Omaha Public Power District

444 South 16th Street Mall
Omaha NE 68102-2247

October 17, 2001
LIC-01-0092

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

References:
1. Docket No. 50-285
2. Letter from OPPD (W. G. Gates) to NRC (Document Control Desk) dated February 7, 2001 "Application For Amendment Of Operating License Which Seeks To Amend The Fort Calhoun Station Unit No. 1 Technical Specifications" (FLC-00-07) (LIC-01-0010)
3. Letter from NRC (A. B. Wang) to OPPD (S. K. Gambhir) dated September 14, 2001, "Fort Calhoun Station, Unit No. 1 – Request for Additional Information" (TAC No. MB1221) (NRC-01-085)

SUBJECT: Response to Request for Additional Information

In support of the Reference 2 "Application for Amendment of Facility Operating License No. DPR-40" to update the Fort Calhoun Station radiological consequences analysis, the Omaha Public Power District (OPPD) provides the attached response to the Nuclear Regulatory Commission's Request for Additional Information of Reference 3.

Also, in response to a question raised by the NRC during an OPPD/NRC telephone meeting, regarding the Stone & Webster Analysis of Alternate Source Term, Appendix E of Reference 3 above, in future revisions of the Appendix E Analysis, OPPD will utilize an overall effective decontamination factor for Iodine of 200 unless a change in the value of the overall effective decontamination factor is revised by supplemental regulator guidance.

Please contact me if you have any questions.

Sincerely,

MT Frans

M. T. Frans
Manager
Nuclear Licensing

MTF/RLJ/rlj

A001

Rec'd 01/17/02

Attachment

c: E. W. Merschoff, NRC Regional Administrator, Region IV
A. B. Wang, NRC Project Manager
W. C. Walker, NRC Senior Resident Inspector
Winston & Strawn

Response to Request for Additional Information (RAI)

The Omaha Public Power District provides the following responses to the NRC questions listed in the NRC Letter (Reference 3).

1. *On page 3 of Attachment D to the February 7, 2001 submittal, it was noted that an approach and schedule for resolving Technical Support Center (TSC) dose concerns would be provided by July 31, 2001. Has this information been provided to the staff? If not, when is it scheduled to be provided?*

   Response

   To assure that the emergency response individuals who reside in the TSC prior to the activation of the TSC do not receive a 30-day integrated dose greater than 5 TEDE following a Loss of Coolant Accident, the TSC ventilation system will be manually placed in emergency ventilation mode within 30 minutes upon receipt of a ventilation isolution actuation signal. The TSC emergency ventilation system design ensures TSC pressurization to 1/8 inch of water column (w.c.) to minimize unfiltered inleakage and includes filtered air intake and recirculation. Manual actuation of the air recirculation mode is planned to be implemented by revising the appropriate Emergency Operating Procedures, Abnormal Operating Procedures, and Emergency Plan Implementing Procedures during the amendment implementation period.

   This approach was adopted as a permanent resolution after considering other options involving circuit modifications or the use of portable or permanently installed radiation monitors in the TSC.

   At the time it was recognized that the July 31, 2001 commitment to supply an approach and schedule was inadvertently missed, the NRR Project Manager was notified that the approach would be included in this response to the RAI.

2. *The approach used for establishing FCS containment spray removal coefficients is different from that described in Regulatory Guide 1.183. The Stone and Webster (S&W) SWNAUA code, a variant of the NAUA/MOD4 computer code, was used. While these calculational methodologies have been used in assessing radionuclide transport during severe accidents, the staff has not previously approved this methodology for use with design basis calculations. The staff requests that a full description of the SWNAUA code be provided. In particular:*

   a) *A complete description of the code's aerosol input, e.g., mean (number or mass) value and standard deviation; minimum and maximum aerosol diameter (or radius); number of aerosol size bins; effective density of the aerosol material, and the total mass of the aerosol injected along with its chemical composition.*

b) A description of the steam condensation model; the source (e.g., computer code, hand calculation) of the thermodynamic state of the containment during spray and aerosol injection (e.g., pressure, temperature, and relative humidity); and the effective rate and/or total amount of steam condensed on spray droplets on and aerosol particles.

c) Justification for the single spray droplet radius of 900 micron. Include a discussion of the effect of spray droplet diameter on the aerosol removal.

d) Justification for the assumption of elemental iodine plate out onto the aerosol particles.

e) Please explain the suitability of the mechanistic SWNAUA code (developed to provide best-estimate values for severe accidents) for use in a deterministic design basis accident analysis. Please identify the uncertainty level associated with the spray lambda values.

