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Director, Office of Nuclear Reactor Regulation
Attention: D. M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket No. 50-206
SEP Topic VI-1
San Onofre Nuclear Generating Station
Unit 1

Enclosed is the draft assessment for SEP Topic VI-1, Organic Materials and Post Accident Chemistry. If you have any questions on this draft topic assessment or require additional information, please let me know.

Very truly yours,

R W Krieger

R. W. Krieger
Supervising Engineer,
San Onofre Unit 1 Licensing

Enclosure

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SAN ONOFRE, UNIT 1

TOPIC VI-1, ORGANIC MATERIALS AND POST ACCIDENT CHEMISTRY

## I. INTRODUCTION

The design basis for selection of paints and other organic materials is not documented for most operating reactors. Topic VI-1 is intended to review the plant design to assure that organic materials, such as organic paints and coatings, used inside containment do not behave adversely during accidents when they may be exposed to high radiation fields. In particular, the possibility of coatings clogging sump screens should be minimized.

Low pH solutions that may be recirculated within the containment after a Design Basis Accident (DBA) may accelerate chloride stress corrosion cracking and increase the volatility of dissolved iodines. The objective of Topic VI-1 is to assure that appropriate methods are available to raise or maintain the pH of solutions expected to be recirculated within containment after a DBA.

Organic Materials: An assessment of the suitability of organic materials in the containment includes the review of paints and other organic materials used inside the containment, including the possible interactions of the decomposition products of organic materials with Engineered Safety Features (ESF), such as filters.

Post Accident Chemistry: An assessment of post accident chemistry includes a determination of proper water chemistry in the containment spray during the injection phase following a DBA, and that appropriate methods are available to raise or maintain the pH of mixed solution in the containment sump.

## II. REVIEW CRITERIA

Organic Materials: The design was reviewed with regard to General Design Criterion 1, "Quality Standards and Records" of Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants", which requires that structures and systems important to safety be designed and tested to quality standards commensurate with the importance of the safety function to be performed.

Post Accident Chemistry: The design was reviewed with regard to General Design Criterion 14, "Reactor Coolant Pressure Boundary" of Appendix A to 10 CFR Part 50. This requires that the reactor coolant pressure boundary be designed and erected so as to have an extremely low probability of abnormal leakage and gross rupture. Also regarded in the review was General Design Criterion 41, "Containment Atmosphere Cleanup", of Appendix A to 10 CFR Part 50. This requires that systems to control substances released in reactor containment be provided to reduce the concentration and quality of fission products released to the environment following a postulated accident.

## III. RELATED SAFETY TOPICS

The effectiveness of the iodine removal system is evaluated as part of Topic XV-19, for a spectrum of loss-of-coolant accidents.

Topic VI-7.E reviews the ECCS in the recirculation mode to confirm the effectiveness of the ECCS.

## IV. REVIEW GUIDELINES

Organic Materials: Current guidance for the review of organic materials in containment is provided in Sections 6.1.1 "Engineered Safety Features Materials" and 6.1.2 "Organic Materials" of the Standard Review Plan and in Regulatory Guide 1.54 "Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants." Regulatory Guide 1.54 endorses the requirements and guidelines described in detail in ANSI N101.4-1972 "Quality Assurance for Protective Coatings (Paints) for the Nuclear Industry."

Post Accident Chemistry: Guidance for the review of post accident chemistry is provided in Sections 6.1.1, 6.1.2, and 6.5.2 of the Standard Review Plan. Sections 6.1.1 and 6.1.2 are related to assuring that appropriate methods are available to raise or maintain the pH of the mixture of the containment spray, ECCS water, and chemical additives for reactivity control and iodine fission product removal in the containment sump during the recirculation phase; and to preclude long term corrosion problems after the accident. Section 6.5.2 is related to providing proper water chemistry in the containment spray during the injection phase following a Design Basis Accident.

## V. EVALUATION

Organic Materials: Protective coating systems comprise the bulk of the organic materials (outside of electrical cable insulation) in the containment. Most of the plant surfaces were coated with a polyamide epoxy primer, a polyamide epoxy intermediate and a polyamide epoxy top coat, with the exception of the containment sphere which has a polyvinyl chloride top coat.

