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OFFICE OF NUCLEAR REACTOR REGULATION

SAFETY EVALUATION REPORT

SAN ONOFRE UNIT 1

INTERIM SEISMIC ADEQUACY

DOCKET NO. 50-206

Dated: November 16, 1981

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I. INTRODUCTION

In accordance with 10 CFR 50.54(f) of the Commission's regulations, letters were issued on August 4, 1980 and April 24, 1981 to Southern California Edison Company requesting that the licensee:

1. submit details of a seismic reevaluation program plan addressing the scope of review, evaluation criteria and a schedule for completion; and

2. provide justification for continued operation in the interim until the program is complete.

In its response tc both letters the licensee referenced its April 28, 1980 submittal (Reference 1) as its basis for continued operation in the interim until the program is complete.

On June 1 through June 3, 1981 the NRC and its consultants met with Southern California Edison (SCE) and their consultants relative to NRC sponsored seismic analyses of the San Onofre Unit 1 auxiliary feedwater system. At this meeting SCE provided drawings of preliminary modifications required to upgrade the four Turbine Building Extension structures and masonry walls to a level of earthquake resistance consistent with 0.67g Housner Spectra as input.

Based upon the extent of these proposed modifications, and the potential consequences on plant safety of structural failure of either the North Turbine Building Extension or the West Feedwater Heater Platform, our detailed review of the seismic resistance of these structures was expedited.

In their July 7, 1981 letter, the licensee committed to upgrade the North Turbine Building Extension and West Feedwater Heater Platform, if possible, during the outage following six effective full power months of operation or at the next extended outage after completion of detailed design of these modifications. In an August 11, 1981 letter the licensee committed to complete these modifications by June 1, 1982. Subsequently, they committed that should the modifications not be complete, they would shut down the facility until the modifications are complete. The licensee also provided a detailed evaluation of these Turbine Building structures to support continued operation until June 1, 1982.

II. Seismic Hazard Considerations

A. Geology and Seismology

The geologic and seismologic investigations and reviews for the San Onofre Nuclear Generating Station (SONGS) site are among the most extensive ever conducted for nuclear power plants. This included seismologic and geologic studies of Southern California and Baja California in general and specific studies related to the immediate site vicinity.

The Offshore Zone of Deformation (OZD) is about 8 km from the SONGS site at its closest approach to the site. The maximum earthquake on the OZD was determined from historic data and instrumentally recovered seismic activity and from fault parameters, including slip rate, fault length and fault area.

The vibratory ground motion at the site due to the occurrence of the maximum earthquake on the OZD was determined by the use of empirical methods, theoretical models and an examination of recent recordings of strong ground motion from earthquakes.

The seismic record in the Southern California region extends back to the 18th century. From 1932 to the present a relatively complete listing of instrumentally determined earthquakes is available. Listings of earthquakes of Richter Magnitude 5 or greater within 320 kilometers of the site and all listed earthquakes within 80 kilometers of the site, for which instrumental records are available, were reviewed. The spatial density of these events varies with location. The vicinity of the SONGS site (within approximately 30 km) appears to be one of relatively low seismicity.

Based upon its evaluation for the SONGS Units 2 and 3 the staff concluded that an appropriate representation of the maximum earthquake on the OZD to be used in determining the safe shutdown earthquake (SSE) at SONGS is Magnitude, Ms = 7.0. The SONGS Units 2 and 3 design actually exceeds a conservative representation of the ground motion expected from an Ms = 7.0 earthquake at a distance of 8 km.

