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NRC/TMI 86-060
June 20, 2986

Docket No. 50-320

Mr. F. R. Standerfer
Vice President/Director, TMI-2
GPU Nuclear Corporation
P. O. Box 480
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Dear Mr. Standerfer:

Subject: Canister Handling and Preparation for Shipment Program

References: (a) Letter 4410-86-L-0010, F. Standerfer to W. Travers, Canister Handling and Preparation for Shipment Safety Evaluation Report, dated February 17, 1986

(b) Letter 4410-86-L-0099, F. Standerfer to W. Travers, Canister Handling and Preparation for Shipment Safety Evaluation Report, dated June 11, 1986

Reference (a) forwarded for NRC staff approval your safety evaluation of the proposed canister handling and preparation for shipment program. Additional information was provided in discussions between members of our technical staffs on April 29, 1986, during which various questions and issues relating to your proposed program were addressed. Reference (b) then submitted a revision to the initial safety evaluation report. Your evaluation addressed the structural design of the canister handling and loading equipment, the canister preparation program necessary to assure packaging in accordance with the shipping cask certificate of compliance, heavy load handling, the on-site and off-site radiological consequences of the proposed program, fire hazards, and the potential impact of the proposed program on TMI Unit 1.

This letter transmits our safety evaluation and approval of the proposed canister handling and preparation for shipment program. Our evaluation, which is attached, determined that of the two methods proposed for verifying sufficient water removal from the defueling canister, only the proposed quantitative measurement technique is acceptable. Insufficient data has been

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presented to provide the necessary level of assurances that your proposed qualitative dewatering acceptance criteria is adequate to verify the minimum required canister void volume. In addition, implementation of the proposed program will be contingent upon our approval of the related procedures subject to Technical Specification 6.8.2.

Sincerely,

ORIGINAL SIGNED BY:
William D. Travers

William D. Travers
Director
TMI-2 Cleanup Project Directorate

Enclosure: As Stated

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NRC STAFF SAFETY EVALUATION FOR THE

DEFUELING CANISTER HANDLING AND

PREPARATION FOR SHIPMENT PROGRAM

1.0 Summary of Program

The licensee's canister handling and preparation for shipment (CHAPS) program includes all activities necessary to prepare and transfer a loaded defueling canister from its storage location in the 'A' spent fuel pool (SFP) to the fuel shipping cask, insertion into the shipping cask, and verifying that the shipping cask is prepared for transport in accordance with its certificate of compliance. It includes the activities associated with dewatering the canisters, purging the canisters with an inert cover gas, verifying that canister weights are in accordance with design specifications, verifying that the catalytic recombiners installed in the canisters are functioning, and verifying that a sufficient amount of water has been removed from the canisters to assure operability of the catalytic recombiners regardless of canister orientation.

2.0 Description of Equipment

The following is a brief description of the major components and systems to be used in implementing the CHAPS program.

2.1 Defueling Canisters

The licensee's defueling systems will load the core debris and related material into defueling canisters constructed of nominal 14 inch stainless steel pipe shells with appropriate end closures and related process connections and handling appurtenances. The canister design is described in detail and evaluated in references 7.1 and 7.2. The design is expected to provide effective confinement for transport and long term storage of the debris; to remain subcritical under all on-site conditions and, when in combination with the cask, during normal and accident transport conditions; and to provide effective control of radiolytically generated combustible gases.

2.2 Shipping Cask

The NUPAC 125-B shipping cask was designed specifically for transporting the loaded defueling canisters. It is a dry loaded rail shipping cask that can carry up to seven defueling canisters. It provides two testable levels of containment per the requirements of 10 CFR 71.63 and is designed to maintain this containment during the normal conditions of transport per 10 CFR 71.71 and during hypothetical accident conditions per 10 CFR 71.73. The shipping cask is described in detail in reference 7.3. The cask design was evaluated by the NRC staff as described in reference 7.4.

2.3 Cask Unloading Station (CUS)

The CUS is a movable lifting frame designed to remove and reload the shipping cask and its support skid from the railroad car. It straddles the rail car while in the fuel handling building (FHB) truck bay. The device attaches to the cask support skid, lifts the cask off of the car using four screw jacks mounted on the frame to allow removal of the rail car from the FHB, and then lowers the cask and support skid to the FHB floor. The skid is then attached to the floor support brackets. The CUS is designed to be removed from the cask loading area when not in use and transferred to a staging area using the FHB overhead crane.

