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Dalwyn R. Davidson
VICE PRESIDENT
SYSTEM ENGINEERING AND CONSTRUCTION

December 11, 1981

Mr. Robert L. Tedesco
Assistant Director for Licensing
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Perry Nuclear Power Plant
Docket Nos. 50-440; 50-441
Response to Request for
Additional Information -
Chemical Engineering

Dear Mr. Tedesco:

This letter and its attachment is submitted to provide draft responses to the concerns identified in your letter dated October 30, 1981 in regard to chemical engineering.

It is our intention to incorporate these responses in a subsequent amendment to our Final Safety Analysis Report.

Very Truly Yours,

Dalwyn R. Davidson

Dalwyn R. Davidson
Vice President
System Engineering and Construction

DRD: mlb

Attachment

cc: G. Charnoff, Esq.
M. Dean Houston
NRC Resident Inspector

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281.1 Verify that provisions have been made for draining and venting
(5.4.8) reactor water cleanup system components through a closed system in accordance with GDC 60 and 61.

Response

The drains and vents of the Reactor Water Cleanup System components are piped directly to the equipment drain sumps, which are then drained to the liquid radwaste system. Equipment drains are discussed in Section 9.3.3.2.2 and the piping is shown on Figures 9.3-10 and 9.3-11. For a discussion of General Design Criterion compliance, refer to Section 3.1.2.

281.2 (5.4.8) (10.4.6) Verify that the initial total capacity of new demineralizer resins (condensate and primary coolant) will be measured. Describe the method to be used for this measurement (Regulatory Position C.3 of Regulatory Guide 1.56, Revision 1).

<u>Response</u>

The response to this question is provided in revised Section 5.4.8.1 and 10.4.6.2.

281.3 (5.4.8) (10.4.6) The reactor coolant limits and corrective action to be taken if the conductivity, pH, or chloride content is exceeded will be established in the Technical Specifications. Describe the chemical analysis methods to be used for their determination (Regulatory Position C.6 of Regulatory Guide 1.56, Revision 1).

Response

The response to this question is provided in revised Sections 5.4.8.2 and 10.4.6.2.

281.4 (10.4.6) Describe the water chemistry control program to assure maintenance of condensate demineralizer influent and effluent conductivity within the limits of Table 2 of Regulatory Guide 1.56, Revision 1. Include conductivity meter alarm set points and the corrective action to be taken if the limits of Table 2 are exceeded.

Response

The response to this question is provided in revised Section 10.4.6.2.

281.5 (10.4.6) In accordance with Position C.1 of Regulatory Guide 1.56, Revision 1, describe the sampling frequency, chemical analyses, and established limits for purified condensate dissolved and suspended solids that will be performed and the basis for these limits.

<u>Response</u>

Dissolved and suspended solids for purified condensate are not addressed in plant Technical Specification. The dual design of condensate demineralizers and filters is to provide maximum removal of dissolved and suspended impurities. The condensate demineralizers are provided with conductivity cells to measure water quality of the bed effluent and at two-thirds resin depth. The second conductivity cell will provide indication of resin depletion and allow for regeneration prior to total bed breakthrough. The design features along with installed conductivity cells and a regular chemistry monitoring program for specific ions will assure dissolved and suspended solids are well below detectable limits using standard analysis methods, and well within the limits recommended by GE.

281.6 (6.1.2)

a. Indicate the total amount of paintor protective coatings (area and film thickness) used inside containment that do not meet the requirements of ANSI N101.2 (1972) and Regulatory Guide 1.54. We will use the above information to estimate the rate of combustible gas generation vs. time and the amount (volume) of solid debris that can be formed from these unqualified organic materials under DBA conditions that can potentially reach the containment sump. A G value of 5 will be used unless a lower G value is justified technically.

b. In order for the staff to estimate the rate of combustible gas generation vs. time due to exposure of organic cable insulation to DBA conditions inside containment, provide the following information:

   1) The approximate total quantity (weight and volume) of organic cable insulation material used inside containment, including uncovered cable and cable in closed metal conduit or closed cable trays. We will give credit for beta radiation shielding for cable in closed conduit or trays if information is provided as to the respective quantities of cable in closed conduits or trays vs. uncovered cable.

