranes or lifting devices designated as "heavy lift cranes." Other cranes or lifting devices may be identified as the design matures. The currently identified applications of heavy lift cranes in the MFFF are the truck bay bridge crane in the fuel truck bay, the waste area waste drum handling crane, a bridge crane stacker for waste drum handling in room B-254, a bridge crane for handling empty PuO_2 shipping package pallets in room B-163, a maintenance crane in the emergency diesel generator building, and one or more cranes in the secured warehouse. For the fresh fuel packages lifted by the truck bay bridge crane, the package lifts are proposed to occur only with the qualified impact limiters installed. These identified devices are all bridge cranes.

The MFFF truck bay bridge crane is described as a top-running, double girder bridge crane, with electric bridge, trolley, and hoist drives. The rated capacity of the crane is 13.6 metric tons [15 short tons] (with a 4.5 metric ton [5 short ton] auxiliary hook). The capacity of the truck bay bridge crane should envelope the weight of a fully loaded fresh fuel cask and associated lifting devices plus any additional design margin specified in the design code. The other cranes, mentioned above, are newly identified as heavy lift cranes in the design of the MFFF, and the staff expects that they will be designed to similar standards or DCS will report any deviations from the standards as the facility design develops. The maximum lift height of the crane in the shipping bay is approximately 4.8 m [16 ft], that is below the MOX fresh fuel cask qualified drop height of 9.1 m [30 ft].

The MFFF general design philosophy is stated as preventing lifts above PSSCs. When not possible to avoid lifts above other PSSCs, such as in moving or stacking MOX fresh fuel casks in the truck bay, IROFS will be identified by DCS in its ISA summary to be submitted as part of its application for a 10 CFR Part 70 operating license. In general, heavy lift cranes are not designated as PSSCs because equipment being lifted would be qualified for drops from the maximum lift height of the cranes. For example, the qualification of the MOX fresh fuel package is to maintain confinement integrity of the package for a drop from a height of 30 feet (9.1 m) onto a solid surface. DCS states that the maximum lift height for any piece of equipment in the MFFF is 16 feet (4.9 m). However, it is possible for cranes to impact PSSCs without a load drop. In this case, the PSSCs identified in the CAR are the material handling controls as discussed in the SER review for Section 11.7. The term material handling controls includes controls on material handling equipment and administrative controls. Examples of these controls include safe travel paths, procedures and training to limit crane operations or to properly prepare loads or nearby equipment prior to crane use, and a radiation protection program to ensure workers are protected during maintenance activities. Specific material handling controls will be identified in the ISA summary. No heavy lift cranes have been identified as PSSCs, however material handling equipment and controls have been identified as PSSCs.

11.10.1.1.1 Function

The function of the MFFF heavy lift cranes is to lift and move critical loads in a manner consistent with the loads' qualification, to limit inadvertent movement, and to retain loads under all design basis conditions, such as earthquake and loss of power events. Critical loads are loads of a type that, if dropped and the contents released, could result in unacceptable radiological dose consequences to the worker, the public, or the environment. Other non-critical loads may also be moved by this equipment at any time. The heavy lift crane's function includes controlling movement of the cranes and loads during operation and maintenance so they will not impact other PSSCs. DCS estimated that 100 package lifts will occur per year and that 33 percent of the duration of the lift will be over another package. This means that over the period of a year the total time one fresh fuel package is estimated to be above another package is 6 hours. These are estimates for the discussion of system function only and are not design basis criteria.

11.10.1.1.2 Major Components

The major components of the heavy lift cranes are the rails on which the cranes run, the girders that span the work area, the electric drives for the bridge, trolley, and hoist, the operators cab or local operating station, and the lights and control systems for the cranes. Crane equipment consists of slings, lifting frames, and other below-the-hook lifting devices. Cranes may also be equipped with auxiliary hoists to perform routine lifting of smaller loads. The capacity of the crane is such that it should meet or exceed the lifted load. The lifted load includes the equipment to be moved plus the weight of the slings and other lifting devices plus applicable design margins specified in the crane design codes and standards.

11.10.1.1.3 Control Concepts

Heavy lift cranes, in general, are operated locally by cane operators that are in visual contact with the crane and the load. The crane control stations are local and the controls are conventional and are required in the industry codes and standards, such as ASME B30.2, “Overhead and Gantry Cranes,” 1996. The operation of the crane may also be limited by design features, such as single failure proof interlocks, bumpers or hard stops and by material handling controls.

Operating experience for similar cranes at the MELOX and La Hague facilities in France have resulted in design improvements for the control and operation of cranes at those facilities. At the La Hague facility, active brake release control was added to 5 short ton (4.5 metric ton) bridge cranes that have a handling frequency greater than one time per year. For 5 short ton (4.5 metric ton) bridge cranes having a handling frequency of less than one time per year, an administrative “checkout” control requiring the lifting mechanisms to be checked prior to use was added. In addition to those changes, the shipping package gripper in the receiving area at the MELOX facility has been modified to improve its load-positioning accuracy for shipping containers unique to that facility. The last modification made as a result of operating experience was that the 7.5 short ton (6.8 metric ton) shipping package handling crane in the MELOX facility was modified to allow for simultaneous movement in both the vertical and horizontal positions to reduce lift durations and operator exposure. DCS has committed to review the need for an active brake control in the final design phase. If the active brake control is an IROF it will be identified in the ISA and controlled by the MFFF QA program as appropriate. For cranes used one time per year or less, the MFFF will implement the "checkout" control for lifting mechanisms in the operating facility. Due to the differences in shipping packages, the shipping package gripper changes made at MELOX will not be implemented at the MFFF. Due to the differences in the shipping package handling process the MFFF does not require simultaneous movement in the vertical and horizontal direction, so this change will not be implemented at the MFFF.

