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Mr. D. M. Musolf, Manager
Nuclear Support Services
Northern States Power Company
414 Nicollet Mall
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Dear Mr. Musolf:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION - NSPNAD-8608 AND NSPNAD-8609

During the course of the staff's review of your topical reports NSPNAD-8608, (Rev.0), "Reload Safety Evaluation Methods for Application to the Monticello Nuclear Generating Plant," and NSPNAD-8609, (Rev. 0), "Qualification of Reactor Physics Methods," the need for additional information has been identified.

To allow the staff to complete its review in a timely manner, please provide the additional information requested in the enclosure to this letter by September 14, 1987.

Should you have any questions regarding this request, please contact me at (301) 492-8146.

The information requested in this letter affects fewer than 10 respondents; therefore, OMB clearance is not required under Pub. L. 96-511.

Sincerely,

/s/

Dino C. Scaletti, Project Manager
Project Directorate III-3
Division of Reactor Projects

Enclosure:
As stated

cc: See next page

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Monticello Nuclear Generating Plant

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REQUEST FOR ADDITIONAL INFORMATION

Topical Report Title: Reload Safety Evaluation Methods for Application to the Monticello Nuclear Generating Plant

Topical Report Number: NSPNAD-8608 (Revision 0)

Topical Report Date: September 1986

1. Does the DYNODE-B fuel rod gap heat transfer coefficient account for exposure and fuel temperature dependence and, if not, what error does this simplification introduce?

2. What direct moderator heating fraction is used and is this value conservative for the transients to be analyzed (Table 4.1-1, MSIV closure, etc.)?

3. Comparisons have been presented for the DYNODE-B and the Nuclear Data Handling (NDH) System prediction of control rod worth and void reactivity. How do DYNODE-B and NDH compare with respect to Doppler reactivity?

4. In the DYNODE-B/REDY comparisons, what REDY input was unknown and how was it determined? Was this input data adjusted to improve the DYNODE-B/REDY comparisons?

5. The reduction in voids in the top of the core is expected to affect the axial albedo for the upper reflector. Has this effect been accounted for and, if not, what is the effect of this simplification on the DYNODE-B predictions?

6. Are any codes that have not been approved by the NRC being used to provide input to DYNODE-B?

7. The recirculation loop modeling for both REDY and ODYN has been verified by comparison to recirculation pump trip tests. Has similar qualification been performed for DYNODE-B?

8. What is the direction of conservatism for each input parameter, for which a conservative uncertainty allowance will be included, for the transients to be analyzed (Table 4.1-1,, MSIV closure, etc.)?

9. Are the void model in DYNODE-B and NDH identical? Are the values for the void concentration parameter, C_0, and drift velocity, V_{gj}, used in the NDH calculations the same as used in DYNODE-B? If not, what is the effect of this inconsistency on the k_∞ and M^2 calculated by DYNODE-B and on the DYNODE-B results?

10. List all significant code and modeling differences between DYNODE-B, and REDY and ODYN and provide estimates of the effect of these differences on the DYNODE-B predictions when it cannot be demonstrated that the differences provide improved modeling or more conservative results.

11. Reference-7 recommends the mechanistic rather than the Profile-Fit void model for transient applications. Since DYNODE-B allows both the mechanistic and Profile-Fit void model, what is the basis for the selection of the Profile-Fit model?

12. The DYNODE-B definition of the volumetric flow fraction, β, the concentration parameter, C_O, and the drift velocity, V_{gj}, involve arbitrary constants (viz., C_{00}, C_{01}, b_1, β_1, V_{gj1}, V_{gj2}). How are these constants determined and what uncertainty is introduced into the DYNODE-B calculations by the selection of these constants? Also, the definition of β in DYNODE-B appears to be in error.

13. Describe in detail the core thermal-hydraulic model used to determine the axial pressure, void, flow and enthalpy distributions. Have the resulting equations been tested for numerical stability?

14. In the calculation of steam dome pressure, what uncertainty is introduced by the use of the "steam-dome pressure model" rather than the "non-equilibrium steam-dome pressure model?"

15. In the static flow distribution calculation, how is the bypass flow fraction determined and does it vary during the transient?

16. How are the feedwater flow, recirculation flow, power level, turbine bypass and stop valve controller lead-lag, lag and controller constants determined and do they change for each cycle?

