APPENDIX 2.2A

EVALUATION OF ACTUAL HAZARDOUS CHEMICAL RELEASES
POSTULATED TO OCCUR NEAR THE WATERFORD 3 SITE

�(DRN 01-231)
2.2A   SECTION OVERVIEW

This section provides an evaluation of the postulated impact of historical events on Waterford 3 prior to receipt of its operating license and is retained for historical purposes only. These events do not reflect the current postulated hazardous chemical release, which is updated approximately every four years. Refer to FSAR Sections 2.2 and 6.4 for the current evaluation of hazardous chemical releases and explosions postulated to occur near the Waterford 3 site.
⬅(DRN 01-231)

2.2A.1   ANALYSIS OF THE POSSIBLE CONSEQUENCES OF THE LIVINGSTON,
                       LOUISIANA DERAILMENT ACCIDENT ON THE Waterford 3 PLANT

2.2A.1.1   Introduction

At 5:00 AM on September 28th, 1982, 43 cars of a 101 car train derailed in an accident near Livingston, Louisiana. The derailment resulted in a series of fires and explosions which lasted several days and necessitated the evacuation of a three mile radius of the accident area. Though the accident occurred far from the Waterford 3 plant, it is of interest to LP&L to evaluate such an accident as if it had occurred on the Union Pacific Railroad which passes near the Waterford 3 plant.
➡(DRN 01-231)

The following presents an analysis of the possible plant safety implications of a similar accident occurring at the Waterford 3 site and may be considered a supplement to analyses previously performed and included in Chapter 2 of the Waterford 3 FSAR. In that section, a detailed analysis of over 200 sources of hazardous chemicals is provided. The analyses address the effects of the release of toxic chemicals on Control Room habitability and the effects of near site explosions on plant safety. These analyses demonstrate that both engineered safety features and administrative controls are sufficient to ensure plant safety.
⬅(DRN 01-231)

The question which is answered in this report is the following:

> If a similar derailment accident occurred at the Waterford 3 site, could the toxic chemicals released seriously affect Control Room habitability and could the explosions directly affect plant safety?

The report is divided into four sections. Following this introduction, Subsection 2.2A.1.2 presents a description of the Livingston accident. Subsection 2.2A.1.3 presents an analysis of the possible effects such an accident at the Waterford 3 site could have on Control Room habitability. The analysis addresses the acute effects of toxic chemicals on the Control Room habitability, and the ability of the Control Room to remain habitable over the duration of such an accident. Subsection 2.2A.1.4 presents the possible consequences of the explosions resulting from such an accident on plant safety. The analyses specifically address overpressure, missiles and damage to offsite power supplies.

2.2A.1.2   Accident Summary

The information provided in this section was obtained from 1) newspaper reports, 2) telephone conversations with representatives of the National Transportation Safety Board (NTSB), the Louisiana Department of Natural Resources, the Louisiana State Police (Hazardous Substance Control Unit) and the EPA, and 3) reports provided by the NTSB and State of

Louisiana. At 5:00 AM on September 28, 1982, 43 railroad cars of a 101 car train derailed near Livingston, Louisiana. On the track, the 43 cars were 2,200 feet long, but following the derailment they covered 725 feet. Of the 43 derailed cars, 27 carried toxic and/or explosive chemicals. The derailment caused a fire and a series of explosions which continued over a 14 day period.

The derailment and subsequent explosions were heard by several emergency response personnel who lived near the accident and responded immediately. All emergency personnel were activated within 15 minutes of the accident. Immediately after the accident, a one mile radius around the derailment site, including Livingston, was evacuated. Shortly thereafter, a three mile radius was evacuated. A total of 2,800 people were evacuated. The evacuation was performed primarily because of concern over explosion, fire, and toxic chemical releases.

Table 2.2A-1 presents the types and quantities of toxic chemicals released during the accident. The following presents a brief description of each chemical.

Ethylene Glycol, a liquid at Normal Temperature and Pressure (NTP - 20°C, 760 Torr) boils at 275°F and ignites at 445°F. It is an irritant to the eyes and to the nose if inhaled.

