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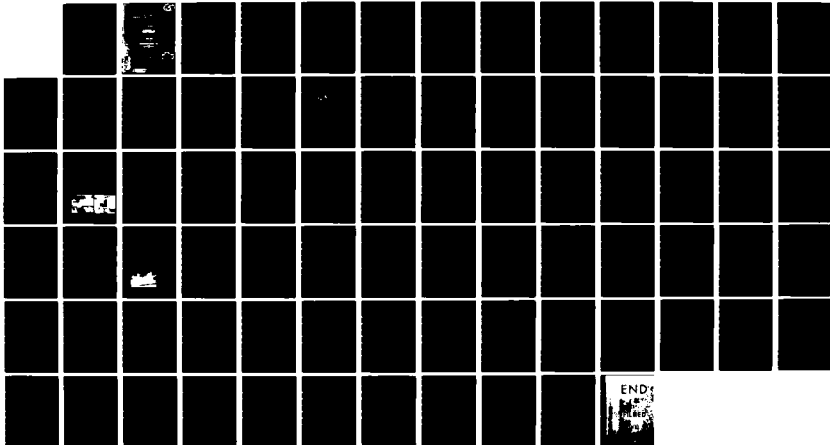
EVACUATION BEHAVIOR: CASE STUDY OF THE TAFT LOUISIANA
CHEMICAL TANK EXPLOSION INCIDENT(U) OHIO STATE UNIV
COLUMBUS DISASTER RESEARCH CENTER E L QUARANTELLI
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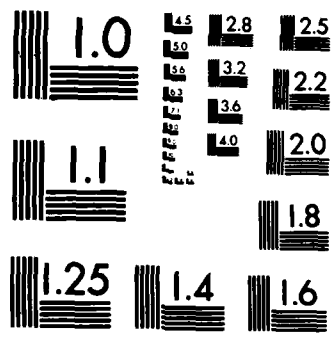
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EVACUATION BEHAVIOR:

CASE STUDY OF THE TAFT, LOUISIANA CHEMICAL TANK EXPLOSION INCIDENT

A FINAL REPORT

for the

Federal Emergency Management Agency

under

Contract EMW-2-4186

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May 1983

Columbus, Ohio

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Acknowledgments

We thank the residents and officials of St. Charles Parish and New Orleans, Louisiana who provided information via personal interviews, phone calls, and correspondence; without their cooperation our field study and subsequent report would not have been produced. We appreciate their assistance and hope this report will be helpful to them, although this kind of report is usually far more informative to those who were not personally involved in the situations. As in all Disaster Research Center (DRC) studies, field material was obtained on a confidential basis. Thus, in this report no quotations are attributed to any identifiable individual unless that material is already part of a public record.

Publication production depended upon the persistent effort of various members of the DRC staff: Jennifer Welch, DRC Administrative Director, through whose editorial skills some version of English was imposed upon the original draft; Mark Fabiano, for assisting her; Connie Hand, DRC Secretary, as efficient as usual in typing and proofreading; and Eva Bridget, Dan Ciritovic, and Julie Young for their production assistance.

Various officials in the Federal Emergency Management Agency (FEMA) and The Ohio State University Research Foundation managed to expedite the process through which the contract agreement was reached. Since time was a factor in getting the field work under way, this was very important. We thank them for their help.

The field work during which most of the data were gathered, was undertaken by David Hutchinson and Brenda Phillips. They helped in writing the first draft of the report, and as such are to be credited with co-authorship. However, the final version was my responsibility, and does not necessarily reflect their views and opinions.

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Director, Disaster Research
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Table of Contents

	page
Acknowledgments	ii
List of Maps, Charts, and Photographs	iv
Preface	v
I. Introduction	1
II. Community Characteristics	2
Socio-geographic features	
Socio-demographic features	
Socio-economic features	
Socio-political features	
III. Disaster Risks and Experiences	13
Risks	
Disaster experiences	
Disaster subculture	
IV. Disaster Preparedness	18
V. A Social Chronology of the Incident	24
Introduction	
The major happenings	
The organizational response	
The formal evacuation	
The wait and return to normal	
The sheltering operation	
VI. Perceptions and Evaluations of Those Involved	47
VII. An Assessment of Actions in the Incident	50
VIII. A Comparison of Situational Contingencies in This and Other Mass Evacuation Situations	57
Appendices: Quantity and Quality of Data Gathered	59
Interview Guide	64
Bibliography	67

List of Maps, Charts, and Photographs

	page
<u>Maps</u>	
Map #1: Vicinity Map	3
Map #2: St. Charles Parish Base Map	4
Map #3: Vicinity Population Growth	6
Map #4: Major Industrial Sites	10
<u>Charts</u>	
Chart #1: Outline of Structure of Parish Government: St. Charles Parish	11
Chart #2: St. Charles Parish Emergency Preparedness Organizational Chart	21
Chart #3: St. Charles Parish Emergency Function and Responsibility Chart	22
<u>Photographs</u>	
Photograph #1: St. Charles Parish, LA, EOC	20
Photograph #2: Norco, LA, evacuation area	35

Preface

In this report, we present a case study of some of the individual and group responses to the threat posed by a tank explosion at a chemical plant in Taft, Louisiana about 30 miles west of New Orleans. The focus is on the activities of the local emergency organizations, particularly their involvement in the relatively large scale evacuation behavior which occurred. In the description presented, the perspective taken is that of the local groups and what they knew or did not know as the threat situation developed. The analysis undertaken is a social science one which assumes that different valid criteria can be applied in evaluating any or all parts of the emergency response.

The study was initiated because early reports and comments from the scene suggested that elements of a nuclear plant disaster plan might have been used in the evacuation. As our on-the-scene field work found, this was not the case in any meaningful sense, and only very indirectly did prior planning for the nuclear plant influence the response pattern of the local emergency organizations. However, our study did find, as other researchers have consistently found, that disaster planning of any kind—and there was much disaster planning in the threatened area—makes a difference during a community threat emergency. Furthermore, it seemed particularly worthwhile to document this particular case because of the high disaster risk nature of the community involved, its extensive experience with small and large scale emergencies, and the complexity of its disaster planning.

We are satisfied that we were able to construct a reasonably valid account of the major aspects of the local organizational response and evacuation behavior in the event. Data did not have to be interpreted beyond what is usual in a social science study, and conscious and explicit qualifications were added to observations and interpretations which rest on weaker data or greater inference than is typical. Field and documentary information was assessed against what studies of similar situations (by ourselves and others) have found in the past. Some local officials were also provided an opportunity to react to an earlier draft of this report, and to raise questions regarding actual details. Thus, despite limited resources (of both time and funds) to do field work and data analysis, we captured the general picture of what we think happened in the situation. Longer and more systematic research would undoubtedly have generated more details and clarified certain points. Almost certainly it would not have altered our overall findings and conclusions.

As is true of almost all field studies, we obtained some conflicting or inconsistent statements from the various parties we contacted. Since such matters are not issues of absolute truth, but involve differential knowledge, perception, and interpretation of the same things, we have made no attempt to force a false reconciliation between the different views. How we handled the problem and some of the questions raised by the quality of our data are briefly noted in an Appendix to the report.

The chemical tank explosion occurred very early on December 11, 1982. The Federal Emergency Management Agency and the Disaster Research Center agreed to a contract to study the event in late December. The field work was carried out January 3-7, 1983. A first draft of the report, required by the contract, was produced January 31, 1983. A few substantive changes and many editorial changes were made in this, the formal, final report which was completed at the end of May 1983.

I. Introduction

On December 11, 1982, a chemical storage tank exploded at the Union Carbide Corporation plant in Taft, Louisiana, about 30 miles from New Orleans. Initial mass media reports alleged that more than 20,000 evacuated in the early morning hours. As it turned out, while there was a period of threat, there were no injuries on the site as a result of the incident and the only major property damage was to some chemical storage tanks. Less than 17,000 evacuated.

On December 13, the Disaster Research Center (DRC), since it had a contract with the Federal Emergency Management Agency (FEMA) to study emergent behavior in emergency time periods, telephoned safety personnel and Red Cross officials in the area. We ascertained that there was no significant emergent behavior during the emergency, and so we initiated no field study. During the phone conversations, it was mentioned that the nuclear plant evacuation plan for the Waterford plant (one mile from Taft) was at least partly used in the evacuation.

Subsequent contact with FEMA officials led to an agreement between DRC and FEMA that the Center would conduct a special study (under a separate small contract) of evacuation behavior during the incident. Delays occasioned by working out of contract details between the University and the FEMA contract office, as well as the Christmas holiday season, precluded sending a DRC team to the area until January 4. Following a research design developed at the Center before going into the field, a two person team spent four days on site. Intensive open-ended interviews were conducted with key persons involved in the emergency response and evacuation efforts. Substantial documentary data were also obtained (the quantity and quality of the data obtained are indicated in the Appendix). Except for the chemical company, all other organizations contacted were cooperative with DRC personnel, not only during field work, but in phone calls before and after.

The data collected were analyzed and worked into the case study which constitutes this report. In the next section, the community characteristics are briefly depicted, including the more salient socio-geographic, demographic, economic, and political features. In section three, we indicate the disaster risks and experiences of the community, covering both natural and technological agents, and we note that the area involved has a disaster subculture. The disaster preparedness of the area is described in section four, where we note not only the organizational aspects of the private and public preparedness planning, but the efforts that have been made to link the planning for disasters generally, for industrial emergencies specifically, and for a nuclear plant accident. The section which follows presents a detailed social chronology of the incident from the threat stage, through the organizational response stage, to the formal evacuation stage, to the return to normal stage. In section six we briefly set forth the perceptions and evaluations of those officials and organizations most involved in the event. Our own short assessments of the actions in the incident are presented in the seventh section. We conclude the text of the report by making a brief comparison between the situational contingencies in this situation and other mass evacuation situations.

II. Community Characteristics

Socio-geographic features

The south central area of Louisiana in which this situation occurred, being near to the coast, is rather flat, has a very mixed land use pattern, and a concentration of residential quarters in a few localities linked together by a relatively limited road system. Physically, the approximately 418 square miles is dominated by a number of chemical companies along both shores of the Mississippi River, which bisects the northern part of the community. Except for the developed residential and industrial sections near the river and alongside US-90 running east-west, most of the rest of the area is farmland, marshes, and lakes.

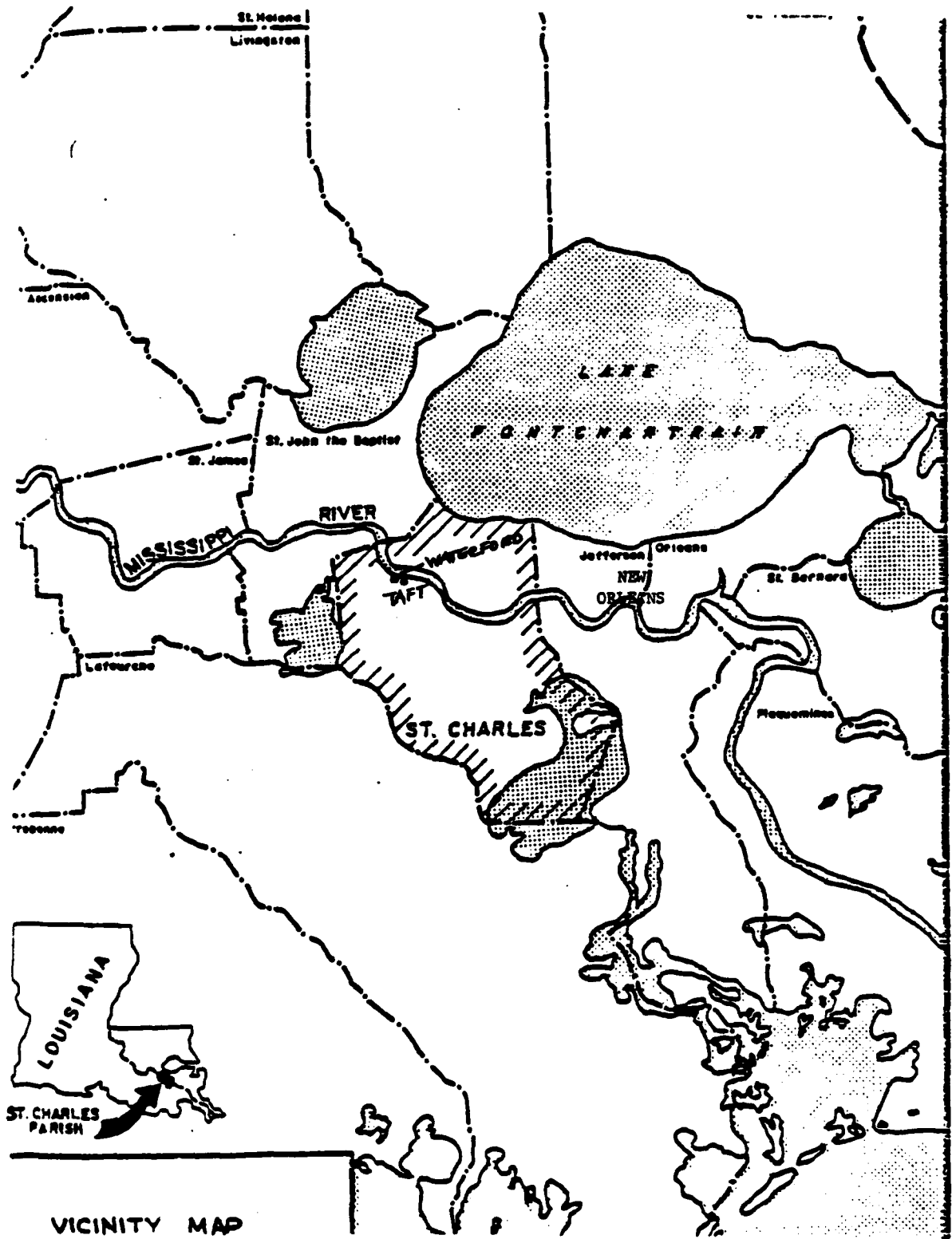
Taft is located on the west bank of the Mississippi River in St. Charles Parish (the parish in Louisiana is the equivalent of the county elsewhere in the United States). This parish is adjacent to Jefferson Parish, and as such, is part of the greater metropolitan area of New Orleans. St. Charles Parish is divided by the Mississippi River into two geographical areas known as the West Bank (the southern part) and the East Bank (the northern part). The only direct link between the two banks is by a ferry crossing at Luling, which is roughly at midpoint on the river in the parish. Otherwise, the nearest bridge crossing the Mississippi is the Huey P. Long Bridge in New Orleans, about 30 miles east of Taft. There is also a ferry crossing at Edgard-Reserve in St. John Parish near the St. Charles Parish line. Each of the ferries transports an average of 100 vehicles per hour.

St. Charles Parish (as indicated on the following map) is bordered on the north by Lake Pontchartrain (which also is the northern boundary of New Orleans), to northwest by St. John the Baptist Parish, by Lafouche Parish to the south/southwest, and by Jefferson Parish to the east. As will be indicated later, evacuation also occurred in St. John Parish. Emergency assistance also crossed over from New Orleans in Jefferson and Orleans Parishes.

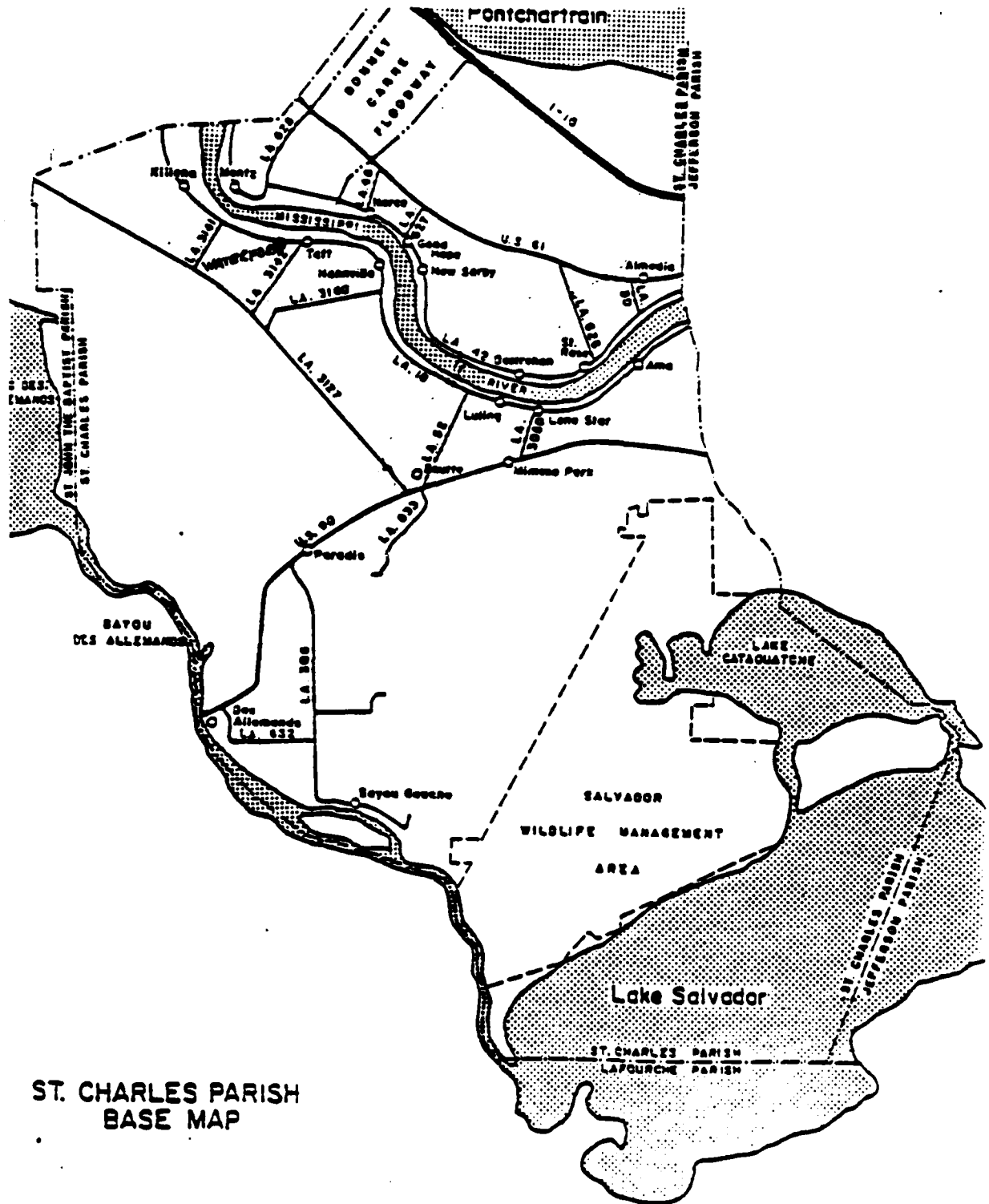
Most of the population centers are concentrated along the natural alluvial levees of the Mississippi River. Additional growth has occurred along a corridor created by US-90 and the Southern Pacific Railroad tracks from Des Allemands to the Jefferson Parish line. The population is primarily distributed along the form of a rough "T" shape in the parish. That the population is concentrated is indicated by the fact that only 4,906 acres of 267,742 in the parish are given over to residential land use. (See the following St. Charles Parish Base Map where the road patterns indicate the whereabouts of the population distribution.)

