10

TCR - TETRA UNIT

OPERATING MANUAL

CONFIDENTIAL:
Subject to Protective Order
of 14th Judicial District Court
No. 91-1145

MANUAL NO. 21

TABLE OF CONTENTS

CHEMICALS IN THE TCE-TETRA PLANT

Name	Abbreviation
Azobisisobutyronitrile	AIBN
Betz Cooling Tower Additive 2020	
Betz Cooling Tower Additive 2040	
Betz Cooling Tower Additive J-12	
Calcium Chloride	$CaCl_2$
Carbon Tetrachloride	CCl_4
Soda Ash	
Chlorine	Cl_2
Chloroform	$CHCl_3$
Cis 1,2-Dichloroethylene	Cis-DCE
Ethylene	C_2H_4
Ethylene Dichloride	EDC
Hexachloroethane	
Hydrogen Chloride	HCl
Nitrogen	N_2
Pentachloroethane	PCE
Perchloroethane	
Sulfuric Acid	
Symmetrical & Assymmetrical Tetrachloroethane	SteCE & ATeCE
Trichloroethane 1,1,2	TCE
Trichloroethylene	TRI
Vinylidene Chloride	VDC

SAFETY SECTION FOR TCE AND TETRA

INTRODUCTION: This section is written to cover the safety rules and precautions which must be adhered to while working in the TCE-Tetra area. It is worthwhile to spend some time on the more general topic of workers attitude. The development of a safe operating plant and a work force of people who are safety conscious is based on the attitude of the people involved. Our attitude must be positive--we must continually strive to do things safely. Our work must include continually looking for safer ways to do things. We must learn to care and watch out for others working with us. I may be aware of a safety hazard, but unless I correct the safety problem or properly warn all others of the problem, I have not done my job. Safety is a continuing and vitally necessary part of every job we perform. We must recognize our responsibility, use our powers of observation and preception to seek out safety hazards and act to get problems solved. Each one of us must TAKE AN ACTIVE PART.

I. SAFETY FOR THE TCE-TETRA UNIT

A. GENERAL

Due to the nature of the operations and the chemicals involved, the TCE Plant is restricted to authorized personnel only.

Company vehicles will be permitted to travel the roads skirting the plant area during normal operations. Special permits will be required for vehicles to enter any of the other areas in this plant.

Never cross a barricade, regardless of whether it is up or down, with a vehicle without a pass. Passes for vehicles will be issued by the operating supervision or lead operators of the area. All passes are immediately revoked if the Plant B evacuation whistle sounds. If you are operating a vehicle and the emergency horns sound, shut down the vehicle and evacuate the area as quickly as possible on foot. A new pass will be issued to remove the vehicle.

The control room and electrical starter rooms are pressurized for safety precautions; therefore, they are to be utilized by authorized personnel only. The doors and windows must be kept closed.

B. RULES

The following list of general safety rules is applicable to the TCE-Tetra area. They are to be used in conjunction with the Employee's Safety Manual until further revisions are made.

The TCE-Tetra area is included in Zone No. 17 in the present zone system along with OHC. The directional center is located inside the door of the Plant B Maintenance Shop.

SL 001085

1. Personnel entering the Organics area will deposit lighters, matches, regular flashlights, etc., at the gate to this area.

2. Smoking will be permitted in the control room only. Permanent lighters will be supplied at this location.

3. The usual safety equipment will be required in the organics area, which is:

   a. Safety hats

   b. Chemical goggles (safety glasses under goggles are optional)

   c. Respirators

   d. Plastic-coated gloves

4. The established plant tagging procedure will apply in the organics area.

5. A vehicle permit signed by the operating supervisor or lead operator will be required before any vehicle is allowed to enter an area.

6. An appropriate work permit, signed by the operating supervisor, will be required before the following equipment may be carried into the organics area:

   a. Welding machines

   b. Cutting torches

   c. Electrically driven drills

   d. Any electrical equipment, except explosion-proof flashlights

7. Only explosion-proof flashlights will be permitted in the organics area.

8. Regular plant utility hoses are not to be used for handling organics. For organics, use Teflon-lined hoses equipped with proper quick-connect fittings and bleed-off valves.

9. All light circuits outside the control building must be off and tagged out before relamping of the area.

10. Do not dump flammable organics into trapped sewers or openings where harmful vapors could be evolved.

11. Do not leave an open sample or container of organics sitting around to give off vapors.

12. Use full face or Scott air-pak masks for protection against organic vapors.

13. Do not trap liquid chlorine in the vaporizer or surge drums.

14. Clothing which has been wet with organics should be removed immediately and the body thoroughly washed with soap and water. These clothes should be properly laundered before they are used again.

15. Do not permit air to enter any of the process equipment which contains organics.

16. In case of an emergency warning, all vehicles and equipment in the area on permits will be shut off immediately.

17. All steam-out nozzles or hose and purge equipment must be properly grounded to prevent the possibility of an arc from accumulated static charge.

18. Do not permit chlorine to be heated above 300°F due to decomposition and reaction with metals.

19. No smoking or open flames will be allowed in the control laboratory or behind the control boards.

20. Always put liquid organics into tanks through standlegs or through bottoms nozzles. Falling liquid can generate static electricity.

C. DEFINITIONS

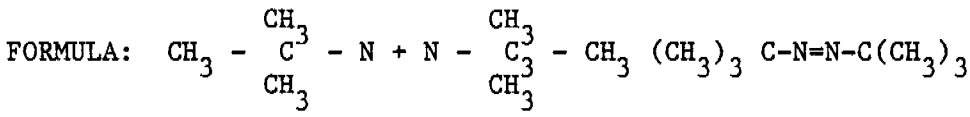
Some of the terms used in the following discussion are defined below:

1. Flash Point - The flash point of a solvent is the lowest temperature at which a vapor is given off in sufficient quantities so that the vapor-air mixture above the surface of the solvent will propagate a flame away from the source of ignition. It is the temperature below which a solvent may be used or stored in open containers without formation of an explosive vapor-air mixture.

2. Explosive Limits - When combustible vapor is mixed with air in the proper proportions, ignition will produce an explosion. The vapor-air mixture which will form this proper proportion is called the explosive range. The explosive range includes all concentrations of a mixture of flammable vapor or gas in air in which a flash will occur or a flame will travel if the mixture is ignited. The lowest percentage at which this occurs is the lower explosive limit and the highest percentage is the upper explosive limit. Explosive limits are expressed in percent by volume of vapor in air.

3. Maximum Allowable Concentration (MAC) - The maximum allowable concentration for a material is the maximum concentration of that material that can be tolerated by personnel for a continuous eight hour exposure with no ill effects.

NAME: Azobisisobutyronitrile (AIBN)

FORMULA: 

MOLECULAR WEIGHT: 142

BOILING POINT: Solid

VAPOR PRESSURE: Solid

FREEZING POINT: Solid

LIQUID DENSITY: Solid

RELATIVE VAPOR DENSITY: Solid

FLASH POINT: Unknown

EXPLOSIVE LIMITS: Unknown

MAXIMUM ALLOWABLE CONCENTRATION: Unknown

DETECTABLE ODOR CONCENTRATION: Unknown

HAZARDOUS PROPERTIES: Avoid heating AIBN in the open because if decomposes, releases nitrogen and highly toxic by-products. AIBN should be stored at temperatures not exceeding 75°F.

It is classified as a flammable solid. Solid material in bulk form will not detonate or explode on impact nor can it be ignited by an instantaneous electrical spark. Self-heating begins in sealed fiber drums to about 120°F with monetary ignition and mild explosion occurring as the temperature reaches 140°F. Dry, solid AIBN can be ignited readily with an open flame or a continuous electrical arc. AIBN dispersions in air are explosive.

NAME: Betz Additives (Cooling Tower Water Treatment Chemicals)

The Betz additives are all harmful if swallowed. Most can cause skin burns and eye irritations. Further, the vapors from some are harmful. Do not get into eyes, on skin or clothing, or inhale. Wear goggles, or face mask, and rubber gloves when handling. In case of contact with skin, wash well with soap and water. In case of contact with eyes, flush promptly and thoroughly with clear water. In case of ingestion or contact with eyes, secure immediate medical attention. Do not mix chemicals.

NAME: Calcium Chloride

FORMULA: $CaCl_2$

MOLECULAR WEIGHT: 110.99

BOILING POINT: 1600°C

MELTING POINT: 772°C

SOLUBILITY IN WATER: 59.5 parts $CaCl_2$/100 parts H_2O at 9°C
347 parts $CaCl_2$/100 parts H_2O at 260°C

DENSITY: 2.512 g./cc. at 25°C

RELATIVE VAPOR DENSITY: Normally a solid

FLASH POINT: None

EXPLOSIVE LIMITS: None

HAZARDOUS PROPERTIES: Generally speaking, calcium compounds should be considered toxic only when they contain a toxic component (such as arsenic, etc.) or as calcium oxide or hydroxide.

The hydration of the anhydrous salt is exothermic (21.7 cal/mole to form the hexahydrate). Thus, when driers are being flushed out with water there is the possibility of heat and some splashing which may carry $CaCl_2$ solution into the operator's eyes. If $CaCl_2$ solution enters the eye(s), a sustained water flush will be most effective in removing the material. Flush at least 15 minutes, then report to the Medical Department.

NAME: Carbon Tetrachloride

FORMULA: CCl_4

MOLECULAR WEIGHT: 154

BOILING POINT: 170.2°F

FREEZING POINT: -9°F

VAPOR PRESSURE: 90.w mm Hg @ 68°F

VAPOR DENSITY: 5.32 (air = 1.0)

LIQUID DENSITY: 98.9 lbs per ft @ 77°F

FLASH POINT: None

EXPLOSIVE LIMITS: Nonflammable and non-explosive in air at ordinary temperatures and pressures.

MAXIMUM ALLOWABLE CONCENTRATION: 10 ppm for 8 hours

DETECTION ODOR CONCENTRATION: Carbon tetrachloride has a distinctive odor, but, unfortunately, can be detected only in concentrations exceeding the maximum allowable concentration.

OCCURRENCE: Present as an impurity in all of the EDC streams (very small concentrations).

HAZARDOUS PROPERTIES: The principal hazard in the industrial use of this chemical is from inhalation of the vapor. The effects of excessive exposure of carbon tetrachloride may be both immediate and delayed. The immediate effects may include headache, symptoms resembling inebriation or drowsiness and abdominal discomfort. The delayed effects may include severe damage to the heart, liver, and kidneys which may not be evident until 1-10 days after the exposure.

Skin contact with the liquid leads to dryness through the removal of natural oils from the skin. Repeated or prolonged exposure may cause dermatitis, cracking of the skin, and danger of secondary infections.

Eye contamination by liquid carbon tetrachloride causes burning, intense irritation, and other symptoms of inflammation.

Subacute or chronic carbon tetrachloride poisoning may result from prolonged or repeated exposure to the vapors or the liquid. A threshold limit value of 10 ppm by volume in air has been set by some agencies as a maximum safe concentration for a daily 8 hour exposure.

TREATMENT: In extensive skin contact the patient should get under the shower immediately, if such is available.

Clothing and shoes should be removed under the shower.

If liquid carbon tetrachloride has entered the eyes, irrigate immediately with water. This can be done with an eye bath, if available, a gentle stream of water from a hose, or by pouring water from a clean container. The eyelids should be held apart during the irrigation to insure contact of water with all the tissues of the surface of the eye and lids. If pain is still present, it is permissible as a first aid measure to instill 2 or 3 drops of 0.5% pontocaine solution or an equally effective aqueous topical anesthetic. No oils or oily ointments should be instilled unless ordered by a physician.

If carbon tetrachloride has been swallowed, call a physician immediately. Vomiting should be induced by having the patient stick his finger down his throat or by giving large quantities of warm salt water (2 tablespoons to a glass of water). If vomiting occurs, give more water in order to attempt to wash out the stomach.

Remove patient to an uncontaminated area. If breathing has stopped an effective means of artificial respiration should be started immediately. If oxygen inhalation apparatus is available, oxygen should be administered, but only by a person authorized for such duty by a physician. The patient should be kept warm, but not hot.

CAUTION: Persons exposed to carbon tetrachloride should not be given alcohol, oils, fats, or epinephrine.

NEVER give anything by mouth to an unconscious patient.

NAME: Chlorine (Cl_2)

FORMULA: Cl_2

MOLECULAR WEIGHT: 70.91

BOILING POINT: -30°F

VAPOR PRESSURE @ 75°F: 92 psig

FREEZING POINT: -148°F

LIQUID DENSITY @ 77°F: 11.6 #/gal, 1.391 gm/ml

RELATIVE VAPOR DENSITY: 2.45 (air = 1.0)

FLASH POINT: None

EXPLOSIVE LIMITS: None

MAXIMUM ALLOWABLE CONCENTRATION: 0.35 to 2 ppm

DETECTABLE ODOR CONCENTRATION: 3.5 ppm

HAZARDOUS PROPERTIES: Liquid chlorine is very dangerous to the eyes as is chlorine gas. High concentrations of chlorine gas can cause pneumonitis and edema of the lungs. Lung irritation is one of the most serious effects of chlorine. Cl_2 is about 2½ times as heavy as air, therefore, it has a tendency to collect in the low spots or stay near the ground.

TREATMENT: Remove patient from toxic area and loosen all constrictive clothing about the neck. Oxygen should be administered in all cases to prevent cyanosis and relieve the pain of deep respiratory effort. Notify a physician.

NAME: Chloroform

FORMULA: $CHCl_3$

MOLECULAR WEIGHT: 119.5

BOILING POINT: 143°F

FREEZING POINT: -82°F

VAPOR PRESSURE: 160 mm Hg @ 68°F

VAPOR DENSITY: 4.13 (air = 1.0)

LIQUID DENSITY: 93 lbs per ft^3 @ 68°F

FLASH POINT: None

EXPLOSIVE LIMITS: Will not burn in air

MAXIMUM ALLOWABLE CONCENTRATION: 50 ppm for 8 hours

DETECTION ODOR CONCENTRATION: 200 ppm (NOTE THAT THIS IS HIGHER THAN THE MAXIMUM ALLOWABLE CONCENTRATION)

OCCURRENCE: Present as an impurity in all of the EDC streams except the lights still bottoms product. The lights still overhead stream will have the highest percentage of chloroform.

HAZARDOUS PROPERTIES: The most important hazard of chloroform arises from the fact that repeated exposure to low atmospheric concentrations may result in damage to the liver and kidneys. In high concentrations it has narcotic properties and is an effective surgical anesthetic. Contact with skin and mucus membranes may produce irritation.

In the presence of excess water or at very high temperatures, such as occur in open flames, chloroform decomposes to give phosgene, hydrogen chloride, and other products.

In the presence of strong alkalis and water, chloroform may become violently explosive.

On exposure to air and sunlight, chloroform slowly oxidizes to phosgene.

TREATMENT: If substantial quantities are spilled upon a person, the contaminated clothing should be removed promptly and the affected skin area should be flushed with plenty of water. The contaminated clothing should not be worn until free of the material.

If the eyes are contaminated, they should be flushed with plenty of flowing water. Medical attention should be obtained if any irritation persists.

If chloroform has been swallowed, vomiting should be induced as soon as possible by tickling the throat with a finger or by giving an emetic, such as two tablespoonfuls of common salt in a glass of warm water. CALL A PHYSICIAN.

Anyone showing signs of ill effects from breathing the vapor of chloroform should be removed to fresh air, kept warm and quiet, and be made to rest. If breathing stops, artificial resuscitation should be given. Get medical attention promptly.

NAME: Cis 1,2-Dichloroethylene

FORMULA: $C_2H_2Cl_2$

MOLECULAR WEIGHT: 96.95

BOILING POINT: 140.2°F

VAPOR PRESSURE: 400 mm @ 41.0°C

FREEZING POINT: -80.5°C

LIQUID DENSITY: 1.2743 @ 25°/4°C

VAPOR DENSITY: 3.34

FLASH POINT: 43°F

EXPLOSIVE LIMITS: 9.7 to 12.8% by volume

MAXIMUM ALLOWABLE CONCENTRATION (OR THRESHOLD LIMIT): 200 ppm

DETECTABLE ODOR CONCENTRATION: Pleasant Odor

HAZARDOUS PROPERTIES: Dangerous fire hazard. Moderate explosive hazard. Dangerous disaster control. When heated to decomposition, it emits highly toxic fumes of chlorides; can react vigorously with oxidizing materials.

TREATMENT:

Skin: Remove contaminated clothing and wash thoroughly with water.

Eyes: Flush with water.

Swallowing: Report to the Medical Department immediately.

Inhalation: Remove patient from contaminated area. Give artificial respiration and oxygen if necessary. Report to the Medical Department.

Fire: Use water, foam, carbon dioxide, dry chemical, or carbon tetrachloride.

NAME: Ethylene

FORMULA: C_2H_4

MOLECULAR WEIGHT: 28.05

BOILING POINT: -155°F

FREEZING POINT: -273°F

RELATIVE VAPOR DENSITY: 0.98 (air = 1.0)

AUTOIGNITION: 1009°F

EXPLOSIVE LIMITS: 3 - 29% (volume)

ODOR: Sweet

HAZARDOUS PROPERTIES: Ethylene is a flammable gas. It is a very dangerous explosion hazard upon exposure to heat or flame. It can react vigorously with oxidizing materials. Ethylene is moderately toxic, but the slight effects disappear as soon as the patient is removed from the exposure. The main danger with C_2H_4 is asphyxiation. The ethylene will displace the oxygen of the air causing the victim to suffocate.

TREATMENT: Remove the patient from the area, perform artificial respiration if breathing has stopped. Report to the Medical Department.

NAME: Ethylene Dichloride (EDC)

FORMULA: CH_2ClCH_2Cl

MOLECULAR WEIGHT: 98.97

BOILING POINT: 182.3°F

VAPOR PRESSURE @ 75°F: 75 mm

FREEZING POINT: -31.8°F

LIQUID DENSITY @ 68°F: 10.45 #/gal, 1.253 gm/mls

RELATIVE VAPOR DENSITY: 3.41 (air = 1.0)

FLASH POINT: 65°F Open Cup; 55°F Closed Cup

EXPLOSIVE LIMITS: 6.2 to 15.9% by volume in air

MAXIMUM ALLOWABLE CONCENTRATION: 75 to 100 ppm

DETECTABLE ODOR CONCENTRATION: Unknown

HAZARDOUS PROPERTIES: Ethylene dichloride is a flammable liquid and a dangerous fire hazard. It is toxic by inhalation, by prolonged or repeated contact with the skin or mucus membranes, and by ingestion. Excessive contact gives rise to symptoms such as headache, depression, mental confusion, fatigue, loss of appetite, nausea, vomiting, cough, loss of sense of balance, and visual disturbances. It has an anesthetic effect, and, in high concentrations, is immediately irritating to the eyes, skin, nose, and throat. It can cause dermatitis upon prolonged or repeated contact with the skin. Ethylene dichloride can cause serious eye damage.

TREATMENT: Quick removal from exposure is important. Ethylene dichloride should be removed from the patient's person, his respiratory tract, skin, or gastrointestinal tract as quickly as possible. If breathing has ceased, start artificial respiration. If material gets in the eyes, wash promptly with copious quantities of water. If ingested, the patient should be made to vomit. Notify a physician.

NAME: Hexachloroethane

FORMULA: C_2Cl_6

MOLECULAR WEIGHT: 236.76

BOILING POINT: 367°F

VAPOR PRESSURE: 1 mm @ 32.7°C

FREEZING POINT: 186.6°C (sublimes)

LIQUID DENSITY: 2.091

DETECTABLE ODOR CONCENTRATION: Camphor-like odor

HAZARDOUS PROPERTIES: Dangerous disaster hazard. Slight explosive hazard by spontaneous chemical reaction with alkalis, metals, etc. When heated to decomposition, it emits highly toxic fumes of phosgene.

TREATMENT:

Skin: Remove contaminated clothing. Wash with soap and water.

Eyes: Flush with copious quantities of water for at least 15 minutes.

Inhalation: Remove patient from contaminated area. Give artificial respiration. Give oxygen if necessary. Keep quiet and warm. Report to the Medical Department.

