OPPD
Omaha Public Power District
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October 17, 1996
LIC-96-0151

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

References:
1. Docket No. 50-285
2. Letter from OPPD (W. G. Gates) to NRC (Document Control Desk) dated January 9, 1995 (LIC-94-0258).
3. Letter from NRC (L. R. Wharton) to OPPD (T. L. Patterson) dated July 18, 1996.

Subject: Response to Request for Additional Information (RAI) on Toxic Gas Monitors (TAC No. M91397)

On July 18, 1996, the Omaha Public Power District (OPPD) received the NRC's request for additional information (RAI) related to the request in Reference 2 to delete the Technical Specification requirements for toxic gas monitors at Fort Calhoun Station. Attached please find OPPD's response to this RAI.

If you should have any questions, please contact me.

Sincerely,

T. L. Patterson
Division Manager
Nuclear Operations

TLP/brh

Attachments

c: Winston & Strawn
L. J. Callan, NRC Regional Administrator, Region IV
L. R. Wharton, NRC Project Manager
W. C. Walker, NRC Senior Resident Inspector

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION UNIT NO. 1
NRC REQUEST FOR ADDITIONAL INFORMATION (RAI)
TAC NO. M91397

On January 9, 1995, the Omaha Public Power District (OPPD) submitted an "Application for Amendment of Operating License" which proposed to amend Technical Specifications 2.22 and 3.1 of the Fort Calhoun Station (FCS) Technical Specifications. The submittal detailed an analytical basis for removal of the control room toxic gas monitors from FCS. After subsequent discussions and teleconferences, the NRC transmitted an RAI on July 18, 1996.

The following information provides an introduction of the activities performed to respond to the July 18, 1996 RAI (reanalyses, additional walkdowns, etc.) and lists the questions from the NRC RAI and the associated OPPD response.

Introduction

In order to respond to the NRC RAI, OPPD undertook several reanalyses and walkdowns of the configurations that represent hazards to FCS. As background information, the following is provided.

Review of Potential Hazards to FCS

OPPD has performed offsite hazards studies for the response to post-TMI Item III.D.3.4, the IPEEE analyses, and in support of the Application for License Amendment. These analyses were performed in 1981, 1994, and 1995, respectively. During those times, and even since the time of the amendment submittal, changes to offsite facilities and offsite transportation have occurred. In order to provide clarity on the hazards of concern for FCS, the sources of hazards were reviewed as part of the activities performed to support RAI response development. In some cases there was change of ownership of the facilities and in other cases the hazard no longer exists or its frequency of shipment/use is changed. This review resulted in the re-establishment of the hazards to FCS. The results of this effort are summarized in Table 1.

Hazards not listed on the table, as compared to prior reports, are not currently a hazard to FCS. This is due to the hazard source not being used (as is the case with the Terra 35,000 ton ammonia tank noted in the 1981 report, which is now abandoned in-place), having been removed (as is the case with the pressurized anhydrous ammonia tank at the Terra fertilizer facility noted in the 1995 submittal), or not having the potential for impact at FCS under the guidelines of Reg. Guide 1.78 (i.e., exceeding the toxic level in the FCS control room within two minutes of sensing by the operators).

The lack of barge hazards is reflective of the fact that there are no longer any toxic hazards shipped by barge past FCS and the highway hazards are limited to highway US 75 (previously designated US 73). The limitation of truck hazards to US 75 is based on dispersion analyses results for the other highways that conclude there is no impact to FCS (i.e., the toxic level in the FCS control room is not exceeded prior to two minutes after sensing by the operators).

Significant revisions are:

1. During conversations with personnel at the Cargill Corn Processing site, it was revealed that carbon dioxide is no longer stored at the facility. This material had been identified in the 1995 submittal as posing a hazard to FCS, with an estimated frequency of loss of control room habitability of 3.09E-7 per year. As such, this risk is removed from further consideration for FCS.

2. The current ammonia truck shipment frequency on U.S. 75 past FCS has been revised to 750 per year. This results in a revision of the estimated contribution to loss of control room habitability from 9.5E-7 per year to 1.7E-6 per year.

In reviewing the hazards for the facilities in Table 1, it is important to note that these facilities are part of a Blair Industrial Park cooperative organization that provides for early notification of events that occur at any of the sites which may have an impact on adjoining facilities. FCS is part of this cooperative and would receive such notification. Additionally, although some of the values are increased over those previously reported, the overall conclusion is still that FCS meets the requirements of Standard Review Plan (SRP) Section 2.2.3, Subsection II criteria.

TABLE 1
POTENTIAL HAZARDS TO FCS

FACILITY/SOURCE	HAZARD	AMOUNT/FREQUENCY
Terra Nitrogen Co.[1]		
Pipeline terminus - fixed source at Terra site	Anhydrous Ammonia (NH_3)	Two (2) - 25,000 ton capacity atmospheric, refrigerated tanks (the 35,000 ton tank reported in the 1981 III.D.3.4 study is abandoned) Two (2) - 30,000 gallon, ambient temp., pressurized horizontal tanks Tanks are used for distribution primarily via trucks. Rail shipments are limited to approximately <10 per year.
Truck Shipments to/from Terra	Anhydrous Ammonia (NH_3)	Estimated 750 trucks per year on Hwy 75.
Cargill Corn Processing Plant		
Fixed source at Cargill site	Sulfur Dioxide (SO_2)	One (1) - 28,000 gallon, ambient temp., pressurized horizontal tank
Fixed source at Cargill site	Ethanol (EtOH)	1,400,000 gallons total storage capacity
Fixed source at Cargill site	Sulfuric Acid (H_2SO_4) (98% concentration)	7,000 gallons
Fixed source at Cargill site	Ammonia (NH_3)	15,000 pounds - stored onsite in a closed system
Fixed source at Cargill site	Aqueous Hydrochloric Acid (HCl) (35% concentration)	25,000 gallons
Fixed source at Cargill site	Gasoline (hexane)	60,000 gallons
Truck Shipments to Cargill	Aqueous Hydrochloric Acid (HCl) (35% concentration)	208 trucks of 5,000 gallon size
Truck Shipments to Cargill	Sulfuric Acid (H_2SO_4) (98% concentration)	12 trucks of 4,000 gallon size

1 Referred to in prior submittals as Agrico Chemical Co. - Terra purchased Agrico's operations in 1994. In addition, it is noted that the existing Terra facility removed its pressurized ammonia tank noted in prior submittals.