We have reviewed the use of organic materials in containment against current criteria to assure that any degradation of organic materials under accident conditions will not interfere with the operation of engineered safety features.

1. The interior surface of the containment sphere was prepared in accordance with Steel Structures Painting Council (SSPC) SP 5 White Metal Blast Cleaning procedures using clear silica sand and coated with a polyamide epoxy primer coat, a polyamide epoxy intermediate coat, and a polyvinyl chloride top coat system. Other working surfaces such as those on pumps, heat exchangers, and control boxes were prepared in accordance with SSPC SP 6 Commercial Blast Cleaning, as a minimum, using clean silica sand and coated with a polyamide epoxy primer coat, a polyamide epoxy intermediate coat, and a polyamide epoxy top coat system.

2. Concrete surfaces were prepared in traffic and work areas with a sandblast method similar to SSPC SP 7 Brush-Off Blast Cleaning, using clean silica sand, followed by airblasting, sealed with a 50 percent polyamide epoxy sealer and coated with a polyamide epoxy primer coat, a polyamide epoxy intermediate coat, and a polyamide epoxy top coat system.

Coatings of the polyamide epoxy and polyvinyl types used at San Onofre, Unit 1, have been subjected to environmental testing involving exposures to the intense radiation, temperature, and chemical conditions during and following a DBA.

In evaluating the radiation resistance of the coatings, we used the results of ORNL-3589 (Reference 1) and ORNL-3916 (Reference 2), which describe radiation tests on about 60 coating systems exposed to intense gamma radiation. The test results show that the principal types of coatings used in the San Onofre Unit 1 containment remained serviceable after larger radiation doses than expected during a DBA. On this basis, we conclude that radiation damage to the organic coatings does not pose a significant hazard to the operation of engineered safety features during a DBA.

Very small amounts of gas evolve when aromatic organic compounds of the types found in radiation-resistant plastics are irradiated. For example, a polyamide irradiated to a dose of $10^9$ rads produced 25 ml (STP) of gas per gram of plastic (Reference 3). For the approximately 160 cubic feet of organic coating in the containment, approximately 450 cubic feet of gas would be generated for the conservatively estimated DBA dose of $10^8$ rads. The presence of this amount of organic gases in containment after a DBA should not interfere with the absorption of organic iodines by the purge charcoal filter.

These results are consistent with literature information (Reference 4) that many organic polymers, in particular phenolic and epoxy resins, are stable to temperatures of the order of 300°F and to mildly acidic or basic dilute aqueous solutions.

There will be no contribution of hydrogen from the coatings since neither the primer nor the topcoats used in the containment have hydrogen-producing constituents. Any hydrogen produced by coatings in the sphere would be from the corrosion of zinc (present in galvanized iron) (Reference 5). Hydrogen generation from the latter source should be considered under SEP Topic VI-5, "Combustible Gas Control".

On the basis of the above information, we find that there is reasonable assurance that the thermal and chemical resistance of the organic coatings used in the plant is sufficiently high that deterioration under DBA conditions would not interfere with the operation of engineered safety features.

Exact information is not available on the present condition of the coatings used in the plant. Therefore, we will make a visual inspection of the coatings inside containment during the spring, 1982 power outage. The amounts of flaking, peeling, rusting, cracking, blistering and delamination will be recorded. The inspection and documentation procedures will follow the guidance given for the examination of coatings with regard to weathering and chemical exposure tests in ANSI N101.2-1972, ANSI N101.4-1972 and ANSI N5.12-1974.

