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CONSOLIDATED EDISON COMPANY OF NEW YORK, INC. - INDIAN POINT NUCLEAR GENERATING UNIT NO. 2, DOCKET NO. 50-247 - OPERATING LICENSE STRUCTURAL REVIEW

We have reviewed the structural information presented in the FSAR for the Indian Point Unit No. 2, and have found it deficient for the purpose of evaluating the adequacy of the proposed design to protect the public safety.

The additional information needed to permit us to proceed with our review is given in the enclosure.

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RT-297A
C&CTB:DRL:EGA

Enclosure:
As stated above

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ADDITIONAL INFORMATION REQUIRED

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

INDIAN POINT STATION NO. 2, DOCKET NO. 50-247

1.0 GENERAL STRUCTURAL DESIGN

1.1 In order to determine whether an exhaustive survey should be made for post earthquake damage prior to continuing operation, information should be available as to the loadings experienced by the structures and Class I equipment. Indicate whether and how accelerometers will be placed, and how determination will be made that the response of the structure and Class I equipment is within allowable design limits. For accelerometers, it would be considered that a minimum useful installation would be one strong motion seismograph at foundation level in the ground, free of structure/ground interactions, and another at the top of the base slab inside the containment.

1.2 Define the relative terms "excessive" and "substantial," as used in definitions for Class I and Class II on page A-2 of the FSAR, in terms of 10 CFR 20/100 limits.

1.3 Indicate which Class I structures and components are located so as to be potentially endangered by Class II structures, and what protection has been provided these components. Also, can the failure of the Class III cranes endanger any Class I function?

1.4 Clarify where backfill has, or has not, been placed against the containment walls. Where backfill is present, justify in detail the seismic loading generated by the backfill and used in the design of the containment. How have the non axisymmetrical effects been considered?

1.5 Provide an analysis of the facility tornado protection, including especially the following:

(a) Protection of control room, auxiliary building, diesel generators, spent fuel storage pool.

(b) The effect on Class I structures and equipment of a collapse of the stack.

1.6 The FSAR discussion on primary system supports (pp 5.1.5-1 through 9) does not indicate whether these were designed for a combination of seismic and accident loads. Provide resultant stresses and deformations under such a combination, including jet forces, and furnish sketches showing the support details for the equipment discussed.

1.7 Show how the temperature stresses in the walls of the spent fuel pool were evaluated and what provisions have been made to limit cracking and prevent leakage.

1.8 Explain the methods used for the design of the interior structure.

(a) Indicate the design pressures and their method of determination.

(b) Indicate the design temperature differentials for the different parts of the structure.

(c) Explain the computation of jet forces.

(d) Present a sketch summarizing the above information.

(e) Indicate the method of stress analysis and give a list of critical stresses, their nature and their location.

2.0 CONTAINMENT STRUCTURAL DESIGN

2.1 With respect to tornado loading, (1) indicate the wind loading and pressure drop the plant is capable of sustaining, and the basis for their selection; (2) identify the equipment which can withstand these loadings; and (3) discuss the ability of the plant components and systems to withstand tornado originated missiles. As a minimum, establish the plant capabilities for a tornado with 300 mph rotational velocity, 60 mph translational velocity, and a pressure drop rate of 3 psi in 3 seconds.

2.2 List the spectrum of any other external missiles that the containment is designed to withstand and the procedures used in checking the containment design to withstand such missile hazards.

2.3 For the containment structure, provide:

(a) A drawing of the containment presenting details of the base slab, dome-cylinder junction, showing reinforcing and liner features, including liner anchors. Fig. 5.1-1

(b) A description of how torsional loads have been handled. These torsional loads may be generated by an earthquake or tornado.

(c) The analytical procedures used for arriving at the forces, shears, and moments in the structural shell, and the analytical procedures used for determining discontinuity stresses at the base and dome. State the assumptions, with regard to structural stiffness, that form the basis for these stress determinations and indicate the extent to which variations of E_c and u_c are considered.

(d) The values of E_c and u_c for cracked and uncracked reinforced concrete structure for different elevations and explain their use in the design of the concrete shell and in thermal liner loading computations. Include the effect of shrinkage. State whether the design takes into account these variations of E_c and μ_c, and also the effect of axisymmetric loads.

(e) Under test and incident conditions, concrete will be cracked and the crack pattern will be three dimensional. Explain how, under this condition, the shears are transferred through the section.

(f) Because of cracking of concrete due to shrinkage, testing, thermal stresses, and during an accident, the problem of adequate bar anchorage is of special concern. Provide information on how the reinforcing bars are anchored at certain critical points, such as: center of the dome, intermediate terminal points of radial bars in the dome, bars provided to take discontinuity stresses, diagonal bars, etc.

2.4 Describe the "splicing" of inclined bars, or horizontal stirrups provided to take the radial shears in the base of the walls with the vertical bars. If done by lapping the diagonal bar with a vertical bar or by bending the stirrup around a vertical bar, demonstrate that, despite biaxial tensile stresses in concrete and vertical and horizontal crack patterns, the load in the diagonal bars or stirrups can be transmitted safely to the vertical bars.

2.5 The reinforcing steel may be stressed to the yield point. Justify the use of this stress which is larger than the guaranteed minimum yield point of the liner (32,000 psi). Clarify whether, under certain conditions, the liner may be stressed beyond the yield point.

2.6 Indicate whether the following has been considered for the mat:

(a) The influence of the elasticity of the ground on the stress distribution in the foundation mat.

(b) The fact that the mat is under radial tension.

(c) The lack of symmetry of certain loads acting on the mat: seismic, tornado.

(d) Thermal stresses.

