Post Emergency Kill Procedure

OPERATING MANUAL
AMS EMERGENCY KILL SYSTEM
ABERDEEN PVC PLANT

September 1, 1981

FINAL ISSUE

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VAB.0001221266

conoco

Interoffice Communication

To C. L. Miller, Aberdeen, Mississippi

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Date September 1, 1981

Subject Emergency Kill System Operating Manual

The final issue of the Emergency Kill System Operating Manual is attached. This issue incorporates comments and suggestions from the August 18 plant review meeting.

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TABLE OF CONTENTS

OPERATING MANUAL

AMS EMERGENCY KILL SYSTEM

ABERDEEN PVC PLANT

		Page No.
I.	INTRODUCTION	1
	A. PURPOSE	1
	B. OPERATOR RESPONSIBILITIES	1
	C. PROCESS INFORMATION	1
II.	GENERAL PROCESS DESCRIPTION	3
III.	SAFETY	5
IV.	OPERATING PROCEDURES	8
	A. INJECTION PROCEDURES	8
	B. ROUTINE OPERATION	12
	C. TESTING PROCEDURES	15
V.	APPENDIX	17
VI.	P&I DIAGRAMS	26

I. INTRODUCTION

A. Purpose

The purpose of the Emergency Kill System is to increase the reliability and effectiveness of equipment and procedures used to safely and quickly stop the polymerization reaction in the reactors. Stopping the reaction prevents excessive pressure buildup which can cause emergency releases through the reactor relief valves. This system allows any or all reactors to be shut down in an orderly and safe manner. This manual describes the system and the operator's responsibilities for operating and maintaining the system.

B. Operator Responsibilities

The operator is responsible for producing quality products in a safe and efficient manner. He fulfills his responsibilities by knowing the following and passing a written exam:

1. Understanding how his equipment functions.
2. Understanding what role each piece of equipment plays in the process.
3. Keeping a close and regular check on equipment.
4. Knowing how to spot malfunctions and correct them.
5. Keeping his area of responsibility safe and clean.
6. Keeping complete and accurate records.

C. Process Information

The polymerization reaction of VCM to form PVC gives off heat and accelerates as temperature increases. As the temperature increases, the reactor pressure also increases. It is therefore necessary to remove the heat of reaction with cooling

I. INTRODUCTION (CONTINUED)

C. Process Information (Continued)

water in the reactor jacket and condenser. Reactor agitation is also required to maintain uniform reactor mixing and efficient heat removal.

If reactor cooling and/or agitation is lost, the reaction must be stopped. Failure to do so would result in a runaway reaction with increasing temperature and pressure. The reactor pressure could increase until the rupture disk/safety valve assemblies would vent the reactor contents to the atmosphere. The new Emergency Kill System provides the capability of injecting up to 25 gallons of killing agent into each reactor either remotely from the control room or manually at the reactor top head platform. Killing agent can be injected into a reactor as soon as agitation is lost to take advantage of mixing caused by residual swirling motion. Maintaining cooling water flow after loss of agitation will also help mixing by refluxing in addition to removing heat of reaction.

II. GENERAL PROCESS DESCRIPTION

Refer to the attached P&I diagrams for the complete system layout for each reactor area.

Emergency kill injection pots are provided at grade level for each reactor. All injection pots are to be maintained at 300 psig pressure using high pressure nitrogen cylinders. A separate nitrogen cylinder and spare are provided for each injection pot. Level gauges and pressure gauges are provided on each pot in addition to board-mounted low pressure alarms and low level indicators. The A operator should check the appropriate injection pot level and pressure before starting each reactor charge sequence. Killing agent can be injected into the reactor either remotely by the lead operator or locally by the A operator. Normally, the emergency kill system will be activated from the board to minimize time and maximize mixing. One switch for each reactor operates automatic double block valves at the reactor top head level. Placing the switch in automatic mode opens the valves and allows a low level switch in the injection pot to close the valves. Placing the switch in the momentary-contact manual mode also opens the valves but the valves close when the switch is released. Each injection pot low level switch also activates a local light at the manual injection point at the reactor top head level. The automatic closure of the remote injection valves and the local low level indicator light are provided to prevent nitrogen from being injected into the reactor, blanketing the condenser and reducing cooling efficiency.

II. GENERAL PROCESS DESCRIPTION (CONTINUED)

Emergency injection headers are provided at the reactor top head level in each reactor area. These headers will allow any injection pot to be used to kill any reactor in each area or to inject additional killing agent if needed. The procedure requires two hoses, one to connect an injection pot to the header, and one to connect the header to the reactor. Killing agent can then be injected locally by the A operator or remotely by the lead operator. It should be noted that when the emergency injection header is used, the injection pot low level switch will neither automatically close the remote injection valves nor light the appropriate local indicator light. Caution should be taken to prevent charging nitrogen into the reactor

The remote injection automatic valves will be operated by nitrogen supplied by a high pressure nitrogen cylinder and spare. A board-mounted low pressure alarm is provided for each area to alert the board operator when the cylinder in use has dropped below 600 psig. A cylinder with less than 600 psig pressure does not contain enough nitrogen to operate the control valves and should be immediately changed out with a full cylinder.

III. SAFETY

The operation of the emergency kill system does not present any extremely hazardous situations. In fact, it's main purpose is to reduce the potential for having hazardous situations in the reactor area. However, some potential hazards are present and precautions should be taken to prevent serious incidents.

A. The killing agent AMS has been in use for some time in the plant and the operators should already be familiar with the corresponding safety hazards and proper handling procedures. The attached vendor literature describes chemical properties and safe handling procedures. It should be emphasized that AMS is highly reactive in the presence of the peroxide initiators used in the plant. AMS AND INITIATOR SHOULD NEVER BE MIXED UNDER ANY CIRCUMSTANCES.

B. The new AMS injection pots will be maintained at 300 psig by high pressure nitrogen cylinders. Due caution should be exercised in the handling of nitrogen cylinders. Operators should avoid damaging the outlet valves on these cylinders. The AMS injection pots will contain AMS under 300 psig pressure, so proper safety precautions should be taken while working with or near these vessels.

