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ATOMIC ENERGY COMMISSION
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Docket No. 50-289

Metropolitan Edison Company
P. O. Box 542
Reading, Pennsylvania 19603

Attention: Mr. R. E. Neidig
Vice President

Gentlemen:

This is a request for supplemental information to your application for a construction permit and operating license for the Three Mile Island Nuclear Station to be located in Dauphin County, Pennsylvania. During meetings on July 17, 1967 and August 8 and 9, 1967, between representatives of your company and our staff, a number of technical areas were discussed and it was concluded that additional written information would be required to continue our review. In this regard you are requested to provide the information listed in the enclosure. A supplemental list of questions will be forthcoming on the subject of thermal shock to the reactor vessel during emergency coolant injection.

In order to facilitate our technical review, we urge that you provide full and complete answers to the attached questions so that further questions covering the same material will not be required. We will be available to amplify the meaning of any of the questions.

Sincerely yours,

POOR ORIGINAL

Original Signed by
D. J. Skovholt Acting

P. A. Morris, Director
Division of Reactor Licensing

Enclosure:
Requested Additional Information

cc: George F. Trowbridge, Esq.

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REQUESTED ADDITIONAL INFORMATION

1.0 GENERAL

1.1 Discuss breifly the conformance of the proposed design to the Commission's General Design Criteria published July 11, 1967, by referencing those portions of the application which discuss the subject of a criterion or group of criteria. If the design does not conform to a criterion or if the subject of the criterion is not treated in the application, the differences should be discussed in detail.

1.2 What is your criterion with respect to the types and timing of operator action to be relied on after a design basis accident? Consideration should be given to such things as switching to the recirculation mode and detecting and isolating a broken injection line. Where the action is vital to accident recovery and is required within a short time after the accident ($\sim$1 hour), we believe that automatic action should be provided.

1.3 State your policy on continued operation of the reactor if it becomes necessary to valve off an accumulator tank due to excess leakage or other malfunction.

2.0 SITE

2.1 Submit the additional information on the foundation soil characteristics which we understand has been obtained. Indicate the relation of the borings to the location of the foundations of the principal structures including reactor, auxiliary and turbine buildings, cooling towers and service water intake structure.

2.2 Discuss the availability of emergency and shutdown cooling water from the intake structure during periods of extreme low flow (for example, the minimum reported flow of 1700 cfs) assuming a failure of the east channel or York Dams. Is there a flow level below which water would be diverted from the channel which serves the service water intake structure? Are periodic dredging or other procedures envisioned to ensure water availability at the intake point over the life of the plant?

2.3 What is the "probable maximum flood" as defined by the U.S. Army Corps of Engineers at the site, including run-up effects? Discuss the uncertainties in the calculated water levels at the site during the 1936 flood which are extrapolations of measured levels at locations other than the site.

2.4 Indicate the location of liquid effluent release from the plant. Discuss the discharge of liquid waste from the site with respect to sources of radioactive waste, concentrations at the discharge point, and dilution downstream from the site.

2.5 Discuss the accidental dumping of on-site stored waste with respect to the effect on downstream water supplies and reconcentration points. Supply a list of these points downstream from the site, the storage capacity of each (including fire reserve) and the length of time water usage could be suspended as compared to the length of time the river would be at concentrations higher than MPC. Supply a similar analysis assuming that the accidental discharge was after the occurrence of a design basis accident. What doses would result to a person who did not suspend normal usage of water under these conditions?

2.6 Provide the following:

2.6.1 an estimate of the population in the area 40 years after plant startup, including the basis for the projection;

2.6.2 a description of the preoperational environmental monitoring program to be conducted;

2.6.3 a description of local airport takeoff and landing patterns with respect to the facility.

2.7 Describe in detail how the confining nature of the Susquehanna River Valley was factored into the long-term diffusion estimates listed in Table 2-4.

