EVALUATION OF CONTROL ROOM HABITABILITY
DURING A POSTULATED RELEASE OF
TOXIC MATERIALS SHIPPED BY RAIL

(Safety Evaluation Report-Outstanding Issue No. 1)

Illinois Power Company

Clinton Power Station - Unit 1

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I. INTRODUCTION

Illinois Power (IP) is required to provide for the Clinton Power Station (CPS) a control room from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions. The release of hazardous chemicals can potentially result in the control room becoming uninhabitable. Therefore, it is important to assess the habitability and protection of the control room during and after a postulated external release of hazardous chemicals.

On this basis, the Nuclear Regulatory Commission (NRC) has required an evaluation of the risks associated with rail transportation of hazardous materials in the vicinity of the CPS. The NRC position was stated in Reference 1, the CPS Safety Evaluation Report (NUREG-0853, Outstanding Issue No. 1):

> "The nearest railroad is a line of the Illinois Central Gulf Railroad which runs parallel to State Route 54 and traverses the site approximately 0.75 mi (1.21 km) north of the station. The Illinois Central Gulf Railroad also has a line approximately 3.5 mi (5.6 km) south of the station. The hazards associated with rail transportation of toxic and explosive materials are still being evaluated. Based on 1976 and 1980 transportation data obtained from Illinois Central Gulf Railroad, the applicant has identified several materials requiring further analysis. These will be addressed in a future SER supplement."

This report evaluates the hazards associated with rail transportation of toxic materials. It demonstrates that the toxic materials shipped near the CPS present no significant risk to control room habitability.

II. EVALUATION

RAIL LINES - The rail lines in the vicinity of the CPS are shown in Figure 1. The two lines being considered are owned and operated by the Illinois Central Gulf (ICG) Railroad.

The ICG line approximately 3.5 miles south of the station is not used to transport hazardous materials. Therefore, no additional evaluation of this line will be made. Further, the railroad is considering abandoning this line.

The ICG line parallel to State Route 54, the Gilman Line, is used to transport numerous commodities including hazardous materials.

SHIPMENT SURVEY - IP performed a comprehensive survey of the Gilman Line from ICG shipping records for the period of December 1, 1981 to November 30, 1982. Hazardous materials were identified on shipping records by a 49-series Standard Transportation Commodity Code number. Title 49 of the Code of Federal Regulations requires that hazardous materials must be itemized on all shipping records. Therefore, this survey of hazardous materials was totally inclusive.

"Hazardous materials" is a shipping category which includes toxic materials. In this evaluation, for conservatism, all hazardous materials were initially considered toxic and then examined individually to determine if an actual health hazard existed.

A summary of all hazardous materials shipped on the Gilman Line during the time period surveyed is given in Table 1.

SHIPPING FREQUENCY - Regulatory Guide 1.78 (Reference 2) requires a control room habitability evaluation for hazardous materials shipped by rail with a frequency of thirty or more times per year. There were nineteen hazardous materials shipped at least thirty times per year on the ICG Gilman Line near CPS. These chemicals are listed in Table 2.

CONTROL ROOM HABITABILITY - In this analysis, chemicals not sufficiently toxic to threaten control room habitability were eliminated on the basis of published toxicity data and criteria listed in Regulatory Guide 1.78. Any remaining chemicals were subjected to a diffusion analysis as described in Regulatory Guide 1.78. The Architect-Engineer, Sargent & Lundy, has developed the HAZCHEM computer program which utilizes this diffusion analysis to calculate the concentration in the control room of a chemical released a specified distance from the ventilation intake. The calculated control room concentration is then compared to the maximum concentration tolerable by human beings for an acute exposure to determine whether the chemical would cause the control room to be uninhabitable if a shipment quantity was released.

There are two HAZCHEM programs: one program is applicable to materials that are gaseous at ambient conditions and one program evaluates the spill of a liquid.

The following assumptions are included in the program for gaseous releases:

1. Instantaneous spill of total contents of a tank containing the chemical.

2. Ground release of tank car contents.

3. Control room intake is modeled as being directly downwind of the point of chemical release with no intervening structures.

4. The chemical is a gas at the input temperature and 14.7 psia but is stored or transported as a liquid under pressure.

5. Instantaneous release results in a puff of finite volume described by the puff model for atmospheric dilution in Appendix B of Regulatory Guide 1.78.

6. The diffusion equation for an instantaneous (puff) ground level release used in the program was taken directly from Appendix B of Regulatory Guide 1.78. The "y" and "z" terms in the diffusion equation were assumed to be zero. This assumption centers the puff at the control room intake in the horizontal crosswind and vertical directions.

   The relationship $x = D - ut$ as defined in Appendix B of Regulatory Guide 1.78 was directly substituted for the "x" term in the equation.

7. The value calculated by the equation represents the chemical concentration at the intake to the control room. The program uses the concentration at the intake and the control room ventilation characteristics to determine the chemical concentration inside the control room. Concentration levels are calculated for various equally spaced wind speeds up to the maximum wind speed supplied as inputs into the program.

The HAZCHEM program for liquid spills uses the diffusion equation of Regulatory Guide 1.78 in the same manner as the program for gaseous releases. The same assumptions apply, except the chemical is assumed to be a liquid at ambient conditions. The mass of chemical vaporized is calculated as a function of the spill radius, molecular weight, density, vapor pressure, molecular diffusivity in air of the chemical, and ambient temperature and pressure. The spill radius may be input directly or calculated by the program from input values for spill thickness, chemical surface tension, viscosity, density and diffusivity. As in the HAZCHEM gas program, all necessary chemical properties, weather conditions, and ventilation values are given as inputs to the program.

As can be seen from the description of the HAZCHEM model, the assumptions made in the analysis are very conservative. The basic idea is, that if the accident occurs, it will occur in the worst possible way, and under the worst possible meteorological conditions, such that the effects on the control room habitability will be worse than what would be anticipated.

BUTANE, PROPYLENE, AND BUTENE

Toxicity information was obtained from Irving Sax's Dangerous Properties of Industrial Materials (third edition), one of the most widely accepted toxicity references (Reference 3). Regulatory Guide 1.78 states that simple asphyxiants (defined by Sax as chemicals that have no specific toxic effects but act by displacing oxygen in the lungs) may be eliminated from consideration unless "a significant fraction of the control room air could be displaced as a result of their release". According to Sax, up to a third of the air in a room can be displaced by a simple asphyxiant before a human being will experience adverse effects. If released, none of the asphyxiants on Table 2 will enter the control room in sufficient amounts to displace one-third of the air. Butane and propylene are described by Sax as simple asphyxiants and can be eliminated from further consideration.

Toxicity information for butene [Liquefied Petroleum Gas (Butene Gas Liquefied)] was taken from Matheson Gas Data Book (Reference 4). The reference describes the various types of butene (1-butene, 2 -butene, etc.) as simple asphyxiants. On the basis of this information, butene was also eliminated.

