Repro 8/20

August 20, 1982

Docket No. 50-237
LS05-82 -08-040

Mr. L. DelGeorge
Director of Nuclear Licensing
Commonwealth Edison Company
Post Office Box 767
Chicago, Illinois 60690

Dear Mr. DelGeorge:

SUBJECT: SEP TOPIC II-1.C, POTENTIAL HAZARDS DUE TO NEARBY TRANSPORTATION, INSTITUTIONAL, INDUSTRIAL AND MILITARY FACILITIES - DRESDEN UNIT 2

Enclosed is a revised copy of our final evaluation of SEP Topic II-1.C for Dresden Unit 2. This evaluation is based on the revised safety evaluation report (SAR) provided by your letter dated June 17, 1982. Based on the additional information contained in the SAR we have concluded that Dresden Unit 2 is adequately protected from offsite hazards.

This evaluation will be abbasic input to the integrated safety assessment for your facility unless you identify changes needed to reflect the as-built conditions at your facility. This assessment may be revised in the future if your facility design is changed or if NRC criteria relating to this subject are modified before the integrated assessment is completed.

SE04
DSU USE (16)

Sincerely,

Paul O'Connor, Project Manager
Operating Reactors Branch No. 5
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

OFFICE	SEPB:DL	SEPB:DL	SEPB:DL	ORB#5:PM	ORB#5:BC	AC:AD:SA:DL	
SURNAME	GCwalina:dk	CGrimes	WRussell	POConnor	DCMitchfield	TIppolito	
DATE	8/06/82	8/9/82	8/9/82	8/11/82	8/19/82	8/19/82	

Mr. L. DelGeorge

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DRESDEN UNIT 2
SYSTEMATIC EVALUATION PROGRAM
II-1.C, POTENTIAL HAZARDS DUE TO
NEARBY TRANSPORTATION INSTITUTIONAL INDUSTRIAL AND
MILITARY FACILITIES

I. INTRODUCTION

The safety objective of this topic is to ensure that the integrity of the safety-related structures, systems and components would not be jeopardized due to the potential for hazards originating at nearby facilities.

II. REVIEW CRITERIA

General Design Criterion 4, "Environmental and Missile Design Basis," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that nuclear power plant structures, systems and components important to safety be appropriately protected against events and conditions that may occur outside the nuclear power plant.

III. RELATED SAFETY TOPICS

Topic III-4.D, "Site Proximity Missiles" reviews the extent to which the facility is protected against missiles originating from offsite facilities.

IV. REVIEW GUIDELINES

The review was conducted in accordance with the guidance given in Standard Review Plan (SRP) Section 2.2.1-2.2.2, "Identification of Potential Hazards in Site Vicinity."

V. EVALUATION

1. Potential Hazards Due to Explosions

Industries within five miles of the plant and the products they handle and listed in Table 1. Figure 1 shows the locations of a representative sample of industrial sites in the vicinity of Dresden. According to Reference 37, none of the industries listed in Table 1 is licensed to store or use solid explosives (TNT, dynamite, tetryl, etc.). Based on available information, the following industries process, store, or transport flammable and/or explosive substances:

Reichhold Chemical Company
Northern Illinois Gas Company
ARMAK Chemicals

Durkee SCM Chemicals
Hydro-Carbon Transportation Incorporated
Mobil Chemical Company
Mobil Oil Corporation

Reichhold Chemical Company is located 1.6 miles west of the plant. The largest amount of flammable and/or explosive substances stored on-site is a 1.5 million gallon tank of benzene (Reference 29). Benzene is transported to the site by barges with a maximum capacity of 400,000 gallons. Based on R.G. 1.91, the safe standoff distance for a 400,000 gallon barge of benzene is 1.63 miles. Since the loading and unloading point of the plant is 1.6 miles from the Dresden site, and since hazards from transportation on waterways have been ruled out (See Section 2), it is concluded that the transportation of benzene to Reichhold Chemical Company does not pose a design basis hazard to the Dresden 2 station.

The safe standoff distance for the 1.5 million gallon tank of benzene at Reichhold Chemical is 2.5 miles, which exceeds the 1.6 mile separation distance. However, the tank is vented to prevent the formation of an explosive vapor-air mixture.

The Northern Illinois Gas Company plant near the Dresden site mainly produces supplemental natural gas (SNG) from petroleum products. According to Reference 8, the existing SNG plant is capable of producing four million cubic feet of gas per hour; however, the plant is virtually non-operational at this time.

ARMAK Industrial Chemical Division is located 3.6 miles from the plant. According to Reference 33, flammable and/or explosive materials are not stored or used in quantities of 100,000 gallons or more at the plant. Based on R.G. 1.91, the overpressure generated by the explosion of 100,000 gallons of any hydrocarbon is less than 1.0 psi at a distance of 3.6 miles. Therefore, this plant presents no hazard to Dresden station.

The Durkee SCM facility located 3.2 miles northeast of the Dresden plant produces edible oil. Based on Reference 34, 1,000,000 cubic feet of liquid hydrogen is stored in a single tank at the Dresden site. Using a hydrogen equivalency factor of 5.9 to calculate the equivalent weight of TNT, it was found that the corresponding safe standoff distance for which the detonation overpressure does not exceed 1.0 psi is 2.6 miles. Since the distance between Durkee and Dresden is greater than 2.6 miles, the stored hydrogen does not present a hazard to the plant.

Hydro-Carbon Transportation, Inc. operates an aboveground propane storage/underground ethane storage facility four miles from the plant (Reference 12). The propane tanks are equipped with 250 psi pressure relief valves; the maximum capacity of any tank is 90,000 gallons. Based on R.G. 1.91, it was found that the corresponding safe standoff distance for which the overpressure does not exceed 1.0 psi is 0.8 mile. Since the separation distance is greater than 0.8 mile, the propane storage facility does not present a hazard to plant safety.