3.0 STRUCTURAL DESIGN

3.1 Clarify the design and maximum earthquake acceleration values to be used. As a result of a recent conference call between us, our seismic design consultants and your consultant, Dr Cornell, a modification to the response spectra was tentatively agreed on. Provide the revised design basis which we understand to be that the El Centro response spectrum would be utilized at those frequencies where it is more conservative than your original proposal.

3.2 Provide the following with respect to the seismic design of the plant:

3.1.1 the damping values which will apply to the maximum eathquake;

3.1.2 the criteria to be used for the critical piping systems with respect to stress loadings (for the maximum and design earthquakes) and further elaboration on the loading combinations to be used in the piping design;

3.1.3 a brief description of the stack (or vent) and whether failure could impair plant safety;

3.1.4 information on the design of the cranes and in particular the support detail and means for ensuring stability during an earthquake.

3.1.5 the consideration given to potential relative motions between the various foundation elements with respect to piping or other interconnecting elements necessary for safety. Include any potential for unequal settlement or tilting of the various structures.

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3.3 Discuss the effect which an assumption of an earthquake simultaneous with the forces imposed by a loss-of-coolant accident and other applicable loads would have on the design of all systems and structures necessary to the prevention or mitigation of fission product release. In particular provide (1) the type and magnitude of forces imposed by the maximum or design earthquakes, accident, and simultaneous accurrence thereof, (2) the type of design modifications, if any, which would be required to cope with the simultaneous occurrence of the earthquake and accident, and (3) criteria with respect to stress levels and the manner of load combination which you would consider appropriate for the postulated simultaneous events. Of particular concern are the steam generator supports, vessel supports, vessel internals, containment penetrations and emergency coolant injection systems.

3.4 Submit a turbine missile analysis which assumes failure at an overspeed of 180% or above.

3.4.1 Show that the mass, shape and velocity of the missiles assumed to be produced by failure of the turbine are the worst missiles from the standpoint of depth of penetration of the structures or equipment required for reactor safety.

3.4.2 State the criterion for protection of components vital to a safe shutdown and in particular how the criterion will be fulfilled for the control room and the feedwater source.

3.5 Are the cooling towers vital to safe shutdown of the plant? Could collapse of a cooling tower affect the safe shutdown of the plant by damaging the switchyard?

4.0 REACTOR DESIGN

4.1 Please revise the PSAR to incorporate the results of your more detailed reactivity calculations, which you summarized in our meeting of August 8, 1967.

4.1.1 For each of the reactivity worths of Table 3-4 of the PSAR, give the expected range of variation due to uncertainties in measurements or calculations. Discuss the basis for the ranges given.

4.1.2 What is the effect of initial reactor operation with the greatest expected value of positive moderator coefficient on the reactivity control distribution listed in Table 3-4.

4.1.3 What is the basis for the specification of the excess control rod worth of 1.6% $\Delta k/k$ over the holddown requirements of 5.4% $\Delta k/k$.

4.2 Your design criteria for reactivity shutdown capability (PSAR Sections 1.4.8 and 1.4.9) specify a minimum shutdown margin at a steady-state reactor condition.

4.2.1 What is your criterion for a minimum shutdown margin during operational transients? Refer to the recently published General Design Criteria 27 to 30 for guidance in formulating your criterion.

4.2.2 Calculate the minimum shutdown margin for the loss-of-coolant flow and loss-of-electric-power transients, using assumptions which result in the most reactive conditions.

4.2.3 Which of the accidents described in the PSAR results in the minimum shutdown margin and what is the range of the margin for this accident for the most probable and most adverse (conservative) conditions?

4.3 Submit DNB ratios for the unit cell, side and corner channels as calculated by the W-3 correlation for the worst combination of nuclear and engineering hot channel factors.

4.4 Discuss in detail the scope of the following research, development, or test programs including projected completion dates for various phases of the programs and test equipment descriptions. To the extent possible, results of the programs to date should be stated.

4.4.1 Thermal design, including DNB and flow distribution. (Will loss of a core barrel check valve be simulated in the flow tests?)