St. Charles is located in the Mississippi River Alluvial Flood Plain. There are visible marshes along the main roadways, which is not surprising in that wetlands constitute approximately 79 percent of the total parish "land" area. (Water and wetlands comprise 86.4 percent of the total parish geographic area.) Along the river, large industrial plants mix with raised plantation cottages, salt box houses, modern

Map #1



Map #2



subdivisions, and cane fields. The Mississippi River at this location primarily serves the industrial economy, with docks for a number of the chemical companies extending from the levees.

Socio-demographic features

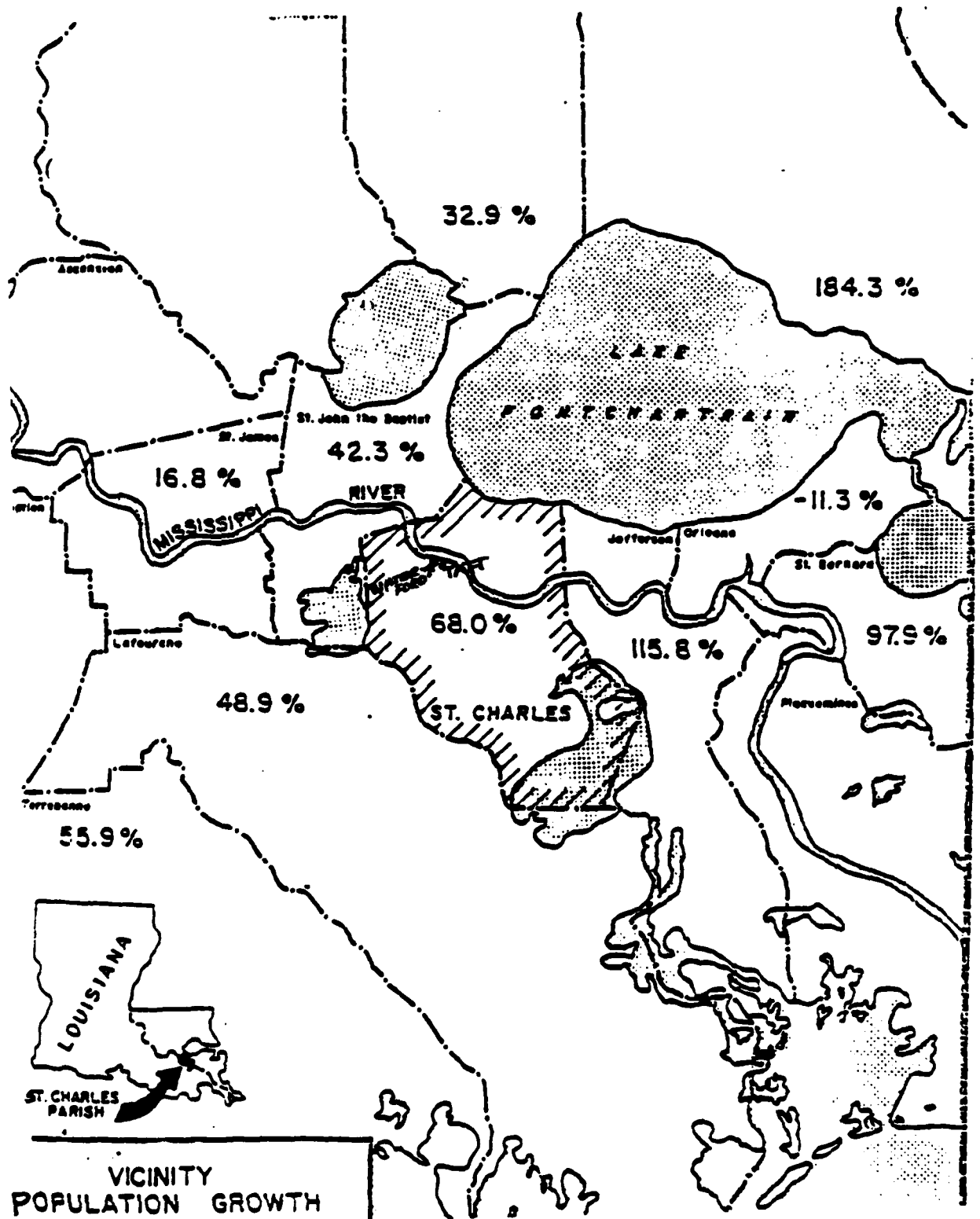
As indicated in the following map, the parish is one of the fastest-growing areas in that section of Louisiana. The resident population is overwhelmingly made up of family units living in their own homes; there are practically no apartment houses in the area. Population characteristics reflect the employment patterns of the area.

The parish, despite a relatively small population, has grown substantially faster than the national and state average in the last two decades. The 1980 census data totaled a population of 37,259 in St. Charles Parish. The West Bank total was 22,399; the East Bank total was 14,860 (with approximately half of this total residing in the town of Norco). There was a population growth of 39.3 percent from 1960 to 1970 (21,219 in 1960; 29,500 in 1970). The bulk of this growth was concentrated on the West Bank (47.7 percent) mainly along the river road and US-90. The East Bank population increased by 29.5 percent mostly along the river road. Overall, the 1980 population was larger on the West Bank (around 60 percent) than on the East Bank.

The population is characterized by family households. It was not possible to obtain exact figures in time for this report, but the age distribution is suggested by estimates that approximately 25 percent of the evacuees were children, 65 percent were adults, and 10 percent were elderly adults (however, one nuclear plant evacuation document estimates that there are approximately 5,000 persons 60 years or over in the parish). Redistricting data for 1980 provide a simple breakdown of the population by race. Of the parish population of 37,259, a total of 27,437 (74 percent) were classified as Caucasian. Other races comprise 9,822 (26 percent), approximately 22 percent Black; the rest apparently are citizens of Oriental or Hispanic descent. There are few overt signs of the early settlers of the area who were primarily of French and German ancestry. However, the area was formerly known as the German Coast and French and German names are still used for streets and towns.

Both population growth and some characteristics of the population reflect area employment patterns. The growth of industry in the parish has brought people to live in the area. In 1981, St. Charles Parish had a 27 percent increase in building permits issued for single family and multifamily homes, the highest percentage increase in the New Orleans metropolitan area. Due to the industrial plants which employ many technicians and professionals, there are many college-educated residents. Impressions of local officials suggest a general education level of high school graduation to one year of college. It is projected that the building of the bridge across the Mississippi scheduled for completion in 1983, and the completion of I-310 (linking I-10 to US-90 by the bridge) expected in 1985 will stimulate both population growth and commercial development. It may also bring more traffic into the area, which in 1981 was able to get along with only 12 traffic control signals in the whole parish.

Map #3



Socio-economic features

The parish, although adjacent to New Orleans, is far from being the typical residential suburban community surrounding metropolitan areas in the United States. Also, in spite of the very large expanses of open space in the parish, the economic base of the area is predominantly non-agricultural. Since World War II, the area has become increasingly industrialized.

Between 1940 and 1980, St. Charles Parish experienced a shift from agricultural enterprises to manufacturing and other industrial activities. While the chemical industry (including petrochemical) is the most important industry in the parish, there are other businesses. The major concerns in the area are indicated in the lists on page 8 and on page 9, the first from a planning group, the second from a utilities company. The location of the major industrial sites are also indicated in a map on page 10. There are no centralized commercial or shopping centers in the parish.

Statistics from 1978 indicate that residents were employed primarily in manufacturing (nearly 40 percent). The chemical industry had 20 percent and the petrochemical industry had 12 percent of the labor force in the area. Contract construction had 13 percent. Much of the rest of the work force, about 10 percent, was employed in wholesale and retail trades. Considerable increase in total employment, and further expansion of the chemical and petrochemical activities, are anticipated as a result of a projected interstate highway in the area, as well as the building of the bridge across the Mississippi mentioned earlier. It is predicted that agricultural activities will become even less important than they are now.

It appears that most of the residents are locally employed. While the road patterns, the crossing of the Mississippi available only at the ferry point, and other geographic and typological factors would appear to discourage commuting out of the area, there is apparently some commuting into the area since a recent report on evacuation planning (in case of accident at the nuclear plant) estimated there were about 10,000 workers just in the industrial plants in the parish.

Socio-political features

St. Charles has the parish system of government typical of Louisiana. In fact, it is not only the important administrative and operational government unit in the area, but the only formal one. None of the localities are incorporated, have elected officials, or have a budget (there are volunteer fire departments).

As the following table of organization shows (page 11), the two key offices in the parish system of St. Charles are the Parish President and the Parish Council. The Presidency can be thought of as somewhat equivalent to a county commissioner in many other areas of the United States, except that the former has more responsibilities and powers than the latter. The Parish Council resembles a Board of County Commissioners elsewhere in the country.

(from St. Charles Parish Planning Report, May 1981, prepared by Dawson Engineers, Inc.)

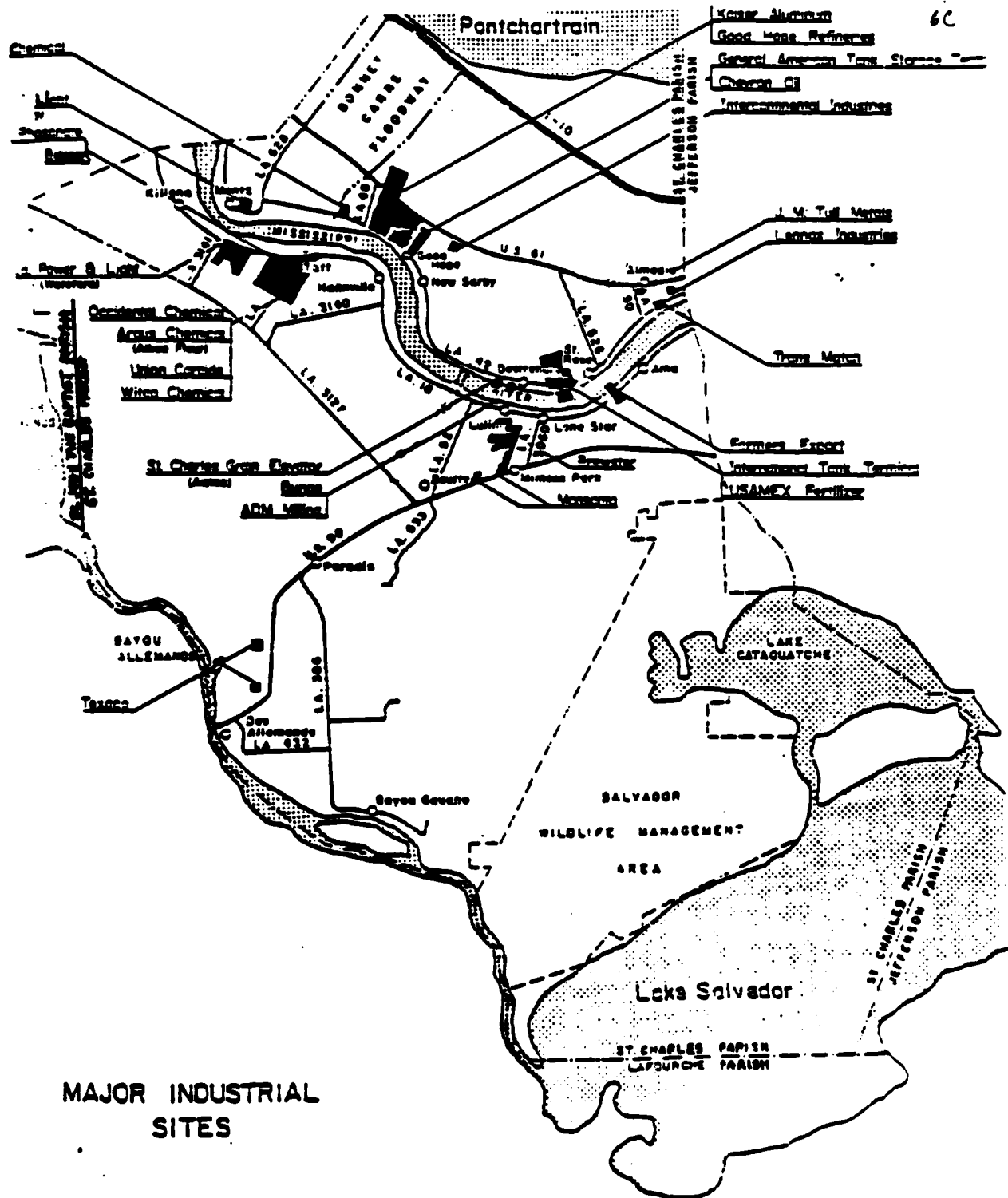
NAME	LOCATION	TYPE
ARGUS-CHEMICAL	Taft	Agricultural Chemicals and Plastics Manufacturing
BUNGE CORPORATION	Destrehan	Grain Products Manufacturing
BREWSTER PHOSPHATE	Luling	Phosphate and Phosphoric Acid Production
CHEVRON OIL	Good Hope	Petroleum Processing
FARMERS EXPORT COMPANY	Ama	Grain Export
GENERAL AMERICAN TANK STORAGE TERMINAL	Good Hope	Bulk Liquid Storage and Transportation
GOOD HOPE REFINERIES	Good Hope	Refined Petroleum Products
HOOKER CHEMICAL	Taft	Chlorine and Caustic Soda Manufacturing
INTERNATIONAL TANK TERMINAL	St. Rose	Bulk Storage and Transport
INTERCONTINENTAL INDUSTRIES	New Sarpy	General Contracting
KAISER ALUMINUM (NORCO COKE CALCINER)	Norco	Coke Processing
LOUISIANA POWER AND LIGHT COMPANY (LITTLE GYPSY PLANT)	Montz	Electric Power Generation
LOUISIANA POWER AND LIGHT COMPANY (WATERFORD UNIT)	Taft	Electric Power Generation
LENNOX INDUSTRIES, INC.	Norco	Air Condition/Heating
MONSANTO COMPANY	Luling	Agricultural Chemicals Manufacturing
NATIONAL PHOSPHATE CORPORATION	Taft	Phosphate and Acids Production
OCCIDENTAL CHEMICAL	Taft	Acids and Phosphate Production
SHELL CHEMICAL	Norco	Industrial Chemicals Manufacturing
SHELL OIL COMPANY	Norco	Petroleum Refining Products
ST. CHARLES GRAIN ELEVATOR COMPANY (ADNAC)	Destrehan	Grain Storage and Transport
J. M. TULL METALS, INC.	Airline Hwy.	Metal Sales and Storage
TEXACO, INC.	Paradis	Natural Gas, Propane and Other Liquid Production
TRANS MATCH, INC.	River Road	Matches Manufacturing
UNION CARBIDE CORPORATION	Taft	Bulk Chemicals
USAMEX FERTILIZER	St. Rose	Fertilizer Manufacturing
ADM MILLING	Destrehan	Bakery Flour Production
BEKER	Taft	Chemical Fertilizer Manufacturing

(Table 15 taken from Evacuation Time Estimate Docket No. 50-382,
February 1982, prepared by Louisiana Power and Light Company)

INDUSTRIAL PLANTS POPULATION
WITHIN 10 MILES OF WATERFORD 3

<u>Industry Name</u>	<u>Estimated 1982 Peak Employment (1)</u>
<u>St. John the Baptist Parish</u>	
Bayou Steel	750
E. I. DuPont de Nemours	1600
Godchaux-Henderson	668
Sewell Plastics	40
Coastal Canning	30
Jones Chemical	23
Continental Grain Elevator	160
Cargill Grain Elevator	110
Marathon Oil Refinery	481
<u>St. Charles Parish</u>	
LP&L Waterford 1 & 2	80
Beker Industries	160
Hooker Chemical	200
Union Carbide Star Plant	80
Union Carbide Linde	80
WITCO Chemical	40
Shell Chemical Taft Plant	40
Union Carbide	3190
Occidental Chemical	40
Shell Crawfish	40
LP&L Little Gypsy	80
Good Hope Refinery	2720
GATX	120
Shell Oil	1960
Shell Chemical Norco	200
International Tank Terminal	80
St. Charles Grain Elevator	120
Bunge Grain Elevator	120
Monsanto	640
Farmers Export	120
Texaco Gas Plant	120

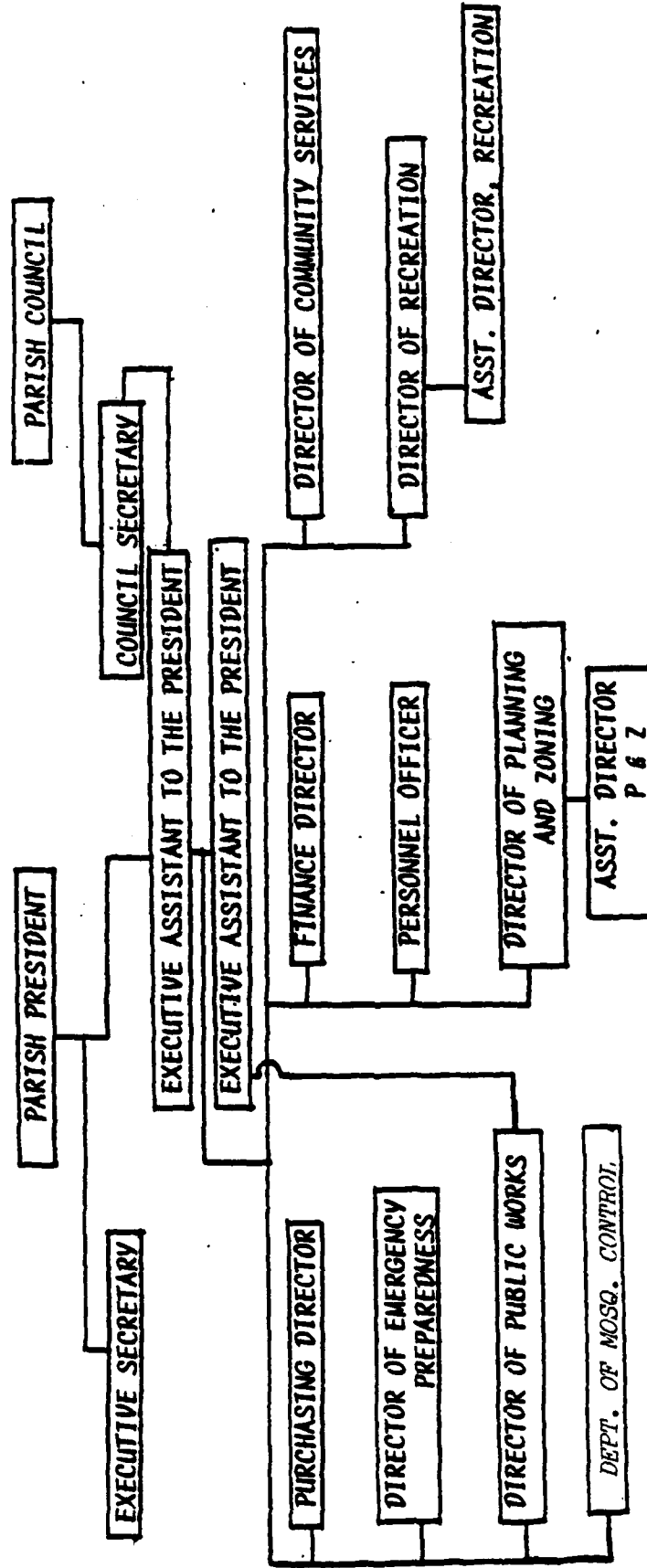
(1) Includes construction worker employment at those plants where significant construction is taking place.



