November 19, 1982

Docket No. 50-206
LS05-82-11-065

Mr. R. Dietch, Vice President
Nuclear Engineering and Operations
Southern California Edison Company
2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770

Dear Mr. Dietch:

SUBJECT: SEP TOPIC III-4.A, TORNADO MISSILES
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

Enclosed is our final evaluation of SEP Topic III-4.A. It is based on a Safety Analysis Report which you supplied on May 4, 1982, and other information available on Docket No. 50-206.

The evaluation concludes that there are safety-related systems which are not adequately protected from tornado missiles.

The evaluation will be a basic input to the integrated plant safety assessment of your facility. It may be changed in the future if your facility design is changed or if NRC criteria relating to this topic are modified before the completion of the integrated assessment.

SEO4

DSU use(08)

Sincerely,

Original signed by:

ADD: G. Staley

Walter Paulson, Project Manager
Operating Reactors Branch No. 5
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Enclosure:
As stated

cc w/enclosure:
See next page

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SAFETY EVALUATION REPORT

SAN ONOFRE UNIT 1
SYSTEMATIC EVALUATION PROGRAM
TOPIC III-4.A - TORNADO MISSILES

I. Introduction

Tornado generated missiles could cause sufficient damage to a plant so that the actual safety of the plant is reduced. Topic III-4.A is intended to review the plant design to assure that those structures, systems and components important to safety can withstand the impact of an appropriately postulated spectrum of tornado generated missiles.

These include those required to assure:

1. The integrity of the reactor coolant pressure boundary,
2. The capability to shutdown the reactor and maintain it in a safe shutdown condition, and
3. The capability to prevent accidents which could result in unacceptable offsite exposures.

Scope of Review

The scope of the review is as outlined in the Standard Review Plan (SRP) Section 3.5.1.4, "Missiles Generated By Natural Phenomena" Revision 1.

An assessment of the adequacy of a plant to withstand the impact of tornado missiles includes:

1. Determination of the capability of the exposed systems, components and structures to withstand key missiles (including small missiles with penetrating characteristics and larger missiles which result in an overall structural impact); and

2. Determination of whether any areas of the plant require additional protection.

II. Review Criteria

The plant design was reviewed with regard to General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena" which requires that structures, systems, and components essential to safety be designed to withstand the effects of natural phenomena such as tornadoes and General Design Criterion 4, "Environmental and Missile Design Bases" which requires that these same plant features be protected against missiles. The plant was also reviewed against the guidance contained in Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Bases," 1.27, "Ultimate Heat Sink for Nuclear Power Plants," 1.117, "Tornado Design Classification", and 1.76, "Design Basis Tornado for Nuclear Power Plants" with regard to plant protection against tornado missiles.

III. Related Safety Topics

Topic II-2-A, "Severe Weather Phenomena" describes the tornado characteristics for the plant. Topic III-2, "Wind and Tornado Loadings" reviews the capability of the plant structures, systems and components to withstand wind loadings. Topic VII-3, "Systems Required for Safe Shutdown" reviews those systems needed to achieve and maintain the plant in a safe shutdown condition.

IV. Review Guidelines

The review was performed in accordance with Standard Review Plan (SRP) 3.5.1.4, "Missiles Generated by Natural Phenomena," Revision 1. This SRP states that the assessment of possible hazards due to missiles generated by natural phenomena is based on the applicant having met the requirements of General Design Criteria 2 and 4 by: (1) meeting Regulatory Guide 1.76, Positions C-1 and C-2 and (2) meeting Regulatory Guide 1.117, Positions C-1 and C-3. SRP 3.5.1.4 further states that plants which were not required at the construction permit stage to design to the missile spectrum in Revision 0 to the SRP should show the capability to withstand the two postulated missiles discussed below.

The following missiles are described in SRP 3.5.1.4 as being appropriate for evaluating OL applications for plants which were not required to be protected against the full tornado missile spectrum during the CP stage:

1. Steel Rod, 1" dia., 3' long, 8 lbs, horizontal velocity=0.6 x total tornado velocity; and
2. Utility Pole, 13 1/2" dia., 35' long, 1490 lbs. horizontal velocity= 0.4 x total tornado velocity.