4.4.2 Control rod drives.

4.4.3 Steam generator including blowdown tests. (Discuss the desirability of insulating or otherwise maintaining the shell at a high temperature to simulate the thermal transient that might be experienced in the actual generator during secondary system blowdown.)

4.4.4 Core barrel check valves. (Discuss the program for testing the valves or a scaled prototype under operational and accident flow and temperature conditions including vibrational effects during operation and mechanical forces during blowdown.)

4.4.5 Material tests at high burnup. (Discuss which material properties are critical, the results expected and the manner in which the results will be used. Could significant data of a confirmatory nature be obtained by removing and testing fuel from the reactor environment at intervals in the future. If other test programs, currently in progress, are relied on for fuel rod failure mechanisms, describe the scope and schedule of these tests and compare your requirements in detail.)

4.4.6 List important milestones in the design of the facility, such as when the core design must be frozen.

4.5 What size are the steam lines and the steam generator outlet nozzles? Discuss the effect of steam line size and arrangement on the consequences of a guillotine break of a steam line.

4.6 Discuss the effect of dropping control rods without snubber action. What procedures ensure detection of gas accumulation in the snubber? Could timed control rod drop tests be performed which would detect the absence of snubbing action and are these planned (for example, following a shutdown)?

4.7 To what extent will in-core thermocouple data be relied on during operation? Describe the location of the in-core thermocouple junction, the expected accuracy of water temperature measurements, and experimental confirmation of the accuracy and applicability of this type of measurement.

4.8 Discuss the possibility of control rod ejection due to a rod drive seal or vent failure.

4.9 Consider supplying feedwater to the steam generator by operating the electrical condensate pumps from the on-site diesel supply as an alternate to the emergency steam driven pumps.

4.10 Discuss the time limitation imposed by the station battery in sustaining heat removal systems during a postulated loss of all on-site and off-site AC power. Include a description of the loads which must be carried and the planned technique for shedding normal battery loads.

4.11 Provide your criterion for the capacity of the shutdown coolers under normal operating conditions.

4.12 Expand the analysis of loss of off-site power with a reactor scram to indicate the long-term consequences. Can the reactor be depressurized so that the low pressure heat removal systems, operative on emergency power, could function? Consider providing means to deliver service water or cooling tower inventory to the hot-well as a means of increasing the available feedwater source.

5.0 ENGINEERED SAFETY FEATURES

5.1 Describe the preliminary design of the means to prevent a vapor lock in the hot leg after an accident which we understand to be check valves located in the core barrel.

5.1.1 Discuss alternate solutions including rearrangement of the primary system.

5.1.2 Describe the assumptions used in calculating the required capacity, number and size of the valves and the redundancy in number and capacity to be provided.

5.1.3 Indicate the location of the valves in the core barrel and the means provided to remove, test, and inspect them.

5.1.4 Discuss the hinge design with respect to failure of components and availability for inspection.

5.1.5 Indicate the consequences of loss of a valve from the standpoint of detecting the occurrence, damage to the core from flow bypass and physical damage potential of the loose valve.

5.2 Discuss the feasibility of actuating emergency coolant injection systems on other signals as well as low primary system pressure. In particular, consider actuating the injection systems on low level or high containment pressure signals.

5.3 Discuss the feasibility of providing a supression tank to condense steam released from the secondary system safety valves from the standpoints of (1) minimizing radioactive effluent release during operation with failed fuel and leaking steam generator tubes, and (2) providing a barrier after a loss-of-coolant accident assuming that the plant had been operating with leakage steam generator tubes and a leaking (not reseated) safety valve. As an alternate to (2) above, could a normally open isolation valve be installed downstream of the safety valve but with a low pressure rupture disk between the valves?

5.4 Summarize the information available to the operating staff after a loss-of-coolant accident with respect to pressures, flow rates, temperatures, water levels and sampling points in the containment, primary system, engineered safety features systems and storage tanks.

5.4.1 Discuss the capability for measuring boron content in the recirculated water following a loss-of-coolant accident. Include the accessibility of the sampling station and chemical lab following an accident and availability of qualified personnel.

