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Re: Radian Report

Dear Mr. Wheeler:

Enclosed is a copy of the report you requested by the Radian Corporation entitled "Assessment of Control Technology for Reduction of Vinyl Chloride Monomer Emissions at Polyvinyl Chloride Plants."

If I can be of any further assistance, please feel free to contact me.

Cordially yours,

Peter L. de la Cruz
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Enclosure

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RESEARCH
CORPORATION

DCN 81-241-139-27-14

ASSESSMENT OF CONTROL TECHNOLOGY FOR
REDUCTION OF VINYL CHLORIDE MONOMER
EMISSIONS AT POLYVINYL CHLORIDE PLANTS

Final Report

January 1981

EPA Contract 68-01-4136, Task 27

Prepared for
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SECTION 1

INTRODUCTION

1.1 BACKGROUND

Following the discovery that Vinyl Chloride (VCM) was carcinogenic, the National Emission Standards for Hazardous Air Pollutants containing allowable emissions of VCM were promulgated. This report reviews technology developments for control of suspension and emulsion process emissions at Polyvinyl Chloride (PVC) plants to comply with the following regulations:

1. 40 CFR 61.64(a) and (e) prescribe limits on VCM emissions from reactor openings and limits on residual VCM in polymers following a stripping operation.
2. 40 CFR 61.65(a) prohibits discharges of VCM except for "emergencies". An "emergency" venting or relief discharge means a discharge which could not have been avoided by taking measures to prevent the discharge.
3. 40 CFR 61.65(b) 1 through 6 prescribe either VCM emission limits or design specifications for use in certain equipment for handling VCM liquids.

The suspension and emulsion processes account for over 90% of the PVC made in the United States. These are batch polymerization processes using stirred tank reactors. The capacity of United States PVC plants was about 3.49×10^6 T/yr (7.69×10^9 lb/yr) in 1979 from thirty-six plants whose capacities range from 23,000 T/yr (50×10^6 lb/yr) to 318,000 T/yr (700×10^6 lb/yr). Figure 1-1 shows the distributions of plant sizes and capacities. It can be seen that the three largest plants produce almost one-fourth and the sixteen largest plants (of the thirty-six total plants) produce over two-thirds of the total capacity. The remaining twenty plants with one-third of

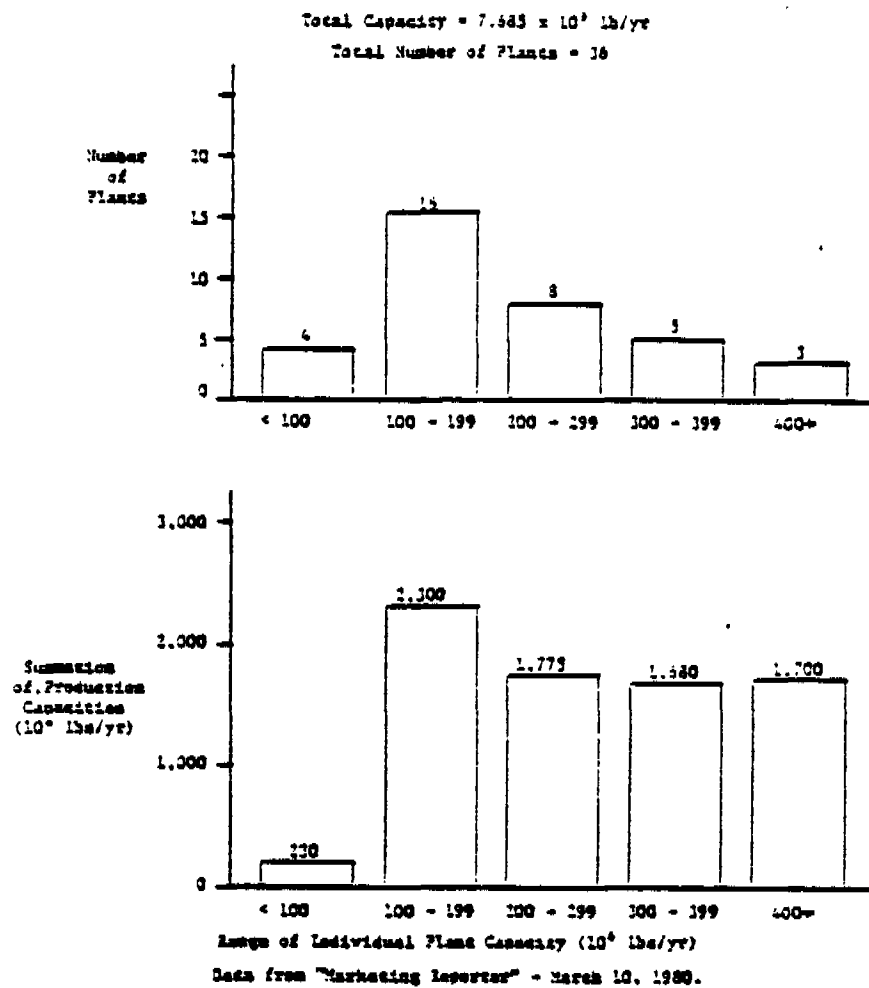


Figure 1-1. Current U.S. FVC capacity by plant size.

the capacity are at a great disadvantage economically. Many of the small plants are able to continue primarily by having captive markets for their products. The older plants generally have smaller reactors which are on the order of 10 to 20 m³ (2,000 to 5,000 gallon) sizes with 20 to 50 such reactors in the plant. Newer plants in the United States have 40 to 100 m³ (10,000 to 30,000 gallon) reactors with 4 to 12 such reactors. Huls in Germany reports development and use of 200 m³ (50,000 gallon) reactors in their operations.

The small reactor systems require more capital, more space, more utilities, more manpower, and additional operating, maintenance, and repair costs. Huls estimated the 200 m³ reactors, compared to 40 m³ reactors, would reduce capital by 25%, space by 33%, utilities by 10%, manpower by 50%, and maintenance by 25%, for a 160,000 T/yr plant. Since the cost of meeting the VCM emissions limits under the regulations is similarly affected by reactor size, a more severe burden is placed on the older smaller plants by these regulations. This is caused by the greater number of pumps, agitators, reactor chargings and reactor openings involved with small reactors.

1.2 OBJECTIVES

A. Relief Valve Discharges

A goal of this work is to provide a comprehensive assessment of technology which can be used in controlling, preventing, containing and destroying VCM discharges. Another goal is to define a method for determining whether specific past and future discharges are "emergencias" or could have been avoided by taking measures to prevent the discharge.

B. Fugitive Emission Sources

A comprehensive assessment of present and near term fugitive emission control technology and technology to reduce reactor opening losses and residual VCM in polymer and wastewater is the goal of this part of the work.

1.3 APPROACH

A literature survey was made of engineering developments and of basic physical-chemical data for suspension and emulsion processes in PVC plants. A description was prepared of dispersion and suspension PVC processes using batch systems starting with the handling of raw materials through the finished PVC product with example flowsheets, material balances, operating procedures, process control systems, equipment design and typical plant layouts.

The chemistry of PVC reactor operation was reviewed including reaction rate vs. temperature and initiator/inhibitor concentrations, VCM and PVC stability vs. temperature, VCM breakdown products, and reaction rates at normal conditions. The physics of PVC reaction operation was reviewed including VCM vapor pressure vs. temperature, heat of reaction, heat balance on reactor, effects of inerts and water on reactor pressure, and effects of three phases, solid, liquid and vapor on heat transfer in the kettle and on handling of vented material.

Plant trips to PVC production facilities were made to review technology in use for control of processes and VCM emissions. Surveys were made of manufacturers of equipment used in PVC plants for control of processes and prevention and/or containment of VCM emissions.

Engineering design of rupture disc/relief valve and vent systems used in the chemical industry for protection of equipment and control of emissions were reviewed. "Premature" failure of rupture discs were discussed with manufacturers and users of such equipment to identify design and operational-maintenance practices used for its prevention.

External controls for relief valve discharges were evaluated including containment, thermal destruction via flaring, incineration, or in a boiler, catalytic destruction and other possible control technologies.

The following were considered in these evaluations:

1. safety,
2. capital and operating costs,
3. energy requirements, and
4. engineering and design factors.

Starting with an analysis of data furnished by EPA on reactor discharges in PVC plants, a study of the chemical, physical, operational, engineering and control aspects of the equipment involved was made. Vent system design, instrumentation, operation and maintenance practices used on reactors and other equipment from which relief valve discharges have occurred were reviewed. The causes of relief valve vents in reactor and liquid storage systems including initiator excess, overcharging, heat exchange failure, inerts accumulation, contaminants accumulation, kettle charge mix error, controller failure, VCM quality, and external activities were established. A computer program was written to provide liquid and vapor discharge rates, reactor temperature and reactor pressure following a relief valve discharge at any given PVC reaction rate and cooling jacket condition.

The variables which affect reactor venting and the techniques which are used to monitor these variables were reviewed. These variables included temperature, pressure, flow and reactor level. Appropriate control actions and operating procedures to prevent safety relief from all equipment in vinyl chloride service were evaluated. Designs and cost estimation for computer control of VCM reactors were developed.

From this information a procedure was recommended to assess the technologies in use at the time of venting from a relief valve in a reactor area of a PVC plant so as to determine the conditions existing at the time of the venting to be a true "emergency" or to be "controllable" with reasonable actions having been taken to prevent or control the discharge.

A review was made of procedures and equipment used in chemical plants to control fugitive emissions from loading-unloading lines, slip gauges, seals on pumps, compressors and agitators, relief valve rupture disc systems, manual venting of equipment, and opening of equipment.

Data on the partition coefficient of VCM from polymers and water in literature and on the effectiveness of stripping and drying operations were collected and evaluated. Preliminary design parameters for equipment to meet EPA requirements were determined.

Data on reactor opening VCM emissions as a function of time, temperature and pressure and when using either water or inert gas displacement were evaluated to establish a range of effectiveness for these procedures. Reactor cleaning technologies using solvent and high pressure washing were reviewed.

SECTION 2

SUMMARY

Four areas of PVC production which are potential sources of significant amounts of VCM emissions were examined and an assessment made of technologies available for their control. The major conclusions or observations of these studies are summarized in this section and references made to the subsequent sections for detailed remarks. The areas assessed were:

- Relief valve emissions,
- Reactor opening loss,
- Fugitive emission control, and
- Polymer stripping.

2.1 RELIEF VALVE EMISSIONS

Emissions of VCM from rupture disc/relief valve (RD/RV) systems on polymerization vessels can potentially account for the largest volume of emissions from a PVC production unit whether a point or fugitive source. In the worst case they can range up to the full contents of one or more reactors, i.e., 15,000 to 65,000 pounds. The releases may result from any number of causes such as the failure of equipment, instrumentation, power or cooling supply, operator error, or inadequate maintenance.

The NESHAP regulations prohibits the discharge of VCM from manual vent valves [40 CFR § 61.64a(3)] and also from relief valves [§ 61.63(a)] except for emergencies, i.e., a discharge which could not have been avoided by taking measures to prevent the discharge. A study of existing facilities and new or

proposed designs indicates that it is possible to essentially eliminate this source of emissions, either by containment or destruction of the VCM, or by implementation of effective preventative measures.

2.1.1 Preventative Measures

Through proper planning, design, operation and maintenance procedures VCM emissions from the RD/RV (other than those defined as emergency) may be eliminated as discussed in Section 4.3 and 4.6.

Plant management is responsible for protecting the environment by ensuring:

- New or existing facilities are well designed with adequate reactor cooling capacity, quick response control and monitoring systems for temperature, pressure, flow, etc., redundant instrumentation, utilities, and cooling water systems.
- Qualified operators are well trained and supervised, provided with standard operating procedures, automatic control systems, and authority to take corrective action to vent, retard or shortstop incipient runaway reactions.
- Maintenance is performed following well defined procedures.
- All personnel are instilled with a concern for preventing emissions.

Fault Tree Analysis

One means of predetermining that a reaction system has been designed and is being operated with the minimum probability of a relief valve opening to the atmosphere is to perform a fault tree analysis (or similar exercise) to be sure that all possible points of failure are covered by proper operating procedures, back up equipment or other redundant features. This technique is described in Section 4.2.2.