NAME: Hydrogen Chloride

FORMULA: HCl

MOLECULAR WEIGHT: 36.47

BOILING POINT: -121°F

VAPOR PRESSURE @ 75°F: 36,000 mm

FREEZING POINT: -174°F

LIQUID DENSITY: Normally a gas

RELATIVE VAPOR DENSITY: 1.26 (air = 1.0)

FLASH POINT: None

EXPLOSIVE LIMITS: None

MAXIMUM ALLOWABLE CONCENTRATION: 10 ppm for 8 hour working day

DETECTABLE ODOR CONCENTRATION: Unknown

HAZARDOUS PROPERTIES: Anhydrous hydrogen chloride is a gas which has a corrosive action upon the skin or mucus membranes. In this form, it will cause rapid and severe burns. It is particularly dangerous to the eyes. It is not flammable; however, the gas is highly soluble in water forming hydrochloric acid, which attacks most metals with the evolution of explosive hydrogen.

TREATMENT: Immediate removal from the toxic area and thorough flushing of the patient's body and/or eyes with large quantities of water is of primary importance. Contaminated clothing should be removed from patient while he is being showered with water. It is essential that all affected body surfaces be washed with copious quantities of water for a sufficient time to remove all hydrochloric acid. No attempt should be made to neutralize the acid with alkaline solutions. Medical assistance should be summoned at the earliest possible moment.

NAME: Nitrogen

FORMULA: N_2

MOLECULAR WEIGHT: 28.02

PHYSICAL APPEARANCE: Colorless, odorless, inert gas

SPECIFIC GRAVITY: 1.0 with relation to air (air is 78% N_2)

HAZARDOUS PROPERTIES: Even though nitrogen is a very safe, inactive gas, it has some inherent dangers since it is used so universally throughout the plant. Its prime use is for padding and sweeping of equipment that has, or has had, flammable organics in it. The hazard involved is that a vessel may have insufficient oxygen or that nitrogen is used to purge the vessel instead of air, before man-entry.

Therefore, in the Tetra Plant, every vessel that is entered not only must be first checked for flammability, etc., it must also be checked for sufficient oxygen. Not only that, nitrogen lines, as well as toxic lines must be isolated from the vessel before entry and a clean air sweep provided.

TREATMENT: Remove person from the oxygen deficient area. Administer artificial respiration if necessary.

NAME: Pentachloroethane

FORMULA: $CHCl_2CCl_3$

MOLECULAR WEIGHT: 202.31

BOILING POINT: 162°C

VAPOR PRESSURE: 10 mm @ 39.8°C

FREEZING POINT: -29°C

LIQUID DENSITY: 1.6728 @ 25°/4°C

MAXIMUM ALLOWABLE CONCENTRATION (OR THRESHOLD LIMIT): Safe concentration below 121 ppm

DETECTABLE ODOR CONCENTRATION: Sweetish odor. Chloroform-like odor.

HAZARDOUS PROPERTIES: Dangerous disaster hazard. Moderate fire hazard when exposed to heat or flame. PCE can cause chronic intoxication. It has an irritating effect upon the mucus membranes. Moderate explosive hazard by spontaneous chemical reaction. When heated to decomposition it emits highly toxic fumes of chlorides.

TREATMENT:

Skin: Remove contaminated clothing. Wash with soap and water. Apply lanolin ointment.

Eyes: Flush with water for at least 15 minutes. Call a specialist. Report to the Medical Department.

Swallowing: Induce vomiting by drinking soapy or salt water. Induce vomiting three times. Follow with a tablespoon of epsom salt in a glass of water. Call a physician. Report to the Medical Department.

Inhalation: Remove patient from contaminated area. Keep quiet and warm. Give artificial respiration. Give oxygen if necessary. If conscious, give tea or coffee. Call a physician. Report to the Medical Department.

Fire: Use water, carbon dioxide, dry chemical, or carbon tetrachloride.

NAME: Perchloroethylene

FORMULA: C_2Cl

MOLECULAR WEIGHT: 165.85

BOILING POINT: 121.20°C

VAPOR PRESSURE: 15.3 mm @ 32°C

FREEZING POINT: -23.3°C

LIQUID DENSITY: 1.6311 @ 15°/4°C

VAPOR DENSITY: 5.3

FLASH POINT: None

EXPLOSIVE LIMITS: Non-explosive

MAXIMUM ALLOWABLE CONCENTRATION (OR THRESHOLD LIMIT): 200 ppm

DETECTABLE ODOR CONCENTRATION: Chloroform-like odor

HAZARDOUS PROPERTIES: Perchloroethylene affects the nervous system, lungs, and mucus membranes. Dangerous disaster hazard. Nonflammable and nonexplosive. It will not support combustion. When heated to decomposition it emits highly toxic fumes of chlorides.

TREATMENT:

Skin: Remove contaminated clothing and wash with soap and water. Apply lanolin ointment.

Eyes: Flush with water for at least 15 minutes. Call a specialist. Report to the Medical Department.

Swallowing: Induce vomiting by drinking soapy or salt water. Induce vomiting three times. Follow with a tablespoon of epsom salt in a glass of water. Call a physician. Report to the Medical Department.

Inhalation: Remove patient from contaminated area. Keep quiet and warm. Give artificial respiration. Give oxygen if necessary. If conscious, give tea or coffee. Call a physician. Report to the Medical Department.

NAME: Sulfuric Acid

FORMULA: H_2SO_4

MOLECULAR WEIGHT: 98.08

BOILING POINT: 330°C

VAPOR PRESSURE: 1 mm @ 145.8°C

FREEZING POINT: 10.49°C

LIQUID DENSITY: 1.834

MAXIMUM ALLOWABLE CONCENTRATION (OR THRESHOLD LIMIT): 0.3 ppm

DETECTABLE ODOR CONCENTRATION: Odorless

HAZARDOUS PROPERTIES: Can cause severe burns. Dangerous disaster hazard. Moderate fire hazard by chemical reaction. It is a powerful oxidizer. Can ignite upon contact with combustibles. When heated it emits highly toxic fumes.

TREATMENT:

Skin: Remove clothing. Wash with water, then soap and water or neutralize with mild alkaline solution.

Eyes: Flush with water for one-half hour. NEVER use ointment. An eye anesthetic may be used for pain. Call a specialist. Report to the Medical Department.

Swallowing: If conscious, have patient wash mouth with water. Give at least 1 oz. of milk of magnesia or aluminum hydroxide gel well diluted in water. If these are not available, drink milk mixed with whites of eggs. DO NOT induce vomiting or pass a stomach tube. Call a physician. Report to the Medical Department.

Inhalation: Remove patient from contaminated area. Give artificial respiration and oxygen if necessary. Report to the Medical Department.

NAME: Symmetrical and Assymmetrical Tetrachloroethane (S.TeCE & A.TeCE)

FORMULA: $CHCl_2CHCl_2$ and CCl_3CH_2Cl

MOLECULAR WEIGHT: 167.86

BOILING POINT: S.TeCE 295°F; A.TeCE 267°F

VAPOR PRESSURE @ 75°F: S.TeCE 4 mm; A.TeCE 13 mm

FREEZING POINT: S.TeCE -47°F; A.TeCE -97°F

LIQUID DENSITY @ 77°F: S.TeCE 1.588 gm/ml; A.TeCE 1.533 gm/ml

RELATIVE VAPOR DENSITY: 5.78 (air = 1.0)

FLASH POINT: None

EXPLOSIVE LIMITS: None

MAXIMUM ALLOWABLE CONCENTRATION: 5 ppm for 8 hour exposure

DETECTABLE ODOR CONCENTRATION: Approximately 5 ppm

HAZARDOUS PROPERTIES: The tetrachloroethanes are not flammable or explosive but are the most toxic of the chlorinated ethanes that will be handled in the plant.

The tetrachloroethanes are toxic by inhalation, by prolonged and repeated contact with skin or mucus membranes or by oral intake. Although toxic, tetrachloroethanes may be handled safety if proper precautions are constantly observed. Prolonged or repeated exposures to the product in any form are hazardous.

The signs and symptoms of excessive absorption usually appear gradually and only after repeated exposures. In order of appearance they commonly are unusual fatigue, loss of appetite and weight, sick stomach and vomiting, constipation, abdominal pain, jaundice, drowsiness, going on in severe cases to unconsciousness and death. Some cases show marked involvement of the nervous system with headache, numbness and tingling in fingers and toes, trembling and twitching of muscles and even paralysis of some muscles.

The signs and symptoms of tetrachloroethane poisoning given above are due to systematic poisoning characterized by marked damage to the liver, kidneys, heart, blood cells, and nervous system. The clinical picture varies with the type of exposure and the amount of the material which has been absorbed either at one time or at repeated times. Most serious effects are usually on the liver and the blood. The principal route of absorption is by breathing the vapor, although it may be absorbed by the skin. Tetrachloroethane is currently considered the most toxic of the chlorinated hydrocarbon solvents in industrial use.

Continued exposure to high concentrations of the tetrachloroethanes leads to local irritation of the eyes and nose. There may be sick stomach and vomiting, but since tetrachloroethane is less volatile than other hydrocarbon solvents, it does not often have an anesthetic effect.

Subacute tetrachloroethane poisoning is the form usually encountered. This develops gradually as a result of prolonged or repeated work in an atmosphere containing more than 5 parts of tetrachloroethane per million parts of air but under conditions where the amount absorbed causes no immediate reaction. Repeated exposure even to low concentrations seems to increase sensitivity, and may lead to subacute poisoning.

For some time, workers with subacute poisoning may show only such signs and symptoms as unusual fatigue, loss of appetite and weight, constipation and abdominal distress or pain. At any time they may develop more severe evidence of absorption such as vomiting, dizziness, tenderness and pain over the liver, and jaundice. Even if removed from further exposure, the illness may persist and grow worse over a period of days, weeks, or even months, and may finally even end in death. However, if after a few months there has been steady improvement, complete recovery is the rule.

Some conditions under which subacute poisoning may occur in employees are as follows:

a. Where the ventilation is inadequate, resulting in high concentrations of more than 5 parts of tetrachloroethane per million of air.

b. Where the vapor concentrations are high intermittently, due to faulty handling of the liquid.

c. Failure of the individual to observe precautionary measures.

Tetrachloroethane is absorbed through the skin so that systemic poisoning can occur by this route with the same signs and symptoms as described above.

Tetrachloroethane may cause dermatitis after repeated or prolonged contact with the skin, such as that which might occur in the handling of rags wet with the chemical product, dipping hands into the liquid, or wearing clothing saturated with it. Reddening, burning, and, rarely, blisters may follow such exposure. In certain rare cases, the dermatitis may be caused by hypersensitivity to tetrachloroethane. The skin becomes rough, red, and dry due to the removal of skin oils. It cracks easily and is readily susceptible to infection. The skin has a chapped appearance.

Tetrachloroethane may enter the eyes either as a vapor or as liquid (spray or splash). The resultant irritation produces lacrimation, burning, and other symptoms of inflammation. It can cause serious eye damage if immediate care is neglected.

The first symptoms after toxic amounts of tetrachloroethane are taken by mouth are those of irritation of stomach and bowels, such as sick stomach, vomiting, and diarrhea with bloody stools. It is absorbed very rapidly and even a small amount may go on to produce unconsciousness and a deep flushing of the skin. Death is apt to occur before such systemic changes as liver and kidney damage occur.

TREATMENT: Most important in the case of any poisoning is quick removal from exposure. In the case of tetrachloroethane poisoning, this means first removing the patient from the contaminated atmosphere, and, insofar as possible, removing the tetrachloroethane from the patient's skin, or gastrointestinal tract, if those areas are involved.

The patient should be kept quiet and comfortably warm, but not hot.

A physician should be called immediately. He should be told briefly and clearly what has happened and the exact location of the patient.

A person showing symptoms of tetrachloroethane vapor poisoning should be removed promptly from the contaminated area. In case breathing has stopped, effective artificial respiration, such as that obtained by the prone pressure method or the Eve rocking method should be started immediately. If oxygen inhalation apparatus is available, oxygen should be administered, but only if one familiar with the operation of the apparatus is present to administer it. If the patient is conscious, hot tea or coffee may be given as a stimulant. A physician should be called at once.

All contaminated clothing should be removed at once. Clothing, including shoes, soaked in tetrachloroethane should be removed and not worn again until thoroughly free from tetrachloroethane. All affected areas should be washed thoroughly with warm water and soap. After this, an ointment containing lanolin should be applied in order to help in replacing the natural skin oils. For serious or persistent cases of skin trouble, and for signs and symptoms of generalized poisoning, a physician should be consulted.

If liquid tetrachloroethane has entered the eyes, they should be washed promptly with copious quantities of water for at least 15 minutes. (It is advisable to irrigate the eyes gently with water at room temperature in order to minimize additional pain or discomfort.) Medical attention should be obtained in all cases involving contact with the eyes.

If a person has swallowed tetrachloroethane he should be made to vomit, if conscious, by having him drink a glassful or more of lukewarm water in which a teaspoonful of salt to the glassful has been dissolved; a similar amount of warm soapy water may be used. If necessary, the patient should be encouraged to stick his finger down his throat to induce vomiting. When possible, vomiting should be induced at least three times. Following this, a tablespoonful of Epsom salt dissolved in a glass of water should be given. A physician should be called at once.

NAME: 1,1,2-Trichloroethane (TCE)

FORMULA: $CHCl_2CH_2Cl$

MOLECULAR WEIGHT: 133.41

BOILING POINT: 237°F

VAPOR PRESSURE @ 75°F: 22 mm

FREEZING POINT: -34°F

LIQUID DENSITY @ 77°F: 11.93 #/gal, 1.4319 gm/ml

RELATIVE VAPOR DENSITY: 4.6 (air = 1.0)

FLASH POINT: None

EXPLOSIVE LIMITS: None

MAXIMUM ALLOWABLE CONCENTRATION: 25 to 100 ppm

DETECTABLE ODOR CONCENTRATION: Unknown

HAZARDOUS PROPERTIES: Trichloroethane can cause burns of the eyes and has a seriously harmful effect upon the liver. It has a local irritating effect upon the mucus membranes, particularly of the eyes and nose. All contact with the eyes and skin should be avoided. This material should generally be handled with caution, because its toxicological properties have not as yet been adequately evaluated.

TREATMENT: Remove patient from toxic area. Removal all contaminated clothing and wash all exposed skin surfaces thoroughly with soap and water. Flush eyes with copious quantities of water. Notify a physician.

NAME: Trichloroethylene

FORMULA: C_2HCl_3

MOLECULAR WEIGHT: 131.4

BOILING POINT: 87°C (188.6°F)

VAPOR PRESSURE: 2.5 psia @ 100°F

LIQUID DENSITY: 11.9 lbs/gal @ 100°F

VAPOR DENSITY: 4.54 (air = 1.0)

FLASH POINT: Practically non-flammable

EXPLOSIVE LIMITS: Not flammable or explosive at ordinary room temperatures but moderately flammable at higher temperatures.

MAXIMUM ALLOWABLE CONCENTRATION (OR THRESHOLD LIMIT): 200 ppm

DETECTABLE ODOR CONCENTRATION: Unknown

HAZARDOUS PROPERTIES: Reacts with strong alkalis, such as caustic soda, to form highly flammable and toxic dichloroacetylene.

Trichloroethylene may be harmful by inhalation, by prolonged or repeated contact with skin or mucus membranes, or when taken by mouth.

TREATMENT: Skin areas affected by a spill should be washed thoroughly with soap and water (except the eyes). A 15 minute eye wash should be used for a spill in the eyes.

In general, remove the patient from the contaminated atmosphere and, insofar as possible, remove the trichloroethylene from the patient's respiratory tract, skin, or gastrointestinal tract. Vomiting may be induced if taken internally.

NAME: Vinylidene Chloride (VDC)

FORMULA: CCl_2CH_2

MOLECULAR WEIGHT: 96.95

BOILING POINT: 89°F

VAPOR PRESSURE @ 75°F: 560 mm

FREEZING POINT: -187.6°F

LIQUID DENSITY @ 68°F: 10.15 #/gal, 1.218 gm/ml

RELATIVE VAPOR DENSITY: 3.35 (air = 1.0)

FLASH POINT: 5°F Open Cup, 55°F Closed Cup

EXPLOSIVE LIMITS: 7.3% to 16.0% by volume in air

MAXIMUM ALLOWABLE CONCENTRATION: 25 ppm

DETECTABLE ODOR CONCENTRATION: 500 to 1,000 ppm

HAZARDOUS PROPERTIES: Vinylidene chloride is a flammable and toxic material. Vinylidene chloride is moderately irritating to the eyes and to the skin. The greatest danger for vinylidene chloride is inhalation. A single exposure for a few minutes to a high concentration of vinylidene chloride vapor rapidly produces a "drunkenness" which may progress to unconsciousness if exposure is continued. Even concentrations too low to cause an anesthetic effect may produce organic injury to the liver and kidneys.

A secondary danger from vinylidene chloride exists. Unstabilized vinylidene chloride in contact with air will decompose and form explosive peroxides. These peroxides are evident by the presence of a white solid. For this reason, all vinylidene chloride will be stabilized and all equipment will be padded with an inert gas such as nitrogen or methane.

TREATMENT: When the skin is contacted by vinylidene chloride it should be thoroughly washed with soap and water and all contaminated clothing removed and washed. If the eyes become contaminated, they should be flushed with water for 15 minutes or more. If a person is affected or overcome from breathing vinylidene chloride vapors, he should be removed to fresh air at once. Medical attention should be obtained immediately. Artificial respiration should be administered if breathing stops.

E. EMERGENCY HORNS: There are two distinct emergency horns in Plant B: The Plant B evacuation horn and the local area evacuation siren.

The Plant B evacuation horn is the regular plant horn blown in short blasts. It may be activated from every Plant B control room or the guard house. The sounding of this horn will shut down all non-process equipment in Plant B and will cause all non-essential personnel to leave the area. The Plant B evacuation horn should be sounded in case of a major break or if there is some reason to expect a major break. Whenever the evacuation horn is sounded, the guard should be notified of the nature of the emergency if at all possible. If it is desired to evacuate the whole plant, the guards will have to be notified and they will sound the plant evacuation. The guards are the only people able to sound the all-clear signal.

The area evacuation siren is used to evacuate all non-essential personnel from the operating area and to have all arcing devices in the operating area shut down. This siren is controlled by a switch on the wall in each control room. The area siren should be used in case of a spill involving release of flammable vapors. Activation of the shutdown system in the TCE unit automatically activates the siren in the OHC-TCE area unless the siren is bypassed.

PLANT B ROAD WARNING LIGHTS: In the event there is a spill that could release flammable vapors across the Plant B main road, the Plant B warning lights should be activated. The lights are rotating red beacons located under the N-S piperacks north of the Per-Tri stabilizer building and south of the HCl compressor building. These warning lights can be activated from every Plant B

control room and are designed to stop all vehicle traffic on the Plant B main road. As soon as it is determined that flammable vapors could be released across the road, the warning lights should be turned on.

F. PARISH ROAD TRAFFIC GATES: These are two gates located at the east and west extremities of the organics area on Parish Road. These are to be lowered when it is felt that there is a possibility that flammable vapors could be released across Parish Road and present a hazard to vehicles utilizing the road. The control switch for the gates is located in the EC-VC-HCl control building. Call that control room as soon as possible if such a need arises.

G. EMERGENCY EXITS:

East - Main east-west road gate

\- Midway between Per-Tri and TCE

North - East of ethylene metering station

West - West of tank car loading station

South - South of Bottoms Recovery Unit

\- Southeast of OHC control room

H. FIRE PROTECTION: The TCE unit is protected by a single deluge system which can be activated by:

1. Manual trip on the control board or at the sprinkler house southwest of the control building.
2. Activation of one of the HADs within the unit.

3. Activation of the deluge systems in the OHC unit. These OHC systems can be tripped as follows:

   a. Manual trips on the control board or in the sprinkler house southwest of the control building.

   b. Activation of one of the HADs within the unit.

A sudden rise in the HAD supervisory air pressure will cause the deluge valve to open and cover the area with a water spray. Do not be afraid to manually trip in any of the areas in case of a fire or spill in that area. Whenever any deluge valve is tripped, an alarm will sound in the guard house, but the fire truck will not come unless the guards are notified or they can see the fire or smoke. Anytime a deluge valve is tripped, the valve must be reset before automatic protection is available again. The valve is reset by closing one water valve upstream of the deluge valve, removing the cover of the deluge valve and resetting the weight.

