Nebraska Public Power District
Nebraska's Energy Leader

NLS2000035
March 24, 2000

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

Subject: Design Basis Accident Radiological Assessment Calculational Methodology - Response to Request For Additional Information (Question #6) Cooper Nuclear Station, NRC Docket No. 50-298, DPR-46

References:
1. Letter to U.S. Nuclear Regulatory Commission (NLS990122) from John H. Swailes (Nebraska Public Power District) dated December 22, 1999, Design Basis Accident Radiological Assessment Calculational Methodology Revision.
2. Letter to Mr. J. H. Swailes (Nebraska Public Power District) from Lawrence J. Burkhart [signed by Robert A. Gramm] (U.S. Nuclear Regulatory Commission) dated March 6, 2000, Cooper Nuclear Station - Request for Additional Information (TAC No. MA7758).
3. Letter to U.S. Nuclear Regulatory Commission (NLS2000029) from John H. Swailes (Nebraska Public Power District) dated March 20, 2000, Design Basis Accident Radiological Assessment Calculational Methodology - Response to Request for Additional Information.

By letter dated December 22, 1999 (Reference 1), the Nebraska Public Power District (District) submitted revised design basis accident radiological assessment calculational methodology for Nuclear Regulatory Commission (NRC) review and approval. In Reference 2, the NRC provided a request for additional information (RAI) to the District. The District's response to those RAIs was submitted in a letter dated March 20, 2000 (Reference 3).

In Reference 3, the District committed to perform additional evaluations in response to RAI Question 6. Question 6 requests justification for crediting iodine removal in the main turbine condenser. While the District believes that crediting iodine removal in the existing main turbine condenser design is already a part of the Cooper Nuclear Station (CNS) licensing basis for radiological assessment calculation accident mitigation, the District committed to provide a description of the structural robustness of the existing main steam line piping from the main steam isolation valves (MSIVs) to the main turbine condenser and the main turbine condenser.

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Attachment 1 provides this evaluation, which describes the structural robustness of the existing main turbine condenser and the main steam line piping from the MSIVs to the main turbine condenser.

The District also performed a probabilistic safety assessment to evaluate the probability of Loss Of Coolant Accident (LOCA) events that could result in core damage concurrent with seismic spectra above the operating basis earthquake (OBE) but less than safe shutdown earthquake (SSE). The seismic event was also evaluated to occur up to 30 days following the LOCA. The assessment results show that probability is much less than 10E-07 (e.g., on the order of 10E-11), which is below the Regulatory Guide 1.174 screening criteria.

In addition, Reference 3 indicated the District would provide a proposed license condition addressing when additional information will be provided to the NRC regarding the ability of the main steam line piping from the MSIVs to the main turbine condenser, and the main turbine condenser, to remain functional during and after a SSE. Based on discussions with the NRC Staff, there are two milestones to be considered. First, the District will provide a submittal for NRC approval outlining the methodology and proposed modifications necessary to assure the ability of the main steam line piping from the MSIVs to the main turbine condenser, and the main turbine condenser, to remain functional during and after a SSE. Second, the District will complete the necessary modifications on a schedule acceptable to the NRC Staff.

Currently CNS is in a refueling outage (RFO19) and is performing the walkdowns necessary to input into the detailed evaluations. As the District begins to develop the methodology, consider the results of the walkdowns, and evaluate modifications that may be suggested by these activities, additional walkdowns and ensuing evaluations may be necessary. Based on personnel safety and dose considerations, certain areas cannot be walked down while at power. To accommodate the potential for additional walkdowns during RFO20, the District proposes submitting the methodology and proposed modifications no later than 8 weeks after CNS Cycle 21 startup. This will also allow final preparation and planning for any necessary modifications to be completed during RFO21.

