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PLANT SYSTEMS BRANCH

INPUT TO THE

SAFETY EVALUATION OF

MONTICELLO NUCLEAR GENERATING PLANTS

PROPOSED INTERIM PROGRAM FOR THE

OFFSITE SHIPMENT OF SPENT FUEL

1.0 Introduction

In response to our February 4, 1974 request, Northern States Power (NSP) submitted on October 1, 1974 the results of their analyses of the adequacy and consequences of utilizing the 70 ton IF 300, spent fuel shipping cask and the 85 ton bridge crane for the offsite shipment of spent fuel. The analyses indicated a number of areas where damage could result from a cask drop accident. Supplemental information was submitted on February 17, 1975 and May 30, 1975, assuming the use of the 70 ton IF 300 cask. In these reports, the licensee indicated that:

(a) the consequences of a cask drop was unacceptable;

(b) it is not feasible to modify the plant's structures to adequately increase their strength;

(c) the crane modifications would require roughly three years to complete once the extent of the crane modifications is established; and

(d) as an interim solution, to alleviate the present spent fuel storage problem, they proposed to use a 25 ton two element fuel cask until a permanent cask handling program can be established and implemented.

On January 22, 1976, NSP submitted its proposed interim offsite fuel shipment program and analyses using either the NFS-4 or the identical NAC-1 25 ton cask. Following a staff review of the interim proposal, NSP submitted supplemental information on June 16, 1976 and July 22, 1976 in response to our requests for certain additional information.

This evaluation is limited to the proposed interim fuel handling program. NSP is expected to submit a final report for NRC review and approval once a permanent cask handling program is established.

2.0 Evaluation

2.1 Other Crane Loads

In addition to the shipping cask, the overhead handling crane will be required to handle other heavy loads, such as the reactor vessel head, reactor internals and reactor vessel shield plugs, during refueling operations. NSP states that the loads associated with refueling will only be handled when the plant is in a cold shutdown condition. Also, the consequences of dropping one of these refueling loads has the potential of causing equipment damage but the event would not pose a safety hazard. Further, NSP stated that sufficient diversity exists in the plant design to maintain the reactor in a cold shutdown condition should one of the refueling loads be dropped.

To reduce the potential for equipment damage and to improve the future load handling capability during offsite shipment of fuel, NSP expects to complete the long term program of upgrading the overhead crane in approximately four years.

Providing that handling of the heavy refueling loads is limited to occasions when the plant is in a cold shutdown condition, we concur that sufficient diversity exists to maintain the plant in a safe cold shutdown condition in the unlikely event of a load drop. On this basis, we find the proposed approach acceptable.

2.2 Operational Capabilities of Crane Hoist

The proposed interim offsite fuel shipment program assumes the use of a NFS-4 or NAC-1 25 ton, shipping cask and impact limiter. Also, the maximum cask drop height will be limited to six inches when traveling over the prescribed path above the operating floor. Using these assumptions, NSP performed an analysis of the adequacy of the structure. The lowest factors of safety at the operating floor level were found to be 1.39 and 1.23 for the floor slab. (See the discussion in Section _____ by the Engineering Branch for an evaluation of structural adequacy).

In response to staff concerns regarding "two blocking" of the hoist, NSP has indicated that they will install two, directly actuated, redundant hoist upper limit switches on the upper load block assembly. Further, to provide additional assurance that the carrying height above the operating floor will not exceed six inches, NSP states that it will incorporate one of the following features in the program:

(a) disable the "up" circuit of the hoist control when the cask reaches the proper elevation; or

(b) set one of the redundant upper load block limit switches such that the hoist motor will stop automatically with the cask less than six inches above the operating floor.

In regard to staff concerns on the ability of the hoist to elevate the cask to an acceptable elevation above the operating floor, NSP states: (a) the minimum clearance required, to avoid having the cask hit the floor due to load swing caused by the application of either the bridge or trolley brakes, is 0.8 inches; (b) administratively, the minimum operating clearance between the floor and cask will be held to two inches to provide sufficient assurance that the cask will not hit the floor during a load swing; (c) the NSP operating experience with the existing hoist, obtained in handling heavy refueling loads, has demonstrated that the crane operator can accurately position the load within one-half inch of the desired elevation.