The HADs are the heat sensing elements and are located at all strategic points in the process. The HADs are empty shells connected to the release diaphragm of the Suprotex deluge valve by a manifold of 1/8" PVC coated copper tubing. The HADs and the tubing manifold are pressurized with 24 oz. air pressure. An abnormal temperature rise in one of the HADs, as would occur in the event of a fire, will create a pressure rise in the units and the tubing manifold. This pressure rise will cause a diaphragm operated release mechanism to release a suspended weight. This weight drops and disengages the latch holding the deluge valve closed, thereby starting the flow of water to the distribution system. The water is dispersed in the area by sprinkler heads,

which are located so as to provide a spray over all exchangers, surge pumps, and skirts of columns. The manual trip lever is the handle located on the Suprotex deluge valve. When pulled, this handle releases the weight.

A change in environment temperature will not trip the system because the Suprotex valve has a compensating vent valve in the diaphragm. This valve is sized so that a slow pressure buildup in the supervisory air (HAD system) system will bleed through the valve to the other side of the diaphragm thereby equalizing the pressure.

As may be seen from the description of the supervisory air system, an accidental break in the HADs or tubing manifold will not trip the deluge valve. Anytime the system has a break in it, all automatic fire protection for this system is lost. Anytime the supervisory air pressure gets below 16 oz. an alarm will sound. Check the alarm out immediately as you are in danger of losing your protection. The alarm will sound if any single circuit of the supervisory air system develops a leak. When the alarm sounds, check the supply pressure and the overall supervisory air pressure. If both of these are normal, then a particular circuit has a leak, but enough air is being bled into the system to maintain the required 24 oz. pressure. Automatic Sprinkler will have to be called to find and repair the leaking circuit. To silence the alarm, the electrical power to the valve house will have to be shut off, the horn disconnected, and power put back to the valve house. This power will come from the emergency circuit. Fire protection exists until the supervisory air is about 6 oz.

I. FIRE EXTINGUISHERS: There are several fire extinguishers in the area, most of them being the dry chemical type. The dry chemical is most effective for organics fires while the CO_2 extinguishers are good for small fires or small electrical fires.

Anytime you are in doubt as to the type of extinguisher to use, use the dry chemical. It is good to avoid the use of the dry chemical on small electrical fires, as the chemical leaves a harmful residue.

J. SAFETY INSPECTIONS: Once per month an inspection of all safety equipment in each plant shall be made. This includes fire extinguishers, fire protection system, protective masks, safety showers, etc. This has a two-fold purpose: (1) To ascertain that required equipment is in good operating condition, and (2) To familiarize operations personnel with the location of safety equipment for quick use in an emergency.

K. ELECTRICAL EQUIPMENT: The characteristics of some of the materials handled in these units are such that each is classified as a Group D, Class I installation by the National Electrical Code. The method and materials of installation are those recommended by Factory Insurance Association. In general, the installation is Class I, Group D, Division 2. Motors are TEFC (Totally Enclosed Fan Cooled), lighting is vapor-tight, and all arcing devices are explosion-proof with seal-offs.

L. RELAMPING AND RECEPTACLES: Vapor-tight fixtures are used in the process area. The relamping procedure will be to first determine the lamps which need changing by turning on all lights. Then, turn off all lights and relamp. To

simplify this procedure, circuit breakers for lights in the process area and control laboratory have been grouped in the lighting panels. Globes and guards must be replaced after relamping.

M. GROUNDING: Grounding has been given special attention due to problems peculiar to the handling of hydrocarbons. Grounds for motors and other electrical devices are contained in the conduit supplying the device and connected to the device frame internally. Motor change-outs should be checked to see that the ground has been replaced.

Due to the tendency for hydrocarbons to build up a static electricity charge as a result of movement or agitation, a system of jumpers for pipe flanges has been installed to provide metallic continuity of the piping system containing flammable materials. All vessels are grounded at two points. The result is a system of lines, tanks, and vessels operating at ground potential. This will not prevent the generation of static charges but should provide adequate leakage to ground to prevent the accumulation of dangerous charges.

It is obviously important that the grounding system be maintained intact. This should be kept in mind when performing maintenance work on any equipment in the area.

N. PUMPS AND EQUIPMENT: Any pump or piece of equipment that is removed from the TCE-Tetra process must be thoroughly cleaned and inspected at a provided location before it is permitted to leave the area for the main shop or other work areas.

O. CLEARING OF TANKS AND PROCESS VESSELS: The area supervisor and maintenance supervisor will see that all vessels of tanks are cleaned and checked with an explosion meter before declaring them suitable for maintenance.

Clearing Procedure:

a. The tank or vessel will be emptied and all valves will be closed and tagged.

b. The vapor contents of the tank will be purged with an inert gas.

c. Blinds will be inserted in all connecting lines and tagged.

d. The equipment will be steam purged where possible to vaporize and remove all flammable materials. If steam cannot be utilized, an inert gas will be used.

e. Purge the equipment with plenty of air.

f. The equipment will then be checked with an explosion meter before work is begun. If entry into the vessel is required, the vessel must be also checked with an oxygen meter.

g. Safety belts and safety lines will be required in top exit tanks.

P. GAS MASKS: The standard pocket respirator will be carried in the area at all times and is effective for emergency protection and escape from light concentrations of harmful contaminants in the air. The cartridge protects against combinations of acid gases, organic vapors, chlorine, ammonia, and carbon monoxide in concentrations not exceeding 2% by volume. The respirator attaches to the belt or may be carried around the neck by a neck strap.

The canister (all service) mask is also available for use in the area and is used for the same contaminants that the pocket respirator is used for. The canister does not supply oxygen and, therefore, there must be at least 16% oxygen in the atmosphere before entering with a canister mask.

Self-contained air-paks (Scott and MSA) are also available for use in emergency situations where breathing air may not be available. The air-paks provide complete respiratory protection for a minimum of 30 minutes when fully charged. Pure breathing air, from the cylinder, flows to the mask automatically through the demand regulator. When the alarm bell sounds on the air-pak, there is approximately a five minute air supply left in the cylinder. The alarm is a signal to leave the contaminated area, proceed to a clear area, and exchange air-paks.

Air line masks are available in the control room for emergency conditions in shutting down the plant. These masks connect to a remote compressed air source by means of stationary lines. They allow a more extended, but not indefinite, stay in a contaminated atmosphere where breathing air is not available.

Q. CONTROL BUILDING: The control building is pressurized to prevent accumulation of any vapors inside. Since it is a pressurized building, non-explosion proof electrical equipment is used and smoking is permitted inside. The positive pressure is maintained by a fan which draws its intake air across an activated carbon filter. Should a major break occur, the filter would be unable to eliminate all contaminants, therefore, the fan should be shut down. To prevent any vapors from entering the building when the fan is off, instrument air bleeds should be opened. (Do not bleed the air system down by taking too much.) To prevent dust from accumulating in the control room, filter bags are in the suction of the air conditioner. For any problems with the air conditioner, notify the supervisor.

R. LAB AND LAB HOOD FAN: The laboratory has some helium and hydrogen outlets. If these are opened up and allowed to purge into the room, any person in the lab could be asphyxiated. Protection against this is given by the lab hood fan. This special hood has two fans, one discharging into the hood and one pulling out of the hood to the outside. The fan pulling out has a larger capacity, thus there is a net flow of air out of the lab, preventing concentration of fumes or helium and hydrogen.

PLANT AIR IS NOT TO BE USED FOR BREATHING PURPOSES.

S. OHC-TETRA SAFETY SHOWERS:

1N	EAST OF PRODUCT STORAGE TANKS
2N	NORTH OF DOWTHERM FURNACE
3N	NORTH OF DH FEED TANK
4N	BETWEEN AIR BLOWERS
5N	WEST OF NO. 3 DOWTHERM PUMP
6N	SECOND DECK - CENTER
7N	SECOND DECK - WEST END
8N	THIRD DECK - CENTER
9N	THIRD DECK - N/W CORNER
10N	FOURTH DECK - CENTER
11N	WEST OF TETRA REACTOR DUMP PUMP
12N	EAST OF AIBN PUMPS
13N	SECOND DECK TETRA - S/W CORNER
14N	OHC CATALYST BUILDING
15N	N/W CORNER COOLING TOWERS GROUND FLOOR

T. OHC-TETRA SAFETY EQUIPMENT

1. SCOTT AIR-PAKS

OHC	CONTROL ROOM	- 3
	4th DECK	- 1

2. ALL-PURPOSE MASKS

OHC	CONTROL ROOM	- 5
	2nd DECK	- 1
	3rd DECK	- 1
	4th DECK	- 1
TETRA	2nd DECK	- 1

3. FIRE EXTINGUISHERS

OHC	LABORATORY	- 1
	GROUND FLOOR	- 2
	2nd DECK	- 1
	3rd DECK	- 1
	4th DECK	- 1
TETRA	GROUND FLOOR	- 2
	2nd DECK	- 1

U. POLLUTION PREVENTION

Today, more than ever, operational decisions are being made with pollution prevention as the primary reason for these decisions. How a product can be made, yet prevent exposure of people and the environment to potentially damaging compounds is today the number one priority. Not only is it a safety concern but it is also an environmental concern. Not only is it the top priority of the company but it is also a top priority of the local, State and Federal governments. That is why every worker at PPG must make it his or her top priority also.

Pollution prevention is <u>not</u> responding to a serious situation of fume releases to the atmosphere or liquids being spilled after it has already been done. Pollution prevention is taking whatever appropriate steps are necessary to <u>prevent</u> the release of fumes to the atmosphere or liquids from being spilled. This results in no safety or environmental hazard ever existing as a result of actions we take.

There have been laws passed that deal with pollution of the air and waterways. This is good but laws do not prevent pollution - people do!

The personnel of the Tetra operating unit are the ones who are assigned to prevent pollution from the Tetra unit. Not those in administration, safety or even environmental. Tetra unit supervisors and operators have this responsibility and must work together to accomplish it. Should a pollution problem develop it must be addressed and corrected immediately. Should a pollution problem develop never attempt to hide it or ignore it in the hopes that it will disappear, go away, or be solved by someone else. Work diligently toward finding the best solution to the problem and restoring the plant to a normal operating condition.

III. TCE-TETRA UNIT OPERATING MANUAL

GENERAL PROCESS DESCRIPTION:

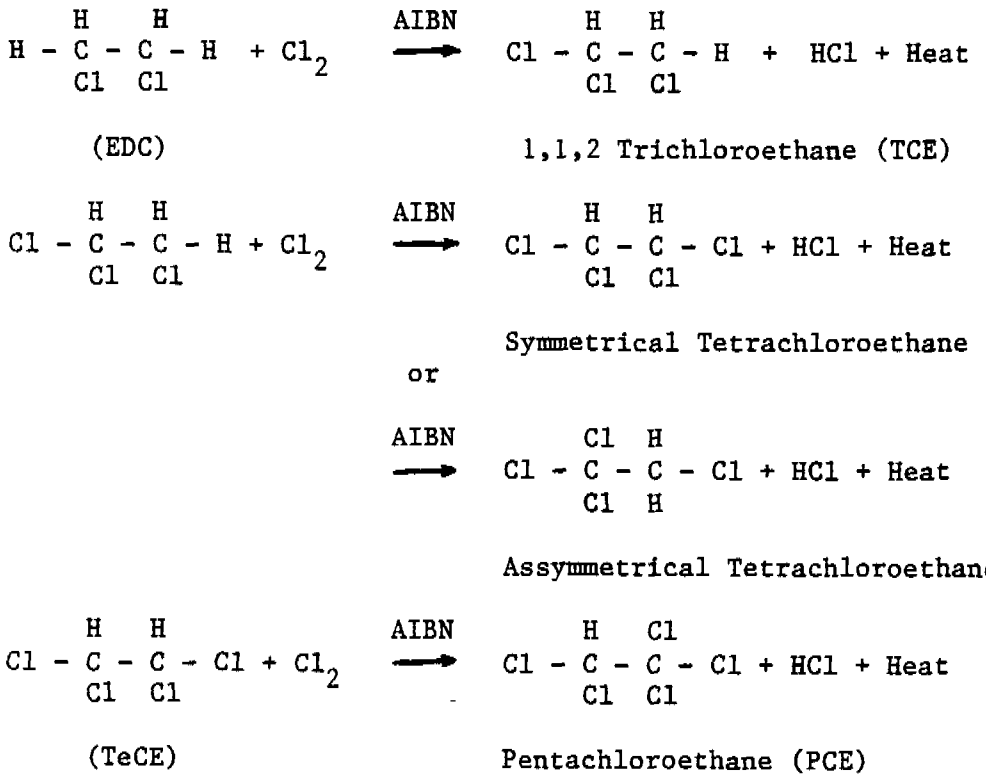
The chlorination of EDC to TCE, Tetra, and Penta with resulting by-product HCl is carried out in a liquid phase TCE reactor. A free radical initiator (catalyst), AIBN (azobisisobutyronitrile), is added to the reactor to cause the reaction to take place. The heat from the exothermic reaction is removed by two thermo-syphon coolers mounted on the side of the reactor and a forced circulation cooler. An overhead condenser and a secondary refrigerated condenser condenses organics out of the HCl before it is sent to OHC.

A liquid mixture of EDC, TCE, and other organics is drawn off of the reactor and fed to the light still. In addition to the liquid from the TCE-Tetra reactor, the product stream from the Bottoms Plant is also fed to the lights still. The function of the lights still is to remove EDC and other lights from the TCE, Tetra, and other heavies which become Per-Tri reactor feed. The unreacted EDC is fed back to the TCE reactor as a recycle stream. The TCE and heavies are taken off of the bottom of the lights still and then pumped to the crude TCE storage tanks. The concentrated lights of $CHCl_3$ and CCl_4 from the overhead of the TCE-Tetra light still is also fed as a purge stream to the TCE storage tanks. From the TCE storage tanks this mixture of TCE and heavies plus lights of $CHCl_3$ and CCl_4 is fed to Per-Tri as feed to the Per-Tri reactors.

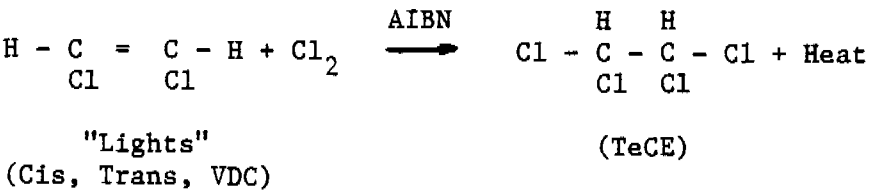
The HCl from the TCE-Tetra reactor is sent to the OHC Plant as feed to the OHC reactors after most of the EDC and TCE has been condensed out of it in the TCE-Tetra reactor overhead condensers.

A. DETAILED PROCESS AND EQUIPMENT DESCRIPTION:

1. CHEMICAL REACTIONS: The chlorination of EDC to TCE, Tetra, and Penta is described by the following reactions:



A lights stream of Tri-still overheads from Per-Tri is also periodically fed to the TCE-Tetra reactor resulting in the following type of chemical reaction:



NOTE: The reaction of lights and chlorine does not give off HCl as the other reactions do.

These reactions are carried out in the TCE reactor at conditions such that 60-85% of the EDC fed to the reactor is converted to the more highly chlorinated organics. The percentage of EDC converted depends on the desired composition of the feed stock to the Per-Tri reactors. A free radical initiator - 2,2 Azobisisobutyronitrile (AIBN) - is added to the reactor to aid in the chlorination reactions.

The presence of water or iron in the TCE-Tetra reactor will inhibit the complete utilization of the chlorine and cause subsequent breakthrough of the chlorine into the HCl and lights still systems.

Since TCE, TeCE, and PCE are all good feed to the Per-Tri reactors, the concentration of TCE in the reactor can be changed to provide Per-Tri with 'light' feed (high in TCE) or 'heavy' feed (low in TCE) by increasing the percent EDC conversion. By increasing the percent EDC conversion, the amount of EDC to be removed in the lights still and recycled back to the TCE-Tetra reactor is reduced, thereby reducing the required size of the lights still.

2. EDC FEED SYSTEM:

A. Equipment

1. EDC Feed Pumps (SAC #55-1232, 1233) - These pumps are Worthington BPO centrifugal pumps, 3500 rpm rated at 50 gpm at 140' of head. These pumps are located at the OHC tank farm. The motors for these pumps are SAC #50-2382 and 50-2383.

2. EDC (Tetra Safety) Feed Drier (SAC #73-85) - This vessel is an all steel construction, 42" IS x 18'0" T/T. The design vessel pressure is 100 psig to full vacuum at 300°F. The charge for the drier is approximately 7,700 pounds of nugget calcium chloride.

3. EDC FEed Filter (SAC #72-162) - This is a cast iron steel commercial Ful-Flo filter Model WYFTSS-10-2. The filter uses six 30" fiberglass filter elements. Design pressure is 150 psig.

4. Lights Still HCl Absorber (SAC #67-79) - The vessel is all steel construction, 24" OD x 22'0" tangent to bottom. The design pressure is 25 psig to full vacuum at 300°F. This vessel is protected from over-pressure by a 2" 25 psig graphite rupture disc. The absorber is packed with approximately 12' of 1½" steel pall rings. The packing is supported by a carbon steel support plate Norton Fig. 818R-2.

5. AIBN Tanks (SAC #60-1156, 1155) - These tanks are steel vessels, 30" x 5'8" seam to seam and 48" OD x 8'0" seam to seam respectively. Both vessels are designed for 100 psig and full vacuum at 100°F. Each tank is protected from overpressure by a single 2" 100 psig graphite rupture disc. There is also an SRV set at 60 psig that is always in service on the tank being used to feed AIBN to the Tetra reactor system.

6. Lights Transfer Pumps (SAC #55-1218, 1219) - These pumps are Worthington BPO centrifugal pumps. They are 3500 rpm pumps rated at 50 gpm at 110' of heat. These pumps are located in the OHC tank farm.

7. Lights Still Vent Condenser (SAC #71-1659) - This heat exchanger is a graphite exchanger with 24 - 7/8" tubes. The overall length is 10'2" with tube side and shell side design pressures of 75 psig at 340°F. Overall heat transfer area is 71 square feet.

B. Operation

The EDC for the TCE-Tetra reactor comes from storage tanks in the OHC Plant or from the liquid phase EDC Plant. This EDC must be dry and free of iron. Each tank is checked for moisture and iron content before pumping it to the TCE-Tetra unit. A calcium chloride drier serves as a backup or safety feature to insure that only low moisture EDC is fed to the reactor.

An additional feed source for the TCE-Tetra reactor comes from the Per-Tri Plant Tri still overhead. This stream is sent through a drier and filter before entering the TCE-Tetra Plant via storage tanks located in the OHC tank farm.

The reactor feed EDC is fed through a FCV and into the top of the lights still absorber. The purpose of the light still absorber is to absorb the HCl from the light still system into the EDC feed and return it to the TCE-Tetra reactor.

A small shell and tube condenser which is cooled using brine from the Per-Tri refrigeration unit has been installed in the vent line from the absorber to minimize the light organics carryover losses. The condensate from this condenser gravity drains back to the OHC unit intermediate crude tanks. A small entrainment separator is downstream of the condenser with condensate from this vessel draining back into the light still reflux pump suction.

The EDC is pumped from the bottom of the light still absorber through a level control valve and into the TCE-Tetra reactor. The absorber bottoms level control valve is instrumented (for safety) such that the valve will close automatically if there is a loss of flow through the line. This is possible because of a $\triangle$P transmitter across the level control valve that closes the valve when the upstream pressure gets less than or equal to the downstream pressure. This feature is to prevent reactor liquor from backing into the light still absorber in the event the absorber bottoms pump should stop pumping for any reason. For maintenance purposes, there is a switch mounted on the panel board that allows the $\triangle$P transmitter feature to be by-passed allowing the valve to maintain operation regardless of the $\triangle$P across the control valve.

The 'no flow' safety feature across the light still absorber level control valve functions in the following manner:

The differential pressure ($\triangle$P) across the control station (level control valve) is measured and sent to a flow transmitter. If for any reason the downstream pressure is equal to or greater than the upstream pressure, the flow transmitter will actuate a pressure switch. The pressure switch de-energizes a solenoid which cuts off the air supply to the control valve. A loss of air closes the control valve; therefore, no material can flow back to the lights still absorber from the level control station.

The total EDC flow to the TCE Plant is computed daily by the computer.

The 'lights' from the OHC tank farm are fed through a flow control valve and into the lights still absorber along with the EDC feed.

AIBN System:

The Tetra AIBN system consists of two tanks working under a 50 psig N_2 pressure on both tanks. The 50 psig pressure is maintained by N_2 regulators. The AIBN flow to the process system is regulated by a manual valve located in the field. Flow indication is provided by a flow transmitter and is recorded on the control room board. The introduction of AIBN can be made at either the suction of the absorber bottoms pumps or the suction of the recycle pumps. This allows AIBN to enter the reactor along with the EDC from the absorber or the EDC from the recycle system.