MAJOR INDUSTRIAL SITES

Chart #1

OUTLINE OF STRUCTURE OF PARISH GOVERNMENT : St. Charles Parish



The St. Charles Parish President is responsible for carrying out legislation passed by council and for implementing the budget. All administrative officers responsible to the Parish President are appointed by the President. The St. Charles Parish Home Rule Charter stresses the kind of interaction which ought to occur between the President and the Council; the President is responsible to the Council and is expected to attend Council meetings. The President may take part in discussions but cannot vote. However, Council action is subject to the veto of the President.

The Parish Council in St. Charles has nine members. Two are elected at large from the Parish, but they must meet residency requirements; that is, one must be from the West Bank and the other from the East Bank. Seven members of the Council are elected from single member districts as established by the governing authority. The Parish Council is vested with all legislative power in St. Charles. Other parish agencies, boards, commissions, etc. which have governmental functions (including their budgets), are controlled by the Council. Local taxes are levied by the Council.

Parish departments are indicated in the parish government structure chart. The two executive assistants to the President operate from two different areas, one from the West Bank, and the other from the East Bank. Parish government business is conducted in the West Bank at the courthouse in Hahnville and in the East Bank in the courthouse in New Sarpy.

Voters in the area are mostly registered Democrats. However, Ronald Reagan, a Republican, reportedly won by a landslide in the last Presidential election. Our field team picked up no indication that the issue of environmental hazards, including the construction of a nuclear plant at Waterford, or any other potential danger in the area, had even been the subject of much open political controversy. Intervenors in New Orleans have filed papers on the nuclear plant, but local people are apparently not involved.

III. Disaster Risks and Experiences

Risks

St. Charles (and neighboring St. John) Parish is a high-risk area for natural and technological disasters. One local disaster service agency official claimed, probably correctly, that St. Charles was the most high disaster risk location in the state. In recent decades, technological risks have been added to the natural risks which the area has always borne.

Because of the concentration of industrial and manufacturing facilities in the parish, there are more technological agent than natural agent risks. Local officials point out that there are at least two dozen major industrial complexes with high risk potential, within a 10-mile radius of the parish and which could affect up to 100,000 people. As one official said of the plants, they use "everything that can hurt you or cure you." The facilities include the largest plants in the world for a major chemical manufacturer and a major oil company, as well as the largest concentration of ammonia "in the free world."

Apart from fixed facilities, numerous dangerous cargoes are transported through the area. (As an earlier DRC study found, the most difficult planning is for, and the most poorly handled response is to, chemical emergencies and disasters resulting from transportation accidents [Gray and Quarantelli, 1981].) Four major railroads with five tracks are used to move hazardous chemicals in St. Charles Parish. Tank trucks hauling chemicals and other hazardous substances from major local industries traverse five highways in the area. An average of 134 ships a day, including tankers and barges hauling dangerous cargo, move up and down the Mississippi River.

The New Orleans international airport, which is located just northeast of St. Charles, is another risk source. Although not affecting the parish, two recent major plane crashes at the airport, including one in 1982, have indicated the risk is real. The crash of a Pan American flight at the end of its takeoff on July 9, 1982 killed not only the 145 people on board, but also eight persons in the eleven houses which were destroyed or damaged substantially in the accident site (National Transportation Safety Board, 1983). Also, pipelines carrying some very dangerous substances cross the parish in every direction. Finally, even though not yet operational, the Waterford nuclear plant is in the middle of the area, close to Taft.

As to natural disaster risks, St. Charles Parish is subject to hurricanes, riverine and flash floods, and tornadoes. The storm surge from hurricanes is a particular risk because of the very low land elevation of most of this section of lower Louisiana. Given certain meteorological conditions, Lake Pontchartrain could come flooding into the area. Floods anywhere along the Mississippi River might have an effect at the start of the river's delta flow into the Gulf of Mexico. Thus, in January 1980, because of severe upstate flooding around Monroe, the

U.S. Corps of Engineers established a flood watch at the parish EOC on the West Bank (a flash flood watch went into effect on January 20, 1980). Tornadoes have also been increasingly recognized as features which accompany hurricanes, although most occur independently of such winds. Insofar as St. Charles is concerned, the official who said the natural risks in the area included "all nature can provide" was only slightly overstating the point.

Disaster experiences

There are some places in the United States which are subject to high risks, but which have had little actual disaster experience. This is not the case for St. Charles Parish and the surrounding areas. They have experienced both natural and technological emergencies and disasters.

New Orleans and the nearby river parishes have been impacted by many hurricanes. A DRC study in 1965 (Forrest, 1979) found that eleven major hurricanes and 42 lesser windstorms had hit the coastal area since the turn of the century. In the last 25 years, the general area was affected by Hurricane Audrey in 1957 (which killed over 400 people in Cameron Parish) (see Bates et al., 1963), Hurricane Carla in 1961 (see Moore, 1963), and Hurricane Hilda (which killed 39 people) in 1964. More directly damaging to the area were two later hurricanes. In 1965, Hurricane Betsy came right over the New Orleans metropolitan area, and created a major flood which forced massive evacuations in and around the city (Forrest, 1979). It, and Hurricane Edith in 1971 (as had Hurricane Hilda earlier and severe flooding later in 1973) resulted in the President declaring the parish a "major disaster area." Although not directly affecting St. Charles Parish, Hurricane Camille in 1969 occasioned a billion and a half dollars in property damage on the nearby Mississippi coast.

While the hurricanes mentioned are now mostly of historical significance, a picture of considerable disaster-relevant experiences emerges if the focus is primarily St. Charles Parish over the last few years. The area has been wracked by a series of emergencies, some with considerable disaster potential, which have necessitated the mobilization of emergency organizations and varying degrees of population evacuations. While no major disaster has actually occurred recently, this would not have been known in the initial stages of many of the events.

In 1980, a tank truck carrying ammonia attempted to cross a parish railroad, and was struck by a train. Three persons were killed as a result of suffocating from inhaling the ammonia. Because of the place and time of the incident, what might otherwise have been merely a traffic accident, developed into a more serious matter. The incident occurred around 7:15 a.m. during the time when individuals were going to work or school. Some nearby homes and automobiles were evacuated, and police cars were used to transport people to shelter in a nearby school.

In 1981, a train moving 12 cars of hydrocarbon was derailed near some of the major refineries in the parish. While the tanks did not rupture, and no deaths occurred, about 30-40 people had to be evacuated near Norco. Then since it took a week to have the railcars righted, and

to insure the danger had passed, about three dozen families were evacuated from a nearby subdivision and housed in hotels and motels paid for by the railroad company.

In July of 1981 there was a fire at one of the chemical plants. Overnight, sheriff's deputies manned roadblocks, controlled traffic, and limited access to the danger area.

That same year, a tornado destroyed a trailer park housing transient power plant workers on a weekend when most of the workers were away, so there were no fatalities. About 100 persons, however, were left homeless and were sheltered in the parish. During the next year, 1982, there were nine tornado watches and one tornado warning in St. Charles. The sighting may actually have been a waterspout rather than a tornado, but nonetheless, the warning resulted in children taking shelter in a nearby school.

This past year (1982) was especially marked by technological accidents, emergencies, and disasters. There were two major incidents in February. First, a Norwegian tanker crashed into the roadway leading to one of the industrial docks at Taft and spilled some ammonia into the Mississippi River. While the dock was being repaired, the affected plant began trucking its fertilizer downriver for shipping. Some of the substance was spilled on the river road. Rains turned the fertilizer into a slippery substance, which resulted in a rash of traffic accidents. While no evacuation ever occurred, the Norco fire department directly across the river from the spill was put on alert to evacuate if necessary. Some plants in close proximity were also put on alert.

That same month, there was a gas and water spill from a 140,000 barrel storage tank at one of the petroleum companies. It temporarily closed part of one of the major highways in the parish, although the incident was primarily handled as an on-site industrial accident.

In March, the following month, a Liberian tanker on the Mississippi River collided with a tugboat pushing three barges near Montz. The resulting fire spewed flames 100 feet high. Four thousand gallons of crude oil poured into the river. Roadblocks were established, and as a result of a warning from the local fire department, 50 homes on the river road were evacuated along a mile and a half of the Mississippi. In all, about 250 persons, mostly home owners, were evacuated. Forty-two sailors and the evacuees were sheltered and fed by the parish.

In May, chlorine escaped from a chemical pipeline. State troopers re-established roadblocks and travelers were prevented from entering the affected zone. While nearby plants were notified of the situation, no evacuation was ordered.

In June, flammable propylene gas leaked from a valve on a truck loading dock at one of the major refineries in Norco. A major thoroughfare was closed to traffic, and about 20 homes near the refinery were evacuated. The evacuees, who were advised to leave by emergency organization personnel, went to the homes of friends.

A refinery experienced a fire in one of its units in August. Oil spilled into some of the plant and into the village of Good Hope. The pipeline, about a block and a half from a major thoroughfare, erupted in flames. Local emergency officials indicated they were not properly notified of the incident, nor of the exact nature of the threat. A local official eventually made a decision to evacuate about 100 persons for the duration of the 5-6 hour fire.

A series of incidents have carried over into 1983. On January 19, one of the chemical plants experienced a sulfur dioxide emission. Also, in the same month, the Jefferson Parish Bomb Squad "defused" a dud in a bomb scare at the Waterford nuclear power plant.

Previous disaster research suggests that all these experiences should lead to certain individual anticipations and organizational expectations for disasters (see Wenger, 1977). In more technical terms, there should be a disaster subculture in St. Charles Parish. This appears to be the case, as we will elaborate in the next part of this report.

Disaster subculture

The term "disaster subculture" has been defined in the disaster literature as a set of cultural defenses which are developed to cope with recurrent dangers, and includes "those adjustments, actual and potential, social, psychological and physical, which are used by residents of such areas to cope with disasters which have struck or which tradition indicates may strike in the future." (Moore, 1964:195) It is also said that "a disaster subculture serves as a blueprint for resident's behavior before, during, and after impact. It includes such cultural elements as norms, values, beliefs, knowledge, technology, and legends." (Wenger, 1977:41; see also Anderson, 1965; Osborn, 1970; Weller and Wenger, 1973; Hannigan and Kueneman, 1978).

Such an orientation is associated with, but is not exclusively dependent on, repeated exposure of a population to repetitive threats or dangers. "This prior disaster experience offers a residue of learning that can influence preparations for and responses to future disaster events. In some communities with extensive experience, routinized patterns of effective disaster behavior have been developed to the extent that some students of disaster behavior refer to them as 'disaster subculture' communities." (Wenger, 1977:23-24)

The subculture develops at least on two levels. The first is among the residents of the threatened or impacted areas. They may develop particular attitudes and beliefs about the danger. In particular, they come to anticipate that there will be occurrences of similar dangers in the future. When the event occurs, therefore, it is responded to as a somewhat anticipated situation and requires less adjustive behavior than otherwise would be the case. At a second level, emergency organizations also come to expect the recurrence of certain kinds of threats. Therefore, when the anticipated event does occur, preparedness measures can be relatively easily implemented.

While a systematic study would be necessary to fully establish and document the fact, it does appear that there is a disaster subculture in St. Charles Parish. Residents of the area, as illustrated above, have experienced many threats and have had to respond to a wide variety of emergencies including actual and potential disasters. For example, evacuations are not unfamiliar to many persons in the area. These repetitive emergencies have seemingly led the resident population to expect at least threats if not dangers, and they have attitudes and beliefs about how they can and should respond in such anticipated situations. The same is true at the organizational level. The emergency organizations in St. Charles Parish expect they will have to respond fairly often to certain kinds of disaster situations in their area. They have actually responded, if not often to large scale, to small scale incidents which had the potential for turning into major actual disasters. These experiences have led them to develop certain kinds of disaster resources (some of which will be discussed in the next few pages). Furthermore, as earlier research has found, for emergency organizations in areas with disaster subcultures "the most direct consequence is to lessen the ambiguity and difficulty in coordinating responses." (Wenger, 1977:42).

It is possible to speak of a probably general disaster subculture in the St. Charles Parish area. However, it does seem that perhaps the disaster subculture at the present time is possibly more oriented to technological rather than natural disaster agents. The recent lack of hurricanes, in particular, means that almost no person or organization in the area has had recent direct experience with the problems associated with hurricanes. Disaster subcultures do appear to dissolve and disintegrate without a direct reoccurrence of the expected threat, and it is probable that this has partially happened with respect to a hurricane subculture in St. Charles. The memory of the experiences in the major hurricanes of the 1960's is fading. On the other hand, the seeming acceleration of technological accidents in the area may be strengthening the technological disaster subculture. But whatever the balance between the natural and the technological, it does appear there is some kind of disaster subculture in this part of Louisiana.

IV. Disaster Preparedness

Whatever the exact nature of the disaster subculture in St. Charles Parish, there is little doubt about the high degree of disaster preparedness in the area. Quality of the preparedness aside, the degree of planning for disasters is extensive, whether measured in relative or absolute terms. While not the most comprehensive disaster planning DRC has observed over the years (see Dynes and Quarantelli, 1977 for a general discussion of this matter), the disaster preparedness in the parish would have to be ranked rather high in any comparative community evaluation. Furthermore, the planning covers what good planning should encompass (see Dynes, Quarantelli, and Kreps, 1981; Quarantelli, 1981). In a thorough and seemingly ongoing planning process, the relevant organizations have been involved, the appropriate resources have been identified, and most importantly, there has been considerable effort to link the various kinds of disaster planning being undertaken. Thus, there have been efforts to integrate the planning of the public and private sectors in the community, and the separate planning for rather different kinds of disaster agents. As a consequence, at least on paper and in terms of a pre-impact situation, St. Charles Parish has a good deal of disaster planning and a degree of disaster preparedness. Neither automatically translates into a coordinated response at times of emergency, but they are necessary steps. Planning can lead to preparedness which can result in an appropriate response.

There is potential for substantial problems in disaster planning in St. Charles. In a sense, there are three kinds of planning for disasters in the area. There is the general planning by public organizations for all disasters. This planning takes manifest form in a comprehensive plan, a full time emergency service director as well as an Emergency Operations Center (EOC) coordinator, and a well-equipped EOC. At the same time, there is planning by private companies in the area of industrial accidents. This kind of planning manifests itself in a Mutual Aid System and also a Hot Line System. Finally, there is planning developed especially for radiological emergencies by those concerned about the Waterford nuclear plant being built in the heart of the parish. Manifestations of this can be seen in the installation of a siren system and a comprehensive plan, although at the time we did our field study, there had not yet been an exercise of the nuclear plant emergency plan.

Unlike what DRC has sometimes found in some other communities, there are not three separate kinds of disaster planning being conducted. This can be seen, for example, in terms of what happened when planning was initiated several years ago as a result of the nuclear plant construction. DRC was told by officials involved in drawing up the plan for radiological emergencies, that they found the area seemed to have adequately prepared for other kinds of disasters. Thus, for their purposes, they were able to take what they perceived as a sound and existing planning base for disasters generally and added a radiologically relevant component. In reality, a little more was done, in that there was clarification of some concepts, a clearer differentiation regarding divisions of labor, and implementation of more exercises. Nonetheless, all this was added to what

already existed, either as procedures or resources. The nuclear emergency planning did not, therefore, develop in a way separate from general disaster planning in St. Charles Parish.

In 1982, training exercises were conducted to acquaint the area with the disaster planning for the nuclear plant. About 500 St. Charles Parish emergency personnel (police, fire, governmental, public works officials, etc.) were involved in two sessions of about 3-4 hours which concentrated on teaching the meaning of certain radiological terms and the technical use of radiological equipment such as a dosimeter. Warning sirens for use in evacuation, as a result of a plant accident, were being installed in the parish EOC but had not yet been publicly tested.

The close connection between the two disaster planning efforts is also illustrated by the fact that the St. Charles Parish President and the Emergency Preparedness Director are to be primarily responsible (during nuclear emergencies) for off-site direction and control of community response and protective actions, notification and public alert and information, and re-entry into an evacuated zone. The plans and planning contain considerable detail, for instance, on how the parish is to provide evacuation transportation for certain categories of potential evacuees such as school children (if classes are in session); institutionalized persons in hospitals, nursing homes, and prisons; household invalids; and those persons without automobile transportation. There is also detailed planning regarding the zones and distances which should be evacuated, what bus transportation can be mobilized (up to 300 buses from four parishes could be used), and routes which evacuees are supposed to take. These and many other features which could be mentioned illustrate that at least on paper, and in pre-impact planning, there has been considerable effort to integrate the general disaster planning of St. Charles Parish and the nuclear plant emergency planning.

