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OIL & HAZARDOUS MATERIALS PROGRAM SERIES

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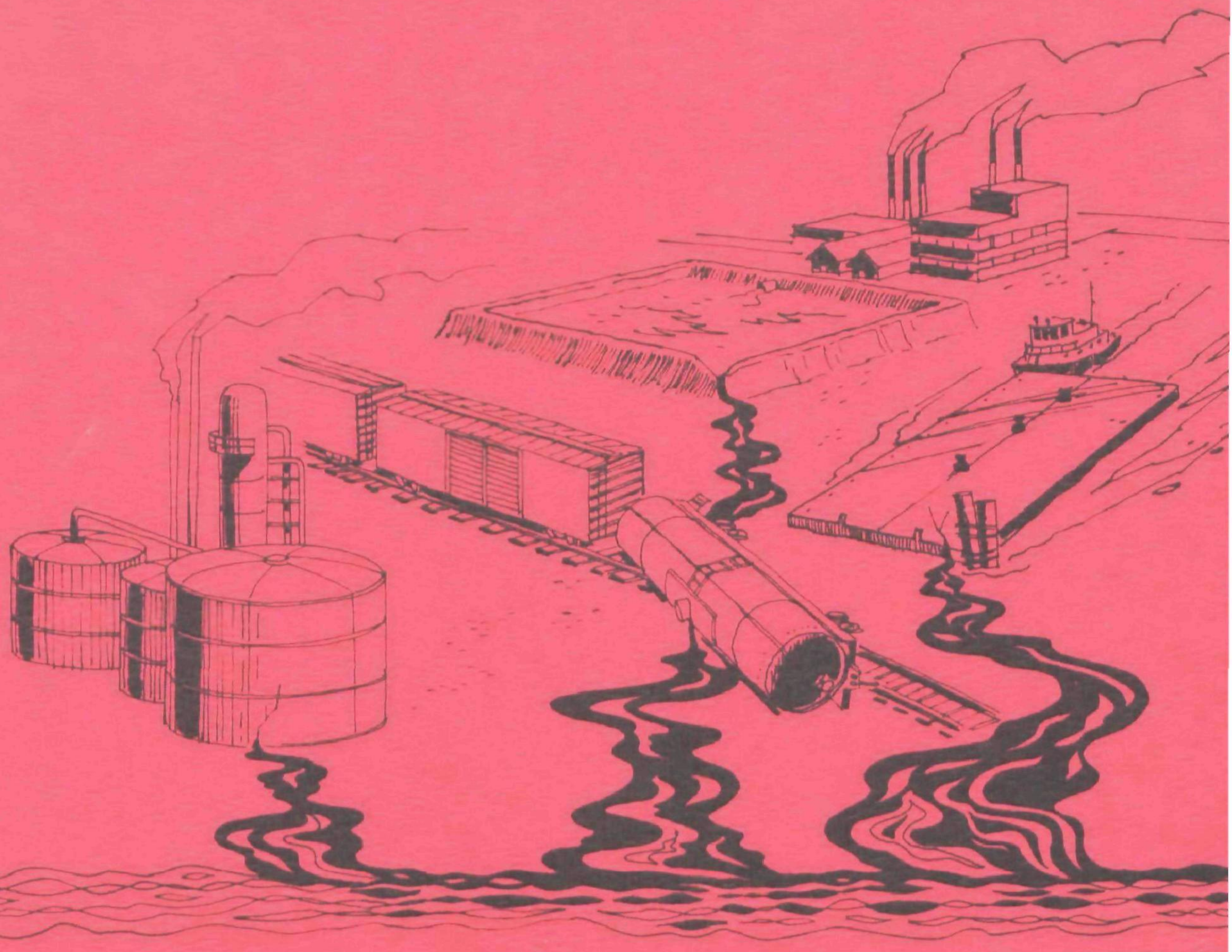
Spill Prevention Techniques for Hazardous Polluting Substances



ENVIRONMENTAL PROTECTION AGENCY • WATER QUALITY OFFICE

SPILL PREVENTION TECHNIQUES
FOR HAZARDOUS POLLUTING SUBSTANCES

An Inventory and Survey of Hazardous Chemical Facilities in Charleston, West Virginia; Baltimore, Maryland; Texas City, Texas; and the Suisun Bay-Delta Area, California

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for

ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
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Arlington, Virginia

FOREWORD

The need for this study of spill prevention techniques for hazardous polluting substances was established by the recently enacted Water Quality Improvement Act of 1970. The Division of Oil and Hazardous Materials, Water Quality Office, Environmental Protection Agency determined that a data base of materials and techniques which are used to prevent discharges of hazardous polluting substances was needed. It was determined that an appropriate means of gathering these data would be to survey selected sites. Four geographically different areas were selected as a random sample to survey various industrial facilities and procedures designed to prevent spills of hazardous polluting substances.

This prevention-oriented study was designed to complement the state-of-the-art study entitled, Control of Spillage of Hazardous Polluting Substances and published by the Water Quality Office. Also, this study was designed to explore in greater detail and complement publications by the U.S. Coast Guard entitled, Control of Hazardous Polluting Substances and the Abstract of Proceedings of the Hazardous Polluting Substance Symposium. The relationship of this prevention-oriented study to these previously published efforts has resulted in the documentation of existing procedures in considerable detail, and in recommendations for the prevention of spillage of hazardous polluting substances.

It is reasonable to expect that subsequent studies will be made with reports prepared to illustrate new prevention and control concepts, modified monitoring and detecting techniques, new countermeasure or removal techniques and procedures, and the development of detailed chemical, physical, and biological testing procedures. These studies will be designed to bridge gaps in the availability of information and technology dealing with the handling of discharges of hazardous polluting substances. This prevention concept survey will constitute a basis for identification of areas of need in which the Federal Government and/or other capable bodies may respond in a coordinated manner to develop only those techniques and information required to minimize the dangers presented to the environment by such discharges.

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I. SUMMARY

A. PURPOSE AND SCOPE OF STUDY

The Office of Oil and Hazardous Materials, Federal Water Quality Administration, retained Arthur D. Little, Inc., to develop an inventory* of major transport, transfer, and storage facilities for hazardous polluting substances** at four geographical locations in the United States.

1. Texas City, Texas,
2. Baltimore, Maryland,
3. Charleston, West Virginia, and
4. Various locations on the shorelines of San Pablo Bay and Suisun Bay, California;

From these inventories strategic facilities at each geographical location were selected to be surveyed. The plants were chosen with the assistance of the various regional offices of the Federal Water Quality Administration, and with the assistance of the various state agencies responsible for the water quality of state-owned and/or- controlled waters. In choosing survey sites, care was given to selecting plants that exposed as full a range of chemicals as possible, and to gaining access to a representative cross section of the chemical industry.

The study was designed to investigate the "prevention" of hazardous material spills, and to determine methods that would prevent such spills from entering a public water course, thus rendering such bodies of water temporarily or permanently useless, or degrading the natural environment of the area.

B. FINDINGS

It was found that the standards of the American Petroleum Institute were closely followed when oil, liquefied natural gas, liquefied petroleum gas, and petroleum were stored or processed. On this basis, standards for the storage of petroleum products have been established and adopted at most plant locations. Storage tanks, retention dikes, and spill-control procedures showed little variation at any of the geographical locations. The same cannot be said for the transportation, transfer, storage, and processing of hazardous polluting substances. Although some of the larger companies have established in-house standards, and a few municipal and state regulations to control fire hazards are in effect, there are no

*The inventory of major transport, transfer, and storage facilities for hazardous polluting substances is presented in Appendix A.

**The FWQA definition of hazardous polluting substances is given in Appendix B.

uniform industry-wide standards in the United States for storage tank construction, secondary means of spill containment, or pipeline and hose positioning and testing. Design and protective measures vary considerably at each plant location.

With few exceptions, the plants visited appeared to be making a concerted effort to prevent spills, for reasons of pollution control, to prevent loss of product, and to maintain good public/customer relations. Considerable sums of money have been spent for waste-water treatment for continuous-flow discharges in an effort to meet the water quality standards established by the various state agencies, and there is a continuing effort to improve many of these waste-water treatment procedures. The present trend appears to be toward the development of recycling effluent systems in which no waste-water discharges leave plant property and enter a public waterway.

Present production and process methods throughout the United States create a great demand for copious quantities of water. One of the plants visited had a 13,000,000 gallon-per-day (gpd) waste-water discharge rate. The cost of producing, handling, and treating this water represents a heavy financial burden to this firm. Consequently, almost any process or production modification that would reduce the water demand and handling and treating costs would be well received. Obviously spills of major proportions would result in an increase in the waste treatment load and could not be contained for any length of time by many of the plant properties. Another problem in handling and treating waste water is created by the extensive land acreage needed to accommodate the various treatment impoundments. Many of the plant photographs included in this report show that the waste-water acreage frequently exceeds the acreage needed for production purposes. At some locations private organizations are providing a service for handling waste oil and spent chemicals. These concerns collect the waste material, remove the solids, and later discharge the treated water into any convenient water course or into deep injection wells. One concern sprays the waste material onto the earth in a remotely located dump site, and then tills the material into the ground using mechanized construction equipment. The results of this disposal method can be best assessed following a series of rainy seasons normal to the State of California.

At other locations "satellite" chemical companies have established themselves adjacent to large chemical processing plants. Their spent chemical wastes are pumped into the recovery plant where the chemicals are extracted and the waste water discharged into an open water course. At least one plant has established a system of deep ocean disposal in which the spent chemicals are barged out to a deep-water, offshore disposal site. Such methods of disposal warrant careful monitoring, however, because off the coast of New York, for example, large schools of bluefish are attracted to the fringe of a spent acid dump.

Most of the plant management were cooperative with our investigators, and we agreed to hold certain data on consumption and storage as "company confidential."

C. SUMMARY RECOMMENDATIONS

As a result of the various plant surveys and the investigators' general knowledge of chemical spill prevention, a series of recommendations have been developed which, if adopted, should aid in the prevention of spills and in effectively reducing chemical spill damage. These recommendations are covered in detail in Chapter III and span the various phases of chemical handling from receiving to final shipment.

II. INTRODUCTION

A. BACKGROUND

The fire and explosion hazards connected with the handling of petroleum products have resulted in rigid regulations for the effective containment of such materials. Although an accidental spill of an oil-based material can be easily detected on the surface of a waterbody, the same is not true for most chemical products, which are either water-soluble, or being heavier than water, sink and settle on the bottom of the water course. In many cases a chemical spill can be more devastating to the natural ecology than an oil spill, resulting in extensive fish kills (see introduction to appendixes).

Methods for treating, containing, or diluting chemical spills are not so advanced as those currently in service, or under development, for the control of oil spills. As a result the prevention of spills is of paramount importance. Normally, the predominant causes of spills can be determined by an analysis of conditions relating to previous spills; they can easily be classified by predominance and frequency, and the action needed to prevent repetition of spills can be accurately determined. Unfortunately, records and data on past chemical spills are not readily available at any of the usual sources – U.S. Coast Guard, Federal Water Quality Administration, U.S. Army Corps of Engineers, or the Water Quality Control agencies of the various states. Most of the available information on past spills record oil spills and slicks predominantly since, as previously stated, they are more readily detected than the chemical spills.

It is known that many spills of hazardous polluting substances occur at marine loading/unloading facilities due to defective flange connections, flexible hose draining, and complete hose failure. Spills also occur at tank truck and tank car loading/unloading facilities. Buried tanks and buried pipelines, being prone to metal deterioration from corrosion and electrolytic actions, have further contributed to chemical spills following metal failure. Production processes have "frothed" or "boiled" over to permit the uncontrolled escape of chemicals during manufacture. The leaching action of rainwater on open stockpiles of materials, stored at water-edge locations, has greatly added to water contamination. The chemical discoloration of the waterbodies is very apparent around such storage areas in wet weather during aerial and marine surveys. Bulk storage tanks have been overfilled, water draw valves have been inadvertently left open, seams have leaked, shell pinholes have developed, and in some spill cases, the contents of an entire tank have been spilled upon tank rupture. At least one tank is known to have suffered complete collapse.

One of the primary objectives of the study of spill prevention techniques for hazardous polluting substances was to observe industrial action being taken to prevent and contain spills resulting from both mechanical and human failures. We hope that the remedial action and precautions undertaken by some of the larger chemical handling companies and their efforts to establish suitable spill control standards and handling procedures will serve to alert industry nationwide to the problems caused by the spilling of hazardous polluting substances.

B. MODE OF SURVEY

To initiate the various surveys, taken as part of this study, our study team contacted plant managers directly – either by telephone or a preliminary visit – to arrange a suitable date and time for the conduct of the survey. For national organizations having one or more plants operating under a remotely located headquarters it was frequently necessary to gain permission from the headquarters to conduct the survey. Such permissions were generally gained through the local plant management. During the meeting, the plant representatives were given a letter of introduction from the Regional Office of the Federal Water Quality Administration, which provided a concise description of the purpose and objectives of the survey. Questions directed to the various investigators by plant management served to elaborate on the contents of the letter.

During these meetings pertinent data were obtained on the following factors

(1) Chemicals used in products –

  (a) mode of receiving and shipping,

  (b) methods of transfer,

  (c) bulk storage facilities – number of tanks and their capacities, number of dikes, dike drainage, piping, valving and pumps, and so forth,

  (d) basic production process; curbing and/or trenching for spill containment;

(2) Plant drainage, normal runoff, plant effluent, waste-water treatment, final discharge and geography of discharge;

(3) Past spill experience and methods introduced to remedy spill cause;

(4) Details on spill containment and cleanup plans in the event of a spill.

Once out in the plant the following locations were visited to determine physical conditions in each area:

(1) Marine loading/unloading area,
(2) Pipelines from dock to storage area,
(3) Bulk storage facilities (tank farm),
(4) Tank car unloading rack,
(5) Tank truck unloading rack,
(6) Production area,
(7) Effluent treatment impoundments and final discharge,
(8) Central control station (if any), and
(9) Site of any past spills (if any) of sizeable proportion.

Security measures at each location were carefully noted.

In Texas most surveys were made jointly with a representative of the Texas Water Quality Control Board Regional Office in LaPorte, Texas.

For the convenience of the reader, a glossary of terms and abbreviations has been prepared to define uncommon words and abbreviations.

Glossary of Terms and Abbreviations

Terms

Boiler Blowdown Water	Water drained from the lowermost section of a boiler for the removal of precipitated/accumulated solids (such water is generally contaminated by chemicals used to control scale buildup within the water and steam section of a boiler)
Boom	a floating structure that can be positioned to enclose and contain a floating spill of oil or hazardous material
Crossed-Spring Lines	a line leading from the forward part of a marine vessel aft to the pier, and a line leading from the aft part of a vessel forward to the pier; such lines prevent surge by restraining the vessel from moving ahead or astern while moored alongside a pier
Fail-Safe	a mechanical and/or electrical device designed to counteract automatically the effect of an anticipated source of failure

Gager	an individual assigned to the task of monitoring the liquid level in a bulk storage tank
"Panic Pond"	a large emergency pit or pond to which effluent discharges can be diverted in the event of a spill
Parapet	a raised curbing around a production area installed to confine spill resulting from product "froth" or "boil-over"
Pickling Liquid	sulfuric acid, caustic, and in some cases, muriatic acid contained in large vats or tanks used to remove mill scale from steel plates, pipes, etc., prior to painting same
Standoffs	mechanical legs or arms attached to a floating boom that will hold the boom off a ship, barge, or dock against the action of the tide, wind, or current
Treated Water	plant process water that has been treated for the removal of the bulk of chemical containments.

Abbreviations

API	American Petroleum Institute
BOD	biological oxygen demand
DOT	Department of Transportation
gpd	gallons per day
ICC	Interstate Commerce Commission
MCA	Manufacturing Chemists Association
mgd	millions of gallons per day
MWP	maximum working pressure

III. RECOMMENDATIONS FOR THE PREVENTION AND CONTROL OF SPILLS OF HAZARDOUS POLLUTING SUBSTANCES

A. BASIS FOR RECOMMENDATIONS

In this chapter we present a series of recommendations which we believe could be adopted to decrease the danger of spills of hazardous polluting substances with the resultant contamination of adjacent waterways. The recommendations are, in large measure, prompted by our plant survey visits, our observations of the facilities, and discussions with operating personnel. We have written these recommendations in light of our knowledge of operating problems in the industries represented and have taken account of histories of past problems with which we are familiar. Our intent is to present a working document which indicates that some types of control are possible to prevent and contain effectively spills of damaging proportions.

It is probable, however, that there are many specific spill problems which were not observed during our surveys and are therefore not covered by specific recommendations. It is also probable that there are alternative solutions to the problems posed. We do not consider our recommendations as mandatory; they are offered only as a guide toward spill prevention.

One topic not adequately investigated is the problem associated with the diversity of types of materials handled. Physical properties and the type of hazard have to be considered on a basis which takes this diversity into account. A good approach for one material may be inadequate for another.

One major factor that can measureably aid in reducing human failure as a prime cause of spills would be fuller use of fail-safe devices which we found to be quite adequate in some plants and entirely lacking in others.

B. SPILL PREVENTION RECOMMENDATIONS FOR HAZARDOUS POLLUTING SUBSTANCES

1. Spill Control

Recommendations for the spill control of hazardous polluting substances are listed below:

a. Whenever acids are maintained in bulk storage, an adequate supply of neutralizing material, such as caustic, lime, or shell, should be available on the plant property. The neutralizing agent should be stored as closely as practical to the acid storage area and in sufficient quantity to neutralize the contents of the largest capacity of acid contained in any one storage tank.

b. A supply of personal protective safety equipment, such as rubberized coveralls, rubber boots, safety goggles, gas masks, and rubber gloves should be maintained for immediate use in a centralized spill control location.

c. When lighter-than-water chemicals are handled and stored within the plant, an adequate length of flotation spill-containment boom should be available on the property, along with a suitable vessel, to position the boom strategically and thus confine the spilled material.

d. Each handler, transporter, or storer of hazardous materials should ascertain the chemical dispersants that have been approved by the state authorities, and an adequate supply of approved chemicals should be stored at the plant for the treatment of chemical spills.

2. Plant Drainage

The following recommendations relative to plant drainage are also made:

a. Drainage from diked, hazardous-material storage areas should be valve-restrained to prevent a spill or other excessive leakage of a product into the drainage discharge or in-plant effluent treatment system.

b. Valves used for the drainage of diked areas should, as far as practical, be of manual, open-and-close design. The condition of the retained storm water should be determined before drainage, especially if such drainage of impounded waters goes into water courses and not into waste-water treating plants.

c. All plant drainage systems, if possible, should flow into ponds, lagoons, or catchment basins designed to retain materials less dense than water. Consideration should also be given to a possible chemical reaction, if spilled chemicals are commingled.

d. If plant drainage is not engineered as above, the final discharge of all in-plant drainage ditches should be equipped with a diversion system that could, in the event of an uncontrolled spill, be returned to the plant for treatment, the objective being to work toward a closed-cycle system.

e. Where drainage waters are chemically treated in more than one treatment unit, natural hydraulic flow should be used. If pump transfer is needed, two "lift" pumps should be provided, and at least one of the pumps should be permanently installed.

3. Marine Unloading-Loading

Relative to marine unloading/loading facilities, the following recommendations are made:

a. On at least an annual basis, all flexible hoselines should be subjected to hydrostatic testing. Inferior or discarded hoses should be removed from the dock area. Consideration should also be given to using hose lines with an outer strain relief braid or using metal-constructed, articulated-joint transfer lines.

b. When conditions permit, all ships and barges loading or unloading materials lighter than water should be effectively boomed in the area of material transfer. When tide and current conditions warrant such protection, "stand-offs" should be used to gain the fullest containment efficiency of the floating boom.

c. Transfer pumps and flange connections should not be positioned directly above the water. When practical, such facilities should be positioned on shore and be confined within a suitable containment curb that will effectively contain material drips and spills.

d. All dock-mounted pumps and pipeline connections should have catch trays positioned under the potential leak area, and such trays should be emptied and cleaned following each material transfer.

e. Pressure-drop alarm and shut-off systems on the lines leading from the ship or barge should be provided so that losses from a line break will be held to a minimum.*

f. Adequate mooring lines forward and aft and crossed-spring lines should be secured to all ships to ensure a minimum of movement during loading-unloading operations.

g. As far as practical, wooden decked docks with gaps between decking should be avoided as chemical spills can drip between the decking. Preferably, full concrete or seawall-type marine loading-unloading facilities should be used. Such dock areas should be equipped with perimeter containment curbs complete with valve-type drains that can be opened to discharge rainwater and be kept closed to contain spills.

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*McDermott, G.N., "Industrial Spill Control and Pollution Incident Prevention" (Procter & Gamble Company), 41st Annual Conference of the Water Pollution Control Federation, September 1968.

h. Access to and from ships or barges should be such that the crews of the ships and/or barges have no occasion to pass in or around the loading/unloading control area; fenced areas should guide persons safely away from the loading-unloading facility.

i. All terminal flange connections on marine dock facilities should be blanked or capped when not in service.

j. All pump controls on marine docks should be secured in the closed position or electrically isolated when not in service.

k. The practice of loading or unloading a barge or ship when such a barge or ship is tied outboard of another ship should be avoided. The fueling or bunkering of a ship with the fueling barge tied outboard of the other should be avoided. When practical, the fueling ship and the fueling barge should be secured directly to the dock facility, using the marine terminal onshore line connections to transfer fuel or hazardous polluting substances.

l. A direct line of communication, separate from other in-plant or outside telephone lines, should be provided between the marine loading/unloading facility and the immediate tank farm area.

m. "Slop" tanks should be provided at all marine loading/unloading facilities to safely contain the products of flexible hose line draining and, when practical, to contain polluted bilge water discharged from visiting ships and barges. Such tanks should be installed in a fire- and explosion-proof manner with adequate systems to prevent mixing of dangerously incompatible materials.

n. For the prevention of spills during flexible hoseline connection and disconnection, butterfly valves should be installed immediately adjacent to the terminal flange connection. The valves will permit manual opening and closing of the hoseline to retain products that cannot be drained from the line after product transfer.

4. Tank Car and Tank Truck Loading/Unloading

The following recommendations are made relative to tank car and tank truck loading/unloading procedures:

a. A system of containment curbs should be used for tank truck unloading areas, using ramps to provide truck access into the confines of the containment curb.* The curb enclosure should be designed to hold at least the maximum capacity of any single tank truck loaded or unloaded in the plant.

b. A trenching system should encompass each railroad tank car unloading area. The trench should be designed to carry away any spill to a catchment basin or holding pond, at least equal in capacity to the capacity of the largest tank car loaded or unloaded in the plant.

c. As a fail-safe precaution, an interlocked warning light or physical barrier system, or warning signs, should be provided in loading/unloading areas to prevent vehicular departure before complete disconnect of flexible or fixed transfer lines.

d. Prior to filling and departure of any tank car or tank truck, the lowermost drain and all outlets of such vehicles should be closely examined for leakage, and if necessary, tightened, adjusted, or replaced to prevent liquid leakage while in transit.

5. Bulk Storage Tanks

Relative to bulk storage tanks, the following recommendations are made:

a. No tank should be used for the storage of hazardous polluting substances, unless its material and construction are compatible with the material stored.

b. All hazardous material bulk storage tank installations should be planned so that a secondary means of containment is provided for the entire contents of the largest single tank. Dikes, containment curbs, and pits are commonly employed for this purpose, but they may not always be appropriate. An alternative system would consist of a complete drainage trench enclosure arranged so that the flow could terminate and be safely confined in an in-plant catchment basin or holding pond. Drainage into a storm drain or an effluent discharge that empties into an open water course, lake, or pond is acceptable, only after thorough analysis of the material ensures compliance with applicable water quality standards.

c. Buried hazardous material storage tanks represent a potential for undetected spills. A buried installation, when required, should be wrapped and coated to retard corrosive action. In addition, the earth should be

*McDermott, G. N., *op. cit.*

subjected to electrolytic testing to determine if the tank should be further shielded by a cathodic protection system. Such buried tanks should at least be subjected to regular hydrostatic testing. In lieu of the above, arrangements should be made to expose the outer shell of the tank for external examination at least every five years. A means of conducting regular internal examinations of the tank at five-year intervals should be provided (down-hole television, etc.).

d. Partially buried tanks for the storage of hazardous materials should be avoided, unless the buried section of the shell is adequately coated, since partial burial in damp earth can cause rapid corrosion of metallic surfaces, especially at the earth/air interface.

e. Above-ground tanks, depending on design (floating roof, etc.), should be subjected to integrity testing, either by hydrostatic testing, visual inspection, or by a system of nondestructive shell thickness testing. When the latter system of integrity testing is used, comparison records of shell thickness reduction should be maintained.

f. The foundation and/or supports of all bulk storage tanks should be subjected to at least annual examination by a person with the technical competence to assess the condition of the foundation and/or supports.

g. To control hazardous material leakage through defective integral heating coils, the following factors should be considered and applied:

   (1) The past life span of internal steam coils should be determined, and a regular system of maintenance and replacement that does not exceed the anticipated life span should be established.

   (2) To reduce failure from corrosive action, prolong life, and reduce replacement costs, the temperature and environment have to be carefully considered when selecting heating coil materials.

   (3) The steam return or exhaust lines from integral heating coils which discharge into an open-water course should be monitored for contamination, or passed through a settling tank, or skimmer, etc.

   (4) The feasibility of installing an external heating system should also be considered.

h. Each hazardous material bulk storage tank should be externally examined at least once a month. Each inspection should include an examination of seams, rivets, nozzle connections, valves, and pipelines directly connected to the tank.

i. New and old tank installations should, as far as practical, be fail-safe engineered or updated into a fail-safe engineered installation. Consideration should be given to providing the following devices:

(1) High liquid-level bell or horn alarms with an audio signal at a constantly manned operating or listening station; in smaller plants an audible air vent may suffice;

(2) Low liquid-level alarms with an audio signal at a constantly manned operating or listening station; such alarms should have a nonbypassing reset device that can be readjusted to a given operating level following tank fill or liquid removal;

(3) High liquid-level pump cutoff devices set to stop flow at a predetermined tank-content level;

(4) Direct audible or code signal communication between the tank gager and the pumping station;

(5) At least one fast response system for determining the liquid level of each bulk storage tank such as digital computers, telepulse, or direct vision gages.

j. "Normal" plant effluent should be constantly monitored by a proven monitoring system, and any deviation from normal should be engineered to activate a visible readout recorder with an audible alarm that can be heard at a constantly manned operating or listening station. If practical, the monitoring device should be designed to operate a bypass to release the effluent discharge into a "panic" or holding pond;

k. Visible product leaks from tank seams and rivets should be promptly corrected.

l. Tanks should not be used with the knowledge that the "head" or "top" is in a corroded-through condition. Action should be taken to drain such tanks and repair the defective member as promptly as possible.

m. When practical, each bulk storage tank should be lettered (code or otherwise) or color-coded to indicate its chemical content, the MCA or DOT coding being preferred, and the coding should duplicate those used for chemical transportation identification.

n. The surveys revealed a number of cases (3) in which chemicals were spilled due to failure of wooden stave-constructed tanks. Under the circumstances, the use of wooden tanks should be confined to water storage and should be avoided for liquid chemical storage.

6. Pump and In-Plant Process and Transfer Pipelines

Recommendations for pump and in-plant process and transfer pipelines are as follows:

a. Each product pipeline should be clearly marked by lettering (coded or otherwise), color banding, or complete color coding to indicate the product transferred therein. The coding should conform with company policy or standard plant practice which, in turn, should conform with state or federal requirements.

b. Each hazardous material product-fill line which enters a tank below the liquid level should have a one-way flow check valve located as closely as possible to the bulk storage tank. In addition to confining the product to the tank, in the event of valve or pipeline failure, the check valve should permit overhaul of the main shut-off valve and should aid in preventing shock loading of the pipeline and valves from a "slug" of the tank content caused by backflow into an empty fill line. As far as practical, the product flow in suction lines should be controlled by use of a positive displacement pump.

c. Buried pipelines should be avoided. However, buried installations should have a protective wrapping and coating and should be cathodically protected if soil conditions warrant. A section of the line should be exposed and inspected annually. This action should be recycled until the entire line has been exposed and examined on a regularly established frequency. An alternative would be the more frequent use of exposable pipe corridors or galleries.

d. When a pipeline is not in service, the terminal connection at the transfer point should be capped or blank-flanged.

e. Wood to metal should be avoided as a pipeline support since it is apt to retain moisture and cause pipeline corrosion which, when coupled with the abrasive action caused by the pulsating action of the line, could cause line failure with resulting leakage. Supports should be designed with only a minimum point of surface contact that allow for the pulsating movement (expansion and contraction) of the line (i.e., rollers).

f. All above-ground valves and pipelines should be subjected to a regular monthly inspection at which time the general condition of items, such as flange joints, valve glands and bodies, catch trays, pipeline supports, locking of valves, and metal surfaces, should be assessed.

g. Elevated pipelines should be subjected to constant review to ensure that the vehicular traffic granted plant entry does not exceed the lowermost height of the elevated line; gate check-in and in-plant travel routes warrant attention in this respect.

h. As far as practical, all hazardous material pumps should be located as close as possible to the storage tank.

i. Flapper-type drain valves should not be used to drain diked areas. Such drain valves should be of manual open and close design, and they should be kept in the closed position when not in service. The drain lines from diked areas should drain directly or indirectly into treatment or holding tanks or ponds or catchment basins.

7. Security

Relative to security, the following recommendations are made:

a. All plants handling, processing, and storing hazardous materials should be fully fenced, and entrance gates should be locked and/or guarded when the plant is not in production or is unattended.

b. The master flow and drain valves and any other valves that will permit direct outward flow of the tank's content should be securely locked in the closed position when not in use.

c. The starter control on all hazardous material pumps should be secured or electrically isolated in the "off" position when the pumps are in a nonoperating status.

d. The terminal loading/unloading connections of all hazardous material product pipelines should be securely capped or blank-flanged when not in service.

Note: This security practice should also apply to pipelines that are emptied of liquid content either by draining or by inert gas pressure.

IV. SURVEY SITE OBSERVATIONS

A. TEXAS CITY, TEXAS

Texas City is located on Galveston Bay, 15 miles north of Galveston Island and 35 miles southeast of Houston, Texas. It has experienced a constant growth in population, having increased from 5,749 recorded in the official census of 1940 to an estimated population high of 42,400 in 1969. The city is heavily industrialized in the production of petroleum and chemical products.

1. Transportation

In addition to having a deep water port (36 feet) channel, the city is served by the Texas City Terminal Railway Company, which has daily connections with the Gulf, Colorado & Santa Fe Railway Company, the Missouri-Kansas-Texas Railway Company of Pacific Railroad, and the Fort Worth & Denver Railroad. Central Freight lines, a motor freight carrier, has trucks and warehousing which also services Texas City.

2. Drainage

Charles R. Haile Associates, Inc., Consulting Engineers, Texas City, reported in 1968 that water drainage in a 2100-acre industrial area was generally poor. These findings were later substantiated by Arthur D. Little, Inc., observations during the period August 20, 1970 through September 3, 1970 and especially during a moderate two-day rainfall of September 2-3, 1970.

The low coastal area has been prone to flooding during heavy rains, high tides, and especially during storms of offshore origin. On July 27, 1943, the city was exposed to a hurricane that resulted in gust wind forces of 104 mph and a rainfall of 17.3 inches in 39 hours. The U.S. Army Corps of Engineers is in the process of completing a 5-mile long levee/dike to protect the land area from inundation. The city's greatest disaster occurred on April 16-17, 1947, when a merchant ship's cargo of ammonium nitrate fertilizer caught fire and eventually exploded, causing a second ship to explode, and complete devastation of the commercial waterfront. The explosions killed 576 persons and effected property damage in excess of $67 million. Some 4000 persons were also injured. The industrial area suffered extensive damage from in-plant fires and explosions. The extent of damage diminished with distance from the waterfront, but witnesses reported "shrapnel" damage to oil and chemical bulk storage tanks as far as two miles from "ground zero."

The water quality control problem in Texas City results from the fact that, even though all plants in the area are making a serious effort to meet the state water quality standards, the continuous effluent discharges and most spills terminate in the same water body. The situation is such that once in the public water course the chemical discharges are cumulative. Tidal flushing is comparatively minimal and could not carry the pollutants effectively out into the Gulf.

A hurricane situation with resulting heavy rains and flooding could also overflow the waste water treatment ponds to create a "massive" spill.

Figure 1 depicts the area of the Texas City survey.

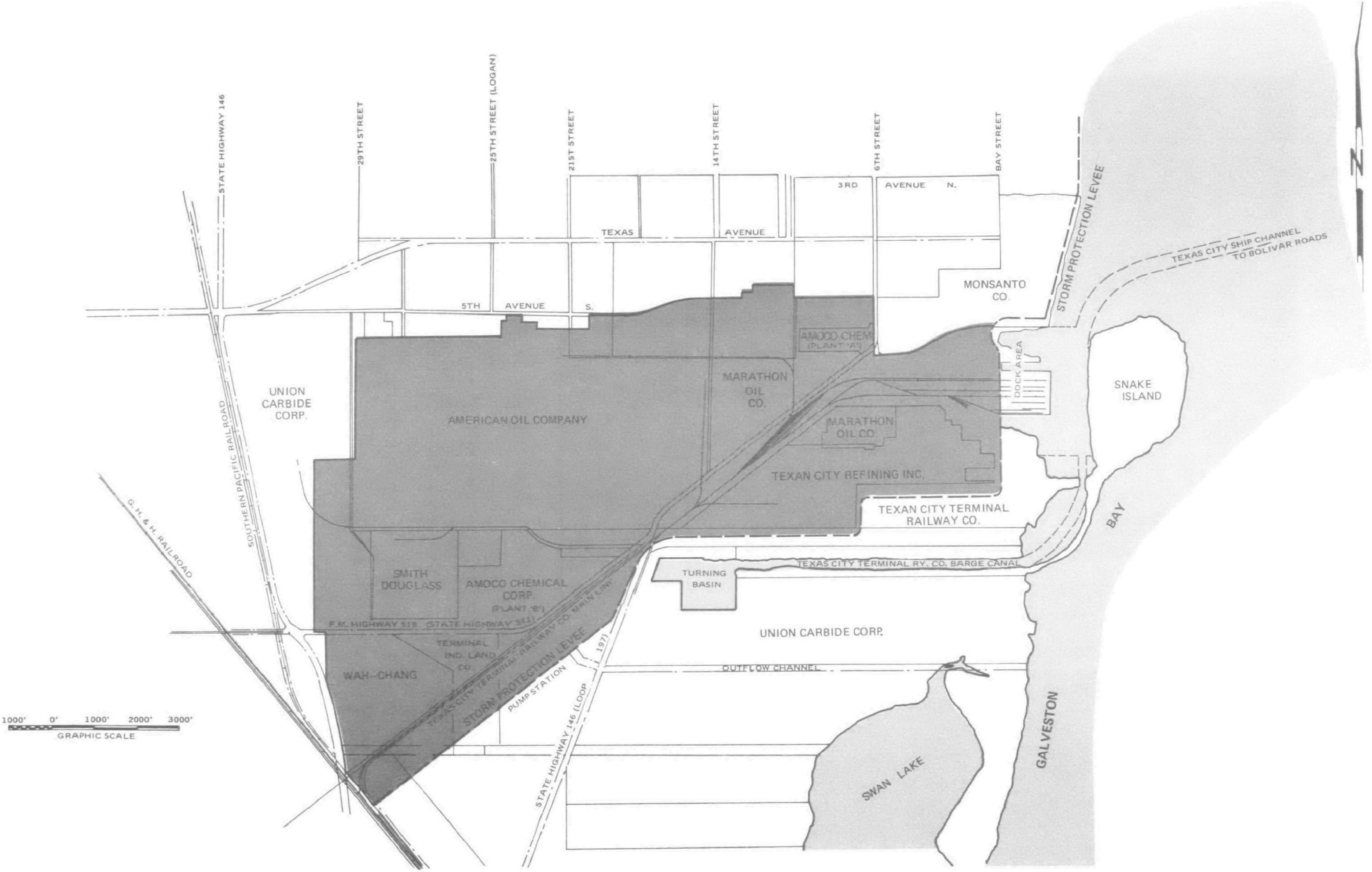

FIGURE 1 AREA OF SURVEY – DRAINAGE PLAN FOR THE INDUSTRIAL AREA OF TEXAS CITY, TEXAS

Texas City Terminal Railway Company
East Galveston Highway
Texas City, Texas

Contacts: Mr. K. L. DeMart, Auditor-Assistant Secretary
and Assistant to General Manager
Mr. D. M. Holbrook, Harbor Master

Date of Survey: August 24, 1970

Property Description

This company controls extensive waterfront acreage on the Texas City Ship Channel. The channel connects the main dock area and a barge canal with Galveston Bay and the Gulf of Mexico. The property also accommodates a railroad marshalling yard. Since its establishment in 1893 the company has provided railroad switching facilities and has managed the deep water port for the various industries in and adjacent to Texas City. The terminal's drainage system utilizes three outfalls, all ultimately emptying into Galveston Bay and San Jacinto Bay, while one of the three first empties into the Terminal Barge Canal. The normal effluent discharge averages 3,150 gpd, which is classified as domestic sewage and waste from a locomotive service pit. The latter passes through an oil/water separator prior to discharge into the drainage ditches that cross the property. Figures 1 and 2 provide an overall view of the land and waterfront area controlled by the Texas City Terminal Railway Company.

Hazardous Chemicals

A total of 33,952,046 bbls. of chemicals were handled in and out of the terminal during 1969. A complete breakdown of chemicals by name was not available, since the practice of categorizing chemicals by name and quantity was abandoned some years ago due to the numerous "trade names" that have developed in recent years. During 1969 the transportation media were as follows:

Barges	6,664	
Steam and Motor Ships	536	
	7,200	Marine Total
Box and Tank Cars (in and out)	25,556	

A generalized inventory of chemicals handled through the terminal in 1969 is provided in Table 1.

Arthur D Little, Inc

Photo Courtesy of U.S. Geological Survey

FIGURE 2 AERIAL VIEW OF TEXAS CITY SHOWING LOCATION OF TEXAS CITY DOCKS, TERMINAL RAILWAY COMPANY, AND MONSANTO COMPANY PLANTS

TABLE 1

CHEMICAL FLOW THROUGH TEXAS CITY TERMINAL RAILWAY COMPANY MARINE AND RAILROAD TERMINAL – 1969

Company	Hydrochloric Acid (bbls)	Chemicals (bbls)	Sulfuric Acid (bbls)	Phosphatic Fertilizer Solution (bbls)
Union Carbide Corporation		19,994,712.25		
Stauffer Chemical			78,229,000	
Monsanto Company		778,724,774		
Borden Chemical				8,720,400
Amoco Chemical		414,291,660		
American Oil Company		73,163,879		
Gulf Chemical	15,722.82			
Falleh Chemical		8,378,810		
American Mineral Spirits		4,805,846		
Diamond Shamrock Corp.		6,865,082		
Southern Towing		2,904,000		
Chotin Trans. Company		1,560,000		
Thomas Pet. Trans.		3,671,872		
Jefferson Chemical		2,044,600		
Houston Chemical		1,378,000		
American Mineral		1,865,146		
Texas Transport & Terminal		704,142		
Enjay Chemical Company		1,621,850		
Shell Chemical		4,527,984		
H.E. Schurig & Company		704,076		

Bulk Storage Facilities and Pipelines

The "terminal" owns no bulk storage tanks, and the various pipelines that cross the property are all owned and maintained by the various chemical plants in the area.

Past Spill Experience

There is no record of a major chemical spill at this location. Some minor spills have been experienced and fast cleanup has been exercised under the supervision of the Harbor Master, who maintains a considerable length of floating boom and a quantity of dispersal chemicals.

Spill Control Plan

The Harbor Master, a well trained and competent individual, has complete control over spill prevention, containment, and cleanup on the terminal. In addition, the Texas City Terminal Railway Company is actively involved in the Texas City Mutual Aid Plan. Even though this plan is engineered toward the control of fire- and explosion-type disasters, it could be utilized to combat a major spill of oil or hazardous chemicals. The Texas City Industrial Mutual Aid Manual (dated April 1964, revised August 1965) is reproduced as Appendix C.

GAF Corporation
P. O. Box 2141, Hwy. 146W
Texas City

Contact: Mr. F. E. Wetherill, Plant Manager

Date of Survey: August 25, 1970

Property Description

This is a comparatively new plant (1967) that produces various chemicals and polymers from high-pressure acetylene chemistry. Ultimate products are given as follows:

- 1, 4-butanediol
- Butanediol
- Butyrolacetone
- Polyvinyl pyrrolidone
- Polyvinyl pyrrolidone – vinyl acetate copolymers
- 2-pyrrolidone
- Vinyl pyrrolidone

The plant is situated well north of Texas City in open land quite clear from urban or other industrial development. Figure 3 provides a schematic view of the plant property. The plant effluent drainage discharge is monitored as 380,000 gpd; the material drains through an open trench into Moses Bayou, Moses Lake, Dollar Bay, and finally into Galveston Bay and San Jacinto Bay.

In-plant effluent treatment consists of an oil skimmer, and two neutralizing ponds (a 3-day capacity holding basin, plus a 7-day emergency, or impounding, pond) that can be used for in-plant confinement of a chemical spill. Additional facilities include a deep-sea disposal system whereby barges are used to transport 50,000 tpy* of waste chemicals (1400 tons per barge trip) into a deep-water disposal area (400 fathoms) 125 miles offshore into the Gulf of Mexico. Offshore waste disposal averages 1 to 3 barge loads a week with each barge transporting 400,000 gallons of spent material. The waste consists of a by-product of herbicide rated as: 2,5-dichloro-6-nitrobenzoic acid, sodium salt, 9% sodium sulfate, 5%; and water 86%.

The plant also utilizes a deep injection well for waste disposal. Plant officials believe that they can effectively confine any major chemical spill to the in-plant waste treatment facilities.

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*Tons per year

Arthur D Little, Inc

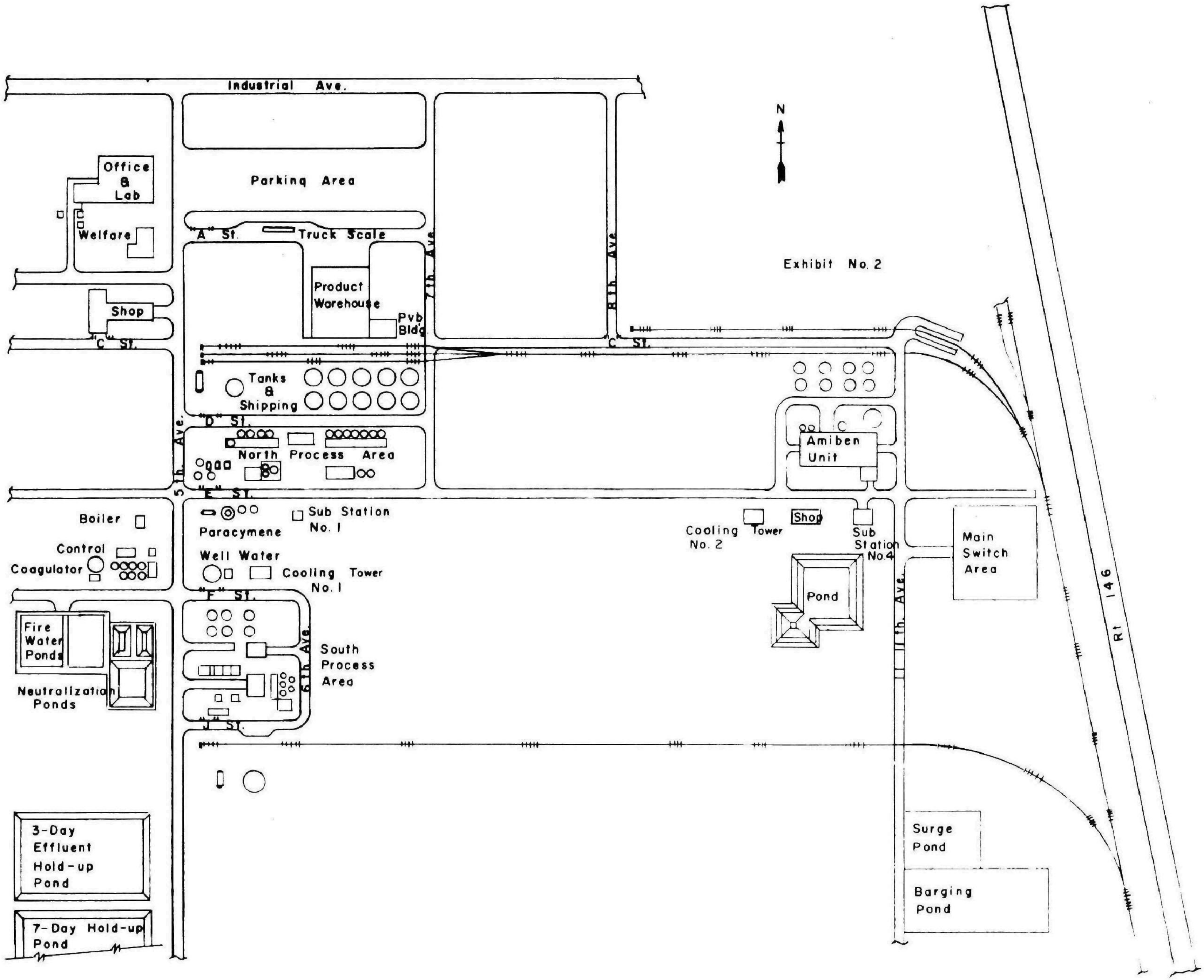

FIGURE 3 GENERAL LAYOUT OF GAF CORPORATION PROPERTY, TEXAS CITY, TEXAS

Hazardous Materials

The plant's annual consumption is company confidential; however, bulk storage capacities for all chemicals are given in Tables 2 and 3.

Bulk Storage Facilities and Pipelines

All tanks and pipelines were new in 1967. There is a regular maintenance schedule of internal examination and nondestructive shell thickness testing, and all tanks exceeding 15 psi MWP are subjected to hydrostatic testing. Production tanks and tanks likely to overfill and overflow have curb enclosures for spill containment. All pipelines are above-ground and hazardous materials are color-coded. Two small gasoline storage tanks and one 500-gal. diesel oil storage tank are buried installations. The tanks have protective coatings and cathodic protection. The plant has no bulk storage of solid materials. Most chemical materials are received and shipped by tank cars and tank wagons of common carriers.

Past Spill Experience

During the spring of 1970 there was a spill of 1000 gallons of nitrating acid, i.e., a mixture of nitric acid and sulfuric acid. The spill, caused by a flexible hose line breaking, was effectively confined within the in-plant drainage ditches and holding ponds.

Spill Control Plan

The plant operates on a 7-day week, 24-hour day basis with a minimum of two supervisors on duty. Each supervisor has complete jurisdiction over spill control, containment, and clean-up. There is a special plan in effect to control chlorine spills, and chlorine gas masks are carried in the chlorine tank car storage area at all times. The plant is an active member of the Texas City Industrial Mutual Aid Plan (Appendix C).

TABLE 2

GAF CORPORATION BULK STORAGE FACILITIES

Acetylene Chemicals

	Storage Capacity (gals.)
1, 4-butynediol – 35%	560,000
Propargyl alcohol – 100%	30,000
1, 4-butanediol – 35%	230,000
1, 4-butanediol – 100%	200,000
γ-butyrolactone – 100%	60,000
2-pyrrolidone – 100%	90,000
N-methyl-2-pyrrolidone – 100%	100,000
N-vinyl-pyrrolidone – 80/100%	34,500
Polymer and copolymer solutions	15,000
Formaldehyde – 30%	400,000
Anhydrous ammonia	30,000
Vinyl acetate	15,000
Ethanol	15,000
Propane	15,000
n-butanol	15,000
p-cymene	5,000
Assorted organic waste mixture	30,000
Total	1,844,500

TABLE 3

GAF CORPORATION BULK STORAGE FACILITIES

Herbicide Chemicals

	Storage Capacity (gals.)
Benzoyl chloride	50,000
Dichlor benzoyl chloride	140,000
Sulfuric acid – 94%	65,000
Sulfuric acid – 50%	100,000
Hydrochloric acid – 32%	100,000
Mixed nitric/sulfuric acid	50,000
Caustic soda – 50%	65,000
Dichlorbenzoic acid	10,000
Dinitrochlorbenzoic acid	35,000
Amiben (chloramben)	180,000

Note: In addition, varying quantities of liquid chlorine are stored in railroad tank cars on a remotely located sidetrack.

Propane	15,000

Gulf Chemical & Metallurgical Corporation
Hwy. FM 519
Texas City

Contacts: Mr. E. B. King, President
Mr. R. C. Barr, Executive Vice President

Date of Survey: August 25, 1970

Property Description:

This is an electrolytic tin refining plant (Figure 4) originally built by the U.S. Government in 1941 to meet the demand for tin during World War II. The refinery had a number of operators and owners until acquired by the present owners in 1968. The original tin processing methods have changed over the years, and many of the original production buildings are now derelict and in an advanced state of decay. The operational buildings, however, appear well maintained. The plant produces 400 long tons of tin in ingot form each month. For the past five years the smelter has been processing low grade Bolivian tin concentrates and some domestic secondary tin residues.

A recent plant report indicates that for the monthly production of 400 long tons of tin, the plant consumed in all departments, excluding the electrolytic section, the following amounts of reagents:

Coal (79.4% fixed carbon)	328.1 short tons
Limestone (53.5% CaO)	104.9 short tons
Machine shop turnings	26.3 short tons
Natural gas (1000 Btu/MCF)	47,814 MCF
Water (from wells)	21.75 million gals.
Power	630,430 kwh
Hydrochloric acid (20°Bé)	1330 short tons
Sulfur	200 lbs
Flake sodium hydroxide	600 lbs
Aluminum ingots	550 lbs
Sawdust chips	150 lbs
Sodium carbonate	35,500 lbs

The plant water drainage system entails three open-ditch outlets that flow into Swan Lake and thence into Galveston Bay. Flow rates are rated as follows:

Outfall	Average Rates (gpm*)	Maximum Rate
1	75	150
2	45	90
3	60	120

The discharge involves waste solution from the tin leaching process. The wastewater treatment section of the plant has an area of 70 acres which includes settling and flocculation processes for solid removal, neutralization of acids, and discharge to further settling and evaporation ponds following which the clear, neutralized water can be drained through an open ditch system into Swan Lake (Figure 1).

Hazardous Chemicals

1. Hydrochloric acid – 50,000 tpy, 500,000-gal. bulk storage capacity; received by marine barge and tank truck;

2. Liquid caustic sodium hydroxide – 10,000 gpm**, 10,000-gal. bulk storage capacity; trucked into plant

3. Liquid ammonium chloride – 10,000 gpm**, 20,000-gal. bulk storage capacity; trucked into plant;

4. Liquid sodium hydrosulfide – 20,000 gpy, 6000-gal. bulk storage capacity; trucked into plant;

5. Ferric chloride – manufactured within the plant to meet production needs; 20,000-gal. bulk storage capacity.

6. Dry soda ash – 50-ton bulk storage capacity tank, trucked into plant, air unloaded;

7. Limestone (crushed oyster shell) – received by rail and truck; 2 to 3 tons on hand at all times;

*gallons per minute
**gallons per month

8. Rock sulfur – 10-ton open storage;

9. Calcium chloride – two 15,000-gal. storage tanks; consumption varying to a maximum of 30,000 gpm.*

Bulk Storage Facilities and Pipelines

The plant tanks are old, and following a recent tank failure, a system of annual hydrostatic testing was introduced. Major storage tanks were hydrostatically tested during August 1970, and four tanks have been subjected to extensive repair. All tanks and pipelines (except those passing through retaining walls) are above-ground, exposed installations.

Past Spill Experience

The plant had a 55,000-gal. spill of hydrochloric acid in July 1970. The spill, which resulted from the failure of a bulk storage tank, was drained into the in-plant settling and treatment ponds. The plant management claims that none of the acid escaped into the water course.

The Texas Water Quality Board claims that effluent samples from this plant contain excessive quantities of iron. The samples were recovered from a communal drainage ditch, but the smelting plant emphatically denies being the source of the iron pollutant.

Spill Control Plan

On the basis of the plant's claimed ability to confine all spills safely to the in-plant treating area, spill control is left to departmental supervisors, who can gain top management assistance when warranted. The plant is an active member of the Texas City Industrial Aid Program.

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* gallons per month

Photo Courtesy of U.S. Geological Survey

FIGURE 4 AERIAL VIEW OF GULF CHEMICAL AND METALLURGICAL CORPORATION, TEXAS CITY, TEXAS

Monsanto Company
201 Bay Street S.
Texas City, Texas

Contacts: Mr. R. V. Butz, Plant Manager
Mr. E. Hendricks, Manager, Environmental Control

Date of Survey: August 27, 1970

Property Description:

Monsanto began operations in Texas City in 1943. The concern produces numerous chemicals, plastics, and petrochemical products for varied industries; however, the final products are reported to be:

- Styrene monomer,
- Methanol,
- Acetic acid,
- Ethylbenzene, and
- Phthalate esters.

The plant (Figure 2) is in the process of constructing a new 45-foot channel and ship/barge facility that is probably one of the most modern and automated in the nation. The new marine facility has 15 line connections, a parapet to contain spills, nitrogen-cleared hoses and lines, a remotely controlled hose-handling system, direct telephone communication with all tank gagers, and an elaborate "slop" tank system for line draining.

Most of Monsanto's drainage now passes into a disposal pit for non-toxic sludges, principally $CaSO_4$ (gypsum), calcium formate, and untreated lime. All material is recovered from the pit and returned to the plant for further treatment.

The pit is located on a 12-acre tract, 0.5 mile south of Swan Lake. The solid effluent is rated at 150 tpd, and since this newly established treatment system has been installed, there is no effluent discharge.

Hazardous Materials

The plant receives and ships materials by train and tank truck; however, 75% of the materials are moved in and out through the plant's ship and barge docks. Table 4 lists the chemicals handled and provides information on marine shipments. Bulk storage capacities, chemical production and consumption, photos and schematic plans of the plant are considered to be company confidential information and are not available for outside publication.