Automatic Control System

Because of the complexity of the polymerization reaction process and equipment, and the unpredictability of temperature and pressure excursions, it is highly desirable to provide a well-designed, reliable, automated system to monitor the reaction parameters, control the cooling water, adjust the release of gas or liquid to an auxiliary vent system, alert the operating personnel, and trigger the addition of retardants or short-stops when necessary. This is discussed in Section 4.3.1. The cost of these systems may be easily justified on the bases of increased productivity and safety.

Auxiliary Vent and Recovery System

The reaction system should have adequate means for relieving excess pressure by discharging inert gases and/or controlled amounts of reactants to an auxiliary vent system as discussed in Section 4.3.2. The released material should be cooled, contained, and then recovered or destroyed. This vent system may be activated manually by the operator and/or automatically by a control system.

2.1.2 Containment and/or Destruction

Although containment of relief valve emissions can be accomplished by means of a gasholder, a charcoal adsorber, or a solvent absorption system, cost studies, summarized in Table 2-1, indicate these methods are not cost effective for any commercial sized reactor. These containment techniques are discussed in detail in Section 4.4. Also the destruction of VCM in boilers or incinerators is not a viable alternative for economic reasons, and flaring of reactor emissions is not feasible for safety reasons as discussed in Section 4.1.

TABLE 2-1. SUMMARY OF CAPITAL AND OPERATING COSTS FOR ALTERNATE SYSTEMS TO PREVENT REACTOR RELIEF VALVE EMISSIONS
(December 1979 Dollars x 10³)

	Automatic Controls	Condensation	Gas Holder	Solvent Absorption	Carbon Adsorption
<u>Capital Costs</u>					
Knock-out Equipment	\$ -	\$ 821	\$ 821	\$ 821	\$ 821
Header Extension*	-	-	600	600	600
Containment Equipment	-	904	1,820	665	1,816
TOTAL EQUIPMENT	\$119	\$1,725	\$3,241	\$2,086	\$3,237
Engineering, Construction & Contingency	91	914	1,717	1,175	2,061
TOTAL INVESTMENT	\$210	\$2,639	\$4,958	\$3,261	\$5,298
<u>Annual Operating Costs</u>					
O & M	\$ 12	\$ 83	\$ 94	\$ 80	\$ 74
Ins. & Taxes (2% of Investment)	4	53	100	66	106
Capital Charges (20% of Investment)	42	530	1,000	660	1,060
Credit for Recovered VCH**	(15)	(20)	(20)	(20)	(20)
TOTAL ANN. OPTG. COST	\$ 43	\$ 646	\$1,174	\$ 786	\$1,220

*Assumes 1000 feet header to containment system area.

**Assumes 3 major event releases/year with automatic controls having 75% success.

Reference Tables: 4-3 4-6, 7 4-8, 9 4-10, 11 4-12, 13

2.2 REACTOR OPENING LOSS

The VCM emissions occurring when a reactor is vented to the atmosphere (other than an emergency relief discharge as defined in § 61.65(a)) are referred to as reactor opening loss (ROL). A well operated facility can readily keep these emissions below 0.02g VCM/kg of PVC product (dry solids basis), as required by § 61.64(a)(2). The numerator, i.e., the amount of VCM in the gas phase just prior to opening, can be minimized by evacuation to a low absolute pressure for an adequate time period, by displacement with water or inert gas, by steaming, or by a combination of these. However, any residual polymer clinging to the reactor walls continues to release unreacted VCM, and hence an elevated jacket temperature for an extended time period is required to further reduce emissions. The divisor, i.e., the total PVC production, may be increased by reducing the frequency of reactor openings. Several batches may be produced before it becomes necessary to open the reactor if special "closed reactor" techniques are used to clean the reactor and/or if the vessel walls are treated to minimize polymer buildup. The various options currently in practice or available for license are discussed in detail in Section 5.4.

2.3 FUGITIVE EMISSION CONTROL

Fugitive emissions of VCM from process equipment in PVC plants are regulated by 40 CFR 61.65(b), and included those from loading-unloading lines, slip-gauges, seals on pumps, compressors, and agitators, relief valve-rupture disc systems, manual venting of equipment and equipment openings. A review of these regulations and the means currently used or recommended for the control of fugitive emissions are discussed in detail in Section 6.

2.4 POLYMER STRIPPING

Emissions of residual VCM from the process equipment downstream of the stripper and from the finished resin, between the time it is shipped to the time it is converted to a consumer product, are dependent on the effectiveness of the polymer stripping process. The release of unreacted VCM from the PVC polymer is dependent on the time, temperature, and pressure (vacuum) of the stripping operation, as well as on the particle size distribution, and the stripper design. Polymers made by the suspension process can be easily and economically steam stripped in a continuous column so that the residual concentration is less than the 400 ppm allowed by § 61.64e(1)(ii). Dispersion type polymers may be stripped batchwise (at milder temperatures to prevent their degradation) to a residual VCM concentration less than the 2000 ppm allowed by § 61.64e(1)(i). A detailed discussion of the problems and process variables is presented in Section 7.

SECTION 3

PVC PROCESS DESCRIPTION

3.1 PROCESSES AND EQUIPMENT

Polyvinyl Chloride (PVC) is produced by polymerization of vinyl chloride monomers (VCM) in one of four processes in the United States. Three of these are batch processes: suspension polymerization which accounts for 78% of capacity; dispersion or emulsion polymerization accounting for 13%; and bulk polymerization which accounts for 6%. The fourth process, solution polymerization, is a continuous process and accounts for only about 3% of the PVC resin capacity.

A brief process description follows. Vinyl chloride is generally received via rail in a tank car, or by pipeline from a VCM unit nearby or within the plant and is transferred to the VCM storage tank. The monomer may or may not contain an inhibiting agent, but if inhibited, the VCM is passed through a caustic decanter or fractionator to remove the inhibitor. Water, initiators, and suspending agents are first charged to the reactor. A measured amount of VCM is then fed to the reactor from the VCM storage tank and/or the monomer recovery system. The polymerization is then carried out at elevated temperatures and pressures. At approximately 85%-90% conversion, the bulk of the unreacted monomer is vented to recovery and the slurry of polyvinyl chloride granules and water is transferred to the stripper to remove the remaining unreacted VCM. The stripping process is accomplished by the application of heat alone, a stripping gas, or a combination of heat and vacuum over a period of time. The unreacted monomer is driven off to the recovery system where it is accumulated in a surge tank and recycled to monomer storage. The stripped slurry goes to a slurry blend tank with several

other batches to obtain a more uniform product. Since any VCM remaining in the polymer after stripping is released to the atmosphere in the subsequent operations (i.e., drying, storage, and shipping) the need for effective stripping is obvious.

From the bland tank the slurry is pumped to a centrifuge for separation of water which is generally transferred to a treatment area before being disposed of or recycled. The wet PVC cake from the centrifuge, containing about 30% moisture, is processed through a hot air dryer. The particle size governs the choice of drying techniques, which include rotary drying, flash-rotary drying, two stage flash drying, and spray drying. The maximum allowable product temperature is 55°C since degradation of the polymer occurs above 65°C. Drying continues until the polymer moisture content is lowered to 0.25 to 0.4 wt %. The dried, solid PVC particles are collected by cyclones and/or bag collectors and then sized by screens. The product is conveyed to storage bins or silos, and oversized particles are rejected. The majority of the finished PVC product is shipped from the plant in bulk rail-cars or trucks although some is packaged in 50 pound bags.

The suspension process will be described in more detail below and the emulsion process will be described briefly in terms of its variation from the suspension process.

3.1.1 Suspension Polymerization Process

Suspension polymerization is by far the most common process used to manufacture PVC resins (78% of the total U.S. capacity). Figure 3-1 presents a simplified flow diagram. The raw materials required include vinyl chloride monomer, initiator, suspending agent, emulsifier, and deionized water (1). Table 3-1 shows the typical range by weight of the input materials.

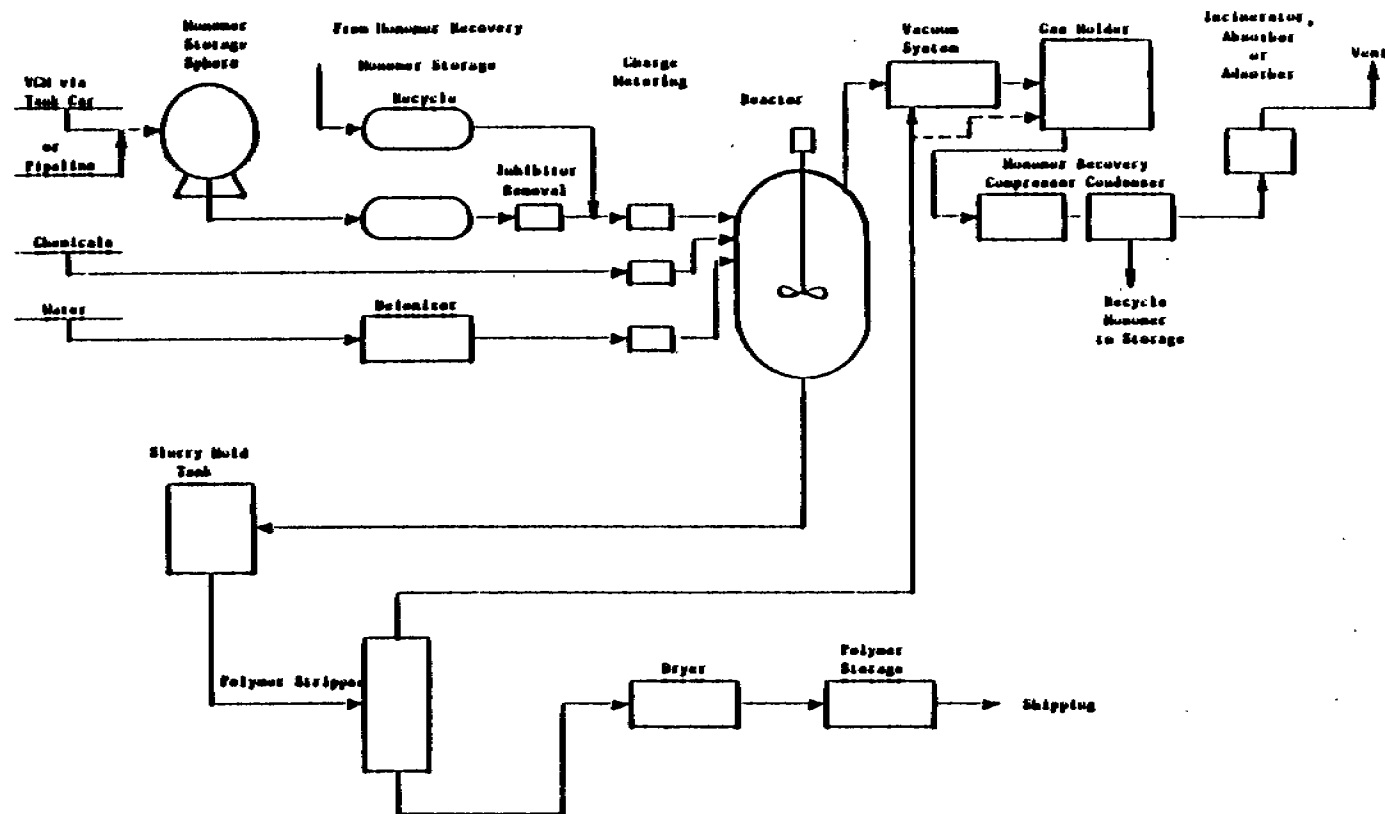


Figure 3-1. Simplified flow diagram of PVC suspension polymerization process.

TABLE 3-1. INPUT MATERIAL FOR POLYVINYL CHLORIDE
EMULSION AND SUSPENSION PROCESSES

Chemical	Parts by Weight
Suspension	
Vinyl Chloride	100
Water	150 - 350
Peroxide Initiator	0.1 - 0.3
Stabilizers	0.01 - 1
Emulsion	
Vinyl Chloride	40 - 60
Fatty Sulfonate	0.4 - 0.6
Fatty Alcohol	0.4 - 0.6
Lauryl Peroxide	0.4 - 0.3
Water	100

EPA 600/2-77-023j.

Initiators are compounds capable of forming free radicals by thermal decomposition. Patent literature reports the use of many initiators. Suspension polymerization of VCM is initiated by organic peroxides in industrial practice, although azo compounds, boron derivatives, and redox systems can be used.

Suspending agents are surface active compounds that prevent agglomeration of PVC particles during polymerization of vinyl chloride. The suspending agent influences particle size, porosity, and thus processing characteristics of the product.