Similarly, the planning for industrial accidents is not something apart from general community disaster planning (previous DRC studies indicate this is an atypical situation with respect to planning for chemical disasters [see Gray and Quarantelli, 1981]). The Mutual Aid System (which is usually for localities with large chemical complexes [see Gabor, 1981]) involves both the St. Charles Sheriff and Emergency Services Directors. While the System primarily serves industries, a few public officials have participated in the monthly drill exercises and in the development of resource lists for industrial accidents and emergencies. The link between the public and private sector can also be seen in the Hot Line System for industrial accidents. There is a two-way phone circuit between the St. Charles Parish EOC in Hahnville and about two dozen industrial companies; no one else can access this line. This system is to be used to notify the civil authorities of "an impending or actual emergency" in any of the individual facilities. There is also a 24-hour monitoring capability with consoles in the: (1) EOC Communications Room; (2) EOC secretary's office; and (3) Radio Dispatcher's Room of the Sheriff's Department. The system is tested weekly. There is a manual which spells out when and how "the Hot Line System is to be used for emergency situations in a member organization's facilities which have, or are anticipated to have, visibility or impact beyond the affected

facility's property line." Again, on paper and in the pre-impact planning at least, an effort has been made to link the planning for industrial accidents and the general disaster planning of St. Charles Parish.

The heart of the area's planning is in the activities and facilities of the St. Charles' public emergency organizations. Local governmental officials, especially the Parish President and Council, are credited with having great concern and providing considerable support for disaster preparations. For example, in 1982, in contrast to almost all other budget items which were cut, the budget for the operations of the EOC was raised for the first time to a six figure number (from about \$74,000 to over \$100,000).

The EOC itself is a modern (five and a half years old), well-equipped facility (see photos). The main EOC (there is a secondary one) is located in the basement of the parish courthouse in Hahnville. It is equipped with three executive offices, a situation room for all emergency operations staff, situation boards and maps, sleeping and eating facilities for 35 persons, two generators, and 20,000 gallons of water. The secondary EOC is in the Parish Council Chambers on the East Bank in New Sarpy. Communication equipment is installed there for potential use. A recently purchased \$60,000 van provides the parish with a moveable off-site command post; it has been used in several emergencies. The van is particularly equipped to allow communications in a variety of ways with many different groups. Thus, there are CB and ham radios, and means for communicating with the State Police and State Office of Emergency Preparedness, as well as radios allowing contact with the Sheriff's office and local fire departments.

Structurally, the parish Emergency Preparedness Office has only three staff members, two on a full time basis. However, at times of disasters, it can expand to include a number of officers and functions (see the organization chart).



Photograph #1. St. Charles Parish, LA, EOC. Hahnville Courthouse. Note the separate situation boards for different disaster agents.

St. Charles Parish
Emergency Preparedness Organizational Chart

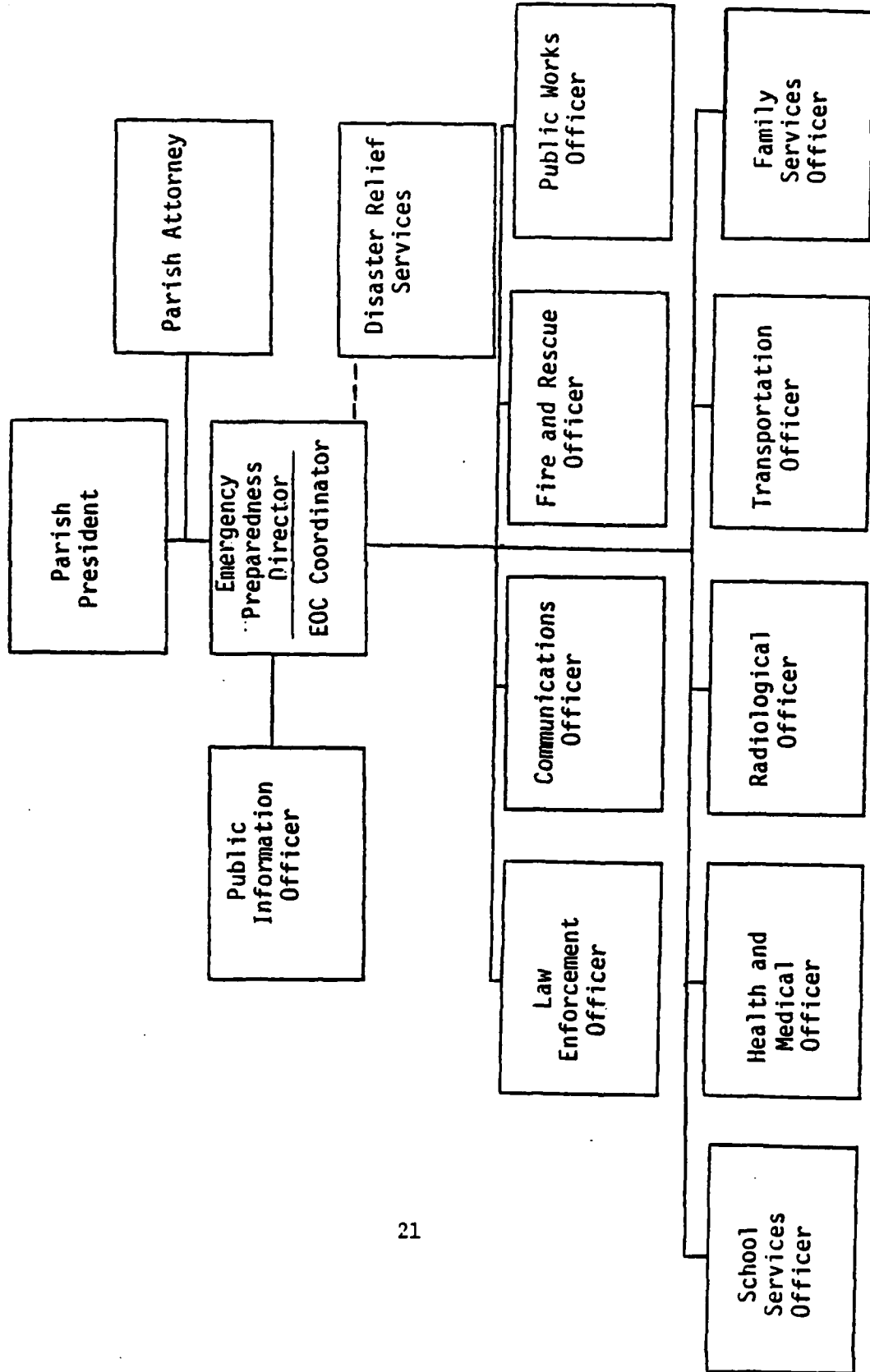


Chart #3

ST. CHARLES PARISH
EMERGENCY FUNCTION
AND RESPONSIBILITY
CHART

	Parish President	Emergency Preparedness Director	EOC Coordinator/Training Officer	Communications Officer	Fire and Rescue Officer	Law Enforcement Officer	Health and Medical Officer	Public Works Officer	Public Information Officer	Transportation Officer	Radiological Officer	School Services Officer	Family Services Officer
Direction and Control	P	S	S			S							
Notification		P	S	S	S	S	S			S	S	S	
Communications		S	S	P		S							
Public Alert/Notification		P	S	S	S	S			S				
Public Information	S	S	S	S					P				
Public Health		S	S			P	S				S		S
Social Services		S	S				S		S				P
Fire and Rescue		S	S	S	P	S	S	S		S			
Traffic Control		S	S	S	S	P		S					
Access Control	S	S	S	S	S	P		S	S			S	
Emergency Medical Services		S	S	S	S	S	P			S			S
Law Enforcement	S	S	S	S	S	P		S					
Transportation		S	S	S	S	S	S	S	S	P		S	
Protective Response	P	S	S	S	S	S	S	S	S	S	S	S	S
Radiological Exposure Control		S	S	S	S	S	S	S	S	S	P	S	
Food and Water Purity		S	S			S	P	S	S				
Shelter and Care		S	S	S		S	S	S			S	S	P
Highway Maintenance		S	S	S		S	P					S	
Security		S	S	S	S	P		S					
Reentry and Recovery	P	S	S	S	S	S	S	S	S	S	S	S	

P-Primary
S-Secondary

Operationally, the major components of the St. Charles Parish disaster plan are the Sheriff's Department and the local fire departments. The Sheriff's Department has about 150 persons, including 60 deputies, as well as 60 cars. It has two-way radio communication not only with all its own units, but with the parish EOC, the St. John Parish Sheriff's Department, and the Louisiana State Police. The department depends on the state police for advice in hazardous material emergencies, since it has only one officer trained on the subject.

Within the parish, there are nine all-volunteer fire departments, which have a total of approximately 220 persons and 25 vehicles. The departments have two-way radio communication with the St. Charles Parish EOC and the Sheriff's Department. These and other organizations are involved, as appropriate, in occasional table-top exercises and in the post-action critiques conducted after each disaster in which the St. Charles emergency organizations have participated.

It should be noted that there is also considerable disaster planning in the adjoining parish to the west, St. John, which also has been involved in the nuclear plant planning. In fact, there are close relations between the emergency organizations in the two areas, and the plan calls for the other parish to be notified if there is a threat or danger in one of the parishes. The American Red Cross, with its national charter mandating the providing of certain disaster services, while it has a representative and plans for St. Charles, operates primarily out of its chapter in New Orleans. Somewhat similarly, both the state police and the U.S. Coast Guard have some disaster planning relevant to the parish, although neither has a local office. The state of Louisiana Civil Defense Agency in 1976 undertook an on-site assistance program and made recommendations which may have encouraged the further development of an already initiated local effort to substantially upgrade disaster planning and preparations in St. Charles Parish at that time.

Overall, it is not the presence of written plans which stand out in this situation. Such documents do exist, but it is the fact of disaster planning which is more notable. Much thinking, many meetings, numerous contacts, frequent exercises—these and other crucial aspects of a planning process are notable in the approach to disasters in St. Charles Parish. The focus is on planning rather than just producing a plan.

We have noted so far that the area has considerable disaster risks and experiences, appears to have developed a disaster subculture, and has undertaken substantial integrated disaster planning. It was against this background that the chemical tank explosion occurred on December 11. What was the community response to the event, and in what way did these background factors affect the individual and emergency organizations reacting to the event? We address the first of these questions in the next section of this report, reserving the question of influence for a later section.

V. A Social Chronology of the Incident

Introduction

At about 12:50 a.m. on Saturday, December 11, at the Union Carbide plant in Taft, Louisiana, a tank containing perhaps 45,000 gallons of acrolein exploded and a fire followed. Acrolein is an intermediate chemical used as an additive in animal foods, and in the manufacture of tear gas and certain herbicides. It is flammable, thermally unstable, and poisonous. It may be ignited by heat, sparks, and flames. Flammable vapors may spread from a spill. A container may explode due to heat or fire, and a runoff may create a fire or explosion hazard in a sewer system. Fire may produce irritating or poisonous gases. Acrolein vapors are extremely irritating and contact may result in burns to the skin and eyes. Vapors may be fatal if inhaled. The Emergency Action Guide for Selected Hazardous Materials (1978) recommends that with a spill of approximately 200 square feet, for maximum safety the downwind evacuation area should be two miles long, one mile wide. For a spill of approximately 800 square feet, the recommended evacuation distance is an area five miles long, three miles wide. An indication of the hazardous nature of acrolein, is that only for phosgene gas (among all other dangerous chemicals) is as large an evacuation area recommended.

The explosion had important activities preceeding it, as well as following. To keep our focus on the important and to avoid getting lost in a welter of details, we will first present a chronological listing of major happenings involved in the incident. Many of the times provided are approximations. (See the Appendix for a discussion of the problem.) We then turn to a more in-depth depiction of what happened. However, even the presentation is selective, as it reflects our interest in the activities of the local public emergency organizations, and our concern about the evacuation and sheltering of the affected residents of the area.

The major happenings

Friday, December 10, 1982

- | | |
|------------|---|
| late p.m. | Union Carbide personnel at the plant in Taft were aware that the acrolein was heating up in one of their tanks. |
| 11:00 p.m. | Company officials began to evacuate workers from the southern portion of the plant. |

Saturday, December 11, 1982

- | | |
|------------|--|
| 12:09 a.m. | Plant officials notify St. Charles Parish sheriff's office of low-level emergency. |
| 12:38 a.m. | Sheriff's office learns from citizens about in-plant evacuation. |

12:50 a. m. Tank of acrolein explodes and erupts into fire.

12:55 a.m. Sheriff's office call to plant confirms an explosion has occurred.

1:02 a.m. Deputies establish roadblocks half mile from plant.

1:09 a.m. Deputies report odors in area.

1:12 a.m. Plant advises roadblock be pulled further back.

1:27 a.m. St. Charles EOC activated.

1:35 a.m. St. John Parish EOC activated.

2:12 a.m. Plant reports "no danger to public."

3:00 a.m. State troopers from Hazardous Materials Unit arrive at plant.

3:35 a.m. Plant reports situation still the same.

4:29 a.m. Plant recommends evacuation within five mile radius.

4:30 a.m. Evacuation initiated.

5:00 a.m. Coast Guard closes Mississippi River.

5:05 a.m. Shelters start opening.

7:00 a.m. Evacuation completed.

10:00 a.m. Coast Guard reopens Mississippi River.

day Monitoring of explosion site.

8:00 p.m. Officials reach conclusion evacuation order could be lifted, but delay it because of darkness.

Sunday, December 12, 1982

8:30 a.m. Final decision to lift evacuation at noon.

10:30 a.m. News conference announcing evacuation to be lifted at noon.

10:35 a.m. Evacuees start returning to area ahead of deadline.

evening Almost all evacuees back.

Tuesday, December 21, 1982

Key organizations hold a post-action critique.

The organizational response

In what way and for how long the situation in the plant developed into a dangerous possibility is presently cloaked in corporate secrecy. At the time DRC did its field work in the area, stories were circulating among some public officials that the problem had been known for hours, if not days, before the explosion. However, no one was able to cite any hard information or verifiable source to back up the stories. What is concretely known is that around 11:00 p.m. on Friday, December 10, plant officials had become sufficiently concerned to evacuate employees from the southern portion of the plant. This does suggest that there must have been some awareness of a problem earlier, but this is only an inference.

It was not until 12:09 a.m. on Saturday that the plant called the sheriff's office on the Hotline and reported that there was an overheating problem with one of their tanks containing acrolein (the chemical name was not volunteered but had to be elicited). The caller said pressure was building up, designated it as a code 4 (a local code for an emergency which is under control), and said they were watching the situation and would advise the sheriff's office of further developments. There was no communication about the nature of the danger which might develop for the surrounding population if an explosion occurred. There was no request for help.

While the message was primarily seen as a notification of a minor internal emergency, the person in the Sheriff's Department who received the call, checked a hazardous material manual regarding the nature of acrolein, tried to contact the EOC Director (who was out of town), and talked about the matter with her supervisor. Also, upon receiving calls about sirens in the locality, the Sheriff's Department called on the Hotline; the phone rang, but no one answered.

About this time the sheriff's office started to receive calls from individual citizens asking about evacuation routes and shelters. These callers had been previously contacted by relatives who worked at Union Carbide and were among those evacuated from the plant. Soon the two officers on duty were swamped with numerous phone calls, the first indication received by any public emergency organization that there might be a far more serious situation than suggested by the first message from the plant.

Thus, at 12:38 the sheriff's office phoned the plant. The caller got through but had considerable difficulty in getting any information. When asked what she wanted, she said she wanted to speak with someone about the calls the department was getting about evacuation; she also asked whether the plant was evacuating and were they having other problems. This led to a lull in the conversation during which she could hear much confusion and noise in the background. Eventually someone (said to be the

plant emergency director) got on the phone and said they had a north wind and were evacuating the southern portion of the plant and requested that the department go on a standby basis if needed. There was no perception that the situation might develop in a way having potentially major negative consequences outside of the plant grounds.

During this time period, the St. Charles Parish Sheriff was off duty at home. He was awakened by a phone call from his secretary who lives in Hahnville. She informed him that she had received several calls from relatives who lived near Taft. They told her that some Union Carbide plant personnel had evacuated and that the plant was expecting a tank to explode. The secretary had initially tried to contact the sheriff's office but had been unable to get through because the lines were busy. The sheriff contacted his office by radio and asked to be kept informed.

At 12:50 a.m., the tank in the plant exploded and a fire erupted. The noise was heard more than five miles away, with some people taking it for thunder. Some windows were broken in Norco, about a mile and a half away. More than 400 claims were filed for property damage. The greatest number of claims against Union Carbide the week after the explosion were for motel expenses or lost wages. One claimant, according to a newspaper account, said "the explosion cracked the concrete foundation under his house." (New Orleans Times-Picayune, River Parishes Section, December 14, 1982, p. 1) Fire alarms were also set off in a number of places in the parish.

Immediately the communications room of the Sheriff's Department began to receive innumerable calls. Most were from citizens asking what had happened. Deputies on the east bank of the Mississippi also called in about temporary electric power outages in St. Rose, Destrehan, and Norco. At 12:52 a.m., a sheriff's unit first reported an explosion. While the sheriff's office could not be certain what had occurred, it suspected that the events were probably related to something going on at the Union Carbide plant in Taft. While it was difficult to call because of all the incoming calls, a telephone call to the plant at 12:55 a.m. confirmed that an explosion had occurred there. In the conversation, the plant official on the line, reported to be the safety director, requested that the Sheriff's Department set up roadblocks at a distance of a half mile from the plant to keep people out of the area. Apparently, the nature of the danger was not clearly indicated, nor that there might be additional threats to the community later that night.

Little is publicly known what went on in the plant at the time of the explosion and its immediate aftermath. Employees of the plant, which employs about 1,250 workers, and the nearby plant of Occidental/ Hooker were immediately evacuated. That no one was killed or injured on site does imply appropriate safety measures had been taken. Earlier DRC research did find that most of the major chemical companies in this country are very safety conscious and have excellent in-plant accident and emergency procedures (see Gray and Quarantelli, 1981). From what was learned later, it appears the explosion partly destroyed the plant's computer capability to monitor its operations, and the blazing fire made visual observation and inspection difficult if not impossible. Thus, it

is possible there could have been little ability to assess future threats that night. On the other hand, since the tank which exploded was near five other tanks also containing acrolein, and to three spheres holding acrylic acid (which if they had caught fire could have produced poisonous gas), the possibilities for other immediate problems might have been obvious. Whatever the case, plant officials volunteered very little information to local public authorities, not only immediately after the explosion, but for at least another three and a half hours.