FACILITY/SOURCE	HAZARD	AMOUNT/FREQUENCY
Truck Shipments from Cargill[2]	Ethanol (EtOH)	7,300 trucks of 9,600 gallon size
Rail Transportation		
(Main rail lines)	Chlorine (Cl_2)	190 rail cars of 90 ton size
(Main rail lines)	Ammonia (NH_3)	32 rail cars of 78 ton size
(Cargill rail spur)	Sulfur Dioxide (SO_2)	26 rail cars of 90 ton size
(Cargill rail spur)[2]	Ethanol (EtOH)	2,373 rail cars of 29,000 gallon size
(Cargill rail spur)	Gasoline	104 rail cars of 28,000 gallon size

In prior documentation provided to the NRC, other hazards beyond the above list were identified. Either the above hazards are the most limiting, in terms of potential for impact to the plant (based on size, location or design/use aspects) or, in some cases, the other hazards have been removed or abandoned. As such, the above list should be regarded as comprehensive and inclusive of all the potential offsite hazards to FCS.

Analysis of Potential Hazards

As part of the RAI response, some of the hazards identified above were reanalyzed. The purpose of this effort was to understand the effect of concurrent hazards, due primarily to a seismic event. The results summary of this reanalysis and all prior hazards analyses is presented in Table 2. The table indicates whether the hazard meets the deterministic criterion in Reg. Guide 1.78, which states that a two minute interval should exist between operator sensing of the hazard and the exceedance of the toxic limits. The screening criteria consists of instantaneous releases (maximum concentration) and slow releases (maximum duration).

2 The shipment of Cargill ethanol output is by either truck or rail. The total yearly quantity is given in both entries in the tables above. The truck/rail hazard estimations for each method of shipment assume the maximum quantity of a single shipment by either mode of transportation to determine the impact to FCS.

TABLE 2
RESULTS OF HAZARDS REANALYSIS
REGULATORY GUIDE 1.78 HAZARD SCREENING

Facility/Source	Hazard	Screened (Y or N)	
		Max. Conc.	Max. Duration
Terra Nitrogen Co.			
	Anhydrous Ammonia (NH_3) - Two (2) - 25,000 ton refrigerated tanks - multiple tank failures assumed	N	Y
	Anhydrous Ammonia (NH_3) - Two (2) - 30,000 gallon tanks - multiple tank failures assumed	N	Y
	Ammonia Truck Shipments to/from Terra - Estimated to be two (2) ton size - 750 shipments estimated for Hwy 75	N	N
Cargill Corn Processing Plant			
	Sulfur Dioxide (SO_2) - One (1) 28,000 gallon tank	N	Y
	Ethanol - 1,400,000 gallons	Y	Y
	Sulfuric Acid (H_2SO_4) - 7,000 gallons	Y	Y
	Ammonia (NH_3) - 15,000 pounds	N	Y
	Aqueous Hydrochloric Acid (HCl) - 25,000 gallons	Y	Y
	Gasoline (hexane) - 60,000 gallons	Y	Y
	HCl truck shipments to Cargill - 208 trucks of 5,000 gallon size	Y	Y
	Sulfuric Acid (H_2SO_4) (98% concentration) truck shipments to Cargill - 12 trucks of 4,000 gallon size	Y	Y
	Ethanol (EtOH) truck shipments from Cargill - 7,300 trucks of 9,600 gallon size	Y	Y
Railroad			
(Main rail lines)	Chlorine (Cl_2) - 190 rail cars of 90 ton size	N	Y
(Main rail lines)	Ammonia (NH_3) - 32 rail cars of 78 ton size	N	Y
(Cargill rail spur)	Sulfur Dioxide (SO_2) - 26 rail cars of 90 ton size	N	N

Facility/Source	Hazard	Screened (Y or N)	
		Max. Conc.	Max. Duration
(Cargill rail spur)	Ethanol (EtOH) - 2,373 rail cars of 29,000 gallon size	Y	Y
(Cargill rail spur)	Gasoline - 104 rail cars of 28,000 gallon size	Y	Y

Using this set of hazards and associated analytical results the NRC RAI responses below were developed.

NRC Question No. 1

During a conference call with the NRC staff on May 13, 1996, Omaha Public Power District (OPPD) indicated that a site-specific study on transportation of toxic chemicals near the plant had been done in 1981. In particular, the 1981 study calculated the frequency of exceeding airborne toxicity limits for railroad and truck shipments of ammonia (Table 6.1.2.1 and Table 6.1.2.2 of the 1981 study). Is this 1981 study the OPPD response to NUREG-0737, Item III.D.3.4 submitted on January 26, 1981? If not, please provide the title of the 1981 study, the publication date, and the author of the study for reference. Also, for reference, provide Table 6.1.2.1 and Table 6.1.2.2 from the 1981 study.

OPPD Response:

The study referred to during the conference call is indeed the OPPD response to NUREG-0737 and its predecessor, NUREG-0660. The title of the study is, "Review of Conformance to the TMI Task Action Plan for Control Room Habitability (NUREG-0660, Section III.D.3.4), Revision A, for the Fort Calhoun Station, Omaha Public Power District," dated January 1981 [3]. Copies of Tables 6.1.2.1 (page 92 of the study) and 6.1.2.2 (page 93) are included as Attachment B. However, there is an apparent typographical error in the table concerning transport routes as noted in Attachment B. Highway US 227 should be highway 133, and F(S) should be 227 not 133. Highway US 73 is now designated as US 75. This information was previously provided to the NRC by facsimile on May 13, 1996, but the typographical error is noted as part of the RAI response effort.

