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Reactor Projects, Division of Reactor Licensing
THRU: Saul Levine, Assistant Director for Reactor Technology
R. C. DeYoung, Chief
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INDIAN POINT NUCLEAR GENERATING UNIT #3, CONSOLIDATED EDISON COMPANY OF NEW YORK, N. Y. PRELIMINARY SAFETY ANALYSIS REPORT, DOCKET NO. 50-286 CONTAINMENT AND OTHER STRUCTURES STRUCTURAL PROBLEMS

DRL:C&CTB:ALG RT-431

We have reviewed the structural information presented in the application for the Indian Point, Unit 3 facility and have found it to be ~~grossly~~ deficient for the purpose of evaluating the adequacy of the proposed design to protect the public safety. We have assisted Reactor Projects Branch No. 1 in advising the applicant and his subcontractors of the details of our concerns in the structural design areas during the course of technical meetings that have been held on this project. We believe the applicant is well aware of the areas where we consider his application deficient and of the type and extent of additional information we believe should be submitted to correct these deficiencies.

We recommend that the applicant be formally advised of the deficiency of his application in the areas of structural design. We have prepared a suggested statement for this purpose. This is presented in Attachment 1.

Attachment 2 is a listing of our detailed comments (in terms of requests for additional information). A draft of this list has been used during our meeting with the applicant and used as the bases for our discussions on structural design. It will also be used as the bases for any further discussions in this area for this project.

Attachments:
As stated above.

cc: Dr. R. Muller, DRL
J. A. Murphy, DRL
A. L. Gluckmann, DRL

bcc: S. Levine, DRL
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ATTACHMENT 1

GENERAL STATEMENT ON STRUCTURAL DESIGN FOR

THE INDIAN POINT, UNIT NO.3 FACILITY

We have completed our review of the information submitted on proposed structures for the facility and have found it to be inadequate for our needs. During the course of meetings with your representatives, we have advised them in some detail of the nature of our concerns. We are also willing to engage in further discussions to clarify any uncertainties that may remain as to the type and extent of additional information we need to complete our evaluation of the structural design adequacy. In general it will be necessary for you to provide information relating to the basic definitions for the different categories of structures, provide lists of structures in each category, provide information on the proposed design of all essential foundations and structures, including information on loads, load combinations, allowable stress and deformation limits, methods of static and dynamic analysis, selection of materials, corrosion protective measures, quality assurance and control requirements, and testing and surveillance specifications.

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ATTACHMENT 2

COMMENTS ON STRUCTURAL DESIGN FOR

THE INDIAN POINT, UNIT NO. 3 FACILITY

1.1 Provide definitions and complete lists of all:

Combined structures, i.e., when part of a structure is classified as Class I structure, and the rest of it is classified as Class II structure.

Class I components housed in adjacent to, or supported by Class II structure.

1.2 Describe in detail the protection which will be provided to Class I components not located in, or supported by, Class I structures.

1.3 State how the earthquake input for the design of these components will be established.

1.4 Describe the design methods used for combined (Class I and Class II) structures.

1.5 List those portions of the secondary system which are rated as Class I for seismic design. In particular, indicate the seismic design criteria for the steam generator shell, and the main steam lines from the steam generator to the valves.

1.6 State your criterion regarding acceptable stresses and strains in components rated Class I for seismic design during the maximum earthquake. In each case, are functional, accident, and seismic load assumed to occur simultaneously or not simultaneously?

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1.7 Define how the uniform building code will be used for the design of Class II structures and components.

1.8 For structures and components rated Class III, indicate the design criteria under seismic loading.

2.0 CONTAINMENT STRUCTURAL DESIGN

2.1 To determine the effect of the wind force caused by a tornado on the structure, provide a discussion of how the tornado wind loading will be translated into direct, torsional and shear loadings on the structure. Describe the design tornado. Consider the influence of the size of the funnel, the translation speed of the tornado and the effect on the structures of a non-uniform pressure distribution.