ISOBUTANE, PROPANE, AND LPG

Several chemicals were eliminated from consideration on the basis of toxicity information in Sax's reference. Sax evaluates the toxicity of each chemical on the basis of a numerical scale ranging from 1 to 3 where 1 = slight toxicity, 2 = moderate toxicity, and 3 = severe toxicity. Sax also gives threshold limit values (TLV) for many chemicals, indicating the maximum concentration of a chemical to which a human can be safely exposed for several hours daily over long periods of time. The toxicity limit for an acute exposure (as in the case of a toxic chemical spill) would be much higher than the TLV. Any chemicals with an acute systemic toxicity rating of only 1 due to inhalation or as an irritant were not considered sufficiently toxic to warrant further investigation. Chemicals with a toxicity rating of 1 are slightly toxic. They cause slight changes which are readily reversible and disappear after the end of the exposure. Isobutane and propane met this qualification. A toxicity rating was not given for liquid petroleum gas (described by Sax as "Toxicity: unknown. May act as a simple asphyxiant"). However, Sax listed a TLV for liquid petroleum gas (LPG) of 1000 ppm, which is equal to that of propane and implies a high threshold of human tolerance. Therefore, LPG was not considered to be sufficiently toxic to warrant further analysis.

SULFURIC ACID, MONOETHANOLAMINE, CORROSIVE LIQUID N.O.S.*, AND SODIUM NITRATE

Regulatory Guide 1.78 states that liquids with vapor pressures less than 10 torr may be eliminated from further consideration. Sulfuric acid, monoethanolamine, and corrosive liquid n.o.s. (either sulfuric acid or sodium hydroxide) all have vapor pressures less than 10 torr at 100°F. Sodium nitrate was eliminated from consideration because it is a solid at ambient temperatures.

PROPYLENE OXIDE, VINYL ACETATE AND CARBON TETRACHLORIDE

Propylene oxide, vinyl acetate and carbon tetrachloride are toxic materials and were therefore evaluated by the HAZCHEM program. The HAZCHEM results showed that insufficient amounts of any of the three chemicals would reach the control room following a railcar spill to be hazardous for acute exposures (see Table 3).

PETROLEUM NAPHTHA AND FORMALDEHYDE

Petroleum naphtha is a mixture of hydrocarbons which, from a DOT classification (Reference 7), consists of pentane, hexane and heptane. The largest shipment of petroleum naphtha was 97 tons. The HAZCHEM program was run for 97 ton release of each of the three hydrocarbons. Insufficient amounts of any of the three hydrocarbons would reach the control room following a railcar spill to be hazardous (see Table 3).

Formaldehyde is a gas, but is shipped an aqueous solution between 37% and 50%. The 37% solution is known as formalin and is the most common form of shipment. The largest shipment of formaldehyde solution was 98 tons. The HAZCHEM program was run for 98 ton releases of the 37% and 50% solutions. Insufficient amounts of either of the solutions would reach the control room following a railcar spill to be hazardous (see Table 3).

DENATURED ALCOHOL AND ALCOHOL N.O.S.

Denatured alcohol is a generic category that includes mixtures of ethyl alcohol with any of a wide number of denaturants. Usually, the weight percentage of ethyl

*N.O.S. = Not otherwise specified (in the Standard Transporation Commodity Code).

alcohol falls within the range of 80 to 99%. Alcohol n.o.s. was described in the railroad shipment data as "ethyl alcohol, anhydrous, denatured in part with petroleum products and/or chemicals, not to exceed 5%." Because alcohol n.o.s. seems to be nothing more than denatured alcohol with a maximum limit placed on denaturant concentrations, the two alcohol groups were evaluated under the common category of denatured alcohol. The maximum car weight in either category is 100 tons.

The HAZCHEM program, was run for a 100 ton release of pure ethyl alcohol. The ethyl alcohol was shown to present no toxic hazard to the control room operator (see Table 3); therefore, an investigation of the toxicity of the specific denaturants used in each type of denatured alcohol was required. The toxicity of a denaturant mixed with ethyl alcohol should not exceed the toxicity of the same denaturant in its pure form. The toxicity literature (References 3,13) for denatured alcohol supports this statement by referring the reader to toxicity information for the individual denaturants.

Because the ICG Railroad was unable to provide information on the composition of denatured alcohol shipped on the Gilman Line, all types of denaturants were evaluated. Several suppliers of denatured alcohol were contacted and asked to provide information on the denaturants used in their products. Several dozen chemicals were found to be used as denaturants; however, many are added to ethyl alcohol in quantities less than 1% by weight and were therefore eliminated from consideration. Of the denaturants used in quantities greater than 1%, the following are considered to be toxic chemicals.

Chemicals	Maximum Percent by Weight Found in Denatured Alcohol Literature
Benzene	5.27%
Butyl Alcohol	2.79%
Chloroform	8.5%
Ethyl Ether	8.15%
Formaldehyde	4.37%
Heptane	5%
Methyl Alcohol	17%
Methyl Isobutyl Ketone	5%
Toluene	5.07%

Raoult's Law states that the partial pressure of a component in a solution can be approximated by the product of the vapor pressure of the pure component and the mole fraction of the component in solution. Therefore, the rates of evaporation of the denaturants listed above should vary with

the vapor pressure of the pure denaturant and the weight percent in the denatured alcohol solution. The denaturant with the highest vapor pressure in its pure form would be expected to result in the highest control room concentrations when released as part of a denatured alcohol solution.

A HAZCHEM computer run was performed for the release of only the denaturant with the highest vapor pressure. Releases of varying quantities corresponding to the varying weight percents of each denaturant were evaluated. The calculated concentration at the control room intake for the denaturant with the highest vapor pressure was compared with the toxicity limit for acute exposure for each of the denaturants on the preceding list. If the calculated concentration of the worst case denaturant did not exceed the toxicity limit for any of the nine denaturants under consideration, then denatured alcohol could be determined to be non-hazardous to control room habitability.

Formaldehyde in its pure form would have the highest vapor pressure of the nine denaturants under consideration; however, a chemical manufacturer provided the information (Reference 9) that only solutions of formaldehyde in water (usually 37% formaldehyde) would be added to alcohol as denaturants. A formaldehyde-water solution has a lower vapor pressure than ethyl alcohol and would not be expected to evaporate rapidly. Methyl alcohol, therefore, has the highest vapor pressure of the nine denaturants under investigation.

A HAZCHEM run was completed for releases of methyl alcohol in quantities corresponding to the maximum weight percents of each denaturant. The toxicity limits were not exceeded for any of the nine denaturants (see Table 4). Therefore, denatured alcohol and alcohol n.o.s. have been determined to present no toxic hazards to the Clinton control room.

ANHYDROUS AMMONIA AND BROMINE

Anhydrous ammonia and bromine, the only chemicals remaining from Table 2, are toxic and were evaluated by the HAZCHEM program. The HAZCHEM results showed that either chemical renders the control room uninhabitable if a railcar containing the maximum shipment quantity should spill its entire contents. These two chemicals required further evaluation to determine if a significant probability existed for an unacceptable transportation accident.

PROBABILITY RISK ASSESSMENT - Reference 10 (NUREG-0800), Section 2.2.3) provides criteria for determining if a toxic release need be considered a design basis event. Specifically, NUREG-0800 states:

> "The probability of occurrence of the initiating events leading to potential consequences in excess of 10 CFR Part 100 exposure guidelines should be estimated using assumptions that are as representative of the specific site as is practicable. In addition, because of the low probabilities of the events under consideration, data are often not available to permit accurate calculation of probabilities. Accordingly, 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."

The risk assessment analysis in this report employs two conservative and cross-checking methods to calculate the probability of a railcar rupture and toxic material release serious enough to affect the habitability of the CPS Control Room.

