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JPN-79-35

Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. Thomas A. Ippolito, Chief
Operating Reactors Branch No. 3
Division of Operating Reactors

Subject: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Spent Fuel Storage Expansion

Dear Sir:

In response to your letters dated March 15, 1979 and March 21, 1979 requesting additional information relative to our submittal of July 26, 1978, "Increase Spent Fuel Storage Modification" for the James A. FitzPatrick Nuclear Power Plant, we are submitting the following attached information.

Very truly yours,

Paul J. Early
Assistant Chief Engineer-Projects

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JAMES A. FITZPATRICK NUCLEAR POWER PLANT

HIGH DENSITY SPENT FUEL STORAGE RACKS

NRC QUESTIONS

QUESTION 1

You stated in your July 26, 1978, submittal that the dose rates above the spent fuel pool are expected to be 10 mrem/hour. Justify why this radiation field will be as low as reasonably achievable (ALARA) during the proposed pool modification. Relevant experience at nuclear power plants show typical values, in the vicinity of spent fuel pools of 1 to 2 mrem/hour. Your response should consider increased purification system operation, increased filter-demineralizer change out frequency, or relocating certain tools and components stored in the pool.

RESPONSE

The July 26, 1978, submittal should have read that the maximum exposure that could be received above the spent fuel pool would be 10 mrem/hr. Recent surveys show that typical values for spent fuel pool area radiation levels are on the order of 1 to 2 mrem/hr. Relocation of tools stored on the floor around the fuel pool has significantly reduced the dose rate in this area. No increased purification system operation is necessary as water chemistry indicates optimum conditions at present.

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QUESTION 2

Identify the principal radionuclides and their typical concentrations in the spent fuel pool water found by gamma isotopic analysis prior to and following refueling. Provide the dose rate above the spent fuel pool and at the pool edge from these concentrations, including crud build-up along the sides of the pool, as compared to the dose rate contribution to the "10 mr/hr... from tools and components stored around the pool." Estimate the compatible occupational exposure, in annual man-rem, due to all operations associated with fuel handling in the spent fuel pool area, from the aforementioned sources. Demonstrate that storage of the tools and components in the spent fuel pool, with commensurate increase in background radiation levels in the SFP operations area, is compatible with achieving ALARA exposures in operating personnel.

RESPONSE

The results of a recent analysis of the fuel pool water is shown below. The concentrations for these radionuclides are less than the maximum permissible concentrations allowed in 10CFR20, Appendix B, Table II, Column 2 for radioactive material in an unrestricted area. Fuel handling is performed from a bridge which is approximately 5 feet above the water. Dose rate readings taken from the bridge are less than 2 mrem/hr in all cases and less than 1 mrem/hr in most cases. Assuming that a refueling outage takes place once per year, and assuming that 30 days are spent over the fuel pool, a cumulative total annual exposure of 1.44 man-rem would result. This would be split up among approximately 20 men, giving a total exposure annually of 72 mrem per man due to work over the spent fuel pool. The dose rate from crud and tools stored in the spent fuel pool is small compared to the potential dose rate from tools stored around the fuel pool which have now been relocated to other areas.

Radionuclide Analysis

Quantitative Analysis

Isotope	Quantity		Std. Deviation
Cs-137	4.94912E-07 uci/ml	+-	9.26351E-08 uci/ml
Mn-54	5.64052E-06 uci/ml	+-	2.36111E-07 uci/ml
Co-60	1.64016E-05 uci/ml	+-	4.69730E-07 uci/ml
Total	2.25E-5 uci/ml		

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QUESTION 3

Provide the estimated man-rem exposure and discuss the occupational exposure expected during this proposed SFP modification. In this evaluation, address the expected dose rates from spent fuel pool water (including items stored in the pool), spent fuel and the equipment to be disposed of, number of workers (including divers, if any) and occupancy times for each phase of the operation; the removal and disposal of the present spent fuel racks and installation of the new higher density racks; and the disposition of miscellaneous equipment presently stored in the pool.

RESPONSE

The Installation Program will be accomplished in three phases with the disposal of the old racks and bracing accomplished separately. Phase I consists of the preparations necessary to install the new racks such as: developing procedures, arrange for diving and disposal services, and removing unnecessary equipment and material from the fuel pool. Phase II consists of removing the seismic bracing and existing racks from the southern half of the fuel pool and installing ten high density racks in that area. Phase III repeats Phase II for the northern half of the pool. The disposal of the old racks and bracing will be accomplished as a separate effort during and after the Installation Program.