The Mobil Chemical site stores styrene monomer; this is the only flammable material stored in large quantities. The largest amount of styrene monomer stored in a tank or transported in a barge is 1,200,000 gallons (Reference 15). Present plans for expansion include the installation of a 3,000,000 gallon styrene tank on the site. Using the approach for hydrocarbons given in R.G. 1.91, it was found that the safe standoff distance for which the overpressure caused by the simultaneous detonation of 3,000,000 gallons of styrene will not exceed 1.0 psi is 3.23 miles. Since the site is 4.1 miles from the plant, an accidental explosion at the existing or expanded storage facility does not present a hazard to the plant.

Mobil Oil Company's refinery is located on Interstate 55 approximately 4.5 miles northeast of Dresden station. Although the refinery stores various petroleum products typical of such a facility, Mobil Oil Company has stated that information on the types and quantities of products stored is confidential and may not be released to any party without the prior written consent of the company. However, based on the information provided informally by Mobil Oil, it is concluded that a sufficient separation distance (based on R.G. 1.91) exists for all petroleum products stored at the facility, with one exception. The standoff distance for this product slightly exceeds the available separation distance; however, the stored product has a high flash point, which eventually rules out the possibility of an explosion hazard from thise source at a distance of 4.5 miles.

Data provided by the following industries indicate that they do not process store, or transport flammable and/or explosive materials:

GE BWR Training Center & Spent Fuel Storage
A. P. Green (Reference 30)
Alumax Mill Products (Reference 32)
Airco Industrial Gases (Reference 31)

Responses to the licensee's inquiries from these industries show that no solid explosives (TNT, dynamite, tetryl, etc.) are stored or used at their sites.

Responses to the licensee's request for information on flammable and/or explosive substances were not provided by the following two industries:

Northern Petrochemical Company
(Northern Petrochemical Dock)
Dow Chemical Company
(Dow Chemical Dock)

For these industries, the staff has assumed the maximum quantity of TNT equivalent required to be stored at 3.3 miles (Northern Petrochemical) and 3.7 miles (Dow Chemical Company) to cause a reflected blast over-pressure of 1 psi and concluded that it is highly unlikely that this amount of material would be stored in any single tank or system. Based on this information and that supplied by other similar plants in the area, we conclude that specific information on these two industrial facilities is not required for our analysis.

The industries that responded to our request for information indicated that they have no plans for expansion, except for Mobil Chemical Company, whose expansion plans were described above and found to pose no hazard to plant safety.

It has also been determined that EXXON Corporation owns a facility located approximately 3.9 miles east northeast of Dresden station. However, it has not been possible to establish the function of this facility or the type of materials stored there at this time.

As shown in Figure 1, the major highways within five miles of the plant are Interstate 55, four miles east of the plant, and US Route 6, 1.9 miles north of the plant. The nearest secondary (country) road is Collins (or Goose Lake) Road, located approximately 0.5 mile south of the plant. The heaviest traffic is on Interstate 55, with a 24-hour annual average of 13,700 cars (Reference 1). Collins Road has a low rate of traffic, and would not be used by heavy trucks carrying explosive materials.

The worst event postulated according to R.G. 1.91 is the explosion of a truck carrying 40,000 lbs of TNT on the nearest road. It was found that the corresponding safe standoff distance for which blast overpressure does not exceed 1.0 psi is 1660 ft. Since the closest road is located more than 1660 ft from the Category I structures of the plant, we conclude that the transport of explosive materials on nearby roads does not present a hazard to plant safety.

There are three railroads within five miles of the plant. The Elgin, Joliet, and Eastern Railroad is located approximately 1.5 miles west of the plant and provides spur track access to the plant. The Atchison, Topeka, and Santa Fe, and the Gulf, Mobil, and Ohio Railroads are located approximately 3.9 miles south-east of the plant, and carry explosive material to and from the Joliet Army Ammunition Plant. The Chicago, Rock Island, and Pacific Railroad is located 3.7 miles northwest of the plant.

An accident which is postulated in RG 1.91 is the simultaneous explosion of three boxcar-loads of TNT (396,000 lbs) on the nearest railroad. It was found that the corresponding safe standoff distance for which blast overpressure will not exceed 1.0 psi is 0.63 mile. Since the nearest railroad is located more than 0.63 mile from the Category I structures of the plant, we conclude that the transport of explosive materials on nearby railroads does not present a hazard to plant safety.

The major rivers within five miles of the plant are the Illinois River, the Des Plaines River, and the Kankakee River. The Kankakee River joins the Des Plaines River east of the plant to form the Illinois River, which extends along the north boundary of the site. The closest navigational channel is on the Illinois River, located approximately 0.5 mile north of the plant. The closest river lock is the Dresden Island Lock, located approximately one mile northwest of the plant. The river traffic passing by the site consists mainly of cargo barges. Reference 11 lists the commodities that passed through the Dresden Island Lock over a period of six years. These commodities consisted mainly of coal, petroleum, steel, sludge, and agricultural products. Based on Ref. 6, no TNT is shipped on the Illinois River near the plant site. A review of the materials passing by the site area indicates that the worst event would be the explosion of an "empty" petroleum barge (one containing the vapors of the previous cargo) on the river 0.5 miles from the plant. For such an explosion to occur, it is assumed that the "empty" tank contains an adequate vapor-air mixture and that a proper detonating stimulus is applied to this mixture. Under these assumptions, the fuel vapor mass contained in a jumbo size (300' x 50' x 12') tank would be approximately 1,000 lbs. The corresponding distance at which the blast overpressure attenuates to 1.0 psi is approximately 600 ft, as determined using RG 1.91. Conservatisms in these calculations include the consideration of the largest volume tank and the use of a TNT equivalency factor of 240% for the mixture. Since the closest Category I structure (crib house) is located more than 600 ft from the Illinois River, we conclude that empty fuel barges do not present a hazard to plant safety.

