NORTHEAST UTILITIES

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WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

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April 30, 1987

Docket No. 50-336
B12504
Re: 10CFR50.36

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Millstone Nuclear Power Station, Unit No. 2
Storage of Consolidated Spent Fuel

In May, 1986,(1) Northeast Nuclear Energy Company (NNECO) submitted to the NRC Staff a request to amend its operating license, No. DPR-65, for Millstone Nuclear Power Station, Unit No. 2, to allow storage of consolidated spent fuel in the Unit No. 2 spent fuel storage pool. As a result of the NRC Staff review of this proposal, the NRC Staff forwarded to NNECO a Request for Additional Information (RAI).(2)

In a subsequent telephone conversation with the NRC Staff on March 17, 1987, the Staff stated that issuance of the requested license amendment would not be delayed pending resolution of this RAI and that the requested license amendment would be issued without proposed Technical Specification (TS) 3.9.19, which is addressed by the RAI. The Staff also stated that all other technical issues have been adequately addressed and that no further NNECO action is necessary for NRC issuance of the license amendment.

The purpose of this letter is to document our understanding of the status of the proposed license amendment and to provide the NRC Staff with the response to this RAI.

NRC Inquiry #1

Proposed TS 3.9.19 would require that candidate fuel assemblies (for consolidation) must have decayed for at least 5 years. Please provide a justification for the proposed decay time in terms of the consolidation process. In this regard, you should provide a complete description of the consolidation process and an associated safety analysis.

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(1) J. F. Opeka letter to A. C. Thadani, dated May 21, 1986, "Millstone Nuclear Power Station, Unit No. 2; Proposed Change to Technical Specifications, Storage of Consolidated Fuel."

(2) D. H. Jaffe letter to E. J. Mroczka, dated March 9, 1987, "Request for Additional Information, Millstone Unit No. 2, Spent Fuel Consolidation."

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Response

The proposed TS 3.9.19 requiring that candidate spent fuel assemblies (for consolidation) have a 5-year decay time is not based on consolidation process considerations.

The May 21, 1986 submittal identifies that the thermal hydraulic design of the consolidated fuel storage box, as well as the design basis heat load for the spent fuel pool (with respect to 688 consolidated boxes), is based upon the 5-year decay criterion. (Refer to submittal pages 1-1, 1-5, 3-11 and Table 3.2-2).

This information is consistent with the March 30, 1984 submittal(3) to the NRC on NNECO's Spent Fuel Disposition Plans for Millstone Unit No. 2 and the May 17, 1984 Summary Meeting with the NRC in Bethesda, Maryland, as documented in the NRC Minutes, dated June 4, 1984.(4) Furthermore, the NRC Minutes identify that the 5-year decay criterion was specifically discussed as a conservative design basis for the storage of consolidated spent fuel.

Attached, for your information, is a copy of a system description on the consolidation process intended for use at Millstone Unit No. 2. Safety evaluations of this consolidation process are currently being conducted. NNECO intends to submit the results of these evaluations to the NRC Staff when complete.

NRC Inquiry #2

TS 5.6.3 provides for a total of 1346 storage locations in the spent fuel pool. The practical limit for fuel storage is 1277 locations due to the need to allow 5 years for decay time of fuel assemblies prior to consolidation. The remaining 69 locations would contain cell blocking devices. You should propose a revised TS 5.6.3, limiting storage to 1277 locations, or justify the need for 1346 locations.

Response

The above referenced paragraph 5.6.3 is the Capacity description that appears in the DESIGN FEATURES portion of the Technical Specifications. The purpose of this description is to delineate the actual number of storage cells associated with the spent fuel rack inventory in the pool. This description does not establish the spent fuel capacity of the pool which is determined by;

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(3) W. G. Counsil to J. R. Miller, dated March 30, 1984, "Millstone Nuclear Power Station, Unit No. 2 Spent Fuel Disposition Plans for Millstone Unit No. 2."

(4) D. B. Osborne to Northeast Nuclear Energy Company, dated June 4, 1984, "Summary of Meeting with NNECO on Spent Fuel Disposition Plans for Millstone Unit No. 2."