Deionized water used for suspension polymerization is deaerated, and free of organic matter and sulfur. Water serves three purposes; it provides heat transfer, it is a medium for the suspending agent which controls the surface properties of the particles and it also moderates the bulk viscosity during processing. Processing of the final product is improved by the addition of small quantities of a secondary emulsifier to the system. Such emulsifiers include sulfonated oils or esters, ethylene oxide condensation products with polyols, and other synthetic surfactants.

Vinyl chloride polymerization is carried out in stainless steel, glass-lined carbon steel, or glass-lined stainless steel reactors, depending on raw materials used, corrosion resistance, and desired lifetime of reactors. Reactor sizes vary between 10 m³ (2,000 gals) and 200 m³ (50,000 gals); each plant uses 4 to 50 such reactors (typically 12-18). Newer plants tend to have larger and fewer reactors. Each reactor is equipped with an agitator, baffles, and temperature controls. The process involves the mixing of a weighed amount of vinyl chloride in a metered amount of water, initiator, and suspending agents which are premixed in a clean reactor. A steam jet or vacuum pump is used to remove most of the noncondensable gas remaining after the reactor is charged. The amount of noncondensable gas left depends on the absolute pressure after evacuation. The reactor is jacketed to provide heating or cooling as necessary for startup and for controlling the reaction. The

temperature of the reactor is raised to 55°C by passing steam through the jacket. Because the polymerization reaction is exothermic, cooling water is circulated through the jacket to keep the temperature constant, i.e., about 55°C during the polymerization.

The agitator, either top or bottom entering, uses multiblade impellers to provide uniform agitation, which is important for both efficiency of heat transfer and control of polymer particle size.

Reaction temperature is one of the primary control variables in suspension polymerization. Temperature influences molecular weight, molecular weight distribution, crystallinity of the product, the particle size of the polymer, and the solubility and adsorptivity of the suspending agent. A master-slave cascade instrument system is used for temperature control. Steam, cold water, and refrigerated water or brine are circulated through the reactor jacket as required. The polymerization temperature can be controlled with 30°C cooling water up to 70% conversion. Subsequently, the reaction rate increases more rapidly due to auto acceleration. At this point, refrigerated water at about 16°C is required to effectively control the temperature.

Polymerization takes place at a pressure of 517 kPa (75 psia) to 690 kPa (100 psia). Completion of the reaction is indicated by a drop in pressure. Prolongation of the cycle is harmful to resin porosity and color. The polymerization reaction continues to 88% conversion which requires approximately six hours. The cycle is then terminated by transferring the slurry to the polymer blend tank or stripper.

3.1.2 Reactor Cleaning

After discharging the bulk of the product, between batches, the reactor is cleaned to remove polymer buildup from the previous polymerization cycle. Reactor cleanliness is extremely important to product quality.

Resin from the previous batch and/or protective coating solution left in a reactor severely downgrades the quality of the subsequent batch. This cleaning process is done either by high pressure water spray and/or solvents, by personnel who enter the vessel and chip away the buildup, or by a combination of these methods. The normal sequence is to (1) wash all the reactor surfaces with water and/or solvents, (2) apply a protective coating (which inhibits polymer buildup), (3) remove the protective coating solvents, and (4) wash with water again to remove excess protective coating.

If the reactor must be opened to perform these operations, it is necessary to first remove the vinyl chloride vapors remaining in the vessel from the previous batch by vacuum or by purging. These vapors are processed in the monomer recovery system. Any noncondensable gases from that system are vented after being routed through an absorber or adsorption system or incinerator.

In some reactors, using the newest technology, the normal process of reactor preparation is performed without opening the reactor to the atmosphere. Lances with special nozzles project into the reactor for the washing and coating steps. Since there is no visual inspection for reactor cleanliness, the washing and coating devices must function properly.

3.1.3 Emulsion Polymerization

The equipment and process used in emulsion polymerization are basically similar to that used in the suspension process in that liquid vinyl chloride dispersed in a water system is polymerized in a batch process. The difference is that more soap is initially added to the reactor to stabilize the dispersed monomer droplets and prevent the formation of agglomerates. Many different soaps and surfactants may be used as emulsifiers, including natural and synthetic colloidal protective agents such as cellulose derivatives and polyvinyl alcohol. The emulsifier and initiator are dissolved in cold deionized water. A measured amount of vinyl chloride is added and agitated

to form a relatively stable emulsion. Polymerization starts when the reactor contents are heated. Emulsion resins can be polymerized at lower temperatures (40-55°C) and at faster rates than suspension resins. The polymerization is terminated at 90% to 95% monomer conversion. Polymerization rates decrease rapidly when a high conversion level is reached. A decrease in pressure signifies completion of the reaction. Unreacted vinyl chloride is recovered and recycled.

Emulsion resins are more sensitive to heat and shear stresses than suspension resins and if care is not taken, the resin particle may be changed in ways that make it unsuitable for use. The particle sizes obtained by the emulsion process are much smaller than those obtained by suspension. A major difference in equipment of the two processes is that the emulsion polymerization uses a spray dryer to ensure the maintenance of small particle size and reduced temperature and shear stresses during drying.

3.2 OPERATION AND MAINTENANCE PROCEDURES

The production of PVC centers around the batch reactors which have a cycle time ranging from 8 to 16 hours duration. The cycle starts with the charging and continues through a heat up period, a reaction period, discharge of product, and then clean up of the reactor to prepare for the next batch. The operations of reactor charging and polymerization in older plants are carried out manually by an operator who changes valve positions, prepares chemical additives, and starts and stops pumps or compression systems, etc., as needed. Automatic controls are used during warm-up and reaction periods to control reactor temperature, but operator supervision is frequently needed to reset control actions and to prepare chemical additives. The reactor clean up is a manually controlled operation and often involves a man entering the reactor for hand cleaning of the reactor walls. Newer plants with sophisticated on-line computer systems have automated some of the reactor charging steps and have also automated the cleaning operation using solvent and coating treatments.

Most plants receive VCM as liquid in tank cars and manually control the transfer to in-plant storage. The recovery of VCM from polymerization vessels and other vents is usually automated, compressing and condensing vapors from a gas holder and recycling the recovered liquid VCM. The polymer strippers and dryers are usually continuous operations processing feed from large polymer slurry holding tanks and conveying the product to bins. Bulk shipments and/or bagging operations are done periodically.

Maintenance of reactors and the equipment associated with them is simplified by the batch operation. Repairs can be prescheduled and carried out as part of the clean-up operation in preparation for the next charge. Maintenance of the major equipment in the more continuous VCM recovery, slurry stripping, and polymer drying operations requires a scheduled "turnaround", as is normally done in continuous chemical plants. Small equipment such as pumps, compressors, tanks, and heat exchangers usually have spares installed in parallel so that repairs can be made without loss of production. Redundancy of this type is especially important for equipment used to control VCM emissions.

As discussed in Section 4.3, the prevention of relief valve emissions of VCM is very dependant on the performance of the operating and maintenance personnel and on the development and application of effective standard procedures.

3.3 REGULATIONS ON VCM EMISSION FROM PVC PLANTS

The owner or operator of a polyvinyl chloride plant is required to comply with the requirements of Sections 61.64 and 61.65 of Title 40 of the Code of Federal Regulations as discussed below.

Reactor and Other Process Equipment through Stripping

The concentration of vinyl chloride in exhaust gases discharged to the atmosphere from each reactor is not to exceed 10 ppm as indicated in § 61.64(a).

The exceptions to this limit are emergency venting (covered below) and reactor opening loss which is not to exceed 0.02g vinyl chloride/kg (0.00002 lb vinyl chloride/lb) of vinyl chloride product, with the product determined on a dry solids basis.

Manual vent valve discharge: Except for an emergency manual vent valve discharge, there is to be no discharge to the atmosphere from any manual vent valve on a polyvinyl chloride reactor in vinyl chloride service. An emergency manual vent valve discharge means a discharge to the atmosphere which could not have been avoided by taking measures to prevent the discharge. Within 10 days of any discharge to the atmosphere from any manual vent valve, the owner or operator of the source from which the discharge occurs shall submit to the Administrator a report in writing containing information on the source, nature and cause of the discharge, the date and time of the discharge, the approximate total vinyl chloride loss during the discharge, the method used for determining the vinyl chloride loss, the action that was taken to prevent the discharge, and measures adopted to prevent future discharges.

In § 61.64(b), (c), and (d), it is stated that the concentration of vinyl chloride in all exhaust gases discharged to the atmosphere is not to exceed 10 ppm (except as provided in Section 61.65a) for the following vinyl chloride process equipment: from each stripper, from mixing, weighing, and holding containers preceding the stripper, and from the monomer recovery system. This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in Section 61.65(b)(6)(i) before being opened.

Equipment Following the Stripper

The following requirements set forth in § 61.64(a) apply to emissions of vinyl chloride to the atmosphere from the combination of all sources following the stripper in the plant process flow including but not limited to, centrifuges, concentrators, blend tanks, filters, dryers, conveyor air discharges, baggers, storage containers, and in process wastewater.

In polyvinyl chloride plants using stripping technology to control vinyl chloride emissions, the weighted average residual vinyl chloride concentration in all grades of PVC resin processed through the stripping operation on each calendar day, measured immediately after the stripping operation is completed, may not exceed:

- (i) 2000 ppm for PVC dispersion (emulsion) resins, excluding latex resins;
- (ii) 400 ppm for all other PVC resins, including latex resins, averaged separately for each type of resin.

The above mentioned emission standards (i and ii) also apply to PVC plants controlling vinyl chloride emissions with technology other than stripping, or in addition to stripping.

Relief Valve Discharge

Section 61.65(a) states that except for an emergency relief discharge, there is to be no discharge to the atmosphere from any relief valve on any equipment in vinyl chloride service. An emergency relief discharge means a discharge which could not have been avoided by taking measures to prevent the discharge. Such a discharge necessitates a written report to the Administrator within 10 days containing all of the necessary information concerning the discharge.

Fugitive Emission Sources

Section 61.65(b) prescribes how the fugitive emission from the following seven sources should be controlled.

1. Loading and unloading lines: After each loading or unloading operation and before opening a loading or unloading line to the atmosphere, the quantity of vinyl chloride in all parts of each loading or unloading line that are to be opened to the atmosphere is to be reduced so that the parts combined contain no

greater than 0.0038 m³ (0.13 ft³) of vinyl chloride at standard temperature and pressure. Any vinyl chloride removed from a loading line is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm (or equivalent as provided in Section 61.66).

2. Slip gauges: During loading or unloading operations, the vinyl chloride emissions from each slip gauge in vinyl chloride service are to be minimized by ducting any vinyl chloride discharged from the slip gauge through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm (or equivalent as provided in § 61.66).
3. Leakage from pump, compressor, and agitator seals: Vinyl chloride emissions are to be minimized from equipment seals in vinyl chloride service by the following provisions:
 - (i) on all rotating pumps by installing sealless pumps or pumps with double mechanical seals;
 - (ii) on all reciprocating pumps by installing double outboard seals;
 - (iii) on all rotating compressors by installing compressors with double mechanical seals;
 - (iv) on all reciprocating compressors by installing double outboard seals;
 - (v) on all agitators by installing agitators with double mechanical seals, (or equivalent equipment and/or procedures as provided in § 61.66).

If double mechanical seals or double outboard seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the pump, compressor or agitated vessel; or by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm (or equivalent as provided in § 61.66).

4. Leakage from relief valves: Vinyl chloride emissions due to leakage from each relief valve on equipment in vinyl chloride service are to be minimized by installing a rupture disc between the equipment and the relief valve, by connecting the relief valve discharge to a process line or recovery system (or equivalent as provided in § 61.66).

5. Manual venting of gases: Except for an emergency manual vent valve discharge, as discussed previously, all gases which are manually vented from equipment in vinyl chloride service are to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm (or equivalent as provided in § 61.66).
6. Opening of equipment: Vinyl chloride emissions from opening of equipment (including loading or unloading lines that are not opened to the atmosphere after each loading or unloading operation) are to be minimized as follows:
 - (i) Before opening any equipment for any reason, the quantity of vinyl chloride is to be reduced so that the equipment contains no more than 2.0 percent by volume vinyl chloride or 0.0950 m³ (25 gal) of vinyl chloride, whichever is larger, at standard temperature and pressure; and
 - (ii) Any vinyl chloride removed from the equipment in accordance with paragraph (b)(6)(i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm (or equivalent as provided in § 61.66).