2.7 With respect to liner design, describe:

(a) The design approach that was used where loadings must be transferred through the liner, such as at crane brackets or machinery equipment mounts. Provide design details and computation results.

(b) How the shears, especially those due to thermal expansion and earthquake, are accommodated. The bottom liner is not accessible for inspection during the life of the plant. It is therefore very important to avoid any unnecessary stresses and strains in the bottom liner. The arrangement for load transfer through the liner under the bottom of the interior structure should have provided for transfer of shears parallel to the liner.

(c) The liner buckling characteristics if a stud anchor should fail or be missing.

(d) The stud sizes and stud/liner weld sizes.

(e) The maximum stress in concrete at liner anchors.

2.8 For penetration design:

(a) Indicate whether stress limits of the ASME Code, Section VIII, can be met, including the effects of jet forces, Include also the design criteria intended to prohibit pipe rupture between the penetration and containment isolation valves.

(b) The extent to which the penetrations and the applicable surrounding liner regions will be subjected to vibratory loading from equipment attached to the piping systems. Indicate how these loads are treated in design.

(c) The capability of the penetration design to absorb liner strain without severe distress at the opening.

(d) For all penetrations, the criteria that have been used for the bending of reinforcing bars which have to clear the opening. Criteria defining maximum slopes and minimum bending radii to avoid local crushing of concrete should be included, also a discussion of the anchorage of bars added to typical reinforcing or interrupted at the opening.

(e) For penetrations between approximately 9 inches and 4 feet in diameter, explain how normal, shear, bending, and torsional stresses are covered by the reinforcing bars.

(f) Provide sample drawings, sketches, and design computations for penetrations and shell adjacent to them.

2.9 For large openings, describe:

(a) Criteria with regard to opening sizes that constitute large openings; hence, meriting special design consideration. List the number and indicate the size of the large openings for the containment.

(b) The primary, secondary, and thermal loads that have been considered in design of the openings, including jet, seismic and tornado loads.

(c) The stress analysis procedures that were used in design.

(d) The method that was followed for the design (working stress design method, ultimate strength design method, or both). If ultimate strength was used, the factored load combinations should be given together with corresponding capacity reduction factors.

(e) How the existence of biaxial tension in concrete (cracking) has been taken care of in the design and how the normal and shear stresses due to axial load, two-directional bending, two-directional shear, and torsion are combined. Also, state the criteria for the design of the thickened part of the wall around the opening.

(f) The method used to check the design of the thickened still part of the shell around large openings and its effect on the shell. Include the manner of considering shrinkage. Describe how torsional stresses have been checked.

(g) Additional information on reinforcing patterns used around large openings.

(h) The safety factor provided in design at large openings. Sample computations should be provided, listing all the criteria and analyzing the effect of all pertinent factors, such as cracking, etc.

2.10 For the insulation, provide:

(a) The design safety factor provided on insulation performance, including specified (80°F) vs. tolerable (?) temperature rise in liner.

(b) An analysis of the consequences of one or more insulation panels being displaced from the liner during, or as a consequence of, an accident situation. Consider whether jet forces may remove panels.

(c) The consideration givento increased conductivity due to humidity and compression during accident pressure transients and pre-compression from structural and leakage testing.

(d) An evaluation of the compatibility of the insulation materials and steel liner (chemical reaction, etc.).

3.0 SEISMIC DESIGN

3.1 Class I structures and equipment are designed in such a way that for a ground acceleration of 0.15g a safe shutdown can be achieved. Please indicate in detail what are the criteria for functional adequacy in this case for structures, equipment, piping, instrumentation and controls.

3.2 Class I structures and equipment are designed in such a way that for the combination of normal loads plus 0.10 g earthquake the stresses are within code allowable. Please list the codes used for structures, equipment, piping, instrumentation and controls and state whether for some elements, a stress increase has been used, as permited by the codes.

3.3 Show the adequacy of the seismic design of the battery racks.

3.4 Describe the mathematical models used for the seismic design of:

Class I structures, equipment, piping and instrumentation and controls and explain how the elasticity of the structures, and the damping have been evaluated.

3.5 Explain what method has been used for seismic design: The response spectrum method or the time history method. If modal analysis has been used, indicate for every important structure, piping system, or equipment how many modes have been considered and describe how the damping was evaluated for each mode. By how much does the use of smooth response spectra underestimate the true response of Class I structures and equipment?

3.6 Discuss how closely the mathematical models represent the actual conditions, especially the effect of the following: Non-linear behavior of the actual structures, piping and equipment; effect of appendages (small masses elastically attached to large masses) clearances (gaps) at equipment restraints and supports; and variable friction.

3.7 List the amplification factors, resulting from seismic analysis, as compared with the ground motion for the following: reactor, main coolant pumps, Class I piping, spent fuel pool.

4.0 TESTING AND IN SERVICE SURVEILLANCE

4.1 Indicate the areas of the containment and liner which are to be instrumented for the strength test.

4.2 Derive a relationship between two test pressures and the actual pressures they represent, showing the validity of the test pressures. Use one test pressure for design basis accident alone, the other for earthquake plus accident. Include the following:

(a) Thermal stresses at large openings: evaluation of temperature gradients, stress computations for concrete and reinforcing steel, methods of combining stresses due to normal, tangential, bending, and torsional load, assumptions on cracking, stresses in stirrups, etc.

(b) Influence of shrinkage.

(c) Influence of liner elastic and plastic deformations.

(d) Liner stresses before cracking of concrete occurs.

(e) Influence of transient thermal gradients.

4.3 Describe the surveillance capabilities provided by the containment design with reference to both periodic inspection of the steel liner and periodic structural testing of the containment. If the 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 surveillance instrumentation requirements.