

November 27, 1981

Docket No. 50-206
LS05-81-11-068

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-3C "Inservice Inspection of Water Control Structures"

We have reviewed your comments of October 23, 1981 to our Safety Evaluation Report sent to you on July 27, 1981 and have incorporated them into the attached final SER.

Regarding your first comment, even though San Onofre 1 does not have an underdrain system, reference to SEP Topic III-3B "Structural and Other Consequences of Underdrain Failure" was made because San Onofre 1 was the lead plant for Topic III-3C. Since San Onofre 1 was the lead plant, the SER on III-3C for San Onofre 1 was to form the basis for licensee prepared SARs including plants which have underdrains.

Regarding your fourth comment, it is true that the soils information included in our SER is applicable to Topics II-4D, F; however, it was included in III-3C as a basis for our conclusion that only normal inspection activities would be required for slopes and foundations of water control structures.

Our review of this topic is complete and the attached final SER will be a basic input to the integrated assessment of your facility.

Sincerely,

Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing

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Systematic Evaluation Program Topic Assessment

Location: San Onofre 1

Topic: III-3.C - Inservice Inspection of Water-Control Structures

I. INTRODUCTION

The safety objective of this review is to assure that adequate and timely inspections of water-control structures, systems and components are accomplished to minimize the risk to public health and safety resulting from operation of nuclear power plants. The review specifically pertains to water-control structures (e.g., dams, reservoirs, conveyance facilities) built for use in conjunction with a nuclear power plant and whose failure could cause radiological consequences adversely affecting the public health and safety. In general, to be included under this topic, the structure must have been built, wholly or in part, for the purpose of controlling or conveying water for either emergency cooling operations or flood protection of a nuclear power plant. Such structures may be located on or off the site.

The scope of the review embraces the following subjects which are evaluated using data developed by the licensee and information available from all sources:

- (a) Engineering data compilation;
- (b) Onsite inspection program and reports of these inspections;
- (c) Technical evaluation of inspection results; and
- (d) Frequency of inspections.

II. CURRENT REVIEW CRITERIA

The criteria which are applicable are (1) 10 CFR Part 50 § 50.36, (2) 10 CFR Part 50, Appendix A including General Design Criteria 1, 2 and 44, (3) 10 CFR Part 100 and (4) 10 CFR Part 100, Appendix A. Pertinent regulatory positions contained in Regulatory Guides 1.27, 1.28, 1.127, 1.132 and 1.38 (Ref. 1) also apply. Review procedures as contained in NUREG 75/087 Standard Review Plan Sections 2.5.4 and 2.5.5 (Ref. 2) are also used where appropriate.

III. RELATED SAFETY TOPICS AND INTERFACES

The slope stability aspect of water-control structures will be reviewed under topic II-4.D. Settlement of water-control structures will be reviewed under topic II-4.F. Other interface topics include: II-4.E, "Dam Integrity"; II-3.A, "Hydrologic Description"; II-3.C, "Ultimate Heat Sink"; III-3.A, "Effects of High Water on Structures"; IX-3, "Station Service and Cooling Water Systems"; III-6, "Seismic Design Considerations"; XVI, "Technical Specifications"; and III-3.B, "Structural and Other consequences of Failures of Underdrain Systems."

IV. REVIEW GUIDELINES

In general the method for complying with specific portions of the Commission's rules and regulatory positions as described in Regulatory Guide 1.127 is used in evaluating inservice inspection programs for water-control structures. Pertinent elements of the licensee's program are evaluated and compared to current criteria and the safety significance of any differences is evaluated. The practices of other public agencies for similar facilities posing similar public risk may also be used for applicable guidance.