   2) The approximate breakdown of cable diameters and conductor or cross section associated or an equivalent cable diameter and conductor cross section which is representative of the total cable surface area consistent with the quantity of cable surface area consistent with the quantity of cable identified in 1) above.

   3) The major organic polymer or plastic material associated with the cable in 1) above. If this information is not provided, we will assume the cable insulation to be polyethylene and a G value of 3.

281.6 (Pg. 2) Cont'd Response

The response to this question is provided in revised Section 6.1.2.

281.7 (9.1.3) Regarding the Spent Fuel Pool Cleanup System, provide the following information:

Describe the samples and instrumentation and their frequency of measurement that will be performed to monitor the Spent Fuel Pool water purity and need for ion exchanger resin and filter replacement. State the radiochemical limits to be used in monitoring the spent fuel pool water and for initiating corrective action. Provide the basis for establishing these limits. Your response should consider variables such as: gross gamma and iodine activity, demineralizer decontamination factor, and crud level.

<u>Response</u>

The response to this question is provided in revised Section 9.1.3.2.

281.8 (9.3.2) Acceptance Criterion 2.g in Standard Review Plan Section 9.3.2 states that passive flow restrictions to limit reactor coolant loss from a rupture of the sample line should be provided. You do not address this criterion in the FSAR. Describe how the requirement of maintaining radiation exposures to as low as is reasonably achievable will be met in the event of a rupture of the sample line containing contaminated primary coolant, in accordance with Regulatory Position C.2.i(6) of Regulatory Guide 8.8, Revision 3 (June 1978).

Response

All reactor coolant sample lines use sample probes with a 1/8 inch diameter hole. This design provides passive flow restrictions to limit reactor coolant loss from a rupture of the sample line. Section 9.3.2.2.2 will be revised to add the following. "For pipe sized less than six inches in diameter there is no probe required. However, sample probes are used in the four inch Reactor Water Cleanup System process lines and are designed as shown in Figure 9.3-3."

281.9 (9.3.2) Acceptance criterion 1.b in Standard Review Plan Section 9.3.2 indicates that atmosphere and sumps inside containment should be sampled. Describe provisions to sample inside the containment in accordance with the requirements of General Design Criterion 64 in Appendix A to 10 CFR Part 50 and Regulatory Guide 1.97, Revision 2.

Response

The response to this question is provided in Section 11.5 for Process and Effluent Radiological Monitoring and Sampling Systems.

281.10 (TMI II.B.3) Provide information that satisfies the attached proposed license conditions for post-accident sampling.

Response

The post-accident sampling system is being designed to meet NUREG 0737 guidelines. The response to this question will be provided March 1982.

NUREG-0737 Post Accident Sampling Capability

II.B.3

Requirement

Provide a capability to obtain and quantitatively analyze reactor coolant and containment atmosphere samples, without radiation exposure to any individual exceeding 5 rem to the whole body or 75 rem to the extremities (GDC-19) during and following an accident in which there is core degradation. Materials to be analyzed and quantified include certain radionuclides that are indicators of severity of core damage (e.g., noble gases, iodines, cesiums and non volatile isotopes), hydrogen in the containment atmosphere and total dissolved gases or hydrogen, boron and chloride in reactor coolant samples in accordance with the requirements of NUREG-0737.

To satisfy the requirements, the applicant should (1) review and modify his sampling, chemical analysis and radionuclide determination capabilities as necessary to comply with NUREG-0737, II.B.3, (2) provide the staff with information pertaining to system design, analytical capabilities and procedures in sufficient detail to demonstrate that the requirements have been met.

Evaluation and Findings

The applicant has committed to a post-accident sampling system that meets the requirements of NUREG-0737, Item II.B.3 in Amendment 3 but has not provided the technical information required by NUREG-0737 for our evaluation. Implementation of the requirement is not necessary prior to low power operation because only small quantities of radionuclide inventory will exist in the reactor coolant system and therefore will not affect the health and safety of the public. Prior to exceeding 5% power operation the applicant must demonstrate the capability to promptly obtain reactor coolant samples in the event of an accident in which there is core damage consistent with the conditions stated below.

