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memo

P. A. Morris, Director
Division of Reactor Licensing

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.; INDIAN POINT UNIT NO. 2; DOCKET NO. 50-247

Enclosed is the FSAR structural evaluation of the containment and other Class I structural designs for the Indian Point Unit No. 2, prepared by the DRS Structural Engineering Branch.

Original signed by
E. G. Case
Edson G. Case, Director
Division of Reactor Standards

Enclosure:
Structural Evaluation for
Indian Point Unit No. 2

cc w/encl:
R. C. DeYoung, DRL
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DATE ▶	5/19/70	5/19/70	5/19/70	5/19/70		

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

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INDIAN POINT NUCLEAR GENERATING UNIT NO. 2

Docket No. - 50-247

5.0 STRUCTURES

The Consolidated Edison Company of New York engaged the United Engineers & Constructors to design and build the overall plant, with Westinghouse designing the nuclear steam supply system, the chemical and volume control system, the reactor engineered safeguards systems, and the associated instrumentation. Previous nuclear facilities operated by Consolidated Edison include the Indian Point #1 nuclear station. Current facilities under construction and design are Indian Point #3 and Nuclear #4 and 5.

5.1 CLASS I STRUCTURES OTHER THAN CONTAINMENT

The major facility foundations bear directly on hard bedrock. Minor structures are founded on either rock or compacted granular fill above the rock. The foundation design is, therefore, conventional and without special difficulties. The station includes Class I, II, and III structures, using definitions and listings with which we agree. Class I structures are designed for a 0.10g operational basis earthquake and 0.15g design basis earthquake, acting in the horizontal direction. These values were accepted at the construction permit review.

The facility has not been designed for any specific tornado loading. The containment, however, has been analyzed for its resistance to tornado loads resulting in a 300 mph uniform wind load on the structure. Due to its accident-containing design requirements, the containment structure can inherently withstand such loads. The containment and concrete portions of the auxiliary building were also found to be capable of withstanding tornado missiles. Not capable of withstanding the tornado currently applied to new plants - with 300 mph rotational velocity, 60 mph translational velocity, and 3 psi pressure drop in 2 seconds -- are the metal-sided plant structures, such as control room, diesel-generator building, upper fuel storage building and upper auxiliary building. Supplement #2, Question 1.11 states that the metal panels cannot withstand tornado missiles but can withstand winds of 162 mph or a 1.18 psi negative pressure. The cooling water intake structure equipment is also not designed to resist tornado loads or missiles.

Tornado loads were not imposed as a design requirement at the time of the construction permit review of this facility, although they have since been considered to be a design requirement for more recent applications. As a minimum for this facility, we recommend that the applicant establish precautionary measures which would permit a controlled plant shutdown if adequate warning of a tornado were received. These measures should be defined in the technical specifications. However, if advance warning were not received and the plant were unexpectedly struck by a severe tornado, there is no assurance of plant capability to safely shut down as it is presently designed. Whether further design measures should be imposed as a design required depends on an evaluation of the frequency of severe tornados at this location.

A strong-motion accelerograph will be installed on a concrete slab directly on bedrock in the yard area of the plant. In the event of an earthquake, the developed traces of the ground acceleration will be available for analysis of the Class I structures, components, and supports. This approach was last accepted for the H. B. Robinson plant (on soil), and is acceptable also for Indian Point #2.

Class I instrumentation will be tested for seismic loading by vibration testing of typical equipment in accordance with WCAP-7397-L "Topical Report Seismic Design Testing of Electrical and Control Equipment" (proprietary). Dynamic analyses of the most adverse seismic location, the control building floor at elevation 53', show that the significant horizontal and vertical accelerations of this floor are within the specified low seismic test envelopes given in WCAP-7397-L.

Another general design requirement which has been applied to nuclear plants designed since the construction permit review of Indian Point Unit No. 2 is the simultaneous application of seismic and accident loads on Class I structures and components. Only the containment structure for this facility was designed for this load combination. However since the seismic loads are much less than those due to the blowdown forces, we believe that the design of other Class I components of this plant are adequate since an acceptable design considering the seismic and blowdown loads to be independent has been completed.

The applicant stated in a meeting with the staff on April 29, 1970, that he is reanalyzing, using dynamic analyses, the turbine building, the fuel storage building, and the Unit No. 1 stack and superheater building for earthquake loads.