The Joliet Army Ammunition Plant, the nearest boundary of which is located approximately four miles east of the Dresden Station, is used for storage of explosive materials from other installations, transported by way of the Santa Fe and the Illinois Central Gulf Railroads (Ref. 1). Based on Ref. 7, no explosive materials are stored within one mile of the eastern property line of the ammunition plant. Thus, the distance from Dresden Station to the storage area of the ammunition plant exceeds five miles. Therefore, we conclude that an accidental explosion at the Joliet Army Ammunition Plant will not affect Dresden Station.

Table 6 summarizes the size, operating pressure, and nearest distance for pipelines located within 5 miles of the plant (Refs. 1, 8, 12, 16, and 17). The potential for a postulated accidental leak or rupture and consequent explosion have been evaluated for pipelines in the vicinity of the plant. The first six pipelines listed in Table 6 pose the greatest potential hazard to the plant. The locations of these lines in relation to the Dresden site are shown in Figure 2. The other pipelines listed in Table 6 do not pose significant hazards to the plant because their diameters are smaller and they are more than two miles from the plant.

Because of the proximity of the pipelines to the Dresden safety-related structures, it is not possible to conclude that the peak overpressure would not exceed 1 psi. Therefore, the probability of exposure to pressure in excess of 1 psi was estimated, per RG 1.91.

The method of analysis used to calculate this probability follows the guidelines of the study presented in Ref. 14. Briefly, the factors included in this analysis are the break size and location, the gas release rate following the break, the plume rise and dispersion of the gas cloud under various meteorological conditions, the time from rupture to ignition, and the possibility of deflagration and explosion of the gas cloud.

Conservatism was ensured in determining the size of the resulting gas cloud by assuming 200% ruptures (i.e., double-ended flow), with the pipeline operating at maximum capacity.

The flow rate from a rupture pipe vs. the time from the start of gas release was obtained by prorating the previously calculated flow rate for a 22-inch diameter pipeline. The flow rate for the 22-inch pipeline was computed using the GASUS computer program (Ref. 15), for pipeline transients. This flow rate was proportionately increased for the areas and pressures of the pipes being analyzed. Independent calculation of steady state flow rates were made to validate the calculated flow rates.

It was found that as a result of rupture anywhere on the six gas pipelines within five miles of the plant, the probability of exceeding 1 psi blast overpressure is approximately 6.2×10^{-6} per year. If the release rate were computed for each pipeline using the GASUS program, lower release rates and lower probabilities of damage to the plant would have been obtained. Therefore, we conclude that Dresden Unit 2 is adequately protected from potential pipeline ruptures.

2. Potential Hazards Due to Vapor Clouds and Fires

Barge shipments of flammable and/or potentially explosive liquefied gases on the Des Plaines and Illinois Rivers may result in the formation of vapor clouds with consequent fire and/or explosion.

The Dresden safety-related structures are not at a safe distance from the river to support the conclusion that the 1 psi peak overpressure will not be exceeded if an accident occurs in the vicinity of the plant. Since the safe distance criterion is not satisfied, R.G. 1.91 requires the estimation of the probability of exposure to pressure in excess of 1 psi.

The method of analysis used to calculate this probability is presented in Reference 9. The input information required to perform the analysis consists of traffic, casualty, and spill statistics for the Illinois River. These statistics are presented in Tables 2 and 3. Where the casualty and spill statistics available for the Illinois River were not sufficient, statistics of exposure to fire/explosion from liquefied gas traffic on the river near the Dresden plant calculated is 4.0×10^{-7}/year. Based on this low probability, we conclude that plant safety will not be affected by liquefied gas shipments on the Illinois, Des Plaines, and Kanakakee Rivers.

The potential hazard to control room operators due to toxic gas releases is being evaluated independently of the SEP program as part of the TMI Task Action Plan (NUREG-0737, Task III.D.3.4) and is not considered in this topic evaluation.

3. Aircraft Hazards

The airports within 10 miles of the plant and the data required for hazard analysis on these airports are given in Table 4 (Reference 22 and 23).

Using the guidelines given in SRP 3.5.1.6, it was found that an evaluation of the probability of aircraft impact was required for Fromm, Morris, and Joliet Airports and for Adelmann Airstrip.

O'Hare International Airport has the heaviest traffic and is outside the 10-mile radius. According to available maps, O'Hare is 46 miles north-northeast of the plant and had 734,555 operations in the 1980 fiscal year (Reference 4). The projected number of operations at this airport for the year 2010 is calculated as 1,183,000, based on Reference 13. This level of operation is lower than the 2,116,000 operations per year calculated using the 1000 d^2 criterion given in SRP 3.5.1.6, where d is the distance from the plant in miles.

The probability per year of an aircraft crashing into the safety-related structures of Unit 2, P_A, is calculated using the methodology described in Reference 19:

$$P_A = \sum_{i=1}^{L} \sum_{j=1}^{M} \sum_{k=1}^{K} N_{ijk} A_{jk} R_{jk} D_k \quad \text{(EQ.1)}$$

where

L = number of flight paths affecting the plant

M = number of different types of aircraft using the airport

K = number of aircraft maneuvers - i.e., landings or takeoffs

N_{ijk} = number of landings or takeoffs per year by the jth aircraft along the ith flight path

A_{jk} = effective plant area, in square miles, for the jth aircraft in the kth maneuver

R_{jk} = accident rate for the jth aircraft for the kth maneuver

D_k = distribution function characterizing the location of a crash relative to the runway being used, per square miles

The pertinent data for the probability calculation are given in Tables 4 and 5.