The NRC by letter dated August 4, 1980 directed the licensee to conduct a seismic reevaluation of San Onofre Unit 1 using 0.67g Housner Spectra as the appropriate free field ground motion for the Safe Shutdown Earthquake (SSE). Based upon our continuing review of the final free field ground motion, the level will be no less than 0.67g Housner Spectra and no greater than 0.67g Modified Newmark-Hall Spectra. The design bases for San Onofre

Units 2 and 3 are the 0.67g Modified Newmark-Hall Spectra. The range between the two spectra is narrowly centered about 0.67g at very short periods (approximately less than 0.05 sec.) and diverge to a larger extent as the period increases. The basis for the conservatism of the 0.67g Modified Newmark-Hall Spectra is contained in the NRC's Safety Evaluation Report (SER) on Geology and Seismology for San Onofre Units 2 and 3, NUREG-0712 (Reference 2). Our evaluation contained in Reference 2 addresses the seismic hazard at the San Onofre site.

The NRC letter dated March 15, 1981 confirmed our earlier direction to the licensee to proceed with the seismic reanalysis of San Onofre Unit 1 using the 0.67g Housner Spectra pending NRC approval of the final spectra. If the appropriate ground motion for reanalysis is not the 0.67g Housner Spectra, the staff will evaluate the margins that exist in the structures, systems and components to determine if additional reanalysis using a higher spectra shape is necessary. The licensee has agreed in a letter dated May 11, 1981 to continue reanalysis effort using the 0.67g Housner Spectra.

The staff expects to reach a final decision on the San Onofre Unit 1 spectra reanalysis following the Atomic Safety and Licensing Board's Partial Initial Decision on San Onofre Units 2 and 3 with respect to geology and seismology issues.

B. Near Term Seismic Hazard

The staff has considered probabilistic estimates of earthquake occurrence and ground motions exceedance at and in the vicinity of the San Onofre site. These include:

1. "Development of Instrumental Response Spectra with Equal Probability of Exceedance for Unit 1," Woodward-Clyde Consultants, April 18, 1980 - Submitted to NRC by letter dated April 28, 1980.

2. A survey of probabilistic estimates of earthquake occurrence and ground motion exceedance at and in the vicinity of the San Onofre site presented to ACRS by the staff on January 31, 1981.

3. "Probability of Exceedance of 0.5g Housner Response Spectrum," submitted to NRC by letter dated October 19, 1981.

In addition, the staff has also utilized the extensive review of theoretical and empirical studies regarding earthquake ground motion at the San Onofre site conducted for the San Onofre Units 2 and 3 Operating License and summarized in the Safety Evaluation Report (NUREG-0712). Examination of the above with respect to the ground motion level defined by the Housner Spectra in the period range of 0.5 to 0.6 seconds at 4% damping indicate the following:

a. Estimates of the probability of exceeding this level of ground motion at or in the vicinity of the San Onofre site in a period of 8 months range from approximately 7×10^{-3} to 1×10^{-4}. The most detailed of these estimates were conducted by Woodward-Clyde Consultants for the site. The most recent study which takes into account new data and/or weighting procedures yields the lowest estimates (3×10^{-4} to 1×10^{-4}).

b. The Safe Shutdown Earthquake (SSE) for the San Onofre site as found in the staff Safety Evaluation Report for Units 2 and 3 is a magnitude 7.0 occurring on the offshore zone of deformation (OZD) approximately 8 kilometers from the site. Estimates of the probability of this event are of the order of 10^{-3} to 10^{-4} for this period. Our examination of the various techniques used to estimate the ground motion deterministically at the site from such an event indicate that the referenced level of ground motion is at about the median (50%) level that could be expected from such an earthquake.

Although absolute estimates of probability with respect to earthquake hazard cannot be made with great accuracy, it is the staff's judgement, based on the above, that the chance of exceeding the 0.4g Housner Spectrum at periods of 0.5 to 0.6 seconds at 4% damping during an 8 month period is low.

III. Seismic Resistance of Structures, Systems and Components

A. Containment Sphere and Reactor Building

The containment sphere and the reactor building were originally designed using the Housner Spectra with 0.25g and 0.5g horizontal acceleration for the Operating Basis Earthquake (OBE) and the Safe Shutdown Earthquake (SSE) respectively.

