Docket File

May 20, 1969

Docket No. 50-263

PDR

Northern States Power Company
414 Nicollet Mall
Minneapolis, Minnesota 55401

Attention: Mr. D. F. McElroy

Gentlemen:

To continue our review of your application for a provisional operating license for the Monticello plant, we need additional information in regard to the seismic and structural design of the plant. This matter was discussed with representatives of your company and the General Electric Company at meetings held on April 1 and 2, 1969.

The structural and seismic design information presented in the Final Safety Analysis Report (FSAR) is insufficient to permit a determination of the adequacy of the Monticello plant to withstand seismic loadings. In many respects the information presented in the FSAR is less informative than that presented in the earlier Preliminary Safety Analysis Report (PSAR). However, your letter of transmittal applying for an operating license states that the FSAR ". . . supersedes in its entirety the application dated July 25, 1966."

The FSAR does not state in sufficient detail how the structural and seismic design objectives presented in the PSAR and amendments were translated into the final design. Accordingly, we request that the appropriate sections of the FSAR related to the seismic design of Class I structures, equipment, piping, instrumentation and controls be revised. We believe that this is the most desirable and expeditious manner in which to update, augment, and present in sufficient detail the information we require to continue our review of your application.

To assist you, we have attached a summary of the type of information that should be included in the appropriate revisions to the FSAR. Please contact us if you have any questions regarding this request.

Sincerely,

(Original signed by Peter A. Morris)

Peter A. Morris, Director
Division of Reactor Licensing

Enclosure:
Summary Info. for
FSAR Revision

Distribution:
AEC Pub Doc Rm
Docket File
DR Reading
RL Reading
RPB-1 Reading
C. K. Beck
M. M. Mann
P. A. Morris
F. Schroeder
R. S. Boyd
R. C. DeYoung (14)
L. Kornblith, CO (3)
D. R. Muller
D. Vassallo
C. J. Hale
N. Blunt

Discussed w/ McElroy on 5/20/69

Office:	RL:RPB-1	RL:RPB-1	RL:RT	RL:RP	RL	RL
Surname:	Hale / Vassallo/eb	Muller	DeYoung	Boyd	Schroeder	Morris
Date:	5/7/69	5/7/69	5/9/69	5/13/69	5/13/69	5/14/69

Rewritten 5-7-69

SUMMARY OF TYPES OF INFORMATION TO BE INCLUDED IN REVISED SECTIONS OF FSAR RELATING TO STRUCTURAL AND SEISMIC DESIGN OF MONTICELLO PLANT

A. SEISMIC DESIGN

-- An indication of the criteria defining the functional adequacy for each type of Class I structure, equipment, piping, instrumentation, and controls, as related to information presented in the FSAR that Class I structures and equipment are designed in such a way that for a ground acceleration of 0.12g a safe shutdown can be achieved.

-- With respect to the methods used in the seismic analysis for Class I structures and equipment, the following should be provided:

- Verification that the earthquake record employed in the seismic analysis (i.e., using as indicated in the FSAR a time history approach using the Taft, July 21, 1952, N 69° W earthquake record appropriately scaled) leads to a spectra of the type presented in Plate 3 of the seismic criteria (first portion of Appendix A), which was the basis of the specified criteria. Also, a discussion as to whether slight changes in the time history input, or alternatively slight changes in the method of modeling the structure could lead to any significant changes in the design values arrived at, and whether an approximate check of the results obtained by the time history approach was made.

- An indication for each Class I structure and equipment of whether the response spectrum method or the time history method of analysis was used for seismic design. If a modal analysis has been used, an indication of how many modes have been considered and a description of how the damping was evaluated for each mode.

-- A comprehensive discussion of the loading combinations, and the applicable stress and deformation limits employed in the design of Class I structures, equipment, piping, and instrumentation and control systems. Also, a listing of the specifications and/or codes related to the information presented in the FSAR that these structures and equipment are designed in such a way that for the combination of normal loads plus design earthquake, the stresses are within code allowable. Also, an indication as to whether for some elements, a stress increase has been used, as permitted by the codes.