The injection pots must be depressurized before the block valves on the pot funnel or AMS fill line are opened. The nitrogen supply to a pot should be turned off at the pot prior to venting the pot. The pots should only be vented through the bleed valve on the pressure gauge/pressure switch piping on the top of the pots. POTS SHOULD NEVER BE VENTED THROUGH THE FUNNELS ON THE SIDE OF THE POTS.

III. SAFETY (CONTINUED)

C. The rupture disk and relief valve assemblies for each injection pot are set to relieve at 400 psig, the vessel design pressure. Since nitrogen bottle regulators occasionally leak through, a potential exists for overpressuring the injection pots and causing the rupture disk to burst. Even if the killing agent didn't spray out when the relief devices opened, it is probable the relief valve would not completely reseat and the nitrogen bottle would slowly depressure through the pot and relief valve to atmosphere. The outside operator should routinely check injection pot pressures to insure it is neither too low nor too high.

D. The AMS killing agent is a volatile hydrocarbon, and thus fire and explosions are theoretically possible. Precautions should be taken to prevent spills and excessive accumulation of flammable vapors.

E. Since the injection pots are connected to the reactors, a potential exists for backing VCM into the pots. This poses no serious immediate problem since the AMS would kill any reaction that was occurring. However, it could present an exposure problem later when the injection pot is opened. The injection pots should be maintained at 300 psig pressure except when refilling.

F. Finally, operators should keep in mind that this system will be used when the plant is in an upset condition, i.e., power failure, loss of cooling water, reactor runaway, etc. It is

III. SAFETY (CONTINUED)

critical that this system must operate properly in such an emergency. System maintenance and operator familiarity with this system are equally important factors ensuring the dependability of this system.

IV. OPERATING PROCEDURES

A. Injection Procedures

1. The emergency kill system should be activated under the following circumstances:

   a. Extended loss of cooling water to a reactor in polymerization mode.

   b. Extended loss of agitation to a reactor in polymerization mode. When agitation is lost, it is important to kill the reaction as soon as possible. The reactor contents will continue to swirl for about four minutes after agitator shutdown, and AMS injection during this period is much more effective.

   c. A runaway reaction with increasing temperature and pressure which is not responding to small AMS injections (short stop) from the initiator charge pot.

   d. Any other circumstance considered by the operator to represent a significant chance of over pressuring the reactor or affecting safe operation of the plant.

2. The emergency kill system must be activated if the reactor reaches the following pressures for the following products:

a. 5305 with CTA	155 psig
b. 5305 without CTA	165 psig
c. All other products	145 psig

3. Lead Operator Duties

   a. The lead operator should remotely inject AMS into the polymerizing reactors which require killing by placing the appropriate hand switches in the AUTO mode.

IV. OPERATING PROCEDURES (CONTINUED)

A. Injection Procedures (Continued)

2. Lead Operator Duties (Continued)

b. The lead operator should then check for confirmation of AMS injection from the board-mounted low level indicating lights, and from the A operator via radio. Injection time should be about 30 seconds. The board-mounted injection pot low pressure alarms will normally be tripped during AMS injection. If the pressure and level alarms are not tripped, the automatic AMS injection line may be plugged requiring manual injection.

c. After AMS injection, the lead operator should closely monitor the reactor temperature and pressure. If cooling water has been lost, he should take steps to restore cooling as soon as possible.

d. If additional killing is required, the momentary-contact manual switch can be used. Caution should be exercised to prevent nitrogen from entering the reactor and blanketing the condenser.

e. If excess nitrogen does enter the reactor, the condenser should be vented to the recovery system.

3. A Operator Duties

a. The A operator is responsible for field-checking AMS injection to each of the reactors to be killed. He should confirm that the injection pot level is at the low level mark on the level gauge. Too high a level

IV. OPERATING PROCEDURES (CONTINUED)

A. Injection Procedures (Continued)

3. A Operator Duties (Continued)

means not enough AMS was injected. No level may mean nitrogen has entered the reactor.

b. The A operator should also check the pressures of the nitrogen cylinders used for AMS injection. Any cylinder with a pressure lower than 750 psig should be changed out to allow for a second AMS injection.

c. After checking the injection pot and nitrogen cylinders, the A operator should proceed to the reactor top level to confirm that the automatic injection valves are closed. If the valves are open, he should manually block in the line and inform the lead operator that nitrogen has entered the reactor. It may be necessary to vent nitrogen to the recovery system to maintain reactor cooling.

d. If the automatic injection system failed to work, the A operator should manually inject AMS to the reactor. He should open the manual double block injection valves, wait for the injection pot low level indicator light to light, then immediately close the double block valves. The valves should also be immediately closed if the line begins to vibrate from flowing nitrogen.

IV. OPERATING PROCEDURES (CONTINUED)

A. Injection Procedures (Continued)

3. A Operator Duties (Continued)

e. If additional injection is required, the A operator should prepare the emergency injection header for use. This header is supplied to allow any injection pot to be used for any reactor. This is accomplished by connecting one hose from a full and pressurized pot to the header and connecting a second hose from the header to the appropriate reactor. Injection can then proceed either locally or from the board. Caution should be exercized when using this header since the injection pot low level switches will not work correctly and nitrogen may enter the reactor.

f. As soon as possible after injection, the A operator should refill the empty AMS pots and prepare for a second injection if needed.

1. Close the block valve on the nitrogen supply line at the pot.

2. Depressure the pot through the pressure gauge vent valve.

3. Refill the pot with AMS from a 55-gallon drum using the air operated drum pump supplied with the system. An alternate filling procedure is to manually pour AMS into the funnel on the side of the injection pot.

IV. OPERATING PROCEDURES (CONTINUED)

A. Injection Procedures (Continued)

3. A Operator Duties (Continued)

f. (Continued)

4. Block in the pot and repressure with nitrogen from the nitrogen bottles.

g. Radio communication between the lead operator and the A operator should be maintained. The A operator should inform the lead operator how the system is operating and what is being done in the field. The lead operator should keep the A operator informed of reactor pressures and any apparent need for additional AMS injection.