V. TOPIC EVALUATION

1. Site Description and Water Supply

The San Onofre Unit 1 site is located on the Camp Pendleton Marine Corps Reservation on the coast of California in San Diego County about 51 miles northwest of San Diego and about 62 miles southeast of Los Angeles. The topographic features of the immediate coastal area includes a narrow band of beach sand terminating at seacliffs which reach a height of 60 to 80 feet in the vicinity of the site. A gentle coastal plain extends inland to the western foothills of the Santa Margarita Mountain Range approximately 1-1/2 miles to the east. The plant site is on the shore-line located at +20 feet MLLW elevation. There are no rivers, streams, or creeks in the plant vicinity which could influence flooding of the site. However, a small 0.86 square mile foothills drainage area east of the site could be a potential flooding source. There are no dams on or in the vicinity of the site that could affect the safe operation of the plant.

A gunited steel sheetpile seawall has been constructed to a height of +28 ft MLLW to provide protection from Probable Maximum Surge, Seiche, and Tsunami flooding from the Pacific Ocean. A small 3,000,000 gallon reservoir is located on the north bluff of the site at bottom elevation +78 ft. The Pacific Ocean serves as the source of plant cooling water during normal plant operating conditions and during plant shutdown and accident conditions. It is the plant ultimate heat sink (Ref. 4).

2. Foundations and Engineering Characteristics of the Site

The subsurface structure exposed in the excavation for the plant facilities include Quarternary terrace deposits which overlie the Pliocene age San Mateo Formation. The terrace deposits consist of tan, buff and light brown, silty or clayey, fine to coarse sand with some cobbles. The deposits are crudely stratified with an average thickness of 40 feet. The San Mateo Formation is a cemented, massive, well graded yellow-brown, fine to coarse sand with gravel and occasional lenses of thin bedded gray shale or siltstone and is approximately 1,000 feet thick at the site. The San Mateo Formation is a poorly cemented but very dense sand. All major structures have been founded on the San Mateo Formation. The engineering properties of this formation were evaluated by field and laboratory testing (Ref. 5). Results of the study indicate the formation has 800 PSF effective cohesion with a 41° angle of internal friction. Results of geophysical investigations indicate the compressional wave velocity for the San Mateo Sand ranges from 3000-7500 feet per second and the shear wave velocity range from 1000 to 2750 feet per second.

To accommodate the plant, the bluff was cut back using a "Bench Design" approach. Cut slope profiles consist of a 15 foot bench at the horizontal interface of the terrace deposit and the San Mateo formation. The San Mateo Formation comprises the lower 25 feet of the cut slope. Above and below the bench, the cuts were excavated to a slope of one horizontal to two vertical. (Refer 4). Results of static and dynamic stability analysis indicates that, while raveling and minor slump of the terrace deposits can be expected under severe seismic loading, there is high confidence that catastrophic deep-slope slides should not occur. The dense nature of the San Mateo sands coupled with the relatively low ground water table located at elevation +5 feet MLLW

data preclude the possibility of liquefaction failure during seismic loadings. Erosion of the cut slopes has been minimal and easily checked thru periodic inspection and preventive maintenance using shotcrete stabilization techniques.

Prior to construction of the plant, the original plant site elevation ranged from ± 60 to $+90$ feet MLLW. The finished plant grade elevation is $+20$ feet MLLW. The average SPT N-value in the San Mateo sand exceeds 200 blows/ft. Based upon information presented in Section 2.5.4.10.4 of the San Onofre Unit 2 and 3 FSAR the Formation shear modulus G has been estimated to be $14,700 \text{ K/Ft}^2$ and the elastic modulus E has been estimated to be $40,000 \text{ K/ft}^2$. Due to unloading by excavation, and the relatively low compressibility, of the San Mateo Formation, insignificant differential settlement of structures founded upon this formation would be expected upon completion of construction loading. Actual total settlement measured at the center of the reactor containment was 0.38 inches. (Ref. 5).

Based upon the data and analysis presented by the licensee and the review by the staff, the Foundations and Engineering aspects of the site appear to be favorable and are not judged to be significant factors which would require other than normal in service water control structure inspection activities as identified in Regulatory Guide 1.127 Paragraph C-2.