2.2 In certain circumstances, the containment structure base may be below ground water level. It appears that no layer of porous concrete and no membrane waterproofing exists between the soil and the containment mat and wall. Consider the possibility of cracking of the concrete in the mat and in the wall. In certain circumstances ground water under pressure may reach the liner. Provide an evaluation of the effects of ground water on liner corrosion and stability under these types of degraded conditions.

2.3 Discuss in detail tornado generated missiles.

2.4 The thermal load from the liner is a function of the stiffness of the encasing concrete and its deformations. It is therefore necessary to define and to justify the values of the Young's modulus E_c and of the Poisson's ratio μ_c for cracked and uncracked reinforced concrete structure. List the values of E_c and μ_c for different elevations and explain their use in the design of the concrete shell and in thermal liner loading computations. The thermal load from the liner is also a function of the thickness of the liner plates, and of the yield point of the liner steel. The thickness of the two adjacent liner plates may vary by as much as 10%. Only the minimum yield point is established in PSAR, but not the maximum yield point, which may differ from the minimum by as much as 25% - 30%. Explain how these two variable parameters are taken care of in the design.

2.5 For the loadings of the containment structure wall and dome, describe:

(a) The analytical procedures used for arriving at the forces, shears, and moments in the structural shell, considering cracking in concrete and not axisymmetric loading distribution.

(b) The considerations given to, and the analytical procedures for, determining discontinuity stresses under axisymmetric and not axisymmetric loading. What assumptions with regard to structural stiffness form the basis for these stress determinations? Is concrete cracking considered?

2.6 It is not clear whether a computer program is used. If such is the case, it should allow to take into account the cracking of concrete and the resulting variation of E_c and μ_c. It should also be able to handle not axisymmetric loading distribution.

2.7 If the effect of temperature rise in the liner will be represented by a uniform pressure increase, please justify this method.

2.8 If the stiffness factors for the cylinder and the mat were computed from formulas given in standard handbooks, such as for example Raymond J. Roark's book "Formulas for Stress and Strain," indicate whether the following has been considered:

(a) Influence of the cracking of the cylindrical wall, as compared with the uncracked mat.

(b) The fact that the mat is under radial tension and is supported on a rigid foundation, which restrains certain deformations of the mat.

(c) That the ground around restrains the deformations of the wall.

2.9 For the loadings of the base slab, describe the analytical procedures used to arrive at the forces, moments, and shears, considering the rigid support afforded by the ground.

2.10 It has been assumed that the subgrade is rigid, this assumption should be substantiated, since the mat has a diameter of approximately 150 feet, and the characteristics of the subgrade may vary.

2.11 For the combination of loadings considered, some clarification of the design procedures and stress limits are required. Describe:

a. The design procedures and stress and strain limits to be used in design of flexural and tension elements of the structure.

b. The design procedures and stress and strain limits to be used in the structural design for radial, lateral, longitudinal, and uplift shear.

c. The design procedures and stress and strain limits for missiles.

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d. The extent to which liner participation is relied upon to provide resistance to lateral (earthquake) shear. If liner participation is not included, describe how the corresponding strains are transmitted to the liner and their effect on the liner.

e. The general reinforcing patterns including layout and typical spacing for tension, flexural and shear reinforcement in the mat, in the wall, and in the dome.

2.12 Indicate factored load combination which includes tornado loading.

2.13 Under incident conditions concrete will be cracked. Explain how, under this condition the shears are transferred through the section?

2.14 The reinforcing steel may be stressed to the yield point. This stress is larger than the guaranteed minimum yield point of the liner which is 32,000 psi. Does this mean, that, under certain conditions, the liner may be stressed beyound the yield point? Clarify this point.

2.15 How are the reinforcing bars anchored at certain critical points such as: center of the dome, at intermediate terminal points of radial bars in the dome, bars provided to take discontinuity stresses, some diagonal bars, etc? Because of cracking of concrete due to shrinkage, to testing, and to thermal stresses, the problem of adequate bar anchorage is of special concern. Provide typical reinforcing pattern at these critical points..