Hydrofluosilicic acid, also known as fluosilicic acid, is produced only in aqueous solution. The material released in the accident was shipped from a chemical plant in Uncle Sam, LA, now Agrico-Uncle Sam. That facility ships hydrofluosilicic acid in aqueous concentrations of 23% to 27%.[5] Other industry sources confirmed that concentrations of the commercial product never exceed 30%. At such concentrations, the acid does not present an inhalation hazard.[3] Recommended personal protective equipment consists of rubber gloves, safety glasses and protective clothing. No respiratory protection is recommended.

Phosphoric acid, a liquid at NTP, boils at 266°F. It is not flammable. Heated to decomposition, it produces toxic fumes of PO_x. Fumes cause burns on the mouth and lips, nausea and vomiting.

Tetraethyl lead, a liquid at NTP, decomposes above 230°F. It explodes in fires. At least one tank car of tetraethyl lead exploded in the Livingston, Louisiana train derailment. Vapors cause eye and skin irritation. Inhalation causes nausea, vomiting and intoxication.

Toluene diisocyanate, a liquid at NTP, boils at 231°F and ignites at 997°F, emitting toxic fumes during combustion. Exposure to vapors causes eye and skin irritation. Inhalation of vapors causes coughing and gagging.

Perchlorethylene, a liquid at NTP, boils at 250°F. Exposures to concentrations in excess of 200 ppm can cause irritation to the eyes, nose and throat, mental confusion, nausea and vomiting. At elevated temperatures, it will decompose into toxic fumes of chlorides.

Styrene Monomer, a liquid at NTP, boils at 293°F and ignites at 914°F. The vapor is heavier than air and can explode. The vapors can cause eye and skin irritation. Inhalation can cause dizziness or narcosis.

Vinyl chloride, a gas at NTP, ignites at 882°F. The gas is heavier than air and is highly explosive. One tank car of vinyl chloride in the Livingston, Louisiana train was blown apart by a BLEVE (Boiling Liquid Expanding Vapor Explosion), propelling the ends of the tank car 500 feet.

Exposure to vinyl chloride vapor can cause eye and skin irritation. Inhalation of vinyl chloride vapor can cause dizziness or, in elevated doses, anaesthesia. Incomplete combustion of vinyl chloride can result in the production of phosgene, a highly toxic gas.

Rail cars containing metallic sodium which explodes and burns upon contact with water, sodium hydroxide, a corrosive base, and polyethylene pellets were removed from the wreck, essentially intact.

Though the accident was extremely severe, and lasted about 14 days, there were no serious injuries among the general public or emergency response personnel.

2.2A.1.3   <u>Control Room Habitability</u>

In this section, the accident is postulated to occur on the Union Pacific Railroad, at its nearest point to Waterford 3 724 meters south of the Control Room (see Figure 2.2A-1). Two issues are addressed. The first relates to the short-term peak concentrations of toxic chemicals in the Control Room, and the second relates to the long-term nature of the accident and its possible effects on long-term occupancy of the Control Room. Refer to Subsection 6.4 for a discussion on Control Room habitability systems.

A.   Short-Term Consequences

The impact of the postulated accident on control room habitability was assessed using the methodology described in Subsection 2.2.3.3. The list of hazardous materials was first screened to eliminate those which did not require a detailed analysis. Following the guidance of Regulatory Guide 1.78, four chemicals--ethylene glycol, phosphoric acid, tetraethyllead and toluene diisocyanate--were eliminated because their vapor pressures at 100°F are below 10 torr (mm Hg). In fact, all four pressures are approximately 1 torr or less. Of the remaining chemicals, vapors from hydrofluosilicic acid do not pose a health hazard, as discussed in Subsection 2.2A.1.2. Fuel or lubricating oils are also non-volatile materials which do not pose inhalation hazards when released in an outdoor environment.

The remaining three chemicals spilled in the derailment were evaluated in a manner similar to that described in Subsection 2.2.3.3.4 for stationary sources. The details of these analyses are presented in Table 2.2A-2. It was conservatively assumed that the total quantity of each chemical was released at the point on the Union Pacific tracks nearest to Waterford 3. The first three columns in the Table after the chemical name list the IDLH concentration, the odor threshold and the ionization potential of each chemical. These properties are discussed in

Subsection 2.2.3.3.4. The next-to-last column lists the maximum concentration in the control room at the time the operators are assumed to have donned their breathing apparatus. The final column lists the ratio of this concentration to the IDLH concentration for the given chemical. The sum of these ratios is a measure of the combined toxicity of the three gases. As is shown in the Table, the sum of the concentration ratios is equal to 0.27, showing that the combined effect of the three gases would be well within the limit set by the IDLH values.