Bulk Storage Facilities and Pipeline

All storage tanks are above-ground installations with diking adequate to contain the entire capacity of each tank. Tank pits and diked areas have valve-controlled drainage lines to permit removal of uncontaminated rainfall collections. The tanks are equipped with remote, liquid-level recorders that indicate tank levels in a control room 24 hours a day. Non-destructive thickness testing (audiogage)* of tank tap and shells is done on a recycling six-month basis. Flammable tanks are blanketed with nitrogen, and high-liquid level alarms are mounted on "critical" tanks, chlorine, and so forth.

Pipelines are 90% exposed above ground, and a system of cathodic protection with isolated flanges for buried lines has been introduced over the past 10 years.

Past Spill Experience

The State and the U.S. Coast Guard have no record of past spills involving hazardous materials at Monsanto, and the plant has no record of any significant spills from loading-unloading operations.

Spill Control Plan

Numerous precautions are taken to prevent and minimize spills at Monsanto. Perhaps the most important is that all loading-unloading operations are *never* left unattended. Material handlers can shut down pumps remotely in emergencies. Flexible hoses are hydrostatically tested at higher pressures and more frequently than Coast Guard requirements (Monsanto 3 X MWP and USCG 1½ X MWP).

The plant spill procedure specifies that a spill alarm be sounded, along with a location code, whenever a spill (gas or liquid) occurs. A trained emergency crew can be at the spill location within minutes.

The plant is an active participant in the Texas City Mutual Aid Plan (Appendix C) and has joined forces with other industries in the plan for handling any large spills that may occur in the harbor. Two sections (2000 to 2500-foot total) of a Slickbar boom are available to contain spills of floating (insoluble) materials. Most of the plant's chemicals are highly water-soluble, which makes containment or recovery impossible once such material has spilled into a water course.

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*A proven and much used method of determining the thickness of metal, such as, especially, the shells of bulk storage tanks. The tank need not be empty to conduct this type of thickness test.

TABLE 4

HAZARDOUS MATERIAL LISTING OF
MONSANTO COMPANY, TEXAS CITY

Raw and Terminated Materials	Shipment Mode Tanker	Barge	Estimated Percent Moved by Water
Benzene		X	100
Condensate Oil		X	100
Orthoxylene		X	100
Olefins		X	100
Caustic Soda	X	X	95
Acrylonitrile	X	X	100
Vinyl Acetate	X	X	80-90
Naphthalene	X	X	100
Butanol	X	X	100
Alkylbenzene	X	X	100
Products			
Styrene monomers	X	X	80-90
Methanol	X	X	–
Acetic acid		X	60
Ethylbenzene		X	100
Phthalate esters	X		50

Union Carbide Corporation
Chemicals and Plastics
P. O. Box 471
Texas City

Contacts: Mr. J. F. Erdmann, Environmental Control Coordinator for Texas Plants
Mr. A. R. Pettyjohn, Environmental Control Specialist

Date of Survey: August 28, 1970

Property Description:

This is an extensive petrochemical manufacturing plant that commenced operations in Texas City in 1941. It immediately adjoins the American Oil Co. and the Borden Co. plants and parallels State Hwy. 146 for a distance of about 7500 feet. In-plant treatment of effluent and plant drainage facilities are as follows:

Outfall 1 – This outlet discharges into a drainage ditch near the mid point of the east boundary of the plant; it then discharges into a communal drainage ditch on the Texas City Terminal R. R. Co. property. The final discharge is into Galveston Bay and the San Jacinto River Basin.

Outfalls 2, 4, and 5 – These outlets discharge from the NW corner of the plant into Moses Lake, Galveston Bay, and the San Jacinto River Basin.

Outfall 3 – This outlet discharges into Swan Lake, Galveston Bay, and the San Jacinto River Basin.

Outfalls 6-13 inclusive – These outfalls discharge into the Texas City Terminal R. R. Co. Barge Canal, Galveston Bay, and the San Jacinto River Basin.

Outfall 14 – This outfall discharges into Galveston Bay and the San Jacinto River Basin.

Each drainage ditch is equipped with an effective oil skimmer trap. The plant does have extensive in-plant effluent treating ponds, and two new federally sponsored 50 by 100 feet, 6 and 12 feet deep, experimental anaerobic treatment tanks, of concrete construction, are currently being built. Figure 5 provides an overview of the anaerobic treatment tanks while in the course of construction,

Photo Courtesy of U.S. Geological Survey

FIGURE 5 AERIAL VIEW OF UNION CARBIDE CORPORATION WASTE-WATER TREATMENT PONDS SHOWING NEW ANAEROBIC TREATMENT PONDS UNDER CONSTRUCTION IN FOREGROUND, TEXAS CITY, TEXAS

along with some of the original ponds used to treat and neutralize plant effluent prior to discharge into the plant outfalls. Figure 6 provides a complete overview of the entire plant and adjacent roads and properties.

Hazardous Chemicals

Bulk storage capacities and figures on chemical consumption are considered company confidential. The plant did, however, provide a listing of 98 chemicals transported, stored and processed, along with transportation methods used to receive and ship the various chemicals (Table 5).

Bulk Storage Facilities and Pipelines

All bulk storage tanks are fully diked. The dikes are mostly clay-constructed with a compacted oyster shell surface. Concrete-constructed dikes have been installed in "restricted" areas. Diked enclosures are drained through a gated valve-type drain located outside of the diked area. The drainage from the diked area passes into the plant's internal drainage ditches and thence into the in-plant effluent treatment ponds.

To prevent spills, precautions are taken to see that the transferred material never exceeds the receiving tank capacity. A number of liquid-level controls have been installed, but are no longer calibrated; the plant feels that too much reliance can be placed on these fail-safe devices. However, this is an educational factor that can be corrected by strict supervision and good preventive maintenance procedures. Remote, centrally located, fill-level indicators are installed on major tanks; however, physical gaging is also used during a fill procedure – some tanks do have high liquid-level-actuated audible alarms. Some high liquid-level pump cut-off controls are provided; however, the facility is not overall or extensive due to remote location of many tanks and pumps which, in some cases, would require extensive electrical installations between the tanks and the pumps.

Check valves are provided on fill lines at the pumps within diked areas; however, no check valves are evident immediately before or after the master fill valve. Excess flow and checks are used on all liquefied petroleum and liquefied natural gas tanks. There are no buried storage tanks.

Tank and pipeline integrity tests are conducted on an "experience schedule" basis. This includes hydrostatic and non-destructive thickness testing (reflectoscope and dye tests). The testing has proven to be most adequate, according to plant personnel. All tanks are coded to indicate health, fire, and reactivity hazards. This is done by a company coding system that features the use of symbols to indicate the chemical hazard of the tank contents.

FIGURE 6 AERIAL VIEW OF COMPLETE UNION CARBIDE CORPORATION FACILITY, TEXAS CITY, TEXAS, SHOWING ADJACENT ROADS AND PROPERTIES

TABLE 5

CHEMICALS AND PLASTICS IN USE AT UNION CARBIDE CORPORATION PLANT, TEXAS CITY

Chemicals Handled and Methods of Bulk Transportation

	Material	Transport Method*			
1.	Acetaldehyde	TT	TC		
2.	Acetic acid	TT	TC	B	S
3.	Acetic anhydride	TT	TC	B	S
4.	Acetone	TT	TC	B	S
5.	Acrylate esters (ethyl, butyl, ethyl hexyl)			B	S
6.	Aminoethyl ethanolamine (crude)	TT	TC	B	
7.	Aminoethyl piperazine	TT	TC		
8.	Ammonia	TT	TC	B	
9.	Amyl acetate (primary)	TT	TC	B	S
10.	Amyl alcohols (primary)	TT	TC	B	S
11.	Benzene			B	
12.	Butanol	TT	TC	B	S
13.	Isobutanol	TT	TC	B	S
14.	Butyl acetate	TT	TC	B	S
15.	Isobutyl acetate	TT	TC	B	S
16.	Butylene oxide	TT	TC		
17.	Carbitol			B	S
18.	Cellosolve	TT	TC	B	S
19.	Methyl cellosolve	TT	TC	B	S
20.	Butyl cellosolve	TT	TC	B	S
21.	Cellosolve acetate	TT	TC	B	S
22.	Chlorine			B	
23.	Crotonaldehyde (crude)	TT	TC	B	
24.	Cumene			B	S
25.	Diacetone alcohol	TT	TC		
26.	Diethyl ether (crude)	TT	TC	B	
27.	Diethyl sulfate	TT	TC		
28.	Di-isobutyl carbinol			B	S
29.	Di-isobutyl ketone	TT	TC	B	S
30.	Di-isopropanolamine	TT	TC		
31.	Dimethyl ether	TT	TC		
32.	Dripolene			B	
33.	Ethanol	TT	TC	B	S
34.	Ethanolamine, mono-, di-, tri-	TT	TC	B	S
35.	Ethyl acetate	TT	TC	B	S
36.	Ethyl benzene		TC		S
37.	2-Ethyl hexanol	TT	TC	B	S
38.	Ethylene	TT	TC	pipeline	
39.	Ethylene diamine, di-, tri-, and tetra-amines	TT	TC	B	S
40.	Ethylene dichloride	TT	TC	B	S
41.	Ethylene glycol, di-, tri-, and tetra-glycols	TT	TC	B	S
42.	Ethylene oxide		TC		
43.	Flexol plasticizers (DOP, DIOP, EPO, JPO, A-26, 3GH)	TT	TC	B	S
44.	Formic acid	TT	TC	B	S
45.	Glutaraldehyde			B	S
46.	Hexylene glycol	TT	TC	B	S
47.	Isobutyraldehyde	TT		B	
48.	Isooctaldehyde	TT		B	

TABLE 5 (Continued)

	Material	Transport Method*			
49.	Isodecaldehyde	TT		B	
50.	n-butyraldehyde	TT		B	
51.	Isooctanol	TT	TC	B	S
52.	Isodecanol	TT	TC	B	S
53.	Isophorone	TT	TC	B	S
54.	Isopropanolamine			B	S
55.	Isopropyl acetate	TT	TC	B	S
56.	Linear alcohols	TT	TC	B	S
57.	Liquified petroleum gases	TT	TC	B	
	(propylene, butadiene, propane,				
	butane)	TT	TC	B	
58.	Methanol	TT	TC	B	S
59.	Methyl acetone	TT	TC	B	
60.	Methyl amyl alcohol	TT	TC	B	S
61.	Methyl amyl acetate	TT	TC	B	S
62.	Methyl butanol	TT	TC		
63.	Methyl butyraldehyde	TT		B	
64.	Methyl ethyl ketone	TT	TC	B	S
65.	Methyl isobutyl ketone	TT	TC	B	S
66.	Methyl isoamyl ketone	TT	TC		
67.	Naphtha	TT			
68.	Niaz polyols				
	(14-46, 16-46, 31-45)	TT	TC	B	S
69.	Nitrogen	TT	pipeline		
70.	Oxygen	TT	pipeline		
71.	Nonane, nonene			B	
72.	Normal paraffins	TT	TC	B	S
73.	Kerosene	TT	TCQ	B	S
74.	n-pentanol	TT	TC		
75.	Phenol		TC		
76.	Phenolic resin solutions	TT	TC		
77.	Vinyl resin solutions	TT	TC		
78.	Piperazine	TT	TC	B	
79.	Polymine "H"	TT	TC		
80.	"Prestone" anti-freeze	TT	TC		
81.	n-propanol	TT	TC	B	S
82.	Isopropanol	TT	TC	B	S
83.	Propionaldehyde	TT	TC	B	
84.	n-propyl acetate	TT	TC	B	S
85.	Propylene diamine, dipropylene triamine	TT	TC	B	
86.	Propylene dichloride	TT		B	
87.	Propylene glycol	TT	TC	B	S
88.	Propylene oxide	TT	TC	B	S
89.	Styrene	TT	TC	B	S
90.	Sulfuric acid		TC	B	
91.	Toluene	TT	TC		
92.	Tridecanol	TT	TC	B	
93.	Ucar latexes (130, 131, 180, 360)	TT	TC		
94.	Valeraldehyde	TT	TC	B	
95.	Vinyl acetate	TT	TC	B	S
96.	Vinyl chloride		TC		
97.	Vinyl resins	Bulk van Boxes by truck,			
98.	Polyethylene resins	rail, and ship			

*Key to abbreviations: TT = tank truck, TC = tank car, B = barge, S = ship or tankers

Buried pipelines are extensive; they are protectively coated and wrapped, with most lines having cathodic protection. Pipeline sections are double-jacketed at roadways, railroad crossings, ditches, and in heavily traveled areas, and all the casings are vented at both ends.

Past Spill Experience

The plant experienced a barge collision in the intercoastal canal in June 1970. A barge carrying refined kerosene was hit on the starboard quarter, which was entirely cut off by the impact. A resulting spark caused a fire, the heat of which welded both barges together. The kerosene barge was leaking when brought into the plant property where the cargo was pumped into the plant's waste disposal system. A spill involving 42,000 gallons of ethanol occurred over a 36-hour period following plant start-up on January 1, 1970.* Another chemical spill was reported January 5, 1970, when 20 to 25 gallons of acetone were drained from a flexible hose without using a drip pan.*

Spill Control Plan

All production units (about 60) are autonomous, having individual spill control plans which are specifically outlined in an operating manual. It is not practical to boom or confine a chemical spill at marine unloading areas since all chemicals handled within the plant are water-soluble. The plant concentrates on spill prevention and prompt removal of lighter-than-water chemical spills. A new waste-treatment clarification plant is on the drawing board to replace the existing 25-year old facility. Construction permits have been applied for and a new $6 million facility has been proposed.

*State Water Quality Control Board, Austin.

American Oil Company
2401-5th Avenue, South
Texas City, Texas

Contacts: Mr. R. E. Dickey, Manager
Oil Movements & Marine Division

Date of Survey: September 1, 1970

Property Description

The American Oil Company facility is considered to be one of the largest refineries in the nation. Its output averages 245,000 bbls of crude oil per day. The plant is surrounded on three sides by the properties of Marathon Oil, Union Carbide, Borden Chemical, and Amoco Chemical. The marine loading/unloading facility is located on the Texas City Barge Canal. The plant drainage terminates in Galveston Bay and the San Jacinto River Basin. One outlet crosses State Highway 341, at the southern end of the plant property, and then joins a communal drainage trench (Union Carbide, Amoco) that crosses the Texas City Railroad property to terminate just south of the Barge Canal. The plant discharges between 13 and 14 million gallons of effluent daily. A new sludge pit – 50 by 100 by 10 feet – was recently installed in the plant, and in-plant drains pass through holding boxes and separator ponds prior to discharge. Another outlet handles three discharges of domestic sewage at an average of 100 to 300 gpd.

Hazardous Materials

A complete listing of chemicals handled at American Oil is given in Table 6; however, major shipments are handled in the following manner.

Sulfuric acid (98%) is received by barges which are unloaded at the Texas City Barge Canal. The material is then pipelined in overhead lines to storage tanks where it is eventually used for the alkylation units. About 98% of the spent acid is recycled back into the system and the remainder, 90% diluted with hydrocarbons and water, is returned into the marine barges.

Caustic (50%) is received in a similar manner for use at the plant's No. 1 alkylation unit and the No. 1 cracking unit. In some cases, it is diluted to 10% strength before using.

Ammonia is stored at –28°F and the entire production is supplied to the export or domestic market. The material is shipped by all modes of transportation – ship, barge, rail, and truck. The maximum storage capacity is 45,000 tons and the plant produces 2000 tons in a daily 24-hour operation. The plant stores miscellaneous treating chemicals, such as commercial scale removers, lime for water softening and others.

Chrome, zinc, and phosphate are used within the cooling towers and hydrochloric acid is used for deionizing water. Other chemicals include drummed inhibitors, liquid dyes, and furnace oil additives. Methanol is received by rail, 25,000 gallons being stored as a gasoline additive.

Cresylic acids, extracted from gas and oil, are stored in up to six railroad tank cars for shipment to Merichem in Houston. Aluminum chloride is stored in bulk quantity in dry storage. Benzene is manufactured, stored, used, and shipped. Toluene is produced for gasoline blending. Xylene is produced and transferred to the nearby subsidiary, Amoco Chemical. Sodium chloride brine is produced from Texas brine for regenerating zeolites; about two to three tank car loads are consumed annually. Tetra-ethyl lead is also stored and used in the plant production process. Chlorine is used for algae control in the plant cooling towers.

Bulk Storage Facilities and Pipelines

All tanks receive regular non-destructive shell thickness tests, and the majority of plant pipelines are installed in an exposed position. All tanks have external liquid-level gages. No dikes or retention barriers are used in the sulfuric or caustic storage areas. Dikes are used for benzene, toluene, and xylene storage, and full-capacity retention pits are provided under the tetra-ethyl lead storage tanks. All lines are cleared of product, using nitrogen gas pressure, after each transfer of material.

Past Spill Experience

The plant has had four or five "boilovers" within the past four or five years. The boilovers were caused by decomposition reaction, and one spill cost between $5000 and $6000 to neutralize. Another spill did escape out into the water course.

A diversion pond is under construction to permit full confinement and neutralization preparatory to outside release.

The following spills were officially recorded:

2/25/70 – 3-bbl. oil spill from faulty flange connection on unloading barge (Texas Water Quality Board, Austin);

3/12/70 – Sulfuric acid foamed over alkylation unit tank (Texas Water Quality Board, Austin);

TABLE 6

STORAGE CAPACITIES FOR CHEMICAL COMPOUNDS HANDLED AT AMERICAN OIL COMPANY
(September 4, 1970)

Material	Unit Location	Normal Capacity
Acid, Fresh		
Sulfuric	No. 2 ammonia	10,700 gals
Sulfuric		10,700 gals
Sulfuric	Main sett. basin	4,500 gals
Sulfuric	Tank farm sett. basin	1,900 gals
Sulfuric	Waste-water ditch	8,200 gals
Sulfuric	No. 2 alkylation	7,500 bbls
Sulfuric	No. 2 alkylation	7,500 bbls
Sulfuric	No. 1 alkylation	1,566 bbls
Sulfuric	No. 1 alkylation	1,566 bbls
Sulfuric	Barge canal	470 bbls
Acid Oils	No. 1 CCU	562 bbls
Acid Oils	No. 3 CCU	500 bbls
Acid, Spent		
Sulfuric (75%)	No. 3 pipe still	14,000 gals
Sulfuric (90%)	No. 3 pipe still	47,000 gals
Sulfuric	No. 2 alkylation	7,500 bbls
Sulfuric	No. 2 alkylation	7,500 bbls
Sulfuric	No. 2 alkylation	335 bbls
Additives and Inhibitors		
Additive Concentrate	OSBL near EPH	184 bbls
Additive Concentrate	OSBL near EPH	133 bbls
Additive Concentrate	OSBL near EPH	133 bbls
Additive Concentrate	OSBL near EPH	382 bbls
Additive Concentrate	OSBL near EPH	382 bbls
Additive Solution	OSBL near EPH	169 bbls
Additive Solution	OSBL near EPH	140 bbls
Additive Solution	OSBL near EPH	168 bbls
Additive Solution	OSBL near EPH	141 bbls
Additive Solution	OSBL near EPH	169 bbls
Additive Solution	OSBL near EPH	169 bbls
Additive Solution	OSBL near EPH	218 bbls
Additive Solution	OSBL near EPH	219 bbls
Sulfur Inhibitor	Styrene	1,400 gals
Aluminum Chloride Solution	Styrene	100,000 gals
Anhydrous	West of No. 1	
Ammonia	Ammonia plant	15,000 tons
Ammonia	Ammonia plant	15,000 tons
Ammonia	Ammonia plant	15,000 tons
Aromatics		
Benzene	OSBL near P.S. #1	20,000 bbls
Benzene	OSBL near P.S. #1	20,000 bbls
Benzene	OSBL near ultraformer #1	40,000 bbls
Benzene	OSBL near ultraformer #1	40,000 bbls
Benzene	OSBL near toluene	18,000 bbls
Benzene	OSBL near toluene	18,000 bbls
Benzene	OSBL near EPH	9,000 bbls
Benzene	OSBL near EPH	8,000 bbls
Benzene	OSBL near toluene	5,000 bbls
Benzene	OSBL near toluene	5,000 bbls
Ethylbenzene	Styrene	158,000 gals
Ethylbenzene	OSBL near styrene	9,000 bbls
Off-test styrene	Styrene	148,000 gals
Polyethyl benzene	Styrene	12,000 gals
Polyethyl benzene	Styrene	20,000 gals
Polyethyl benzene and styrene residue	Styrene	100,000 gals
Toluene or xylene	OSBL near ARU	70,000 bbls
Toluene or xylene	OSBL near ultraformer #4	70,000 bbls
Toluene or xylene	OSBL near toluene	40,000 bbls
Toluene or xylene	OSBL near fire drill grounds	40,000 bbls
Toluene or xylene	OSBL near fire drill grounds	40,000 bbls
Toluene or xylene	OSBL north of sludge ponds	105,000 bbls
Caustic, Fresh	No. 2 alkylation	500 bbls
Caustic, Fresh	No. 1 alkylation	1,008 bbls
Caustic, Fresh	No. 1 alkylation	1,008 bbls
Caustic, Fresh	No. 1 alkylation	1,008 bbls
Caustic, Fresh	Main sett. basin	108 bbls
Caustic, Fresh	Tank farm sett. basin	182 bbls
Caustic, Fresh	No. 2 ammonia	6,800 gals
Caustic (10%)	No. 3 pipe still	47,000 gals
Caustic (10%)	No. 3 pipe still	6,500 gals
Caustic (40%)	No. 3 CCU	500 bbls
Caustic (50%)	No. 3 CCU	550 bbls
Caustic (5-10%)	No. 3 CCU	100 bbls
Caustic, Fresh	No. 1 CCU	1,000 bbls
Caustic, Fresh (25%)	No. 2 CCU	1,000 bbls
Caustic, Spent	No. 2 CCU	1,000 bbls
Caustic, Fresh (25%)	No. 3 ultraformer	340 bbls
Caustic, Fresh	No. 2 ultraformer	5,400 gals
EDTA, Boiler Water Chemical	No. 1 power station	4,000 gals
Monoethanol		
Amine	No. 1 ammonia	4,850 bbls
Amine	No. 2 ammonia	950 bbls
Amine	Ultracracker	250 bbls
Amine	No. 3 CCU	290 bbls
Amine	No. 3 CCU	318 bbls
Sulfolane	Aromatics recovery	1,780 bbls
Wet Sulfolane	Aromatics recovery	360 bbls
Sodium Phosphate and Caustic	No. 2 power station	2,500 gals

Note: 42 gallons per barrel
OSBL - outside battery limits
Acid oils are mixed cresylic acids
EPH – ethyl pump house
ARU – aromatics recovery unit
CCU – catalytic cracking unit

3/17/70 – Duplicate to foamover incident took 12 hours to neutralize (Texas Water Quality Board, Austin).

3/23/70 – Sulfuric acid spill; no details (Texas Water Quality Board Files, Austin).

Spill Control Plan

The emergency spill plan forms a lengthy section of the company's operating manual. The company is also an active member of the Texas City Industrial Mutual Aid System. Outfall monitoring for pH is continuous with a remote readout at a control center, operated and staffed 24 hours a day. The plant further maintains six organic detectors for emergency use. A 1600-foot length of spill containment boom is readily available for plant use.

Borden Chemical Company, Smith-Douglas Division
Grant Avenue
Texas City, Texas

Contact: Mr. William F. Frazier, Jr., Production Manager

Date of Survey: September 1, 1970

Property Description

The Borden Chemical Company plant (Figure 7) began operation in 1957 for the manufacture of sulfuric acid and fertilizer. The sulfuric acid manufacturing has been abandoned, and production is now being concentrated on the manufacture of a complete range of fertilizers. During this visit the plant had temporarily stopped production to further modify its production flow. Since the production changes will alter raw chemical product storage and quantity demands, this report is directed to detailing new production which was to have commenced late in November 1970.

The property fronts on FM Highway 519 and is bounded on three sides by the plants of Union Carbide, American Oil, and Amoco Chemical. The plant's drainage system averages 30,000 gpd of industrial waste, graded as 1% domestic sewage, 2% boiler blowdown water, 90% process water, and 7% cooling water. The drainage passes through the plant into a communal ditch also utilized by the Gulf Chemical and Metallurgical Corporation. The terminal outfall empties into Swan Lake (Figure 1). A marine unloading facility is leased from the Texas City Terminal Railway Co.

Hazardous Materials

The following raw materials are used and stored on the property to process the various mono-ammonium fertilizers into finished products:

1. Sulfuric acid (99%) – received by barge and currently trucked to plant. This transportation procedure may change, but current consumption averages 2200 tpy.

2. Phosphoric acid (73% H_3PO_4) – received by barge and currently trucked to the plant. This transportation procedure may change, but current consumption averages 30,000 tpy.

3. Anhydrous ammonia – 12,000 to 13,000 tpy – pipelined in from an immediately adjacent plant (American Oil).

4. Ammonium sulphate – received in railcar from Houston; the plant utilizes 20,000 tpy; average storage, 300 tons.

5. Muriate of potash (60% K_2O content) – received from Carlsbad, New Mexico, by hopper cars (90%) and pneumatic trucks (10%); average consumption, 15,000 tpy; average storage, 300 tons plus railroad cars on siding.

6. Gypsum – 15,000 tpy mined on plant property; 1 million tons of reserve on site.

Bulk Storage Facilities and Pipelines

Sulfuric acid tanks:

Four at 42,000 gal. capacity each
Two at 260,000 gal. capacity each
Three at 10,000 gal. capacity each.

> **Note**: It is anticipated that when production is reactivated that two 42,000-gal. tanks will be used and that the remaining tanks will be "dead storage." The two 42,000-gal. tanks will not be used to capacity and an average storage of 6000 to 7000 tons of sulfuric acid is expected.

Phosphoric acid tanks:

Three at 54,000 gal. capacity each
One at 61,300 gal. capacity
One at 160,000 gal. capacity
One at 260,000 gal. capacity
One at 81,100 gal. capacity
Four at 45,300 gal. capacity each
One at 601,800 gal. capacity
Four at 26,000 gal. capacity each.

Anhydrous ammonia tanks:

One at 18,000 gal. capacity
One at 6,000 gal. capacity

PAGE NOT

AVAILABLE

DIGITALLY

Use of the 6,000-gal. tank will probably be terminated. Only the ammonia storage tanks and lines are hydrostatically tested; welds are also X-rayed, and the pressure relief valves are tested and reset every 2 to 3 years. The ammonia transport line is maintained by the plant; it is a 4-inch diameter line that is doped, wrapped, and cathodically protected.

Past Spill Experience

The plant's largest spill occurred about five years ago when 10,000 gallons of phosphoric acid escaped, following the rupture of a lead-lined wooden stave tank. Some 5000 gallons of acid went into a ditch that empties into Swan Lake. Payloaders were used to dam the plant, and the acid-filled ditches were pumped out. The plant's wooden tanks have since been removed from active service. Other rubber-lined phosphoric acid tanks have sprung pinhole leaks, but they are promptly detected and repaired.

Spill Control Plan

The plant is a member of the Texas City Industrial Mutual Aid System (Appendix C). As of February 1970, the plant was engineered into a totally enclosed water system and any spill will eventually enter the in-plant ditching system. The following pumps can operate individually or in tandem to recirculate spilled liquid or slurry:

One 3 by 4 Gallagher 40-hp 400 gpm,*
One 4 by 6 Gallagher 50-hp 600 gpm.*

Plant management feels that it now has a system that could handle any spill except the large 260,000-gal. phosphoric acid tank which will eventually be removed from service. The use of mechanized equipment to build temporary dikes and to block drainage ditches would be employed as an interim contingency plan to contain a large spill.

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*gallons per minute

Amoco Chemicals Corporation
2800 Farm Road (519E)
Texas City, Texas

Contacts: Mr. G. D. Fesperman, Operations Supervisor
Mr. D. Womacks, Pollution Control Engineer

Date of Survey: September 2, 1970

Property Description

The Amoco Chemicals facility has two operational locations: Plant A (12 acres) and Plant B (55-60 acres). Plant A, the original plant, has been in operation since 1947. Both plants produce petrochemical products, none of which could be considered as finished products. Each item is used for the manufacture of terminal products by concerns other than the Amoco Chemicals Corporation. The Texas City operations are closely integrated with the adjoining American Oil Company's refinery for "charge stocks." The produced chemicals are used mostly by domestic chemical concerns. There is, however, some limited export of chemicals to the foreign market.

The plant has a marine loading/unloading facility on the Texas City Terminal Railway Co.'s Barge Canal in addition to its main marine terminal facility. All drainage from the dock facilities goes to sumps that are cleaned as required. The diked areas have valves which remain closed under normal conditions and, when open, drain to a proven effective oil-separator unit. Rainfall on areas other than the loading facilities or the diked area drains into the Barge Canal.

In Plant A all surface runoff and process waste water in the eastern section of the property drain to an oil separator and a holding basin located near the entrance to the plant. The area comprises the older section of the plant, a common sewer system of which necessitates that all water go through a treatment facility. The western section of Plant A has a new process unit, and the sewer and drainage systems are designed to segregate contaminated water from clean rainwater. Rainwater falling outside the unit or tank farm area drains into a ditch that runs along the west side of the plant. Contaminated water from the unit or the tank farm area is collected for treatment. All of the diked areas of Plant A have drains which remain closed under normal conditions.

In Plant B the drainage system design provides for collection of all contaminated water within the processing and tank farm areas for treatment. The rainfall from the same areas drains into conventional drainage ditches. Similar to the other locations, all diked areas have outlet valves which remain closed under normal conditions. Heavy settled material from in-plant waste-water treatment is disposed of in a sludge pit located on the company property.

The plant itself disposes of 400,000,000 gallons of liquid waste each year. Of this total about 1% is hauled offsite for processing by an outside firm. About 2½% of the total quantity is hauled offsite by a local firm for disposal at a facility which has the Texas Water Quality Board disposal permit. The remaining waste-water discharge joins waste water from the Union Carbide Chemical property and later joins American Oil waste water in a communal drainage ditch. The combined waste water from all three plants then flows through a ditch from the Texas City Barge Canal into Galveston Bay. The total treated waste-water volume (three plants) averages 200,000 gpd or 73 mgy.

Hazardous Materials

Products processed for shipment include:

- Indopol polybutenes,
- Amoco resin 18
  (a linear alphamethylstyrene polymer),
- Amoco styrene monomer,
- Amoco surfactants and oil production chemicals
  (corrosion inhibitors),
- Amoco methyl mercaptan
- Panaflax BN-1-plasticizer
  (an alkylated aromatic), and
- Panasol solvents
  (aromatic solvents)

Panasol Type	AN-1	AN-2	RX-34
Initial Boiling Point (°F)	384	398	365
End Point (°F)	504	525	441
Aromatics Vol.%	99.9	100	100
Gravity API @ 60°F	15.5	13.3	23.2
Mixed Aniline Point (°C)	13.6	13.4	15
Flash, Closed Cup (°F)	195	200	146 (TCC)
Color, Saybolt	+17	−5	−29
Kauri-butanol value	108	102	105

Table 7 provides a listing of chemical-type storage capacities, transfer methods and transfer rates.

TABLE 7

HAZARDOUS CHEMICALS, STORAGE CAPACITIES, AND TRANSFER RATES AT THE AMOCO CHEMICALS CORPORATION, TEXAS CITY

Chemical	Storage Capacity (gals. plus 10^3)	Transfer Method	Transfer Rate (gals. plus 10^3/hr)
Plant A			
Caustic 50%	5.8	Tank truck	–
Caustic 5-10%	2.5	Tank truck	–
Sulfuric acid	20.0	Tank truck	–
Methanol	40.0	Tank truck	–
Toluene sulfonic acid	100,000 lbs	Tank truck	
Plant B			
Aluminum chloride solution 25%	15.0	Tank truck	–
Aluminum chloride solution 25%	20.0	Tank truck	–
Benzene	170.0	Pipeline	13.7
Benzene	2,800.0	Pipeline	13.7
Ethylbenzene	830.0	Tank truck	–
Residue	100.0	Tank truck	–
Sulfuric acid	4.4	Tank truck	–
Ethyl chloride	11.0	Tank truck	–
Caustic solution 50%	23.0	Tank truck	–
Caustic solution 5%	97.0	Tank truck	
Styrene	4,200.0	Pipeline	52.7
Xylene	2,800.0	Pipeline	13.7
Xylene	1,000.0	Pipeline	13.7
Paraxylene	2,800.0	Pipeline	90.0
Paraxylene	160.0	Pipeline	3.0
Heavy aromatic hydrocarbon	63.0	Pipeline	12.0
Light aromatic hydrocarbon	170.0	Pipeline	24.0
Sulfur	97,000 lbs	Tank truck	–
Aluminum chloride (100%)	110,000 lbs	Tank truck	–

Bulk Storage Facilities and Pipelines

The plant has extensive bulk storage facilities, most of which are diked, curbed, or trenched. Each tank is internally inspected and non-destructively tested each time it is removed from service for cleaning. Tanks and piping in service under corrosive conditions are inspected periodically, depending on the severity of the corrosive conditions.

All underground lines between Plants A and B and the American Oil Company's refinery are cathodically protected. An undergound barge-loading line from Plant A is cathodically protected two-thirds of the way from the Plant A docks to Plant A. All lines at Plant B between the American Oil refinery and Plant B dock facilities are protected by a polyethylene coating. When used, flexible hoselines at the dock facilities are tested to a pressure of 250 pounds, and all insulating flanges are checked for conductance. It should be noted, however, that most docklines are rigid metal lines with a packed swivel joint to permit movement and connections between the marine vessel and the dock connection.

Past Spill Experience

The U.S.C.G. Port Captain's office in Galveston has a record of the following spills which were reported by its pollution control staff:

3-11-69 Amoco – light crude oil leak from barge
5-29-70 Amoco – S/S Amoco experienced naphtha spill
3-24-70 Amoco – chemical leaked from valve on dock

Each of the spills was investigated and corrective action was introduced to prevent a repetitive spill.

Spill Control Plans

The plant's spill plan was subjected to revision on June 1, 1970. A complete copy of the plan is provided as Appendix D.

Marathon Oil Company – Texas Refining Division
Foot of Sixth Street
Texas City, Texas

Contacts: Dr. A. L. Benham, Acting Manager
Mr. Harold Smith, Technical Service Manager
Mr. Noble Norton, Engineering Dept. Manager
Mr. Malcolm Johnson, Tech. Advisor/Water Treatment
Mr. L. D. Rice, Manager/Production Control

Date of Survey: September 2, 1970

Description of Property

The Marathon Oil Company commenced operations at its Texas City plant (Figure 8) in 1962. The refinery has a 45,000-bbl/day throughput capacity. In addition to basic petroleum production, the plant produces the following petrochemical products:

- Heavy aromatics,
- Benzene,
- Cumene,
- Propylene,
- Toluene,
- Xylene.

The plant utilizes seven marine dock locations that can handle vessels sized from barges to super tankers (36-foot channel at MLW). The property is quite extensive, located on both sides of the FM Highway 519 (State Hwy. 341) between the Amoco Chemical, American Oil, and Texas City Refining plants.

Plant drainage averages 1.156 mgd at one outfall, and 3.2 mgd at a second outfall. The effluent travels in a roadside ditch under Loop 197 through a culvert, mixes with other plant wastes, and then drains into the industrial barge canal, Texas City Harbor, Galveston Bay, and the San Jacinto-Brazos Coastal Basin. The effluent consists of:

Process water	71.4%
Cooling tower water	24.4%
Boiler blowdown	4.4%

The plant utilizes a 45-acre oxidation pond for in-plant water treatment prior to final discharge from the plant property.

FIGURE 8 AERIAL VIEW OF REFINING DIVISION, MARATHON OIL COMPANY, TEXAS CITY, TEXAS

Hazardous Materials

Hazardous materials handled by Marathon Oil include:

- Benzene – Maximum storage capacity, 50,000 bbl; average storage, 50% of total; production, 3 to 5 mgy,
- Toluene – Maximum storage capacity, 80,000 bbl; average storage, 20% of total; production, 8 to 10 mgy,
- Xylene – Maximum storage capacity, 80,000 bbl; average storage, 20% of total; production, 8 to 10 mgy,
- Cumene – Maximum storage capacity, 80,000 bbl; average storage, 50% of total; production, 120 million bbl/yr,
- Sulfuric acid 98% – Maximum storage capacity, 16,000 gal.; normal consumption averages eight 8,000-gal. tank cars/yr; spent sulfuric acid is used for in-plant water treatment,
- Caustic – Maximum storage, 16,000 gal. average consumption; one 8,000-gal. tan car/month; two tank cars (16,000 gal.) are normally transferred into and maintained in an above-ground storage tank. Spent caustic in 4000-gal. loads is trucked out of the plant monthly by Arlhem Company of Houston.

Bulk Storage Facilities and Pipelines

The bulk storage tanks are located in four tank farms; viz., the North, West, South, and Atlantic tank farms. The farms immediately surround the main processing units. Immediately prior to visiting this plant, two days of heavy rain had overflowed the roadside drainage ditches on FM Highway 519 and partial flooding was evident in the West tank farm. This is apparently a common condition that has been worsened by the retention and diversion of drainage waters to facilitate construction of the hurricane levee that is being built under U.S. Army Corps of Engineers sponsorship. It would seem that the State Highway FM 519 drainage ditches are inadequate to handle even moderate rainwaters since the actual highway was under water. The waters that entered the private plant property of Marathon could mix with any contaminating substances (spills, splashes, etc.) and cause these substances to flow into the highway storm drainage system. The main storage tanks and piping appeared well preserved, and the plant piping was adequately coated and protected at underground locations.

Past Spill Experience

The only spill at Marathon Oil was recorded in the U.S. Coast Guard files in Galveston: October 26, 1969, Marathon Oil spill from separator leaked through into drainage ditch. The separator was adjusted to prevent further leakage.

Spill Control Plan

Marathon Oil is an active member of the Industrial Mutual Aid System of Texas City, and an in-plant spill control plan is part of the company's operating procedures. The plant also owns and maintains 1,600 feet of oil containment boom that could be handled by the Texas City Harbor Pilots Association in the event of a floating chemical or oil spill. There are two boats that can, in an emergency, be made available on a 24-hour day basis to position the oil-containment boom.

Malone Service Company
Malone Trucking Company
Malone Chemical Products Company
300-20th Street, S.
Texas City, Texas

Contacts: Mr. Paul Malone, President
Mr. Arthur Malone, Vice President

Date of Survey: August 24, 1970

Property Description

The Malone Service Company collects and disposes of plant waste materials, combats oil and hazardous material spills, and conducts ship and barge draining. The downtown location houses the main office and chemical trucking terminal. The firm's main waste treatment and disposal area is located southwest of town in a 56-acre tract. (Monsanto Chemical also operates a 12-acre lime disposal facility on the property.) The land is flat and drains through ditches and settling pits into Swan Lake, a tidal "lake" connecting into Galveston Bay. The disposal area can store and treat 10,500 gpd of chemical waste. Six company-owned 130-bbl (5,460 gal.) capacity tank trucks collect the spent chemicals from various plant and dock locations and transport them to the disposal site. The disposal facilities consist of a series of six spent-chemical storage and disposal ponds and reclaiming tanks, a still, an evaporator, and a deep injection disposal well. The well was drilled under the supervision of the Geologist of the State of Texas. It has a total depth of 5,300 feet and is cased to a depth of 5,100 feet.

The initial treatment pond is slightly acidic, having a pH of 5.5. A small amount of Monsanto waste lime is added to maintain a pH of around 7. The material has a natural overflow into a 50 by 100 by 10-foot unlined pond that maintains a water level of about 5 feet. A large quantity of suspended salts, chromates, and other solids is settled out at this phase, with the material flowing into a second 50 by 50-foot pond. The material is then lifted by a pump to pass through either of two available filters, with the filtered liquid backflushed into the salt pit. The material then passes through a metering system into the cased deep injection well.

There are also five oil storage tanks and three oil/water settling pits. The contaminated water passes through a catch basin where it is separated from the oil. The reclaimed oil is stored in a 15,000-bbl capacity storage tank. Plans are being developed for the installation of a smokeless incinerator to dispose of waste oil that cannot be reprocessed. Currently, all oil is sold to reprocessors for reprocessing or for oiling road surfaces within the state.

Hazardous Chemicals

The product handled by Malone can only be classified as industrial petroleum, chemical wastes, and crude oil contained in a 90% water mix, which is a varying mixture of waste chemicals resulting from petroleum and chemical product manufacturing.

Bulk Storage Facilities and Pipelines

The plant is new, and during the survey only a few test runs had been attempted. Well pumping was to commence on September 1, 1970, and full waste processing was anticipated for October 1, 1970. The storage tanks and process vessels gave a new or reconditioned appearance. Plans were under way to increase the dikes around the tanks to a height of 5 feet. All pipelines are stilt-supported to a height of 14 feet above sea level as a precaution against high-water flooding. In the event of a flood higher than the diked enclosure, the spent chemicals in storage would be intermixed with the flood water.

Past Spill Experience

The State Water Quality Board records showed a 6,000-bbl reclaimed oil spill at Malone Service; 200 bbl reached Swan Lake where it was burned. The spill was attributed to the action of an ex-employee who intentionally opened the valves of two tanks to permit the oil to escape. The valves were not locked at the time of this survey.

Spill Control Plan

All electric control switches (pump controls, etc.) are installed 7 feet above grade level and 14 feet above sea level to protect them from flood situations. Electric motors, and even some buildings, can be moved following warning of a hurricane or high tide. It is anticipated that open pits, with the exception of the chemical settling pit, will be removed from service within a year, and that they will be replaced with a system of closed tanks to control the previously described flood situation. An additional flood precaution can be effected with the complete flooding of all tanks to anchor them securely into position. The concern has the advantage of being Texas City's main spill control agency, having the experience and equipment to contain and clean up most types of lighter-than-water material spills. Their equipment includes floating booms, vacuum pumps, and various chemical absorbents, dispensers, and burning and singeing agents.

Texas City Refining, Inc.
East Galveston Highway
Texas City, Texas

Contacts: Mr. L. W. Robbie, Vice President/Operations
Mr. P. D. Parks, Supervisor/Environmental and Corrosion Control
Mr. A.E. Bynum, General Refinery Superintendent

Date of Survey: August 31, 1970

Property Description

Texas City Refining, Inc. has been a producer of petroleum (65,000 bbl/day) and related products in Texas City since 1951. The plant is quite extensive (Figure 9) and in close proximity to the properties of Marathon Oil Company, Amoco Chemical Corp., Plant A, and the Texas City Terminal Railway Company.

Plant production drainage averages between 900 to 1200 gpd, most of the waste material emanating from the plant's sulfide stripping process. The discharge is classified as 10.6% boiler blowdown water, 39.2% cooling water, 13% process water, 37.2% service water, and others. In-plant water treatment is quite extensive, flowing through a primary treatment pond into an aerated lagoon, then through four additional treating ponds prior to discharging into a common drainage ditch which carries drainage from FM Highway 519 (State Highway 341) and Amoco Plant A. The ditch terminates in the Texas City Railway Company Barge Canal, which has tidal flow into the Texas City Ship Channel and Galveston Bay. Figure 10 shows the water-treatment flow sequences.

Hazardous Materials

After petroleum, the main product at Texas City Refining is considered to be propylene; however, plant officials provided a list of materials used and/or processed within the plant (Table 8). The actual bulk storage figures and annual chemical consumption rates were not made available during the survey. Hazardous materials are delivered neither by barge nor ship. Such materials are received and shipped either by truck or rail, using local common carriers and railroad facilities.

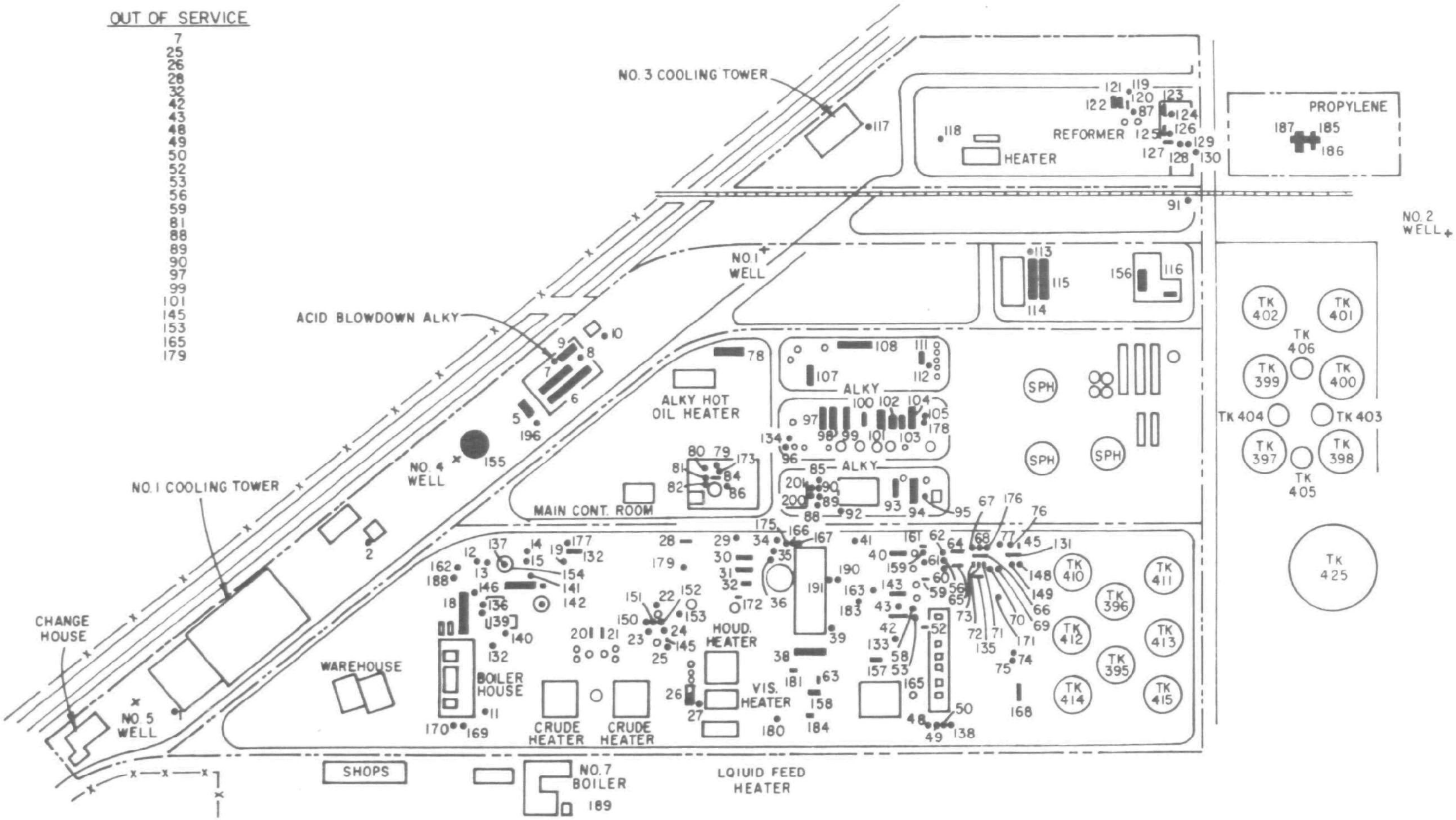


FIGURE 9 GENERAL LAYOUT OF TEXAS CITY REFINING CORPORATION, TEXAS CITY, TEXAS

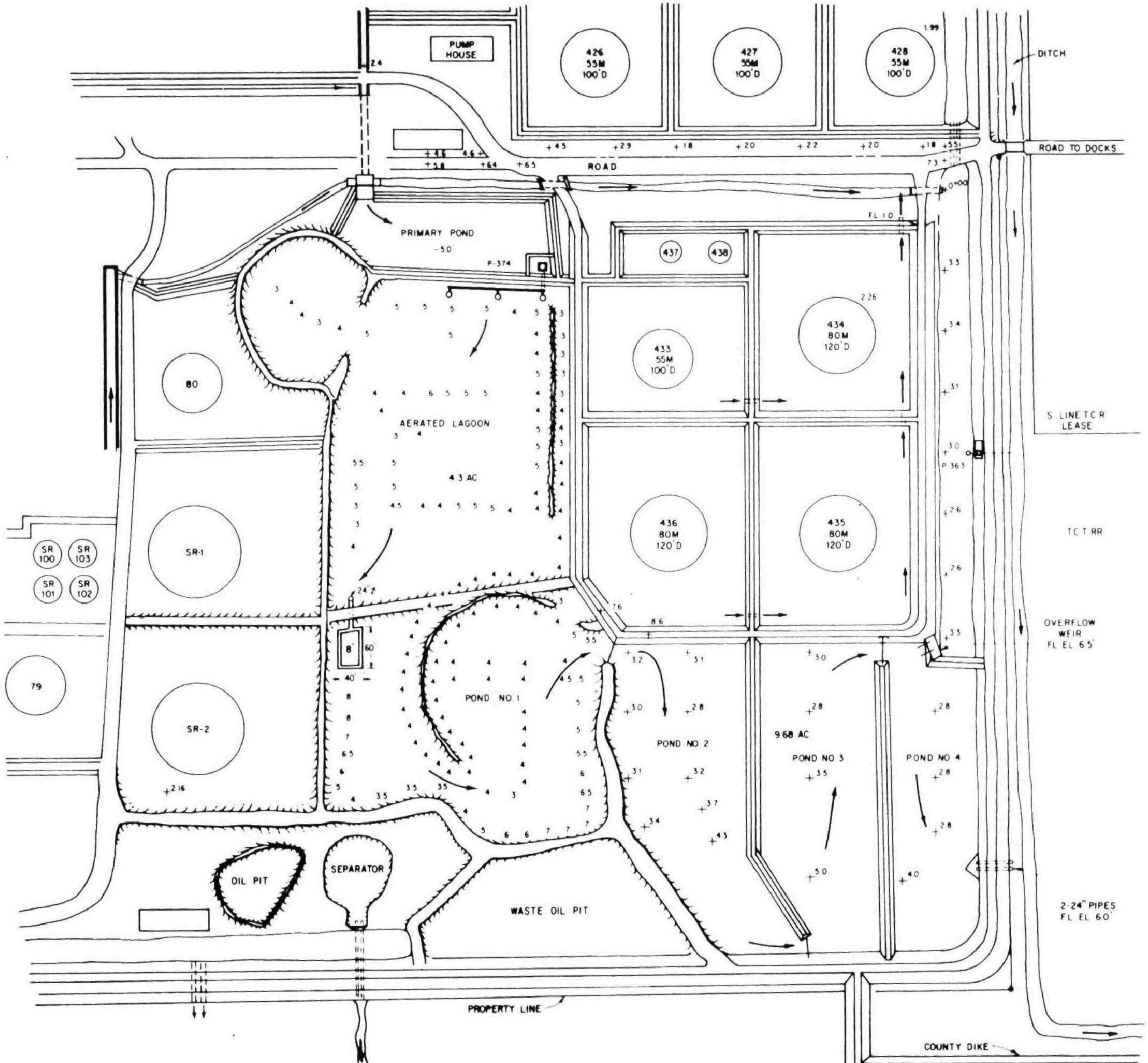


FIGURE 10 TOPOGRAPHICAL SURVEY OF TEXAS CITY REFINING CORPORATION PLANT, TEXAS CITY, TEXAS, SHOWING OIL AND WATER SEPARATOR FOR PLANT EFFLUENT

TABLE 8

HAZARDOUS CHEMICALS HANDLED AT TEXAS CITY REFINING, INC.