Based on the above, the District proposes the following License Condition:

> No later than eight weeks after the Cooper Nuclear Station (CNS) Cycle 21 startup, the licensee shall submit to the NRC a request for the staff to review and approve a seismic evaluation of the main steam line piping from the main steam isolation valves (MSIV) to the main turbine condenser, the main turbine condenser, and the turbine building. The evaluation will be performed to assess the ability of the main steam piping and main turbine condenser to remain sufficiently intact to direct main steam leakage from the MSIV to the main condenser, consistent with the leakage assumptions in the design basis accident dose calculations during and after a Safe Shutdown Earthquake. This seismic evaluation will employ an analytical methodology acceptable to the staff and will identify any modifications necessary to support the evaluation. The licensee's request, upon approval, shall be fully implemented, including the completion of modifications, prior to CNS Cycle 22 startup.

Should you have any questions concerning this matter, please contact Sharon Mahler at (402) 825-5236.

Sincerely,

John H. Swailes
Vice President of Nuclear Energy

/dw

Attachment

cc: Regional Administrator w/attachment
USNRC - Region IV

Senior Project Manager w/attachment
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector w/attachment
USNRC

NPG Distribution w/o attachment

Summary of Seismic and Structural Design of the Condenser, MSIV Leakage Path to the Condenser, and Turbine Building

I. INTRODUCTION

Reference 2, Question 6 requests justification for crediting iodine plateout on the condenser. (In justifying the iodine plateout on the condenser, the leakage pathway (piping) from the Main Steam Isolation Valves (MSIVs) to the condenser must also be addressed.) This attachment provides a summary of the seismic and structural design of the condenser, the MSIV leakage pathway (piping) to the condenser, and Turbine Building structure. This information confirms the robustness of the current design with respect to remaining structurally intact and not suffering gross structural failure following expected events. Eighteen drawings are included in this Attachment for reference purposes.

II. BACKGROUND

A. CNS Seismic Design Criteria

CNS seismic design criteria are summarized as follows:

Seismic Category	Seismic Acceleration and Stress Acceptance Criterion
Class II - Uniform Building Code (UBC)	0.1g base shear, 1/3 increase in allowable stress, no vertical seismic load
Class I - Operating Basis Earthquake (OBE)	0.1g ground input acceleration, no 1/3 increase in allowable stress, 2/3 ground acceleration for vertical seismic load
Class I - Safe Shutdown Earthquake (SSE)	0.2g ground input acceleration, increase in allowable stress (e.g., 0.9 F_y for steel), 2/3 ground acceleration for vertical seismic load

CNS Updated Safety Analysis Report (USAR) Section I-6.1.1.8 states:

> "The station seismic design criteria for Class I structures and equipment, important to safety, are based on dynamic analyses using acceleration or velocity response spectrum curves which are based on a ground horizontal acceleration of 10% of gravity [OBE]. As an additional requirement, the design is such that a safe shutdown of the station can be made based on a ground acceleration of 20% of gravity [SSE]."

B. Comparison of Seismic Loads (Class II versus Class I)

Utilizing the response spectra of the Class I Control Building and Reactor Building a comparison between Class I and Class II systems, structures and components (SSCs) seismic loads can be made. For the OBE load case, the lateral (horizontal) seismic design loads of nearly rigid (natural frequency > 10 Hz) Class II SSCs at elevations below 40 ft above grade is approximately 1/3 (0.1g compared to 0.3g) of the lateral seismic design loads for nearly rigid Class I SSCs. Similarly for the SSE comparison, the lateral seismic loads for nearly rigid Class II SSCs is approximately 1/5 (0.1g compared to 0.5g) of the lateral seismic loads for nearly rigid Class I SSCs.

The design of SSCs uses structural acceptance criteria typically associated with allowable stresses (% of yield). For ductile steel, initial plastic deformation (stresses beyond yield) would not result in structural failure and substantial margin exists between initial plastic deformation and rupture. Therefore, there is inherent conservatism in the design, relative to remaining structurally intact and not suffering gross structural failure following postulated seismic events.