The analysis is conservative in the following respects:

a. The maximum concentrations for the three chemicals are found to occur under three different sets of meteorological conditions; therefore, all three concentrations could not occur simultaneously.

b. All the releases were assumed to occur at the same point. Actually, as stated in Subsection 2.2A.1.2, the 43 cars involved in the derailment were spread over a distance of 725 feet. Therefore, portions of the release would have to occur at a greater distance than the postulated 724 meters. More importantly, each car containing one of the chemicals in question would constitute a discrete source--only one of those sources could be directly upwind of the control room air intake.

C. The analysis calculates the concentrations of the three chemicals as if each occurred separately, when in fact the three plumes would dilute one another.

Before leaving this section several additional factors need to be emphasized:

1) The fires and heat will cause decomposition of some of the toxic chemicals.

2) The heat of the fires will cause large updraft of many toxic chemicals which might otherwise be available near ground level, resulting in greater dispersion.

3) The explosions will give immediate notification to Waterford 3. Either they or one of the chemical facilities nearby will contact emergency response authorities on the "hot line". In the case of the Livingston, Louisiana derailment, emergency response personnel were on-scene within 15 minutes.

4) The derailment will occur downhill of Waterford 3 (see Figure 2.A-2). Thus, under calm meteorological conditions, when atmospheric dispersion is reduced, chemicals which are significantly heavier than air would be transported away from the Waterford 3 site.

B. Long-Term Effects

The accidents analyzed in Section 2.2 of the FSAR are extremely intense accidents which last from minutes to hours. For chemical releases which persist for a long period of time, protection is provided by continued Control Room isolation and use

of self-contained breathing air apparatus, if these are necessary. Since the Livingston derailment lasted several days, it is appropriate to ask whether the Control Room would remain habitable over the duration of the accident.

➡(DRN 01-282, R11; 06-926, R15)

Should such an accident occur, toxic chemicals and products of combustion may be present at the air intake of the Control Room for several days, necessitating prolonged isolation of the Control Room. Although a large amount of highly toxic materials was released following the Livingston derailment, the results of this analysis have shown that if a similar accident were to occur in the vicinity of the Waterford 3 site, the chemicals would not have an adverse impact on Control Room habitability. As indicated in Subsection 6.4, the Control Room may remain isolated until the wind shifts and fresh air is taken in. A review of the meteorological record (see Table 2.2A-3) reveals that SW to SE (appropriate range of direction from segment of rail line) wind persistence has not exceeded 20 hours. As seen on Figure 2.2A-2, the same is true of calm conditions, even neglecting the fact that the land slopes away from the plant towards the railroad. It should be noted that the two Control Room Emergency Ventilation intakes are on opposite sides of the RAB. The operator, therefore, has the capability to selectively provide make-up air based on acceptable concentrations.

⬅(DRN 01-282, R11; 06-926, R15)

2.2A.1.4   Fires and Explosions

The fires that can result from the spillage of the hazardous materials from the derailed train cars can be caused by a) burning of the material in the train car, b) burning at the surface of any liquid pool of flammable material formed by leakage from the tank cars, or c) deflagrations of vapor clouds with the fire eventually retreating to the source of the cloud.

In the first case the maximum horizontal extent of the fire cannot be much more than the area covered by the derailed train. Thus, on the basis (see Figure 2.2A-3) that the probability of a car exceeding a perpendicular distance from the track from which it derailed is negligible past 500 feet, the farthest fringes of such fires toward the plant would remain 1,500 feet away from any plant structure important to safety.

At this distance thermal effects are negligible.