	Chemical	Supplier	Unit
1.	Koppers liquid oil bronze	American Aniline	250-lb drum
2.	Liqui treat	Betz Laboratories	Appr. yearly usage, 7500 gal.
3.	Dianodic 116	Betz Laboratories	4000 lbs.
4.	Slimicide C-30	Betz Laboratories	600 lbs.
5.	Duosperse 408	Betz Laboratories	1500 lbs.
6.	Agel C-17	Betz Laboratories	4000 lbs.
7.	OGA 290	Chevron Chemical	LCL-LTL
8.	Hydrated lime	Dixie Chemical	50-lb bags
9.	Sodium sulfite	Dixie Chemical	100-lb bags
10.	Aluminum sulfate	Dixie Chemical	100-lb bags
11.	Soda ash	Dixie Chemical	100-lb bags
12.	Liquid chlorine	Dixie Chemical	150-lb cylinders
13.	Liquid chlorine	Dixie Chemical	2000-lb cylinders
14.	Aqua ammonia	Dow Chemical	Currently pending
15.	Aqua ammonia	McKesson Chemical	Currently pending
16.	Caustic soda solution	Dow Chemical	10,000 gal. T/C
17.	Sulfuric acid	E. I. du Pont	T/C or T/T
18.	HF acid	E. I. du Pont	T/C or T/T
19.	Tetra-mix 50	E. I. du Pont	T/C
20.	Oil orange liquid	E. I. du Pont	240-lb drum
21.	Oil red liquid	E. I. du Pont	240-lb drum
22.	Oil blue "B" Liquid	E. I. du Pont	240-lb drum
23.	AFA-1	E. I. du Pont	240-lb drum
24.	AO-23	E. I. du Pont	240-lb drum
25.	DMD-2	E. I. du Pont	240-lb drum
26.	DMA-4	E. I. du Pont	400-lb drum
27.	FOA-208	E. I. du Pont	400-lb drum
28.	Paradyne 20	Enjay Chemical	Appr. 390-lb drum
29.	733-PDA-D-75	Ethyl Corporation	5 drums or more LTL 55-gal. drums
30.	Diesel ignition improver-2	Ethyl Corporation	LTL, 5 drums or more
31.	Red-B liquid dye	Ethyl Corporation	55-gal. drums 240-lb drums
32.	Red-G liquid dye	Ethyl Corporation	55-gal. drums 240-lb drums
33.	Orange liquid dye	Ethyl Corporation	55-gal. drums 240-lb drums
34.	Orange-R liquid dye	Ethyl Corporation	55-gal. drums 240-lb drums
35.	Blue liquid dye	Ethyl Corporation	55-gal. drums 240-lb drum
36.	Bronze liquid dye	Ethyl Corporation	55-gal. drums 240-lb drum
37.	Black liquid dye	Ethyl Corporation	55-gal. drums 240-lb drum
38.	Yellow liquid dye	Ethyl Corporation	55-gal. drums 240-lb drum
39.	Green liquid dye	Ethyl Corporation	55-gal. drums 240-lb drum
40.	Purple liquid dye	Ethyl Corporation	55-gal. drums 240-lb drum

TABLE 8 (Continued)

	Chemical	Supplier	Unit
41.	MLA 500	Ethyl Corporation	Bulk
42.	Grade 110 catalyst	Filtrol Corporation	70T H/C
43.	HZ-1 catalyst	Houdry	70T H/C
44.	MAF-50R	Houston Chemical	Bulk
45.	Liquid caustic soda	Jefferson Chemical	Bulk
46.	Oxygen	Koenig Welding	Bulk
47.	Nitrogen	Koenig Welding	Bulk
48.	Hydrogen	Koenig Welding	Bulk
49.	AEP-151	Milchem Corp.	Bulk
50.	Cronox 605	Milchem Corp.	Drum
51.	Cronox 624	Milchem Corp.	Drum
52.	Cronox 650	Milchem Corp.	416-lb drum
53.	Throcon R-10	Milchem Corp.	600-lb drum
54.	Durabead 6-B Catalyst	Mobil Chemical	50T H/C
55.	Nalco 39	Nalco Chemical	500-gal. drum
56.	Nalco 161	Nalco Chemical	55-gal. drum
57.	Nalco 262	Nalco Chemical	55-gal. drum
58.	Nalco 372	Nalco Chemical	Bulk
59.	Nalco 373	Nalco Chemical	Bulk
60.	HF acid	Olin Chemical	Bulk
61	United granulated water softening salt	Ranch & Home	100-lb bags (min. order 100)
62.	Reynolds activated RA-1	Reynolds Metal	100-lb burlap bags
63.	Primene 81-R	Rohm & Haas	Drums
64.	Crushed limestone 1/2" to 1/4" (S) 1" to 3/8"	Servtex	Bulk
65.	Sulfuric acid	Smith Douglas	Bulk
66.	Sulfuric acid	Stauffer Chemical	Bulk
67.	HF acid	Stauffer Chemical	Bulk
68	Hydrated lime	Thompson-Hayward	50-lb bags
69.	Sodium sulfite	Thompson-Hayward	100-lb bags
70.	Aluminum sulfate	Thompson-Hayward	100-lb bags
71.	Soda ash 58% light	Thompson-Hayward	100-lb bags
72.	Cat lubricant	Thompson-Hayward	50-lb bags (36,000 lbs)
73.	Hydrogen	UCC	Bulk
74.	Nitrogen	UCC	Bulk
75.	Oxygen	UCC	Bulk
76.	Polyflo 123	UOP	LTL
77.	Unicor LHS	UOP	LTL
78.	Unicor	UOP	LTL
79.	Cat lubricant	Van Waters & Rogers	36,000 lbs (50-lb. bags)
80.	Liquid caustic soda	Wyandotte Chemical	Bulk

LTL = less than tank load

LCL = less than car load

H/C = hopper car

Bulk Storage Facilities and Pipelines

The Texas City Refining plant has extensive tank fields. There are no buried tanks, and the only buried pipelines are used only to transport hydrocarbons. All buried lines are cathodically protected. The tetra-ethyl lead storage tanks offer considerable potential for property damage and personal injury, and are confined within a special building that has restricted entry; the storage tanks are mounted over pit enclosures. The "lead" tanks are subjected to DuPont/Ethyl inspection service which is quite extensive. The remaining tanks are subjected to regular ultrasonic integrity testing. No flexible hoselines are used for the transfer of hazardous materials. Diking, trench, pit, and containment curb protection is provided to confine accidental spills of acids effectively. The remaining chemicals (Table 8) are not all protected in this manner.

Past Spill Experience

A sulfuric acid spill was experienced two years ago, when a fiberglass storage tank split and released its acid content. The U.S. Coast Guard records one minor oil spill on February 18, 1970 when crude oil overflowed from a drip pan. Instructions were given for more frequent inspection and emptying of drip pans.

Spill Control Plan

Shift foremen, who are on 24-hour duty, have been trained in spill control by the plant's Safety Department. Spill reports are routed to top management. Individual workers are knowledgeable on procedures that should be undertaken to control an accidental spill effectively. The plant is an active member of the Texas City Industrial Mutual Aid Plan (Appendix C).

Reagent Chemical & Research, Inc.
East Galveston Highway
Texas City, Texas

Contacts: Mr. George J. Melder, Plant Manager
Mr. Louis A. Claveloux, Manager Engineering (N.J./Hq.)

Date of Survey: September 1, 1970

Property Description

The Reagent Chemical & Research, Inc., plant is a new facility that recently acquired a building and unfenced, open-land space on the Texas City Terminal Railway property. Work was under way to complete the installation of the processing and storage vessels at the time of the survey. The operation will involve the recovery of ammonium chloride from 20% to 25% ammonium chloride liquor effluent originating from the nearby Monsanto Company plant. The anticipated annual production of ammonium chloride recovery is in the vicinity of 8 million bbl/year. Plant drainage has been estimated at 40,000 to 48,000 gpd through an open ditch across the Railway property into Galveston Bay. The predicted effluent analysis, as filed with the State Water Pollution Control Board in Houston, is 72% water, 25% ammonium chloride, 2.896% methanol, 0.1% methyl lactate, and 0.004% organic nitrates.

Hazardous Materials

Hazardous materials handled by Reagent Chemical & Research, Inc., include:

- Ammonium chloride liquor (20-25%); maximum storage capacity, 99,000 gal.;
- Hydrochloric acid (32%); maximum storage capacity, 6000 gal.;
- Anhydrous ammonia; maximum storage capacity, 2000 gal.; and
- Methanol.

Since the plant was not in active production at the time of the survey, the annual consumption of listed materials could not be assessed.

Bulk Storage Facilities and Pipelines

The plant has three 33,000-gal. capacity, undiked, ammonium chloride liquor (20-25%) storage tanks. The tanks have a 0.5-inch wall thickness, are rubber-lined, and were originally mounted on a marine barge owned by the Dow Chemical Company. The tanks, which were recently hydrostatically tested, will be open-vented when in service. The firm also has a new 6000-gal. capacity fiberglass constructed hydrochloric acid (32%) storage tank that has also been pressure-tested and will be open-vented when in service. The remaining tank, a 2000-gal. anhydrous ammonia storage unit, has been built and equipped to all ICC code specifications. All exposed pipelines and valves are of 2-inch diameter PVD and PVC construction. U.S. Navy tests of this type pipe for retaining core samples indicates very little dehydration of the cores, although the design of the valves makes it almost impossible to lock them in the closed position. The ammonium chloride liquor will be transferred from the Monsanto plant during daylight hours (8 a.m. to 4 p.m.) in below-ground fiberglass pipe. The finished product – reclaimed ammonium chloride – will be bagged for shipment.

Past Spill Experience

None to date.

Spill Control Plan

Plans are under way to install a security fence around the bulk storage area and to cover the ground within the storage tank area with an oyster-shell surface. Although none of the tanks is equipped with high liquid-level alarms, an alarm device has been installed as an integral part of the production system. The plant would have the immediate assistance of Texas City Terminal Railway and Monsanto spill specialists in the event of an emergency.

B. BALTIMORE, MARYLAND

The City of Baltimore, located on the Patapsco River near its entry into Chesapeake Bay, is one of the major harbor ports of the United States. The city and the harbor areas it surrounds – and to which it is adjacent – handle large amounts of materials from ships, barges, railroads, and trucks.

1. Drainage

The drainage from the city and its industrialized areas into the Patapsco River and the Chesapeake Bay emanates from the following major points:

1. Jones Falls, draining into the Inner Harbor and the Northwest Branch of the Patapsco River;

2. Gwynns Falls, draining into the Middle Branch of the Patapsco River;

3. Curtis Creek, draining into Curtis Bay and then into the Patapsco River, and

4. Colgate Creek, draining into the Patapsco River.

Because of the large number of industrial plants located on or near the harbor area, drainage occurs directly from property into the river and bays from a large number of outlets.

2. Potential Source of Hazardous Spills

Before beginning field surveys of the Baltimore area, information on the nature of the industries involved, the size of their operations, and records of past spills of hazardous materials was sought. An excellent index of the probable major sources of potentially hazardous spills was obtained through reviews of the Directory of Maryland Manufacturers for 1969-1970 and the Waterborne Commerce of the United States for the Calendar Year 1968. For example, approximately 75% of the total port tonnage is represented by ores, coal, and petroleum products, with each totalling approximately 25% of the total. The major bulk-liquid hazardous material handled in Baltimore is sulfuric acid which accounts for slightly over 1% of the total port traffic. Liquid sulfur, sodium hydroxide, molasses, and a number of chemical products not otherwise classified contribute slightly over 1% of total port traffic on a combined basis.

Based on our assessment of the port traffic, it was apparent that manufacturers or users of basic bulk chemicals would be expected to present the greatest potential for spills of hazardous materials because of the volumes handled and the frequency of handling. Consequently, we established a tentative list of sources for discussion with members of the Baltimore Harbor Project of the Maryland Department of Water Resources.

The inner harbor in Baltimore appeared to be the most polluted waterbody observed during the survey. Floating solid debris was much in evidence on the surface of the water. Chemical runoff from open stockpiles of material is common, and many hues were evident during an aerial survey we made. Although a number of extensive spills have taken place, constant effluent discharges create the greatest problem in the area.

As a result of the reviews cited above, we selected certain plants for the survey. The reports of this survey follow.

3. Past Spill History

In discussions with members of the Maryland Department of Water Resources, Baltimore City Sewers, U.S. Coast Guard, Maryland Port Authority, and the Corp of Engineers regarding past spills of hazardous materials, we found that the recent (July 1970) spill of concentrated sodium hydroxide into the harbor is the only one that was documented to any degree. Other spills or entries of hazardous materials, such as creosote, paints, dyestuffs, plating solutions, pickle liquors, and so on, were mentioned, but very little definitive information could be obtained. In some spill instances, such as dyes and pickle liquors, the sources have been established, with orders issued the offending firms to adopt methods for preventing such spills from entering water courses in the future.

We got the impression that these spills could be largely attributed to operational inattention or poorly designed facilities. The past history of spills was traceable largely to visible or floating substances, such as creosote, paint, or dyes, to larger scale spills, such as the concentrated sodium hydroxide spilled during transfer to a barge by Keystone Shipping Company's vessel, the Chancellorsville, or to toxic substances, such as heavy metals. The spills were detected by various methods. The large number of small spills that could have occurred during transfer operations at plants, loading terminals, and so on, could have contributed significant amounts of hazardous materials to the water courses, but in individual quantities difficult to document.

Continental Oil Company
3441 Fairfield Road
Baltimore, Maryland

Contacts: Mr. Frank Wilson, Safety Director
Mr. Alan Goldfarb, Chemist

Date of Survey: September 1, 1970

Property Description

The Continental Oil Company plant (Figure 11), located on the Patapsco River, has provisions for receiving and shipping hazardous materials by ocean tanker and barge. Finished products are shipped by truck, tank car, and tanker.

Hazardous Materials

The plant manufactures detergent alkylates from petroleum fractions. The hazardous raw materials are chlorine, sulfuric acid, and concentrated sodium hydroxide solutions. Spent mixed acids (hydrochloric and sulfuric) are produced, along with hydrochloric acid and an aluminum chloride solution which are sold as by-products.

Bulk Storage Facilities and Pipelines

Sodium hydroxide (50%) is stored in a 1000-barrel (42,000 gallon) tank in a diked area. Sulfuric acid is stored in two 125-barrel tanks; these are not presently located in a diked area, but they will eventually be diked. Hydrochloric acid generated in the process is stored in a 5000-barrel tank for shipment as it is sold. Spent mixed acids are stored in two curbed tanks of 300 to 400 barrels, and an aluminum chloride by-product solution is stored in six fiberglass-reinforced tanks estimated to hold about 15,000 gallons each.

Past Spill Experience

The Continental Oil dock was the scene of a large spill of concentrated sodium hydroxide during transfer from tanker to barge by companies using Continental's facilities, but the caustic was not destined for its use. There have been no other spills of hazardous materials in large quantities.

Photo Courtesy of Air Photographics, Incorporated

FIGURE 11 AERIAL VIEW OF BALTIMORE, MARYLAND, HARBOR SHOWING GENERAL LOCATION OF CONTINENTAL OIL COMPANY

Spill Control Plans

There is a large supply of oyster shells stored near the diked area which contains the hydrochloric acid. The oyster shells are used to neutralize occasional spills made in transfer operations. The water from the diked areas can be drained through valved sewer connections and will thus pass through an API separator and beds of oyster shells before entering the Patapsco River. Operating personnel have a manual outlining protective procedures, and safety meetings held periodically stress these procedures. Notifications of spills go to the shift foreman who must make rapid spot-decisions on methods of handling them. However, since such spills commonly occur in normal plant operations, the quantity is not large. Because of the chlorine handling, all personnel entering the plant are equipped with gas masks. The potential for spillage at this plant appears minimal, and fail-safe methods exist for the containment of most hazardous materials. Completion of the diking around the sulfuric acid tanks and completion of the dike maintenance program already under way should materially improve the capability for controlling spills.

Swift & Company
2000 Chesapeake Avenue
Baltimore, Maryland

Contact: Mr. Gue, Plant Manager

Date of Survey: September 2, 1970

Property Description

The Swift & Company property, located on the Patapsco River at the end of Chesapeake Avenue, is the former Mobil Oil fertilizer plant which has been converted exclusively to the production of dry mix fertilizers.

Hazardous Materials

Nitrogen solutions, anhydrous ammonia, phosphoric acid, and sulfuric acid constitute the hazardous materials in this plant.

Bulk Storage Facilities and Pipelines

Liquid raw materials are brought in by tank car in the case of nitrogen solutions, phosphoric acid, and anhydrous ammonia. Sulfuric acid is delivered by tank truck. These materials are stored in diked tankage areas, the maximum storage capacity of which is approximately 25 tons for anhydrous ammonia, and 90 to 100 tons for the other materials. The unloading rates are low and the pipelines are small and of limited length.

Past Spill Experience

There have been no spills of any consequence because every effort is made to contain the valuable raw materials.

Spill Control Plans

Unloading and transfer procedures are dictated by standard companywide procedures and insurance safety regulations. No provisions for drainage of water from diked tank areas through waste treatment plants have been made. Drainage sewers empty into a ditch, but they have never been needed, since the porosity of the ground is sufficient for natural percolation to take care of the rainfall within the diked area. The major spill problem at Swift exists in the potential for percolation into the ground water. Because of the small amount of chemicals handled and the reactive nature or biological utilization, a spill is judged to have low potential for significant contamination.

Alcolac Chemical Corporation
3440 Fairfield Road
Baltimore, Maryland

Contact: Dr. Peter P. Bouroff, Director of Research

Date of Survey: September 2, 1970

Property Description

The Alcolac Chemical plant is located on property with no river frontage. Drainage from the plant goes to a storm drain that ultimately enters Curtis Bay through Stonehouse Cove. The property is fenced. This plant produces detergents as its major product line, along with a number of special chemicals.

Hazardous Materials

The raw materials are mostly water-soluble liquids. These include sulfuric acid, chlorosulfonic acid, liquid sodium hydroxide, anhydrous ammonia, and organic compounds, such as fatty alcohols, triethylenemelamine, diethylene-melamine, ethylene oxide, acetone, and isopropanol. Some process intermediates are active monomers.

Bulk Storage Facilities and Pipelines

Raw materials and products are shipped by tank cars and tank trucks. Sulfuric acid is stored in tanks ranging in size from 1,000 to 14,000 gallons; sodium hydroxide is stored in 15,000-gallon tanks. In-process tanks of various sizes are used. Storage tanks are generally located in diked areas or in process plants equipped with curbing and drainage. Hydrochloric acid as a 28-30% solution is stored prior to shipment. The firm would not release a breakdown of individual volumes of chemicals handled. Alcolac usually ships about 3 to 4 million pounds of products per month which requires some 2 to 3 million pounds of liquid raw materials.

Past Spill Experience

Spills at Alcolac have all been minor, and have taken place in areas where clean-up or recovery was possible.

Spill Control Plan

Automatic dumping procedures, along with containing tankage, are incorporated into the process at Alcolac because of personnel hazards and property protection requirements. Plant drainage proceeds through beds of marble chips for neutralization prior to running into a storm drain that enters Curtis Bay through Stonehouse Cove. In-plant control of spillage is based largely on personnel safety requirements. Good housekeeping, pressure from regulatory groups, and the fact that Alcolac has a water pollution control subsidiary combine to make the company quite conscious of its image, resulting in a low potential for hazardous spills at this site. Also, the final products are biodegradable materials which, for minor spills, might be readily treated by natural biological processes. Some solid wastes and sludges are sent to a landfill area operated by a licensed contractor. Plant drainage water is monitored for pH and the instruments are alarmed.

Environmental Technology, Inc.
6001 Chemical Road
Baltimore, Maryland

Contact: Mr. Robert Taylor, Owner

Date of Survey: September 3, 1970

Property Description

Environmental Technology, Inc., on a rental basis, uses the property on Chemical Road for pilot plant work on a proprietary waste treatment process. The company also leases storage tank facilities at the site of the former duPont plant on Curtis Bay. The storage tank facilities were not visited.

Hazardous Materials

This company is operating a waste collection service in the Baltimore area. Its service consists of storing wastes for future processing. The wastes are segregated only on the basis of corrosivity since some of the tankage is constructed of plain carbon steel.

Bulk Storage Facilities and Pipelines

The concern has leased a 200,000-gal. rubber-lined tank, in which it proposes to store corrosive wastes, and two carbon steel tanks, one of 150,000-gal. and the other of 2,000,000-gal. capacity. The firm has made arrangements with a local transport company, Skyline Transport, to collect the wastes. Only about 10,000 gallons of waste are in storage at the present time. We did not see the tankage. However, we were told that the tanks in which organics are stored, presumably the 150,000- and 2,000,000-gal. carbon steel ones, are diked.

Past Spill Experience

None has occurred.

Spill Control Plan

Diked storage is apparently the only control plan since disposal methods have not yet been developed.

Minerac Corporation
3520 Fairfield Road
Baltimore, Maryland

Contact: Mr. L. E. Strow, Plant Manager

Date of Survey: September 3, 1970

Property Description

The Minerac plant, which is land-locked, is located about 500 yards from the Patapsco River. Its drainage goes into a small stream which enters the river. The entire area is fenced.

Hazardous Materials

The company manufactures and ships proprietary chemical formulations used in the mineral dressing industry, but it would not identify them. However, we did ascertain that the raw materials it uses include sodium hydroxide, sulfuric acid, carbon disulfide, and various alcohols.

Bulk Storage Facilities and Pipelines

All chemicals are received in tank cars or tank trucks and products are shipped out in tank cars and drums. Various small tanks up to 10,000 gallons in capacity are used to store chemicals; most of these tanks are located in buildings. Carbon disulfide is stored in an underground 10,000-gal. tank for fire insurance reasons. Permission to survey the plant was not granted, and no listing of tankage volumes or plant production was released by the firm.

Past Spill Experience

Minerac, according to its management, has had waste disposal problems, viz., sodium sulfides and some nickel and sludge washings from tanks. Those effluents have apparently come from poor control of wash waters, and so on, and not from uncontrolled spills.

Spill Control Plan

No special plan for handling spills exists, other than those for routine operations. Curbed areas in the process buildings are drained through a limestone pit to meet pH regulations on effluents. At the present time, up to 10,000 gallons of a sodium sulfide solution might be stored, awaiting pickup by Rollins-Purle with whom Minerac has a contract for waste disposal. These wastes are trucked to the R-P plant in New Jersey by Matlack. Transfer rates for loading and unloading are in the low hundreds of gallons per minute range. The small size of the operation and the value of the product indicates that the potential for significant spillage entering a water course is quite limited.

SCM-Glidden-Durkee
Hawkins Point Road
Baltimore, Maryland

Contact: Mr. Leonard D. Burgess, Pollution Control Engineer
Process Engineering Department

Date of Survey: September 4, 1970

Property Description

The SCM-Glidden-Durkee plant is located on Hawkins Point Road in the lower Patapsco River. Its principal product is titanium dioxide. Drainage from the area ultimately reaches the river. Apparently the plant has good security protection. Permission to inspect the property could not be obtained so the following information is based on answers to questions posed.

Hazardous Materials

- Sulfuric acid
- Sodium hydroxide (50% solution)
- Hydrochloric acid
- Aqua ammonia
- Chlorine

Bulk Storage Facilities and Pipelines

Sulfuric acid is barged into the plant from local sulfuric acid manufacturers and off-loaded into a 2000-ton undiked storage tank located approximately 600 feet from the Patapsco River at Hawkins Point. Another (approximately 500-ton) storage tank is used along with numerous in-process tanks of unspecified size. Sodium hydroxide as a 50% solution is brought into the plant by tank trucks and stored in two 5000-gallon tanks. Hydrochloric acid is delivered by tank truck and stored in a 16,000-gallon tank. Aqua ammonia is delivered to the plant by tank car and is pumped into a 16,000-gallon tank. Chlorine is received in tank cars from which it is used directly.

Past Spill Experience

Past spills have all been local in nature, involving broken lines, leaking pumps, and so on, and have been handled efficiently.

Spill Control Plan

SCM's in-plant handling facilities can best be described as conventional for a chemical plant. Since easily traceable solids (colored) can be emitted, Glidden-Durkee uses holding ponds for settling prior to emission into the river. A major effort is made to control pH and, we were told, provisions are made to neutralize before waste waters enter the settling basins in the river. Operating personnel are trained in spill cleanup around outside tanks, especially with respect to acids, and supplies of limestone are available for pouring onto acid spills.

Leidy Chemicals
900 South Eutaw
Baltimore, Maryland

Contact: Mr. Tom Strohm, Vice President

Date of Survey: September 4, 1970

Property Description

The Leidy Chemicals plant is located in Baltimore in rather old buildings which are conveniently located for rail and truck shipments. Its drainage runs into the Baltimore sanitary and storm sewer system. The premises are fenced, although tank car sidings are located on a commercial street and are not secured.

Hazardous Materials

The list of hazardous materials is essentially that of bulk commercial chemicals. Those which have the greatest spill potential are listed in the following section.

Bulk Storage Facilities and Pipelines

Volatile liquids are stored in an underground tank according to Baltimore Fire Department regulations. The following storage volume estimates were provided:

• Hydrochloric acid	15,000 gallons
• Hydrofluoric acid	15,000 gallons
• Sulfuric acid	15,000 gallons
• Acetic acid	10,000 gallons
• Inhibited hydrochloric acid	6,000 gallons
• Ferric chloride solution	6,000 gallons
• Nitric acid	8,000 gallons
• Phosphoric acid	Not provided
• Sodium hydroxide	Tank cars on rail sidings
• Volatile solvents	Two 7500-gal. tanks, three 5000-gal. tanks
• Anhydrous ammonia	18,000 gallons
• Aqua ammonia (30%)	35,000 gallons
• Chlorine	Usually less than six 100-lb cylinders

Most loadings and unloadings are made from the top of the tanks. Consequently, air pressure transfer is effected. Many of the chemicals must be packaged and shipped according to ICC regulations.

The following general information on magnitude of major chemicals handled was provided:

Hydrochloric acid and sulfuric acid – one tank car/week each
Hydrofluoric acid – one tank car/month
Nitric acid – two tank cars/month
Ferric chloride – 50,000-60,000 gallons/year
Inhibited hydrochloric acid – 50,000-60,000 gallons/year
Volatile liquids – 1 million gallons/year

Past Spill Experience

Leidy has a low accident rate which, it purports, stems from the necessity of achieving the best possible insurance rates. The Baltimore Fire Department regularly inspects the premises. Because of the large number of transfers, there is a large number of drips, and so forth. Consequently, a large amount of flushing water is kept flowing in the plant. No large spills have occurred at this facility, although small drips are an inadvertent aspect of its operation.

Spill Control Plan

In the acid handling areas, the water collected from drainage areas is passed through beds of marble chips for neutralization before going into a storm sewer. It is apparent that dilution and flushing will become the method of coping with spilled chemicals. The installation is well operated for receiving, repackaging, warehousing, and shipping. The tankage and equipment seem to be well maintained and of modern design, although the building is very old. Transfer hoses are inspected and serviced on a monthly basis by an outside contractor.

At this location, any spill enters the storm sewer system; of course, a significant portion of the acids is removed by neutralization. The unloading of sodium hydroxide from tank cars on the siding occurs along the street front and any spill runs down the gutters into the sewers. In this case the ICC regulations regarding tank car designs may be adequate protection unless a tank ruptures.

Davison Chemical
W. R. Grace Company
101 North Charles Street
Baltimore, Maryland

Contact: Mr. Bert Mobley, Pollution Control Engineer

Date of Survey: September 16, 1970

Property Description

The Davison plant is located on Curtis Creek. Permission to inspect the property could not be obtained. However, the results of questions posed their representative are presented below.

Hazardous Materials

Liquid sulfur
Sulfuric acid
Oleum
Sodium silicate
Phosphoric acid

Bulk Storage Facilities and Pipelines

Molten sulfur is received via tank ship, and it was surmised that about 10,000 tons are off-loaded into a tank estimated to have a storage capacity of about 10,000 tons. This tank, which is not diked, is located about 150 feet from Curtis Creek. Unloading rates are unknown, but are estimated to be as great as a 1000 tons per hour.

Sulfuric acid is shipped out by barge, rail, and truck, with spent acid returned to the plant in the same manner. It was estimated that at least 12 tanks were used to store sulfuric acid, with the capacity ranging from 50,000 to 500,000 gallons, i.e., from perhaps 375 to nearly 4000 tons. We estimate that the firm could possibly store between 10,000 and 20,000 tons of concentrated sulfuric acid at any time. Tanks are not diked and high rate transfers are made through a 6-inch line (indicating that transfer rates of possibly 800 to 1000 gpm are used). We were told that the usual provisions of valving, pumping, and so on, are made for notification of spills. No estimate of yearly tonnage was provided.

Phosphoric acid is brought into the plant in railroad tank cars, and is used directly from these cars. Very few cars are used per year. A sodium silicate solution is made and stored. It was estimated that maximum storage might involve three to four tanks, each containing from 50,000 to 100,000 gallons. Alkaline filtrates are stored in small quantities (unspecified) and used to neutralize acid wastes or sold to other companies for neutralization.

Past Spill Experience

All spills have been of a localized nature and handled by established procedures, such as the neutralization of acids by lime or oyster shells.

Spill Control Plan

At the Davison plant, waste water from process areas and cooling waters run into a lagoon. Monitoring of pH (acid or caustic addition) is used to ensure that records are maintained for regulatory purposes. Continued pH values outside of a nominal range call for shutdown and repair of equipment.

Manganese Chemicals
Diamond Shamrock
711 Pittman Road
Baltimore, Maryland

Contact: Mr. Kenneth W. Olson, Engineer

Date of Survey: September 14, 1970

Property Description

The Manganese Chemicals plant extracts manganese chemicals from ore. The plant drainage system ultimately discharges into Curtis Creek before reaching Curtis Bay. Normal plant security fences were in place, and security personnel were obvious since the plant was on strike. The plant is about 10 years old and seems to be well maintained; however, because of the nature of its processes, it is not especially clean looking.

Hazardous Materials

Hazardous materials handled in its operation include:

- Sulfuric acid
- Aniline
- Nitric acid
- Liquid chlorine
- Hydrochloric acid
- Propane
- Liquid nitrogen

Bulk Storage Facilities and Pipelines

The major hazardous materials are brought in by tank car and tank truck. The estimated storage capacities for these materials were given as follows:

Sulfuric acid (66° Bé) (tank truck)	8,000-10,000 gallons
Aniline (tank car)	10,000 gallons
Nitric acid (tank truck)	4,000 gallons
Liquid chlorine (tank car)	Used from tank car
Hydrochloric acid (20°Bé) (tank truck)	8,000 gallons

Both liquid nitrogen and propane are stored, the latter in a well-diked area.

Past Spill Experience

Plant spills have been limited to small quantities such as sometimes occur in process areas due to line breakage, pump gland failures, and so on. Such spills, which involved only the acids and aniline, have been localized; no spill of liquid chlorine has occurred.

Spill Control Plans

The local fire department has equipment for handling chlorine leaks and the company relies on this source. Aniline is stored in a curbed area, along with hydrochloric acid, whereas the other tankage storage areas have no curbed or diked zones. Top loading and unloading techniques are preferred for transfer and are normally used. In-plant surge tanks are provided, and a diked pond with no outlets is provided for retention of liquids which cannot enter the waste water stream from the plant.

Settling ponds are used to collect water primarily to remove suspended solids before discharge into Curtis Creek. The suspended solids' content is usually less than 100 ppm, well below the permissible level. In-plant handling of spills, notification, and the like, are based principally on personnel safety and economic losses.

Mutual Chrome
Allied Chemical Company
Block and Willis Streets
Baltimore, Maryland

Contacts: Mr. Edward Walsh, Assistant Plant Manager
Mr. Nick Borodulia, Industrial Hygienist

Date of Survey: September 15, 1970

Property Description

The Mutual Chrome plant (Figure 12), which is located on the northwest branch of the Patapsco River at the entrance to the inner harbor, has some drainage still going into the river. Guards and security fences prevent unauthorized access to the plant from the land side; however, access could be easily achieved from the harbor by boat. Housekeeping appeared quite good for an ore processing plant.

Hazardous Materials

The major hazardous raw materials handled at Mutual Chrome include sulfuric acid, oleum, and ammonia. In addition, various chromate and dichromate chemical products fall into the hazardous materials category.

Bulk Storage Facilities and Pipelines

Sulfuric acid (66° Bé) and oleum ($>$ 100% H_2SO_4) are received by barge, with each unloaded into an individual 75,000-gal. tank. The unloading rates are typically in the range of 200 to 300 tons per hour. Barge shipments of approximately 1000 tons are received weekly. Anhydrous ammonia is used intermittently upon demand in which case it is used directly from the tank car. Liquid potassium hydroxide is used infrequently, also directly from the tank car. The plant also serves as a transshipping plant for Allied Chemicals 50% sodium hydroxide solutions, and from 7 to 10 tank cars per month are off-loaded into tank trucks. The barge unloading area has flexible hoses, and the pipeline to the sulfuric acid tanks is relatively short. A fuel oil tank is surrounded with a high concrete wall over which all piping goes; many other tanks are in curbed areas, but no other tanks are diked as the oil tank.

Other tankages which exist at this plant are listed below:

1 – 75,000-gal. tank, approximately 25% sodium bichromate
2 – 80,000-gal. tanks – sodium chromate
2 – 40,000-gal. tanks – mixed chromates
6 – 10,000-gal. tanks – mixed chromates
2 – 30,000-gal. tanks – weak dichromates
1 – 10,000-gal. tank – treating solutions
1 – 10,000-gal. catch-all tank
1 – 6,500-gal mix tank
1 – 8,000-gal. chemical run tank
1 – 15,000-gal. in-process sulfuric acid tank.

Past Spill Experience

This plant has had difficulties in the past due to chromium chemicals entering the surrounding waters. The personnel admitted, quite frankly, that these spills were caused by poor attention to operating details, problems during startup operations of new processes, and inadequate retention of the small leaks and spills that occur in the normal operation of liquid-handling processes. Large spills from storage tanks have never occurred, according to the plant personnel contacted.

Spill Control Plans

The plant plans to install more curbed areas and to eliminate all potentials for process spills escaping from off the premises. The unloading facilities appear adequate, but are not especially outstanding. Apparently the plant is operated in a manner which brings it little trouble from the Maryland Department of Water Resources. Surface drainage from the area enters the harbor. Any catastrophic spill, such as a rupture of one or more larger tanks, would enter the harbor.

The plant has a well-documented action plan for dealing with hazardous and catastrophic accidents. The plan, dated August 1969, included information such as individual persons, lines of authority, local authorities, and the like. Although certain improvements could be made in housekeeping and appearance, the general impression is that the operational procedures are reasonably tight and that the professed plans have been directed toward abating past pollutional excesses.

Photo Courtesy of Air Photographics, Inc.

FIGURE 12 AERIAL VIEW OF BALTIMORE, MARYLAND, HARBOR SHOWING GENERAL LOCATION OF MUTUAL CHROME, ALLIED CHEMICAL COMPANY PLANT

Hynson, Westcott and Dunning
1030 North Charles Street
Baltimore, Maryland

Contact: Mr. C. Baxter McLaughlin, Product Manager

Date of Survey: September 16, 1970

Property Description

The Hynson, Westcott and Dunning property is located near the heart of the city in a section near hotels and professional buildings. Its external appearance belies the fact that it is a manufacturing plant. All spills or drainage go into the Baltimore city sewers. We were not permitted to inspect the manufacturing facilities.

Hazardous Materials

Hazardous materials handled at the plant include:

- Glacial acetic acid
- Bromine
- Sulfuric acid
- Acetone
- Various pharmaceuticals
- Mercury compounds

Bulk Storage Facilities

The raw materials are received in carboy and drum lots, so there is no bulk storage. The amounts used annually were estimated as follows:

Glacial acetic acid	600-700 lb/yr
Bromine	1000-1200 lb/yr
Sulfuric acid	4500 lb/yr
Sodium hydroxide (flake)	3500 lb/yr

Past Spill Experience

The company has been cited for spills by the Department of Water Resources due to the entrance of highly colored dyes, such as fluorescein, into the harbor through storm drains.

Spill Control Plan

The company is having a collection and neutralization system installed in response to a citation by the Department of Water Resources, and is making provisions for putting the treated waste water from this system into the sanitary sewerage system of Baltimore.

National Starch Company
700 South Caton
Baltimore, Maryland

Contact: Mr. George Meily, Plant Superintendent

Date of Survey: September 15, 1970

Property Description

The National Starch Company plant is located on an elevated area quite a distance from the street; however, there appears to be little plant security. Cooling water and boiler blowdown drain from an area behind the plant and ultimately to Maiden's Choice Run which empties into the Middle Branch of the Patapsco River.

Hazardous Materials

Hazardous materials handled at National Starch include:

- Formaldehyde
- Hydrochloric acid
- Mercury compounds

Bulk Storage Facilities and Pipelines

There are no bulk storage facilities at National Starch, since its demands for hazardous materials are met by shipments involving 55-gal. drum lots. The maximum usage rate is two or three drums per week.

Past Spill Experience

No spills have occurred.

Spill Control Plan

A spill control plan exists only for protection of personnel. Volumes handled indicate that spill potential is minimal.

Olin Corporation
Curtis Bay Plant
5501 Pennington Avenue
Baltimore, Maryland

Contacts: Mr. Moon, Plant Manager
Mr. Charles Estep, Facilities Engineer

Date of Survey: September 17, 1970

Property Description

The Olin Corporation plant is located on Curtis Bay and has its own dock facilities. Its major products are sulfuric acid and oleum. The area is bounded by Pennington Avenue, a major industrial trucking route. Its drainage flows into Curtis Bay and water from the bay is used for once-through (single pass) cooling of process equipment.

Cooling water is pumped in quantities to 13,000 gpm. The general appearance of the plant indicates good maintenance, and obsolete facilities are being removed to maintain the appearance.

Hazardous Materials

Hazardous materials handled at the Olin Corporation include:

- Molten sulfur
- Sulfuric acid
- Sodium hydroxide.

Bulk Storage Facilities and Pipelines

Molten sulfur is received from tank ships and transferred into two tanks, each capable of storing 12,500 tons. Sulfur is unloaded at the rate of 1500 tons/hour through steam-heated lines. The sulfur storage tanks appear to be well maintained in an undiked storage area near Pennington Avenue and the docks. In the event of tank failure the earth gradient would drain the acid directly into the water course. A very limited amount of molten sulfur is transshipped in tank trucks. Sulfur is received approximately monthly in quantities from 5000 to 20,000 tons.

Concentrated sulfuric acid and oleum are stored in quantities up to 18,000 tons. The maximum capacity of an individual tank is 5000 tons. Sulfuric acid can be loaded aboard barges at rates up to 400 tons/hour. Three to five barges per month are loaded in the range of 1500 to 2500 tons. Some 30 to 40 barges, carrying up to 150 tons, may be loaded per month. Tank car shipments average 15 per month, while tank truck loadings vary between 100 and 150 per month. Spent acid is collected at this plant for barge shipment to other Olin plants, and some 30 to 40 tank truck shipments per month are received. The barge-loading facilities for sulfuric acid are separated from the sulfur unloading facilities. The acid is pumped through overhead lines aboard the barges through swing-joint pipes, with a manually operated valve located at the base of the swing-joint assembly. The operator responsible for loading has the stop-start station for the loading pump located near the shut-off valve.

Past Spill Experience

No spill of any significance has ever occurred in the plant.

Spill Control Plan

During unloading, both Olin and ship crew members are responsible for visual monitoring of the unloading lines. The dock is equipped with warning lights as required by the U.S. Coast Guard Regulation 1-21-16, dated January 1968, regarding security of vessel and waterfront facilities. These lights are to warn of the loading or unloading of hazardous cargoes.

The return stream is monitored for pH, and should an acid leak occur, the plant is shut down for repair. Supervisory personnel are present on an around-the-clock basis at the plant. The general appearance of the plant indicates good housekeeping operations, and we judge the potential for a hazardous spill to be minimal.

FMC Corporation – Baltimore Plant
Organic Chemicals Division
1701 East Patapsco Avenue
Baltimore, Maryland

Contact: Mr. J. Ford Wilson, Manager

Date of Survey: September 17, 1970

Property Description

The FMC Corporation plant at Baltimore is located on Curtis Bay. Although a slip exists alongside the plant, it appears unused, since shipments to and from the plant are made by truck and rail. Various processing areas are scattered throughout the area which is well secured from the land side. Area drainage goes into Curtis Bay from a number of points.

Hazardous Materials, Bulk Storage Facilities and Pipelines

A large number of organic chemicals are handled and manufactured. A listing of the storage capacities of the major chemicals follows:

Ethanol	10 – 10,000-gal. tanks
Methanol	6 – 10,000-gal. tanks
Methylene di-bromide	1 – 7,800-gal. tank
Toluene	2 – 13,000-gal. tanks
Anhydrous ammonia	1 – 20,000-gal. refrigerated tank
50% sodium hydroxide	4 – 10,000-gal. tanks
	3 – 21,000-gal. tanks
66° Bé H_2SO_4	1 – 10,000-gal. tank
	1 – 15,000-gal. tank
Hydrochloric acid	3 – 10,000-gal. tanks
Aniline	1 – 8,000-gal. tank
Allyl alcohol	8 – 10,000-gal. tanks
Chlorosulfonic Acid	1 – 5,000-gal. tank
Dimethyl succinate	1 – 10,000-gal. tank
Diketene	1 – 8,000-gal. tank
Orthonitrophenol	1 – 14,000-gal. tank
Sodium ethylate	2 – 10,000-gal. tanks
Ethyl acetate	1 – 16,000-gal. tank
Aqua ammonia	1 – 14,000-gal. tank
Methyl di-bromide	1 – 8,500-gal. tank
Sodium nitrite	1 – 15,000-gal. tank
Diethylcarbonyl	2 – 10,000-gal. tanks

Di-allyl phthalate monomers	8 – 10,000-gal. tanks
Unsymmetrical dimethyl hydrazine	2 – 50,000-gal. tanks
Ethyl and methyl chloroformate	3 – 10,000-gal. tanks
Methyl chloride	2 – 10,000-gal. tanks

Other chemicals handled in drum lots and occasional tank cars are:

Butyl carbitol
Diethyl amine
Monochlorobenzene
Orthochloraniline
Orthotoluidine
Trichlorobenzene
Triethylamine

Several tanks are located in diked areas, but there is no effort being expended to ensure that the volume in the diked areas is greater than the sum of the stored volumes.

Past Spill Experience

Plant spill experience has been limited to relatively small quantities in process areas and from hoses and lines at loading points. Because of the diversity and economic value of the chemicals, in addition to the hazardous natures, these are removed and recovered in many instances. According to management, no large spills have occurred at the plant, at least in the last 15 years.

Spill Control Plans

Many tanks are located in curbed areas. Diked areas with drains which must be manually actuated run off into the bay. If a large spill occurred in a diked area, it would be removed by pumps and trucks for treatment or disposal. The plant has a supervisor for all shifts around the clock, and has its own fire and security departments which are continually making plant inspections.

Procter and Gamble
1422 North Nicholson
Baltimore, Maryland

Contacts: Mr. Richard C. Smith, Plant Manager
Mr. J. M. Davidson, Plant Engineer

Date of Survey: September 17, 1970

Property Description

The Procter and Gamble (P&G) plant, shown in Figures 13 and 14, is located on the Patapsco River and receives shipments by truck, rail, barge, and ocean vessel. Normal drainage goes into the Patapsco River; however, much of the plant area drains to collecting sumps within the plant for treatment or recovery before entering the sanitary sewer system of Baltimore.

Hazardous Materials

Hazardous materials handled at P&G include:

- Oil, such as coconut
- Sodium hydroxide
- Sulfuric acid
- Glycerine
- Liquid sulfur trioxide
- Phosphoric acid, and
- Aqua ammonia.

Bulk Storage Facilities and Pipelines

The largest shipments by water are coconut oil, and the only other material received by water is 50% sodium hydroxide. There are many storage tanks situated throughout the plant both indoors and outdoors. An undiked tank farm, probably 600 feet from the nearest slip, contains 18 tanks of various sizes for the storage of coconut oil and various other oils and products. The two largest tanks are estimated to contain about 500,000 gallons, the next two tanks about 300,000 gallons, eight tanks of approximately 150,000 gallons, and six between 5 and 100,000 gallons. Oil is pumped through overhead lines through the plant to the farm. Fifty percent caustic is stored in four tanks near the pier; each tank is estimated to have a capacity of about 500,000 gallons. Two other caustic tanks of nearly the same capacity are located within the plant complex.

Sulfuric acid (oleum) is stored in three tanks estimated to have a capacity of 50.000 to 60,000 gallons each. Phosphoric acid is stored in a tank with an estimated capacity of 10,000 gallons. and the same size tank is used for storage of liquid sulfur trioxide. Aqua ammonia storage is handled by a single 15,000-gal. tank. The glycerine produced is stored in two tanks, each having an estimated capacity of 400,000 gallons. Sodium nitrate and caustic mixes are made and stored in three tanks, each of which has an estimated maximum capacity of 100,000 gallons.

Barge shipments of caustic are estimated to be received about every six weeks. Tank cars and tank truck loadings and unloadings are too frequent to document; of course, typical transfer rates are under 100 gpm. Caustic unloading piping is approximately 4 inches in diameter, which means ultimate unloading rates of probably 200 tons/hour maximum.

Past Spill Experience

Troublesome past spills consisted of detergents which, when they entered waterways, were easily seen, even in small quantities, e.g., excess foam. The spills usually took place in process areas and occurred when less attention was given to operational details prior to institution of the recently initiated spill control plans outlined below. Besides the adverse publicity resulting from such a spill, the mere expense of the products, of course, would have dictated that considerable attention be given to controlling spills in the past.

Spill Control Plans

P&G is making every effort to adopt an operational philosophy based on containing any spilled materials on its property in such a manner that releases to water courses will be known and controlled. We were shown plans for installing sumps within the plant to collect possible spills, and told that the present storm drain system is being revised. Drains from the dock surface into the harbor are being sealed off and any spillage will be forced to enter plant sumps. P&G is spending considerable money to ensure against spills entering the water courses. Because of the value of the materials involved, building sumps are pumped to collection and recovery areas before waste-water discharges are put into the sanitary sewage system under permit from the city. Once-through cooling water is used in the plant and a small amount of BOD is added to this water from process components, such as barometric condensers. Space limitations prevent diking tank storage areas in a manner which would contain the entire liquid volume; however, plans are under way to install dikes which would be capable of containing the liquid volume of the largest tank in a complex.

Around-the-clock supervisory personnel are on duty at the plant, and it appears that operational procedures exist for minimizing and controlling spills.

Photo Courtesy of Air Photographics, Inc.

FIGURE 13 AERIAL VIEW OF BALTIMORE, MARYLAND, HARBOR SHOWING GENERAL LOCATION OF PROCTER & GAMBLE, NATIONAL MOLASSES, AND UNIROYAL PLANTS

FIGURE 14 AERIAL VIEW OF PROCTER & GAMBLE PLANT, BALTIMORE, MARYLAND

Lever Brothers
5300 Holabird Avenue
Baltimore, Maryland

Contacts: Mr. Wm. Wilson, Asst. Plant Manager
Mr. Harlan Hyde, Plant Engineer

Date of Survey: September 18, 1970

Property Description

The Lever Brothers plant is located in an industrial area, is well maintained, has good security fencing, but is not located on any water course. Its natural drainage goes into storm sewers which empty into the water course. All shipments are made by rail or truck. It manufactures a large line of soaps and syndets.

Hazardous Materials

Hazardous materials handled by Lever Brothers include:

- Coconut oil
- Sodium hydroxide
- Sulfuric acid
- Hydrochloric acid
- Fatty alcohols, and
- Aqua ammonia

Bulk Storage Facilities and Pipelines

Because of the large number of storage tanks holding raw materials, in-process materials, and products, we were unable to secure a list of tank storage volumes. We were told that coconut oil is stored in tanks with capacities of up to 2.5 million pounds, and that 50% sodium hydroxide is stored in quantities up to 500,000 pounds.

Past Spill Experience

The most significant spill at Lever Brothers occurred when process materials were spilled into the sewer system, plugging the sewers and causing floods in a lot used to store new General Motors cars. Because of the liability damages incurred at that time, the plant installed a collecting basin in which oils and solids could be retained before waste waters entered the city sewage system.

Spill Control Plan

The Lever Brothers plant has elaborate drainage systems with provisions made to reprocess most spills. Lever Brothers' policy is to keep everything on its premises, other than the waste waters which can be monitored as they enter the sanitary sewage system of the city. The provisions that have been made to retain and prevent uncontrolled spills from leaving the premises appear to be well devised and operable. A large number of rail car unloading stations exist as well as a large number of tank truck stations. Some tanks are located in diked areas, other than fuel oil; however, a large number is located either in undiked or curbed areas.

This plant appears to have one of the best developed systems for handling product and raw material spills of any plant visited in the Baltimore area. In many of the process areas, curbed areas are provided with drainage to collection sumps equipped with level-control pumps that direct spillage into interim holding tanks from which it is usually returned to the process. Provisions have been made in certain areas for the collection of rainwater and its introduction into processes since small amounts of spilled detergents could be washed from the area. Drain pans have been placed under all bottling lines so that spilled materials can be collected for reprocessing along with washdown waters. In-building and area drainages are designed to go through a limited number of points where monitoring and control are possible. As previously mentioned, it is the objective of the plant to either retain all materials on the property or to monitor discharges for record purposes.

M&T Chemicals
Subsidiary of American Can
1900 Chesapeake Avenue
Baltimore, Maryland

Contacts: Mr. James Feorine, Plant Manager
Mr. Richard Rush, Production Supervisor
Mr. Arnold Wasser, Corporate Environmental Officer

Date of Survey: September 19, 1970

Property Descriptions

The M&T Chemicals plant handles tin-plated steel scrap for recovery of tin and various ores. The accumulated scrap metal does not lend itself to good housekeeping. However, the operation appears well maintained. There is no frontage on Curtis Bay, although the plant's drainage terminates in the Bay. All materials are received and shipped by truck.

Hazardous Materials

Hazardous materials handled by M&T Chemicals include:

- Sodium hydroxide
- Sodium nitrite solution, and
- Various process solutions of chromium, tin, and antimony.

Bulk Storage Facilities and Pipelines

All liquids are received via tank trucks. The following tanks, volumes, and materials stored were presented:

50% sodium hydroxide	1 – 19,500 - gal. tank
Sodium nitrite solution	1 – 9,500 - gal. tank
Settling tanks - various process solutions	6 – 22,500 - gal. tanks
Sodium antimonate (all of the sodium antimonate tanks are in buildings)	2 – 4,700 - gal. wooden tanks 1 – 6,750 - gal. wooden tank 1 – 3,000 - gal. wooden tank

Caustic shipment and sodium nitrite shipments are made at a rate of approximately one tank truck per week. Chromium chemicals, antimony, and strontium ores are brought into the plant as solids. Mixtures of chemical for plating baths are shipped out in drums as solids.

Past Spill Experience

Small process spills from pumps and overflowing tanks in process areas have caused high concentrations in waste waters.

Spill Control Plan

All process areas are sumped and overflows are returned to process. Obviously, catastrophic spills, such as tank rupture, for example, might escape from the building. Process tanks have low- and high-level liquid alarms. The plant has a settling pond, but it is used primarily for holding the solids from the process. The plant has supervisory personnel on duty around-the-clock because of its continuous electrolytic tin-recovery operations.

C. SUISUN BAY-DELTA, CALIFORNIA

The final section of the Sacramento River, below its confluence with the Sacramento Ship Canal and, further below, at its confluence with the San Joaquin River, was the actual site of the California survey (Figure 15). At this point, the river has traveled slightly less than 400 miles from its source in the Klamouth Mountains near Mt. Shasta. For most of its length, the river flows in a southerly direction. At the City of Sacramento, the river begins to move westward, with its final course flowing due West past the towns of Antioch, Pittsburg, Port Chicago, Martinez, Crockett, and Benecia on the river's northern bank. After passing through Suisun Bay, the flow passes through the Carquinez Strait into San Pablo Bay, thence to San Pablo Strait into San Francisco Bay.

Transportation

Marine access up the river to Antioch is gained through a series of channels ov varying depths, i.e.:

Channel	Depth at Middle Half of Channel (feet)
Suisun Pt. Reach	34.4
Bulls Head	35.6
East Head	31.7
Pt. Edith Crossing Range	31.6
Preston Point Reach	29.9
Roe Island	30.8
Port Chicago Reach	31.5
Middle Ground Channel	
West Reach	30.5
East Reach	30.4

The Southern Pacific Company Railroad and its connecting systems service the area, and there are numerous automotive trucking concerns in the San Francisco Bay area.

Drainage

Rolling agricultural countryside runs along the banks of the river, with industrial complexes immediately adjacent to the river (Figure 15). Natural water drainage empties into the Suisun Bay Delta and, on occasion, extensive floods have been experienced, with muddied waters visible as far as 30 miles off shore in the area of the Farallon Islands in the Pacific Ocean. The average annual rainfall for the area has been recorded at 18 inches.

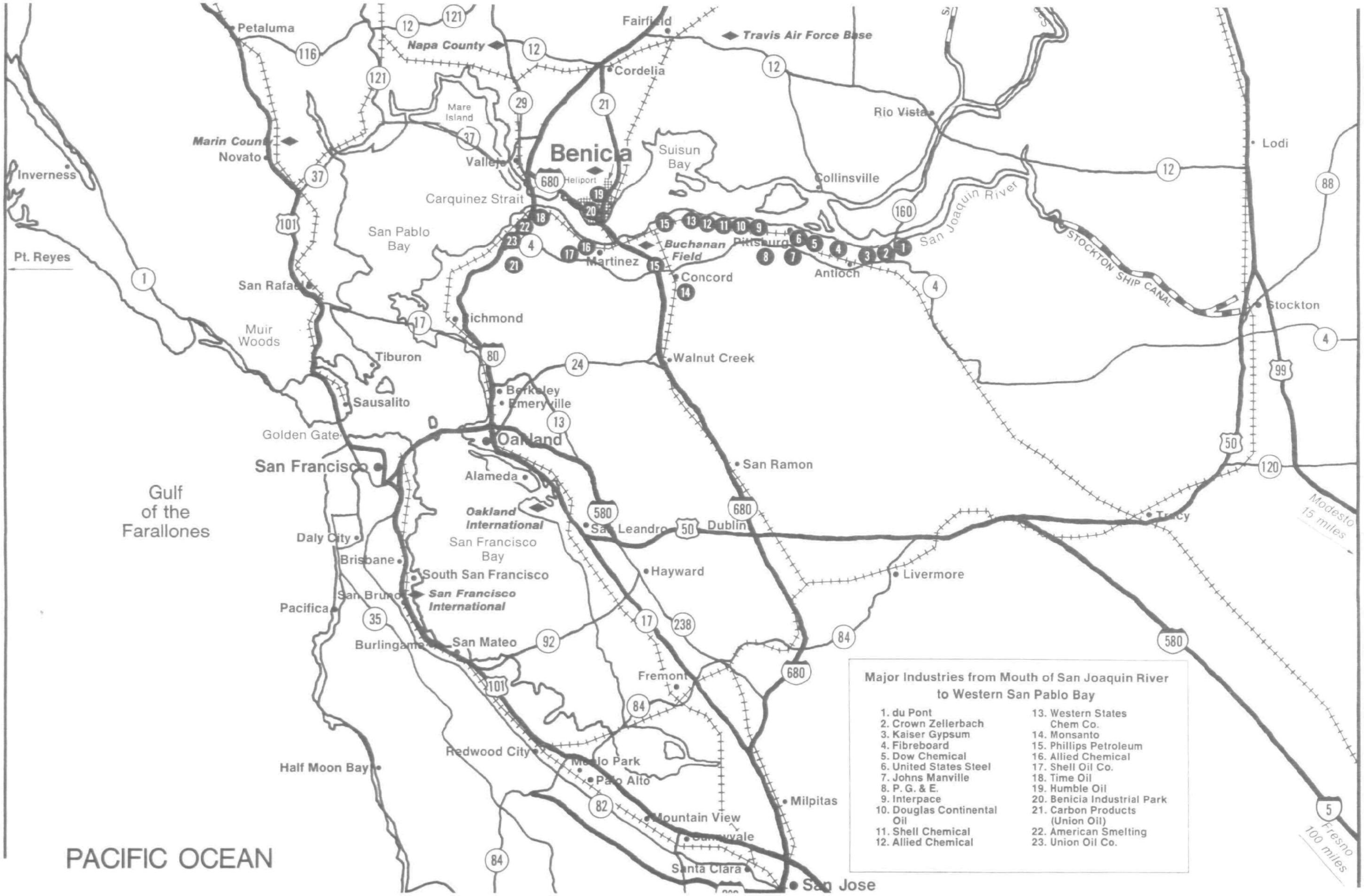


FIGURE 15 AREA OF SURVEY CONDUCTED IN SUISUN BAY-DELTA, CALIFORNIA

Spill Incidents

The record of spill incidents for the entire San Francisco Bay area in 1968 and 1969 are presented in Tables 9 and 10, respectively. The Suisun Bay-Delta area has had a total of 32 reported spills in the past two years. However, many chemical spills could have gone undetected and unrecorded, except for the "fish kills" which occurred.