5.4.2 Discuss the ability to obtain information and operate vital equipment from outside the control room.

5.5 Discuss the ability to flood the primary cavity including (1) the level and size of the overflow drains and (2) the cavity volume.

5.6 Discuss the route which containment spray and injection water must take to reach the sump. Indicate the size and location of drain lines to the sump, the criterion for sizing the drains and the method to be used to prevent plugging of the drains and sump.

5.7 What volume of water is necessary (in the sump area) to provide the required NPSH of the recirculation pumps? We believe that the sump should retain a high enough column of water to provide the required head without the necessity of a large water inventory in the containment.

5.8 Provide an analysis of local pressure forces imposed by primary coolant piping breaks within the primary cavity.

5.8.1 What is the largest break which the primary cavity can withstand (the pressure transient and criterion for failure should be included)?

5.8.2 What is the largest break size possible within the cavity or shield, what piping restraints will be provided and what pressure transient and loading does this impose?

5.8.3 Perform a similar analysis of local pressures resulting from a break outside the primary cavity.

5.9 Discuss the reasons for not providing check valves in the recirculation line between the sump and pumps and in the containment spray line upstream of the thiosulfate tank to prevent backflow.

5.10 Discuss the physical isolation provisions for the recirculation pumps for protection against flooding including provisions to isolate the leak.

5.11 Provide the preliminary design for the fan coolers. In particular, indicate the geometry and heat transfer coefficients that will be utilized to ensure that the units are conservatively designed to remove heat in the accident environment.

5.12 What criterion is proposed with respect to removal of engineered safeguards components for maintenance? For example, would the plant be shut down if one high pressure pump were unavailable for use since a single failure criterion could not be met in the event of an accident.

5.13 Provide the following with respect to the thiosulfate injection system. If development programs are required in any of the following areas, specify the scope and schedule of the programs. If other research programs are to be relied on to develop required information, compare the scope and schedule of these programs with your requirements in detail.

5.13.1 Discuss the interaction of the thiosulfate with the containment, reactor, and recirculation system environment under accident conditions.

5.13.2 Discuss the stability of the thiosulfate solution over long time periods in the accident environment, including the effect of radiation and the formation of byproducts in the solution.

5.13.3 What is the ability of the thiosulfate spray to remove other than elemental iodine from the containment atmosphere including iodine on particulate matter and methyl iodide?

5.13.4 What is the effect of condensate on the outside of the spray drop on the mass transfer rate of the iodine?

5.13.5 Discuss the redundancy provided in the spray system.

5.13.6 Provide the basis for the injection rate of the thiosulfate solution for various primary system break sizes. For example, if the spray system runs at full available capacity but the core injection system is required at a low makeup rate (for a small break), would the thiosulfate be exhausted before the borated water storage tank was emptied and the recirculation mode begun? Could this result in a period in which water without thiosulfate was sprayed into the containment?

5.14 Consider adding flexibility to the emergency service water source by providing a cross-tie between the secondary services and nuclear services pumps so that any of the pumps could serve as an emergency water source.

5.15 Discuss the consequences of a small leak and a large line break within the containment in the closed loop nuclear service system after an accident. Would the source of a large line break be detectable in time to prevent major loss of inventory from the system and resulting dilution of the borated recirculation water in the containment if the only indication is surge tank level?

6.0 ACCIDENT ANALYSIS

6.1 Provide calculations of the environmental effects resulting from an accident which released TID-14844 fission product fractions to the containment but in which 5% of the core iodine inventory is considered to be methyl iodide and that it is all released to the containment atmosphere (that is, 20% of the iodine in the containment atmosphere is in a nonremovable form). Also, a volumetric rather than a virtual source should be used for the release with a shape factor of one-half. Calculate the doses with and without the thiosulfate spray.

6.2 Calculate the effect on the peak loss-of-coolant accident containment pressure of (1) a steam generator blowdown due to a massive failure during primary system blowdown, and (2) a steam generator blowdown through a number of tubes ruptured during the primary system blowdown.