1. A letter to the NRC Staff, dated May 21, 1986, which states the capacity as 1965 fuel assemblies.

2. Attachment 2 to the May 21, 1986 letter, which states on page 1-5, that the storage restrictions and thermal load restrictions imposed by the cooling system establish the maximum spent fuel capacity of 1965 to be distributed as:

10	spare cells
362	intact fuel assemblies with less than 5-year decay
217	reserved for full core offload
688	cells containing consolidated fuel @ 2:1 (equivalent to 1376 intact fuel assemblies)

3. Attachment 1 to the May 21, 1986 letter, the proposed TS 3.9.20 establishes the storage configuration requirements surrounding the presence or absence of the cell blocking device in Figure 3.9-2 of the submittal.

   If the cell blocking device is surrounded by consolidated fuel, it may be removed and a consolidated storage box placed in the cavity location. However, the cell blocking device's primary function is to prevent inadvertent usage of the blocked location when the area is occupied by intact spent fuel assemblies.

   Statement (2) above indicated that 362 intact assemblies with less than a 5-year decay comprised part of the total capacity. Specifically, 157 intact assemblies would reside in Region I and 205 intact assemblies would reside in Region II, requiring 69 blocked locations to support the criticality bases for the assemblies in Region II.

   Therefore, in order for the total spent fuel pool capacity to support a total spent fuel assembly inventory of 1965, the total spent fuel rack capacity must be 1346 (i.e., 1277 plus 69), as stated in DESIGN FEATURE Section 5.6.3.

We trust you find the above information responsive to your request.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

E. J. Mroczka

E. J. Mroczka
Senior Vice President

cc: W. T. Russell, Region I Administrator
D. H. Jaffe, NRC Project Manager, Millstone Unit No. 2
T. Rebelowski, Resident Inspector, Millstone Unit Nos. 1 and 2

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Attachment 1

Fuel Consolidation Demonstration
Program Description

April, 1987

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FUEL CONSOLIDATION DEMONSTRATION PROGRAM

SYSTEM DESCRIPTION

A consolidation concept has been developed which permits the coordinated disassembly of spent fuel assemblies and subsequent repackaging of the rods into dense close packed arrays. For this program, the actual in plant work will be performed in the Millstone II spent fuel pool cask laydown area. Here, as shown in Fig. 1, the respective work stations, fuel support components, hoisting equipment, filtration system, and various handling tools, which comprise the consolidation system, are installed. Also located within this general area is the main control console from which operations are maintained and controlled. A temporary storage rack, which is serviced by both the fuel handling machine and the consolidation system hoist, holds intact and consolidation assemblies.

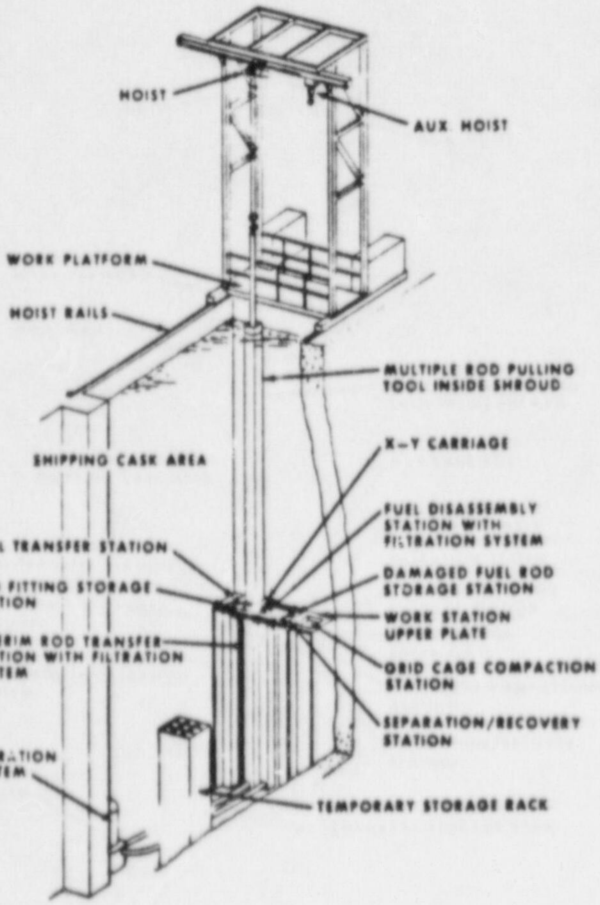

Fig. 1. Fuel Consolidation Equipment Layout.