The waterbody does not give an objectionable appearance, largely due to the constant flushing action of the Sacramento River. The contaminants would, however, be cumulative in San Pablo and San Francisco Bay due to the restricted opening to the open sea afforded by the Golden Gate.

TABLE 9

REPORTED OIL AND OTHER SPILL INCIDENTS IN SAN FRANCISCO BAY REGION IN 1968[a]

Month	Number of Incidents	Location[c]							Source			Material		Number of Citations Issued by SDF&G[b]
		Suisun Bay-Delta Area	San Pablo Bay	North Bay	Central Bay	Lower Bay	South Bay	Stream	Land	Vessel	Unknown	Oil	Other	
Jan.	17	1	1	2	12	0	0	1	8	6	3	13	4	4
Feb.	14	1	2	2	7	0	1	1	6	4	4	13	1	2
Mar.	10	1	0	2	6	0	1	0	4	5	1	9	1	5
Apr.	7	1	1	0	5	0	0	0	2	5	0	6	1	4
May	12	1	1	1	9	0	0	0	3	9	0	11	1	5
Jun.	12	0	0	2	10	0	0	0	4	6	2	11	1	2
Jul.	12	0	1	2	7	0	1	1	6	5	1	9	3	3
Aug.	10	2	2	3	2	0	0	1	2	4	4	8	2	2
Sept.	4	1	0	1	2	0	0	0	2	1	1	4	0	1
Oct.	7	2	0	2	3	0	0	0	1	4	2	7	0	5
Nov.	7	2	3	2	0	0	0	0	4	3	0	7	0	7
Dec.	7	0	2	3	2	0	0	0	2	3	2	6	1	3
Total	119	12	13	22	65	0	3	4	44	55	20	104	15	43

Notes: a. Spill incidents were reported to the Regional Board office by telephone and/or Fish and Game WLP-519, entitled, "Initial Pollution Report."

b. SDF&G = State Department of Fish and Game

c. The shipping wharfs of various refineries are located in various bays as follows:
Suisun Bay - Humble Oil Company, Phillips Petroleum Company, and Shell Oil Company
San Pablo Bay - Sequoia Refining Corporation and Union Oil Company
North San Francisco Bay - Standard Oil Company

Source: State of California, San Francisco Bay Region, Water Quality Control Board

Arthur D Little, Inc.

TABLE 10

REPORTED OIL AND OTHER SPILL INCIDENTS IN SAN FRANCISCO BAY REGION IN 1969[a]

Month	Number of Incidents	Location[c]							Source			Material		Number of Citations Issued by SDF&G[b]
		Suisun Bay-Delta Area	San Pablo Bay	North Bay	Central Bay	Lower Bay	South Bay	Stream	Land	Vessel	Unknown	Oil	Other	
Jan.	10	0	1	4	4	0	1	0	6	2	2	8	2	2
Feb.	17	2	2	5	8	0	0	0	6	7	4	17	0	2
Mar.	15	2	5	3	3	0	1	1	9	2	4	12	3	2
Apr.	13	1	1	6	5	0	0	0	4	5	4	13	0	5
May	23	0	2	5	14	0	2	0	4	10	9	17	6	6
Jun.	11	2	3	1	4	0	0	1	4	3	4	11	0	3
Jul.	16	2	4	0	8	0	0	2	8	6	2	12	4	4
Aug.	11	2	1	0	7	0	1	0	3	7	1	7	4	1
Sept.	23	5	0	3	12	0	2	1	6	13	4	19	4	3
Oct.	23	2	3	2	11	0	0	5	12	4	7	15	8	5
Nov.	12	0	0	6	5	0	0	1	6	5	1	11	1	3
Dec.	12	2	3	1	4	1	0	1	4	4	4	12	0	3
Total	186	20	25	36	85	1	7	12	72	68	46	154	32	38

Notes: a. Spill incidents were reported to the Regional Board office by telephone and/or Fish and Game WLP-519 entitled, "Initial Pollution Report."

b. SDF&G = State Department of Fish and Game

c. The shipping wharfs of various refineries are located in various bays as follows: Suisun Bay - Humble Oil Company, Phillips Petroleum Company, and Shell Oil Company
San Pablo Bay - Sequoia Refining Corporation and Union Oil Company
North San Francisco Bay - Standard Oil Company

Source: State of California, San Francisco Bay Region, Water Quality Control Board

California and Hawaiian Sugar Company
830 Loring Avenue
Crockett, California

Contacts: Dr. Philip F. Meads, Technical Director
Mr. Henry C. Strecker, Chief Chemist – Quality Control

Date of Survey: October 27, 1970

Property Description

The "C and H Sugar" plant located on Carquinez Strait, where the Sacramento River empties into the San Pablo Bay and thence into San Francisco Bay, is the world's largest sugar refinery. In a 27-acre floor space the plant produces consumer, institutional, and industrial granulated, brown, powdered, and specialty sugars, as well as tablets and cubelets, and a full line of manufacturers' grades of granulated and liquid sugars, both in bulk and packaged form. The bulk raw cane sugar is delivered by cargo ships from Hawaii. A granary elevator and belted conveyor unloading system transports the raw material from the ship into large storage hoppers from which it passes into production. The maximum production averages 4200 tons of refined sugar and 40 tons of molasses per day, the production period running 10 out of every 14 days. The plant's industrial waste drainage involves a total of 21 outfalls that discharge into the Carquinez Strait, as illustrated in Figure 16, and described in Appendix E. All outfalls have shutoff valves, some of which are locked and opened only under controlled conditions.

Hazardous Materials

Materials used at the C and H sugar plant, which if spilled in quantity could degrade the natural water quality, include:

- Bagged lime – delivered by truck,
- Phosphoric acid – delivered by truck,
- Liquid sugar – processed material,
- Bagged diatomaceous earth - delivered by truck and train,
- Bagged bone charcoal – delivered by truck and train, and
- A limited quantity of descaling chemicals, such as soda ash, which are used to clean production lines, but which are neutralized before discharge into the Strait.

A dry refined-sugar marine loading facility is used by vessels of the Bay and River Navigation Co. The in-harbor vessels deliver the products to nearby Richmond, San Francisco, and Oakland, on a maximum twice-a-day sailing schedule.

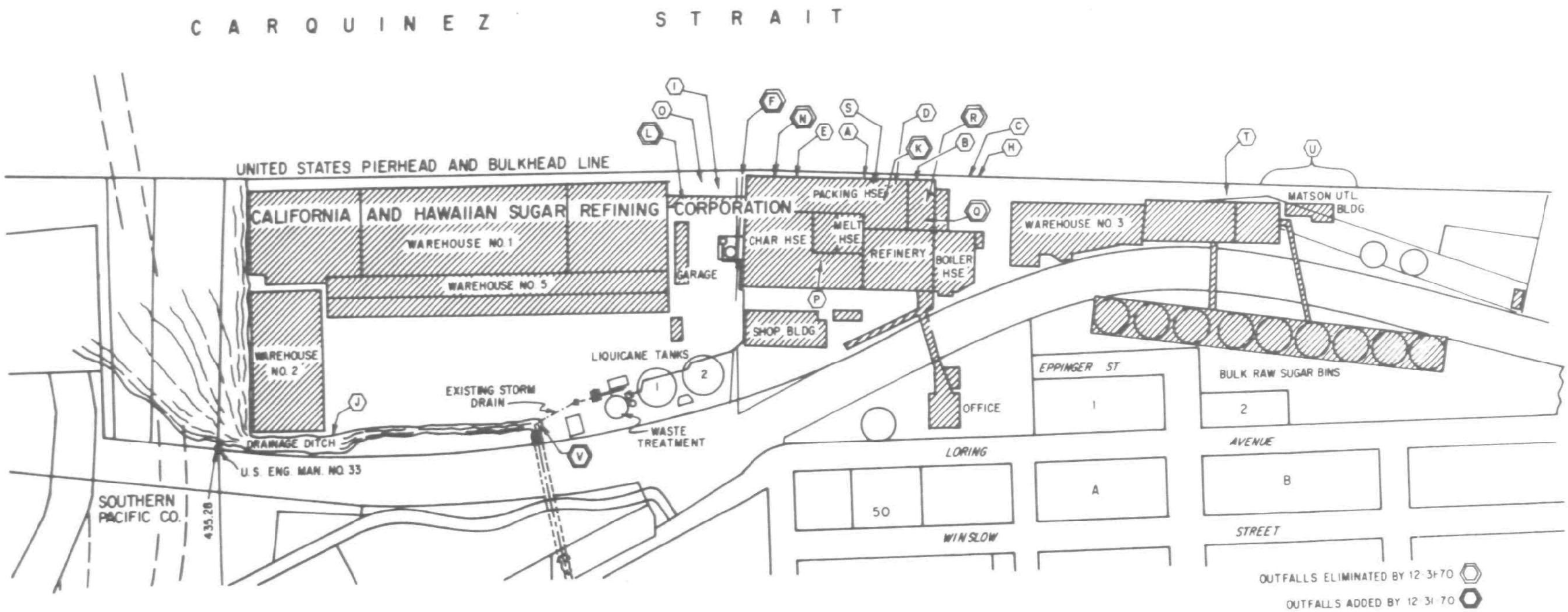


FIGURE 16 GENERAL LAYOUT OF CALIFORNIA AND HAWAIIAN SUGAR REFINING CORPORATION PROPERTIES, CROCKETT, CALIFORNIA

Arthur D Little, Inc.

Bulk Storage Facilities and Pipelines

The bulk storage tanks are above-ground, undiked installations. The tanks in evidence and utilized by the plant have the following capacities:

Liquid Sugar Storage

1, 2 – 1 million gallons each.
3, 4, 5, 6, 7, 8, and 11 – empty, not currently in service.
9 – 260,000 gallons
10 – 240,000 gallons
12 – 13,000 to 160,000 gallons
14 – holding tank.
15 – 250,000 gallons.

There is also a 10,000-gal. capacity stainless-steel tank used for the storage of phosphoric acid, and a 25,000-bbl boiler fuel oil storage tank.

Note: Tanks 13 and 15 are located on land leased from the Railroad Corporation. All tanks are epoxy-lined, and are internally inspected on an annual basis to determine the condition of the inner lining.

Past Spill Experience

There have been no sudden and accidental spills which, to the knowledge of plant management, have in any way damaged the marine environment or degraded the ecology of the area. The state records indicate a 1-bbl bunker oil spill when the S.S. Hawaiian Builder was bunkering on June 23, 1969, and a milky white discharge from the plant was also recorded on October 24, 1969.

Spill Control Plan

Under the control of the State of California Regional Water Quality Control Board, San Francisco Region, the plant operates on a self-monitoring system of effluent discharge. This involves in-house and outside laboratory analysis of the waste water, and submittal of a quarterly analytical report to the Water Quality Control Board. In the event of a spill, the plant would immediately contact the local Water Quality Control Board, and would be guided by their direction in rectifying spill damage.

Johns-Manville Products Corporation
P. O. Box 591
Pittsburg, California 94565

Contacts: Mr. Al C. Pennewell, Plant Manager
Mr. Saul H. Bernstein, Paper Mill Production Superintendent
Mr. Charles Beaney, Plant Engineer

Date of Survey: October 28, 1970

Property Description

The Johns-Manville plant is located in the downtown area of Pittsburg, one block from the Sacramento River. Figure 17 is a plot plan of the plant. The production area is essentially flat. The plant can be divided into four working areas: a paper mill; a roofing manufacturing area; an asbestos shingle production area; and a flexboard and corrugated transite manufacturing operation. There is a 48-inch storm drainage line which runs along the side of the plant and then empties into the river. Sanitary, process, and cooling water is pumped to the city sewer system.

Hazardous Chemicals

This plant produces asbestos paper, asphalt shingles and roofing, corrugated asbestos-cement sheets, asbestos insulating cements, and roofing coatings.

Bulk Storage Facilities and Pipelines

The plant has three (two 25,000-gal. and one 50,000-gal.) steam-traced tanks for storage of asphalt. These tanks have no safeguards, but cutting down the steam-tracing causes the asphalt to set up, thus creating, in fact, a spill prevention condition. The plant also has a 50,000-gal. capacity storage tank which holds only 10,000 gallons of fuel oil for emergency purposes. There is no diking, and the area where there is a storm drain lies 200 yards away from the tank.

In addition, the plant has two 5,000-gal. storage tanks, sitting six to eight feet above the ground, which contain "cutback," a free-flowing, asphalt-base material. There are no spill-containment methods for these tanks; however, the tanks are located approximately 200 yards from the nearest storm drain. There are no underground storage tanks. All materials enter and leave the plant by truck or rail. There is no waterborne movement of material. The asphalt enters the plant by truck only. Ninety percent of the products are shipped by truck.

Past Spill Experience

The plant was on strike when this survey was undertaken. There have been no spills of record. Periodically, there may be some small spillage; however, this facility has very little spill potential.

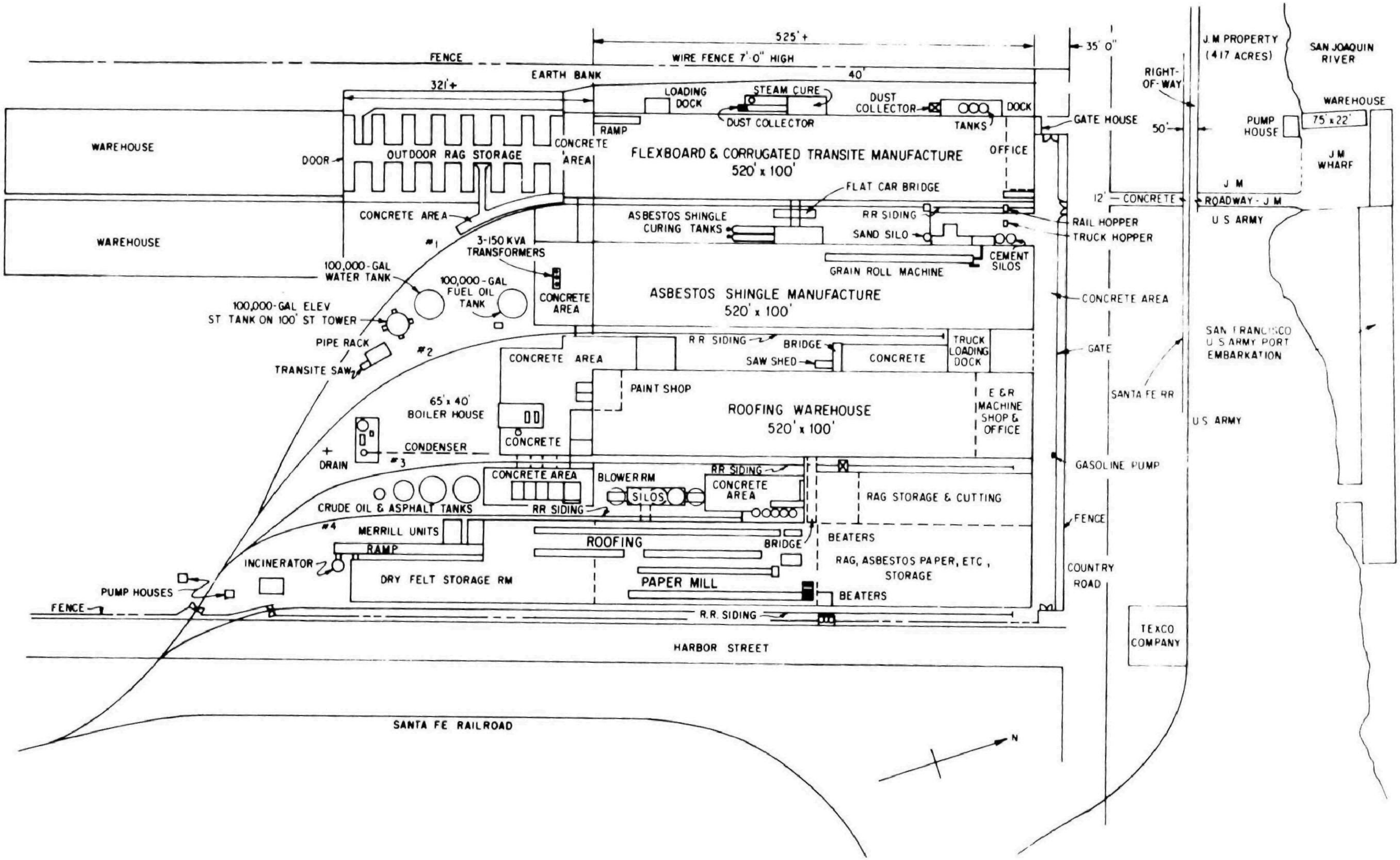


FIGURE 17 GENERAL LAYOUT OF JOHNS-MANVILLE PRODUCTS CORPORATION PLANT, PITTSBURG, CALIFORNIA

Monsanto Company
Martinez, California

Contacts: Mr. V.T. Matteuci, Plant Manager
Mr. W. L. Germain, Technical Supervisor

Date of Survey: October 28, 1970

Property Description

The Monsanto Company plant (Figure 18) at Martinez is one of its smaller plants. It is located adjacent to the Phillips Petroleum-Avon refinery, approximately one mile from Suisun Bay. It immediately borders a slough that flows into Suisun Bay. It produces:

- Sulfuric acid
- Sulfur
- Catalysts.

The waste-water disposal system, as approved by the Regional Water Quality Control Board, consists of a network of sewers which collect all effluent and drainage from the plant site. This waste water is collected in a sump and pumped by a double-pump system to the Phillips-Avon refinery for treatment in the Phillips waste-water treatment system. The plant has no marine facilities and considers its bulk storage and loading facilities to be minimal.

Hazardous Materials

The following is a listing of the bulk, liquid chemicals stored, transported and processed by the plant and the percentages shipped by various modes of transportation:

Chemical	Rail	Truck	Marine
Sulfur	0%	100%	0%
Sulfuric acid	2%	45%	0%
Potassium hydroxide	0%	100%	0%
Potassium silicate		not shipped	
Diethanolamine	0%	100%	0%

Photo Courtesy of Air-Photo Company, Inc.

FIGURE 18 AERIAL VIEW OF SUISUN BAY-DELTA AREA SHOWING GENERAL LOCATION OF MONSANTO COMPANY PLANT, AVON, CALIFORNIA

Bulk Storage Facilities and Pipelines

All storage tanks are above-ground installations. Secondary means of containment are not provided, but the plant's trenching system could handle a major spill and direct same to the Phillips Petroleum waste-water treatment facility. Storage capacities are as follows:

• Sulfur	– 600,000-gal.
• Sulfuric acid	– 640,000-gal.
• Potassium hydroxide	– 12,000-gal.
• Potassium silicate	– 12,000-gal.
• Diethanolamine	– 80,000-gal.

The annual consumption of these chemicals is company confidential. There are no buried tanks or pipelines.

Past Spill Experience

The plant has never experienced a major chemical spill. Management considers that the possibility of "a major spill is highly unlikely."

Spill Control Plan

Thery is no formal spill control plan, but any minor spills that might occur could be contained within the limits of the waste-disposal trenches and treating system. Acid spills would be treated with caustic and/or washed with large volumes of water for dilution (caustic was not included on the plant's listing of hazardous materials).

Shell Oil Company
1801 Escobar Street (P. O. Box 711)
Martinez, California

Contact: Mr. A. P. Cupit, Administrative Superintendent
Mr. R. M. Thompson, Mgr., Air and Water Conservation

Date of Survey: October 28, 1970

Property Description

The Shell Oil Company (Figure 19) is a 100,000-bbl per day refinery producing agricultural spray oils, gasoline, diesel fuel, fuel oils, asphalt, kerosene, lubricating oil, naphthas, road oils, cleaning fluids, solvents, stove oils, and greases. The plant is located in an elevated position on the south side of Suisun Bay. It has a closed drainage system of waste sewers, all of which pass through an API oil/water separator. The separator has an open and closed bay which allows the use of scrapers to remove surface oil and bottom sediments. The pH is controlled with acid and/or caustic and flocculants such as iron or aluminum sulfate. The waste water then passes through air flotation clarification units. The clarified effluent is then held in a treatment pond preparatory to being pumped through a deep-water (35 feet) diffuser. The final discharge into the river is made on a programmed cycle, set to match the tidal flow in the river. The rate of final discharge varies from 3000 to 10,000 gpm to match the rate of tidal flow and to gain a dilution factor in excess of 100 to 1 at the edge of the rising plume from the subsurface discharge in the river. Samples of the effluent are taken weekly to determine the biological oxygen demand (BOD), metal content, fish toxicity, and dissolved grease. The analysis is conducted partially in-house and partially by an independent analytical laboratory, the latter conducting the biological testing phase.

Monthly reports are submitted to the State Water Quality Control Board which may also ask for spot-sampling on an unscheduled basis. In addition to the main water treatment ponds, the plant has four diversion ponds, having dimensions of 150 by 50 by 6-10 feet. The diversion ponds provide a 24-hour holding capacity. The facility also provides a storm water pond 300 by 400 by 10 feet in dimension.

Photo Courtesy of Air-Photo Company, Inc.

FIGURE 19 AERIAL VIEW OF SUISUN BAY-DELTA SHOWING GENERAL LOCATION OF SHELL OIL COMPANY PLANT, MARTINEZ, CALIFORNIA

Hazardous Materials

In addition to the petroleum-based products, the following production chemicals are used at Shell Oil:

- Sulfuric acid – received by both tank truck and tank car,
- Filter clay – 100-lb bags received by truck,
- Miscellaneous organic chemicals (viscosity improvers) – tetra-ethyl, lead, soaps, lithium stearates, and caustic – received by tank car,
- Lime and milk of lime (slurry) – received by tank truck,
- Bulk rock salt – received by truck,
- Commercial inhibitors (NALCO) – received in paper cartons by truck,
- Dow liquid chlorine (for cooling water systems) – received in 1-ton containers by truck,
- Ferric sulfate and aluminum sulfate (flocculants) – received by truck,
- Liquid sulfur dioxide (for extraction process) – shipped from Dow Chemical or local smelters by truck,
- Furfuraldehyde (solvent) – received in drums by truck,
- Diethanolamine (for scrubbing gases) – received by truck,
- Miscellaneous cracking catalysts (heavier than water, similar to diatomaceous earth) – received by truck.

Bulk storage capacities and annual consumption of chemicals are considered to be company confidential information, and were not made available.

Bulk Storage Facilities and Pipelines

The plant has no buried pipelines, tanks, or flexible hose lines. All petroleum product storage tanks have diked enclosures; a number of chemical storage tanks do not have this protection. When provided, the dikes have concrete reinforcement on the inside. The exterior surfaces are protected from erosion by a coating of "flux" that is actually cut back asphalt which coagulates when the solvent content evaporates. Since all tanks are at elevated locations, the hillsides have been stabilized with the same material. The Engineering Services Department has established a regular inspection program for all vessels, tanks, and vessels containing materials at pressures above static. Such vessels are also subjected to regular inspection by the representatives of the plant's insurance carrier.

Process vessels are subjected to non-destructive tests on a frequency determined by past experience. Sulfuric acid tanks are subjected to testing annually. From a fail-safe standpoint, all dike enclosure draining is monitored; product transfer lines are equipped with pressure-drop, shut-off controls; and one-way flow check valves are installed on all sulfuric acid fill lines.

Past Spill Experience

The plant has not had any hazardous material spills since 1964, this being as far back as the plant contacts could recall. A number of petroleum product spills were found in the state records, viz.:

6/17/69 – Fuel oil spill when bunkering S. S. Andrew Jackson

7/7/69 – Failure to properly close valve after loading caused oil spill into Carquinez Strait

8/13/69 – Opened wrong valve and spilled between 1-4 bbl of oil, while loading S.S. Catawba Ford

9/8/69 – One-bbl fuel oil spill from S. S. Barbara

9/15/69 – Three-bbl oil spill occurred when loading S. S. Millspring

6/30/70 – Jet fuel spill (10-15-bbl) when barge buckled during loading operation.

Spill Control Plan

The plant has a regular procedure for alerting personnel and initiating action in the event of a spill. In addition, aid can be gained from any or all of six refineries in the area. The Western Oil and Gas Bay Area Subcommittee, which is made up of the managers from the six refineries, is in the process of forming either a profit or non-profit cooperative to provide mutual aid in the event of a chemical or oil spill. The cooperative is under legal study for such items as the "Good Samaritan Law." Until legal aspects are fully considered, only a verbal agreement of aid is effective.

E. I. DuPont de Nemours & Company, Inc.
Antioch Works
Antioch, California 94509

Contact: Mr. F. J. Hodges, Plant Manager

Date of Survey: October 29, 1970

Property Description

The DuPont de Nemours & Company plant is a modern facility which produces the following products:

- Freon 11, 12, 21, 22, 113, and 114
- Tetra-ethyl lead
- Titanium dioxide pigment.

All three products are produced at one plant location within which each product has its independent production area. The production areas and floors are graded so that spilled liquids drain into a ditch system. The ditches terminate in any of the plant's retention basins which have an 8,000,000-gal. capacity in total. There are no by-passes around the basins. The ditches have strategically positioned traps, skimmers, and control gates. The plant operates around the clock, seven days a week. Occasionally on holidays, one or two of the areas are shut down, but a supervised skeleton crew is always in attendance. All of the production areas are highly automated, with centrally located alarms, recorders, and controllers. The drainage ditches are equipped with pH analyzers which operate an on-site and central control room alarm. The pH values of plant effluents range to a maximum of 9 and a low of 6. Field operators routinely inspect ditch and basin facilities and log their observations. The inspections include pH equipment operability and sampling of the various streams for laboratory testing.

Hazardous Materials

Hazardous materials handled at the duPont de Nemours plant include:

- Sulfuric acid (various concentrations) – maximum storage, 26,200 gallons;

- Hydrochloric acid (including chemicals which form HCl when mixed with water) – maximum storage, 162,000 gallons;

- Hydrofluoric acid – maximum storage, 18,800 gallons;
- Caustic (including chemical blends which have a caustic base) – maximum storage, 39,000 gallons;
- Carbon tetrachloride – maximum storage, 48,000 gallons;
- Ethylene dibromide – maximum storage, 40,000 gallons;
- Ethylene dichloride – maximum storage, 48,000 gallons;
- Kerosene – maximum storage, 8,700 gallons;
- Acetone – maximum storage, 7,000 gallons;
- Tetra-ethyl lead – maximum storage, 780,000 gallons.

Bulk Storage Facilities and Pipelines

The plant's tank installations which are all above-ground include the following:

Sulfuric – 5 tanks
Hydrofluoric acid – 1 tank
Hydrochloric acid – 7 tanks
Caustic – 5 tanks
Carbon tetrachloride – 1 tank
Ethylene dibromide – 1 tank
Ethylene dichloride – 1 tank (diked)
Kerosene – 1 tank (diked)
Acetone – 1 tank
Tetra-ethyl lead – 3 tanks (separately diked).

None of the diked areas has drains, and the dikes themselves are of natural earth construction covered with a "Gunite" coating to retard erosion. In addition, the tank pumping systems are located outside of the main diked area in an adjacent but separately diked section. All pipelines are above-ground with the exception of a length of liquefied natural gas line and one buried water line. One small toluene tank is also a buried installation. The capacity of this tank was not readily available during the survey. Scale (measuring) tanks within the plant are equipped with earthquake protection and are spring-supported against an earth tremor.

Past Spill Experience

No spills of any consequence have been experienced within the plant.

Spill Control Plan

Management of each of the three production areas has developed a plan of action that could go into effect in the event of a spill. There is constant supervision, and in an emergency employees would be departmentally interchangeable. In spite of a very elaborate system of controls and fail-safe devices, such as high- and low-liquid level alarms and even a high/high-liquid level alarm, plant personnel realize that a storage tank could rupture – in the event of a severe earthquake, for example. In such an event, the storage content of any diked tank would be readily contained within the dikes. If the tank were not in a diked area, the contents would flow into a ditch. If the earthquake did not alert operations, the level alarm in the tank would. *All* of the storage tanks have high- and low-level alarms which sound and flash in a central control room. The spilled liquid would run down the ditch system to the effluent treatment basins which are 0.2 mile from the closest production area. An alerted operator would arrive at the basins and close the inlet gate, which would divert the liquid in the ditches to a 4,000,000-gal. emergency basin. Material entering the emergency basin would remain there until it was pumped out – there is no drainage except for the basin to overflow the dikes. Should there be a delay before an operator diverted the ditch stream to the emergency basin, the liquid would enter the normal 1,800,000-gal. basin. The residence time for liquid entering this basin is a minimum of 24 hours.

To enhance the described spill protection plan, further improvements that will probably be installed during 1971 are being planned. In addition, the plant retains the services of Dr. Ruth Patrick, Philadelphia Academy of Science, an authority on environmental management, who conducts regular in-plant and offshore surveys to appraise and improve waste-water and effluent treatment.

Fibreboard Paper Products Corporation
Wilbur Avenue
Antioch, California 94509

Contact: Mr. Frank J. Lyman, Technical Superintendent

Date of Survey: October 29, 1970

Property Description

The Fibreboard Paper Products Corporation plant is located east of Antioch on the Sacramento River, adjacent to the large Crown Zellerbach facility. The property slants gradually toward the river. Most of the manufacturing facilities are far removed from the waterfront. Surface drainage of the plant goes into storm sewers which go into the river. The effluent of the plant – process water and cooling water – is discharged directly into the river (approximately 1000 feet offshore) after being treated for pH adjustment.

Hazardous Chemicals

The plant produces Kraft corrugated board, Kraft lines, and bleached food board. In treating the waste water, both sulfuric acid and caustic soda are used for pH adjustment, with all data recorded.

Bulk Storage Facilities and Pipelines

The plant has two well-diked storage tanks for fuel oil; one, 35,000-gal. capacity, and the other, 120,000-gal. capacity. Each is curbed, draining to the main effluent discharge line. The plant also has a 1,000,000-gal. plus storage tank for handling the weak black liquor; it is classified as emergency storage. This same tank has provisions to handle all emergency spill situations in the plant.

The only waterborne movement is fuel oil. The fuel oil barge depot is well designed, with check valves, flanged hose connections, appropriate spill tanks, and so forth. Alum used in the process is received by pipeline from the adjacent Crown Zellerbach plant. The 9% caustic soda is received by pipeline from the Dow plant near Pittsburg. Chlorine is received by tank cars, and the cars are used as a storage facility.

Past Spill Experience

There have been no spill incidents since the plant was started.

Spill Control Plan

The plant has very elaborate water intake and discharge systems, and very careful control of the operation is maintained. Any anomaly is reported immediately to the local water control authorities. Excellent records are kept of the pH value of the plant effluent. No formal spill plan has been adopted. Flexibility in the operation allows the facility to avoid major spills.

The Dow Chemical Company
Pittsburg, California

Contacts: Mr. Edward Elkins, Manager, Western Division Planning
Mr. David L. Bauer, Manager, Utilities and Environmental Control
Mr. Dennis Brisco, Materials Handling Field Superintendent

Date of Survey: October 29, 1970

Property Description

Operations in what is now the Dow Chemical Company plant (Figure 20) began in 1919; Dow took it over in 1938. It should be classified as a post-World War I facility. It is located adjacent to the United States Steel facility, approximately half way between the central business areas of Pittsburg and Antioch. The plant is on the Sacramento River. From the entrance to the plant to the water's edge there is a gradual sloping of about 3 feet over a distance of one-half mile. This plant has no flooding potential. For the purposes of this analysis, the plant has been divided as follows: dock storage and ponding; in-plant storage next to ponding; and in-plant storage in the remainder of the plant (see Figure 20 for areas under consideration).

Hazardous Chemicals

Dow's Pittsburg plant produces chlorine, caustic soda, chlorinated hydrocarbons, xanthates, pesticides (antimicrobial), hydrochloric acid, protective coatings, styrene and butadiene latex, and miscellaneous industrial organic chemicals for the mineral industry.

Bulk Storage Facilities and Pipelines

Dow's dock storage area has 16 tanks ranging in size from 20,000 to 1,000,000 gallons. The largest tank holds 50% caustic soda, while the next largest one holds 22° Bé hydrochloric acid. The smaller tanks hold chlorinated solvents and styrene. The tanks are properly diked and are properly cross-piped to allow transfer where appropriate. Standard valving procedures are used in all tanks. The ponding area adjacent to the river is the collection point for the waste water and is the emergency area for caustic spills where they could be neutralized with acid. The in-plant storage next to the ponding area has six tanks – 10,000 to 40,000 gallons in size, containing 10-50% NaOH. The tanks are curbed and have drainage to the pond.

The rest of the in-plant storage is for chlorine, ammonia, latex, and alcohol. (There are 30 of these tanks, all under 10,000-gal. capacity.) If any spilling

Photo Courtesy of Air-Photo Company, Incorporated

FIGURE 20 AERIAL VIEW OF SUISUN BAY-DELTA AREA SHOWING GENERAL LOCATION OF DOW CHEMICAL COMPANY PLANT, PITTSBURG, CALIFORNIA occurred with the chlorine or ammonia, it would vaporize. Spilled latex would result in a frozen ooze because of the low melting point. The alcohol tanks, located near the rear of the plant are curbed and drain to the pond. There is no underground storage, except the chlorine tanks.

The primary raw material movement consists of salt, which comes in by barge and rail. The other movement consists of hydrocarbons which come in by pipeline from nearby points. A third or less of the products is shipped by water; most are shipped by truck. Dockside filling stations, as well as truck filling operations, are available. Both are operated competently, using appropriate methods.

Past Spill Experience

There have been no spills recorded in the history of the Dow plant.

Spill Control Plan

No formal spill control plans have been published. Spill division areas, such as a holding pond for the latex operation, and a holding pond for caustic (the pond near the river), which will allow pH adjustment before discharging, have been provided.

American Smelting and Refining Company
Selby, California

Contacts: Mr. Armand Labbe, Plant Manager

Date of Survey: October 30, 1970

Property Description

The American Smelting and Refining Company plant is presently being shut down. It can be broken down into three areas: the silver and gold refinery, the zinc smelter, and the lead smelter; associated with the lead smelters is a 35-ton sulfuric acid plant. The greater area of the plant is taken up by the slag piles which are – and have been – used for both fill and sweetener for the operation. The plant area is flat. An excellent dock facility exists which makes the area a desirable deep-water site.

Hazardous Chemicals

The plant produces sulfuric acid, liquid SO_2 lead, zinc, refined silver and gold, and associated lead and zinc smelter products. It is located across from Mare Island. Figure 21 shows the entire facility from the air.

Bulk Storage Facilities and Pipelines

In the acid plant there are five 125,000-gal. storage tanks for the 98% sulfuric acid. They are not diked. However, in case of spills, lime from another area of the plant is available for use to preclude any spill reaching the water area. The plant also has one 320-ton capacity (160-ton useful capacity) liquid sulfur dioxide tank, and two 5000-gal. caustic soda tanks which are curbed and sumped. The general area around the tanks is sumped. The raw materials for the plant (concentrates) are brought in by boat and discharged by a modern unloading system. The sulfuric acid and other products are moved by rail.

Past Spill Experience

This plant is 85 years old; it is and has been under constant pollution control surveillance. There has never been a hazardous spill, except for a coke spillage from a barge. The plant will definitely be shut down by the end of 1970 and is for sale; approximately 15 concerns are bidding for the property.

Photo Courtesy of United Aerial Survey

FIGURE 21 AERIAL VIEW OF AMERICAN SMELTING AND REFINING COMPANY, SELBY, CALIFORNIA

Industrial Chemical Division
Allied Chemical Corporation
Bay Point Works
Pittsburg, California

Contacts: Mr. V. A. Fink, Plant Manager
Mr. B. C. Rager, Safety Supervisor

Date of Survey: October 30, 1970

Property Description

The Industrial Chemical Division of the Allied Chemical Corporation plant has been operational in the Suisun Bay area since 1910. Figure 22 is a land view of the firm's general layout, and Figure 23 is a water view. Its chemical products include:

- Sulfuric acid } manufactured products
- Aluminum sulfate } manufactured products
- Hydrofluoric acid } manufactured products
- Sodium bichromate [not manufactured but warehouse-stored and distributed].

The plant drainage has been engineered to flow to a single, submerged outfall that discharges into Suisun Bay. All waste water is passed through a 2500-ton capacity treatment pond prior to final discharge into the bay. The effluent discharge is rated at 3000 gpm, and the pond has a total retention time of 12 hours.

Hazardous Materials

The following materials are produced, handled, and stored within the plant:

- Sulfuric acid – maximum storage, 4,000 tons; the material is tank-trucked from the plant to the consumer.

- Aluminum sulfate liquor – maximum storage capacity, 200 tons of actual liquor with makeup from dry alum; material is tank-trucked to consumer.

- Hydrofluoric acid – maximum storage, 300 tons; shipping procedure: 90 percent, tank car; remaining 10 percent, tank truck.

Photo Courtesy of Allied Chemical Corporation

FIGURE 22 LAND VIEW OF INDUSTRIAL CHEMICAL DIVISION OF ALLIED CHEMICAL CORPORATION, NICHOLS, CALIFORNIA

Photo Courtesy of Air-Photo Company, Inc.

FIGURE 23 WATER VIEW OF INDUSTRIAL CHEMICAL DIVISION OF ALLIED CHEMICAL CORPORATION, NICHOLS, CALIFORNIA

- Sodium bichromate (69 percent solution) – maximum storage, 60 tons; shipments into the plant are made by tank car; shipments out of the plant are made by tank truck.

- Nitric acid – maximum storage, 3000 gallons;

- Acetic acid – maximum storage, 1500 gallons;

- Anhydrous and aqua ammonia – maximum storage, 530 gallons;

- Drummed caustic – maximum storage, 1300 gallons;

- Lime – maximum storage, 14,750 gallons.

Bulk Storage Facilities and Pipelines

Bulk storage and service tanks are positioned at various locations on the plant property; some are elevated, and some have a secondary means of containment. A 4-inch diameter pipeline about 300 yards long lies buried within the plant. The line (recently renewed) does not have cathodic protection. All tanks are hydrostatically tested on a regular inspection frequency, and some of the sulfuric acid tanks are equipped with high liquid-level alarms.

Past Spill Experience

Mr. V. A. Fink has managed this plant since 1934 and cannot recall any spills of hazardous materials during that period of time.

Spill Control Plan

The plant has both a "spill plan" and a "disaster plan." In addition, $250,000 is being spent for water pollution control monitoring. The plant's main outfall has been completely reworked. All drainage lines have been equipped with pH recorders and a drop of 1 to 1.5 would trigger an audible alarm within the plant's main control center. It is anticipated that the improved monitoring/spill control system will be fully installed and operational by March 1971. The plant further maintains a readily available supply of caustic to neutralize acid spills. All sulfuric acid tanks are equipped with internal plugs that can be lowered into position to seal off all tank outlets in the event of a valve or pipeline failure.

Industrial Tank, Inc.
210 Berrellessa Street
Martinez, California

Contacts: Mr. Henry W. Simonsen and
Mr. Jack O. Fries, Owners

Date of Survey: October 29, 1970

Property Description

Industrial Tank, Inc., has operated in the Martinez area for the past 22 years. The original services included tank cleaning (marine and industrial), vacuum tank trucks, oil and special liquid pumping, weed control, and general industrial services. Its waste water and spent chemical disposal services are currently being extended.

In addition to a downtown office and trucking terminal, Industrial Tank has a spent-chemical treatment and disposal site on acreage that is surrounded by oil refineries (Shell and Phillips), the closest water bodies being Walnut Creek and Vine Hill Slough, which flow into Suisun Bay and the Sacramento River. A total of 20 trucks (11 with 100-bbl capacity) are used to collect waste oil and spent chemicals from an area that includes Sacramento, Antioch, and Richmond, California, transporting same to the Martinez disposal site. Currently 10 major industries are serviced, including Shell, Phillips, Humble, duPont, Dow, Union, and Standard Oil. The concern also provides oil spill clean-up services using absorbent straw and a California Fish and Game Department approved "Hydro-purge" oil suction device. Marine craft with oil spill clean-up capability are under investigation for possible acquisition, and the services of an environmental control geologist have been retained on a consultant basis.

Hazardous Materials

Hazardous materials can best be described as waste oil and a mixture of spent chemicals, some of which are commingled. The majority of the oil is recovered and used for spreading on highways for road dust control.

Bulk Storage Facilities and Pipelines

At the disposal site there are a total of 10 receiving tanks with each tank averaging 400-bbl capacity. The treatment flow includes a 700-bbl treatment tank, a 10,000-bbl settling tank, and a battery of evaporation ponds which will eventually extend over a 20-acre area. When in full operation, the solids that remain after treatment and evaporation will be buried within the disposal site. All pipelines and tanks are exposed, above-ground installation with the exception of one tank, which is partially buried.

Past Spill Experience

The plant experienced one major spill when flood water came over the perimeter levees and washed out the treatment ponds. To prevent repetition of this occurrence, flood control levees have been raised and stabilized.

Spill Control Plan

As the leading spill control and water clean-up agency in the Sacramento River Basin, Industrial Tank has a built-in spill control plan that would go into effect in the event of an emergency. Suction trucks, dispersants, and mechanized grading equipment, backed up by a number of years of spill containment and clean-up experience, would go into immediate service.

Hercules, Incorporated
Hercules, California

Contacts: Mr. Gordon Hoffman, Assistant Plant Manager
Mr. C. Sausaman, Assistant Technical Superintendent

Date of Survey: October 29, 1970

Property Description

The Hercules plant, which comprises the town of Hercules, is located on San Pablo Bay. The property was not surveyed because corporate approval could not be obtained. The plant seems to be well laid out. There is a definite sloping toward the bay, but provisions have been made for surface drainage to go to the waste water treatment plant which is used for the ammonia and nitric acid plant and is equipped with appropriate pH control. A second waste-water treatment system will be in operation in 1971 for the methanol and formaldehyde plant. Biological techniques will be used. Some surface water will probably be handled in that facility.

Hazardous Chemicals

This facility produces urea, methanol, formaldehyde, ammonia, nitric acid, ammonium nitrate, nitrogen tetroxide, and urea formaldehyde.

Bulk Storage Facilities and Pipelines

The following storage tanks are located in the plant. Most of the tanks are diked; exceptions are noted.

2 – 100,000-gal. tanks for ammonium nitrate and UN-32 (mixture of NH_4NO_3 and urea)
These two tanks are submerged. The first one is an old tank which has been newly lined with stainless steel, while the second is a submerged concrete tank.

1 – 20,000-gal. methanol tank,

4 – 30,000 to 50,000-gal. fertilizer solution tanks, which will be diked in 1971,

2 – 10,000-gal. sulfuric acid tanks, which are undiked,

1 – 100,000-gal. tank plus an anhydrous ammonia tank,

8 to 10 small tanks containing methanol and formaldehyde.

Most shipments are made by truck; some by rail. There are no waterborne movements. The loading docks are located in individual plant areas.

Past Spill Experience

Approximately 10 years ago, a spill of formaldehyde from a tank was recorded. This was a tank overfill-overflow occurrence.

Spill Control Plan

Plant spill control practice is said to be excellent. Spill prevention procedures are stated to be in existence, but were not discussed or shown, except for surface water problems and waste-water treatment. We were assured that appropriate procedures are being followed.

J and J Disposal
Benicia Industrial Park
Benicia, California

Contacts: Mr. Howard Jenkins, President
Mr. C. J. Tranby (Winton Jones Contractor, Inc.)

Date of Survey: October 30, 1970*

Property Description

The J and J Disposal firm is a comparatively new concern involved in the disposal of waste chemicals. Its 243-acre disposal site is located in the rolling hill country north of Suisun Bay and the Sacramento River. The elevation is estimated to be 600 to 700 feet above sea level and has a State of California "Class 1" dump rating which is given only to sites that have no waste water discharge. The operators contend that prior to commencing operations they met – and continue to meet – the demands of 13 regulatory bodies.

The concern has six 110-bbl capacity vehicles and uses four to five common carrier tank trucks (mostly 30-bbl capacity with 42 gal/bbl) to haul spent chemicals from as far as Richmond, California (10 miles) to the dump site. The chemicals are pumped into evaporation and settling ponds where sun and wind evaporation separates the waste water from the chemicals. The University of California in Berkeley has measured a 76-inch annual evaporation rate in the locale and an 18-inch average rainfall has been recorded for the area. There are no perennial streams at the disposal site, and the intermittent flow of rain water in the various gulches has been diverted from the area. The operators have experimented with spraying the waste liquids directly onto the soil to hasten evaporation. The separated chemical solids are then finally bulldozed into the soil.

Hazardous Materials

The firm's report (dated September 1970) to the California Department of Health reported disposal of the following waste materials during the month:

Sour water	7,750 bbl
Spent caustic	8,035 bbl
Oil slop	4,180 bbl (from tank bottoms)
Floc	9,066 bbl
Wash water	1,070 bbl
Phenolic water	1,820 bbl
Sulfuration tar	2,743 bbl (contaminated asphalt).

*Data further clarified during telephone conversation of November 4, 1970.

Bulk Storage Facilities and Pipelines

The disposal area has no storage tanks or pipelines.

Past Spill Experience

Spills have been confined to a 1-bbl spill resulting from careless operation during preparation for a spray test. The spill was reported to the State of California even though it was confined to the disposal site.

Spill Control Plan

J and J Disposal has a close business relationship with Winton Jones Contractor, Inc. In the event of a spill, all of the Jones mechanized contracting equipment could be quickly diverted and transported to the disposal site to control and confine the spill by the fabrication of earthen retainment dikes.

D. CHARLESTON, WEST VIRGINIA

Charleston, the capital city of West Virginia, is located on the Kanawha River at the junction of the Elk River, principal tributary of the Kanawha. This site has been located on the main stream of East-West transportation since development of highways to the West began in the early 19th century. Its development as a major center for chemical manufacture began after World War I and was based on the availability of fuel. Complex plants for the manufacture of a variety of materials were established by a number of major national chemical companies. These plants have been expanded and modernized continuously, and the trend continues today. The Kanawha is navigable for about 90 miles from its source at the junction of the Gauley and New Rivers above the London dam to its junction with the Ohio at Point Pleasant above Huntington. Charleston is located at about 55 miles up the river.

The industrial development of the river extends from the head of navigation about 90 miles to about 40 miles up river at Nitro, West Virginia. This area is the territory covered by the Charleston survey. It includes the Elk River on which are no facilities of interest. Industrial development on the Ohio River at the mouth of the Kanawha has begun, notably with a polyester plant operated by Goodyear. These facilities, however, are outside the geographical area of interest and the Kanawha between that point and Nitro is relatively undeveloped. This definition of the area of interest was selected by the Cincinnati Regional Office of the FWQA and was based upon maps provided by the American Electric Power Company and on river charts provided by the Corps of Engineers. These data provide reliable information on facilities which are so located that spills of hazardous materials could contaminate the Kanawha River.

1. Site Character

The topography of this area is that of low mountainous terrain with very little flat land. The Kanawha flows between steep banks with tributary streams joining the river through relatively narrow valleys. There are three navigation and flood control dams on the river – the Marmet and London dams above Charleston and the Winfield dam below Charleston. Spills from the facilities in the area would quickly find their way to the Kanawha where they would be confined to a restricted water course rather than dispersed over widespread harbor and beach systems. The existence of the dam and lock systems suggests that confinement of the river water on a temporary emergency basis would be possible in the event of a spill which might require such action.

2. Data Sources

The Department of Water Resources (DWR) of the State of West Virginia, with offices located in Charleston, was an important source of information. This agency works quite closely with local industry and operates under water quality criteria established by law by the State of West Virginia in 1965. The state has had a voluntary spill alert system in operation since 1958. As part of their water quality criteria, reporting of spills is now mandatory. Operational malfunction and discharge of wastes through treatment-plant outfalls is the most frequent occurrence; direct chemical spills are infrequent. Attention to these spills is paid by the state on a single-case basis. No attempt at coordination and analysis has yet been made.

An industry committee known as the Kanawha River Industrial Advisory Committee (KRIAC) has operated for many years in close cooperation with the DWR. Almost all of the large chemical plants have members on this committee. The committee has been coordinating the use of the Kanawha River by the plants in the interests of protection of the river as well as maximum usefulness of this resource to industry. Furthermore, the committee takes an active interest in all environmental problems relative to industry in the valley and was thus a valuable resource for data to fulfill the objectives of this study.

Visits were made to the Huntington offices of the Corps of Engineers and the Coast Guard. Both agencies receive spill reports, and the Coast Guard takes action on a case basis where it is required to control the spill. Records of spill problems are also available in the Department of Water Resources files at Charleston. The Corps of Engineers provided three items which gave valuable data for the Charleston survey, the first being a set of Kanawha River navigation charts showing the location and character of all of the riverside dockage and shipping facilities, as well as the industrial intakes in the valley; the second document being a listing of all of the riverside facilities for which permits have been issued; and the third item being a set of aerial photographs which provide good illustrative detail of the nature of the physical facilities in the survey area.

3. Past Spill Experience

In 1958 a cooperative program of spill reporting on a voluntary basis was initiated by KRIAC and the West Virginia authorities. On the basis of this experience a mandatory program was adopted as part of rules and regulations adopted by the Water Resources Board of West Virginia in 1965. Copies of reporting forms are offered as Appendix F. This system incorporated two features which appear especially desirable:

(1) The quantity, name, nature, and specific hazard of the material spilled; and

(2) the current estimate of the river flow and consequent dilution.

This information is considered vital toward the preparation of an effective spill control plan and is lacking on most reporting systems viewed throughout the nation.

Other sources of past spill data are the Coast Guard, the Corps of Engineers, and FWQA itself. Data from these sources is summarized in Table 11. It is apparent that the spill data are fragmentary and incomplete; only 12 instances of spills are reported for the years 1965 through 1970. Many water-soluble and heavier-than-water chemical spills could have gone undetected.

The work of the KRIAC Committee and the unified approach to control and improvement of the river quality represent a good program. This work, together with the design and operating standards of the larger companies, indicates a serious attempt is being made to improve water quality in the valley. Because spills will be carried downstream with the flow of the river, emphasis is on prevention, and primary containment of spills is of paramount importance.

TABLE 11

PARTIAL LISTING OF SPILLS INTO THE KANAWHA RIVER IN THE CHARLESTON AREA – 1965-1970

Date	Material	Amount	Cause/Remarks
7/27/65	Acrylic Acid	10,000 gal.	Tank dumped to cooling water drain to prevent runaway polymerization
7/28/65	Croton oil	45 gal.	Hose drainings
10/26/65	Toluene	1,000 gal.	Truck overturned
12/15/65	Tetralone and tetralol	100,000 lb	Operating error
1/19/66	Crotonaldehyde	38,900 lb	Faulty relief valve
8/18/66	Isopropanol	22,800 gal.	Barge leak
5/4/68	Normal paraffins	75 gal.	Valve leak on barge
10/26/69	MIBK	100 gal.	Hose leak
4/22/70	2-ethyl-butyraldehyde	25 gal.	Barge leak
9/ /70	Methanol	N/A	Hose break
11/ /70	Acrylonitriles	42,000 gal.	Pumping into tank with valve open
11/24/70	PPCH	N/A (< 100 gal.)	Intentional disposal.

Union Carbide Corporation
Environmental Control Group
South Charleston, West Virginia

Contacts: Mr. George J. Hanks, Manager
Mr. F. D. Bess, Assistant Manager
Mr. E. M. Hall, Manager Institute Plant
Mr. R. Payne, Engineering Manager

Date of Interview: October 8, 1970

The Environmental Control Group has responsibility for all of the Union Carbide facilities in the Chemicals and Plastics Division, including the two plants in the Kanawha Valley and the plant at Texas City. This plant was visited in recognition of the fact that the larger chemical companies, such as Carbide, have had extensive experience in coping with dangerous chemicals, including the problem of spills and hazards to the public and contamination of the waterways. The most significant development relative to these problems is the establishment of the Environmental Control Group itself. The corporation recognizes this function as an essential part of operating a chemical industry and has established the group with qualified personnel with the authority to enforce adequate control measures. Its personnel participate actively and continuously in the planning of new functions, and in the maintenance of existing plants. The group has veto power over process design features on new facilities where it considers that operation of the proposed process would endanger the environment.

Union Carbide is an active participant and an initiator of the cooperative program with the state for voluntary reporting of chemical spills and analysis of the danger involved. In connection with this effort, Union Carbide entered into a cooperative program with the Mellon Institute to classify the potential hazard of all materials handled by the Chemicals and Plastics Division. As a result, data on the degree of hazard and methods for containment and clean-up are swiftly available in the event of any spill. An alerting procedure ensures that qualified people at Carbide and at the Mellon Institute are quickly available at any time to help with a spill problem. In the event that a spill reaches the river, data on the flow in the river at the time of the spill are available; this information, combined with an estimate of the quantity of the spilled material, can effect a prediction of the concentrations expected downstream in the river and thereby an overall assessment of the problem. The concentration in the river is then monitored to verify the prediction and, if necessary, water users can be advised to discontinue using the water until the danger is passed. Union Carbide's experience shows that there are two or three spills a year which must be reported and monitored in this way. There have been no spills of toxic materials. The problem has been with chemicals which impart taste, odor, or affect the clarity of the river.