➡(DRN 01-464; 02-87)

In the second case it is necessary to determine what the dimensions of the liquid pool may be. Such discussions are of course a function of a multiplicity of variables. However, a statistical sampling of train accidents involving propane spills indicates that pools exceeding lateral dimensions of 200 feet are of negligible probability, although long pools are possible. (See Figure 2.2A-4.) Given the topography of the Waterford 3 site, wherein the ground slopes gently upward from the railroad bed to the plant, it is logical to surmise that only the longest pool dimension will be in a direction away from the plant, and hence that the fires from liquid pools would be no closer to the plant than 200 feet from their sources. Hence even if a train car travels 500 feet toward the plant then spills its contents, the closest resulting fire (if any) to the plant will be approximately 1,300 feet, at which distance thermal effects would be negligible. In either case, however, the transmission lines located overhead of the derailed train would have to be assumed as lost. The height of the flame from pool fires is known to exceed tens and even 100 feet (as for instance Figure 2.2A-5 shows for LNG). Since the length of the derailment area can be about 1,000 feet, and pools can be of similar or longer lengths, either fires from the train cars or from ensuing pools can simultaneously damage the overhead lines, although the probability of that occurrence is perceived to be low. It should also be noted that there is significant separation between the two overhead transmission lines as they cross the railroad.

⬅(DRN 01-464; 02-87)

Finally, rapid fires, or deflagrations, are examined. Deflagrations of vapor clouds result in overpressures which are lower than those resulting from detonations of the same clouds. However, the thermal effects of deflagration can be more pronounced than those of detonation since the event lasts a considerably longer time.

The kinds of vapor clouds that can be formed from derailments result from either evaporation of liquid pools and subsequent atmospheric dispersions toward the plant or gravity slumping about the source. For the particular products carried by the train derailed in Livingston, the major hazardous component vinyl chloride, is a gas heavier than air which will slump by gravity about the source unless wind speeds are very significant, since slumping velocities will be of the order of 35 fps initially and still be about 13 fps when the vapor cloud is about two feet thick.

Again because of the geographic contour such a cloud would slump away from the plant. At a thickness of two feet the vapor cloud could travel about 1,000 feet from the railroad bed (this distance corresponds to the radius of a pancake cloud of two foot average thickness and also the distance from the railroad track at which the ground rises by more than two feet). Thus, it is reasonable to expect that the extent of the vapor cloud would not extend more than 1,000 feet toward the plant. In actuality it would probably be less, since slumping will be away from the plant.

Vinyl Chloride cannot explode until it entrains sufficient air to drop its volume concentration below 22 percent. Since the initial process of slumping does not entrain much air, the mixing must occur farther away from the plant than the initial extent of the cloud. Hence, one can model the deflagration of such vapor cloud as one of a cloud that originally would be no closer than 1,300 feet to the plant structures. The expansion of the cloud as it burns produces a two fold increase in dimension, and hence at the end of the deflagration the flame front may be just 300 to 400 feet away from the plant safety structures. Because of the short duration of the deflagration, again this would not be considered to present a thermal problem.

The deflagration would also create an overpressure, but of a value lower than that caused by the detonation of the vapor cloud. If the cloud were to detonate it would have the equivalent yield of a 150 ton TNT detonation (it is not known if vinyl chloride can detonate in open air), and a 3 psi overpressure would be generated if it is assumed that the center of the detonation is conservatively 1,300 feet away from the plant.

Because of the lower quantities of the other hazardous materials, and their comparable or lower explosive yield, involved in the Livingston derailment, their hazards to the plant, even by atmospheric dispersion toward the plant are expected to be less than those caused by vinyl chloride.

Finally, the question of missiles generated by either the accident itself or an explosion is addressed. Figure 2.2A-6 illustrates that statistically missiles travel as far as the distance from the railroad to the plant. Similarly Figure 2.2A-7 shows that debris and missiles from a 150 ton of TNT equivalent detonation are capable of reaching distances in excess of 2,500 feet.

It is therefore possible for missiles generated from the accident to reach the plant. Since neither the velocities nor the missile sizes are known, it cannot be said with certainty whether they can present a hazard. An approximate assessment can be made however, by considering the kind of missiles that can reach the plant from a 150 ton detonation (larger missiles fall at shorter distances) at 1,300 feet.

➜(DRN 01-464)

To ascertain the probability of a missile from the 150 ton TNT explosion hitting a critical structure, it is assumed that the total weight of missiles is proportional to the volume of the crater which would be created by the detonation, had it been a TNT detonation near the surface. The crater in turn is proportional to the detonation yield. Roughly the volume of the crater is estimated by the scaling law and the knowledge that a one kiloton surface detonation in dry soil results in a crater diameter of 180 feet and depth of 35 feet. Assuming none of the mass falls back within the crater, the areal density 1,300 feet away from the center of the assumed detonation is 8.4×10^{-3} lb/ft^2. The area of the critical structure being of the order of 10^5 ft^2, the total weight of missiles hitting these areas would only be 421 lbs. Assuming that all of this mass is concentrated in one missile, and that missile travels at the maximum air particle velocity of 140 ft per sec, the impact energy of this missile is below the energy required for penetration of the structures (see response to Question 311.2). In summary, explosively driven missiles do not pose a significant risk to the plant.