The first probability calculation is a function of the probability of release per car mile and the shipping frequency in cars per year. The probability of releases per year of a railcar carrying hazardous materials is:

$$Pa = Pr(C) \times F(C) \times \sum_{D=1}^{8} L(D) \times Pw(D) \quad (1)$$

where:

Pa = probability of accident $[\frac{\text{releases}}{\text{year}}]$

$Pr(C)$ = probability of release $[\frac{\text{releases}}{\text{car mile}}]$

$F(C)$ = frequency of shipment $[\frac{\text{cars}}{\text{year}}]$

$L(D)$ = length of track under consideration (function of wind direction) [miles]

$Pw(D)$ = probability that a wind of any stability class and any velocity class is blowing in a direction such that a toxic chemical release is carried toward the control room air intake (function of wind direction) [dimensionless]

D is the direction from which the wind is blowing (W, WNW, etc.). Only those eight wind directions from

which a wind could blow from the railroad towards the plant were included (see Figure 2).

The second probability calculation is a function of the probability of release per ton mile and the shipping frequency in tons per year. The probability of release per year of a railcar carrying hazardous material is:

$$Pa = Pr(T) \times F(T) \times \sum_{D=1}^{8} L(D) \times Pw(D) \quad (2)$$

where:

Pa, L(D), Pw(D), and D are as defined before and,

$Pr(T)$ = probability of release $[\frac{\text{releases}}{\text{ton mile}}]$

$F(T)$ = frequency of shipment $[\frac{\text{tons}}{\text{year}}]$

For the purpose of the probability calculations, minor releases are excluded because they do not threaten control room habitability. The release probabilities used include major releases; those releases expected to threaten control room habitability by being capable of causing at least $5000 in damages (loss of lading, property damage, cleanup crew, etc.). The assumption of using accident frequencies with damages of at least $5000 is reasonable since nearly all hazardous materials are shipped in quantities which are worth at least $5000. Loss of lading alone would exceed the $5000 criteria, exclusive of damage or emergency response effort costs.

From Tables 5 and 6, anhydrous ammonia, classified as a non-flammable gas, has accident (release) frequencies of:

$$Pr(C) = 0.019 \times 10^{-6} \ [\frac{\text{releases}}{\text{car mile}}]$$

$$Pr(T) = 0.27 \times 10^{-9} \ [\frac{\text{releases}}{\text{ton mile}}]$$

From Table 2, anhydrous ammonia has shipping frequencies of:

$$F(C) = 37 \ [\frac{\text{cars}}{\text{year}}]$$

$$F(T) = 3,119 \ [\frac{\text{tons}}{\text{year}}]$$

From Table 7:

$$\sum_{D=1}^{8} L(D) \times Pw(D) = 0.5769 \ [\text{miles}]$$

Using equation (1), the probability of an anhydrous ammonia release is:

$$Pa = Pr(D) \times F(C) \times \sum_{D=1}^{8} L(D) \times Pw(D) \quad (1)$$

Substituting data:

$$Pa = 0.019 \times 10^{-6} \left[\frac{\text{releases}}{\text{car mile}}\right] \times 37 \left[\frac{\text{cars}}{\text{year}}\right] \times 0.5769 \text{ miles}$$
$$= 4.06 \times 10^{-7} \left[\frac{\text{releases}}{\text{year}}\right]$$

Using equation (2), the probability of an anhydrous ammonia release is:

$$P_a = P_r(T) \times F(T) \times \sum_{D}^{8} L(D) \times P_w(D) \quad (2)$$

Substituting data:

$$P_a = 0.27 \times 10^{-9} \left[\frac{\text{releases}}{\text{ton mile}}\right] \times 3119 \left[\frac{\text{tons}}{\text{year}}\right] \times 0.5769 \text{ miles}$$
$$= 4.86 \times 10^{-7} \left[\frac{\text{releases}}{\text{year}}\right]$$

Similar calculations are made for bromine. From Tables 5 and 6, bromine, classified as a corrosive, has accident (release) frequencies of:

$$Pr(C) = 0.090 \times 10^{-6} \left[\frac{\text{releases}}{\text{car mile}}\right]$$

$$PR(T) = 1.10 \times 10^{-9} \left[\frac{\text{releases}}{\text{ton mile}}\right]$$

From Table 2, bromine has shipping frequencies of:

$$F(C) = 34 \left[\frac{\text{cars}}{\text{year}}\right]$$

$$F(T) = 1{,}340 \left[\frac{\text{tons}}{\text{year}}\right]$$

From Table 7:

$$\sum_{D=1}^{8} L(D) \times Pw(D) = 0.5769 \text{ miles}$$

Using equation (1), the probability of a bromine release is:

$$Pa = Pr(C) \times F(C) \times \sum_{D=1}^{8} L(D) \times Pw(D) \quad (1)$$

Substituting Data:

$$Pa = 0.090 \times 10^{-6} \left[\frac{\text{releases}}{\text{car mile}}\right] \times 34 \left[\frac{\text{cars}}{\text{year}}\right] \times 0.5769 \text{ miles}$$
$$= 1.77 \times 10^{-6} \left[\frac{\text{releases}}{\text{year}}\right]$$

Using equation (2), the probability of a bromine release is:

$$Pa = Pr(T) \times F(T) \times \sum_{D=1}^{8} L(D) \times Pw(D) \quad (2)$$

Substituting data:

$$Pa = 1.10 \times 10^{-9} \left[\frac{\text{releases}}{\text{ton mile}}\right] \times 1{,}340 \left[\frac{\text{tons}}{\text{year}}\right] \times$$
$$0.5769 \text{ miles} = 8.50 \times 10^{-7} \left[\frac{\text{releases}}{\text{year}}\right]$$

To summarize:

	RELEASE PROBABILITY	$\left[\frac{\text{release}}{\text{year}}\right]$
TOXIC MATERIAL	CAR-MILE BASIS	TON-MILE BASIS
Anhydrous Ammonia	4.06×10^{-7}	4.86×10^{-7}
Bromine	1.77×10^{-6}	8.50×10^{-7}

These probabilities demonstrate that the expected rates of occurrences for the initiating events leading to potential consequences in excess of 10 CFR Part 100 exposure guidelines are approximately 10^{-6} per year or less. These frequencies are acceptable if, when combined with reasonable qualitative arguments, the realistic probabilities can be shown to be lower.

The use of this probability assessment is conversative and the realistic probability can be shown to be lower because of following conservatisms:

1. No credit was taken in the release probabilities for the improved safety from recent tank car modifications. The release probability data were from 1971-77, before the tank car modifications were complete.

   Bromine is transported in tank car types 105A300W and 105A500W (49CFR173.252). All specification 105A (including 105A300W and 105A500W) tank cars built after February 28, 1981 are required to be equipped with a coupler restraint system. All specification 105 (including 105A300W and 105A500W) tank cars built before March 1, 1981 are required by 49CFR179.106 to be

equipped with a coupler restraint system by February 28, 1982.

Anhydrous ammonia is transported in tank car types 105A300W, 106A500-X, 112S340-W, 112S400F, 114A340-W and 114S340-W (49CFR173.314). All specification 105A (including 105A300W) tank cars shall meet the design requirements described above. In addition, each 105 (including 105A300W) tank car used to transport ammonia built after August 31, 1981 shall be class 105S. This change would require the car to be additionally equipped with a tank head puncture resistance system.

All specification 112 and 114 tank cars are required to be equipped as follows:

SPECIFICATION	REQUIREMENT
114A (including 114A340-W)	coupler restraint system
112S and 114S (including 112S340-W, 112S400F, and 114S340-W)	coupler restraint system and tank head puncture resistance system

Tank cars 114A, 112S and 114S built after December 31, 1977 shall be built with these requirements.

