ATTACHMENT C
Marked-up Pages for Proposed Changes

DPR-29	DPR-30
3.2/4.2-3	3.2/4.2-3
3.2/4.2-11	3.2/4.2-8
3.2/4.2-28	3.2/4.2-17

/scl:1316:53

E. Postaccident Instrumentation

The limiting conditions for operation for the instrumentation which is read out in the control room, required for postaccident monitoring are given in Table 3.2-4.

F. Control Room Ventilation System Isolation

1. The control room ventilation systems are isolated from outside air on a signal of high drywell pressure, low water level, high main steamline flow, high toxic gas concentration, high radiation in either of the reactor building ventilation exhaust ducts, or manually. Limiting conditions for operation shall be as indicated in Table 3.2-1 and Specification 3.2.H. and 3.2.F.2.

2. The toxic gas detection instrumentation shall consist of ~~a chlorine,~~ an ammonia~~, and sulphur dioxide~~ a analyzer with ~~each~~ trip setpoint set at ≤ 50 ppm.

   ~~a. Chlorine concentration ≤ 5 ppm.~~
   ~~b. Ammonia concentration ≤ 50 ppm.~~
   ~~c. Sulphur dioxide concentration ≤ 3 ppm.~~

   The provisions of Specification 3.0.A. are not applicable.

E. Postaccident Instrumentation

Postaccident instrumentation shall be functionally tested and calibrated as indicated in Table 4.2-2.

F. Control Room Ventilation System Isolation

1. Surveillance for instrumentation which initiates isolation of control room ventilation shall be as specified in Table 4.2-1.

2. Manual isolation of the control room ventilation system shall be demonstrated once every refueling outage.

The instrumentation which is provided to monitor the postaccident condition is listed in Table 3.2-4. The instrumentation listed and the limiting conditions for operation on these systems ensure adequate monitoring of the containment following a loss-of-coolant accident. Information from this instrumentation will provide the operator with a detailed knowledge of the conditions resulting from the accident; based on this information he can make logical decisions regarding postaccident recovery.

The specifications allow for postaccident instrumentation to be out of service for a period of 7 days. This period is based on the fact that several diverse instruments are available for guiding the operator should an accident occur, on the low probability of an instrument being out of service and an accident occurring in the 7-day period, and on engineering judgment.

The normal supply of air for the control room ventilation system Trains "A" and "B" is outside the service building. In the event of an accident, this source of air may be required to be shut down to prevent high doses of radiation in the control room. Rather than provide this isolation function on a radiation monitor installed in the intake air duct, signals which indicate an accident, i.e., high drywell pressure, low water level, main steamline high flow, or high radiation in the reactor building ventilation duct, will cause isolation of the intake air to the control room. The above trip signals result in immediate isolation of the control room ventilation system and thus minimize any radiation dose. Manual isolation capability is also provided. Isolation from high toxic chemical concentration has been added as a result of the "Control Room Habitability Study" submitted to the NRC in December 1981 in response to NUREG-0737 Item III D.3.4. ~~As explained in Section 3 of this study, ammonia, chlorine, and sulphur dioxide detection capability has been provided.~~ (see insert) The setpoints chosen for the control room ventilation isolation are based on early detection in the outside air supply at the odor threshold, so that the toxic chemical will not achieve toxicity limit concentrations in the Control Room.

The radioactive liquid and gaseous effluent instrumentation is provided to monitor the release of radioactive materials in liquid and gaseous effluents during releases. The alarm setpoints for the instruments are provided to ensure that the alarms will occur prior to exceeding the limits of 10 CFR 20.

INSERT FOR TECHNICAL SPECIFICATION PAGE 3.2/4.2-11

Ammonia, chlorine and sulphur dioxide detection capability was added to the plant in response to the referenced study. In a report generated by Sargent and Lundy in May, 1988, justification was provided and the chlorine and sulphur dioxide detectors were deleted from the plant.

TABLE 4.2-1 (Cont'd)

Instrument Channel	Instrument Functional Test (2)	Calibration (2)	Instrument Check (2)
RCIC Isolation			
1. Steamline high flow	Once/3 months (9)	Once/3 months (9)	None
2. Turbine area high temperature	Refueling outage	Refueling outage	None
3. Low reactor pressure	Once/3 months	Once/3 months	None
HPCI Isolation			
1. Steamline high flow	(1) (9)	Once/3 months	None
2. Steamline area high temperature	Refueling outage	Refueling outage	None
3. Low reactor pressure	(1)	Once/3 months	None
Reactor Building Ventilation System Isolation and Standby Treatment System Initiation			
1. Refueling floor radiation monitors	(1)	Once/3 months	Once/day
Steam Jet Air Ejector Off-Gas Isolation			
1. Off-gas radiation monitors	(1) (4)	Refueling outage	Once/day
Control Room Ventilation System Isolation			
1. Reactor low water level	(1)	Once/3 months	Once/day
2. Drywell high pressure	(1)	Once/3 months	None
3. Main steamline high flow	(1)	Once/3 months	Once/day
4. Toxic gas analyzer (~~chlorine,~~ ammonia ~~sulphur dioxide~~)	Once/month	Once/18 months	Once/day

Notes

1. Initially once per month until exposure hours (M as defined on Figure 4.1-1) are 2.0 X 10^5; thereafter, according to Figure 4.1-1 with an interval not less than 1 month nor more than 3 months. The compilation of instrument failure rate data may include data obtained from other boiling water reactors for which the same design instrument operates in an environment similar to that of Quad Cities Units 1 and 2.

2. Functional tests, calibrations, and instrument checks are not required when these instruments are not required to be operable or tripped.

F. Control Room Ventilation System Isolation

1. The control room ventilation systems are isolated from outside air on a signal of high drywell pressure, low water level, high main steamline flow, high toxic gas concentration, high radiation in either of the reactor building ventilation exhaust ducts, or manually. Limiting conditions for operation shall be as indicated in Table 3.2-1 and Specification 3.2.H. and 3.2.F.2.

2. The toxic gas detection instrumentation shall consist of an ammonia analyzer with a trip setpoint set at $\leq$50 ppm.

   The provisions of Specification 3.0.A. are not applicable.

G. Radioactive Liquid Effluent Instrumentation

The effluent monitoring instrumentation shown in Table 3.2-5 shall be operable with alarm setpoints set to ensure that the limits of Specification 3.8.B are not exceeded. The alarm setpoints shall be determined in accordance with the ODCM.

1. With a radioactive liquid effluent monitoring instrument alarm/trip setpoint less conservative than required, without delay suspend the release of radioactive liquid effluents monitored by the affected instrument, or declare the instrument inoperable, or change the setpoint so it is acceptably conservative.

F. Control Room Ventilation System Isolation

1. Surveillance for instrumentation which initiates isolation of control room ventilation shall be as specified in Table 4.2-1.

2. Manual isolation of the control room ventilation system shall be demonstrated once every refueling outage.

G. Radioactive Liquid Effluent Instrumentation

Each radioactive liquid effluent monitoring instrument shown in Table 4.2-3 shall be demonstrated operable by performance of the given source check, instrument check, calibration, and functional test operations at the frequencies shown in Table 4.2-3.

so that none of the activity released during the refueling accident leaves the reactor building via the normal ventilation stack but that all the activity is processed by the standby gas treatment system.

The instrumentation which is provided to monitor the postaccident condition is listed in Table 3.2-4. The instrumentation listed and the limiting conditions for operation on these systems ensure adequate monitoring of the containment following a loss-of-coolant accident. Information from this instrumentation will provide the operator with a detailed knowledge of the conditions resulting from the accident; based on this information he can make logical decisions regarding postaccident recovery.

The specifications allow for postaccident instrumentation to be out of service for a period of 7 days. This period is based on the fact that several diverse instruments are available for guiding the operator should an accident occur, on the low probability of an instrument being out of service and an accident occurring in the 7-day period and on engineering judgment.

The normal supply of air for the control room ventilation system Trains "A" and "B" is outside the service building. In the event of an accident, this source of air may be required to be shut down to prevent high doses of radiation in the control room. Rather than provide this isolation function on a radiation monitor installed in the intake air duct, signals which indicate an accident, i.e., high drywell pressure, low water level, main steamline high flow, or high radiation in the reactor building ventilation duct, will cause isolation of the intake air to the control room. The above trip signals result in immediate isolation of the control room ventilation system and thus minimize any radiation dose. Manual isolation capability is also provided. Isolation from high toxic chemical concentration has been added as a result of the "Control Room Habitability Study" submitted to the NRC in December 1981 in response to NUREG-0737 Item III D.3.4. Ammonia, chlorine and sulphur dioxide detection capability was added to the plant in response to the referenced study. In a report generated by Sargent and Lundy in May, 1988, justification was provided and the chlorine and sulphur dioxide detectors were deleted from the plant. The setpoints chosen for the control room ventilation isolation are based on early detection in the outside air supply at the odor threshold, so that the toxic chemical will not achieve toxicity limit concentrations in the Control Room.

The radioactive liquid and gaseous effluent instrumentation is provided to monitor the release of radioactive materials in liquid and gaseous effluents during releases. The alarm setpoints for the instruments are provided to ensure that the alarms will occur prior to exceeding the limits of 10 CFR 20.

TABLE 4.2-1 (Cont'd)

Instrument Channel	Instrument Functional Test (2)	Calibration (2)	Instrument Check (2)
HPCI Isolation			
1. Steamline high flow	(1) (9)	Once/3 months	None
2. Steamline area high temperature	Refueling outage	Refueling outage	None
3. Low reactor pressure	(1)	Once/3 months	None
Reactor Building Ventilation System Isolation and Standby Treatment System Initiation			
1. Refueling floor radiation monitors	(1)	Once/3 months	Once/day
Steam Jet Air Ejector Off-Gas Isolation			
1. Off-gas radiation monitors	(1) (4)	Refueling outage	Once/day
Control Room Ventilation System Isolation			
1. Reactor low water level	(1)	Once/3 months	Once/day
2. Drywell high pressure	(1)	Once/3 months	None
3. Main steamline high flow	(1)	Once/3 months	Once/day
4. Toxic gas analyzer (ammonia)	Once/Month	Once/18 months	Once/day

Notes

1. Initially once per month until exposure hours (M as defined on Figure 4.1-1) are 2.0 X 10^5; thereafter, according to Figure 4.1-1 with an interval not less than 1 month nor more than 3 months. The compilation of instrument failure rate data may include data obtained from other boiling water reactors for which the same design instrument operates in an environment similar to that of Quad Cities Units 1 and 2.