2.4 Cask Hydraulic Lift Assembly (CHLA)

The CHLA is designed to raise the horizontal cask in a controlled manner to the vertical position for loading, and to return it to horizontal after closure. The CHLA consists of a hydraulic power system and two hydraulic cylinders which connect to the cask support skid at the bottom and to a lifting saddle attached to the cask lifting trunnions. The CHLA is not used to provide support or retention of the uprighted cask. Rather, the cask is supported by the jib crane support platform as described below.

2.5 Jib Crane Support Platform (JCSP)

The JCSP straddles the east end of the FHB truck bay over the cask loading area. It provides working access to the uprighted cask, a support platform for a 7.5 ton jib crane used for handling other cask supporting equipment, support for the mini-hot cell, and an attachment point for the upper end of the vertical cask. The cask will be uprighted to vertical using the CHLA. After uprighting, ratchet binders and screw jacks are used to attach the upper end of the cask securely to the JCSP. After securing the cask, a removable portion of the JCSP is set in place to allow 360° access to the top of the cask.

2.6 Shipping Cask Loading Collar (SCLC)

The SCLC is attached to the top of the uprighted cask after removal of the inner and outer closure lids. It provides a shielded indexing collar to align the canisters to one of the seven storage cavities in the cask inner vessel. It provides the interface between the cask and the fuel transfer cask. It consists of an inner stationary ring which is pinned to the cask inner vessel, and a shield collar which rests on and rotates around the inner ring. It has a sliding shield door that can open either to a hole in the center to align the canister to the center cask cavity, or can be opened to a hole near its edge to align a canister to one of the six outer cask cavities.

2.7 Mini Hot Cell (MHC)

The MHC is a small shielded transfer cask used for removal and installation of the shield plugs from the top of the seven canister holding cavities in the shipping cask. It interfaces with the cask through the SCLC and provides radiation shielding during canister shield plug removal and installation. The MHC has an integral hoist and grapple for handling the shield plugs and is moved between the cask and its storage location by the jib crane on the JCSP.

2.8 Fuel Transfer Cask (FTC)

The FTC is a cylindrical bottom loaded cask used to transfer a defueling canister from the SFP to the shipping cask. It is suspended from the FHB overhead crane. It will be lowered to the FTC loading station in the SFP where its integral grapple and hoisting mechanism will be lowered to engage a canister. The canister is then lifted up out of the water through a shielded platform into the shielded FTC. The bottom door of the FTC is closed and the entire unit is moved with the overhead crane to the shipping cask where it mates with the SCLC. The operation is then reversed to lower the canister into the shipping cask.

3.0 Structural and Load Handling Evaluation

The most significant aspects in the area of physical handling of defueling canisters and loading them into the shipping cask relate to the structural design of the equipment as pertains to heavy load handling, and the affect of mechanical failure of components.

The staff has completed a review of the licensee's submittal and determined that the licensee has invoked appropriate industrial codes, standards, and specifications in the design of the equipment to insure that canister handling and preparation for shipment can be performed safely.

The defueling canisters have been designed and fabricated as ASME Section VIII coded pressure vessels. They are designed to withstand the effects of unrestrained drops of 6 feet-1½ inches in air followed by 19 feet- 6 inches in water or 11 feet-7inches in air and still maintain fuel debris confinement in a critically safe geometry. Such performance bounds all postulated canister drops during handling except for a potential drop from the FHB overhead crane in the truck bay. This potential drop is discussed later in this report. The detailed structural evaluation of the canisters is discussed in references 7.1 and 7.2 .

The shipping cask is designed to the requirements of 10 CFR 71 and the applicable industrial codes and standards. The detailed evaluation is presented in references 7.3 and 7.4.