B. Routine Operation

1. A reactor should not be charged unless its AMS injection system is in proper operating condition. It is the responsibility of the A operator to check this in the field and notify the lead operator prior to each reactor charge. The following items should be checked immediately before each charge:

a. The AMS level in the injection pot should be at the full mark on the level glass.

b. The pressure in the injection pot should be 300 psig. This should be checked both on the injection pot pressure guage and on the nitrogen cylinder regulator outlet pressure guage.

IV. OPERATING PROCEDURES (CONTINUED)

B. Routine Operation (Continued)

c. The block valve in the AMS line near the injection pot should be fully open.

d. The block valve in the AMS line at the reactor top head leve near the hose connection should be fully open.

e. Both block valves on the manual AMS injection line should be fully closed.

If any of the above conditions are not met, they should be corrected before the reactor is charged.

2. To insure proper operation of the system, the following items should be checked by the A operator at the beginning of each shift:

a. The pressure of the nitrogen cylinders being used for AMS injection should be at least 1200 psig. Cylinders with lower pressures should be changed out with full cylinders. EMPTY BOTTLES ARE NOT TO BE LEFT IN THE BOTTLE RACKS.

b. The pressure of the nitrogen cylinder being used to actuate the automatic AMS injection valves should be at least 600 psig. Cylinders with lower pressures should be changed out with full cylinders. The pressure on the outlet of the regulator for this cylinder should be 100 psig.

IV. OPERATING PROCEDURES (CONTINUED)

B. Routine Operation (Continued)

c. The pressure gauges between the double block valves on both the automatic and the manual injection lines should routinely be bled to 0 psig. If pressure subsequently builds up on these guages, it indicates that one or both of the double block valves are leaking. Note: These gauges will have pressure on them after AMS injection.

d. All spare nitrogen cylinders in the racks should be full, i.e., cylinder seals are intact.

The above items are vital to the proper operation of the emergency kill system. If any of these conditions are not met, they should be immediately corrected.

3. Other items which should be checked on a routine basis are:

a. The automatic AMS injection line reactor nozzles should be checked for plugging. This can be done while the reactor is being rinsed. Full port ball valves have been provided on this line so that a rod or long wire brush can be run through the line to knock out plugging. This line should be checked once a week when the system is being tested.

b. The manual AMS injection line reactor nozzles should also be checked for plugging on a weekly basis. This should be done in a manner similar to that used for checking the automatic injection line.

IV. OPERATING PROCEDURES (CONTINUED)

C. Testing Procedures

1. The AMS injection system for each reactor will be tested weekly on a schedule set up by the process superintendent. Each system will be checked for line pluggage and valve operation. The testing procedure is outlined below:

a. The A operator should perform a complete visual check of the system to be tested both at grade level and at the reactor top head level.

b. He should then contact the lead operator on the radio and confirm that the reactor and Emergency Kill System are ready to be tested.

c. He may then manually inject approximately one gallon of AMS to the reactor by opening the manual injection valves for approximately two seconds.

d. After AMS has been injected manually, the A operator should close the block valve near the hose connection and notify the lead operator that the automatic system is ready for testing. The lead operator may then remotely cycle the injection valves using the momentary-contact MANUAL mode of the control valve hand switch.

e. During automatic AMS injection testing, the A operator should be checking for proper operation of the system, i.e., control valves, actuators, and solenoids.

IV. OPERATING PROCEDURES (CONTINUED)

C. Testing Procedures (Continued)

f. After automatic injection testing, the A operator should rod out the vertical sections of line at both reactor injection nozzles to confirm the nozzles are not plugged

3. The following must be done following a test prior to charging the reactor:

a. The pot should be refilled with AMS.

b. The pot should be pressurized to 300 psig.

c. The AMS injection nitrogen cylinder pressure should be checked (above 1200 psig).

d. The pressure of the nitrogen cylinder used to supply instrument air to the automatic AMS injection control valves should be checked (above 600 psig).

e. The manual block valve at the reactor top head level near the hose connection should be reopened.

V. APPENDIX

STORAGE AND HANDLING OF ALPHA-METHYL STYRENE

Alpha-Methyl styrene is usually stored and handled in steel equipment. It is also compatible with stainless steel, aluminum, and galvanized iron. Copper and copper alloys are not recommended for this service.

This product has a fairly low freezing point (about -10°F) and low viscosity. Underground storage tanks and lines should be considered, as their use will prevent freezing in winter and keep the product cool in summer. Storage temperature should not exceed 100°F. Storage under a nitrogen blanket is preferred; exclusion of air (oxygen) will reduce the chances of polymerization, peroxide formation, and fire.

Piping can be of the materials listed above. A centrifugal pump is suggested for transfer service. "Teflon" is suitable for gaskets and packing.

An inhibitor, para-tertiary butyl catechol (10-20 ppm), is used in alpha-methyl styrene to inhibit polymerization. If storage time is prolonged, the inhibitor concentration should be checked occasionally and more inhibitor added, if needed. Alpha-Methyl styrene is a toxic chemical; contact with liquid or vapors should be avoided.

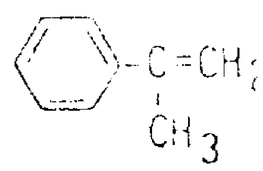
REACTIVE CHEMICALS

CHEMICAL NAME: α-Methylstyrene

SYNONYMS: Isopropenylbenzene, alpha-methylstyrene, 2-phenylpropene, 1-methyl-1-phenylethylene

CHEMICAL FORMULA: C_9H_{10}

CHEMICAL STRUCTURE:



A. PHYSICAL PROPERTIES

Appearance	Water-white liquid
Molecular weight	118.18
Flammability limits, vol %, upper	6.1
lower	1.9
Flash point, open cup, °C (Tag)	52 (126°F)
closed cup, °C (Tag)	44 (112°F)
Autoignition temperature in air, °C	575 (1066°F)
Boiling point at 760 mm Hg, °C	165.4
at 10 mm Hg, °C	48.5
Freezing point, °C	-23.2
Vapor pressure, mm Hg at 20°C	1.9
Solubility, wt % in water	<0.1
(20°C) water in	<0.1
Specific gravity at 20/4°C	0.9106
Heat of vaporization at 1 atm, Btu/lb	140
Heat of combustion at 25°C, Btu/lb	17,748
Coefficient of expansion at 20°C, vol/°C	0.00096
Viscosity at 20°C, cps	0.94

Revised 3/15/76

Some significant reactions with the more common chemicals are briefly discussed below:

Oxidation - Forms aldehydes and peroxides if exposed to air (oxygen). Can be epoxidized and is attacked by strong oxidizing agents.