It is also noted that the analyses [3] are superseded by those provided with the License Amendment Application [2]. The revised results for these hazards (truck and rail) are discussed in the responses to RAI Questions 6 and 7.

NRC Question No. 2

Provide a map which shows the rail and highway transportation routes within a 5 mile radius of Fort Calhoun which are used for transporting ammonia and chlorine. Indicate which routes transport the ammonia and chlorine.

OPPD Response:

Attachment C provides the requested figure. The figure previously transmitted by facsimile on May 14, 1996, was an excerpt from the 1981 study [3]. Changes since the 1981 study consist of:

- US 73 is now designated US 75,
- Addition of Cargill Corn Processing plant between Blair and FCS, a map of which was transmitted to the NRC [7],
- The rail line shown on the map which goes to the town of Fort Calhoun was abandoned and is now just a rail spur for the Cargill Corn Processing Facility.

The only highway shipment route of concern is the ammonia shipments on US 75. As stated in the introduction, the shipments of ammonia on US 30 and Nebraska 133 do not impact the plant.

NRC Question No. 3

In the January 9, 1995 submittal, loss of control room habitability frequencies were provided. Were the suggested frequencies and probabilities used for the calculations taken from the "HANDBOOK OF CHEMICAL HAZARD ANALYSIS PROCEDURES" for the potential offsite railroad, highway, and storage tank release accidents? If not, how were the frequencies and probabilities determined?

OPPD Response:

Highway Accident - The frequency of loss of control room habitability following an ammonia truck accident (9.51E-07 per year) is from the 1995 Fort Calhoun Station IPEEE submittal [4]. However, the loss of control room habitability frequency, found in Table 5.3.1 of the submittal, uses the truck accident rate from the "HANDBOOK OF CHEMICAL HAZARD ANALYSIS PROCEDURES" (the Handbook)[5]. The truck accident rate used, 4E-07 accidents per mile that result in a significant spill, is the product of the accident rate (2E-06 accidents per mile) and conditional spill probability (0.2 for significant spills), both of which are shown in Table 11.4 of the Handbook.

Railroad Accidents - For rail hazards, the mainline accident rate of 6E-07 per car-mile is taken from Table 11.5 of the Handbook. This accident rate is then used in the calculation of loss of control room habitability frequency.

Storage Tank Accidents - In the case of storage tank releases, the tank failure rate of 1E-04 per year was taken from Table 11.8 of the Handbook. This failure rate applies to single-walled storage tanks or pressure vessels and is appropriate for the offsite storage facilities under consideration. Additional information on the tank failure modes and the seismic event failure mode is provided in the responses to RAI Questions 9 and 10.

For all cases above, the frequency of loss of control room habitability considers, in addition to the accident frequencies described above, applicable meteorological conditions, probability of each particular release scenario, probability of plant impact, and number of shipments for transportation hazards.

NRC Question No. 4

What is the source of the weather data used in the January 9, 1995, submittal?

OPPD Response:

The meteorological data used for the submittal were from the FCS semi-annual radioactive effluent release reports for the time periods January 1, 1982 to December 31, 1991. These data, which were included in the FCS IPEEE, were for a tower elevation of 10 meters. As such, the data are current and site specific.

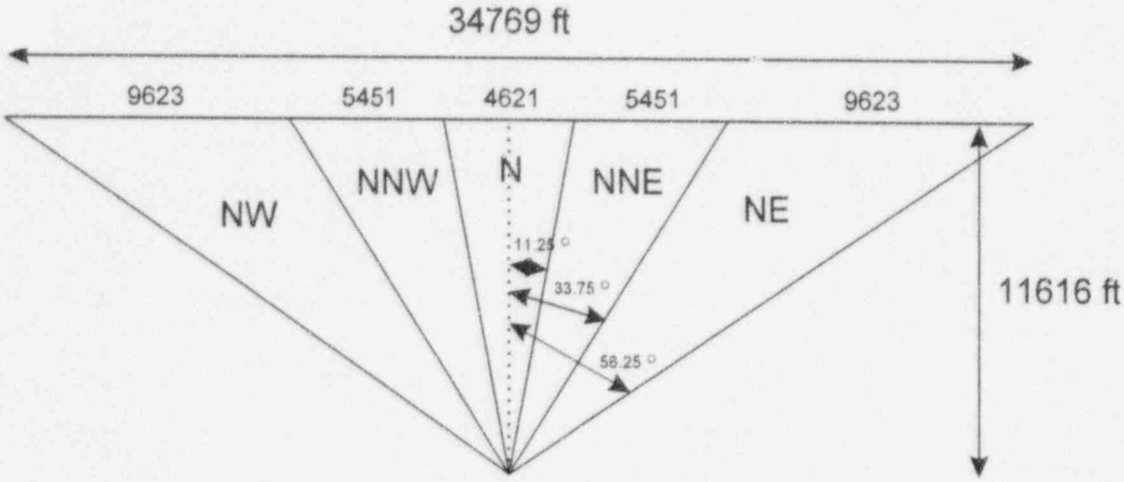
NRC Question No. 5

For reference, please provide the title, publishing date, and author of the document which describes the methodology used to calculate the parameter, P_{imp}, which is used in the calculation of the loss of control room habitability frequency.

OPPD Response:

The parameter, P_{imp} ,is not considered a published and referenced entity; rather, it represents the derivation of the factors that influence the probability that an accident could impact the control room. This information was previously provided to the NRC by facsimile on May 8, 1996. The parameter represents the normalized probability that the wind is directed from the hazardous length of track/highway toward the control room. This is determined by partitioning the length of critical track/highway into 22.5° sectors corresponding to the sixteen wind directions with respect to the control room. Consider the example below:

> The critical track, located 11,616 feet due north from the control room, has been partitioned into five sectors: NW, NNW, N, NNE, and NE.