2. Functional tests, calibrations, and instrument checks are not required when these instruments are not required to be operable or tripped.

3. This instrumentation is excepted from the functional test definition. The function test shall consist of injecting a simulated electric signal into the measurement channel.

4. This instrument channel is excepted from the functional test definitions and shall be calibrated using simulated electrical signals once every 3 months.

5. Functional tests shall be performed before each startup with a required frequency not to exceed once per week. Calibrations shall be performed during each startup or during controlled shutdowns with a required frequency not to exceed once per week.

6. The positioning mechanism shall be calibrated every refueling outage.

7. Logic system functional tests are performed as specified in the applicable section for those systems.

8. Functional tests shall include verification of operation of the degraded voltage. 5 minute timer and 7 second inherent timer.

9. Verification of the time delay setting of $3 \leq t \leq 9$ seconds shall be performed during each refueling outage.

ATTACHMENT D
Evaluation for Significant Hazards Consideration of Proposed Changes

As described in Attachment B, the proposed changes involve deletion of the chlorine and sulfur dioxide analyzers insolation trip functions and surveillance requirements from the Control Room Ventilation System isolation instrumentation Technical Specification. These changes have been reviewed by Commonwealth Edison, and we believe that they do not present a Significant Hazards Consideration. The basis for our determination is documented as follows:

<u>BASIS FOR NO SIGNIFICANT HAZARDS CONSIDERATION</u>

Commonwealth Edison has evaluated this proposed amendment and determined that it involves no significant hazards consideration. In accordance with the criteria of 10 CFR 50.92 (c), a proposed amendment to an operating license involves no significant hazards considerations if operation of the facility, in accordance with the proposed amendment, would not:

1. Involve a significant increase in the probability or consequences of an accident previously evaluated because:

   The proposed changes involve deletion of the control room air intake chlorine and sulfur dioxide analyzers isolation trip functions. This change does not involve any accident precursors and, therefore, cannot increase the probability of an accident previously evaluated. In order to determine if the chlorine and sulfur dioxide isolation functions are needed, a habitability study of the control room following postulated accidents involving chlorine and sulfur dioxide shipments in the vicinity of Quad Cities Station was performed. The results of this control room habitability study indicate that by combining conservative calculation with reasonable qualitative arguments, the probability of causing uninhabitable control room conditions by accidents involving railroad shipment of chlorine and sulfur dioxide falls within the acceptable limits as defined by Reg. Guide 1.70 and the SRP. Therefore, these potential events should not be considered design basis events, and the chlorine and sulfur dioxide detectors isolation functions should be deleted at the Quad Cities Station without significantly increasing the consequences of an accident previously evaluated.

   The correction of the typo "streamline" is and administrative change to the Unit Two Technical Specifications which by its nature cannot involve a significant hazards consideration.

2. Create the possibility of a new or different kind of accident from any accident previously evaluated because:

   The deletion of the isolation functions of the chlorine and sulfur dioxide analyzers has been evaluated and found to meet the criteria of applicable Regulatory Guides and the SRP. The realistic probability of occurrence of an event involving chlorine or sulfur dioxide that would cause the control room to become uninhabitable has been determined to be low enough such that these events no longer need to be classified as design basis events.

The detector isolation functions that are being deleted are only required to provide a trip function in the event of a very low probability chlorine or sulfur dioxide spill. Therefore, the deletion of these detectors from the plant cannot create the possibility of a new or different kind of accident from any previously evaluated.

3. Involve a significant reduction in the margin of safety because:

The installation of the chlorine, ammonia, and sulfur dioxide detectors was based on a survey of performed in 1981 which determined that concentrations of these substances would exceed toxicity levels in the control room in less than 2 minutes after detection. This 1981 survey did not consider whether uninhabitable conditions could be caused in the control room during an actual offsite accident which releases chlorine or sulfur dioxide. This study also did not consider the probability of occurrence of and event where chlorine or sulfur dioxide would be released in sufficient quantities to make the control room uninhabitable.

The recent completed study makes the determination using accepted probability analysis methods, that these events are of sufficiently low probability of occurrence that they should not be classified as design basis events. The study also demonstrates that the 1981 study was overly conservative and as such, should not be used to establish a basis for a determination of a reduction in a margin of safety. If the methodology used in the latest study had been used in the 1981 study, then these chlorine and sulfur dioxide detectors would have probably never been installed in the plant. Since these detectors are not needed in the plant to mitigate a potential chlorine or sulfur dioxide release that would make the control room uninhabitable, then the deletion of these detectors' isolation functions does not involve a significant reduction in any margin of safety.

ATTACHMENT E
Environmental Assessment of the Proposed Changes

The proposed changes to the Quad Cities Station Technical Specifications involve the deletion of isolation functions and surveillance requirements for the Control Room Ventilation System automatic isolation instrumentation (Technical Specification (TS) 3.2.F.2 and Table 4.2-1). The proposed changes will reduce unwarranted challenges to the Control Room Ventilation system die to spurious trips of the chlorine and sulfur dioxide analyzers. The proposed change is based upon an analysis which indicates that these isolation functions are not required to ensure control room habitability following a postulated accident involving chlorine and sulfur dioxide shipments in the vicinity of Quad Cities Station.

Commonwealth Edison has evaluated the proposed amendment in accordance with the requirements of 10 CFR 51.21 and has determined that the amendment meets the requirements for categorical exclusion as specified by 10 CFR 51.22 (c) (9).

The proposed change to TS 3.2.F.2 and Table 4.2-1 for the Control Room Ventilation System isolation instrumentation does not change the types of effluents or increase the amount of effluents that may be released offsite. Engineering studies have indicated that the proposed change would not impact the habitability of the Control Room following a postulated accident involving chlorine and sulfur dioxide shipments in the vicinity of the Quad Cities Station. Based upon this fact, the deletion of the isolation functions for chlorine and sulfur dioxide analyzers would not affect the ability of control room personnel to mitigate the consequences (including the types or amounts of effluents released offsite) of previously evaluated accidents.

The proposed change does not significantly affect individual and cumulative occupational radiation exposures. The deletion of the Control Room Ventilation system toxic gas isolation functions would reduce unwarranted challenges to a safety system, without impacting the habitability of the control room during postulated toxic gas accidents. Individual and cumulative radiation exposures would not be significantly affected since the radiation levels in the plant are independent of the toxic gas isolation instrumentation.

In conclusion, the proposed amendment will not result in any increase in the environment consequences beyond those already accepted by the NRC in the Final Environmental Statement.

ATTACHMENT F

Report LS-7125, Revision 1, April, 1991, "Habitability of Control Room Following Postulated Accidents Involving Chlorine and Sulfur Dioxide Shipments in the Vicinity of Quad Cities Station"

/scl:1316:57

SARGENT & LUNDY
ENGINEERS
CHICAGO

HABITABILITY OF CONTROL ROOM FOLLOWING POSTULATED ACCIDENTS INVOLVING CHLORINE SULFUR DIOXIDE SHIPMENTS IN THE VICINITY OF QUAD CITIES STATION

REPORT SL-7125
REVISION 1

COMMONWEALTH EDISON COMPANY
CHICAGO, ILLINOIS

Project Number 8827-14
April 1991

PREPARED BY
SARGENT & LUNDY ENGINEERS
CHICAGO, ILLINOIS

1.0 INTRODUCTION

In 1982, Commonwealth Edison Company provided the final control room habitability report for the Quad Cities Station to the Nuclear Regulatory Commission (Reference 1). This report was required by NUREG 0737 Item 111.D.3.4. The Quad Cities Station Control Room Habitability Study included a 1981 survey for potentially toxic chemicals stored or transported onsite or within a 5-mile radius offsite of Quad Cities Station Units 1 and 2. This survey was conducted to meet the requirements of Attachment 1 to NUREG 0737 Item 111.D.3.4.

The control room habitability study was performed to meet the criteria of Sections 2.2.1, 2.2.2, 2.2.3 and 6.4 of the Standard Review Plan (SRP) following guidance provided in Regulatory Guides 1.78 and 1.95. The 1981 survey indicated that concentrations of chlorine and sulfur dioxide would exceed toxicity levels in the control room in less than 2 minutes after detection, and therefore monitors would be needed at the control room air intake to detect chlorine and sulfur dioxide and isolate the control room upon detection. At that time no further analysis was performed to determine whether uninhabitable conditions could be caused in the control room during an accidental release of chlorine and sulfur dioxide. Instead, to expedite the licensing of the plant, redundant chlorine and sulfur dioxide detectors were provided on each outside air intake of the control room.

A second survey was conducted between February and April 1988 in order to supplement the 1981 data. The purpose of the second survey was to gather additional data needed to perform quantitative analyses of the Quad Cities Station Control Room habitability and exposure risk due to accidental releases of chlorine and sulfur dioxide. Two distinct types of analyses were performed. The first analysis considered the dispersion of the vapor released from a postulated accident to the station and subsequent infiltration into the control room. This analysis utilized the normal air exchange rate of the control room based on the design makeup air and the control room volume. The second consisted of a determination of the probability that uninhabitable conditions in the control room could be caused by an accident involving rail tank cars containing chlorine and sulfur dioxide. The probability analysis considered the statistical data for rail tank car accidents and the meteorological parameters, based on wind direction and atmospheric stability, that could cause the development of toxic concentrations in the control room. A description of the control room HVAC system is presented in the Quad Cities Updated Final Safety Analysis Report (UFSAR) Section 10 (Reference 2).