Tank cars 114A, 112S and 114S built before January 1, 1978 shall be equipped with a coupler restraint system after December 31, 1978. Tank cars 112S and 114S built before January 1, 1978 shall be equipped with a tank head puncture resistance system by December 31, 1979.

The impact of these safety modifications for reducing future tank car ruptures were not reflected in the release probabilities used in the risk assessment.

2. No credit was taken for unstable winds. Stability classes A, B and C were considered even through these Pasquill Categories result in highly unstable atmospheric conditions that would not be conducive to a slow diffusion of the toxic chemicals.

3. No credit was taken for the effects of the lake. One control room air intake faces Lake Clinton. A significant impact of the lake will be the warm surface it presents to the atmosphere which, during nighttime and the winter, will be significantly warmer than the surrounding ground. This increase in temperature will cause the layer of air in contact with the lake to achieve a neutral lapse rate, especially when stable conditions prevail over the land.

Thus, material released from a ground-level source would receive additional diffusion in the vertical over the lake
than would be computed using a stable delta T stability category determined from the meteorological tower.

4. No credit was taken for operator incapacitation events that would not result in exposures in excess of 10 CFR 100 guidelines. This analysis assumed all such events resulted in an overexposure. There is precedent for assuming that only one out of ten operator incapacitation events would result in an overexposure (see Reference 12, Control Room Habitability Study, Beaver Valley Station).

Since the probability analysis used a conservative approach with conservative data and since the calculated probability of toxic releases were approximately 10^{-6} per year or less, anhydrous ammonia and bromine releases need not be considered as design basis accidents.

III. CONCLUSION

This study demonstrated that all hazardous materials shipped via rail in the vicinity of the CPS were evaluated for their toxic potential on control room habitability. Each hazardous material was systematically evaluated and eliminated based on shipping frequency, potential toxicity or probability risk assessment.

Based on this study, releases of hazardous materials shipped by rail in the vicinity of CPS need not be considered as design basis accidents.

IV. REFERENCES

1. "Safety Evaluation Report related to the operation of Clinton Power Station, Unit No. 1"; NUREG-0853; February 1982 (CPS-SER).

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11. Nayak, P. R. and D. W. Palmer, Issues and Dimensions of Freight Car size: A Compendium, U.S. Department of Transportation, Federal Railroad Administration Report No. FRA/ORD-79/56, October, 1980.

12. "Control Room Habitability Study, Beaver Valley Power Station Units Nos. 1 and 2," prepared for Duquesne Light Company, by Stone and Webster Engineering Corporation, December 1, 1981.

13. Material Safety Data Sheets supplied by manufacturers for each chemical.

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TABLE 1

HAZARDOUS MATERIAL SHIPMENTS OVER THE
ILLINOIS CENTRAL GULF-GILMAN LINE,
12/1/81 to 11/30/82

STCC No.	Description of Commodity	Carloads	Total Tons
	NONFLAMMABLE COMPRESSED GAS:		
4904210	Anhydrous Ammonia	37	3,119
4904509	Carbon Dioxide, Liquefied	1	99
	FLAMMABLE COMPRESSED GAS:		
4905702	Butane (butane, impure for further refining)	9	675
4905703	Butadiene, inhibited (butadiene, impure for further refining)	1	75
4905706	Butane	443	31,146
4905707	Liquefied Petroleum Gas (butene gas liquefied)	345	24,459
4905711	Liquefied Petroleum Gas (butylene, impure for further refining)	13	875
4905741	Liquefied Petroleum Gas (NIC)	1	75
4905747	Isobutane	793	57,001
4905748	Isobutylene	1	75
4905750	Isobutane (Isobutane for further refinery processing)	8	523
4905752	Liquefied Petroleum Gas	885	61,816
4905761	Methyl Chloride	3	141
4905781	Propane	164	11,559
4905782	Propylene	801	57,132
4905785	Trifluorochloroethylene	1	75
4905792	Vinyl Chloride	4	300

TABLE 1

HAZARDOUS MATERIAL SHIPMENTS OVER THE ILLINOIS CENTRAL GULF-GILMAN LINE, 12/1/81 to 11/30/82

STCC No.	Description of Commodity	Carloads	Total Tons
	FLAMMABLE LIQUID:		
4906070	Pyrophoric Liquid	6	350
4906610	Ethylene Oxide	12	915
4906620	Propylene Oxide	77	5,164
4907215	Ethyl Acrylate, inhibited	5	443
4907230	Isoprene	6	440
4907270	Vinyl Acetate	137	10,769
4907420	Epichlorohydrin	17	1,219
4907846	Morpholine	4	316
4908105	Acetone	3	170
4908110	Benzene (benzol)	6	460
4908120	Butylamine	1	50
4908183	Hexane	6	363
4909110	Alcohol, N.O.S. (ethyl alcohol, anhydrous, denatured in part with petroleum products and/or chemicals not to exceed five percent)	60	4,817
4909117	Butyl Alcohol (n-butyl alcohol (butyric alcohol or 1-butanol))	2	157
4909130	Butyl Alcohol (tert-butyl alcohol)	1	94
4909131	Butyl Alcohol (isobutyl alchol)	1	67
4909141	Denatured Alcohol	56	3,874
4909149	Diacetone Alcohol	1	85
4909160	Ethyl Acetate	2	143
4909183	Flammable Liquid, N.O.S. (acrylamide solution)	1	65

TABLE 1

HAZARDOUS MATERIAL SHIPMENTS OVER THE ILLINOIS CENTRAL GULF-GILMAN LINE, 12/1/81 to 11/30/82

STCC No.	Description of Commodity	Carloads	Total Tons
4909190	Heptane	3	181
4909193	Hexane (NIC)	1	65
4909205	Isopropanol	17	1,123
4909207	Isobutyl Acetate	1	97
4909230	Methanol (methyl alcohol, wood alcohol, columbian spirits)	2	140
4909243	Methyl Ethyl Ketone	1	77
4909245	Flammable Liquid, N.O.S. (Methyl Isobutyl Ketone)	1	70
4909305	Toluene	8	458
4909330	Methylcyclohexane	1	80
4909350	Xylene	26	1,754
4910157	Compound, Tree (or) Weed Killing Liquid	1	50
4910185	Flammable Liquid, N.O.S.	6	438
4910245	Oil, N.O.S. Petroleum	2	101
4910258	Petroleum Distillate	1	50
4910259	Petroleum Naphtha	20	1,439
4910280	Resin Solution	2	80
4910285	Road Asphalt or Tar, Liquid	1	88
4910442	Flammable Liquid, N.O.S. (rosin liquor)	1	41
4910444	Flammable Liquid, N.O.S. (rosin solution)	1	100