Flood Protection Berm at Top of Bluff

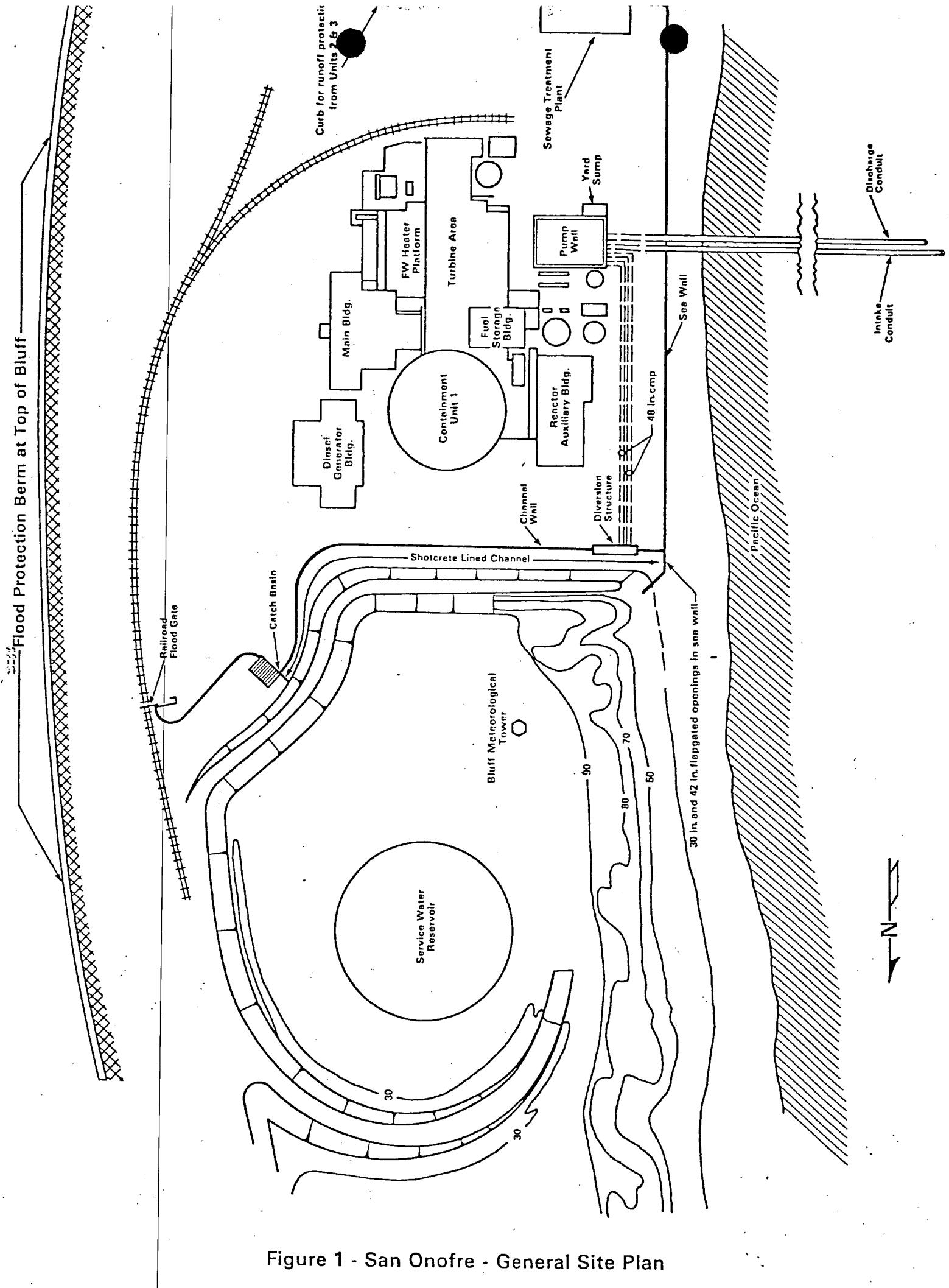


Figure 1 - San Onofre - General Site Plan

3. Description of Water-Control Structures

The following structures and components associated with the San Onofre Unit 1 site have been identified as requiring surveillance in accordance with applicable Commission rules and the regulatory guidance in Regulatory Guide 1.127. (See Figure 1)

A) Cooling Water System Structures:

- 1) Intake and discharge conduits, screen well and gates, terminal structures, and manholes.
- 2) Three million gallon (3 MG) reservoir (backup cooling water system).

