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MIDDLE SOUTH UTILITIES SYSTEM

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August 9, 1984

Director of Nuclear Reactor Regulation
Attention: Mr. G. W. Knighton, Director
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Waterford 3 SES
Docket No. 50-382
Toxic Chemicals

Reference: LP&L Letter W3P84-1094 dated 4/30/84

Dear Sir:

The above reference submitted to you the results of the LP&L-conducted toxic chemical survey of the industries surrounding Waterford 3. The purpose of this letter is to give you an update on the same subject. The data collected in the survey were evaluated and our evaluation indicates that the protective features described in the FSAR will provide adequate protection for the control room operators.

The attachment to this letter is a complete report on the analysis performed and the model and assumptions used. The results of the analysis are summarized in Table 1 of the attachment.

In comparison with Regulatory Guide 1.70 and Standard Review Plan Subsection 2.2.3, the probability of Immediately Dangerous to Life or Health (IDLH) levels being exceeded is smaller than 10^{-6} per year if credit is taken for odor detection and will be reduced even further by the toxic gas detectors. Also, considering the conservatisms of the analysis, the results indicate that the level of protection is marginally adequate even without reliance on odor detection or the broad range toxic gas detectors.

If you have any questions, please advise.

Very truly yours,

K W Cook

K. W. Cook
Nuclear Support & Licensing Manager

KWC/PC/ch

cc: E.L. Blake, W.M. Stevenson, J.T. Collins, D.M. Crutchfield, J. Wilson, G.L. Constable, K. Campe

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ATTACHMENT

RESULTS OF THE 1983-1984 SURVEY OF TOXIC CHEMICALS STORED OR TRANSPORTED IN THE VICINITY OF WATERFORD SES UNIT 3

BACKGROUND AND SUMMARY

In its letter of February 24, 1983, the NRC requested that the FSAR be updated to include all significant quantities of hazardous chemicals near the Waterford 3 site. It further requested that any additions to the listing be evaluated to ensure that the consequences of any accident involving these hazardous chemicals are within the design basis envelope for Waterford 3.

In response to this request we have updated the survey of major industries within 5 miles of Waterford 3 to determine the types and quantities of hazardous materials which are stored or transported in the vicinity of the site. Our evaluation of the materials indicates that the protective features described in the FSAR will provide adequate protection for the control room operators.

INDUSTRIAL SURVEY

To determine the types and quantities of hazardous materials which are stored or transported in the vicinity of Waterford 3 we had sent detailed written questionnaires to the major industrial facilities located within 5 miles of Waterford 3. Questionnaires were sent to, and replies received from, the following facilities:

Beker Industries
EI Dupont de Nemours & Co.
GATX Terminals Corp.
GHR Energy, Inc.
Hooker Chemical
LP&L Little Gypsy SES
LP&L Waterford SES 1&2
Occidental Chemical, Taft
Occidental Agricultural Products
Shell Chemical, Taft Plant
Shell Oil, Norco
Shell Western E&P, Crawfish Plant
Union Carbide Linde Division
Union Carbide, Star Plant
Union Carbide, Ethylene Oxide/ Glycol Plant, Taft
Witco Chemical Co.

In addition, we obtained from the Missouri Pacific Railroad Co. data on the types, quantities and shipment frequency of hazardous materials through Taft, LA in 1983. When necessary, written information provided by the industrial facilities and Missouri Pacific was supplemented by telephone inquiries.

ANALYSIS OF DATA AND RESULTS

The survey revealed that many of the toxic chemical sources listed in the FSAR, such as ammonia and chlorine, are still present. In addition, a number of new chemicals were identified. Using the methodology described in Section 2.2.3.3 of the FSAR, all of the toxic chemical sources were examined to identify those chemicals which, on the basis of their proximity to the plant, volatility and toxicity, could pose a threat to the control room operators in case of an accidental release.

The locations and quantities of chlorine and ammonia were found to be the same as in the FSAR. As demonstrated there, for these chemicals, the redundant, dedicated detectors will assure control room habitability. In fact, we reanalyzed the ammonia sources and found that the 5 ppm setpoint and 2 second response time of the ammonia detectors which were assumed in the FSAR can both be relaxed. The analysis showed that a detector set to isolate the control room at 50 ppm of ammonia and having a 20 second response time would provide adequate protection.