After the 12:55 phone conversation, the Sheriff's Department quickly moved to set up roadblocks. Three were set up at intersections to the southeast, southwest, and northwest of the plant. A roadblock was also established on Route 18 to the east of the plant. The Sheriff's Department logs indicate that all roadblocks were in place about seven minutes after obtaining the confirmation of the explosion. The nearness of the deputies to the scene, their familiarity with the roads, prior experience in blocking highways during chemical emergencies, and the absence of much traffic at that time of the night, undoubtedly facilitated the action taken.

The sheriff, who had been notified by radio at home that an explosion had occurred, immediately came to his office, and mobilized off-duty personnel. Exactly what was happening was not very clear. But deputies on the roadblocks reported around 1:10 a.m. that they were smelling strong odors in the air. Police called the plant a few minutes later to inquire about the odors. After being questioned by police, the plant official (said to be the safety officer) advised that the roadblocks be extended further from the plant since vapors from the explosion and fire could be hazardous. It was also requested that a roadblock be set up at Route 90 and Route 3127, an intersection about six miles from the plant site on the main road from New Orleans. Then, at 1:18 a.m., when vapors were reported drifting in that direction, St. John Parish was notified. At 1:20 a.m. the plant called to verify that an acrolein tank had exploded.

At approximately 1:03 a.m., the sheriff's office informed the office of Troop B of the State Police in New Orleans about the situation. In turn, it contacted its Hazardous Materials Unit at its state headquarters in Baton Rouge, who within ten minutes, dispatched two troopers to Taft; they arrived at the plant around 3:00 a.m. They joined two locally operating troopers from Troop B who had arrived at the plant at approximately 1:45. The four troopers attempted to meet with company officials.

It is known that numerous meetings occurred between company plant officials during this time period. However, public emergency personnel were not directly involved or informed in any detail about the situation. In fact, a state police document notes that even though some troopers were at the plant from 1:45 a.m. on, "the officers as well as the Hazardous Materials Specialist (who arrived about 3:00 a.m.) and D.N.R. personnel (Department of Natural Resources personnel) were not included in any meeting or evaluation, but were isolated with the public relations man from Union Carbide" until after 4:00 a.m.

Earlier, in considering the situation, the sheriff had EOC personnel called. The St. Charles Parish EOC at Hahnville was activated at around

1:32 a.m. The EOC Director was on a fishing trip in the backlands of Jefferson Parish (various efforts to reach him were unsuccessful until around 8:45 a.m. when he phoned the EOC, and returned about two hours later). Thus, the part time assistant director had to assume direction of operations. The EOC coordinator, who lives across the river, was temporarily delayed at the ferry crossing by a sheriff's deputy apparently blocking traffic ingress at that point, but she was soon allowed to proceed. The sheriff and his communications officer left their offices on the third floor of the building and went to the basement where the EOC is located, and from that point, worked from that location.

The major concern of the assembled officials was that the vapors from the acrolein might drift into a populated area. Thus, they checked wind directions carefully (the EOC is equipped with a barometer, wind gauge, and other weather instruments) and instructed the Sheriff's Department deputies to be alerted to strong odors. However, given their perception of the situation, there was little for the officials at the EOC to do, other than monitor the situation.

About 1:45 a.m., the sheriff talked on the phone with an official of the chemical company, in an attempt to learn what the specific dangers might be for the surrounding community. He was also concerned that his deputies might be affected by the vapors. However, few details were provided and the official was perceived as talking in generalities. It was reconfirmed that an explosion had occurred, that acrolein was the chemical involved, and that the situation in the plant was being closely watched. In the conversation, the "plant was told that it was being depended on" for air monitoring.

Later contacts with the plant provided no more information. For example, the Sheriff's Department notes that in a 2:17 a.m. contact with Union Carbide, "no danger to the public at this time" was stated. The EOC log of a 3:35 a.m. call reads "situation still the same."

However, at 2:20 a.m. the Coast Guard contacted the plant and was told the entire plant had been evacuated except for a handful of people, and that no one had been injured. The plant assured the Coast Guard that there was no pollution in the river. The Coast Guard had initially talked with the plant at 1:20 a.m., when the New Orleans office had been notified of an explosion at Mile 127, a point on the Mississippi River.

The personnel in the EOC were concerned because they feared that the situation would worsen but were unable to take any concrete steps because of the lack of substantive information about what was going on and whether there were any future dangers for the community. As one official phrased it, "nobody knew nothing, nobody was telling us anything." A few measures were taken. The EOC Director of St. John Parish was updated on what was known. The sheriff's civilian reserve was mobilized. Contact was made with air quality control personnel in the State Department of Natural Resources (DNR), although the local unit in New Orleans was not notified. However, for the most part, discussion in the EOC was about different possibilities which might develop, what organizations might need to be contacted, and planning in a general way about evacuation possibilities.

At 4:22 a.m., a message was received from the plant manager recommending the evacuation of all persons within a five mile radius of the plant. It was said this decision was reached because the other five tanks near the fire contained sufficiently large amounts of acrolein to create an even greater explosion than had already occurred and that a chain reaction was possible. This apparently was the first time the local public authorities were told about the additional tanks and the danger they posed. The distance of five miles appears to have been picked on the basis of technical knowledge regarding what could occur, but with a leaning to "err on the side of safety." Thus, while there was very little wind at the time, it could arise in any direction. However, the fact that the distance recommended might have been on the high side, or the factors supporting the recommendation, were not communicated at all when the message was sent. As it turned out, and as we shall note later, those implementing the evacuation (for a variety of reasons) did not accept the five mile radius as a minimum. As one official said, "we were arbitrary on selecting a point to which we would evacuate."

There was almost no discussion in the EOC about the recommendation; it was taken at face value, with attention immediately turned toward how to commence evacuation. In that sense, there was no decision as such on evacuating. However, formal procedures were followed. Only the St. Charles Parish President, as the highest executive officer, has the legal authority to order an evacuation. Not being in the EOC, he was called, awakened, and asked to provide a written order to evacuate the area. He quickly complied and at around 4:45 a.m., evacuation was formally initiated.

However, even before the written document was in hand, calls were going out from the EOC. For example, logs indicate that the school official responsible for bus transportation (according to the school disaster plan) was called at 4:29 a.m. He arrived at the EOC and operated from that point. Calls also went out extending the roadblocks to a five mile radius. Although some state police personnel operating in the local parish area had been aware of a hazardous material incident since about 12:30 a.m. (according to the organization log), the State Police Tactical Unit was called out only about this time, and about two dozen officers were assigned primarily to security posts at the perimeter of the evacuated area. It does not appear that security forces were stationed at the Union Carbide plant. No on-site command post was ever established by any emergency agency. Also, by this time there may have been relatively few people left at the site. Plant workers were reported as seen leaving at 4:20 a.m.

The Coast Guard also contacted the plant at 4:45 a.m. and learned about the recommended five mile radius evacuation. This was the first time they became aware that the explosion had created a situation which could have a negative influence outside of the plant property. As a consequence, at 5:00 a.m., a safety zone was established on the Mississippi from Mile 125 to Mile 130 (the Union Carbide plant is located at Mile 127.8). Later the zone was extended to twelve miles. When a safety zone is established, all shipping is advised by radio that movement into the zone is prohibited. It was not until 5:50 a.m. that the Coast Guard received a call from the State Police advising them that an evacuation was under way.

The formal evacuation

Defining exactly which areas had to be evacuated was done in an interesting way. One feature of the nuclear plant evacuation plan was used. Officials at the EOC looked at the plastic map overlay with concentric circles outlining the distances 1, 2, 3, 4, 5, and 10 miles from the nuclear plant under construction in the parish. Then they moved the overlay to a point on the same map where its center was on the site of the Union Carbide plant, and thus were quickly able to define the areas which needed to be evacuated. There was some discussion about specific localities, but the general areas indicated were accepted as those to be evacuated. These areas included Killona, Taft, Good Hope, New Sarpy, Montz, and Norco (see map on page 4).

This exercise also showed that parts of nearby St. John Parish fell within the five mile radius. In fact, the five mile evacuation zone extended at points two miles into St. John, including the town of Lucy. The director of the St. John EOC had heard the explosion at the plant, even though his home was more than five miles away. He immediately turned on his radio to monitor the communication traffic of the St. John's Sheriff's office. By 1:05 a.m., he learned that there had been an explosion in St. Charles Parish. Three minutes later, the St. John's Sheriff office contacted the St. Charles Sheriff office and learned about the explosion and fire at the Union Carbide plant in Taft. In about half an hour, as we shall describe later, the St. John's EOC was activated and received a call at approximately 4:45 a.m. from the St. Charles EOC about the decision to evacuate a five mile radius including part of St. John's Parish.

In fact, even within St. Charles Parish, the five mile radius was not taken as an absolute necessity. It was early decided in the St. Charles EOC that highest priority should be given to evacuating people within a 2-3 mile radius of the chemical plant. As one official said, there was "no exactness about five miles. No magic about it." There was less concern about getting people who were near the perimeter of the area to leave. Furthermore, a decision was made not to evacuate the Hahnville Court House which is approximately three miles from the Union Carbide plant. The Court House contained the St. Charles Parish EOC. The belief was also expressed that if another explosion occurred, and the winds shifted so as to carry fumes in their direction, they would still have enough warning time to evacuate. In addition, there was the desire to avoid an evacuation of the jail which was in the Court House and which contained individuals arrested and/or convicted of felony charges. As a result, most of the area beyond three and a half miles of the plant was not formally evacuated. (However, those portions of Hahnville to the west of the Court House were formally evacuated.)

With the recommendation to evacuate accepted, quick contact was made by the EOC with the local fire departments and certain school officials. The fire departments were given the task of awakening and warning the residents in the areas to be evacuated. School officials were asked to open schools to shelter evacuees and to make school buses available to move those without their own transportation. Organizational

logs indicate most of these calls were made minutes after receiving the recommendation.

Given the time of the night, the radio and television stations operating had very small audiences. However, one of the first calls went to WCKW, a radio station. It was asked to announce the evacuation order, and what specific schools in both St. Charles and St. John Parishes would be opened as shelters. As one official said, the announcement was very simple, something to the effect that "because of the explosion, there will be an evacuation of these towns, and these are the schools which will be used for shelters." Other mass media outlets were provided the same statement.

The selection of the specific schools was made at the St. Charles EOC (and apparently with some consultation with the St. John EOC). Two high schools (Hahnville and Destrehan) and a junior high (Destrehan Jr.) were selected in St. Charles (the last school was eventually not used). West St. John in Edgar and John L. Ory in LaPlace were chosen in St. John Parish. Distances from the explosion site appeared to be the main criteria for choice, at least in the instance of St. Charles Parish.

Some thought was given to using the siren system installed recently in the St. Charles EOC for use in connection with the nuclear plant evacuation plan. However, this idea was quickly rejected, since the sirens had never been publicly tested (that is, actually sounded). Also the official who primarily thought of the sirens realized that he did not know how to activate the system. (The sirens are currently scheduled to be tested in March, 1983.) So the original idea of using fire officers was implemented instead.

The fire department operations went as follows. In St. Charles Parish, the chiefs of the volunteer departments in Hahnville and Norco were called. They in turn, using a page system, called their volunteer fire officers. After meeting at their fire stations, the volunteers were assigned to contact people in specific areas. The fire trucks were driven to particular neighborhoods, their sirens were turned on, and when it was felt everyone was awake, the evacuation order was announced over the public address speakers on the vehicles. After that, the fire officers went door-to-door, checking each house to make sure that its occupants were awake and knew they were supposed to leave. The residents were also informed of the location of shelters. After the evacuation was completed, fire officers remained patrolling the neighborhoods to watch for house fires and to notify deputy sheriffs if any unusual incidents should occur. As it turned out, only one case of burglary was reported, which the Sheriff's Department thought probably occurred when the evacuees were returning on Sunday.

Residents in St. Charles Parish living closest to the plant were notified first. From the perspective of some top officials, those within roughly one mile of the plant were "ordered" to leave immediately; those who protested were told there was no choice and that they must leave. Some local emergency officials indicated they were prepared to arrest anyone who refused, although nothing was provided to the DRC team

which would indicate that such a step was legal. (In previous studies of evacuation, DRC sometimes found public officials who believed they had a legal right to force evacuation, but in fact, such a forceful step, if the citizen was inside one's own house, would have been completely illegal.) In fact, no one within the one-mile radius was reported refusing to leave, although some households expressed reluctance.

Top officials involved in evacuation indicated that persons beyond the one-mile radius were given somewhat more choice. It was reported persuasion rather than ordering was often employed in neighborhoods roughly within the two-mile radius; that is, households were warned of the danger and urged to leave. Those within the three-mile radius were told to leave, but no great effort was made to persuade them to evacuate. They were told that if they chose to remain, they should stay indoors; if they were found outside, they would be arrested. The households within a four-mile radius were supposedly merely warned to leave.

DRC has very little data that the fire officers and the deputy sheriffs actually knocking on doors differed sharply in their interaction with citizens living varying distances from the plant. On the other hand, there is reason to believe that the public authorities felt less urgency about evacuating residents the further away they lived from the plant. As indicated earlier, a major exception was the area around the Court House. It seems probable that those who were involved in trying to get people to evacuate made some differentiations, but almost certainly not in the neat fashion implied in a post-disaster recounting of what had happened in St. Charles.

In the parish adjacent to St. Charles, as mentioned earlier, the St. John EOC Director had learned of the explosion and fire at the Union Carbide plant about 15 minutes after it happened. He continued to monitor the radio traffic in St. Charles and learned that the chemical involved was acrolein. He called a chemical consultant who told him there probably would be no danger for the parish as long as the fire continued and the wind blew the fumes toward uninhabited areas. The Director checked with the Weather Bureau in New Orleans and was told the wind was expected to shift towards the north (that is, toward St. John) later that morning.

About 1:35 a.m., he called the St. John Sheriff and a few volunteers, and together they decided to activate their parish EOC and go into a stand-by basis. The St. Charles EOC was told of this decision and the willingness of St. John Parish to provide any needed aid, at about 1:50 a.m. Between 2:30 and 2:45 a.m., St. John Sheriff deputies reported that there was a strange, sweet odor in their patrol areas, but that it did not seem to be particularly troublesome. After 3:00 a.m., the wind began blowing toward the northwest, leading to concern that dangerous fumes from the fire in Taft might be carried into a populated portion of St. John. About 4:10 a.m., the St. John EOC phoned the St. Charles EOC to check on the condition of the fire. The reply was that the fire was continuing to burn, that the acrolein vapors were being burned up, and that there was no apparent danger.

Around 4:30 a.m., the wind had shifted to blowing directly north. Reports also came in over the EOC radio in St. John that personnel at the

Little Gypsy steam generating plant were experiencing breathing difficulty. Although the plant is in St. Charles Parish, about a mile and a half north of the Union Carbide plant, the St. John EOC dispatched an emergency medical technician unit because it was easier for it to do so, than for St. Charles. St. John Sheriff units were sent to the east bank of the Mississippi River at Montz to check for odors. They reported back that they were unable to smell anything, but were experiencing burning sensations in the eyes. They also said they were able to see the fire in the plant from the levee, and confirmed that the wind was blowing toward the Little Gypsy area. At this point the St. John EOC contacted the St. Charles EOC, and asked if any thought was being given to evacuation. The reply was no.

A few minutes later, at around 4:45 a.m., St. Charles EOC notified the St. John EOC that the plant officials had recommended evacuation of the population within a five mile radius. The sheriff's deputies who were still on the levee were withdrawn to the parish line, about three miles from Taft. The fire departments in LaPlace and Reserve were placed on standby alert in case evacuation should be necessary. At that time, the official at the St. John EOC felt that because the wind was continuing to shift and was now blowing towards the northeast, no evacuation would be necessary since dangerous fumes were unlikely to reach their area. However, in another communication exchange with the St. Charles EOC, the St. John EOC Director was told that more explosions could occur.

The St. John EOC staff decided at this point to order an evacuation. The time was 5:05 a.m. St. John has a very comprehensive disaster plan, and the relevant components were put into effect. As in St. Charles Parish, fire department volunteers initiated the evacuation of Lucy in St. John. Montz, which is in St. Charles Parish, was evacuated by volunteers from the Norco fire department who live in Montz, and by deputies from St. John Parish. As the map will show, the reason for this combination of help stems from the relative geographic isolation of this part of St. Charles from the rest of the parish (see Map #1, page 3).

In both parishes, it appears that the evacuation was over in about two hours. That is, those who were going to leave had left by 7:00 a.m. By most criteria, the evacuation was rapid, especially since it was done under steady rain and temperatures in the 40's. It is interesting that the Louisiana Power and Light Company in February 1982 released a revised evacuation estimate for a 10-mile radius from the Waterford nuclear power plant. The estimated time to evacuate this 10-mile radius was 5½ hours in clear weather conditions, and 7½ hours in adverse weather. While the two situations are far from identical, this evacuation (of roughly a 5-mile radius) was accomplished in about two hours in adverse weather, as well as darkness.

Not only was the evacuation rapid, but it was almost problem-free. All reports indicate there were no traffic jams; the flow of cars was heavy but not massive, and there does not appear to have been a single traffic accident. This movement was accomplished at night, while rain was coming down, and on few (and relatively narrow) roads (see the DRC photo taken during daylight of a typical road in the area).

The actual number of evacuees is unknown. DRC was told that about 6,000 people lived in Norco; 4,000 in the Hahnville area; 10,000 in Montz; and 1,000 in Killona—all in St. Charles Parish—and another 5,000 people lived around the LaPlace area in St. John Parish; and that almost all these people evacuated. While the figure of about 17,000 evacuees was used by many emergency organization officials, it is clear that the number is an estimate, not based on anything resembling a formal count. One official indicated that because he believed about 20,000 lived within the three-mile radius, and because he thought that at least 90 percent evacuated, therefore the evacuees must have totaled about 18,000. While there is no evidence to challenge the figures advanced, they appear to be educated guesses based upon informal knowledge and personal familiarity with the local population rather than anything more substantial. Media accounts and the statements of local officials frequently alluded to the evacuation of Hahnville, but as we have already indicated, many were not even asked to leave that locality. In any case, even if the highest estimates are accepted, less than 40 percent of the St. Charles Parish population left their homes (and this figure ignores that some of the evacuees were from St. John Parish).

While the total number of evacuees is unclear, there is less uncertainty about where they went. Later we shall note that, at the very most, 2,000 people may have gone to the public shelters. A few are known to have gone to hotels and motels, but that figure, given all the circumstances, probably is only in the dozens. Mass media reports, anecdotal accounts, and the impressions of officials in the emergency organizations, are that



DRC Photo by Brenda Phillips

Photograph #2. Norco, LA, evacuation area. East Bank of St. Charles Parish; population 7,000. Note narrow streets and sewer repair.

the vast majority of evacuees went to friends and relatives. There is no reason to doubt that statement; such behavior would be quite consistent with what disaster research has found repeatedly in studies of evacuation behavior. The great majority of evacuees go to friends and relatives if at all possible. There did not appear to

have been anything in this incident which would have changed this pattern, which can occasionally happen under very rare circumstances (Quarantelli, 1982b).