"Equivalent Equipment" and Procedures

Section 61.66 states that upon written application from an owner or operator, the Administrator may approve use of equipment or procedures which have been demonstrated to his satisfaction to be equivalent in terms of reducing vinyl chloride emissions to the atmosphere to those prescribed for compliance with a specific paragraph of this subpart. For an existing source, any request for using an equivalent method as the initial measure of control is to be submitted to the Administrator within 30 days of the effective date. For a new source, any request for using an equivalent method is to be submitted to the Administrator with the application for approval of construction or modification required by § 61.07.

SECTION 4

REACTOR RELIEF DISCHARGE EMISSIONS

4.1 SAFETY AND OPERABILITY CONSIDERATIONS

The rupture disc/relief valve (RD/RV) system on PVC reactors is there to prevent over-pressuring of the reactor to the extent that the vessel ruptures. If this rupturing should occur, personnel in the area would be exposed to serious injury and other equipment nearby would be damaged. Since several reactors are generally near each other, one such rupture could escalate into a series of incidents. The effects are likely to be catastrophic. Existing regulations require safety relief devices on such vessels and strictly define the requirements for their installation and for both upstream and downstream connections. Both these legal requirements and insurance company requirements for safety relief are strictly enforced. There is no likelihood that companies would accept the principle of connecting PVC reactor safety relief valves into headers which connect to gasholder and other collection or destruction systems.

The discharge of large quantities of VCM vapor into the air is itself inherently unsafe. The flammability limits of VCM in air range from 4.0 percent to 21.7 percent by volume. When the relief valve opens, a VCM vapor cloud of up to 130 m³ VCM/m³ reactor volume (17 ft³/gal) may exit into the air and, under certain meteorological conditions, the VCM concentration in a cloud could remain at flammable levels for long distances. Although no case of a VCM emission explosion is known, similar flammable materials have caused explosions with injury and damage from such clouds. This safety consideration, in addition to the known carcinogenic nature of VCM, justifies expenditures to minimize the frequency and amounts of relief valve discharges to the atmosphere.

Since oxidation of VCM produces a stream containing hydrochloric acid, chlorine and phosgene gases, it will be necessary to caustic scrub the product gas from incinerators, catalytic oxidation units and boilers. Catalytic chlorination reactors would require condenser/absorber trains with collection of product and treatment of vent streams to prevent further air pollution. Although heat recovery from these operations is possible, the low frequency and short duration of the occurrences indicates that more energy would be expended for equipment manufacture and erection than could be recovered in many years of operation. Such equipment sized for the large flows expected from reactor relief valves would not be operable for cases of minor events.

Previous cost estimates have shown that VCM destruction systems with heat recovery for high VCM concentration require higher capital and operating costs than containment and/or recovery systems. The destruction systems lack the advantage of recovering the VCM as a useable material and the heat recovered is not usually at a useful level of energy. Reactor relief discharges are of very large magnitude over a short period of time and are accompanied by some unusual conditions if they are truly "emergency" discharges. Except for a flare, the use of destruction systems, which involve a chemical reaction (oxidation, addition or disproportionation of the VCM), requires instantaneous start-up of large complex pieces of equipment under upset conditions which are demanding the attention of all personnel in the plant to control the production equipment then in operation.

Flaring in a chemical plant is always a last resort approach. Its effects on the environment are about the same order of magnitude as a VCM spill. In fact, it may be worse than spills when the high heat release, high noise level, and toxic as well as noisome fumes produced are considered.

4.2 DISCUSSION OF EVENTS

4.2.1 Causes and Effects of Relief Discharges

The two most frequent causes of relief discharges from PVC reactor are

- 1) too much liquid or the presence of noncondensable gases in the reactor caused by errors in instrumentation and improper charge operations, and
- 2) high temperature in the reactor because of inadequate cooling. Each of these results in high pressure in the reactor with substantial VCM emissions to the atmosphere when the relief valve opens.

Since VCM liquid expands an unusual amount (up to 20 percent) when heated to reaction temperature, an overfilling of the reactor may not be evident when materials are initially added. As the reactor contents are heated toward reaction temperature, expansion of VCM liquid takes place and the liquid level rises. When the liquid reaches the reactor top, hydraulic pressure will open the relief valve. Overfilling of the reactor can be caused by a water or VCM charge meter error, a liquid leaking into the reactor through a block valve, or wash water not completely drained before starting the charging operation. The presence of noncondensable gases in the reactor will also cause high pressure to develop. Since the partial pressure of VCM and water vapor in the reactor top will each reach their vapor pressure, a multiplying effect occurs. For example, if 50 percent of the vapor space is noncondensable gas, then the total pressure will be twice the sum of VCM vapor pressure and water vapor pressure.

Table 4-1 shows the density and vapor pressure of liquid VCM at various temperatures. The operating procedure is to charge water with additives of suspension agents and initiator to about 50 percent of reactor volume and then reduce reactor pressure to about 0.05 atmosphere using a vacuum pump. Some vaporization of the water occurs to sweep noncondensables out of the system. With the reactor blocked in under vacuum, the liquid VCM is added to bring the total liquid level to about 80 percent of the reactor volume. As the reactants

TABLE 4-1. VAPOR PRESSURE AND DENSITY OF VCM

Temperature		Vapor Pressure psia	Density g/ml
°C	°F		
-13.8	7.14	14.7	0.96
0	32	25.1	0.94
37.3	100	83.3	0.38
51.6	125	119.8	0.85
63.4	150	163.0	0.82
79.4	175	223.2	0.78
93.3	200	293.4	0.76

are heated to reaction temperature, liquid expansion raises the liquid level to about 90 percent of the reactor volume so that the concentration of noncondensables in the reactor at liquid VCM entry is increased as much as 5-fold. Since the combined VCM and water vapor pressure at the normal operating temperature can reach about 10.2 ATM (150 psia) and RD/RV systems are often set at about 13.2 ATM (195 psia), the presence of only 25 percent noncondensables in the vapor space may trigger a relief discharge. This would occur if there were 5 percent noncondensables in the reactor vapor space at start of the liquid VCM charge. The source of noncondensables are 1) gases not removed by the evacuation, 2) gases dissolved or entrained in VCM liquid charge, and 3) leakage past block valves into the reactor between vacuum treatment and heat-up completion. A failure to complete the purging of noncondensables is likely unless carried out thoroughly. Foaming of the water during vacuum purging can carry additives out of the systems and cause problems with polymer quality. This makes it difficult to get a thorough purging without careful operation.

The temperature at which the sum of the vapor pressures of VCM and water may reach reactor relief valve discharge pressure settings, even with no noncondensable gases present, is about 72°C or 17°C above the normal reactor initiation temperature of 55°C. The polymerization reaction is exothermic and cooling water flowing through the reactor jacket removes this heat. The polymer formed is insoluble in both monomer and water phases and appears as a solid particle suspended in the water-VCM liquid mixture. As the reaction proceeds, the polymer tends to form a coating on the walls reducing the heat transfer effectiveness. At some point above the 50 percent conversion level an auto-acceleration of the reaction rate occurs with increased heat evolution. If an increase in temperature occurs at any time, the reaction rate and heat evolution will increase. In normal operation cold water is used in the reactor jacket to provide a larger temperature differential between the reactor contents and the jacket as needed to control the reaction temperature. Heat transfer effectiveness depends on vigorous agitation and ample supplies of chilled water. Any unusual reactor fouling or loss of agitation or

inadequacies in cooling water supplies will allow rapid heating of the reactor contents and the relief valve may open from the resulting excessive pressure in the reactor. The loss of agitation is of most concern since heat transfer is significantly reduced and super-heated VCM from lower parts of the reactor will flash suddenly as it is moved slowly toward the liquid surface by convection currents. In this case a very rapid rise in reactor pressure can occur.

When the relief valve first opens on a reactor, a rapid flow of wet VCM vapor, VCM liquid, and liquid water goes through the valve. The material present is one vapor phase, two liquid phases and possibly one solid phase, sometimes with reaction proceeding to produce more solids and heat. At the outlet of the valve, liquid VCM flashes as the pressure is reduced with cooling of the mixture. The VCM boiling point at atmospheric pressure is below -12°C (10°F) and under some conditions water may be frozen in the lines to make another solid phase. Generally, the duration of a major event is 10 to 15 minutes and the flow rate of VCM vapor is estimated to range from 2500 kg/min ($\approx$ 5000 lb/min) to 50 kg/min ($\approx$ 100 lb/min) over this period depending on reactor size and how much monomer had already polymerized before the relief valve opened.

In the case that the reactor is overfull, the hydraulic pressure which opens the valve is quickly relieved by liquid and vapor flows and little or no polymer is present. The valve generally reseats itself with only a small spill resulting; however, if the valve is of the type which remains open, a large volume of material continues to flow until reactor temperature and pressure is reduced to a low level and operators can manually stop the flow. Similarly, in the case of noncondensables in the reactor, these are also quickly purged, normal pressure is obtained, and only a relatively small emission will result if the relief valve reseats itself.

With inadequate heat removal, the rising temperature aggravates the situation and a major discharge generally results unless the reaction is in

the last stages, e.g., above 80 percent polymerized. At this high conversion level, most of the VCM has been consumed and since the polymer density is higher (up to twice) than the monomer density, the liquid level in the reactor is lower and hence there is less entrainment of liquids and solids with the vapors. Under reacting conditions, essentially all of the remaining VCM will be vaporized unless the reaction is stopped quickly. This can only be done with vigorous agitation and quick addition of proper chemicals.

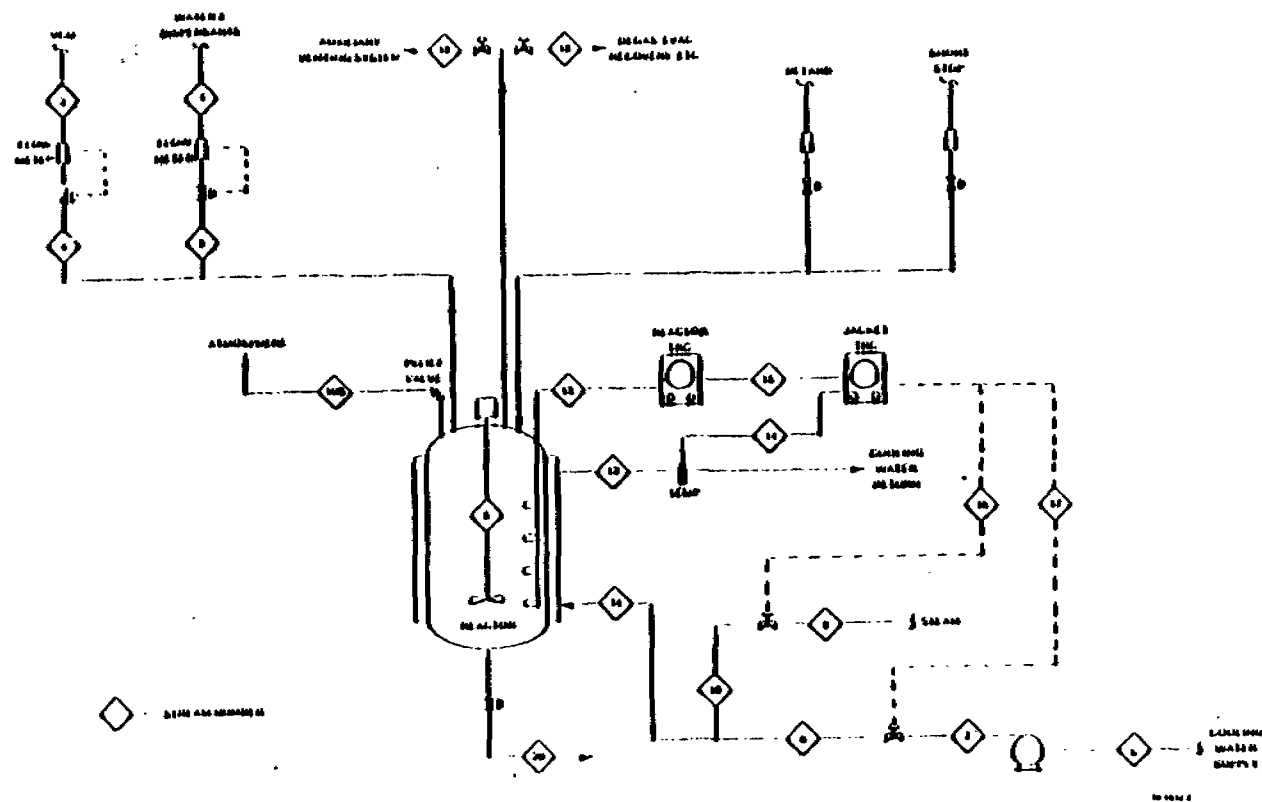
4.2.2 Fault Tree Analysis

It is desirable to foresee the potential causes for actuation of a reactor relief valve and to provide effective methods for reducing the probability of this type of occurrence. Several techniques have been developed and used within the chemical industry to describe and explain the events - which can cause a relief valve to lift. A common approach for analyzing complex systems, such as the batch reactor, uses logic models which are concerned primarily with the logical (on, off) relationships between variables and events. Two well known and publicized techniques which utilize logic models are:

- 1) failure modes and effects analysis, and
- 2) fault tree analysis.