Union Carbide's primary defense against spills is concentrated on the process unit which is designed to prevent spills and to contain them should they occur. This includes sumps in the process area, drip pans, check valves, and operating standards which tend to emphasize the importance of containment of chemical materials. An economic incentive is added by a charge imposed on each process unit for the amount of waste it sends to the waste-treatment plant. The manager of a process section cannot afford to be careless with chemical discharge because it hurts his profit performance record. The second line of defense against spills – and a very effective one – is the collection of all liquid wastes and processing them in a waste-water treatment system. The only water used in the plants that is not processed through this system is cooling water which is not exposed to process materials. Drainage from process areas, sumps at receiving and loading stations, and the diked areas around storage tanks is all connected to a process sewer system which discharges to a waste-treatment plant.

An important function of Union Carbide's Environmental Control Group is a system of inspection and maintenance to ensure that control measures remain in efficient operation and that hazards for spills do not develop. Several features of this program were outlined. First, the position of all dike valves is inspected on a weekly basis. Open valves are called to the attention of the operating supervisors. All tanks and other equipment have a regular schedule of inspection. The timing varies with the nature of the tank and its contents, but it generally never exceeds one year. The method of inspection also varies. In some cases, inspection is by visual survey of the empty tank. Many are hydrostatically tested, and on most the shell thickness is measured. Safety valves are subject to regular examination. This includes, in most cases, replacement of the valve with a shop-inspected and-tested unit.

Engineering standards are developed in conjunction with the Engineering Division by active participation in the design of new facilities, and by specific designs for modification of the existing plants in the interests of better spill prevention, containment, and control. Safety is also a primary consideration in design. An example of the attention given to design matters of this nature is in a study of the problem of filling storage tanks with flammable materials. If such tanks are filled from the top, the chances for vaporization and formation of an explosive atmosphere in the tank are high. If they are filled from the bottom, the entire head of the tank is imposed on the fill line with consequent dangers of a break and a major spill. Another problem is whether or not the falling liquid stream in a topfill operation would create a static charge with a resulting spark and ignition of the tank contents. After considerable design study, it was concluded that a real hazard in this respect did exist and a small-scale model fill operation was set up by the research group. Under proper conditions, it was found that static charges and an explosion could be initiated. The resulting design standard for storage tanks in this category is, therefore, to fill from the top, but through a pipeline which extends to the bottom of the tank and whose outlet is below the liquid level in the tank. To prevent siphoning back through this line, the top of the loop is vented with a second line which extends to a sufficient height to serve as a siphon breaker and is connected to the top of the tank.

In addition to the plant facilities, Union Carbide operates an extensive barge fleet with operations not only on the Kanawha River, but in the Ohio and Mississippi systems as well. Operations of this fleet are controlled from a center in the Kanawha Valley and extensive use of radio contact and control is made. Any barge can make contact with this center in a matter of minutes for assessment and advice on any problem.

Union Carbide Corporation
Chemicals Division
P. O. Box 8004
South Charleston, West Virginia

Contacts: Mr. R. G. Lilley, Department Head
Environmental Control Coordinator
Mr. William Young, Assistant to Mr. Lilley
Mr. Robert Aspley, Supervisor
North Charleston Bulk Storage Area

Date of Survey: October 7, 1970

Property Description

The principal production plants of Union Carbide's Chemicals Division in the South Charleston area are located on a large island in the Kanawha River channel and on the left bank in South Charleston (Figure 24). These plants are about 55 miles above the mouth of the Kanawha River. A large bulk storage area is located directly across the river in North Charleston.

This is a very large organic chemicals plant employing over 2000 men. The plants have two sewer systems – one for cooling water and rain run-off, the other for water contaminated with chemicals. The contaminated water sewer system connects with the South Charleston municipal sewage plant, which was designed in cooperation with Union Carbide and is presently operated by Union Carbide personnel.

The Union Carbide Company has made and is continuing to make improvements in its handling of the extremely large number of potentially hazardous chemicals to reduce the possibility of spillage into the waterways. The experience and procedures of this company can serve as an excellent guide to other organic chemical producers who are altering old plants or building new ones. In a large organic chemicals plant it is desirable to have separate sewer systems to ensure the collection and treatment of spilled chemicals. Systematic diking, modification of equipment to reduce spills, provision of catch basins and drip troughs, systematic loading and unloading procedures, level indicators, leak alarms, and the like, have served to reduce the spill hazards in this plant.

Photo Courtesy of U.S.A. Corps of Engineers

FIGURE 24 AERIAL VIEW OF UNION CARBIDE CORPORATION, SOUTH CHARLESTON, WEST VIRGINIA

Union Carbide Chemicals Division – North Charleston Bulk Storage Area

The North Charleston bulk storage area consists of 35 acres of developed land and 10 acres of undeveloped land, and has a total storage capacity of 17,200,000 gallons. Individual tank (30 to 40) capacities range from 33,000 to 810,000 gallons. There is also storage for approximately thirty 30,000-gal. tank cars on a temporary basis.

All tanks are diked with a containment volume greater than the capacity of the enclosed tank. Most of the dikes are earthen but a few are concrete. Earthen dike areas are sprayed with a weed killer each year in late July or August to kill vegetation. All dikes have a drain valve which is kept closed, except when opened to drain off rainwater. All dike valves are checked every Sunday to make sure they are properly closed. If a valve is opened to drain a dike, it is closed on the same shift. If it is necessary to leave a valve open into the following shift, that fact is entered in the log so it may be properly closed by the next shift. All pumps with packing glands have been replaced by pumps with mechanical seals to eliminate leakage into diked areas.

Liquid chlorine, gasoline, and 26 organic chemical liquids are unloaded from barges and 6 organic liquids are loaded into barges at the barge station. All drainage from flexible hoses goes to a 40,000-gal. holding tank for pumping to the treatment plant on demand. Flanges on hoses from the barge are broken over a trough and all drips are picked up in a sump and pumped to a holding tank by a pump operated by a float switch for delivery to the contaminated sewer. Most barges are loaded or unloaded promptly, but chlorine barges are held from 4 days to 2 weeks as the chlorine is used in the plant processes. The chlorine is piped under the river through a jacketed pipe buried 6 feet below the normal river bottom. The inner pipe is 3 inches (schedule 80) and the outer pipe is 6 inches (schedule 40). Possible leakage at both the inner and outer pipes is checked once a year by applying up to 50 pounds of air pressure to the jacket and checking for pressure drop and bubbles. All other pipe lines are not jacketed. In case of a leak in the chlorine line, the control room can shut off the flow by remotely controlled valves. Chlorine storage tanks are inspected visually and by reflectoscope or audio gage every 4 years. Chlorine hoses are tested with dry air at 350 pounds of pressure every 3 months.

All solvent storage tanks are held under pressure equal to 2 inches water and vented to atmosphere through flame arresters. There are high-level, low-level and leak detectors on all tanks, and these are monitored in the control house. When a tank is being pumped out, the leak alarm will go on after the level drops one-eighth inch to 1 inch. The leak alarm is reset automatically when the remote valve is closed again after pumping. Vented air from acrylate tanks and vented air from filling tank cars with acrylates goes through scrubbers using 20% triethylene tetramine and 80% ethylene glycol for removal of acrylate fumes from exit air.

All truck and tank car loading and unloading areas have collection drains which go to the 40,000-gal. holding tank for pumping to the water-treatment plant.

Automated Warehouse

This facility is located on the South Charleston side of the river. The warehouse has storage capacity for sixty-four thousand 55-gal. drums of liquid chemicals. Any spillage or drips from this entire area go to a sump and thence to the treatment plant which was designed to handle loads of this nature. If the flood system of spray heads is activated, the water flow would exceed the capacity of the contaminated-water sewer connection and excess water would flow over the weir and into the river.

Tank Car and Tank Truck Loading and Unloading Areas

There are numerous tank car and tank truck stations on the mainland and the island portions of this plant. With the exception of one remote area where few cars are loaded, all tank car and tank truck loading and unloading is done over drains that go to the contaminated-water sewer system.

Tank cars are spotted from 8 p.m. to 8 or 9 a.m. to avoid in-plant traffic during the day. All spotted tank cars were observed to have derail devices in place ahead of cars to prevent other cars from hitting them by accident while they were being loaded or unloaded.

Tank cars and tank trucks are cleaned with steam and, while still hot, are dried by inserting an air nozzle system of special design to sweep the walls of the tank. All washings go to the contaminated-water sewer. If a car contains a large "heel" of solvent, it may be drained and sent to be burned in the boilers.

Sewer Systems

Prior to 1954 all wastes went to the river, except for concentrated wastes, which were burned. In 1954 two completely separate sewer systems were installed; one for clean cooling water, rainwater, etc., and the other for water contaminated with chemicals. The cooling water and run-off water outfalls drain to the "back channel" between the island and the South Charleston shore. The contaminated-water sewers go to a flume system which carries the waste to the treatment plant. All drains and pits are clearly marked to make sure plant personnel do not dump waste or washings into the clean-water sewer system.

Outfalls of the clean-water sewer system go into the river from above water level and the mixing zones are surrounded by floating booms to catch any floating material that might accidentally go into the river. Some time ago an operator tried to wash down some spilled detergent and the resulting foam collected in the boom at the clean-water sewer outfall. The foam was recovered by a floating skimmer pump which can be moved from place to place as needed.

Flow of water to the treatment plant now runs 8 to 9 million gpd, but is down from the almost 14 million gpd of a few years ago, because of tighter controls by operators in the plant. Instruments for monitoring the organic carbon content of the waste water are located at two points in the waste-water flume system. Plans call for increased installation of remote sensing units which can be monitored form a central control station. A "panic pond" is under consideration. It may be used to hold highly contaminated water which may be diverted to it on the basis of the organic carbon monitors.

Spill Notification Procedure

All spills – regardless of size and whether they went to ground, to the treatment plant, or to the river – are reported by calling the Utilities Foreman who enters it in the log. He is kept advised of the effect of all the plant materials on the treatment plant, effect on river, and other considerations. If the spill is large, it is reported to the state authorities, and the FMC plant and the Nitro water works downstream are notified. As is usual in the area's approach to spill control, Carbide has available a nomograph system. It allows them to calculate the parts per million (ppm) of the spilled substance in the river from the spillage rate in gallons per hour and the river flow in cubic feet per second. Depending on the oral toxicity hazard rating (1 to 5), the Nitro water plant may be shut down for spill concentrations ranging from 10,000 down to 1.0 ppm.

The company belongs to the Kanawha River Industrial Advisory Committee (KRIAC) which has taken an active interest in all environmental problems of the area, and has set up the reporting system with the state for all spill incidents.

Hazardous Materials

Materials transported by barge at the North Charleston bulk storage area are listed below.

A. Incoming Chemicals

1. Ethylene glycol
2. Acetone
3. Methanol
4. Methyl ethyl ketone
5. Propionic acid
6. Cellosolve acetate, 99%
7. n-propanol
8. Butanol
9. Ethylene glycol
10. Propionaldehyde
11. Ethyl acrylate
12. 2-ethyl hexyl acrylate
13. Vinyl acetate
14. Cellosolve acetate, 95%
15. Methyl cellosolve
16. Butyl acrylate
17. Isopropyl alcohol
18. Acetic anhydride
19. Isobutyl acetate
20. Cellosolve
21. Glyoxal, 40%
22. L. G. Carbitol
23. Amyl alcohol
24. Isobutyl alcohol
25. Isopropyl acetate
26. Ethylenediamine
27. Chlorine

B. Outgoing Chemicals

1. Butyl acetate
2. Propylene dichloride
3. Methyl amyl alcohol
4. Ethylene Dichloride
5. Butyl cellosolve
6. Ethyl acetate

Past Spill Experience

See Table 11 for a listing of past spills.

Union Carbide Corporation
Institute, West Virginia

Contacts: Mr. M. E. Hall, Environmental Control Manager
Mr. William Miller, Engineer

Date of Survey: October 7, 1970

Property Description

The Union Carbide Corporation Institute plant (Figure 25) is a large facility that processes about 20 major organic chemicals. Ethylene is a principal raw material, and derivatives include ethylene glycol, many plasticizers, resins, polyurethane, and also derivatives of chlorine and of HCN. It is a newer facility than Union Carbide's plant at Blaine Island in Charleston and for this reason was easier to update relative to the most modern safety and spill control measures. Three separate docks are operated for shipment and receipt of materials by barge. One of these docks is reserved exclusively for chlorine receiving; the others handle a full line of liquid materials. Floating docks are provided, with provisions for the barge to moor securely to the dock by conventional shipping practice. Transfer pumps are installed on the docks and the barge connection is made by a combination of flexible hose and portable pipeline. The flexible hose is required to prevent undue strain on the pipeline system. Armored high-pressure hoses are used. The pumps are fitted with drip pans and slop tanks. Upon completion of a transfer the pipeline is blown clear to the storage tank and back to the barge by an appropriate gas, either air, if a non-flammable material is involved, or nitrogen, if an inert gas is required.

Adjacent to the dock area there is a storage tank farm with about 20 tanks of 100,000-gal. capacity. These tanks are vertical and cylindrical with fixed roofs and contain such materials as ethyl acetate, ketone, acetone, and glycol. There are also four spherical tanks for storage of ethylene oxide. Each tank is surrounded by a separate earthen dike. There is a drainage connection from inside the diked area to the chemical plant sewer. This drain is fitted with a valve which is closed, except when there is need to drain rainwater from the system. Fill lines to the tanks are installed in the standard vented-loop Union Carbide system. Discharge pumps are located inside the diked area. This system is typical for tank farm areas at the Institute plant.

In addition to the riverside tank farm, there are five other large systems of storage tanks complete with appropriate diking. The diking is either earthen or concrete. In crowded areas it has been necessary to use concrete dikes. In some of the process areas, there is also a sizeable amount of storage. For example, at one location there are a number of 5000-gal. vertical storage tanks. These are located

Photo Courtesy of U.S.A. Corps of Engineers

FIGURE 25 AERIAL VIEW OF UNION CARBIDE CORPORATION, INSTITUTE, WEST VIRGINIA

behind a concrete dike and the drainage from the dike system is to the process sewer. Proper operations of such a system in a process area is more controversial than a diked storage tank farm area. There are problems with both housekeeping and safety if the drain from the diked area is maintained closed and operating personnel are in favor of keeping these drains open. At the present time, however, the standard is to keep the drain valve in the closed position. If it must be opened for any reason, the process supervisor must obtain permission to open the valve. Such permission is granted after sampling and analyzing the material to be drained. If the drainage time overlaps a change of shift, the outgoing operator closes the valve, logs it closed, and the incoming operator then opens it and logs it open. This procedure avoids any controversy over the responsibility for leaving a valve open. The position of all of these valves is checked on a weekly basis by the Environmental Services Group. Any open valves are called to the attention of the operating supervisor who must then come out and close it.

The plant receives and ships material both by truck and rail. There are two major terminals of transfer in the plant which handle many products. There are also about 12 stations at the individual process units which handle specific products. At the multiple product stations, transfer lines terminate in a manifold and are then connected to the tank car or rail car by flexible hose systems. Transfer pumps are available at this station with a suction line connected to the car by flexible hose and a discharge connected to the appropriate transfer line by another flexible hose. These manifolds and the transfer pump are located within a curbed area with a special drain. In some cases this drains to a special sump for pumping to a reclaiming area. In other cases, the sump drains to a process sewer. The tank car or tank truck spot is also sloped so that it drains to the process sewer.

Drainage

At the Union Carbide Institute, the process sewer system is entirely separate from the storm sewer system. Only clean water can get to the storm sewer. The process sewer line takes all of the waste from the processing areas of the plant and is also connected to the diked areas around all of the storage tanks, as well as the rail and truck shipping areas. This system effectively prevents the discharge of any contaminated waste directly to the river. All waste must be processed through the treatment plant before discharge to the river.

The waste-treatment plant includes primary settling basins, aeration chambers, and secondary clarifiers. Union Carbide has developed and employs special instrumentation to analyze the effluent from the treatment plant for total carbon. These instruments are also used to monitor the sample process areas which discharge to the treatment plant. In this way, trouble can be located quickly and the offending unit can correct the difficulty. The waste-treatment facility is designed to minimize the impact of a large spill. At normal flow rates, the aeration basins provide a total of three days of residence time. This large capacity allows for dilution and equalization of contamination problems, and also allows time for analysis of unusual situations requiring corrective measures. In addition, a very large area adjacent to the treatment plant has been reserved as a "panic" pond for a temporary holding of contaminated fluids for emergency treatment.

Hazardous Chemicals

A general description of the materials handled in this facility and at the Institute plant is presented in Table 12.

Past Spill Experience

See Table 11 for a listing of past spills.

Spill Control Plan

Union Carbide is a member and follows the practice of the several Kanawha Valley emergency and disaster control plans.

TABLE 12

HAZARDOUS MATERIAL STORAGE AT UNION CARBIDE CORPORATION INSTITUTE AND SOUTH CHARLESTON, WEST VIRGINIA*

Product Name	Container Type	Source	Storage Tank Size*	Product Name	Container Type	Source	Storage Tank Size*
Aerosol MA pur	T/T	Purchased	A	Acetic acid strong	Barge	"	A
Ammonium lauryl polyether	T/T	"	A	Mixture PM 4325	T/C	514	A
Benzene thiophene free	T/T	"	A	Acte Acid PM 1417	T/C	"	A
Tertiary butanol	T/T	"	A	Acetic Acid PM 1486	T/T	"	A
1-2 butylene oxide	T/C	"	A	Acetic anhydride	Barge	Interplant	B
Calcium carbide sludge	Barge	"	A	Acetic anhydride	T/C & T/T	"	B
Calcium chloride fuel pro	T/C	"	A	Acetic anhydride	T/C	"	B
Carbon tetrachloride pur	T/T	"	A	Acetone	T/C & T/T	Interplant	C
Chloroform	T/T	"	A		Barge		
Dichloreth´eth	T/T	"	A	Acetone	T/T	"	A
Diphenyl amine	T/T	"	A	Mixture PM 4200	T/T	514	A
Dipotassium hydrogen	T/T	"	A	Acetone PM 3964	T/T	"	A
Tert dodecyl mercaptan	T/T	"	A	Acrylonit MMHQ	T/C & T/T	Interplant	B
Epichlorohydrin	T/C	"	A		Barge		
Flexol plasticizer TCP	T/T	"	A	Acrylonitrile	T/C & T/T	"	B
Formalin, 37%	T/T	"	A		Barge		
Formaldehyde 50%	T/T	"	A	Airecon PM 4578	T/T	514	A
Gasoline white	T/T	"	A	Amino et ea	T/C & T/T	Interplant	A
Gluconic acid 50% tech	T/C	"	A		Barge		
Glycerine superol	T/T	Purchased	A	Pri amyl alc	T/C & T/T	"	B
Granular carbon 12 x 4 cal	Pkg	"	A		Barge		
Heptane pur	T/T	"	A	Amyl tallate	Barge	514	A
Hexane pur	T/T	"	A		T/C & T/T		
Hydrogen peroxide albone	T/T	"	A	Anhydrol PM 1473	T/T	"	A
Isobutylene	T/T	"	A	Anhydrol PM 1474	T/C & T/T	"	A
Lauryl alcohol sulfate	T/T	"	A	Mixture PM 4078	T/T	"	A
Laurly alcohol Sipanol L2X	T/T	"	A	Mixture PM 4079	T/T	"	A
Methacrylic acid - glacial	T/T	"	A	Mixture PM 4080	T/T	"	A
Meth methyl acetate mix	T/C	"	A	Mixture PM 4081	T/T	"	A
Nonane napht mineral sprt	T/T	"	A	Mixture PM 4082	T/T	"	A
Phosphoric acid, 75%	T/T	"	A	Mixture PM 4083	T/C & T/T	"	A
Phosphorous oxychloride	T/C	"	A	Mixture PM 4084	T/T	"	A
Plasticizer extender 125	T/T	"	A	Mixture PM 4085	T/C & T/T	"	A
Potassium hydrox, 45% LC	T/T	"	A	Mixture PM 4135	T/T	514	A
Silicate of soda	T/T	"	A	Mixture PM 4157	T/T	"	A
Sodium aluminate tech	T/T	"	A	Mixture PM 4176	T/T	"	A
Solvent Bronoco rubber	T/T	"	A	Antidust Agt JM	T/C & T/T	"	A
Sulfur dioxide comm gr.	T/T	"	A	Mixture PM 4337	T/C	"	A
Sulfuric acid, 93% W.N.	T/C	"	A	Butanol	T/C & T/T	Interplant	C
Tall oil fatty acid pur	T/C	"	A		Barge		
Teta isopropyl titanate	T/T	"	A	Butanol esters gr.	Barge	"	B
Urea pur	T/T	"	A	Butanol residue	T/C	514	A
Vinyl chloride	T/C	"	B	Mixture PM 1524	T/C & T/T	"	A
Xylol commercial gr.	T/T	Purchased	A	Sec butanol	T/T	Purchased	A
Nitrogen driox	T/T	"	A	Butox ethoxprop	T/C & T/T	Interplant	A
A 160 silicone tet	T/C	"	A	Prop filmer bep	T/C	"	A
Acetic acid glacial	T/C	"	B	Butoxy triglyco	T/T & T/C	514	A
Butoxy triglycol	T/C	"	A	Bu acet AM visc	T/C & T/T	"	A
Dichlorethyl ether	T/T	"	A	Butyl acetat 98	T/T & T/C	"	A
Isobutyl acrylate	T/T	"	A	Butyl acet PU G	T/C & T/T	"	A
Methanol	Barge	"	B	Bu acetat CA 149	T/C & T/T	"	A
Tridecanol mixed isomers	T/T	"	A	N butyl acetate	T/C & T/T	"	C
UCON brake fluid PM 4869	T/T	"	A		Barge		
UCON brake fluid PM 4823	T/T	"	A	Mixture PM 3934	T/T	"	A
Vinyl acetate HQ	T/C	"	A	Butyl acrylate	Barge	Interplant	B
Vinyl acetate L-HQ	T/C	"	B	Butyl acry MMHQ	T/T	"	B
R-21	T/C & T/T	Interplant	A	Butylamine	T/C & T/T	Interplant	A
AF gly	T/T	"	C	Butylamine CR	T/C & T/T	"	A
Acetic acid gla	T/C & T/T	"	A	Butylamine 97PC	T/T	"	A
Acetic acid	T/T & Barge	"	B	Butyl Carbitol	T/C & T/T	514	A

* From a computer program prepared by the Union Carbide Corporation.

TABLE 12 (Continued)

Product Name	Container Type	Source	Storage Tank Size*
Butyl Carbitol	T/C	"	A
Butyl CB acetat	T/C & T/T	"	A
Butyl Cellosolve	T/C & T/T	"	B
	Barge		
Butyl CS acet	T/C & T/T	"	A
Butyl chloride	T/C & T/T	"	A
Butyl chloride	T/T	"	A
Butylene OX 12	T/C & T/T	"	A
Butyl Ether	T/T	"	A
Butyralde anhyd	T/T	"	A
Butyralde anhyde	T/C	"	A
Butyraldehyde	Barge & T/C	Interplant	B
Butyric Acid	T/T & T/C	514	A
Carbitol low gr.	T/C & T/T	Interplant	B
	Barge		
Carbitol PM 0600	T/C & T/T	514	A
Mixture PM 4467	T/T	"	A
Carbitol Acetat	T/C & T/T	"	A
Cellosolve	T/C & T/T	Interplant	B
	Barge		
Cello Acet PU G	T/C & T/T	Interplant	B
	Barge		
Mixture PM 4446	T/T & T/C	"	A
Cellosolve Acet	T/C & T/T	"	B
	Barge		
Cyclohexanone	T/C	Purchased	A
Cyclohexylamine	T/T & T/C	"	A
Diaceton Alc	T/C & T/T	514	B
Diac Al T PM 0365	T/T	"	A
Mixture PM 4143	T/T	"	A
Dibutylamine	T/C & T/T	Interplant	A
Dibutylamine	T/T	"	A
Dibutyl phthala	T/C & T/T	514	A
Diene 221	T/T & T/C	"	A
Diene 234	T/C & T/T	"	A
Diene 234	T/T & T/C	"	A
Diethanolamine	T/T & T/C	Interplant	A
Diethanolamine	T/T & T/C	"	A
Diethanolamine	T/C	"	A
Dieth PM 1713	T/C & T/T	"	A
Dieth PM 3368	T/T	514	A
Mixture PM 4047	T/T	"	A
Diethox terragl	T/C & T/T	"	A
Diethylamine	T/T & T/C	Interplant	A
Dietene glycol	T/C & T/T	Interplant	A
	Barge		
Dietene glycol A/F grade	Barge	"	A
Dieth Gl PM 3253	T/T	"	A
Dieth triami HP	T/T & Barge	"	A
Mixture PM 3931	T/T	514	A
Diethyl ethanol amine	T/T & T/C	"	A
Di 2 ehex phos ac	T/T & T/C	"	A
Diethyl maleate	T/T & T/C	"	A
Diethyl succinat	T/T & T/C	"	A
Diisobutyl carbinol	T/C & T/T	"	A
	Barge		
Diisobu carbino	T/T & T/C	'	A
	Barge		
Diisobu ketone	T/T & T/C	Interplant	A
Diisopropanolamine	T/T & T/C	514	A
Mixture PM 4246	T/C & T/T	"	A
Mixture PM 4280	T/T	"	A
Mixture PM 4490	T/T	"	A
Diisopropylamine	T/T & T/C	Interplant	A

Product Name	Container Type	Source	Storage Tank Size*
Dimet am propyl	T/T & T/C	514	A
Dimethyl ea anh	T/T & T/C	"	A
Dime ea R. Haas	T/T & T/C	"	A
Dioxane PM 4805	T/T & T/C	514	A
Dioxane	T/T & T/C	"	A
Dioxane	T/C & T/T	"	A
Di-n-propylamine	T/C & T/T	"	A
Dipropylene gly	T/C & T/T	"	A
Epichlorohydrin	T/C & T/T	Interplant	A
Estanol	T/C & T/T	"	B
	Barge		
Ester Diol 204	T/T & T/C	514	A
Ethane liquifier	T/T	Interplant	A
Ethane	T/T	514	A
Ethanol 190 pf gross	Barge	Interplant	C
Ethano CS 19 190	T/C & T/T	"	A
Et 190 PF und LO	T/C & T/T	514	A
	Barge		
Ethan 190 und LO	T/T	"	A
Ethanol SD1 190	T/C & T/T	514	A
Ethano SD2B 190	T/C	"	A
Ethano SD3A 190	T/C & T/T	"	A
Mixture PM 3163	T/C & T/T	"	A
Mixture PM 4811	T/C	"	A
Ethanol SD29E	T/C & T/T	"	A
Ethan SD29C 190	T/T	"	A
Ethano SD29 190	T/C & Barge	"	A
Ethan SD29B 190	T/C & T/T	"	A
Ethano SD30 190	T/T	514	A
Eth 190 PF SD29H	T/T	"	A
Ethan SD39B 190	T/T	"	A
Ethano SD40 190	T/C & T/T	"	A
Eth 190P SD40 8	T/T	"	A
Ethan SD3A 190P	T/C & T/T	"	A
Eth SD4 Spir Gr	T/C & T/T	"	A
Et 190 SD23H LO	T/C & T/T	"	A
Et 190 SD30A	T/C	"	A
Et 190 SD35A LO	T/T	"	A
Ethan SD38B 190	T/T	"	A
Eth SD38F 190 LO	T/T	"	A
Eth 190P SD40 1	T/T	"	A
Eth 190P SD40 1	T/T	"	A
Ethanol 200PF spirits	Barge	Interplant	B
Ethanol 200 SD2	T/C & T/T	"	B
Ethano CD 19 200	T/C & T/T	"	B
Ethano CD 19 200	T/T	514	A
Ethan SD2B 200	T/C & T/T	"	A
Mixture PM 3856	T/T	"	A
Ethan SD3A 200	T/C & T/T	"	A
	Barge		
Eth SD3A 200 PF	T/T	"	A
Ethano SD29 200	T/C	"	A
Eth SD29 200 PFE	T/T	514	A
Ethan SD39C 200	T/T	"	A
Eth 200P SD70 7	T/T	"	A
Ethan 200 SD40	T/T	"	A
Ethoxydimethyldihydropyran	T/T	"	A
Ethoxytrigly TE	T/T	"	A
Ethoxy triglyco	T/T & Barge	Interplant	B
Et Acet 95 98PC	T/C & T/T	514	A
	Barge		
Etac 87 89PC IG	T/T & T/C	"	A
Eth acet 99PC	T/C & T/T	"	B
	Barge		

TABLE 12 (Continued)

Product Name	Container Type	Source	Storage Tank Size*
Et ac 99 5PC UG	T/C & T/T Barge	"	B
Etac USP NF FCC	T/T & T/C	"	A
Eth acet ACS	T/C & T/T	"	A
Mixture PM 5228	T/C & T/T	"	A
Et acet 95 98PC	T/T & T/C Barge	"	A
Mixture PM 3640	T/C & T/T	"	A
Mixture PM 5146	T/T	"	A
Ethyl acrylate	Barge	Interplant	B
Ethylamine anhydrous	T/C	"	A
Ethylamine	T/T & T/C	"	A
2-ethylbutanol	T/C & Barge	"	B
2-et-butanol CR	T/C & Barge	Interplant	B
2-ethyl butyraldehyde	Barge	"	A
Etene clhy anhy	T/C & T/½	514	A
Ethyl dia 98PC	T/T & Barge T/C	Interplant	B
Eth diam water	Barge & T/C	"	A
Mixture PM 3648	T/T	514	A
Etene dichlorid	T/C & T/T Barge	Interplant	B
Eth dich redist	T/T & T/C	514	A
Ethylene glycol	T/C & T/T Barge	Interplant	C
Ethylene glycol A;F grade	Barge	"	C
Ethylene gly CR	T/C & T/T	"	C
Ethyl gly 879A	T/C & T/T Barge	Exchange	C
Et Gl IN PM 1717	T/T	514	A
Mixture PM 1975	T/T	"	A
Ethyl gly tails	T/C & Barge	Interplant	A
Ethylene oxide	T/C	514	A
Et oxide redist	T/C	Interplant	A
2 ethyl hexaldehyde	Barge	"	A
2 ethylhexanol	T/C & Barge	"	B
2-e-hexanol rec	T/T & Barge	"	A
2-et hexoic acid	T/C & T/T	514	A
2-et hexoic acid	T/T	"	A
2-et hexyl acet	T/C & T/T	"	A
Et-hexacry MMHQ	T/T & Barge	Interplant	B
2-ethyl hexylami	T/T & T/C	"	A
2-et hex tallate	T/C & Barge	514	A
n-ethylmorpholi	T/T & T/C	"	A
Et prop acrolei	T/C	Interplant	A
Eth sil prehydr	T/T & T/C	514	A
Et silicate 40	T/T & T/C	"	A
Et silicate cond	T/T & T/C	"	A
Flexol PM 5303	T/T	"	A
Armstrg plast A	T/T & T/C	"	A
Flex plast 3 GH	T/C & T/T Barge	"	B
Flex Pl 3 GM	T/C & T/T Barge	"	B
Flex plast 4 GO	T/C & T/T	"	A
Flex plast 1010	T/C & T/T	"	A
Mixture PM 4316	T/C & T/T	"	A
Flexol PM 4574	T/T	"	A
Flex plast 10 A	T/T & T/C	"	A
Mixture PM 4373	T/T	"	A
Flex plast 380	T/C & T/T	514	A
Flexol PM 3321	T/T	"	A
Flex plast A 26	T/C & T/T	"	A
Mixture PM 4847	T/C & T/T	"	A
Flex plast 3 CF	T/T & T/C	"	A

Product Name	Container Type	Source	Storage Tank Size*
Mixture PM 4803	T/C & T/T	"	A
Flex TOF SP FMC	T/T & T/C	"	B
Flex plast TOF	T/C & T/T	"	B
Flexol TOF FMC	T/T	"	B
Flexol TCP	T/T	"	A
Flex plast Z 88	T/T & T/C	"	A
Flex Pla PM 4398	T/T	"	A
Mixture MP 4592	T/T	"	A
For aci phar GR	T/T & T/C	Interplant	A
Methane FMC 153	Pipeline	514	-
Glutaralo 25PC	T/T	Interplant	A
Glycerine super	T/T	Purchased	A
Gly triacetate	T/C & T/T	514	A
Mixture PM 3989	T/T	"	A
Mixture PM 4298	T/T	"	A
Glycol diacetat	T/C & T/T	"	B
Glyoxal 40 SPC	T/T & T/C Barge	Interplant	B
Glyoxal	Barge	"	B
Heptadecanol	T/C & T/T	Interplant	A
Heptanol PM 1655	T/C	514	A
Hexane	T/T	Interplant	A
1-hexane pur	T/T	Purchased	A
1-hexanol	T/T	Interplant	A
Hexyl cellosolve	T/T & T/C	514	A
Hex gly diacet	T/T & T/C	"	A
Hexylene glycol	T/C & T/T Barge	"	B
Mixture PM 4607	T/T	"	A
Isobutanol	T/C & T/T Barge	Interplant	B
Isobutanol mons	T/C & T/T Barge	"	B
Isobu Ace CA 149	T/T & T/C Barge	"	B
Isobutyl acetat	T/C & T/T Barge	"	B
Mixture PM 4624	T/T	514	A
Isobutyl Cellosolve	T/C & T/T	"	A
Isobutyl acrylate	T/T	Interplant	A
Isobutyl heptyl ketone	T/T	514	A
Iso octanoic ac	T/T & T/C	"	A
Isobutyraldehyde	Barge	Interplant	B
Isodecanol mixed isomers	T/T	"	A
Isopentanoic ac	T/T & T/C	514	A
Isooctylaldehyde	T/C & Barge	Interplant	A
Isopentanoic ac	T/C & T/T	514	A
Isop rec HG Gr	T/T & T/C Barge	"	B
Isop ref PM 0437	T/T	"	A
Isoprop PM 0455	T/T	"	A
Isopropanol 99	T/C & T/T Barge	Interplant	B
Mixture PM 3921	T/T	514	A
Mixture PM 4333	T/T	"	A
Isoprop PM 3710	T/T	"	A
Mixture PM 3852	T/T	"	A
Mixed isops	T/T & T/C	"	A
Isopropyl acet	T/C & T/T Barge	Interplant	B
Isop acet 99PC	T/C & T/T	"	A
Isopropylamine	T/C	"	A
Kromfax solvent	T/C & T/T	"	A
U Lat TCX878 HS	T/T	514	A
UCAR latex 862	T/T	"	A

TABLE 12 (Continued)

Product Name	Container Type	Source	Storage Tank Size*
UCAR latex 879	T/T	"	A
U Lat TCX8740	T/T	"	A
Latex TPX 3410	T/T	"	A
Mixture PM 4675	T/T	"	A
Mesityl oxide w. sat.	Barge	Interplant	A
Mesityl oxid an	T/C & T/T	514	A
Methanol	T/C & T/T	Interplant	C
	Barge		
Methanol	T/T	"	C
Methanol	T/C & T/T	"	C
Mixture PM 4784	T/T	514	A
Mixture PM 3922	T/C	"	A
Mixture PM 5102	T/T	"	A
Methoxytriglyco	T/C & T/T	Interplant	B
	Barge		
Methoxytriglyco	Barge	"	B
Methyl acetate	T/T & T/C	514	A
Me Aceto acetat	T/C & T/T	"	A
Me Aceton PM 1039	T/C & T/T	"	A
Me Amyl acetate	T/C & T/T	"	B
	Barge		
Mixture PM 4433	T/T	"	A
Methyl amyl alc	T/C & T/T	"	B
	Barge		
Methyl amyl alc. semi ref.	Barge	Interplant	B
Methyl Carbitol	T/C & T/T	"	A
	Barge		
Methyl Butyraldehyde	Barge	"	A
Methyl Cellosol	T/C & T/T	"	B
	Barge		
Methyl CS aceta	T/T & T/C	514	A
Methyl CS aceta	T/T * T/C	"	A
Me ethanolamine	T/C & T/T	514	A
Me et ketone	T/C & T/T	Interplant	A
	Barge		
Mixture PM 5166	T/T	514	A
Me isoamyl keto	T/C & T/T	"	A
Me isobu ketone	T/T	Interplant	A
Mixture PM 3987	T/T	514	A
Meth pentaldehy	T/T & Barge	Interplant	A
Met tet hy ph a	T/T & T/C	514	A
Mixture PM 0021	T/T	"	A
Mixture PM 0261	T/T	"	A
Mixture PM 1633	T/C & T/T	"	A
Mixture PM 3076	T/C & T/T	"	A
Mixture PM 3091	T/C & T/T	"	A
Mixture PM 3094	T/T	"	A
Mixture PM 3101	T/C	"	B
Mixture PM 3104	T/T	"	A
Mixture PM 3171	T/T	"	A
Mixture PM 3231	T/T	"	A
Mixture PM 3260	T/C	"	A
Mixture PM 3349	T/T	"	A
Mixture PM 3390	T/T	"	A
Mixture PM 3477	T/T	"	A
Mixture PM 3492	T/T	"	A
Mixture PM 3538	T/C & T/T	514	A
Mixture PM 3539	T/T	"	A
Mixture PM 3549	T/T	"	A
Mixture PM 3610	T/T	"	A
Mixture PM 3634	T/T	"	A
Mixture PM 3659	T/T	"	A
Mixture PM 3665	T/T	"	A
Mixture PM 3675	T/T	"	A
Mixture PM 3677	T/T	"	A
Mixture PM 3737	T/T	"	A
Mixture PM 3754	T/T	"	A
Mixture PM 3863	T/C & T/T	"	A
Mixture PM 3899	T/C & T/T	"	A
Mixture PM 3949	T/T	"	A
Mixture PM 3979	T/T	"	A
Mixture PM 4067	T/C & T/T	"	A
Mixture PM 4077	T/T	"	A
Mixture PM 4101	T/T	"	A
Mixture PM 4137	T/T	"	A
Mixture PM 4165	T/T	"	A
Mixture PM 4257	T/T	"	A
Mixture PM 4260	T/T	"	A
Mixture PM 4265	T/T	"	A
Mixture PM 4293	T/C	514	A
Mixture PM 4312	T/T	"	A
Mixture PM 4313	T/T	"	A
Mixture PM 4321	T/C	"	A
Mixture PM 4371	T/T	"	A
Mixture PM 4374	T/T	"	A
Gly mix PM 4384	T/T	"	A
Mixture PM 4389	T/T	"	A
Mixture PM 4448	T/T	"	A
Mixture PM 4450	T/C & T/T	"	A
Mixture PM 4468	T/C & T/T	"	A
Mixture PM 4517	T/T	"	A
ERLA 4565	T/T	"	A
Mixture PM 4610	T/C & T/T	"	A
Mixture PM 4622	T/T	"	A
Mixture PM 4645	T/T	"	A
Mixture PM 4709	T/T	"	A
Mixture PM 4733	T/T	"	A
Mixture PM 4761	T/T	"	A
Mixture PM 4767	T/T	"	A
Mixture PM 4819	T/C	"	A
Mixture PM 4820	T/T	"	A
Mixture PM 4825	T/C & T/T	"	A
Mixture PM 4828	T/T	"	A
Mixture PM 4851	T/T	514	A
Mixture PM 4863	T/C	"	A
Mixture PM 4876	T/T	"	A
Mixture PM 4896	T/T	"	A
Mixture PM 4903	T/C & T/T	"	A
Mixture PM 4904	T/T	"	A
Mixture PM 4927	T/T	"	A
Mixture PM 4934	T/T	"	A
Mixture PM 4936	T/C & T/T	"	A
Mixture PM 4973	T/T	"	A
Mixture PM 5006	T/T	"	A
Mixture PM 5021	T/T	"	A
Mixture PM 5028	T/T	"	A
Mixture PM 5052	T/T	"	A
Mixture PM 5053	T/T	"	A
Mixture PM 5069	T/T	"	A
Mixture PM 5101	T/T	"	A
Mixture PM 5137	T/C & T/T	"	A
Mixture PM 5161	T/T	"	A
Mixture PM 5169	T/C & T/T	"	A
Mixture PM 5175	T/T	"	A
Mixture PM 5184	T/T	"	A
Mixture PM 5194	T/T	"	A
Mixture PM 5196	T/T	514	A
Mixture PM 5197	T/T	"	A
Mixture PM 5219	T/T	"	A
Mixture PM 5259	T/T	"	A
Mixture PM 5268	T/T	"	A
Mixture PM 5273	T/T	"	A

TABLE 12 (Continued)

Product Name	Container Type	Source	Storage Tank Size*
Mixture PM 5301	T/T	"	A
Monoethen ICF	T/T & T/C	Interplant	A
Monoethanolamin	T/C & T/T	"	A
Monoethanolamin	T/T & T/C	"	A
Monoeth ee 148	T/T & T/C	"	A
Monoeth ee 11038	T/T & T/C	"	A
Monoisopropano	T/T & T/C	"	A
Mixture PM 4670	T/C & T/T	514	A
Morpho line	T/C & T/T	"	A
Mixture PM 3757	T/T	"	A
Mixture PM 0371	T/T	"	A
NI polyol D 413	T/C & T/T	"	A
AX pol PPG 425	T/T	"	A
N D PPG 1025 ONE	T/T	"	A
NI pol PPG 1025	T/T	"	A
N diol PPG 1225	T/T	"	A
NI pol PPG 2025	T/T	"	A
NI pol PPG 2025	T/C	514	A
N P PPG 2025 ONE	T/C & T/T	"	A
NI Pol PPG 3025	T/C & T/T	"	A
NIAX tri LG 168	T/T	"	A
NIAX triol LG 56	T/C & T/T	"	A
NI Tri LG 56 ONE	T/C & T/T	"	A
NIAX tri LHT 240	T/T	"	A
NIAX tri LHT 112	T/T	"	A
NIAX tri LHT 67	T/T	"	A
NIAX pol E338	T/T	"	A
NIAX poly E 341	T/C	"	A
NIAX tri LHT 42	T/T	"	A
NIAX pol E 321	T/C	"	A
NIAX poly D 410	T/C	"	A
NIAX poly E 322	T/C & T/T	"	A
NIAX poly E 325	T/C & T/T	"	A
NIAX poly D 414	T/C	"	A
NIAX triol LC 60	T/C & T/T	"	A
NIAX triol LF 70	T/C	"	A
NIAX resin S 109	T/T	"	A
NIAX poly E 261	T/T	"	A
NI polyol 50 48	T/C & T/T	"	A
NIAX isocy TDR	T/T	"	A
NIAX polyol 3145	T/C, T/T & Barge	514	A
NI polyol 14 46	T/T & Barge	"	A
Ni polyol E 241	T/T	"	A
NIAX pol 33 45	T/T	"	A
NI polyol E 344	T/T	"	A
NI polyol E 193	T/T	"	A
NIAX pol 60 58	T/T	"	A
NIAX polyol D	T/C & T/T	"	A
NIAX poly D 417	T/T	"	A
NIAX poly E 147	T/T	"	A
N polyol E 151	T/T	"	A
N polyol E 160	T/T	"	A
NI polyol E 204	T/T	"	A
NI polyol E 229	T/T	"	A
NIAX poly E 304	T/C & T/T	"	A
NIAX res T 110 R	T/T	"	A
NIAX poly 1646	T/C, T/T, Barge	"	A
NIA tri LHT 34 RG	T/T & T/C	"	A
NIAX triol LM 52	T/T	"	A
NIAX pol E 316	T/C & T/T	"	A
NI polyol D 403	T/T	"	A
NIAX poly E 274	T/C	"	A
N poly LG 650	T/T	514	A
NI poly 50 785	T/T	"	A
NI polyol LS 490	T/T	"	A
Octylene glycol	T/T & T/C	"	A
Pentanedion-2, 4	T/T	"	A
Pentanol-2	T/T & T/C	"	A
Phenyl acetate	T/C & T/T	"	A
Phen me carb cr	T/C & T/T	"	A
Mixture PM 4581	T/T	"	A
Mixture PM 4580	T/C & T/T	"	A
Plawel Y PM 4582	T/T	"	A
Plawel LS PM 4579	T/T	"	A
Placewel PM 4799	T/C & T/T	"	A
Fl entend ex 1	T/T	"	A
Polyamine H	T/T & T/C	Interplant	A
Polyprop gly 150	T/T & T/C	514	A
Polyprop gly 425	T/T & T/C	"	A
Polyprop Gl 1025	T/T & T/C	"	A
Polyprop gl 2025	T/T & T/C	"	A
N-propanol	Barge	Interplant	B
Crude propanaldehyde	Barge	"	B
Propionic acid	T/C & T/T	514	A
Crude propionic acid	Barge	Interplant	B
Mixture PM 3609	T/T	514	A
N-propanol	T/C, T/T & Barge	Interplant	B
Propasol P	T/T & T/C	514	A
N propyl acet	T/T & T/C & Barge	Interplant	A
P isob acetate	T/C	514	A
Propylene pur	T/C	Purchased	A
Propylene diami	T/T, T/C & Barge	Interplant	A
Propylene dich	T/C, T/T & Barge	514	C
Prop gly feed G	T/T & T/C	"	A
Propylene gly	T/C, T/T & Barge	"	C
Prop gly USP	T/C, T/T & Barge	"	C
Prop gl sen USP	T/C & T/T	"	A
Mixture PM 3080	T/T	"	A
Mixture PM 3583	T/C & T/T	"	A
Mixture PM 4769	T/T	"	A
Mixture PM 5274	T/T	"	A
Propylene oxide	T/C & T/T	"	A
Retardwl PM 4586	T/C & T/T	"	A
Solvation PM 0013	T/T	"	A
Solvent 8PM 1	T/T	"	A
Solvent 42 EB	T/C & T/T	"	A
Stabilen fly re	T/C & T/T	514	A
Styrene monomer	T/C & T/T	Interplant	A
Synasol APM 0509	T/C & T/T	514	A
Synasol PM 3259	T/T	"	A
Synasol PM 0041	T/T	"	A
Synasol PM 3224	T/C & T/T	"	A
Mixture PM 4351	T/T	"	A
Mixture PM 5218	T/T	"	A
TERG Minfoam	T/C	"	A
TERG 15 SS 3	T/T & T/C	Interplant	A
Mixture PM 4879	T/C & T/T	514	A
Mixture PM 4870	T/T	"	A
Tergitol 15 S 9	T/C & T/T	Interplant	A
Mixture PM 4671	T/T	514	A
Tergitol 15 S 12	T/C & T/T	Interplant	A
Mixture PM 5307	T/C & T/T	514	A

TABLE 12 (Continued)

Product Name	Container Type	Source	Storage Tank Size*
Tergitol NPX AN	T/T	Interplant	A
Tergitol TMN	T/C	"	A
Tergitol X D	T/T	514	A
Tergitol X D	T/T	"	A
Mixture PM 4881	T/T	"	A
TEOS 40	T/T & T/C	"	A
Tetraethyl gly	T/T & Barge	Interplant	A
Tetetenepentami	T/T & T/C	Interplant	A
Tetraethylorsil	T/T & T/C	514	A
1, 2, 3, 6-te benz	T/C & T/T	"	A
1, 2, 3, 6-te benz cr	T/C & T/T	Interplant	A
Toluene, nitrogen gr	T/T	"	A
Trichlorethane	T/T & T/C	514	A
Triethanolamine, comm.	T/C	Interplant	A
Triethanolamine	T/C & T/T	Interplant	A
Triethanolamine	T/T & T/C	"	A
Trieth 99	T/C & T/T	"	A
Mixture PM 4024	T/T	514	A
Mixture PM 4771	T/T	"	A
Trietene Glycol	T/T, T/C & Barge	Interplant	B
Trietene glycol	T/T, T/C & Barge	"	B
Trietene gly HP	T/C, T/T & Barge	"	B
Trieth gly HP	T/T, T/C & Barge	"	B
Mixture PM 3129	T/T	514	A
Triethylene tetramine	T/T	Interplant	A
Triisopropanola	T/T & T/C	514	A
Tri propy gly	T/T & T/C	514	A
UCAR latex 46	T/C & T/T	"	A
UCAR latex 131	T/C & T/T	"	A
UCAR lat 180 Wet	T/T	"	A
UCAR lat 360 Wet	T/C & T/T	"	A
U Lat L19 Kelly	T/T	"	A
U Lat 360 modif	T/C & T/T	"	A
UCAR Lat PM 5100	T/T	"	A
UCAR Lat 131 mod	T/C & T/T	"	A
Mixture PM 5178	T/C & T/T	"	A
UCAR Lat 180 mod	T/C & T/T	"	A
UCAR lat add ft	T/C & T/T	"	A
UCAR latex 360	T/T	"	A
UCAR latex 891	T/T	"	A
Mixture PM 3923	T/T	"	A
UCAR latex 680	T/T	"	A
UCAR latex 370	T/T	"	A
UCAR imp F120S2	T/T	"	A
UCAR PM 4386	T/T	"	A
Mixture PM 4096	T/T	"	A
UCAR fuel AD 600	T/T	"	A
UC lat VCX 1370	T/T	"	A
UCAR Pap B1 40	T/C & T/T	"	A
UCAR Pap BI 40	T/C & T/T	514	A
UCAR Solv LM	T/C & T/T	"	A
UCAR 2 LM	T/T	"	A
UCAR latex 865	T/T	"	A
UCAR lat WC 130	T/C & T/T	"	A
Mixture PM 5124	T/T		
UCON diester JL1	T/C & T/T	"	A
Mixture PM 4461	T/T	"	A
UCON B F PM 4961	T/C	"	A
UCON PM 4274	T/T	"	A
UCON PM 3265	T/T	"	A
Mixture PM 4250	T/T	"	A
Mixture PM 4210	T/C	"	A
Mixture PM 4016	T/C & T/T	"	A
UCON PM 4324	T/C & T/T	"	A
Mixture PM 4329	T/C & T/T	"	A
UCON PM 746	T/C & T/T	"	A
Mixture PM 4602	T/C & T/T	"	A
UCON PM 4823	T/C & T/T	"	A
UCON PM 4916	T/T	"	A
Mixture PM 3983	T/T	"	A
UCON PM 5157	T/C	"	A
UCON PM 5158	T/T	"	A
UCON PM 5255	T/C	"	A
UCON 75H 1400	T/T	514	A
Mixture PM 3031	T/T	"	A
UCON PM 3427	T/T	"	A
Mixture PM 4191	T/C & T/T	"	A
Mixture PM 4191	T/C & T/T	"	A
UCON PM 1884	T/T & T/C	"	A
UCON 50HB 170	T/T & T/C	"	A
UCON 50 HB 260	T/C, T/T & Barge	"	A
Mixture PM 4857	T/T	"	A
UCON lub PM 1269	T/T	"	A
UCON lub PM 0903	T/T	"	A
Mixture PM 3736	T/T	"	A
UCON 50HB 400	T/C & T/T	"	A
UCON 50 HB 600	T/C & T/T	"	A
U 50HB 660 COS G	T/T	"	A
UCON lub SA 33	T/C & T/T	"	A
Mixture PM 4952	T/T	"	A
Mixture PM 5008	T/T	"	A
UCON lub SA 20	T/T	"	A
UCON 50HB 3520	T/T & T/C	"	A
UCON 50HB 5100	T/C & T/T	"	A
UCON lub LB 65	T/T	"	A
Mixture PM 4775	T/T	"	A
UCON lub Lb 285	T/T	514	A
UCON lub LB 385	T/T	"	A
UCON lub PM 1461	T/C	"	A
UCON PM 5066	T/T	"	A
UCON lub LB 625	T/T	"	A
UCON lub PM 0827	T/T	"	A
UCON PM 1175	T/T	"	A
UCON PM 1243	T/T	"	A
UCON rub lub 77	T/T	"	A
UCON lub LB 1145	T/C & T/T	"	A
UCON lub PM 0824	T/T	"	A
UCON lub LB 1715	T/T	"	A
UCON lub LB 1715	T/C & T/T	"	A
UCON lub PM 1018	T/C	"	A
UCON DA 1905	T/C	"	A
Mixture PM 3196	T/T	"	A
UCON sol WC 144	T/C & T/T	"	A
UCON sol WC 322	T/C & T/T	"	A
UCON PM 3068	T/T	"	A
UCON PM 3047	T/C & T/T	"	A
UCON PM 3417	T/C	"	A
UCON WC 65	T/T	"	A
Valeraldehyde	Barge	Interplant	A
Valeric acid	T/T	"	A
Valeric acid	T/C & T/T	514	A
Mixture PM 4000	T/T	"	A
Vinyl acetate	Barge	Interplant	B
Vin acet in LHQ	T/C & T/T	"	B
Mixture PM 3847	T/T	514	A
Mixture PM 3870	T/C & T/T	"	A
Viny chlo	T/C	Purchased	B
Vin et ether cr	T/C	514	A
Vinyl et ether	T/C	"	A

FMC Corporation
Inorganic Chemicals Division
South Charleston, West Virginia

Contacts: Mr. M. E. Birmington, Resident Manager
Mr. F. Harvey Herbert, General Engineering Superintendent
Mr. E. P. Cook, Assistant Pollution Control Supervisor
Mr. Jack Bowling, Department Superintendent
Mr. E. F. Eckert, Department Superintendent
Mr. Chuck Taylor, Department Superintendent
Mr. George Walther, Department Superintendent

Date of Survey: October 6, 1970

Property Description

The Inorganic Chemicals Division plant of the FMC Corporation is located on the south bank of the Kanawha River and covers an area about one-quarter mile wide by one mile long. It is bounded on the east by UCC's plant and on the south and west by mixed commercial and residential districts of South Charleston. The land is flat, but is on a bluff situated about 20 to 30 feet above the river. A large number of chemicals are processed and manufactured; the most significant of these are chlorine, caustic soda, carbon bisulfide, carbon tetrachloride, ammonia, and hydrogen peroxide. A relatively new operation is the manufacture of a dry bleach from chlorine, urea, and caustic soda.

Hazardous Materials

Table 13 is composed of a list of hazardous materials handled at the FMC Corporation, Inorganic Chemical Division Plant.