The systems, structures, and components required to be protected because of their importance to safety are identified in the Appendix to Regulatory Guide 1.117.

V. Evaluation

A. Tornado Event Description

In accordance with Regulatory Guide 1.76, the San Onofre Plant is in Region II. Southern California Edison Company's (SCE) analysis indicated that the design basis tornado is characterized by a maximum wind speed of 260 miles per hour based on a maximum rotational windspeed of 220 miles per hour and a maximum translational wind speed of 40 miles per hour and a pressure drop of 1.5 pounds per square inch in 4.5 seconds. These values were based on tornado data from seven southwestern California counties surrounding the plant site. Although the parameters deviate from design basis tornado characteristics for Region II in Regulatory Guide 1.76, the staff's independent assessment for SEP II-2.A, "Severe Weather Phenomena" indicates that these design parameters are appropriate for the San Onofre site. Therefore, SEP Topic II-2.A will be used to provide an acceptable design basis tornado wind velocity for the San Onofre plant.

In accordance with SRP 3.5.1.4, Revision 0, and SEP Topic II.2.A, the total horizontal velocities for the two postulated missiles are:

1. Steel Rod, 229 ft./sec.
2. Utility Pole, 152 ft./sec.

These missiles are considered to be capable of striking in all directions with vertical speeds equal to 80% of the horizontal speeds listed above.

B. Structural Considerations

In our evaluation, we have considered the adequacy of the following structures for tornado missile protection:

1. Control Building
2. Reactor Auxiliary Building
3. Fuel Storage Building
4. Turbine Building
5. Ventilation Equipment Building
6. Sphere Enclosure Building
7. Diesel Generator Building
8. Intake Structure

In order to assess the adequacy of tornado missile protection of these structures, we have compared their wall and roof thicknesses to the current NRC requirements for the two postulated missiles for the San Onofre site specific design basis tornado. For a concrete strength of f'c = 4000 psi, the required concrete thicknesses are stated below:

Missile	Required Wall Thickness (Inches)	Required Roof Thickness (Inches)
Utility Pole	10	10
1-inch Steel Rod	6	6

The masonry walls do not provide adequate protection against tornado missiles.

Most of the buildings of interest were constructed of 3000 psi concrete, but it is assumed that the strength of this concrete after aging is approximately 4000 psi.

C. Systems Considerations

The following structures, systems and components as listed in the Appendix to Regulatory Guide 1.117 were evaluated in order to determine their susceptibility to tornado generated missiles:

1. Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary is totally enclosed within the containment sphere. The walls of the containment have a minimum concrete thickness of three feet. The roof of the containment sphere also consists of concrete thickness of 18 inches. The containment sphere enclosure provides adequate tornado missile protection for the reactor coolant pressure boundary because the concrete thicknesses are greater than the 10 inch minimum requirement listed in V.B.

2. The Main Steam and Main Feedwater System

As with the reactor coolant pressure boundary those portions of the main steam and main feedwater systems from the steam generators up to the area they penetrate the containment are considered to be adequately protected from tornado missiles. There are no isolation valves for these two systems inside containment. The main steam and main feedwater lines exit containment and enter the turbine building. The turbine building consists of masonry walls. The masonry walls are considered to be ineffective against tornado missiles. Therefore, the portions of these piping systems within the turbine building are not tornado missile protected.

We conclude that even though the portions of the main steam and main feedwater systems located within the containment sphere are adequately protected from the effects of tornado missiles, isolation of these systems is not possible due to the lack of isolation valves and the vulnerability of the portions of these systems located in the turbine building.

3. Reactor Core and Individual Fuel Assemblies

The reactor vessel which houses the core constitutes a portion of the reactor coolant pressure boundary as discussed in Item 1 above. The fuel assemblies of the core are protected from damage by tornado missiles while they are in the reactor vessel by the containment structure. The protection provided for stored spent fuel assemblies is discussed in item 5 below.