A detailed discussion of these two types of analysis is beyond the scope of this report. However, an example of fault tree analysis applied to a small portion of the reactor system will illustrate some of the features which may be applied to the entire process.

A simplified schematic of a polymerization batch reactor in Figure 4-1 shows the individual reactant charging systems and the basic control instrumentation. The primary mode of controlling the reactor pressure and thereby prevent the relief valve from lifting is to control the total mass of material



charged to the reactor and the reactor temperature. Vinyl chloride monomer (VCM) and water containing dispersents, initiators, and stabilizers are charged separately to the reactor. Reactor temperature is controlled by continuous stirring of the contents and regulating the flow of cooling water or steam to the vessel jacket. In the event the primary controls fail to function as designed, an automatically controlled valve may release excess pressure to an auxiliary venting system and/or a dump tank on signal from the controller.

The first step in performing a fault tree analysis is to define the system and then to define the faults or events to be investigated. For the system shown in Figure 4-1, the fault or top event to be investigated is the lifting of the relief valve in stream 100. A simplified diagram of some of the system interactions and control loops is presented in Figure 4-2. The relief valve is actuated by vessel pressure, which is in turn affected by 1) the mass of material charged, 2) the temperature in the reactor, and 3) operator action. As the logic progresses to the next level, the system and interactions become more complex. The object of fault tree analysis is to set up these interactions in a manageable format suitable for analysis.

The depth of analysis can and should be appropriate for the problem under consideration. Initial studies can be tailored to include only general items such as those shown in Figure 4-2. As more detail is needed, the analysis is expanded to include additional features. A level of analysis can quickly be reached which will be quite complex and will require considerable time and effort for manual development.

To illustrate this type of analysis, visualize only the control system for charging vinyl chloride monomer to the reactor as shown in Figure 4-3. This consists of a flow control loop which is temperature compensated.

One possible fault tree for this loop is presented in Figure 4-4. This tree is not complete since items such as loss of electrical service, loss of instrument air, etc., are not yet included. The possible initiating faults

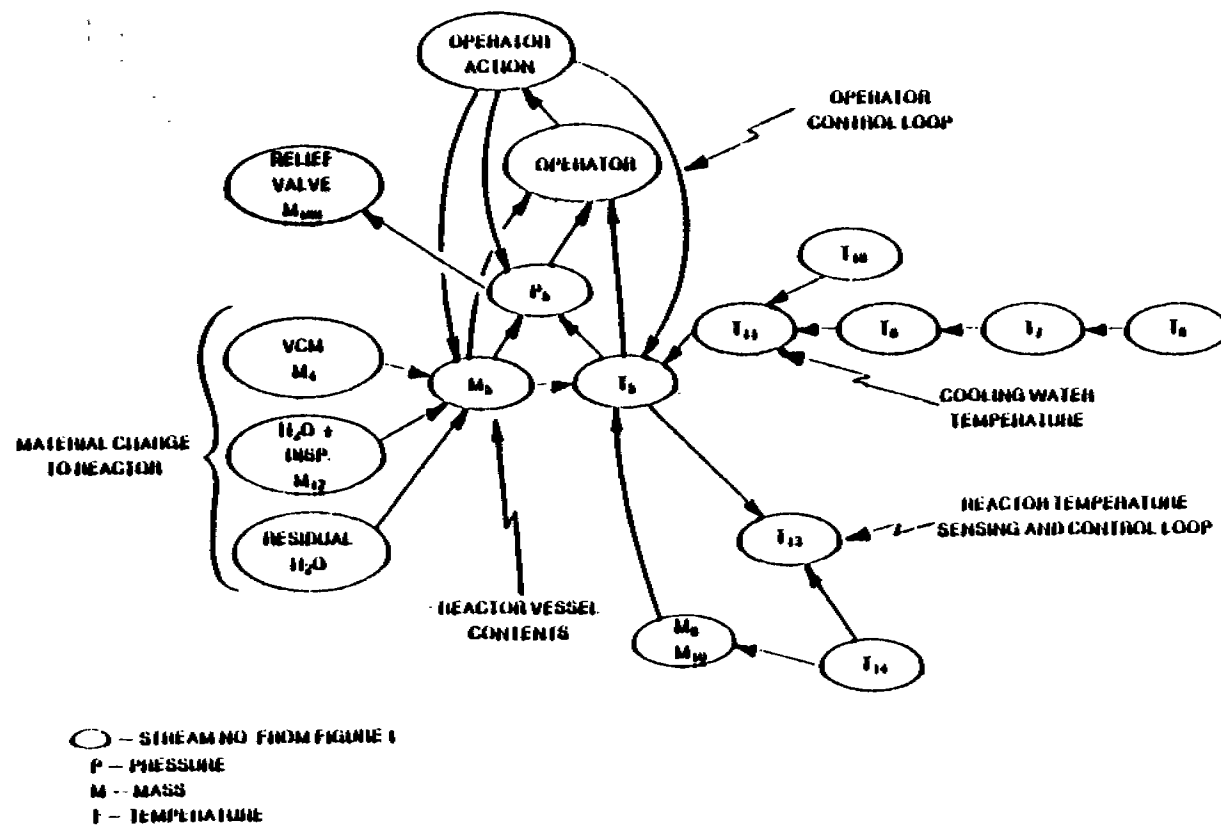
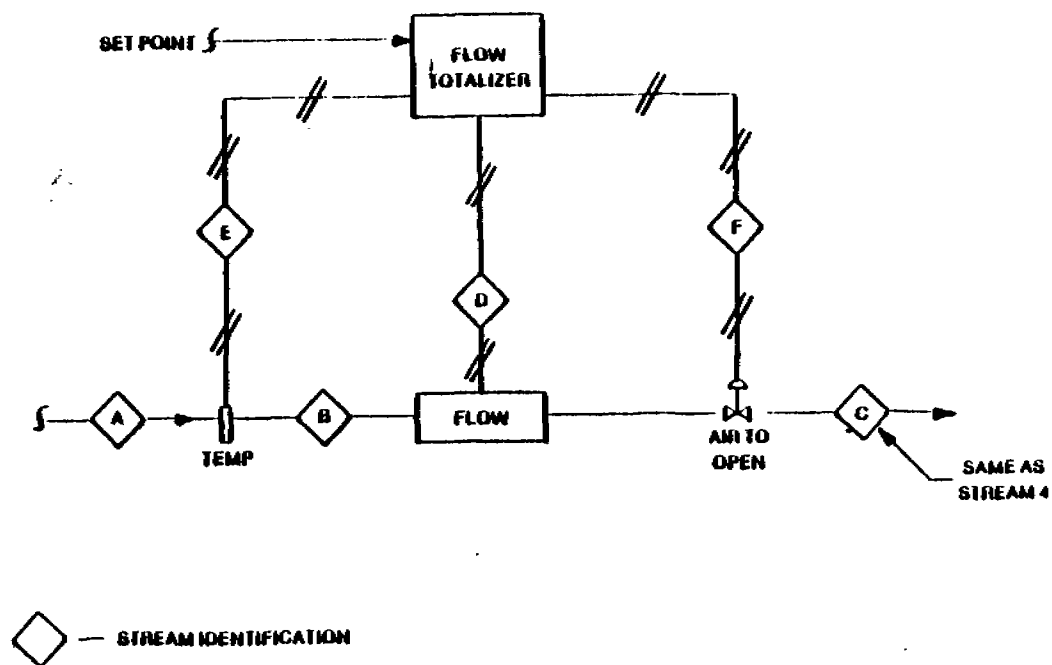


Figure 4-2. Overall diagram of reactor system.



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Figure 4-3. Temperature compensated flow control loop.



due to mechanical failures are easily identified in the left hand portion of this figure. The right hand chain reflects potential errors in instrumentation setting or configurations which might be overlooked. This tree should be expanded to include all possible events that may occur in the VCM charging system. Similarly, this approach should be applied to the water charging system, the reactor temperature control loop, the cooling water supply loop, the agitator, etc.

After the fault tree is defined, the next step is to develop a frequency of occurrence for each event. A valid occurrence rate can usually be found for equipment events in one of the many U.S. data bases for each kind of event. If data cannot be found then additional analysis can usually be undertaken to deduce realistic occurrence rates. The interaction of the human operator with the system may well be much more difficult to quantify than equipment failures and may produce results which are misleading. Herein lies one of the major objections to this type of analysis. It also is why, right or wrong, many operating systems are designed to minimize the human elements.

Once the occurrence rates have been established, then evaluation of the fault tree can proceed to the point where initiating events which would cause a relief valve to open, or other top event, can be ordered by frequency of occurrence. Additional analysis can also define probable severity, i.e., the consequences of each occurrence, and then define which initiating events must be avoided, changed, or do not require alteration. Additionally, the impact of alterations can be quickly evaluated.

The fault tree analysis can thus be utilized to highlight system weaknesses which might not otherwise be apparent. The results of the fault tree analysis can be used to prioritize the available effort and resources in the most effective manner to prevent the occurrence of the top event through equipment and system design, operator and maintenance personnel training,

redundancy, and development of effective operating procedures. For a more thorough discussion of fault tree analysis references in Section C in the bibliography, Appendix A, are suggested.

4.2.3 Operation and Maintenance

Many reported ventings have been ascribed to operator error in charging the reactor and in improper adjustment of controls during operation. Maintenance, through failure to coordinate repair work with operators, may cause ventings when operating equipment is opened. EPA has indicated that most operation is considered to be a "controllable" factor as related to venting of reactors and other equipment in VCM service. To aid in assessing the cause of a reactor venting and to prevent similar occurrences in the future, it is suggested that the data listed in Table 4-2 be supplied by the plant management when reporting such an incidence.

Adequate supervision of a production unit implies that each man involved in the operation is known to be trained in the work he is to do and is ready to do it properly when he reports to work. Anytime a man does not do his work properly, this supervision has failed by either giving the man too much to do or by not having the man properly equipped to do the job. Records of training need to be established for each man utilized in operations and periodic testing should be carried out to establish need for additional training. Evaluation of performance needs to be made regularly on each man. Supervision also needs to contact each man daily before he goes to work to be sure he is in condition to carry out his duties properly.

Repairs of equipment must be thoroughly done as needed but only when the equipment is available for work to be done on it. A checklist of action before dismantling the equipment should include confirmation by operations that the equipment is available and is not in service. This type of coordination is standard practice in the chemical industry.

TABLE 4-2. DATA NEEDED FOR REPORTING OF VENTING OF PVC REACTOR

1. Personnel - Each operator, maintenance man and supervisor involved
 - a. Names, training history, work history (experience)
 - b. Date and time reported for work - day of occurrence
 - c. Condition at time reported for work - physical/mental
 - d. Hours worked at time of occurrence
 - e. Date and times start/end work for 7 previous days
 - f. Duties
 - g. Dates of other reactor vents involving them during the previous 12 months

2. Operating Data - Reactor involved
 - a. Date and time of occurrence
 - b. Date and time charged - quantities of each material
 - c. Approximate % polymerized at venting
 - d. Length of time vent continued
 - e. Reactor temperature and pressure at start of occurrence
 - f. Copy of temperature chart, pressure chart, and log sheet
 - g. Actions taken to prevent venting
 - h. Deviations from standard procedure
 - i. Status of other reactors at start of occurrence
 - j. External conditions - weather, utility supplies, other upsets
 - k. Quantity of VCM vented

3. Cause of Venting

Detailed chronological description with exact timing of each action in preparing, charging, starting up, and operating this charge to and after the occurrence in the form of sworn statements from each of personnel listed in 1.a. above.