In the PSAR (Section 5.3.1.2) it was noted for the maximum earthquake that ". . . where calculations indicate that a structure or piece of equipment is stressed beyond the yield point, an analysis is made to determine its energy absorption capacity. In addition, the design is reviewed to assure that any resulting deflections or distortions will not prevent the proper functioning of the structure or piece of equipment." Additional information is needed to indicate whether such conditions were encountered at any point in the design and if so, what limits on stress and deformation criteria were adopted to ensure the adequacy of the design to meet the intended design criteria.

-- A description of the mathematical models used for the seismic design of each of the Class I structures, equipment, piping, instrumentation and controls systems, and an explanation of how the elasticity of the structures, and the damping have been evaluated.

Also, a discussion of how closely the mathematical models represent the actual conditions, especially the effect of non-linear behavior of the actual structures, piping and equipment; effect of appendages (small masses elastically attached to large masses) such as vent pipes and header, equipment hatch, and personnel lock; effect of clearances (gap) at equipment restraints and supports; and effect of variable friction.

-- Justification of the assumption used in the seismic analysis of the primary containment structure that the drywell is completely fixed on its foundation.

-- A detailed discussion of the seismic design of the plant stack, torus, ring header and its supports. The seismic design of these features was omitted from the FSAR.

-- Justification for subdividing the Class I structures and equipment into the three categories; rigid, resonant, and flexible, and an explanation of the manner in which these categories are used in the final design.

-- An explanation of how the interaction between soil and the reactor building has been provided for in the seismic analysis and the design of the building and whether non-linear behavior of soils has been considered; e.g., details as to how spring constants, such as those designated K3 and K4, which represent the foundation stiffness and lateral resistance (soil-structure interaction), were obtained for use in most of the analyses presented in Appendix A of the FSAR.

-- Details on the foundation design and construction; e.g., the conditions that were encountered and the actual procedures that were employed in constructing the foundations for the plant.

-- A listing of the amplification factors resulting from seismic analysis, as compared with the ground motion for the reactor, recirculating pumps, Class I piping, and spent fuel pool.

-- Clarification as to the damping values used in the final design. In Appendix A it is noted that damping values of 10 percent of critical are to be employed for ground rocking modes of vibration. On the other hand, our records indicate that in reply to Question 8.8 of Amendment 6 of the PSAR, Northern States Power stated that a value of 5 percent would be used.

-- Clarification as to whether as noted on page 12.2.2 of the FSAR that Class II structures were designated by the Uniform Building Code for Zone 1 conditions. This appears to be at variance with the material presented in answer to Question 8.10 of Amendment 6 of the PSAR wherein Northern States Power indicated that a seismic coefficient of 0.05 would be used for Class II structures and equipment.

-- Information to show that at points where structures and/or equipment are interconnected, the dynamic deformations are compatible; e.g., (a) for horizontal restraints of the reactor at elevation 994'-2", and of the drywell and the shield at elevation 992'-5-1/2", (b) for the drywell, at the shear lugs between the drywell and the reactor building at elevation 992'-4-13/16".

-- The design criteria supporting the statement that parts of Class II structures covering or supporting Class I equipment have been designed as Class I structures.

B. STRUCTURAL DESIGN

-- For the drywell, clarification of the following:

- Method of evaluating the jet forces and the area subjected to their effect.

- How the maximum metal temperature of 300°F was established for jet impacted steel plate and an evaluation of the corresponding thermal stresses in the shell.

- Why the temperature of the steel plates was reduced to 150°F when jet action is considered with design internal pressure, and what this pressure is.

- Why local yielding has been permitted when the shell is backed up by concrete. This criterion is not a code criterion. How was it established that a rupture will not occur? Where the shell is not backed up by concrete, the primary membrane stresses are permitted to go up to 0.9 of the yield point; this is not allowed by the code. Note all of the loads which were combined when this criterion was used.

-- For the design of the torus, consideration of the following:

  - A justification of the value of 21 kips for the jet force at each downcomer pipe in the torus.