Specific refusals to evacuate were reported as being rare. The major example cited by officials was 18 households in Norco, who (it was said) flatly refused to leave. Accounts by fire department volunteers suggest there were other cases. However, it does appear that most (not all) residents approached evacuated. Officials attributed this to the fact that the vast majority of the population in the area knew about the hazardous chemicals around them (a great number actually worked in the local chemical and petrochemical companies), most of them were aware of prior emergencies in which small scale evacuation had taken place, and some had evacuated before.

It should be noted that even the so-called evacuated areas were not devoid of people at any time during the crisis. The sheriff's deputies and fire department volunteers remained in the area (some of the latter apparently felt they were forgotten as they patrolled neighborhoods). Others, such as other emergency personnel, government officials, and mass media personnel, traversed the area. Also, as noted later, apart from those at the Union Carbide explosion site, skeleton teams of workers continued to operate a number of the industrial plants. One deputy did report the evacuation of the Waterford nuclear plant at 5:18 a.m. The Coast Guard, after learning of such operations when they arrived at the St. Charles EOC at 11:45 a.m., recommended the plants be closed down if any strong odor was detected.

Other groups got involved in the evacuation besides those already mentioned. For example, there was the convergence of personnel and assistance from Jefferson and Orleans Parishes, and cities of New Orleans and Alexandria, and even from outside the state, from Jackson, Mississippi. Some of the responses were part of prior disaster planning; some were not. In addition, all the services offered were not actually used in the incident. The state emergency services agency (at 8:30 a.m.) notified the EOC it was on a standby basis, that the Governor had been informed, and that all aid necessary including the mobilization of the National Guard would be provided. There was in fact at that time of the morning a surge of calls offering organizational assistance.

Among the more relevant organizations for our purposes were the Red Cross chapter in New Orleans, the Salvation Army units in New Orleans and Jackson, and the Louisiana Baptists Convention in Alexandria. Their activities will be discussed later in connection with our descriptions of the sheltering operation.

Chronologically, the sheltering activities followed the evacuation. However, because sheltering involved only a relatively small proportion of the evacuees, and is more meaningful to treat as a whole, from the beginning to the end, we will postpone our discussion of that behavior. Instead, we will continue in the next part with our description of other post-evacuees returned home.

The wait and return to normal

The completion of the evacuation at around 7:00 a.m. did not slow the pace of activities at the St. Charles EOC. If anything, there was an acceleration, as more and more officials converged on the EOC. The initial impetus appeared to have been related to the evacuation itself. As word about the movement spread, various groups who thought they might be helpful came to the EOC. It became very crowded as representatives of different organizations arrived in great number. DRC was told, for example, that five Coast Guard officers showed up at one point (although the organization's own records shows the dispatching of a single representative to the EOC at 6:50 a.m.). But the convergence on the scene accelerated with the coming of daylight. Individuals and groups, particularly from outside the area, learned of the news upon waking. Many who thought they could provide a service therefore also came to the EOC. Thus, five members of an emergency medical service appeared, even though there was very little need at any time in the crisis for medical personnel. Thus, it appears that convergence at the EOC peaked several hours (9:00 a.m.) after the evacuation had been completed.

One consequence was bad overcrowding, confusion, and noise. One official present in the EOC who characterized the situation as hectic said, "I was working radio and 15 people—at least it seemed like 15—were yelling and asking me this and that. Where is this? Get that." The description of EOC activity at the peak of the convergence (of messages as well as people) corresponded very well to what earlier studies have found about problems EOC's have at the height of an emergency (see Quarantelli, 1978).

Out in the evacuated areas, the situation was calmer and slower paced. During Saturday, for example, state troopers manned the perimeters of the evacuated area; St. Charles' Sheriff Department personnel aided by some deputies from Jefferson Parish to the east patrolled the inner zone. St. John deputies guarded their much smaller evacuated zone. There were no security problems of a serious nature. (It should be noted also that the security forces had to carry on their regular police and traffic duties elsewhere in the parish since a clear majority of the citizens were not that directly affected by the evacuation.) There was no looting, which was not surprising, since previous disaster research has consistently found that the belief in the occurrence of looting is one of the major myths about disaster situations (Quarantelli and Dynes, 1973; Quarantelli, 1981). A few people did try to get by roadblocks in order to retrieve personal belongings, get medications they had left behind, or to feed a family pet which had been left behind. A deck hand, apparently not having heard of the evacuation, landed by boat from the river and was arrested because he was in an unauthorized area. In St. Charles Parish, the records indicate that only three persons were arrested for running the roadblocks, and three others were arrested for disregarding the order of security forces. On Saturday night, in one of the shelters, an individual was arrested for disorderly conduct and two were warned about drinking, but that is probably a lower than average rate for such activities on an ordinary Saturday night in St. Charles Parish.

The security forces did have some difficulties in establishing who had a legitimate right to be in the industrial parts of the evacuated area. Much of the industrial activity had been at a low ebb because of the weekend, and there was a further slowing down of work because of the evacuation. However, many of the chemical and petrochemical plants in particular are 24-hour operations and require some workers on hand all the time. So skeleton crews remained at a number of industrial sites within the evacuation area, or were in time replaced by others. The security forces at the roadblocks had no way of separating essential from non-essential workers, and thus tended to allow entry to those who said they were essential to a plant's operation. There was also the attempt by one company to restaff back up to its normal working level for a Saturday, which required communication between the public authorities and corporation officials. (One group in the parish actually called the Governor's office in an attempt to get him to let them into the area to work the cane fields.)

There were also problems with mass media representatives. The St. Charles EOC had no room in which reporters could be placed; they were eventually located in a training room of the Sheriff's Department. Some mass media personnel got into the EOC itself; a security guard had to be stationed at the entrance. A New Orleans television station mobile van appeared at about 6:40 a.m. and they and other mass media personnel wanted (and were allowed) to enter the evacuated area. Somewhat to the surprise of officials in the EOC, the Associated Press called a few hours after the evacuation was over, and national media representatives showed up Saturday. As disaster research has shown, local emergency officials come to see themselves as being "harassed" by reporters in such situations (see Committee on Disasters and Mass Media, 1980); this was the perception in St. Charles.

Also, evacuees sometimes asked emergency officials what stations they should listen to for information, especially about when the evacuation would be lifted. While there were hourly broadcasts over the Emergency Broadcast Radio Station and some television stations, apparently not all officials contacted were aware of those operations. In fact, lack of information about what was happening was widespread among both officials and citizens. As one official phrased it, "we must have been told 'no change' twenty thousand times." This is related to another problem regarding the reporting by the mass media: reporters sometimes conducted interviews or made observations at roadblocks or elsewhere in the evacuated area. These accounts, when broadcast later, were heard at other roadblocks or by fire department personnel still in the area. The reports were not always consistent with what they were getting (or not getting) through their official communication channels; this led to some confusion.

Early Saturday afternoon, there were many efforts to determine the status of the threat. For example, at 1:00 p.m. the State Department of Natural Resources instituted its Air Quality Control operation. At 2:30 p.m. a helicopter from the State Police flew over and photographed the explosion site. At 4:30 p.m., films were reviewed at the Monsanto EOC. Apparently at this time it was determined that one of the five acrolein tanks had exploded, that a second tank had ruptured, and that three of the other

tanks had had their protective concrete covers blown off. This was reported at a meeting called by local emergency officials, and which was also attended by representatives of the State Police and the Coast Guard. However, it appears a few local officials never learned about this information since they never indicated knowledge of the matter when the DRC research team visited the area.

While the plant manager and the safety officer (along with key technicians) remained at the plant, most of the other important officials went to the Monsanto chemical plant, seven miles away. It was said this was done because the Monsanto EOC was a very good one. Whatever the reason, Union Carbide officials operated primarily out of this location during the emergency. There appears to have been little initial direct contact between this operation and local emergency officials. This is supported by the fact that the Coast Guard was disturbed not to find any representative from Union Carbide when it arrived at the St. Charles EOC at 11:45 a.m.

There is considerable difference of opinion, not resolvable by DRC data, on who was responsible for getting a chemical company official to the EOC, and what that company representative did when he got there. Two different organizations claimed they contacted Union Carbide at the Monsanto EOC, and urged the company to send a technical advisor to the EOC. Whoever was responsible, a chemical company representative did arrive at the EOC in the afternoon. Some at the EOC indicated that they did not believe that the representative of the company provided much information flow in either direction. Others indicated to DRC that there were meetings between local emergency personnel and the representative and that at the conclusion of each meeting the information was passed on to the staff located in the operations room. At least, it can be said that the Union Carbide official was not visible to all, and that not everyone at the EOC thought they were getting direct information about the plant from him.

After the hectic activities of the early morning, as Saturday passed, even the St. Charles EOC reached a slower pace. Local officials spent most of the day waiting for word that all danger had passed. Since the fire was burning the acrolein, no effort was made to extinguish it. Most accounts indicate that the fire at the plant burned itself out in about 16 hours, or sometime Saturday afternoon (although minor burning and small flames continued for hours after that). This time reference is supported by a report that company teams went into the explosion/fire site around 6:00 p.m. and found the fire generally out and that no more vapors were being emitted.

This is consistent with a conclusion reached around 8:00 p.m. Saturday. At that time, company personnel, the State Police Hazardous Unit, the deputy from the St. Charles Parish assigned to hazardous material problems, and other officials involved, all agreed that the evacuation could be lifted for the entire area, except for a small zone near the explosion site. However, it was dark by the time this consensus was reached. Some other public officials were reluctant to initiate and oversee the return of evacuees to their homes during the night hours. A decision was made to delay the lifting of the evacuation order until noon Sunday. It was felt that the morning could be used to announce via radio and television that

the evacuation was being lifted, and those evacuees who were farthest away could plan to arrive back in the area at about the same time as those who were staying closer or on the perimeter.

At 10:00 p.m. Saturday the Coast Guard reopened that twelve miles of the Mississippi River which it had closed (the two ferry crossings, according to some information, were allowed to resume normal operations earlier in the day). The river was closed to traffic because of a concern that a spark from a boat might ignite concentrated acrolein fumes, and create a "flashback" that could lead to another explosion. While the closing of the river was the major task undertaken by the Coast Guard, it attempted to do some other things. Some local officials alleged that early in the crisis, the Coast Guard (one of the very few federal agencies involved in the incident) had urged that federal agencies be brought into the operation. The Coast Guard at 9:45 a.m. Saturday put the Gulf Strike Team on standby alert (a team trained to deal with oil spills and hazardous chemical incidents). Local officials do not appear to ever have seriously considered asking for any federal action.

Around 5:30 a.m. Sunday, a Union Carbide team using an infrared scan and other equipment approached the explosion site as closely as possible. A State Police helicopter photographed the site with video and infrared cameras. The Air Quality Control operation had been continued from the previous day. The results of the various observations, it is said, led the plant manager to conclude that the fire had died down sufficiently so as to no longer constitute a significant threat, and that the entire evacuation order could be lifted.

At 8:30 a.m., there was another meeting at the Monsanto EOC. Plant officials and some public officials decided that the danger of another explosion appeared to be minimal. There was no significant evidence of threatening vapors. A final decision was made to recommend the lifting of the evacuation order at noon.

A news conference was called at 10:30 a.m. to make the announcement, and almost immediately, television and radio carried the news. When word reached the evacuees in shelters and elsewhere, many immediately headed back into the evacuated areas. Because of an internal communication confusion, the security forces at the roadblocks allowed the evacuees to reenter when they started to appear fairly soon after the 10:30 a.m. announcement. The security forces present continued to patrol for a few hours after that, but there were no traffic problems or unusual incidents. Evacuees continued to return all the rest of the day, and it is probable almost all of them were back in their homes by nightfall. There does not appear to have been any formal shutting down of the St. Charles EOC.

The sheltering operation

It is important to keep in mind that the sheltering operation probably involved no more than 10 percent of the evacuees. Our focus on the shelters should not obscure the fact, as already noted, that the vast majority of evacuees went to friends and relatives. However, we have no information about them (as noted in the Appendix, the limited resources

for the study precluded making a population survey), and organizational officials understandably also had few ideas or observations about the evacuees who went to places other than shelters.

In all, four shelters were used, two in St. Charles Parish and two in St. John Parish. As is usually the case in disaster situations, even after the event is over, there are varying estimates about the total number of evacuees who used the shelters. Previous disaster research indicates that some of the problems in establishing a firm figure are that some evacuees typically use shelters only as a temporary stopping place en route to a more permanent location; not all evacuees sign in even when registration is attempted; relief workers and other emergency personnel also used the shelter--especially to eat; and round figure estimates are sometimes "eyeballed" by different officials. The varying estimates in this situation appear to have been affected by these factors, but overall, it seems that a maximum of 2,000 persons used the shelters at some time, with the figures probably including other than evacuees. At the most, less than 10 percent of all evacuees spent any time at any shelter.

St. Charles

We will first briefly describe the shelter operations in St. Charles Parish. The Red Cross has six designated shelters in the parish (as of May, 1982), three on the East Bank (New Sarpy Middle School, New Destrehan High School, and St. Rose Middle School) and three on the West Bank (J. B. Martin School, New Hahnville High School, and St. Charles Parish Courthouse). As many as 15,000 evacuees can be housed in them, according to Red Cross calculations.

Schools have traditionally been used as shelters in St. Charles Parish in the past, especially for hurricanes, and more recently for technological disasters. Apart from tradition, the school system has very elaborate planning, manifested in a detailed manual, which covers a variety of emergencies and disasters in which the schools might be involved (these range from tornadoes to civil disorders to nuclear plant accidents). Because the school children might have to be evacuated, the manual elaborates procedures, designates facilities, and otherwise indicates how to transport students and teachers. Furthermore, the planning is more than something which exists on paper; schools have been evacuated and schools have been used as shelters for evacuees in recent times.

As we have indicated, the St. Charles EOC called the designated school official involved, the Chief of Physical Plant Operations, to initiate the process of opening some of the 17 school buildings for public shelter. Logs indicated he was reached around 4:30 a.m. on Saturday. At about the same time, the EOC contacted the transportation officer of the school district. Following planned procedures, the necessary approval was obtained within the school system. The designated principals apparently had all their schools open by 4:50 a.m. (One of those opened was closed down soon after opening.) Shelter-relevant school personnel, such as cafeteria supervisors and janitors were mobilized for the onset of the evacuees who started arriving some time after 5:30 a.m.

The transportation officer, meanwhile, had gone to the transportation center of the school system, obtained a bus, and drove it to the St. Charles EOC for the evacuation of the jail if necessary. After arriving at the EOC, he called two additional drivers on the West Bank and one on the East Bank. They were instructed to stand by at various roadblocks and were dispatched from these points as needed. Two other drivers were called by deputy sheriffs to service the East Bank. No specific written or general plan was used by the transportation officer, but a pattern was followed. People living in neighborhoods known to contain the poor and/or elderly were serviced first, on the assumption that they usually lacked vehicles. Once these areas were evacuated, the bus drivers stood by and were dispatched to wherever they were needed. In retrospect local officials indicated they were surprised "by the number of evacuees who used their personal vehicles to go to homes of relatives and friends." Their prior consultant service studies on evacuation had indicated they would have to use many buses; they only put four buses into service.

The transportation officer remained at the EOC until 3:30 p.m. Saturday, in case it became necessary to evacuate the jail. At that time, he conferred with the EOC staff and they jointly decided evacuation of the jail would be unnecessary and then went to the transportation center until 11:00 a.m. Sunday. He learned the evacuation was cancelled over a radio announcement, confirmed it with the school superintendent, and arranged for buses to return evacuees from the shelters to their homes. Apparently less than 100 people used the bus transportation.

Destrehan High School

This school, at the perimeter of the five-mile radius, appears to have received the greatest number of evacuees. Some officials early on the scene guessed that perhaps 1,500 people were present. The EOC log states that 950 persons spent the night. The Red Cross estimated that there were 600-700 individuals at the school.

The Red Cross representative arrived before 9:30 a.m. to organize the operation (she had earlier helped to set up the two shelters in St. John Parish). She found deputy sheriffs, some council members, and school personnel informally working at the school. With the help of a Red Cross volunteer who apparently had arrived from New Orleans, a roster was initiated of evacuees present. School cafeteria personnel helped serve lunch which consisted of sandwiches supplied by the Red Cross. Two nurses were available to provide services; they set up cots in a mail room for two bedridden elderly evacuees.

The weather was cool to cold on Saturday so both children and adults remained indoors. To combat boredom, a film was shown in one room, some games were provided for children, and cards were given to adults. Older persons became annoyed with children running about; but the impression of observers was that there were few problems. The deputy sheriffs who were present had little to do since the evacuees were quite orderly. There was one minor problem with drinking Saturday night.

When the school services officer realized that the evacuees would have to stay overnight, he arranged for two employees from the school board to be present at all times in each school. They worked four hour shifts and their duties were to make certain that the buildings were used properly and that unnecessary damage was avoided.

Most evacuees were housed in the school auditorium. About 100 cots, obtained from local sources, were set up and assigned to the elderly and the disabled at approximately 7:30 p.m. An additional 600 cots, supplied by the New Orleans Red Cross, arrived around 10:30 p.m. They were quickly set up for those who wanted to sleep. Some people stayed up all night and played cards or talked.

On Sunday morning, the superintendent, the assistant superintendent, the principal, and the school services officer met at the school to plan for the day and coming night; but the evacuation was lifted by noon. School personnel, as well as some parish personnel, cleaned the shelters (which were not especially dirty, as janitorial services had been provided throughout the emergency period). This was finished by 6:30 p.m. Sunday and school opened Monday morning as usual.

Hahnville High School

Estimates on the evacuees at this school, seven miles from the explosion site, vary from 400 to 600. In the morning a roster was taken in case relatives would call wanting to find family members. It had 525 names.

At around 5:00 a.m. Saturday, some clients from the Community Services Program called the director to ask for information on the evacuation. She sought information from the Executive Assistant to the President and then went to the school. Several Red Cross volunteers, apparently from New Orleans, arrived around 7:00 a.m. with coffee and doughnuts.

A Red Cross nurse checked to see if there were any health problems. Two evacuees were taken to a hospital as a precautionary measure.