17. The flux, ϕ, rather than the source, $S=\nu\Sigma_f\phi$, satisfies the standard time-dependent diffusion equation. Has the additional term $\phi\partial_t(\nu\Sigma_f)$ been accounted for in the DYNODE-B source equations and, if not, what error is introduced by this approximation?

18. What is the mechanism responsible for the underprediction of the scram curves (Figure 3.1-4) and can this result in a non-conservative overprediction for other static and transient states?

19. How do the DYNODE-B and ODYN peak powers in the load rejection, feedwater controller failure and MSIV closure transients of Figures 3.2-93, 3.2-100 and 3.2-107, respectively, compare? Are these differences due to DYNODE-B and ODYN modeling differences and, if so, why should they not be considered as a measure of the uncertainty in performing transient analyses of Monticello reloads?

20. Describe how DYNODE-B is used in the calculation of the fuel misloading error and how the reactivity input is determined. How are radial redistribution effects accounted for?

21. In the application of DYNODE-B to the control rod withdrawal event, what error is introduced by not including the radial flux distribution changes explicitly in the calculation? Does the non-equilibrium model include the time dependent mass and energy balance for the (1) riser and dome steam (2) riser liquid (3) dome liquid and (4) the entrapped steam. If not, what error is introduced by this approximation?

22. Explain any differences between the Table 4.2-1 initial conditions and input parameters and the corresponding values and conditions assumed in the ODYN analyses. What effect do these differences have on the DYNODE-B predictions of ΔCPR, peak pressure and decay ratio for the transients to be analyzed?

23. How are the uncertainties in the bundle power and relative inlet flow due to differences in the static and transient radial power and flow distributions accounted for in the determination of ΔCPR?

24 What range of operating state variables, including power level, flow, inlet subcooling, control rod pattern and exposure, were used to determine the collapsing factor (AF)? Demonstrate that this set of states is sufficient in view of the wide range of intended applications (Table 4.1-1, MSIV closure, etc.). What is the Doppler reactivity collapsing factor (AF) and how is this uncertainty accounted for?

25. Describe in detail the method used to determine the DYNODE-B equivalent one-dimensional k_∞, M^2, g_v and albedos from the three-dimensional NDH solutions. Describe the perturbed states used in this determination in terms of core power, flow, inlet subcooling, pressure and exposure. Demonstrate that these selected perturbed states provide an adequate representation of the transient states encountered in the events to be analyzed (Table 4.1-1, MSIV closure, etc.).How are the k_∞, M^2, g_v and albedos determined for the control rod insertion/withdrawal events?

26. The ODYN model has had difficulty in predicting core inlet flow oscillations above 5 Hz. If DYNODE-B will be required to analyze oscillations above this frequency, demonstrate that DYNODE-B does not have the same difficulty.

27. The qualification data base provided to demonstrate the accuracy of the DYNODE-B code (e.g., Tables 4.4-1, 4.4-2 and 4.4-3) is insufficient in the number and quality of the comparisons to allow a reliable estimate of the code uncertainty. For example, the Peach Bottom turbine trip calculations were normalized to insure that DYNODE-B reproduced the measured peak and integrated power, and the comparison for the Monticello turbine trip startup test includes a large (-300%) DYNODE-B/measurement transient power discrepancy. A detailed code uncertainty analysis is therefore required to insure there is sufficient margin to the thermal-hydrulic design basis and the reactor coolant pressure boundary limit.

Provide a listing of the important sources of uncertainty in the DYNODE-B predictions required for the intended reload analyses. Consideration should be given to factors such as: void coefficient, controller set-points, jet pump loss coefficients, scram reactivity, void model, separator model, steam line model, neutronics collapsing, etc. Estimate the 95% probability limits for these uncertainties, and determine the corresponding ΔCPR/ICPR for each uncertainty for the turbine trip without bypass transient. Determine the corresponding Δ-pressure (%) for each of these uncertainties for the MSIV closure event with position switch scram failure. Also, provide an estimate of the corresponding uncertainty in the calculated decay ratio.

28. What mesh is used in the MOC representation of the steam line and does this satisfy the stability criteria? The steam line flow in Figure 3.2-96 does not exhibit the same behavior as the ODYN prediction. What is causing this difference?

29. How does the DYNODE-B decay heat precursors model compare with more recent revisions of this standard (e.g., the ANS standard of September, 1978)?