Fuel assemblies to be consolidated, having a minimum of 85% burnup and 5 years' subsequent residence time in the pool, are deposited in the temporary storage rack by the spent fuel handling machine. Consolidation takes place in the work station frame, which supports seven individual work stations. A traversing carriage on the work station upper plate aligns fuel manipulating equipment accurately with the individual stations.

The fuel is dissembled in the first station by cutting off the upper end fitting and then removing fuel rods singly or up to one row at a time by means of a multiple rod pulling tool (MRPT). Rod pulling forces are maintained between preset limits. Fuel rods are then deposited in an interim transfer canister (ITC) at the next work station. The ITC has channels which guide the rods into a close packed triangular array at the bottom. Damaged fuel rods are deposited in the damaged fuel rod storage station after being separated form the row in the separation/recovery station. The fuel rods in the ITC are normally transferred by gravity into a consolidated fuel storage box located in the next work station. Descent of the rods is controlled by a telescoping cylinder through the bottom of the box. A rod transfer tool can also be used to assist in this operation if required. The close packed triangular rod array results in a compaction ratio of 2:1. Lockable covers are installed on the filled consolidation fuel boxes before they are removed for storage in the spent fuel pool.

Fuel assembly end fittings are placed in storage boxes at the end fitting storage station, for storage in the fuel pool since they have high activity. Zircaloy grid cages and control guide tubes have much lower activity and are compacted by hydraulic cylinders in the compaction station, for transportation to a radwaste disposal facility.

A filtration system is connected to the fuel disassembly, ITC, transfer and compactor work stations to collect and filter out radioactive particulates generated by operations performed at these stations. The MRPT is enclosed by a shroud assembly which provides guidance and alignment, and vents released gases to the plant gas handling system.

The consolidation system is controlled from a panel at a work platform on the hoist assembly. Control logic is programmable to allow for changes as experience is gained. A TV system is provided for remote viewing of all consolidation operations. The overall process is depicted in the Fig. 2 flow chart.

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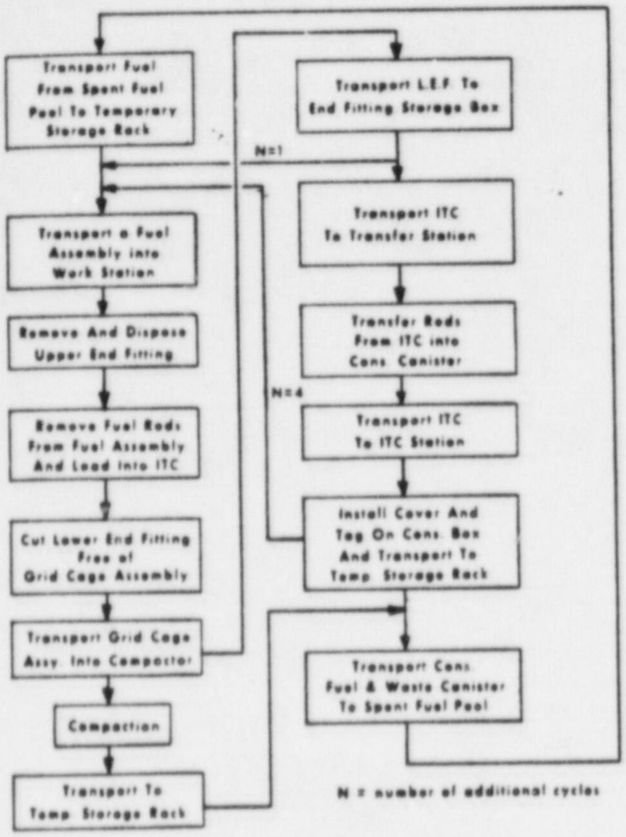

Fig. 2. Process Flow Chart.

