December 7, 1982

Docket No. 50-206
LS05-82-12-014

Mr. R. Dietch, Vice President
Nuclear Engineering and Operations
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Dear Mr. Dietch:

SUBJECT: SEP TOPIC IX-1, FUEL STORAGE - SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1

Enclosed is our evaluation of SEP Topic IX-1, Fuel Storage for the San Onofre Nuclear Generating Station Unit 1. This evaluation is based on your submittals of April 29, 1982, September 1, 1982, and November 16, 1982 (R. W. Krieger to D. M. Crutchfield).

We have concluded that the fuel storage facility meets current criteria. The structural capability with regard to seismic capacity is being reviewed in Topic III-6 and the protection of the facility against the effects of tornado missiles is being reviewed in Topic III-4.A. Since the seismic capability and protection against tornado missiles is being reviewed by other SEP topics, we consider Topic IX-1 to be complete.

This evaluation will be a basic input to the integrated assessment for your facility unless you identify changes needed to reflect the as-built conditions at your facility. This assessment may be revised in the future if your facility design is changed or if NRC criteria relating to this subject is modified before the integrated assessment is completed.

SE04

Sincerely,

DSU USE (08)

Walt Paulson, Project Manager
Operating Reactors Branch #5
Division of Licensing

Enclosure: As stated

cc w/enclosure: See next page

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SYSTEMATIC EVALUATION PROGRAM
TOPIC IX-1

SAN ONOFRE

TOPIC: IX-1, FUEL STORAGE

I. INTRODUCTION

The purpose of SEP Topic IX-1 is to review the storage facility for new and irradiated fuel, including the cooling capability and seismic classification of the fuel pool cooling system of the spent fuel storage pool in order to assure that new and irradiated fuel is stored safely with respect to criticality, cooling capability, shielding, and structural capability. At San Onofre, the new fuel storage room and spent fuel storage pool are housed in the fuel storage building.

II. REVIEW CRITERIA

The plant design was reviewed with regard to Section VI, "Fuel and Radioactivity Control of Appendix A to 10 CFR Part 50, General Design Criteria for Nuclear Power Plants" which requires that the fuel storage systems shall be designed to assure adequate safety under normal and postulated accident conditions.

III. RELATED SAFETY TOPICS

SEP Topic II-3.B, "Flooding Potential and Protection Requirements" identifies the design basis flood for which the plant must be adequately designed.

SEP Topic III-1, "Classification of Structures, Components and Systems (Seismic and Quality)" is intended to assure that structures, systems and components important to safety are of the quality level commensurate with their safety function.

SEP Topic III-4.A, "Tornado Missiles" covers tornado missile protection of a number of structures and systems including fuel storage areas and support systems.

SEP Topic III-6, "Seismic Design Considerations" will ensure the capability of the plant to withstand the effects of earthquakes.

SEP Topic IX-2, "Overhead Handling Systems - Cranes" covers the potential for dropping heavy objects onto spent fuel. This topic has been deleted since the review criteria is identical to that of Unresolved Safety Issue A-36, "Control of Heavy Loads Near Spent Fuel."

SEP Topic IX-5, "Ventilation Systems" assures that the ventilation systems have the capability to provide a safe environment for plant personnel and engineered safety features equipment.

IV. REVIEW GUIDELINES

Current guidance for the review of spent fuel storage is provided in Standard Review Plan Section 9.1.0 New Fuel Storage, Section 9.1.2 Spent Fuel Storage, Section 9.1.3 Spent Fuel Pool Cooling and Cleanup System, Section 9.1.4 Fuel Handling System and Regulatory Guides 1.29 Seismic Design Classification, 1.13 Fuel Storage Facility Design Basis, 1.26 Quality Group Classification and Standards for Water-Steam and Radioactive Waste-Containing Components of Nuclear Power Plants as well as the guidance contained in the April 14, 1978 generic letter - OT

Position for Review and Acceptance of Spent Fuel Storage and Handling Applications (i.e., DOR Technical Activities Category A, Item 27, Increase in Spent Fuel Storage Capacity).

V. EVALUATION

New Fuel Storage

The new fuel storage facility is housed in the fuel storage building. The fuel storage building and the fuel storage racks including the support systems were not designed to seismic Category I requirements. The seismic capability of these structures will be evaluated separately under SEP Topic III-6, "Seismic Design Considerations."