Using the Pythagorean theorem, the length of track in each sector has been calculated as shown in the figure. The contribution to the overall probability of plant impact from each sector is the fraction of the total critical length of track in each sector multiplied by the probability of wind blowing from that sector. Assuming the following probabilities of wind blowing from the sectors of concern:

SECTOR	PROBABILITY
NW	0.05
NNW	0.03
N	0.04
NNE	0.02
NE	0.03

as well as the track lengths shown above, the probability of plant impact may be calculated. In this case, P_{imp} is:

$$P_{imp} = \sum P_i(L_i/L_t)$$

$$= P_{NW}L_{NW} + P_{NNW}L_{NNW} + P_N L_N + P_{NNE}L_{NNE} + P_{NE}L_{NE}$$

$$= (0.05)(9623/34769) + (0.03)(5451/34769) + (0.04)(4621/34769) + (0.02)(5451/34769) + (0.03)(9623/34769)$$

$$= 0.014 + 0.005 + 0.005 + 0.003 + 0.008$$

$$= 0.035$$

NRC Question No. 6

The USAR, Chapter 14, Section 14.23, "Control Room Habitability During Toxic Chemical Release Accidents," indicates that toxic gas monitors are required to be present for certain toxic gas release scenarios. One such scenario involved a rupture of a 104 ton ammonia railroad tank car. The 1981 site-specific study indicates that, for railroad shipments of ammonia, the frequency of exceeding airborne toxic limits was 1.16×10^{-5} per year. The January 9, 1995, submittal indicates that, for railroad shipments of ammonia, the frequency for loss of control room habitability is 1.45×10^{-8} per year. This represents a decrease in the loss of control room habitability frequency by three orders of magnitude. One order of magnitude decrease in this frequency can be attributed to an order of magnitude decrease in the railroad transportation frequency of ammonia. Please explain the remaining two orders of magnitude decrease in the loss of control room habitability frequency, (1) indicate the railroad transportation of ammonia accident frequency used in the 1981 site-specific study in units that allow a comparison with the railroad transportation frequency used in the January 9, 1995, submittal; (2) indicate how much of the remaining two orders of magnitude decrease is attributable to weather data and the methodology used to calculate the probabilities of weather conditions; and (3) describe any additional differences in frequencies, probabilities, and methodologies used in the 1981 study and the January 9, 1995, submittal for the calculation of the loss of control room habitability frequency.

OPPD Response:

The railroad transportation frequency cited in the 1981 study was 341 shipments per year, while for the 1995 submittal it was 32 shipments per year. This yields an order of magnitude decrease in the loss of control room habitability frequency as noted above. An additional two orders of magnitude decrease results primarily from differences in the accident rate used in the calculations. For the 1981 study, a value of 3.41E-05 was used for the frequency of accidents yielding a major chemical release. As described in the response to RAI question 3 above, the 1995 submittal used the overall accident rate of 6E-07 per car-mile from the EPA's "Handbook of Chemical Hazard Analysis Procedures", and a 0.3 conditional probability of a significant spill occurring. These values yield a frequency of accidents resulting in a significant spill of approximately 1.8E-07 per year, which is more than two orders of magnitude less than that assumed in the 1981 study. Table 3 summarizes the changes in these variables and their contribution to the loss of control room habitability frequency:

TABLE 3
COMPARISON OF 1995 SUBMITTAL TO 1981 STUDY
FOR RAIL ACCIDENTS

Variable	1981 Study	1995 Submittal	Change Factor From 1981 To 1995
Rail Transportation Frequency	341/yr	32/yr	0.094
Frequency of Rail Accident w/ Release that Impact FCS	3.41E-05/car-mile	1.8E-07/car-mile	0.0053
		Total	0.00050

The total difference in loss of control room habitability frequency between the 1981 study and the 1995 submittal is a factor of 0.00125. The two variables listed in Table 3 account for the majority of the change. Differences in stability class probabilities, probability of plant impact, and other factors contribute to the remaining change.

NRC Question No. 7

The 1981 site-specific study also indicated that the frequency of exceeding airborne toxicity limits for truck accidents on U.S. Highway 73 was 2.6E-05 per year. The loss of control room habitability frequency from truck shipments of ammonia in the January 9, 1995, submittal was estimated to be 9.5E-07 per year. The number of truck shipments per year indicated in the 1995 submittal is approximately 20% less than indicated in the 1981 site-specific study. The remainder of the decrease in loss of control room habitability frequency may be attributed to change in the actual traffic accident frequency and/or the probabilities of weather conditions. Please indicate how each of these two factors have changed in order to understand the remainder of the decrease in the loss of control room habitability frequency. Describe any additional differences in frequencies, probabilities, and methodologies used in the 1981 study and the January 9, 1995, submittal for the calculation of the loss of control room habitability frequency. Also, does the loss of control room habitability frequency of 9.5E-07 per year correspond to potential truck accidents on U.S. 73 only? If so, why are other routes excluded?

OPPD Response:

The truck transportation frequency cited in the 1981 study is 508 shipments per year, while for the 1995 submittal it was 413 ammonia shipments per year on US 73 (Now US 75). This results in approximately 20% reduction in the loss of control room habitability frequency as noted above. Updated information provided by the ammonia shipping company, Terra, indicates that the shipment frequency is now approximately 750 shipments per year.

