February 16, 1984

Docket No.: 50-410

APPLICANT: Niagara Mohawk Power Corporation

FACILITY: NINE MILE POINT NUCLEAR STATION, UNIT 2

SUBJECT: SUMMARY OF STRUCTURAL AUDIT OF NINE MILE POINT 2

The week of December 12-16, 1983, the NRC staff met with representatives from NMPC and Stone and Webster Engineering Corporation (SWEC) at the SWEC offices in Cherry Hill, New Jersey to perform the structural audit for Nine Mile Point 2. Prior to the structural audit, the NRC staff visited the Nine Mile Point site on November 29, 1983, in order to become familiar with the structural aspects of Nine Mile Point 2.

A copy of the audit guidelines is included as Attachment 1. These guidelines were used as the basis of the audit performed December 12-16, 1983.

Attachment 2 contains a list of meeting attendees at the December 12-16 audit.

Attachment 3 contains a list of open items from the structural audit.

Indicated for each item is an estimated submittal date.

Original signed by:

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Attachments:
As stated

cc w/ attachments:
See next page

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ATTACHMENT 1

ENCLOSURE

STRUCTURAL DESIGN AUDIT GUIDELINES

I. BASIC DESIGN CRITERIA

A. General Design Data

1. Wind and Tornado
   - a. Wind profile
   - b. Design pressure on flat and curve surfaces
   - c. Surface coefficients
   - d. Windward and leeward distribution
   - e. Gust factors
   - f. Conversion of wind velocities into forces
   - g. Effects of missiles from tornadoes
   - h. Others

2. Snow and Ice
   - a. Design loads

3. Flood
   - a. Design basis flood elevation
   - b. Design groundwater table elevation

4. Earthquake

   Design ground motion in the free field
   - a. Peak acceleration or zero-period acceleration (in g's)
     - (i) Operating basis earthquake (OBE)
     - (ii) Safe shutdown earthquake (SSE)
   - b. Response spectra
     - (i) OBE, SSE
     - (ii) Horizontal, vertical for various damping values
   - c. Time history
     - (i) Source: natural or artificial
     - (ii) Composition: rising time, strong motion duration, decaying time
     - (iii) Baseline correction: check the integrated velocity and displacemnt time histories
     - (iv) Time interval
     - (v) Procedure of synthesizing

(vi) Derived response spectra corresponding to time histories, and frequency intervals used

d. Damping

5. Soil Properties

a. Soil profile -- layering

(i) Elevation

(ii) Depth of layers

(iii) Bearing capacity at foundation

(iv) Lateral soil pressure, static and dynamic

b. Physical properties of each layer

(i) Type of soil

(ii) Dry weight

(iii) Shear modulus and shear wave velocity

(iv) Poisson's ratio

(v) Bulk modulus

(vi) Damping characteristics

6. Blast Environment

a. Class of explosives

b. Distance of blast

c. Air blast and time pressure curves

d. Ground shock

e. Missiles and fragmentation

7. Aircraft Impact Environment

a. Weight of projectiles

b. Speed of projectiles

c. Explosion and forcing function

8. Turbine Missiles

B. Applicable Codes, Standards and Specifications

C. Materials

1. Structural steel - modulus of elasticity, Poisson's ratio, yield strength and allowable stresses

2. Concrete - modulus of elasticity, Poisson's ratio, ultimate strength, and allowable stresses

3. Reinforcing steel - modulus of elasticity, Poisson's ratio, yield strength and allowable stresses

4. Others (Specify)

II. GENERAL METHODS OF ANALYSIS AND DESIGN

A. Static Analysis
   1. Overall analysis
   2. Localized analysis
   3. Computer codes used

B. Seismic Analysis
   1. Selection of masses and degrees of freedom
   2. Number of modes considered
   3. Consideration of three components of motion
   4. Consideration of torsional and translational response
   5. Soil-structrue interaction
   6. Development of floor response spectra
      a. General procedures
      b. Smoothing
      c. Peak widening
      d. Typical results
   7. Computer codes used