The CUS is designed in accordance with ANSI N14.6, and is designed to accommodate the effects of both static and dynamic loads. The system complies with Section 6 of ANSI N14.6 in that the lifting jack design is such that no single failure will cause an uncontrolled lowering of the load. In the unlikely event of total catastrophic failure of the CUS, the result would be a drop of the loaded cask which weighs about 80 tons (without the impact limiters) a distance of about five feet to the FHB floor with no compromise of the package integrity. The cask will be positioned such that this load drop event can occur only outside of the load handling exclusion area of the FHB. This load handling exclusion area has been imposed because of the presence of redundant electrical circuits beneath the floor, one of which is required to be operable to assure the safe shutdown capability of TMI Unit-1. Prohibiting load handling in this area prevents floor impacts that could potentially impair both circuits. Consequently, an event of this kind will not cause failure of safety related equipment that would result in loss of required safe shutdown functions at TMI Unit-1.

The CHLA is designed with redundant hydraulic cylinders either of which is capable of restraining the full weight of the cask. In the event of hydraulic system failure, the cylinders are provided with hose break valves. These valves are essentially excess flow check valves which prevent uncontrolled lowering of the cask following a loss of hydraulic pressure.

The MHC jib crane is designed in accordance with ANSI B30.11 and has a design safety factor of 10:1 to ultimate material strength based on a 7.5 ton load rating. The lifting system integral to the MHC is designed to ANSI B30.16 with a safety factor of 10:1 to ultimate material strength when used for handling a single shield plug. The FTC hoisting system is also designed to ANSI B30.16 with appropriate safety factors applied to the load bearing components when handling the intended loads.

The fuel handling building crane has been evaluated by the NRC staff against the requirement of NUREG 0612, "Control of Heavy Loads at Nuclear Power Plants", and has been determined to be acceptable for heavy load handling. The details of this evaluation are documented in reference 7.5.

In addition, the licensee has defined load travel pathways such that the potential for dropped loads impacting important to safety components is minimized.

Based on the above, the staff has determined that the design of the fuel handling equipment associated with the CHAPS program is adequate to assure that the probability of a load drop is extremely small, and, based on reference 7.6, the potential releases of radioactive material that may result from a related load handling accident would produce offsite doses that are well within the 10 CFR 100 limits.

The staff has concluded that the load handling aspects of the CHAPS program can be carried out without undue risk to the health and safety of the public.

4.0 Canister Preparation

The canister preparation aspects of the CHAPS program involve verification of final canister weights, verification that the catalytic recombiners are functioning, and verification that the canisters have been dewatered sufficiently to insure that the catalytic recombiners remain operable regardless of canister orientation.

4.1 Verification of final canister weights is performed to assure that the canisters conform to the design limits factored into the canister structural and criticality analysis, and to assure that cask loading conforms to the requirements of the certificate of compliance for the NUPAC-125B shipping cask. It also provides a means of verification of canister integrity by confirming that there has been no water inleakage during storage in the SFP. The canisters are weighed by the weighing systems integral to the canister handling bridges. The licensee will implement administrative procedures that provide for adequate determinations and documentation of canister tare weight, loaded weight, and dewatered weights to insure conformance to the applicable loading specifications of the shipping cask Certificate of Compliance and references 7.1 and 7.2.

4.2 The canisters are designed with catalytic recombiners to prevent the buildup of radiolytically generated combustible gases during shipment. The recombiner design was evaluated in references 7.1 and 7.2.

The shipping cask Certificate of Compliance (CofC) (reference 7.4) requires that the hydrogen and oxygen generation in a canister must be controlled so that hydrogen concentration remains no more than 5 percent by volume at STP or the oxygen concentration remains no more than 5 percent by volume at STP over a period of time that is twice the expected shipping time. It further requires that the elapsed time between canister closure and purging and completion of shipment of that canister be no more than the period of time during which the canister gas concentration will be below these specified limits.

The licensee will determine the gas generation rate in each canister by one of two means. Either a gas sample will be obtained from a dewatered canister, or the canister pressure will be measured and compared to the pressure recorded at the time of final dewatering. These checks will be performed after the canister has been dewatered and allowed to remain in the storage pool for a period of time. The length of time necessary to reach the maximum allowable gas concentration will be calculated from the gas appearance rate. This time period will be used to determine a maximum on site storage time which would permit shipment within the time constraints specified in the CofC. The gas monitoring program will be implemented through appropriate procedures reviewed and approved by the NRC staff.

4.3 Canister dewatering is required to assure that there is sufficient void volume in the loaded fuel canister for the accumulation of radiolytic gases without overpressurizing a canister. In addition, there must be sufficient void volume to assure that at least half of the installed catalytic recombiners are not submerged in free water regardless of canister orientation. This aspect of canister design is discussed in reference 7.1 and 7.2. At all times, the void space within the canisters must be equal to or greater than one-half the free empty volume of the canister.