11.10.1.2 System Interfaces

The heavy lift cranes interface with the building structure, the rails on which the cranes run, the girders that span the work area, the electric drives for the bridge, trolley, and hoist, local operating stations, and the lights and control systems for the cranes. The crane may be controlled by radio communication with the operator. In these cases, the interactions between the crane controls and the building security, process monitoring, and control systems will be considered.

As indicated in Chapter 4 of the CAR, DCS will maintain continuity of control over principal SSCs during and following the transition from design and construction to operations. This control will also extend to chemical safety as an integrated component of the ISA process to be performed by DCS in conjunction with submitting its application for a 10 CFR Part 70 operating license.

11.10.1.3 Design Bases of PSSCs

None of the current cranes or hoists have been identified as PSSCs in CAR Section 11.10. However, the applicant has described the means by which heavy lift cranes are prevented from moving over safety, confinement and other principal SSCs by the following means:

- By design: the handling crane cannot physically access over a PSSC, or is prevented by single failure proof interlocks from moving over PSSCs/

- By administrative control: the handling crane must be in its withdrawn position if a load must be transferred below a crane, safe travel paths must be followed to prevent interactions with other PSSCs, and lift height restrictions must be adhered to prevent lifts above design basis lift heights (Reference 11.10.3.7, RAI 217).

Several of the MFFF cranes have been identified as heavy lift cranes as defined in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." The design basis for non-PSSCs, discussed in the CAR references the following national codes and standards for the design, fabrication, and qualification of heavy lift cranes:

- CMAA-70, "Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes," 1994 edition

- ASME B30.2, "Overhead and Gantry Cranes," 1996 edition

- ANSI N14.6, “Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10,000 lbs or More,” 1993 edition

- ASME B30.9, “Slings,” 1996 edition

The CAR Section 5.0 discusses load handling events. A load handling hazard is postulated to occur from the presence of lifting or hoisting equipment used in normal or maintenance activities. A load handling event could be what a lifted load is dropped, the lifted load impacts other equipment during the lift, or the loading equipment impacts other nearby items. An event of this type could damage handled loads thereby dispersing nuclear material or chemicals, damage nearby equipment resulting in a loss of confinement or loss of subcritical conditions, or damage IROFS. These events were postulated to occur both inside and outside gloveboxes, in C2 areas, in AP process cells, and outside the MFFF involving Pu and MFFF, the waste transfer line, transfer containers, and DU containers.

The bounding load handling event postulated to produce the largest radiological consequences is a load drop of a jar containing plutonium inside a glovebox in the Jar Storage and Handling Unit. These jars contain the MOX master mix of which approximately 20 percent by weight of Pu. Therefore, load handling events involving cranes are bounded by the drop of a jar in the Jar Storage and Handling Unit.

The following causes have been identified by DCS for these events:

- Failure of handling equipment to lift or support load
- Failure to follow designated load paths
- Toppling of loads

11.10.2 EVALUATION FINDINGS

In Chapter 11.0 of the CAR, the applicant did not designate heavy lift cranes as PSSCs. Based on the staff’s review of the CAR and supporting information provided by the applicant relevant to the heavy lift cranes, the staff concurs with the applicant’s proposal that heavy lift cranes are not PSSCs required for protection against natural phenomena and the consequences of potential accidents.

11.10.3 REFERENCES

11.10.3.1 American Society of Mechanical Engineers (ASME). B30.2, “Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist Overhead and Gantry Cranes.” ASME: 1996.

11.10.3.2 ASME B30.9, “Slings,” 1996.

11.10.3.3 ASME B30.16, “Overhead Hoists (Underhung),” ASME: 1998.

11.10.3.4 Crane Manufacturers Association of American (CMAA). 70, "Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes." CMAA: 1994.

11.10.3.5 CMAA-70, "Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes," 1994.

11.10.3.6 Department of Energy (US)(DOE). DOE-STD-3013, "Stabilization, Packaging, and Storage of Plutonium-Bearing Materials," September 2000.

11.10.3.7 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE Response to Request for Additional Information, August 31, 2001.

11.10.3.8 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE Clarification of Responses to NRC Request for Additional Information, January 7, 2002.

11.10.3.9 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission RE Clarification of Responses to NRC Request for Additional Information, DCS-NRC-000083, February 11, 2002

11.10.3.10 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE Clarification of Responses to NRC Request for Additional Information, March 8, 2002.

11.10.3.11 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE Clarification of Responses to NRC Request for Additional Information, April 23, 2002.

11.10.3.12 Ihde, R, Duke Cogema Stone & Webster, letter to W. Kane, U.S. Nuclear Regulatory Commission, RE. Mixed Oxide Fuel Fabrication Facility—Construction Authorization Request, February 28, 2001.

11.10.3.13 Nuclear Regulatory Commission (US)(NRC). NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility." NRC: Washington, D.C. August 2000.

11.10.3.14 Persinko, A., U.S. Nuclear Regulatory Commission (NRC), memorandum to E.J. Leeds, NRC, RE: 10/16-18/2001 Meeting Summary: In-Office Review of DCS CAR Supporting Documents for the MFFF, November 6, 2001

11.10.3.15 Persinko, A., U.S. Nuclear Regulatory Commission (NRC), memorandum to E.J. Leeds, NRC, RE 11/27-29/01 In-Office Review Summary of DCS Construction Authorization Request Supporting Documents for the MFFF, December 18, 2001.

11.10.3.16 Persinko, A., U.S. Nuclear Regulatory Commission (NRC), memorandum to E.J. Leeds, NRC, RE 2/22/02 Phone Call Summary: DCS Construction Authorization Request Supporting Documents for the MFFF, February 28, 2002.