C. Buckling Analysis

D. Load Combinations

E. Design Consideration for Tornado and Turbine Missiles
   1. Design requirements
   2. Local damage
   3. Overall response
   4. Conformance to SRP 3.5.3

F. Special Considerations for Containment Structure
   1. Ultimate capacity analysis
   2. Special design loads - in addition to general design loads listed in Section I
      a. Dead and live loads for various operating floors and base slab
      b. Internal pressure and temperature
      c. Pool dynamic loads (BWR only)
   3. Analysis of penetration effects
   4. Tangential shear (concrete containment only)
   5. Steel liner analysis (concrete containment and concrete basemat only)

G. Interaction with Non-Category I Structures

H. Quality Control Criteria

III. SUMMARY OF ANALYSIS AND DESIGN

A summary of analysis and design should be provided for each structure or item listed in Section IV.

A. General layout, dimensions, sections and details

B. Generation of applicable dead and live loads

C. Mathematical model; including idealized masses, geometrical and physical properties

D. Summary of dynamic responses

E. Computer input (if applicable)

F. Computer output (if applicable)

G. Governing load combinations and critical sections

H. Design parameters for proportioning structural members

I. Summary of key results

J. Factor of safety against overturning, sliding and flotation (for foundations only)

K. Verification that drawings reflect design calculations

IV. AUDIT ITEMS

A. Containment Building

1. Containment Shell

2. Internal Structures (BWR plant)

   a. Drywell wall

   b. Weir wall

   c. Operating floor

   d. Reactor vessel supports or predestals

   e. Coolant pump supports

   f. Cable trays and their supports

   g. Reactor shield walls

   h. Polar crane support

   i. Other structures (specify)

2. Internal Structures (PWR Plant)

   a. Reactor vessel support

   b. Reactor coolant pump support

   c. Steam generator support

   d. Primary shield walls

   e. Secondary shield walls

   f. Operating floor slab

   g. Cable trays and their supports

   h. Polar crane support

   i. Other structures

3. Foundation Mat Including Reactor Pit

4. Audit of Key Designs

   For each key design area audited, the design calculations should be reviewed together with applicable drawings, sketches, etc. Also, key details and/or sections, as appropriate, in this audit report should be included.

   a. Containment liner design

      (i) Conformance with ASME B&PV Code Section III Div. 2-Article CC-3000 and Div. 1 for fatigue and tensile evaluation if liner is subjected to such loads

      (ii) Key liner locations

      (iii) Forces and displacements obtained from computer analysis

(iv) Liner anchor design

(v) Key penetration design

b. Fuel pool liner design

(i) Analysis

(ii) Conformance to code

(iii) Corrosion effects (e.g. pitting) on liner integrity

c. Containment Hatch Design

(i) Model, design assumptions and analysis procedures

(ii) Governing load combinations

(iii) Conformance to CC-3000

d. Containment wall-base mat junction design

(i) Design requirements and model

(ii) Governing loads

(iii) Key results (Forces, moments & stresses)

(iv) Section showing details

(v) Any waterstop membranes at the joints their design considerations and installations

(vi) Conformance to CC-3000

e. Dome to cylinder junction design

(i) Design requirements and model

(ii) Governing loads

(iii) Key results (Forces, moments & stresses)

(iv) Sections showing details

(v) Conformance to CC-3000

f. Seismic Analysis for Buried Piping and/or Electrical Conduits

(i) Method of analysis

(ii) Stiffness calculations

(iii) Inputs

(iv) Key analysis results

g. Post-Tensioning System

(i) Tendon system used

(ii) Prestressing force at transfer

(iii) Tendon load under LOCA

(iv) Method used to calculate prestress losses:

- Initial
- Creep and shrinkage of concrete
- Tendon relaxation or degradation
- Other losses

h. Buttress Design for Post-Tensioning System

(i) Maximum bursting stress in concrete

(ii) Reinforcing provided to resist bursting stresses

(iii) Stress under the anchor plate

(iv) Allowable stresses

(v) Stress under tendons anchorage

(vi) Method for calculation of stresses

B. Other Category I Structures

Provide summary of analysis and design for structure and foundation of the following:

1. Auxiliary Building
2. Control Building
3. Diesel Generator Building
4. Fuel Handling Building
5. Miscellaneous (specify)