TABLE 1

HAZARDOUS MATERIAL SHIPMENTS OVER THE ILLINOIS CENTRAL GULF-GILMAN LINE, 12/1/81 to 11/30/82

STCC No.	Description of Commodity	Carloads	Total Tons
	COMBUSTIBLE LIQUID:		
4912215	Combustible Liquid, N.O.S. (butyl acrylate)	3	284
4913103	Alcohol, N.O.S.	7	393
4913116	Ethlene Glycol Monoethyl Ether	1	45
4913121	Alcohol, N.O.S. (decyl alcohol, other than perfumery grade)	1	50
4913126	Alcohol, N.O.S. (hexyl alcohol, other than perfumery grade)	1	50
4913143	Alcohol, N.O.S. (methyl isobutyl carbinol)	2	152
4913144	Formaldehyde (or) formalin solution (in containers over 100 gallons)	38	3,227
4913162	Ethylene Glycol Monomethyl Ether	2	158
4913179	Combustible Liquid, N.O.S. (cyclohexanone)	4	285
4913183	Combustible Liquid, N.O.S. (methylethanolamine)	1	50
4913194	Combustible Liquid, N.O.S. (glycol ethers)	9	706
4915112	Fuel Oil No. 1, 2, 4, 5 (or) 6	20	1,316
4915185	Combustible Liquid, N.O.S.	3	130
4915229	Combustible Liquid, N.O.S. (lubricating oil, nec)	1	45
4915239	Naphtha	1	67
4915240	Naphtha Distillate	6	410

TABLE 1

HAZARDOUS MATERIAL SHIPMENTS OVER THE ILLINOIS CENTRAL GULF-GILMAN LINE, 12/1/81 to 11/30/82

STCC No.	Description of Commodity	Carloads	Total Tons
4915242	Combustible Liquid, N.O.S. (petroleum lubricating oil)	6	318
4915245	Oil, N.O.S. Petroleum Oil	14	703
4915253	Varnish (asphaltum or coal tar varnish)	1	75
4915257	Petroleum Distillate (petroleum distillate fuel oil, not for illuminating purposes)	2	90
4915258	Petroleum Distillate	1	67
4915259	Petroleum Naphtha	47	3,468
4915263	Tar, Liquid (tar or pitch, coal or petroleum)	8	600
4915302	Combustible Liquid, N.O.S. (asphalt pavement surface sealer, asphalt, coal tar or petroleum base)	2	177
4915401	Alcohol, N.O.S. (alcohol distillates, synthetic)	1	65
4915490	Combustible Liquid, N.O.S. (aromatic concentrates, suitable only for further processing)	9	655
4915535	Combustible Liquid, N.O.S. (additives, fuel oil, gasoline or lubricating oil, containing less than 50% by weight of petroleum)	6	440
	FLAMMABLE SOLIDS:		
4916141	Phosphorus, white or yellow in water	2	100
	OXIDIZING MATERIALS:		
4918335	Hydrogen Peroxide Solution (over 52% peroxide)	20	1,103
4918746	Sodium Nitrate	34	1,980

TABLE 1

HAZARDOUS MATERIAL SHIPMENTS OVER THE ILLINOIS CENTRAL GULF-GILMAN LINE, 12/1/81 to 11/30/82

STCC No.	Description of Commodity	Carloads	Total Tons
	POISONS B:		
4921220	Carbolic Acid (or) phenol	3	225
4921445	Motor Fuel Antiknock Compound (or) antiknock compound	9	459
4021466	Orthonitroaniline	7	388
4921575	Toluene Diisocyanate	8	594
	RADIOACTIVE MATERIALS:		
4926252	Radioactive Material (Maleic Anhydride Molten Acid Corrosive)(NIC)	1	92
	CORROSIVE MATERIALS:		
4930024	Hydrofluoric Acid, Anhydrous (or) Hydrogen Fluoride	20	1,703
4930040	Sulfuric Acid	156	13,831
4930042	Sulfuric Acid, Spent	4	261
4930204	Chlorosulfonic Acid	8	424
4930228	Hydrochloric Acid (muriatic (hydrochloric) acid)	6	579
4930247	Phosphoric Acid (phosphoric fertilizer solution, containing not more than 77% of phosphoric anhydride by weight)	18	1,554
4930248	Phosphoric Acid	16	1,299
4931303	Acetic Acid, glacial	5	423
4931405	Acrylic Acid	7	529
4932380	Sulfur Chloride (mono and di)	3	254

TABLE 1

HAZARDOUS MATERIAL SHIPMENTS OVER THE ILLINOIS CENTRAL GULF-GILMAN LINE, 12/1/81 to 11/30/82

STCC No.	Description of Commodity	Carloads	Total Tons
4935220	Alkaline liquid, N.O.S.	1	89
4935223	Alkaline liquid, N.O.S. (fatty alcohols, aliphatic or cyclic, cyanoethylated and hydrogenated and derivatives thereof, such as salts, diamines, oxyalkylates and quarternary ammonium compounds)	1	75
4935230	Potassium Hydroxide, liquid (or) solution	6	371
4935235	Sodium Hydroxide, dry solid, flake bead, (or) granular (sodium caustic)	1	37
4935240	Sodium Hydroxide, liquid, (or) solution	4	349
4935243	Sodium Hydroxide, liquid, (or) solution (caustic sodium (sodium hydroxide) containing not less than 48% water by weight in solution)	4	303
4935245	Sodium Hydroxide, liquid (or)solution (caustic soda and caustic potash, mixed in solution)	3	155
4935268	Sodium Hydrosulfide, solution	3	150
4935665	Monoethanolamine	44	3,391
4936110	Bromine	34	1,340
4936515	Compound, cleaning liquid	1	75
4936516	Compound, cleaning liquid (cleaning compounds, iron or steel, nec, liquid)	1	30
4936520	Compound, cleaning, liquid (containing phosphoric or acetic acid)	1	75
4936539	Corrosive Liquid, N.O.S. (petroleum refinery sulfide waste)	2	125

TABLE 1

HAZARDOUS MATERIAL SHIPMENTS OVER THE ILLINOIS CENTRAL GULF-GILMAN LINE, 12/1/81 to 11/30/82

STCC No.	Description of Commodity	Carloads	Total Tons
4936540	Corrosive Liquid, N.O.S.	34	2,621
4936565	Alkaline Battery Fluid packed with battery charger, radio current supply device (or) electronic equipment and actuating device.	2	82
	OTHER REGULATED MATERIAL-GROUP A:		
4940320	Carbon Tetrachloride	185	15,560
4940335	Ethylene Dibromide (or) 1, 2 - dibromoethane	1	50
4940341	Formaldehyde (or) formalin solution (in containers of 110 gallons or less)	1	95
	GROUP B:		
4950110	Acids, Chemicals, and Other Articles, Mixed Loads	1	20
	GROUP E:		
4962356	Naphthenic Acid	2	92
4966110	Adipic Acid	2	156

TABLE 2

HAZARDOUS MATERIALS SHIPMENTS WITH A FREQUENCY OF 30 OR MORE CARS PER YEAR OVER THE ILLINOIS CENTRAL GULF-GILMAN LINE, 12/1/81 TO 11/30/82

STCC No.	Description of Commodity	Carloads	Tons
4904210	Anhydrous Ammonia	37	3,119
4905706	Butane	443	31,146
4905707	Liquefied Petroleum Gas (butene gas, liquefied)	345	24,459
4905747	Isobutane	793	57,001
4905752	Liquefied Petroleum Gas	885	61,816
4905781	Propane	164	11,559
4905782	Propylene	801	57,132
4906620	Propylene Oxide	77	5,164
4907270	Vinyl Acetate	137	10.769
4909110	Alcohol, N.O.S. (ethyl alcohol, anhydrous, denatured in part with petroleum products and/or chemicals not to exceed five percent)	60	4,817
4909141	Denatured Alcohol	56	3,874
4913144	Formaldehyde (or) formalin solution (in containers over 100 gallons)	38	3,227
4915259	Petroleum Naphtha	47	3,468
4918746	Sodium Nitrate	34	1,980
4930040	Sulfuric Acid	156	13,831
4935665	Monoethanolamine	44	3,391
4936110	Bromine	34	1,340
4936540	Corrosive Liquid, N.O.S.	34	2,621
4940320	Carbon Tetrachloride	185	15,560