For the turbine building, the reanalysis is to determine whether there is any potential for failure of this Class III structure onto Class I structures or components, such as the control room. If such a potential should be shown to exist, the applicant stated that structural revisions would be made to eliminate it.

For the fuel storage building, the reanalysis will be done with an unloaded crane to assure that the Class III crane and building superstructure cannot fail and endanger the spent fuel in the pool below.

Additional structural reinforcing will be installed if required as a result of the reanalysis.

The Unit No. 1 stack is being reanalyzed in combination with the superheater building and with a planned stack height reduction of 80'-0". Preliminary information indicates that the reduced height stack has a 242 mph wind capability, with elastic buckling as the failure mode and not taking any credit for the effect of the gunite lining. The applicant's consultants originally concluded that the superheater building would be capable of resisting only a maximum horizontal ground acceleration of 0.03g and a wind velocity of 150 mph.

We concur with the applicant's approach in reanalyzing these three structures and making any changes which may be required as a result of these analyses.

5.2 CONTAINMENT

5.2.1 Description

The reactor containment structure has the shape of a reinforced concrete, right cylinder with a hemispherical dome and flat base. Its inside diameter is 135' - 0" with 4' - 6" thick walls and a 3' - 6" thick dome. The spring line of the dome is

135' above the 9' - 0" thick foundation mat, with a dome inside radius of 67' - 6". The liner is constructed of 1/4" minimum thick carbon steel plate, ASTM A442, Grade 60, fire box quality, with a minimum yield strength of 32,000 psi. Part of the liner is insulated.

5.2.2 Functional Evaluation

See report of DRS Systems Evaluation Branch.

5.2.3 Structural Evaluation

The reinforcing in the cylinder wall is placed in the horizontal and vertical directions. The applicant does use added diagonal tangential reinforcing for earthquake. We and our consultants have reviewed the design and find the resulting arrangement acceptable.

The reinforcing bars conform to ASTM A432 specification. Cadweld splices are used on 14S and 18S bars. Although some difficulties were experienced during construction, Appendix C to the FSAR demonstrates that the Cadweld splices can be considered to be acceptable as placed in the structure.

The containment is designed to remain within the elastic range for the 0.10g operational basis earthquake concurrent with accident and other applicable loads. It is also designed to withstand a 0.15g design basis earthquake without loss of function. A critical damping factor of 2% has been used for the operational and design basis earthquake.

We and our consultants are in agreement with the loading combinations and allowable stresses selected by the applicant. Stress and strain limits conform to the requirements of ACI 318-63, Part IV-B. The ACI load factors have been replaced by factors suitable for concrete containment structures.

The spacing of anchors for the liner is such that no buckling will occur below the allowable stress with an adequate safety factor. The limiting stresses for the liner are in accordance with Section III of the ASME Boiler and Pressure Vessel Code. The stresses and strains are below yield for both the operational and design basis earthquake conditions. We and our consultants concur in this approach.

Appendix D to Supplement 6 described erection inaccuracies in the containment liner. We concur in the applicant's conclusion that appropriate corrective measures were taken and that the liner and its erection tolerances are acceptable.

5.2.4 Testing and Surveillance

Strength and leakage tests will be performed after construction is completed with a 115% overpressure test at 54 psig and during a 100% pressure test at 47 psig respectively. Test channels are provided at all liner seams for long-term surveillance. No permanent instrumentation is being installed on the containment for strength testing, although examinations will be made for cracking and distortion during the pressure test. A series of leakage rate tests are planned for periodic testing of the containment and the penetrations.

The applicant will submit a containment test program report for our review prior to performing the initial containment proof test.

5.3 CONCLUSION

We believe that the design of Class I structures of the Indian Point Unit 2 facility is generally acceptable. The containment design is acceptable from both a seismic and tornado standpoint. Other structures are being analyzed and will be modified as necessary to assure that all seismic requirements for Class I structures are satisfied. The plant is not designed to withstand present tornado loading design requirements, although many of the structures can withstand strong winds and a moderate vacuum, to assure safe plant shutdown. Precautionary measures should be established to provide advance warning of the possibility of severe tornadoes affecting the site so that the reactor can be safely shutdown before damage occurs.