Hydrogenation - Can be hydrogenated catalytically in the presence of metals. The unsaturated vinyl group and the aromatic ring can both be hydrogenated under selective conditions.

Halogenation - Characteristic addition to the vinyl group and substitution on the aromatic ring can occur with halogens such as chlorine or bromine.

These exothermic addition reactions generally require catalysts and/or elevated temperatures and are not considered hazardous if properly controlled. However, reaction with chlorine which occurs at ambient temperatures can be violent in the presence of light. Accidental contact of α-methylstyrene with halogens or halogen-containing compounds must be prevented.

Acids - Under special conditions, the aromatic ring may be attacked by concentrated nitric or sulfuric acids. These reactions must be carefully controlled to avoid hazardous consequences. Also, hazardous oxidation may occur by contact with concentrated nitric acid.

Methoxylation - α-Methylstyrene can be reacted under special conditions with formaldehyde or CO-H_2 in the presence of a catalyst to yield an aldehyde or alcohol. This reaction is considered to be nonhazardous as it is unlikely to occur accidentally.

The above discussed reactions other than oxidation, halogenation, and polymerization are generally considered to be nonhazardous. However, when conducted in the plant or laboratory, all of the reactions of α-methylstyrene should be properly controlled to avoid hazardous consequences.

Revised 5/15/76

If the UCC customer wants to use rubber hoses for unloading tank trucks, the recommended materials are Viton A or polyethylene lining and steel or 304 SS fittings. Both Uniroyal and Goodyear manufacture rubber hose with a Viton A or polyethylene liner. [redacted]. Other elastomers such as neoprene, butyl, buna-N, etc., are not recommended for handling AMS because they will be chemically attacked by the AMS. Another type of hose that can be used is 304 SS flexible metal hose. or Teflon-lined.

A-METHYL STYRENE

This is a summary of single exposure studies on animals. The data indicate the relative degree of hazard in handling the product. Increasing degrees of hazard are expressed by these terms: slight, moderate, definite, serious. It must be remembered that results of experiments on animals cannot be numerically translated to probable human response.

The National Research Council defines toxicity as the capacity of a substance to produce injury. Hazard is the probability that injury will result from the handling or use of the substance in the quantity, frequency and manner proposed.

Toxicity is only one factor important in determining the degree of hazard in handling a chemical or in a proposed use. Physical properties of the chemical together with extent and frequency of exposure are equally important.

The term LD_{50} has been adopted as a uniform expression of single dose toxicity for comparing one chemical with another. It refers to that quantity of chemical which kills 50 per cent of exposed animals. For further uniformity, quantities are expressed in grams or milliliters of chemical per kilogram of animal body weight.

Single skin penetration refers to a covered 24-hour skin contact with the liquid chemical.

Single inhalation refers to continuously breathing a certain concentration of chemical vapors for a specified period of time.

Primary irritation refers to the skin response following uncovered skin contact. A covered contact can be expected to have a more severe effect.

Eye injury refers to surface damage produced by contact of the eye with the chemical.

Legal responsibility is assumed only for the fact that all studies reported here, and all opinions, are those of qualified experts.

Single oral dose in rats: moderate hazard.
LD_{50} = 6.50 ml per kilogram of body weight.
For comparison, isopropanol has an LD_{50} of 5.84 grams/kg.

Single skin penetration in rabbits: slight hazard.
16.0 ml/kg body weight killed 3 of 7 animals from a 24 hour covered exposure.
This result suggests that skin penetration in harmful amounts is not apt to occur.

Single inhalation by rats: slight hazard.
Breathing vapors in a state approaching saturation in room air for 8 hours killed 2 of 6 animals.

Skin irritation, rabbit belly: moderate hazard.
The undiluted chemical caused redness of short duration on the tender skin of the rabbit belly.

Eye injury, rabbits: slight hazard.
The undiluted chemical caused no irritation when an excess was instilled in the rabbit eyes.

TYPED
5/24/77

For Further Information Write To:
Industrial Medicine and Toxicology Department
UNION CARBIDE CORPORATION
270 Park Avenue, New York, N.Y. 10017

Substance	TWA ppm[a]	TWA mg/m³[a,b]	STEL ppm[a]	STEL mg/m³[a,b]
Acetone	750	1780	1000	2375
Acetylsalicylic acid (Aspirin)	—	5	—	—
† Acetic Acid	10	30	—	—
Acrylamide	A1b	A1b	—	—
Acrylic and methacrylic — Skin	2	10	5	20
Antimony, soluble salts (as Sb)	—	2	—	—
Antimony trioxide production	—	—, A2	—	—
Arsine (soluble), as As	—	0.2	—	—
Arsenic trioxide production	—	—, A2	—	—
Asbestos	—	0.1	—	0.3
† Butane	800	1900	—	—
† 2-Butoxyethanol (Butyl Cellosolve)-Skin	25	120	75	300
† sec-Butyl acetate	200	950	250	1185
† n-Butyl glycidyl ether (BGE)	25	135	—	—
o-sec Butylphenol — Skin	5	—	—	—
Cadmium oxide production	—	— A2	—	—
Carbon disulfide	10	30	—	—
† Carbon tetrachloride — Skin	5, A2	30, A2	20	125
† Carbonyl fluoride	2	5	5	15
Chloroacetyl chloride	0.05	0.2	—	—
Chloromethyl methyl ether	A1b	A1b	—	—
† 1-Chloro-1-nitropropane	2	10	—	—
† Chloropentafluoroethane	1000	6320	—	—
β-Chloroprene — Skin	10	45	—	—
† Chromium metal	—	0.5	—	—
† Chromium (II) compounds (as Cr)	—	0.5	—	—
† Chromium (III) compounds (as Cr)	—	0.5	—	—
† Chromium (VI) compounds (as Cr) Water soluble Cr VI compounds	—	0.05	—	—
Certain water insoluble Cr VI compounds	—	0.05, A1a	—	—
† Chrysene	A2	A2	—	—
Cobalt metal, dust & fume (as Co)	—	0.05	—	0.1
C Cyanogen chloride	0.3	0.6	—	—
† Cyclohexanone	25	100	100	400
† Cyclopentane	600	1,720	900	2,580
Dalapon	1	—	—	—
1, 2-Dibromoethane — Skin	A1b	A1b	—	—
1, 2-Dichloroethane	10	40	15	60
Dichlorodifluoromethane	[illegible]	[illegible]	[illegible]	[illegible]