1. Demonstrate compliance with all requirements of NUREG-0737, II.B.3, for sampling, chemical and radionuclide analysis capability, under accident conditions.

2. Provide sufficient shielding to meet the requirements of GDC-19, assuming Reg. Guide 1.3 source terms.

3. Commit to meet the sampling and analysis requirements of Reg. Guide 1.97, Rev. 2.

4. Verify that all electrically powered components associated with post accident sampling are capable of being supplied with power and operated, within thirty minutes of an accident in which there is core degradation, assuming loss of offsite power.

5. Verify that valves which are not accessible for repair after an accident are environmentally qualified for the conditions in which they must operate.

6. Provide a procedure for relating radionuclide gaseous and ionic species to estimated core damage.

7. State the design or operational provisions to prevent high pressure carrier gas from entering the reactor coolant system from on-line gas analysis equipment, if it is used.

8. Provide a method for verifying that reactor coolant dissolved oxygen is at <0.1 ppm if reactor coolant chlorides are determined to be >0.15 ppm.

9. Provide information on (a) testing frequency and type of testing to ensure long term operability of the post accident sampling system, and (b) operator training requirements for post-accident sampling.

10. Demonstrate that the reactor coolant system and suppression chamber sample locations are representative of core conditions.

In addition to the above licensing conditions the staff is conducting a generic review of accuracy and sensitivity for analytical procedures and on-line instrumentation to be used for post-accident analysis. We will require that the applicant submit data supporting the applicability of each selected analytical chemistry procedure or on-line instrument along with documentation demonstrating compliance with the licensing conditions four months prior to exceedin. 5% power operation, but review and approval of these procedures will not be a condition for full power operation. In the event our generic review determines a specific procedure is unacceptable, we will require the applicant to make modifications as determined by our generic review.

The above stated license conditions will have to be satisfactorily addressed by the applicant prior to exceeding 5% power operation.

c. Minimizes temperature gradients in the main recirculation piping and reactor pressure vessel (RPV) during periods when the main recirculation pumps are unavailable.

d. Minimizes the RWCS heat loss.

e. Enables the major portion of the RWCS to be services during reactor operation.

f. Prevents the standby liquid reactivity control material from being removed from the reactor water by the cleanup system when required for shutdown.

g. Total capacity of media used in the RWCS filter demineralizer will be determined prior to initial load and yearly thereafter on a new loading. A total capacity test will be performed if manufacturer or media type is changed. Total capacity analysis will be performed per approved chemistry instructions.

5.4.8.2 System Description

The system takes its suction from the inlet of each reactor main recirculation pump and from the reactor pressure vessel bottom head. The process fluid is circulated with the cleanup pumps through a regenerative and nonregenerative heat exchanger for cooling, through the filter demineralizers for cleanup and back through the regenerative heat exchanger for reheating. The processed water is returned to the RPV and/or the main condenser or radwaste. (See Figures 5.4-16, 17 and 18.)

The major equipment of the reactor water cleanup system is located outside the drywell. This equipment includes pumps, regenerative and nonregenerative heat exchangers, and filter-demineralizers with precoat equipment. Flow rate capacities for the major pieces of equipment are presented in Table 5.4-3.

The temperature of the filter-demineralizer units is limited by the resin operating temperature. Therefore, the reactor coolant must be cooled before being processed in the filter-demineralizer units. The regenerative heat exchanger transfers heat from the tube side (hot process inlet) to the shell side (cold process inlet). The shell side flow returns to the reactor. The nonregenerative heat exchanger cools the process further by transferring heat to the reactor building closed cooling water system.

The filter-demineralizer units (see Figure 5.4-19) are pressure precoat type filters using filter aid and mixed ion-exchange resins. Spent resins are not regenerable and are sluiced from the filter-demineralizer unit to a backwash receiving tank from which they are transferred to the radwaste system for processing and disposal. To prevent resins from entering the reactor recirculation system in the event of failure of a filter-demineralizer resin support, a strainer is installed on the filter-demineralizer unit. Each strainer and filter-demineralizer vessel has a control room alarm that is energized by high differential pressure. Upon further increase in differential pressure from the alarm point, the filter-demineralizer will automatically isolate.