Since the nearby airports are used mostly by small aircraft, the number of different types of aircraft M was assumed to be equal to 1 for each airport. This is a conservative assumption because the accident rate per operation for small aircraft is higher than that for large aircraft.

The number of landings and takeoffs at Fromm and Adelmann are taken to be equally distributed along the two possible flight paths at each airport. The Morris and Joliet Airport Managers (References 25 and 26) stated that about 25% or fewer of the operations are on the turf runway, and 75% on the asphalt runway at the airports. Furthermore, the Joliet turf runway handles only 5-10% of the total landing operations in the NE direction. Therefore, to obtain a more realistic distribution of the traffic along the possible flight pather, the number of landings and takeoffs shown in Table 5 for Morris and Joliet Airports was proportioned according to the ratios given above.

The effective area of the plant includes the actual plan area of the safety-related and non safety-related buildings housing safety-related equipment, a 45° shadow area to account for aircraft descent trajectories, and a 100-ft. long skid area to account for aircraft crashing in front of the plant and skidding into these buildings. The effective area varies with the type of aircraft

and flight path. For conservatism, the maximum effective area was used in the calculations; this area was found to correspond to the north to south flight path, and its value when all three units are considered was calculated at 0.01684 square miles. The buildings considered in calculating the effective area are the reactor, turbine and HPCI buildings of Units 1, 2 and 3; the cribhouse of Units 2 and 3, and the fuel handling buildings of Unit 1. The effective area of Unit 2, which was used in the calculations, is 1/3 of the plant effective area; i.e., 0.0056167 square miles.

The values of R_{jk} were evaluated by Vallance (Reference 20) using the general aviation accident data for the five-year period 1964-1968. Because of improvements in technology and air traffic control, there has since been a decrease in the accident rate per aircraft movements. Assuming that the same rate of decrease holds for accident rates for landing and takeoff operations, and using 1966 as the base year for Vallance's (Reference 20) accident statistics, Reference 21 derives the accident rates for the year 1980 to be 0.9×10^{-6} and 2.4×10^{-6} per takeoff and landing respectively. These accident rates were used in the calculations. The distribution function D_k used in the calculations was derived by Vallance (Reference 19) and is expressed as follows:

$$D_k = \frac{0.22}{r} \; e - r/2_e - o/80 \quad \text{for takeoff}$$

$$D_k = \frac{0.31}{r} \; e - r/2.5_e - o/43 \quad \text{for landing}$$

where

r=distance from the end of the runway to the crash location, in miles.

o=angle between the extended runway centerline and a line from the end of the runway to the crash location, in degrees.

The present probability of an aircraft crashing into Dresden 2, as calculated by EQ. 1 for each direction of travel at the four airports, is presented in Table 5.

Four low-altitude federal airways have their newest edge within two miles of the station: V69, V38, V171, and V429.

According to the Air Route Traffic Control Center (Reference 24), peak daily IFR traffic within 10 nautical miles of Dresden for 1981 before the PATCO strike was 327 aircraft traversing the area. The amount of VFR traffic is not available since the traffic control centers have no control over these flights. The VFR traffic is, therefore, estimated to be equal to the amount of IFR traffic.

Thus, using SRP 3.5.1.6,

$$P_{FA} = (4 \times 10^{-10} \times 2 \times 326 \times 365 \times 0.0056167)/9.21$$
$$= 0.581 \times 10^{-7} \text{ per year}$$

The present and projected probabilities of aircraft from the four airports and nearby airways crashing into Dresden 2 are presented in Table 7. As shown in the table, the total projected probability of aircraft crashing into Dresden 2 is 4.16×10^{-7} per year.

Conservatisms included in these calculations are:

- The use of the maximum effective area of Unit 2 of the plant.

- The distribution function D and accident rate R used for the Morris and Joliet Airports are those derived for crashes within five miles of an airport. Use of these rates for Morris and Joliet, which are 8 miles and 10 miles from the station, respectively, is conservative.

- The use of peak daily or monthly traffic from FAA-supplied documents to calculate the yearly number of operations.

- VFR traffic was estimated to be equal to peak IFR traffic before the PATCO strike.

Based on these conservatisms, and since the total probability (Table 7) of aircraft impact is within the acceptance criteria of SRP 3.5.1.6, it is concluded that aircraft operations in the vicinity of Dresden do not present an undue risk to the plant.

4. Potential Hazards Due to Barge Impact

Cooling water for Units 2 and 3 is provided through intake canals from the Des Plaines and Kankakee Rivers, and from an existing cooling lake. There is no commercial or recreational water traffic on the cooling lake.

Thus, there is no potential for collision of vessels with the intake canals of the cooling lake.

The cribhouse is located approximately 2,000 ft. from the navigational channels. Thus, there is no potential for collision of river traffic with the cribhouse.

An event which has been postulated is the collision of a barge on the river with the intake canal, causing failure of the canal. Since water would be available from the cooling lake, this type of failure will not have an adverse effect on plant safety. Therefore, we conclude that Dresden Unit 2 is adequately protected from potential barge impacts.

5. Potential Hazards Due to Accidental Liquid Spills

The accidental release of corrosive, coagulant, or cryogenic liquids into the Des Plaines, Kankakee, and Illinois River near the site does not pose a potential hazard to plant safety, because the essential service water system is supplied from the cooling lake. The potential intake of highly polluted water that would exist in the rivers as a result of a major spill is highly improbable, for the following reasons:

1. Cooling water is drawn from the river only when needed to make up for water lost due to evaporation or circulation.

2. The river water is tested daily to detect any potential releases of corrosive, coagulant, or cryogenic liquids.

3. According to Reference 2, the Illinois, Des Plaines, and Kankakee Rivers in the vicinity of the plant were reclassified in 1972 as "Public and Food Processing Supplies," which implies that the upstream pollution is continuously abated by pollution control activities.