3. CHLORINE FEED SYSTEM:

A. Equipment

1. Chlorine Vaporizers (SAC #71-1424, 1381) - This exchanger is an Armstrong size "I" vaporizer. It has a shell design pressure of full vacuum to 300 psig at 400°F. The tube side design pressure is 300 psig at 400°F. The vaporizer has 200 1" carbon steel tubes 6'0" long. Each steel tube has a ½" copper bayonet tube inside it. The vaporizer has two 4" chlorine inlet nozzles to reduce impingement against the tubes. The vaporizer is protected from overpressure by an SRV set to relieve at 300 psig.

2. Chlorine Surge Drum (SAC #60-1126) - This steel vessel is 66" OD x 16'0" seam to seam. It is rated at full vacuum to 178 psig at 300°F. This drum is protected from overpressure by an SRV set to relieve at 150 psig.

B. Operation

Liquid chlorine enters the plant through a 3" line that is supplied from the main E-W piperack in Plant B, through the Per-Tri Plant. This section of line between the main Plant B chlorine supply line and the TCE Plant is protected from overpressure by two expansion bottles in series. The expansion bottle system on the liquid chlorine header works as follows:

Two bottles are mounted in series such that liquid chlorine floats in the inlet of the first expansion bottle. The outlet of the first suction bottle is sealed with a 300 psig rupture disc that, upon rupturing, discharges into the second expansion bottle. A pressure gauge on the second expansion bottle indicates any failure of the rupture disc. A block valve on the inlet to the first expansion bottle allows the expansion bottles to be isolated in the event of rupture disc failure after the pressure surge has been corrected. During normal operation, the inlet block valve to the expansion bottles should be sealed (locked) in the open position.

Liquid chlorine enters the bottom of the shell side of the vaporizer and is vaporized by the steam condensing in the vertical tubes. The vaporized chlorine goes out near the top and goes to the pressure control system. The

outlet nozzle has a spool piece inside the vaporizer that elbows in the upward direction. This reduces the possibility of liquid chlorine at a higher level in the vapor space of the vaporizer. The steam enters the chest at the bottom of the vaporizer. Any condensate entrained in the steam feed stream (for example - when using saturated steam) drops out in the inlet chest and is removed via two small steam traps at the bottom. Steam flows from the chest upward through the bayonet tubes into the main (carbon steel) heat transfer tube. It is condensed on the tube surface and falls down to the condensate chamber. This condensate is removed through two larger steam traps.

The chlorine vaporizer operates under a variable heat transfer area principle. The vaporizer runs with a level of liquid chlorine in the shell side. The chlorine chest pressure is near the liquid line pressure since a pressure control valve is on the outlet of the chlorine vaporizer. As chlorine throughput increases (rates increase), more area is required to transfer the additional heat; so the liquid level builds up until enough additional tube area is covered to boil off the additional chlorine. Conversely, if chlorine throughput (rates) decreases, the chlorine level drops using less heat transfer area thus decreasing chlorine boilup.

Steam to the chlorine vaporizers comes from the 150 psig steam supply to the TCE Plant which is supplied from the 150 psig steam system in the Per-Tri Plant. The steam used for TCE-Tetra is routed through a desuperheater at Per-Tri which maintains the steam temperature at approximately 435°F. It is important that the steam temperature is maintained below 483°F because at 483°F, the corrosion rate of chlorine upon steel becomes infinite. This is commonly referred to as a spontaneous chlorine and steel reaction or chlorine

"fire". The term "fire" is used to describe this type of spontaneous reaction because the heat of reaction is enough to keep the chlorine and steel reaction going once the reaction starts. Therefore, a temperature of 483°F or greater could cause a dangerous condition in the chlorine vaporizers. For this reason, the temperature of the 150 psig steam entering the TCE-Tetra Plant is recorded and alarmed on the panel board in the control room. The low temperature alarm is set at 380°F and the high temperature alarm is set at 450°F.

The 150 psig steam supply to each chlorine vaporizer goes through a PCV where the pressure is reduced to the desired vaporizer steam chest pressure; normally 3-15 psig. There is an SRV on the steam line between the PCV and the vaporizer that is set to relieve at 40 psig. Each Cl_2 vaporizer has its own steam PCV and SRV.

The steam chest pressure is recorded and alarmed on the panel board. The low pressure alarm is set at 2 psig and the high pressure alarm is set at 30 psig.

Vaporized chlorine leaves the vaporizer and passes through a PCV which reduces the pressure to 115 psig. The temperature of the chlorine leaving each vaporizer is recorded and alarmed on the panel board. The low temperature alarm is set at 150°F and the high temperature alarm is set at 170°F. Normal operating temperature is approximately 195°F. The temperature of the chlorine downstream of the PCV is recorded and alarmed on the panel board. This alarm is a low temperature alarm and is set at 150°F. Also, the temperature of the chlorine in the bottom of the chlorine surge drum is monitored, recorded, and alarmed on the panel board. This alarm is a low temperature alarm and is set at 150°F. The temperature element for the chlorine in the surge drum is located near the bottom of the surge drum.

The temperature on the inlet to the chlorine surge drum and in the bottom of the surge drum are connected to the TCE-Tetra reactor shutdown system. If the temperature of the chlorine at the inlet of the chlorine surge drums drops to 130°F or if the temperature in the bottom of the chlorine surge drum drops to 130°F, it actuates the TCE-Tetra reactor shutdown system. Whenever the shutdown system is actuated, the following valves will close - Cl_2 PVC, Cl_2 FCV, and the reactor PCV. The reactor PCV closes to prevent any HCl from backing into the TCE-Tetra Plant from OHC.

The temperature of the vaporized chlorine must be controlled so that no liquid chlorine is formed in the chlorine system piping or the chlorine surge drum. Any liquid chlorine fed to the TCE-Tetra reactor could lead to a greater than normal reaction rate, possibly so great that the normal cooling equipment would be inadequate to handle the increased heat removal load. This, along with the reaction product of HCl, could lead to overpressure of the TCE-Tetra reactor with subsequent blowing of the reactor SRVs or rupture discs. Excessive amounts of liquid chlorine feed could possibly lead to rupture of the reactor vessel.

Vaporized chlorine begins to condense at 88°F when under 115 psig pressure. The temperature of the chlorine in the surge drum is controlled at approximately 180°F. This is done by adjusting the steam chest pressure controller. The steam chest pressure determines the condensing steam temperature and the degree of superheat given to the vaporized chlorine by the tubes above the liquid chlorine level is determined by the temperature driving force between the steam and the chlorine. Thus, an increase of steam pressure, at a given rate, results in more superheat.

The chlorine leaving the top of the surge drum passes through a FCV and an anti-backup (or anti-reverse flow) valve and a check valve before entering the reactor through the chlorine sparger. The chlorine FCV is instrumented with a $\triangle$P transmitter across the control valve such that the valve will close if there is a loss of chlorine through the valve (or in effect, an upstream pressure less than or equal to the downstream pressure).

See writeup on the EDC feed system for an explanation of how the "no flow safety feature" operates.

In addition to the "no flow safety feature" across the chlorine FCV there is a similar feature across the anti-backup valve just downstream of the chlorine FCV. There is a three-position switch mounted near the anti-backup valve that operates the anti-backup valve in the following manner:

1. One position on the switch opens the valve automatically by-passing the "no flow safety feature" for maintenance purposes.
2. One position is a manual trip for the valve which allows the valve to stay in the closed position regardless of the "no flow safety feature". This position is used primarily while the reactor is shut down.
3. One position is the normal operating position which allows the "no flow safety feature" to govern the valve position based on the $\triangle$P (or flow) through the valve.

The chlorine anti-backup valve is instrumented with the same type of $\triangle$P transmitter across it such that the valve will close on the loss of chlorine through the valve (an upstream pressure less than or equal to the downstream pressure). The valve should always be in the "normal operating position" while the TCE-Tetra reactor is in operation.

The chlorine flow to the reactor is measured through the orifice run and computed daily by the computer.

4. ETHYLENE SYSTEM:

Ethylene to the TCE-Tetra Plant comes off the main ethylene header feeding the OHC I Plant. Ethylene is used only during the reactor start-up as one of the principle reactants, along with chlorine. The reaction of ethylene and chlorine produces EDC and gives off a large amount of heat. This heat is used to bring the TCE-Tetra reactor up to normal operating temperatures where the chlorine and EDC will react in the presence of a catalyst, AIBN. The ethylene is flow controlled to the TCE-Tetra reactor as needed during reactor start-up.

This ethylene is also computed daily by the computer.

5. TCE-TETRA REACTOR SYSTEM:

A. Equipment

1. TCE-Tetra Reactor (SAC #59-22) - The TCE-Tetra reactor is 8'5" ID x 37'9" seam to seam. The vessel is constructed with 20% nickel clad steel. Design pressure is full vacuum to 125 psig at 400°F. A 4" chlorine sparger ring is located near the bottom of the reactor. There are two inlets to the chlorine sparger. The reactor is protected from overpressure by a 3" SRV with a monel rupture disc mounted beneath the SRV. These are set at 117 psig. The rupture disc is an Ametek type SRK reverse buckling assembly. There are also two 8" Monel rupture discs with bursting pressure of 215 psig.

2. TCE-Tetra Reactor Condenser (SAC #71-1377) - This condenser is a shell and tube exchanger. The shell, tubes, and tube sheets are 304 SS. The heads are made of carbon steel. There are 464 - 3/4" stainless steel 16 BNG tubes. The tube side and shell side are designed for 117 psig at 300°F. The total heat transfer area is 1457 square feet.

3. TCE-Tetra Reactor 'Sidearm' Coolers (SAC #71-1435, 1425) - These coolers are mounted on the side of the TCE-Tetra reactor and are thermosyphon type coolers. Each one has 330 - 1" 16 BWG nickel tubes, 12' long. The tube side and shell side have a design pressure of 117 psig at 300°F. The tube sheets are nickel. The total heat transfer area of each cooler is 1037 sq. ft.

4. TCE-Tetra Reactor Forced Circulation Cooler (SAC #71-1459) - This is a two-pass exchanger with the cooling water on the shell side. The exchanger is 2'1-3/4" in diameter and 10'7" long with 268 - 1", 16 BWG tubes. The heads, tubes, and tube sheets are constructed of 316 SS. The shell is made of carbon steel. The exchanger is rated for 200 psig at 500°F shell side and tube side. There is a 2" SRV on the process side of the heat exchanger set at 200 psig with a Monel rupture disc beneath it. The shell side of the exchanger is also protected from overpressure by a 1" SRV set at 200 psig.

5. TCE-Tetra Reactor Forced Circulation Cooler Pump (SAC #55-1813) - This pump is a Goulds Model 3196 MT. The motor SAC number is 50-3340.

6. TCE-Tetra Reactor Dump Pump (SAC #55-1755) - This pump is constructed of ductile iron. It is a Durco Mark II, size 2 x 1 x 10, with an 8¼" impeller. The pump is driven with a 3 hp, 1750 rpm motor with SAC #50-3243.

B. Operation

Chlorine is fed through two nozzles near the bottom of the reactor and into a sparger ring inside of the reactor. EDC and recycle from the light still enters through separate nozzles near the bottom of the reactor. As the reactions to TCE, TeCE, and PCE are carried out, heat is evolved. The heat of reaction is removed by two means - the sidearm coolers and the forced circulation cooler. The horizontally mounted overheads condenser is used to condense the organics that goes overhead with the HCl stream and return by gravity flow the condensed organics to the TCE-Tetra reactor.

The two TCE-Tetra reactor 'sidearm' coolers are thermosyphon coolers mounted on the side of the TCE-Tetra reactor. The reactor liquor circulates through the tube side of the cooler, with the cooling water on the shell side. The reactor liquor circulation is created by the thermosyphon effect. The material in the cooler has a greater average density than the material in the reactor itself. The more dense material flows toward the bottom of the cooler and reactor which sets up a circulation path. The direction of flow is opposite in a thermosyphon cooler to that encountered in a thermosyphon reboiler.

The TCE-Tetra reactor temperature is controlled by two temperature control valves throttling the organic outlet from both sidearm coolers. A manual loading station in the control room sets the valve position for each valve. These temperature control valves are 12" Posiseal valves with a pneumatic operator mounted on it. The operator should have 80 psig pressure or it may not operate the valve sufficiently. For this reason, it is connected to the N_2 header. The valve can also be turned by using a wrench if the N_2 pressure is not sufficient to operate the valve.

The TCE-Tetra reactor level is controlled at 26' - 27' by the make up EDC and recycle streams. The reactor liquor drawoff point is located at 24'10". The reactor pressure is maintained at approximately 80 psig by a pressure controller in the HCl system.

As mentioned previously, iron in the TCE-Tetra reactor is detrimental to the reaction. Any water present can lead to corrosion in the associated equipment and result in iron being fed to the reactor. The iron content normally runs 1 ppm, and the water content ranges from 40 - 70 ppm (Karl Fischer reagent method).

AIBN flow to the TCE-Tetra reactor is regulated to keep free chlorine from coming out of the reactor into the light still system by promoting the reaction. Chlorine breakthrough is determined by mixing a sample of light still feed, or reactor bottoms liquor, or reactor vent gas with an orthotolidene-water solution. Presence of free chlorine is indicated by a yellow to red color. Small amounts of free chlorine results in a pale yellow color, while a major chlorine breakthrough is indicated by a dark red color. This mixture should show clear to indicate no free chlorine. If a color is developed, an increase in AIBN flow should be made.

In the event that chlorination of the TCE-Tetra reactor cannot be corrected by increasing AIBN flow, the chlorine to the reactor should be decreased. If chlorination should continue even at a reduced chlorine feed rate, the reactor should be shut down as described in the "Start-Up and Shutdown Section". Ethylene is never to be added to the reactor except during start-up.

6. HCl PURIFICATION AND DISTRIBUTION:

A. Equipment

1. TCE-Tetra Reactor Condenser (SAC #71-1377) - Described under the reactor system.

2. TCE-Tetra Reactor Secondary Condenser (SAC #71-2304) - This condenser is a graphite shell and tube heat exchanger. The shell is carbon steel and the tubes and tube sheet are graphite. There are 134 - 3/4" graphite tubes. The tube side is designed for 125 psig at 340°F. The shell side is designed for 100 psig at 340°F.

3. HCl Separator (SAC #60-1132) - This is a steel vessel 42" OD x 5'10" seam to flange face. The top of the vessel is flanged so a demister can be installed and removed. The support ring is located 1'6" below the flange face. There is a hold-down ring that fits on top of the demister that is made of ¼" x 2" flat bar. This entire assembly is held in place by three pieces of ¼" x 2" flat bar that are welded to the top flange. The vessel is designed for full vacuum to 150 psig at 300°F. It is protected from overpressure by a 2" graphite rupture disc with 150 psig bursting pressure.

4. TCE Process Vent Scrubber (SAC #67-87) - This vessel is 4' diameter by 18' high. It is constructed to Haveg 61 composite. The design pressure is liquid full of water at 200°F. The scrubber has a 12' packed section of 3" carbon rashig rings. The packing is supported by a special plate made by Haveg Corporation. Water is distributed over the packing by means of a Model 1837 thermal plastic Weir Trough Distributor made of polypropylene.

5. Reactor Vent Gas Cl_2 Analyzer - The gaseous chlorine analyzer is a DuPont 400 Photometric analyzer. The principle of its operation is the absorption of light by the sample material. A continuous sample is made from the reactor vent stream and the analyzer is calibrated for pure HCl or no chlorine. If a chlorine breakthrough should occur, the analyzer will detect it and alarm at a set point.

6. Reactor Liquor Chlorine Analyzer

B. Operation

The HCl gas coming off the TCE-Tetra reactor contains sufficient EDC and TCE to cause plugging problems in the OHC reactor heads to which the HCl is ultimately fed. The major portion of the EDC and TCE is removed in the TCE-Tetra reactor condenser. The organics condensed here drains into the TCE-Tetra reactor.

When the HCl gas leaves the reactor overhead condenser, it is cooled further in the Tetra reactor secondary condenser. This condenser utilizes 15-20°F brine from the P/T refrigeration unit as a cooling medium on the shell of the condenser. The HCl gas from the reactor overhead condenser enters the secondary condenser on the tube side at 90-100°F. The HCl gas exit temperature averages 30-40°F. The organics condensed in the secondary condenser drains to the light still feed degasser where it is then fed to the Tetra light still.

From the secondary condenser, the HCl gas passes through the HCl separator which acts as an entrainment separator. Liquid removed in the HCl separator is periodically drained to the HCl absorber. There is a sight glass on the HCl separator and a level indicator on the panel board. Liquid should always be kept drained out of the HCl separator. The level in the HCl separator is also alarmed on the panel board.

The HCl gas leaves the top of the separator and goes through the HCl flow orifice. The flow of the HCl gas leaving the plant is recorded on the panel board and is computed daily by the computer. This HCl flow should correspond to the chlorine feed flow. A deviation alarm is in service such that if the ratio of chlorine to HCl flow is not adequate, it indicates a possibility of incomplete chlorine utilization and possible chlorine breakthrough.

Downstream of the orifice run is the TCE-Tetra reactor PCV which maintains the reactor system pressure (normally approximately 80 psig). Just upstream of the reactor PCV is the takeoff for another PCV which vents to the process scrubber. This secondary PCV is used during start-up and emergency situations. During normal operation, the PCV that vents to the scrubber (vent relief PCV) is set to open at 85 psig. An alarm will sound on the panel board whenever the vent relief PCV opens which gives indication of HCl being sent to the process scrubber.

this possibility of Cl_2 breakthrough, continuous samples of the HCl gas stream leaving the HCl separator and the reactor liquor are sent through an on stream analyzer and the resulting chlorine content is continuously monitored. If the chlorine content reaches a set point, an alarm will sound indicating that an adjustment is needed to correct the chlorine breakthrough. If the chlorine breakthrough cannot be corrected, then the HCl flow should be diverted to the TCE-Tetra process vent scrubber through the vent relief PCV in anticipation of shutting the TCE-Tetra reactor down.

During the start-up of the TCE-Tetra reactor, the HCl generated will be routed to the process vent scrubber where it can be scrubbed with well water. The HCl enters below the packed section and is absorbed in water as it passes up through the packing. Water to the scrubber is regulated by an MLS which operates a valve in the water line.

7. LIGHTS STILL SYSTEM:

A. Equipment

1. Lights Still (SAC #67-90) - This still is constructed of steel and is 84" ID x 81'8½" seam to seam. Overall length is 104'5-3/8". The column has 45 trays with 18" tray spacing. The trays are Nutter valve trays with 258 valves per tray. The main feed tray is #21. There are feed points located at trays 6 and 12. Tray #40 is the light still drawoff tray. The column is designed for full vacuum to 50 psig at 300°F. It is protected from overpressure by a 4" graphite rupture disc with a bursting pressure of 50 psig.

2. Lights Still Feed Pumps (SAC #55-1757, 1750) - These pumps are of Durco Mark II pumps, size 3 x 2-7, with 6½" impellers. These pumps are constructed of ductile iron. They are powered by 25 hp motors (SAC #50-3245, 3246) at 3600 rpm.

3. Lights Still Feed Heater (SAC #71-1378) - This exchanger is a shell and tube type with a steel shell, 304 stainless steel heads, 304 stainless steel tube sheets, and 118 - 3/4" 304 stainless steel 16 BWG tubes. Total heat transfer area is 231 square feet. There are four passes on the tube (process) side. Tube side design pressure is 150 psig at 400°F and shell side design is 200 psig at 400°F.

4. Lights Still Feed Degasser (SAC #60-1127) - This vessel is constructed of 304 stainless steel. It is 42" OD x 6'0" tangent to tangent. It is designed for full vacuum to 189 psig at 300°F. It is protected from overpressure by a SRV set to relieve at 150 psig.

5. Lights Still Condenser (SAC #71-1376) - This is a steel shell and tube exchanger with two passes on the tube side. It has 910 - 3/4" carbon steel 12 BWG tubes. It is designed for full vacuum to 50 psig at 300°F on the shell (process) side and 150 psig at 300°F on the tube side. The exchanger has 2143 square feet of heat transfer area.

6. Lights Still Reboilers (SAC #71-1374, 1375) - These steel exchangers have 723 - 1" 12 BWG tubes. Shell side design pressure is full vacuum to 150 psig at 350°F and the tube (process) side design is 150 psig at 350°F. Each reboiler has 2340 square feet of heat transfer area.