Bulk Storage Facilities and Pipelines

Caustic soda is a principal product of the plant and is loaded and shipped in 16,000-gal. railroad tank cars. There is also some shipment of 70% caustic by tank truck and barge. The loading station is comprised of eight spots for tank cars and one for trucks. Operation is usually confined to the day shift and is controlled by two operators. The cars are top-loaded and the operator observes the fill visually, stopping the pump by remote control. The loading area is surrounded by a drainage culvert which runs directly into the river. Caustic soda is stored in a number of vertical tanks, each about 20 feet in diameter by 30 feet high with a capacity of 500 tons of 50% NaOH. The tanks are emptied, cleaned, inspected, and repaired on an annual basis. Level monitoring is effected by a float-type gage with an indicator outside the tank. All transfers are recorded and cross-checked by gaging both the sending and receiving tanks.

TABLE 13

HAZARDOUS MATERIAL STORAGE AT FMC CORPORATION, INORGANIC CHEMICALS DIVISION SOUTH CHARLESTON, WEST VIRGINIA

Material	Shipment Container Size (thousands of gallons)	Source	Storage Tank Size*	Comments
Sulfuric acid, 93%	8	Rail	(a)	5 storage tanks
Hydrochloric acid, 33%	8	Rail	(a)	2 storage tanks
Brine (25% NaCl)	264-580	Barge	(c)	1 storage tank
Liquid chlorine	16, 30, 55, 85, 90 tons	Rail	(b)	3 storage tanks
NaOH, 70%	10	Rail	(a)	1 storage tank
NaOH, 50%	180-200	Barge		16 storage tanks
NaOH, 50%	18-16	Rail	(c)	
NaOH, 50%	3	Tank truck		
NaOH, 20%	8	Rail	(a)	3 storage tanks
	2-3	Tank truck		
KOH, 45%	8	Rail	(a)	1 storage tank
Urea	5	Tank truck	(a)	1 storage tank
H_2O_2, 70%	4-18	Rail		
H_2O_2, 50%	4-18	Rail	(b)	
H_2O_2, 25%	4-18	Tank truck		
Tri-octyl phosphate	4	Tank truck	(a)	1 storage tank
Carbon tetrachloride	160-180	Barge		7 storage tanks
	8-15	Rail	(c)	
	3	Tank truck		
Liquid sulfur	150	Barge	(b)	1 storage tank
Aromatic solvent	10	Rail	(a)	1 storage tank
Carbon bisulfide	160	Barge		10 storage tanks
	4-18	Rail	(b)	
Anhydrous ammonia	11-33	Rail	(b)	2 storage tanks
Aqua ammonia, 29%	10	Rail	(a)	2 storage tanks
	4-5	Tank truck		

*(a) Under 100,000 gallons
(b) 100,000 to 500,000 gallons
(c) Over 500,000 gallons

Liquid chlorine is stored in horizontal cylindrical tanks of about 100 tons capacity. (There are three storage tanks; one is maintained empty as an emergency receiver.) The tanks are mounted on scales and transfers are by weight; shipment is usually in 65-ton rail cars, although some are of 90-ton capacity. There are four spots for loading cars; the procedure is to evacuate the car and load from the weigh tank.

Carbon tetrachloride is stored in an above-ground tank farm consisting of one large (100,000-gal.) and seven small vertical tanks. Carbon bisulfide is stored in horizontal tanks which are located in a below grade concrete sump and are permanently covered with water. Any spill or leakage sinks to the bottom of the sump and is collected and recovered from a low spot. Shipment is by rail car with top connections only. The transfer is made from storage by nitrogen pressure and is monitored from an elevated control booth.

FMC maintains two transfer stations for barge shipments on the river bank. One of these is exclusively for receipt of liquid sulfur and is fitted with steam-traced transfer lines. The transfer pump is on the sulfur barge and the storage tank is located on the river bank. Inspection of these tanks is carried out twice a year.

At the dry bleach plant chlorine is received by tank car and used, as needed, by unloading with dry air; there is no storage for chlorine. Urea is stored in a tank with a capacity for about two tank trucks; the trucks are unloaded by their own self-contained pumps. There is a storage tank for 10,000 gallons of sulfuric acid, unloaded from tank cars by air pressure. The product of this plant is a dry powder; it is stored in aluminum tote bins prior to packing for shipment in fiber drums.

The hydrogen peroxide plant is new and has been built with careful attention to desirable safety features. The principal danger is one of detonation; there is little spill potential. An "organic work solution" is used and stored in four 5000-gal. horizontal tanks in a scuppered area. The solution is expensive and care is necessary to prevent any loss by leakage or spill.

Past Spill Experience

See Table 11 for a listing of past spills in the Charleston area.

Spill Control Plan

FMC uses a rather formal procedure of notification and action in the event of a spill; in general, it conforms to the KRIAC system. The first step is notification to the FMC Pollution Control Department. This group determines the severity of the spill by consideration of the nature and quantity of the material spilled and the river flow data at the time of spill. When appropriate, FMC then notifies the state and the other industrial and municipal water users which may be affected.

FMC follows company standards, which recognize the spill hazard, in the design and maintenance of its facilities. Recommendations of the Pollution Control Department are given full consideration in development and review of these standards.

FMC Corporation
Organic Chemicals Division
Nitro, West Virginia

Contacts: Mr. Robert Simokat, Engineering Superintendent
Mr. Martin Smith, Process Engineer

Date of Survey: October 6, 1970

Property Description:

The FMC Corporation plant at Nitro, West Virginia, is a small producer of organic chemicals. The facility is approximately 40 years old and was owned by the Ohio Apex Chemical Company until the 1950's. It is located on the right bank of the Kanawha River about 42.7 miles from its mouth (Figure 26). The plant is on sloping ground fairly close to the river. All chemicals come into the plant by rail or truck.

Chemical Storage Facilities

Most chemicals are stored in tanks which have been removed from railroad tank cars and are now located on permanent concrete footings. These tanks are not diked. The principal tank farm is located along a railroad siding in the plant. Most of the tanks have sight glasses and some have level indicators in the tank yard control room as well as in the process control room.

Old tank-car tanks are gradually being replaced by new tanks. Dikes are being placed around new installations. Money has been budgeted for long-range diking of all tanks in the plant. Methanol is stored in a diked area and $POCl_3$ is stored in two sets of two tanks in separate diked areas. The dikes will hold more than one tank volume. The $POCl_3$ tanks are of solid nickel as are the lines. Carbon bisulfide is stored in two 330,000-gal. tanks under water and below ground level. The product is stored for resale.

Spill Notification Plan

FMC's spill plan consists of a shift foreman notifying the area supervisor who determines what has been spilled and the quantity and then calls the engineering superintendent, the laboratory superintendent, or the plant manager; the West Virginia Department of Water Resources is also notified.

Photo Courtesy of U.S.A. Corps of Engineers

FIGURE 26 AERIAL VIEW OF MONSANTO CHEMICAL COMPANY (left) AND FMC CORPORATION ORGANICS PLANT (center), NITRO, WEST VIRGINIA

Sewage Treatment

Some of the truck loading areas have drains that go to the "acid sewers" and thence to a neutralizing tank before going to the aerated lagoon for biological treatment. Several process areas are also connected to this system so the spills are treated before being released to the river.

Preventive Maintenance Program

There is no routine preventive maintenance program. As leaks are noted, the parts are repaired or replaced.

Hazardous Materials

Hazardous materials handled at the FMC Corporation, Organic Chemicals Division, are presented in Table 14.

TABLE 14

FMC HAZARDOUS MATERIAL STORAGE AT FMC CORPORATION, ORGANIC CHEMICALS DIVISION NITRO, WEST VIRGINIA

Material	Shipping Container Size (thousands of gallons)	Source	Storage Tank Size*
$POCl_3$	6	T/T & T/C	(a)
PCl_3	8	T/T & T/C	(a)
KP-140	10	T/T & T/C	(a)
TBP	10	T/T & T/C	(a)
MDP	10	T/T & T/C	(a)
Kronitex	10	T/T & T/C	(c)
Butyl alcohol	10	T/T & T/C	(a)
Butyl cellosolve	10	T/T & T/C	(a)
Caustic	10	T/C	(a)
Cyclohexanol	10	T/T & T/C	(a)
Heptane	6	T/T	(a)
Methanol	6	T/T	(a)
Phenol	20	T/T & T/C	(a)
Cresylic acid	20	T/T & T/C	(a)
Phosphorus	17	T/C	(a)

TC denotes tank car
TT denotes tank truck.

* (a) Under 100,000 gal.
(b) 100,000 to 500,000 gal.
(c) Over 500,000 gal.

Past Spill Experience

See Table 11 for a discussion of past spill experience.

Conclusions

This plant has many old but fairly small tanks of 8,000-10,000 gal. capacity that are close enough to the river to present a potential spill hazard. The plant is gradually replacing these old tanks and is incorporating dikes in its new installations. While the size of potential spills from this plant is relatively low, the present policy of improving the installation should be pursued actively to further minimize spill potential.

FMC Corporation
American Viscose Division
Nitro, West Virginia

Contacts: J. C. Moody, Plant Manager
H. C. Gainer, Technical Superintendent
John Janicki, Chief Environmental Chemist

Date of Survey: October 9, 1970

Property Description

FMC's American Viscose Division is a fairly large operation producing essentially a single product – rayon staple. The property is located on the right bank of the Kanawha River, 42.9 miles above its mouth. While the property goes to the river, most of the manufacturing facilities are about one-quarter mile back from the river bank.

Barge Station

Caustic soda is brought in by barge and by-product anhydrous sodium sulfate is shipped out by barge. In a heavy rain, some sodium sulfate could be washed into the river, but there is little likelihood of a large spill.

Carbon Bisulfide Storage

Carbon bisulfide is stored in steel tanks in a concrete basin and submerged in water. Carbon bisulfide is brought into the plant in 20,000-gal. tank cars and one car will fill two of the submerged tanks. When carbon bisulfide is pumped into the storage tank in the process area, the tank is monitored by a Magnetrol level control. The tank also has an overflow and a sight glass. Any overflow returns to the water pit. Periodically, any spilled carbon bisulfide is pumped to a tank car and sent back to the producer for repurification.

Sulfuric Acid Storage

Sulfuric acid is pumped directly from the Allied Chemical plant. There are three storage tanks, but only one is used as a receiver and the acid is transferred from it. There are level indicators on the tanks and plant personnel call for a specific number of gallons of sulfuric acid to be pumped over. The warning horn is checked daily and the functioning of the level and alarm system is checked twice a week.

There are no dikes around tanks, but most leaks from sulfuric acid tanks are of pinhole size and are usually taken care of by neutralizing the acid with soda ash until the leaking part can be repaired. These tanks are also so far from the water that little danger of water pollution exists.

Zinc Sulfate Solution

Zinc sulfate is shipped into the plant in tank cars containing a 34% solution of $ZnSO_4 \cdot H_2O$. The car is air-pressurized at 7 pounds per square inch to force the solution to prime the pump. The suction pipe goes in through the dome of the car to the bottom, and when the contents are pumped out, the pump is shut off and the suction line drains back into the car. The storage tanks hold over one tankcar load each, so there is little danger of running them over. There is no sewer or sump in the area so if any solution were spilled it would go on the ground. Because of the method of operation, the possible spill volume would be only a few drops.

Caustic Storage

Sodium hydroxide is pumped from the barge into tanks that will hold more than a bargeload. The tanks have a level control. The caustic line is steamed out back to the barge with a 15-pound steam line, so all drainage is returned to the barge. Tank areas are not diked, but are very far from the river.

Sodium Hydrogen Sulfide

Sodium hydrogen sulfide is shipped into the plant as a 48% solution in tank cars and is pumped to the process areas.

Amine-Phenol Mixture

An amine-substituted phenol mixture is brought into the plant in tank cars and is pumped to a process area storage tank. A Magnetrol level control cuts off the pump when the tank is full. Any overflow goes back to the tank car. If the overflow line were plugged, there is a 2000-gal. catch tank to take any overflow, but it has never been needed.

Oleic Acid

Oleic acid (red oil) arrives at the plant in tank cars and is pumped to the process areas.

Spill Reporting Procedure

Spills are reported to the Technical Department and, if they are serious, are also reported to the state as is done in the other companies in the KRIAC group.

Sewer System

This plant has one section that is connected to an aerated lagoon disposal system, while all other areas are on a common sewer system connected to a river outfall. They will soon separate sewers to comply with the new West Virginia requirements, and also plan to install a "panic pond" to protect their disposal system from heavy overloads.

Hazardous Materials

Potentially hazardous materials handled at this plant are listed below.

Material	**Shipping Container Size**	**Source**
93% H_2SO_4	—	Pipeline
50% NaOH	1,200,000 pounds	Barge
Carbon bisulfide	195,000 pounds	Rail
Amine-phenol mix	66,000 pounds	Rail
Oleic acid (red oil)	30,000 pounds	Rail
NaHS 45%	106,000 pounds	Rail
Chlorine	2,000 pounds	Truck (cylinders)

Past Spill Experience

See Table 11 for a listing of past spills.

Conclusions

This plant has relatively few chemicals that could contaminate the river. Tanks holding caustic and sulfuric acid are not diked, but are a long distance from the river. Materials such as CS_2 and the amine-phenol mixture are handled in well-designed equipment with good safeguards to minimize spill dangers.

Monsanto Chemical Company
Nitro, West Virginia

Contacts: Mr. H. M. Galloway, Environmental Control Manager
Mr. John J. Matten
Mr. Bernard H. Estep

Date of Survey: October 6, 1970

Property Description

Monsanto's storage areas include one fairly large facility along the river in which acetone and crude oil are stored on receipt from barges, a separate tank farm area where organic solvents are handled, and a number of storage tanks adjacent to process areas where the material is used.

At the river there are two separate receiving stations (Figure 26). Barges are tied to piles. The pumping station for unloading materials is located on shore and connection is made to the barge with flexible pressure hose. The hose is inspected and pressure-tested on a regular schedule and the date of latest inspection is stencilled on the hose. One of the two receiving stations handles acetone which is pumped to a 500,000-gal. tank on the river bank enclosed in a large earthen dike. The second receiving station handles tall oil which is pumped to three 500,000-gal. tanks and a variety of product and intermediate organic materials which are stored in four 300,000-gal. aluminum tanks. This tank farm follows the standard Monsanto practice for diking.

Monsanto handles and stores carbon disulfide. This material is received by pipeline from the adjacent FMC plant. In many plants the standard for carbon disulfide is to keep the storage tanks completely immersed in a diked area in water. Any spill or leakage of carbon disulfide in such a system must drain to a low point in the water pool from which it can be recovered by a sump pump. Monsanto's installation is new and follows a different design philosophy. The tank is enclosed in a dike and provision is made for water flooding if necessary. Since the diked area is normally empty, any spill can be quickly detected and handled. In the storage tank proper, Monsanto follows the usual practice of maintaining the tank full of water above the carbon disulfide level. When the tank is filled, water is displaced through a separator and flows to the process sewer. When the tank is emptied, water is automatically admitted to maintain the tank full and at atmospheric pressure. It is necessary to use thermostatic temperature control to prevent freezing of this sealed water in the tank and in the transfer lines. The dike around the carbon disulfide tank is of reinforced concrete design.

HCN is obtained from the Belle plant of DuPont by railroad tank car. When the car is shipped, DuPont notifies Monsanto and any delay in the 60-mile transfer down the river can be investigated immediately. A carefully worked out plan of notification and emergency action is in force in the event of any emergency during shipment of the car between the two plants. At the Monsanto plant the tank car is spotted in an exact location at the unloading position. The car is of special design, including roller bearing trucks so that easy movement without shock can be effected. Connection from the tank car to Monsanto's unloading pump is made by a solid stainless-steel pipeline; no flexible joints are used. The pipe is pickled with acid and washed before installation and then pressure-tested to 40 psi with nitrogen. Nitrogen at 10 psi is then used to force unload the car to Monsanto's storage tank. Monsanto's storage tank is a refrigerated tank with special provision for monitoring for leaks of HCN gas. A pressure control system maintains 2 psi of nitrogen on the storage tank and the vent is through a flare. A pilot light burns constantly at the top of the flare so that any HCN in the vent gas is automatically destroyed. All connections to the storage tank, as well as to the box car, are at the top of the tank. There are no bottom connections of any kind. HCN is soluble in water and there is a deluge system fitted to the storage tank as well as to the tank car area for immediate flooding of any leak with water.

Drainage

Although the plant is located directly on the Kanawha River, there is no drainage directly to the river. All effluent flows through a treatment plant, including rainfall. The storm runoff does not greatly increase the load on the treatment plant.

Design and Operating Practices

Monsanto's practice is to build a dike around any tank containing a toxic, flammable, or water-insoluble material. Chemicals such as HCN, aniline, butyl acetate, formalin, xylene, and acrolein are diked. Inorganic reagents such as sulfuric acid are not diked. Monsanto feels that the cost of a dike for these materials is not justified, since the most likely method of disposal of a spill would be by dilution and control discharge to the river in any event. A spill would not flow directly to the river, but would be handled via the treatment plant. Carbon disulfide and HCN were cited as two dangerous materials for which special handling is required. Facilities for these chemicals were inspected during the plant tour.

In addition to diking, it is Monsanto's practice to use catch basins and sumps wherever the likelihood of leakage and spill is high. The standard for fill lines to large storage tanks is evolving. Current practice is to run this line to the tank via a high loop. The line enters the top of the tank and extends to near the bottom so that during the fill there is no fall of liquid in the tank. This practice guards against vaporization of volatile materials and ignition via static charge. To prevent siphoning, Monsanto drills a small vent hole in the fill line inside the tank near the top. This design is under review because of the fear that during the fill spray of liquid through this vent hole may cause some static electricity problems. All tanks are subject to regularly scheduled inspection to determine their condition. The shell thickness is inspected by ultrasonic gaging. On tanks where corrosion is likely to be a problem, the tank is emptied, cleaned, and visually inspected.

Hazardous Chemicals

A list of materials handled at the Nitro plant is included as Table 15.

Past Spill Experience

See Table 11 for a discussion of postspill experience.

Spill Control Plan

Monsanto is a member of the KRIAC Committee and follows the practice of the several Kanawha Valley emergency and disaster control plans.

TABLE 15

HAZARDOUS MATERIAL STORAGE AT MONSANTO CHEMICAL COMPANY, NITRO, WEST VIRGINIA

Material	Ship. Container Size (gal.)	Source	Storage Tank Size*	Comments
Acetone	300,000	Barge	(b)	
Dimer acid	8,000	Rail	(a)	
93% H_2SO_4	150,000	Barge	(b)	
100% H_2SO_4	10,000	Rail	(a)	Not diked
TSA	10,000	Rail/truck	(a)	Toluene sulfonic acid
Acrolein	6,000	Rail	(a)	
Hydrobetyl alcohol	8,000	Rail	(a)	
TAA	5,000	Truck	(a)	Tert-amyl alcohol
Aqua ammonia	5,000	Truck	(a)	Not diked
ATC	10,000	Rail	(a)	Ammonium thiocyanate
Aniline	20,000	Rail	(a)	
Butyraldehyde	10,000	Rail	(a)	Stored in tank car
Carbon-bisulfide	Pumped from neighboring plant	– –	(a)	
Clenzoline	6,000	Truck	(a)	Kerosene
Chlorine	10,000	Rail	(a)	Stored in tank car
TBM cresol	20,000	Rail	(a)	Tert-butyl meta-cresol
Cyclohexylamine	10,000	Rail	(a)	
Dodecyl benzene	10,000	Rail	(a)	
DIPA	10,000	Rail	(a)	Diisopropyl amine
DTAP	8,000	Rail	(a)	Ditertiary amyl phenol
DDA	10,000	Rail	(a)	Dodecyl aniline/not diked
Heavy aromatic naphtha	10,000	Rail	(a)	Not diked
Heptane	6,000	Truck	(a)	
Hydrogen cyanide	6,000	Rail	(a)	
Isopropanol	6,000	Truck	(a)	
Kerosene	10,000	Rail	(a)	
Methanol	6,000	Truck	(a)	
Methyl mercaptan	20,000	Rail	(a)	Stored in tank car
Morpholine	6,000	Truck	(a)	
#5 process oil	8,000	Rail	(a)	Lube oil/not diked
Paraphenetidine	10,000	Rail	(a)	Not diked
Santolube 393	10,000	Rail	(a)	Lubricating oil additive
Santolube 394-C	10,000	Rail	(a)	Lubricating oil additive
TBA	20,000	Rail	(a)	Tert-butyl amine
Trichloropropene	10,000	Rail	(a)	
Toluene	10,000	Rail	(a)	
Xylene	6,000	Truck	(a)	
50% caustic	12,000	Rail	(a)	Not diked
Isoamylene	6,000	Truck	(a)	
Formaldehyde	6,000	Truck	(a)	
Potassium hydroxide	10,000	Rail	(a)	Not diked
CTO	300,000	Rail, truck, barge	(c)	Crude tall oil/not diked
#2 Varsol	6,000	Truck	(a)	Kerosene
Butanol	6,000	Truck	(a)	
CHM	10,000	Rail	(a)	Cyclohexyl mercaptan
Phthalic anhydride	6,000	Truck	(a)	Not diked
Ethyl acrylate	8,000	Rail	(a)	Stored in tank Ca
2-Ethyl-hexyl acrylate	8,000	Rail	(a)	
Anhydrous ammonia	6,000	Truck	(a)	Not diked
Nitrogen	6,000	Truck	(a)	Liquid/not diked
Acetaldehyde	10,000	Rail	(a)	Stored in tank car
2, 6-dimethyl morpholine	10,000	Rail	(a)	Stored in tank car
Sulfur dichloride	8,000	Rail	(a)	Not diked
Sulfur	4,000	Truck	(a)	Not diked
Sulfur monochloride	10,000	Rail	(a)	Not diked

Material	Ship Container Size (gal.)	Source	Storage Tank Size*	Comments
#2 Varsol	6,000	Truck	(a)	Kerosene
Butanol	6,000	Truck	(a)	
CHM	10,000	Rail	(a)	Cyclohexyl mercaptan
Phthalic anhydride	6,000	Truck	(a)	Not diked
Ethyl acrylate	8,000	Rail	(a)	Stored in tank Ca
2-Ethyl-hexyl acrylate	8,000	Rail	(a)	
Anhydrous ammonia	6,000	Truck	(a)	Not diked
Nitrogen	6,000	Truck	(a)	Liquid/not diked
Acetaldehyde	10,000	Rail	(a)	Stored in tank car
2, 6-dimethyl morpholine	10,000	Rail	(a)	Stored in tank car
Sulfur dichloride	8,000	Rail	(a)	Not diked
Sulfur	4,000	Truck	(a)	Not diked
Sulfur monochloride	10,000	Rail	(a)	Not diked
TCE	6,000	Truck	(a)	Trichloroethylene/not diked
Muriatic acid	20,000	Rail	(a)	HCl/not diked
Creosote oil	6,000	Truck	(a)	Stored in tank car
Dowtherm A	6,000	Truck	(a)	Not diked
Diphenyl-amine	6,000	Truck	(a)	Not diked
2, 3 Dichloropropene	10,000	Rail	(a)	
Diisobutylene	10,000	Rail	(a)	
Mersize	10,000	Rail/truck	(a)	Paper sizing agent/not diked
Santoflex DD	10,000	Rail/truck	(a)	6-dodecyl-1,2-dihydro-2,2, 4-trimethylquinoline/not diked
Santoquin	10,000	Rail/truck	(a)	Not diked – Ethoxyquin-1,2-dihydro-6-ethoxy-2,2,4-trimethylquinoline
Oil additives	10,000	Rail/truck	(a)	Not diked proprietary, complex mixtures
Santocizer 429	6,000	Rail/truck	(a)	Plasticizer/not diked
Avadex	10,000	Rail/truck	(a)	Not diked – Solution of S-2,3-dichloro-allyl diisopropylthio carbamate
Vegadex	10,000	Rail	(a)	Not diked – Solution of 2-chloroallyl diethyldithio carbamate
Santoflex 13	6,000	Truck	(a)	Not diked – N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine
Santoflex 503A	10,000	Rail	(a)	Not diked, rubber antioxidant
Avadex BW	10,000	Rail/truck	(a)	Not diked – Solution of 2,2, 3-trichloroallyl diisopropylthio carbamate

* (a) Under 100,000 gal.
(b) 100,000 to 500,000 gal.
(c) Over 500,000 gal.

E. I. DuPont
Belle, West Virginia

The E. I. DuPont facility was not visited. A list of hazardous materials handled was furnished by DuPont and is included as Table 16. Figure 27 shows the DuPont facility at Belle, West Virginia.

TABLE 16

HAZARDOUS MATERIAL STORAGE AT E. I. DuPONT BELLE, WEST VIRGINIA

Material	Ship Container Size	Source	Storage Tank Size*
Acetic acid	• Tank car sizes range from 7,000 to 30,000 gals. • Tank truck sizes range from 2,000 to 7,000 gals. • Barge sizes range from 300,000 to 850,000 gals.	T/C	(a)
Anhydrous ammonia		T/C B	(c)
Methyl, di and tri-methyl amines		T/C T/T	(a)
Acetone		B	(c)
Aniline		T/C	(a)
Cyclohexane		B	(c)
Di-isopropylamine		T/T	(a)
Ethanol		T/C T/T	(a)
2-ethyl hexanol		T/T	(a)
Ethylene glycol		T/C B	(c)
Hexamethylimine		T/C	(a)
Hydrogen cyanide		T/C	(a)
Isobutanol		T/C T/T	(a)
Isopropyl ether		T/C	(c)
Methyl ethyl ketone		T/C	(a)
N-butanol		T/C	(a)
Methacrylate monomers		T/C T/T	(c)
Methyl formate		T/C	(a)
Molten sulfur		T/T	(a)
Tergitol®		T/T	(a)
Methanol		B	(c)
Dimethyl sulfate		T/C T/T	(a)
Dimethyl ether		T/C	(a)
Formamide		T/C	(a)
Phosphoric acid		T/T	(a)

T/C = Railroad Tank Car T/T = Tank truck B = River barge

*(a) Under 100,000 gal. (b) 100,000 to 500,000 gal. (c) Over 500,000 gal.

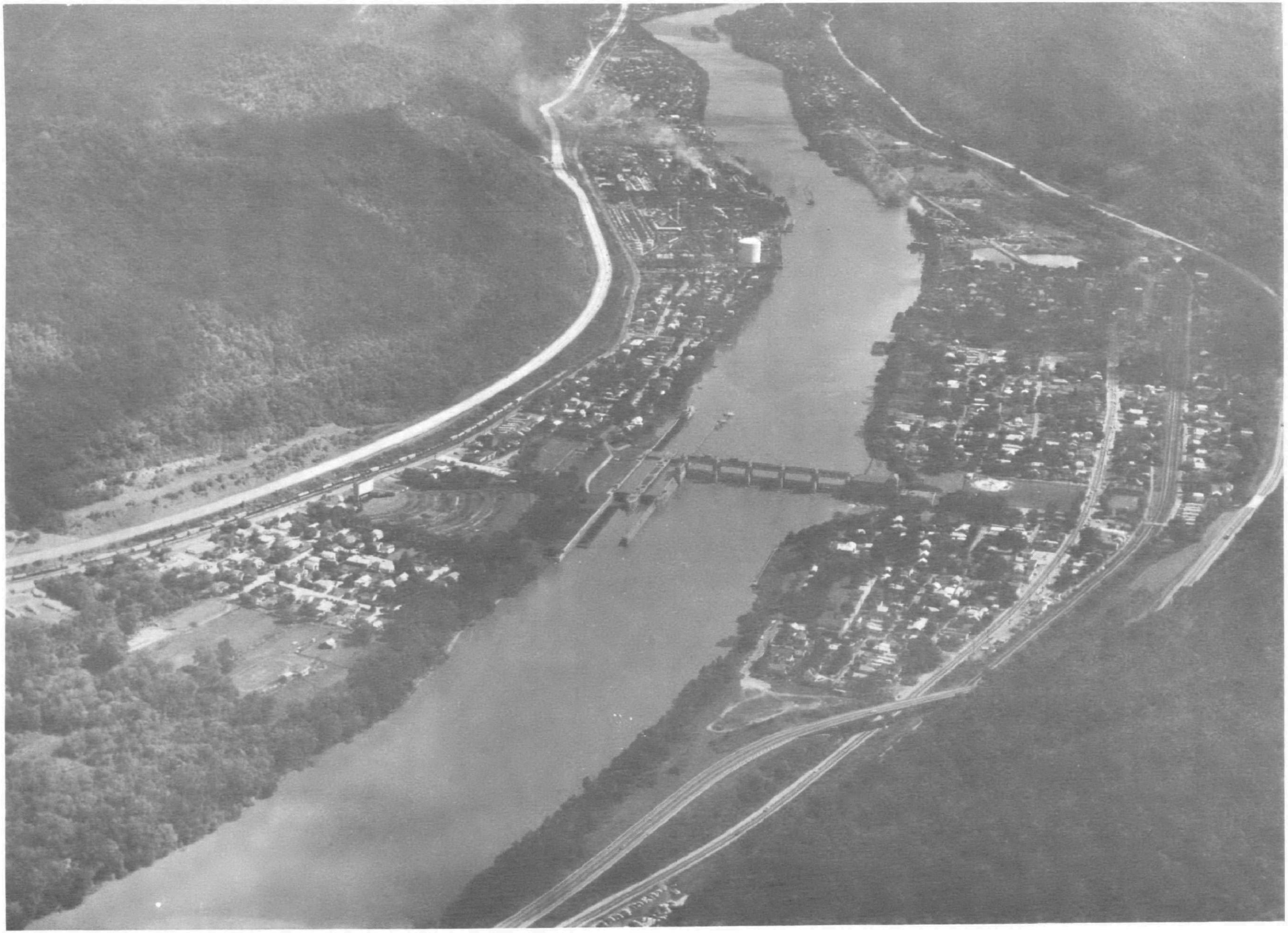


Photo Courtesy of U.S.A. Corps of Engineers

FIGURE 27 AERIAL VIEW OF DUPONT PLANT, BELLE, WEST VIRGINIA

Allied Chemical Corporation
Industrial Chemicals Division
Nitro, West Virginia

Contacts: Mr. Kelley Fagg, Plant Superintendent
Mr. William Stocker (from Morristown Office)

Date of Survey: October 8, 1970

Property Description

This company produces sulfuric acid and hydrofluoric acid in a plant located close to the Kanawha River on the right bank of the river 43.2 miles above its mouth. It is a comparatively small plant producing only two products. There is a barge unloading area at the river, a sulfuric acid manufacturing unit, a hydrofluoric acid manufacturing unit, storage tanks for both products and a series of lagoons for settling out the gypsum by-product.

Barge Station

Barges of fluorospar and molten sulfur are unloaded to supply the chemical processing plants. In addition to the sulfuric acid manufactured by the plant, additional sulfuric acid may be barged in and unloaded for resale. Also soda ash is unloaded and shipped out by rail in covered hopper cars.

Sulfur Storage

Two tanks for storage of liquid sulfur are maintained at 275°F by means of internal steam coils. The tanks are provided with quench water and steam to blanket out any possible fire. The total capacity of these tanks is 18,000 tons, but there is little danger of a spill that would contaminate the river because the spilled sulfur would cool quickly and it will not flow below 243°F.

Hydrogen Fluoride Storage

The anhydrous hydrogen fluoride is stored under 40 pounds of pressure in three tanks of 100,000 to 110,000 pounds capacity each. These tanks are on scales and any leakage can be detected by weight loss as well as by odor. This product is more likely to be an air pollutant than a water pollutant. Any spills in this area or any vapors knocked down by fog nozzles would go to the treatment ponds where the acid would be neutralized before final release to the river.

Sulfuric Acid Storage

Sulfuric acid is stored in four tanks of 1000 tons capacity each. They are used at the 800-ton level so total capacity is 3200 tons. The tanks are on pads 3 feet off the ground and there are no dikes. Loading is done only in daylight hours with an operator present. If a leak should occur, the operator can cut off the pump. Any back drainage or pump drips resulting from filling a tank car or tank truck are drained into the sump under the filling area and to the soda ash pit for neutralization.

Preventive Maintenance and Inspection Program

Two men are assigned to the preventive maintenance program and also spot any leaks that might occur. From experience, the plant personnel know the expected lives of various components. Tanks are inspected every 2 to 3 years by test drilling and rewelding.

Spill Monitoring and Reporting

A pH probe is constantly monitoring the cooling water in both the hydrofluoric acid unit and the sulfuric acid unit. As a further check for leaks, a manual determination of pH is done at 7 a.m. each day. In addition the operators have methyl orange, and a colorimetric test is run twice per shift. In case of an emergency the operators call the supervisor or plant superintendent.

Materials Shipped from the Plant

All anhydrous hydrogen fluoride is shipped in tank cars. Sulfuric acid is shipped both by rail and in tank trucks. Allied Chemical also ships three truckloads of molten sulfur per week to the nearby Monsanto plant and 2000 tons per month to the FMC plant in South Charleston. Soda ash is loaded in covered hopper cars.

All hazardous materials are shipped with an accompanying "MCA Chem-Card – Transportation Guide" (obtained from the Manufacturing Chemists' Association) which contains instructions to cover spills of the particular chemical being shipped.

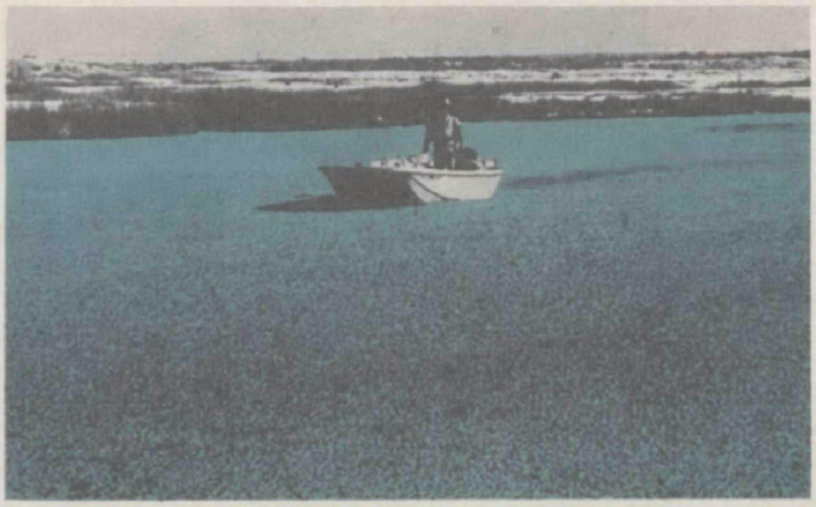
Past Spill Experience

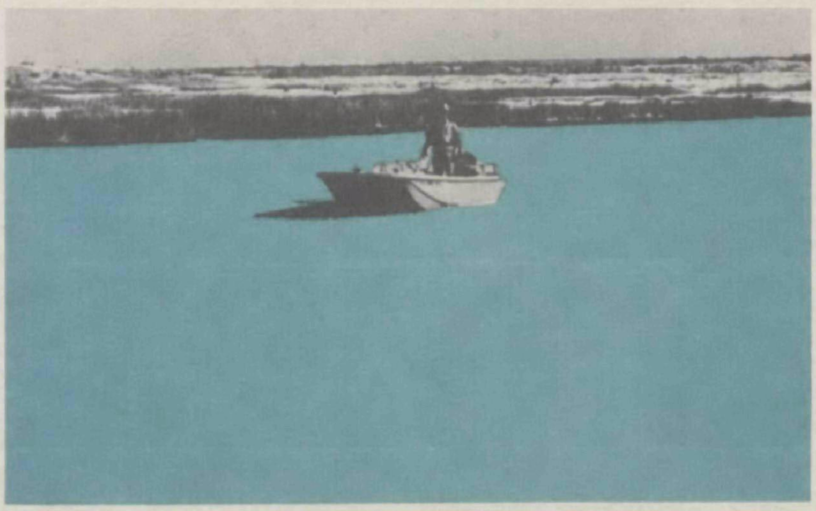
See Table 11 for discussion of past spills.

Conclusions

This plant has only a limited potential for spills that would affect the river. Sulfuric acid is non-toxic in dilute solution and only small amounts of acid would normally get to the river. It is questionable whether diking of the sulfuric tanks would be desirable in this plant due to the distance of the tanks from the river. The hydrogen fluoride tanks present a much greater potential for air pollution than water pollution.

APPENDIXES





The illustration (top) on the opposite side depicts the 31st major chemical fish-kill during 1970 in Escambia Bay, Florida.

– *Wide-World Photo*

APPENDIX A

INVENTORIES OF MAJOR TRANSPORT, TRANSFER, AND STORAGE FACILITIES INVOLVED IN HANDLING HAZARDOUS POLLUTING SUBSTANCES

Texas City, Texas

Baltimore, Maryland

Suisun Bay—Delta Area, California

Charleston, West Virginia

The plant inventories, upon which the survey covered in this report was based, were developed from the following sources:

1. Fortune Plant and Product Directory, Volumes 1 and 2, 1966;

2. Local telephone directories for each community;

3. Directory of Texas Manufacturers, Volumes 1 and 2, Bureau of Business Research, The University of Texas at Austin, 1970;

4. West Virginia Manufacturers Directory, West Virginia Department of Commerce/Industrial Development Division, 1970;

5. Maryland Manufacturers Directory, Maryland Department of Economic Development, 1969/1970;

6. Chamber of Commerce listings:

   - Charleston, West Virginia,
   - Texas City, LaMarque, Texas, and
   - Metropolitan Baltimore;

7. Baltimore Charles Center Inner Harbor Management, Inc.

8. City of Charleston, West Virginia, City Engineers Office;

9. Contra Costa County Directory of Industries, published by Contra Costa County Development Association, Martinez, California.

TEXAS CITY, TEXAS

1. American Oil Company
(Subsidiary of Standard Oil Company of Indiana)
Box 401, 2401-5th Avenue, S.
Refining Manager: Guy L. Honeycutt
Employees: 1500

2. Amoco Chemicals Corporation
(Subsidiary of Standard Oil Company of Indiana)
P.O. Box 568,
2800 Farm Road, 519 E.
Plant Manager: L.T. Larson
Employees: 400

3. Borden Chemical Company, Smith-Douglas Division
(Subsidiary of the Borden Company)
P.O. Box 1571, Grant Avenue
Production Manager: W.M. Fraser, Jr.
Employees: 100

4. GAF Corporation
P.O. Box 2141, Highway 146, W
Plant Manager: F.E. Wetherill
Employees: 185

5. Gulf Chemical & Metallurgical Corp.
P.O. Box 2130, Highway FM 519
President: E.B. King
Employees: 150

6. Malone Chemical Products Company
Malone Service Company
Malone Trucking Company
P.O. Box 709
300-20th Streets, S.
President: Paul Malone

7. Marathon Oil Company-Texas Refining Division
P.O. Box 1191, Ft. of 6th Street
Acting Manager: A.L. Benham
Employees: 345

8. Monsanto Company
P.O. Box 1311, 201 Bay Street, S.
Plant Manager: R.V. Butz
Employees: 1700

9. Reagent Chemical and Research, Inc.
East Galveston Highway
Plant Manager: G. Melder

10. Texas City Refining, Inc.
P.O. Box 1271, East Galveston Highway
President and General Manager: W.H. Fetter
Employees: 300

11. Texas City Terminal Railway Company
P.O. Box 591, E. Galveston Highway
General Manager: W. Wimberly
Employees: 92

12. Union Carbide Corporation
Chemicals & Plastics Division
P.O. Box 471, Texas City Heights
Plant Manager: R.P. Barry
Employees: 2600

BALTIMORE, MARYLAND

1. Acme Plating Company
   6001 Chemical Road
   Baltimore 21226
   Plant Executive: P.M. Kaiser
   Employees: 5

2. Adcrafters, Inc.
   1701 Washington Boulevard
   Baltimore 21230
   President: William L. Graf
   Employees: 51

3. Aerosol International, Inc.
   3511 8th Avenue
   Baltimore 21226
   Plant Manager: A.A. Prestwidge
   Employees: 13

4. Agrico Chemical Company
   (Division of Continental Oil Company)
   2272 S. Clinton Street
   Baltimore 21224
   President: D.H. Bradford, Jr.
   Employees: 109

5. Allied Chemical Corporation
   Agricultural Division
   2000 Race Street
   Baltimore 21230
   Supervisor: W.P. Chamberlain
   Employees: 50-130 seasonal

6. Alcolac Chemical Corporation
   3440 Fairfield Road
   Baltimore 21226
   President: Dr. V.J. Blinoff
   Employees: 160

7. Allegheny Pepsi-Cola Bottling Co.
   400 Key Highway
   Baltimore 21230
   General Manager: Stanley Goldberg
   Employees: 300

8. Allied Research Products, Inc.
   4004 E. Monument Street
   Baltimore 21205
   President: Jules Horelick
   Employees: 125

9. Almag Chemical Corporation
   1800 Cherry Hill Road
   Baltimore 21230
   President: Joseph Eisenberg
   Employees: 22

10. Alpha Chemical Company
    1503-13 Argyle Avenue
    Baltimore 21217
    Owner: Maurice H. Simson
    Employees: 11

11. Aluminum Finishers, Inc.
    5000 E. Monument Street
    Baltimore 21205
    President & Sales: L.Coburn Kingsbury
    Employees: 22

12. American Brewery
    (A Division of Allegheny Beverage Corp.)
    1700 N. Gay Street
    Baltimore 21213
    General Manager & Purch: Louis A. Urbanski
    Employees: 141

13. American Can Company
    Boston & Hudson Streets
    Baltimore 21224
    Plant Manager: Wendell Strickland
    Employees: 900

14. American Oil Company
    3901 Asiatic Avenue
    Baltimore 21226
    Manager: M.C. Hopkins
    Employees: 70

15. American Smelting & Refining Company
    Highway & Eastbourne Avenue
    Baltimore 21224
    Manager: A.J. Kleff, Jr.
    Employees: 968

16. American Sugar Company
    1100 Key Highway E
    Baltimore 21230
    Refinery Manager: James A. Moore
    Employees: 700

17. Ansam Metals Corporation
1026 Patapsco Avenue
P.O. Box 2847
Baltimore 21225
President Purch. & Sales: E. Hettleman
Employees: 11

18. Armco Steel Corporation
Advanced Materials Division
3501 E. Biddle Street
Baltimore 21213
P.O. Box 1697
Baltimore 21203
General Manager: George J. Arnold
Employees: 2367

19. Armco Steel Corporation
Advanced Materials Division
Research Section
3501 E. Biddle Street
Baltimore 21213
P.O. Box 1697
Baltimore 21203
Manager: G.N. Goller

20. Athey, C M Paint Company, The
1809 Bayard Street
Baltimore 21230
Chairman of the Board: C.B. Athey
Employees: 35

21. Baltimore Copperas Company
3900 Hawkins Point Road
Baltimore 21226
President: Jacob Caplan
Employees: 3

22. Baltimore Paint & Chemical Corp.
2325 Hollins Ferry Road
Baltimore 21230
President: E.L. O'Brien
Employees: 375

23. Baltimore Rustproof Company
409 N. Exeter Street
Baltimore 21202
Partner & Manager: Solomon Berman
Employees: 11

24. Baltimore Tar Corporation
1900 Race Street
Baltimore 21230
President & Purch.: Fred N. Lyons
Employees: 13

25. Bauer Chemical Company
1120 N. Appleton Street
Baltimore 21217
President, Plant Mgr., Purch. & Sales:
John G. Bauer
Employees: 4

26. Bethlehem Steel Corporation
Baltimore Yard
1101 Key Highway
Baltimore 21230
Chairman: E.F. Martin
Employees: 2685

27. Braun Rendering Company, Inc.
2008 Ontario Avenue
Baltimore 21230
Exec. VP & Purch.: Clarence E. Braun
Employees: 31

28. Bruning Paint Company, Inc.
Fleet & Haven Street
Baltimore 21224
Director of Sales: Raymond S. Kerin
Employees: 100

29. Burrough Bros. Pharmaceuticals, Inc.
2301 Hollins Street
Baltimore 21223
VP & General Manager: Reuben H. Israelson
Employees: 76

30. By-Products Processing Company, Inc.
829 W. Pratt Street
Baltimore 21201
President: Kenneth H.L. Turner
Employees: 7

31. Chesapeake Asphalt Products Company
110 S. Regester Street
Baltimore 21218
General Manager & Purch.: W.D. Gerber, Jr.
Employees: 8

32. Chesapeake Paperboard Company, The
Fort Avenue & Woodall Street
Baltimore 21230
President; Plant Manager & Purch.:
James E. Smith
Employees: 200

33. Coca-Cola Bottling Company of Baltimore
1200 W. Hamburg Street
Baltimore 21230
President & General Manager:
William R. Ellis
Employees: 212

34. Contact Paint & Chemical Corp.
4903 Snader Avenue
Baltimore 21215
President & Sales: Marvin Sklar
Employees: 12

35. Continental Can Company, Inc.
Plant 16
3500 E. Biddle Street
Baltimore 21213
Plant Manager: G.R. Decorato
Employees: 1500

36. Continental Oil Company
3441 Fairfield Road
Baltimore 21226
Plant Manager: W.B. Carter
Employees: 205

37. Crusader Chemical Company, Inc.
2330 Seven Street
Baltimore 21230
President, Director Research, Plant Manager, Purch. & Sales:
Paul Stamberger
Employees: 6

38. Dek, Inc.
701-09 Luzerne Avenue
Baltimore 21224
President, Plant Manager & Purch.:
Cyprien L. Brien
Employees: 3

39. Delta Chemical Manufacturing Company, Inc.
2101 Washington Boulevard
Baltimore 21230
President & Purch.: D.H. Koumjian
Employees: 17

40. Dentocide Chemical Company
3437 S. Hanover Street
Baltimore 21225
President & Sales: Dr. Saul Moses

41. Donahue, J. Paints, Inc.
2220 Langley Street
Baltimore 21230
President, Plant Exec. & Sales: F. Donahue
Employees: 40

42. Dryden Oil Company, Inc.
Braddish Avenue & Western Md. RR
Baltimore 21216
President: Lindsey D. Dryden
Employees: 58

43. Dulany-Vernay, Inc.
2250 Reisterstown Road
Baltimore 21217
President: John F. Miller
Employees: 63

44. Duro-Lite Paint Company
1525 Benhill Avenue
Baltimore 21226
President Purch. & Sales: Dr. David Sonnenschein
Employees: 5

45. Dynasurf Chemical Corpation
1411 Fleet Street
Baltimore 21231
President: Dr. Irvin Baker
Employees: 35

46. FMC Corporation
1701 Patapsco Avenue
Baltimore 21226
P.O. Box 1616
Baltimore 21203
Res. Manager: J. Ford Wilson
Employees: 378

47. Feralloy Eastern Corporation
2001 Kloman Street
Baltimore 21230
VP General Manager: T.B. Treadwell
Employees: 20

48. Fuld Bros., Inc.
702-710 S. Wolfe Street
P.O. Box 6073
Baltimore 21231
President: E.K. Lipsy
Employees: 60

49. GAF Corporation
1500 S. Ponca Street
P.O. Box 5166
Baltimore 21224
Chairman & President:
Dr. Jesse Werner
Employees: 130

50. Glidden-Durkee Division
Pigments & Color Group
3901 Hawkins Point Road
Baltimore 21226
Sales Manager: L.C. Byrne
Employees: 571

51. Glidden-Durkee Division of
of SCM Corporation
3901 Hawkins Point Road
Baltimore 21226
VP & Plant Exec.: W.L. Rodich
Employees: 527

52. Glidden-Durkee Division
SCM Corporation
Ceramics Group
5601 Eastern Avenue
Baltimore 21224
VP & General Manager: W.L. Rodich
Employees: 300

53. Grace, W.R. & Company
Agricultural Products Division
Curtis Bay Works & Mill Plant
Baltimore 21226
VP – Agricultural Chem. Grp.:
F.J. Sergeys
Employees: 264

54. Grace, W.R. & Company
Davison Chemical Division
101 N. Charles Street
Baltimore 21201
President: Charles E. Brookes
Employees: 139

55. Grace, W.R. & Company
Davison Chemical Division
Curtis Bay Plant
Baltimore 21226
P.O. Box 2117
Baltimore 21203
President: Charles E. Brookes

56. Green Spring Dairy, Inc.
1020 W. 41 Street
Baltimore 21211
President: James J. Ward, Sr.
Employees: 490

57. Griffith & Boyd Company
1800 S. Clinton Street
Baltimore 21224
Employees: 12

58. Hanline Bros., Inc.
1400 Warner Street
Baltimore 21230
President: Leonard H. Cohan
Employees: 50

59. Haven Chemical Corporation
1501 S. Haven Street
Baltimore 21224
President: K.N. Yellott
Employees: 15

60. Hynson, Westcott & Dunning, Inc.
Charles & Chase Streets
Baltimore 21201
President: J.H. Fitzgerald Dunning
Employees: 145

61. Industrial Chemical Division
Allied Chemical Corporation
Block & Wills Streets
Baltimore 21231
President: J.S. Brown
Employees: 321

62. Koontz, H.E. Creamery, Inc., The
5600 Reisterstown Road
Baltimore 21215
President: George C. Oursler
Employees: 320

63. LACO Products, Inc.
4201 Pulaski Highway
Baltimore 21224
President: S.A. Hoffberger
Employees: 50

64. Langrall, J & Bros., Inc.
2105 Aliceanna Street
Baltimore 21231
VP & Sales: H. Edwin Jones
Employees: 35-250

65. Lenmar Lacquers, Inc.
150 S. Calverton Road
Baltimore 21223
President: Leonard E. Eisenberg
Employees: 50

66. Lever Bros. Company
5300 Holabird Avenue
Baltimore 21224
P.O. Box 1737
Baltimore 21203
Plant Manager: F.A. Vaughan
Employees: 1111

67. M&T Chemicals, Inc.
1900 Chesapeake Avenue
Baltimore 21226
Plant Manager: D.B. Read

68. Mangels, Herold Company, Inc.
1414 Key Highway
Baltimore 21230
Chairman: Walter B. Mangels, Jr.
Employees: 96

69. Marvelite, Inc.
3020 Nieman Avenue
Baltimore 21230
Employees: 29

70. Maryland Plating Company, Inc.
316 N. Holliday Street
Baltimore 21202
President: Joseph Eisenberg

71. Masury Paint Company
1403 Severn Street
Baltimore 21230
P.O. Box 778
Baltimore 21203
President: W. Graham Schwartz
Employees: 120

72. Mrs. Bee's Packing Company, Inc.
137 S. Warwick Avenue
Baltimore 21223
President: Myles Katz
Employees: 66

73. National Brewing Company
3720 Dillon Street
Baltimore 21224
President: Jerold C. Hoffberger
Employees: 844

74. National Chemical & Plastics Company, The
1424 Philpot Street
Baltimore 21231
VP & Plant Exec. Arthur A. Eisenberg
Employees: 22

75. National Cylinder Gas Division
Chemetron Corporation
1700 Newkirk Street
Baltimore 21224
Branch Manager: John C. Ross
Employees: 17

76. National Lead Company
Baltimore Branch
214 W. Henrietta Street
Baltimore 21230
P.O. Box 1815
Baltimore 21203
Plant Sup.: Ralph W. Hisey
Employees: 51

77. National Pharmaceutical Manufacturing Company, The
4128 Hayward Avenue
Baltimore 22115
President: I.M. Mendelsohn
Employees: 44

78. Occidental Petroleum
Occidental Agricultural Chemical Corp.
Summers Fertilizer Division
Easter Division, Totman Building
(210 E. Redwood)
Baltimore 21202

79. Olin Mathieson Chemical Corporation
5501 Pennington Avenue
Baltimore 21226
Works Manager: A.B. Moon
Employees: 105

80. Philadelphia Quartz Company
1301 E. Fort Avenue
Baltimore 21230
Plant Manager: J. Van Winkle
Employees: 12

81. Platt Corporation
1415 Key Highway
Baltimore 21230
President: James Beach Platt, Jr.
Employees: 50

82. Pompeian Olive Oil Corporation
4201 Pulaski Highway
Baltimore 21224
President: S.A. Hoffberger
Employees: 47

83. Prima Paint Corporation
819 S. Caroline Street
Baltimore 21231
President: Albert A. Shuger
Employees: 42

84. Procter & Gamble Manufacturing Co.
1422 Nicholson Street
Baltimore 21230
Plant Manager: Richard C. Smith
Employees: 450

85. Royal Crown Bottling Company of Baltimore, Inc.
401 E. 30th Street
Baltimore 21218
President & Purch.: Kenneth H. Burcham
Employees: 158

86. Royster Company
2001 Chesapeake Avenue
Baltimore 21226
Supervisor: M.G. Rogers
Employees: 101

87. Schaefer, F&M Brewing Company, The
1101 S. Conkling Street
Baltimore 21224
General Manager: Joseph J. Waters
Employees: 350

88. Schapiro & Whitehouse, Inc.
Parking & McHenry Streets
Baltimore 21230
President: Daniel Schapiro
Employees: 300

89. Seaboard Asphalt Products Company
Asiatic Avenue N. of Northbridge Road
Baltimore 21226
Owner: H.R. Gundlach
Employees: 26

90. Seaboard Lacquer, Inc.
3105 W. Coldspring Lane
Baltimore 21215
President: Merle W. Rubens
Employees: 10

91. Sherwood Feed Mills, Inc.
2341 Boston Street
Baltimore 21202
President: E.F. Sherwood Dickinson
Employees: 66

92. Sinclair and Valentine
(Division of Martin Marietta Corp.)
2950 Loch Raven Road
Baltimore 21218
Br. & Plant Manager & Sales: Charles J. Sweeney
Employees: 23

93. Solarine Company
4201 Pulaski Highway
Baltimore 21224
President: S.A. Hoffberger
Employees: 50

94. Southern Galvanizing Company
1620 Bush Street
Baltimore 21230
President: Irvin B. Golboro
Employees: 106

95. Southern Lacquer Company
1426 Philpot Street
Baltimore 21231
Work Manager: Aaron A. Eisenberg
Employees: 23

96. Stalfort, Inc.
Chemical Specialties Division
319 W. Pratt Street
Baltimore 21201
President: John Irving Stalfort
Employees: 82