The Installation Program will be accomplished by an 8-member Installation Team consisting of 5 maintenance personnel, 1 technical advisor, 1 rad protection technician, and 1 Q.C. inspector. In addition, divers will be used during Phase II to cut a 10 inch seismic brace and to cut five swing bolts. The diving team will consist of a supervisor, a diver, a backup diver, and a diver tender. The preparation and disposal of the removed fuel racks and bracing will be accomplished by a 4-man team of health physic technicians.

The estimated man-rem exposure for completing the installation of the high density spent fuel storage rack and the disposal of the existing racks and bracing is 5.935 man-rem. This exposure is broken down as follows:

Rack and bracing removal	1.840 man-rem
New rack installation	1.065 man-rem
Rack and bracing disposal	2.550 man-rem
Diver	.285 man-rem
Fuel transfer	.195 man-rem

The estimated man-rem exposure is based on a recent survey of the fuel pool areas which shows that the average dose rate 3 ft from the fuel pool as being 1.9 mr/hr and the dose rate on the refueling bridge as less than 2 mr/hr. Since most of the operation will be performed from these areas, 2 mr/hr was used as the average dose rate.

The spent fuel stored in the fuel pool will be stored at the opposite end of the pool from the end where the installation work is being performed. This results in a negligible effect on the dose rate to the installation team.

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All miscellaneous equipment and materials presently stored in the fuel pool will either be removed and disposed of or placed in the opposite end of the fuel pool from the installation work and will have a negligible impact on the dose rate.

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QUESTION 4

Provide the additional occupational exposure (in man-rem) from normal operation in the spent fuel pool area, including refueling, after the SFP modification proposed in your July 26, 1978 submittal. Include the expected exposure from more frequent changing of SFP filters and demineralizers, from spent fuel pool water, from any equipment stored in this water, and from spent fuel.

RESPONSE

The fuel has approximately 266 inches of water over it. The resulting dose rate from stored fuel is a negligible contributor to the cumulative occupational exposure. The effect of the extra fuel added to the fuel pool on radiation exposure received while working around the pool is still negligible. The effect of more fuel in the fuel pool on spent fuel pool filters is also negligible. The same amount of fuel would have passed through the spent fuel pool over the same time period. The effect on filters is experienced over the first few days during and after the time fuel bundles are moved and has little or no contribution after it has been in place for an extended period. The frequency of filter back-flushing is controlled by high differential pressure, and more frequent back-flushing is not anticipated. No additional equipment will be stored in the pool as a result of this modification.

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QUESTION 5

Describe the method that will be used to dispose of the present racks (i.e., crating intact racks or cutting and packaging). If the racks are to be cut and packaged, show that the exposure received by this disposal method, as compared to crating the intact racks for disposal will provide as low as is reasonably achievable (ALARA) exposure to personnel.

RESPONSE

The existing fuel racks will be hydrolazed during removal from the fuel pool to remove the loose surface contamination. The existing racks will then be placed in the reactor internal storage pit to dry. Localized decontamination will be performed, if necessary, prior to packaging.

The existing racks will be packaged in waterproof wooden boxes and shipped intact to a disposal site as low specific activity (LSA) radioactive wastes.

2311 289

QUESTION 6

Discuss in some detail the impact of the proposed SFP modification on radioactive liquid effluents from the plant, including leakage of water from the pool. Discuss the spent fuel pool leak collection system, including the disposition of leakage if it should occur.

RESPONSE

The modification has no impact on radioactive liquid effluents from the plant. The same activity and approximately the same volume of water is in the fuel pool as prior to the modification.

Any leakage from the pool will be collected in the reactor building floor drain sumps through the spent fuel pool leakage detection system and processed in the floor drain radwaste system. The spent fuel pool leakage detection system is described in Section 9.3.4.1 of the FSAR.

2311 290

QUESTION 7

Discuss the capability of the spent fuel pool cooling system to keep the expected, not design, spent fuel pool bulk water temperature at or below the FSAR design of 125°F during normal refuelings until the modified pool is filled. If the bulk water temperature is expected to be above FSAR design value, discuss when this will occur and for what period of time.

RESPONSE

The fuel pool cooling system is designed to maintain the bulk fuel pool temperature at or below 125°F. Analysis of the expected decay heat loads and cooling system indicates that the bulk spent fuel pool temperature will exceed 125°F when the decay heat load is greater than 7.5×10^{6} Btu/hr. Based on the conservative assumptions that the refuelings will be accomplished on a 12 month schedule and one-quarter of the fuel bundles will be simultaneously discharged to the spent fuel pool 150 hours after plant shutdown, the temperature will first reach 125°F during the third refueling for less than one day and exceed 125°F each subsequent refueling. During the sixteenth refueling, the temperature will be above 125°F for approximately 14 days.