Post Accident Chemistry: By letter dated January 18, 1977, SCE submitted Proposed Change No. 55, which reflected modifications to the containment spray system and the recirculation system to maintain the post-accident sump chemistry within acceptable values. NRC authorized the proposed change to enhance the performance and control of the San Onofre Unit 1 Iodine Removal System and the recirculation system by issuing Amendment No. 25 to Provisional Operating License No. DPR-13. According to this Amendment, we provided an Iodine Removal Hydrazine Tank containing a minimum of 150 gallons of $\geq$ 21 percent by weight of hydrazine solution, and a Trisodium Phosphate Addition System containing a minimum of 5400 lbs. of trisodium phosphate. With the coincidence of a Containment High Pressure signal and Safety Injection signal, the Iodine Removal System automatically injects hydrazine solution into the refueling water pump suction which discharges to the spray header, to provide a minimum 50 ppm hydrazine to reduce the post-accident level of iodine fission products in the containment atmosphere. The trisodium phosphate additive is a passive system which is initiated when there is liquid in the sump and will adjust the pH of the boric acid solution to preclude chloride stress corrosion cracking and long term corrosion of safety related structures. It also increases the containment spray/sump solution iodine partition factor to enhance the affinity for iodine removal within containment, and to prevent the reevolution of iodine from the recirculation water.

We have evaluated the post-accident chemical concentration and pH of the containment spray and sump water and have determined that the San Onofre Unit 1 Plant meets SRP 6.5.2 and GDC 41 for the following reasons:

1. During the injection phase, the Iodine Removal System contains adequate quantity and concentration of hydrazine to assure that the containment spray hydrazine concentration will exceed 50 ppm.

2. We calculated that during the recirculation phase, the minimum pH of 7.0 can be assured in the post-accident containment sump.

3. The design objectives of the system for storage of chemical additives in a state of readiness whenever the reactor is critical during the design life of the plant are met. The hydrazine storage tank has a nitrogen cover gas to preclude chemical reaction and decomposition of the hydrazine during long term storage.

Also, during the recirculation phase, the Trisodium Phosphate Addition System provides an adequate concentration of trisodium phosphate to meet the minimum 7.0 pH requirement of SRP 6.1.1,BTP MTEB 6.1, and GDC 14 for inhibition of stress corrosion cracking for the prevention of abnormal leakage or failure of the reactor coolant pressure boundary.

VI. CONCLUSIONS

Organic Materials: Tests, which are documented by ORNL-3916, (Reference 2) have demonstrated that the types of organic coating materials used in the containment will remain in serviceable condition after exposure to the severe environmental conditions of a DBA. These test results, and the fact that the coatings were applied using methods consistent with good industrial practice, indicate that the coatings will maintain their integrity under accident conditions.

Nevertheless, because the present condition of the coatings is not exactly known, and since they were applied before the guidance of Regulatory Guide 1.54 was available, we will make a visual inspection of all exposed coated surfaces in containment according to the ANSI guidelines during the next power outage of sufficient duration to conduct the inspection. All significantly degraded areas shall be repaired according to the ANSI standards. The results of the inspection and repair (if necessary) shall be documented by SCE and be submitted to the NRC for review.

Based on the above, we conclude that there is reasonable assurance that the integrity of organic coatings within the containment will be maintained under normal operating conditions and those of a DBA, and that there will be no undue hazard to the health and safety of the public.

Post Accident Chemistry: On the basis of the above evaluation, we conclude that the San Onofre Unit 1 Iodine Removal System meets the post accident chemistry requirements of SRP 6.5.2 and GDC 41 and SRP 6.1.1 BTP MTEB 6-1 and GDC 14 and is, therefore, acceptable.

References

1. ORNL-3589, Gamma Radiation Damage and Decontamination Evaluation of Protective Coatings and Other Materials for Hot Laboratory and Fuel Processing Facilities, G.A. West and C.D. Watson, February, 1965.

2. ORNL-3916, Unit Operations Secion Quarterly Progress Report, July - September, 1965, M.E. Whately et al., March 1966, pp. 66-75.

3. Radiation Effects on Organic materials, edited by R.O. Bolt and J.G. Carroll, Academic Press, New York and London, 1963, Chapter 6, p. 239.

4. Chemical Engineers Handbook, J. H. Perry, Editor, 5th Edition, pp. 23-60 to 23-68.

5. H. E. Zittel, "Post-Accident Hydrogen Generation from Protective Coatings in Power Reactors," Nuclear Technology 17, 143-6 (1973).

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