2.16 With respect to seismic design of the containment, please describe:

a. The general analytical model for the containment including mass distribution, stiffness coefficients, modes of vibration, and analytical procedures for arriving at a loading distribution on the containment structure, taking into account several vibration modes.

b. The magnitude of lateral earth pressure under seismic loading and indicate how such loading will be factored into the containment design.

c. The manner in which damping will be considered in the structural design for different modes and for the design and maximum earthquake.

d. The extent and manner in which the horizontal, vertical and rocking motions will be considered in the design, and how the corresponding damping will be included. These three components of motion describe the motion of the structure with respect to ground.

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2.17 It is stated in the PSAR that diagonal bars will be provided to take the earthquake loading in the containment shell. Describe how they will be designed and whether their action will be combined with horizontal and vertical reinforcing.

2.18 How will seismic shears be taken at large openings?

2.19 The design spectra for 0.05 g and 0.10 g accelerations developed by G. W. Housner and presented in the PSAR appear to be scaled from the El Centro spectrum. Indicate the degree to which this scaling was examined in connection with the present site, which is on sound bedrock. What is the spectrum for 0.15 g ?

2.20 Discuss the stress levels and loading criteria that will be employed in the design for the maximum-earthquake and the design earthquake, and the limitations on deformations utilized.

2.21 Justify the use of a stress in the reinforcing, which is higher than the yield point of the liner (32,000 psi).

2.22 With respect to liner design, describe:

(a) Types and combinations of loading considered with regard to liner buckling, and the safety factors applied with respect to buckling. Include the influence of large strains due to cracking of concrete and to high level of stresses and strains in the inclined reinforcing bars.

(b) The geometrical pattern, type, and spacing of liner attachments; and the analysis procedures, boundary conditions, and results with respect to buckling under the loads cited above.

(c) Tolerance on liner plate thickness and liner yield strength variation and their bases.

(d) Examine the possibility of elastic and unelastic buckling especially at base of the wall. In this study cover the influence of all pertinent parameters, such as:

Variation of plate thickness.

Variation of yield point of liner steel.

Influence of Poisson's ratio for steel.

Erection inaccuracies (local bulges, offsets at seams, wrong anchor location).

Shrinkage of concrete.

Variation of Young's modulus and Poisson's ratio for cracked

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and uncracked concrete.

Ground water infiltration, earthquake, temperature loading, etc.

2.23 Indicate:

(a) The stress and strain limits used for the liner, the bases for these limits, and the extent to which these limits relate to liner leakage.

(b) The type, character, and magnitude of cyclic loads for which the containment liner will be designed. Include a discussion of the pressure/thermal load variations considered. Evaluate realistically the number of cycles generated by seismic tremors.

(c) The analytical procedures and techniques to be used in liner anchorage design including sample calculations.

(d) 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 leaktight integrity?

2.24 For the design of the anchors, elastic and unelastic buckling of the liner should be considered. Consider for the design of the anchors, the possibility of unbalanced loads acting on one or several anchors. At least the parameters indicated above should be considered. The study should prove that no chain reaction can occur and that the possibility of massive buckling of the liner, and mass failure of anchors is excluded.

2.25 What plastic strains can the liner material accommodate without cracking?

2.27 The details of arrangement for load transfer through liner under the bottom of the interior structure should provide for transfer of shears parallel to the liner. Indicate how the shears, especially those due to thermal expansion and earthquake, will be taken care of. It should be noted that test channels on the bottom liner are not accessible after the bottom concrete above the liner is installed. It is therefore very important to avoid any unnecessary stresses and strains in the bottom liner.

2.28 Provide:

(a) 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 and earthquake conditions.

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(b) The design approach that will be used where loadings must be transferred through the liner. Provide typical design details.

2.29 Discuss possible shearing off of the test channels, by differential strains in concrete above and below the bottom liner.

2.30 Describe the analytical procedures for analysis of liner stresses around openings. Also, provide the method of liner design to evaluate these stresses and the related stress limits. Justify the proposed thickening of the liner at penetrations.