6.3 Discuss the effect of assuming heat transfer to the steam generator during blowdown on (1) the peak containment pressure, and (2) the core thermal transient.

6.4 Justify the assumption of a heat transfer coefficient of 20 Btu/hr ft^2 $^{\circ}$F in the upper half of the core when the core is one-half filled with water after a loss-of-coolant accident.

6.5 Provide an analysis of the loss-of-coolant accident for a spectrum of break sizes and locations, including those breaks in the emergency core cooling systems which also reduce the injection capability. Include curves of the pressure, water level, and fuel cladding temperature transients for each break size considered. Submit a chart showing the overlap and redundancy in the systems which cover various break sizes. In the discussion include the following:

6.5.1 A detailed description of how the steam bubble velocity as a function of pressure was determined. Include a description of the physical process occurring in the reactor vessel during blowdown and discuss the limits of applicability of steady-state bubble rise data to blowdown analyses.

6.5.2 A comparison of pressure and water level transients for the variable-bubble-velocity model and the constant-bubble-velocity model for a spectrum of break sizes. In addition, compare these with Loft semi-scale blowdown data with and without internals in place for various break sizes.

6.5.3 How the design of the high pressure injection system is affected by the assumed bubble velocity model.

6.6 Discuss the influence of the void geometry assumed on the calculation of the reactivity inserted due to a positive moderator temperature coefficient during a loss-of-coolant accident. Would a reduced density in the center of the core have more effect on peak temperatures than a uniform decrease in density?

6.7 Discuss the damage and calculate the doses which would result from dropping a fuel bundle onto the core during refueling.

6.8 Justify the assumption that the amount of diversion of injection water to the ruptured line during blowdown accident is not significant in the sizing of the accumulator volume. Include a description of the physical phenomena in the annulus including the mass and velocity of water and steam for various break sizes during the period which the accumulators inject water.

7.0 CONTAINMENT DESIGN

7.1 Design Loadings and Factors

7.1.1 Provide scaled load plots as a function of containment height for moment, shear, deflection, longitudinal force, and hoop tension resulting individually from prestress, dead, pressure, design basis earthquake, wind, liner thermal (normal and accident), and concrete thermal (normal and accident) loadings.

7.1.2 Provide stress levels in the dome, shell, cylinder-base junction and in the ring girder region in the containment structure which result from the chosen loading combinations.

7.1.3 Provide a load combination for tornado loading.

7.1.4 Provide the temperature gradients calculated to exist across the concrete containment shell under operational and design basis accident conditions.

7.1.5 Describe in more detail the wind load parameters including drag coefficient, gust factor, velocity to pressure conversion, and pressure distribution assumed.

7.2 Seismic Analysis

7.2.1 Provide the analytical model (including consideration of mass distribution, stiffness coefficients, and vibrational modes) and the analytical procedures used in arriving at a loading distribution on the structure.

7.2.2 Clarify the "algebraic" addition of vertical and horizontal seismic components.

7.3 Large Openings

7.3.1 Provide criteria with regard to what size opening constitutes a large opening; hence, meriting special design consideration.

7.3.2 List the number and indicate the sizes of the large openings for the containment.

7.3.3 Indicate the primary, secondary, and thermal loads that will be considered for design of these openings, including design load combinations.

7.3.4 Provide more detail on the analytical methods that are being used in the design of large openings.

7.4 Shell Analysis

7.4.1 The general shell analysis procedures are not provided in sufficient detail that a judgment may be made as to their adequacy. Provide a description of the analysis procedures for the structure to include a detailed description of the analytical technique used, information verifying the acceptability of of the technique, sample calculations, the general geometry utilized to determine structural stresses and the consideration given to structural stiffness and discontinuity effects.

7.4.2 The analysis procedures for treating nonaxisymmetric loadings such as wind lateral loading are not clear. Provide a detail explanation.

7.4.3 Describe the analysis procedures for the containment base slab design, particularly with respect to nonaxisymmetric loadings.