According to school board policy, the cafeteria manager was present to supervise food preparations. She worked with a Red Cross representative. The Red Cross ordered fried chicken (on credit, later paid) for lunch Saturday and sandwiches (bought on credit) from a local grocery store for supper that night.

Observers reported that the evacuees were not very upset, but were bored. The Community Services Director called the Executive Assistant to the President, who called a local appliance dealer who loaned a large screen television to the shelter. A number of evacuees watched a football game that afternoon.

More cots arrived Saturday evening than were needed. A common area, a large carpeted open space with lockers, was used for sleeping. Elderly evacuees were put closest to restroom facilities. Families were put in next, and all others were put in other designated areas.

Sunday breakfast was prepared by the cafeteria manager and some of her helpers. They used some school food which was later reimbursed by the Red Cross. Evacuees left the shelter after the 10:30 a.m. announcement. Lunch had been prepared, and was offered, but no one stayed. All evacuees left in about 15 minutes. School maintenance personnel folded up cots and blankets for the Red Cross and cleaned the school.

The two schools in St. John

There are eleven designated Red Cross shelters in St. John Parish. Eight are located on the East Bank and three are on the West Bank. Two of them were opened: John L. Ory High School in LaPlace on the East Bank, and West St. John High School in Edgar on the West Bank. Two more schools were scheduled to be opened but they were not needed.

St. John Parish had been preparing for the opening of the Waterford nuclear plant through the last year and had participated in three mock evacuation drills including one only four or five days before this chemical incident. However, the EOC Director indicated that the parish hurricane plan was used. The St. John sheltering plan is set up to care for victims of hurricanes, as well as other emergencies. Each year the local school officials review the plan with EOC staff members and determine which of the schools can most appropriately be used to shelter evacuees. This was the sheltering plan St. John used in the chemical plant incident.

The St. John EOC asked school officials to open the shelters and to notify the school bus drivers to provide any transportation necessary. Most evacuees arrived in their own cars. Two buses, one on each side of the river, were available but were almost unused.

A Red Cross representative organized the opening of the schools as shelters. A roster was taken of those who arrived. Approximately 400 people registered at West St. John High School in Edgar, but just how many persons stayed overnight is unknown. By nightfall, most of the approximately 360 who registered at the John L. Ory High School had left. One estimate is that only 85 stayed overnight.

There were some problems about cots. They had been promised for 10:00 p.m. Saturday but only arrived from Alexandria at 12:30 a.m. on Sunday. This delayed people getting to bed, so breakfast was served around 1:00 a.m. As in the shelters in St. Charles Parish, the evacuees primarily remained in the buildings, sitting around and talking. Union Carbide provided five or six television sets for each of the shelters in St. John so a variety of programs were available for watching. There were no disorders or untoward behavior.

While it had not been anticipated that St. John would have to shelter St. Charles residents, the matter presented no problem. For reasons noted earlier, John L. Ory High School sheltered St. Charles Parish evacuees from the East Bank. Evacuees from both parishes went to West Bank St. John High School.

About 1:30 a.m., the St. John EOC learned that a decision would probably be made around 7:30 a.m. on whether or not to lift the evacuation order. The wind by that time had been blowing steadily from the north for hours and it seemed unlikely that there would be any further threat to anyplace in St. John. The St. John EOC reduced its staff to about five persons for about three and a half hours in the middle of the night. However, three staff members remained on duty at the shelter in the West St. John High School.

Very early Sunday morning, many of the staff returned to the St. John EOC and attention turned to the lifting of the evacuation order in St. John Parish. After consultation among public officials and emergency personnel, a decision was reached to lift the evacuation in St. John Parish at 8:00 a.m., whether or not this was recommended by Union Carbide, the State Police, or officials in St. Charles Parish. However, evacuees from St. Charles would be permitted to remain in the two shelters.

When St. John communicated this information to St. Charles, officials in St. Charles indicated that they preferred that St. John wait to make their announcement until 8:00 a.m. It was noted that a major meeting would be held at that time involving the chemical company hazardous material specialists and others (as we have discussed earlier). St. John officials agreed to postponing their announcement, recognizing that the public might be confused if one parish lifted the evacuation order and others did not do so at the same time. A 9:15 a.m. call between the St. John EOC and the St. Charles EOC led to an agreement that the evacuation would be lifted for both parishes at noon, but announced at a news conference at 10:30 Sunday morning.

Who assisted in the school shelters?

The Red Cross was the primary organization in shelter operations. Five vans were sent from the New Orleans chapter. Personnel consisted of eight regular staff members and 18 volunteers. An early estimate was that costs to the Red Cross would be around \$4,200, and that 2,095 evacuees, parish residents, and relief workers were given some assistance. Red Cross officials thought they should have been notified by the public authorities sooner than they were, but they had been contacted by their own local representative at around 5:45 a.m. She had learned of the evacuation order about 15 minutes earlier through a call from the St. Charles EOC. Operations were conducted along traditional Red Cross lines and were in conformity with their national charter to provide services in disasters.

The Salvation Army also responded, initially sending a food truck from New Orleans. This truck, after it reached the area, was used as a roving unit. Division headquarters in Jackson, Mississippi, offered the use of three Mobile Feeding Canteens to the St. Charles EOC. After the offer was accepted, and the units arrived in the area, they were positioned in different places. One canteen was stationed at the St. Charles EOC and provided around-the-clock food for the emergency workers in that location. Another canteen was sent from roadblock to roadblock and fed state troopers and deputy sheriffs. The third unit was used to help the Red Cross feed evacuees at two of the shelters.

The Louisiana Baptist Convention from Alexandria, Louisiana, sent a Mobile Disaster Relief van, equipped for mass feeding. It arrived at 6:00 p.m. Saturday and was then stationed at Destrehan High School. About 700 people were fed that night and the next morning.

VI. Perceptions and Evaluations of Those Involved

Overall, those involved felt that the incident was handled well insofar as the emergency organizations were concerned. Almost all organizational officials gave their own groups high ratings. There was less consensus on how other emergency organizations performed but evaluations were generally on the positive side. Groups also tended to give high marks to how citizens reacted. We have no direct data on how the public perceived the actions of the emergency agencies, but at least as reported through organizational eyes, citizens approved the behavior of the groups. No official was singled out for extraordinary acclaim, but little of a negative nature was said about any particular person. Since neither organizations nor private citizens have shown any inclination to hold back on negative comments in other studies conducted by DRC and other researchers (see e.g., Veltfort and Lee, 1943; Wright, 1977; Neal, 1982), it can be assumed that the general positive tone was an expression of true feeling and not merely politeness.

No one thought everything was handled perfectly or that some matters could not be managed better in future incidents. But even the criticisms of Union Carbide, the chemical industry, and the private sector were relatively muted. In a few instances, there did seem to be concern about community officials voicing manifest criticisms of a very economically important part of the local private sector. However, there was not that much general criticism of the chemical company's handling of the incident, except that considerable unhappiness was expressed about the perceived failure of Union Carbide to give the public agencies any warning about how serious the crisis might become (a point to which we shall return later). Similarly, not all emergency organizations were pleased with one another's performance. Some of the volunteer fire departments, for example, expressed misgivings regarding how some other groups acted. But compared to the blame assessment and fault-finding which typically surface in technological and especially chemical disasters, the views expressed to us, off and on the record, were relatively mild (see Bucher, 1957; Drabek and Quarantelli, 1967; Wright, 1977).

In fact, many of the negative statements which were made about self or others were not so much a criticism of anyone as an expression of the feeling that although things went generally well, they could have been and should be better handled in the future. For example, some flaws were noted in how some of the shelters were organized (or perhaps not organized). But it was acknowledged that the evacuees who went to shelter did get services which, however, ought to be provided in a better way in a future case.

There was certainly the feeling that not only the particular company involved in this incident, but all chemical companies in the area, ought to prepare to respond in different ways in the future. Community officials particularly thought that the companies should give them forewarnings of potential problems for the larger community if there were accidents within a plant. It was noted that the physical means existed for providing such

warnings (such as the Hotline System). The company view, at least as expressed in a post-action critique of all responses, was that there were too many incidents and that the vast majority never accelerated into serious events, to constantly send alerts even to a limited number of public emergency groups. It was noticeable that company personnel stressed the need to develop mutual trust, whereas emergency organization officials tended to talk about implementing a procedure and their need not to be caught unaware (a typical difference of opinion DRC found in its earlier study of chemical disasters, see Gray and Quarantelli, 1981; Quarantelli, forthcoming).

Many of the evaluative comments revolved around specifics. The existing general pattern of disaster preparedness in the community was not questioned; instead, there was a focus on details. What could be done so community agencies could get more and quicker alerts and warnings from industry? How could various EOC's better communicate with one another? In what way could information be better transmitted to the press?

However, it is of interest that the focus on specific details of communication dealt more with procedures than with mechanical means. Very often in the aftermaths of disasters, the involved parties think that future improvements in response might be generated by having more radios, more telephone lines, or more equipment of some kind. While those interviewed sometimes voiced the need for particular pieces of equipment, the general tendency was to suggest how existing plans could be better implemented (usually by updating) or how procedures could be improved. Such a point of view is not the typical one expressed in the aftermath of a threatened or actual disaster.

Some, although far from all, officials suggested that the planning that had been under way to cope with emergencies at the nuclear plant might have helped in the chemical incident. However, only a few and very specific examples of how such an extrapolation occurred were noted, such as the use of the overlay to establish the five mile radius. Sometimes cited as helping in the incident, perhaps because of its recency, was a drill which had been held in November 1982 where a release of chlorine gas at one of the plants had been simulated. Participants took steps which might occur in an actual emergency (e.g., while no stoppage of traffic occurred, personnel from the Sheriff's Department went to the various places where traffic controls or roadblocks would be set up in an actual emergency). The view was expressed that this exercise sensitized those involved to some of the factors which would have to be taken into account in an evacuation (e.g., the dangers of gas concentrations in virtually windless conditions).

Many of the officials involved tended to credit their successful handling of the incident to their prior experience in smaller-scale emergencies. Several noted that small scale evacuations, as a result of chemical incidents, had not been uncommon in their recent experiences. Thus, they were not dealing with a totally unfamiliar situation.

Finally, there was a very widespread expression of the necessity of instituting improvements as a result of the lessons learned from the incident. Earlier disaster studies have noted this is a very common reaction in the aftermath of a community crisis (see Adams, Stallings, and Vargo, 1970). The post-action critique held on December 21, in which many of the local emergency organizations participated, was seen as a first step toward improving community and organizational performance in the future.

VII. An Assessment of Actions in the Incident

Any assessment requires the consideration of three things: what is being assessed, the criteria used for assessing, and the perspective being used in the assessment. In this case, we will not make an overall assessment, but evaluate the activities in five different time stages (namely, pre-incident planning, learning of the threat, organizing and performing the evacuation, sheltering of evacuees, and returning to routine). As we examine these, we will note the criteria used in our assessments. Finally, our perspective is that of an outside party who has no vested interest in the situation, who has the advantage of a post-emergency examination of the incident, but who is also operating with the disadvantage of a relatively small and partial data base.

In question form we can ask:

1. How well-prepared were the organizations and the community for the incident that occurred?

Preparedness here is thought of as a prior planning. For example: Was there expectation of such incidents? What would be done if one occurred? Who was supposed to do what? What problems were visualized as arising in such an eventuality? In essence, the question is how much thought and action was given to the general possibility of what actually occurred?

In a general sense, it can be said that there was prior planning in this community, and in the relevant organizations, for the type of emergency which happened: a chemical incident was not unexpected. The possibility of evacuation was known, and so on. Even in the more specific sense of a chemical emergency, there was prior planning. For example, there was the Hotline System. The Sheriff's Department in St. Charles Parish had a trained hazardous material specialist. It was known how and where the State Police could be contacted for chemical emergencies.

Not everything had been foreseen, either generally or specifically. For example, the magnitude of the actual evacuation seems to have been beyond what was visualized in a planning sense. Little thought had been given to how mass media (especially national mass media representatives) would be handled, although some adjustments were made during the emergency. But there was planning and there was a degree of preparedness for the kind of emergency which occurred. In fact, as we have noted, relative to what is known about planning and preparedness for chemical emergencies around the country (see Gray and Quarantelli, 1981), this was a situation for which there was better than average preparations.

2. How well did the community and the organizations learn about the threat?

Forewarning is obviously crucial in any emergency, because the more forewarning time, the more it is possible to mount an effective response.

Important in the process is knowing the nature of the threat, the probability of its occurrence, when it is likely to impact, and where the impact may be expected. Planning can be an element in these matters only up to a certain point.

In this incident, the planning worked fairly well but the rest of the process was the most poorly handled aspect of the whole event. Thus, the nature of the threat was established very early. In the first call to the Sheriff's Department, the person receiving the call not only obtained the name of the chemical involved but immediately checked in an available handbook about the nature of the substance. Later, too, since wind direction could have been important, key officials were able to use available weather instruments or knew where to call to obtain relevant information. These and other related matters were the result of planning, and in this respect the nature of the threat was early and correctly identified; in many chemical emergencies one of the initial problems is that the threat is not, or is only very slowly, identified (see Gray, 1981).

However, almost everything else involved in learning about the threat left much to be desired. The knowledge that something of a serious nature could occur, remained known only inside the chemical company. For a long time even the chemical company might have had only limited immediate knowledge of the probability of an escalation of the threat after the explosion. It is clear the public emergency organizations had little idea how serious the threat might be until they received the recommendation about the five mile radius evacuation. Thus, the probability, the when, and the where of the threat were unknowns. Even before the explosion, the Sheriff's Department had to learn from citizens calling the organization that evacuation was taking place at the plant and had to initiate a call to the plant; this indicates part of the problem. In this and other instances, both the means and procedures for communicating were available but were not effectively used. Similarly, while there was physical means of communicating between the plant and St. Charles EOC, the failure to have a plant representative in person at the EOC or a local emergency organization official at the decision-making point at the Monsanto EOC, helped perpetuate an information void about the threat both before and after the evacuation.

3. How well was the evacuation organized?

An evaluation of any evacuation is complicated because different criteria can be used (see Quarantelli, 1980). For instance, it is possible to apply an effectiveness criteria: Were people evacuated before anything happened to them? An efficiency criteria can also be used: Were there many problems in getting people out? Or a matching criteria can be used: Did the evacuation follow evacuation plans or planning? Apart from these and other criteria which could be advanced, an assessment in this incident is further complicated by the fact that while there was a threat from the acrolein fumes (and from further explosions), there was not much actual danger.

The application of different criteria leads to different evaluations. The most positive assessment comes from using the efficiency criteria. A substantial number of people were moved out very rapidly without serious problems. To be sure, not everyone left (and there was almost certainly an underestimation about how many remained behind in supposedly evacuated areas), but a substantial number of people were evacuated in a relatively easy movement.

The application of the effectiveness criteria suggests a more mixed evaluation. Many people were moved before anything happened to them, but of course, as the situation actually developed, there was no danger. An unanswerable question: What if there had been a second massive explosion spreading dangerous fumes a long distance? Would the evacuation have proceeded as smoothly under those circumstances? What if the danger developed as the evacuation was under way? It is somewhat unfair to evaluate hypothetical situations, but for purposes of assessing the lessons learned from a current situation to a future one, the exercise is not irrelevant. (We will return later to the fact that the incident involved more of a threat than a danger.)

The application of the matching criteria generates an even more mixed picture. Actually there are two only partly-related matters here: Did the evacuation follow plans and was the evacuation effected by planning? In some respects written plans were used, although often minimally as in the employment of the overlap of the nuclear plant evacuation plan. In many respects, however, it was the (prior) general disaster planning which influenced what different officials and organizations did. Furthermore, superimposed upon the whole process were the prior experiences of many officials and some citizens in evacuating in small-scale emergencies (and to an unknown degree, remembered experiences in natural disasters such as floods and hurricanes). At any rate, whether at the organizational or individual level, written plans played only a part in the evacuation; disaster planning seems to have been more important; and prior experiences appeared to have provided the most crucial guidance for many evacuators and evacuees. In short, the disaster subculture was the most important operative factor.

Thus, an evaluation of how well the evacuation was organized is dependent on the criteria used. For purposes of illustration, we have used three standard criteria, but others are possible (e.g., the positive perceptions or complaints of evacuees, or the kinds of interorganizational problems that surface in coordinating an evacuation and return across jurisdictional boundaries, as was necessary in this incident). We have also not addressed (because of lack of adequate data) the important question of what, if any, planning would have become operative in the event evacuation became necessary for all the personnel (e.g., security forces, plant workers, etc.) within the evacuated areas, or if the St. Charles EOC itself had to be evacuated. That the St. Charles EOC had an off-site command post van, or that it had signed agreements for hospitals, nursing homes, and jails to be moved to other parishes in the case of some emergencies, does not indicate how the planning would have worked in practice, or if the different institutions had viable internal evacuation plans. Disaster studies show there is a tendency for some

kinds of organizations such as emergency service offices, hospitals, and radio and television stations to do little or no planning for the evacuation of their own facilities, which can create problems of enormous magnitude if evacuation becomes necessary.

Finally, we have examined primarily the formal evacuation, that which was recommended and implemented by both parish EOC's between 4:30-5:00 a.m. Saturday morning. We have ignored, again because of lack of hard data, the phenomena of the early evacuee. That the Sheriff's Department in St. Charles Parish started to receive inquiries around midnight from private citizens, strongly suggests that some households left an hour before the explosion. For everyone who called the sheriff's office, there probably were even more who left on their own without checking with anyone. A full assessment of how well the evacuation was organized would have to take into account the early departers and those who never left (phenomena which have been neglected in both disaster planning or disaster research [see Quarantelli, 1980]).

4. How well were evacuees sheltered?

A major point in answering this question is that we can say practically nothing about the great majority of evacuees who went to their friends and relatives. As we have noted several times, we only know some things about the evacuees who went to the public shelters in the schools. Thus, any assessment of sheltering has to ignore the majority of the population affected.

Insofar as public sheltering is concerned, relevant questions deal with pre-disaster identification of shelters, development of procedures to use such quarters, and management of the shelter quarters.

In this incident, the identification of the shelters and the procedures used to open them, would have to be evaluated as "well done." When the emergency occurred, there was a rapid mobilization of these resources because the shelters had been pre-identified and a clear procedure existed regarding who was to be contacted to open the schools. The shelters were not only known, but school officials were rapidly contacted, and the school shelters were opened very soon after the evacuation recommendation was made. These activities were among those emergency actions which most closely followed written plans.