We conclude that the reactor core and fuel assemblies located within the reactor vessel are adequately protected from the effects of tornado missiles.

4. Systems or Portions of Systems Required for Safe Shutdown

As previously stated, those systems, structures, and components required to be protected because of their importance to safety are identified in the Appendix A to Regulatory Guide 1.117. However, for the SEP Evaluation, SEP Topic VII-3, "Systems Required for Safe Shutdown" covers those systems or portions of systems required for safe shutdown. Therefore, in this portion of our review, we examined those systems identified in SEP Topic VII-3.

a. Atmospheric Dump Valves and Steam Dump Control Systems

The atmospheric dump valves and the steam dump control system are located outside the containment sphere in the open area. The supporting structure of these components do not provide tornado missile protection. Therefore, we conclude that the atmospheric dump valves and steam dump control system are not tornado missile protected.

b. Turbine and Motor-Driven Auxiliary Feed Pumps (Auxiliary Feedwater System)

Two auxiliary feedwater pumps (AFPs), one turbine-driven and one motor-driven, are provided to supply steam generator feedwater in the event of a loss of the main feedwater system. These pumps are located at the lower level in the west side of the turbine building. The supporting structure of the associated piping does not provide tornado missile protection. The turbine building consists of masonry walls. The masonry walls are considered to be ineffective against the tornado missiles. Therefore, this building does not provide tornado missile protection to the auxiliary feedwater pumps.

We conclude that inadequate protection against the effects of tornado missiles is provided for the auxiliary feedwater system.

c. Water Source - Condensate Storage Tank

The condensate storage tank is located on the southwest side of the turbine building in an open area. The pumps and associated

piping are located at the lower level of the turbine building. As discussed in Item 4b above, this building does not provide any tornado missile protection. Therefore, we conclude that this water source is not tornado missile protected.

d. Residual Heat Removal (RHR) System

The residual heat removal (RHR) system consists of two RHR pumps, two heat exchangers and associated piping, and instrumentation necessary for operational control. These components which are located inside the containment sphere have the same protection against tornado missiles as the reactor coolant pressure boundary as discussed in Item 1 above. Therefore, we conclude that this system is adequately protected from the tornado missiles. However, since this system is cooled by the component cooling water system, its function can not be assured following a tornado missile event.

e. Component Cooling Water (CCW) System

The component cooling water (CCW) system is an intermediate cooling system between the RHR system and the salt water cooling system. The CCW consists of three pumps, two heat exchangers, a surge tank, cooling water lines to the various components being cooled, and associated valves and instrumentation. The system is located outside on the roof of

the reactor auxiliary building. The supporting structures of these components do not provide tornado missile protection. Therefore, these components are not protected against tornado missiles. We conclude that the CCW system is not tornado missile protected.

f. Salt Water Cooling (SWC) System

The salt water cooling (SWC) system's only function is to cool the CCW heat exchanger. The SWC system consists of two pumps and associated piping. The two pumps take suction from the intake structure, and the salt water, after passing through the tube side of the CCW coolers, discharges into the facilities discharge structure. The system is located outside, on the west side of the turbine building. The supporting structure of these components do not provide tornado missile protection. Therefore, these components are not protected against tornado missiles. We conclude that the SWC system is not tornado missile protected.

g. Chemical and Volume Control System (CVCS) - Refueling Water Storage Tank

The chemical and volume control system (CVCS) consists of two centrifugal charging pumps, the regenerative heat exchangers, pressure reducing valves and orifices, either or both of the two RHR heat exchangers, the volume control tank (VCT), refueling water storage tank (RWST), and associated piping, valves,

fittings and instruments. The VCT is located in a room at the top level of the reactor auxiliary building (RAB). This building consists of masonry walls which do not provide adequate protection against tornado missiles. The charging pumps are in the lower level of the RAB which is below ground level. This level of the RAB is covered by at least two feet of concrete which provides adequate missile protection. The RWST and associated piping are located outside in the southwest corner of the containment sphere. The boric acid tank and associated piping are located outside on the roof of the reactor auxiliary building. These components are not enclosed by any structure. Therefore, because of the exposure of these components we conclude that the CVCS system is not tornado missile protected.