  - A description of the stress criteria and design methods used for the design of the torus for jet forces. A discussion of whether other jet forces exist in the torus in addition to downcomer pipe jet forces.

  - A description of how the flooding of the drywell and the torus has been considered and combined with seismic loads. Also, an indication of the corresponding critical stresses.

-- With respect to the penetrations in the drywell and torus, the following:

  - A discussion of the applicable design criteria and the load combinations used in the design.

  - A description of the stress analysis methods used to evaluate the stresses in the shell; penetration sleeves, bellows and guard pipes; and process piping at penetrations, their anchors and supports.

-- The significance of the statement in the FSAR that ". . . the containment vessel was code stamped for the design pressure and design temperature"; i.e., does this mean that it is not a code vessel for other loads such as seismic loads, jet forces and equipment loads?

-- An evaluation of the capability of the facility, including the stack, to withstand a tornado with 300 mph rotational velocity, 60 mph translational velocity, and a 3 psi pressure drop in 3 seconds. Also, an indication of whether stack failure can endanger any Class I systems or structures required for safe shutdown.

-- An explanation of how the gap between the drywell and the shielding concrete outside of the drywell is drained and vented, since it appears that strips of polyurethane foam used in construction have been left in the gap at specific elevations.

-- Indicate the temperature stresses in the concrete walls of the spent fuel pool under normal operating conditions, and the provisions made to limit cracking of the concrete.

-- A discussion of whether means will be available to monitor possible settlement of Class I structures and equipment.

C. REACTOR, PIPING AND EQUIPMENT DESIGN

-- A detailed explanation and supporting analyses to show how the effect of a seismic disturbance on the Class II part of the main steam lines has been taken care of in the design of the Class I part, especially for the anchors and the valves.

-- A comprehensive discussion and details in regard to the design of the reactor internals and primary system piping including but not limited to the following:

- The extent and findings of the analyses by which the conclusions stated in Section 3.6.3 of the FSAR are reached; i.e., it is stated the reactor vessel internals are designed to maintain a reflooding capability following a loss-of-coolant accident and that the internals are also designed to preclude a failure mode which would result in any part being discharged through the main steam line in the event of a steam line break.

- In your discussion pertaining to the directly added simultaneous peak loads resulting from normal operation plus the worst loss-of-coolant accident plus the design basis earthquake, and for the combination of the normal operating loads plus the peak loads from the worst loss-of-coolant accident include:

  (a) The methods of analysis (elastic, elastic-plastic, limit).

  (b) The limits to which the critical components were evaluated (stress, strain, deflection, buckling) with numerical values for several critical items.

  (c) For each method of analysis, relate the possible errors in the analytical method and the possible errors in loads used for the stress calculations to the margin of safety which is being provided.

-- Information as to the frequencies and mode shapes for the "coupled system" related to the design analysis of the reactor pressure vessel noted in Section 4 of Appendix A.

-- Information showing how the seismic design of Class I tunnels and underground piping and cables entering or leaving a structure were handled, since the seismic response within and outside the structure is quite different.

-- The design procedures employed for the Class I piping, including as a minimum the following:

  - Methods of analysis used.

  - Stress limits to which the piping systems were designed.

  - Supporting systems, snubber locations, etc.

  - Seismic factors, amplification factors and other pertinent factors used.

  - Accommodation of pipe whip.

-- Method used to support the recirculation pumps. Also, an indication of the design criteria, materials, and design methods used for these supports. Indicate the potential for pumps to become missiles under the combined action of earthquake and jet forces.

-- A justification of the adequacy of the seismic design of the battery racks.

Docket No. 50-263

Northern States Power Company
414 Nicollet Mall
Minneapolis, Minnesota 55401

Attention: Mr. D. F. McElroy

Gentlemen:

To continue our review of your application for a provisional operating license for the Monticello plant, we need additional information in regard to the seismic and structural design of the plant. This matter was discussed with representatives of your company and the General Electric Company at meetings held on April 1 and 2, 1969.

