June 17, 2003

Mr. R. T. Ridenoure
Division Manager - Nuclear Operations
Omaha Public Power District
Fort Calhoun Station FC-2-4 Adm.
P.O. Box 550
Fort Calhoun, NE 68023-0550

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION – FORT CALHOUN STATION USE OF THE GOTHIC (VERSION 7.0) COMPUTER PROGRAM (TAC NO. MB7496)

Dear Mr. Ridenoure:

By letter dated January 27, 2003, Omaha Public Power District requested an amendment to update the Updated Safety Analysis Report to use the GOTHIC (Version 7.0) computer program for performing containment pressure analyses. The staff has reviewed the submittal and determined that additional information is needed to complete our review. A request for additional information is enclosed. This request was discussed with Richard Jaworski of your staff on May 21, 2003, and it was agreed that a response would be provided by July 31, 2003.

If you have any questions, please contact me at (301) 415-1445.

Sincerely,

/RA/

Alan B. Wang, Project Manager, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-285

Enclosure: Request for Additional Information

cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION
CONTAINMENT PRESSURE ANALYSIS USING THE GOTHIC COMPUTER PROGRAM
OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION, UNIT 1
DOCKET NO. 50-285

By letter dated January 27, 2003, Omaha Public Power District (OPPD/the licensee) proposed to use the GOTHIC (Version 7.0) computer program to perform containment design basis accident (DBA) analyses for the Fort Calhoun Station (FCS) as a replacement for the currently approved CONTRANS computer program (CENPD-140-A). OPPD has also requested the use of CEFLASH-A4 to determine the loss-of-coolant accident (LOCA) mass and energy releases, and the use of SGN-III to determine the main steam line break (MSLB) mass and energy releases. These mass and energy releases are input data for GOTHIC. CONTRANS documentation indicates that separate codes were used to generate the LOCA mass and energy releases for the blowdown, reflood and post-reflood periods. The LOCA mass and energy releases, after the post-reflood period, were calculated within CONTRANS. Both CEFLASH-4A and SGN-III have been previously accepted by the staff for this purpose.

Since the GOTHIC analyses are typically characterized as a "best estimate," it is important to identify those modeling and analysis assumptions used for DBA evaluations to ensure that the calculation includes an adequate level of conservatism in demonstrating safety margins.

The staff requests the following information to complete its review of the proposed change.

1. Describe the CEFLASH-4A calculation used to develop the mass and energies for the design basis LOCA. Use Standard Review Plan (SRP) Section 6.2.1.3, "Mass and Energy Release Analysis for Postulated Loss -of -Coolant," as a reference. Where a selected value is maintained as described in CONTRANS, for example, no consideration given to a conservative value, indicate this as being part of the current analysis of record (AOR). Include the assumptions used to analyze the core energy release for maximum containment pressure for the following (Table 5 in the CENPD-140-A provides sample reference data, but does not describe the method used to determine these values):

   - maximum expected operating temperature
   - allowance in initial temperature to account for instrument error and dead band
   - margin in reactor coolant system (RCS) volume
   - allowance in volume for thermal expansion
   - power level
   - allowance for calorimetric error
   - methods which ensure that RCS metal and steam generator stored energies are released at a conservatively high rate
   - allowance in core stored energy for effect of fuel densification
   - margin in core stored energy
   - allowance in initial pressure to account for instrument error and dead band
   - margin in steam generator mass inventory
   - amount of the Zirconium around the fuel is assumed to react
   - safety system failures
   - break spectrum (break size and location - as noted in Section 5.1.1.5.1 of Attachment 1 of the licensee's January 27, 2003, submittal)

2. Describe the methodology to be used to obtain the LOCA mass and energy releases after the post-reflood period, which were previously calculated within CONTRANS.

3. Describe the SGN-III calculation used to develop the mass and energies for the design basis MSLB. Use SRP Section 6.2.1.4, "Mass and Energy Release Analysis for Postulated Secondary System Pipe Ruptures," as a reference. Where a selected value is maintained as described in CONTRANS, for example, no consideration given to a conservative value, indicate this as being part of the current AOR. Include the assumptions used to analyze the core energy release for maximum containment pressure for the following:

   - The major factors that influence the release of mass and energy following a steamline break:

     (1) steam generator fluid inventory
     (2) primary-to-secondary heat transfer
     (3) protective system operation
     (4) the state of the secondary fluid blowdown

   - The plant variables that have a significant influence on the mass and energy releases:

     (1) plant power level
     (2) main feedwater system design
     (3) startup feedwater system design
     (4) postulated break type, size, and location
     (5) availability of offsite power
     (6) safety system failures
     (7) steam generator reverse heat transfer and RCS metal heat capacity

4. On page 9 of Attachment 1, Section 5.1.1.3.2.2.3, the containment spray delay time for the LOCA evaluation model was reduced from 133 seconds to 131.1 seconds. How was the revised value determined?

5. From page 11 of Attachment 1, Section 5.1.1.3.2.2.5, describe the modeling approach, and changes to the evaluation models, as appropriate, to be used to perform the post-recirculation actuation signal (RAS) analyses, including the addition of the shutdown cooling (SDC) heat exchanger. Future plant changes (replacement steam generators (RSGs) or power uprates) will require long term LOCA analyses if credit for containment pressure reduction after 24 hours is taken for consequence analyses. The modeling of the sump and its impact on the post-RAS containment spray performance should also be considered.