7. Lights Still Reflux Drum (SAC #60-1157) - This horizontally mounted steel tank is 72" OD x 12'0" tangent to tangent. Design pressure is full vacuum to 50 psig at 250°F. It is protected from overpressure by a 2" graphite rupture disc with a bursting pressure of 50 psig.

8. Lights Still Reflux Pumps (SAC #55-1753, 1754) - Pump #55-1754 can be used as a spare for the lights still bottoms pump. These pumps are Durco Mark II, size 3 x 1½ x 10, with 8 3/4" impellers. They are constructed of ductile iron. They are powered by 40 hp motors (SAC #50-3241, 3242) at 3600 rpm.

9. Lights Still Bottoms Pump (SAC #55-1756) - This pump is a Durco Mark II pump, size 3 x 2 x 10, with a 7 5/8" impeller. It is constructed of ductile iron. The pump is driven by a 5 hp motor (SAC #55-3244) at 1800 rpm.

10. Crude TCE Bottoms Cooler (SAC #71-1379) - This is a steel constructed Brown fintube exchanger. It has 7 - 1" U-tubes. The shell (process) side design pressure is 400 psig at 650°F and the tube side design pressure is 500 psig at 650°F. It has 74 square feet of heat transfer surface.

11. Bottoms Product Preheater (SAC #71-1319) - This is a spiral heat exchanger 26" in diameter and 3'7" in length. The material of construction is carbon steel. The process side design pressure is 200 psig at 400°F and the steam side pressure is 200 psig at 400°F. The heat transfer area is 175 square feet.

12. Lights Still Recycle Tank (SAC #60-1236) - This tank is a carbon steel vessel protected from overpressure by a 50 psig graphite rupture disc 10" in diameter.

13. Lights Still Recycle Pumps (SAC #55-1877, 1878) - These pumps are Durco Mark II 2 x 1 - 10 pumps with 25 hp motors (SAC #50-3457, 3458) at 3600 rpm.

14. Tetra Vent Compressor (SAC #56-262) - This compressor is a Cooper Penjax reciprocating compressor. Size 9 x 5-3/4 x 7; class 11-ATCP; serial number 123400. It has a 50 hp motor (SAC #50-3445) operating at 1770 rpm.

B. Operation

The function of the lights still is to remove the unreacted EDC from the TCE reactor liquor and the Bottoms Plant product stream. The EDC is then recycled back to the TCE-Tetra reactor. The design EDC concentration in the lights still bottom is 1.0%, but this will vary with operating conditions.

Feed to the lights still comes from the TCE-Tetra reactor and the Bottoms Plant.

Feed to the lights still from the TCE reactor is pumped through the lights still feed heater where it is heated to 280°F. The outlet temperature of the lights still feed heater is controlled by a TCV located in the 150 psig steam supply to the heater. Heating the lights still feed reduces the amount of HCl that can be kept in solution at the reactor pressure of 80 psig. At 80 psig an increased amount of HCl is dissolved in the TCE-Tetra reactor liquor.

After the reactor liquor leaves the heater, it goes through a FCV and into the lights still feed degasser. As the feed to the lights still flows through the FCV, there is a reduction in pressure which causes some flashing of the heated feed stream. The mixture of liquid and gas enters the degasser where the vapor and liquid separates. The vapor leaving the top of the degasser flows through a vent line back to the reactor. Liquid from the degasser is fed through a LCV and into the lights still.

The feed streams enter the lights still at tray 21. The EDC and lighter compounds are driven up the column. The overhead out of the lights still are condensed in the lights still condenser. This condenser is a partial condenser in that the dissolved HCl in the feeds is driven overhead from the still and is only partially reabsorbed in the condenser. The vent HCl from the lights still overhead condenser goes into the lights still HCl absorber where it is absorbed in the EDC feed to the TCE-Tetra reactor. Any HCl not absorbed goes through the refrigerated vent condenser and on to OHC via the Tetra vent compressor.

The condensate from the lights still condenser flows into the lights still reflux drum. From here the liquid is returned to the lights still as reflux through a FCV. A purge stream is taken from this reflux feed to the lights still and routed to the TCE-Tetra storage tanks where it is blended with feed to Per-Tri (lights still bottoms). This purge stream removes the lights, CCl_4 and $CHCl_3$ from the lights still system. The purge is adjusted to maintain a maximum of 40% EDC in the reflux stream.

EDC in the lights still is concentrated at tray 40. A draw-off stream is removed from the still at this point through a draw-off FCV to the recycle tank. From the recycle tank this EDC is pumped through a LCV and back into the TCE-Tetra reactor as recycle.

Heat input to the still comes from two vertical thermosyphon reboilers. Steam flow to the shell of these exchangers is controlled so as to minimize EDC in the lights still bottoms and TCE in the recycle stream. The overhead pressure on the lights still should run 2 - 6 psig with the bottom pressure at 6 - 10 psig. The bottom control temperature (at tray #5) should run at 275 - 280°F.

The heavier stream of TCE, TeCE, and PCE is pumped from the bottom of the reboiler through the crude TCE cooler, which is cooled using CTW, and then into the TCE storage tanks. The flow from the bottom of the lights still is regulated by a LCV which maintains the level in the lights still. From the crude TCE storage tanks, the material is pumped through an orifice to the Per-Tri reactors as feed.

8. CRUDE TCE STORAGE:

A. Equipment

1. Crude TCE Storage Tank No. 6301 (SAC #60-1143) - This is a steel tank, 24'0" ID x 30'0" tangent to tangent. it is equipped with a level transmitter and an externally mounted varac. Design pressure is three ounces of pressure and three ounces of vacuum. It is protected from overpressure and vacuum by an 8" vent seal pot. The tank capacity is approximately 100,000 gallons. An eductor circulating header is mounted inside the tank to thoroughly mix the contents.

2. Crude TCE Storage Tanks No. 6302 & No. 6303 (SAC #60-1118, 1119) - These tanks are steel, 35'0" ID x 30'0" tangent to tangent. They are equipped with level transmitters and externally mounted varacs. Design pressure is three ounces of pressure and three ounces of vacuum. They are protected from overpressure and vacuum by 20" seal pots. The tank capacity for each is approximately 200,000 gallons. An eductor circulator header is mounted inside the tank to thoroughly mix the contents.

3. Crude Storage Tank No. 6301 Vent Scrubber (SAC #67-88) - This is a 2'0" ID x 6'6" (bottom to top) open top Haveg vessel. There is a 4' packed section with polypropylene packing. The packing support ring is a piece of plastic grating.

4. Crude Storage Tank No. 6302/6303 Vent Scrubber (SAC #67-144) - This is a Furan vessel, 12" ID x 11'8" in length. It is designed for liquid full H_2O and 3 psig at 180°F.

5. Crude TCE Feed Pumps #1 & 3 (SAC #55-2487, 2486) - These pumps are Goulds Model 3196 MT pumps size 3 x 4 - 10, with 8 ½" impellers. They are constructed of ductile iron. They are powered by 7 ½ hp motors (SAC #50-4502, 4503) at 3600 rpm.

6. Crude TCE Feed Pumps #2 & 4 (SAC #55-1761, 1762) - These pumps are Durco pumps, size 3 x 2 - 7. They are constructed of ductile iron and are powered by 7 ½ hp motors (SAC #55-2382, 3250) at 3600 rpm.

B. Operation

The organics from the bottom of the lights still is pumped to the crude TCE storage tanks. This material is continually stirred in the storage tank being produced into because of an eductor circulating header mounted inside of each storage tank. The production tank is continually recirculated by a spare TCE feed pump which discharges through a recirculation header into the eductor

circulating header in each tank. The flow of organics from the eductor draws organics through an outer suction header that consists of a vertical header with weep holes on four sides running the length of the header. Organics is drawn into the weep holes and out of the annulus by the flow of organics moving through the eductor. This gives the circulating action to the tank and allows a more consistent composition of feed to be sent to Per-Tri over the duration of the tank transfer.

Each tank is sampled and qualified on moisture (<100 ppm), FeCl (<20 ppm), and TCE content prior to being transferred to Per-Tri.

When a tank is transferred, the material is opened up to the suction of the TCE feed pump being used to transfer organics to Per-Tri and another tank is used for TCE-Tetra Plant production.

The material from the light still reflux drum purge is mixed with the lights still bottoms continually during production. In addition to this stream, Per-Tri DH vent condensate and VDCM heavy still bottoms are also introduced into this stream and eventually fed to Per-Tri as organic feed.

The vents from the TCE storage tanks consist of HCl and organics and are piped into the respective TCE storage tank vent scrubbers where they are scrubbed with water. The tanks are protected from overpressure by seal pots filled with TCE Plant production out of the TCE storage tanks. A level should always be kept in the seal pots to prevent wet air from entering the tank and to keep HCl and organic fumes from escaping through the seal pot. A slight nitrogen purge is maintained on the TCE storage tanks to sweep the HCl and organics through the vent header into the scrubber.

9. UTILITIES & AUXILIARY EQUIPMENT:

Steam and Condensate: Steam to the TCE-Tetra Plant is 150 psig steam supplied from the 150 psig steam system at Per-Tri. An SRV on Per-Tri's steam header protects the line from overpressure. The following list gives the major equipment supplied by the 150 psig steam header.

150 psig Steam

1. Lights Still
2. Lights Still Feed Heater
3. Bottoms Product Preheater
4. Chlorine Vaporizers

The steam condensate from the major equipment, except the chlorine vaporizers, is piped to the Per-Tri condensate collection tank.

The steam headers are provided with small steam traps in low spots or at dead-ends. These traps remove condensate as it collects and are important in that they rule out the possibility of 'water hammer' developing. If condensate collects and is suddenly boiled off, the sudden increased volume and pressure can damage lines and equipment. These traps are also important in freeze precaution.

Cooling Tower Water System:

A. Equipment

1. Cooling Tower Pumps (SAC #55-1698, 1700, 1701) - These pumps are Allis Chalmers single stage vertical pumps model H 16 x 12 VTMC-1. Each pump is rated 4000 gpm at 120' of head. They are powered by 150 hp 1770 rpm motors (SAC #50,3020, 3017, 3018, 3019).

2. Fans (SAC #57-541, 542) - The tower has two 20' diameter, 6 bladed fans (single speed) driven by 100 hp motors (SAC #50-3171, 3172).

3. Sulfuric Acid Storage Tank (SAC #60-1129) - This is a 4' diameter x 4' high steel tank. The design pressure is atmospheric and 3 oz. of vacuum. It is protected from overpressure by an open vent to the atmosphere. A small N_2 purge is maintained on the vessel to prevent moisture ladden air from entering the vent pipe.

4. Cooling Tower - This is a 2-cell tower, counter flow type model 260-568 made by Flour. Overall dimensions are 36' x 60' x 31'.

5. Chemical Treatment Tanks - There are two tanks by Betz that hold various water treatment chemicals.

B. Operation

The cooling tower is designed to cool 12,000 gpm of water from 115°F to 90°F. This water will be supplied to the TCE-Tetra Plant and to the still line at Per-Tri by the 4 vertical cooling tower water pumps.

Two fans pull air through the counterflow-type tower. Each fan is driven by a 100 hp motor with a gear reducer. Loss of either fan sounds an alarm. A vibration switch will stop the motor if vibration is excessive. This vibration could result from misalignment of the drive system or wear in the equipment. The oil level in the gear reducer must be checked periodically.

The vibration switch can be reset by removing the top of the box that contains the switch and replacing the steel ball in its cup-like holder. Low gear reducer oil pressure will shut down the fans also. The low gear reducer oil pressure cut-out switch is set at 4 psi. When starting the fans the start button must be held down until the oil pressure gets above 4 psi or the fan will stop again. There is a pressure gauge mounted near the start/stop button so that the oil pressure can be seen easily when starting the fans.

The cooling action of the tower creates a loss of water by evaporation which causes hardness salt (particularly silica and calcium) to concentrate in the circulating water stream. Concentration to the saturation point will cause plating out of the silica and calcium in the heat exchangers throughout the

system. The degree of concentration is monitored continually by a potentiometer on the return water to the cooling tower. The higher the dissolved salts (hardness) the greater the potential of the cooling water. A set point on the potentiometer indicates at what (hardness) concentration the system is blown down (purged of salts). At this point, the blowdown FCV will open automatically on the return water to the cooling tower and relieve some of it to the storm sewer until the system concentration comes back within range. The concentration of salts in the cooling water is measured by lab analysis and compared with the amount of salts coming into the tower with the well water make-up. This ratio of system hardness to make-up water hardness is called cycles and the system is maintained at 6 to 7 cycles. (The system salts are kept 6 to 7 times higher than the make-up water salts.)

The make-up water to the cooling tower is supplied by the Sabine water distribution system. The level in the basin of the tower is controlled by a LCV in the make-up Sabine water line. An alarm on the control board will sound if the level in the cooling tower basin should drop below a safe point. The level in the cooling tower basin must be maintained at a minimum of 3' above the pump suction or the vertical pumps will not pump as designed.

Tests are run daily on the cooling water and adjustments made as needed on the treatment chemicals. Sulfuric acid can be added to the water to maintain the proper pH. A pH meter monitors the cooling water from the discharge of the pumps and is recorded on the panel board. There are high and low alarms on the cooling water pH.

10. NITROGEN SYSTEM:

Nitrogen is available in the TCE Plant at 90 psig. The consumption of nitrogen should be small since there are no big users in this plant. Nitrogen is used for a few small purges and to operate the piston on the sidearm cooler organics outlet valves, the reactor vent relief valve to the scrubber, CTW blowdown valve, and Cl_2 anti-backup valve. These pistons may not operate properly if the nitrogen supply pressure is below 80 psig. There are nitrogen utility stations in the plant that can be used when clearing lines and vessels.

11. INSTRUMENT AIR SYSTEM:

Instrument air is supplied to the area by Elliot Air compressors located west of vinyl chloride and also by Big 3 Inc. This air is dried and filtered at the compressor building. Plant B air pressure normally runs about 80 psig. In the case of loss of instrument air, the control valves in the TCE Plant are designed to fail in the 'safe' position.

B. POSITION OF CONTROL VALVES ON AIR OR N_2 FAILURE

Process No.	Service	Position	Air Or N_2
FCV-7153	CTW To Process Vent Scrubber	Open	N_2
PCV-7092	HCl To Process Vent Scrubber	Open	N_2
PCV-7063	HCl To OHC Plant	Close	Air
PCV-7005	Steam To #1 TCE Chlorine Vaporizer	Open	Air
PCV-7204	Steam To #2 TCE Chlorine Vaporizer	Open	Air
FCV-7007	EDC To Light Still HCl Absorber	Close	Air
PCV-7010	Chlorine Press To TCE Reactor	Close	Air
LCV-7027	HCl Absorber Bottoms LCV	Close	Air
FCV-7016	Ethylene To TCE Reactor	Close	Air
FCV-7013	Chlorine To TCE Reactor	Close	Air
FCV-7053	Light Still Feed Degasser Feed	Close	Air
TCV-7070	Steam To Light Still Feed Heater	Close	Air
TCV-7066	Steam To HCl Heater	Close	Air
PCV-7068	Light Still Feed	Close	Air
TCV-7078	Steam To Light Still Reboiler	Close	Air
LCV-70-7	Light Still Level	Close	Air
LCV-7128	Light Still Reflux Drum Level	Close	Air
FCV-7129	Light Still Reflux	Close	Air
TCV-7136	Crude TCE Cooler Inlet	Close	Air
FCV-7098	Bottoms To Lights Still	Close	Air
LCV-9006	Make-Up Water To Cooling Tower	Open	N_2
TCV-7038	Organic Outlet From Sidearm Cooler	Open	N_2
TCV-7080	Organic Outlet From Sidearm Cooler	Open	N_2
	Cl_2 Anti-Backup Valve	Close	N_2

IV. START-UP AND SHUTDOWN SECTION

A. REACTOR SYSTEM

The purpose of this section of the Manual is to give a detailed procedure for start-up and shutdown of the Cl_2 vaporizer and TCE reactor.

The lights still should be started up before the TCE reactor is started. During start-up of the lights still, the overheads (recycle from the still) will be sent through the LCV back to the reactor. The bottoms stream can also be sent back as feed to the still. The lights still feed heater should not be put in service until the TCE reactor is started.

Before proceeding on the start-up of either the TCE reactor or the Cl_2 system, the pre-start-up check lists must be completed. As the sequence of starting up the reactor and Cl_2 system progresses, the start-up checklist of each must be referred to and items checked off as they are done. An item must be satisfied on the checklist before proceeding with the next step of the start-up.

1. Sample TCE reactor liquor for no chlorine - use sample point near bottom of TCE reactor and at LSF pump.

2. Start up lights still and have on recycle.

3. Block HCl to OHC Plant PCV and check out the vent PCV to the scrubber for good operation. Introduce N_2 into reactor to mix contents (through spargers).

4. Pressurize TCE reactor and have the TCE side arm coolers out of service. Do not try to purge the reactor with plant N_2 after reactor has been pressurized to above 40 psig. The pressure at the bottom of the reactor will be greater than plant N_2 pressure.

5. About 30 minutes before starting Cl_2 to the TCE reactor, put AIBN into the TCE-Tetra reactor via the recycle stream. Be sure that flow is going to the reactor.

6. Start C_2H_4 to the TCE reactor at 12,000 SCFH. Vent to the scrubber. Check LSF and TCE reactor for chlorination before putting C_2H_4 to the reactor. Shut off the N_2 to the reactor. Build reactor pressure to 80 psig with C_2H_4.

7. Check to be sure CTW flow is established through the TCE reactor overhead condenser and side arm coolers. The manual loaded valves on the organic lines should be closed.

8. The Cl_2 sparger valves should be open and the anti-backup valve should be closed at this point.

9. The downstream block valves of both the Cl_2 PCV to the surge drum and Cl_2 FCV should be blocked as the bypasses will have to be used for start-up. The bypasses of both the Cl_2 FCV and PCV are sealed with a serialized seal. The lead operator must authorize use of the bypass on either one of these control valves. As soon as the bypass has been closed again, it must be immediately resealed by the lead operator and the time and serial number of the new seal will be logged into the log book. These seals carry the same requirements for removal as does a lead operator tag. This policy also applies to the ethylene system.

10. Check liquid Cl_2 line pressure and notify Liquefaction that you are ready for liquid Cl_2 take. On the start-up you will be using about 120 TPD liquid Cl_2. Refer to the checklist concerning Cl_2 vaporizer start-up and check off the items as they are completed. There are items that need to be checked before starting Cl_2 to the reactor.

11. Bleed any condensate out of the Cl_2 vaporizer steam chest and leave bleeds open for start-up. Establish a steam flow through the vaporizer. Be sure no liquid Cl_2 is in the vaporizer as at this point the Cl_2 vaporizer is a closed system.

12. Check for liquid Cl_2 at:

    a. Cl_2 PCV to the surge drum.
    b. Cl_2 surge drum (bottom drain)
    c. Cl_2 FCV.
    d. Cl_2 piping downstream of Cl_2 surge drum.

13. Slowly crack liquid Cl_2 into the Cl_2 vaporizer. Watch PI on Cl_2 vaporizer.

14. Bypass the Cl_2 PCV. Build up to system pressure of 115 psig on the Cl_2 surge drum. Check the anti-backup valve to be sure it is open. ($\triangle P$ between Cl_2 surge drum and TCE reactor greater than 3 psi will open the anti-backup valve.) Be sure the manual trip device on the anti-backup valve has been deactivated.

15. Crack the bypass on the Cl_2 FCV to the TCE reactor and start feeding Cl_2 to the TCE reactor. An operator will have to be at the Cl_2 PCV and one at the Cl_2 FCV. Bring the reactor up to 50 TPD TCE rates. Maintain 115 psig on the Cl_2 surge drum. Watch Cl_2 vaporizer outlet temperature to be sure it is heating up.

16. Check LSF, TCE reactor overhead, and TCE reactor bottom for chlorination.

17. When the temperature alarms on the inlet to the surge drum and Cl_2 surge drum bottom clear green, the low temperature shutdown system (it closes the Cl_2 PCV and FCV at 130°F) is deactivated. However, rather than trying to put the FCV and PCV into service (and risk a premature shutdown) do not put the control valves into service until the Cl_2 temperature into the surge drum and the Cl_2 surge drum bottom temperature are both above 150°F.