A third survey was conducted between October and November 1990 in order to supplement the 1988 data. The purpose of the third survey was to gather more recent data needed to perform quantitative analyses of the Quad Cities Station Control Room Habitability and exposure risk due to accidental releases of chlorine and sulfur dioxide.

The following discussion describes the Regulatory Guides which form the basis of the control room habitability evaluation, the results of the two surveys, and the analysis regarding evaluation of chlorine and sulfur dioxide as a hazard to the Quad Cities Station control room. Based on the information collected to date, it is concluded that chlorine and sulfur dioxide detectors are not required at the Quad Cities Station.

2.0 REGULATORY GUIDES

Regulatory Guide 1.78 (Reference 3) identifies chlorine and sulfur dioxide as hazardous chemicals and requires a control room habitability analysis in case there is an accidental release from stationary or mobile sources near the plant. It also provides a methodology for analyzing the effects of the release.

Regulatory Position 1 of Regulatory Guide 1.78 states that chlorine and sulfur dioxide stored or situated at distances greater than five miles from the control room need not be considered in evaluating habitability analysis.

In order to establish the design basis events for a plant, Section 2.2.2.2 of Regulatory Guide 1.70 (Reference 4) requires identification of hazardous and toxic chemicals processed, stored or transported in the vicinity of the site. It further requires consideration of all facilities and activities within five miles of the plant and inclusion of facilities and activities at greater distances as appropriate to their significance. For evaluation of potential accidents, section 2.2.3.1 of Regulatory Guide 1.70 defines the design basis events external to the nuclear plant as those accidents that have a probability of occurrence on the order of about 10^{-7} per year or greater and have potential consequences serious enough to affect the safety of the plant to the extent that 10CFR Part 100 of the guidelines could be exceeded. For toxic chemicals, the Regulatory Guide requires consideration of accidental releases of these chemicals from onsite storage facilities and nearby mobile and stationary sources. These toxic chemical concentrations determined for a spectrum of meteorological conditions then should be used in evaluating control room habitability according to Regulatory Guide 1.78.

Sections 2.2.1 and 2.2.2 of the standard Review Plan, NUREG-0800 (Reference 5) requires a review of identified hazardous materials which are stored and/or transported in accordance with Regulatory guide 1.78. The review procedures require identification of facilities and activities within eight kilometers (5 miles) of the plant. Facilities and activities at greater distances should be considered if they otherwise have the potential for affecting the plant safety-related features.

As part of its acceptance criteria, Section 2.2.3 of the standard review Plan (SRP) provides a probability criteria for determining if a toxic release need be considered a design basis event. Specifically, it 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.

3.0 SURVEY OF CHLORINE AND SULFUR DIOXIDE SHIPMENTS AROUND QUAD CITIES STATION

3.1 1981 Survey of Chlorine and Sulfur Dioxide Shipments

The 1981 survey revealed that chemicals could be transported within 5 miles of the Quad Cities Station on the Mississippi River; Chicago, Milwaukee, St. Paul, and Pacific Railroad; Chicago and Northwestern Railroad; U.S. Route 67, and Illinois State Road 84. There are no toxic chemicals present onsite requiring control room habitability evaluation.

Chlorine and sulfur dioxide were found to be shipped by railroad at frequencies greater than 30 times per year, and requiring control room habitability evaluation. Based on the U.S. Army Corps of Engineers data on commodity shipments by barge, it was concluded that the actual number of shipments for toxic chemicals would not exceed the shipment frequency for barges (50 per year); therefore, barge shipments of chemicals (including chlorine and sulfur dioxide) were not analyzed.

Data on highway commodity traffic showed that chlorine was shipped in one-ton containers. Reference 1 and UFSAR Sections 2.2 and 2.8 provide the location of the plant site transportation routes, and potential hazardous materials transported near the site.

3.2 1988 Survey of Chlorine and Sulfur Dioxide Shipments

A survey was conducted between March and April of 1988. The purpose of this survey was to identify all industrial, municipal, transportation, and other facilities that handle containers of chlorine or sulfur dioxide large enough to pose a potential hazard to the power plant in the event of an accidental release. The following entities were contacted to obtain information:

- 15 government agencies and public organizations;
- 40 industries and municipalities located within 10 miles of the power plant;
- 15 barge terminals located on the Mississippi River between the closest upstream lock (lock #13 near Fulton, Illinois) and the closest downstream lock (lock #14 near Rapids City, Illinois).
- 25 chemical producers and distributors; and
- 11 railroads, barge lines, and trucking companies.

The results of this survey are summarized below:

Type of Facility	Chlorine and Sulfur Dioxide Containers that Could Affect the Quad Cities Station Control Room Habitability
Industries and municipalities within 10 miles	None
Barge terminals	None
Barge transportation	None
Highway transportation	None
Railroad transportation	Chlorine and sulfur dioxide tank cars carried by the Soo Line[†] and Chicago and Northwestern Railroads

[†]The Soo Line Railroad now operates on the tracks previously owned by, Milwaukee, St. Paul and Pacific Railroad.

According to the Soo Line Railroad records (Reference 6), in 1987 the Soo Line shipped 276 tank cars (90 ton capacity) of chlorine and 132 tank cars (90 ton capacity) of sulfur dioxide on the tracks within 5 miles of the Quad Cities Station. All of these shipments were on the Iowa side of the Mississippi River; none were in Illinois. The tracks on the Illinois side are for local runs and do not involve shipment of these chemicals.

The closest approach from the Quad Cities control room make-up air intake to Soo Line tracks on the Iowa and Illinois side is 1.78 and 0.71 miles, respectively.

According to the Chicago and Northwestern Railroad personnel (Reference 7), in 1987 21 tank cars of chlorine and 45 tank cars of sulfur dioxide were shipped on tracks in the power plant vicinity. The closest approach from the Quad Cities control room air intake to these tracks is 5.0 miles.

3.3 1990 Survey of Chlorine and Sulfur Dioxide Shipments

A survey similar to one conducted in 1988 was peformed and a detailed listing of sources contacted is enclosed as Appendix A. As a result of the survey, some changes in the 1987-1988 information occured. These changes are discussed below:

Of the companies contacted in the 1988 survey, eight now do business under new names. An additional 17 sources were contacted based on information obtained from the original sources. Also, two companies contacted in 1988 have since gone out of business. Transportation of chlorine and sulfur dioxide by truck is done at two establishments. The probability results, however, are not affected since the routes are outside of the 5 mile radius of the control room. Also, there are no barge shipments of either chlorine on SO_2 in the area. These maximums, identified as "1988-1990 Maximum Shipments", are compared with the 1987 shipments as follows:

	SOO Line		C&NW Railroad	
	Cl_2	SO_2	Cl_2	SO_2
1987 Shipments	276	132	21	45
1988-1990	168	144	29	41
Maximum Shipments	276	144	29	45

Since some of the 1988-1990 maximum shipment data exceeds the 1987 data, presented in the 1988 survey, dispersion and probability analyses of the data obtained were conducted. Listings of the entities contacted are shown in Appendix A.

4.0 DISPERSION ANALYSIS AND CONTROL ROOM INFILTRATION IN ACCORDANCE WITH REGULATORY GUIDE 1.78

Regulatory Guide 1.78 states in Paragraph C.2 that "If hazardous chemicals such as those indicated in Table C-1 are known or projected to be frequently shipped by rail, water, or road routes within a five-mile radius of a nuclear power plant, estimates of these shipments should be considered in the evaluation of control room habitability... Shipments are defined as being frequent if there are 10 per year for truck traffic, 30 per year for rail traffic, or 50 per year for barge traffic." Based on this, railroad traffic[2] of chlorine and sulfur dioxide need to be considered for the Quad Cities Station.

In Paragraph C.4 the regulatory guide states: "The toxicity limits should be taken from appropriate authoritative sources such as those listed in the References section. For each chemical considered, the values of importance are the human detection threshold and the maximum concentration can be tolerated for two minutes without physical incapacitation of an average human (i.e., severe coughing, eye burn, or severe skin irritation). The latter concentration is considered the

[2]Truck shipments of chlorine probably exceeded the shipping frequency of 10 per year. However, the quantities shipped are less than quantities requiring a control room habitability analysis per Table C-2 of Regulatory Guide 1.78. No truck shipments of sulfur dioxide were found to pass within 5 miles of the site.

"toxicity limit."* Based on this the human detection threshold for chlorine is 3 ppm and the toxicity limit is 15 ppm. Similarly, fore sulfur dioxide, the human detection threshold is 3 ppm and the toxicity limit is 5 ppm.

In Paragraph C.5 Regulatory Guide 1.78 states: "Two types of industrial accidents should be considered for each source of hazardous chemicals: maximum concentration chemical instantaneous release of the total contents of one of the following: (1) the largest storage container falling within the guidelines of Table C-2 and located at a nearby stationary facility, (2) the largest shipping container (or for multiple containers of equal size, the failure of only one container unless the failure of that container could lead to successive failures) falling within the guidelines of Table C-2 and frequently transported near the site, or (3) the largest container stored onsite..." Maximum concentration accidents were analyzed for Items 1 and 2.

Exhibit 1 shows the parameters used to evaluate accidental chlorine and sulfur dioxide releases from the tank cars shipped on the SOO Line Railroad tracks in town. The control room air exchange rate used in the analyses is that of a control room in the non-isolated mode. According to Regulatory Guide 1.78, this control room is classified as a Type C control room. Exhibit 1 shows that the toxicity limits of chlorine and sulfur dioxide would be exceeded in the control room 2 minutes after detection.