In its Seismic Backfit Project, as discussed in Reference 3, the licensee performed a seismic reevaluation for certain structures (containment sphere and reactor building), piping (the primary reactor coolant system), and components (steam generators, reactor coolant pumps, pressurizer, and reactor vessel).

The analyses were performed using 0.67g Housner Spectra. The containment sphere, the reactor building and the primary reactor coolant system are three subsystems considered in the system analysis. Each system model included the dynamic characteristics of all major subsystems in a coupled time history analysis. The effect of soil-structure interaction was included. The models used in these analyses were three dimensional, and torsional effects were automatically included.

The response spectrum method in conjunction with a three-dimensional finite element model was used for the seismic reevaluation of containment sphere, foundation and the reactor building. The multidirectional components of the earthquake and the modal responses were combined in accordance with Regulatory Guide 1.92.

Based upon their reanalyses, the licensee concluded for the containment sphere, the reactor building and structural steel framing that these structures have resistance capacities in excess of those required to meet 0.67g Housner Spectra. As a result, modifications were not necessary. While we have not completed our review of these reanalyses, our preliminary review indicates that these results appear reasonable and are consistent with results from audit analyses performed by NRC for structures of other SEP plants.

B. Standby Power Addition Project and Sphere Enclosure Project

The Standby Power Addition Project (including the Diesel Generator Building) and the Sphere Enclosure Project (including the Sphere Enclosure Building) were designed based on the 0.67g Design Spectra developed for San Onofre Units 2 and 3 (Reference 2). The design criteria and procedures used for these two structures are the same as those used for SONGS Units 2 and 3 which have been evaluated and accepted by the NRC staff. These projects were approved by the NRC in Amendment No. 25 to Provisional Operating License No. DPR-13 (Reference 5).

C. Reactor Auxiliary Building, Fuel Storage Building, Control Building

For these three buildings, with the exception of masonry walls, the Housner Response Spectra scaled to 0.5g for the SSE and 0.25g for the OBE were used in the simplified dynamic analysis for the original design. The vertical spectra were 2/3 of the horizontal spectra. The stress components were combined by absolute addition for the vertical and horizontal direction.

Design margins of at least 2 to failure typically exist in well built stuctures as a result of design code allowables, seismic design conservatisms and inherent seismic resistance. Therefore, 34% increase in input motion, 0.67g vs. 0.5g Housner Spectra, should be accommodated safely by these structures, although modifications may be required to restore design margins for the higher seismic input.

Evaluations of masonry walls in the facility considering the 0.67g Housner Spectra are proceeding. The licensee's analysis to date indicates that masonry walls are capable of resisting this level of motion without collapse.

D. Turbine Building Structures

The Turbine Building structures consist of five separate free-standing structures, connected by common foundation elements. These structures are:

1) The Turbine Pedestal;

2) The North Turbine Building Extension;

3) The South Turbine Building Extension;

4) The East Feedwater Heater Platform; and

5) The West Feedwater Heater Platform.

The turbine pedestal consists of massive concrete slabs and columns and its initial seismic design basis was 0.5g Housner Spectra. The remaining turbine building structures were designed to a 0.2g horizontal static coefficient. These structures consist of post-tensioned concrete slabs supported by steel framing. The columns are welded to the beams supporting the slabs and attached to the concrete foundation elements using embedded anchor bolts. Some reinforced concrete block masonry walls exist in each structure.

During meetings and a site visit in early June 1981 the licensee identified the following preliminary modifications to the Turbine Building structures to provide resistance to the 0.67g Housner Spectra seismic input. The modifications include the addition of substantial lateral bracing from floor to ceiling in both the North-South and East-West directions for both the North and South Turbine Building Extensions and both Feedwater Heater Platforms to increase their lateral resistance to seismic motions and to prevent possible impact with the Turbine Pedestal.