Response

While the SWNAUA computer code is a derivative of the NAUA/MOD4 computer code, the spray removal model was developed by S&W and included in SWNAUA as a conservative model suitable for Design Basis Accident calculations. (Note that the NAUA/MOD4 code does not include a model for aerosol removal by sprays.)

The NRC staff has previously reviewed the SWNAUA spray model in Combustion Engineering's (CE's) application for design certification of System 80+. In its Safety Evaluation Report, NUREG-1462, the staff said, "The staff performed a comparative analysis of ABB-CE's spray model with its own spray model. The staff used the lower bound spray removal coefficient values in its analysis and found that ABB-CE's model produced spray coefficients which were conservative relative to the staff's values. As a result, the staff finds ABB-CE's spray model proposed for the System 80+ containment design to be acceptable."

a) The aerosol input data for SWNAUA is provided in Table 1.

   The chemical composition of the aerosol is only important as it relates to the density of aerosol utilized in the development of spray lambdas. The chemical composition during the gap release phase is assumed to be predominantly CsOH. The chemical composition during the in-vessel release phase is assumed to be 20 percent CsOH, 20 percent indium, and 60 percent silver. The above-assumed compositions are based on a review of the SASCHA experimental results.

b) The steam condensation rates used by SWNAUA are calculated by the LOCTIC computer code. The LOCTIC code has been used to calculate the conservative design basis accident (DBA) containment pressure and temperature responses on several applications and has been accepted by the Nuclear Regulatory Commission (NRC). LOCTIC pressure and temperature results have been shown to be in close agreement with the NRC's CONTEMPT-LT computer code by confirmatory analyses performed by the staff.

Because LOCTIC predicts a conservatively high containment pressure transient, the rate of steam condensation from the containment atmosphere is minimized. The steam condensation rates that are input to the diffusiophoresis calculation of SWNAUA are calculated as LOCTIC's prediction of the steam removal rate from the containment atmosphere minus the steam condensation rate on the heat sinks. The condensation rates are given in Table 2.

c) The mass mean droplet radius of 900 microns is calculated specifically for the Fort Calhoun Station containment spray system.

Justification for use of a single spray droplet size in the analysis instead of a drop size distribution is based on the ASME paper *Advanced Method for Calculating the Removal of Airborne Particles with Sprays* by Frank A. Elia, Jr. and D. Jeffrey Lischer, 1993, no. 93-WA/SERA-5. While the paper does not specifically analyze the Fort Calhoun Station containment spray system, the parameter sensitivities for the spray model are applicable. The discussion at the end of page 4 demonstrates that the droplet diameter distribution can be represented by a single diameter that is the mass mean diameter. The case 6 droplet distribution is for the Sprayco 1713A nozzle that is frequently used by the nuclear industry for fission product/heat removal spray systems. The paper notes that the mass mean droplet diameter for this nozzle is 1050 microns. This diameter approximates that used in case 1, 1000 microns. The spray flow rate used for both case 1 and case 6 is 10,000 gpm. Table 2 in the paper indicates that the spray removal rates for these two cases are very close.

Also, with reference to the above paper, cases 1 through 3 vary the mass mean droplet diameter from 500 microns to 1500 microns. Table 2 in the paper indicates that for a spray flow of 10,000 gpm, the spray removal coefficient will be reduced by about 67 percent. This variation is expected to be independent of spray flow rate.

d) Studies done as part of Stone & Webster's Advanced Light Water Reactor (ALWR) Source Term Project concluded that at least some of the elemental iodine would deposit on the aerosol particles due to the high quantity of aerosol released. For Fort Calhoun Station, all of the elemental iodine is conservatively assumed to be removed at the same rate as the aerosol particles since the spray removal rate for aerosol is much lower than that for elemental iodine.

e) As discussed above, the spray removal model was developed and implemented into SWNAUA by S&W. NAUA/MOD4 did not contain a spray removal model. The spray model was incorporated into SWNAUA in order to calculate spray removal coefficients for DBA calculations. To this end, the model correlations that were implemented tend to underestimate the spray removal coefficient. The spray model is described in the Section 7.2 of the Fort Calhoun Station Alternate Source Term

Report (Attachment E of Reference 2) and in the above referenced ASME paper. S&W employs only the conservatively developed spray removal model and conservative condensation rates for the diffusiophoresis calculation when performing DBA calculations. While agglomeration was considered in the calculation, its impact on the resulting particulate removal rates was negligible.