B) Flood Water Control Structures:

- 1) North side flood protection system including: railroad gate, catch basin, shotcrete lined channel, north channel wall, existing diversion structure including two 48" corrugated metal pipes and one 30" and one 42" flap gate openings in seawall.
- 2) South side flood curb (currently under construction).
- 3) East side flood berm (currently under construction).
- 4) West side seawall and tsunami gates and the beach walkway which is currently under construction.
- 5) Yard drainage sump.

to be accomplished in a systematic manner. Items inspected include the screen-wall area, tsunami gates, intake and discharge conduits, manholes, terminal structures, junk traps and marker buoy systems. An appropriately detailed check list has been developed and the inspection program has been conducted under the direction of engineers and marine biologists experienced in the investigation, design, construction and operation of submerged water-control structures. Inspection reports have been prepared presenting the results of each inspection accomplished and are available for reference. An inspection interval of approximately two years has been followed for the emergency cooling water control structures and provision has been made for accomplishment of special inspections immediately after the occurrence of earthquake events.

Based upon the results of our onsite observations and in-office analysis of information presented by the licensee, we conclude that, although this inspection effort was not formally established under current regulatory guidance, we consider that it encompasses most essential elements of the Inservice Inspection Program described in Regulatory Guide 1.127. We further conclude that this inspection effort is in accordance with the rules of the Commission and the guidelines of Regulatory Guide 1.127, and is, therefore, acceptable.

A formal inspection program for the remainder of the water control structures at the site has not been established. However, all water control structures coming under the purview of Regulatory Guide 1.127 have already had a post-construction inspection as a part of previous quality assurance efforts. These inspections have been performed either by or under direct supervision of engineering personnel. However, due to the record retention requirements in effect at the time of construction, records may not be available

4. Engineering Data Compilation on Water Control Structures

Engineering data for all existing water control structures (with the possible exception of the original plant data) is available on-site and has been consolidated within Southern California Edison's Corporate Document Management (CDM) center for ready accessibility. This data includes: general site data, hydrologic and hydraulic data, foundation and embankment materials data, construction and construction inspection and testing data, date related to concrete materials and sources, data related to geologic features, geotechnical engineering data, seismic and seismic design data and as-constructed drawings. Some photographs of as-constructed and/or existing conditions of structures are available. A considerable amount of additional engineering and geologic data developed in conjunction with the San Onofre Unit 2 and 3 PSAR and FSAR are readily accessible at the site.

Based upon the information presented by the licensee, we find that the general type and quantity of engineering data available on site and/or readily accessible is adequate to meet the inservice water control structures inspection program required for San Onofre Unit 1 structures.

5. On Site Water Control Structure Inspection Program and Reports

A formal inspection program for inservice water control structures employing the methodology set forth in Regulatory Guide 1.127 has not been established to date. An inspection program has been established for the submerged water control structures which are required for emergency cooling operations. This program includes all appropriate elements to allow inspections

at the earliest practical time (such as in conjunction with the next post-construction inspection of a presently incomplete or inactive water control structure). For subsequent inspections of all facilities, appropriate engineering data should be compiled for each structure and reviewed prior to the actual inspection. An appropriate check list, as detailed in Section C-2 of Regulatory Guide 1.127 and Reference 3, should be prepared and an inspection report, as described in Section C-5 of Regulatory Guide 1.127, should be accomplished documenting the results. The report should be placed on file at the site for ready reference and future access. Special inspections, to be performed after the occurrence of significant unusual events, such as earthquakes or intense local rainfall capable of degrading the capability of site water control structures, should also be planned and carried out under the supervision of engineering personnel using preestablished checklists. A report of these special inspections should also be placed on file at the site. It is recommended that an appropriate written directive, such as a San Onofre Unit 1 station procedure, be issued establishing guidelines for inspection of each water control structure similar to the Southern California Edison - Division Order D-M20 issued for Inspections of Circulating Water Conduits.