An additional change between the 1981 and 1995 studies was in the frequency of a truck accident that has a release of material. Table 4 summarizes the changes in these variables and their contribution to the loss of control room habitability frequency:

TABLE 4
COMPARISON OF STUDIES
FOR TRUCK ACCIDENTS

Variable	1981 Study	1995 Submittal	1996 RAI Response	Change Factor From 1981 to 1996
Truck Transportation Frequency	508/yr	413/yr	750/yr	1.48
Frequency of Truck Accident w/ Release that Impact FCS	2.0E-07/yr	4.0E-07/yr	4.0E-07/yr	2.0
			Total	2.95

The total difference in loss of control room habitability frequency between the 1981 study and the 1995 submittal is a factor of 0.0365. The net impact of changes in the two variables above is an *increase* in the loss of control room habitability frequency. The other factors that contribute to a *decreased* hazard frequency include differences in stability class probabilities, probability of plant impact, and the criteria for plant impact. No attempt was made to quantify the contribution from these factors. However, the criteria for plant impact in the 1981 evaluation was based on the ability for the material to cause an unacceptable concentration in the control room. The concentration that was deemed unacceptable was also a factor of three lower than the value used in the 1995 study (100 ppm used in 1981 vs. 300 ppm used in 1995). The 1995 study also used the Reg. Guide 1.78 criteria for two-minute operator response to take self-protection actions, where the 1981 study only analyzed up to the point where the toxic limit was exceeded.

Based on these differences, the 1981 method will predict significantly larger distances at which a material could impact the control room. Therefore, routes other than US 75 have been excluded as having no impact on the plant. In addition, the number of stability classes in each sector that could impact the control room could also increase due to the greater level of dispersion necessary to preclude the release from impacting the control room. The contribution to the overall hazard frequency could, therefore, change significantly with changes in the plant impact criteria. Upon examination of the assessment methods used, this was the conclusion reached. Without further detailed evaluation of these factors, it is not possible to quantify their actual impact. It is concluded that the change in plant impact criteria accounts for the majority of the differences in the loss of control room habitability frequency between the 1981 and 1995 studies.

NRC Question No. 8

The "HANDBOOK OF CHEMICAL HAZARD ANALYSIS PROCEDURES", reviewed by the Federal Emergency Management Agency, the U. S. Department of Transportation, and the U.S. Environmental Protection Agency, indicates that the spill frequency associated with loading/unloading storage tanks at chemical plants is as follows: 10^{-4}/loading or unloading or 10^{-2}/hose spills per year. If a postulated spill during loading or unloading operations at the ammonia tanks referenced in the January 9, 1995, submittal fails to meet the NRC deterministic criteria for control room habitability, provide a discussion on the impact of such a spill size on the loss of control room habitability frequency.

OPPD Response:

As indicated in the introduction, the hazards at both Terra Corporation and Cargill have been re-verified and additional analyses performed of the realistic scenarios. The results of the analyses are summarized in Table 1.

For all of the hazards at both facilities an unloading accident is similar to a maximum duration accident for the identified hazards. This is due to the fact that the hose sizes used at the facilities, in Terra's case for loading of trucks with ammonia, and in Cargill's case for loading from trucks to the storage facilities for their use of the materials in their processing of corn sweeteners and associated products, are similar in size to the assumption made in Reg. Guide 1.78 for the maximum duration accident scenario (i.e., "the largest safety relief valve"). As shown in the introductory table, none of the maximum duration release scenarios result in exceeding the toxic levels in the FCS control room within two minutes of detection by the FCS control room operators.

Based on this reanalysis, no probabilistic review of the initiating event hazard is required.

NRC Question No. 9

Indicate the potential failure mechanisms of the offsite ammonia storage tanks that were considered in the January 9, 1995, submittal. Were seismic events considered in the calculation of the loss of control room habitability frequency? If not, discuss the basis for excluding this as a contributor to tank release. If an assessment was done, provide the assessment including the seismic hazard curve used and tank fragilities.

OPPD Response:

Specific failure modes of the offsite ammonia storage tanks were not considered as part of the development of the 1995 submittal. As indicated in the response to RAI Question 3 above, a 1E-04/yr tank failure frequency was used based on generic industry tank failure data. No additional analyses were performed. In the analyses supporting the 1995 submittal, seismic events were not explicitly considered. As indicated in the response to Question 3, the tank failure rate was considered to be inclusive of all failure modes, including seismic events. For discussion of the consideration of seismic events in the calculation of loss of control room habitability, see the response to RAI Question 10 below.

NRC Question No. 10

How many of the offsite ammonia storage tanks could fail and result in a release such that the deterministic criteria in Regulatory Guide 1.78 are not met? If seismic events were considered, indicate (1) how many tanks could fail for seismic event(s) such that the deterministic criteria for control room habitability are not met, and (2) the frequency of such a seismic event(s).

OPPD Response:

As part of the development of the responses to the RAI, additional evaluations of the potential effects of seismic events were performed and the results of these evaluations are reported below. The additional evaluations included consideration of the dispersion effects of multiple failures of the atmospheric pressure (refrigerated) and pressurized ammonia tanks at Terra. The additional evaluations were limited to these hazards as stated above, for the following reasons:

1. These tanks represented the majority (90%) of the loss of control room habitability from offsite fixed sources predicted in the 1995 submittal. As stated in the introduction, carbon dioxide is no longer stored at Cargill and no longer poses a hazard to FCS. Therefore, the only credible offsite hazards are ammonia at Terra (CDF of 1.16E-09 per year) and sulfur dioxide at Cargill (1.40E-10).

2. The atmospheric pressure tanks at Terra are of similar design, size and location to each other, so common cause failure in a seismic event would be a reasonable postulation. A similar argument may also be made for the two pressurized tanks at Terra.

3. In terms of quantities, the Terra site represents the single largest hazard to FCS.

4. The transportation hazards are largely independent of the seismic event (i.e., the truck would have to be traveling by FCS, or the train would have to be on the rail spur passing FCS at the exact time of the earthquake for an additional seismic hazard to be postulated).