Substance	TWA ppm[a]	TWA mg/m³[a,b]	STEL ppm[a]	STEL mg/m³[a,b]
† 1, 1-Dichloro-1-nitroethane	2	10	10	60
Dichloropropene	1	5	10	50
Diethanolamine	3	15	—	—
† Diethylamine	10	30	25	75
† Diethyl ketone	200	705	—	—
† Diglycidyl ether (DGE)	0.1	0.5	—	—
† Dioxane, tech. grade — Skin	25	90	100	360
† Dipropyl ketone	50	235	—	—
Divinyl benzene	10	50	—	—
Epichlorhydrin — Skin	2	10	5	20
† 2-Ethoxyethanol — Skin	50	185	100	370
† 2-Ethoxyethyl acetate (Cellosolve acetate) — Skin	50	270	100	540
† Ethyl acrylate — Skin	5	20	25	100
Ethylene dibromide, see 1, 2-Dibromoethane	A1b	A1b		
Ethylene dichloride, see 1, 2-Dichloroethane	10	40	15	60
TC Ethylene glycol, vapor	50	125	—	—
† Ethylene glycol dinitrate	0.02	0.2	0.04	0.4
† Ethylene oxide	10	20	—	—
† Furfural — Skin	2	8	—	—
† Glycidol (2, 3-Epoxy-1-propanol)	25	75	100	300
Hexachlorobutadiene	A2	A2	—	—
† Hexane (n-hexane)	25	90	100	350
(other isomers)	500	1,800	—	—
† Hexone (Methyl isobutyl ketone) — Skin	50	205	75	300
C Hydrogen cyanide — Skin	10	10	—	—
2-Hydroxypropyl acrylate — Skin	0.5	3	—	—
† Isopropoxyethanol	25	105	75	320
n-Isopropylaniline — Skin	2	10	5	20
† Mesityl oxide	15	60	25	100
† Methacrylic acid	20	70	—	—
† Methyl n-amyl ketone (2-Heptanone)	50	235	100	465
† Methyl bromide — Skin	5	20	15	60
† Methyl n-butyl ketone	5	20	—	—
† Methyl chloride	50	105	100	205
Methylene chloride (dichloromethane)	100	350	500	1,700
4, 4-Methylene dianiline	0.1	0.8	0.5	4
† Methyl iodide — Skin	2, A2	10, A2	5	30
† Methyl isopropyl ketone	200	705	—	—
† Methyl silicate	1	6	5	30
C † α-Methyl styrene	50	240	100	485
† Nitrogen dioxide	3	6	5	10
† Nitroglycerin	0.02	0.2	0.04	0.4
† 1-Nitropropane	15	55	25	90
C 2-Nitropropane	25, A2	90, A2	—	—

Substance	TWA ppm[a]	TWA mg/m³[a,b]	STEL ppm[a]	STEL mg/m³[a,b]
† Phenyl ether — Diphenyl mixture (vapor)	0.5	4	2	[illegible]
Phosphorous pentachloride	0.1	1	—	—
† Platinum metal	—	1	—	—
† β-Propiolactone	0.5, A2	1.5, A2	1	[illegible]
Propionic acid	10	30	15	[illegible]
† Propylene glycol dinitrate	0.02	0.2	0.04	[illegible]
† Propylene oxide	20	50	—	—
Silver, metal	—	0.1	—	—
† Silver, soluble compounds (as Ag)	—	0.01	—	—
Sodium bisulfite	—	5	—	—
Sodium metabisulfite	—	5	—	—
† Styrene, monomer (phenylethylene)	50	213	100	42[illegible]
Sulfur dioxide	2	5	5	[illegible]
C Terphenyls	0.5	[illegible]	—	—
Tetrasodium pyrophosphate	—	5	—	—
† Toluene-2, 4-diisocyanate (TDI)	0.005	0.04	0.02	0.1
† Tributyl phosphate	0.2	2.5	0.4	
Trichloroacetic acid	—	1	—	—
† Trichloroethylene	50	270	150	[illegible]
† Trimellitic anhydride	0.005	0.04	—	—
† Vanadium (V_2O_5), as V, dust & fume	—	0.05	—	—
Vinyl bromide	5, A2	20, A2	—	—
Vinyl chloride	5, A1a	10, A1a	—	—
† Vinyl toluene	50	240	100	48[illegible]
† Wood dust, hard wood (as in furniture making)	—	1	—	—

NOTICE OF INTENDED CHANGES
MINERAL DUSTS

Substance	TLV
Asbestos	
Amosite	0.5 fiber/cc, A1a
Chrysotile	2 fibers/cc, A1a
Crocidolite	0.2 fiber/cc, A1a
Tremolite	0.5 fiber/cc, A1a
Other forms	2 fibers/cc, A1a
Diatomaceous earth, natural	1.5 mg/m³, Respirable dust
Silica, amorphous	6 mg/m³, Total dust (all sampled sizes)
	3 mg/m³, Respirable dust (< 5 μm)
Talc (fibrous)	0.5 fiber/cc

Capital letters refer to Appendices.