EQUIPMENT DESCRIPTION

The following equipment has been designed and fabricated for use in the program.

Interim Transfer Canister (ITC)

The ITC, shown in Fig. 3, serves to guide the rods from a rectangular array into a triangular array. This is accomplished by providing each rod with a straight-line path from top to bottom, through an upper gridded section and a lower section of gradually occurring converging corrugations.

Attached to the bottom of the canister is a gate mechanism, which supports a transferable bottom during loading and while transporting fuel from the ITC station to the transfer station. The gate mechanism also allows the transfer piston to pass through and accept the load of the fuel rods. Actuation of the gate mechanism allows for the release of the floor for a controlled transfer of rods from the ITC into the consolidated canister, the floor then becoming the base of the consolidated canister.

Guide Tube Cutter

A guide tube cutter is used to disassemble the fuel assembly. The guide tube cutter is a single-pass, internal tubing cutter. The consolidation system requires the use of three variations of this cutter for Millstone II fuel, because there are three possible diameters to contend with in removing upper and lower end fittings. They are as follows:

1. Upper end fitting removal of an unsleeved fuel assembly.
2. Upper end fitting removal of a sleeved fuel assembly.
3. Cutting within the necked-down area of the guide tube for removal of the lower end fitting.

The commercially available cutter tool bit angles utilized in the guide tube cutter have been optimized to give reasonable cutter life with an improved cut, which has no "curlycue" or loose fragment, while also providing good penetrating characteristics.

Fig. 3. Interim Transfer Canister.

Mulitple Rod Pulling Tool (MRPT)

The multiple rod pulling tool as shown in Fig. 4 is comprised of three sub-assemblies: the pulling head, the shroud and, the mast.

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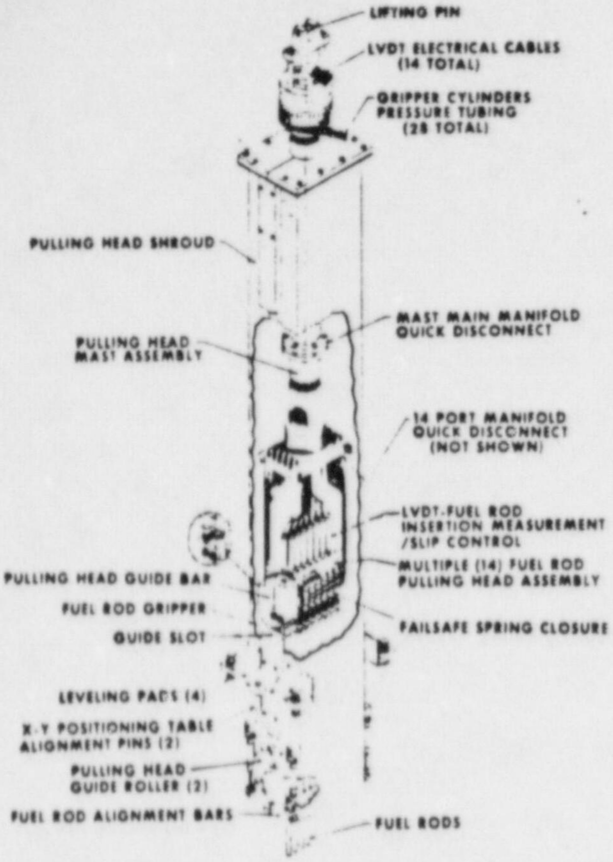

Fig. 4. Multiple Fuel Rod Pulling Tool.

The shroud assembly sits on a X-Y positioning table and can be located above any of four stations (i.e., fuel disassembly, ITC, separation, or damaged fuel rod). The mast and pulling head assemblies are supported on the hoist assembly, and are guided by their shroud during their vertical travel. The pulling head is the mechanism that graples from one to fourteen fuel rods for removal from the fuel assembly. The grippers of the pulling head can be oriented to pull up to one row of fourteen rods. Each gripper can be individually controlled from the main console to either release a rod, or pull the rod with a maximum preset force. Preloaded springs provide fail-safe gripper closure and a detection system provides information to control logic regarding rod penetration into the grippers and rod slip. Detection of rod slippage immediately stops the hoist pull and informs the operator of which rod has slipped.