2.31 A statement that all penetrations will be anchored into the concrete wall and that the anchorage will develop at least the plastic strength of the penetration sleeve would not be satisfactory if not followed by an explanation what plastic strength is meant? In tension, bending, shear, or combined?

2.32 With regard to penetration design, describe:

(a) The design criteria that will be applied to ensure that, under postulated design basis accident loadings that could result in pipe rupture or relative displacement of the internal systems relative to the containment, a subsequent pipe rupture due to torsional, axial, bending, or shear piping loads will not cause a breach of the containment. Also, include the detailed design criteria with respect to pipe rupture between the penetration and containment isolation valves. These piping sections represent an extension of the containment boundary under a condition when isolation is required. What code will be used?

(b) Typical designs to illustrate how the criteria are applied.

(c) The extent to which the penetrations and their surrounding linerr regions will be subjected to vibratory loading from machinery attached to the piping systems. Indicate how these loads will be treated in design.

(d) Criteria for concrete thermal protection at penetrations; include the temperature rise permitted to exist in the concrete under operating conditions and the (time dependent) effect that loss of thermal protection would have on the containment's structural and leak-tightness characteristics.

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

(f) If the full plastic strength of a pipe with regard to torsion, bending, and shear is to be used, an explanation should be given as to the manner in which axial stresses, loop stresses, shear stresses, bending stresses (in two directions) and shear stresses due to torsion are combined in the plastic domain. What failure criterion is used? Indicate how the exterior loads are combined, including jet forces. Give factored loading combinations for all loads and all cases considered in the design. Explain how the USA Standard Code for pressure Piping-Power Piping, USAS B31.1.0 - 1967 will be used for all loading cases. Will factored load combinations be used with this code?

2.33 Add the following information:

(a) For all penetrations: Indicate criteria for the bending of reinforcing bars which have to clear the opening. Maximum slope and minimum bending radius to avoid local crushing of concrete should be shown.

(b) For penetrations greater than approximately 9 in. and up to and including approximately 4 ft., explain how normal, shear, bending, and torsional stresses are covered by reinforcing bars and what loading combinations are covered.

(c) Justify the length required to anchor the bars in cracked concrete, and the use of ACI Code 318 for concrete under biaxial tension, and cracked in two directions.

2.34 With respect to large opening design, describe:

a. Your definition of large openings which merit special design attention.

b. Identification and sizes of the large openings that exist in the containment.

c. The loads that will be considered in design of the openings and allowable stresses to be used.

d. The stress analysis procedures that will be used in design.

e. Indicate what method will be followed for the design: the working stress design method or the ultimate strength design method, or both. If the ultimate strength design method is used, the factored load combinations should be given together with corresponding capacity reduction factors.

f. Indicate how the existence of biaxial tension in concrete (cracking) will be taken care of in the design. How will the normal and shear stresses due to axial load, two-directional bending, two-directional shear, and torsion, be combined? Clarify these points and establish criteria for the design of the ring girder. Reference to recent pressure tests of similar openings would not be conclusive, since the thermal and earthquake loads were not applied during tests, and since these tests have not established the safety factor provided in the structure (tests have not been contined till failure occurred).

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(g) The method to check the design of the thickened stiff beam around large openings and its effect on the shell should be indicated. The comparison with stresses in a circular flat plate would not be convincing, since it eliminates one of the most important effects: the effect of torsion. The applicant should present a method which allows to check torsional stresses.

(h) Provide detailed sketches of additional reinforcing and sample design computation.

(i) State the safety factor provided in concrete and reinforcing 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.

2.35 Insulation

(a) If insulation is required, present a detailed study of it. Design requirements and performance specifications should be included to provide confidence that the insulating qualities will be achieved under accident conditions. Describe therefore:

(b) The specified and tolerable temperature rise in the liner and the design safety factor provided on insulating performance.

(c) Means provided for fastening the insulating material to the backing liner and for precluding steam channeling in back of the insulation (from the top or through joints). Will the insulating panels be removable?

(d) 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.

(e) Indicate the consideration given to increased conductivity due to humidity and compression during accident pressure transients and precompression from structural and leakage testing.