5.0 PROBABILITY OF CAUSING UNINHABITABLE CONDITIONS IN THE CONTROL ROOM DUE TO THE RUPTURE OF A CHLORINE AND SULFUR DIOXIDE TANK CAR ON THE CHICAGO AND NORTHWESTERN RAILROAD AND SOO LINE RAILROAD

Since the dispersion analysis showed that the calculated chlorine and sulfur dioxide concentrations exceeded the toxicity limits under certain stability classes, a probability analysis was performed by the following method:

Statistical meteorological data for the years 1986 - 1989 collected at the Quad Cities Station site (33-foot level) were used which consisted of occurrence probabilities of stability class, wind direction and wind magnitude (Reference 8). Exhibit 2 shows the orientation of the wind direction sectors of the meteorological data with respect to the Soo Line and Chicago and Northwestern railroad tracks and the Quad Cities Station. The probability that the control room could be made uninhabitable is calculated from the probability of an accident within each wind direction sector the probability that the wind had a direction which would carry released vapor to the control room and that the stability of the atmosphere was of a class under which the control room could become uninhabitable. Only the portion of the railroad track within a distance of 5 miles from the station was considered in this analysis according to Regulatory Guide 1.78.

The equation used to evaluate the hazard to the control room is the following:

$$Pa = Pr(c) \times F(c) \times \sum_{i=1}^{N} L_i \, Pw\,(D_i)$$

where:

Pa = probability of accident resulting in control room uninhabitability (accident/year)

$Pr(c)$ = probability of accident with chemical release (accidents/car/mile)

$F(c)$ = frequency of shipment (cars/year)

L_i = length of track in each sector

$Pw(D_i)$ = probability under certain stability classes, that wind is blowing in a direction such that released chemical is carried to control room air intake

Exhibits 3 through 6 show the length of track in each sector and the probability that the wind has a direction that will carry the released gas to the control room air intake for a given stability class. Only those stability classes are shown for which the control room concentration can exceed toxic limits. Exhibits 3 and 4 show the calculations performed for chlorine and Exhibits 5 and 6 show the calculation performed for sulfur dioxide.

Exhibit 7 gives a comparison of railroad accident statistics for various hazardous materials and damage thresholds expressed in dollars. Accidents involving tank cars of chlorine and sulfur dioxide are recorded in the category of non-flammable gases. For the purpose of the probability calculations, minor releases are excluded because these do not result in control room uninhabitability. The release probabilities used include major releases; those releases expected to cause control room uninhabitability by being capable of causing at least $5000 in damages i.e., loss of cargo, property damage, cleanup crew, etc. The assumption of using accident frequencies with damages of at least $5000 is reasonable since chlorine and sulfur dioxide are shipped in quantities which are worth at least $5000. This yields the accident statistic of 1.9×10^{-6} releases per car per mile (Reference 9).

The evaluation of the probability that occurrences of control room uninhabitability may occur is shown in Exhibit 8 for each railroad and for each gas. The values are based on shipment frequencies recorded by the railroads during the years 1986 - 1990 (References 6 and 7).

6.0 DISCUSSION OF RESULTS

The conservative risk exposure of the control room is shown to be 6.29×10^{-7} occurrences of uninhabitable conditions per year for shipments of chlorine and 1.282×10^{-5} for shipments of sulfur dioxide due to releases of these chemicals on the Soo line and the Chicago and Northwestern Railroads. These probabilities are acceptable if, when combined with reasonable qualitative arguments, it is shown that the realistic risk or probability is lower. The following arguments are presented to show that the realistic probability is less than the calculated conservative probability.

1. The railroad accident statistic used to evaluate the hazard to the control room is 1.9×10^{-8} accidents releases per car per mile of travel. This statistic was obtained from Reference 9 (Table 4-34) and is applicable to hazardous materials cargos in the category of non-flammable gas with an accident threshold value of $5000 which represents loss of cargo, property damage, cleanup crew etc. Cargo releases of 90 tons which are considered in this analysis by themselves exceed the threshold value of $5000 (in terms of values existing in the years 1973-1977 when the statistics of Reference 10 were compiled) and therefore would have a lower release probability of causing uninhabitable conditions.

2. The conservative probability analysis considered summer meteorological conditions. Since the chemical shipments occur year around, the fraction of chemicals that would evaporate during average conditions would be lower, thereby lowering the probability of causing uninhabitable condition in the control room.

3. The conservative probability considered all wind speeds for the stability classes under which the control room would become uninhabitable. However, the wind speeds that could cause such conditions occur only a certain percentage of time, thereby lowering the probability of causing uninhabitable conditions.

7.0 CONCLUSIONS

The quantitative evaluation of the exposure risk of causing uninhabitable control room conditions by accidents involving railroad shipments of chlorine and of sulfur dioxide have been calculated to be 6.29×10^{-7}/year and 1.282×10^{-6}/year, respectively. These are within acceptable limits as defined by Regulatory Guide 1.70 and NUREG-0800. In addition, the realistic exposure risk is shown to be lower when qualitative assumptions are taken into account.

The results of this analysis show that chlorine and sulfur dioxide detectors are not required at the Quad Cities Station. It should be noted that in accordance with plant emergency plans and procedures, self-containing breathing apparatus is provided for assurance of control room habitability in the event of possible human detection of chlorine and sulfur dioxide due to accidents.

8.0 REFERENCES

1. E. D. Swartz, Commonwealth Edison Company letter dated June 28, 1982 "Dresden Station Units 2 and 3 Quad Cities Station Units 1 and 2 NUREG 0737 Item 111.D.3.4 Control Room Habitability Studies NRC docket No. 5 50-237/249 and 50-254/265" to D. G. Eisenhut, Director, US Nuclear Regulatory Commission

2. Quad Cities Station Units 1 and 2 Updated Final Safety Analysis Report, May 1986.

3. U.S. NRC Regulatory Guide 1.78, "Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release".

4. U.S. NRC Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Report for Nuclear Power Plants", Sections 2.2.3.1 and 2.2.2.2.

5. U.S. NRC Standard Review Plan, "Evaluation of Potential Accidents," Sections 2.2.1, 2.2.2 and 2.2.3 NUREG-0800, Rev. 2, July 1981.

6. ...nis Kerner, Soo Line Railroad, Personal Communication with Sargent & Lundy, April 13, 1988. (See Appendix A for updated reference)

7. Jim Miller, Chicago and Northwestern Railroad, Personal Communications with Sargent & Lundy, March 12, 1988. (See Appendix A for updated reference)

8. Quad Cities Station Onsite Meteorological Monitoring Data (January 1, 1986 - December 31, 1989) collected by Murray & Trettel for Commonwealth Edison Company.

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

10. U.S. NRC Regulatory Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors", Revision 2, June 1974.

EXHIBIT 1

CONTROL ROOM HABITABILITY ANALYSIS FOR ACCIDENTS
RELEASES ON THE SOO LINE RAILROAD

Material Spilled	Liquified Chlorine	Liquified Sulfur Dioxide
Weight, tons	90	90
Closest approach to control room, ft	9375	9375
Atmosphere stability class	F	F
Ambient Temp., °F	90	90
Concentration detectable by odor, ppm	3.5	3
Toxic concentration, ppm	15	5
Maximum concentration at Quad Cities air intake, ppm	3,374	4,332
Control room make up air flow, CFM	2000	2000
Control room volume, ft^3	240,500	240,500
Air exchange rate	0.499	0.499
Maximum concentration in control room 2 minutes after detection, ppm	45.4	56.0
Wind speed causing maximum concentration in control room, m/sec	2.17	2.21

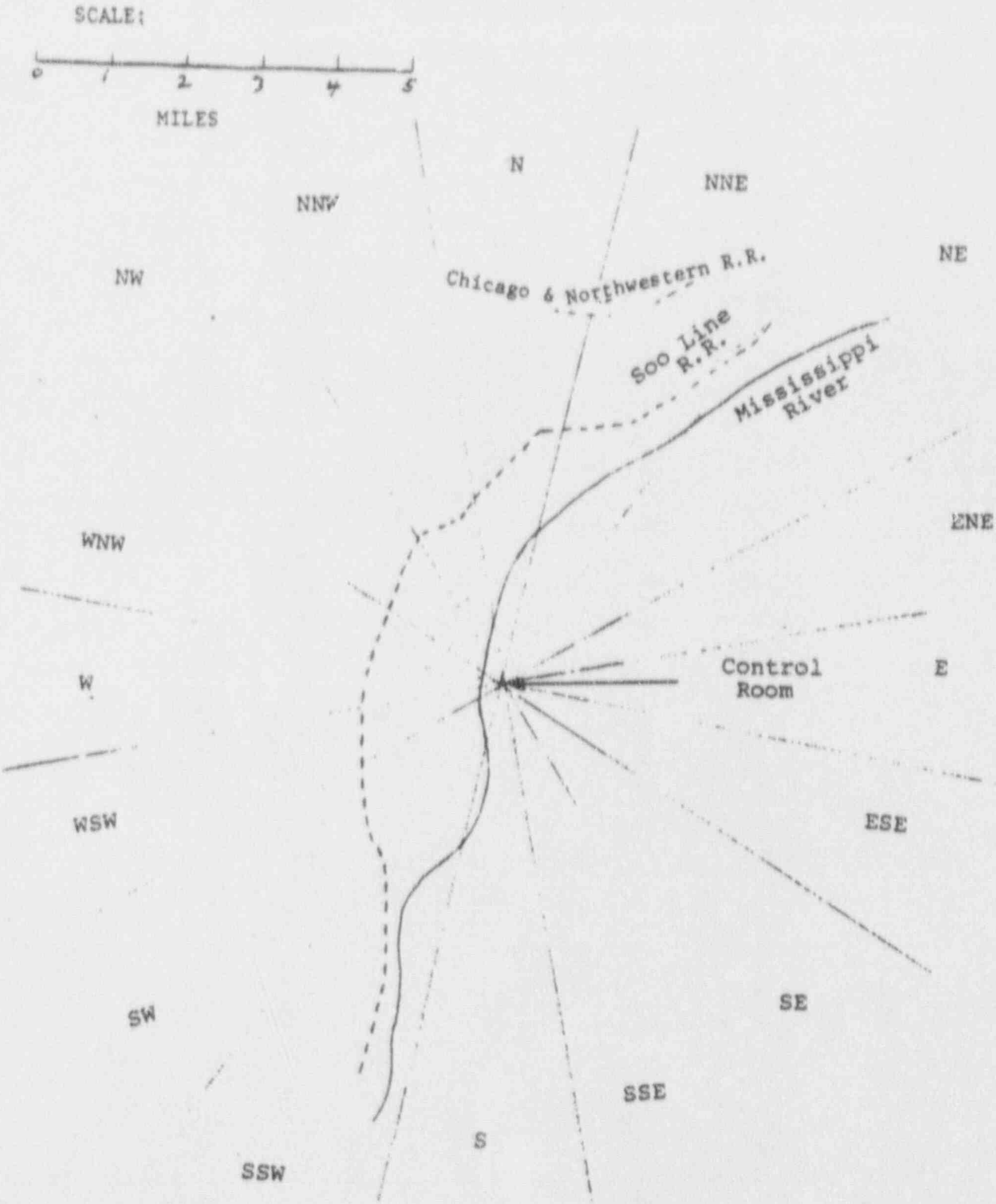

Exhibit 2 - Schematic Showing Relationship Between Control Room, Railroads within 5 Miles, Mississippi River, and Wind Sectors