2311 291

QUESTION 8

Provide the present frequency of replacing the filter-demineralizer resin beds for the spent fuel pool.

RESPONSE

FitzPatrick has stone septum precoat filters. The filters are changed approximately weekly during refueling and approximately monthly during normal operations.

2311 292

QUESTION 9

Provide the estimated volume of contaminated material (e.g., spent fuel racks, seismic restraints) expected to be removed from the spent fuel pools during the modification and shipped from the plant to a licensed burial site.

RESPONSE

The estimated volume of contaminated material to be shipped to a licensed burial site is as follows:

1. Existing spent fuel racks
   171.6 ft^3 per rack x 39 racks = 6,692.4 ft^3

2. Control rod racks
   110.55 ft^3 per rack x 3 racks = 331.65 ft^3

3. Safety curtains
   1.6 ft^3 per curtain x 32 curtains = 51.2 ft^3

4. Upper and lower rack restraints = 110.0 ft^3

Total Volume = 7,185.25 ft^3

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QUESTION 10

Provide a list of typical loads that might be carried near or over the spent fuel pool. Provide the weight and dimensions of each load. Discuss the load transfer path, including whether the load must be carried over the pool, the maximum height at which it could be carried, and the expected height during transfer. Provide a description of any written procedures instructing crane operators about loads to be carried near the pool. Provide the number of spent fuel assemblies that could be damaged by dropping and/or tipping each typical load into the pool.

RESPONSE

During normal plant operations, after completion of the high density spent fuel storage rack modification, the loads which will be moved over the stored spent fuel will be:

- Spent fuel
- Blade guides
- Nuclear instruments
- Control rods
- Fuel channels
- Fuel handling tools

During the installation of the high density fuel racks, the existing racks and bracing and the new racks will be lifted and transported into and out of the fuel pool. No loads will be transported over fuel racks which contain spent fuel.

The weights and dimensions of the loads are as follows:

1. Existing spent fuel racks:
   2,030 lb, 15.2' x 5.6' x 2.01'

2. Safety curtains:
   800 lb, 5.5' x .875' x 0.333'

3. Control rod storage racks:
   1,032 lb, 10.19' x 5.54' x 1.96'

4. 8 x 8 new spent fuel rack:
   7,250 lb, 14.99' x 4.65' x 4.64'

5. 8 x 10 new spent fuel rack:
   9,050 lb, 14.99' x 4.65' x 5.75'

6. 10 x 11 new spent fuel rack:
   12,450 lb, 14.99' x 6.3' x 5.75'

The movement of these loads will be controlled by approved procedures and marked areas on the refueling floor to prevent carrying over any spent fuel presently in the pool.

Because of the height of the new racks and the low level of contamination of the old racks, this equipment will be transported over the floor and fuel pool area approximately 6 inches above the floor elevation of 369'-6". The maximum height that the loads could be transported are as follows:

1.	Old spent fuel racks:	7'-8" above 369'-6"
2.	New spent fuel racks:	12'-0" above 369'-6"
3.	Failed fuel racks:	12'-0" above 369'-6"
4.	Safety curtains:	23'-0" above 369'-6"
5.	Bracing (old)	15'-0" above 369'-6"

By using the previously mentioned procedures and restricting the movement of the loads as described above, no spent fuel can be damaged.

2311 295

QUESTION 11

Discuss the instrumentation to indicate the spent fuel pool water temperature. Include the capability of the instrumentation to alarm and the location of the alarms.

RESPONSE

A thermocouple, 19-TE-71, is mounted in the spent fuel pool and is logged on recorder 10-TR-131. The recorder is located on the Nuclear Steam Temperature Recorder Panel. An alarm switch on the recorder is set to annunciate at 130°F. The high temperature alarm is alarmed on the "Fuel Pool Cooling and Clean Up System Trouble" annunciator drop in the control room and the plant computer.

Thermocouples located on the outlets of the fuel pool cooling system heat exchangers, 19-E-1A and 1B, are also logged on recorder 10-TR-131 and provide alarm signals to the plant computer and the "Trouble" annunciator identified above.

2311 296

QUESTION 12

Propose a technical specification which prohibits carrying loads greater than the weight of a fuel assembly over spent fuel in the storage pool; or justify why this specification is not needed to limit the potential consequences of accidents involving dropping heavy loads, other than casks, onto spent fuel to those of the design basis fuel handling accident.