6. The proposed update to USAR Section 14.16 does not address the long-term LOCA pressure response. Provide a justification for not providing this information. GDC 38 of 10 CFR Part 50, Appendix A includes, in part, a requirement to rapidly reduce the containment pressure and temperature following an accident. FCS Criterion 52 does not include this requirement. The FCS active systems (sprays and fan coolers) perform

this function. The FCS USAR (Section 14.15.8.1) also states that the containment leak rate is 0.1 percent of the free volume for the first 24 hours, and 0.05 percent of the free volume for the remaining duration of the accident. Therefore, the long term LOCA analysis should show a reduction in pressure to 50 percent within 24 hours.

7. From page 12 of Attachment 1, Section 5.1.1.3.4, clarify the statement, "The temperature values used for these materials are arbitrary values." Are the heat transfer properties of these materials expected to be insensitive to temperature over the expected range of temperatures during the accident and therefore, a constant value (at an representative temperature) for heat transfer characterization is appropriate? (See also page 28 of Attachment 1, Section 5.1.2.3.4).

8. In the models, OPPD indicates that radiation heat transfer is considered (Section 5.1.1.3.4.2.1 for LOCA and Section 5.1.2.3.4.2.1 for MSLB). However, the GOTHIC data for radiation heat transfer is not specified (thermal conductor data in Table 2). If OPPD is planning to use radiation heat transfer in the evaluation models, a description of the emissivity factors and their source needs to be provided. The shape factors also need to be provided.

9. On page 26 of Attachment 1, Section 5.1.2.3.2.2.3, the containment spray delay time for the MSLB evaluation model was increased from 94.54 seconds to 104.3 seconds. How was the revised value determined?

10. CONTRANS does not use the COMTEMPT formulation for the Uchida heat transfer correlation. It uses the modified Uchida form which applies to stagnant steam-air mixtures, and has been accepted as a conservative model. GOTHIC uses a data fit to the Uchida data. The comparison of the models is as follows:

Mass ratio (M_{air}/M_{steam}) —	CONTEMPT (Uchida data) (BTU/hr-ft^2-F)	GOTHIC (Data fit) (BTU/hr-ft^2-F)	CONTRANS (Modified Uchida) (BTU/hr-ft^2-F)
0.1	280	500.5	502.0
0.5	140	138.1	102.0
0.8	98	94.8	64.5
1.3	63	64.3	40.5
1.8	46	49.6	29.8
2.3	37	40.7	23.7
3	29	32.9	18.7
4	24	26.2	14.5
5	21	21.9	12.0
7	17	16.7	9.1
10	14	12.6	7.0
14	10	9.6	5.6
18	9	7.9	4.8
20	8	7.2	4.5
50	2	3.5	3.0

In CONTRANS, the modified Uchida model is used for both the LOCA, post-blowdown, and the MSLB. For the LOCA, the CONTRANS decay, or transition, coefficient following the blowdown period is 40 times greater than the coefficient used in GOTHIC with the Uchida model and 20 times greater with the modified Uchida model.

The benchmark studies should be performed with the modified Uchida model for comparison to the CONTRANS results. The comparisons to the evaluation models should then be considered and modified as necessary to describe the differences.

11. The thermal heat conductors do not include input for the characteristic length, and therefore, GOTHIC uses the hydraulic diameter of the cell in which the conductor is located. Therefore, for all thermal conductors the characteristic length is the containment volume hydraulic diameter. The characteristic length is used to determine the Rayleigh number for use in the natural convection heat transfer calculation and in the Reynolds number for the forced convection heat transfer calculation, as well as in the determination of the heat transfer coefficient. Provide a justification for the use of a single characteristic length for all thermal conductors, or modify both the benchmark and evaluation models to properly portray the thermal conductor characteristic lengths. If the thermal conductors are modified, the comparisons to the evaluation models should then be considered and modified as necessary to describe the differences.

12. OPPD proposes to use GOTHIC (Version 7.0) to verify that containment pressure will be maintained below its design pressure of 60 psig at FCS during a LOCA or MSLB and to determine the bounding temperature profile associated with environmental equipment qualifications (EEQ) when OPPD installs its RSGs. GOTHIC will also be used to demonstrate adequate margins of safety during a potential future power uprate at FCS for containment pressure analyses. Describe the model approach and, if applicable, changes to LOCA and MSLB evaluation models necessary to do the EEQ analyses.

13. The staff is limiting its review to the LOCA and MSLB evaluation models described in the license amendment request (LAR), and any additional description of models to be included in future analyses (for example post-RAS, LOCA and EEQ), as identified in questions 5, 11 and 12 above. For example, the staff is not reviewing the jet break up model, the mist/diffusion layer model or models associated with multi-node representations of the containment which would include critical flow models. If there are other models not addressed in the LAR or in response to this request for additional information, OPPD should identify them for consideration in the staff's evaluation.

14. OPPD should consider augmenting Section 14.16 of the USAR to include additional details related to describing the assumptions used in the CEFLASH-4A (Section 14.16.4) and SGN-III (Section 14.16.5 — Note: in the LAR, Section 14.16.4 is used twice, once for LOCA then again for MSLB, renumbering should be considered) calculations to facilitate future reviews. OPPD should consider augmenting Section 14.16 to include Figure 5.14 (modified to include the post-RAS features) and Figure 5.25, the GOTHIC LOCA and MSLB evaluation models, to facilitate future reviews.