6) Technical Evaluation of Inspection Results

In meeting the requirements of the rules and regulatory positions of the Commission, the methodology of Regulatory Guide 1.127 includes the accomplishment of a technical evaluation of inspection results when significant changes have occurred which potentially impact upon the capability of water control structures to function as designed. The technical evaluation should

for some structures. Formal inspection reports of post-construction inspections were not prepared.

Recent modifications and/or additions to most of the existing structures, due to construction of Units 2 and 3 and Unit 1 back-fit work have already resulted in, or will soon culminate in, additional post-construction inspections. These inspections are also performed either by or under the direct supervision of appropriately qualified engineering personnel.

The Staff's discussion with licensee representatives indicate that future post-construction inspections will be accomplished by an inspection team staffed on an "as required" basis. Composition of the team will be restricted to engineer and engineering aide personnel who embrace the pertinent engineering disciplines related to the specific structures to be inspected. The licensee's office review and analysis of the results of the field inspections will also be accomplished under the direction of qualified engineering personnel. Administrative control of these activities will be described in appropriate plant procedures which will be audited by the SCE Quality Assurance Organization.

It is the staff's position that post-construction inspections which include features similar to the inspections described in Regulatory Guide 1.127 Section C.2. may be considered as initial inspections meeting the requirement of the Commission rules and the regulatory guidance of Regulatory Guide 1.127. For those structures not currently under construction or modification, or for which complete inspections reports are not presently available, a subsequent inspection should be accomplished by the licensee

of a specific frequency of inspection would not have been practical due to the number of on going modifications to existing structures and/or construction of additional water control structure associated with the construction of Units 2 and 3.

Upon completion of construction of Units 2 and 3 and the finalizing of grading improvements at the site related to that construction, the licensee anticipates establishing a schedule for subsequent inspections varying from yearly to once every 3 to 5 years for inservice water control structures, based upon the type of structure, condition, age, potential for distress and factors related to maintenance schedules.

Special inspections to be performed after the occurrence of significant unusual environmental events will be planned on an "as required" basis.

We find that the licensees general estimate of required frequency of inspections is in accord with the Regulatory guidance of Regulatory Guide 1.127 and is, therefore, acceptable. It is recommended that a specific schedule for each structure be established as soon as practical and documented in a suitable manner such as by inclusion in appropriate SCE station procedures.

VI. Conclusions

1. Appropriate water-control structures associated with the San Onofre Unit 1 site which come under the rules and the regulatory positions of the Commission have been identified. Engineering data related to the site

and the structures have been developed and are available within the Corporate Document Management Center or are on-site and readily accessible.

2. Initial post-construction acceptance inspections have been performed for all existing water control structures and further acceptance inspections are planned upon completion of ongoing modification to existing structures and upon the completion of construction of new structures. In-so-far as post-construction inspections contain elements similar to those included in the suggested methodology for inspections set forth in Regulatory Guide 1.127, it is the conclusion of the Staff that post-construction inspection may be considered suitable alternatives to the initial inspections identified in Regulatory Guide 1.127.
3. A routine inspection program has been established for the San Onofre Unit 1 site water control structures required for emergency cooling operations. The program includes appropriate elements to allow inspections to be accomplished in a systematic manner. An appropriately detailed check list has been developed and the inspection program has been accomplished biennially under direction of engineers and marine biologists experienced in the design, construction, operation and inspection of submerged water control structures and equipment. Provision has been made for accomplishment of special inspections immediately after the occurrence of earthquake events. Inspection reports presenting the results of each inspection accomplished to date are available on-site

include a complete presentation of the existing condition of the structure and a thorough assessment of the impact of changes on such factors as hydraulic and hydrologic design capacities, slopes, subsurface materials, foundation stability, structural integrity, and structural stability.