C. SSCs Pertinent to Reference 2, Question 6

During normal power operation, steam from the reactor pressure vessel (RPV) flows through the Main Steam system piping and eventually to the condenser. Primary portions of this piping are located in the Reactor Building steam tunnel and the Turbine Building. The MSIVs, located on the Main Steam lines, would close following a postulated Loss of Coolant Accident (LOCA). However, there may be leakage past the MSIVs that would be carried to the condenser. The applicable SSCs to be considered are those necessary to ensure the structural and pressure boundary integrity of the MSIV leakage pathway to the condenser. The Main Steam system piping from the RPV to the structural anchors downstream of the outboard MSIVs are seismic Class IS and, as such, require no further discussion.

D. General Plant Characteristics

Drawings 1 through 5 show the general layout of the Turbine Building.

Turbine Building top of base mat elevation is at 877'-6"
Turbine Building basement elevation is at 882'-6"
Turbine Building floor elevation at grade is at 903'-6"
Turbine Building Mezzanine elevation is at 909'-6
Turbine Building Operating Floor elevation is at 932'-6"

III. TURBINE BUILDING

The Turbine Building houses the condenser and a majority of the primary MSIV leakage pathway (piping) from the MSIVs to the condenser (as described above, some of the piping is located in the Class I Reactor Building steam tunnel, etc.). The overall dimensions of the Turbine Building are approximately 324' x 144'. The Turbine Building base mat is reinforced concrete. The Turbine Building is a reinforced concrete structure up to the operating floor. Structural steel framing (superstructure) rises above the operating floor. The building is enclosed with insulated metal siding and roofing. The interior walls of the Turbine Building are reinforced concrete with concrete block enclosing smaller areas. The turbine pedestal is a massive reinforced concrete structure supported by the same foundation mat as the building. Concrete shield walls surround the turbine-generator. The Turbine Building was designed to the requirements for Class II SSCs, including 100 mph wind loadings and 0.1g UBC seismic loadings.

The Turbine Building superstructure above the operating floor (932-6") was evaluated as part of the District's Individual Plant Examination for External Events (IPEEE). The District's IPEEE report concluded that the Turbine Building superstructure was screened for a 0.3g Review Level Earthquake (RLE). This report indicates that the seismic load computed using UBC criteria is well exceeded in the transverse direction by the wind shear load. Therefore, the District has reasonable assurance that the main Turbine Building superstructure will remain intact following an SSE (0.2g ground input acceleration) without gross structural failure.

In addition, the District has performed an evaluation of the Turbine Building concrete structure to confirm that this structure is capable of remaining structurally intact without gross structural failure following a postulated SSE. Samples of key Turbine Building substructures (e.g., walls, floor slabs, and columns) were evaluated for increased seismic loading resulting from a postulated SSE. The horizontal seismic acceleration input to the operating floor of the Turbine Building at elevation 932'-6" due to the Turbine Building response was assumed to be 0.30g based on a comparison with Class I structures (Reactor Building and Control Building). The evaluations show that the increase in design loadings from the original seismic Class II criteria to the postulated SSE condition do not result in stresses that exceed the allowable limits applicable to the SSE load case. Therefore, this evaluation concludes that there is sufficient margin in the original design to ensure that the concrete portion of the Turbine Building structure will remain intact during and following the SSE. These results are based primarily on the fact that allowable stresses are permitted to be increased for the SSE load case and, consequently, the increase in seismic loading is offset by the increase in allowable stresses.

The District has reasonable assurance that the Turbine Building structure will remain structurally intact following an SSE without gross structural failure.

IV. CONDENSER

The main condenser is a twin-shell, horizontal tube unit, cooled by river water. There are two shell units of the condenser. The condenser shell units are massive structures, with 7/8-inch thick steel shell walls, that contain substantial internal bracing and are seismically rugged. The condenser is located beneath the low pressure cylinders of the main turbine. To accommodate thermal expansion, a rubber belt expansion joint is provided for each condenser neck.