EXHIBIT 3

STATISTICAL PARAMETERS FOR ESTIMATE OF HAZARD TO CONTROL ROOM HABITABILITY DUE TO CHLORINE SHIPMENTS OF CHLORINE ON SOO LINE RAILROAD

SECTOR FROM WHICH WIND IS BLOWING	CLOSEST APPROACH OF TRACK TO STATION, FT	PROBABILITIES OF WIND FROM SECTOR AT STABILITY CLASSES CAUSING TOXIC CONDITIONS IN CONTROL ROOM (ALL WIND SPEEDS) $Pw(D_i)$				SUMMATION OF PROBABILITIES OF WIND FROM SECTOR FOR ALL STABILITY CLASSES CAUSING TOXIC CONDITIONS IN CONTROL ROOM (ALL WIND SPEEDS) $Pw(Di_i)$	LENGTH OF TRACK IN SECTOR, FT L_i	$L_i x Pw(D_i)$ FT
		G	F	E	D			
NNE	480	0.001875				0.001875	11,220	21.0375
N	13,200	0.001275	0.00284			0.004105	8,580	35.2209
NNW	11,880	0.0009	0.00333			0.00423	5,280	22.3344
NW	10,000	0.001975	0.00453			0.006506	6,600	42.933
WNW	9,375	0.0034	0.00743		0.03048	0.043131	3,750	154.9125
W	9,375	0.0032	0.00589		0.02475	00.03383	4,000	135.32
WSW	10,250	0.001775	0.00315			0.004925	5,000	24.625
SW	12,500	0.00308	0.0056			0.00868	6,750	58.59
SSW	16,000	0.0032	0.00913			0.01233	11,220	138.3426

Sum of $L_i x Pw(D_i)$ = 633.32 FT

EXHIBIT 4

STATISTICAL PARAMETERS FOR ESTIMATE OF HAZARD TO CONTROL ROOM HABITABILITY DUE TO CHLORINE SHIPMENTS ON CHICAGO AND NORTHWESTERN RAILROAD

SECTOR FROM WHICH WIND IS BLOWING	CLOSEST APPROACH OF TRACK TO STATION, FT	PROBABILITIES OF WIND FROM SECTOR AT STABILITY CLASSES CAUSING TOXIC CONDITIONS IN CONTROL ROOM (ALL WIND SPEEDS) $\frac{Pw(D_i)}{G}$	LENGTH OF TRACK IN SECTOR, FT L_i	$L_i x Pw(D_i)$ FT
N	25,400	0.001275	2,640	3.366

EXHIBIT 5

STATISTICAL PARAMETERS FOR ESTIMATE OF HAZARD TO CONTROL ROOM HABITABILITY DUE TO SHIPMENTS OF SULFUR DIOXIDE ON SOO LINE RAILROAD IN IOWA

SECTOR FROM WHICH WIND IS BLOWING	CLOSEST APPROACH OF TRACK TO STATION, FT	SUMMATION OF PROBABILITIES OF WIND FROM SECTOR AT STABILITY CLASSES CAUSING TOXIC CONDITIONS IN CONTROL ROOM (ALL WIND SPEEDS) $Pw(D_i)$				PROBABILITIES OF WIND FROM SECTOR FOR ALL STABILITY CLASSES CAUSING TOXIC CONDITIONS IN CONTROL ROOM (ALL WIND SPEEDS) $Pw(D_i)$	LENGTH OF TRACK IN SECTOR, FT L_i	$L_i x Pw(D_i)$ FT
		G	F	E	D			
NNE*	18,480	0.001875	0.0038	--	--	0.005675	11,220	63.6735
N*	13,200	0.001275	0.00283	0.0089	--	0.0130	8,580	111.54
NNW*	11,880	0.011625	0.00333	0.0009	--	0.01586	5,280	83.742
NW*	10,000	0.001975	0.00453	0.022125	0.03498	0.0436975	6,600	288.4
WNW	9.375	0.0034	0.00743	0.03048	0.05028	0.09159	3,750	343.46
W	9.375	0.0032	0.00589	0.02475	0.03095	0.06478	4,000	259.12
WSW	10,250	0.001775	0.00315	0.0202	0.01885	0.043975	5,000	219.875
SW	12,500	0.00308	0.0056	0.03023	0.02183	0.06074	6,750	409.99
SSW	16,000	0.0032	0.00913	0.02948	0.0201	0.06191	11,220	694.63

Sum of $L_i x Pw(D_i)$ = 2474.43 FT

* Diffusion of the released chemical from sectors NNE to NW to the control room air intake is affected by the turbine building. Concentrations were reduced by a factor of 3 in accordance with Regulatory Guide 1.40

EXHIBIT 6

STATISTICAL PARAMETERS FOR ESTIMATE OF HAZARD TO CONTROL ROOM HABITABILITY DUE TO SHIPMENTS OF SULFUR DIOXIDE ON CHICAGO AND NORTHWESTERN RAILROAD

SECTOR FROM WHICH WIND IS BLOWING	CLOSEST APPROACH OF TRACK TO STATION, FT	SUMMATION OF PROBABILITIES OF WIND FROM SECTOR AT STABILITY CLASSES CAUSING TOXIC CONDITIONS IN CONTROL ROOM (ALL WIND SPEEDS) $Pw(D_i)$				PROBABILITIES OF WIND FROM SECTOR FOR ALL STABILITY CLASSES CAUSING TOXIC CONDITIONS IN CONTROL ROOM (ALL WIND SPEEDS) $Pw(D_i)$	LENGTH OF TRACK IN SECTOR, FT L_i	$L_i x Pw(D_i)$ FT
		G	F	E	D			
N	26,400	0.001275	0.00283	--	--	0.004105	2,640	10.837

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EXHIBIT 7

ACCIDENT FREQUENCIES PER MILLION CAR-MILES
FOR HAZARDOUS MATERIALS COMMODITIES

	Damage Threshold		
	$0	>$100	>$5000
Explosives	1.30	0.63	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

*chlorine and sulfur dioxide are classified as non-flammable gases

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

Excerpted from US DOT FRA/ORD-79/56 (Reference 9)

EXHIBIT 8

PROBABILITY OF CONTROL ROOM UNINHABITABILITY DUE TO RAILROAD SHIPMENTS OF CHLORINE AND SULFUR DIOXIDE

Chlorine

Railway	Cars/Year	$\Sigma L_i Pw (D_i)$*	Pa**
Soo Line	276	633.32	6.29×10^{-7}
Chicago & Northwestern	29	3.366	3.513×10^{-10}
	Aggregate Probability =		6.2935×10^{-7}

Sulfur Dioxide

Railway	Cars/Year	$\Sigma L_i Pw (D_i)$*	Pa**
Soo Line	144	2474.43	1.28×10^{-6}
Chicago & Northwestern	45	10.84	$1.755 \times 10^{[illegible]}$
	Aggregate Probability =		1.282×10^{-6}

* See Exhibits 3 through 6.

** Pa = Probability of accident resulting in control room uninhabitability (accident/year)

Pr(c) = Probability of accident with chemical release (accident/car(mile) 1.9×10^{-6} accidents/car/mile, Reference (9))

F(c) = Frequency of shipment (cars/year)

Li = Length of track in each sector

Pw(Di) = Probability under certain stability classics, that wind is blowing in a direction such that released chemical is carried to control room air intake.