The results of the additional dispersion evaluations of multiple tank failures are summarized as follows:

1. The concurrent failures of the 30,000-gallon pressurized ammonia tanks at Terra do not result in estimated risk values beyond that already reported in the 1995 submittal for failure of a single 30,000-gallon tank.

2. Failure of one of the 25,000 ton atmospheric tanks individually does not result in estimated risk values beyond those already reported in the 1995 submittal.

3. The concurrent failures of both 30,000 gallon pressurized tanks and one of the 25,000 ton atmospheric tanks at Terra do not result in estimated risk values beyond that already reported in the 1995 submittal. In this case, the limiting failure is failure of the single 25,000 ton atmospheric tank.

4. Concurrent failures of both 25,000 ton atmospheric tanks do result in estimated risk values beyond that already reported in the 1995 submittal. See discussions in below for the evaluations of an enveloped condition.

5. The concurrent failures of both the 30,000 gallon pressurizeu tanks and both of the 25,000 ton atmospheric tanks at Terra do result in estimated risk values beyond that already reported in the 1995 submittal. The increase in risk levels for the concurrent pressurized tank failure modes are discussed below.

Terra indicated that the pressurized tanks are filled at a level of ≤ 50% for approximately ten (10) months of the year. This is due to the seasonal use of the anhydrous ammonia for agricultural fertilizer which peaks in April during the local planting preparation season. From this it is concluded that Items 4 and 5 above are only of concern for an approximate two (2) month period, as the failure of two ≤ 50% filled pressurized ammonia tanks is equivalent to the failure of one 25,000 ton tank described in Item 2 above, which is considered in the risk values reported in the 1995 submittal. The increase in risk due to concurrent seismic tank failure, for the time period when the tanks are more than 50% full results in an annual loss of control room habitability at FCS being increased from 8.7E-07/yr to 1.88E-06/yr, a 117% increase. This increased estimate is very conservative based on the following:

1. The 117% increase in the estimated frequency of loss of control room habitability is due to the postulated common cause, catastrophic failure of the tanks in a seismic event. OPPD has performed seismic capacity evaluations using the same methodology and team that performed the IPEEE seismic capacity estimations and concluded that the High Confidence Low Probability of Failure (HCLPF) for these tanks for a seismic event is in the 0.1 "g" range which correlates to a mean annual probability of exceedance of 6.7E-05. This probability (6.7E-05) is based on a site specific hazard estimation from an EPRI/SOG study of the Eastern United States Seismicity Issue. The HCLPF's estimates have higher confidence levels than the median values, and therefore are conservative.

2. The only credible concurrent tank failure mode is a seismic event. It is conservative to postulate that all of the seismically induced common mode tank failures are catastrophic, total release of contents failures.

3. The increase comes from the consideration of an additional stability class in the dispersion portion of the P_{imp} parameter. The potentially large spill that would result from a catastrophic tank rupture results in a larger source term and consequently another stability class, Class D, for consideration in the impact portion of the determination of the hazard to the plant. Thus, the frequencies associated with the D stability class are added to the E, F and G stability classes required to be considered for this event.

4. The Terra tanks have an exterior wall to hold the Pearl-Lite tank insulation. Based on the Terra facility walkdown, this exterior wall could be credited and the double wall tank failure rate of 1E-06/yr [5] used for the random tank failure rate. If this was credited, the current estimation of FCS loss of control room habitability frequency for this hazard would be 1.1E-06/yr or only a 34% increase over that previously reported.

Conclusion:

As indicated above, although all tanks could fail in a seismic event, the refrigerated ammonia tanks are the only multiple failure scenario of concern. The seismic event that results in this failure mode has a recurrence frequency of approximately 6.7E-05/yr. Due to variations in tank levels at the Terra facility and other factors, consideration of this multiple failure event scenario results in an estimated 117% increase in the values reported in the 1995 submittal. For the reasons cited above, this estimate is conservative.

NRC Question No. 11

In the January 9, 1995, submittal, a conditional core damage probability (CCDP) is calculated given that the operators are physically incapacitated. The submittal states that a transient is considered as the limiting initiating event while the operators are physically incapacitated. Indicate why this is the limiting initiating event. Is this CCDP based on the potential that the control room habitability will be recovered in a certain time interval, and that during this time interval there is a small probability of an initiating event occurring? If so, indicate what the basis for the time interval used. If not, please clarify the assumptions made in the calculation of the CCDP. In either case, provide the probabilities of the initiating events used in the calculation of the CCDP. Also, were seismic events considered in the CCDP? If so, describe how. If not, discuss the basis for excluding seismic events.

OPPD Response:

The discussion provided in Section 6.4.2 of the enclosure to the January 9, 1995 submittal [2] is fairly comprehensive and is not repeated here. In response to the question the following clarification is offered.

The Section 6.4.2 conditional core damage probability (CCDP) is based on the plant's response to a transient category event. Although not explicitly stated in Reference 2, this event category was chosen for the following reasons:

- The other event categories modeled in the FCS PRA, which are detailed in Section 6.4.2 of Reference 2, are relatively low frequency events, whose occurrence are independent of the initiation of an offsite toxic hazard to the plant.

- Upon incapacitation of the operators it is reasonable to postulate that the operators would trip the plant as their last act prior to their incapacitation from the effects of a toxic hazard. As tripping the plant challenges the ability of the plant to prevent core damage, it was chosen as the modeled event.

A manual plant trip at the initiation of an offsite toxic hazard event is a limiting assumption with respect to initiating events since the human reliability of tripping the plant is not quantifiable for the toxic gas event. Operators may not trip the plant. The scenario where the plant is not tripped is of less risk and therefore the plant trip is a reasonable representation of risk with incapacitated operators. Accordingly, an initiating event probability of 1.0 for a manual plant trip is used as the plant transient following a toxic hazards event.

The CCDP is not based on the supposition that there is a small probability of a concurrent initiating event, but on the probability that the plant, tripped by the incapacitated shift crew and unmanned until the next shift crew arrives, does not proceed to core damage.