(f) What consideration will be given to the compatibility of the insulation and liner?

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3.0 Materials

3.1 Indicate the type of cement to be used, explain the basis for the selection, and state the user check testing to be performed.

3.2 Describe the concrete mix procedures and indicate the scope and extent of testing of trial mixes.

3.3 Indicate the type and extent of admixtures which may be used. Describe their purposes, their extent of compliance to ASTM specifications, and their testing.

3.4 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. Provide more explicit information with regard to the type of Cadweld splicing intended.

3.5 Indicate the extent to which aplice stagger will be achieved.

3.6 Indicate the extent to which splicing of reinforcing steel will be made by welding. State the location of these welds. Indicate whether tack welding of reinforcing will be permitted.

3.7 Add the description of the "splicing" of inclined bars, provided to take the radial shears in the base of the walls, with the vertical bars. If the "splicing" is done by lapping the diagonal bar with a vertical bar, demonstrate that, despite biaxial tensile stresses in concrete and vertical and horizontal crack pattern, the load in the diagonal bars can safely be transmitted to the vertical bars.

3.8 Specify quality control for the strength welds of reinforcing bars to structural elements such as plates, rings, sleeves, and for occasional strength weld splicing of heavy reinforcing bars.

3.9 Provide the detailed material selections for containment penetrations, list the corresponding ASTM specifications and indicate NDTT considerations in their selection.

4.0 Corrosion Protection

4.1 Describe the concrete cover provisions for reinforcing steel for the dome, slab, and cylinder. Include for comparison the minimum ACI-318-63 code requirements.

4.2 Discuss the extent to which cathodic protection has been considered and is being provided. Have soil resistivity surveys been conducted? What are the results?

4.3 Discuss the extent to which protective coatings will be applied to the liner.

4.4 Drainage provisions do not include a layer of porous concrete located at base. No provisions have been made for a porous layer at the cylindrical wall of the containment. Justify the omission of drainage at such critical locations. Consider that, contrary to normal foundation work, the containment structure is continuously subjected to the effect of thermal gradients, which generate tensile stresses in the outside concrete layers and increase the danger of cracking.

5.0 <u>Construction</u>

5.1 Indicate the codes of practice that will be followed in the containment construction.

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

5.3 Indicate the specific extent to which ASME fabrication standards or any other standards will be adhered to in liner manufacturing.

5.4 The listing of codes should be supplemented with an additional list of codes covering items which are not covered in listed codes (Army Engineers, Bureau of Reclamation, AWS, etc.) but which may be used as basis for applicant's specifications.

5.5 State on what basis the supplementary mandatory requirements, which may be required, will be prepared.

5.6 ASME standards define erection tolerances in a way that is not sufficient to ensure a satisfactory erection of the liner. For example they do not cover local curvature deviations. Establish a comprehensive set of erection tolerance standards for the liner, limiting all inaccuracies likely to occur during erection.

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

5.8 Add a detailed description of erection of the bottom liner. What provisions will be made to ensure a good bearing of the liner on concrete below? Will grouting be resorted to? How will the liner plates be fitted to the embedded anchors?

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5.9 Describe the concrete placing and curing procedures to be used.

5.10 Describe the procedures for bonding between lifts.

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

5.12 Give a detailed description of the placing of concrete in the dome, especially nearer to the center portion of the dome.

5.13 Describe the extent of concrete compression and slump testing to be used. Include the statistical basis for the proposed program and the standards for batch rejection and pour removal.

5.14 Indicate the planned program of user testing of reinforcing steel for strength and ductility. Include the statistical basis for the program and the basis for reinforcing steel shipment rejection.

5.15 Indicate the controls that will be provided to ensure that the proper specification reinforcing bars are received, and, if different grades of steel are used, how will mistakes be avoided during erection?

5.16 Indicate the Cadweld splice procedures including operator qualification, procedures to be followed, inspection and testing, and standards for rejection.

5.17 Add the minimum percentage of Cadweld splices which will be tested. A tolerance limiting the offset of two bars to be spliced should be provided.