1. System Considerations

The failure of any, or all, of the following structures could adversely affect safety systems:

- North Turbine Building Extension.

  Earthquake induced collapse of this structure would impair the function of safety related systems, including the main steam lines and their isolation valves (i.e. the turbine stop valves), the feedwater and auxiliary feedwater (AFW) system lines, Emergency Core Cooling System (ECCS) lines, cables for instrumentation and controls required for decay heat removal, and the power supply cables for the charging pumps, thereby eliminating all methods for providing water to remove reactor decay heat.

- West Feedwater Heater Platform.

  Collapse of this structure, induced by an earthquake, would impair the function of safety related systems, including the AFW pumps, instrument air compressors, and steam and feedwater lines. All methods for providing water to the steam generators to remove decay heat would be eliminated. An alternate method for cooling of the core using primary system feed and bleed is possible and is discussed below.

- East Feedwater Heater Platform

  Collapse of this structure, induced by an earthquake, would impair the function of safety related systems, including the feedwater and ECCS systems. The break of the feedwater system is postulated at the Feedwater Heater. Check valves are installed upstream of the heater on the three feedwater lines going to each steam generator. Therefore, a path for decay removal using the auxiliary feedwater system is available. The alternate method for cooling the core using primary system feed and bleed is also available. Therefore, the consequences of collapse of this platform are less severe than those of the West platform.

- South Turbine Building Extension

Collapse of this structure, induced by an earthquake, would impair the function of safety related systems including the remote Safe Shutdown Panel, loss of electrical power for ECCS loop C, loss of one loop of ECCS for recirculation mode, loss of off-site power and possible loss of the condensate storage tank or piping. However, an alternate suction suction path for auxiliary feedwater would be available with operator action using the fire water system. The consequences of collapse of this structure are the least severe and would not prevent removal of reactor decay heat.

- Alternate Method of Decay Heat Removal

In their August 11, 1981 submittal the licensee discussed an alternate method of decay heat removal, using primary system feed and bleed, which can be initiated by the operator from the control room. The charging pumps, taking suction on the refueling water storage tank (RWST), would be used to deliver water to the primary system through the long-term post-accident recirculation flowpath. The pressurizer power-operated relief valves would be opened to reject heat to the primary containment. After sufficient water is in the sump the recirculation heat exchanger would be used to remove the decay heat to the ultimate heat sink.

The equipment needed to implement the above means of decay heat removal are separate from and independent of a postulated failure of the west feedwater heater platform. The equipment can be powered from on-site power sources. Backup nitrogen supplies are available and may be needed to operate pneumatic components if the instrument air system is impaired.

The licensee has calculated that a delay of 30 minutes before the alternate decay heat removal system is operational would not result in uncovering of the core. The calculations also showed that the alternate method has sufficient capacity to remove the decay heat load.

As discussed in the licensee submittal of September 28, 1981, plant operating procedures were developed in response to post-TMI Bulletins and Orders for natural circulation cooling, for inadequate core cooling and for PORV operation. Primary feed and bleed using these procedures is a scenario that is covered in operator training.

Although the staff has not reviewed the licensee calculations in detail, this alternate decay heat removal method would be available for cooling should the West Feedwater Heater Platform be damaged by a large earthquake.

2. Inherent Seismic Resistance

The licensee performed a detailed analysis to establish the structural capacity of the North Turbine Building Extension, the West Feedwater Heater Platform and masonry walls in the Turbine Building. These results were reviewed during a meeting with the staff on July 30, 1981. A simplified dynamic analysis of the entire Turbine Bulding considering soil structure interaction (SSI) was performed to determine the fundamental vibrational modes and mode shapes for the North Turbine Building Extension and the West Feedwater Heater Platform. To determining the capacity of the structures, accelerations from the 4% damped 0.5g Housner Spectrum was used in a static analysis. Total force response in any one direction was obtained by combining 100 percent of the maximum response due to one earthquake component with 40 percent of the maximum response due to the other two earthquake components. During the meeting, the staff requested the licensee to verify by inspection that the welded connections were installed as designed and to evaluate the capacity of the column to girder connections. The results of the licensee's analyses and evaluations are contained in their August 11,1981 submittal. The results indicate that:

1) the welded connections were installed in accordance with the original design;

2) the connections are adequate up to the onset of yield in the columns; and

3) the connections would exceed their elastic limit at significantly less than the full moment capacity that could be developed by the column.