At San Onofre 1, the results of the inspections of the emergency cooling water control structures performed to date indicate that no significant changes in the condition of the structures have occurred which warranted accomplishment of a technical evaluation of the change. Additionally, no change to any site water control structure as-built conditions has been identified as a "reportable occurrence" (as defined by Regulatory Guide 1.16-Ref. 1) that required plant shutdown or remedial action or corrective measures to present continued plant operation in a manner less conservative than that considered in the design and construction of the plant, or to prevent the existence or development of an unsafe condition. Therefore, no technical evaluation has been required or performed for any of the site water control structures to date.

7) Frequency of Inspections

The licensee has not, to date, established a formal schedule of inspections for all San Onofre Unit 1 water control structures. Inspection of the submerged water control structures required for emergency cooling operation has been accomplished on an approximate biennial basis. For the majority of the remainder of the site water control structures, establishment

for reference and inspection. On the basis of on-site observations and in-office analysis of information presented by the licensee, the staff concludes that the ongoing inspection program for emergency cooling water operation structures conforms to the rules and regulatory guidance of the Commission and thus may be considered as an acceptable element of the San Onofre Unit 1 inspection program for inservice water control structures.

4. A formal inspection program, as outlined in Regulatory Guide 1.127, has not been established for the site flood control structures or the 3 MG Reservoir (backup cooling water system). It is the recommendation of the staff that a program be formulated and inspections subsequent to post-construction acceptance inspections for all water control structures be scheduled on a routine bases. It is our understanding that the licensee is contemplating establishing such a program and schedule for appropriate structures, varying from yearly to once every 3 to 5 years, based upon the type of structures and the potential for distress, and upon the condition and maintenance schedule for each structure. Special inspection to be performed after the occurrence of significant unusual events, such as earthquake or intense local rainfall are planned on an "as require" basis. We concur in this general schedule approach and find that the planned frequency of inspections is in accord with the Commission rules and the regulatory guidance of Regulatory Guide 1.127. However, since the licensee's present position has not been formalized into a specific program we conclude that the frequency schedule for each structure, and a copy of the developed inspection checklist for each structure should be submitted to the NRC by the licensee for staff review.

VII. REFERENCES

Documents marked with an asterisk are available for inspection and copying for a fee in the NRC Public Document Room, 1717 H St. N.W. Washington D.C. 20555 (PDR). They are also available for purchase from the NRC/GPO Sales Program, U.S. Nuclear Regulatory Commission, Washington D.C. 20555 and from the National Technical Information Service, Springfield Virginia 22161.

1. U.S. Nuclear Regualtory Commission, Office of Standards Development, Regulatory Guides.*
 - a. 1.27 "Ultimate Heat Sink for Nuclear Power Plants."
 - b. 1.28 "Quality Assurance Program Requirement (Design and Construction)".
 - c. 1.127 "Inspection of Water-Control Structures Associated with Nuclear Power Plants".
 - d. 1.132 "Site investigations for Foundations of Nuclear Power Plants".
 - e. 1.138 "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants".
 - f. 1.16 "Reporting of Operating Information Appendix A Technical Specifications".
2. U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Standard Review Plans, NUREG-75/087*
 - a. Section 2.5.4 - "Stability of Subsurface Materials and Foundations"
 - b. Section 2.5.5 - "Stability of Stopes"
3. Report by ACI Committee 201, ACI Journal Procedings, Vol. 65 No. 11, November 1968 - "Guide for Making a Condition Survey of Concrete in Service."
4. "Final Safety Analysis Report, San Onofre Unit 1" (available for inspection and copying for a fee in the NRC Public Document Room, 1717 H St. N.W. Washington D.C. 20555).
5. "Final Safety Analysis Report, San Onofre Units 2 and 3" (available for inspection and copying for a fee in the NRC Public Document Room, 1717 H St. N.W. Washington D.C. 20555)