June 30, 1982

Docket No. 50-237
LS05-82-06-136

Mr. L. DelGeorge
Director of Nuclear Licensing
Commonwealth Edison Company
Post Office Box 767
Chicago, Illinois 60690

Dear Mr. DelGeorge:

SUBJECT: SEP TOPIC VI-1, ORGANIC MATERIALS AND POST ACCIDENT CHEMISTRY, DRESDEN NUCLEAR POWER STATION, UNIT NO. 2

Enclosed is our final evaluation of SEP Topic VI-1 for Dresden Unit 2. This evaluation is based on the safety analysis provided in your letter dated May 21, 1982, as supplemented by information received during telephone conversations between your staff and NRC personnel.

The staff has determined that Dresden Unit 2 meets the current licensing criteria for this topic.

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

Sincerely,

Paul O'Connor, Project Manager
Operating Reactors Branch No. 5
Division of Licensing

Enclsoure:
As stated

cc w/enclosure:
See next page

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SYSTEMATIC EVALUATION PROGRAM
TOPIC VI-1

DRESDEN 2

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 possiblity 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 plant 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. Also, contained in the review was Appendix B to 10 CFR 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." This guide describes an acceptable method of complying with the Commissions quality assurance requirements with regard to protective coatings.

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" and ANSI N5.12-1972, "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. and 6.5.2 of the Standard Review Plan. Section 6.1.1 is 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 and sump during injection phase following a Design Basis Accident.

V. EVALUATION

Organic Materials: Protective coatings of types commonly used for severe industrial service were applied to the interior surfaces of the drywell (approximately 59,000 sq. ft.) and of the suppression pool torus (approximately 122,000 sq. ft.). The coatings on the concrete surfaces of the drywell are of the polyamide epoxy and modified phenolic types. The structural steel and grating areas are painted with zinc chromate primer and alkyd enamel finish coats. The suppression pool surfaces were coated with inorganic zinc and modified phenolic systems.

Tests have shown that all of these paint types are resistant to radiation and to exposure to the temperatures and containment spray solutions during a DBA. On the basis of these test results, there is reasonable assurance that there would be no interference with the operation of engineered safety features by the deterioration of these types of paint under DBA conditions.

However, the existing polyvinyl chloride resin top coatings on the drywell shell, bio-sheild wall on vessel support surfaces (approximately 26,300 sq. ft.) are of special concern. Vinyl paints are less resistant to the effects of radiation than the other paints used, but tests have shown that coatings of the vinyl type have remained in serviceable condition after radiation doses in excess of 10^8 rad, which is a conservative DBA dose estimate. Vinyl polymers have good resistance to chemical attack by the BWR spray solutions, but only limited resistance to heat. Polyvinyl chloride begins to soften with the potential release of HCl above 150°F. Even though the maximum calculated DBA temperature inside the drywell is 281°F, the amount of HCl expected to be released is insignificant.

During periodic inspections, the licensee has observed peeling of the vinyl coating in the upper part of the drywell, which reaches a temperature of 135°F during normal power operation. The degraded areas were scraped, blasted and repainted with an inorganic zinc coating qualified to resist the DBA conditions. These repairs have decreased the likelihood of paint peeling in the areas most susceptible to degradation.

Since in the Mark I design, the ESF fluids are not taken from the sump, it is unlikely that any peeling of the vinyl paint on drywell surfaces would lead to significant safety problems. The sump at the bottom of the drywell acts as a drain which is valved off during the DBA. The containment and core sprays during a DBA take suction from the bottom of the suppression pool. Any peeled vinyl paint flakes would collect in the bottom of the drywell where they would not interfere with the coolant recirculation during a DBA. Taking into account these features of the Mark I design, there is reasonable assurance that any peeling of the vinyl paints in a DBA environment would not interfere with the operation of the engineered safety features.

Certain small surface areas of plant equipment were coated with industrial coatings whose radiation resistance has not been tested. However, because only small areas of these coatings are exposed in the containment, we conclude that their failure under accident conditions would not present a significant safety hazard.

Very small amounts of gas are evolved when aromatic organic compounds of the types found in radiation-resistant plastic are irradiated. For example, a phenolic plastic irradiated to a dose of 10^9 rads produced 3 ml (STP) of gas per gram of plastic (Reference 4). For the approximately 150 cubic feet or organic coating existing in the containment, approximately 90 cubic feet of gas would be generated for the conservatively estimated DBA dose of 10^8 rads. The gas is mostly hydrogen and carbon dioxide, and less than a tenth of it is volatile organic compounds. The presence of this small amount of organic gases in containment after a DBA would not interfere with the absorption of organic iodides by the purge charcoal filters.

The amount of hydrogen from this source is small compared to that which could be produced in a DBA from the zirconium-water reaction, from the radiolysis of water, or from the reaction of the zinc in inorganic zinc coatings with high temperature borate solutions (Reference 6). Hydrogen generation from the latter sources is reviewed under SEP Topic VI-5, "Combustible Gas Control."