These results confirmed that the welded column to girder connections were the limiting element in the original design of these structures.

The licensee has also performed a detailed inelastic analysis of the masonry walls using an input of 0.67g Housner. The analysis results indicate that displacements up to 10" at midspan could occur but the wall would not collapse. The staff has not completed its review but believes that, although degradation (spalling and potential limited overstraining of rebar) could occur, collapse is not likely.

For analyses of the North Turbine Building Extension and West Feedwater Heater Platform Structures, the licensee assumed a ground motion amplification factor of 1.4 (based upon their calculated frequencies and a 4% damped Housner Spectrum). The onset of structural yielding was predicted to occur at approximately 0.3g to 0.4g Housner Spectrum for the North Turbine Building Extension and for both East and West Feedwater Heater Platforms. The South Turbine Building Extension would yield at a lower value.

At the onset of ductile behavior, significant redistributions of loads in the members will begin to take place. Since the original column to girder connections could not develop the full plastic moment capacity of the columns, the licensee upgraded the strength of the connections on column lines B and D of the North Turbine Building Extension (a total of 5 of 8 such connections). These connections have been modified such that the full plastic moment capability of the columns can be developed. Considering that girder capacities are in excess of the column capacities and assuming that the column to foundation anchorages (i.e., bottom connections) are adequate, the top connections for columns line B and D are sufficient to allow some limited ductility for the North Turbine Building Extension. Column line B provides primary resistance to North-South motion, therefore without considering restraint from adjacent structures (given the several inch gap that exists between the Enclosure Building and North Turbine Building Extension), these modified connections should be adequate to develop ductile behavior.

The adequacy of the column to foundation anchorages in the North Turbine Building Extension is a key factor in the strength of the structure to resist earthquakes. Previous licensee analysis indicated anchor bolt capacities in the range of 0.39g to 0.48g Housner. These results indicated capacities in excess of the original top connections. Additional analysis considering the effects of column imbedment in the floor was presented to the staff on October 16, 1981, and is contained in the licensee's submittal dated October 19, 1981. Recognizing the limitations of using elastic analysis to predict ductile behavior and other uncertainties in the licensee's analysis of the anchor bolt capacities, the staff believes that the capacity of the structure to resist North-South ground motion is about 0.4g Housner Spectrum.

Column lines A and D provide the primary resistance of the North Turbine Building Extension to East-West motion. Only column line D is being modified. However, substantial restraint to the half of the structure supported by column line A is provided by the approximate 1 1/2 inch gap between it and the top of the spent fuel pool on the west side and the operating deck of the Control Building on the east side. Therefore, considering (1) the unmodified column line A connections should remain elastic up to a displacement of about 1 1/2 in., at which point the gaps would close and the restraint from the adjacent structure would be realized; and (2) the ductile behavior of column line D to resist seismic motions including any torsion which may result from the impacts with the adjoining structures, the staff concludes the seismic resistance capability of the structure in the East-West direction should be comparable to that of the North-South direction.

The staff estimates that the East and West Feedwater Heater Platforms are likely to have the capability to resist earthquake input in the range of 0.3 to 0.4g Housner. The performance of the North Turbine Building Extension based upon the recent modification of the top connections and considering the displacement constraints offered by the adjacent structures is likely to have the capability to resist earthquake input of about 0.4g Housner. The South Turbine Building Extension would be expected to fail at an earthquake level less than that for the East or West Feedwater Platform due to the substantial added load that it must carry due to the crane which is normally positioned over the South Turbine Building Extension.