The structural and seismic design information presented in the Final Safety Analysis Report (FSAR) is totally inadequate to permit a determination of the adequacy of the Monticello plant to withstand seismic loadings. In many respects the information presented in the FSAR is less informative than that presented in the earlier Preliminary Safety Analysis Report (PSAR). However, your letter of transmittal applying for an operating license states that the FSAR ". . . supersedes in its entirety the application dated July 25, 1966."

Our principal concern is that the FSAR does not state in sufficient detail how the structural and seismic design objectives presented in the PSAR and amendments were translated into the final design. Accordingly, we request that the appropriate sections of the FSAR related to the seismic design of Class I structures, equipment, piping, instrumentation and controls be extensively revised. We believe that this is the most desirable and expeditious manner in which to update, augment and present in sufficient detail the information we require to continue our review of your application.

To assist you, we have attached a summary of the type of information that should be included in the appropriate revisions to the FSAR. Please contact us if you have any questions regarding this request.

Sincerely,

Peter A. Morris, Director
Division of Reactor Licensing

Enclosure:
Summary info. for
FSAR revision

Distribution:
AEC Pub Doc Rm
Docket File
DR Reading
RL Reading
RPB-1 Reading
C. K. Beck
M. M. Mann
P. A. Morris
F. Schroeder
R. S. Boyd
R. C. DeYoung (14)
L. Kornblith, CO (3)
D. R. Muller
D. Vassallo
C. Hale
N. Blunt

OFFICE ▶	RL:RPB-1	RL:RPB-1	RL:RT	RL:RP	RL	RL
SURNAME ▶	Vassallo/eb	Muller	DeYoung	Boyd	Schroeder	Morris
DATE ▶	4/21/69	4/23/69	4/23/69	4/25/69	4/29/69	4/ /69

SUMMARY OF TYPE OF INFORMATION TO BE INCLUDED IN REVISED SECTIONS OF FSAR RELATING TO STRUCTURAL AND SEISMIC DESIGN OF MONTICELLO PLANT

-- A detailed explanation of the means by which functional adequacy will be analyzed for Class I structures, equipment, piping, instrumentation and controls which, as stated in the FSAR ". . . are designed in such a way that for a ground acceleration of 0.12g a safe shutdown can be achieved."

-- A listing of the codes used for Class I structures, equipment, piping, instrumentation and controls related to the statement in the FSAR that these structures and equipment ". . . are designed in such a way that for the combination of normal loads plus design earthquake the stresses are within code allowable." Also, an indication as to whether for some elements, a stress increase has been used, as permitted by the codes.

-- A description of the mathematical models used for the seismic design of each of the Class I structures, equipment, piping, instrumentation and controls systems, and an explanation of how the elasticity of the structures, and the damping have been evaluated.

-- An explanation of whether the response spectrum method or the time history method of analysis was used for seismic design. If a modal analysis has been used, then for every important structure, piping system, or equipment, an indication of how many modes have been considered and a description of how the damping was evaluated for each mode. Also, an indication of the degree to which the true response of Class I structures and equipment is underestimated by the use of smooth response spectra.

-- A discussion of how closely the mathematical models represent the actual conditions, especially the effect of non-linear behavior of the actual structures, piping and equipment; effect of appendages (small masses elastically attached to large masses) such as vent pipes and header, equipment hatch and personnel lock; effect of clearances (gape) at equipment restraints and supports; and effect of variable friction.

-- Sufficient information to show that at points where structures and/or equipment are interconnected, the dynamic deformations are compatible: For instance (a) for horizontal restraints of the reactor at elevation 994'-2" and of the drywell and the shield at elevation 992'-5-1/2", (b) for the drywell, at the shear lugs between the drywell and the reactor building at elevation 992'-4-13/16".

-- Justification for subdividing the Class I structures and equipment into the three categories: rigid, resonant, and flexible, and an explanation of the manner in which these categories are used in the final design.

-- An explanation of how the interaction between soil and the reactor building has been provided for in the seismic analysis and the design of the building and whether non-linear behavior of soils has been considered.

-- A listing of the amplification factors resulting from seismic analysis, as compared with the ground motion for the reactor, recirculating pumps, Class I piping, and spent fuel pool.