AVB00022190

MATERIAL SAFETY DATA SHEET

(Approved by U.S. Department of Labor "Essentially Similar" to Form LSB-OOS-4)

A

PRODUCT NAME: *alpha*-METHYLSTYRENE

CHEMICAL NAME: — CHEMICAL FAMILY: Aryls

FORMULA: $C_6H_5C(CH_3):CH_2$ MOLECULAR WEIGHT: 118.18

SYNONYMS: Isopropenylbenzene; α-methylstyrene; 2-phenylpropene; 1-methyl-1-phenylethylene

I. PHYSICAL DATA

BOILING POINT, 760 mm. Hg	165.4° C. (329.7°F.)	FREEZING POINT	−23.2°C.
SPECIFIC GRAVITY (H_2O = 1)	0.9116 at 20/20°C.	VAPOR PRESSURE AT 20°C.	1.9 mm. Hg
VAPOR DENSITY (air = 1)	4.1	SOLUBILITY IN WATER, % by wt.	0.06
PER CENT VOLATILES BY VOLUME	~100	EVAPORATION RATE (Butyl Acetate = 1)	0.22
APPEARANCE AND ODOR	Colorless liquid; characteristic odor.		

II. HAZARDOUS INGREDIENTS

MATERIAL	%	TLV (Units)
Methylstyrene	~100	100 ppm. ceiling
(See Sections III through VIII)		See 1979 Notice of Intended Change

III. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (test method(s))	112°F., Tag closed cup ASTM D 56 126°F., Tag open cup ASTM D 1310

FLAMMABLE LIMITS IN AIR, % by volume	LOWER	1.9	UPPER	6.1

EXTINGUISHING MEDIA	Use carbon dioxide or dry chemical for small fires. Use foam (alcohol, polymer, or ordinary) for large fires.
SPECIAL FIRE FIGHTING PROCEDURES	Self-contained breathing apparatus should be available to firemen.
UNUSUAL FIRE AND EXPLOSION HAZARDS	None

EMERGENCY PHONE NUMBER

304/744-3487

This number is available days, nights, weekends, and holidays.

While Union Carbide Corporation believes that the data contained herein are factual and the opinions expressed are those of qualified experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which Union Carbide Corporation assumes legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of these data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

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IV. HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE	100 ppm. — not to be exceeded. Value from ACGIH (1976)
EFFECTS OF OVEREXPOSURE	Vapors cause irritation of eyes, nose, and throat. Headache, nausea, and vomiting may occur. Eyes are irritated by the liquid.
EMERGENCY AND FIRST AID PROCEDURES	Remove to fresh air and call a physician. In case of contact, flush skin or eyes with plenty of water for at least 15 minutes. Call a physician for eyes.

V. REACTIVITY DATA

STABILITY			
UNSTABLE	STABLE	CONDITIONS TO AVOID	Avoid heat and open flame.
—	√		

INCOMPATIBILITY (materials to avoid)	Avoid contamination with oxygen, strong acids, chlorine.
HAZARDOUS DECOMPOSITION PRODUCTS	Burning can produce carbon monoxide and/or carbon dioxide.

HAZARDOUS POLYMERIZATION			
May Occur	Will not Occur	CONDITIONS TO AVOID	Avoid contamination with peroxides, strong mineral acids, metal halides, and similar polymerization catalysts. Para-tertiary butyl catechol is used as inhibitor; maintain its concentration at 10-20 ppm.
√	—		

VI. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Wear suitable protective equipment. Collect for disposal. Toxic to fish; avoid discharge to natural waters. See Section VIII.
WASTE DISPOSAL METHOD	Incinerate in a furnace where permitted under appropriate Federal, State, and local regulations. Absorb on paper, evaporate on glass dish, then burn paper.

VII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type)		Air-supplied mask in confined areas		
VENTILATION	LOCAL EXHAUST	May be needed	SPECIAL	—
	MECHANICAL (general)	✓	OTHER	—
PROTECTIVE GLOVES		Rubber	EYE PROTECTION	Monogoggles
OTHER PROTECTIVE EQUIPMENT		Eye bath and safety shower		

VIII. SPECIAL PRECAUTIONS

alpha-METHYLSTYRENE

PRECAUTIONARY LABELING

DANGER! CAUSES BURNS
COMBUSTIBLE

Do not get in eyes, on skin, on clothing.
Keep away from heat and open flame.
Avoid breathing vapor.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

FIRST AID: In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse.

FOR INDUSTRY USE ONLY

OTHER HANDLING AND STORAGE CONDITIONS

Store under a nitrogen atmosphere; forms acetophenone, aldehydes, and peroxides if stored under air. Dangerous concentrations of peroxides are not expected to form in normal storage and handling, but storage under a nitrogen atmosphere is recommended.

This chemical floats on water, is resistant to rapid biodegradation, and is highly toxic to aquatic life. Spills should not be flushed to sewers or waterways. The preferred method of disposal is to dilute with a non-reactive solvent or fuel stream and incinerate.

Ground areas can be covered with sand or sawdust after most of the spilled material has been removed. Absorbing materials, after use on small spills, should be disposed of in an approved chemical landfill or by burning.

CAUTION: Do not use clays, micas, or acidic materials which might catalyze polymerization, as absorbents. Personnel engaged in disposal work should avoid contact of waste by wearing proper protective clothing.