7.5 <u>Missile Protection</u>

7.5.1 Describe the analytical procedures to be used in design of missile shields.

7.6 <u>Penetrations</u>

7.6.1 Describe the analysis that shows that the piping penetration details as shown assure that pipe ruptures at the containment shell will not result in loss of containment leakage integrity. What loading combinations are considered in the penetration design?

7.6.2 Provide the general criteria for and methods of reinforcing the concrete structure at and around penetrations.

7.6.3 The meaning of your "5.1.2.6.1 d criterion" is not understood. Provide further definition of this criterion.

7.7 <u>Shear</u>

7.7.1 Reliance on ultimate values of shear (used as a measure of beam strength in diagonal tension) does not seem particularly applicable to shell structures. Provide amplification and justification.

7.7.2 In view of the indicated nonconservatism of the ultimate strength provisions of ACI 318-63 for combined loadings, your design criteria in this area must be more explicitly indicated.

7.8 <u>Liner</u>

7.8.1 Discuss the types and combinations of loading considered with regard to liner buckling. What are the stress levels in the liner and how do they relate to the buckling stress?

7.8.2 Describe the geometrical pattern, type and spacing of liner attachements and the analysis procedures, boundary conditions and results with respect to buckling under the loads cited in answer to "1" above. Describe the analytical procedures and technique to be used in liner anchorage design, including example calculations.

7.8.3 Describe the pressure/thermal load variations considered.

7.8.4 Describe the failure mode and failure propagation characteristics of anchorages. Discuss the extent to which these characteristics influence leak tightness integrity. What design provisions will be incorporated to prevent anchorage failures from jeopardizing leak-tight integrity? Describe the anchorage design considerations given to and tolerances on liner plate out-of-roundness, liner plate fitup, liner plate thickness and liner yield strength variation and these bases.

7.8.5 Describe the procedures for analysis of liner stresses around openings. Also provide the method of liner design to accommodate these stresses and the related stress limits.

7.8.6 Describe the design approach that will be used where loadings must be transferred through the liner such as at crane brackets or machinery equipment mounts. Also, provide typical design details.

7.8.7 Provide the liner detail to be used at the base-cylinder liner juncture, the strain conditions imposed at the juncture, and an analysis of the capability of the chosen liner detail to absorb these strains under design basis accident conditions.

7.8.8 Discuss the extent to which containment vacuum can influence liner buckling and the capability of the chosen liner/attachment arrangement to resist possible vacuum loading.

7.9 Anchorage Zone Design of Prestressing Tendons

7.9.1 Describe the analytical procedures used for anchorage zone analysis and typical analytical results.

7.9.2 Provide typical details of anchorage zone reinforcing.

7.9.3 Provide test data supporting the acceptability for your reinforcing method to resist the impaired anchorage loading (particularly under extended loading).

7.10 Reinforcing Steel

7.10.1 Considering the critical nature of the structure, a material specification on splicing in conformance with ACI 318-63 does not provide adequate assurance of structural ductility. Revise your material performance criteria in this regard and provide more explicit information with regard to the type of cadweld splicing intended.

7.10.2 Indicate the extent to which splice stagger will be achieved.

7.10.3 Indicate the location of and extent to which splicing or tacking of reinforcing steel will be made by welding.

7.10.4 Discuss in detail the extent to which NDT requirements will be imposed on the reinforcing steel. Also, indicate how quality control will be exercised to insure that these requirements are achieved. (If no requirements are imposed justify the ommission.) Discuss similar requirements for the prestressing wire and anchorage hardware.

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7.11 Prestressing Materials

7.11.1 Submit a detailed description of the prestressing materials and hardware selected.

7.11.2 Justify the prestressing system selection. Include data with regard to ultimate tendon strength, elongation, anchorage strength, hardware dynamic performance, etc.

7.12 Corrosion Protection

7.12.1 Describe the concrete cover provisions for reinforcing steel and prestressing for the dome, base slab and cylinder. Include for comparison the minimum code requirements.