Omitted in revision

-- Information as to whether installation of strong motion seismographs is planned for the facility (the number and type) and how determination will be made that the response of the structure and primary equipment is within allowable design limits. The data obtained from seismographs would be helpful in evaluating post-earthquake damage to the facility.

-- A justification of the adequacy of the seismic design of the battery racks.

-- Supporting information to show how the seismic design of Class I tunnels and underground piping and cables entering or leaving a structure were handled, since the seismic response within and outside the structure is quite different.

-- A discussion of whether means will be available to monitor possible settlements of Class I structures and equipment.

Omitted

-- Provisions made to limit the gradual increase of the leakage rate of the reactor building due to gradual deterioration of the structure, such as increased cracking, aging of caulked joints and gaskets.

-- A detailed explanation and supporting analyses to show how the effect of a seismic disturbance on the Class II part of the main steam lines has been taken care of in the design of the Class I part, especially for the anchors and the valves.

-- An explanation to support the statement that parts of Class II structures covering or supporting Class I equipment have been designed as Class I structures. All such equipment in this category should be included in the discussion.

-- An evaluation of the capability of the facility, including the stack, to withstand a tornado with 300 mph rotational velocity, 60 mph translational velocity, and a 3 psi pressure drop in 3 seconds. Also, an indication of whether stack failure can endanger any Class I systems or structures required for safe shutdown.

-- A description on how the gap between the drywell and the shielding concrete outside of the drywell is drained and vented, since it appears that strips of polyurethane foam used in construction have been left in the gap at specific elevations.

-- Method used to support the recirculation pumps -- design criteria, materials used, and design methods used for these supports -- potential for pumps to become missiles.

-- With respect to the spent fuel pool:

- An evaluation of the temperature stresses in the walls of the spent fuel pool and provisions made to limit cracking and prevent leakage.

Omitted - The provisions to protect the pool from the loss of water from tornado generated missiles and such things as an inadvertent dropping of a spent fuel shipping cask.

-- The design procedures employed for the Class I piping including as a minimum the following:

- Methods of analysis used.

- Stress limits to which the piping systems were designed.

- Supporting systems, snubber locations, etc.

- Seismic factors, amplification factors and other pertinent factors used.

- Accommodation of pipe whip.

Omitted -- ~~Adequate~~ details on the foundation design. The only mention of the foundation design in the FSAR consists of a brief description of the foundation investigation in Section 2.5.5 and several brief sentences in Section 12.2.1.5. The latter discussion indicates that ". . . and other structures are supported on undisturbed soils or compacted selected backfill." Without some discussion of the conditions that were encountered and the actual procedures that were employed in constructing the foundations for the Monticello plant, we cannot assess the adequacy of the foundation design.

Omitted -- Verification that the revised seismic criteria developed in the construction permit review of the PSAR and amendments were actually employed in the final design of the facility; e.g., one of the seismic reports included in Appendix A of the FSAR pre-dates any final dated documents relating to the construction permit review.

-- Verification that the earthquake record employed in the seismic analysis (i.e., using as indicated in the FSAR a time history approach using the Taft, July 21, 1952, N 69° W earthquake record appropriately scaled) leads to a spectra of the type presented in Plate 3 of the seismic criteria (first portion of Appendix A), which was the basis of the specified criteria. Also, a discussion as to whether slight changes in the time history input, or alternatively slight changes in the method of modeling the structure could lead to any significant changes in the design values arrived at, and whether an approximate check of the results obtained by the time history approach was made.

-- Sufficient information as to the frequencies and mode shapes for the "coupled system" related to the design analysis of the reactor pressure vessel noted in Section 4 of Appendix A.

-- Additional details as to how spring constants such as those designated K3 and K4, which represent the foundation stiffness and lateral resistance (soil structure interaction), were obtained for use in most of the analyses presented in Appendix A.