Periodic inspection of the protective coatings inside containment will provide added assurance of the integrity of the coatings. In the letters of July 27, 1979 and May 21, 1982, the licensee stated that plant practice is to inspect and repair painted surfaces during each refueling outage in accordance with ANSI N-101.2-1972. We find that the inspection procedure and frequency are acceptable for monitoring the condition of coatings.

Post-Accident Chemistry: Dresden Station, Unit No. 2, uses high purity demineralized water in the reactor vessel and for post-accident containment spray and core spray. The torus also contains demineralized water. Post-accident iodine control is accomplished through containment integrity and operation of the standby gas treatment system, but does not rely on a chemical additive in the containment spray system.

The plant Technical Specifications state that the reactor water is sampled and analyzed for conductivity and chloride concentration every 96 hours during normal operation, to ensure that the conductivity and chloride concentration do not exceed 5 µmho/cm and 0.5 ppm, respectively. In a telephone conversation on June 22, 1982, the licensee indicated that the water in the Condensate Storage Tank is sampled three times a week, to ensure that the conductivity and chloride concentration do not exceed 1 µmho/cm and 0.1 ppm, respectively, and that the pH is between 5.6 and 8.6. The torus water is sampled monthly, but no chemical limits are given. The latest readings for the conductivity chloride concentration, and pH in the torus water are 7 µmho/cm, less than or equal to 1 ppm, and 7.0, respectively.

We determined that the use of demineralized water in the reactor vessel, in the post-accident containment and core spray and the periodic sampling programs of the water provide reasonable assurance that, at the onset of an accident, the conductivity pH, and chloride concentration of the water will remain within the normal plant operating limits, consistent with the acceptance criteria of Standard Review Plan Section 6.1.1 for boiling water reactors.

Although there are no limits regarding the water chemistry of the torus, the licensee's sampling program combined with their commitment to provide compatibility with the primary system provides adequate assurance that proper water chemistry can be maintained during the recirculation phase following a design basis accident.

The licensee has stated that in the unlikely event that the Standby Liquid Control System (SBLCS) is actuated following a DBA, sodium pentaborate solution would be introduced to the reactor vessel. There are no plant technical specifications limiting the chloride concentration of the SBLCS. However, the SBLCS is designed to shutdown the reactor in the event of loss of control rod motion. The system must be manually initiated by the control room operator using a key switch which operates explosive valves. It is highly unlikely that the SBLCS would be used following a primary system pipe break since the reactivity control function of the borated water would be lost due to dilution with engineered safety feature fluids. Therefore, the staff concludes that the potential for chloride introduction into the containment by the SBLCS following a DBA is not a significant safety concern.

The licensee has stated that all piping inside containment is covered with metallic mirror-type insulation. Therefore, the potential for stress corrosion cracking due to the presence of leachable chlorides in nonmetallic thermal insulation is not a concern.

Hydrogen generation from chemical reactions between metals inside containment and the containment and core spray water will be evaluated, independent of the Systematic Evaluation Program, under the TMI Task Action Plan (Task II.B.7 in NUREG-0660) and Unresolved Safety Issue A-48 in NUREG-0705.

VI. CONCLUSION

Organic Materials: On the basis of our review we conclude that the organic materials used in the plant are acceptable and will not interfere with the operation of required safety features. Qualification tests demonstrate that, except for the vinyl paints, the types of organic coating materials used in the containment will maintain their integrity and remain in serviceable condition after exposure to the severe environmental conditions of a DBA. Insignificant quantities of organic gases and of hydrogen would be generated under these conditions. Vinyl paints are more susceptible to thermal damage after a DBA, but paint failure is not likely to affect the operation of the coolant recirculation system after a DBA.

To provide further assurance that delamination, flaking or peeling of coatings materials will not interfere with the operations of engineered safety features, the licensee has proposed an acceptable inspection program for coated surfaces in containment according to ANSI guidelines during each refueling outage. All significantly degraded areas will be repaired according to the ANSI standards. The results of the inspection and repair will be documented.

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, and, therefore, the organic coating materials are acceptable.

Post-Accident Chemistry: On the basis of the above evaluation, we conclude that the post-accident water chemistry meets the acceptance criteria of Standard Review Plan Section 6.1.1 (NUREG-0800) and the requirements of General Design Criterion 14 in Appendix A to 10 CFR Part 50, as it relates to assuring that the reactor coolant pressure boundary shall have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. We conclude, therefore, that the post-accident water chemisry of Dresden Unit 2 is acceptable.

VII. REFERENCES

1. NUREG-0458, "Short Term Safety Assessment on the Environmental Qualifications of Safety-Related Electrical Equipment of SEP Operating Reactors," May 1978.

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

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

4. Radiation Effects on Organic Materials, edited by R. O. Bolt and J. G. Carroll, Academic Press, New York and London, 1963.

5. Chemical Engineers Handbook, J. H. Perry, Editor, 5th Edition, pp. 23-54 to 23-57.

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