Chemicals other than ammonia and chlorine were analyzed to assess the severity and likelihood of the threat to control room operators. We also evaluated the feasibility of protective action based on odor detection or notification by offsite authorities. Since the broad range toxic gas detectors are not yet operational, no automatic control room isolation or alarm was assumed.

The results of this analysis are presented in Table 1. This table lists all the chemical sources which were found to be capable of producing IDLH*

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* Immediately Dangerous to Life or Health. (Ref. 1)

concentrations in the control room within 30 minutes of the plume's arrival on site under a spectrum of meteorological conditions, including 5 percentile conditions. Though the 30 minute period is somewhat arbitrary, we considered it reasonable to assume that within this period the control room operators would be notified that an accident has occurred by either the St. Charles Parish Industrial Hotline, or other means. We expect it would take the parish between 2 and 5 minutes to notify LP&L of an emergency condition at a nearby industrial facility, after the parish were notified.

The name of each chemical is shown in Column 1. Columns 2 and 3 list, respectively, the IDLH value and the odor threshold for each chemical. Except as noted in the notes to the table, the IDLH values were taken from Reference 1 and the odor thresholds from Reference 2. Whenever both detection and recognition levels were listed in Reference 2, the latter value was used.

Columns 4, 5 and 6 show, respectively, the location of the source from which the release is postulated to occur, the annual shipment frequency for mobile sources and the amount of material which is assumed to be released. These data were provided by the survey respondents. The amount released, listed in Column 6, is the quantity contained in the largest single storage tank. For the Missouri-Pacific data, it is the average lading for each chemical.

Column 7 shows the minimum time from when the release occurs to when the IDLH concentration is calculated to be reached in the control room for the spectrum of meteorological conditions considered. Neglecting the possibility of notification prior to release, the values indicate the time available for notification by offsite authorities. Column 8 shows the minimum time from odor detection to when the IDLH concentration is reached. This indicates the minimum available response time by the operators based on odor detection. Column 9 shows the maximum concentration in the control room at two minutes following odor detection - time within which the control room operators would be expected to don breathing apparatus [3].

It should be noted that the values in columns 7, 8 and 9 may not correspond to the same meteorological conditions. Generally, IDLH is reached most rapidly at relatively high wind speeds whereas the maximum concentration at 2 minutes following odor detection occurs at lower wind speeds and very stable conditions. As such, the values presented in columns 7, 8 and 9 present the envelope of "worst" consequences.

The likelihood of transportation accidents which can result in the consequences presented in columns 7, 8 and 9 are indicated in columns 10 and 11. These columns list the annual probabilities for IDLH levels being exceeded within 30 minutes of plume arrival on site or within 2 minutes of odor detection, respectively. These probabilities were calculated as follows: The length of railroad track, highway or shoreline within a five-mile radius of the plant was divided into a number of segments. An accident was postulated at the center of each segment resulting in a total release of lading. Using the median windspeed for each meteorological stability class and the joint frequency data in FSAR Tables 2.3-126 through 2.3-132, the probability that the accident at a given location would result in control room concentration in excess of IDLH levels was calculated. The resultant values of probability were multiplied by the lengths of the segments and summed to obtain the probability-weighted hazard length. This length was then multiplied by the annual shipment frequency in Column 5 and, finally, by the appropriate probability per vehicle mile of an accident involving a carrier of hazardous material which results in a loss of lading [(4)].

Column 12 lists the ionization potentials (in electron volts) of the listed chemicals [(5)]. All chemicals with ionization potentials less than 11.7 eV would be detectable by the Broad Range Toxic Gas Detectors. The ionization potential of sulfur monochloride was not found in the literature; however, as indicated in the notes to the table, we expect this chemical to also be detectable.

The results in Table 1 show that only three stationary sources can produce IDLH levels in the control room within 30 minutes of the plumes' arrival on site. Of these, thionyl chloride gives an adequate warning through odor detection, and can also be detected by photoionization. Hydrogen chloride and sulfur dioxide do not provide a 2-minute odor detection warning, nor can they be detected by photoionization. However, we were informed by Union Carbide that they plan to terminate the process using hydrogen chloride in November, 1984, in which case this hazard will no longer exist. In the case of sulfur dioxide, the IDLH concentration is not reached until 23 minutes after the accident. This should allow sufficient time for notification by the St. Charles Parish Industrial Hotline. Furthermore, the actual concentration is likely to be much lower. Sulfur dioxide has over twice the density of air and will tend to concentrate near the ground. Also, while above the IDLH level, the calculated concentration of 280 ppm 2 minutes after odor detection is not likely to be immediately incapacitating. Patty [5] and Fairhall [6] give 400-500 ppm as the concentration that is dangerous for short exposures.