5.18 Indicate the reinforcing bar welding procedures and quality control to be used in performing reinforcing bar strength 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. Will any tack welding of reinforcing steel be permitted?

5.19 Indicate the minimum percentage of reinforcing splices to be checked by the welding inspector, using non-destructive inspection methods (x-raying dye penetrant test, etc.). The statement ". . . performed on a random basis. . . ." alone would not be sufficient.

5.20 Describe the general sequence of liner erection and testing in relationship to the structural concrete construction.

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5.22 Indicate the controls to be employed in reference to liner plate out-of roundness. A check on out-of-roundness alone is not sufficient. At all locations where the liner may be in compression, the local curvature of the liner should be checked. The formation of local bulges should be prevented.

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

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

5.24 Indicate the requirements that will be placed on seam welds to assure adequate ductility.

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

5.26 Discuss the planned seam weld radiography program. Also, provide an evaluation of the liner radiography with respect to providing assurance that flaws that may develop into positive leakage paths under design basis accident conditions do not, in fact, exist.

5.27 Describe the quality control procedures for test channels, liner angle, and stud welding.

5.28 Describe your quality control procedures and standards for field welding of liner plate and test channels; include welder qualifications, welding procedures, post weld heat treatment, visual inspection, magnetic particle inspection, liquid penetrant inspection, and construction records.

6.0 Construction Inspection

6.1 Describe the organization for inspection. Indicate the manner in which inspectors are divorced from construction pressures and the manner in which the engineering design group works with the inspection organization.

6.2 Indicate the qualification, minimum experience, and authority of inspectors.

6.3 Indicate the degree to which material preparation and construction activities will be subject to inspector surveillance.

6.4 Discuss the manner in which records of quality control and inspection will be kept.

7.0 Testing and In-service Surveillance

7.1 Describe the sequence for structural testing.

7.2 Describe the instrumentation program for structural testing.

Include:

(a) Identification of structural, and liner areas to be instrumented.

(b) Purpose, type, expected accuracy, and redundancy of instrumentation.

(c) The range of strains and deformations expected.

(d) The protective measures that will be taken to ensure instrument performance during structural testing, considering the interval between instrument installation and its use.

7.3 Evaluate the extent to which the test pressure will simulate design basis accident conditions by comparing the stresses under various test pressures, with those in the structure under accident pressure, temperature gradient and accident pressure, temperature gradient, plus earthquake (and other combinations, if governing) for the following structural elements: (a) circumferential reinforcing; (b) axial [longitudinal] reinforcing; (c) dome reinforcing; (d) base slab reinforcing; and (e) large openings.

7.4 By comparing stresses and strains which are experienced by the structural elements under test loadings with those calculated to exist under design basis accident loading, provide a discussion in support of the selected test pressures. Include in this discussion the extent to which increased test pressure or design modifications might be considered in an effort to obtain closer test verification of structural integrity.

7.5 Present a detailed discussion supporting the selected test pressure. A table should compare the computed stresses for two different pressure test conditions with the computed stresses due to incident alone, and to the earthquake plus incident. The information should be sufficient to evaluate the reliability of the stress computations. Explain in detail the methods used in the preparation of this table, the physical constants employed, etc. The following points should be carefully covered:

(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.

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(b) Influence of shrinkage.

(c) Influence of liner deformations: elastic and plastic.

(d) Stresses in liner, before cracking of concrete does occur.

7.6 Provide an analysis of crack size, spacing, and pattern expected during containment structural testing.

7.7 Discuss the influence of cracking on bond and anchorage of bars terminating in a cracked zone. The increase of crack width during the life of the plant due to thermal cycling, to progressive shrinking of concrete, to weathering (freezing and thawing), to seismic loading occurring during the life of the plant, should be considered.

7.8 Explain whether it is intended to measure stresses at different points in concrete and reinforcing steel, especially in ring girders at main openings and in the discontinuity zones.

8.0 In-service Surveillance

8.1 Describe the surveillance capabilities provided by the containment design with reference to 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.

cc: A. L. Gluckmann, DRL

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