GOVERNMENT AGENCIES AND PUBLIC ORGANIZATIONS CONTACTED

		Ref. No.
1.	American Waterways Operators Association, Arlington, VA	1
2.	Chlorine Institute, Washington, D. C.	2
3.	Disaster Services Coordinator, Clinton County, IA	3
4.	Disaster Services Coordinator, Scott County, IA	4
5.	Emergency Response Coordinator, Rock Island County, IL	5
6.	Emergency Response Coordinator, Whiteside County, IL	6
7.	Illinois Department of Transportation, Chicago, IL	7
8.	Iowa Department of Transportation, Des Moines, IA	8
9.	Lockmaster, Lock #13, Fulton, IL	9
10.	Lockmaster, Lock #14, Rapids City, IL	10
11.	Sulfur Institute for Chemical Research, Washington, D.C.	11
12.	U.S. Army Corps of Engineers, Chicago, IL.	12
13.	U.S. Army Corps of Engineers, Rock Island, IL.	13
14.	U.S. Coast Guard, Chicago, IL.	14
15.	U.S. Coast Guard, Washington, D.C.	15

ALL IDENTIFIED INDUSTRIES WITHIN 5 MILES OF THE QUAD CITIES STATION

	Company	Product(s)	Chlorine or SO_2 Use	Ref. No.
1.	Golden Seed Co., Cordova, IL	Seed Processing	None	16
2.	Magnetic Materials Resources, Cordova, IL	Magnetic Oxides	Included in 3 below	-
3.	Minnesota Mining & Manufacturing, Cordova, IL	Magnetic Oxides, Resins, Adhesives, Epoxy	Chlorine in 1-ton cylinders, delivered by truck; no SO_2	17
4.	Xylem Co., Cordova, IL	Landscaping Materials	None	18
5.	Adept Cutting Die Co., Camanche, IA	Steel Rule Dies	None	19
6.	Arcadian Corp. Camanche, IA	Chemicals	Chlorine in 1-ton cylinders, delivered by truck; no SO_2	23
7.	Camanche Machine Corp., Camanche, IA	Metal Fabricating & Machining	None	21
8.	Compliment Conversions Inc., Camanche, IA	Car & Truck Conversions	None	20
9.	Determann Blacktop Inc., Camanche, IA	Asphalt	None	29
10.	DuPont, DeNemours & Co., Camanche, IA	Oriented Polyolefin Film	Chlorine in 150-lb cylinders, delivered by truck; no SO_2	22
11.	Ipsco Steel, Inc Camanche, IA	Steel Products	Chlorine in 150-lb cylinders, delivered by truck; no SO_2	102
12.	Service Concrete Co., Camanche, IA	Concrete	None	24
13.	Vertex Chemical Corp., Camanche, IA	Chlorine Bleach	Chlorine in railroad tank cars; no SO_2	25
14.	Carver Lumber Co., Princeton, IA	Lumber Products	None	26
15.	Johnson Mfg. Co., Princeton, IA	Solders and Industrial Chemicals	None	27

	Company	Product(s)	Chlorine or SO_2 Use	Ref. No.
16.	Schult Engineering & Pattern Co. Princeton, IA	General Machining & Pattern	None	101
17.	C. F. Industries, Inc. Albany, IL (located outside the town but within 5 miles of the power plant)	Fertilizer Products	None	31

ALL IDENTIFIED BARGE TERMINALS BETWEEN LOCK #13 AND #14

	Company	Product(s)	Chlorine or SO_2 Handling	Ref. No.
1.	Westway Trading Corp., Cordova, IL	Fertilizer, Stone, Sand, and General Cargo	None	28
2.	Determann Industries, Camanche, IA	General Cargo	None	29
3.	Vertex Chemical Corp., Camanche, IA	Caustic Soda	None*	114
4.	Bunge Corp., Albany, IL	Grain	None	30
5.	C. F. Industries, Albany, IL	Fertilizer	None	31
6.	Growmark, Inc., Albany, IL	Petroleum	None	32
7.	ADM Clinton, Clinton, IA	Alcohol	None*	33
8.	C. F. Sales, Inc. Clinton, IA	Petroleum By-Products, Dry Materials	None	34
9.	Interstate Power Co., Clinton, IA	Coal	None*	35
10.	Peavy Co., Clinton, IA	Corn, Soybeans	None	36
11.	Pillsbury Co., Clinton, IA	Soybeans, Corn, Coal	None	37
12.	AGRI Grain Co. Fulton, IL	Grain	None	38
13.	Agrico Chemical Co., Fulton, IL	Fertilizer	None	39
14.	Fulton River Terminal, Fulton, IL	Fertilizer, Chemicals	None	40
15.	Le Clair Quarries, Inc. Le Claire, IA	Sand, Stone	None	41

*None by barge; for rail and/or truck shipments, see entry in listings titled Industries/Facilities Within 5/10 Miles of Station.

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OTHER SIGNIFICANT FACILITIES WITHIN 10 MILES
OF THE QUAD CITIES STATION

	Company	Product(s)	Chlorine or SO_2 Use	Ref. No.
1.	Water Treatment Facility Cordova, IL	Water and Wastewater Treatment	Chlorine in 150-lb cylinders, delivered by truck; no SO_2	42
2.	Water Treatment Facility Camanche, IA	Wastewater Treatment	Chlorine in 150-lb cylinders, delivered by truck, April to October; no SO_2	43
3.	Water Treatment Facility Port Byron, IL	Water and Wastewater Treatment	Chlorine in 150-lb cylinders, delivered by truck; no SO_2	44
4.	Sandstrom Products Co., Port Byron, IL	Paint Finishings and Coatings	None	45
5.	Water Treatment Facility Albany, IL	Water and Wastewater Treatment	Chlorine in 150-lb cylinders, delivered by truck; no SO_2	46
6.	C & J Service Co., Low Moor, IA	Blended Fertilizer	None	47
7.	Cropmate Fertilizer Co., Low Moor, IA	Fertilizer	None	48
8.	Iowa Culvert & Supply Low Moor, IA	Steel Culverts	None	49
9.	ADM Clinton, Clinton, IA	Corn and Dextrose Products, Livestock Feed and Enzymes	SO_2 in 90-ton railroad tank cars; SO_2 in 45,000-lb tank trucks; chlorine in 1-ton cylinders, delivered by truck; the chlorine and SO_2 truck shipments do not pass within 5 miles of power plant.	33
10.	Balanced Energy Clinton, IA	Animal Feed Pellets	None	103
11.	Carlon, Clinton, IA	Plastic Fittings, Electrical Conduits	None	50

	Company	Product(s)	Chlorine or SO_2 Use	Ref. No.
12.	Champion International, Dairypak Div., Clinton, IA	Milk Cartons	None	51
13.	Water Treatment Facility Clinton, IA	Wastewater Treatment	Chlorine in 1-ton cylinders, delivered by truck; no SO_2	52
14.	Clinton Parks & Recreation Municipal Pool, Clinton, IA	Municipal Pool	Chlorine in 150-lb cylinders, delivered by truck; no SO_2	109
15.	Collis, Inc. Clinton, IA	Welded Wire and Tool Holders	SO_2 in 1-ton cylinders delivered by truck; no chlorine	53
16.	Custom-Pak, Inc., Clinton, IA	Plastic Products, Industrial Parts	None	54
17.	International Paper Co., Clinton, IA	Boxes, Cartons	SO_2 in 150-lb cylinders delivered by truck; no chlorine	55
18.	Interstate Power Co., Clinton, IA	Electrical Generation	Chlorine in 1-ton cylinders, delivered by truck; no SO_2	35
19.	Iowa-American Water Co., Clinton, IA	Drinking Water Treatment	Chlorine in 150-lb cylinders, delivered by truck; no SO_2	56
20.	Johnson's Metalcrafters Clinton, IA	Metal Fabrication	None	104
21.	National By-Products, Inc., Clinton, IA	Petfood, Meat Scraps	Chlorine in 1-ton cylinders, delivered by truck; no SO_2	108
22.	Pinney Printing Co. Clinton, IA	Commercial Printing	None	112
23.	Quantum, USI Division, Clinton, IA	Plastic Resins	Chlorine in 1-ton cylinders, delivered by truck; no SO_2	57
24.	Ralston Purina Co., Clinton, IA	Pet Foods	None	58

	Company	Product(s)	Chlorine or SO_2 Use	Ref. No.
25.	Sethness Products Co., Clinton, IA	Caramel Coloring Syrup	SO_2 in 50-ton railroad tank cars; SO_2 in 40,000-lb tank trucks, but not within 5 miles of power plant; no chlorine	59
26.	S. J. Smith Welding Supply, Clinton, IA	Welding Supply	Chlorine in 150-lb cylinders, delivered by truck; no SO_2	106
27.	Starbuck Machinery International, Clinton, IA	Packaging Equipment Components	None	110
28.	Two Mile Machine and Welding, Inc., Clinton, IA	Machining and Welding	None	111
29.	Waldorf Corp., Clinton, IA	Folding Cartons	None	60
30.	Beuse's Pattern Works, Inc., Le Claire, IA	Metal and Wood Patterns, Dies and Molds	None	61
31.	Kroeger Co., N.A. Le Claire, IA	Aluminum Castings	None	105
32.	Water Treatment Facility Le Claire, IA	Water and Wastewater Treatment	Chlorine in 150-lb cylinders, delivered by truck; no SO_2	62
33.	McKay's Plating Works Hampton, IL	Electroplating of Metals	None	113
34.	Central Pool Supply Co., Moline, IL	Water Treatment	Chlorine in 150 lb cylinders, delivered by truck; no SO_2	107

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CHEMICAL PRODUCERS AND DISTRIBUTORS CONTACTED

	Company	Bulk Chlorine or SO_2 Shipments Through Power Plant Area*	No.
1.	Air Products & Chemicals, Inc., Allentown, PA	None	64
2.	Alexander Chemicals, Lemont, IL	Shipments of 1-ton chlorine and SO_2 cylinders	C5
3.	Ashland Chemical Co., Moline, IL	None	66
4.	Autochem, St. Paul, MN	None	81
5.	Di-Chem Co., Milan, IL	Shipments of 1-ton chlorine cylinders; no SO_2	68
6.	Dixie Petrochemicals, St. Paul, MN	None	69
7.	Dow Chemical USA, Midland, MI	None	70
8.	Dow Chemical, Plaquemine, LA	None	115
9.	DuPont, DeNemours & Co., Wilmington, DE	None	71
10.	FMC Corporation, Philadelphia, PA	None	72
11.	Georgia Gulf, Rolling Meadows, IL	None	116
12.	Georgia-Pacific Corp., Atlanta, GA	None	73
13.	Harcros Chemical Co., Davenport, IA	Shipments of 1-ton chlorine cylinders; no SO_2	86
14.	Hawkins Chemical Co., St. Paul, MN	None	74
15.	Hoechst-Celanese, Charlotte, NC	None	88
16.	Hy-Drite Chem, Milwaukee, WI	None	117
17.	ICI American, Wilmington, DE	None	63
18.	Jones Chemicals, Inc., Caledonia, NY	None	75
19.	LCP Chemicals & Plastics, Inc., Edison, NJ	None	76

	Company	Bulk Chlorine or SO_2 Shipments Through Power Plant Area*	No.
20.	Liquid Carbonic, Chicago, IL	None	77
21.	Marsulex, Norwalk, CT	None	67
22.	Occidental Chemical Corp., Dallas, TX	None	78
23.	Olin Corp., Stamford, CT	None	79
24.	PPG Industries, Inc. Pittsburgh, PA	None	82
25.	Rhone-Poulenc Naperville, IL	None	84
26.	Specialty Chem Products Corp., Marinette, WI	None	83
27.	K. A. Steel Chemicals, Inc., Chicago, IL	None	85
28.	Van Waters & Rogers Co., Burlington, IA	Shipments of 1-ton chlorine cylinders; no SO_2	87
29.	Vulcan Chemicals, Birmingham, AL	None	89

*Railroad shipments are not included here; they are shown in the table of transportation companies. Bulk shipments are defined as more than 100 lbs (largest single container) on the Mississippi River or more than 1,000 lbs (largest single container) by road. Power plant area is defined as within 5 miles of the control room normal air intake.