⬅(DRN 01-464)

2.2A.2   ANALYSIS OF THE POTENTIAL CONSEQUENCES OF THE DECEMBER 11, 1982 EXPLOSION AT THE UNION CARBIDE PLANT ON WSES-3

2.2A.2.1   Introduction

At 12:45 AM on December 11, 1982 (as recorded by the Waterford 3 Control Room), an explosion occurred in a tank at Union Carbide. This tank was about one-half empty and contained 20,000 gallons (approximately 225,000 lbs) of acrolein. The tank is one in a group of five located approximately two miles from Waterford 3. Radio reports indicate that windows were shattered two miles away across the river. Effects of the explosion felt at Waterford 3 included a non-essential unlatched door near the Control Room blown open, and electric power transients including flickering lights and spurious alarms. No loss of offsite power occurred at Waterford 3, and all operating LP&L fossil stations remained on line. The explosion threw debris from the tank up to one-half mile away, displacing the destroyed tank nine feet, and destroyed much of the piping connecting the five tanks with the equipment used to keep the tank's contents at a low pressure.

Louisiana Power & Light Company has analyzed the effects of this incident. In these analyses, the habitability of the Control Room and the plant overpressure from the explosion have been studied. The results of these analyses show that the accident consequences are well within the design basis events for Waterford 3. The analyses are described below.

2.2A.2.2   Acrolein

Acrolein is primarily used as an intermediate in the production of glycerine and in the production of methionine analogs (poultry feed protein supplements). It is also used in chemical synthesis, as a liquid fuel, antimicrobial agent in algae and aquatic weed control, and as a slimicide in paper manufacture.[1]

The Federal standard for occupational exposure to airborne concentration of acrolein is 0.1 ppm. This is the Time-Weighted Average (TWA) value as of 1980. The Short-Term Exposure Level (STEL) value is 0.3 ppm. Immediately Dangerous to Life or Health (IDLH) value is 5.0 ppm as opposed to anhydrous ammonia (500 ppm) or chlorine (25 ppm).

In the liquid or pungent vapor form, acrolein produces intense irritation of the eye and mucous membranes of the respiratory tract. Skin bums and dermatitis may result from prolonged or repeated exposure. Because of acrolein's pungent, offensive odor and the intense irritation of the conjunctiva and upper respiratory tract, severe toxic effects from acute exposure are rare as workers will not tolerate the vapor even in minimal concentration.

The properties of acrolein are such that when cooling is lost to the tank, an explosive reaction can set in when the temperature of the substance exceeds 453°F. The most conservative calculations indicate that the explosive capability of acrolein could be as high as six times that of TNT: indicating that the five tanks of acrolein are equivalent to approximately 7,000 tons (14 million pounds) of TNT. The atmospheric boiling point of acrolein is 127°F (52°C); therefore, the substance will tend to puddle on the ground and evaporate, but not form an explosive cloud. It is estimated that 10,000 to 15,000 lbs of acrolein formed the initial explosion; the approximately 210,000 lbs remaining in the tank burned off in about 17 hours.

2.2A.2.3   Accident Scenario

Acrolein is a liquid at atmospheric pressure (as opposed to anhydrous ammonia or chlorine, which are gases); the chance that large quantities of acrolein will become airborne is small. When heated, acrolein emits highly toxic vapors. In a fire, the vapors burn and are prevented from becoming airborne. Thus, with respect to adverse impact on Control Room habitability, a more severe, and less probable scenario would involve the evaporation of acrolein without ignition. The latter scenario is assumed for this evaluation.

2.2A.2.3.1   Control Room Habitability Evaluation Methodology

The maximum credible accident involving the release of acrolein at the Union Carbide Industrial Chemicals facility in Taft, LA is the process failure involving one tank. Since dikes would only contain 25% of such a release, for purposes of a conservative analysis the source is considered undiked. The impact of such an accident was analysed as part of the evaluation of all toxic chemical sources in the Waterford 3 vicinity, described in Subsection 2.2.3.3. The specific assumptions employed in this analysis are summarized in Table 2.2A-4.