18. Check LSF and TCE reactor overhead for chlorination. Start cutting C_2H_4 stepwise keeping a close check on the reactor for chlorination.

19. Reset the Cl_2 PCV and FCV shutdown system on the panel board. Check the Cl_2 PCV and FCV for good operation and put them in service. As soon as the bypass valves are closed, the lead operator will seal them both and log the seal numbers (and times) in the log book.

20. Once the ethylene is blocked at the TCE reactor and the Cl_2 PCV and FCV are put in service. Then the HCl can be diverted from the scrubber to OHC.

21. As the rates are increased, additional cooling can be obtained by opening the manual load valves on the side arm coolers.

B. CHLORINE SYSTEM

Start-up and shutdown of the chlorine system should be carried out with the following points in mind:

1. Never leave liquid chlorine trapped in a vessel or line - particularly one which has a heat source other than ambient temperature.

2. Vaporized chlorine will condense in the piping and surge drum when under normal liquid line pressure and normal ambient temperature.

3. Any change in liquid chlorine flow will effect the other users, in that the line pressure will change. Sudden, large changes could possibly lead to closing of the excess flow valves on the chlorine feed tanks.

The start-up of an empty vaporizer is accomplished (assuming the vaporizer is already dry and ready for use) by first establishing a steam flow through the chest. Partial bypassing of the steam traps will be necessary at this point. Maintain a 2 psig steam chest pressure. Slowly open the inlet chlorine valve (with all outlet valves closed). The liquid will vaporize until the pressure in the vaporizer is equal to the feed line pressure. At this time,

the inlet line next to the vaporizer will feel warm - as there will be an equilibrium condition here such that a small flow of chlorine will flow into the vaporizer, boil off and blow back up the inlet liquid line until it recondenses. When this condition is reached, the inlet valve can be fully opened and flow started forward through the pressure control system, while paying careful attention to the steam chest pressure.

Chlorine vaporizer shutdown is accomplished by slowly reducing chlorine flow off the vaporizer to the cut-off point. Then close the block valves at the pressure control valve. At this point the vaporizer is in the equilibrium condition described in the start-up sequence. This is a safe way to leave a chlorine vaporizer, and leaves it ready for easy start-up. An alternate method is to slowly shut down chlorine flow by closing the inlet chlorine valve, while leaving steam chest pressure at 2 psig. No liquid will form in the vaporizer under this condition; however, liquid chlorine could form in the downstream line and surge drum under ambient temperature conditions. Also, start-up involves coordinating the very slow opening of the inlet chlorine valve with the establishment of downstream chlorine flow and subsequent increases in steam chest pressure as rates are increased.

C. TCE-TETRA REACTOR SHUTDOWN

Shutdown of the TCE Plant can be as follows:

1. Notify Liquefaction that the TCE Plant is to be shut down.
2. Decrease reactor rate over reasonable time so as not to adversely affect other liquid chlorine users.
3. Drop lights still feed rate while cutting reactor rate. Be sure that the steam to the lights still feed heater is blocked before feed is cut off the lights still.
4. Once HCl is no longer being sent to OHC, shut the TCE reactor down at a steady rate being careful not to upset liquid chlorine users.
5. Block off feed to lights still from the Tetra reactor.
6. Be sure all feeds to the reactor are blocked.

In the event of a shutdown that involves one of the safeguard systems on the Cl_2 system, follow the below listed procedure for shutting down the TCE section and other equipment.

1. Thoroughly check the Cl_2 system to determine the cause of the malfunction - is it truly an upset or did an instrument fail.
2. If there is no liquid Cl_2 in the system (and the malfunction is due to instrument failure), break the seals on the bypass valves on the Cl_2 PCV and FCV (log in log book) and start the Cl_2 system back up. Get someone out to work on the instrumentation. Refer to the check lists and start-up procedures for the TCE reactor and Cl_2 vaporizer. Check TCE reactor for Cl_2 before starting up (reactor and LSF). Check for Cl_2 often on start-up. Be sure the Tetra reactor bottom temperature is above 200°F and AIBN is still being fed to the reactor.
3. If there is liquid Cl_2 in the system, notify supervision and shut the plant down as follows:
4. Block the Cl_2 FCV to the TCE reactor. Manually trip the anti-backup valve on the Cl_2 to the TCE reactor.
5. Block the HCl PCV going to the OHC Plant.
6. Take TCE reactor side arm coolers out of service.
7. Block Cl_2 PCV to Cl_2 surge drum.
8. Put lights still on recycle or bottom product feed (min. 40 gpm).
9. Shut off AIBN to the reactor

10. Check LSF and TCE reactor for chlorination.

11. Check all equipment that has been completely shut down to be sure there is a positive pressure to eliminate getting water into the system.

D. LIGHTS STILL SYSTEM

The following sequence should be used for start-up.

1. The entire system should be dried and then purged with nitrogen until the oxygen concentration is less than 1%.

2. Put the pad system in service.

3. Establish operating levels within the reflux drum and the still.

4. A circulation flow can now be established out the bottom of the still to the suction of the lights still bottoms pump through the rework line back to the still reflux system.

5. Cooling water flow should be established through the overhead condenser and bottoms cooler.

6. Light still reflux drum purge lined up to the OHC Per-Tri tanks.

7. The still is now ready for heatup. The steam condensate flow should be blocked from the condensate collection system and open to the pad. After all residual steam condensate has been drained to the pad, very slowly start steam flow to the still (the flow control valve may be used if it does not leak through - otherwise, the bypass should be used initially). During the initial start-up, or following reboiler maintenance, trapped air in the steam jacket may have to be bled off.

   The still temperature profile should be observed during the heatup; the steam should be flow-controlled to give a moderate rate of temperature rise. The reboiler level should be watched closely and any steps necessary to maintain the proper operating level must be taken (change steam flow, feed flow, etc.). The reboiler design calls for the liquid level in the column to be at the top tube sheet of the reboiler.

8. Overhead vapor flow will be indicated by a temperature rise at the top of the still. The bottoms pumps should be lined up to product storage and the still LCV put in service. The reflux pumps should be started when the level starts to increase in the reflux drum. The reflux drum level controller should be put in service. The still level should be maintained with make-up feed from the Bottoms Plant product or Tetra reactor.

9. The steam flow, feed flow, and reflux flow should be adjusted to match the feed rate and content expected to be fed to the still. The condensate flow may be directed to the condensate collection system at any time after the reboiler is hot. Care should be taken in this switch-over, since the reboiler chest pressure may be initially below the condensate system pressure.

10. The recycle system can now be put in service and recycle fed back to the reactor or a purge taken from the light still reflux and sent to the OHC Per-Tri tanks.

The following sequence should be used for shutdown:

1. Decrease feed, steam, and reflux rates slowly until completely shut off. Shut down all pumps.

2. Leave nitrogen pad in service.

E. EMERGENCY SHUTDOWNS

Loss of power, instrument air, nitrogen, cooling water, chlorine, and EDC (other than momentary loss) will require complete shutdown of the TCE-Tetra unit. This shutdown will involve taking the following actions.

1. Block liquid chlorine going to vaporizers, block chlorine PCV and FCV and other feeds to the reactor. Trip the chlorine anti-backup valve.
2. Block HCl to OHC and make sure valve to scrubber is open (scrubber valve may be blocked as soon as HCl evolution stops).
3. Shut down still - block steam, feed, reflux and shut down pumps.

In the event the OHC Plant shuts down on an emergency basis, the TCE-Tetra rate should be reduced to a low rate with the HCl going to the scrubber. A long-term outage of OHC will then result in an orderly TCE-Tetra shutdown as described on page 4-5.

F. START-UP CHECKLIST

Cl_2 VAPORIZER START-UP CHECKLIST

Initial

_____ 1. Cl_2 PCV and FCV block valves blocked. Bypass shut.

_____ 2. Liquid Cl_2 or organic check:

_____ a. Cl_2 vaporizer

_____ b. Cl_2 PCV

_____ c. Cl_2 surge drum

_____ d. Cl_2 FCV

_____ e. Cl_2 piping downstream of Cl_2 surge drum

_____ 3. Steam condensate drained from Cl_2 vaporizer. Drains open.

_____ 4. Liquid Cl_2 line pressure up to 130 psig maximum. Liquefaction notified for Cl_2 take.

_____ 5. Establish steam flow through the chest maintaining a 2 psig steam chest pressure; bypass on traps partially open.

_____ 6. Slowly open inlet Cl_2 valve; when inlet line to vaporizer feels warm (vaporizer is in equilibrium condition when this occurs), fully open inlet Cl_2 valve.

TETRA REACTOR PRE-START UP CHECKLIST

Date _____
Lead Operator _____
Operator _____

Initial

_____ 1. Tetra reactor bottom and light still feed sampled for assurance of no Cl_2.

_____ 2. Cl_2 PCV and bypass blocked.

_____ 3. Cl_2 FCV and bypass blocked.

_____ 4. Reactor PCV and bypass blocked.

_____ 5. Reactor BPCV in service and wide open.

_____ 6. Cl_2 anti-backup valve closed.

_____ 7. Cl_2 sparger valves open.

_____ 8. Nitrogen purge the reactor through Cl_2 spargers downstream of Cl_2 anti-backup valve (minimum 15 minutes).

_____ 9. Raise reactor pressure to 40 psig; establish feed to light still and a recycle flow back to the reactor.

_____ 10. Establish AIBN flow to suction of recycle pumps (approximately .8 gpm).

_____ 11. Check Tetra reactor for no O_2 (vapor space).

_____ 12. If O_2 check is good, remove N_2 purge.

_____ 13. Raise reactor pressure to 80 psig; establish C_2H_4 flow to reactor at 12,000 SCFH.

_____ 14. Side arm coolers and forced circulation cooler out of service (organic side).

_____ 15. CTW flow through reactor condenser, side arm coolers, and forced circulation cooler.

_____ 16. EDC feed to reactor ready.

_____ 17. Steam tracing on Cl_2 pressure and flow impulse lines.

_____ 18. Divert Tetra scrubber water to WTU.

TETRA REACTOR START-UP CHECKLIST

Initial

_____ 1. Cl_2 vaporizer floating on line up to Cl_2 PCV.

_____ 2. Reactor BPCV in controlling position at 80 psig after reactor contents saturated with C_2H_4.

_____ 3. a. Have Liquefaction raise liquid Cl_2 header pressure up to approximately 180 psig.

_____ b. Cl_2 surge drum pressured up to 115 psig.

_____ 4. Cl_2 anti-backup valve switch in normal position with valve open.

_____ 5. Cl_2 to Tetra reactor at 112 TPD Cl_2 rates (stepwise).
_____ a. Chlorination checks
_____ b. Reactor bottoms
_____ c. Light still feed
_____ d. Reactor overheads

_____ 6. Cl_2 surge drum inlet and bottom temperatures above 130°F (alarm green).

_____ 7. Tetra reactor temperature at 250°F.

_____ 8. Tetra reactor pressure at 80 psig.

_____ 9. Chlorination checks
_____ a. Reactor bottoms
_____ b. Light still feed
_____ c. Reactor overheads

_____ 10. C_2H_4 reduction stepwise with chlorination checks.

_____ 11. C_2H_4 valve at reactor blocked, sealed, seal No. logged in log book.

_____ 12. C_2H_4 FCV blocked. Bypass shut, sealed. Seal No. logged in log book.

_____ 13. Reset Tetra shutdown system.
_____ a. Stroke Cl_2 PCV
_____ b. Stroke Cl_2 FCV
_____ c. Stroke reactor PCV

_____ 14. Cl_2 PCV in service. Bypass shut, sealed. Seal No. logged in log book.

_____ 15. Cl_2 FCV in service. Bypass shut sealed. Seal No. logged in log book.

_____ 16. Reactor PCV in service. Bypass shut, sealed. Seal No. logged in log book.

CLASSIFIED DRAWING
Not to be reproduced without approval of Project Engineer, Plant Engineer, or Process Engineering Group Leader.

REVISIONS

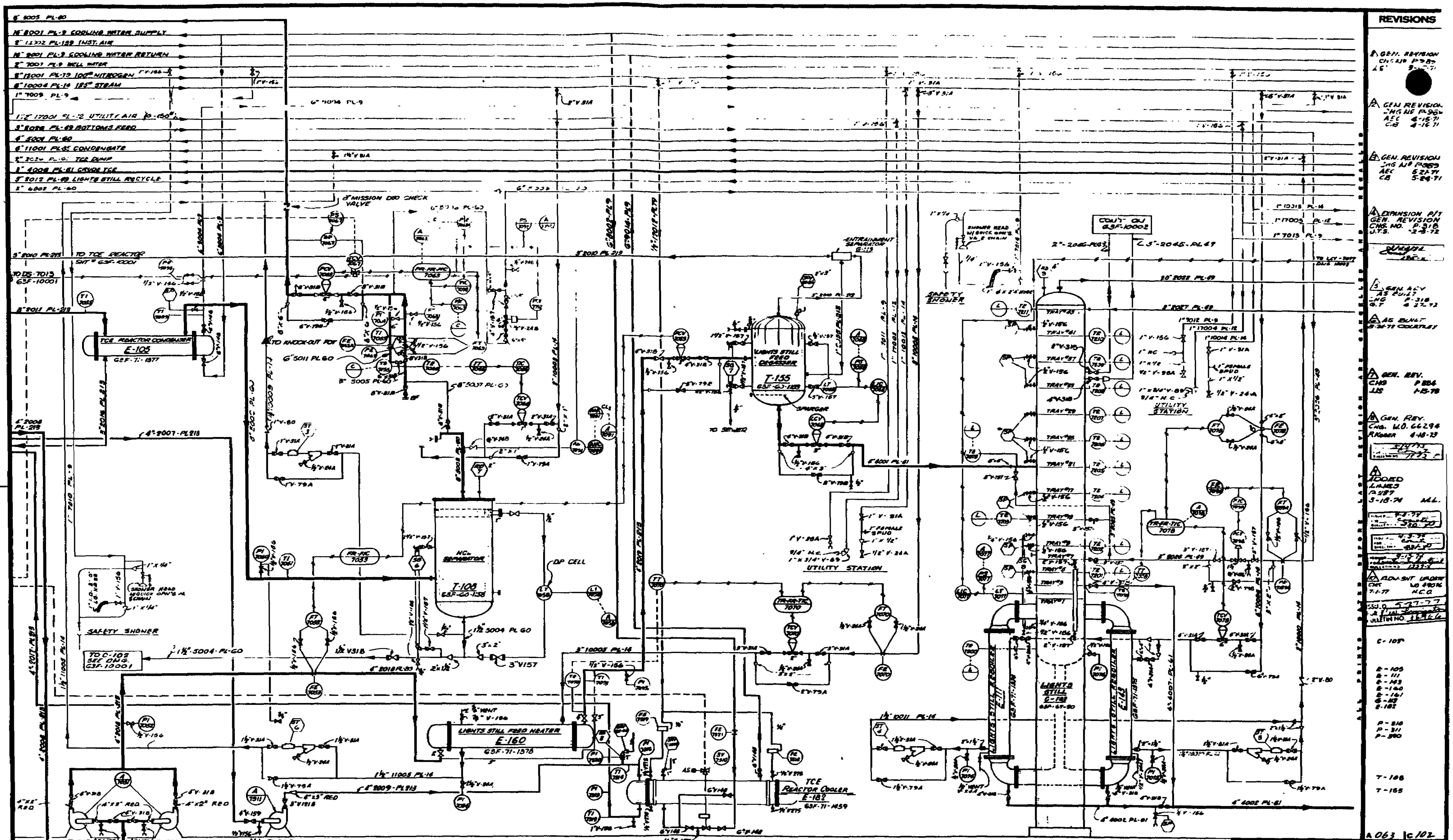
CONFIDENTIAL:
Subject to Protective Order
of 14th Judicial District Court
No. 91-1145

SL 001164

INDUSTRIAL CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA

'71 PER-TRI EXPANSION
CRUDE TCE PLANT
MECHANICAL FLOW SHEET
SHEET 1 OF 4

DWG. 63F-10001.H



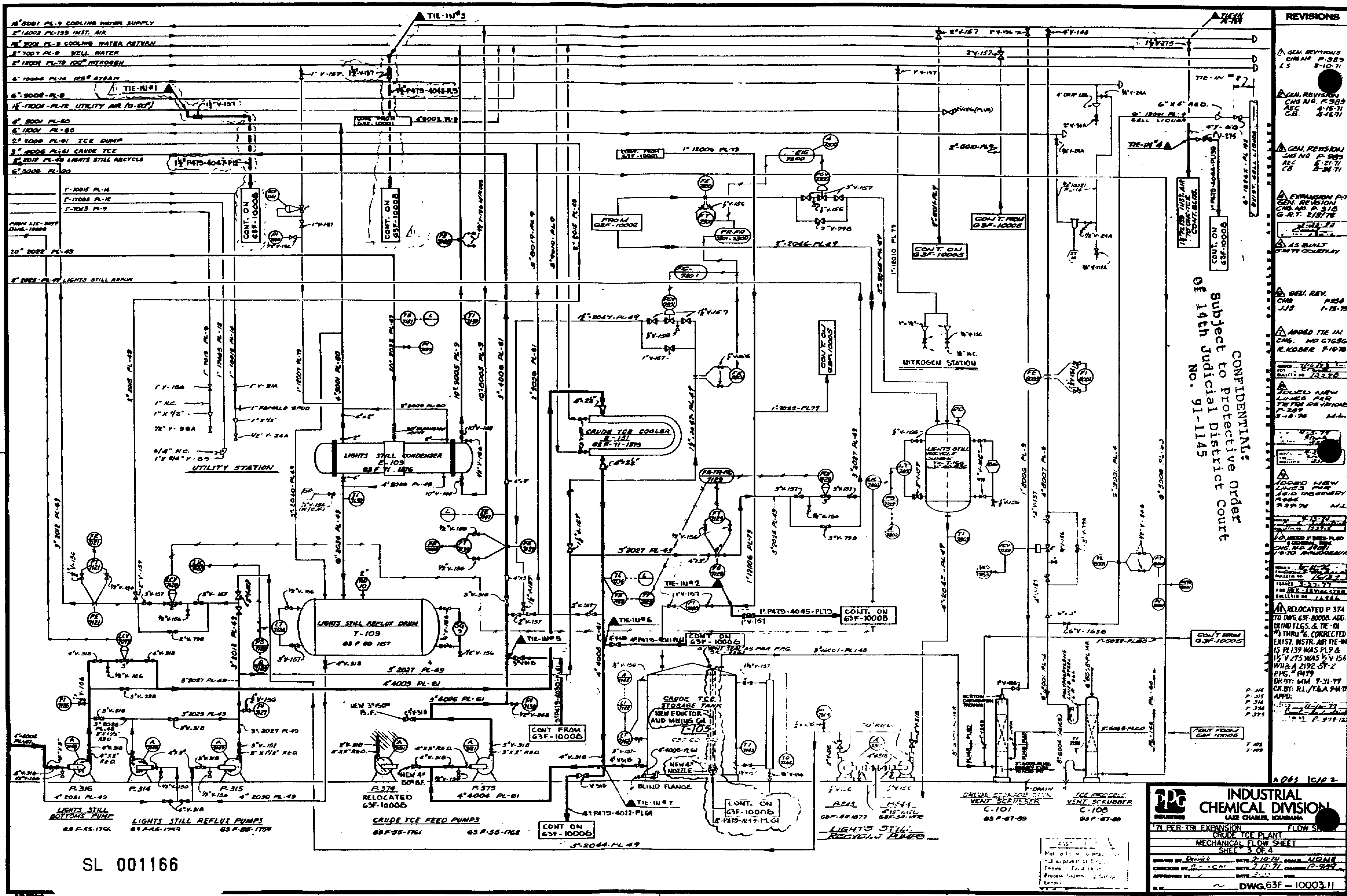
INDUSTRIAL CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA

'71 PER-TRI EXPANSION FLOW SHEET
CRUDE TCE PLANT
MECHANICAL FLOW SHEET
SHEET 2 OF 4

DWG. 63F-10002.10

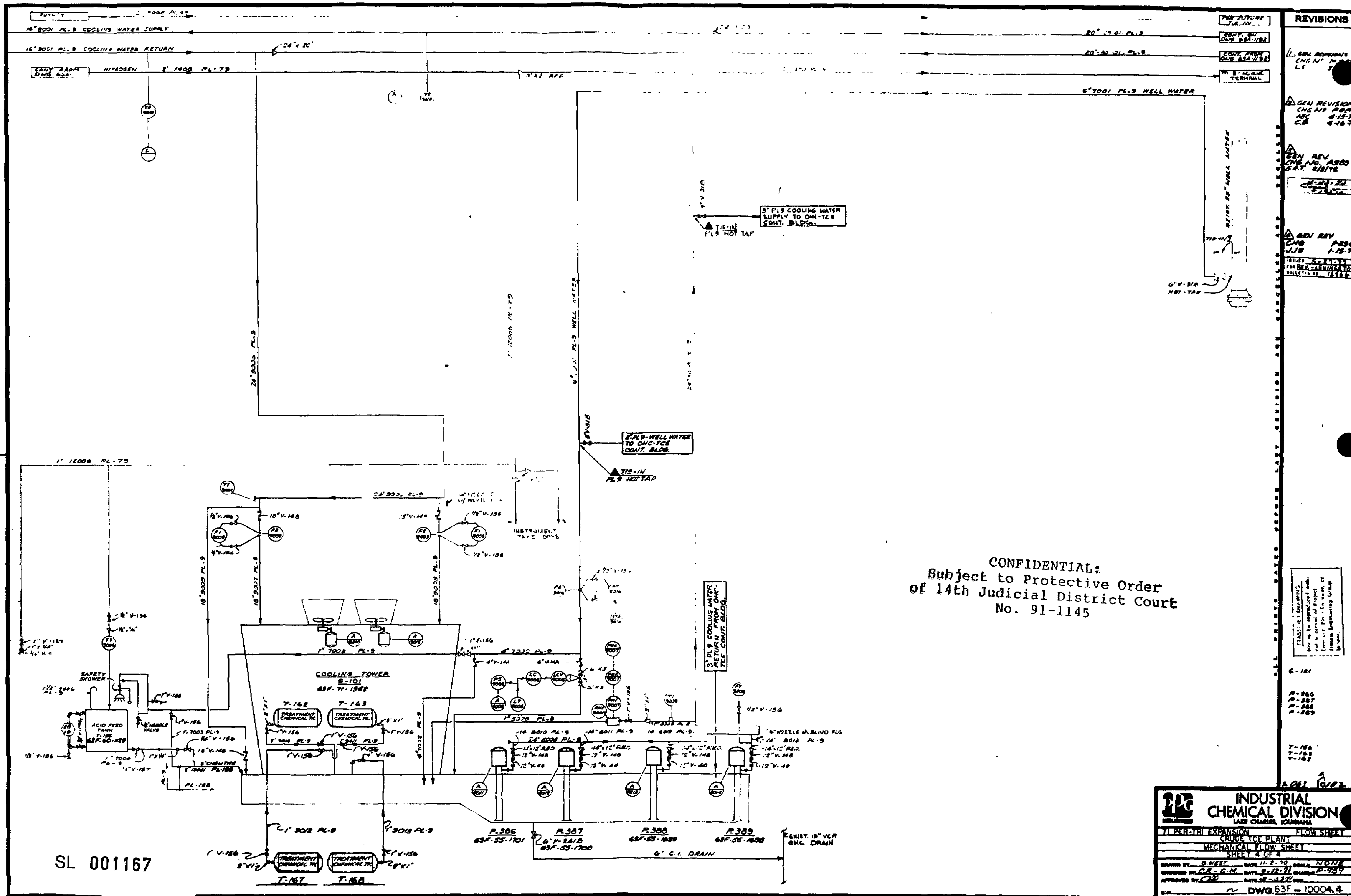
CONFIDENTIAL:
Subject to Protective Order
of 14th Judicial District Court
No. 91-1145

SL 001165



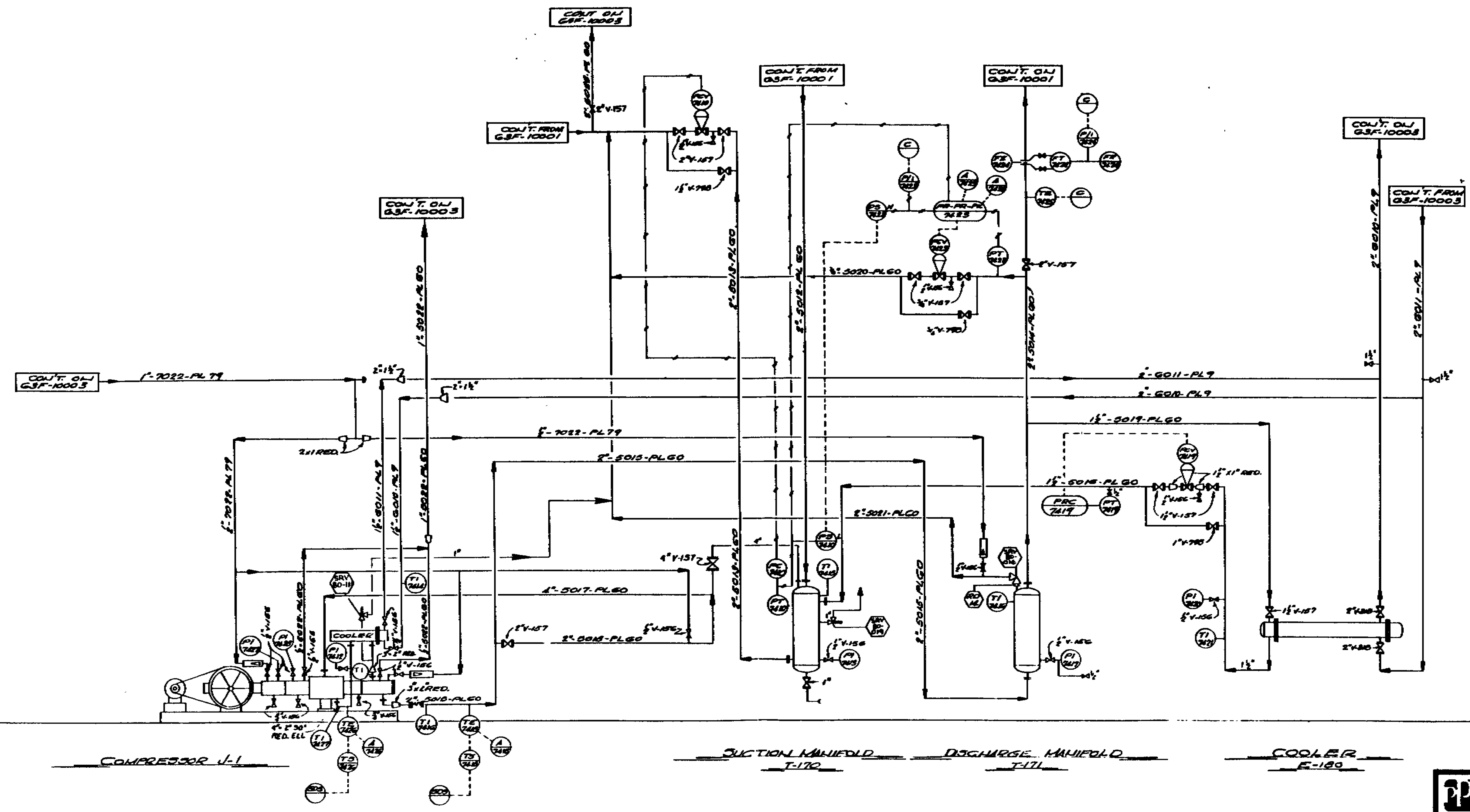
CONFIDENTIAL:
Subject to Protective Order
of 14th Judicial District Court
No. 91-1145

SL 001166



CONFIDENTIAL:
Subject to Protective Order
of 14th Judicial District Court
No. 91-1145

SL 001167



REVISIONS

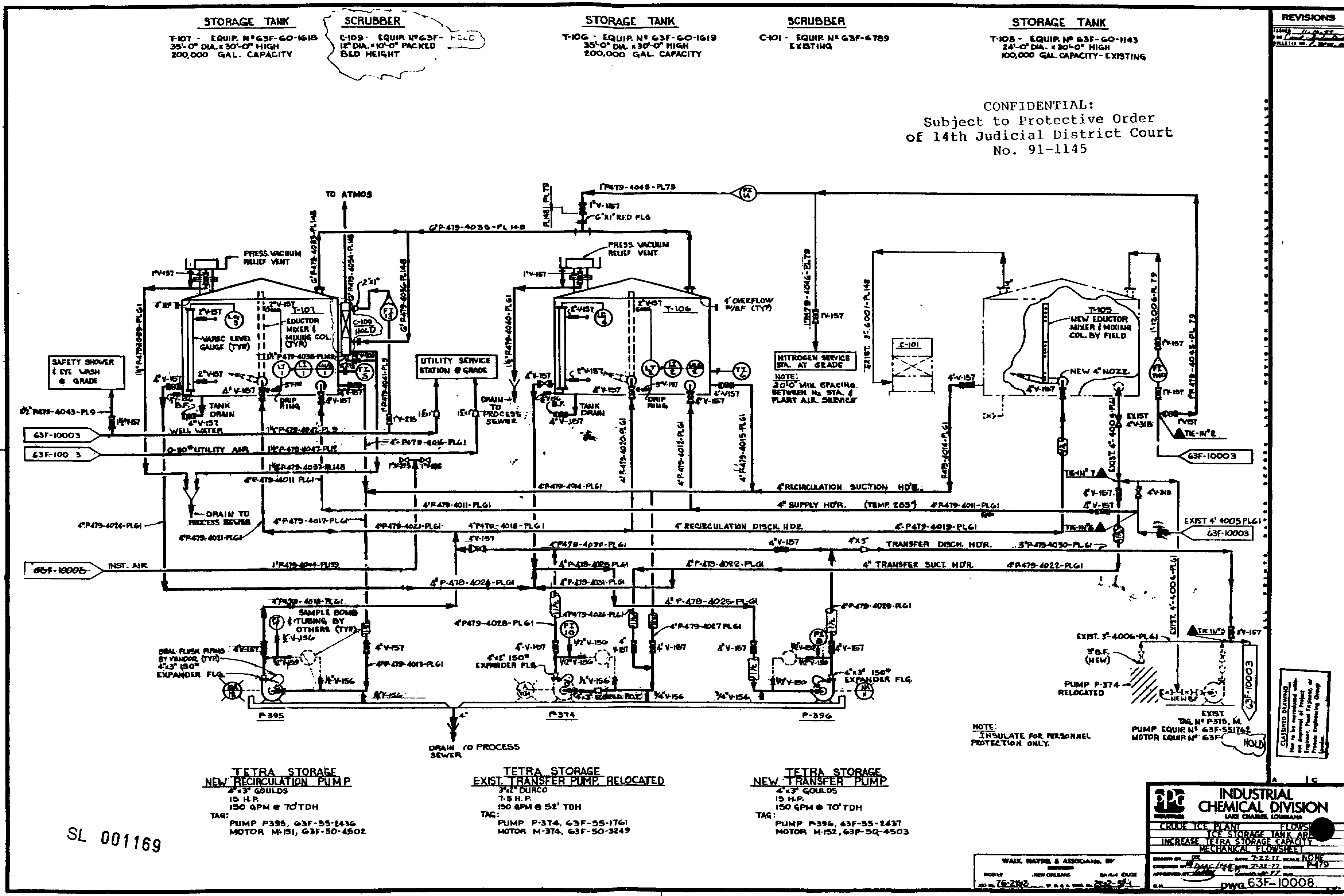
CLASSIFIED DRAWING

INDUSTRIAL CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA

TCE PLANT FLOW SHEET
ACID RECOVERY
MECHANICAL FLOW SHEET

DWG 63F-10005.2

SL 001168



STORAGE TANK
T-107 - EQUIP. Nº 63F-60-1618
35'-0" DIA. x 30'-0" HIGH
200,000 GAL. CAPACITY
SCRUBBER
C-109 - EQUIP. Nº 63F- HOLD
12" DIA. x 10'-0" PACKED
BED HEIGHT
STORAGE TANK
T-106 - EQUIP. Nº 63F-60-1619
35'-0" DIA. x 30'-0" HIGH
200,000 GAL. CAPACITY
SCRUBBER
C-101 - EQUIP. Nº 63F-6789
EXISTING
STORAGE TANK
T-105 - EQUIP. Nº 63F-60-1143
24'-0" DIA. x 30'-0" HIGH
100,000 GAL. CAPACITY - EXISTING
REVISIONS
CONFIDENTIAL:
Subject to Protective Order
of 14th Judicial District Court
No. 91-1145
TO ATMOS
PRESS. VACUUM RELIEF VENT
SAFETY SHOWER & EYE WASH @ GRADE
UTILITY SERVICE STATION @ GRADE
NITROGEN SERVICE STA. AT GRADE
NOTE: 20'-0" MIN. SPACING BETWEEN N2 STA. & PLANT AIR SERVICE
NEW EDUCTOR MIXER & MIXING COL. BY FIELD
NEW 4" NOZZ.
4" OVERFLOW W/BF (TYP)
4" RECIRCULATION SUCTION HD'R.
4" SUPPLY HD'R. (TEMP. 285°)
4" RECIRCULATION DISCH. HDR.
TRANSFER DISCH. HD'R.
4" TRANSFER SUCT. HD'R.
DRAIN TO PROCESS SEWER
INST. AIR
0-80# UTILITY AIR
WELL WATER
63F-10003
63F-10003
SAMPLE BOMB & TUBING BY OTHERS (TYP)
SEAL FLUSH PIPING BY VENDOR (TYP)
4"x3" 150# EXPANDER FLG.
P-395
P-374
P-396
DRAIN TO PROCESS SEWER
PUMP P-374 RELOCATED
EXIST. TAG Nº P-375, M.
PUMP EQUIP. Nº 63F-55-1762
MOTOR EQUIP. Nº 63F- HOLD
NOTE: INSULATE FOR PERSONNEL PROTECTION ONLY.
TETRA STORAGE
NEW RECIRCULATION PUMP
4"x3" GOULDS
15 H.P.
150 GPM @ 70' TDH
TAG:
PUMP P395, 63F-55-2436
MOTOR M-151, 63F-50-4502
TETRA STORAGE
EXIST. TRANSFER PUMP, RELOCATED
3"x2" DURCO
7.5 H.P.
150 GPM @ 52' TDH
TAG:
PUMP P-374, 63F-55-1761
MOTOR M-374, 63F-50-3249
TETRA STORAGE
NEW TRANSFER PUMP
4"x3" GOULDS
15 H.P.
150 GPM @ 70' TDH
TAG:
PUMP P-396, 63F-55-2437
MOTOR M-152, 63F-50-4503
SL 001169
WALK, HAYDEL & ASSOCIATES, INC.
76-2152
PPG INDUSTRIAL CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA
CRUDE TCE PLANT
TCE STORAGE TANK AREA
INCREASE TETRA STORAGE CAPACITY
MECHANICAL FLOWSHEET
7-22-77
SCALE NONE
P479
DWG. 63F-10008

LINE LIST

LINE NO	LINE SIZE	SPEC. NO	FROM	TO	MAT'L CONVEYED	FLOW	TEMP.	SPEC GRAVITY	VISC CP.	EQUIV. LENGTH PIPE	ΔP/100	INSULATION SPEC	STEAM TRACE SPEC	FLOW SHEET NO	REMARKS
1001	1½"	PL-51	ETHYLENE SUP TIE-IN	TCE REACTOR R-102	ETHYLENE							NONE		G3F-10001	
1002	1"	PL-51	LINE 1001	T-155	ETHYLENE							NONE			
1400	3 & 2"	PL-75	6" 1700 PL-101 (ONC AREA)	FUTURE TIE-IN	N_2									10002	
2001	3"	PL-49	EDC SUP. TIE-IN	E-158	EDC							NONE		G3F-10001	
2002	3	PL-49	E-158	C-102	EDC										
2003	1"	PL-49	T-110, T161	P-318 & P-319	EDC										
2004	½"	PL-49	P-318 & P-319	R-102	EDC										
2005	3"	PL-49	C-102	P-312 & P-313	EDC										
2006	3"	PL-49	P-312 & P-313	R-102	EDC										
2008	4"	PL-213	R-102	P-310 & P-311	TCE		220°F					Efg: I&I: A		G3F-000 & G3F-10002	PERSONNEL PROTECTION (PUMP SUCTIONS)
2009	4	PL-213	R-102	LINE 2008	TCE							NONE		G3F-10001	
2010	3"	PL-213	T-155	R-102	TCE		250°F					Efg·I&I·AB		G3F-6001 10002	
2011	8"	PL-213	R-102	E-105	HCL-ORGANIC VAPOR							NONE		10001 & 10002	
2012	3"	PL-49	2027	R-102	EDC							NONE		10001, 10002 & 10003	
2013	2"	PL-49	E-106	P-381	TCE		220°F					Efg·I&I: A		10002	PERSONNEL PROTECTION (PUMP SUCTION)
2014	2"	PL-49	P-381	2036	TCE		220°F					Efg·I&I A		10002	PERSONNEL PROTECTION (PUMP DISCHARGE)
2015	2"	PL-49	2012	2036	EDC							NONE		10002	
2016	2	PL-49	E-105	T-151	EDC							NONE		10002	
2017	2"	PL-49	T-151	C-103	EDC							NONE		10002	
2018	4"	PL-136	P-310 & P-311	E-160	TCE		250°F					Efg·I&I: AB		10002	
2019	4"	PL-136	E-160	T-155	TCE		180°F					Efg·I&I A		10002	
2020	3"	PL-49	2023 & 2027	E-151	EDC		150°F					Efg I&I: AB		10003	
2021	2"	PL-49	2017	4001	TCE		260°F					Efg: I&I· AB		10002	
[illegible]2	20"	PL-49	C-103	E-109	EDC VAPORS							NONE		10002 & 10003	
[illegible]	3"	PL-49	2020 & 2027	C-103	EDC							Efg·I&I·AB		10002 & 10003	PERSONNEL PROTECTION (THRU LAST BLOCK VALVE @ CONTROL STA FCV 322 [illegible])
2024															
2025	3"	PL-49	2026	4001	TCE							NONE		10002	
2026	3"	PL-49	BOTTOMS PROD. LINE	C-103	TCE							NONE		10001 & 10002	
2027	3"	PL-49	P-315	2020 & 2023	EDC		150°					Efg·I&I· A		10003	PERSONNEL PROTECTION (PUMP DISCHARGE)
2028	3"	PL-49	P-314	4003	EDC		280°					Efg I&I AB		10003	
2029	3"	PL-49	2028	2027	EDC		150°					Efg·I&I· A		10003	PERSONNEL PROTECTION
2030	4"	PL-49	T-109	2031 & P-315	EDC		150°					Efg: I&I· A		10003	PERSONNEL PROTECTION (PUMP SUCTION)
2031	4"	PL-49	4002	2030 & P-314	TCE		280°					Efg: I&I· AB		10003	
2033	3"	PL-49	E-151	2023	EDC		150°					Efg I&I: AB		10003	PERSONNEL PROTECTION
2034	6"	PL-49	E-109	T-109	EDC							NONE		10003	
2035	1"	PL-213	G-113	T-155	EDC		260°					Efg·I&I· AB		10002	
2036	2"	PL-61	4005 & 4006	T-10 ONC PLT.	TCE							NONE		10001, 10002, 10003	
2037	1"	PL-49	2002	T-161	EDC									10001	
2038	3"	PL-49	2002	2005	EDC									10001	
2039	4"	PL-49	E-109	2034	EDC		150°					Efg·I&I· AB		10003	
2040	3"	PL-49	T-109	5001	EDC							NONE		10003	
041	4"	PL-49	SRV 9	ATMOSPHERE	HCL ORGANIC VAPOR							NONE		1000[illegible]	

REVISIONS

PITTSBURGH PLATE GLASS COMPANY
CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA
71 PER-TRI EXPANSION FLOW SHEET
CRUDE TCE [illegible]
PIPE LINE SCHEDULE
[illegible] SHEET OF —
DRAWN BY T. HUGHES DATE [illegible] SCALE NONE
CHECKED BY CM DATE [illegible] [illegible] P-[illegible]
APPROVED BY