7.12.2 To what extent will a water proofing compound or membrane be used for the containment base slab and lower cylinder area?

7.12.3 Discuss the corrosion protection to be provided for the containment liner. In particular, what corrosion could develop at the liner due to concrete structural shrinkage or other cracking at or below the water table?

8.0 CONSTRUCTION

8.1 General

8.1.1 Indicate where and to what extent ACI 301 standard practice for construction will be equaled, exceeded, or not followed.

8.1.2 Describe the general construction procedures and sequence that will be used in construction of the containment to include excavation ground water control, base slab construction, liner erection and testing, and concrete construction in cylinder and dome regions.

8.2 Concrete

8.2.1 Describe the concrete mixing, placing and curing procedures to be used.

8.2.2 Describe the procedures for bonding between lifts.

8.2.3 Indicate the manner in which concrete lifts will be placed and staggered.

8.2.4 Indicate the amount of user check testing of cement to be accomplished.

8.3 Reinforcing Steel

8.3.1 Indicate the amount of user check testing of reinforcing steel for strength and ductility to be accomplished. Include the statistical basis for the program and the basis for reinforcing steel shipment rejection.

8.3.2 Indicate the attention that will be given to cadweld splice quality control and include operator qualification and procedural requirements.

8.3.3 Indicate the reinforcing bar welding procedures and quality control to be used in performing reinforcing bar welds. Include bar preparation, user check testing of reinforcing steel composition, maximum permissible alloy specifications, temperature control provisions, radiographic and strength testing requirements, and the basis for welded splice rejection and cut-out.

8.4 Liner

8.4.1 Describe the general sequence of liner construction and testing in relationship to the backing structural concrete construction.

8.4.2 Indicate the liner plate dimensional construction controls to be employed for liner plate out-of-roundness with respect to its influence on liner buckling.

8.4.3 Indicate the extent of user check testing of liner NDT properties, liner thickness, ductility, weldability, etc.

8.4.4 Indicate the applicable ASME or API code sections that will be adhered to in liner construction.

8.4.5 Indicate the procedures and criteria for control of seam weld porosity.

8.4.6 Indicate the requirements for and the control that will be placed on seam weld ductility.

8.4.7 Describe the quality control procedures for liner angle and stud welding.

8.4.8 Describe the quality control procedures and standards for field welding of liner plate to include welder qualifications, welding procedures, postweld heat treatment, visual inspection, magnetic particle inspection, liquid penetrant inspection, radiographic inspection, and construction records. Justify, in detail, the measures selected and in particular the amount of seam weld radiography.

8.5 Prestressing System

8.5.1 Indicate the basis for the wire/buttonhead factory quality control requirements imposed to ensure production material meeting design requirements and specifications. Where a system other than BBRV is specified, provide these requirements. Also indicate the extent to which anchorage hardware will (1) be periodically tested for hardness and threading and hole tolerances, and (2) have controlled NDT properties.

8.5.2 Describe the corrosion protection provisions that will be given to wire/strand at the factory, through transportation, and in the structure prior to prestressing.

8.5.3 Indicate the corrosion protection attention that will be given to the tendon ducting.

8.5.4 Describe the prestressing sequences, procedures and tendon stress verification that will be employed.

8.5.5 Describe the grouting procedures and controls that assure propor tendon grouting.

8.6 Preoperational Testing

8.6.1 Describe, in detail, the manner and extent to which all valving will be tested for leaktightness both individually and during preoperational integrated leak testing.

8.7 In-Service Surveillance

8.7.1 Describe the surveillance capabilities provided by the containment design to facilitate periodic inspection of the steel liner, and monitoring and/or periodic structural testing of the containment. Since leak-rate testing is intended to be performed at reduced pressure, provide an evaluation of the minimum level of such tests that would also serve to verify continued structural integrity. Consider in the evaluation structural response and installed surveillance instrumentation requirements.

8.7.2 Indicate the extent of long-term structural surveillance to be provided by test samples and in-place instrumentation of the containment.