The management of the shelters was criticized by some persons, but again there remains the question of what is being evaluated. Clearly, there can be many criteria (see Quarantelli, 1981). For example, one basis for judgment is to ask whether the evacuees were provided basic necessities. It does appear evacuees expeditiously received indoor space, food, medical attention, personal security, and recreational facilities. If anything, as time went on, more of these things were provided. Perhaps not enough sleeping cots were immediately available in one shelter (and possibly another), but in terms of physical necessities, that appears to be the only delay in providing service. There was even some recordkeeping through the making of rosters of evacuees in the

shelters, a task frequently poorly-handled in many disasters. Evacuees could, of course, find out very little about what was happening. However, this lack of information was not peculiar to the shelters; it was a problem even within the emergency organizations themselves. Thus, the management of the shelters would have to be evaluated at least as "adequate," if provision of basic necessities is the evaluative criterion used.

5. How well handled was the return to normal?

For our purposes, this question covers both the waiting period and the actual movement by evacuees back to their homes. Once an emergency situation is under way, there is typically both a convergence on the scene and a need to deal with non-routine problems. This is what happened in the chemical incident. As already noted, there was an escalation of convergence, especially on Saturday morning. There was also the need for non-routine interaction among several key organizations, especially between those at the St. Charles Parish EOC and those key decision makers at the Monsanto Plant EOC; the interaction was needed so the necessary information to operate would be available. There was also the need for non-routine interaction between organizations at the St. Charles EOC and some at the St. John EOC, as well as the Red Cross (mostly operating out of New Orleans). This interaction was necessitated because the public shelter locations and staffing cut across usual jurisdictional boundaries. In this incident, the need existed for inter-organizational information exchange and inter-organizational coordination.

The criteria which can be applied to inter-organizational information exchange and coordination can be relatively simple. Were such linkages anticipated before the situation developed? What planning had gone into an effort to provide emergency time linkages? What sort of relationship existed during the emergency? What problems were occasioned by the links which did or did not exist?

Judged in terms of these criteria, the response in the chemical incident cannot be given high marks. Organizational convergence had been partly anticipated (the St. Charles EOC, for example, was unusually large for an installation of this kind). On the other hand, certain other possible kinds of convergence had not been foreseen, as seen in the absence of a way and location for interaction with the mass media personnel who converged. There was apparently little anticipation that during a chemical emergency, there would be a need for considerable interaction with the chemical company involved. (The Hotline System seemed designed primarily for warning purposes and little else, although local officials see it as an important asset to overall emergency planning in a highly industrial area.) Further complicating this crisis, the key technical decision-making activity did not even remain at the explosion site, but was moved to the Monsanto EOC seven miles away. There were some contacts among the St. Charles Sheriff's Department, the State Police, the St. Charles EOC, and the Monsanto Plant EOC, but insufficient until nearly the end of the emergency to provide the necessary information flow and exchange.

The cutting across of everyday jurisdictional boundaries generated some problems. St. Charles evacuees were in St. John Parish school shelters (even part of that evacuation had to be undertaken by St. John Parish groups). The Red Cross shelter operation had its primary base in New Orleans (and even the other major relief groups had non-local origins). That a large scale evacuation and sheltering effort in St. Charles Parish would cut across jurisdictional boundaries and necessitate coordination was not well anticipated and the situation did not markedly improve during the emergency. Fortunately, potentially serious problems which could have arisen because of this lack of inter-organizational coordination did not materialize. As we shall note later, the sheltering operation was actually better than what some critics contended. The evacuation was not lifted in St. John Parish before it was lifted in St. Charles Parish, although the possibility was considered. So this part of the return to normal skirted but avoided some serious problems.

Overall, it might appear that we are saying that while the community and emergency organizations had planned and were relatively well-prepared for chemical emergencies, the actual response fell short in some significant ways from what had been visualized. This is true, but should be understood in the following context, which involves three different points.

First, planning and actuality never match. There is always a discrepancy between the two. It is naive to expect that disaster planning will eliminate all disaster problems; at most it can reduce the problematical aspects of emergency situations. Second, because plans are not followed in a situation, does not mean the ensuing behavior is automatically poor or inappropriate. Emergent behavior is characteristic of a crisis situation, and what sometimes emerges is the best solution for that situation. In this instance, St. Charles Parish residents ended up in shelters in schools in St. John, but this was probably the best solution given the situation. This in no way is an argument against making plans; it does, however, suggest that plans should allow for flexibility (in the incident studied, one organization was far better able to obtain current information on what was going on than many others because it had enough internal flexibility in its plans to allow adjustment to the situation). Finally, one should always ask: What would the situation have been like if there had been no disaster plans or planning? If approached in this way, it becomes very clear how important plans and planning were in the situation. What happened did fall short of ideal goals, but what had been done prior to the incident, did make an important difference in the response.

Finally, any assessment of the response in the incident cannot be ignored. As we have already stressed this was a threat more than a danger situation. Thus, in many ways, what happened in Taft, Louisiana, on December 10-12 was a potential disaster situation but not an actual disaster. Without raising legal, operational, or research questions about what constitutes a disaster (see Quarantelli, 1982a for a discussion of the difficulties involved in conceptualizing disasters), there were not many disaster agent-generated problems in this incident. Agent-generated problems are those which are directly created by the disaster agent itself such as casualties, property damages, etc., as contrasted to

response-generated problems which arise from the very effort to deal with agent-generated problems; they include such matters as the coordination of multi-organizational responses; the communication to, from, and within groups; the gaining of legitimacy by agencies carrying out new or unusual tasks, etc. (see Dynes, Quarantelli, and Kreps, 1981). The incident in St. Charles Parish had more response- than agent-generated problems. Everything else being equal, it is easier to respond to a situation which involves only response-generated problems or demands than one which also includes agent-generated demands (although the incident at Three Mile Island does show that everything is not always equal, see Staff Report, 1979).

VIII. A Comparison of Situational Contingencies in This and Other Mass Evacuation Situations

To anyone knowledgeable about the disaster research literature (e.g., Barton, 1970; Dynes, 1975) and specifically the evacuation (e.g., Perry, 1979; Quarantelli, 1980; and Perry, Lindell, and Greene, 1981) and chemical disaster literature (e.g., Albert and Segaloff, 1962; Yutzy, 1964; Tierney, 1980; and Gray, 1981) the incident provides no surprises. There was nothing reported or observed which previous studies have not noted as fairly typical. While the specifics did vary, as they do in any emergency or disaster, the general picture derivable from our data is a familiar one. A number of these similarities (between this incident and other emergencies) were alluded to (and referenced) earlier in this report. We will not repeat or expand on these points in the concluding section of this report, but briefly comment on another theme which can be drawn from the evacuation literature.

This is the idea that there are always situational contingencies affecting how well or how poorly a response, such as an evacuation, will be carried out in an emergency or disaster. Several years ago, DRC did a study for the Health Resources Administration on the delivery of emergency medical services in large-scale mass-casualty situations (see Quarantelli, 1983). The study projected that emergency medical services could be best delivered if the disaster happened on an early Sunday morning in an area close to, but not an actual part of, a large metropolitan area. We reasoned that in such a setting, families would be at home together. No one would be at school and few would be at work. Road traffic would be minimal, and few outside of emergency organizations would learn of the disaster. Proximity to a metropolitan area would maximize the probability that adequate medical resources could be mobilized. A specific empirical case where emergency medical services were well delivered, manifested all these features.

The chemical incident discussed in this report shared many of the same features of the case we just cited. Families were together. Children were not away at school. Few people were at work. Since there is a very strong tendency for family members to evacuate together as a unit (Drabek, 1969), this was a facilitating situational condition in the chemical incident. The occurrence at night on a weekend minimized traffic on the roads (in 1979 the average daily traffic count at Hahnville was nearly 6,000 vehicles) and served to reduce convergence, the in-towards-the-disaster-site flow of people, material, and information (Fritz and Mathewson, 1957). Convergence began to accelerate Saturday morning, but by then, the evacuation was completed. Still another facilitating situational contingency is that there was never any interruption of the public utilities services. There was no absence of electric power or failure of the telephone system. The school system personnel could easily be called to prepare the schools for public shelters. As a last example of facilitating situational contingencies, there was no need to evacuate large numbers of institutionalized populations. The one hospital, two nursing homes, and the two jails in St. Charles and St. John Parishes

did not need to be evacuated (although the one jail at Hahnville was not evacuated because of a deliberate decision that to do so would create too many operational problems).

These situational contingencies, all favorable to a "good" evacuation response, are mentioned so that whatever the evaluation of the response in the chemical incident, it should not be forgotten that just a relatively slight shift in the time of occurrence, for example, would have created a rather different context for evacuation. While the situational contingencies at Taft were not the most favorable that could be visualized, they definitely were on the favorable side. Thus, there should be some caution in extrapolating from the incident to other emergency situations involving evacuation.

Appendix: Quantity and Quality of Data Gathered

The limited resources (time and money) available to do the field work placed severe limits on the data gathering. It was possible to have only two DRC staff workers in the field for only a four-day period. However, within those limits, and using other DRC field operations as a criteria, the quantity and quality of the data we gathered in this study were well within an acceptable range for the purposes of this report. We were able to contact all important officials and/or organizations relevant to the study (with the exception of the chemical company, a problem discussed below). While candor and honesty of reporting by those interviewed is generally typical of almost all disaster research on emergency time behavior, the cooperation and openness of our respondents and informants was unusually high. While it would be naive to suppose that the DRC field team was told everything as those involved perceived it (even when not tape recorded, or when "off the record"), when we put all our interviews, documents, and observations together, little surfaced that suggested that important pieces of information had been deliberately withheld by anyone we contacted.

Previous DRC research in the disaster area (see Gray and Quarantelli, 1981) had uncovered that almost all chemical companies involved in emergencies and disasters are very reluctant to cooperate in social and behavioral science research on the incidents. Part of the reluctance stems from unfamiliarity with this kind of research; part is dictated by legal considerations, such as that chemical companies frequently are the objects of lawsuits in the aftermaths of such kinds of situations. In fact, a Hahnville couple filed a \$15.3 million class-action suit on December 20, 1982 on behalf of all evacuees in the incident. Four other suits totaling \$14 million had also been filed against the company. Thus, in the Taft incident, prior to entering into the field, we decided not to expend too much time and effort trying to get chemical company cooperation, but to use our limited resources for obtaining other kinds of data from other groups.

As it turned out, certain documentary data did partially provide at least the formal position of the chemical company on happenings in the situation. The documentary data we gathered in this study was somewhat quantitatively better than DRC has typically obtained in similar situations and localities, although that implies qualitative adequacy only in a relative rather than absolute sense. Different organizational logs and records, for example, sometime give widely differing time references for the same event. In fact, in some cases, two organizations in communication with one another will log different times on when the contact was made. There are many reasons for such inconsistencies and contradictions. Also some parts of records are reconstructed at varying periods of time after the event, so recorded times, actions, personages, etc., are often guesses or subject to substantial memory losses. Since recordkeeping is one of the activities which is given lower priority during emergencies, there are also understandable gaps in even contemporary records. Nonetheless, to keep the matter in perspective, we obtained quantitatively better and qualitatively equal data compared to what is typically obtained in these

kinds of studies.

We obtained acceptable data from almost all of the local organizations involved. Insofar as coverage of local groups is concerned, our major mistake in the field was to interview in only one of the local fire departments. In addition, it would have been helpful in developing the overall picture if we could have gotten more direct and detailed information from those emergency organizations which came to this event from outside of the local area, such as the state police. Also, while our general coverage of organizations was satisfactory, we only got indirect information about the individual population, especially the evacuees. Our knowledge of the reaction of the population is primarily filtered through the perceptions of officials and agency personnel. To obtain more direct data, we would have had to undertake a systematic survey of the population, and perhaps conduct a special sample survey of the evacuees, particularly those who went to the shelters (which, given our resources, were totally out of the realm of possibility). Finally, it would have been preferable if some of the field research had been conducted as soon as possible after the event. While we have no indications that the delay in undertaking the field work affected the quantity of data we obtained, there is reason to suspect from other disaster research that the quality would have been slightly better if we could have been on the scene sooner. There is a tendency for respondents in interviews to "remember" an earlier event in terms of their knowledge of what later happened, and the further away from the event, the greater the retrospective reconstruction.

Listed below are the organizations (and within them, the positions) from whom we obtained information in our study.

- St. Charles Parish Sheriff's Department
 - Sheriff
 - Assistant Chief Deputy
 - Deputy Sheriff
 - Deputy Sheriff
 - Deputy Sheriff

- St. Charles Parish Emergency Services
 - Director
 - Assistant Director
 - Coordinator

- St. Charles Parish Government
 - Parish President
 - Councilmen
 - Community Services Director

- St. Charles Parish Schools
 - Director of Transportation
 - School Services Officer

- Norco Fire Department
 - Fire Chief

Red Cross
Disaster Services Director
Parish Representative St. Charles Parish
Parish Representative St. John Parish

Salvation Army
Public Information Secretary (New Orleans)
Public Relations Officer

Louisiana Power and Light
Engineer
Consultant

New Orleans Times-Picayune
River Parishes Bureau Chief
River Parishes Reporter
Reporter

St. John Parish Emergency Services
Director

U.S. Coast Guard
Lieutenant (New Orleans)

State Troop B
Hazardous Materials Officer (New Orleans)

Army Corps of Engineers
Officer (New Orleans)

Louisiana Baptist Convention
Disaster Services Minister

Whelan Engineering Company
Representatives

Union Carbide
Secretary

Louisiana Department of Natural Resources
Air Quality Control Specialist

Listed below are the major documents we obtained.

DOCUMENTS

1. St. Charles Parish Sheriff's Department Log
2. Office of State Police Hazardous Materials Incident Report
3. St. Charles Parish Schools Emergency Plans
4. St. Charles Parish Emergency Plan Enclosure
5. Emergency Plan Implementing Procedures (Waterford Steam Electric Station Unit No. 3)
6. St. Charles Parish Civil Defense On-Site Assistance Study
7. St. Charles Parish Emergency Preparedness/Industrial Hotline System Operating Procedure Manual
8. Louisiana Power and Light Off-Site Emergency Preparedness-Training Resource Book
9. St. Charles Parish EOC Log
10. St. Charles Parish EOC Floor Plan
11. New Orleans American Red Cross Statistical and Cost Report of Disaster Operations, Taft, Louisiana
12. New Orleans American Red Cross Disaster Shelter Plan
13. Louisiana Power and Light Evacuation Time Estimates Waterford Steam Electric Station Unit No. 3
14. Organization Chart of St. Charles Parish Government
15. St. Charles Parish Home Rule Charter
16. Tape Recording of After Action Critique of Organizational Responses
17. St. Charles Parish Validated 1980 Census Data for Redistricting
18. State Police Map of Taft Area Industrial and Nuclear Plants
19. Photo Atlas by St. Charles Parish Department of Planning and Zoning of Union Carbide Industrial Plant Site
20. New Orleans American Red Cross Disaster Shelters (area parishes)
21. Whelan Engineering High Power Siren and Communication System Brochure
22. St. Charles Parish. A Brief Look at the Past
23. River Region Telephone Book (South Central Bell)
24. Dawson Engineers St. Charles Parish Planning Report 1980-2000
25. Various U.S. Weather Service pamphlets
26. Other Red Cross pamphlets
27. Various maps of area
28. New Orleans Time-Picayune Newspaper (issues with articles on incident)
29. Other newspaper accounts
30. Various photos of activities and facilities in area
31. Various notes on untaped interviews, phone conversations, and in the field observations

On the next page, there is a copy of the interview guide used in the field. It should be stressed that this was a general guide for the DRC interviewers on the information which we sought; these are not necessarily the specific questions asked or the interview probes made.

INTERVIEW GUIDE

(Taft, Louisiana Threat Incident)

We are interested in getting a detailed picture of what happened in connection with the chemical tank explosion incident on December 11.

Let's focus on your organization (the X).

We would like to get a step-by-step account of what your group did.

To start off:

1. a. Tell me how your organization first got involved in the situation?
(Get initial perceptions, definitions, actions)
(Distinguish between informant/respondent data)
(Separate out own organization and other organizations)
- b. What happened next?
(Trace from first hearing of something was going on to later actions)
(Get clear decision points)
(Obtain picture as informant/respondent saw at the time)
- c. What was the last involvement of your organization in the situation?
(Trace to cessation of organizational action)
(Obtain definition of normal)
2. a. Let's look at the evacuation a little more closely and in detail--
When did the question of evacuation first come up in your organization?
(Get who, when, and why)
- b. What sort of problems arose in the evacuation?
(People, organizations, other things)
- c. Was your organization involved in sheltering the evacuees?
If so, what did you do?
Were there any problems in the shelters?
(People, organizations, other things)
- d. When was the evacuation over?
(How long had they expected it to last?)
(Get perceptions, definitions, actions)
(Who, when, and why involved in return of evacuees)
3. Why did your organization do what it did in the situation?
(Separate out threat, warning, evacuation and return stages)
(Find out to what extent decisions and actions followed:
prior planning and/or experiences, and/or was ad hoced)

4. a. How would you evaluate how well or how poorly your organization acted in the situation?
(Keep in mind different stages)
 - b. How about other organizations?
(Especially those with which the organization had the most interaction)
 - c. How well or how poorly do you think the public (especially those evacuated) felt the situation was handled?
(Separate evacuation and sheltering)
5. If your organization had to do it all over again, would you do anything different than you did this time?
(Any lessons learned)

Leaving this particular situation aside:

6. What kind of disaster planning does your organization have?
(Formal and/or informal)
(Intra- and inter-organizational)
7. What disaster-relevant resources does your organization have?
(People, equipment, facilities)

THANK FOR HELP

INDICATE MIGHT PHONE LATER TO FILL IN GAPS

ASK IF THEY WOULD RECOMMEND ANYONE IN PARTICULAR WE SHOULD TALK TO

- OBTAIN:
- 1) logs and/or radio tapes, if any
 - 2) after-action report or critique
 - 3) disaster plan
 - 4) organizational table of organization
 - 5) any write ups of prior disasters

Contact: local disaster agency (or Civil Defense office)
 Sheriff's Department
 other local police agencies
 Red Cross chapter
 chemical plant (also mutual aid system, if any)
 local fire departments
 involved local governmental executives (e.g., county judge), if any
 local school officials
 participating extra-community organizations (e.g., state police, Coast Guard, etc.)

Within organizations: head
operational decision makers
line (staff) personnel
communication personnel (radio, switchboard)
liaison personnel

Get: interviews
statistics (e.g., crime/arrest records—week before and after
incident, year before)
documents
photographs (if so, get written permission to use)

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