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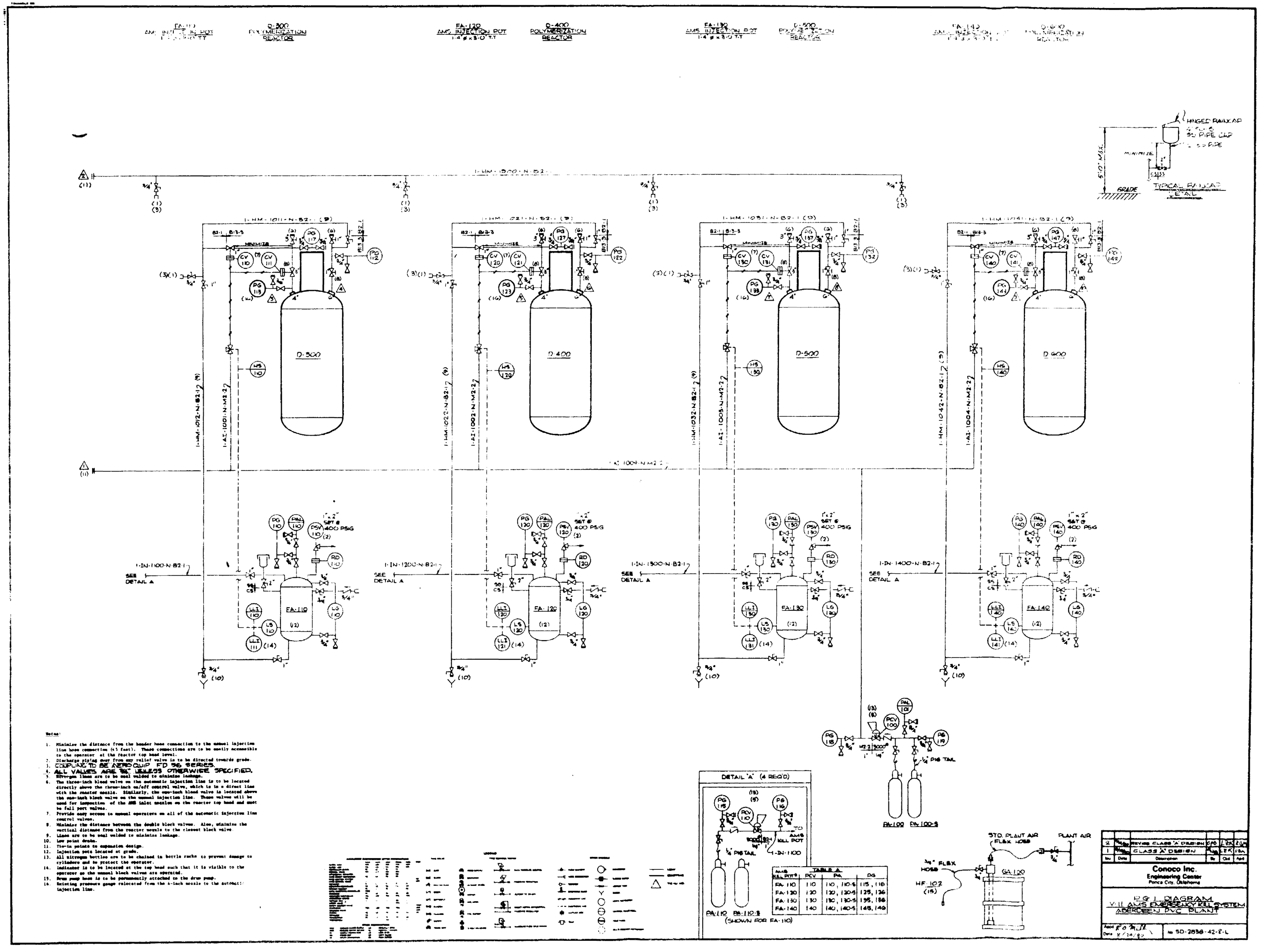

Notes:

1. Minimize the distance from the header hose connection to the manual injection line hose connection (4) feet). These connections are to be easily accessible to the operator at the reactor top head level.
2. Discharge piping deep from any relief valve is to be directed towards grade.
3. COUPLING TO BE AERO QUIP FD 36 SERIES.
4. ALL VALVES ARE 3/4" UNLESS OTHERWISE SPECIFIED.
5. Nitrogen lines are to be seal welded to minimize leakage.
6. The three-inch bleed valve on the automatic injection line is to be located directly above the three-inch on/off control valve, which is to a direct line with the reactor nozzle. Similarly, the one-inch bleed valve is located above the one-inch block valve on the manual injection line. These valves will be used for inspection of the AMS inlet nozzles on the reactor top head and must be full port valves.
7. Provide easy access to manual operators on all of the automatic injection line control valves.
8. Minimize the distance between the double block valves. Also, minimize the vertical distance from the reactor nozzle to the closest block valve
9. Lines are to be seal welded to minimize leakage.
10. Low point drain.
11. Tie-in points to expansion design.
12. Injection pots located at grade.
13. All nitrogen bottles are to be chained in bottle racks to prevent damage to cylinders and to protect the operator.
14. Indicator is to be located at the top head such that it is visible to the operator as the manual block valves are operated.
15. Drum pump hose is to be permanently attached to the drum pump.
16. Existing pressure gauge relocated from the 4-inch nozzle to the automatic injection line.