The total probability for a transportation accident causing an IDLH concentration in the control room within 30 minutes of the plume's arrival on site is 2.9×10^{-6} per year. The probability of exceeding IDLH before the operators can don breathing apparatus (2 minutes after odor detection) is 9.4×10^{-7} per year. This latter value includes those chemicals which cannot be detected by odor. If only chemicals which cannot be detected by the Broad Range Toxic Gas Detectors are considered, the probabilities are reduced to 6.1×10^{-7} without odor detection and 4.4×10^{-7} with it (assuming adequate detector sensitivities and response times).

The above probability estimates may be compared to the guidance in Section 2.2.3 of Regulatory Guide 1.70 [8]. Also, Section 2.2.3 of the Standard Review Plan [9] indicates:

> "...the identification of design basis events resulting from the presence of hazardous materials or activities in the vicinity of the plant is acceptable if the design basis events include each postulated type of accident for which the expected rate of occurrence of potential exposures in excess of the 10 CFR Part 100 guidelines is estimated to exceed the NRC staff objective of approximately 10^{-7} per year."

Furthermore,

"...the expected rate of occurrence of potential exposures in excess of the 10 CFR Part 100 guidelines of approximately 10^{-6} per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower."

As indicated before, the model used to evaluate the consequences of postulated chemical releases is very conservative. Among the conservatisms are the following:

1. Initial dilution due to entrainment of air in flashing liquids is neglected.

2. Material spilled on the ground is assumed to evaporate from a pool which has a depth of 1 cm. While this conservative assumption eliminates the need for a detailed characterization of the spill terrain, it results in unrealistically large evaporation rates.

3. Both source and receptor are assumed to be at ground level. In reality, the effects of gravity on dense vapors from pressurized liquids would tend to reduce the concentration at the 17 meter height of the control room outside air intake.

4. Except for atmospheric turbulence, processes which would tend to reduce the concentration of airborne chemicals are neglected. These processes would include condensation and dissolution in atmospheric water vapor by cold gases such as hydrogen chloride and sulfur dioxide as well as deposition on the ground.

5. IDLH values are appropriate for an exposure period of approximately 30 minutes. Significantly higher concentrations can be tolerated for the short time in which the operators would take protective action.

6. The possibility of notification prior to plume arrival on site is not considered.

Considering the additional fact that incapacitation of the operators need not result in exposures in excess of the 10 CFR Part 100 guidelines, the results of our analysis indicate that the level of protection is marginally adequate even without reliance on odor detection or the Broad Range Toxic Gas Detectors. The probability is below the 10^{-6} per year criterion if credit is taken for odor detection and will be reduced even further by the toxic gas detectors. Thus, the results indicate that the protective features described in the FSAR provide adequate protection for the control room operators.

References

1. NIOSH/OSHA. Pocket Guide to Chemical Hazards. DHEW (NIOSH) Publication No. 78-210, (1978).

2. Fazzalari, F.A., ed. Compilation of Odor and Taste Threshold Value Data. American Society for Testing and Materials (1978).

3. U.S. Nuclear Regulatory Commission. Regulatory Guide 1.78. Assumptione for Evaluating the Habitability of a Nuclear power Plant Control Room During a Postulated Hazardous Chemical Release (June 1974).

4. Arthur D. Little, Inc. A Modal Economic and Safety Analysis of the Transportation of Hazardous Substance in Bulk. COM-74-11271. National Technical Information Service (1974).

5. Weast, R.C., ed. Handbook of Chemistry and Physics, 64th Ed., CRC Press, Inc. (1983).

6. Patty, F.A., ed. Industrial Hygiene and Toxicology, Second Ed., Vol. II. Interscience Publishers (1967).

7. Fairhall, L.T., Industrial Toxicology. Hefner Publishing Co. (1969).

8. U.S. Nuclear Regulatory Commission. Regulatory Guide 1.70. Standard Format and Content of SAfety Analysis Reports for Nuclear power Plants, LWR Edition. Rev. 3, (November 1978).

9. U.S. Nuclear Regulatory Commission. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, LWR Edition, NUREG-0800 (July 1981).