Based on the above, we conclude that Dresden Unit 2 is adequately protected from potential liquid spills.

VI. CONCLUSIONS

We have concluded that the Dresden Unit 2 facility is adequately protected and can be operated with an acceptable degree of safety with regard to industrial, transportation and military activities in the vicinity of the plant. Therefore, we conclude that Topic II-1.C is complete.

VII. REFERENCES

1. Braidwood Station FSAR, Section 2.2.

2. Final Environmental Statement, Dresden Nuclear Power Station, Units 2&3, November 1973, USAEC.

3. Dresden FSAR, Amendment 9/10, Response to NRC Question IF.

4. Telephone conversation between J. Bueler, Federal Aviation Administration, and J. Wilson, Sargent & Lundy, October 6, 1981.

5. "Waterborne Commerce of the United States, 1973-1978," and telephone conversations between B. K. Lemba, US Corps of Engineers, and J. A. Wilson, Sargent & Lundy, Novebmer 6, 1981.

6. Department of the Army, Corps of Engineers, "Waterborne Commerce of the US," 1978.

7. Telephone conversation between J. A. Wilson of Sargent & Lundy and Mr. Hurley of Uniroyal Company, speaking for the Joliet Army Ammunition Plant, October 27, 1981.

8. Telephone conversation between J. Becia of Northern Illinois Gas and J. A. Wilson, Sargent & Lundy, October 1981.

9. "Evaluation of the Risks to the Marble Hill Nuclear Generating Station from Traffic on the Ohio River," IIT Research Institute, February 21, 1979.

10. "Analysis of Risk in the Water Transportation of Hazardous Materials," National Academy of Sciences, 1976.

11. Lockage Statistics, Chicago District Corps of Engineers, Department of the Army, 1973-1978.

12. Telephone conversations between G. Warner, Hydrocarbon Transportation, Inc., and J. A. Wilson, Sargent & Lundy, October and November 1981.

13. FAA Aviation Forecasts, 1981-1992.

14. Safety Evaluation Report, Hartsville Nuclear Plant, March 1976.

15. User's Guide for GASUS Computer Program for Transient Flow Behavior in Natural Gas Pipelines, Stone & Associates, Inc., Carlisle, Pennsylvania.

16. Telephone and personal conversations between M. Harbach, Natural Gas Pipeline Co. of America, and J. A. Wilson, Sargent & Lundy, October and November 1981.

17. Oil & Gas Industry in Illinois Map, 1977.

18. Response to SEP Topic II-1.B-Dresden, "Population Distribution," April 1981.

19. "A Study of the Probability of an Aircraft Using Waukegan Memorial Airport Hitting the Zion Station," by J. M. Vallance, Pickard, Lowe, & Associates, Inc., April 7, 1972.

20. "Supplement to a Study of the Probability of an Aircraft Using Waukegan Memorial Airport Hitting the Zion Station," by J. M. Vallance, Pickard, Lowe, and Associates, Inc., August 2, 1972.

21. "Report of the ASCE Committee on Impactive and Impulsive Loads," Civil Engineering and Nuclear Power, Vol. V, September 15-17, 1980.

22. Chicago Aeronautical Chart, May 14, 1981.

23. Telephone conversation between Owen Leander of the FAA and J. A. Wilson of Sargent & Lundy, February 5, 1982.

24. Letter from G. C. Gunter, Chicago ARTCC, February 25, 1982.

25. Telephone conversations between E. White, Joliet Airport and J. A. Wilson, Sargent & Lundy, March 16 and 24, 1982.

26. Telephone conversation between Morris Municipal Airport and J. A. Wilson, Sargent & Lundy, March 16, 1982.

27. FAA Form 5010-1, Airport Master Record.

28. Letter from K. J. Eger, Senior Engineer, Licensing and Radiological Safety, General Electric Company, to J. A. Wilson, Environmental Coordinator, Sargent & Lundy, December 4, 1981.

29. Telephone conversation between J. Beard, Plant Manager, Reichhold Chemical Company, and J. A. Wilson, Environmental Coordinator, Sargent & Lundy, January 20 and April 21, 1982.

30. Written response from F. M. Gamble of A. P. Green Refractories Company to J. A. Wilson, Environmental Coordinator, Sargent & Lundy, December 3, 1981.

31. Letter of confirmation from J. A. Wilson, Environmental Coordinator, Sargent & Lundy, to T. DeSanty of Airco Industrial Gases, November 30, 1981.

32. Written response from G. Melhorn, General Manager, ALUMAX Mill Products, Inc. to J. A. Wilson, Environmental Coordinator, Sargent & Lundy, dated December 3, 1981.

33. Telphone conversation between J. Erzen, Armak Industrial Chemical Division, and J. A. Wilson, Environmental Coordinator, Sargent & Lundy, February 4, 1982.

34. Written response from Durkee-SCM Chemical Company to J. A. Wilson, Environmental Coordinator, Sargent & Lundy, January 22, 1982.

35. Letter from N. Namani, Environmental Engineer, Mobil Chemical Company to J. A. Wilson, Environmental Coordinator, Sargent & Lundy, March 12, 1982.

36. Letter from D. E. Choate, Refinery Manager, Mobil Oil Corporation, to J. A. Wilson, Environmental Coordinator, Sargent & Lundy, February 12, 1982.