4.3 PREVENTION OF DISCHARGES TO ATMOSPHERE

An emergency relief valve discharge is defined in 40 CFR 61.65(a) as one which could not have been avoided by taking measures to prevent the discharge. EPA has suggested that a combination of proper instrumentation to detect upset conditions, a gasholder and an automatic inhibitor solution addition system can eliminate vinyl chloride lost from this source in existing plants. There are, however, several additional operating and maintenance factors that should be considered to ensure that there are no relief valve discharges as discussed in the following paragraphs.

Manual systems for addition of retardant and short-stop solutions to the reactor require evacuation of the charge manifold, measurement and siphoning of the solution into the manifold and then opening the manifold to the reactor to allow the solution to drain into it. A considerable time is required to carry out these actions and in the case of short-stop addition, the operator may have to locate and get approval of a supervisor before putting the solution into the reactor. A procedure for adding cold water directly to the reactor may be part of an operator's function but the heat content of water which can be added provides only a short (≈ 10 minute) delay in the reactor temperature rise.

All plants have redundant power supply systems either locally at the reactors or general for the entire plant. It is imperative that the agitators, the cooling water supply, and the instrumentation continue to be operable to prevent a major event release of VCM from reactors.

Many operating plants have computer systems to evaluate transmitted signals from the reactors and alert operators of any deviation from normal conditions as they develop. Some of these take automatic action to add retardant and short-stop solution to the reactors when high pressure, high temperature, or unusual viscosity conditions are indicated. Some plants also have vent lines with knock-out tanks connected to recovery systems

separate from the rupture disc/relief valve systems which protect the reactor. These auxiliary vent lines may have relief valve settings below the rupture disc/relief valve settings or they may be automatically activated or signal from a controller.

Some plants also have spare slurry hold tanks to which a reactor charge can be dumped before control of the reaction is completely lost. Such a dump can be automatically activated and the tank may have chilled water with short-stop solution in it. The literature indicates that at least one plant maintains a stored volume of chilled (48°F) water for use in reactor jacket cooling when either excess heat is generated in the reactor or an unusual fouling condition has developed which reduces heat transfer and the normal cooling water in the jacket can be replaced in less than 5 minutes by the chilled water.

Literature also indicates technology development using multiple initiator systems which give a high initiation rate early in the cycle and a slower initiation rate when auto acceleration normally occurs. Whether this technology is available for license was not determined. Its effect is to maintain near-constant reactor temperature and pressure.

4.3.1 Instrumentation and Automation

Almost all plants have an automated cascade temperature control system for the PVC reactors which adjusts jacket temperature to minimize reactor temperature rise. The reactor temperature is measured by a sensor usually mounted in the reactor baffle. This sensor gives a response to changing temperature and is subject to giving low readings when polymer collects on it. When clean, the error can be near $\pm 2^\circ\text{F}$ but under fouled conditions the error increases on the low side. As reactor temperature rises due to lowered heat transfer to the reactor shell, this temperature measurement will lag considerably behind the actual reactor temperature due to the polymer buildup. When polymer is being formed in the reactor, the reactor pressure is a better indication of reactor temperature than is the temperature measurement.

Systems were designed for instrumentation and automation of certain operations which can prevent relief discharges from reactors. The over-charge case and/or noncondensable case are prevented by comparing reactor pressure during heat up to the vapor pressure of VCM at the temperature indicated for the reactor and venting of a small amount of gases to the VCM recovery system or dumping slurry to a tank if pressure is too high. The inadequate cooling case is prevented by observing the rate of pressure rise on the reactor and comparing this to a standard condition for the stage of reaction with addition of retardant or short-stop automatically as needed. The high viscosity case is prevented by monitoring agitator power and comparing this to a standard with addition of short-stop automatically before the agitation and heat transfer ceases.

For the multi-reactor systems used in PVC production, a central control processor and the alternative of many locally mounted single-unit processors were both evaluated. Costs for sensors, transmitters, control units and control equipment not already in place were included in the estimates. For the central processor, costs were based on a commercially developed and competitive unit which required little development work to apply it on the PVC reactor control project. The costs of locally mounted single unit processors were based on known hardware to do the job but required software development of major magnitude. There may be already developed controllers of this type for which development costs would be much less but the only known equipment of this type are proprietary with PVC manufacturers. Potentially, they may be obtained by license agreements.

4.3.1.1 Central Processor—

The central processor will use data stored in memory to decide when or if modifications need to be made to the reactants. These data will represent not only measurements made on typical reaction cycles but also thermodynamic calculations of the reaction cycle. The central processor should be much

more responsive and accurate in assessing the reaction condition and in responding to any problems than a human operator. A diagram of the central processor is shown in Figure 4-5.

The central processor will be redundant such that if one unit becomes inoperable the second one can be brought on line immediately, if not automatically. The system will also be powered from a noninterruptable power supply so that in the event of a power failure the control will remain operable.

The historical data may be obtained by monitoring and storing reaction cycle parameters using the central processor. The central processor will be capable of acting as a data logger. It will also be able to indicate, before taking action, any reactors expected to have problems so that they may be watched more closely.

The Teletype keyboard and printer will be the input/output device for the processor. The keyboard will allow for requesting information, etc. The printer will be used by the computer to output data as well as any specific information requested by the operator. The disc may be used for program modification or data storage.

4.3.1.2 Processor for Single Reactor--

The processor for the single reactor will monitor the status of four input signals versus time. A diagram of the single reactor processor is shown in Figure 4-6. It will provide the proper control signals to valves V_1 - V_4 to maintain proper control over the reaction. The control parameters will be developed by monitoring the same signals as used by the controller during actual reactions. This information will be used along with thermodynamic calculations to develop the guidelines used by the processor in its decision making process.

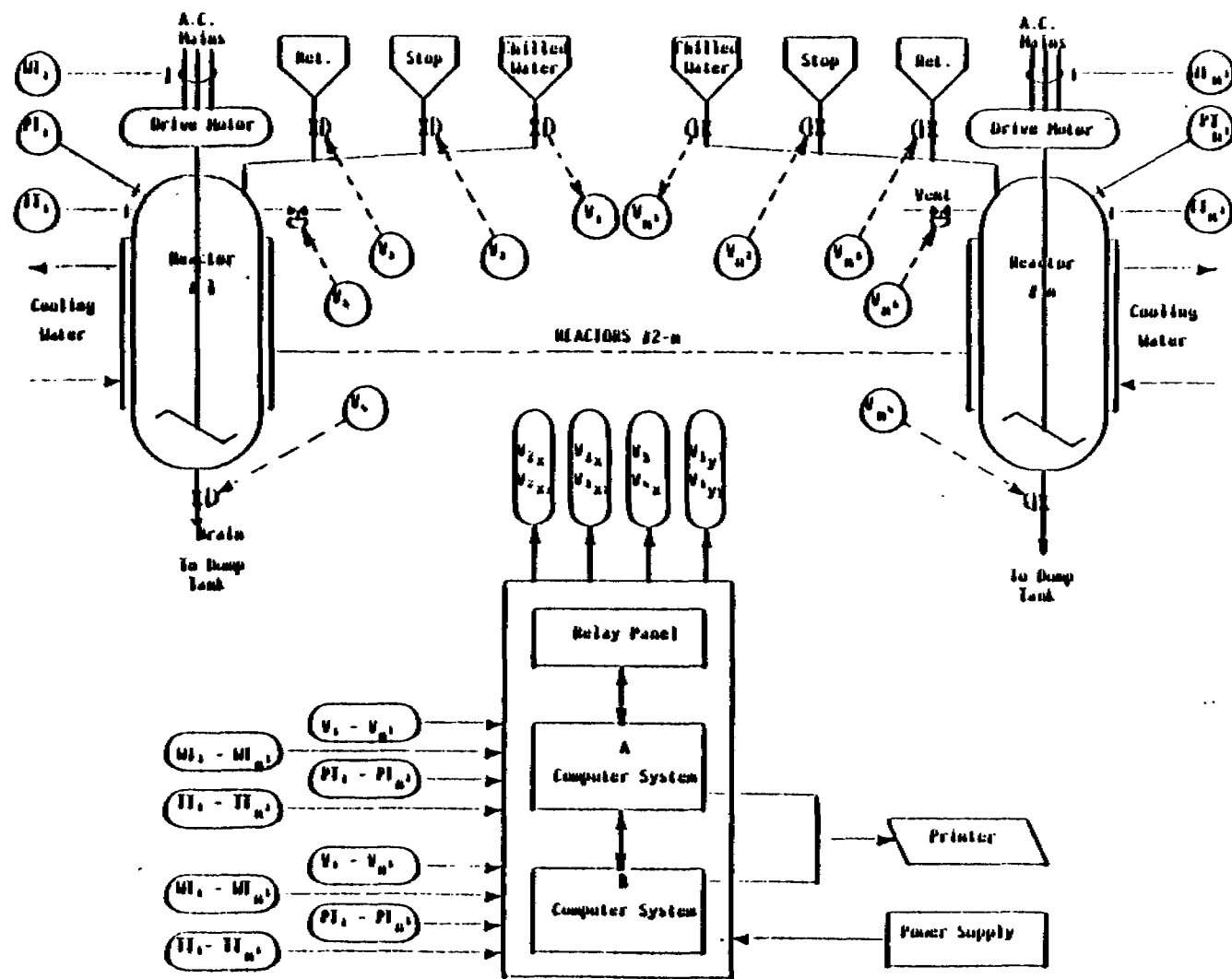


Figure 4-5. Diagram of central processor.

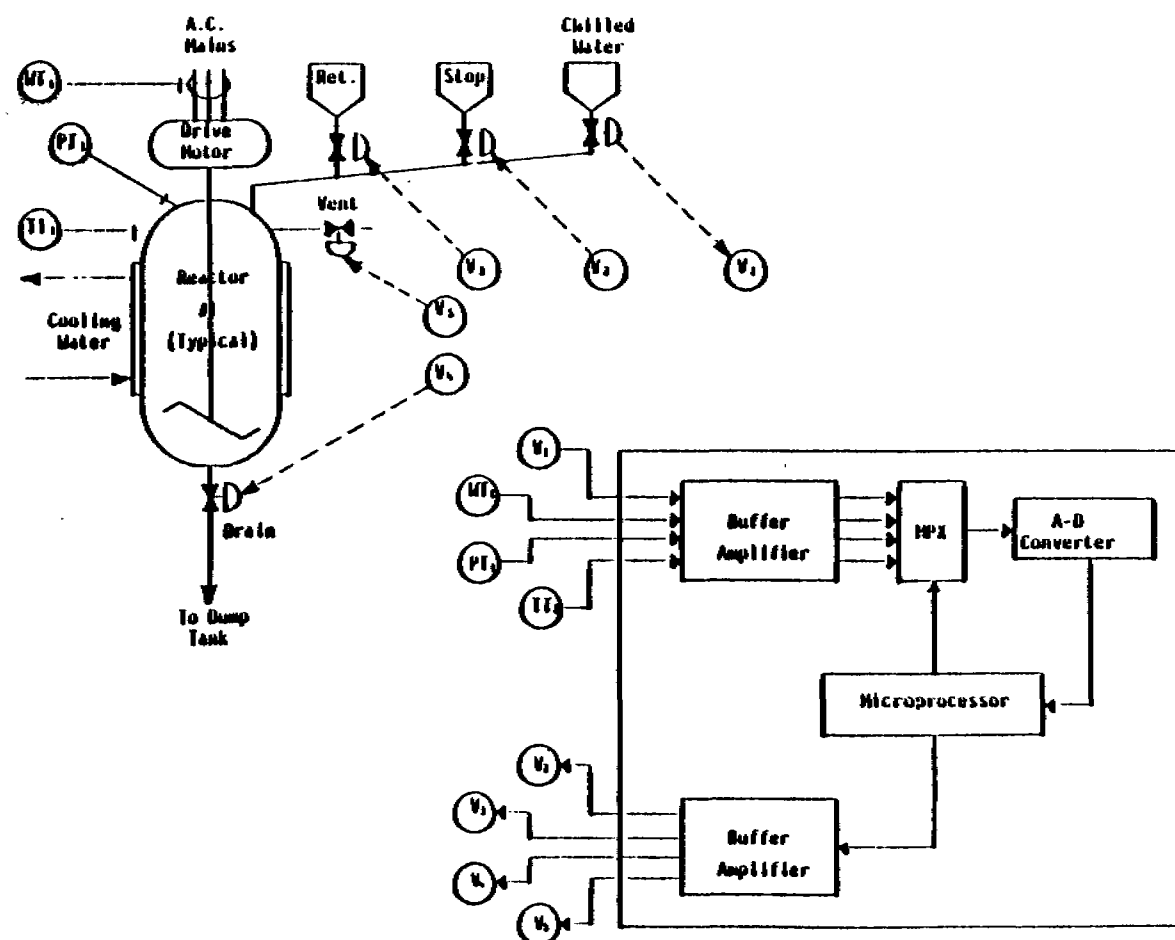


Figure 4-6. Single reactor processor.