8.7.3 To what extent will destructible test elements be used to verify the long term structural integrity of the prestressing tendons? (i.e., what will take the place of frequent inspection of the tendons?)

9.0 INSTRUMENTATION AND CONTROL

9.1 Does the design of your protection system conflict in any way with the proposed IEEE Standard for Nuclear Power Plant Protection Systems? If so, please state reasons justifying your position.

9.2 Provide a list all electrical components (cabling included) located within containment whose operation during the design basis accident is required for the proper functioning of the engineered safety features.

9.2.1 Throughout what time intervals must each component operate?

9.2.2 What tests will be performed to ensure that these components can, in fact, withstand the postulated accident environment and perform as required?

9.3 One can postulate several "First faults" in the "trip" bus feeding the rod release mechanisms whose existence cannot be detected during routine testing (e.g., the connection of the positive side of a d.c. source to the bus). The bus can therefore be disabled by the first detectable fault. For this reason the design does not conform to the single failure criterion. Discuss any changes you may make to remove this vulnerability.

9.4 The protection system is required, under some circumstances, to take action in response to coolant pump-monitor signals. Is there sufficient margin in the design of the power/flow protection system to allow for single failures within the monitors which give rise to false indication of pump operation?

9.5 Identify the sources of power to (1) the coils of trip circuit breakers in the protection system and (2) the rod drive clutch power supplies.

9.6 Explain the purpose of separate dual logic channels for reactor building spray pumps and valves.

9.7 Discuss the significance of the alarm function of the incore instrumentation system. What are the consequences of its failure?

9.8 Provide your criteria for the design of those sub-systems which control the operation of load-shedding and load-connecting circuit breakers under design basis accident conditions.

9.9 To what extent are your engineered safety feature systems vulnerable to an accidental reversal of a three-phase voltage supple? What precautions will be taken to prevent such an occurrence?

9.10 Describe the proposed 250/125 vdc system. In addition, provide the following:

9.10.1 The capacity of each battery and battery charger.

9.10.2 The emergency loads in each d.c. bus section. Will each battery be capable of carrying full emergency load?

9.10.3 Tests to be performed on the batteries and the test frequencies.

9.11 What is the rating of each diesel generator unit? Assuming a failed generator, what margin exists in terms of power requirements for minimum engineered safety feature operation?

9.12 Discuss the independence of the diesel generator units with respect to (1) physical separation, (2) starting systems, (3) lubrication systems, (4) fuel supplies, fuel pumps, (5) cooling systems, (6) control signals, and (7) fire protection.

9.13 Assuming a total loss of external power coincident with a design basis accident, provide a failure analysis to show that no single failure can prevent the actuation of sufficient engineered safety feature devices. Postulated failures should include, but not necessarily be limited to: (1) short circuit, (2) open circuit, (3) failed diesel generator, (4) failed engineered safety feature device, (5) malfunctioning circuit breaker (load-shedding or connecting), (6) loss of one battery, and (7) faulted undervoltage monitor (at emergency bus).

10.0 RADIATION MONITORING

10.1 Provide justification for not utilizing radiation monitoring system signals to initiate isolation or interlock functions in the plant liquid and gas discharge lines.

10.2 Describe the system which automatically drains wastes to the waste batch tank when they are sufficiently concentrated, the means used to determine concentration of wastes and the consequences of failure of the automatic system.

10.3 What is the release rate used in the waste gas decay tank failure analysis?

10.4 Provide a Radiation Monitoring System schematic similar to the format of Figure 7-2 which indicates location, equipment type, power sources, and interlock functions. The schematic should show the relationship of the area, waste and gas disposal, ventilation, and site monitoring systems. The schematic should be accompanied by adequate description.

10.5 Discuss how the design basis accident releases and other accidental releases relate to the radiation monitoring system design including range, sensitivity and detector location.

10.6 What actions are initiated upon receipt of a high radiation alarm?

10.7 Discuss the reason for not monitoring the turbine building exhaust.

10.8 Describe the operation of the control room heating and ventilation systems during normal and emergency operations.

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