37. Illinois Department of Mines and Minerals, Explosives Division, Benton, IL, "Certificate of Compliance for Explosive Storage," 1981-1982.

38. E.D. Swartz (CECo-NLA) letter to D.G. Eisenhut (NRC) dated December 17, 1981, "Dresden Units 2 and 3, Quad Cities Station Units 1 and 2, Zion Station Units 1 and 2, Supplemental Response to NUREG 0737 Item III.D.3.4".

Table 1 Industries Within 5 Miles of Dresden Station (Ref. 18)

INDUSTRY	DISTANCE (MILES) & DIRECTION	PRODUCT
GE BWR Training Center & Spent Fuel Storage	0.7 - SW	Spent nuclear fuel storage
Reichhold Chemicals	1.6 - W	Resins and chemicals
A. P. Green	2.1 - SSW	Brick and clay
Airco Industrial Gases	2.5 - NW	CO_2
Northern Illinois Gas	2.5 - NW	Natural gas
Alumax Mill Products	2.8 - NW	Aluminum sheet and coil
Northern Petrochemicals	3.3 - NW	Ethylene, ethylene oxide glycol
Northern Petrochemical Dock	2.1 - W	
ARMAK Chemicals	3.6 - WNW	Fatty nitrogen chemicals
Durkee SCM Chemicals	3.2 - ENE	Edible oil
Truck Terminal	3.6 - ENE	Under construction
Dow Chemicals	3.7 - E	Polystyrene plastic
Dow Chemical Dock	2.7 - E	
Exxon (chemical plant)	3.9 - ENE	Under construction
Hydrocarbon Transportation, Inc.	4.0 - NW	Propane
Streator Industrial Supply	4.0 - S	Industrial supplies
Mobil Chemical Co.	4.1 - NE	Polystyrene sheets & crystal
Joliet Livestock Market	4.2 - ESE	Livestock
Mobil Oil Refinery	4.5 - NE	Petroleum products
Commonwealth Edison Co. Collins Station	5.0 - WSW	Electricity

Table 2: Dresden Island Traffic Statistics
Fiscal Years 1973 - 1978 (Refs. 6, 11)

COMMODITY TYPE	FISCAL YEAR 1973	1974	1975	1976	1977	1978	Average
Total commodities, tons $x10^6$	28.476	30.853	27.808	25.882	23.452	19.521	26.0
Hazardous materials,* tons $x\ 10^6$	5.653	6.073	5.358	5.059	4.093	3.658	5.0
Liquefied Gases,** tons	0.0	0.0	0.0	17,992	0.0	0.0	3000.0

*Hazardous materials are defined as all materials listed under the category of petroleum products in the lock statistics.

**Liquefied gases shown are the amounts tranported on the entire navigable length of the Illinois River.

Table 3: Casualty and Spill Statistics - Fiscal Years 1969 through 1972 (Ref. 10)

	Illinois River	Western Rivers*
Casualties** of all type barges	178	2831
Casualties of hazardous material barges***	40	508
Spills from hazardous material barges	1	69
Casualties of liquefied gas barges	---	9
Spills from double-skinned vessels	---	7
Total length of waterway, miles	333	3137

*Lower Mississippi, Upper Mississippi, Ohio, and Illinois Rivers; casualties from these rivers constitute 97% of the casualties on western rivers.

**Casualties which result in any of the following: loss of life, damage to cargo in excess of $1,500, or release of cargo.

***Hazardous material barges are generic type 17, 18, and 29 vessels. See Ref. 10 for description.

TABLE 4

DATA ON AIRPORTS WITHIN 10 MILES
OF DRESDEN STATION (REFS. 22, 23, 27)

	TYPE	APPROX. DIST. FROM STATION	DIRECTION FROM STATION	NO. OPERATIONS	LENGTH OF RUNWAY	WIDTH OF RUNWAY	TYPE OF RUNWAY	ORIENTATION OF RUNWAY
FROMM	PVT.	4.5 miles	E	50*	2,773 ft.	100 ft.	TURF.	NNE-SSW
MORRIS	PVT.	8 miles	WNW	1,942*	2,400 ft. 2,897 ft.	135 ft. 60 ft.	TURF. ASPH.	E-W N-S
ROSSI	PVT.	9 miles	N	< 50**	2,400 ft.	70 ft.	TURF.	E-W
BUCHBY	PVT.	9.9 miles	NNE	45**	1,800 ft.	100 ft.	TURF.	N-S
JOLIET	Pub.	10 miles	NNE	10,000*	3,452 ft. 2,970 ft.	125 ft. 100 ft.	TURF. ASPH.	NE-SW NW-SE
ADELMANN ***	PVT.	1 mile	NE	20**	1,600 ft.	70 ft.	TURF.	SE-NW