The operator will still control the process so long as it stays in safe limits. The device will control the process only when it gets outside the proper bounds.

The unit will provide switch closures to activate lights at the operator's station to indicate first a problem situation is imminent and then a second switch closure and light to indicate the control activated.

These units will not necessarily provide signals suitable for data logging.

4.3.1.3 System Comparison—

The interesting outcome of the cost analysis is that the individual reactor control system (with more than 4 reactors) costs more than the central control unit which has higher redundancy and many more features. The major factor in this high cost is the research and development costs. Table 4-3 shows comparative costs of central and local units.

Although the local unit is considerably less complex than the control unit, its controlling function must be the same. The software design is not much easier for the remote unit than the central control unit. In fact, it is actually greater because the complete operating system must be designed. The central unit data acquisition routines have already been designed. The only hardware design costs in the central system will be the configuration of the option and checkout to be certain that they function properly. No real hardware development must be done as in the case of the local unit. The central system unit, because it already has data acquisition and logging capabilities, may be brought on line as a data logger. Then as sufficient data are obtained, it may be phased in as a controller. The local unit will require the use of a data logger since it will not inherently have data logging capability. This will be an extra expense not required by the central unit for development of controlling routines.

TABLE 4-3. COMPARATIVE COSTS* OF LOCAL AND CENTRAL UNITS
FOR PVC REACTOR CONTROL

Source	Local Unit	Central Unit (2 with 1 on line)
Development (Hardware)	\$55,000	\$10,500
Software Development	\$58,000	\$17,500
Installation	\$5,000/Reactor	\$ 95,000 + \$3,000/Reactor
TOTAL COST	\$113,000 + \$5,000/Reactor	\$123,000 + \$3,000/Reactor
Maintenance (Routine) Instrument Technician	1 hr/wk/unit	4 hrs/wk
Service Contract	\$100/yr/unit	\$6,000/yr

*December 1979 Dollars

The two features which could make the local unit more cost effective are not utilized in this situation. Conduit and cabling costs are not saved because noninterruptable power must be supplied to each unit and signals must also be sent back to the control station. Volume production which could recover development costs is also not used because only a relatively few units will be built for an individual plant.

The local units will have several disadvantages. The units will not have the inherent self test feature designed into them. They will need to be plugged into a testing unit to determine that they are functional. The central unit will have a self test routine which will be run periodically. The central unit will be able to take itself off line or could be manually taken off line in case of problems. The other central unit will immediately take over control.

The instrumentation included does not have a level alarm on the reactor so does not provide adequate protection from overfilling. It does provide for protection from other causes. If development of a reliable level alarm is obtained then the overall instrumentation system would provide the needed protection. Such a level instrument would probably cost \$6,000 per reactor as installed. One instrument company indicated success in this measurement using a radioactive source detected by ion chamber sensing.

4.3.2 Auxiliary Venting System

Under most conditions which can lead to rupture disc/relief valve emissions, a relatively small amount of material removed from the reactor will prevent the overpressure developing. These are the cases of reactor overcharge, noncondensable gases in the reactor, or moderate unexpected reaction rate increases and heat transfer reductions. An auxiliary vent and recovery or destruction system which is separate from the emergency system is a practical way to prevent relief valve emissions where a true emergency is not involved.

The system or systems would consist of reactor vent lines with pressure control valves, a header, a surge tank, a condenser with liquid trap, a vent line with back pressure control valves leading to an existing gasholder or incinerator, a chilled water storage tank, with chiller and circulation pumps and pumps for disposition of material collected in the surge tank. Figure 4-7 is a flow diagram of a system such as this.

4.3.2.1 Reactor and Venting Dynamics--

Pressure rise in the reactor is the result of temperature increases as it is heated to reaction temperature and as the reaction proceeds. Both liquid volumes and vapor pressures are increased by the temperature rise. The rate of pressure rise is relatively slow (< 2 psi/minute) during normal heat up to initial reaction temperature unless an overcharge condition or noncondensable gases exist in the reactor. These can cause a rapid (> 5 psi/minute) rate of pressure rise as the reaction temperature is approached. Similarly, after reaction is initiated and stabilized with normal cooling water on the jacket, pressure rises are slow (< 1 psi/minute) because of the heat capacity of the materials in the reactor and the continuous heat removal by the jacket. However, when reduction of heat transfer and auto-acceleration of reaction rate conditions develop, the heat evolution increases and heat removal decreases resulting in increases in the rate of pressure rise.

A computer program was developed to simulate the changing conditions within the reactor and the flow through the relief valve. It is assumed that the amount of PVC present is small so that the flow through the relief valve is in three phases: liquid water, liquid VCM, and gas. The reactor effluent flashes across the relief valve and critical flow (Sonic) is usually obtained. The program calculates the heat generated by the polymerization reaction and that removed via the cooling jacket with provision for varying water jacket temperature. The quantity of liquid entrained in the effluent flow is initially equal to the liquid/gas volume ratio in the reactor and as mass

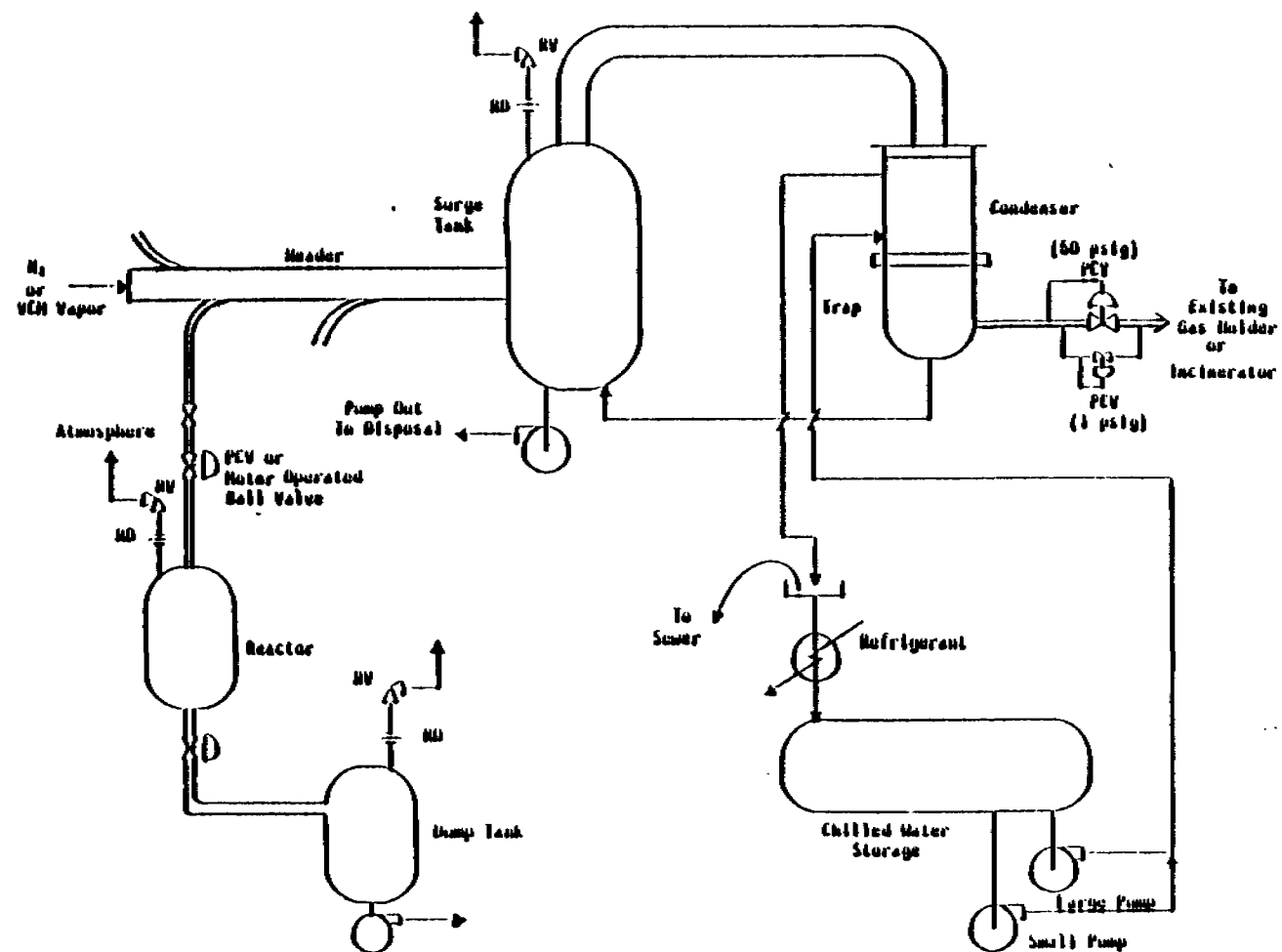


Figure 4-7. Auxiliary venting system.

leaves the reactor, it is reduced linearly to 1% by volume in the total flow.

The Runge-Kutta technique is used to integrate the dynamic material and heat balances over time. Figure 4-8 shows the flow chart for this program. The governing equations, program listing, and case result printouts are in the appendix.

The relief valve discharge simulation program was run for 10,000 gal and 20,000 gal reactors. The results are summarized in Tables 4-4 and 4-5. Cases 3 and 4 are simulations of discharges due to reactor overfilling and they compare the effect of introducing chilled water to the jacket with maintaining a constant (90°F) jacket temperature. In the five other cases, discharge is due to an excessive reaction rate of 40%/hr initially. In cases 2, 6, and 8 chilled (48°F) water is introduced into the cooling jacket, while in cases 1, 5, and 7 it is assumed that the agitator failed and no cooling occurs.

For the cases with 40%/hr reaction rate and no cooling (cases 1, 5, and 7) the pressure rises to a maximum of 3 psig above the discharge pressure in approximately 30 sec. and then declines. When agitation is lost, higher pressures may occur in a shorter time due to sudden flashing of material brought from the lower part of the reactor by thermal circulation.

When the reactor is vented through a pressure control or relief valve, the initial flow is a vapor/liquid mixture with some solids possibly present. Liquid VCM flashes in the valve and the inertia of the unflashed material uses up the available energy. In cases 1-4 the initial flow is assumed to be 96% liquid by volume, while for the overfilling cases the initial flow is entirely liquid. Although in normal operation the liquid level in the reactor is at the jacket level and entrainment may not be this large, it must be considered in the dynamic analysis. In all cases there was a linear reduction to a minimum of 1% liquid entrainment as the amount of liquid