ENCLOSURE

STRUCTURAL AUDIT OF NINE MILE POINT 2
CHERRY HILL, NEW JERSEY
DECEMBER 12-16, 1983
LIST OF ATTENDEES

NRC

Nilesh Chokshi	Structural
Li Yang	Structural
*Mary Haughey	Project Manager

NMPC

Ed Klein	Assistant Manager, Project Engineer
Norm Rademncher	Licensing
*Samir Nashed	Structural
*Anthony Zallnick	Licensing

SWEC

*C. E. Crocker	Engineering
*J. A. Burgess	Quality Assurance
*M. I. Gilman	Quality Assurance
*R. H. Pinney	Licensing
*J. M. Lord	Manager
A. M. Shah	Structural
T. Conghlin	Structural
M. J. Shah	Structural
J. S. Posusney	Structural
B. E. Ebbeson	Structural
M. S. Dixit	Structural
*W. Chamberlain	Assistant Engineering Manager
G. E. Duda	Structural
D. K. Roy	Structural
A. P. Burg	Structural
Y. T. Lee	Structural
C. Lee	Structural
R. Murphy	Structural
N. Rapagnani	Engineering Mechanics
C. T. Ly	Engineering Mechanics
K. Fischer	Engineering Mechanics
P. Mitchell	Equipment Qualification
D. Bhargana	Equipment Qualification
R. Seeberger	Structural
K. Wislocky	Structural

*part time

ENCLOSURE

STRUCTURAL AUDIT OF NINE MILE POINT 2
MEETING MINUTES

Date: December 12-16, 1983
Location: Stone & Webster Office
Cherry Hill, New Jersey
Attendees: See attached list

NRC Requested Action Items.

1. Provide a final design assessment of Nine Mile Point 2 containment and its interior structures with respect to the verified pool Hydrodynamic loads - SRV/LOCA. (6/1/84 and 9/1/85)

2. With respect to Nine Mile Point 2 seismic analysis provide justification for not considering vertical floor flexibility. (6/1/84)

3. With respect to the design of interior structures and other Category I Structures provide an assessment and justification of all deviations from the applicable requirements of ACI 349 code as augment by Regulatory Guide 1.142. (6/1/84)

4. Provide seismic design analysis of cable tray supports within the division I electrical tunnel between the control building and Reactor building. (1/31/84)

5. With respect to the polar crane rail anchorage design provide the design provide the design wheel loads and the bases for using four anchor clips to distribute the wheel loads. (3/31/84)

6. Provide reference for the Nelson stud anchors used the design of polar crane rail anchorage. (1/31/84)

7. Provide justification and discussion for not considered rope stack effects in the Seismic analysis of polar crane design. (1/31/84)

8. Provide justification for using Segments Section instead of Circular ring section for the calculation of primary containment stiffness properties. (1/31/84)

9. For Nine Mile Point 2, the additional ±5% accidental torsion effects were not considered in the structural analysis. Provide an assessment of the adequacy of their analysis by considering the effects of ±5% accidental torsion. (FSAR Amendment 6)

10. With respect to the use of equivalent static load method of analysis, provide justification for applying a factor of 1.3 to the peak acceleration rather than the staff accepted value of 1.5. (FSAR Amendment 6)

11. With respect to the design of spent fuel pool columns the applicant used two different models for the analysis. The staff request the applicant provide:

    a) A comparison of the column reactions obtained from both analysis and identify the critical design loads used in the column design. (1/31/84)

    b. Spent fuel pool column splice details and the design forces of the base plates. (1/31/84)

12. Provide the design basis for shear lugs used in Nine Mile Point 2 polar crane rail support. (1/31/84)

13. Verify that upward seismic load effects was considered in the foundation stability analysis of Schreewell building. (3/1/84)

14. Verify that the bearing capacity of Vermiculite concrete which was filled between the Category I structures is adequate to accommondate the anticipated sliding force due to seismic. (3/1/84)

15. With respect to seismic analysis of screenwell building evaluate the impact on the original design without the integrated effects of Radwaste building. (3/1/84)