The licensee has proposed two methods to verify that this specification is met. The first involves quantitative measurements. The weight of a filled and flooded canister will be compared to the weight of the canister after dewatering. The difference will be the weight of water removed and can be used to calculate the remaining canister void volume. The staff has determined that this method, if implemented through appropriately controlled procedures is acceptable to assure that the canister void volume meets the design specifications. The second method proposed by the licensee is a qualitative method which allows purging of a canister with inert gas until no further water is removed. The staff has determined that this method does not provide for an acceptable quantitative determination to verify conformance to the design specifications.

The staff has concluded that the licensee's proposed program for canister weight verification, catalytic recombiners, operation verification, and for quantitative canister void volume determination are acceptable and will provide reasonable assurance that the canisters can be shipped in the NUPAC-125B shipping cask in compliance with the cask certificate of compliance.

5.0 Radiological and Environmental Considerations

All systems and components used in the licensee's proposed CHAPS program have been designed with appropriate engineered features to minimize the radiation exposure to plant personnel. Operation of the equipment will be performed by personnel trained in normal radiation protection practices, and will be controlled by approved procedures that incorporate normal radiological controls. The licensee has performed a radiological review of the proposed activities and has projected a total dose commitment for the CHAPS program of 184 person-rem. The staff review of the licensee's estimate concluded that it is based on expected manhours needed for the proposed tasks and the maximum radiation levels expected at various locations. The projected occupational exposure is within the scope of consideration made in the staff's Programmatic Environmental Impact Statement.

The proposed activities are not expected to increase airborne radioactivity in the fuel handling building nor do they present any greater potential for spills of radioactive liquids other than those previously analyzed. Since the activities will be performed within the FHB with the normal ventilation system in operation, planned CHAPS activities do not present a potential for any abnormal environmental releases. The analysis of a dropped fuel canister presented in reference 7.6 bounds the worst case handling accident postulated during the CHAPS program. That analysis determined that the worst case offsite dose commitment from this accident is less than 20 percent of the 10 CFR 100 limits.

The licensee's analysis also demonstrates that normal activities associated with the CHAPS program will not result in radiation levels in excess of 2.5 millirem per hour in any exposed areas of TMI-Unit 1. The program will have no adverse impact on the operation of TMI Unit 1.

6.0 Conclusion

The staff has completed its review and determined that the licensee's proposed canister handling and preparation for shipment program complies with the applicable regulatory requirements.

Equipment has been designed to the requirements of industrial codes and standards acceptable to the NRC staff. The licensee has presented an analysis which provides reasonable assurance that the program will be accomplished in accordance with procedures that are sufficient to assure compliance with the applicable license conditions. The proposed activities do not present the possibility of any accident not previously analyzed nor do they change the likelihood or consequences of any previously analyzed accident and margins of safety as previously analyzed are not reduced. The staff concludes that the program does not require changes to the plant technical specifications and does not constitute an unreviewed safety question. The scope of the proposed activities and the associated environmental impact are within those previously considered in the Programmatic Environmental Impact Statement. The activities do not pose a significant risk to the occupational work force or the public. The proposed canister handling and preparation for shipment program as described in this SER is therefore approved contingent upon the submittal of the applicable procedures subject to Technical Specification 6.8.2.

7.0 References

7.1 Letter 4410-85-L-0183, F. Standerfer to B. Snyder, Defueling Canister Technical Evaluation Report, dated September 10, 1985.

7.2 Letter NRC/TMI 85-083, W. Travers to F. Standerfer, Defueling Canister Technical Evaluation Report, dated November 5, 1985.

7.3 Safety Analysis Report for the NUPAC 125-B Fuel Shipping Cask, Docket No. 71-9200, dated January 1986.

7.4 Certificate of Compliance 9200, Revision 0, for the Model No. 125-B Shipping Container, dated April 11, 1986, and the attached NRC Staff Safety Evaluation Report.

7.5 NRC letter, Docket No. 50-289, J. Stolz to H. Hukill, dated January 11, 1985.

7.6 NRC letter, Docket No. 50-320, B. Snyder to F. Standerfer, dated November 5, 1984.

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