97. Standard Distillers Products, Inc.
306-310 E. Lombard Street
Baltimore 21202
President & Purch.: Andrew W. Merle, Jr.
Employees: 64

98. Standard Oil Company (Indiana)
American Oil Company
Baltimore Refinery
3901 Asiatic Avenue
Baltimore 21226

99. Swift & Company
Agricultural Chemicals Division
5600 Chemical Road
P.O. Box 3410
Baltimore 21226
Manager: C.P. LaVo
Employees: 47

100. Webb, A.L. & Sons, Inc.
921 E. Fort Avenue
Baltimore 21230
President: Charles A. Webb
Employees: 12

101. Young Aniline Works, Inc.
2731 Boston Street
Baltimore 21224
VP & Sales: Robert J. Grant
Employees: 50

102. Young, J.S. Company, The
2701-2851 Boston Street
Baltimore 21224
President: W.B. Belitz
Employees: 123

Curtis Bay

103. Kennecott Refining Corporation
Kenbo Road
Curtis Bay
P.O. Box 3407
Baltimore 21226
Refinery Manager: C.A. Zeldin
Employees: 780

104. Manganese Chemicals Company
(A Division of Pickands Mather & Co.)
711 Pittman Road
Curtis Bay
Baltimore 21226
President: F.R. Dykstra
Employees: 144

105. USS Agri-Chemicals, Inc.
Ordnance Road
P.O. Box 3478
Curtis Bay
Baltimore 21226
District Manager: S.R. Post
Employees: 70

Dundalk

106. Cello Chemical Company, The
8200 Fischer Road
Dundalk
Baltimore 21222
President: Michael J. Catena
Employees: 40

107. Eastern Stainless Steel Corporation
Rolling Mill Road
Dundalk
Baltimore 21224
President: John M. Curley
Employees: 1396

108. Farboil Company, The
Division of Beatrice Foods
8200 Fischer Road
Dundalk
Baltimore 21222
President: H.D. Hammond
Employees: 125

109. Four Roses Distilling Company
1919 Willow Spring Road
Dundalk
Baltimore 21222
P.O. Box 357
Baltimore 21203
Plant Manager: C.N. Belik
Employees: 525

110. Intercoastal Corporation
2320 Edgewater Avenue
Dundalk
Baltimore 21222
General Manager: Roy L. Hartman
Employees: 90

Sparrows Point

111. Bethlehem Steel Corporation
Sparrows Point Plant
Baltimore 21219
Chairman: E.F. Martin
Employees: 27,750

112. Bethlehem Steel Corporation
Sparrows Point Yard
Baltimore 21219
Chairman: E.F. Martin
Employees: 2902

113. National Can Corporation
Reservoir Road
P.O. Box 6606
Sparrows Point
Baltimore 21219
President: R. Stuart
Employees: 376

114. Palm Oil Recovery, Inc.
c/o Bethlehem Steel Company
Sparrows Point Plant
P.O. Box 6657
Baltimore 21219
President: J.C. Van Esterik
Employees: 25

115. U.S. Protective Coatings, Inc.
5 Church Lane
Sparrows Point
Baltimore 21219
President & Purch.: Robert L. Henry III
Employees: 5

116. Vulcan Materials Company
Metallics Division
Gray's Road
P.O. Box 6501
Sparrows Point
Baltimore 21219
Plant Manager & Purch.: J.J. Jeffries
Employees: 35

Halethorpe

117. Carling Brewing Company
4501 Hollins Ferry Road
Halethorpe
Baltimore 21227
VP Eastern Division: Bruce P. Wilson
Employees: 290

118. Union Carbide Corporation
Linde Division
Yale and Benson Avenues
Box 7475
Halethorpe
Baltimore 21227
Plant Sup.: John H. Hecox
Employees: 25

SUISUN BAY–DELTA, CALIFORNIA

Antioch

1. Antioch Building Materials Company
   Sumersville Road & Pillsbury –
   Antioch Highway
   President: Joe Cesa
   Employees: 36

2. Antioch Newspapers, Inc.
   1700 Cavallo Road
   Manager: Keith Emenegger
   Employees: 42

3. Crown Zellerbach Corp.
   Box 10
   Resident Manager: Charles E. Young
   Employees: 900

4. E.I. du Pont de Nemours & Co.
   P.O. Box 310
   Manager: Frank J. Hodges
   Employees: 435

5. Fibrebrand Corporation
   San Joaquin Pulp & Board Mill
   Wilbur Avenue
   Plant Manager: R.G. Beauregard
   Employees: 575

6. Fulton Shipyard
   Waterfront
   Owner: F.L. Fulton
   Employees: 40

7. Imperial West Chemical Company
   P.O. Box 313
   President: D.A. Huckabay
   Employees: 9

8. Kaiser Gypsum
   P.O. Box 460
   VP & General Manager: R.A. Costa
   Employees: 100

9. Kerley Chemical Corp.
   Willow Road & S.P. Railroad Tracks
   Manager: Ralph E. Kerley
   Employees: 4

10. S & H Boatyard
    Route 1, Box 514
    President: Dan Sanderson
    Employees: 7

Avon

11. Monsanto Company
    Post Office: Martinez
    Manager: V.T. Mattericci
    Employees: 28

12. Phillips Petroleum – Avon Refinery
    Post Office: Martinez
    Manager: C.R. McCullough
    Employees: 900

Benicia

13. Humble Oil Refinery
    Benicia

14. J and J Disposal
    Benicia Industrial Park
    President: Howard Jenkins

Crockett

15. California and Hawaiian Sugar Company
    830 Loring Avenue
    General Manager: Neil L. Pennington
    Employees: 1450

Hercules

16. Hercules Incorporated
    Hercules
    Manager: L.B. Johnson
    Employees: 225

17. Sequoia Refining Corporation
    Old Highway 40 – P.O. Box 68
    Plant Manager: Walter O. Nelson
    Employees: 85

Suisun Bay – Delta, California (California)

Martinez

18. Berwind Railway Service Company
111 Mococo Road
Plant Manager: William L. Heritage
Employees: 15

19. Industrial Tank Inc.
210 Bevellessa Street
Owners: Henry W. Simonsen and
Jack O. Fries
Employees: 25

20. Shell Chemical Company
P.O. Box 751
Plant Manager: Marvin L. Baker
Employees: 190

21. Shell Oil Company
P.O. Box 711
Refinery Manager: A.J. Wood
Employees: 1015

22. Telfer Tank Lines, Inc.
Foot of Talbart
President: John W. Telfer
Employees: 50

23. Trumbull Asphalt Company
120 Waterfront Road
Superintendent: Louis E. Southers
Employees: 13

Nichols

24. Chemical and Pigment Company
Post Office: Pittsburg
Manager: Everett Harris
Employees: 25

25. Collier Carbon and Chemical Corp.
Port Chicago Highway
Superintendent: Robert A. Royce
Employees: 30

26. Industrial Chemical Division
Allied Chemical Corp.
Post Office: Pittsburg
Superintendent: V.A. Fink
Employees: 115

Pittsburg

27. The Dow Chemical Company – Western Division
Loveridge Road
General Manager: E.C. Stalhling
Employees: 660

28. Linde Company (Division of Union Carbide)
California Avenue at Loveridge Road
Plant Manager: L.P. Mitchell
Employees: 53

29. Shell Chemical Company
Willow Pass Road
Manager: Marvin Baker
Employees: 250

30. Standard Pipe Protection Division
General Steel Industries, Inc.
P.O. Box 310
Manager: Gale O. Carroll
Employees: 25

31. Stauffer Chemical Company
(Cowles Chemical Division)
Loveridge Road
Plant Manager: Alfred J. Lukks, Jr.
Employees: 20

Shelby

32. American Smelting and Refining Co.
Post Office: Crockett
Plant Manager: A.F. Labbe
Employees: 425

CHARLESTON – KANAWHA RIVER, WEST VIRGINIA

1. E.I. Du Pont (Belle)
   P.O. Box 65
   Belle
   Plant Manager: G.A. Cato

2. FMC Corporation
   Inorganic Chemicals Division
   P.O. Box 8127
   So. Charleston
   Plant Manager: M.E. Birmingham

3. FMC Corporation
   Organic Chemicals Division
   P.O. Box 547
   Nitro
   Plant Manager: L.L. Cavender

4. FMC Corporation
   American Viscose Division
   Nitro
   Plant Manager: J.C. Moody

5. Monsanto Company
   Organic Chemicals Division
   Nitro
   Plant Manager: Bill G. McGuire

6. Union Carbide Corporation
   Chemicals Division
   P.O. Box 2831
   Institute
   Plant Manager: W.B. Corydon

7. Union Carbide Corporation
   Chemicals Division
   P.O. Box 8004
   South Charleston
   Plant Manager: R.L. Yelton

8. Union Carbide Corporation
   Mining & Metals Division
   Alloy
   Plant Manager: F.M. Charles

9. Union Carbide Corporation
   Technical Center
   Plant Manager: F.D. Bess (Asst.)

10. Union Carbide Corporation
    Linde Division (Belle)
    Plant Manager: M.H. Kunneman

11. Diamond Shamrock
    P.O. Box 615
    Belle
    Plant Manager: R.J. Sutch

12. Libbey-Owens-Ford Glass Company
    57th Street E.
    Charleston
    Plant Manager: J.T. Zellers, Jr.

13. Owens-Libbey-Owens Gas Department
    Charleston

14. Allied Chemical Corporation
    Industrial Chemicals Division
    P.O. Box 478
    Nitro
    Plant Manager: Ray Maize

15. Allied Chemical Corporation
    Semet-Solvay Division
    Harewood

16. National Lead Company
    Evans Division
    P.O. Box 1467
    Charleston
    Plant Manager: F. Leake, Jr.

17. Republic Steel Corporation
    P.O. Box 37
    Nitro
    Plant Manager: W.L. Grimm

18. Midwest Steel Corporation
    Sattes
    Riverside
    Plant Manager: J.W. Harper (Charleston)

19. West Virginia Steel
    900 Brooks Street
    Charleston
    Plant Manager: J.R. Harris

20. Trojan Steel
    1414 MacCorkle Avenue
    Charleston
    Plant Manager: J.R. Harris

21. True Temper Steel
    P.O. Box 1233
    Charleston
    Plant Manager: C.E. Peckham

APPENDIX B

SUMMARY OF PROPOSED REGULATIONS DESIGNATING HAZARDOUS SUBSTANCES

December 30, 1970

DRAFT

The proposed regulations provide a flexible designation scheme which not only provides a maximum of protection to the public health or welfare, but also provides for the development of information to define more accurately what dangers are involved. The purpose of the proposed regulations is to make it clear that the spill of any substance is potentially hazardous depending upon the properties and effects of the substance discharged. These regulations will provide a basis for related regulations to be issued under section 12, particularly notice regulations to be issued by the Coast Guard. The proposed regulations will provide a basis for decisions by qualified persons in charge of response activities.

Three separate groups of designated hazardous substances are proposed, which when taken together, include the full range of elements and compounds:

1. A table of specifically identified substances which when discharged as a result of a spill or abnormal discharge produce a receiving water quality which exceeds permissible standards specified in the table.

2. Substances which possess a high potential for danger because of certain detrimental or lethal properties and effects when discharged in any quantity as a result of a spill or abnormal discharge, unless the Administrator can be assured that a tolerable negligible risk of danger is presented.

3. Substances which when discharged as a result of a spill or abnormal discharge produce receiving water criteria which exceed applicable State or Federal water quality criteria, or exceed other specified criteria and limits.

The theory underlying the proposed regulations is that as data and information are developed, the hazardous substances designated in groups 2 and 3 will be redesignated as hazardous in group 1 with specific permissible standards.

PRELIMINARY
Subject to Revision

Environmental Protection Agency
Washington

(18 CFR Part 611)

DESIGNATION OF HAZARDOUS SUBSTANCES

Notice of Proposed Rule Making

Notice is hereby given that the Administrator, Environmental Protection Agency, pursuant to the authority contained in section 12(a)(1) of the Federal Water Pollution Control Act (33 U.S.C. 1162(a)(1)) which was delegated to the Secretary of the Interior by the President in Executive Order No. 11548 dated July 20, 1970 (35 F.R. 11677) and transferred to the Administrator by Reorganization Plan No. 3, 1970, proposes to adopt a new Part 611.

The Water Quality Improvement Act of 1970 (P.L. 91-224, 84 Stat. 91) amended the Federal Water Pollution Control Act (33 U.S.C. 1151 *eq seq.*) to add a new section 12 to that act which provides in subsection (a)(1) of that section as follows: "The President shall, in accordance with subsection (b) of this section, develop, promulgate, and revise as may be appropriate, regulations (1) designating as hazardous substances, other than oil as defined in section 11 of this Act, such elements and compounds which, when discharged in any quantity into or upon the navigable waters of the United States or adjoining shorelines or the waters of the contiguous zone, present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, shorelines, and beaches; . . . ." The President by Executive Order 11548 dated July 20, 1970, has delegated his authority under section 12(a)(1) quoted above to the Secretary of the Interior which authority was transferred by Reorganization Plan No. 3, 1970, to the Administrator, Environmental Protection Agency, who proposes to designate hazardous substances that present an imminent and substantial danger to the public health or welfare when discharged in any quantity into or upon the navigable waters of the United States or adjoining shorelines or the waters of the contiguous zone as indicated in the following proposed regulations.

In determining those elements and compounds which are proposed to be designated as hazardous for purposes of section 12(a)(1) of the Federal Water Pollution Control Act, it was recognized that any substance has the potential for presenting an imminent and substantial danger to the public health or welfare depending upon the properties and effects of the substance discharged. It was also recognized that for the majority of materials which may be designated as hazardous substances, sufficient verification of existing and developed data must be obtained to permit the establishment of definitive safe minimum standards which should not be exceeded in receiving waters. Accordingly, a flexible designation is proposed which it is believed not only provides a maximum of protection to the public health or welfare from the dangers associated with the discharge of hazardous substances, but also provides for the development of information and data to define more accurately what those dangers are. This proposed designation would particularly reference and direct attention to substances which have been determined to be hazardous during transportation, storage, or other handling modes.

Three separate groups of designated substances are proposed in section 4 which when taken together, would include the full range of elements and compounds. Notification of any pollution event involving the discharge of any hazardous substances designated in the following proposed regulations will be made in accordance with regulations issued by the United States Coast Guard under the authority of section 12(c) of the Federal Water Pollution Control Act and Executive Order No. 11548 dated July 20, 1970. The proposed regulations will serve as a basic reference for other related regulations to be issued under the authority of section 12 of the Federal Water Pollution Control Act.

Interested persons may submit, in triplicate, written data or arguments in regard to the proposed regulations to the Administrator, Environmental Protection Agency, Washington, D.C. 20460. All relevant material received not later than 30 days after publication of this notice in the *Federal Register* will be considered.

Part 611 would be adopted as follows:

PART 611 – DESIGNATION OF HAZARDOUS SUBSTANCES

Section

1. Applicability
2. Definition
3. Purpose and Intent
4. Designation of Hazardous Substances
5. Receiving Water Standards for Hazardous Substances
6. Notice

Authority: The provisions of this Part 611 issued under section 12(a)(1) of the Federal Water Pollution Control Act (33 U.S.C. 1162(a)(1)).

Section 1 APPLICABILITY

The regulations of this part apply to hazardous substances other than oil, which when discharged into or upon the navigable waters of the United States, adjoining shorelines or the waters of the contiguous zone present an imminent and substantial danger to the public health or welfare within the meaning of section 12(a) of the Federal Water Pollution Control Act.

Section 2 DEFINITIONS

As used in this part, the following terms shall have the meaning indicated below:

(a) "Discharge" means, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying, or dumping.

(b) "Vessel" means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water other than a public vessel.

(c) "Public vessel" means a vessel owned or bare-boat chartered and operated by the United States, or by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce.

(d) "United States" means the States, the District of Columbia, the Commonwealth of Puerto Rico, the Canal Zone, Guam, American Samoa, the Virgin Islands, and the Trust Territory of the Pacific Islands.

(e) "Person" means an individual, firm, corporation, association, and a partnership.

(f) "Contiguous zone" means the entire zone established or to be established by the United States under article 24 of the Convention on the Territorial Sea and the Contiguous Zone.

(g) "Offshore or onshore facility" means any facility (including, but not limited to, motor vehicles, rolling stock, and pipelines) of any kind and related appurtenances thereto which is located in, on, or under the surface of any land, or permanently or temporarily affixed to any land, including lands beneath the navigable waters of the United States and which is used or capable of use for the purpose of processing, transporting, producing, storing, or transferring for commercial or other purposes any hazardous substance designated under this part.

(h) "Applicable water quality standards" means water quality standards adopted pursuant to section 10(c) of the Federal Water Pollution Control Act (33 U.S.C. 1060(c)) which are identified and described in 18 CFR 620 and State-adopted water quality standards for waters which are not interstate within the meaning of that Act.

(i) "Public health or welfare" means, but is not limited to, the physical, economic and social well being of persons and includes the preservation of fish, shellfish, wildlife and public and private property, shorelines and beaches.

(j) "Persistent" means that quality ascribed to elements and compounds whereby they remain appreciably unchanged regardless of physical, chemical or biological action occurring in the aquatic environment over an extended period of time.

(k) "Administrator" means the Administrator, Environmental Protection Agency.

(l) "Pollution event" means a discharge, other than a normal chronic discharge, during transportation or storage, or a discharge, other than a normal chronic discharge, from commercial, mining, manufacturing, refining, processing, or related activities which, over a short period of time, significantly exceeds the average maximum hourly flow or significantly exceeds the average maximum hourly concentration of the element or compound discharged.

(m) "Qualified" means a demonstrated ability of a person through professional registration or other recognized water quality management or water pollution control experience to make decisions for the protection of the public health or welfare during pollution events.

(n) "Degradable" means that quality ascribed to elements and compounds which can be ultimately destroyed or stabilized by physical, chemical or biological processes, natural or induced.

(o) "Cumulative" means the effect resulting from a persistent material being exposed to life forms in the aquatic environment and thereby being complexed into their metabolism.

Section 3 PURPOSE AND INTENT

(a) This part designates hazardous substances within the meaning of section 12(a) of the Federal Water Pollution Control Act so that any person in charge of a vessel or of an offshore or onshore facility of any kind shall be on notice that any substance discharged as a result of a pollution event has the potential for presenting an imminent and substantial danger to the public health or welfare depending upon the properties and effects of the substance discharged.

(b) This part provides a basis for regulations issued by the United States Coast Guard which provide for notification of any pollution event resulting in the discharge of a hazardous substance designated in this part.

(c) This part will provide a basis for decisions by qualified persons in charge of pollution event response activities to insure that immediate and effective actions are taken to mitigate dangers presented to the public health or welfare from discharges of hazardous substances.

Section 4 DESIGNATION OF HAZARDOUS SUBSTANCES

(a) Any element or compound identified in section 5 of this part is designated a hazardous substance when discharged as a result of a pollution event which reduces or threatens to reduce the quality of the receiving waters below the receiving water standards specified for the element or compound in section 5 of this part.

The table of elements and compounds with receiving water standards set forth in section 5 of this part may be amended or revised on the basis of information and data developed or received by the Administrator.

(b) Elements or compounds other than the elements or compounds designated as hazardous substances in subsection (a) of this section, which possess a high potential for presenting an imminent and substantial danger to the public health or welfare because of their nondegradable or persistent nature, or because they can be biologically magnified, or because they can be immediately lethal, or because they otherwise cause or tend to cause detrimental cumulative effects, and for which insufficient information and data are available to permit the establishment of definitive safe minimum standards which are not to be exceeded, are designated as hazardous substances when discharged in any quantity as a result of a pollution event, unless the Administrator can be assured by any person responsible for such discharges that a tolerable negligible risk of imminent and substantial danger to the public health or welfare is presented: *Provided,* that at such time as the Administrator establishes minimum standards in section 5 of this part for such elements or compounds, the provisions of this subsection will no longer be applicable to such elements or compounds, but the provisions of subsection (a) of this section will apply. Elements or compounds designated as hazardous substances by the provisions of this subsection include:

(1) The following elements in their elemental form or as ions, compounds or in any combination or mixture including, but not limited to, alloys, ores or other minerally identifiable forms: antimony, arsenic, beryllium, boron, cadmium, copper, chromium, lead, mercury, nickel, selenium, silver, thallium, zinc, and other elements with similar properties and effects except those elements identified in section 5 of this part.

(2) Any element identified in subsection b(1) above which may exist in the anionic form and other elemental combinations that may exist in toxic anionic form such as: arsenates, arsenites, chromates, cyanide, fluoaluminates, fluorides, fluosilicates, phosphides and other toxic anions with similar properties and effects except those toxic anions identified in section 5 of this part.

(3) The poisons defined, described, named and classified by the provisions of 46 CFR 146.25 including extremely dangerous poisons, Class A, such as cyanogen and phosgene; less dangerous poisons, Class B, such as acetone cyanohydrin and sodium arsenite; tear gases or irritating substances, Class C, such as bromobenzyl cyanide and chloroacetophenone and other such poisons with similar properties and effects except those poisons identified in section 5 of this part.

(4) The radioactive materials defined, described, named and classified by the provisions of 46 CFR 146.19 such as uranium 233 and iodine 129 and other radioactive materials and mixtures with equally dangerous properties and effects except those radioactive materials identified in section 5 of this part.

(5) The poisons registered as economic poisons in accordance with the provisions of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended (7 U.S.C. 135 *et seq.*) including DDT, aldrin, chlordane, endrin and toxaphene and other such poisons with similar properties and effects except those poisons identified in section 5 of this part.

Additional elements or compounds may be designated as hazardous substances under this subsection when determined appropriate by the Administrator on the basis of the chemical, physical, biological or radioactive properties and effects of each element or compound so designated.

(c) Any other elements or compounds, other than the elements or compounds designated as hazardous substances in subsections (a) and (b) of this section, which have physical, chemical, biological, or radioactive properties that may produce or tend to produce toxic, corrosive, irritating, strongly sensitizing, flammable or other conditions which limit beneficial uses of water are designated as hazardous substances when discharged as a result of a pollution event which:

(1) Reduces or threatens to reduce the quality of the receiving waters below the criteria of applicable water quality standards, or

(2) If there are no applicable water quality standards, reduces or threatens to reduce the quality of the receiving waters below the guidelines of water quality criteria set forth in the report of the National Technical Advisory Committee to the Secretary of the Interior entitled *Water Quality Criteria* dated April 1, 1968, and any subsequent revisions thereto, or

(3) If there are no data specifically addressed to the elements or compounds concerned in *Water Quality Criteria,* results in concentrations or characteristics in the receiving waters which exceed or threaten to exceed limits determined in accordance with test procedures designated by the Administrator to predict the potential for physical, chemical or biological damage to shorelines, beaches and beneficial water uses. For purposes of this section, fish bioassay techniques prescribed in *Standard Methods for the Examination of Water and Waste Water* or as hereafter amended or revised, published by the American Public Health Association, Inc., using fish and receiving waters from any geographical area in which the potential for the pollution event exists, shall be used as an interim technique for determining 96 hour TLm values under flow-through conditions. Application factors of 1/100 for detrimental persistent or cumulative substances, and 1/10 for detrimental degradable, non-cumulative or non-persistent substances shall be used to establish limits of toxic discharges.

Provided, that at such time as the Administrator estăblishes minimum standards in section 5 of this part for such elements or compounds, the provisions of this subsection will no longer be applicable to such elements or compounds, but the provisions of subsection (a) of this section will apply.

Elements or compounds designated as hazardous substances by the provisions of this subsection include, but are not limited to, the following broad categories and specific examples:

CATEGORY I

Inorganic

Acids

- perchloric acid
- nitric acid
- hydrochloric acid
- phosphoric acid
- sulfurous acid
- chloric acid
- chlorous acid
- hypochlorous acid
- chlorosulfonic acid

CATEGORY II

Inorganic

Bases, Alkalies

- potassium hydroxide
- calcium hydroxide
- ammonium hydroxide
- barium hydroxide
- sodium carbonate

CATEGORY III

Inorganic

Elements and Salts

- phosphorus
- aluminum
- barium
- bismuth
- cerium
- cesium
- cobalt
- niobium
- gallium
- germanium
- indium
- lanthanum
- magnesium
- manganese
- molybdenum
- osmium
- palladium
- platinum
- rhenium
- rhodium
- rubidium
- ruthenium
- tantalum
- tellurium
- tin
- titanium
- tungsten
- vanadium
- zirconium
- strontium
- phosphorus pentasulfide
- sodium sulfide
- sodium hypochlorite
- ammonium perchlorate
- potassium iodide
- ammonium phosphate
- sodium hydrosulfite
- aluminum sulfate
- calcium carbide
- ammonium sulfate
- zinc chloride
- zinc sulfate
- calcium phosphate
- ammonium nitrate
- ferrous sulfate
- sodium borate
- sodium chlorate
- magnesium sulfate
- potassium sulfate
- sodium silicate
- ammonium chloride
- sodium sulfate
- sulfur dioxide

CATEGORY IV

Organic

Hydrocarbons

isoprene	l-octene
ethylene	l-pentene
pentane	petrolatum
propylene	l-dodecene
propane	l-tetradecene
l-dodecene	dicyclopentadiene
heptane	l-tridecene
hexane	turpentine
l-hexene	cyclohexane
l-nonene	l-decene

CATEGORY V

Organic

Halocarbons

trichloroethane	dibromochloropropane
carbon tetrachloride	dichlorodifluoromethane
chloromethane	chloroethane
chloroform	ethylene dichloride
trichloroethylene	monochlorodifluoromethane
dichloropropane	allyl chloride
propylene dichloride	

CATEGORY VI

Organic

Alcohols

butyl alcohol	ethylene glycol	heptanol
ethyl alcohol	amyl alcohol	hexylene glycol
n-propyl alcohol	furfuryl alcohol	isobutyl alcohol
isopropyl alcohol	n-decyl alcohol	isodecyl alcohol
isooctyl alcohol	diacetone alcohol	methyl amyl alcohol
sorbitol	diethylene glycol	ethyl isobutyl carbinol
cyclohexanol	diisobutyl carbinol	nonanol
hexanol	dodecanol	octanol
propylene glycol	ethoxylated dodecanol	pentadecanol
glycerol	ethoxylated pentadecanol	tetradecanol
triethylene glycol	ethoxylated tetradecanol	tridecanol
dipropylene glycol	ethoxylated tridecanol	triethylene glycol
tetraethylene glycol	ethyl butanol	2-undecanol
p-chlorothymol	2-ethylhexyl alcohol	allyl alcohol

CATEGORY VII

Organic

Aldehydes and Ketones

formaldehyde	isodecaldehyde
benzaldehyde	isooctylaldehyde
acetaldehyde	propionaldehyde
furfural	n-valeraldehyde
methyl ethyl ketone	n-butyraldehyde
cyclohexanone	isobutyraldehyde
methyl isobutyl ketone	crotonaldehyde
glyoxal	2-ethyl-3-propyl acrolein
acetophenone	

CATEGORY VIII

Organic

Acids

acetic acid	adipic acid
benzoic acid	fumaric acid
cresylic acid	propionic acid
oxalic acid	lactic acid
acrylic acid	formic acid
citric acid	butyric acid

CATEGORY IX

Organic

Esters, Ethers, and Related Substances

acetyl bromide	2-ethyl hexyl acrylate	diethylene glycol monoethyl ether
dibutyl phthalate	isopropyl acetate	diethylene glycol monomethyl ether
vinyl acetate	sec-butyl acetate	ethylene glycol monobutyl ether
methyl methacrylate	dioctylphthalate	ethylene glycol monoethyl ether
ammonium acetate	ethylene glycol monoethyl ether acetate	ethylene glycol monomethyl ether
n-butyl acetate	isobutyl acetate	polypropylene glycol methyl ether
sodium methylate	methyl amyl acetate	ethyl ether
zinc acetate	n-propyl acetate	
propyl acetate	n-butyl acylate	
methyl acetate	isobutyl acrylate	
ethyl formate	ethyl acrylate	
ethyl acetate		

CATEGORY X

Organic

Aromatic Compounds

m-cresol	toluene	cumene
p-cresol	acetophenone	diethylbenzene
nonyl phenol	chlorobenzene	naphthalene
benzene	dodecylbenzene	nonyl phenol
trichlorophenol	dichlorobenzene	triethylbenzene
pyridine	styrene	vinyltoluene
benzene hexachloride	tetrahydronaphthalene	o-xylene
ethyl benzene	benzoyl chloride	m-xylene
pentachlorophenol	p-cymene	p-xylene

CATEGORY XI

Organic

Compounds Containing Nitrogen

trimethylamine	diethanolamine	nitrobenzene
acetonitrile	nitroaniline	adiponitrile
aniline	urea	aminoethylethanolamine
cyclohexylamine	isopropylamine	diethylenetriamine
ethylamine	ethylenimine	diisopropanolamine
methylamine	diethylamine	dimethylamine
butylamine	morpholine	ethylenecyanohydrin
ethylenediamine	diamylamine	monoisopropanolamine
nitrophenol	hexamethylenediamine	triethylenetetramine
triethanolamine	pyridine	skatole
monoethanolamine		

CATEGORY XII

Organic

Compounds Containing Sulfur

dodecyl mercaptan	thiocyanuric acid
carbon disulfide	sodium thiocyanate
isobutyl mercaptan	dodecylbenzenesulfonic acid
thioglycolic acid	

CATEGORY XIII

Organic

Oxides, Peroxides, and Anhydrides

phthalic anhydride	benzoyl peroxide
ethylene oxide	propylene oxide
hydrogen peroxide	butyl peroxide
nitrous oxide	acetic anhydride

CATEGORY XIV

Miscellaneous Compounds

Carbohydrates

dextrose	starch
lactose	cellulose

Proteins

albumin	globulin

Lipids

myristic acid	glyceryl trioleate
palmitic acid	glyceryl tripalmitate
stearic acid	glyceryl tristearate
oleic acid	

Medicinal Chemicals

streptomycin sulfate	atropine methylnitrate
methoxymethyl salicylate	

CATEGORY XV

Pathogenic or Toxic Organisms & Groups

Enteroviruses	Anacystis	Leptospira canicola
Nodularia	Salmonella typhosa	Brucella melitensis
Anabaenea	Salmonella paratyphosa	Staphylococcus aureus
Gonyaulax	Vibrio comma	Clostridium botulinum
Gymnodinium	Vibrio cholera	Endamoeba histolytica
Nostoc	Shigella	

Nuisance Organisms & Groups

Blue-green algae	Cladophora	Gallinella
Actinomycetes	Thiobacillus	Enterobius vermicularis
Synura	Crenothrix	

Section 5 RECEIVING WATER STANDARDS FOR HAZARDOUS SUBSTANCES

The receiving water concentrations and characteristics described for the elements and compounds identified in this section are to be used for the purposes of section 4(a) of this part. The substances are specified and numerically quantified in Table B-1 to indicate permissible standards which if violated present a hazard. The permissible standards express effects of discharge under normal conditions in the aquatic environment. Under certain circumstances such as deviations in pH, temperature, alkalinity, time of exposure, flow regime, synergism or other complicating factors, more stringent permissible standards than those illustrated in Table 1 may be required and in such circumstances the provisions of subsection 4(c) of this part shall apply.

Section 6 NOTICE

Any person in charge of a vessel or of an offshore or onshore facility of any kind, as soon as he has knowledge of any pollution event resulting in the discharge of a hazardous substance designated in section 4 from such vessel or facility, shall immediately give notice of such discharge in accordance with regulations issued by the United States Coast Guard.

TABLE B-1

RECEIVING WATER STANDARDS

	Permissible Standards*				
	Fresh Water Uses			Salt Water Uses	
Substance	Drinking Water Supply	Fish	Plant & Aesthetics	Fish	Shellfish
Phenol	J,C ⩽ 0.001	H ⩾ 4. A ⩽ 3.	A ⩽ 40.	A ⩽ 3.	A ⩽ 50
Sulfuric Acid	B ⩾ 6.	B ⩾ 6. A ⩽ 10.	–	B ⩾ 6.7	B ⩾ 6.7
Sodium Hydroxide	B ⩽ 8.5	B ⩽ 9.0 A ⩽ 40.	A ⩽ 20.	B ⩽ 8.5	B ⩽ 8.5
Sucrose (molasses)	–	H ⩾ 4. A ⩽ 200.	–	H ⩾ 4.	–
Ammonia	A,J ⩽ 0.5	A ⩽ 6. H ⩾ 4.	G,E ⩽ 0.5	A ⩽ 6.	–
Hydrogen Sulfide	C ⩽ 0.05	A ⩽ 1.	C,G ⩽ 0.05	A ⩽ 1.	A ⩽ 2.5
Methanol	A ⩽ 0.01	H ⩾ 4. A ⩽ 10,000	–	A ⩽ 10,000	–
Acetone	C ⩽ 300.	H ⩾ 4. A ⩽ 10,000	–	A ⩽ 10,000	–
O-cresol	C ⩽ 0.0001	A ⩽ 3.	C,E ⩽ 0.05	A ⩽ 3.	–
Acrylonitrile	–	A ⩽ 10. D ⩽ 5.	G,C ⩽ 50.	A ⩽ 15.	–

*Undesirable effects

Symbols: ⩽ means less than or equal to
⩾ means greater than or equal to
– no standard

A Toxicity – mg/l of substance
B pH – pH units of receiving water
C Taste-odor to water – mg/l of substance
D Fish flesh tainting – mg/l of substance
E Color, turbidity, floating, foaming, settling – mg/l of substance
F Biologically magnified – mg/l of substance
G Biostimulatory to certain lifeforms – mg/l of substance
H Dissolved oxygen – mg/l of dissolved oxygen in receiving water
I Salinity fluctuation – change greater than ±10% of normal variation
J Reactivity – mg/l of substance

APPENDIX C

INDUSTRIAL MUTUAL AID SYSTEM
OF TEXAS CITY, TEXAS

Manual of Procedures during Emergencies

First issue: 1949
Ninth Revision: April 1964
Supersedes All Previous Issues

FOREWORD*

The subscribers to the Industrial Mutual Aid System and to the Manual of Procedures recognize that it becomes a civic and moral duty to offer assistance to another in an emergency, when the ability to assist is present and when the furnishing of assistance would not be attended by undue or unreasonable risk of personal injury or severe property damage.

The Industrial Mutual Aid System and the Manual of Procedures formulated hereunder are efforts on the part of neighboring industries and governmental members in the Greater Texas City Area to anticipate that one or more of the subscribers may be faced with a sudden emergency requiring outside assistance over and above such assistance that may be rendered by the governmental members subscribing hereto in the discharge of their official duties, to the end that prompt and efficient assistance can be given.

The System and the Manual are designed to determine in advance of any emergency what personnel and facilities may be reasonably available.

Lastly, they provide a method of employing that assistance in a prompt and efficient manner in any given emergency.

It is not intended that the subscribers shall assume or relieve themselves of the rights, duties, responsibilities, and liabilities which would otherwise attach by operation of law, anything to the contrary, whether expressed or implied in the System and Manual notwithstanding.

Nor is it intended that any of the provisions of the System and Manual shall apply to any governmental agency subscribing thereto when discharging the duties for which they were created.

Personnel from any member (governmental or private enterprise) entering the premises of another member will be expected to act under the direction of the affected member, or the governmental member having jurisdiction and authority as a matter of law, as the case may be. Wherever possible, employees of a member offering assistance will not enter the affected plant but will deliver the assistance requested to the main gate of the affected member. This procedure should be adhered to almost without exception since insurance coverages may be invalid in case of injury. Traveling from one plant to an affected plant is not the responsibility of the affected plant.

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*There are eight appendixes — I through VIII — included within Appendix C, and the reader should not confuse them with Appendixes A through F of this report.

It is expected that all members will cooperate to the fullest extent in furnishing aid to the affected member; however, there is no obligation to do so if circumstances within a member plant in their sole judgment do not permit their lending assistance.

SCOPE OF THE INDUSTRIAL MUTUAL AID SYSTEM

The primary purpose of the Industrial Mutual Aid System is the development of a plan of cooperative action, whereby assistance of other companies or members will be made available to any member having an emergency which may be beyond the ability of the affected member to control. Such aid or assistance will be available upon request from the affected member and unless requested, none of the participating members will respond to the scene of the emergency.

It shall be expressly understood that any member receiving aid from another is responsible for the return in good order or reimbursement for materials or equipment obtained under this agreement.

An agreement has been reached between mutual aid organizations of the Gulf Coast area whereby assistance will be rendered on a reciprocal basis. Requests shall be made only by officers of the organization in emergency to officers of the organization expected to furnish assistance. See Appendix VIII.

OFFICERS AND ORDER OF SUCCESSION

There shall be a general chairman, secretary, and five vice-chairmen, to administrate the activities of the Texas City Industrial Mutual Aid System.

An election shall be held in the regular meetings of member representatives in January of even-numbered years for the purpose of selecting Industrial Mutual Aid System Officers. Each member shall be entitled to one vote. Elected officers shall serve for a period of two years, beginning with the first regular meeting following the election.

The general chairman shall appoint first and second alternates from the roster of vice-chairmen to succeed him in any absence.

The vice-chairmen shall each appoint one alternate, subject to approval of the general chairman, to succeed to committee leadership during declared emergencies. Any appointed alternate shall succeed an elected officer during term of office only in the event of unavoidable removal of that officer.

RESPONSIBILITIES AND FUNCTIONS

The general chairman or his ranking alternate, as the case may be, shall direct all activities of the Texas City Industrial Mutual Aid System.

Executive Committee

The elected officers shall constitute an Executive Committee. The current committee consists of:

Charles Gilmore	General Chairman
H. C. Reiniger	Secretary
K. E. Agee	Vice-Chairman – Communications and Public Information
R. L. DeWalt	Vice-Chairman – Traffic Control
Gail Atkins	Vice-Chairman – Equipment and Plant Emergency Systems
Dr. Roy Joyner	Vice-Chairman – Medical Coordination
Carter Goodwin	Vice-Chairman – Allied Services

The purpose of the Executive Committee is to develop Industrial Mutual Aid System policies and to coordinate activities in accordance with such policies.

Each vice-chairman shall appoint a committee from the roster of member representatives and alternates to develop procedures pertinent to his scope of responsibility.

CONTROL CENTER

The Texas City Police Department Headquarters shall be utilized as a Control Center during emergencies. Executive Committee members and their appointed alternates should report there to coordinate emergency activities.

CENTRAL COMMITTEE

Each participating member of Industrial Mutual Aid System shall appoint one person to serve as its official representative in Industrial Mutual Aid System activities. The appointment of one or more alternates is desirable but optional. Attendance at all regular meetings by representatives and alternates is encouraged.

This group shall be known as the Central Committee and will meet as directed to conduct affairs of the Industrial Mutual Aid System. The primary purpose of the Central Committee is to serve as the liaison agency between member managements and the Industrial Mutual Aid System Executive Committee.

The roster of Industrial Mutual Aid System members appears as Appendix I of this manual.

The roster of member representatives and alternates shall be maintained by the secretary.

THE COMMUNICATIONS COMMITTEE SHALL DEVELOP PROCEDURES FOR:
(See Procedures, Appendix II)

1. Form of message or code word to be used for requesting help and for dispatching assistance to other members.

2. Method of placing calls from an affected member to the Central Police Station of Texas City which will be used as the dispatching station for all incoming or outgoing messages including those that will cover Red Cross requirements. (The Red Cross Disaster Committee will separately organize other means of communications to meet their detailed requirements.)

3. Dispatching assistance to any member making request for help.

4. Release of information to public through the newspaper, radio, or other desirable means.

5. Education of the public and controlled publicity relating to the Industrial Mutual Aid System. The advance publicity will be advantageous at the time of an incident by having the general public realize the importance of their coooperation in case of an emergency.

6. The coordination of telephone and telegraph facilities to assure that maintenance of service is immediately available if required.

7. Enlistment of mobile two-way radio equipment, sound trucks, and all other modes of communication which will be available to supplement existing equipment as needed.

8. Maintain an up-to-date listing of communications equipment available and publish same to members.

THE TRAFFIC CONTROL COMMITTEE SHALL DEVELOP PROCEDURES FOR:
(See Procedures, Appendix III)

1. Zoning the greater Texas City area for traffic control purposes.

2. The coordination of efforts of all governmental police agencies during an emergency and the control of all traffic into or out of the property of any member at the time of an emergency.

3. The control of all traffic into or out of the corporate limits of Texas City in general emergencies.

4. Establishing road blocks during emergencies and detouring traffic as required.

5. Permitting member plant personnel to pass road blocks to enter their respective plants.

6. Identification for member representatives and member employees for use during time of emergencies.

THE EQUIPMENT AND PLANT EMERGENCY SYSTEMS COMMITTEE SHALL DEVELOP PROCEDURES FOR:
(See Procedures, Appendix IV)

1. Conducting member plant surveys for purpose of maintaining list of fire, safety, and mechanical equipment.

2. Maintaining lists of persons, including their day and night telephone numbers, who are authorized to request or release such equipment.

3. Issue the above lists to all member companies.

4. Arrangements with each member to designate place or places to which equipment being requested can be delivered in case of an emergency.

THE MEDICAL COORDINATION COMMITTEE SHALL DEVELOP PROCEDURES FOR:
(See Procedure, Appendix V)

1. The development of procedures for establishing medical aid at the scene of emergency.

2. The establishment of a series of locations in the Texas City area to which injured personnel can be taken so as to remove them from the emergency area.

3. The establishment of a procedure for alerting hospitals in Galveston and Houston. The authority to transmit such information should be established. (This phase is very important.) By the establishment of these procedures, false alarms and unnecessary confusion will be reduced to an absolute minimum and yet insure adequate medical facilities.

4. The coordination of both ambulance and nurse services.

5. The establishment of a pool of medical supplies which can be drawn upon as deemed necessary by the chairman of the Medical Coordination Committee in cases of emergencies affecting IMAS members.

ALLIED SERVICES
(See Appendix VII and VIII)

The vice-chairman, Allied Services shall coordinate development of necessary intersectional exchange agreements.

APPENDIX I

THE PARTICIPATING MEMBERS OF THE MUTUAL AID SYSTEM ARE AS FOLLOWS:

American Oil Company (Texas)	WI	5-2311
Amoco Chemicals Corporation	WI	8-1601
Community Public Service Company	WI	5-2386
Emken-Linton Funeral Home	WI	5-4444
Galveston County Amateur Radio Club (Bach)	WI	5-4431
Galveston County Medical Society		
Galveston County Memorial Hospital	WE	5-2421
Galveston County Sheriff's Department	SO	5-6686
Houston Natural Gas Corporation	WI	5-4471
Houston Pipe Line Company (Houston)	MI	4-5015
Monsanto Chemical Company	WI	5-4431
Pan American Gas Company	WI	8-2501
Marathon Oil Company	WI	5-2331
Radio Station KTLW	WI	5-4418
Service Pipe Line Company (Houston)	HU	4-2334
Smith-Douglass Company, Inc.	WI	8-1691
Southwestern Bell Telephone Company	WI	5-7481
Texas City Civil Defense	WI	5-2325
Texas City Fire Department	WI	5-2325
Texas City Police Department	WI	8-2525
Texas City Refining, Inc.	WI	5-4451
Texas City Sun	WI	5-4483
Texas City Terminal Railway Company	WI	5-4465
Texas Highway Patrol (Houston)	OX	4-2374
Union Carbide Chemicals Company	WI	5-7411
Unites States Coast Guard (Galveston)	SO	3-1635
Wah Chang Corporation	WI	5-4411

APPENDIX II

PROCEDURE FOR COMMUNICATIONS COMMITTEE

Chairman – K. E. Agee

The procedure and form of message to be used in requesting assistance from the Industrial Mutual Aid System should be known by authorized personnel of each member company. The message will relate the general conditions of the situation and will establish positive identification of the member company and name of person transmitting the message. Code words will not be utilized.

I. GENERAL CONDITIONS

A. "Alert"

All members stand by. A situation exists but is under control. May create hazardous traffic condition or undue public alarm.
Traffic control required.

B. "Emergency"

Assistance required from other members.

C. "All Clear"

No further assistance required.

II. TO ACTIVATE SYSTEM

A. Call Texas City Refining, Inc.

1. By IMAS radio network to KFG-92
2. By telephone to WI 5-4451.

B. Message Form –

State the following:

1. Name of member company and person calling.
2. This is an IMAS "Alert" or "Emergency."
3. Assistance required – medical, ambulance, fire department, etc.

III. RESPONSE

A. "Alert Condition" Texas City Refining, Inc.

1. Dispatches traffic control
2. Alerts Galveston County Memorial Hospital and Emken-Linton Funeral Home
3. Alerts IMAS Chairman or alternates.
4. Checks all IMAS radio units.
5. Alerts Sheriff's Department and State Highway Patrol.

B. "Emergency Conditioning"

Texas City Refining, Inc.:

1. Dispatches traffic control.
2. Notifies Galveston County Memorial Hospital, Emken-Linton, and Fire Department for emergency condition. Transmits detail message of assistance required.
3. Calls IMAS Chairman or alternates giving location, condition, assistance required.

4. Alerts Sheriff's Department and State Highway Patrol.

IV. ACTION TO BE TAKEN BY OTHER MEMBERS

A. Galveston County Memorial Hospital calls doctors, nurses, and hospitals as required.

B. IMAS Chairman or alternates calls the Equipment Committee Chairman and the Red Cross Disaster Committee Chairman and Communications Chairman, repeating the condition and the location of the emergency.

The IMAS Chairman or alternates will call those members requiring notification by telephone. These are listed below:

Amoco Chemicals Corporation	WI 8-1601
Community Public Service Company	WI 5-2386
Daily Sun	WI 5-4483
Houston Natural Gas Corporation	WI 5-4471
Houston Pipe Line Company	MI 4-5015
Pan American Gas Company	WI 8-1781
Radio Station KTLW	WI 5-4418
Service Pipe Line Company (Houston)	HU 4-2334

Smith-Douglass Company, Inc.	WI 8-1691
Southwestern Bell Telephone Company	WI 5-7481
Texas City Civil Defense	WI 5-2671
Texas City Terminal R.R. Company	WI 5-4461
U. S. Coast Guard (Galveston)	SO 3-1635

C. The Communications Committee Chairman calls the representative of press and radio, repeating the condition and location of the emergency.

V. RELEASE OF PUBLIC INFORMATION

A. The Chairman of the Communications Committee or a person designated by him must cooperate with member officials in order to secure the necessary information for the preparation of the news releases.

B. No information relating to an incident is to be issued except that which is released by proper authorization of the affected member. It will be understood that all information released to IMAS is confidential. This measure will be of great assistance in avoiding panic in case of serious emergency.

VI. PUBLIC EDUCATION

The Communications Committee Chairman or a person designated by him will issue public educational material only as authorized by the IMAS Executive Committee.

VII. EQUIPMENT SURVEY

The Chairman and his committee shall make a survey of all communications companies and their facilities, and their locations. The committee will also maintain a list of company officials to be called in order to maintain constant and uninterrupted service insofar as possible.

VIII. MOBILE EQUIPMENT SURVEY

The Chairman and his committee shall make a survey and list of all available mobile and portable communications equipment and shall authorize the use of such equipment in the event such is needed.

MEMBERS OF INDUSTRIAL MUTUAL AID EMERGENCY NET

Unit No. 1	Net Control (Communications Chairman)
Unit No. 2 – KFG-81	American Oil Company
Unit No. 3 – KFG-80	City Fire Department (Central or Heights)
Unit No. 4 – KFG-94	Monsanto Chemical Company
Unit No. 5 – KFG-96	Marathon Oil Company
Unit No. 6 – KFG-92	Texas City Refining, Inc.
Unit No. 7 – KFG-98	Union Carbide Chemicals Company
Unit No. 8 – KFG-93	Wah Chang Corporation
Unit No. 9 – KFG-95	Emken-Linton
Unit No. 10 – KFG-83	Community Public Service Company
Unit No. 11 – KFG-97	City Police Department
Unit No. 12 – KFG-99	Galveston County Memorial Hospital

The above list will be revised and forwarded upon additions or deletions of stations in this network.

REQUIREMENTS AND PROCEDURES FOR TEXAS CITY INDUSTRIAL MUTUAL AID RADIO NET

ORGANIZATION

The Industrial Mutual Aid Radio Net was adopted by members of this organization for the purpose of providing an additional form of communication among heavy industry and service organization members, which will augment our efforts in the preservation of life and property in the event of man-made or natural disasters.

AUTHORIZATION

The Industrial Mutual Aid Radio Net is authorized to operate in the Special Emergency Radio Service.

OPERATING REQUIREMENTS

1. All persons operating radio equipment on this net must be an employee or a member of the Industrial Mutual Aid System.

2. No person will utter any obscene, indecent or profane language by means of these radio communications.

3. No station in this net shall be used to transmit or receive messages for the purpose of compensation direct or indirect and shall at no time be used for the purpose of conducting company business or operations unless such message would be used directly for the preservation of life and property.

STATION IDENTIFICATION

When stations of the Industrial Mutual Aid are engaged in network operation, each station or unit must fully identify itself at least once by using the assigned call of the licensee in addition to their own assigned unit number. Any further identification by any station other than the acting control station or unit during that period of network operations may be accomplished by the use of its assigned unit number only.

The control station upon closing the network operation shall fully identify itself by the use of the assigned call sign of the licensee in addition to its assigned unit number.

USE OF STATIONS

In considering the use of the radio emergency net, it is understood that any member may activate the network or any portion thereof for the purpose of requesting aid or transmission of information regarding any emergency which would effect the preservation of life and property.

Practice drills will be conducted at times designated by the Communications Chairman.

OPERATING PROCEDURES

1. Voice Transmission

In order that a message be received with as much clarity as possible, the operator transmitting the information should train himself to speak slowly and directly into the microphone. The loudness of voice which is normally used on the telephone is usually sufficient to properly operate the average microphone.

2. Net Control

The term NET CONTROL STATION is that unit which may activate the network or any portion thereof for the purpose of requesting aid and transmitting information during an emergency or any unit which has been delegated by the Communications Officer to act as net control station for the purpose of conducting drills or tests. In case of a serious disaster or large scale emergency, the net control station will be established by IMAS in the Texas City Police Headquarters.

OPERATION

To alert the net, the following example should be utilized by the operator. This example assumes that Unit No. 1 is the net control station:

"Attention all units of the Industrial Mutual Aid Net.

This is* Unit No. 1 acting net control.

This is a(n) { emergency / stand-by alert / practice drill / equipment check }

All units stand by."

*Call sign will be inserted upon assignment.

Arthur D Little, Inc.

The above transmission should be repeated three times to alert other units on the net.

The net control station will then call the roll of member stations as follows:

(This example assumes that Unit No. 1 is the net control station.)

"Unit No. 2, this is net control* Unit No. 1."
Unit No. 2 (American Oil Co.) will then reply –

"Unit No. 1, this is* Unit No. 2."
Net control will then acknowledge by answering.

"Thank you, Unit No. 2."

"Unit No. 3, this is net control* Unit No. 1."
Unit No. 3 (City Fire Department will then reply.)

"Unit No. 1, this is* Unit No. 3."
Net control will then acknowledge by answering.

"Thank you, Unit No. 3."

Etc. for all other units.

*Call sign will be inserted upon assignment

LIST OF COMMUNICATIONS EQUIPMENT

Contact	Business Telephone	Residence Telephone
K. E. Agee – Chairman	WI 5-4451	WI 5-2414

RADIO STATION KTLW

At the time of emergency, the radio station will broadcast facts as furnished by the Mutual Aid Headquarters and render any other assistance possible in reporting of the news.

Contact	Business Telephone	Residence Telephone
Station Manager	WI 5-4418	WI 5-2754

SOUTHWESTERN BELL TELEPHONE COMPANY

Personnel will be available to provide emergency communications and telephone service as soon as possible. State assistance required to the Chief Operator, i.e., mobile telephone, equipment repairman, etc.

Contact	Business Telephone
Chief Operator	WI 5-7401

THE DAILY SUN

THE DAILY SUN will assist in any way possible in distributing and publishing news of an emergency.

Contact	Business Telephone	Residence Telephone
Carl Hooper	WI 5-4483	WI 8-2643

TEXAS ARMY NATIONAL GUARD
COMPANY "B" – 111TH MEDICAL BATTALION

5 – Field Units – AM and FM – range 15 miles – activate on request from County Judge, Sheriff, or Mayor of City.

Contact

Building 401 – Fort Crockett, Galveston, Texas

U. S. COAST GUARD

2 – Communication trucks with AM equipment.
3 – Mobile two-way FM equipment.

Contact	**Business Telephone**
Captain of the Port	SO 3-1635

TEXAS CITY POLICE DEPARTMENT

1 – 250 watt FM transmitter located at 5th Avenue North – 155.37 mc.
9 – Police cars – mobile units – 155.37 mc.
2 – Mobile unit equipped with public address system
1 – Teletype – State Department of Public Safety
1 – Two-way radio equipment to State Highway Patrol and County Sheriff's Department
1 – IMAS receiver-transmitter

TEXAS HIGHWAY PATROL

1 – Portable station (transmit-receive) – FM – 42.9 mc.
Relay through patrol unit to 155.37 mc.
Several patrol units with two-way FM radio, available if required.

Contact

Texas City Police Department

TEXAS CITY FIRE DEPARTMENT

Central Station

1 – Base station, 250 watt FM – 154.43 mc.
4 – Two-way radio equipped trucks.
1 – Two-way radio equipped mobile unit (Chief).
1 – IMAS receiver-transmitter

Heights Station

1 – Base station – 250 watt FM – 154.43 mc.
2 – Two-way radio equipped trucks.

No. 4 Station (West Texas City)

1 – Base station – 250 watt FM – 154.43 mc.
2 – Two-way radio equipped trucks

AMERICAN OIL COMPANY

1 – Base station – 60 watt FM – 153.05 mc. (relay to mobile).
1 – Mobile – 30 watt – relay 153.05 mc. to Texas City Policy Department on 155.37 mc.