One tank contains a maximum of 425,000 pounds of acrolein at ambient temperature and pressure, as reported by Union Carbide during the 1988 survey of toxic chemicals. These tanks are located in Area 34 of the Union Carbide Industrial Chemicals plant. Measurements made using the plant's plot plan and the U.S. Geological Survey map of the area (the Hahnville, LA 7.5 minute quadrangle, photo revised in 1979) show the nearest point in this area to be 1.75 miles from the Waterford 3 control room air intake.

Control Room Parameters

The normal control room air exchange rate is 0.6 volume per hour, based on a net free volume of the control room envelope of 220,000 cu. ft. and a normal outside air makeup rate of 2200 cfm, as listed in Table 6.4-2. The height of the outside air intake is listed as 73' above MSL, while the site plan shows the ground elevation to be between 12' and 13' above MSL, for a net height above ground of approximately 60'. The air exchange rate after control room isolation is assumed to be 0.06 volume per hour, in accordance with Regulatory Guide 1.95, Rev. 1, Regulatory Position 5.

Characteristics of Broad Range Gas Detector System

The photoionization detectors, which are part of the Broad Range Gas Detector System (BRGDS), are adjusted to alarm and isolate the control room when the acrolein vapors reach a constant concentration of 3 ppm. The actual response of the detector, which depends on the time-varying concentration of the vapor, was modeled as follows.

A commonly-used equation for the response of an electronic instrument, such as the BRGDS, to a step-function increase of the quantity being measured, such as concentration, is:

$$t = t_d - T_o \ln(1 - y/x) \tag{1}$$

t	=	time after start of exposure to concentration x
t_d	=	delay time of detector (includes transit time of sample)
t_o	=	characteristics time constant of detector
y	=	concentration registered by the detector
x	=	actual (constant) concentration

The constants t_d and t_o were determined by a statistical analysis of data collected during a test performed by the vendor, HNU Systems, Inc. on the detectors which are now installed at WSES-3. A fit of the data to equation, above, produces values of 4.06 and 6.84 seconds for t d and top respectively, for the slower of the two instruments. These tests were performed with an instrument pump speed of 6 liters/minute. The pump speed is currently adjusted to 3 1/m however, which, according to the HNU Instruction Manual, doubles the response time.

Adding the transit time through the sampling tube to the newly calculated delay time produces the values of 13.0 and 13.7 seconds for t_d and t_o , respectively. The travel time in the duct between the sampling port and the isolation valve is calculated to be 4.7 seconds, while the isolation valves have specified closure times of two seconds following the receipt of the isolation signal.

2.2A.2.4   <u>Results and Conclusions</u>

A.   Control Room Habitability

The results of the analysis show that the highest concentration that could occur in the control room by the time the operators were assumed to have donned breathing apparatus (two minutes after the alarm or after odor detection, whichever occurs first) would be 3.7 ppm. This concentration, which would occur at near-calm conditions over four hours after the accident, is well below the IDLH concentration of 5 ppm and would thus pose no threat to the operators for the brief time that they would be exposed. In the case of this particular accident scenario, moreover, the operators would have been notified by the St. Charles Parish industrial hot line and would have taken protective action long before the vapors reach their site. Assuming that notification would take place within 30 minutes after the accident, the highest concentration to which the operators could be exposed prior to donning breathing apparatus is 2.3 ppm, which is less than one-half the IDLH concentration.

According to Regulatory Guide 1.78, the control room would therefore remain habitable under all credible accident conditions.

B.   Plant Overpressure

In the unlikely event that the entire contents of all five tanks of acrolein (2,250,000 lbs) exploded simultaneously, and using the conservative estimate that one lb of acrolein equals six lbs of TNT, this would cause a shock wave at Waterford 3 of about 1.3 psi. This overpressure is less than half than that caused by the design basis explosion: 3 psi peak incident overpressure caused by an explosion of an LPG truck on the road outside the plant (see Response to NRC Question 311.2). The Union Carbide explosion on December 11, 1982 may have caused an overpressure at Waterford 3 as high as 0.05 psi.