As described in Section 6.4.2 of Reference 2, the cutsets for the CCDP quantification were reviewed for those human actions required to occur sooner than four (4) hours following a plant trip and none were found. The four hour time period is the mean time for shift crew relief (FCS is currently on an 8-hour shift rotation). In the development of the RAI response, OPPD has concluded that the four hour time period for restaffing the FCS control room is conservative and appropriate for the following reasons:

1. In the event of a plant trip OPPD Systems Operations personnel, who operate the transmission and distribution system on a 24-hour basis, would contact the FCS control room. If there was no response, personnel would be dispatched to FCS to investigate. These events would happen well within the assumed four-hour period.

2. In the event of a spill at Terra or other facilities, the Blair Industrial Park emergency notification system ensures the investigation of event impact at FCS.

3. As indicated above, the CCDP cutset review found no important human actions within the four hour period. A review of longer term actions concluded that refill of the emergency feedwater storage tank at 8 hours to be the only long term human action of significance. The oncoming operations shift or emergency response personnel who relieve the incapacitated or impaired operators would still have ample time to complete this relatively straight forward action. Thus, the assumed time period could be longer, with the same conclusion regarding CCDP.

From the discussion presented in Section 6.4.2 of the 1995 submittal as clarified above, it is concluded that the CCDP calculation was appropriate and, since plant trip is postulated for all hazard events, conservative.

With regard to the seismic events, for reasons expanded upon in the response to Question 10 above and considering the seismic capacities of FCS systems, structures and components, the seismic event can be precluded from simultaneous consideration at the offsite facilities. This is due to the fact that the higher frequency seismic events are postulated to result in the release of materials from the offsite facilities and these seismic levels do not degrade the ability of FCS to achieve safe shutdown. For further information regarding the seismic capacity of FCS refer to the FCS IPEEE [4].

References

1.0 Letter, NRC to OPPD, Fort Calhoun Station, Unit No. 1, Request for Additional Information on Toxic Gas Monitors (TAC No. M931397), dated July 18, 1996.

2.0 Letter, OPPD to the NRC, Letter No. LIC-94-0285, Subject: Application for Amendment of Operating License, dated January 9, 1995.

3.0 "Review of Conformance to the TMI Task Action Plan for Control Room Habitability (NUREG-0660, Section III.D.3.4), Revision A, for the Fort Calhoun Station, Omaha Public Power District," dated January 1981.

4.0 Enclosure to OPPD Letter LIC-95-0130, "Individual Plant Examination of External Events for Fort Calhoun Station," dated June 30, 1995.

5.0 "HANDBOOK OF CHEMICAL HAZARD ANALYSIS PROCEDURES", US Environmental Protection Agency (EPA), dated 1989.

6.0 EPRI NP-6041-SL, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin (Rev 1)", Jack R. Benjamin & Associates, et. al., August 1991.

7.0 Enclosure to OPPD Letter LIC-95-0007, "Request for Additional Information (RAI) to assist closure of NRR Staff review Fort Calhoun Station Revised Evaluation of Control Room Habitability (TAC No. M90495)," dated January 17, 1995.

Attachment B - Tables 6.1.2.1 and 6.1.2.2 from the FCS Post-TMI Control Room Habitability Study

Attachment C - Figure 6.1.2.1 from the FCS Post-TMI Control Room Habitability Study

Attachment B

Tables 6.1.2.1 and 6.1.2.2
from the
FCS Post-TMI Control Room Habitability Study

Table 6.1.2.1

PROBABILITY OF TOXICITY LIMITING TRUCK TRANSPORT ACCIDENT

REVISION

Chemical		Ammonia	
Transport Route	US ~~73~~ 75	US ~~227~~ 133	US 30
F (S) *	508	~~133~~ 227	300
F (A) *	1.0×10^{-4}	5.5×10^{-5}	6.0×10^{-5}
$(X/Q)_{TL}$ *	4.5×10^{-9}	4.5×10^{-9}	4.5×10^{-9}
Segment	$F\ (X/Q)_{TL}$, %	$F\ (X/Q)_{TL}$, %	$F\ (X/Q)_{TL}$, %
1	0.14	0.30	0.30
2	0.14	0.17	0.21
3	0.11	0.17	0.26
4	5.55	0.14	0.88
5	10.73	0.02	2.86
6	2.92	0.02	2.86
7	2.93	-	2.08
8	1.31	-	2.08
9	0.30	-	-
10	0.70	-	-
Total Probability**	2.6×10^{-5}	4.5×10^{-7}	7.5×10^{-6}

*F (S) = the number of trucks per year using the transport route

F (A) = probability per segment for accidents with major chemical release

$(X/Q)_{TL}$ = toxic limiting dispersion factor, s/m^3

$F\ (X/Q)_{TL}$ = probability of equaling or exceeding the limiting dispersion factor

** Total Probability = $\Sigma\ F\ (X/Q)_{TL} \times F\ (A)$ events per year

TABLE 6.1.2.2

PROBABILITY OF TOXICITY LIMITING RAILRAOD TRANSPORT ACCIDENTS

Chemical	$TiCl_4$	Methanol	Vinyl Chloride Leakage	Vinyl Chloride Burning	Gasoline	Ammonia
F (S) *	45	105	53	53	51	341
F (A) *	4.5^{-6}	1.05^{-5}	5.3^{-6}	5.3^{-6}	5.1^{-6}	3.41^{-5}
$(X/Q)^{C}_{TL}$ *	3.36^{-5}	1.49^{-4}	N/A	N/A	1.32^{-4}	N/A
$(X/Q)^{P}_{TL}$	N/A	N/A	2.95^{-8}	2.75^{-10}	N/A	9.17^{-10}
Segment	$F(X/Q)_{TL}$,%	$F(X/Q)_{TL}$,%	$F(X/Q)_{TL}$,%	$F(X/Q)_{TL}$,%	$F(X/Q)_{TL}$,%	$F(X/Q)_{TL}$,
1	.07	0	0	4.94	0	3.25
2	.08	0	.00	2.56	0	1.58
3	.15	.02	.02	3.63	.02	2.35
4	.43	.02	.03	4.08	.02	2.35
5	.40	.05	.19	10.66	.06	3.58
6	.53	.04	.21	10.05	.05	6.00
7	.75	0	0	9.48	0	6.63
8	.07	0	0	4.21	0	2.22
9	.08	0	0	2.09	0	.99
10	.43	.02	.08	1.18	.03	0.50
Total Probability**	1.34^{-7}	1.58^{-8}	2.81^{-8}	4.32^{-6}	8.95^{-9}	1.16^{-5}