Explanation of Abbreviations, Words, and Symbols referred to in Tables 1 and 2

Words, Symbols, and Abbreviations	Explanation
BA	Blasting Agent
CFR	Code of Federal Regulations
CL	Combustible Liquid
CM	Corrosive Material
DOT	U.S. Department of Transportation
EA	Etiologic Agent
ETC	et cetera
FG	Flammable Gas
FL	Flammable Liquid
FS	Flammable Solid
HAZMAT	Hazardous Materials
ID	Identification
IR	Irritating Material
LSA	Low Specific Activity
NEC	Not Elsewhere Classified
NG	Non-Flammable Gas
NOS	Not Otherwise Specified
OA	Other Regulated Materials-Group A
OB	Other Regulated Materials-Group B
OE	Other Regulated Materials-Group E
OM	Oxidizing Material (Or) Oxidizer
OP	Organic Peroxide
PA	Poison A
PB	Poison B
PC	Product Class
RM	Radioactive Material
RQ	Reportable Quantity
STCC	Standard Transportation Commodity Code
TOFC	Trailer-On-Flat-Car
U.S.	United States
XA	Class A Explosive
XB	Class B Explosive
XC	Class C Explosice
%	Percent
NIC	Not In Code - commodity was coded with a STCC number which could not be identified from the STCC tariff. Commodity was assumed to be of the same family of nearest identified commodity by STCC number.

Table 3

HAZCHEM CALCULATIONS OF TOXIC CHEMICAL CONCENTRATIONS AT CLINTON STATION

CHEMICAL	AMOUNT OF * CHEMICAL EVALUATED	CONCENTRATION AT CONTROL ROOM INTAKE CALCULATED BY HAZCHEM	MAXIMUM ALLOWABLE CONCENTRATION FOR ACUTE EXPOSURES	REFERENCE/COMMENTS
Propylene Oxide	121 tons	0.843×10^{-4} lb/ft^3 (562 ppm)	0.22 10^{-3} lb/ft^3 (1500 ppm)	Reference 5
Vinyl Acetate	101 tons	0.171×10^{-4} lb/ft^3 (77 ppm)	No acute exposure limits were found	Reference 6 (reports it to be a "relatively non-toxic material.")
Carbon Tetrachloride	130 tons	0.442×10^{-4} lb/ft^3 (109 ppm)	0.609×10^{-3} lb/ft^3 (1500 ppm)	Reference 3
Pentane (Petroleum Naphtha)	97 tons	0.1707×10^{-3} lb/ft^3 (927 ppm)	0.221×10^{-3} lb/ft^3 (1200 ppm) = 2 x TLV**	Reference 7
Hexane (Petroleum Naphtha)	97 tons	0.5097×10^{-4} lb/ft^3 (232 ppm)	1.10×10^{-4} lb/ft^3 (500 ppm) = TWA**	Reference 7
Heptane (Petroleum Naphtha)	97 tons	0.2371×10^{-4} lb/ft^3 (95 ppm)	2.00×10^{-4} lb/ft^3 (800 ppm) = 2 x TLV**	Reference 7
37% Formaldehyde (Formalin)	98 tons	0.4496×10^{-7} lb/ft^3 (0.6 ppm)	7.49×10^{-7} lb/ft^3 (10 ppm)	References 2,
50% Formaldehyde	98 tons	0.5941×10^{-7} lb/ft^3 (0.8 ppm)	7.49×10^{-7} lb/ft^3 (10 ppm)	References 2,
Ethyl Alcohol	100 tons	0.497×10^{-5} lb/ft^3 (42 ppm)	0.587×10^{-3} lb/ft^3 (5000 ppm)	References 2,

* Maximum Shipping Weight from survey.

** If an acute exposure limit could not be found, a value of 2 x TLV (Threshold Limit Valve for an 8-hour, daily exposure) or the TWA (Time Weighted Average for lengthy exposure) was used. These valves are very conservative.

TABLE 4

HAZCHEM CALCULATIONS OF TOXIC CHEMICAL CONCENTRATIONS AT CLINTON STATION

CHEMICAL	AMOUNT OF CHEMICAL EVALUATED	CONCENTRATION AT CONTROL ROOM INTAKE CALCULATED BY HAZCHEM	MAXIMUM ALLOWABLE CONCENTRATION FOR ACUTE EXPOSURES
Methyl Alcohol (as a worst case for denatured alcohol)	100 tons	0.2234×10^{-4} lb/ft^3 (296 ppm)	2 x TLV* = 0.3015×10^{-4} lb/ft^3 (400 ppm)

DENATURED ALCOHOL: Concentrations at the control room intake for the following denaturants were estimated by scaling down the concentration for a 100-ton methyl alcohol spill to the maximum amount of each denaturant found in 100 tons of denatured ethyl alcohol.

DENATURANT	MAXIMUM % BY WEIGHT IN ETHYL ALCOHOL FOUND IN LITERATURE	CONCENTRATION AT CONTROL ROOM INTAKE FOR AN EQUIVALENT AMOUNT OF METHANOL	MAXIMUM ALLOWABLE CONCENTRATION FOR ACUTE EXPOSURES
Benzene	5.27%	13 ppm	2 x TLV* = 50 ppm
Butyl Alcohol	2.79%	7 ppm	2 x TLV* = 200 ppm
Chloroform	8.5%	12 ppm	2000 ppm
Ethyl Ether	8.15%	25 ppm	800 ppm
Formaldehyde	4.37%	8 ppm	10 ppm
Heptane	5%	16 ppm	2 x TLV* = 1000 ppm
Methyl Isobutyl Ketone	5%	14 ppm	2 x TLV* = 200 ppm
Toluene	5.07%	13 ppm	2 x TLV* = 400 ppm

* If an actue exposure limit could not be found, a value of 2 x TLV (Threshold Limit Value for an 8-hour, daily exposure) was used. This value is very conservative.

NOTE: All denaturant maximum allowable concentrations were taken from Reference 3, except for formaldehyde, which was taken from Reference 2.

TABLE 5

ACCIDENT FREQUENCIES PER MILLION CAR-MILES
FOR HAZARDOUS MATERIALS COMMODITIES

	DAMAGE THRESHOLD		
	$0	>$100	>$5000
Explosives	1.30	0.53	0.210
Non-Flammable Gas	1.00	0.15	0.019*
Flammable Gas	0.94	0.20	0.094
Flammable Liquid	1.20	0.32	0.110
Flammable Solid	0.69	0.17	0.058
Oxidizer	1.60	0.66	0.069
Organic Peroxide	1.40	1.40	-
Toxic	1.10	0.43	0.079
Radioactive	3.00	1.30	0.420
Corrosive	2.50	0.45	0.090**
All Hazardous Material	1.40	0.33	0.086

* ammonia is classified as a non-flammable gas

** bromine is classified as a corrosive

SOURCE: Materials Transportation Board Data 1971-77;
Arthur D. Little, Inc., Estimates

Excerpted from USDOT FRA/ORD-79/56 (Reference 11)

