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SUBJECT: Forwards addl info re crack in reactor bldg wall,per NRC 800821 request.Photographs & oversize drawings encl.

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NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION/300 ERIE BOULEVARD WEST, SYRACUSE, N.Y. 13202/TELEPHONE (315) 474-1511

December 15, 1980

Director of Nuclear Reactor Regulation
Attn: Mr. Thomas A. Ippolito, Chief
Operating Reactors Branch #2
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Gentlemen:

Re: Nine Mile Point Unit 1
Docket 50-220
DPR-63

On August 21, 1980 members of the Nuclear Regulatory Commission staff met with Niagara Mohawk to discuss the crack in the reactor building wall at Nine Mile Point Unit 1. The attached information was requested by your staff at that meeting.

Very truly yours,

NIAGARA MOHAWK POWER CORPORATION

Donald P. Dise

Donald P. Dise
Vice President Engineering

MGM:ja
Attachments

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NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT UNIT 1

REACTOR BUILDING WALL CRACK

Request for Additional Information

December 1980

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Item 1

It is requested that Niagara Mohawk provide its bases for the crack mechanism philosophy.

Response

Attachments A and B provide drawings and pictures of the Nine Mile Point Unit 1 reactor building wall crack. The crack is located in the exterior north wall of the Reactor Building approximately 10.5 feet west of the east wall. The maximum width of the crack is approximately one-eighth of an inch at approximately eighteen inches below the one foot ledge at Elevation 237 feet. The crack extends down from the ledge at Elevation 237 feet approximately eight feet and extends above the ledge about the same distance. The upper and lower ends of the crack disappear in a random hairline pattern.

The design drawings for Nine Mile Point Unit 1 (attachment A) were reviewed. The North-South exterior 15 inch thick x 22 foot average height screenhouse foundation wall runs continuously for about 160 feet without a wall return or expansion joint. The wall elevation shows that the column pilasters as well as foundation wall lengths are established at the common base elevation of about 240 feet, which is also the elevation of the bedrock.

As described by ACI recommendations, the recommended maximum length for concrete foundation walls without vertical interruptions is approximately 40 to 60 feet. Therefore, for the 160 foot length wall, at least two vertical expansion joints were in order, but do not exist for the wall in question.

These walls and pilasters were constructed during approximately a one year time period. As a result, some wall elements were winter pours, and after proper curing for strength, they were exposed to the ambient temperatures. The change in ambient temperature and final operating temperature provided a thermal expansion force to each end of the wall.

The north end of the 160 foot north/south wall had a return and that portion of the thermal expansion force was dissipated by geometry.

However, the south end of the 160 foot north/south wall had a 4 foot-2 inch hard jointed vertical surface of contact with the 4 foot thick east/west secondary containment wall (@ elevation 237 feet). The balance of the common wall height was separated by one inch resilient (compressible) material. Both elevation and plan centerline location align for the two walls at the crack location.

Calculations have shown that a sufficient temperature gradient could have existed to overcome frictional forces, apply a force to the north face of the east/west secondary containment wall and crack the wall. The wall crack is vertical in nature, due to horizontal flexure of the east-west secondary wall that spans continuously between adjacent pilaster and return wall in the reactor building.

The north/south wall thermal force and corresponding horizontal displacement is considered uniform at the walls cross-section for the full height of wall. This caused the topping (only) to crack (several years ago) at floor elevation 261 feet. This is the only other area of the joint detailing that was hard jointed to the east-west secondary containment wall. No vertical displacement was observed, since the curbing at elevation 261 feet broke in a concave fashion (i.e. hard jointed to east west secondary containment wall), designating compression load primarily.

Item 2

It is requested Niagara Mohawk review the seismic design of the Reactor Building to assure interaction by the screen house wall will not precipate unacceptable stress during a design basis seismic event.

Response

A simple beam analysis was performed to determine the effect of the combined seismic and thermal loading on the Reactor Building wall. Utilizing a simple beam model and conservative inputs, the combined seismic and thermal loads approach Reactor Building wall limits.

However, the simplistic model and conservative inputs used in the analysis result in greater than expected stresses as detailed below:

(1) The design does not consider the localized two-way flexural action that would occur in the wall. As modeled, we have considered the wall as spanning in the horizontal direction only. In reality the wall would also span in the vertical direction. The applied load would be divided proportional to the relative stiffness between the horizontal and vertical spans. This would increase the margin to yield.

(2) The assumption of rigid boundry conditions results in a formula which indicates loads higher than those which would be found under actual conditions. This is due to the fact that the principal of moment distribution is not applied in the calculation.

(3) In reality reinforced concrete exhibits a creep effect which would allow the wall to undergo a plastic deformation. The deformation would provide a relaxing effect and reduce applied thermal load. This would increase the margin to yield.

(4) Historically Grade 40 steel rebar has been found to have a yield point 10% to 15% above the specified 40 ksi. Additionally, the modeling assumes that yielding occurs only in those localized areas at a crack in the concrete. The probability of experiencing a minor flaw in this minute area is smaller than in the sample used to test Fy at the mil. Therefore, the margin to yield in likely greater than calculated.

(5) Under combined loading, spalling of concrete free cover (about 2") on wall reinforcing may occur. It is believed that this action would not cause sufficient damage to the structural steel stairway to hinder egress.

(6) It is also believed that "through" cracks would not occur until the ultimate failure mode is obtained, and the wall pivots about the north face. A very large applied force would be required, since the surrounding wall would attempt to retain this increment. A combination flexural and axial compression stress would have to be overcome.

Based on the conservatisms outlined above, the actual combined seismic and thermal loadings would be less than the Reactor Building wall yield.

Item 3

It is requested Niagara Mohawk develop a monitoring program to determine movement of the Reactor Building wall and above ground movement of the screenhouse wall.

Response

To monitor movement of the Reactor Building wall, Niagara Mohawk will install monitoring equipment as detailed on Figure 1.

To monitor above ground movement of the screenhouse wall, Niagara Mohawk will install monitoring equipment as detailed on Figure 2.

Data obtained since 1977, from existing monitoring equipment, indicates no increase in crack size. If movement is observed on the monitoring equipment to be installed, this information will be provided to NRC.

Item 4

It is requested Niagara Mohawk provide Reactor Building and screenhouse building drawings.

Response

Attachment A contains Reactor Building and screenhouse building drawings.

Item 5

It is requested Niagara Mohawk provide pictures of the Reactor Building wall crack.

Response

Attachment B contains pictures of the Reactor Building wall crack.