The new fuel storage racks are designed to store the fuel assemblies in an array sufficient to ensure that k_{eff} does not exceed 0.98 with fuel of the highest anticipated reactivity in place assuming optimum moderation. In fact, the calculated value of k_{eff} for worst case abnormal conditions with all uncertainties including optimum moderation is 0.843 (see November 16, 1982 letter). The new fuel storage room is maintained dry. The new fuel racks are above the floor and not in a sunken pit or vault. The new fuel storage is located approximately 21 feet above grade. While there are no features specifically designed to prevent flooding of the new fuel storage area, we conclude that this is a low probability event. While the room is not water tight, access to the room is via a metal roll-up door at the east end; the base of the door has a "trench" which directs water away from the door. There are no water sources or piping passing through the new fuel storage area, except the fire fighting water (fire hoses) is available to the room from connections outside of the area.

The design of the new fuel storage racks is such that a fuel assembly cannot be inserted other than in design locations. The crane cannot engage the racks because the fuel element is higher than the storage racks. Furthermore, the entry of new fuel into the storage racks is accomplished by opening one side of the storage racks. Therefore, the potential for uplift forces is minimized.

Therefore, we conclude that new fuel storage is in conformance with requirements of General Design Criteria 61, "Fuel Storage Handling and Reactivity Control" and 62, "Prevention of Criticality in Fuel Storage Handling." Subject to resolution of the structural response of the San Onofre plant with respect to seismic capability, which is being evaluated as part of SEP Topic III-6, Seismic Design Considerations, and the protection of the facility against the effects of tornado generated missiles which will be evaluated under SEP Topic III-4.A, Tornado Missiles, we conclude that this new fuel storage facility is acceptable.

Spent Fuel Storage

The spent fuel storage facility, is also housed in the fuel storage building. The fuel storage building and the spent fuel pool (including its liner) and support systems were not designed to seismic Category I requirements.

The spent fuel pool provides underwater storage for 216 fuel assemblies. The design of the storage racks is such that a fuel assembly cannot be inserted other than in design locations. The storage racks have cross bars spanning the spaces between fuel locations which physically prevent a fuel assembly from being inserted other than in design locations. In a letter dated November 16, 1982, the licensee provided the results of calculations of the maximum k_{eff} for the spent fuel racks assuming the worst case abnormal conditions including unborated water temperature. from $68^{o}F$ to $212^{o}F$. The result was k_{eff} of 0.896 which is less than the current criteria value of 0.95 and is therefore acceptable. Therefore, we conclude that the design of the spent fuel storage meets the requirements of General Design Criteria 61, "Fuel Storage and Handling and Radioactivity Control" and 62, "Prevention of Criticality in Fuel Storage and Handling," and that the guidelines of Regulatory Guide 1.13, Positions C.1 and C.4 concerning fuel storage facility are satisfied.

The spent fuel pool is a reinforced concrete structure, completely lined with stainless steel and is connected to the refueling cavity by the fuel transfer system. The seismic capability of the liner and wall of the pool will be evaluated separately under SEP Topic III-6, "Seismic Design Considerations," and will be assessed during the integrated assessment. The surface area between the pit bottom and the stainless steel liner has several one inch channels that connect to a two inch perimeter channel. These will direct any leakage to a monitoring well located on the north side of the pit. A waterproof membrane surrounds the portion of the pit that is underground.

The fuel pool is designed to be filled with borated water to provide reactivity control, shielding and cooling for the spent nuclear fuel. There are high and low spent fuel pit water level alarms in the control room. Normal water depth is 39 feet. These alarms are set at two inches above and below the normal water level. The low level alarms provide a minimum of 25 feet and 5 inches of water above the top of the stored spent fuel. An area radiation monitor on the south wall of the spent fuel room provides an alarm to the control room if radiation level exceeds 25 mr/hr. Makeup water for the spent fuel pool can be provided via the spent fuel pool cooling water return line by either the refueling water filter pump from the refueling water storage tank or the primary plant makeup pumps from the primary plant makeup tank. In addition the fire protection water system could also be utilized to provide makeup water to the spent fuel pool. Makeup water to the spent fuel pool could also be provided by gravity flow from the condensate storage tank through the fill/drain connection with fire hoses. These features satisfy the requirements of General Design Criterion 63, "Monitoring Fuel and Waste Storage" and the guidelines of Regulatory Guide 1.13, Positions C.6, C.7 and C.8.

Based on the above, we conclude that the spent fuel storage facility meets the requirements of General Design Criterion 63 as related to monitoring provisions and the guidelines of Regulatory Guide 1.13. The structural response of the San Onofre plant with respect to seismic capability is being evaluated as part of SEP Topic III-6, Seismic Design Considerations. The protection of the facility against the effects of tornado generated missiles will be evaluated under SEP Topic III-4.A, Tornado Missiles.