The fully enclosed shroud is vented to the plant's gas handling system to capture any released gases. Remotely retractable fuel rod alignment bars are located at the bottom of the shroud. The alignment bars are retracted to allow the pulling head to exit the shroud and [illegible]ple the fuel rods. As soon as the pulling head is lifted past them, the alignment bars, are closed to maintain precise fuel rod alignment for correct insertion into the ITC. These fuel rod alignment bars are also designed to gauge the maximum allowable rod diameter. If a fuel rod has an excessive diameter or localized blister, it will not pass through the alignment bar. Rod slippage will occur and identify a possibly damaged rod. The alignment bar is then partially retracted to allow the localized deformation to pass by, and then closed to continue alignment and gauging operations.

Filter System

The filter system consists of two pump and filter units running in parallel, manifolded to four work stations to provide positive downward flow in each station. The pump and filter units are sized to ensure sufficient velocity at the MRPT and work station interface in order to entrain and filter out released crud before it can disperse within the cask laydown area.

The filtering occurs in several stages to minimize filter usage and therefore minimize the volume of waste products. A strainer at the pump inlet protects the pump from large chips. The filter also collects zirconium alloy chips which may be released in the consolidation effort. Downstream of the pump are two additional stages of filtering.

Volume Reduction System/Compactor

The volume reduction system depicted in Fig. 5, is a hydraulic powered compactor which systematically shears sections of the grid and grid guide tube assembly and compacts each section in three directions to form briquettes. The briquettes are then loaded into a waste box and further compacted to achieve a 10:1 compaction ratio.

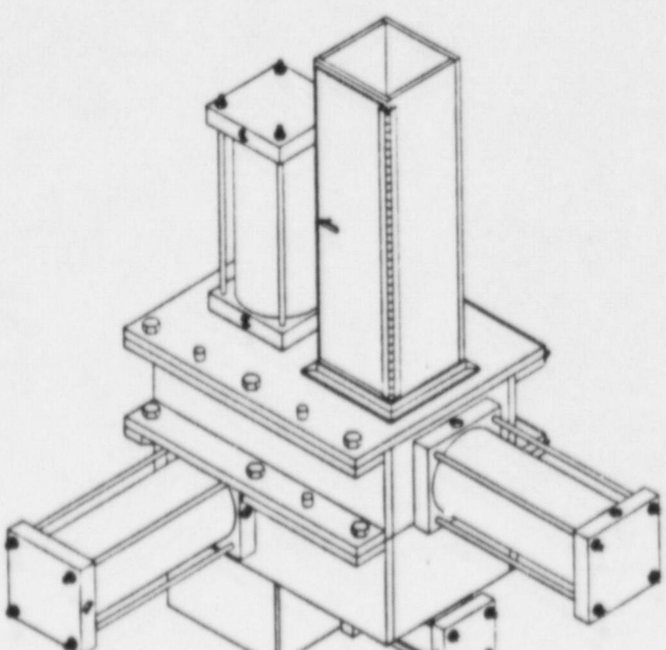

Fig. 5. Compactor.

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Temporary Fuel Storage Rack

The temporary fuel storage rack is a free-standing assembly, located within the cask laydown area, and is used to temporarily store 9 fuel assemblies in a 3x3 array for batch processing. The spent fuel pool can then be isolated from the processing area by installation of the cask laydown gate, thus minimizing crud infiltration and accidental contamination of the spent fuel pool during the fuel consolidation process.

Hoist Assembly

The gantry styled hoist assembly, similar in design to the spent fuel handling machine, spans the cask laydown area, and the assembly is guided on parallel rails installed at deck level. The track rails extend beyond the cask laydown area to permit "parking" of the hoist assembly in a remote area, allowing the spent fuel handling machine to maneuver within the cask laydown area. The hoist assembly has a 6,000 pound load capacity with a total vertical travel of 52 feet, 22 feet of which is above deck level.