Water quality will be tested to insure compliance with Technical Specifications. Analysis will be performed on grab samples for pH using standard industrial practice and chloride by specific ion electrode with a backup $AgNO_3$ Turbidity method. Water conductivity will be monitored and recorded continually on the sampling panel. 281.3

The backwash and precoat cycle for a filter-demineralizer unit is entirely automatic to prevent human operational errors, such as inadvertent opening of valves that would initiate a backwash or contaminate reactor water with resins. The filter-demineralizer piping configuration is arranged to ensure that transfers are complete and crud traps are eliminated. A bypass line is provided around the filter-demineralizer units.

In the event of low flow or loss of flow in the system, flow is maintained through each filter-demineralizer by its own holding pump. Sample points are provided in the common influent header and in each effluent line of the filter-demineralizer units for continuous indication and recording of system conductivity. High conductivity is annunciated in the control room. The influent sample point is also used as the normal source of reactor coolant grab samples. Sample analysis also indicated the effectiveness of the filter-demineralizer units.

The suction line (RCPB portion) of the RWCS contains two motor-operated isolation valves which automatically close in response to signals from RPV low water level, leak detection system, actuation of the standby liquid control system (SLCS), and nonregenerative heat exchanger high outlet temperature. Section 7.6 describes the leak detection system requirements, and they are summarized in Table 5.2-9. This isolation prevents the loss of reactor coolant and release of radioactive material from the reactor, prevents removal

The nonmetallic insulating system used inside containment (Owens-Corning "Nu'k'on" fiberglass blanket insulation) has also undergone a qualification program[4] to verify its performance following a LOCA.

6.1.2 ORGANIC MATERIALS

Many protective coatings that are common in industrial use can deteriorate in a post accident environment and contribute substantial quantities of foreign solids and residue to the reactor building sump. Therefore, protective coatings to be used inside the reactor building have been demonstrated to withstand the post accident conditions by satisfying all the criteria listed in ANSI N101.2. Also included in this qualification is the epoxy calking material which is used to seal weld discontinuities, such as porosity and laminations prior to final application of the coating system. 281.6

The suitability of reactor building coating systems to withstand the DBA has been evaluated. Coatings have been applied in accordance with manufacturer's recommendations. In addition, the guidance of Regulatory Guide 1.54 is followed.

Organic coating materials for inside the reactor building are listed in Table 6.1-2. Stainless steels will not be placed in contact with organic coatings or cleaning materials that could contribute to stress corrosion cracking. These materials are compounds containing unacceptable levels of leachable chlorides, fluorides, lead, zinc, copper, sulfur or mercury.

Various nonmetallic materials may be used as follows: in bearings; ethylene propylene, silicone or butyl rubber for O-rings; wire wound asbestos for gaskets; and lubricants with less than 200 ppm leachable chlorides. Cross-linked polyethylene or ethylene propylene rubber is used for electrical cable insulation and chlorosulfonated polyethylene is used for cable jacketing. The cabling has been designed to withstand radiation dose. There is approximately 330,000 ft of electrical cabling inside containment which results in less than 40,000 lb. of these materials. Total exposed surface area of these materials is conservatively estimated to be 86,400 sq. ft. based 281.6

on an equivalent cable diameter of 1.0 inch. Any plastics or elastomers used in a high radiation area will be evaluated to determine service deterioration in accordance with ANSI N4.1. 281.6

Penetrants used in liquid penetrant testing will contain not more than 1 percent total sulfur and not more than 1 percent total halogens.

The only significant organic materials on equipment supplied by General Electric are the protective coatings used on some carbon steel components. These coatings are specified to meet the requirements of Regulatory Guide 1.54 and are qualified using the standard ANSI tests. However, because of the impracticability of using these special coatings on all equipment, certain small size equipment (e.g., electronic/electrical trim, covers, face plates, valve handles, etc.) may be coated with unqualified organic coatings. The total coated area for this equipment is approximately 2,000 sq.ft.

Insulation used in containment (Owens Corning "Nu'K'on") is 95-100 percent inorganic. Exterior cloth and fiberglass insulating wool are the major components of the insulation. Together they represent over 95 percent of the total mass of the insulation.