* Total peak month from FAA supplied documents

** Number per month as supplied by owner of airport

*** Recently approved airstrip

TABLE 5 **Data for Aircraft Crash and Probability Analysis**

AIRPORT	OPERATING MODE	r (MILES)	θ (DEG)	D(r,θ) (/MILES^2)	$R_x 10^{-6}$ (/OPERATION)	N (OPERATIONS/ YEAR)	A (MILES^2)	NARDx10^{-7} (/YEAR)
FROMM	Landing	4.5	90	0.0014	2.4	150	0.0056167	0.02833
		4.5	90	0.0014	2.4	150	0.0056167	0.02833
	Take-Off	4.5	90	0.00167	0.9	150	0.0056167	0.01267
		4.5	90	0.00167	0.9	150	0.0056167	0.01267
MORRIS	Landing	8.0	25	0.000883	2.4	1456	0.0056167	0.17333
		8.0	155	0.000043	2.4	1456	0.0056167	0.00833
		8.0	65	0.00035	2.4	4370	0.0056167	0.206
		8.0	115	0.00011	2.4	4370	0.0056167	0.06467
	Take-Off	8.0	25	0.000369	0.9	1456	0.0056167	0.027
		8.0	155	0.000073	0.9	1456	0.0056167	0.00533
		8.0	65	0.00022	0.9	4370	0.0056167	0.04867
		8.0	115	0.00012	0.9	4370	0.0056167	0.02633
JOLIET	Landing	10.0	10	0.00045	2.4	6000	0.0056167	0.364
		10.0	170	0.000011	2.4	9000	0.0056167	0.01333
		10.0	80	0.000088	2.4	22500	0.0056167	0.26667
		10.0	100	0.000056	2.4	22500	0.0056167	0.17
	Take-Off	10.0	10	0.00013	0.9	7500	0.0056167	0.04933
		10.0	170	0.000018	0.9	7500	0.0056167	0.00667
		10.0	80	0.000055	0.9	22500	0.0056167	0.06267
		10.0	100	0.000043	0.9	22500	0.0056167	0.049
ADELMANN	Landing	1.0	115	0.01433	2.4	60	0.0056167	0.116
		0.9	80	0.0374	2.4	60	0.0056167	0.30233
	Take-Off	1.0	115	0.0317	0.9	60	0.0056167	0.0906
		0.9	80	0.05734	0.9	60	0.0056167	0.174

TABLE 6 **Pipelines within 5 Miles of the Site**

PIPELINE COMPANY	PIPE SIZE (in)	MATERIAL CARRIED	OPERATING PRESSURE (PSI)	CLOSEST DISTANCE TO THE PLANT (MILES)
Natural Gas	36	Natural Gas	858	1.75
Pipeline Co.	36	Natural Gas	858	1.70
	30	Natural Gas	858	1.60
	36	Natural Gas	650	1.25
	30	Natural Gas	858	1.70
	30	Natural Gas	858	1.60
HydroCarbon	10	Propane, Natural Gas	2100	4.0
Transportation, Inc.	10	Propane, Natural Gas	2100	4.0
	6	Propane, Butane	500	2.0
Northern Illinois Gas	36	Natural Gas	740	2.5
	10	Out of Operation	---	2.5
	4	Natural Gas	Unknown	3.0
Amoco	10	Crude Oil	---	3.0
	12	Crude Oil	---	3.0
	22	Crude Oil	---	3.0

Table 7 Probability of Aircraft Impact from Airports and Airways within 10 Miles of Dresden Station

SOURCE	PRESENT PROBABILITY OF IMPACT PER YEAR	PROJECTED* PROBABILITY OF IMPACT PER YEAR
Fromm Airstrip	0.082×10^{-7}	0.082×10^{-7}
Morris Airport	0.560×10^{-7}	0.896×10^{-7}
Joliet Airport	0.982×10^{-7}	1.571×10^{-7}
Adelmann Airstrip	0.683×10^{-7}	0.683×10^{-7}
Airways	0.58×10^{-7}	0.929×10^{-7}
TOTAL	2.887×10^{-7}	4.161×10^{-7}

*Air traffic projections are based on the forecasts given in Reference 13.

INDUSTRIAL SITES IN VICINITY

1 MIDWEST FUELS REPROCESSING PLANT (GE)
2 NORTHERN PETROCHEMICAL CO.
3 ALUMAX
4 REICHHOLD CHEMICAL CO
5 A. P. GREEN
6 GENERAL ELECTRIC CO TRAINING SCHOOL
7 MOBIL CHEMICAL
8 MOBIL OIL
9 DURKEE SCM