Control Console

The main control console, located on the work platform of the hoist assembly, houses a programmable controller and the read-outs and controls for the hoist assembly, compactor system, multiple rod puller, filter system, X-Y positioning table and TV system. This programmable controller monitors the entire fuel consolidation process, and the controller interfaces the logic of the numerous controls to minimize operator error. In addition, the programmable controller facilities modification of the process logic as experience is gained.

Lower Work Platform

The main fuction of the lower work platform is to support the individual stations listed below:

1. Fuel Disassembly Station
2. Interim Transfer Canister Station
3. Damaged Fuel Rod Station
4. Separation/Recovery Station
5. End-Fitting Station
6. Fuel Rod Transfer Station
7. Compactor Station

The lower work platform is supported by the cask laydown area floor. Adjustable support pads are incorporated into the lower work platform design for proper leveling and load distribution. The platform is located and stabilized by brackets tied to pool wall embedments.

TV System

A three camera TV system monitors all aspects of the process. The monitors and a video recorder are located in the main control console on the work platform.

Consolidated Fuel Storage Box

The consolidated fuel storage box shown in Fig. 6, is sized to accept the fuel rods from two fuel assemblies reconfigured into a tightly packed triangular array. The consolidated fuel storage box contains the floor which is transferred from the interim transfer canister to the fuel storage box. The floor design includes flow holes to allow for cooling of the consolidated fuel assembly. A locking cover assembly is installed into the upper portion of the consolidated fuel storage box to contain the fuel rods. The cover design permits grappling of the loaded storage box in a manner similar to grappling of the spent fuel assembly. A locking tab, not designed to be removable, provides for visual fuel accountability.

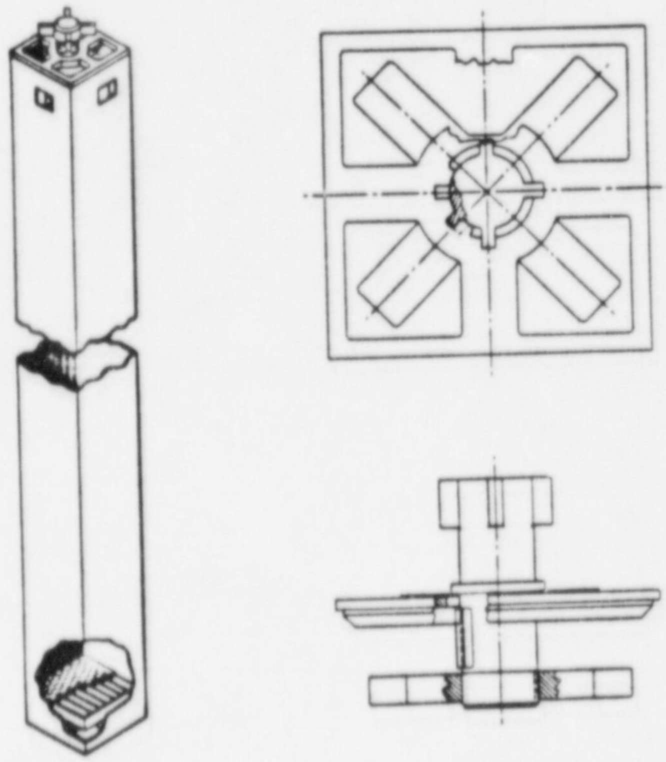

Fig. 6. Consolidated Fuel Storage Box and Cover Assembly.

METHODS DEVELOPMENT AND TESTING

The fuel consolidation process results in rearrangement of fuel rods from a square or triangular pitch and from a spaced to tight packed array. The analytical methods used to satisfy safety and licensing requirements for seismic, criticality, and thermal hydraulic design analysis were modified to account for these changes. The following discussion highlights the work completed on this aspect of the program.