The insulation is comprised of a quilted, light density, semi-rigid fiberous glass (pad) material, encapsulated in woven glass (cloth) to form a composite blanket. The blankets will use stainless steel Velcro hooks and Nomex nylon hooks for ease of installation and removal.

Insulation blankets outside guard pipes are encapsulated with rolled and formed 26 gauge (304) stainless steel jacketing, combining quick release latches and closure handles.

6.1.3 REFERENCES FOR SECTION 6.1

1. Bechtel Corporation, "Standard Specification Coatings for Nuclear Power Plants," Spec. Nos. CP-951, CP-952, CP-956.

2. American National Standards Institute, "Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities," ANSI N101.2, 1972.

FPCC system will revert to single pump and single heat exchanger operation. With two pumps operating, the entire inventory of water in the fuel handling building pools is circulated every seven hours. The major portion of the equipment is located in the intermediate building near the fuel pools.

Water from the upper and lower pools is transferred through surface skimmers to the surge tanks in the fuel handling building. Overflow from the tanks is channeled to the radwaste system. The circulating pumps take suction from the bottom of the tanks and pump the water through the components of the system. Remote manual operation of flow control valves in the return lines ensure that the correct flow will be maintained to each of the pools.

The FPCC System is designed to remove suspended or dissolved impurities from the following sources:

a. Dust or other airborne particles.
b. Surface dirt dislodged from equipment immersed in the pool.
c. Crud and fission products emanating from the reactor during refueling.
d. Debris from inspection or disposal operations.
e. Residual cleaning chemicals or flush water.

Clarity and purity of the pool water are maintained by a combination of filtration and demineralization. The cleanup system will keep the water quality within the following limits: conductivity, 5 μmho/cm at 25°C; chlorides (as Cl^-), 0.5 ppm; suspended solids, 1.0 ppm; total heavy elements (Fe, Cu, Ni), 0.1 ppm; crud levels by filterable solids 1.0 ppm; effluent gross gamma 2000 cpm/ml. The pH range at 25°C will be 5.3 to 7.5 for compatibility with aluminum fuel storage racks and other equipment. Conductivity will be monitored and recorded continually on the sampling panel. Other analysis will be performed on a periodic basis to insure that the filter-demineralizer is maintaining design water quality. The individual filter-demineralizer will be removed from service for recoating on the basis of filter-demineralizer delta-pressure and/or effluent conductivity. The water quality will assure visual clarity of the pool water during normal fuel movements.

The cleanup system consists of two sets of filter-demineralizers, each has its own piping and is capable of independent operation. Each set of filter-demineralizers is located in a separate shielded room in the fuel handling building with controls and instrumentation located outside the rooms to enable the system to be operated without unnecessary exposure to radiation.

The design flow rate of each set of filter-demineralizers is 1,000 gpm. Using both units simultaneously will provide a maximum capacity of 2,000 gpm. A bypass line around the filter demineralizers allows the balance of the cooled

d. One sample station in each turbine power complex for:

1. Cation regeneration tank effluent
2. Anion regeneration tank effluent
3. Resin mix/hold tank effluent
4. Mixed bed effluent (6 each)
5. Mixed bed resin (6 each)

e. Two sample stations in the water treatment building; one for:

1. Raw water
2. Coagulator sludge levels (5 each)
3. Each coagulator effluent

The other for:

1. Each anion exchanger effluent
2. Each anion exchanger rinse effluent
3. Mixed bed exchanger effluent
4. Two bed or mixed bed water recirculation

This tabulation does not include sample points provided for process and effluent radiological monitoring. Such sample points are discussed in Section 11.4. In addition, there are numerous local grab samples not included in this listing.

9.3.2.2.2 Sample Probe Design

For pipe sized less than six inches in diameter, there is no probe required. However, sample probes are used in the four inch Reactor Water Cleanup System process lines and are designed as shown in Figure 9.3-3. The main steam sample probe is in accordance with ASTM D 1066-59T, "Tentative Method of Sampling Steam", Volume 10 pages 1273-1281. The feedwater sample probe is designed in accordance with Figure 9.3-2. Sample probes in the NSSS systems are designed in accordance with Figure 9.3-3. All other probes are designed as shown in Figure 9.3-4. Where practicable, a sample connection is located after a run of straight process pipe of at least ten pipe diameters, but in no case less than three pipe diameters. On horizontal process pipes, the connection is be made on the side or top of the pipe rather than on the bottom. In the radwaste system, the floor drains and detergent drains sample lines are provided with wire mesh screens at the sample probe connection to protect against plugging.