TRANSPORTATION COMPANIES CONTACTED

	Company	Bulk Chlorine or SO_2 Shipments Through Power Plant Area*	No.
1.	Brent Towing Co., Greenville, MS	None	90
2.	Burlington Northern Railroad, Moline, IL	None	91
3.	Chicago and Northwestern Railroad, Chicago, IL	29 tank cars of chlorine and 45 tank cars of SO_2 per year**	92
4.	Clinton Harbor Service, Clinton, IA	None	93
5.	Davenport, Rock Island and Northwestern Railroad, Davenport, IA	None	94
6.	Ingram Barge Line, Nashville, TN	None	96
7.	Lock City Transportation Co., Menominee, MI	None	96
8.	Port Arthur Towing Co., Port Arthur, TX	None	97
9.	Shotan Transportation Co., Cincinnati, OH	None	98
10.	Shotan Transportation Mandeville, LA	None	80
11.	Soo Line Railroad, Minneapolis, MN	276 Tank cars of chlorine and 144 tank cars of SO_2 per year**	99
12.	Southern Towing Co., Memphis, TN	None	100

*Bulk shipments are defined as more than 100 lbs (largest single container) on the Mississippi River or more than 1,000 lbs (largest single container) by road or railroad. Power plant area is defined as the area within 5 miles of the control room normal air intake.

**These numbers are the maximum numbers selected from data obtained from 1987-1990. See table next page.

RAIL SHIPMENTS

	SOO Line		C&NW Railroad	
	Cl_2	SO_2	Cl_2	SO_2
1987	276	132	21	45
1988	168	144	29	41
1989	158	132	10	34
1990	161*	110*	10**	34**

* These are projected numbers for 1990 based on recorded shipments for January-September 1990 (reference 99).

**The C&NW spokesman was unable to provide numbers for 1990, but stated that they are approximately the same as the numbers for 1989 (reference 92).

REFERENCES TO APPENDIX A

1. American Waterways Operators, Arlington, Virginia, Ms. Angela Todd, personal communication with Sargent & Lundy, October 10, 1990.

2. Chlorine Institute, Washington, D.C., Mr. Mike Lyden, personal communication with Sargent & Lundy, October 30, 1990.

3. Disaster Services Coordinator, Clinton County, Iowa, Mr. Walter Henry, personal communication with Sargent & Lundy, October 19, 1990.

4. Disaster Services Coordinator, Scott County, Iowa, Mr. Bud Whitfield, personal communication with Sargent & Lundy, October 19, 1990.

5. Emergency Response Coordinator, Rock Island County, Illinois, Mr. Dave Carlson, personal communication with Sargent & Lundy, October 22, 1990.

6. Emergency Response Coordinator, Whiteside County, Illinois, Mr. Stewart Richter, personal communication with Sargent & Lundy, October 22, 1990.

7. Illinois Department of Transportation, Chicago, Illinois, Mr. Jim Johnson, personal communication with Sargent & Lundy, November 1, 1990.

8. Iowa Department of Transportation, Des Moines, Iowa, Mr. Craig O'Riley, personal communication with Sargent & Lundy, November 1, 1990.

9. Lockmaster - Lock #13, Fulton, Illinois, Mr. Ernest Jackson, personal communication with Sargent & Lundy, November 1, 1990.

10. Lockmaster - Lock #14, Rapids, City, Illinois, Mr. Roger Hofland, personal communication with Sargent & Lundy, November 1, 1990.

11. Sulfur Institute for Chemical Research, Washington, D.C., Mr. Harold Weber, personal communication with Sargent & Lundy, November 9, 1990.

12. U.S. Army Corps of Engineers, Chicago, Illinois, Mr. Rick Hurt, personal communication with Sargent & Lundy, November 9, 1990.

13. U.S. Army Corps of Engineers, Rock Island, Illinois, Mr. Ron Rothert, personal communication with Sargent & Lundy, November 14, 1990.

14. U.S. Coast Guard, Chicago, Illinois, Mr. Jim Pilko, personal communiation with Sargent & Lundy, November 9, 1990.

15. U.S. Coast Guard, Washington, D.C., Ms. Crystal Hollingsworth, personal communication with Sargent & Lundy, November 13, 1990.

16. Golden Seed Company, Inc., Cordova, Illinois, Mr. Don Davis, personal communication with Sargent & Lundy, October 15, 1990.

17. 3-M Company, Cordova, Illinois, Mr. John Hardy, personal communication with Sargent & Lundy, October 15, 1990.

18. Xylem Company, Cordova, Illinois, Mr. Chuck Dornfeld, personal communication with Sargent & Lundy, October 15, 1990.

19. Adept Cutting Die Company, Comanche, Iowa, Mr. Elmer Kemp, personal communication with Sargent & Lundy, October 15, 1990.

20. Compliment Conversions, Camanche, Iowa, Mr. Dan McChane, personal communication with Sargent & Lundy, October 15, 1990.

21. Comanche Machine Corporation, Comanche, Iowa, Mr. Emil Hurt, personal communication with Sargent & Lundy, October 15, 1990.

22. Du Pont De Nemours and Company, Camanche, Iowa, Mr. Dan DuVall, personal communication with Sargent & Lundy, October 16, 1990.

23. Arcadian Corp., Camanche, Iowa, Ms. Kris Rossmiller, personal communication with Sargent & Lundy, October 16, 1990.

24. Service Concrete Company, Camanche, Iowa, Mr. Robert Holesinger, personal communication with Sargent & Lundy, October 16, 1990.

25. Vertex Chemical Company, Camanche, Iowa, Mr. Warren Ahrens, personal communication with Sargent & Lundy, October 15, 1990.

26. Carver Lumber Company, Princeton, Iowa, Ms. Evelyn Carver, personal communication with Sargent & Lundy, October 15, 1990.

27. Johnson Manufacturing Company, Princeton, Iowa, Mr. Bill Meyer, personal communication with Sargent & Lundy, October 15, 1990.

28. Westway Trading Corporation, Cordova, Illinois, Mr. Bruce Heuchlin, personal communication with Sargent & Lundy, November 2, 1990.

29. Determann Blacktop, Inc., Camanche, Iowa, Mr. Tom Determann, personal communication with Sargent & Lundy, October 15,1990.

30. Bunge Corporation, Albany, Illinois, Mr. Bruce Bastert, personal communication with Sargent & Lundy, November 2, 1990.

31. C. F. Industries, Inc., Albany, Illinois, Mr. Ron Boonstra, personal communication with Sargent & Lundy, October 16, 1990.

32. Growmark, Inc., Albany, Illinois, Mr. Mike Mask, personal communication with Sargent & Lundy, November 2, 1990.

33. ADM Clinton, Clinton, Iowa, Mr. Paul Caswell, personal communication with Sargent & Lundy, October 17, 1990.

34. C. F. Sales, Inc., Clinton, Iowa, Mr. Bob Wilkins, personal communication with Sargent & Lundy, November 2, 1990.

35. Interstate Power Company, Clinton, Iowa, Mr. Gary Carlson, personal communication with Sargent & Lundy, October 17, 1990.

36. Peavy Company, Clinton, Iowa, Mr. Jim Veenstra, personal communication with Sargent & Lundy, November 2, 1990.

37. Pillsbury Company, Clinton, Iowa, Mr. Forrest Storm, personal communication with Sargent & Lundy, November 2, 1990.

38. Agri Grain Marketing Company, Fulton, Illinois, Mr. Melvin Ammon, personal communication with Sargent & Lundy, November 2, 1990.

39. Agrico Chemical Company, Fulton, Illinois, Mr. Russel Gies, personal communication with Sargent & Lundy, November 2, 1990.

40. Fulton River Terminal, Fulton, Illinois, Mr. Rich Shepper, personal communication with Sargent & Lundy, November 2, 1990.

41. Leclaire Quarries, Inc., Leclaire, Iowa, Mr. Jerry Welvaert, personal communication with Sargent & Lundy, October 23, 1990.

42. Water Treatment Facility, Cordova, Illinois, Mr. Bill Churchill and Ms. Betty Shaffer, personal communication with Sargent & Lundy, October 15, 1990.

43. Water Treatment Facility, Camanche, Iowa, Mr. Dave Ramsey, personal communication with Sargent & Lundy, October 16, 1990.

44. Water Treatment Facility, Port Byron, Illinois, Mr. Mel Bowers, personal communication with Sargent & Lundy, October 16, 1990.

45. Sandstrom Products Company, Port Byron, Illinois, Mr. Allen Hoeschele, personal communication with Sargent & Lundy, October 16, 1990.

46. Water Treatment Facility, Albany, Illinois, Ms. Janet Price, personal communication with Sargent & Lundy, October 16, 1990.

47. C&J Service Company, Low Moor, Iowa, Mr. Roger Oltman, personal communication with Sargent & Lundy, October 16, 1990.

48. Cropmate Fertilizer Company, Low Moor, Iowa, Ms. Sharon Witt, personal communication with Sargent & Lundy, October 16, 1990.

49. Illowa Culvert & Supply Company, Low Moor, Iowa, Mr. Jeff Greve, personal communication with Sargent & Lundy, October 16, 1990.