*F (S) = the number of railroad cars per year using the given railway route

F (A) = probability per segment for accidents with major chemical release

$(X/Q)^{C}_{TL}$ = toxic limiting dispersion factor for continuous release, s/m^3

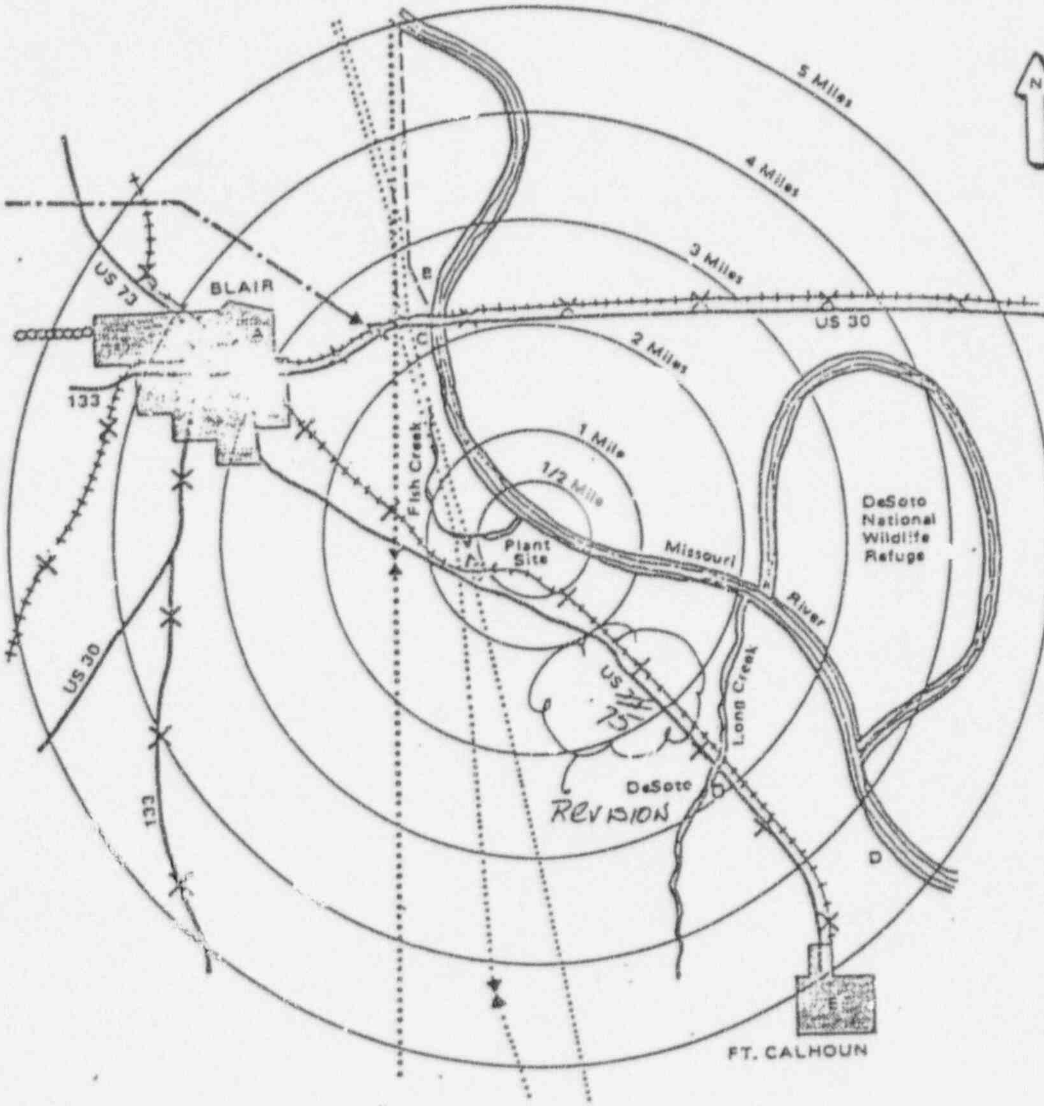
$(X/Q)^{P}_{TL}$ = toxic limiting dispersion factor for puff release, s/m^3

**Total Probability = Σ $F(X/Q)_{TL} \times F(A)$ events per year

Attachment C

Figure 6.1.2.1
from the
FCS Post-TMI Control Room Habitability Study

Figure 6.1.2.1



FACILITIES

A - ROGERT OIL & PROPANE
B - FAIRWAY PROPANE
C - AGRICO CHEMICAL CO
D - FORT CALHOUN STONE CO
E - WILKINSON MANUFACTURING
CHICAGO & NORTHWESTERN RAILROAD (North/South Track Abandoned)

PIPELINES

WILLIAMS BROTHERS (8" & 12")
MID AMERICAN PIPELINE CO (MAPCO - 4")
GULF CENTRAL (6")
NORTHERN NATURAL GAS CO (6")
MOBIL OIL CORPORATION (6")
DENOTES LOCATION OF ISOLATION VALVES
X CORRESPONDS TO RELEASE SEGMENTS