-- Clarification as to the damping values used in the final design. In Appendix A it is noted that damping values of 10 percent of critical are to be employed for ground rocking modes of vibration. On the other hand, our records indicate that in reply to Question 8.8 of Amendment 6 of the PSAR, Northern States Power stated that a value of 5 percent would be used.

-- In the PSAR it was noted in Section 5.3.1.2 that for the maximum earthquake in cases in which the stress combinations exceeded yield stress, analyses would be made to determine the energy absorption capacity and to review that the resulting deflections or distortions would not prevent proper functioning of the structure or piece of equipment. Additional information is needed to indicate whether such conditions were encountered at any point in the design and if so, what limits on stress and deformation criteria were adopted to insure the adequacy of the design to meet the intended design criteria.

-- A comprehensive discussion of the loading combinations employed in the design, the applicable stress and deformation limits employed in the design, and any other information of this type to provide a basis for evaluating the adequacy of the facility seismic design. The limited data of this type which appeared in the PSAR apparently were deleted from the FSAR.

-- Clarification as to whether as noted on page 12.2.2 of the FSAR that Class II structures were designed by the Uniform Building Code for Zone 1 conditions. This appears to be at variance with the material presented in answer to Question 8.10 of Amendment 6 of the PSAR wherein Northern States Power indicated that a seismic coefficient of 0.05 would be used for Class II structures and equipment.

-- A comprehensive discussion and details in regards to the design of the reactor internals and primary system piping including but not limited to the following:

- The extent and findings of the analyses by which the conclusions stated in Section 3.6.3 of the FSAR are reached; i.e., it is stated that the reactor vessel internals are designed to maintain a reflooding capability following a loss-of-coolant accident and that the internals are also designed to preclude a failure mode which would result in any part being discharged through the main steam line in the event of a steam line break.

- In your discussion pertaining to the directly added simultaneous peak loads resulting from normal operation plus the worst loss-of-coolant accident plus the design basis earthquake, and for the combination of the normal operating loads plus the peak loads from the worst loss-of-coolant accident include:

  (a) The methods of analysis (elastic, elastic-plastic, limit).

  (b) The limits to which the critical components were evaluated (stress, strain, deflection, buckling, with numerical values for several critical items.

  (c) For each method of analysis relate the possible errors in the analytical method and the possible errors in loads used for the stress calculations to the margin of safety which is being provided.

-- For the drywell, clarification of the following:

- Method of evaluating the jet forces and the area subjected to their effect.

- How the maximum metal temperature of 300°F was established for jet impacted steel plate and an evaluation of the corresponding thermal stresses in the shell.

- Why the temperature of the steel plates was reduced to 150°F when jet action is considered with design internal pressure, and what this pressure is.

- Why local yielding has been permitted when the shell is backed up by concrete. This criterion is not a code criterion. How was it established that a rupture will not occur? Where the shell is not backed up by concrete, the primary membrane stresses are permitted to go up to 0.9 of the yield point; this is not allowed by the code. Note all of the loads which were combined when this criterion was used.

-- For the design of the torus, consideration of the following:

- A justification of the value of 21 kips for the jet force at each downcomer pipe in the torus.

- A description of the stress criteria and design methods used for the design of the torus for jet forces. A discussion of whether other jet forces exist in the torus in addition to downcomer pipe jet forces.

- A description of how the flooding of the drywell and the torus has been considered and combined with seismic loads. Also, an indication of the corresponding critical stresses.

-- With respect to the penetrations in the drywell and torus, the following:

- A discussion of the applicable design criteria and the load combinations used in the design.

- A description of the stress analysis methods used to evaluate the stresses in the shell; penetration sleeves, bellows and guard pipes; and process piping at penetrations, their anchors and supports.

-- The significance of the statement in the FSAR that ". . . the containment vessel was code stamped for the design pressure and design temperature"; i.e., does this mean that it is not a code vessel for other loads such as seismic loads, jet forces and equipment loads?

-- Justification of the assumption used in the seismic analysis of the primary containment structure that the drywell is completely fixed on its foundation.

-- A detailed discussion of the seismic design of the plant stack, torus, ring header and its supports. The seismic design of these features were completely omitted from the FSAR.