50. Carlon, Clinton, Iowa, Mr. Rick Heidgerken, personal communication with Sargent & Lundy, October 17, 1990.

51. Champion International, Dairypak Division, Clinton, Iowa, Mr. Don Hosette, personal communication with Sargent & Lundy, October 17, 1990.

52. Water Treatment Facility, Clinton, Iowa, Mr. Virtus Clasen, personal communication with Sargent & Lundy, October 17, 1990.

53. Collis, Inc., Clinton, Iowa, Mr. Dan Deters, personal communication with Sargent & Lundy, October 17, 1990.

54. Custom-Pak, Inc., Clinton, Iowa, Mr. Paul Nugent, personal communication with Sargent & Lundy, October 17, 1990.

55. International Paper Company, Clinton, Iowa, Ms. Karen Krause, personal communication with Sargent & Lundy, October 18, 1990.

56. Iowa-American Water Company, Clinton, Iowa, Mr. Ed Stoltengerg, personal communication with Sargent & Lundy, October 17, 1990.

57. Quantum, USI Division, Clinton, Iowa, Mr. Bob Schuter, personal communication with Sargent & Lundy, October 17, 1990.

58. Ralston Purina Company, Clinton, Iowa, Mr. Dan Bruehl, personal communication with Sargent & Lundy, October 18, 1990.

59. Sethness Products Company, Clinton, Iowa, Mr. William Cotter, personal communication with Sargent & Lundy, October 18, 1990.

60. Waldorf Corporation, Clinton, Iowa, Ms. Mary Korous, personal communication with Sargent & Lundy,. October 18, 1990.

61. Beuse's Pattern Works, Inc., Leclaire, Iowa, Mr. John Biles, personal communication with Sargent & Lundy, October 18, 1990.

62. Water Treatment Facility, Leclaire, Iowa, Mr. Randy Dreese, personal communication with Sargent & Lundy, October 23, 1990.

63. ICI America, Wilmington, DE, Mr. Mike Starling, personal communication with Sargent & Lundy, November 6, 1990.

64. Air Products and Chemicals, Allentown, Pennsylvania, Mr. Kevin Raymundo, personal communication with Sargent & Lundy, October 24, 1990.

65. Alexander Chemical Company, Lemont, Illinois, Mr. Gill Lavitt, personal communication with Sargent & Lundy, October 25, 1990.

66. Ashland Chemical Company, Moline, Illinois, Mr. Steve Dallman, personal communication with Sargent & Lundy, October 24, 1990.

67. Marsulex, Norwalk, CN, Mr. Eric Bohn, personal communication with Sargent & Lundy, November 6, 1990.

68. Di-Chem Company, Milan, Illinois, Mr. Norm Wirtala, personal communication with Sargent & Lundy, October 26, 1990.

69. Dixie Petrochemical, St. Paul, Minnesota, Mr. Mike Hambleton, personal communication with Sargent & Lundy, October 24 & 30, 1990.

70. Dow Chemical USA, Midland, Michigan, Mr. Tom Schwartz, personal communication with Sargent & Lundy, October 24, 1990.

71. Du Pont De Nemours, E. I. & Company, Wilmington, Delaware, Ms. Edna Cephas, personal communication with Sargent & Lundy, October 29, 1990.

72. FMC Corporation, Philadelphia, Pennsylvania, Mr. Larry Margioli, personal communication with Sargent & Lundy, October 24, 1990.

73. Georgia-Pacific Corporation, Atlanta, Georgia, Ms. Phylis Erb, personal communication with Sargent & Lundy, October 24, 1990.

74. Hawkins Chemical Company, St. Paul, Minnesota, Mr. John Eaton, personal communication with Sargent & Lundy, October 29, 1990.

75. Jones Chemicals, Inc., Caledonia, New York, Mr. William Ginther, personal communication with Sargent & Lundy, October 29, 1990.

76. LCP Chemicals and Plastics, Edison, New Jersey, Mr. Greg Schultz, personal communication with Sargent & Lundy, October 26, 1990.

77. Liquid Carbonic, Chicago, Illinois, Ms. Karen Pufahl, personal communication with Sargent & Lundy, October 29, 1990.

78. Occidental Chemical Corporation, Dallas, Texas, Mr. Dwayne Carley, personal communication with Sargent & Lundy, October 26, 1990.

79. Olin Corporation, Stamford, Connecticut, Mr. Dennis Holgerson, personal communication with Sargent & Lundy, October 30, 1990.

80. Shotan Transportation, Mandeville, LA, Mr. Floyd West, personal communication with Sargent & Lundy, October 26, 1990.

81. Autochem, St. Paul, MN, Mr. Bob Gies, personal communication with Sargent & Lundy October 30, 1990.

82. PPG Industries, Inc., Pittsburgh, Pennsylvania, Mr. Mike Petrucelli, personal communication with Sargent & Lundy, November 5, 1990.

83. Specialty Chem Products, Marinette, Wisconsin, Ms. Tammi Salewski, personal communication with Sargent & Lundy, October 26, 1990.

84. Rhone-Poulenc, Naperville, IL, Mr. Ron Lang, personal communication with Sargent & Lundy, October 31, 1990.

85. K. A. Steel Chemical Company, Chicago, Illinois, Ms. McFall, personal communication with Sargent & Lundy, October 30, 1990.

86. Harcross Chemical Company, Davenport, Iowa, Mr. Bill Ryder, personal communication with Sargent & Lundy October 31, 1990.

87. Van Waters & Rogers Company, Burlington, Iowa, Mr. Peter Goodwin, personal communication with Sargent & Lundy, November 1, 1990.

88. Hoechst-Celanese, Charlotte, NC, Mr. Harold Walton, personal communication with Sargent & Lundy, November 5, 1990.

89. Vulcan Chemicals, Birmingham, Alabama, Mr. Ed Phillips, personal communication with Sargent & Lundy, October 30, 1990.

90. Brent Towing Company, Greenville, Mississippi, Ms. Dixie King, personal communication with Sargent & Lundy, October 23, 1990.

91. Burlington Northern Railroad, Moline, Illinois, Mr. Dick Kenney, personal communication with Sargent & Lundy, October 23, 1990.

92. Chicago and North Western Railroad, Chicago, Illinois, Mr. Don Fredbeck, personal communication with Sargent & Lundy, October 30, 1990.

93. Clinton Harbor Service, Clinton, Iowa, Mr. Jim Clark, personal communication with Sargent & Lundy, October 23, 1990.

94. Davenport, Rock Island, and North Western Railroad, Davenport, Iowa, Mr. Ron Ries, personal communication with Sargent & Lundy, November 6, 1990.

95. Ingram Barge Line, Nashville, Tennessee, Mr. John Kristen, personal communication with Sargent & Lundy, October 23, 1990.

96. Lock City Transportation, Menominee, Michigan, Mr. Ron Rife, personal communication with Sargent & Lundy, October 23, 1990.

97. Port Arthur Towing Company, Port Arthur, Texas, Mr. Dennis Foret, personal communication with Sargent& Lundy, October 23, 1990.

98. Shotan Transportation, Cincinnati, Ohio, Mr. Mike Gubser, personal communication with Sargent & Lundy, October 26, 1990.

99. Soo Line Railroad, Minneapolis, Minnesota, Mr. Phil Marbut, personal communication with Sargent & Lundy, November 14, 1990.

100. Southern Towing Company, Memphis, Tennessee, Ms. Rachel Embey, personal communication with Sargent & Lundy, October 23, 1990.

101. Schult Engineering & Pattern Co., Princeton, Iowa, Mr. Mike Schult, personal communication with Sargent & Lundy, October 15, 1990.

102. IPSCO Steel Inc., Camanche, Iowa, Mr. Al Decatur, personal communication with Sargent & Lundy, October 31, 1990.

103. Balanced Energy, Clinton, Iowa, Mr. Ted Wilson, personal communication with Sargent & Lundy, October 17, 1990.

104. Johnson's Metalcrafter's, Clinton, Iowa, Mr. Rex Wingel, personal communication with Sargent & Lundy, October 17, 1990.

105. Kroeger Co., N.A. LeClaire, Iowa, Ms. Connie Kroeger, personal communication with Sargent & Lundy, October 23, 1990.

106. S. J. Smith Welding Supply, Clinton, Iowa, Mr. Mike Mitchell, personal communication with Sargent & Lundy, November 5, 1990.

107. Central Pool Supply Company, Moline, Illinois, Mr. Scott Wood, personal communication with Sargent & Lundy, November 6, 1990.

108. National By-Products Inc., Clinton, Iowa, Mr. Leroy Michaelsen, personal communication with Sargent & Lundy, October 30, 1990.

109. Clinton Parks & Recreation Municipal P[illegible] Clinton, Iowa, Mr. Greg Obren, personal communication with Sargent & Lundy, October 30, 1990.

110. Starbuck Machinery International, Clinton, Iowa, Mr. Dennis Bicker, personal communication with Sargent & Lundy, October 18, 1990.

111. Two Mile Machine & Welding Inc., Clinton, Iowa, Ms. Linda Laughlin, personal communication with Sargent & Lundy, October 18, 1990.

112. Pinney Printing Company, Clinton, Iowa, Mr. Bill Ogan, personal communication with Sargent & Lundy, October 18, 1990.

113. McKay's Plating Works, Hampton, Illinois, Mr. Sam McKay, personal communication with Sargent & Lundy, October 23, 1990.

114. Vertex Chemical Corp., Clinton, IA, Ms. Dixie Ploog, personal communication with Sargent & Lundy, November 1, 1990.

115. Dow Chemical, Plaquemine, LA, Jennifer Kusch, personal communication with Sargent & Lundy, October 26, 1990.

116. Georgia Gulf, Rolling Meadows, Illinois, Mr. Stan Lewis, personal communication with Sargent & Lundy, October 30, 1990.

117. Hy-Drite, Chem, Milwaukee, WI, Mr. Bob Adams, personal communication with Sargent & Lundy, November 5, 1990.