Each of the two shell units of the condenser are approximately 40' x 30' x 48' high. The base of each condenser shell unit is rigidly mounted to the reinforced concrete Turbine Building base mat which is 26 feet below grade. The top of each unit is located approximately 22 feet above grade elevation. These units are self-supporting structures that do not require any external support from the Turbine Building structure at any point other than the base anchorage. The base anchorage includes bolts for tension restraint, a centrally located seismic shear key, and a thrust anchor for resisting operating loads. Typical condenser shell unit anchorage details are shown on Drawings 6 and 18. The two shell units are interconnected by a large, rounded edge, rectangular-shaped, steel passageway approximately 8' long with cross-sectional dimensions of 14'-6" x 9'-6". This interconnection was originally field welded to the condenser shells. The approximate mass center of the condenser tube sheets is at elevation 895'-6" (approximately 18' above the top of the Turbine Building base mat).

The District has performed a calculation to evaluate the seismic capability of the condenser anchorage for postulated SSE loading. The center of gravity (CG) of one condenser shell unit was determined to be located approximately at elevation 896'-3" (approximately 18'-8" above the top of the anchor bolt plate) in the full "wet" operating condition. The calculation determined that seismic loading up to approximately 0.6g horizontal acceleration can be postulated before any tension in the four perimeter anchorage details of a condenser shell unit, which are designed as tension anchor points, will be loaded in tension from a postulated seismic event assuming no vacuum in the condenser. Under full operational loading including vacuum in the condenser, the calculation determined that the anchorage is sufficient for the maximum expected horizontal acceleration of 0.21g for the postulated SSE. In addition, the calculation determined that the seismic anchor in the center of each condenser shell unit is capable of resisting a horizontal acceleration up to approximately 1g when using stress allowables for the SSE load case assuming no vacuum in the condenser. Therefore, the calculation concludes that the existing tension and shear anchorage details for the condenser shell units are adequate to ensure the condenser units will remain structurally intact for postulated SSE loading.

The condenser is a seismic Class II structure/component that was originally designed for lateral seismic forces resulting from a horizontal base shear of 0.1g (UBC provisions) in combination with design operating loads (e.g., shell design pressures of 20 psig and 30" Hg vacuum). Vertical seismic loading was not included in the original design; however, the previously mentioned calculation has concluded that the vertical seismic acceleration for a postulated SSE would not have a substantial effect on the condenser shell unit anchorage.

The District has reasonable assurance that the condenser will remain structurally intact following a postulated SSE.

V. MSIV LEAKAGE PATHWAY (PIPING) TO THE CONDENSER

Piping in the Turbine Building is designed and installed to the USAS B31.1 "Power Piping" Code (1967). Per the Code, the piping is analyzed for pressure, deadweight, and thermal loads. The piping is classified as Seismic Class IIS, corresponding to a seismic category Class II. In addition to the pressure and deadweight load cases, the piping is supported/restrained to withstand seismic horizontal forces equal to 0.10 times the operating dead load of the piping.

The Main Steam piping system downstream of the MSIV's (beginning at the Steam Tunnel Anchor), including the Main Steam piping from the turbine bypass valve to the condensers, is designed and supported/restrained to seismic Class IIS requirements. In addition to the seismic Class IIS requirements, this piping system is analyzed for dynamic loading (steam hammer) associated with a turbine stop valve closure event and for fatigue associated with normal system vibration. The results of the analyses show that the resultant pipe stresses for all load cases considered are less than the applicable Code (B31.1) allowable stress limits. The District has also performed a preliminary dynamic analysis of this primary pathway from the MSIVs to the condenser which has demonstrated that this piping and its associated pipe supports will remain within operability limits under postulated SSE loading. The District used its standard pipe stress analysis computer program (ADLPIPE) to evaluate the piping. ADLPIPE is a digital computer program used for safety-related analyses of complex piping/structural systems at CNS.