Contact	Business Telephone	Residence Telephone
		Dickinson
H. C. Reiniger	WI 5-2311	534-4029

COMMUNITY PUBLIC SERVICE COMPANY

1 – Base station – 120 watt FM – 48.30 mc.
Texas City (2), La Marque, Dickinson, Alvin, Angleton, West Columbia
15 – Two-way mobile units (local)

Contact	Business Telephone	Residence Telephone
G. R. Boyd	WI 5-2386	WI 5-4009

HOUSTON NATURAL GAS CORPORATION

8 – Base stations – 60 watt FM – 48.18 mc.
Texas City, Baytown, LaPorte, Freeport, Alvin, Wharton, Victoria, Corpus Christi.
10 – Two-way mobile units (local).

Contact	Business Telephone	Residence Telephone
J. B. Meyers	WI 5-4471	WI 5-6228
J. S. Sullivan	WI 5-4471	WI 5-9331

PAN AMERICAN GAS COMPANY

1 – Base station – 60 watt FM.
7 – Two-way radio equipped mobile units
1 – Mobile units for battery power or mobile use.

Contact	Business Telephone	Residence Telephone
C. F. Bryce	WI 8-2501	WI 5-9678

SERVICE PIPE LINE COMPANY

6 – Base stations – two-way FM – 48.70 mc.
Located at Texas City, Alvin, Houston, San Jacinto, Tomball, and Huffsmith.
30 – Two-way FM mobile units at various locations.
Service Pipe Line Company private phone system Galveston and Harris Counties.

Contact	Business Telephone	Residence Telephone
George Speed	WI 5-5762	Alvin OL 8-3950

APPENDIX III

PROCEDURES FOR TRAFFIC CONTROL COMMITTEE

Texas City Police Department – Chairman – Chief of Police R. L. DeWalt

Texas Department of Public Safety – Highway Patrol

Galveston County Sheriff's Department

La Marque Police Department

I. MAPS

A. This committee shall maintain up-to-date zone maps of the Texas City-LaMarque area and furnish necessary revisions to members.

B. This committee shall maintain up-to-date maps of each zone showing preferable locations of road blocks and routes of detour from various zones in case of an emergency.

II. CONTROL

The control of all traffic into or out of the corporate limits of Texas City will be the responsibility of the available governmental police agencies co-operating with the Texas City Chief of Police.

III. COORDINATION

The Texas City Chief of Police is to be responsible for the coordination of efforts of all governmental police agencies during an emergency, and the control of traffic into or out of any member plant at the time of such emergency will be conducted by the available governmental police agency designated by him.

IV. IDENTIFICATION CARDS

A. Normal plant identification cards or badges of affected member employee shall constitute sufficient identification to permit passage through road blocks to reach their respective plants. However, in the event an emergency should develop at or near the time of changing shifts, it may be necessary for the affected member and ajoining members to determine what portion of their respective personnel will enter or leave their respective plants and to so advise the Texas City Chief of Police.

V. LIST OF TRAFFIC CONTROL EQUIPMENT

Texas City Police Department
Police personnel – Thirty-one men
Police units – nine cars

Texas Highway Patrol
Police personnel
Police units – Five

Galveston Sheriff's Department
Police personnel
Police units – Four

LaMarque Police Department
Police personnel
Police units – Four

VI. ROAD BLOCKS AND PATROLS

Notice: Permit vehicles of Southwestern Bell Telephone Company, Community Public Service Company, and Houston Natural Gas Corporation to enter any restricted area.

Streets Restricted to Emergency Traffic Only	Employee Groups Permitted to Pass
A. American Oil Company (Refinery)	
1. 5th Avenue South between 21st Street and Grant Avenue	1. American Oil Company
2. Grant Avenue between 5th Avenue South and Union Carbide rear gate.	2. American Oil Company Pan American Gas Company
B. American Oil Company and Marathon Oil Company (Tank Farms)	1. Amoco Chemicals
1. Highway 146 (business route) between 4th Avenue South and junction with Highway 519	1. Marathon Oil Company Amoco Chemicals Texas City Refining Texas City Terminal RR Co.

2. 14th Street between Texas Avenue and American Oil Company gate	2. American Oil Company Marathon Oil Company Warren Petroleum Corporation
3. 7th Avenue South between 10th Street and 14th Street	3. American Oil Company Marathon Oil Company Warren Petroleum Corporation

C. Monsanto Chemical Company

1. Bay Street south of 2nd Avenue South	1. Monsanto Chemical Company
2. 2nd Avenue South between Bay Street and 3rd Street	2. Monsanto Chemical Company
3. 3rd Street between 2nd Avenue South and 4th Avenue South	3. Monsanto Chemical Company
4. 4th Avenue South between Highway 146 (business route) and 3rd Street	4. Monsanto Chemical Company
5. Highway 146 (business route) between 4th Avenue South and entrance to Texas City Terminal RR Company	5. Monsanto Chemical Company Amoco Chemicals Marathon Oil Company

D. Marathon Oil Company and Amoco Chemicals (Refineries)

1. Highway 146 (business route) between 4th Avenue South and junction with Highway 519	1. Marathon Oil Company Amoco Chemicals American Oil Company Sea Train Texas City Terminal RR Co. Union Carbide Chemicals Co. (Crews of docked ships)
2. 4th Avenue South between Highway 146 (business route) and 10th Street	2. Marathon Oil Company Amoco Chemicals

E. Texas City Refining, Inc.	
1. Highway 146 (business route) between 4th Avenue South and junction with Highway 519	1. Texas City Refining, Inc.
F. Smith-Douglass Company, Inc.	
1. Grant Avenue between 5th Avenue South and junction with Highway 519	1. Smith Douglass Company, Inc. American Oil Company Pan American Gas Company Union Carbide Chemicals Co.
G. Amoco Chemicals – Plant "B"	
1. Highway 519	1. Amoco Chemicals Corporation
H. Texas City Terminal Railway Co. (Docks and Tank Farms)	
1. Highway 146 (business route) between 4th Avenue South and junction with Highway 519	1. Texas City Terminal RR Co. American Oil Company Amoco Chemicals Marathon Oil Company Sea Train Texas City Refining, Inc. Union Carbide Chemicals Co. U. S. Coast Guard (Crews of docked ships)
I. Union Carbide Chemicals Company (Chemicals Plant)	
1. 5th Avenue South between Grant and Highway 146	1. Union Carbide Chemicals Co.
2. Grant Avenue between 5th Avenue South and Highway 519	2. Union Carbide Chemicals Co. American Oil Company Pan American Gas Company Smith-Douglass Company, Inc.

3. Highway 146 between 5th Avenue South and junction with Highway 519	3. Union Carbide Chemicals Co.
4. Texas Avenue cut-off to 5th Avenue South between 28th Street and 5th Avenue South	4. Union Carbide Chemicals Co.

(Barge Terminal)

1. Highway 146 (business route) between 4th Avenue South and junction with Highway 519	1. Union Carbide Chemicals Co. Texas City Refining, Inc. Amoco Chemicals Corporation

VII. IMAS ROAD BLOCKS FOR THE CITY OF TEXAS CITY TO PREVENT ENTRY OF ALL BUT EMERGENCY TRAFFIC

1. Highway 146 at 25th Avenue North
   Turn traffic north to FM 517 to Dickinson and Highway 3

2. Palmer Highway (13th Avenue North) at Highway 3
   Turn traffic north or south

3. 5th. Avenue South (Intercity) at Highway 146
   Turn traffic west to Highway 3

4. Highway 519 (LaMarque Main Street) at Highway 146
   Turn traffic west to Highway 3

5. Junction Highway 3 and Highway 146
   (Texas City business route-Texas City Wye.)

   Turn traffic north and south on Highway 3

APPENDIX IV

PROCEDURE FOR EQUIPMENT AND PLANT EMERGENCY SYSTEMS COMMITTEE

Chairman — Gail Atkins — Wah Chang

I. IN CASE OF EMERGENCY

To order equipment and Supplies, call Unit No. 11 or WI 8-2525.

A. State Name of Company and Your Name.

B. Quantity and Description of Supplies or Materials Required.

II. EQUIPMENT SURVEY

A. The individual members of this committee are responsible for furnishing lists of fire, safety, and mechanical equipment of the respective companies to the committee chairman.

B. The individual members of this committee are responsible for furnishing lists of the names and telephone numbers of persons authorized to release equipment in case of emergency.

III. DISTRIBUTION OF INFORMATION

The above information is to be submitted to the chairman of the committee whenever revision is necessary. The chairman shall be responsible for preparing lists which will be submitted to the secretary of the IMAS for distribution to all member companies.

IV. See page Nos. 250 - 254 for list of equipment.

FOR AUTHORIZATION TO RELEASE EQUIPMENT IN CASE OF EMERGENCY

Use IMAS radio (refer to company call designations) or telephone, as conditions indicate:

American Oil Company	**Days**	**Business**	**Residence**
(KFG-81)	G. L. Honeycutt	WI 5-2311	WI 5-6908
	F. K. Webb	WI 5-2311	WI 5-9567

Nights and Week Ends – WI 5-9788 and ask for Night Superintendent.

Amoco Chemicals Corporation	**Day or Night**	**Business**	**Residence**
	M. S. Weir	WI 8-1601	877-2429 (Kemah)
	O. W. Collier	WI 8-1601	WE 5-6475

Community Public Service Co. Call WI 5-2386 and give necessary information.

Houston Natural Gas Corporation	**Day or Night**	**Business**	**Residence**
	J. S. Sullivan	WI 5-4471	WI 5-9331
	E. B. Langford	WI 5-4471	WI 5-7317

Houston Pipe Line Company	**Day or Night** Gas Control – Houston FA 3-2984
Monsanto Company (KFG-94)	**Day or Night** Call WI 5-5022 and give necessary information.
Marathon Oil Company (KFG-96)	**Day or Night** Call WI 5-2331 and give necessary information.
Smith-Douglass Company, Inc.	**Day or Night** Call WI 8-1691 and give necessary information.
Texas City Refining, Inc. (KFG-92)	**Day or Night** Call WI 5-4451 and give necessary information.
Texas City Terminal R.R. Company	**Days** Call WI 5-4461 and give necessary information. **Nights** Call WI 5-5011 or WI 5-5311 and give necessary information.

U. S. Coast Guard	**Day or Night** Call Galveston SO 3-1635 and give necessary information.
Union Carbide Company (KFG-98)	**Days** Call WI 5-7411, Ext. 409 or 491, and give necessary information **Nights** Call WI 5-7411 and give necessary information.

LISTS OF FIRE, SAFETY, AND MECHANICAL EQUIPMENT

AMERICAN OIL COMPANY

Fire Equipment

50 - 50′ lengths	– 2½″ fire hose with NST
12	– Adjustable straight stream and fog nozzles
3	– National D-25 foam generators (dual powder) complete with 4″ mixing hose, Siamese and nozzles
1	– 52′ National hydraulic foam tower
2	– Goose neck foam maker chambers for hydraulic tower (mechanical and chemical)
300 - 50 lb. cans	– National "A" foam powder
300 - 50 lb. cans	– National "B" foam powder
500 - gallons	– National 3% foam liquid

Safety Equipment

2	– All-purpose canister gas masks
4	– Self-contained air paks (15-minute approval, recharging equipment available)
80	– Wool blankets
1	– Stokes metal splint stretcher

AMOCO CHEMICALS CORPORATION

Safety Equipment

6	– Self-contained air masks
1	– Resuscitator

MONSANTO COMPANY

Fire Equipment

2,000′	– 2½″ fire hose NST couplings
5	– 2½″ adjustable straight stream and fog nozzles
10	– 2¼″straight stream nozzles (1¼″ tips)
2	– 1½″ mechanical foam nozzles with pick up tubes.
500 - gallons	– Mechanical foam 6% National "99" for alcohol, ether, esters, etc.

1	– Portable dual foam generator complete with 4" mixing hose, Siamese and nozzle.
200 - cans	– "A" foam powder (10,000) lbs.
200 - cans	– "B" foam powder (10,000) lbs.
2	– 2½" mechanical foam nozzles with pick up tubes.

Safety Equipment

8	– Wool blankets
4	– U. S. Army canvas stretchers
1	– Stokes metal splint stretcher
4	– All-purpose canister masks
1	– Fresh air hose mask without blower
1	– Fresh air hose mask complete with hand-operated blower
1	– Pneophore assembly complete – 40 cu. ft. capacity cylinder (to be used for giving oxygen)
6	– Air line respirators
2	– Chemox oxygen breathing apparatus (12 canisters).

MARATHON OIL COMPANY

Available Fire Equipment And/Or Supplies

1	– 500 gpm Chrysler fire pump mounted on trailer
2	– Hydraulic foam towers for mechanical foam
6	– 150 lb. dry powder wheeled extinguishers
1,000'	– 2½" fire hose, NST couplings
2	– 30-minute self-contained air paks
120 - 5 gal. cans	– Mechanical foam 3% (600 gallons).

SMITH-DOUGLASS COMPANY, INC.

Available Fire Equipment And/Or Supplies

300'	– 2½" fire hose, NST
1	– Adjustable straight stream and fog nozzle
1	– First-aid kit complete – additional equipment as needed.
2	– Basket stretchers with blankets
2	– All-purpose gas masks
1	– Pickup truck or station wagon to be used as needed.

TEXAS CITY FIRE DEPARTMENT

Fire Equipment

3	– Bean high pressure trucks
4	– 750 gpm – GMC pumpers
1	– 750 gpm International (pumper)
1,000′	– 1½″ hose, NST
8,000′	– 2½″ hose, NST
2,300′	– ¾″ and 1″ booster hose
10	– Gas masks (smoke)
4	– Self-contained air paks
3	– Portable electric generators (1500 Watt) 2-DC; 1-AC
4	– Portable floodlights
1	– Resuscitator
8 - 15 lb.	– Carbon dioxide extinguishers
6 - 15 lb.	– Dry powder extinguishers.

TEXAS CITY REFINING, INC.

Fire Equipment

250 - cans	– "A" foam powder
250 - cans	– "B" foam powder
40 - cans	– Single foam powder
300′	– 2½″ fire hose, NST
150′	– 1½″ fire hose, NST
2	– 2½″ adjustable straight stream and fog nozzles.
2	– 2½″ deluge guns (2-way)
2	– 2½″ Wyes (1½ x 1½)
2	– 2½″ straight stream nozzles
3	– Single powder foam hoppers
3 - 350 lb.	– Dry powder extinguishers (wheeled)
300 - pounds	– Dry powder
4	– Spare nitrogen cylinders for 350 lb. extinguisher
1	– Hydraulic (single powder) foam tower.

Safety Equipment

12 - pair	– Seiberling Neoprene Gloves – sizes 10 and 11
2	– Asbestos suits
2	– Air masks and blowers with hose
2	– All-purpose gas masks
2	– 30-minute self-contained air paks with extra cylinders.

TEXAS CITY TERMINAL RAILROAD

Fire Equipment

100 - gallons	– 3% foam liquid
1	– 1½" mechanical foam nozzle with pick up tube.

UNION CARBIDE COMPANY

Fire Equipment

200 - 50 lb. cans	– National "99" foam powder (alcohols, Ketones, etc.)
1,000'	– 2½" fire hose, NST
1,000'	– 1½" fire hose, NST
1	– Foam generator (1050 gpm capacity) for "99" powder foam
4	– 2½" straight stream nozzles
4	– 2½" adjustable straight stream and fog nozzles
4	– 1½" adjustable straight stream and fog nozzles
1	– Asbestos suit
3 - pair	– Asbestos gloves
2	– 2½" double female couplings, NST
1	– 2½" x 1½" x 1½" Siamese couplings, NST
6 - 15 lb.	– CO_2 extinguishers

Safety Equipment

6	– All-service gas masks
12 - each	– Spare all-service gas masks canisters
12	– Industrial gas masks (any type canister)
12 - each	– Spare canisters for industrial gas masks for protection against any of the following gases or vapors: acid gases, organic vapors

		acid gases and organic vapors, ammonia or chlorine
6	–	Blankets
6	–	Stretchers.

TEXAS CITY CIVIL DEFENSE ORGANIZATION

Safety Equipment

3	–	New oxygen breather masks (for use in toxic chemical or toxic sewer emergencies). This type will run 1 hour to a can of chemical breathing material.
19	–	Cans of chemical breathing material which will run 19 hours of actual use in the oxygen breather masks.
24	–	New gas masks, for use in heavy smoke areas, or chemical areas which dissipate gases in the same category as mustard gas or chemical warfare. (Note also that 79 other masks of this type are available within the city-at present assigned to Fire and Police Departments)
50	–	New cots for emergency use.
140	–	New wool blankets, for use in rescue, fire, exposure, explosion, and hurricane.
34	–	Emergency medical kits for nerve gas victims only.
1	–	Rescue truck, for use in high water emergencies, etc., which is maintained through the auspices of the Texas City Fire Department.

Services Available

COMMUNITY PUBLIC SERVICE COMPANY

Electrical assistance and emergency personnel for public service power lines:

Call WI 5-2386

HOUSTON NATURAL GAS CORPORATION

and

HOUSTON PIPE LINE COMPANY

Emergency personnel and equipment to care for failure in public service gas lines:

Call	Office	Home
J. S. Sullivan	WI 5-4471	WI 5-9331
E. B. Langford	WI 5-4471	WI 5-7317

TEXAS CITY TERMINAL RAILROAD

When it is feasible to move railroad equipment that is endangered in an emergency, equipment and personnel will be made available to move the same to a safer location.

Call WI 5-5311

APPENDIX V

PROCEDURE OF MEDICAL COORDINATION COMMITTEE
Chairman – Dr. R. E. Joyner – Union Carbide Chemicals Company

I. PROCEDURE AT SCENE OF EMERGENCY

A. If plant physician is employed:

1. The physician would follow his present standard operating procedure – survey the situation and make request for whatever medical service is required and would attach medical tags to victims.

B. In cases where no plant physician is available, the person in authority should evaluate the disaster as follows:

1. How many persons are injured?
2. What type of injury?
3. Are they transportable? If yes – how many?
4. Medical personnel needed immediately at site?
5. What special medical supplies are needed at site?

This information should be given to the physician normally called and also to the IMAS chairman or the chairman of the Medical Coordinating Committee as quickly as possible.

II. FIRST AID STATIONS

A. Plant first aid stations or dispensaries.

B. Doctors' offices, clinics, or other necessary facilities depending on the nature and scope of situation. This is to be determined by extent of situation by plant doctor and chairman of the Medical Coordinating Committee. In event aid stations are necessary after disaster for use by rescue workers or crews, etc., the choice of the aid station would be determined by accessibility, size of rooms, availability of electricity, heat, water, and toilet facilities.

III. PROCEDURE FOR ALERTING HOSPITALS

The chairman of the Medical Coordination Committee, his assistant, or the plant doctor will alert the hospitals and give information requested in No. 1 above.

IV. PROCEDURE FOR ALERTING AMBULANCES

Upon receiving information requested in No. I, the hospitals, clinics, or the chairman of the Medical Coordination Committee will direct ambulances as required.

V. LISTING OF MEDICAL SUPPLIES AND THEIR LOCATIONS ARE AS FOLLOWS

Medical Supply chests for established First Aid Field Stations under the direction of or by a doctor are located as follows:

American Oil Company	4 Chests
City of Texas City	1 Chest
Community Public Service Company	1 Chest
Monsanto Chemical Company	2 Chests
Marathon Oil Company	1 Chest
Smith-Douglass Company, Inc.	1 Chest
Texas City Refining	2 Chests
Texas City Terminal Railway	1 Chest
Wah Chang Corporation	1 Chest
Union Carbide Chemicals Company	4 Chests

1. These chests will be retained in the locations listed and will be available for the use of any company or the Medical Committee of the IMAS.

2. In the event chests are used by any company or organization, it is understood that the user will be responsible for the immediate replacement of materials used and return of the chests to the owner or owners.

3. That the chests will be placed under constant observation within the specific locations and the use of supplies except in cases of *extreme emergency* will be discouraged. These are not First Aid chests in any sense – but *treatment chests* for DOCTORS' USE.

4. That the contents of the chest be checked periodically (at least one time per year) and that chests be resealed, keeping a permanent record of the number of the seal used.

5. Dextran in the chests has an indefinite life expectancy. Replacement should be arranged through the plant physician or the clinic, or the physician handling the plant medical work. THIS IS IMPORTANT.

6. Chests should be stored in a cool location, i.e., normal room temperature.

CONTENTS OF MEDICAL CHESTS

4 Pints	Alcohol
1 Pint	Mercresin
2 Units	Dextran
1 Dozen	Ace Bandage – 4-inch
2 Dozen	Yard square
2 x 100	4 x 4 Gauze sponge
2 x 100	2 x 2 Gauze sponge
1 x 90	2-inch roller gauze bandage
2 x 2 oz.	Sterile cotton
1 Tube	Adhesive tape – mixed cut
1 Dozen	Sterile towels (packed in threes)
1	50 ml Vial sterile H_2O
1 Package	Sterile applicator sticks
1 Dozen	Needles
2	5 ml syringe
6	2 ml Syringe
1	50 ml 1% Novocaine
1 Dozen	Identification tags and pencils (red)
	Stimulants – Coramine
	Caffeine
	Adrenalin
1 Can	Suture material
1 Quart Jar	Instruments – Thumb forceps
	Mouse tooth
	Hemostats (2)
	Needle holder
	Scissors
	Rubber tubing – 15 inches
	Dropper bottle pontacaine sol.
2	Bandage Scissors
2	Large ear bulb syringe
1	Flashlight

MEDICAL SUPPLIES AVAILABLE IN THIS AREA

Anderson and Kolb	Texas City Hospital
Magliolo Clinic	Union Carbide Chemicals Co.
Danforth Clinic	American Oil Company
Beeler-Manske Clinic	Galveston County Memorial Hospital

EMERGENCY EQUIPMENT AVAILABLE

1 - Portable water chlorinating unit	Water Department City of Texas City

APPENDIX VI

PROCEDURES FOR IMAS CHAIRMAN

I. Shall determine time and place meetings are to be called and held.

II. Shall coordinate the work of the various sub-committees and distribute information and emergency lists to all IMAS member companies.

III. Shall report to the Texas City Police Department Headquarters in case of emergency and coordinate activities incident thereto.

IV. Shall maintain liaison between the IMAS and other organizations which may function in case of emergency.

APPENDIX VII

INTERSECTION MUTUAL AID ORGANIZATION'S RECIPROCAL AID AGREEMENT TEXAS GULF COAST Adopted 4-25-61

PURPOSE:

This agreement is intended to clarify method and procedures to employ in obtaining industrial emergency aid by and from Mutual Aid Organizations listed below:

Names of Organizations

Channel Industries Mutual Aid	Houston
Texas City Industrial Mutual Aid System	Texas City
Victoria-Calhoun Counties Mutual Aid Organization	Port Lavaca
Corpus Christi Refinery-Terminal Fire Company	Corpus Christi

DEFINITIONS:

The word "subscriber" as used, means a Mutual Aid Organization.

The words "company" or "member" mean an industry belonging to, or within the area of, any Mutual Aid Organization.

METHOD:

The above subscribers agree that when an emergency occurs in an area of any individual subscriber and the local supplies are inadequate to control that emergency, the officer in charge of the affected subscriber, upon the authority of the company or member in emergency, may request fire fighting or medical supplies or equipment from another subscriber.

Where applicable, the officer in charge of the affected subscriber will inform the State Civil Defense Coordinator, through the State Highway Patrol Captain at the emergency area, of the requests made of other subscribers.

Transportation of such equipment and supplies shall be from the location of the lending subscriber to a point designated by the borrowing subscriber with the express understanding that at no time shall transportation facilities and operators be subjected to undue hazard by reason of location of destination.

RESPONSIBILITY:

A request for equipment and supplies originating from the officer in charge of the affected subscriber at the request of the member or company in emergency shall be the binding agreement between the member or company lending requested assistance, to the extent that the receiving member of the company shall make reimbursement either in cash at current prices or in kind, to the lending member or company for equipment and supplies received.

In the implementation of the Agreement, officers of Mutual Aid Organizations whose names and telephone numbers are listed below must understand that no call for assistance should be originated without the request of a responsible official of the distressed company. This entails the probability of being subpoenaed to testify concerning the authenticity of the request.

Since reimbursement for any aid furnished is to be based upon supplies and equipment received, Mutual Aid officers should advise company officials who request aid that they should make inventory and give receipts upon delivery.

LIST OF OFFICERS AUTHORIZED TO MAKE ASSISTANCE REQUESTS:

Channel Industries Mutual Aid:

Name	City	Organization	Telephone Day	Telephone Night
L. S. Buenger, Chairman	Pasadena	Diamond Alkali Company	GR 9-2301	GR 2-5017
W. T. Crouse, Vice-Chairman & Specialist	Pasadena	Rohm & Haas Company	GR 9-2861	GR 2-6150
T. C. Smith Communications Officer	Baytown	Humble Oil & Refining Co.	583-7461	583-1465
L. J. Grossheim CIMA Specialist	Houston	Shell Oil Company	GR 9-2311	WA 6-5521
Texas City Industrial Mutual Aid System:				
C. L. Gilmore, Chairman	Texas City	Monsanto Chemical Company	WI 5-4431	WI 5-6903
Carter Goodwin, Vice-Chairman	Texas City	Marathon Oil Company	WI 5-2331	WE 5-2659
K. E. Agee, Vice-Chairman	Texas City	Texas City Refining, Inc.	WI 5-4451	WI 5-2414
Victoria-Calhoun Counties Mutual Aid Organization:				
T.H. Kinney	Port Lavaca	Union Carbide Chemical Co.	(Victoria) HI 5-6411 –Ext. 234	(Victoria)[1] HI 3-2670
J. E. Ebensberger	Port Lavaca	Union Carbide Chemical Co.	(Victoria) HI 5-6411 –Ext. 413	(Victoria)[2] HI 3-7329
Corpus Christi Refinery – Terminal Fire Company:				
L. K. Grove	Corpus Christi	Great Southern Chemical Company	TU 3-9286	TE 5-0642
G. W. Stephenson	Corpus Christi	Southwestern Oil & Refining Company	TU 4-8863	TE 5-8157
R. R. Reed	Corpus Christi	Pontiac Refining Corp.	TU 2-8871	TU 4-9563
A. J. Besselman	Corpus Christi	General American Tank Storage Terminals	TU 4-5285	TU 2-4786
H. E. Ammerman	Corpus Christi	Corpus Christi Refinery Terminal Fire Company	TU 3-8062	UL 3-2135

LIST OF SUPPLIES AVAILABLE FOR LOAN THROUGH THE INTERSECTIONAL MUTUAL AID ORGANIZATION'S RECIPROCAL AGREEMENT

I. CHANNEL INDUSTRIES MUTUAL AID

1,000 lbs. - "A" foam powder
1,000 lbs. - "B" foam powder
72,000 lbs. - Single foam powder
10,000 gal. - 3% foam liquid

Dow Chemical Company

5,000 lbs. - "A" foam powder
5,000 lbs. - "B" foam powder

II. CORPUS CHRISTI TERMINAL FIRE COMPANY

37,500 lbs. - "A" chemical foam powder
37,500 lbs. - "B" chemical foam powder

III. TEXAS CITY INDUSTRIAL MUTUAL AID SYSTEM

American Oil Company

29,000 lbs. - "A" foam powder
29,000 lbs. - "B" foam powder

Monsanto Chemical Company

5,000 lbs. - "A" foam powder
5,000 lbs. - "B" foam powder
500 gal. - 6% "National 99" (alcohol) liquid

Marathon Oil Company

300 gal. - 3% Mechanical foam liquid

Texas City Refining, Inc.

16,750 lbs. - "A" foam powder
16,750 lbs. - "B" foam powder
2,000 lbs. - Single powder

Union Carbide Chemicals Company

10,000 lbs. - "National 99" (alcohol) powder

IV. VICTORIA-CALHOUN COUNTIES MUTUAL AID ORGANIZATION

Alcoa

40 gal. - Liquid foam chemical

Union Carbide Chemicals Company

200 gal. - Unox wet penetrant foam liquid

Du Pont

12,500 lbs. - "National 99" (alcohol) foam powder

APPENDIX VIII

CO-OPERATIVE AGREEMENT

I. PARTIES TO THE AGREEMENT

(A) Texas City Industrial Mutual Aid
F. A. Randall, Chairman
C. L. Gilmore, Alternate Chairman
J. M. Eason, Alternate Chairman
H. B. Williams, Secretary

(B) Gulf Area Water Works and Sewerage Association
Allan Wood, President
Guy Wilkinson, Secretary-Treasurer
H. D. Winkler, Program Chairman

II. PURPOSE

(A) The Texas City Industrial Mutual Aid System agrees to serve only as communication liaison between the Gulf Area Water Works and Sewerage Association and Texas City industries to transmit messages through its system of communications within the industrial complex, requesting assistance in the form of heavy hoisting equipment, gasoline power units, compressors, etc., during emergencies.

(B) The Gulf Area Water Works and Sewerage Association, because of the strategic locations of its sources of potable water, can supply drinking water to Texas City industries during emergencies which cause contamination of normal supply sources.

III. UNDERSTANDING

PARTIES TO THIS AGREEMENT understand that when emergency requests are made by authorized officers of either party for assistance, diligent effort will be exercised toward compliance, however, this agreement does not constitute a binding contract upon either party.

IV. REIMBURSEMENT

PARTIES TO THIS AGREEMENT understand that reimbursement for equipment and/or service supplied shall be incumbent upon the individual member requesting available assistance and the same shall be made promptly, directly to the supplying member.

Neither party to this agreement shall be held liable for costs of equipment and/or supplies delivered by request of any one of its members.

This agreement may be cancelled by written notice from either party.

Signed on this 6th day of September 1962

(SIGNED) F.A. RANDALL

FOR PARTY A – Texas City Industrial Mutual Aid System

(SIGNED) ALLAN WOOD

FOR PARTY B – Gulf Area Water Works and Sewerage Association

APPENDIX D

HANDLING OF CHEMICAL SPILLS IN PUBLIC WATERS

Amoco Chemicals Corporation
Texas City, Texas

HANDLING OF CHEMICAL SPILLS IN PUBLIC WATERS
PLANT ADMINISTRATIVE BULLETIN

Purpose

To minimize contamination of public waters by spills of chemicals in or adjacent to public waters and to provide a reporting procedure to be followed by plant supervisors and management in reporting such spills.

I. Materials and Equipment

A. The Texas City industrial complex has mutually provided certain materials and equipment and has call on other materials and equipment to minimize public waters contamination by a spill of chemicals and/or hydrocarbons. The equipment consists of:

2450 feet of slickbar oil boom (in sections) stored at the docks

Kidde-Hi ex foam generator (stored in City Fire Station #1)

Catamaran equipped with polyurethane foam oil extraction device (available from American Oil)

Boats for placing slickbar, etc. (Texas City Boatman's Association)

Vacuum trucks to pick up spill (Malone and Weeren)

B. The Company maintains the following equipment to contain and remove small spills:

200 feet of floating boom

2 barrels dispersant

25 bales of straw

life jackets (available at docks)

hand tools as needed from warehouse

II. Procedure to Follow

A. In case of a spill at any dock area or adjacent public waters, the person discovering the spill shall notify the process supervisor in charge of the source unit to initiate corrective action, if this is not already in progress. If he cannot locate the unit supervisor quickly, he will contact the night superintendent or operations supervisor, as appropriate.

B. The process supervisor or his representative shall notify one of the following, in the following preference order:

1. Superintendent, Operations

2. Operating Supervisor, Process II

3. Operating Supervisor, Process I

Note: The engineer responsible for Air and Water Conservation at the plant should be notified as soon as possible.

C. In the event of a spill of 50 gallons or more, the process supervisor should also notify the Plant Manager, who will in turn notify the Vice President or senior executive of the department.

D. The supervisor in (B) who is contacted shall judge whether the spill is significant enough to warrant notifying the authorities. If so, he will call the following as soon as possible and advise them of the time, cause, location, type of material, hazard involved, estimated general magnitude of the spill, environmental conditions, and of the corrective measures being taken as well as people notified, and name of vessel, if any involved.

1. Mr. R. Z. Fincham
   Parks & Wildlife Department
   Office – SO2-0732 (Galveston)
   Home – 534-3384 (Dickinson)

2. Mr. John Latchford
   District Supervisor
   Texas Water Quality Board
   Office – 471-0384 (LaPorte)
   (Call during normal working hours)

3. U.S. Coast Guard
   Officer of the Day
   Phone – 713-763-1635

4. Company coordinator of Air and Water Conservation,
   Chicago office.

E. In addition, the person notified will immediately carry out the following procedures:

1. *Small Spill:*
   If the location and magnitude of the spill is such that it can be contained and removed by Company personnel and available equipment (including vacuum trucks) immediate steps should be taken to put this procedure into action.

2. *Medium Spill:*
   a. Call the Texas City Boatman's Association, giving details and securing assistance to contain the spill by use of the slickbar, if required.
   DAY – Texas City Boatman's Association
   945-3496 (days only)

   NIGHTS, HOLIDAYS, WEEKENDS
   – Troy Wright – 945-9336
   – Angelo Amoto – 948-2375

   b. If the spilled material is readily flammable (below 80° flash point such as benzene), the Kidde-Hi ex foam generator shall be secured from the Texas City Fire Department to be operated by Company personnel to cover the area of the spill with foam and minimize flash hazard.

   c. Vacuum trucks shall be secured if this method of pickup is practical.

   d. The catamaran should be secured from American Oil if that be a more practical way of picking up the spilled material. This is to be operated by the Boatman's Association.

3. *Large Spill:*

In case of a spill or any loss beyond the capabilities of local facilities, where large areas may suffer extensive contamination, the Vice President or senior executive will be notified immediately and will be responsible for directing the clean-up action.

F. Only as a last resort should a dispersant be used on the spill.

G. A report of any such spill will be prepared by the process supervisor involved, describing the occurrence, when discovered, to whom reported, the amount and type of material lost, corrective measures taken, and disposition of material if picked up. This shall be sent to the Plant Manager for information and file.

III. Press Relations

All relations with the news media will be handled locally by the Plant Manager or his designee, or the Superintendent, Industrial Relations.

IV. Objective

The objective at all times is to prevent or minimize contamination, and, also, to prevent fires. The procedure should be put into effect as soon as possible. Failure to notify the proper Federal authorities of harmful spills could result in a penalty of $10,000 fine or a year's imprisonment, or both.

Revision 1 – June 1, 1970

APPENDIX E

RESOLUTION NO. 68-65

PRESCRIBING REQUIREMENTS FOR TWENTY-ONE WASTE DISCHARGES BY CALIFORNIA AND HAWAIIAN SUGAR COMPANY INTO CARQUINEZ STRAIT NEAR CROCKETT, CONTRA COSTA COUNTY

State of California
Regional Water Quality Control Board
San Francisco Bay Region, California

WHEREAS THIS REGIONAL BOARD HAS CONSIDERED

REPORT ON WASTE DISCHARGE

1. California and Hawaiian Sugar Company, called the discharger below, filed a Report on Waste Discharge dated April 4, 1968, with this Regional Water Quality Control Board pursuant to Section 13054 of the California Water Code.

2. That report and other data describe these waste discharges as follows:

Waste "A" is about 28 mgd of industrial waste only, consisting of barometric cooling water from evaporators used in sugar refining. It is not treated and is being discharged into Carquinez Strait at a point about four feet below mean low water and about 15 feet inshore from the outer edge of the discharger's wharf, via a 24-inch pipe identified herein as Outfall "A.'

Waste "B" is about 7 mgd of industrial waste only, consisting of closed cooling water from steam turbine heat exchanger. It is not treated and is being discharged into Carquinez Strait at a point below mean low water and about 10 feet inshore from the outer edge of the discharger's wharf, via a ten-inch pipe identified herein as Outfall "B."

Waste "C" is about 4.4 mgd of industrial waste only, consisting of barometric cooling water from evaporators used in sugar refining. It is not treated and is being discharged into Carquinez Strait at a point above mean low water and about 40 feet inshore from the outer edge of the discharger's wharf, via a 14-inch pipe identified herein as Outfall "C."

Waste "D" is about 3 mgd of industrial waste only, consisting of barometric cooling water from evaporators used in sugar refining and sodium carbonate cleaning chemical; sodium carbonate cleaning solution is added one day each 14 days. It is not treated and is being discharged into Carquinez Strait at a point about 4 feet below mean low water and about 14 feet inshore from the outer edge of the discharger's wharf, via a 14-inch pipe identified herein as Outfall "D."

Waste "E" is about one mgd of industrial waste only, consisting of filter backwash and process tank cleaning waste. It is not treated and is being discharged into Carquinez Strait at a point below mean low water and about 15 feet inshore from the outer edge of the discharger's wharf, via a 14-inch pipe identified herein as Outfall "E."

Waste "F" is about 0.78 mgd of industrial waste only, consisting of waste from bone char de-ashing column. It is not treated and is being discharged into Carquinez Strait at a point above mean low water and about 50 feet inshore from the outer edge of the discharger's wharf, via a 10-inch pipe identified herein as Outfall "F.'

Waste "G" is about 0.5 mgd of industrial waste only, consisting of barometric cooling water from evaporators used in sugar refining. It is not treated and is being discharged into Carquinez Strait at a point about 4 feet below mean low water and about 25 feet inshore from the outer edge of the discharger's wharf, via a 14-inch pipe identified herein as Outfall "G."

Waste "H" is about 0.5 mgd of industrial waste only, consisting of closed cooling water, boiler blow down, effluent from silica reactor, and effluent from ion exchanger backwashing; ion exchanger backwashing operates one in 7 days. It is not treated and is being discharged into Carquinez Strait at a point above mean low water and about 25 feet inshore from the outer edge of the discharger's wharf, via a 10-inch pipe identified herein as Outfall "H."

Waste "I" is about 15,000 gpd intermittent industrial waste only, consisting of rail car washings and steam rack waste. It is treated by a trap for oil and grease removal and is being discharged into Carquinez Strait at a point above mean low water and about 30 feet inshore from the outer edge of the discharger's wharf, via an 18-inch pipe identified herein as Outfall "I."

Waste "J" is about 6,000 gpd intermittent industrial waste only, consisting of waste from washing trucks used for carrying processed sugar. It is not treated and is being discharged into an unnamed creek west of the discharger's plant, via a ditch identified herein as Outfall "J"; the waste flows about 250 feet to Carquinez Strait.

Waste "K" is about 13,000 gpd of intermittent industrial waste only, consisting of magnesium chloride cleaning solution and sulfamic acid. It is not treated and is being discharged into Carquinez Strait at a point above the surface and about 120 feet inshore from the outer edge of the discharger's wharf, via a 10-inch pipe identified herein as Outfall "K.'

Waste "L" is about 300 gpd of industrial waste only, consisting of waste containing traces of battery acid and grease from discharger's garage. It is not treated and is being discharged into Carquinez Strait at a point above the surface and about 75 feet inshore from the outer edge of the discharger's wharf, via a 4-inch pipe identified herein as Outfall "L."

Waste "M" is about 200 gpd of intermittent industrial waste only, consisting of waste from laboratory. It is not treated and is being discharged into Carquinez Strait at a point above the surface and about 50 feet inshore from the outer edge of the discharger's wharf, via a 4-inch pipe identified herein as Outfall "M.'

Waste "N" is about 150 gpd of intermittent industrial waste only, consisting of filter press leaf cleaning with sulfamic acid, hydrochloric acid and hydrofluoric acid solution. It is not treated and is being discharged on alternate days into Carquinez Strait at a point above the surface and about 50 feet inshore from the outer edge of the discharger's wharf, via a 3-inch pipe identified herein as Outfall "N.'

Waste "O" is industrial waste only, consisting of runoff from the discharger's plant and storage area. It is not treated and is being discharged into Carquinez Strait at a point above the surface and about 30 feet inshore from the outer edge of the discharger's wharf, via a 10-inch pipe identified herein as Outfall "O."

Waste "P" is industrial waste only, consisting of runoff from the discharger's plant and storage area. It is not treated and is being discharged into Carquinez Strait at a point above the surface and about 50 feet inshore from the outer edge of the discharger's wharf, via an 8-inch pipe identified herein as Outfall "P."

Waste "Q" is less than 100 gpd of intermittent industrial waste only, consisting of roof runoff and soda tank washings. It is not treated and is being discharged into Carquinez Strait at a point above the surface and about 120 feet inshore from the outer edge of the discharger's wharf, via a 4-inch pipe identified herein as Outfall "Q."

Waste "R" is about 30,000 gallons each two weeks of intermittent industrial waste only, consisting of sand filter backwash. It is not treated and is being discharged one day each 14 days into Carquinez Strait at a point above the surface and about 50 feet inshore from the outer edge of the discharger's wharf, via a 10-inch pipe identified herein as Outfall "R."

Waste "S" is about 9,000 gpd of industrial waste only consisting of miscellaneous refinery washings. It is not treated and is being discharged into Carquinez Strait at a point above the surface and about 50 feet inshore from the outer edge of the discharger's wharf, via a 4-inch pipe identified herein as Outfall "S.'

Waste "T" is less than 100 gpd of intermittent industrial waste only consisting of wash-water from the wharf. It is not treated and is being discharged into Carquinez Strait at a point above the surface and about 15 feet inshore from the outer edge of the discharger's wharf, via a 4-inch pipe identified herein as Outfall "T."

Waste "U" is about 200 pounds of raw sugar each five days, and is washed from unloading conveyors by immersing them in the Strait at the edge of the wharf.

CORRESPONDENCE

The Regional Board has considered recommendations about this matter from:

State Department of Fish and Game in its memorandum dated August 15, 1968

State Department of Water Resources in its memorandum dated August 6, 1968.

STAFF INVESTIGATION

1. These wastes can affect the following present beneficial water uses in Carquinez Strait and contiguous water bodies:

Industrial cooling water supply year-round

Water-skiing, pleasure boating, marinas, fishing, and hunting

Fish and wildlife propagation and sustenance, and waterfowl and migratory birds habitat and resting

Esthetic appeal.

2. Land within 1000 feet of the Outfall is used for residence, industry, and transportation.

RESOLVED BY THIS REGIONAL BOARD

BOARD INTENT

1. Protect public health as it may be affected by this waste discharge.

2. Prevent nuisance, as defined in Section 13005 of the California Water Code.

3. Recognize waste disposal, dispersion, and assimilation as economic beneficial water uses which shall be regulated to protect other beneficial water uses.

4. Protect the beneficial water uses listed under "Staff Investigation," above.

WASTE DISCHARGE REQUIREMENTS – RECEIVING WATERS

The discharge of these wastes shall not cause:

1. Atmospheric odors recognizable as being of waste origin at any place outside the discharger's property.

2. Unsightliness, odors, nor damage to any of the protected beneficial water uses resulting from:

   Floating, suspended, or deposited macroscopic particulate matter, foam, oil, or grease in waters of the State at any place; floating oil shall be considered present if in enough quantity to cause iridescence;

   Bottom deposits at any place outside the discharger's wharf;

   Aquatic growths at any place outside the discharger's wharf;

3. Temperature, turbidity or apparent color beyond present natural background levels in waters of the State at any place outside the discharger's wharf.

4. Waters of the State to exceed the following limits of quality at any place outside the discharger's wharf:

pH	7.0, minimum 8.5, maximum
Dissolved oxygen	5.0 mg/l, minimum

Any one or more substances in concentration that impair any of the protected beneficial water uses or make aquatic life or wildlife unfit for consumption.

WASTE DISCHARGE REQUIREMENTS – WASTE STREAMS

The wastes as discharged shall meet these quality limits at all times:

1. In any grab sample:

   Settleable matter in Wastes "A," "B," "C," "D," and "G" shall not exceed that in the discharger's intake water from Carquinez Strait, and settleable matter in the other wastes shall not exceed:

The arithmetic average of any six or more samples collected on any day	0.5 ml/1/hr, maximum
80% of all individual samples collected during maximum daily flow over any 30-day period	0.4 ml/1/hr, maximum
Any sample	1.0 ml/1/hr, maximum

2. In any representative, 24-hour composite sample:

   5-day, 20°C BOD removal shall be sufficient to maintain the dissolved oxygen concentration prescribed above, but BOD removal is not required to exceed:

Average, during any 21 or more days	90%
Not more than two consecutive daily determinations shall indicate BOD removals less than	80%

3. The discharge of Wastes "D" and "E" shall not cause the waters of Carquinez Strait at any point outside the outer edge of the discharger's wharf to exceed the following limit of quality:

Toxicity: the concentration of the waste itself in the receiving waters	10 percent of the 96-hour TL_m concentration of the waste as discharged maximum;

The discharger may use the following as an optional alternate to the toxicity requirement on Wastes "D" and "E" prescribed above:

Toxicity: survival of test fishes in 96-hour bioassays of the wastes as discharged	
Any sample	75%, minimum
Average of any three or more consecutive samples collected during any 21 or more days	90%, minimum

4. In any sample of Wastes "F," "H," "K," "M," "N," "Q," and "S."

Toxicity: survival of test fishes in 96-hour bioassays of the wastes as discharged	
Any sample	75%, minimum
Average of any three or more consecutive samples collected during any 21 or more days	90%, minimum

OTHER REQUIREMENTS AND CONDITIONS

1. If the discharger elects the toxicity requirement limiting the concentrations of Wastes "D" and "E" in the waters of Carquinez Strait, instead of the optional toxicity requirement on those wastes themselves, this Board requires him to file a written report on the dilution of those wastes which is achieved at the offshore edge of his wharf under the least favorable tidal and/or current conditions. That report shall be based upon actual observations as part of a study for which specifications shall be developed pursuant to the Board's Resolution No.398.

2. This Resolution includes items numbered 1, 2, 3, 4, 5, 6, 8, and 11 of the attached "Requirements and Conditions" dated October 2, 1968.

JEROME B. GILBERT
Chairman

December 18, 1968

I, Fred H. Dierker, hereby certify that the foregoing is a true and correct copy of Resolution No. 68-65 adopted by the Regional Water Quality Control Board of Region No. 2 at its regular meeting on December 18, 1968.

FRED H. DIERKER
Executive Officer
REGIONAL WATER QUALITY CONTROL
BOARD NO. 2

APPENDIX F

INDUSTRIAL SPILLS AND HAZARD ALERT PROCEDURES

Department of Natural Resources
Division of Water Resources
State of West Virginia

STATE OF
WEST VIRGINIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RESOURCES
1709 WASHINGTON ST., EAST - CHARLESTON 1. W. VA. - TEL.: 343-4411, EXT. 2107

STATE WATER RESOURCES BOARD

INDUSTRIAL SPILLS AND HAZARD ALERTS

SECTION I

RECORD OF INDUSTRIAL REPORT
(APPLICABLE ANYWHERE IN STATE)

NAME OF REPORTING COMPANY ____________________

LOCATION (CITY ____________________ (RIVER BASIN) ____________________

PERSON REPORTING (NAME) ____________________ (TITLE) ____________________

DATE REPORTED ____________________ TIME REPORTED ____________________

SPILL STARTED (DATE) ____________________ (TIME) ____________________

SPILL STOPPED (DATE) ____________________ (TIME) ____________________

NAME OF MATERIAL SPILLED ____________________

QUANTITY OF UNDILUTED MATERIAL LOST ____________________ POUNDS

SOLUBILITY ____________________ SPECIFIC GRAVITY ____________________

RIVER CONCENTRATION ____________________

CAUSE OF SPILL ____________________

____

____

ACTION TAKEN TO STOP SPILL AND PREVENT RECURRANCE ____________________

____

____

____

RIVER FLOW (CFS) ____________________ RIVER GAGE (LOCATION) ____________________

ESTIMATED RIVER VELOCITY ____________________ MILES/HOUR

ESTIMATED TIME OF ARRIVAL AT (LOCATION) ____________________ WATER PLANT

HAZARD ESTIMATE

TOXICITY TO HUMANS ______________________________

____

TOXICITY TO FISH ______________________________

____

TASTE AND ODOR ______________________________

____

NUISANCE ______________________________

____

COMPANY'S RECOMMENDATION FOR SAFEGUARDING PUBLIC WATER SUPPLIES (IF SAFEGUARDS ARE NEEDED) ______________________________

____

____

____

COMPANY'S PLAN FOR MONITORING (SAMPLING & ANALYSIS), IF DEEMED NECESSARY ______________________________

____

____

____

____

____

COMMENTS (INDICATE HERE IF SIGNIFICANCE OF SPILL WAS NOT GREAT ENOUGH TO WARRANT NOTIFICATION OF OTHER AGENCIES). ______________________________

____

____

____

____

STATE WATER RESOURCES DIVISION REPRESENTATIVE TAKING REPORT ______________________________

____
(SIGNATURE)

STATE OF
WEST VIRGINIA

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RESOURCES

1709 WASHINGTON ST., EAST - CHARLESTON 1, W. VA. - TEL.: 343-4411, EXT. 2107

STATE WATER RESOURCES BOARD

INDUSTRIAL SPILLS AND HAZARD ALERTS

SECTION II

PART B

REPORT OF IMMEDIATE ACTION BY THE STATE WATER RESOURCES COMMISSION ON INDUSTRIAL SPILLS OCCURRING IN AREAS OUTSIDE THE KANAWHA RIVER.

I. CHECK RIVER CONCENTRATION

QUANTITY OF MATERIAL SPILLED ______________________ POUNDS

GAGE HEIGHT ______________ FEET AT (LOCATION) ______________

(INFORMATION FROM WHATEVER SOURCE AVAILABLE; I.E., LOCKMASTER, USGS, THE REPORTING INDUSTRY OR OTHER SOURCE)

A. RIVER FLOW FROM RATING TABLE, REPORTING INDUSTRY OR FROM U.S.G.S.,

______________________________________ CFS

B. RIVER FLOW IN POUNDS PER HOUR

(3,600 x 62.4) x (A) ______________ = ______________ LB/HR

C. MATERIAL SPILLED IN POUNDS PER HOUR

QUANTITY SPILLED ______________ LB
DURATION OF SPILL ______________ HRS
= ______________ LB/HR

D. RIVER CONCENTRATION

(C) ______________ LB/HR
(B) ______________ LB/HR
x 1,000,000 = ______________ PPM

II. ESTIMATED ARRIVAL TIME AT NEAREST WATER PLANT

A. RIVER FLOW FROM I. A. ABOVE = ______________________ CFS

MILE POINT OF SPILL = ______________________ MILES

SUBTRACT MILE POINT OF NEAREST WATER PLANT = ______________________ MILES

B. Miles between spill and water plant = ______________________ miles

C. If river velocity data are available find average velocity in river

reach ______________________ mph/1,000 cfs

D. Time required to travel to water plant

$$\frac{1{,}000 \times (B)\_\_\_\_\_\_}{(C)\_\_\_\_\_\_ \times (A)\_\_\_\_\_\_} = \_\_\_\_\_\_\_\_\_\_ \text{ hrs}$$

III. Notification

A. Case I (Fish Kill)

1. Notify Fish Division if fish kill develops (Ext. 2786); or Law Enforcement Division (Ext. 2784)

Time notified ______________, Date notified ______________

Check name of person notified:

( ) Ed Kinney, Res. DI 6-2256

( ) Ray Clemens, Res. WA 5-7907

( ) Robert Leeson, Res. WI 9-2247

( ) Allen Woodburn (Do not call residence)

2. If Interstate problem in Ohio Basin notify ORSANCO (Cincinnati, Garfield 1-1151)

Time notified ______________, Date notified ______________

Person notified ______________________________

In Potomac Basin, notify Potomac River Commission (Washington, D.C., Executive 3-1978 or 3-1979)

Time notified ______________, Date notified ______________

Person notified ______________________________

3. If fish kill develops notify Sanitary Engineering Division

Time notified ______________, Date notified ______________

Check name of person notified:

( ) John Millar, Ext. 2970

( ) G. O. Fortney, Ext. 2981

( ) Ray Lyon, Ext. 2983

B. CASE II (TASTE & ODOR ONLY)

1. NOTIFY SANITARY ENGINEERING DIVISION

TIME NOTIFIED________________, DATE NOTIFIED______________________

CHECK NAME OF PERSON NOTIFIED:

( ) JOHN MILLAR, EXT. 2970

( ) G. O. FORTNEY, EXT. 2981

( ) RAY LYON, EXT. 2983

2. IF INTERSTATE PROBLEM

IN OHIO BASIN, NOTIFY ORSANCO (CINCINNATI, GARFIELD 1-1151)

TIME NOTIFIED________________, DATE NOTIFIED______________________

PERSON NOTIFIED____

IN POTOMAC BASIN, NOTIFY POTOMAC RIVER COMMISSION (WASHINGTON, D.C., EXECUTIVE 3-1978)(OR 3-1979)

TIME NOTIFIED________________, DATE NOTIFIED______________________

PERSON NOTIFIED____

C. CASE III (TOXICITY)

1. IMMEDIATELY NOTIFY SANITARY ENGINEERING DIVISION

TIME NOTIFIED________________, DATE NOTIFIED______________________

CHECK NAME OF PERSON NOTIFIED

( ) JOHN MILLAR; OFF: EXT 2970, RES: DI 2-3060

( ) G. O. FORTNEY; OFF: EXT 2981, RES: WA 5-1418

( ) RAY LYON; OFF: EXT 2983, RES: PA 7-3635

2. IF INTERSTATE PROBLEM

IN OHIO BASIN, NOTIFY ORSANCO (CINCINNATI, GARFIELD 1-1151)

TIME NOTIFIED________________, DATE NOTIFIED______________________

PERSON NOTIFIED____

IN POTOMAC BASIN, NOTIFY POTOMAC RIVER COMMISSION (WASHINGTON, D.C., EXECUTIVE 3-1978 OR 3-1979)

TIME NOTIFIED________________, DATE NOTIFIED______________________

PERSON NOTIFIED____

D. CASE IV (NUISANCE)

PERSON NOTIFIED____________________DEPARTMENT____________________

TIME NOTIFIED____________________, DATE NOTIFIED____________________

3. REMARKS, INCLUDING SUMMARY OF ACTION TAKEN BY SANITARY ENGINEERING DIVISION____________________

IV. ATTACH ADDITIONAL REMARKS, REPORT OR FOLLOW-UP ACTION, MEMOS, CORRESPONDENCE, FISH KILL REPORTS, LABORATORY DATA AND OTHER INFORMATION.

SIGNATURES: