Wayne H. Jens
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January 10, 1985
EF2-72045

Director of Nuclear Reactor Regulation
Attn: Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Youngblood:

Reference: (1) Fermi 2
NRC Docket No. 50-341

(2) Detroit Edison Letter to NRC, "Coatings Inside Containment", EF2-72778, dated August 28, 1984

(3) Detroit Edison Letter EF2-72271, "Transmittal of Additional Information", dated October 11, 1984

Subject: Primary Containment Coatings Evaluation - Transmittal of Responses to Six (6) Additional NRC Staff Questions

Following the initial submittal of Detroit Edison Report No. DECo-12-2191 (Reference 2), supplemental information was provided via Revision 3 of the subject report via EF2-72271.

On December 18, 1984, Edison received, via telecopy, six additional NRC Staff questions. In a subsequent telephone conference on December 20, 1984, Edison's response was provided to assist completion of the NRC review. The attachment documents information provided to the NRC in this telecon.

The attachment also provides the proposed revision to Report No. DECo-12-2191 reflecting the Edison responses. This information is provided for NRC review and approval. Subsequent to NRC's approval of the proposed changes, Edison will reissue the subject report.

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We trust that the above information will enable you to close this item prior to our scheduled fuel load date. Any questions regarding this matter can be directed to Mr. O. K. Earle at (313) 586-4211.

Sincerely,

Wayne H. Jens

cc: All with attachments

Mr. P. M. Byron
Mr. M. D. Lynch
Mr. A. W. Serkiz, NRC-NRR Generic Issues Branch
Mr. J. C. Lane, NRC-NRR CSB
Mr. F. J. Witt, NRC-NRR CMEB
Mr. J. Norton, NRC-RIII
USNRC Document Control Desk
Washington, D.C. 20555

ATTACHMENT NO. 1 TO LETTER EF2-72045

RESPONSES TO NRC QUESTIONS
"PRIMARY CONTAINMENT COATINGS EVALUATIONS"

1. Provide the data, or your analysis, which you used to reach your conclusion on Page 12 of your Report No. DECO-12-2191, "Enrico Fermi Atomic Power Plant Unit No. 2, Evaluation of Containment Coatings", Revision 3, dated October 1984, that "The total affected surface area due to steam and water scouring is less than 10% of the CZ-11 coated area."

   RESPONSE: The statement will be deleted from the report as shown on the enclosed marked-up pages 12 and 20 of the report.

   The discussion was meant to provide a quantitative margin of conservatism used in the safety evaluation. No credit was taken in the analysis for this mitigating effect, as stated in Section 8.2 of the report. The mitigating effect was evaluated on the basis of the large break design jet model, computing actual surface areas exposed to the jet. For the Fermi 2 containment, the largest break exposes a total of 3315 ft^2 to the steam/water jet which translates to 1.55% of the total CZ-11 and mill scale surfaces within the drywell.

2. State the calculated velocities you assume to support your statement on Page 17 of your report that "Drywell floor and vent line/header velocities are very low..." Provide the calculations used to arrive at such velocities and identify the time frame following a postulated loss-of-coolant accident (LOCA) that such velocities exist (e.g., immediately after the postulated break, during long-term recirculation or the depressurization period when the operators are bringing the reactor to cold shutdown).

   RESPONSE: Question Nos. 2, 3 and 4 are directed toward the discussions provided for the debris transport mechanism in the report Section 8.1. As in our response to Question No. 1, the discussions were provided to illustrate the degree of conservatism and the mitigating effects associated with the debris transport path. In the safety evaluation, none of these mitigating effects were used. To clarify this aspect, the assumptions used are summarized as follows:

   (a) All CZ-11 and mill scale coatings as given in Table 1 (page 8 of the report) were assumed to fail and separate from their surfaces during a LOCA.

   (b) All unqualified coatings (3 mils DFT and less, Galvanox V) are assumed to fail during the LOCA.

(c) All hydroxide and fibrous debris generated from the failure of CZ-11, mill scale, unqualified paints and Galvanox V are assumed to be transported from the drywell to the torus during the initial stages of the LOCA (RPV depressurization).

(d) All debris deposited in the torus is evenly distributed within the suppression pool water volume and held in suspension to produce the concentrations of hydroxide and fibrous debris as given in Section 8.2 of the report (0.35% and 4.1×10^{-4}%, respectively).

(e) The debris concentrations are ingested into the ECCS flow and are circulated through the ECCS flow path.

3. Provide the data, or your analysis, which you used to arrive at the following statement on Page 18 "... average water velocities within the torus following the initial transient are below 0.25 ft/sec, but approach 0.3 ft/sec within a 4 foot hemisphere..."

RESPONSE: See response to Question 2 above.

4. Indicate what the velocities would be in the torus pool following the initial transient if the safety/relief valves were to discharge or the automatic depressurization system were to be activated. State the effect that such a valve discharge would do to paint particulates in the pool. Indicate whether ingestion of paint particulates into the emergency core cooling system (ECCS) recirculation trains would occur. Provide your calculations or data, to support your conclusions on this matter.

RESPONSE: See response to Question 2 above.

5. Indicate the effect of ingesting paint particulates into the ECCS recirculation loops on the equipment needed to bring the plant down to cold shutdown following a postulated LOCA.

RESPONSE: The cold shutdown path for the Fermi 2 reactor, following a LOCA, consists of the RHR system operating in the shutdown mode or LPCI mode. Equipment needed to operate with circulating cooling water containing coating debris, consists of the RHR pumps, heat exchangers and valves. In the initial stages of the LOCA and subsequent core flooding and cooling, the core spray pumps and associated valves may also be required to operate.

The effect of coating particulates circulating through the cooling loops has been evaluated as follows:

(a) RHR and Core Spray Pumps

These pumps are vertical, centrifugal pumps, equipped with mechanical seals. Experience with this type of pump and seals in fossil power applications has shown very satisfactory operation under long-term continuous duty conditions, for example, pumping general service water (such as lake and river water) which contains silt, organics and corrosion particles. Special design features were incorporated into the Fermi 2 ECCS pumps to further assure long-term operability. These features include a recirculating seal cooling loop which contains a cyclonic separator to extract any solids from the seal cooling loop before reaching the seal. The solids are continuously recirculated to the pump suction stream to mix with the main flow. The pump seals thus are adequately protected from the effects of circulating coating debris particulates. Potential seal leakage and ultimate failure has previously been addressed as documented in the Fermi 2 SER (NUREG-0798) pages 6-21 and 15-15.

(b) RHR Heat Exchanger

The heat exchanger is a vertical vessel, 4.5 feet in diameter and 24 feet long. The RHR primary fluid is pumped through the shell side with top entry and near bottom exit. Flow velocities in the shell are between 6 and 10 ft/sec, far in excess of settling velocities of the particulates. Due to the near bottom exit flow, any particulates that could accumulate in low velocity fields, would be swept out of the heat exchanger and remain in suspension in the ECCS flow. The U-tubes are arranged vertically with the U-bend exposed to the top entry RHR flow. Particle build-up on the tubes, therefore, is not considered feasible and the heat transfer capacity of the heat exchanger would not be affected.

(c) Valves

The valves used in the ECCS flow path of the RHR and core spray loops consist of large wedge-type OSY gate valves with electric motor operators. These type of valves are standard in nuclear and fossil power plants for fluid shutoff where pressure exceeds the service rating of butterfly valves (usually about 150 psig). The seating surfaces are perpendicular to the flow stream, thus avoiding a build-up of particulates. During the closing of the valve, the fluid velocity across the seat increases nearly proportional to the decrease of available flow area across the seat, thus promoting a self-cleaning action. Particulates entrained within the flow stream would not affect the operability of the valve, in either the closing or opening phase. The seating surfaces (body seat rings and wedge surfaces) are hard-surfaced with stellite No. 6 to prevent seat erosion. Such gate valves are indeed well suited for the intended service, including slurries with particulate concentrations far above those postulated to result from coating debris.

(d) Reactor Vessel

The behavior and affects of particulate concentrations within the reactor vessel have been previously evaluated by General Electric Co., as discussed in Response No. 3 of the Addendum to Report No. DECO-12-2191, Rev. 3.

6. Provide the breakdown of the total surface area of mill scale and varnish in the drywell and in the torus. Provide the range of particle sizes and the distribution of the 25.22 cubic feet of mill scale indicated in Table 1 on Page 8.

   RESPONSE: There is no mill scale and varnish within the torus. Some minor items previously identified in Section 2.4 of the report will remain uncoated until the first refueling outage. Though no mill scale is present, the surfaces are oxidized (rusted). These surfaces represent about 150 ft^2.

   Within the drywell, the mill scale and varnish is generally evenly distributed as part of the structural steel and a few piping sections. Structural steel consists mainly of hanger attachments, brackets, reinforcing gussets and similar small items which are difficult to clean and coat. These uncoated surfaces are also present on the inside of rectangular structural tubing, not generally accessible to spray guns, brushes or wire wheels. From a series of tests conducted at the Detroit Edison Research Department, it was determined that the measurable mill scale particle sizes ranged from approximately 4 to 60 microns. As stated in the response to Question 2, all the mill scale and varnish are assumed to separate from their surfaces and be transported to the torus.

Response to two additional questions was requested during the teleconference on December 20, 1984.

7. The amounts of unqualified coatings shown on Table 1 (page 8 of the report) are not consistent with the responses provided in the Addendum.

RESPONSE: The unqualified coatings shown on Table 1 have been reduced in quantity due to the removal of unqualified coatings thicker than 3 mils DFT and due to recategorizing unqualified inorganic zinc primers. The remaining unqualified coatings consist of:

Valve yoke, bonnets, bodies	- 460 ft^2 at 0.7 mills=	0.027 ft^3
MSIV top works	- 100 ft^2 at 2.1 mills=	0.018 ft^3
Conduit labelling	- 350 ft^2 at 2.5 mills=	0.073 ft^3
Terminal box labelling	- 62 ft^2 at 2.0 mills=	0.010 ft^3
Total	- 972 ft^2	0.128 ft^3

Table 1 will be revised accordingly as marked on the attached copy.