Therefore, NSP concludes and we concur that the hoist is capable of positioning the cask within the four inch band between the six inch maximum and two inch minimum elevation above the floor.

In the event of a cask drop accident, the analysis of the structural adequacy of the operating floor assumes the cask will follow a prescribed path of travel. Bright colored floor markings will define the path and serve as a guide to the crane operator during cask handling. NSP states there are no critical drop locations within about plus or minus 2 feet of this prescribed travel path. Further, NSP will install bridge and trolley limit switches to pre-

clude cask movement outside the north and west limits of travel required by the spent fuel shipping cask.

Contingent upon: (a) the adequacy of the structural review (see Section ); (b) the installation of two upper load block limit switches; (c) implementation of one of the two above described means to provide assurance that the cask will not be elevated more than six inches above the operating floor; (d) the installation of bridge and trolley limit switches limiting the north and west movements of the cask; and (e) the bright colored floor markings to define the cask's path of travel, we conclude that adequate interim measures have been taken, when handling a NFS-4 or NAC-1 cask above the operating floor (elevation 1027'-8") to preclude unacceptable consequences following a cask drop accident on the operating floor, and therefore, in this respect the proposed approach is acceptable. Furthermore, we expect that the interim offsite fuel shipment program will be replaced with a permanent cask handling program in approximately four years.

2.3 Precautions Taken To Preclude The Crane From Experiencing A Hard Stop

During the lifting of the shipping cask, several potential points exist where the load or load carrying members could encounter a hard stop (i.e., a rigid structure causing a sudden stop) that would create excessive dynamic loads which in turn could lead to the failure of a load carrying member and the loss of the load. One example of such a possibility is for the hoist lower load block to contact the upper load block while lifting the cask. The licensee indicated that the two upper limit switches, directly coupled to the drum rotation would

preclude the above described event from occurring. Considering the relatively short distance between the limit switch settings and where "two blocking" could occur, the staff expressed concern regarding this indirect method of establishing the upper limit height of the load and its accuracy. The potential for erroneous information by the present system exists if the cable should jump the cable drum grooves or if a failure should occur in the gear train that transmits load travel information to the limit switch actuator.

NSP, in response to staff concerns, has agreed to install two limit switches on the upper load block and thereby remove these uncertainties (also discussed in Section 2.2 above).

In addition, a hard stop may occur when the cask is lifted from the transporter. Should the bridge, trolley or cask transporter be improperly positioned during this lift, it is possible for the lower load block assembly or cask to be stopped by the underside of the floor at elevation 962'-6". To preclude such an occurrence, the following steps will be taken: (a) the bridge and trolley will be properly positioned over the equipment hatch prior to hoisting the cask; and (b) power to the bridge and trolley drive motors will be locked out to prevent horizontal movement while the cask is being raised clear of the transporter. Further, while hoisting the cask in the equipment hatch, the maximum lift speed will be limited to five feet per minute and thereby reducing the kinetic energy and the developed dynamic loads in the unlikely event that a hard stop should be encountered.

We conclude that the proposed interim measures are adequate to assure that a hard stop will not occur while lifting the cask in the equipment hatch and to ameliorate the effects in the unlikely event that a hard stop is experienced. Therefore, in this respect the proposed approach is acceptable.

2.4 Spent Fuel Shipping Cask

The NFS-4 shipping cask and lifting yoke will be transported to the plant site by a transporter. Impact limiters are attached to the cask to protect it from axial and radial accident impact loads that may be experienced during transport. In the NSP analysis of structural adequacy of the reactor building operating floor, it was assumed that the cask bottom head impact limiting device remains attached to the cask. The analysis takes credit for the resulting reduction in impact load due to its action.

The staff expressed its concerns regarding the potential effects of variations in crushing strength of the stainless steel encased balsa wood impact limiting device if it should become water logged. NSP states that the potential for water-logging of the balsa wood, when it is submerged in the storage pool, does not appear probable for the following reasons:

(a) the past operating experience with two 25 ton casks shows that in 2,500 setdown conditions, no observable damage or leakage has occurred to the impact limiter;

(b) in addition to the preoperational tests on the cask impact limiters, i.e., dye penetrant and leak tests, the impact

limiter is leak tested annually using the bubble check method at Nuclear Fuel Services (NFS). Furthermore, the cask is subjected to a thorough visual inspection at both the NFS facility and the reactor site; and

(c) during fabrication of the impact limiting device, each individual piece of balsa wood is coated with epoxy and once the pieces have been assembled, the entire assembly is recoated with epoxy. These epoxy coatings provide additional assurance that water-logging of the balsa wood is unlikely if the encasing stainless steel water barrier were to develop a leak.