TABLE 6

ACCIDENT FREQUENCIES PER BILLION TON-MILES
FOR HAZARDOUS MATERIALS COMMODITIES

	Damage Threshold		
	\$0	>\$100	>\$5000
Explosives	26.0	13.0	4.30
Non-Flammable Gas	15.0	2.2	0.27*
Flammable Gas	13.0	2.7	1.30
Flammable Liquid	17.0	4.7	1.60
Flammable Solid	11.0	2.9	0.95
Oxidizer	21.0	8.8	0.91
Organic Peroxide	17.0	18.0	-
Toxic	18.0	7.3	1.30
Radioactive	66.0	28.0	9.40
Corrosive	31.0	5.6	1.10**
All Hazardous Material	20.0	4.7	1.20

* ammonia is classified as a non-flammable gas
** bromine is classified as a corrosive

SOURCE: Materials Transportation Board Data 1971-77;
Arthur D. Little Inc., Estimates

Excerpted from USDOT FRA/ORD-79/56 (Reference 11)

TABLE 7

Σ L(D) x Pw(D) CALCULATION

Track Segment	Segment Length L(D) (miles)+	Wind Direction D	Wind Probability* Pw(D) (dimensionless)	L(D) x Pw(D) (miles)
1	3.30	W	0.0770	0.2541
2	0.90	WNW	0.0792	0.0713
3	0.46	NW	0.0584	0.0268
4	0.34	NNW	0.0438	0.0149
5	0.35	N	0.0425	0.0149
6	0.45	NNW	0.0405	0.0182
7	0.80	NE	0.0528	0.0422
8	3.10	ENE	0.0434	0.1345
Total	9.70			0.5769

$$\Sigma \, L(D) \times Pw(D) = 0.5769 \text{ miles}$$

+Denotes length of track in wind direction section under consideration (see figure 2)

*Pw(D) = Probability that a wind of any stability class and any velocity class is blowing toward the control room air intake (from Table 8).

TABLE 8

JOINT FREQUENCY DISTRIBUTION

CLINTON POWER STATION

33 FT WIND — DISTRIBUTION OF WIND DIRECTIONS AND SPEEDS — 4/14/72 - 4/30/77

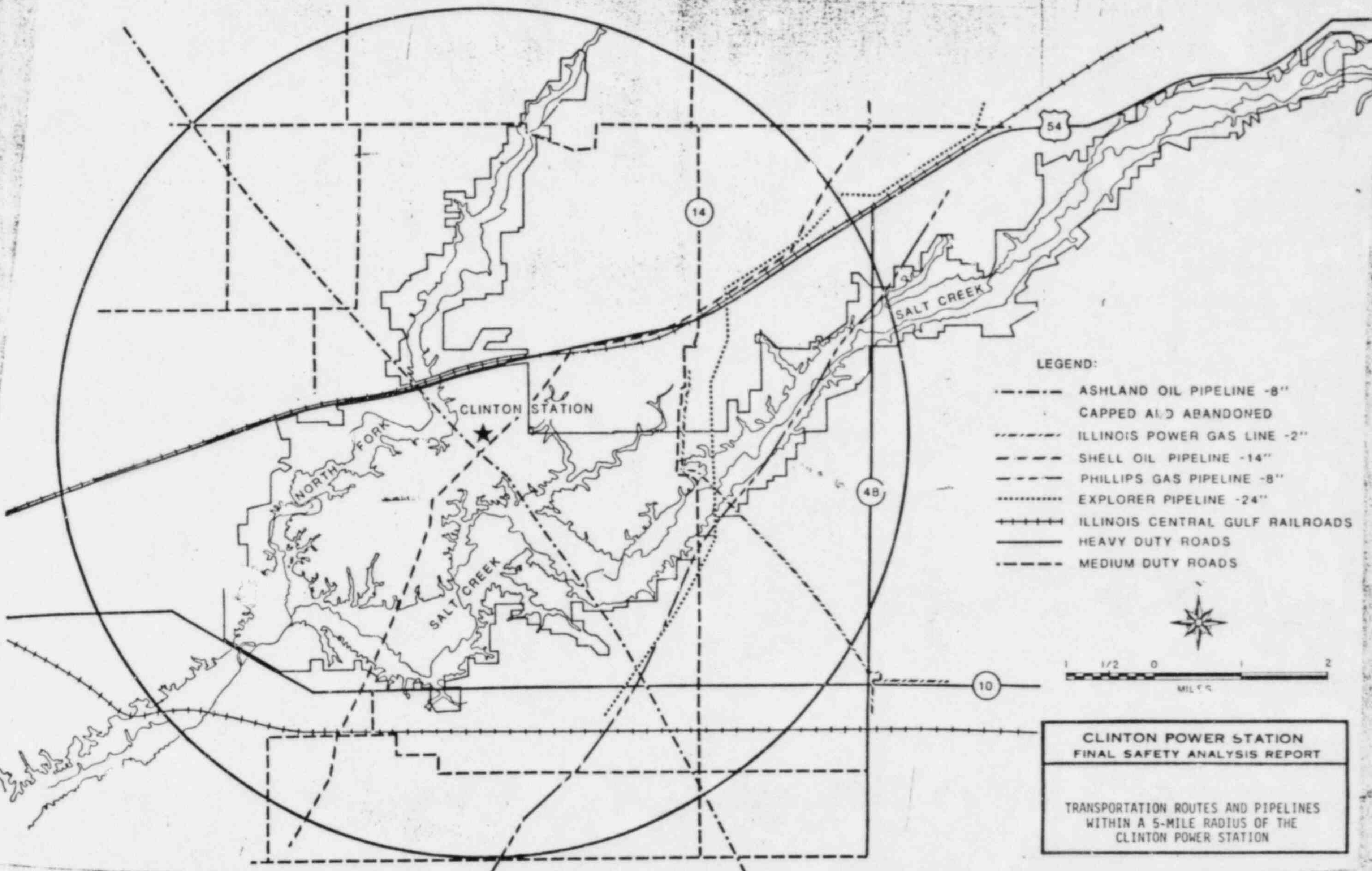
198-33 FT DELTA T — ALL STABILITIES COMBINED