10. Sax, N.I. Dangerous Properties of Industrial Materials, 3rd Edition. Van Nostrand Reinhold Co. (1968).

TABLE 1

Chemicals in Vicinity of WSES-3 Posing Potential Hazards to Control Room Personnel

1	2	3	4	5	6	7	8	9	10	11	12
						Time of IDLH From:			P(IDLH) (yr^{-1})		
Chemical	IDLH (ppm)	Odor thr. (ppm)	Source[a]*	Shipment Freq. (yr^{-1})	Amount (kg.)	Release	Odor thr.	Conc. at Odor+2min (ppm)	≦30 min	≦Odor+2min	Ion. Pot. (eV)
Acrolein	5	.21	MPRR	164	$7.1x10^4$	2.4 min	42 sec	36	$2.0x10^{-6}$	$4.5x10^{-7}$	10.1
Acrylo-nitrile	4000	21	MISS	4	$1.9x10^6$	25 min	18 min	240	$1.5x10^{-9}$	0	10.9
Benzene	2000	4.7	MISS	70	$1.8x10^6$	25 min	19 min	110	$2.4x10^{-8}$	0	9.2
Ethylene oxide	800	500	MPRR	814	$7.3x10^4$	40 min	30 min	54	$3.3x10^{-9}$	0	10.6
Formalde-hyde (37%)	100	1	MPRR	33	$7.6x10^4$	12 min	8.6 min	24	$2.4x10^{-8}$	0	10.9
Hydrogen chloride	100	10	UC-T	--	$6.6x10^4$	6.8 min	30 sec	1100	--	--	12.7
			MPRR	166	$6.2x10^4$	1.5 min	10 sec	4400	$4.3x10^{-7}$	$3.5x10^{-7}$	
Hydrogen cyanide	50	1	MPRR	1	$4.7x10^4$	4.8 min	2.2 min	47	$3.5x10^{-9}$	0	13.8
Hydrogen fluoride	20	--	MPRR	10	$6.6x10^4$	1.4 min	--	--	$7.5x10^{-8}$	--	15.8
Phosphorus trichloride	50	--	MPRR	67	$8.1x10^4$	12 min	--	--	$4.5x10^{-8}$	--	9.9
Sulfur dioxide	100	.47	OCC	--	$7.8x10^4$	23 min	1.3 min	280	--	--	12.3
			MPRR	61	$7.6x10^4$	4 min	50 sec	950	$1.0x10^{-7}$	$1.9x10^{-8}$	
Sulfur monochloride	10	5[b]	MPRR	130	$8.6x10^4$	30 min	14 min	6	$2.0x10^{-9}$	0	$<$11.7[c]
Thionyl chloride	2[d]	.47[e]	OCC	--	$1.9x10^4$	14 min	7 min	2	--	--	11.1[f]
			3127	77	$1.8x10^4$	20 min	8 min	2	$2.0x10^{-7}$	0	

* See notes to this table.

NOTES TO TABLE 1

a. Location Code:

MISS - Mississippi River

MPRR - Missouri-Pacific Railroad

OCC - Occidental Chemical Co.

UC-T - Union Carbide Corp., Ethylene Oxide/Glycol Plant (Taft)

3127 - Louisiana Route 3127

b. Odor detection threshold not listed in Reference 2. However, since each molecule of S_2Cl_2 would yield two molecules of HCl upon contact with water (such as in the moist mucous membrane), and since the odor threshold for HCl is 10 ppm, 5 ppm seemed to be a reasonable value.

c. Value not listed in references, but was inferred as follows: Sulfur monochloride (S_2Cl_2) is structurally analogous to thionyl chloride ($SOCl_2$). Oxygen and sulfur have the same electronic configuration in the outermost shells, but the sulfur valence electrons are less tightly bound. Comparison of analogous O and S compounds shows that the sulfur compound always has the lower ionization potential. Therefore, we are reasonably certain that the ionization potential of S_2Cl_2 is less than that of $SOCl_2$ and, thus, less than 11.7 eV.

d. Value not in references. Sax[10] cites 17.5 ppm as fatal to cats in 20 minutes. Action is comparable to phosgene, in that both compounds react with water to liberate hydrogen chloride. 2 ppm, which is the same as the IDLH for phosgene, is a conservative value.

e. Not listed in Reference 2. Sax[10] describes the odor as similar to sulfur dioxide, so the odor threshold of the latter was used.

f. Value quoted by HNU Systems, Inc.