RESPONSE

A technical specification is not required because the reactor building crane is equipped with interlocks which prevent the operation of the main and 20-ton auxiliary hoists over the fuel pool with the exception that the main hoist is allowed to operate within a small area over the cask area. The 20-ton auxiliary hoist will be required to remove the existing fuel racks. A Temporary Maintenance Procedure has been written and will be reviewed and approved by the Plant Operations Review Committee which will detail the installation of control jumpers to allow the operation of the 20-ton hoist over the fuel pool during SFP rack replacement. This procedure also identifies load transfer paths into and out of the fuel pool so that no loads are transported over fuel racks which contain spent fuel. The fuel rack installation team will be instructed on all aspects of the installation program.

2311 297

QUESTION 13

Discuss the analysis and results of the fuel pool concrete walls to verify their integrity under the proposed increase in the mechanical and thermal loadings.

RESPONSE

The fuel pool walls were included in the finite element model. Figure 4-1 in the submittal is a sketch of the area used in the finite element model which was analyzed. Both mechanical and thermal stresses were less than design allowables.

2311 298

QUESTION 14

Provide the following information for DBE loading case, considering both an empty rack and a rack with full fuel load.

a. The computed sliding and rocking displacements for critical loading conditions.

b. The corresponding factor of safety against impacting the wall and other objects in the pool.

RESPONSE

a. The maximum horizontal rocking displacement at the top of the rack is 0.38 inch for the DBE under the critical rocking loading conditions as defined on page 3-6 of the submittal which is 0.8 coefficient of friction for two full racks.

The maximum sliding displacements occur for empty racks at 0.2 coefficient of friction. These displacements were calculated at 1.472 inches for DBE and 0.737 inch for OBE. No lift-up or rocking was noted under these conditions.

b. The following table summarizes the factor of safety against impacting into walls or other objects in the pool for OBE and DBE conditions.

Description	OBE	DBE
Spent Fuel Walls	8.22	4.11
Existing Floor Swing Bolts	7.46	3.74
Cask Drop Protection System	5.42	2.52
Sparger Pipe Brackets	4.07	2.03
Existing Rack NE Corner	7.46	3.74

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QUESTION 15

Discuss the extent of rack-to-rack impact during a DBE and/or SSE. Discuss also the design effort taken to minimize the effect of such impact on the integrity of the rack and fuel elements contained therein.

RESPONSE

The maximum rack-to-rack impact forces have been calculated to be 81,000 pounds for the DBE and 64,000 pounds for the OBE. The forces occur at the top grid only and are included in the stress analysis of this member. Since the upper fitting of the fuel assemblies is not attached to the top grid, these impact loads are not directly transmitted to the fuel assemblies.

2311 300

QUESTION 16

Clarify that three components of earthquake were used in the seismic analyses of ANSYS and SAP IV models. If not, justify the conservatism of using less than three components.

RESPONSE

All three components of earthquake have been conservatively considered in the rack design. As explained in the submittal, the ANSYS time history was done for only two components of earthquake which were the maximum horizontal (X-direction and vertical Y-direction). However, the forces computed from this planar time-history model were applied on the detail (3-D) model simultaneously in both the X-Y and Z-Y planes. These resultant loads were then combined by an SRSS to obtain the overall loads. Note that this method, in effectively considering all three components of earthquake, doubles up on the vertical (Y-direction loading).

2311 301

QUESTION 17

In the dropped fuel bundle analysis of 18-inch drop, verify that the rack model stays elastic during impact and hence the elastic energy balance method is adequate in predicting a static impact load.

RESPONSE

The maximum combined stress calculated for the 18-inch drop conditions as defined on page 3-6 of the submittal was 10,540 psi. This maximum stress occurred on an inner rib of the top grid and consisted primarily of major axis bending stress. Since the minimum yield strength of the top grid is 16,000 psi, the grid remains elastic except for a small localized area at the impact interface. Hence the elastic energy balance method used is adequate in predicting the impact loads. Full sized tests on an actual grid casting indicate plastic behavior is small producing on the order of a 1/10-inch indentation.

2311 302

QUESTION 18

Verify that the loads, load combinations, and acceptance criteria used for the rack design are consistent with Sections 3.8.4.11.3 and 3.8.4.11.5 of the Standard Review Plan for Steel Structures.

RESPONSE

In addition to the three load combinations and acceptance criteria as specified in paragraph 3.3.1.1 of the submittal, the following OBE load condition was analyzed.

$$D + L + T_a + E = 1.0S$$

These four load combinations and acceptance criteria conservatively cover all applicable loading for spent fuel racks as specified in Sections 3.8.4.11.3 and 3.8.4.11.5 of the Standard Review Plan for Steel Structures.

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