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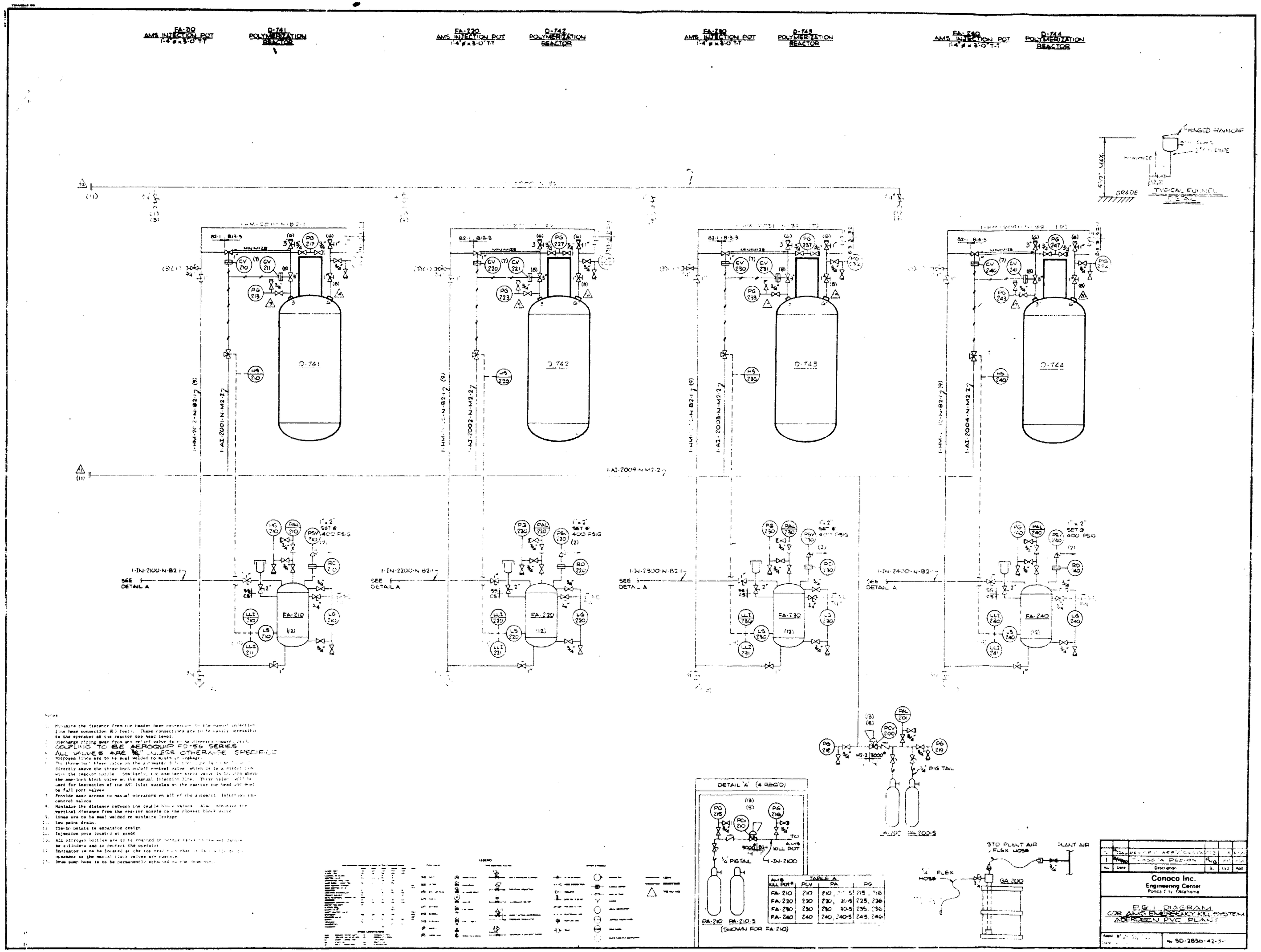

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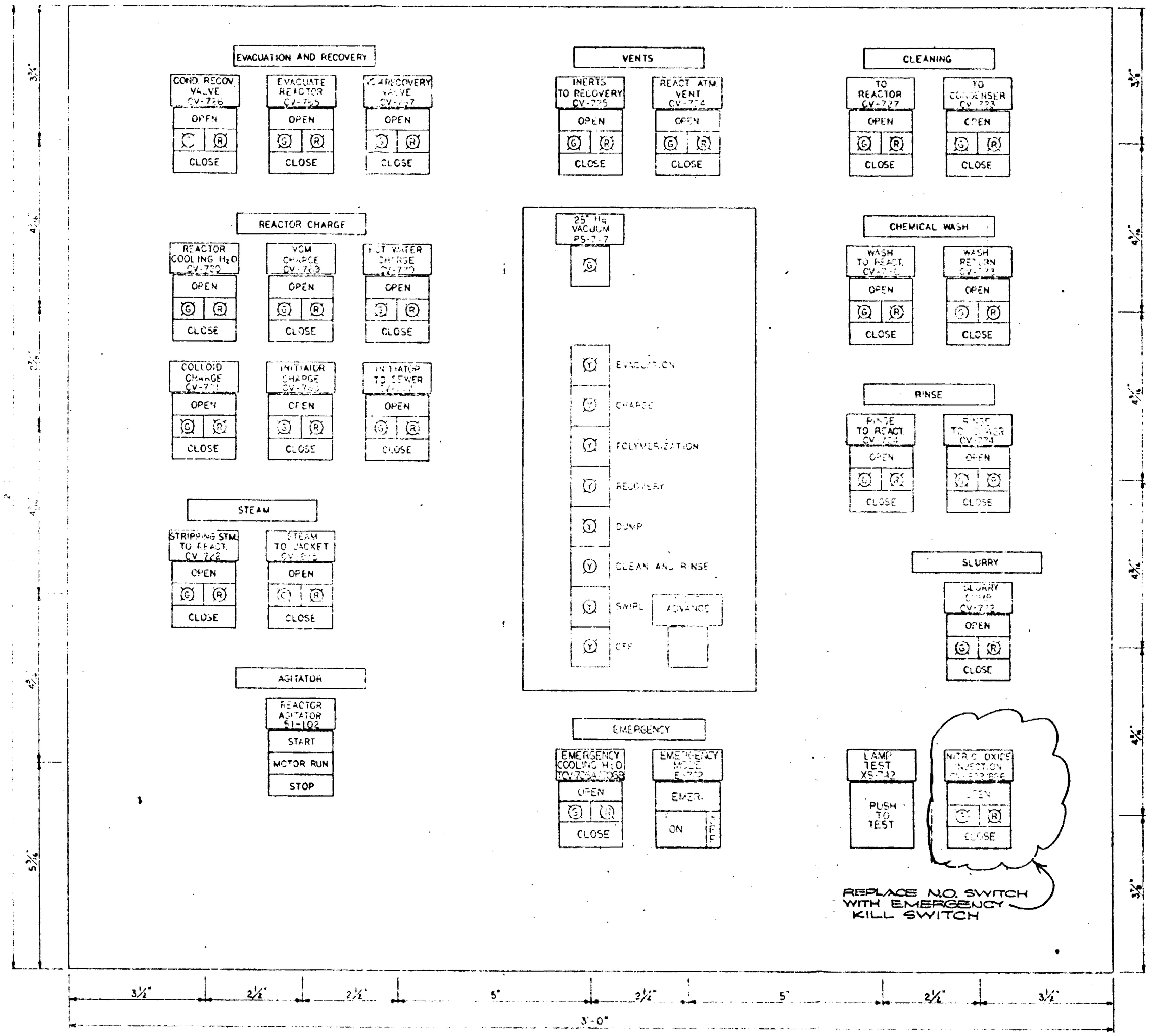
REACTOR SECTION 45-742



TELLEPSEN PETRO-CHEM CONSTRUCTORS