8. Provide documentation regarding failure modes of unqualified coatings with DFT of 3 mils or less as stated on page 11 of the report.

RESPONSE: The mode of failure of unqualified thin film coatings under accident conditions involving steam exposure at 340°F can be postulated based on an examination of test panels following exposures. Coating manufacturers and utilities have conducted many tests at Oakridge National Labs, which included coatings unsuitable for nuclear service. The failure of cured thermoset type films is normally in the form of blistering. Preradiation at $1x10^9$ rad causes some disintegration of non-radiation resistant films. Nominally blisters average less than 1/4 inch in size.

Blisters form due to the reaction of the steel substrate with steam to form hydrogen. The film is soft at 340°F and blisters which form, cause the film to be reduced to a fraction of the original thickness. If any cracking or removal occurs, there is insufficient film tensile strength in the resulting 1 to 2 mil film to maintain any film integrity, and the resulting debris is present as a fine sludge. However, in most cases the blister formation relieves the hydrogen pressure and this results in no further force acting to cause film removal, except in areas where steam may directly impinge the surface.

Discussions with coating experts associated with nuclear coating manufacturers indicate that tensile strength measurements would be of little value unless measurements could be made on film heated in the 200° to 340° range. There is no conventional equipment or test method known to perform such a test in a reliable manner. At the temperatures predicted, unqualified coatings at 1 to 2 mils thickness such as alkyds are too fragile to be mounted for test.

MULTIPLE DYNAMICS CORPORATION

SUBJECT: EVALUATION OF CONTAINMENT COATINGS FOR FERMI 2

DATE ISSUED: Oct. 1984

REVISION: 3

DOC. NO. DECO-12-2191

PAGE 8

TABLE 1

SUMMARY OF PRIMARY CONTAINMENT COATINGS

Type of Coating	Qual. Coatings	Average DFT* (mils)	Total Surface (ft^2)	Approx. Dry Film Density ($\#/ft^3$)	Total Volume (ft^3)	Total Mass (lbs)
Carbo-Zinc 11	No	7	125,000	217	73	15,841
Plasite 7155	Yes	12	67,000	150	66.9	10,035
Ameron 66 and Surfacer	Yes	1/16" plus 10 mills	7,380	125	44.6	5,575
Galvanox V	No	5	775	202	0.36	73
Mill Scale and Varnish	No	3.4	89,000	350	25.22	8,827
Unqualified Paints	No	0.7 to 3 2.5	1,782** 972	90 to 150	0.48 0.128	72 15

* DFT (Dry Film Thickness) measurements were taken with a Positector 2000 gauge, Serial #30531, calibrated with NBS shims #22272.

** For details see Item 5 of Addendum.

all the unqualified coatings was conservatively assumed.

The DBA test report No. 56878 issued by Carboline (Reference 1) demonstrated that Carbo-Zinc 11 is not lost in flakes, but rather in particles of a size less than 20 microns. The report further states that the particles do not dissolve in water and do not clog screens. The density of CZ-11 dry film coatings is between 3 to 4 times that of water, and particles are expected to settle to the bottom of the drywell and the suppression pool, concentrating as sludge in low velocity areas. The particle separation mode is a result of continuous scouring action of steam and water spray as simulated in DBA testing programs. In a typical BWR containment, direct scouring occurs only in the immediate vicinity of the postulated pipe break and within a few feet of the containment spray headers (if used). The total affected surface area due to steam and water scouring is less than 10% of the CZ-11 coated areas. Temperature resistance of CZ-11 up to 750°F is considered excellent by the manufacturer, as described in Reference 2.

delete

The failure mode for Galvanox V is considered similar to that of CZ-11, based on the physical properties provided by the manufacturer (Reference 3). However, no detailed test data exist to quantify the rate of deterioration. The tensile strength of Galvanox V dry film coating is such that if flaking occurs, the flakes

8.2 ECCS Performance

To conservatively evaluate the postulated performance of plant systems and equipment, it was assumed that the hydroxide type debris, consisting of CZ-11 and mill scale particles, are completely suspended in the pool water during the early turbulent phase of the LOCA. Under this assumption, the total hydroxide particle concentration in the pool is calculated to be less than 0.35%. A more realistic assumption, using a 10% fraction of the debris as discussed in Section 6.0 would produce a hydroxide debris concentration of 0.035% in the pool water. In accordance with the conclusions and guidelines given in NUREG-0897, Section 3.2.2.4, a solid hydroxide concentration of less than 1% of mass does not affect pump performance. The solid particles are less than 60 microns in size, and will therefore freely pass through the 1/8" holes in the suction strainers of the RHR, Core Spray and HPCI lines.

delete

The fibrous debris, generated by failure of unqualified thin coat paints, is also transported to and distributed in the pool water volume. The total volume of 0.5 cu ft (72 pounds), as shown on Table 1, results in a volumetric concentration of 4.1×10^{-4}%, well below the acceptable limits of 4% given in NUREG-0897 for fibrous debris. The particles are expected to be small enough to freely pass through the strainers. In addition, the ECCS pumps and system piping has been 3