Sample points for the turbine power complex, nuclear sampling system and reactor plant sampling system are shown on Figure 9.3-21 through 9.3-28.

9.3.2.2.3 Sample Piping Design

Sample lines are routed to be as short as possible, avoiding traps, dead legs, and dips upstream of the sample station. Lines are sized to maintain turbulent flow. Reynolds number will be $\geq$ 4000 at the minimum required flow for each sample line and the minimum sample flow for any line will be 500 ml/min., measured at 100°F.

Coolers are provided as necessary to maintain samples below 105°F, and heat tracing is provided on lines where a minimum temperature must be maintained to prevent dissolved solids from plating out. Chiller condensers are also provided for sampling racks, where conductivity instrumenation requires constant temperatures of 77 ± 1°F.

9.3.2.2.4 Operator Protection

Temperature and pressure of all process samples at the sampling stations are maintained below 105°F and 200 psig, respectively, using coolers and pressure reducing devices as necessary. As an additional safety precaution, pressure relief valves (set at 200 psig) are provided on all sample lines with pressure reducing devices.

Separate chemical fume exhaust hoods are provided at each turbine sampling station, at each reactor water sampling station and at the radwaste building sampling station. The exhaust hoods are vented to the building ventilation system.

10.4.6.2 Design Bases

Each cleanup system consists of eight filter vessels and six mixed bed demineralizer vessels designed for continuous treatment of 22,110 gpm full condensate flow at an operating temperature of 103°F through seven filters and five mixed bed demineralizer vessels. Two vessels, a filter and a mixed bed demineralizer are standby service vessels. Each vessel is located in an individual shielded area due to the possibility of accumulating significant amounts of radioactive debris removed from the condensate. Condensate is cleaned through the filters and the mixed bed demineralizers in series for startup, condenser leakage and normal operation.

The system design provides maximum removal of both suspended and dissolved impurities. In addition, an extensive condenser sampling and analyses system is provided to insure prompt detection of small condenser leaks. The condensate demineralizers are provided with conductivity cells to measure water quality in the bed effluent and at two-thirds resin depth. The second conductivity cell will provide indication of resin depletion and allow for regeneration prior to total bed breakthrough. The conductivity cells are set to alarm at 0.15 μmho/cm to assure water is maintained within the limits of Table 2 of Regulatory Guide 1.56, Rev. 1. Upon receipt of an alarm, the alarming bed will be removed from service and regenerated. 281.4

The condensate cleanup system components are designed to meet provisions of ASME Section VIII, Division 1 and/or ANSI B31.1.0 Code for Pressure Piping, Power Piping along with ASME addenda and applicable code cases in effect at the time of component order.

The cleanup system is designed based on the influent concentrations shown in Table 10.4-1. Startup concentrations are defined to occur for periods up to a week. Extended normal operation concentrations are defined as those occurring during full power operation without condenser tube leaks.

The total capacity of condensate demineralizer resin will be measured for the initial resin load on each resin lot and whenever the demineralizers are recharged with resin. Total capacity analysis will be performed per approved chemistry instructions. 281.2

Water quality will be tested to insure compliance with Technical Specifications. Analysis will be performed on grab samples for pH using standard industrial practice and chloride by specific ion electrode with a backup $AgNO_3$ Turbidity method. Water conductivity will be monitored and recorded continually on the sampling panel.

The effluent composition from the cleanup system based on the influent concentrations listed in Table 10.4-1 is as follows:

Conductivity at 25° C	0.1 μmho/cm
pH at 25° C	6.5 to 7.5
Metallic Impurities	10 ppb of which copper shall not exceed 2 ppb
Silica	5 ppb
Chloride	Feedwater chloride concentration shall be less than 1 to 2 ppb