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Storage Box Loading Configuration Testing

The goal of this effort was to achive a 2:1 consolidation ratio. Packing test with actual depleted UO_2 rods having the dimensions of Millstone II fuel were performed and a optimum storage box was designed. The resulting metal to water ratio has been used for seismic, criticality, and thermal hydraulic modeling and analysis.

Seismic and Structural Testing

The purpose of this work was to develop analytical models and methods for seismic analysis of spent fuel racks and storage pools. Full scale tests covering load deflection, local stiffness and forced vibration of a loaded storage box have been performed to determine characteristics not easily determined by analytical means. Based on this work, model/test correlation of natural frequency, damping and local box stiffness properties was performed. Further, a model for the storage box/fuel rack/fuel pool combination was developed for use in non-linear time history seismic analysis.

Criticality

The purpose of this work was to revise the normal light water criticality analysis methods for higher rod density and triangular rod pitch. A calculational model has been developed for use in design and licensing of consolidated spent fuel racks and has been defined and vertified against existing critical experiments. This model is based on a homogenized fuel module representation and 16 neutron energy groups which is suitable for design use in both KENO and DOT type analyses. The model yielded multiplication factors for critical experiments which are comparable to those obtained with 123 neutron energy group KENO calculations employing a more detailed spatial model.

Another aspect of this work is the evaluation of EPRI methods for reactivity monitoring and the testing of a reactivity monitor for use in a hot consolidation demonstration at Millstone II.

Thermal Hydraulics

The objectives of this work were to:

1. Develop analytical methods for use in evaluating consolidated spent fuel pool thermal hydraulics by modifying appropriate existing T-H computer codes. VIPRE, GFLOW, and CEPOOL were examined and CEPOOL was selected for design analysis because it is a proven licensing tool, is more conservative and requires less computer time than the others.
2. Perform heated flow tests to provide thermal hydraulic data for triangular pitch flow channels to verify analytical T-H methods. A test program has been completed on a full scale 19 rod triangular pitch heated test section with rods in contact. Test results indicate significant conservatism in analytical methods for friction pressure drops and for these tight packed arrays the decay time prior to consolidation may be reduced.
3. Perform T-H design analysis to demonstrate that the consolidated spent fuel storage design meets the criteria that bulk boiling of the pool does not occur and that maximum fuel clad temperature does not exceed 650°F during both normal operation and accident conditions. This work has resulted in a consolidated storage rack design which meets the thermal hydraulic design criteria.

DESIGN AND ANALYSIS

In this phase of the program, the analytical methods developed were utilized to complete detailed design and fabrication of the consolidation hardware. Also, the developed analytical methods for seismic, criticality, and thermal hydraulics were used to design racks for storing consolidated fuel.

Radiological Considerations

It was concluded that fuel consolidation can be performed at Millstone II with the system developed in the program with minimal exposure to the plant operators. In general, radiation levels due specifically to normal consolidation operations are very low relative to the spent fuel storage pool area radiation level. In the case of consolidation equipment malfunction, the operator dose is well within NU's administrative limits, which are themselves more stringent than 10CFR20 limits. It was also concluded that, in the most severe accident postulated during fuel consolidation, the dropping of a loaded consolidation storage box, the site boundary dose is well within 10CFR100 limits.

Spent Fuel Pool Cooling

The plant spent fuel cooling system capacity was found to be insuffiecent for the normal operation design basis condition with the maximum quantity of spent fuel stored in the pool. The addition of a heat exchanger or technically specifying the allowable pool temperature was recommended. No change was necessary to conform to the abnormal operation (fuel core offload) design basis.

It is recomended that the cask laydown pool water be kept isolated from the spent fuel storage pool water by means of the transfer gate during consolidation operations to prevent contamination from entering the spent fuel pool. A submersible filtration unit should be available to clean up any accidental release of crud to the cask laydown pool. Separate cooling should be provided for the removal of heat generated in the cask laydown pool by fuel assemblies awaiting consolidation

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and while being consolidated. Circulation of cooling water through a simple pipe loop immersed in the pool would be adequate. The decay heat from candidate assemblies is low since they must have reached 85% of design burnup and have been discharged from the reactor for at least five years.