<u>REFERENCES FOR APPENDIX 2.2A</u>

1.   Sittig, M. Handbook of Toxic and Hazardous Chemicals, Park Ridge, NJ, Noyes Data Corp. (1980).

2.   NIOSH/OSHA Pocket Guide to Chemical Hazards, Publication No. 78-210, 1978.

3.   Weiss, G. Hazardous Chemicals Data Book, Park Ridge, NJ, Noyes Data Corp. (1980).

4.   Wing, J. Toxic Vapor Concentrations in: the Control Room Following a Postulated Accidental Release, NUREG-0670. (1979).

5.   Dennis, R., Acting Production Manager, Agrico-Uncle Sam: Private communication, July 12, 1988.

TABLE 2.2A-1   Revision 2 (12/88)

TOXIC CHEMICALS LOST IN TRAIN DERAILMENT

	Total	Recovered	Lost[1]
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Ethylene Glycol	194,2OO lb	0	194.200 lb
Hydroflousilicic Acid	202,000 lb	0	202,000 lb
Phosphoric Acid	271,544 gal	21,551 gal	250,033 gal
Tetraethyl Lead	75,680 lb	0	75,680 lb
←			
Toluene Diisocyanate	192,560 lb	174,500 lb	18,060 lb
Perchloroethylene	189,900 lb	0	189,900 lb
Styrene Monomer	176,451 lb	0	176,451 lb
Vinyl Chloride	11,239,060 lb	0	1,239,060 lb
Fuel Oil/ Lubricating Oil	120,172 gal	75,024 gal	45,148 gal

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(1)   Due to burning, evaporation or spilling on ground-

TABLE 2.2A-2   Revision 2 (12/88)

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CHEMICALS RELEASED IN DERAILMMENT POSING POTENTIAL HAZARDS TO CONTROL ROOM HABITABILITY

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Chemical	IDLH (ppm)	odor thr.[a] (ppm)	K_{ion}[b] (eV)	Total amt. (lbs)	Max. Conc.[c] (ppm)	MC/IDLH[d]
Perchloroethylene	500	4.7	9.32	189,900	6.3	.013
Styrene Monomer	5000	0.1	8.47	176,451	1.3	.0003
Vinyl chloride	1000	---	10.00	1,239,060	259	.259
Total						.272

[a]Odor recognition or detection threshold

[b]Photoionization potential. Chemicals with K_{ion} <11.7 eV are normally detectable by WSES 3 photoionization detectors.

[c] Maximum concentration in control room two minutes after detection

[d]Ratio of maximum concentration to IDLH

TABLE 2.2A-3

WATERFORD STEAM ELECTRIC STATION UNIT 3
ONSITE METEOROLOGICAL DATA: 1972-1978
SUMMARY OF MAXIMUM PERSISTENCE OCCURENCES

Direction	Number of Hours	Average Speed (MPH)	Date
N	13	12.5	10/12/77
NNE	13	18.8	12/09/77
NE	23	7.9	10/20/74
ENE	22	3.4	07/01/77
E	18	12.6	09/01/77
ESE	25	11.9	04/11/74
SE	20	10.5	10/29/74
SSE	19	12.9	04/03/74
S	20	14.1	04/04/77
SSW	17	9.2	03/30/77
SW	14	11.1	02/24/77
WSW	9	2.1	06/11/73
W	10	13.8	02/22/74
WNW	16	11.8	04/04/73
NW	13	5.7	02/10/73
NNW	17	11.4	11/22/72

TABLE 2.2A-4   Revision 2 (12/88)

CALCULATIONAL ASSUMPTIONS USED IN ACROLEIN RELEASE ANALYSIS

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I.   Assumptions and Parameters

1.	Available liquid inventory	425,000 lbs
2.	Distance from tank to Control Room	1.75 miles
3.	Outside air intake (OAI) height above ground	60 feet
4.	Control Room normal air exchange rate	0.6 vol/hr
5.	Isolated Control Room air exchange rate	0.06 vol/hr
6.	Duct travel time (from detector sampling port to isolation valve)	4.7 sec
7.	Isolation valve closure time	2.0 sec
8.	Broad Range Gas Detectors: a. alarm and isolation setpoint b. delay time c. time constant	 3 ppm 13.0 sec 13.7 sec
9.	Evaluation Methodology	NUREG-0570[4]