Consumers Power Company

David J VandeWalle
Nuclear Licensing Administrator

General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-1636

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Dennis M Crutchfield, Chief
Operating Reactors Branch No 5
Nuclear Reactor Regulation
US Nuclear Regulatory Commission
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DOCKET 50-155 - LICENSE DPR-6 -
BIG ROCK POINT PLANT - SEP TOPIC
III-7.B, "DESIGN CODES, DESIGN
CRITERIA AND LOADING COMBINATION"

The attachment to this letter provides Consumers Power Company response to a recent NRC/FRC inquiry regarding SEP Topic III-7.B, "Design Codes, Design Criteria and Loading Combination", for the Big Rock Point Plant.

David J VandeWalle
Nuclear Licensing Administrator

CC Administrator, Region III, USNRC
NRC Resident Inspector-Big Rock Point

Attachment - 3 pages

A035

BIG ROCK POINT
EVALUATION REPORT OF SEP TOPIC III-7.B
"DESIGN CODES, DESIGN CRITERIA AND LOADING COMBINATION"

REQUEST FOR ADDITIONAL INFORMATION

1. With respect to operating or accident loads is there any significant (i.e., high energy) piping supported from the following structures?

   - Piping supported from containment shell, including penetration?
   - Support for reactor enclosure plenum?
   - Intake structure?

   If so, were operating and accident pipe reactions considered in the original design of these structures?

   Reference to source where this information is documented?

   Answer

   The Big Rock Point Plant containment shell and the support for the reactor enclosure plenum have no piping connected to either of these structures. The intake structure for the Big Rock Point Plant does not contain high energy piping.

2. What load combinations were originally considered for the following structures?

   - Intake structure?
   - Stack?
   - Diesel generator enclosure?

   Has the design of any of these structures subsequently been reviewed under other (or additional) load combinations?

   Reference to documentary source of this information?

4. What design codes were used for the stack and for the diesel generator enclosure?

Answer

The following is a combined answer to questions 2 and 4.

According to the Bechtel Specification 3159 C-21, the concrete stack was designed to resist stress due to dead load, wind load, seismic load and temperature effects in both the vertical and circumferential directions according to the specification for the design of reinforced concrete chimneys ACI 505-54. The seismic forces acting on the stack were analyzed as recommended in "Earthquake Design Criteria for Stack-like Structures" Paper 1696 Journal, Structural Division, ASCE, July 1958.

The stack was reanalyzed by D'Appolonia as part of a reevaluation of the Big Rock Point Plant to withstand earthquake loads. From Volume IV, Appendix E of the D'Appolonia report for the above grade portion of the stack the analysis utilized a combination of dead load, seismic load using the response spectrum method, and thermal loads. For below grade structural elements earth pressure was combined with dead loads and seismic loads. Volume IV, Appendix E, Attachment E1 at the end of the report rationalizes the determination of the allowable compressive strength of concrete and the allowable yield stress of steel.

The screenwell, pumphouse, and discharge structure which I believe is what the Franklin Research Center Communication dated July 15, 1982 refers to as the intake structure, has been designed to the fifth edition of the AISC Specification for Design, Fabrication, and Erection of Structural Steel, the ACI Building Code Requirements for Reinforced Concrete (ACI 318-56), and the 1958 Edition of the Uniform Building Code according to the Bechtel Design Criteria for Big Rock.

The loads considered for the screenwell, pumphouse, and discharge structure were snow load, dead load, live load, crane and impact loading, and earthquake loads. These loads were combined in the following manner to obtain a maximum realistic loading combination:

1. Dead load + live load + snow + crane + impact
2. Dead + live + wind + ½ snow
3. Dead + live + seismic

The screenhouse was reanalyzed by D'Appolonia as part of a reevaluation of the Big Rock Point Plant to withstand earthquake loads. From Volume VII, Appendix H of the D'Appolonia report for above grade structures the analysis utilized a combination of dead load and seismic loads using the response spectrum method. For below grade structural elements earth pressures acting on foundation walls was combined with dead loads and seismic loads. The codes utilized for determination of allowable stresses were the AISC 1970 Edition and the ACI 349-76 requirements for nuclear safety related structures.

All the above design criteria also applies to the diesel generator room structure.

3. What were the design stress limits for the containment shell for each of the loading combinations considered?

Answer

The design load combinations and stress limits utilized in the design of containment shell are as follows: According to the Bechtel Specifications 3159 C-1 the containment vessel was designed to the ASME Specifications. The specific Specifications referred to are ASME Section II-Material Specifications, ASME Section VIII-Pressure Vessels, and Section IV-Welding Qualifications.

The loading combinations considered in design of the containment structure were a 27 psig internal gauge pressure with dead weight of steel containment shell, snow load, 60 mph wind load, and dead weight of 1.50 psf for insulation. A second loading combination utilized for design of the containment shell was the 27 psig internal pressure in combination with dead weight of containment shell, wind load as specified in ASA-58.1, and dead weight of 1.50 psf for insulation. The third loading combination considers an external pressure of 0.94 psig in combinaiton with dead load ans snow load.

Chicago Bridge and Iron's design criteria for design of the containment vessel states the stress at any point may be expressed as an equal biaxial compressive stress plus a uniaxial compressive stress. From Section VIII of the ASME Code the allowable biaxial compressive stress is $900,000\ t^2/R$ and the allowable uniaxial compressive stress is $1,800,000\ t^2/R$ where t is the shell thickness and R is the sphere radius. The max allowable membrane stress is 15,000 psi.

The containment shell was reanalyzed by D'Appolonia as part of a reevaluation of the Big Rock Point Plant to withstand earthquake loads. From Volume II, Appendix A, Attachment A1 of the D'Appolonia report the containment shell analysis utilized a combination of dead load and seismic loads using the response spectrum technique. The allowable stresses specified by the ASME (1977) are 16,500 psi for membrane stress and 24,750 psi for combined membrane plus bending stress. The max allowable compressive for the containment shell is based on ASME (1977) Subsection NE 3133.4 and ASME Section III, Appendix VII. According to USNRC Standard Review Plan 3.8.2 the allowable compressive stress can be taken as 1.2 times the allowable value of ASME Subsection NE, therefore, yielding an allowable compressive stress of 2,100 psi.