h. Instrument Air System

The instrument air system's function is to provide compressed air for instrumentation and the control of system valves. This system consists of three air compressors, three receivers and an auxiliary air compressor. These components are located inside the west side of the turbine building. The surrounding structure of these components is composed of masonry and this does not provide tornado missile protection. Therefore, these components are not protected against tornado missiles.

We conclude that the instrument air system is not tornado missile protected.

i. Instrumentation for Shutdown and Cooldown

Indication for the shutdown equipment instrumentation is located within the control room. The control room is located on the second floor of the control and administration building and has reinforced concrete walls which vary in thickness from 9 inches to 34 inches and a concrete roof thickness which varies from 7 inches to 24 inches. We conclude that control room construction does not meet the current NRC requirements for concrete wall and roof thickness as discussed in Section V of this SER and thus it provides inadequate tornado missile protection to the instrumentation for safe shutdown equipment. While it is recognized that the majority of instrument sensors are located within the containment sphere and thus are adequately protected as discussed in Item 1 above, the associated cables that electrically connect these sensors to the control room pass through a switchgear room which is not tornado missile protected. Therefore those portions of the instrumentation located outside containment are not tornado missile protected.

We conclude that even though those portions of the instrumentation located inside the containment are adequately protected against tornado missiles, the function of this instrumentation can not be assured following a tornado missile event since the cables for the instrumentation located in the control building are not adequately protected.

j. Emergency Power (AC and DC) and Control Power for the Above Systems and Equipment

AC Emergency System

The two diesel generators are housed in a seismic Category I building. The walls and roof of this building consist of 18-inch thick reinforced concrete. The units are physically and electrically isolated by being located in separate rooms divided by a steel reinforced concrete wall. Each diesel is supplied from a separate fuel storage tank of 45,000 gallons capacity. These tanks are underground outside of the building.

In addition, each diesel engine has a day tank with a 550-gallon capacity. We conclude that the diesel generators and their fuel supplies are protected from tornado missiles.

The 4160V system includes the 4160V switchgears and cable spreading room which are located at the lower level of the control and administration building. This building consists of masonry walls. The masonry walls are considered ineffective against tornado missiles. Additionally, there are electrical conduits running along the outside of these masonry walls. Therefore, we conclude that 4160V system is not tornado missile protected.

The 480V system consists of 480V switchgears 1, 2 and 3 served respectively by 4160V/480V service transformers 1, 2 and 3 and motor control centers 1 through 3. The 480V system is located on the bottom floor of the fuel storage building. This building

consists of masonry walls. The masonry walls are incapable of withstanding the impact of tornado missiles. Therefore, we conclude that the 480V system is not tornado missile protected.

Based on the above, we conclude that the AC emergency power is not adequately protected against tornado missiles; even though the diesel generators are adequately protected, the operability of the AC emergency power system can not be assured following a tornado missile event since its power distribution portion is vulnerable to tornado missiles.

Station Batteries (DC System)

The 125V DC system consists of two subsystems, No. 1 and 2, each containing a bus, a battery, and two battery chargers. The No. 1 subsystem is located in the south side of the control and administration building and the No. 2 subsystem is located in the diesel generator building. The control building consists of masonry walls. As previously stated the masonry walls do not provide adequate protection against tornado missiles. Therefore we conclude that subsystem No. 1 is not protected against tornado missiles. The diesel generator building is constructed of steel reinforced concrete. This building is capable of withstanding the impact of tornado missiles. Therefore the No. 2 subsystem is adequately protected against tornado missiles. However, the DC distribution system is not adequately protected since it is routed through unprotected portions of the plant.

k. The Reactivity Control System

The reactivity control systems consists of control rod drive system and a boron injection system and the associated piping. The control rod drive system is located in the containment sphere. These components have the same acceptable level of protection against the tornado missiles as discussed in Item 1. However, the boron injection system is located on the top floor of the reactor auxiliary building. This building consists of masonry walls and does not provide adequate protection against tornado missiles.