E. Safety Related Mechanical Equipment

The original design of the safety related piping was based on the ANSI B31.1 code for power piping using the Housner Spectrum (0.5% damping) scaled to 0.25g which resulted in response accelerations of 1.0g and 0.67g for horizontal and vertical components respectively (Reference 4). The original design basis for all equipment (mechanical and electrical) initially classified as safety related was 0.5g Housner Spectra with 1% and 2% damping ratios.

In its Seismic Backfit Project (as discussed in Reference 3), the licensee performed a seismic reevaluation for certain structures (containment sphere and reactor building), piping (the primary reactor coolant system), and components (steam generators, reactor coolant pumps, pressurizer, and reactor vessel). The analyses were performed using 0.67g Housner Spectra. The containment sphere, the reactor building and the primary reactor coolant system are three sub-system models considered in the analysis. For example, the system model for the coolant loops included a detailed model of the reactor coolant system, with simplified models representing other components, systems and structures (containment sphere and reactor building). The simplified models were developed from more detailed models. The analysis included the dynamic characteristics of all major subsystems in the coupled time history analysis.

The analysis of the reactor coolant system was based on the direct application of ground motion input to the complete closed system model. Based upon the results of this analysis some support modifications were made for large NSSS equipment (i.e., steam generators and pressurizer, etc.) to resist overturning and to accomodate large thermal expansion. We have not yet completed our review of these reanalyses. Attached branch piping was not included in this reevaluation, but was initially designed considering a 0.5g Housner Spectra.

The equipment in the Standby Power Addition Project was designed for the same seismic input as San Onofre Units 2 and 3. The design basis was 0.67g Modified Newmark-Hall Spectra (Reference 2). The piping and mechanical equipment were designed (Reference 11) in accordance with the applicable sections of the ASME B&PV Code and are acceptable.

The auxiliary feedwater (AFW) system was not originally designated as a safety related system. Therefore, the system was originally designed to resist a 0.2g static horizontal acceleration. New discharge piping and portions of the steam supply piping to the steam driven AFW pump have been installed and were upgraded in their seismic design to 0.67g Housner Spectra. However, other portions of the AFW system (e.g., the supply piping to the AFW pumps and the condensate storage tank) have not been and are not presently being upgraded. The seismic design basis for the portions of the system which have not been upgraded is a 0.2g static horizontal acceleration.

On November 24 and 25, 1980, the NRC staff conducted a site visit and a walk-down of the SONGS 1 auxiliary feedwater (AFW) system. Based on our observations of the existing AFW system, the NRC Staff concluded that some inherent seismic resistance capability was provided in the initial design and construction for much of the system. Piping, cable trays, equipment and components were generally provided with lateral support.

Three areas of concern were identified which required remedial actions prior to the resumption of power operation of SONGS 1. The first concern was the Station No. 1 battery racks. While the existing racks provided for some degree of lateral seismic load resistance and are redundant to the much more substantial No. 2 battery racks, the configuration did not appear to have a level of integrity commensurate with the importance of the batteries to plant safety. These racks appeared less capable of continued integrity following a seismic event when compared to the No. 2 battery racks which were installed to the seismic design criteria specified for their diesel generator installation. Therefore, we required that the existing No. 1 battery racks be re-evaluated using the current SSE specified criteria, and modified accordingly.

The second concern was the suction piping to the AFW pumps, which consists of a single header from the condensate storage tank to the pumps. The header has some lateral support. However, the condensate storage tank was not qualified to the initial or current SONGS 1 seismic criteria for safety related systems. The tank is not anchored at its base. It merely rests on the ground. Also, the permanent alternate water supply is through the tank. There is a capability to install a hose from a seismically qualified water source to the AFW pump suction and bypass the condensate storage tank. We required that a hose be installed and kept attached to the appropriate connections to facilitate its use if it became necessary to do so.