SPEED (MPS)		DIRECTION																
		NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	TOTAL
0.3- 1.4		152	212	215	209	164	195	248	290	233	235	187	195	185	137	137	146	3140
	(1)	0.37	0.52	0.53	0.51	0.40	0.48	0.61	0.71	0.57	0.58	0.46	0.48	0.45	0.34	0.34	0.36	7.72
	(2)	0.37	0.52	0.53	0.51	0.40	0.48	0.61	0.71	0.57	0.58	0.46	0.48	0.45	0.34	0.34	0.36	7.72
1.5- 3.0		433	690	671	692	629	839	1033	1071	1054	912	654	635	703	594	433	434	11477
	(1)	1.06	1.70	1.65	1.70	1.55	2.06	2.54	2.63	2.59	2.24	1.61	1.56	1.73	1.46	1.06	1.07	28.21
	(2)	1.06	1.70	1.65	1.70	1.55	2.06	2.54	2.63	2.59	2.24	1.61	1.56	1.73	1.46	1.06	1.07	28.21
3.1- 5.0		538	599	568	575	554	618	911	1240	1319	1096	803	820	919	788	572	562	12472
	(1)	1.32	1.47	1.40	1.41	1.36	1.52	2.24	3.05	3.24	2.69	1.97	2.02	2.23	1.94	1.41	1.38	30.66
	(2)	1.32	[illegible]	1.40	1.41	1.36	1.52	2.24	3.05	3.24	2.69	1.97	2.02	2.23	1.94	1.41	1.38	30.66
5.1- 8.0		377	472	229	243	314	418	503	786	1080	834	673	937	1011	668	470	420	9635
	(1)	0.93	1.16	0.56	0.60	0.77	1.03	1.24	2.42	2.66	2.05	1.65	2.30	2.49	1.64	1.16	1.03	23.69
	(2)	0.93	1.16	0.56	0.60	0.77	1.03	1.24	2.42	2.66	2.05	1.65	2.30	2.49	1.64	1.16	1.03	23.69
8.1-10.4		96	79	19	20	37	51	64	233	227	183	228	339	280	134	131	106	2227
	(1)	0.24	0.19	0.05	0.05	0.09	0.13	0.16	0.57	0.56	0.45	0.56	0.83	0.69	0.33	0.32	0.26	5.47
	(2)	0.24	0.19	0.05	0.05	0.09	0.13	0.16	0.57	0.56	0.45	0.56	0.83	0.69	0.33	0.32	0.26	5.47
OVER 10.4		51	95	65	96	81	70	88	124	150	121	177	207	135	56	40	61	1617
	(1)	0.13	0.23	0.16	0.24	0.20	0.17	0.22	0.30	0.37	0.30	0.44	0.51	0.33	0.14	0.10	0.15	3.98
	(2)	0.13	0.23	0.16	0.24	0.20	0.17	0.22	0.30	0.37	0.30	0.44	0.51	0.33	0.14	0.10	0.15	3.98
ALL SPEEDS		1647	2147	1767	1835	1779	2191	2847	3944	4063	3381	2722	3133	3223	2377	1783	1729	40568
	(1)	4.05	5.28	4.34	4.51	4.37	5.39	7.00	9.70	9.99	8.31	6.69	7.70	7.92	5.84	4.38	4.25	99.73
	(2)	4.05	5.28	4.34	4.51	4.37	5.39	7.00	9.70	9.99	8.31	6.69	7.70	7.92	5.84	4.38	4.25	99.73

(1)=PERCENT OF ALL GOOD OBS FOR THIS PAGE
(2)=PERCENT OF ALL GOOD OBS FOR THE PERIOD

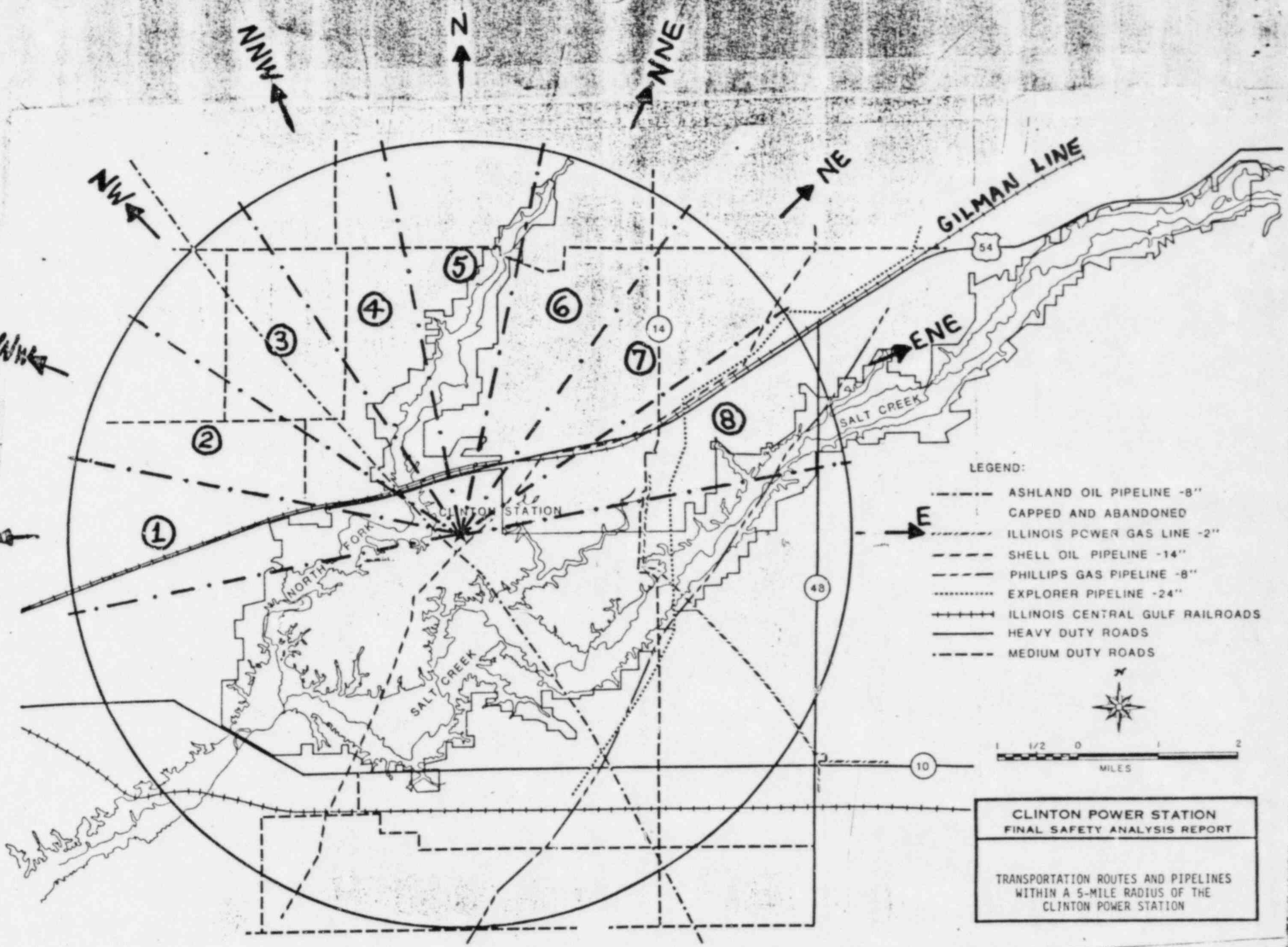
40677 GOOD HRS   109 HRS (0.3 PCT) LESS THAN 0.3 MPS   44208 HRS IN THE TIME PERIOD   92.0 PCT DATA RECOVERY

List of Figures



CLINTON STATION
NORTH FORK
SALT CREEK
SALT CREEK
14
54
48
10
LEGEND:
ASHLAND OIL PIPELINE -8"
CAPPED AND ABANDONED
ILLINOIS POWER GAS LINE -2"
SHELL OIL PIPELINE -14"
PHILLIPS GAS PIPELINE -8"
EXPLORER PIPELINE -24"
ILLINOIS CENTRAL GULF RAILROADS
HEAVY DUTY ROADS
MEDIUM DUTY ROADS
1 1/2 0 1 2
MILES
CLINTON POWER STATION
FINAL SAFETY ANALYSIS REPORT
TRANSPORTATION ROUTES AND PIPELINES
WITHIN A 5-MILE RADIUS OF THE
CLINTON POWER STATION

FIGURE 1


N
NNE
NNW
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GILMAN LINE
1
2
3
4
5
6
7
8
CLINTON STATION
NORTH FORK
SALT CREEK
SALT CREEK
54
14
48
10
LEGEND:
ASHLAND OIL PIPELINE -8"
CAPPED AND ABANDONED
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EXPLORER PIPELINE -24"
ILLINOIS CENTRAL GULF RAILROADS
HEAVY DUTY ROADS
MEDIUM DUTY ROADS
1 1/2 0 1 2
MILES
CLINTON POWER STATION
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FIGURE 2