Spent Fuel Pool Cooling and Cleanup System

The spent fuel pit cooling system loop removes the decay heat from fuel stored in the storage pit. It consists of a pump, heat exchanger, filter, demineralizer, piping, valve and associated power and instrumentation. The decay heat is transferred from the spent fuel pit cooling system to the component cooling water system which in turn transfers it to the salt water cooling system.

The licensee stated that the cooling system is capable of maintaining the pit water temperature at or below 88.5°F for the maximum normal heat load generated by four discharges of one third cores consisting of 53 fuel assemblies each. It also is capable of maintaining the pit water temperature at or below 116°F for an abnormal maximum heat load consisting of a full core discharge and one third core normal discharge. We have independently verified the above capability.

In the event the spent fuel pit cooling water pump should fail, all pit cooling would be lost and the pit water temperature would commence to rise. The licensee stated that there is ample time to make repairs without extensive heating of the pit water, but if necessary, a spare pump is provided and can be connected to the system. In the event of a spent fuel heat exchanger failure, a component cooling heat exchanger can be used. There are two component cooling heat exchangers, one being located below the other. The bottom heat exchanger being more accessible can be temporarily substituted for the spent fuel heat exchanger by connecting it to the spent fuel pit cooling loop using existing emergency cooling connections with flexible hoses and piping. The elapsed time before boiling would be dependent upon the heat load in the pit. In the case of the maximum normal heat load the elapsed time would be 136 hours while for the maximum abnormal heat load 47 hours of elapsed time would be required before boiling occurs. We have verified the elapsed times and conclude that there is sufficient time available to accomplish the above temporary modifications and thereby restore pit cooling. Based on the above we conclude the General Design Criterion 44 "Cooling Water" has been satisfied.

There is one normal source and three backup sources of makeup water. The normal makeup source of 80 gpm is from the Category A refueling water storage tank via a refueling water filter pump to the cooling loop return line. The first backup source of 100 gpm is from the Category B primary makeup tank via the primary plant makeup pumps to the same return line. The second and third source of makeup water are the fire pump and the service water pumps each rated at 1000 gpm. Makeup water from these sources would be accomplished by utilizing an emergency hose connection provided on the spent fuel cooling system return line.

The licensee states that the plant design is such that heavy loads cannot be handled above the stored spent fuel. Further, the cask loading pit area is separated from the fuel storage area by a weir. The elevation of the weir is such that the loss of all water in the cask loading pit area would not result in the stored spent fuel being uncovered. Therefore, we conclude that load drops would not cause a significant loss of water level in the spent fuel pool and the makeup rate is controlled only by the boil-off rate. We have conservatively established that maximum boil-off rate to be 40 gpm. Therefore, we conclude that the redundancy and makeup rate from the various makeup sources satisfy Regulatory Guide 1.13, Position C.8.

In the event a failure occurs at any point in the spent fuel pit cooling loop the design is such that the loss in water inventory could not drop the water level more than 10 feet, since ~~that~~ neither the suction nor return line of the cooling loop extends below this point. A line, provided to dewater the pit, extends to the bottom of the pit but it has a normally open high point vent which prevents this line from siphoning water from the pit. Therefore following the failure of any pipe there would still remain approximately 15'-7" of water above the top of the stored spent fuel.

Water clarity is accomplished by diverting a portion of loop flow through the spent fuel pit filter. The removal of corrosion products, fission products and water impurities is accomplished by manually bleeding part of loop flow through demineralizers and ion exchangers. We conclude that a cooling loop malfunction or failure could not uncover the stored fuel, Regulatory Guide 1.13 Position C.6 has been satisfied, and the design is therefore acceptable.

The design of the spent fuel storage facility makes it impossible to handle the spent fuel shipping cask or other heavy loads over stored spent fuel. Therefore we conclude that Regulatory Guide 1.13 Position C.5 is satisfied and the design is acceptable.

An area radiation monitor is provided in the spent fuel building with readouts locally and in the control room. In addition high activity level is alarmed locally and in the control room. A fuel pit water level alarm is provided which actuates when the level deviates from the normal level by more than two inches. Thus, we conclude that the guidelines of Regulatory Guide 1.13, Position C.7 are satisfied.

Based on the above, we conclude that the spent fuel pool cooling and cleanup system meets the requirements of GDC 44 and the guidelines of Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," and Standard Review Plan Section 9.1.3, "Spent Fuel Pool Cooling and Cleanup System." The seismic design considerations will be evaluated in SEP Topic III-6, Seismic Design Considerations.

VI. TOPIC CONCLUSION

We conclude that the fuel storage facilities at San Onofre Unit 1 meet current criteria.