The third concern was with the main instrumentation and control panels in the control room. These are supported at the bottom by a concrete channel and at the top by steel knee braces anchored to the concrete ceiling with expansion anchors. The requirements of IE Bulletin 79-02 (the concrete expansion anchor and base plate issues) had not been applied to these anchor bolts and base plates. We stated that conformance with the IE Bulletin requirements for factors of safety, considering base plate flexibility, must be assured for the original design of these panels. Also, some bolts and screws were missing in these panels. We required that the licensee inspect all screws, bolts and nuts in the panel for their presence and integity. Missing fastening devices were to be replaced.

These three actions were completed by the licensee prior to their restart in June 1981.

Based upon the detailed walk-downs of the SONGS 1 AFW system, the AFW system possesses an adequate degree of seismic resistance and redundancy to permit plant operation during the near term seismic reevaluation and upgrading of this system required of all operating PWRs by NRR Generic Letter dated February 10, 1981. However, this conclusion is contingent upon the structural integrity of the North Turbine Building Extension, the West Feedwater Heater Platform and any masonry walls whose failure could impair the function of the AFW system.

F. Anchorage and Support of Class IE Electrical Equipment

In response to the NRC's letters of January 1 and July 28, 1980, on tie-down of safety related electrical equipment, the licensee conducted a walk-through visual inspection of the plant and made a preliminary assessment of the adequacy of equipment tie down. The licensee surveyed approximately fifty-nine items and found that approximately two-thirds were adequately secured. Based on the results of these preliminary assessments, interim modifications were completed for the remaining items in July and August 1980.

Following completion of these interim modifications, detailed analyses were performed on the anchorages of all identified items. These analyses were divided into two phases. The first phase included all equipment at grade elevation for which response spectra were available (the 0.67g Housner Spectra). The results of these analyses confirmed the adequacy of the preliminary assessments and the interim modifications with five exceptions. The five items were the battery racks, the Uninterruptable Power Supply battery rack, the High Voltage control board, the 5kVa inverter and the battery chargers.

The second phase of the program included all equipment located in the control room. The analysis of the anchorage of safety related electrical equipment in the control room is based on the estimated floor response spectra with a peak floor acceleration of 2.0g. From the results of the analyses, additional modifications were found to be required for process control racks R1 through R7, R10 and R11, the nuclear instrumentation system, radiation monitoring system, vital bus assembly, and containment system actuation system logic Train A cabinets.

All modifications identified by the licensee to be necessary to resolve all electrical equipment anchorage have been implemented. Our review of the adequacy of these modifications is continuing.

IV. Seismic Reevaluation Program

In accordance with 10 CFR 50.54(f) of the Commission's regulations, a letter was issued on August 4, 1980 to Southern California Edison Company requesting that the licensee:

1. submit details of a seismic reevaluation program plan addressing the scope of review, evaluation criteria and a schedule for completion; and

2. provide justification for continued operation in the interim until the program is complete.

It was noted in our letter that the proposed program plans and schedule for an expanded program should include an evaluation of the following:

1. the remainder of the reactor coolant pressure boundary (i.e., all attached piping/equipment),

2. safety related mechanical and electrical equipment to bring the plant to cold shutdown, and

3. safety related mechanical and electrical systems required to mitigate the consequences of an accident.

In its response to this letter the licensee referenced its April 28, 1980 submittal (Reference 1) as its basis for continued operation in the interim until the program is complete. The program scope and schedule in this submittal needed to be modified to include the reevaluation of piping and mechanical/electrical equipment.

Subsequently, several meetings were held between the licensee and the NRC Staff to discuss the seismic reevaluation program scope and schedule.

The licensee partially responded in a letter submitted on February 23, 1981, entitled "Balance of Plant Structures Seismic Reevaluation Criteria." This document provides a detailed description of the methodology and criteria to be used in seismic reevaluation of each of the plant strutures included in the program, with the exception of the upgraded projects previously discussed which include the Reactor Building, Steel Containment Sphere, Sphere Enclosure Building, and Diesel Generator Building.