REQUEST FOR ADDITIONAL INFORMATION

QUESTIONS ON THE NSP REACTOR PHYSICS METHODS QUALIFICATION
NSPNAD-8609

1. In order to eliminate selected TIP readings from the statistical analysis, it should be demonstrated that the eliminated TIP signals are erroneous and are not, in fact, a result of differences between the design model and the as-built core. What is the increase in the reliability factors for MCPR, LHGR and APLHGR when no TIP signals are eliminated?

2. Describe in detail how the value $\%\Delta k/\%\Delta V = .0077$ is determined from the data in Table 3.3.1.

3. Provide quantitative justification (using results from references 5-8 if appropriate) that the 95/95 upper tolerance limit on the Doppler coefficient is $RF_{DOP} = .10$.

4. The NDH model has been normalized to the Monticello cycles 7 through 10 measurement data and, consequently, the reliability factors determined from the cycle 7-10 calculation/measurement differences are smaller than those for a cycle to which NDH has not been normalized. What increase in the reliability factors is expected for future cycles and how is this accounted for?

5. In view of the differences between the PWR and BWR measurement systems and the source of the measurement system errors, demonstrate that the factor of three reduction in the number of measurements is adequate to account for the lack of independence of the Monticello measurement errors.

6. In the calcul ion of both the void coefficient and control rod worth reliability factors, the error in the void and control rod reactivity defects, $\delta\Delta k$, is assumed to be the same as the error in the statepoint k_{eff}, δk_{eff}. In fact, in the determination of the reactivity defect, $\Delta k = k_{eff,2} - k_{eff,1}$, the statepoint error, δk_{eff}, to a good approximation "subtracts out" and the reactivity defect error, $\delta\Delta k$, is independent of the statepoint error, δk_{eff}. Therefore, provide a calculation of the void coefficient and control rod worth reliability factors based on the error in predicting the void and control rod reactivity differences.

7. Based on the comparisons of Table 3.6.3 and Figure 3.6.44 it is concluded that all γ-scan measurement data was not included in the power distribution comparisons. On what basis was the measured data discarded and what effect does this data selection have on the reliability factors?

8. Are the generic normalization factors based on data from cycles 7 through-10? Are these factors intended for use in all future cycles of Monticello? What core parameters affect these normalization factors? How are these factors affected by operating history?

9. Describe the method used to generate the radial albedos and leakage factors. How is void dependence in the radial albedos determined? Are these albedos updated for each cycle? How sensitive are the albedos to exposure, rod pattern, temperature and core loading?

10. Describe the procedure used to derive the correction factor for a bundle moved from a peripheral to a central location. How sensitive is this correction factor to exposure, rod pattern, temperature and core loading?

11. Describe the spectrum correction factor used to correct for the extrapolated flux.

12. How are incore detector signals calculated? Specifically, indicate how the contributions from each of four dissimilar uncontrolled/controlled assemblies are derived, indicating the parameter dependence.

13. Do any of the few-rod criticals listed in Table 3.1.1 include the withdrawal of the highest worth (strongest) rod at the time the critical was measured? If not, how would this withdrawal effect the results of the measurement/calculation comparisons?

14. How are uncertainties in the fuel pin temperature associated with power changes accounted for in the Doppler reliability factor? Similarly, how are uncertainties resulting from differences between the as-built and assumed dimensions and/or materials and fuel densification treated?

15. What effect do the differences (e.g., cross sections) between the initial version of CASMO used in the Kritz benchmarking and the more recent version used by NSP (CASMO-II) have on the reliability factors?

16. Are control rod history effects accounted for in the NDH calculations and, if not, how are the uncertainties introduced by this simplification accounted for?

17. Has the effect of excluding from consideration 8 of the 48 axial values of the instrument signals been evaluated? What is the increase in the uncertainty and, correspondingly, what is the additional allowance by which the power distribution reliability factor must be increased when this data is not excluded?

18. If NSP selects the option to provide its own support for the process computer and generates its own data for this system, how will the change in uncertainty be accounted for in the safety limit?

19. Describe the fuel loadings for the cycles 7 through 10 cores which are included in the verification process of the NDH code. Provide information on fuel types, U^{235} - enrichment, gadolinia, water rods, etc. Are the fuel loadings of cycles 7 through 10 representative of cycle 14 and future cycles?