The dynamic analysis shows that under postulated SSE loading the maximum calculated stress in the system (approximately 28,000 psi) is less than the operability limit of 36,000 psi (2.4S_h or 2.4 x 15,000 psi). Amplified floor response spectra do not exist for the Turbine Building; therefore, horizontal seismic loads were computed using the ground response spectra multiplied by 1.5 with 5% damping. This methodology was selected based on the Safety Evaluation Report for Monticello's power uprate program dated September 16, 1998. Vertical seismic acceleration was also applied in accordance with standard CNS requirements for seismic Class IS piping analyses. The operability limit is per the recommendations of Generic Letter 91-18. Support loads were reviewed and found to be similar in magnitude to those produced by the steam hammer event mentioned above. The system has previously experienced the steam hammer event and did not sustain any damage. This would indicate that the supports would also remain operable under SSE loading. Additionally, supports with higher loads were examined and found to be operable by engineering judgement.

Furthermore, as stated in NEDC-31858P-A, Volume 2, "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control Systems", "The BWROG seismic experience study has concluded that possibility of significant failure in GE BWR main steam piping or condensers is highly unlikely and that any such failure also would be contrary to a large body of historical earthquake experience data, and thus unprecedented."

VI. STRUCTURAL INTEGRITY VERIFICATION

The SSCs discussed in this attachment are periodically inspected for a variety of reasons. For example, the Turbine Building structure and piping and equipment supports within the Turbine Building are subject to periodic structural inspections in support of Maintenance Rule activities. The last structural Maintenance Rule inspection walkdowns were performed in 1996 and are scheduled on a five year cycle. The NRC has previously inspected the CNS structural Maintenance Rule program and subsequently published NUREG-1522, "Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures" which discusses the CNS program. Furthermore, the Main Steam piping system is inspected each cycle to potentially identify any deficiencies with pipe supports.

The District is also conducting structural integrity walkdowns of the condenser, main steam piping systems, and the Turbine Building structure during Refueling Outage 19 to confirm that no obvious gross structural inadequacies currently exist on these SSCs. (It should be noted that no equipment will be disassembled for these walkdowns.)

The District plans to expand the scope of the Maintenance Rule structural inspections to include the subject SSCs as determined to be appropriate by the CNS Maintenance Rule program.

VII. LIST OF SUBMITTED DOCUMENTS

Burns and Roe Drawings

1. 2050, Rev. N06
2. 2051, Rev. N16
3. 2052, Rev. N14
4. 2053, Rev. 9
5. 2054, Rev. 10
6. 4052, Sheet 3, Rev. 5
7. 4053, Sheet 1, Rev. 18
8. 4055, Sheet 1, Rev. 7
9. 4056, Sheet 2, Rev. 13

Maryland Shipbuilding and Drydock Co. Drawings

10. EC93877GA, Sheet 1, Rev. N02
11. EC93877GA, Sheet 2, Rev. M
12. EC93877SP-1B, Rev. F
13. EC93877SP-1A, Rev. N01
14. EC93877S1, Sheet 1, Rev. N01
15. EC93877S1, Sheet 2, Rev. B
16. EC93877S2, Sheet 1, Rev. B
17. EC93877S3, Sheet 1, Rev. 0
18. DC93877GA, Sheet 4, Rev. F

Correspondence No: NLS2000035

The following table identifies those actions committed to by the District in this document. Any other actions discussed in the submittal represent intended or planned actions by the District. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the NL&S Manager at Cooper Nuclear Station of any questions regarding this document or any associated regulatory commitments.

COMMITMENT	COMMITTED DATE OR OUTAGE
1. Expand the scope of Maintenance Rule inspections to include SSCs (identified in NLS2000035 Attachment 1) as determined to be appropriate by the CNS Maintenance Rule program.	N/A

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