Therefore, we conclude that the control rod drive system is tornado missile protected. However, the boron injection system is not adequately protected.

l. The Control Room

The control room is inadequately protected from tornado missiles as described in 4i above. The ventilation system which supports the control room environment is located on the top floor of the control and and administration building which consists of masonry walls which provide little resistance to tornado missiles.

Therefore, we conclude that the control room is not protected against tornado missiles.

5. Systems Whose Failure May Release Unacceptable Amounts of Radioactivity

a. The spent fuel storage and the spent fuel pit cooling system is located in the fuel storage building which consists of masonry block walls and metal decking roofs. The spent fuel storage pool is composed of 4 feet thick reinforced concrete walls which are capable of withstanding the tornado missile. Since the masonry walls are not effective against tornado missiles, we conclude that the fuel storage building does not provide adequate tornado missile protection to the spent fuel stored in the pool and to the spent fuel pit cooling system. However, the pool boundary dimensions are adequate to preclude significant loss of watertight integrity following a tornado missile strike.

b. Radioactive Liquid Waste System

All of the radioactive liquid waste system equipment is located in the lower level of the reactor auxiliary building. This portion of the building is below ground level with a concrete roof at least 2 feet thick above it. Therefore, we conclude that the radioactive liquid waste system is tornado missile protected.

c. Radioactive Gaseous Waste System

The radioactive gaseous waste system is located in the lower level of the reactor auxiliary building. As discussed in item b above, this area provides adequate tornado missile protection. Therefore, we conclude that the radioactive gaseous waste system is tornado missile protected.

6. Systems or Portions of Systems Not Required for Safe Shutdown But Serve a Safety Function

a. Safety Injection System

The safety injection system consists of safety injection pumps, feedwater pumps and associated piping. These components are located outside to the west of the turbine building and on the lower level of the turbine building. The supporting structures of these components do not provide tornado missile protection. Therefore, these components are not protected against tornado missiles.

We conclude that the safety injection system is not tornado missile protected.

b. Ventilation Equipment Building

The ventilation equipment building is a single-story structure with a roof of steel decking on a structural steel frame. The roof is supported by peripheral, reinforced, hollow, concrete block walls. Being masonry, these walls offer little resistance to tornado missiles.

Therefore, we conclude that the ventilation equipment building is not protected against tornado missiles.

VI. CONCLUSIONS

Based upon our evaluation of the information provided by the licensee, we conclude that the following portions of the San Onofre Unit 1 are adequately protected from the effects of tornado missiles.

1. Reactor coolant pressure boundary
2. Reactor core and individual fuel assemblies
3. Control rod drive system

Therefore, the above features meet the requirements of General Design Criteria 2 and 4 with respect to missiles and environmental effects.

However, we have concluded that the San Onofre Unit 1 does not meet the current criteria for tornado missile protection in the following areas.

1. Atmospheric dump valves and steam dump control system
2. Turbine and motor-driven auxiliary feed pumps (auxiliary feedwater system)
3. Water source - condensate storage tank
4. Component cooling water system
5. Salt water cooling system
6. Chemical and volume control system
7. Refueling water storage tank
8. Instrument air system
9. Spent fuel pool storage and spent fuel pit cooling system
10. The boron injection system
11. Ventilation system for the control room

12. Control Room

13. Safety injection system

14. Instrumentation for shutdown

15. Emergency power (AC and DC)

16. Main steam and main feedwater system

17. Systems serviced by the component cooling water (CCW) system (e.g., RHR) since the CCW is unprotected.

The need for providing tornado missile protection to these systems should be evaluated during the integrated assessment of the San Onofre Plant.