In summary, the aerosol removal rates calculated by SWNAUA for Fort Calhoun Station are conservative lower bound estimates.

TABLE 1
DESCRIPTION OF AEROSOL INPUT

Minimum Aerosol Radius	1.0000E-07 cm
Maximum Aerosol Radius	1.0000E-02 cm
Maximum Number of Aerosol Size Bins	100

From 30 seconds to 1830 seconds

Aerosol Injection Rate	6.84000E+00 (g/sec)
Mean Geometric Radius	7.50000E-06 cm
Geometric Standard Deviation	1.560
Aerosol Density	3.700 g/cm^3

From 1830 seconds to 6510 seconds

Aerosol Injection Rate	5.69900E+01 (g/sec)
Mean Geometric Radius	4.00000E-05 cm
Geometric Standard Deviation	1.460
Aerosol Density	4.600 g/cm^3

Notes:

cm = centimeter
g = grams
sec = second

TABLE 2
DESCRIPTION OF THERMODYNAMIC DATA

1. Containment Temperature vs Time

Time (sec)	Temperature (°F)
0.0000E+00	120.00
5.0000E+00	254.40
1.0000E+01	278.60
1.3500E+01	282.40
2.0000E+01	280.70
6.0000E+01	275.10
1.8500E+02	269.20
3.0000E+02	263.40
6.0000E+02	251.80
1.2000E+03	234.80
1.8000E+03	222.50
2.4000E+03	213.60
3.0000E+03	207.10
3.6000E+03	202.50
4.2000E+03	199.20
4.8000E+03	196.90
5.4000E+03	195.20
6.0000E+03	194.10
6.5100E+03	193.40
6.6000E+03	229.60
6.8800E+03	256.40
6.9200E+03	255.80
7.2000E+03	242.10
7.8000E+03	233.90
8.4000E+03	228.70
9.0000E+03	225.20
1.0800E+04	219.70
1.4400E+04	215.70
1.8000E+04	213.20

TABLE 2 (Continued)
DESCRIPTION OF THERMODYNAMIC DATA

2. Containment Pressure vs Time

Time (sec)	Pressure (psia)
0.0000E+00	17.700
5.0000E+00	53.000
1.0000E+01	69.700
1.3500E+01	72.800
2.0000E+01	71.300
6.0000E+01	67.000
1.8500E+02	62.600
3.0000E+02	58.700
6.0000E+02	51.300
1.2000E+03	43.000
1.8000E+03	38.100
2.4000E+03	35.200
3.0000E+03	33.500
3.6000E+03	32.400
4.2000E+03	31.700
4.8000E+03	31.400
5.4000E+03	31.200
6.0000E+03	31.200
6.5100E+03	31.200
6.6000E+03	43.100
6.8800E+03	56.600
6.9200E+03	56.200
7.2000E+03	48.800
7.8000E+03	45.000
8.4000E+03	42.700
9.0000E+03	41.300
1.0800E+04	39.300
1.4400E+04	37.800
1.8000E+04	37.000

TABLE 2 (Continued)
DESCRIPTION OF THERMODYNAMIC DATA

3. Containment Relative Humidity vs Time:

Time (sec)	Relative Humidity
0.0000E+00	0.500
1.0000E-01	1.000
1.8000E+04	1.000

4. Rate of Steam Condensing vs. Time

Time (sec)	Rate (g/sec)
0.0000E+00	0.0000E+00
1.8600E+02	0.0000E+00
2.1000E+02	2.0320E+04
3.6000E+02	1.9197E+04
5.1000E+02	1.8366E+04
7.2000E+02	1.7165E+04
1.0700E+03	1.5659E+04
1.4200E+03	1.4442E+04
1.8200E+03	1.3559E+04
2.5200E+03	8.0854E+03
3.2200E+03	7.1123E+03
4.2200E+03	6.2482E+03
5.2200E+03	5.8114E+03
6.2200E+03	5.6334E+03
6.9200E+03	1.8393E+04
7.1200E+03	1.1764E+04
7.8700E+03	9.2483E+03
8.2200E+03	8.5189E+03
9.2200E+03	7.1834E+03
1.0970E+04	6.2859E+03
1.4470E+04	5.6864E+03
1.8020E+04	5.4863E+03