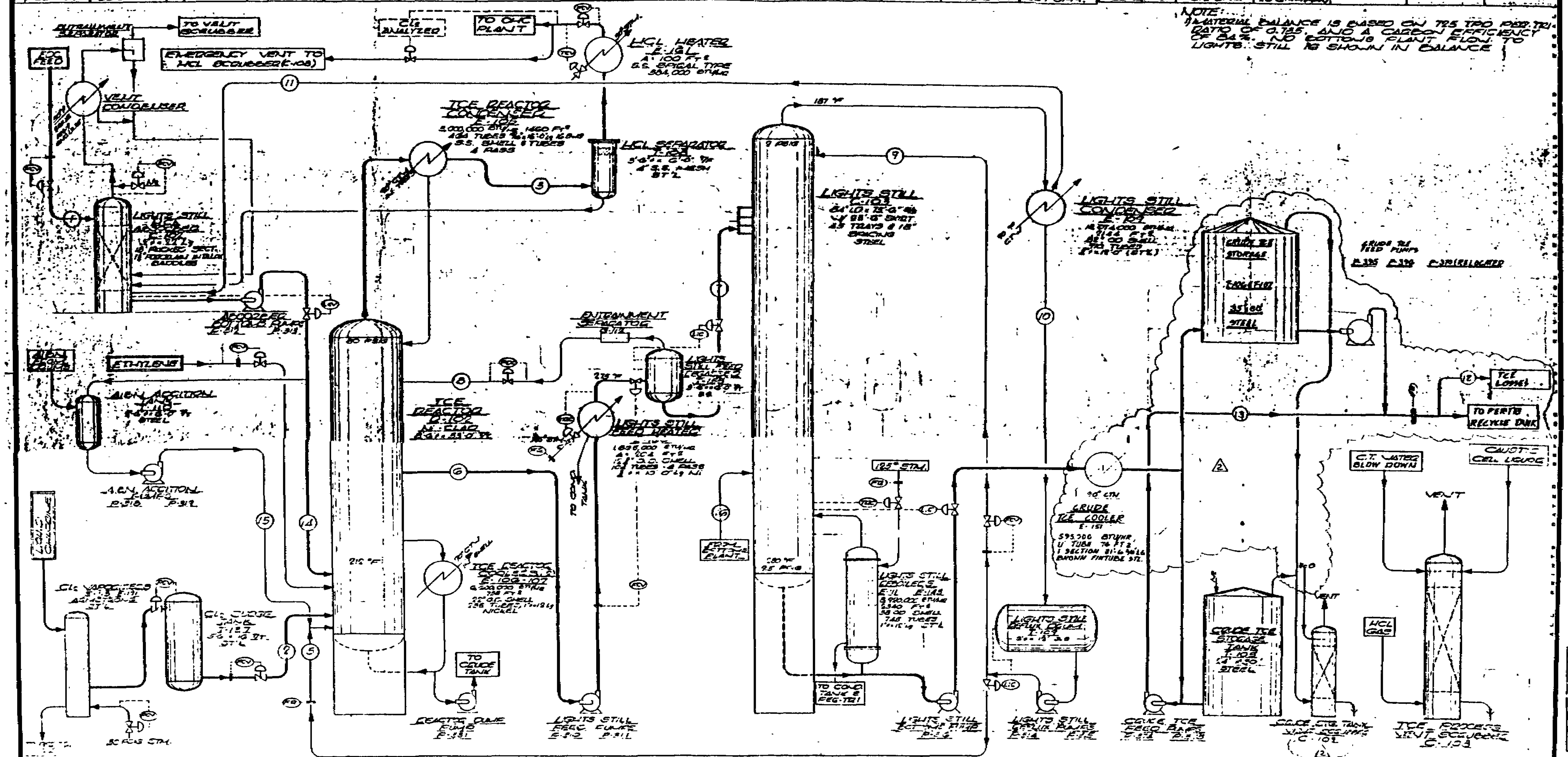
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	WT. %	LBS/HR	MOL %	LBS/HR	MOL %	LBS/HR			WT %	LBS/HR	WT %	LBS/HR	WT %	LBS/HR	MOL %	LBS/HR
HCL					97.60	23,273			0.70	60	1.60	1,092	0.39	283	71.75	809
EDC					1.60	990			93.30	7464	9.80	7,170	9.75	6,965	8.53	255
TCE	100	51,090			0.80	789			6.00	490	59.20	43,017	59.78	42,671	16.75	690
UNSYM. T.											13.30	9,679	13.57	9,583	1.85	96
SYM. T.											13.30	9,679	13.57	9,619	1.16	60
PENTA											2.90	2,151	3.02	2,142	0.15	9
ACN.																
CL_2			100	45,787												
TOTAL		51,090		45,787		25,002				8,000		72,788		71,215		1,919
FLOW	85 GPM		93,500 SCFH		234,500 SCFH				15 GPM		107 GPM		115 GPM		11,000 SCFH	

	(9)		(10)		(11)		(12)		(13)		(14)		(15)		(16)	
	WT %	LBS/HR	WT %	LBS/HR	MOL %	LBS/HR	WT %	LBS/HR	WT %	LBS/HR	WT %	LBS/HR	WT %	LBS/HR	WT%	LBS/HR
HCL	0.70	224	0.70	280	74.70	574					0.75	374				
EDC	93.30	29,856	93.30	37,320	24.90	537			1.00	710	99.24	51,427	99.00	100	90.00	
TCE	6.00	1,920	6.00	2,400	0.40	7	100	150	66.00	47,258	0.01	7			25.00	
UNSYM. T.									14.85	10,628					15.00	
SYM. T.									14.85	10,628					30.00	
PENTA									3.30	2,306					10.00	
ACN.													1.00	1	(AS 2200 TO MAX OF 10 TPH)	
CL_2																
TOTAL		32,000		40,000		718		150		71,572		51,808		101		
FLOW	52 GPM		65 GPM		4,880 SCFH		0.2 GPM		107 GPM		85 GPM		0.2 GPM		28 GPM(MAX)	

REVISIONS

△ AS BUILT

NOTE:
1) MATERIAL BALANCE IS BASED ON 725 TPD FEED. TRI RATIO OF 0.725, AND A CARBON EFFICIENCY OF 84%. NO BOTTOMS PLANT FLOW TO LIGHTS STILL IS SHOWN IN BALANCE



SL 001171

CONFIDENTIAL:
Subject to Protective Order
of 14th Judicial District Court
No. 91-1145

PPG INDUSTRIES
CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA

PROCESS FLOWSHEET
TCE SECTION

DWG. 23F-10023-2

A0031C102

LINE LIST

LINE NO	LINE SIZE	SPEC NO	FROM	TO	MAT'L CONVEYED	FLOW	TEMP	SPEC GRAVITY	VISC CP.	NOMN. LENGTH PIPE	ΔP 100	INSULATION SPEC	STEAM TRACE SPEC	FLOW SHEET NO.			REMARKS
3001	3"	PL-7	Cl_2 SUPPLY TIE-IN	E-113 & E-176	LIQUID Cl_2							NONE		1000'			
3501	4"&6"	PL-74	E-176	T-137	VAPOR Cl_2							Efg. 1&1. A		10001			
3502	6"	PL-74	T-137	R-102	VAPOR Cl_2							Efg 1&1. A		10001			
3503	4"	PL-74	E-113	3501	VAPOR Cl_2							Efg 1&1 A		10001			
3504	6"&4"	PL-74	E-176, SRV-1	VENT	VAPOR Cl_2							NONE		10001			
3505	4"	PL-74	E-113, SRV-3	3504	VAPOR Cl_2									10001			
3506	4"	PL-74	T-137	3504	VAPOR Cl_2									10001			
3507	4"	PL-74	3501	3502	VAPOR Cl_2							Efg 1&1. A		10001			
3508	6"	PL-74	3502	3502	VAPOR Cl_2							Efg 1&1. A		10001			
3509	4"	PL-74	SRV-7	3504	VAPOR Cl_2							NONE		10001			
3510	4"	PL-74	E-176, SRV-2	3504	VAPOR Cl_2							NONE		10001			
3511	4"	PL-74	E-113, SRV-4	3504	VAPOR Cl_2							NONE		"			
4001	4"	PL-61	T-155	C-103	TCE		260°F.					Efg: 1&1: AB		10002			
4002	4"	PL-61	[illegible] & E-143	P-316	TCE		280°F					Efg: 1&1: A		10002 & 10003			PERSONNEL PROTECTION (PUMP SUCTION)
4003	4"	PL-61	P-316	E-151	TCE		280°F					Efg: 1&1: A		10003			" " (PUMP DISCHARGE)
4004	4"	PL-61	T-105	P-374 & P-375	TCE		220°F					Efg: 1&1: A		10003			" " (PUMP SUCTIONS)
4005	4"	PL-61	E-151	4004	TCE		220°F					Efg: 1&1: AB		10003			
4006	3"	PL-61	P-374 & P-375	T-19 OHC	CRUDE TCE		250°F					Efg 1&1: A		10001, 10002 & 10003			PERSONNEL PROTECTION (PUMP DISCHARGES)
4007	4"	PL-61	C-103	4002	CRUDE TCE		280°F					Efg 1&1 AB		10002			
4008	4"	PL-61	T-105	DRAIN	CRUDE TCE							NONE		10003			
4009	3"	PL-61	T-105	6001	ORGANIC VAPORS									10003			
4010	3"	PL-61	3"-4006 PL 61	3"-2026 PL-49	CRUDE TCE		250°F					Efg 1&1 A		67A-1003			PERSONNEL PROTECTION
5001	4"	PL-60	E-109	C-102	INERTS-HCL-SAC							NONE		1001, 10002 & 10003			
5002	8"	PL-60	E-105	T-108	HCL									10002			
5003	8"	PL-60	T-108	E-161	HCL VAPOR									10002			
5004	2"	PL-60	T-108	T-151	EDC									10002			
5005	8"	PL-60	E-161	OHC PLT	HCL VAPOR		200°					Efg: 1&1: AB		10001 & 10002			
5006	6"	PL-60	5005	C-108	HCL VAPOR							NONE		10002 & 10003			
5007	8"	PL-60	5005	5005	HCL VAPOR									10002			
5008	2"	PL-49	FUTURE	FOR FUTURE TIE-IN										10004			
5009	2"	PL-60	E-109	8001	INERTS VENT									10003			

SL 001172

CONFIDENTIAL:
Subject to Protective Order
of 14th Judicial District Court
No. 91-1145

REVISIONS

[illegible] 9-989
[illegible] 9-989
5-21-71
5-24-71

PITTSBURGH PLATE GLASS COMPANY
CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA
71 PER-TRI EXPANSION
CRUDE PIPE RACK
PIPE LINE SCHEDULE
2 SHEET OF 4
DRAWN BY T. HUGHES DATE 2-26-71 SCALE NONE
CHECKED BY C.M. DATE 3-2-71 DRAWING D-989
APPROVED BY DATE
SHT OF MATERIAL P.C. DRAWING NO. 63F-100512

LINE LIST

LINE NO	LINE SIZE	SPEC NO	FROM	TO	MAT'L CONVEYED	FLOW	TEMP	SPEC GRAVITY	VISC CP	EQUIV. LENGTH PIPE	ΔP 100	INSULATION SPEC	STEAM TRACE SPEC.	FLOW SHEET NO			REMARKS
5010	2"	PL 60	5001	6002	INERTS VENT							NONE		10001			
6001	3"	PL-148	4003	C-101	ORGANIC VAPOR							NONE		10003			
6002	2"	PL-60	C-102	5006	INERTS GAS									10001, 10002			
6003	3"	PL-148	C-101	DRAIN	ACID WATER									10003			
6004	6"	PL-19	C-108	DRAIN	ACID WATER									10003			
6005	4"	PL 60	C-108	ATMOSPHERE	INERTS GAS									10003			
7001	6"	PL-9	W.W. TIE-IN # 1 (EXIST. 20" W.W.	G-101	W.W. MAKE UP							NONE		10004			
7002	4"	PL-9	7001	G-101	WELL WATER									10004			
7003	1"	PL 9	7002	SAFETY SHOWER	WELL WATER									10004			
7004	1"	PL-11	T-156	2" 15001 PL-128	CONC H_2SO_4									10004			1" VALVE OUT OF T-156, 1/4" VALVE INTO FUNNEL
7006	1½"	PL-9	T-156	ATMOSPHERE								NONE		10004			
7007	2"	PL-9	4 1000 PL-101	HEADER (W.W.)	WELL WATER									10001, 10002, 10003			
7008	1"	PL-9	7007	UTILITY STATION										10001			
7009	1"	PL-9	7007	SAFETY SHOWER										10001			
7010	1"	PL-9	7007	SAFETY SHOWER										10002			
7011	1"	PL-9	7007	UTILITY STATION										10002			
7012	1"	PL-9	7007	UTILITY STATION										10002			
7013	1"	PL-9	7007	UTILITY STATION										10003			
7015	1"	PL-9	7007	SAFETY SHOWER										10002			
8001	16"	PL-9	8008	C. WTR. HEADER	C.T. H_2O SUPPLY							NONE		10001, 10002, 10003, 10006			
8002	4"	PL-9	8001	E-158	C.T. WATER									10001			
8003	8"	PL-9	8001	E-106	C.T. WATER									10001			
8004	6"	PL-9	8001	E-105	C.T. WATER									10002			
8005	10"	PL-9	8001	E-109	C.T. WATER									10003			
8006	1"	PL-9	8001	C-101	C.T. WATER									10003			
8007	4"	PL-9	8001	C-108	C.T. WATER									10003			
8008	24" & 20"	PL-9	P-386, P-387, P-388 & P-389	8001 & 20" 29-01 PL-9	C.T. WATER									10004			
8009	1" & 3"	PL-9	8008	G-101	C.T. WATER									10004			
8010	14"	PL-9	P-386	8008	C.T. WATER									10004			
8011	14"	PL-9	P-387	8008	C.T. WATER									10004			
8012	14"	PL-9	P-388	8008	C.T. WATER									10004			
8013	14"	PL-9	P-389	8008	C.T. WATER									10004			
9001	16"	PL-9	HEADER (RET.)	9006	COOLING H_2O RETURN							NONE		1000-, 10002, 10003, 10004			
9002	4"	PL-9	E-158	9001	COOLING H_2O RETURN									10001			
9003	8"	PL-9	E-106	9001	COOLING H_2O RETURN									10001			
9004	6"	PL-9	E-105	9001	COOLING H_2O RETURN									10002			
9005	10"	PL-9	E-109	9001	COOLING H_2O RETURN									10003			
9006	24" & 20"	PL-9	9001 & 20" 30-01 PL-9	9007 & 9008	COOLING H_2O RETURN									10004			
9007	18"	PL-9	9006	G-101	COOLING H_2O RETURN									10004			
9008	18"	PL-9	9006	G-101	COOLING H_2O RETURN									10004			
9009	18"	PL-9	9007	G-101	COOLING H_2O RETURN									10004			

REVISIONS
1 REMOVED LINE [illegible] 8/21/71

SL 001173

PITTSBURGH PLATE GLASS COMPANY
CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA
71 PER-TRI EXPANSION FLOW SHEET
CRUDE TCE [illegible]
PIPE LINE SCHEDULE
[illegible] SHEET [illegible]
DRAWN BY T. HUGHES DATE [illegible] SCALE NONE
CHECKED BY C.M. DATE [illegible] CHARGE P-389
APPROVED BY DATE
BILL OF MATERIAL DWG. NO. E3F-100521

LINE LIST

	LINE SIZE	SPEC NO.	FROM	TO	MAT'L CONVEYED	FLOW	TEMP.	SPEC GRAVITY	VISC CP	TRACE REMOTE PIPE	ΔP 100	INSULATION SPEC.	STEAM TRACE SPEC	FLOW SHEET NO			REMARKS
10001	6"	PL-14	(ONC TIE-IN) 10"-1600 PL-105	HEADER	50# STEAM SUPPLY		275°F					A-1 & ABCD		10001, 10002			
10002	4"	PL-14	10001	E-113 & G-176	50# STEAM		276°F					F-1 & ABCD		10001			
10003	2"	PL-14	10001	E-161	50# STEAM		275°F					A-1 & 1 ABCD		10002			
10004	6"	PL-16	(P/T AREA) 10"-28.08 PL-14	HEADER	125# STEAM SUPPLY		355°F					A-1 & 1 ABCD		10001, 10002, 10003			
10005	3"	PL-16	10004	E-160	125# STEAM		355°F					A-1 & 1 ABCD		10002			
10006	6"	PL-16	10004	E-111 & E-163	125# STEAM		355°F					A-1 & 1 ABCD		10002			
10007	1½"	PL-16	E-118	SEWER	CONDENSATE		275°F					A-1 & 1 A		10001			
10008	1½"	PL-16	E-176	SEWER	CONDENSATE		275°F					E-1 & 1 A		10001			
10009	1"	PL-16	E-161	11001	CONDENSATE		278°F					E-1 & 1 ABC		10002			
10010	1½"-2"	PL-16	E-163	11001	CONDENSATE		358°F					C-1 & 1 ABC		10002			
10011	1½"	PL-14	E-111	11001	CONDENSATE		355°F					E-1 & 1 ABC		10002			
10012	1"	PL-14	10004	UTILITY STATION	125# STEAM		355°F					E-1 & 1 ABC		10001			
10013	1"	PL-14	10004	UTILITY STATION	125# STEAM		355°F					E-1 & 1 ABC		10002			
10014	1"	PL-14	10006	UTILITY STATION	125# STEAM		355°F					E-1 & 1 ABC		10002			
10015	1"	PL-14	10006	UTILITY STATION	125# STEAM		355°F					E-1 & 1 ABC		10003			
10017	1½"	PL-14	E-160	11001	CONDENSATE		240°F					E-1 & 1 A		10002			
10018	1½"	PL-14	E-113	SEWER	CONDENSATE		275°F					E-1 & 1 A		1000			
10019	½"	PL-14	E-176	SEWER	CONDENSATE		275°F					E-1 & 1 A		1000			
10020	¾"	PL-14	10001	11001	CONDENSATE		275°F					C-1 & 1 A		1000			
10021	¾"	PL-14	10004	11001	CONDENSATE		365°F					E-1 & 1 ABCD		10003			
10022	6"	PL-14	SRV G	ATMOSPHERE	STEAM		278°F					NONE		10001			
11001	6"	PL-85	COND. COLL. HDR.	3"-3310 PL-85	CONDENSATE		240°F					E-1 & 1 A		10001 & 10002			
12001	8"	PL-79	(ONC AREA) 6"-1700 PL-101	HEADER	N_2 SUPPLY							NONE		10001, 10002 & 10003			
12002	6"	PL-79	12001	3003	N_2									10001			
12003	3/4"@ 1/2"	PL-79	12002	T-110 & T-161	N_2									10001			
12004	4"	PL-79	12001	6002	N_2									10001			
12005	3"	PL-79	1400	G-101 VICINITY	N_2							NONE		10004			
12006	1"	PL-79	12001	T-108	N_2							NONE		10003			
12007	1"	PL-79	12001	5001	N_2									10003			
12008	1"	PL-79	12001	NITROGEN UTILITY STATION	N_2									10001			
12009	1"	PL-79	12001	NITROGEN UTILITY STATION	N_2									10002			
12010	1"	PL-79	12001	NITROGEN UTILITY STATION	N_2									10001			
13001	6"	PL-4	6"-1866 K-PL-102	C-108	CELL LIQUOR CAUSTIC							NONE		10003			
14001	5"	PL-139	3"-1600 PL-139 (ONC PLANT)	2"-14002 PL-139	INST. AIR							NONE		10001			
14002	2"	PL-139	3"-14001	TCE PLANT	INST. AIR							NONE		10001, 10002, & 10003			(SUPPLY HEADER)
15001	2"	PL-128	1" 7002, 1" 7004	G-101	DILUTE H_2SO_4							NONE		10004			
16001	1½"	PL-81	3" 2006 PL-49	SEE FLOW SHEET #16 IN PER TRI	TRI-STILL REFLUX							NONE		10001			
17001	1½"	PL-12	3"-16001 PL-139	TCE PLANT	UTILITY AIR							NONE		10001, 10002, 10003			(SUPPLY HEADER)
17002	1"	PL-12	1½"-17001	UTILITY STATION										10001			
17003	1"	PL-12	1½"-17001	UTILITY STATION										10002			
17004	1"	PL-12	1½"-17001	UTILITY STATION										10002			
17005	1"	PL-12	1½"-17001	UTILITY STATION										10003			

UTILITY AIR

REVISIONS

A [illegible]

A [illegible]

PITTSBURGH PLATE GLASS COMPANY
CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA
71 PER-TRI EXPANSION FLOW SHEET
CRUDE TCE & 4N
PIPE LINE SCHEDULE
4TH SHEET OF 4
DRAWN BY T HUGHES DATE -28-71 SCALE NONE
CHECKED BY GM DATE 8-2-71 CHARGE D-962
APPROVED BY DATE
BILL OF MATERIAL DWG. NO. 63F-10053.1