A follow-up to the 10 CFR 50.54(f) letter was sent to the licensee on April 24, 1981 requesting the information on the complete scope and schedule for the reevaluation program. In response to our April 24, 1981 letter, the licensee submitted a description of complete program scope and schedule on July 7, 1981.

SCE has committed to complete the balance-of-plant structures and masonry wall evaluations by January 1982. SCE also proposed that any modifications be evaluated to determine if they would be impacted by other SEP topic evaluations and therefore should be deferred to the SEP integrated safety assessment. By May 1, 1982, SCE is scheduled to have reevaluated the remainder of the primary coolant pressure boundary and all structures and mechanical systems required to bring the plant to a safe shutdown. Accident mitigating systems will be completed by November 1982.

V. Conclusion

As discussed in the above evaluation, significant seismic upgrading of the San Onofre Unit 1 facility is underway, much has been accomplished and more is scheduled. The staff also agrees with the licensee's April 28,1980 basis for continued operation for those structures, systems and components which were originally designed to meet a 0.5g Housner Spectra as ground motion input.

However, not all safety related structures and systems were designed to this level of ground motion. In particular two critical areas of the Turbine Building complex (North and West Extensions), several masonry walls and the Auxiliary Feedwater system are in this category. It is the NRC's judgment that the inherent seismic capability of the AFW system and the additional water supply that bypasses the normal suction piping provide an adequate basis for continued operation during the seismic reanalysis and upgrading of the Auxiliary Feedwater System. Based on our review to date, we consider the masonry walls have adequate seismic resistance, although spalling and rebar overstraining may be expected to occur at levels somewhat below the 0.67g Housner Spectra used by the licensee in his analyses. Our evaluation of the North Turbine Building Extension and the West Feedwater Heater Platform indicate an inherent capacity to withstand seismic events in excess of the original design (0.2g Static). As discussed in Section III.A.4, the staff estimates that the North Turbine Building Extension would have the capacity to withstand an earthquake input level of 0.4g Housner.

The staff has concluded that certain modifications to (1) the North Turbine Building Extension and (2) the West Feedwater Heater Platform are necessary in the near term to increase the capability of certain plant structures to resist earthquakes at SONGS 1 to assure that continued operation of the facility is not inimical to the health and safety of the public.

For the reasons discussed in Section II.B., Near-Term Seismic Hazard, the probability is low that ground motion at the reactor site greater than that characterized by 0.4g Housner Spectrum would be exceeded. Therefore, considering the plant's ability to resist strong ground motion, as discussed in Section III, Seismic Resistance of Structures, Systems and Components, and considering the low probability of the ground motion discussed above until June 1, 1982; the staff concludes that short term operation of San Onofre Unit 1 during the seismic re-evaluation of the facility and the implementation of any modification shown to be necessary as a result of seismic reanalysis is acceptable under the following conditions:

(1) Structural upgrading of the North Turbine Building Extension and West Heater Platform by adding diagonal steel bracing is to be completed by June 1, 1982 or the facility is to be shut down until such upgrading is completed;

(2) Results of seismic analysis of structures are to be submitted for NRC review by January 31, 1982 and for all other items on the schedule specified in the licensee's November 3, 1981 letter;

(3) Any modifications shown to be necessary as a result of the seismic analysis which are not implemented by January 1, 1983 are to be justified on a case by case basis with a schedule for implementation; and

(4) Prior to upgrading of the North Turbine Building Extension and West Heater Platform, either the gantry crane is to be parked at the extreme south limit of travel or the reactor is to be shut down during periods when crane movement is required.

REFERENCES

1. "Seismic Reevaluation Program," San Onofre Nuclear Generating Station, Unit 1, April 28, 1980.

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