We conclude that adequate measures have been taken to preclude a change in the impact limiting characteristics due to water-logging. Therefore, in this respect, the proposed interim program for offsite shipment of spent fuel, using the NFS-4 or the identical NAC-1 cask, is acceptable.

2.5 Adequacy Of Shipping Cask Trunnions And Handling Yoke

NSP states that the shipping cask's lifting trunnions and handling yoke, respectively, have safety factors at rated load of 5.7 and 3.0. Further, it is stated the handling yoke is proof tested to 130,000 pounds (65,000 pounds on each arm) based on a 250 percent load test criterion.

In response to a staff concern on the magnitude of the maximum possible dynamic loads imposed on the shipping cask trunnions and yoke by the hoists two spring loaded solenoid operated brakes,

NSP states that adequate allowance has been taken in the design for the dynamic loads incurred during cask handling.

We find that the information submitted in response to Item 11 does not adequately address the staff's concern and does not support the licensee's conclusion cited above when the following assumptions are made:

(a) the load is being lowered at its maximum speed;

(b) the hoist experiences a power failure thereby causing each of the two hoist brakes (each rated at 150 percent of the hoists rated load of 85 tons) to automatically set when handling the 25 ton shipping cask; and

(c) the least amount of distance separates the upper and lower hoist load blocks when the loss of electrical power is experienced.

We require that NSP perform a conservative dynamic analysis which demonstrates that the cask trunnions and handling yoke will not fail due to the dynamic loads created under the above listed assumptions.

2.6 Cask Drop In Equipment Hatch Area

Analyses have been conducted by NSP to predict the effects of a cask drop at two locations in the equipment hatch of the reactor building. The results are presented in Table 3-2 of the licensee's January 22, 1976 submittal. The two locations are designated as position numbers 7 and 8. Position number 8 is the location of the cask when it is being lifted from or lowered onto the transporter.

The cask will be elevated slightly to clear the transporter and yet not exceed 10 feet above the floor slab at this location. Once the cask has been raised clear of the transporter, the crane bridge and trolley will move the cask horizontally to a location denoted as Position number 7 in the equipment hatch area from which the lift will be continued until the cask is above the operating floor (93'-2" above the equipment hatch floor slab).

A three foot thick diagonal wall is located beneath the equipment hatch floor slab. This wall rests on the reactor building base slab. This diagonal wall and the reactor building walls form one of the four triangular corner compartments housing essential engineered safety feature equipment, i.e., two RHR pumps, one RHR heat exchanger and one core spray pump. The equipment hatch floor slab thickness between the diagonal wall and torus is a 68-inch thick concrete slab. In the portion of the triangular corner compartment beneath lifting location Position number 7 the equipment hatch slab is a 24-inch thick concrete slab.

At Position number 8, the impact area of the cask would be bisected by the junction of the 68-inch thick slab and the 36-inch thick concrete diagonal wall that rests on the base mat. At Position number 7 the impact area of the cask would be above the 24-inch thick concrete slab forming the ceiling of the corner compartment.

The NSP analysis shows that at Position number 8, the safety factor is 1.26 when a 25 ton cask is used and a drop height of 10 feet is assumed. At Position number 7, the potential cask drop height is 93'-2". At this location, the calculated safety factor is 0.14 indicating the slab cannot sustain a cask drop from a height of 93'-2".

The licensee has made the following statements in its submittal:

(a) "The crane system is not designed to be single failure proof and may be subjected to either single random mechanical or or control system failures"

(b) "The analyses results show that the 24 inch thick slab below elevation 935-0" at drop location 7 in the equipment hatch opening will not sustain a 93'-2" free drop of the cask."

We find that sufficient information has not been furnished to support the licensee's conclusion: "A drop down the equipment hatch would not impair the ability to complete a normal reactor shutdown or the ability to maintain cold shutdown conditions".

We have requested and will require NSP to furnish additional information relative to Item 12 and to supply any other additional information which will support the conclusion quoted above.