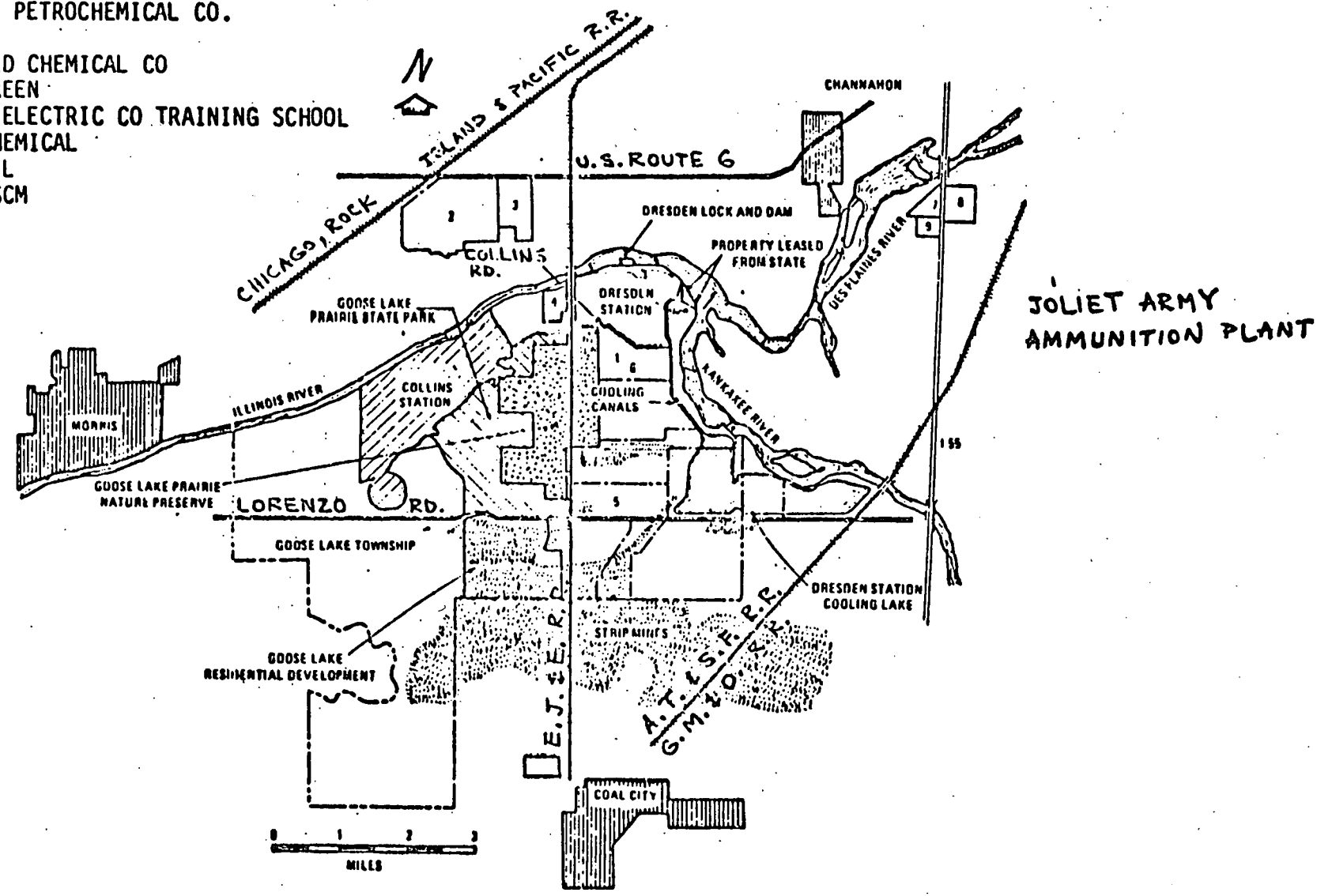

Figure 1 Dresden Nuclear Power Station Area Map

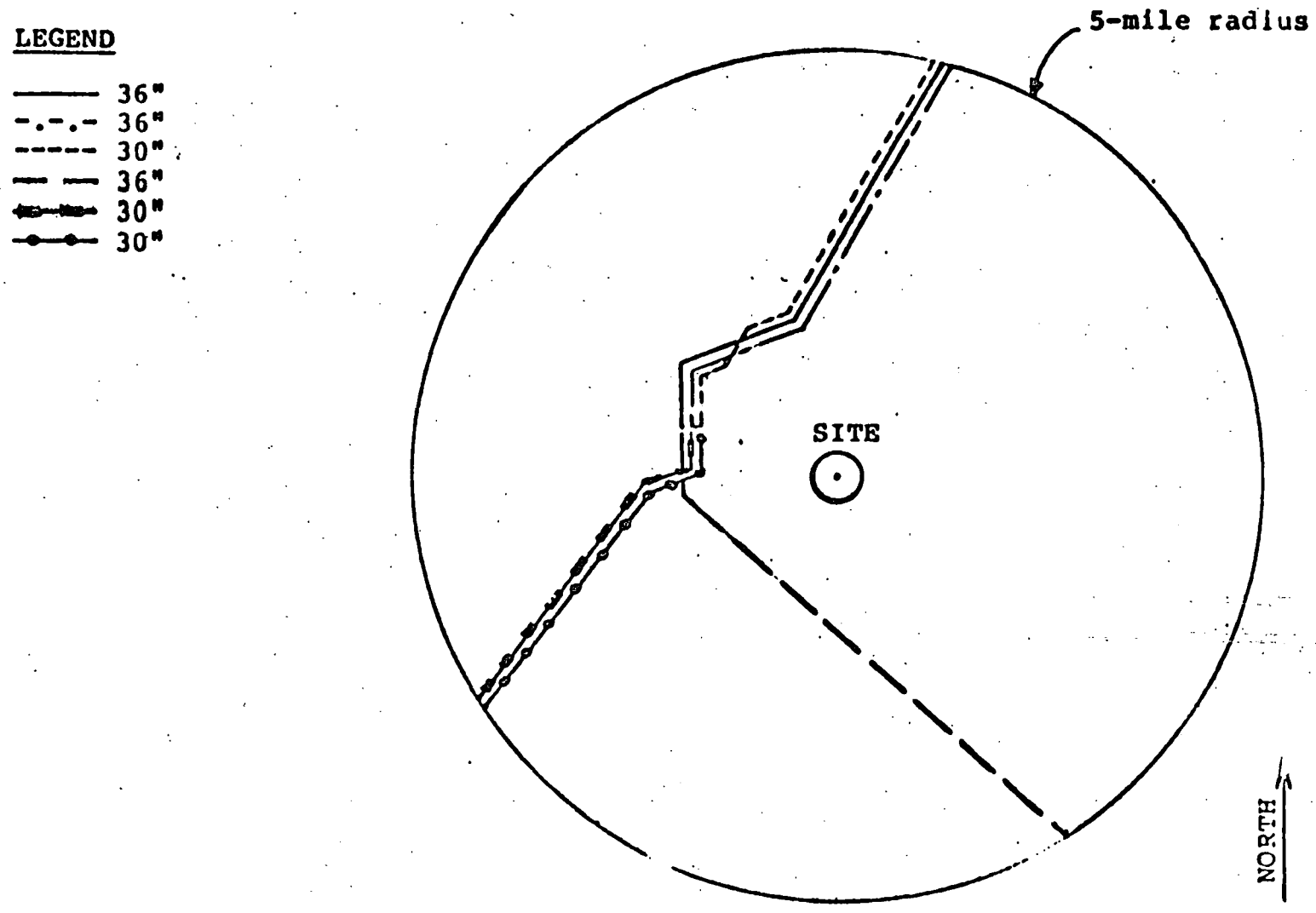

Figure 2 Pipelines Considered in the Evaluation of Hazard From Explosion