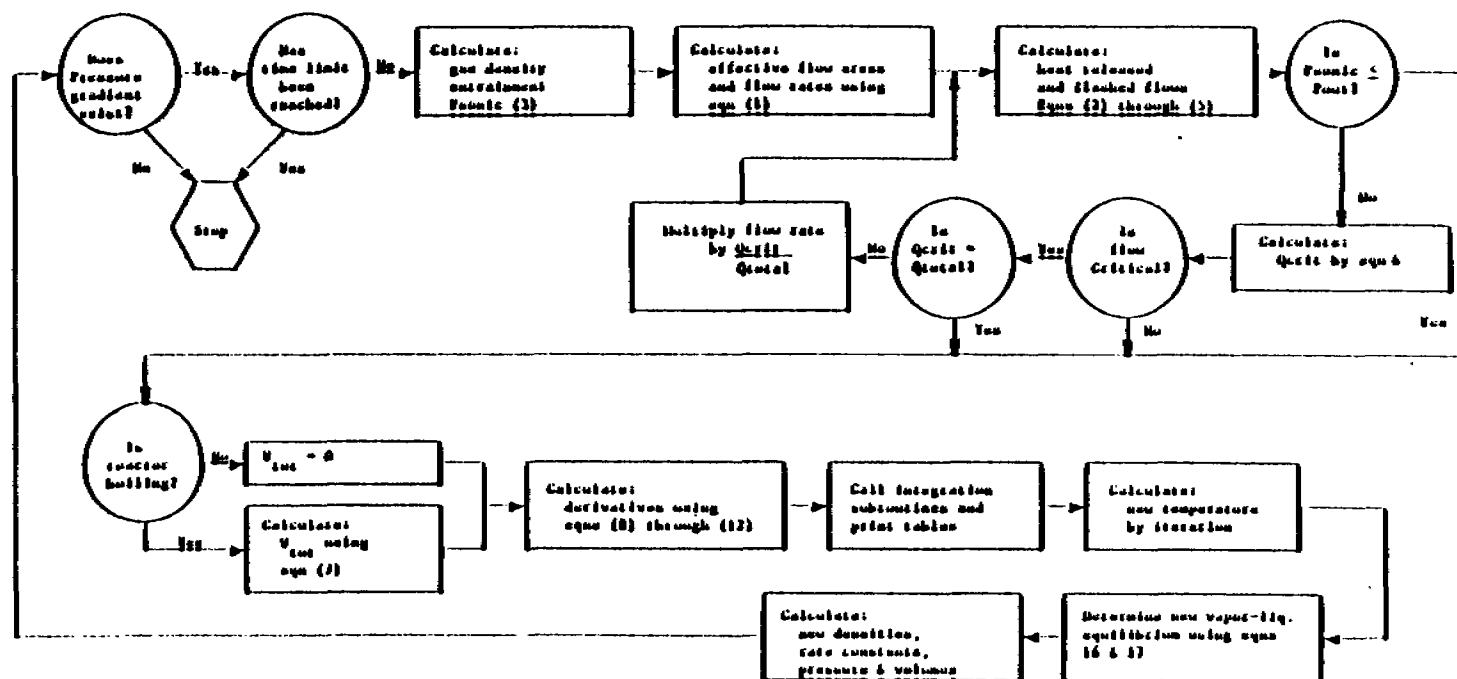


TABLE 4-4. SUMMARY OF REACTOR CONDITIONS AND RELIEF VALVE FLOW
RATE CALCULATED BY SIMULATION PROGRAM (10,000 gal Reactor)

Case	Nozzle Area in ²	Cooling Jacket UA Btu/min °F	Initial RRR Rate L/hr	Reactor Conditions			Maximum Pressure and Temp			Maximum Vapor Flow		Total VCM liq emitted lb mole	Total VCM vap emitted lb mole
				Initial Pressure psia	Jacket Initial Temp °F	Jacket Water Temp °F	Press. psia	Temp °F	Time min	Rate lb mole/min	Time min		
1	10	0.0	40	195	161.8	-	198	162	0.5	51.3	0.8	1.69	313
2	10	364.2	40	195	161.8	90-40	196	162	0.4	50.1	0.8	1.72	292
3	10	364.2	1.0	195	135	90-90	195	135	0.0	32.6	1.6	12.6	199
4	10	364.2	1.0	195	135	90-40	195	135	0.0	32.5	1.6	12.6	194

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TABLE 4-5. SUMMARY OF REACTOR CONDITIONS AND RELIEF VALVE FLOW
RATE CALCULATED BY SIMULATION PROGRAM (20,000 gal Reactor)

Case	Nozzle Area in ²	Cooling Jacket UA Btu/min °F	Initial RRR Rate L/hr	Reactor Conditions			Maximum Pressure and Temp			Maximum Vapor Flow		Total VCM liq emitted lb mole	Total VCM vap emitted lb mole
				Initial Pressure psia	Jacket Initial Temp °F	Jacket Water Temp °F	Press. psia	Temp °F	Time min	Rate lb mole/min	Time min		
5	20	0.0	40	215	168.5	-	218	170	0.6	110	0.9	1.63	662
6	20	895.6	40	215	168.5	90-48	216	169	0.4	108	0.9	1.60	626
7	40	0.0	40	215	168.5	-	215	168.5	0.0	211	0.5	1.81	858
8	40	895.6	40	215	168.5	90-48	215	168.5	0.0	209	0.5	1.84	820

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removed totaled to the volume of the reactor head. In all cases, a period of up to two minutes of venting was required to achieve a significant VCM vaporization rate in the reactor, depending upon the relief valve area. For a nozzle area of 10 in²/10,000 gal (cases 1, 2, 3, and 6), the maximum vapor rate into the header of 50 to 35 lb mole/min per 10,000 gal was achieved in less than one minute. If a higher auxiliary relief valve pressure setting is desired, a larger nozzle flow area, surge tank, and condenser must be used in order to keep the pressure from rising above that of the safety relief valve. Conversely, choice of a lower discharge pressure permits use of a smaller valve area and recovery system. The simulation program enables one to select a discharge pressure and flow area which are most suitable for a particular design. In addition, the program gives a time history of the conditions within the reactor which is useful in determining when the relief valve should close.

The VCM liquid entering the valve is flashed and goes to the vent lines and headers with the gases which entered the valve. The calculated vapor rate leaving the valve for the initial 96% liquid entrainment (first minute) is about half the vapor rate for the 1% liquid entrainment condition. This indicates that entrainment contributes to the stability of the vent system rather than the reverse. However, since entrainment may not be severe depending on the level in the reactor, vent system dynamics must be based on the maximum possible vapor flow leaving the valve at the inception of the venting. The vapor leaving the valve passes through the vent line into the header and then into the surge tank. The volume of this tank needs to be based on the time needed to actuate the chilled water flow to the condenser and to reach a stable operation. The simulation program output includes the quantities of VCM liquid and vapor emitted into the recovery system at specified times, which are necessary for sizing the surge tank.

4.3.2.2 Design Basis--

The design of an auxiliary relief system can be based on results of the computer program which provides rate of pressure rise in the reactor and rate of venting from the reactor. Using the most adverse conditions of reaction rate and heat transfer, the pressure setting of the auxiliary relief valve which will prevent the rupture disc/relief valve from being actuated is determined. It should be noted that several minutes delay may occur after the auxiliary relief valve opens before significant VCM vapor generation occurs inside the reactor. The auxiliary vent valves, lines, header, surge tank and condenser are sized based on the vent rate of liquid and vapor leaving the valve. The maximum vent flow usually develops after entrainment is reduced by the lowering of reactor level which can take as long as 2 minutes and depends on the valve size and initial reactor level.

In order to ensure smooth operation of the auxiliary vent system, the pressure control valve on the vent lines may have to be slow opening. The pressure reduction section of the vent line may also have to be a special design transition piece of equipment such as a flow nozzle. A motor operated ball valve which has a variable speed drive will probably provide a sufficient solution to the operating problem. The surge tank provided should be sized so that the pressure will reach 50 psig in the surge tank after more than 1 minute when a venting starts with no entrainment and in about 2 minutes with worst case liquid entrainment. These times will be lengthened some by the condensation which should begin at about 40 psig. There should be adequate time allowed for the large pump to be started up and chilled water to flow at the desired rate into the condenser.

When the reactor pressure is reduced, the auxiliary vent valve should close. The vent system then should stabilize at about 25 psig. Water/polymer slurry should be pumped out to a slurry hold tank and liquid VCM can be either pumped to a recovery tank or allowed to vaporize slowly to the gasholder, the

VCM vapor recovery systems, or the incinerator at a slow rate as desired. The quantity of VCM and water to be expected can be determined from the computer program.

In a standby condition the equipment should be maintained at 1 psig with a nitrogen or VCM vapor purging through the small bypass on the vent line. The condenser and chilled water tank are maintained at the 30°F temperature by the slow water circulation through the equipment and to the chiller. This circulation should be designed to recover the chilled water storage within 24 hours after a period of venting has occurred. Provision for periodic or continuous caustic flushing of the header may be needed as a safety factor and the "short-stop", needed in the surge tank, may require periodic replacement.

4.3.2.3 Auxiliary Vent Capital and Operating Costs—

The equipment shown in Figure 4-7 can be sized using data from the reactor and vent dynamics computer program. For capital estimating purposes, all the valves, lines and tanks handling VCM were assumed to be stainless steel materials. The vertical down flow exchanger was assumed to be carbon steel shell with stainless tubes and heads. The water pumps, lines, tanks and chiller were of carbon steel material. Table 4-6 shows the estimated capital costs per 1,000 gallon of reactor capacity and values indicated for a plant using 10,000 gallon reactors. The accuracy of these estimates are $\pm 30\%$.

Operation of the system requires one hour daily for a man to check the flows, levels, and temperature of the system. It will, periodically, take a full 24-hour shift position to return the unit to operational status after a significant emission occurs, which may be as often as 3 to 20 times/year. With the overtime requirement, about 1,000 man hours/year were estimated.

TABLE 4-6. ESTIMATED CAPITAL COST FACTORS AND COSTS FOR AUXILIARY VENT WITH CONDENSER (December 1979 Dollars)

	Cost Factor* \$/1000 gal	Using Eight 10,000 gal* Reactors
A Reactor Release and Collection System		
A ₁ Surge Tank	\$ 68,000 V ^{0.75}	\$ 419,300
A ₂ Pump and Motor	1,150 V ^{0.7}	15,800
Total Installed Equipment	\$ A ₁ + A ₂	\$ 435,100
A ₃ Piping	7,050 V ^{0.4} R	224,500
A ₄ Instruments, Control Valves and Safety	2,700 V ^{0.4} R	65,200
A ₅ Building and Site Development	0.22 (A ₁ + A ₂)	95,700
A ₆ Total Physical Cost	\$ $\sum (A_1 - A_5)$	\$ 820,500
B Condensing System		
B ₁ Condenser	\$ 66,200 V ^{0.7}	\$ 332,000
B ₂ Refrigeration Unit**	12,600 V ^{0.7}	63,000
B ₃ Auxiliary Vessels (pumps, tanks, exchangers, etc.)	26,800 V ^{0.6}	106,700
Total Installed Equipment	\$ B ₁ + B ₂ + B ₃	\$ 501,700
B ₄ Piping (water lines, vent lines, utility)	59,300 V ^{0.6}	236,900
B ₅ Instrumentation and Safety	18,100 V ^{0.6}	54,700
B ₆ Buildings and Site Development	0.22 (B ₁ + B ₂ + B ₃)	\$ 110,400
B ₇ Total Physical Cost	\$ $\sum (B_1 - B_6)$	\$ 903,700
C Combined Systems Total Physical Cost	A ₆ + B ₇	\$1,724,200
D Engineering and Construction (33%)	.33 C	569,000
E Contingency and Fee (20%)	.20 C	344,800
Total System Cost	C + D + E	\$2,638,000

*V = Thousands of gallons in each reactor; R = Number of reactors in plant.

**If adequate short term (1 day) and continuous refrigeration (+ 40°F) supply is available from existing units, this unit will not be needed.

Maintenance of the valves and pumps will be the major expense involved in keeping the system operational. An instrument technician for 2 hours/day and machinist 2 hours/week will be needed. Maintenance materials will be about \$10,000/year.

The cost of supplying purge nitrogen and steam is estimated at \$5,000/year.

The major energy requirement is the refrigeration needed. The annual operating costs are shown in Table 4-7 for the 10,000 gallon reactor case.

4.4 CONTAINMENT OF EMISSIONS FROM MAJOR EVENT RELIEF VALVE DISCHARGES

One category of control that is often proposed for eliminating VCM emissions resulting from major event relief valve discharges is containment. In this approach, the vapors released from the reactor are routed through a knock-out system to remove entrained polymer slurry and liquid VCM and then piped to either:

- 1) a gasholder,
- 2) an absorption system, or
- 3) an adsorption system.

Although all of these techniques are technically feasible and have essentially no impact on the environment, the capital, operating, and energy costs are significant as discussed in the following sections.

The containment system should be sized for the worst case, i.e., to accommodate the entire VCM charge to one reactor. In these discussions, the costs are developed for an example reactor of 10,000 gallon capacity, in a 200×10^6 lb/yr plant with eight reactors.

TABLE 4-7. ANNUAL OPERATING COST FACTORS FOR AUXILIARY
VENT WITH CONDENSER (December 1979 Dollars)

Investment = \$2,638,000 = I

Item	Engrg. Factor* \$/yr/1000 gal Reactor	Example Cost for 10,000 gal Reactor System
<u>Operating and Maintenance</u>		
A Labor and Supervision	\$ 12,700 V ¹	\$ 16,000
B Supplies and Chemicals	1,100 V ²	4,400
<u>Utilities</u>		
C Power (kWh @ 4¢)	4,600 V	46,000
D Steam	200 V	2,000
E Cooling Water	30 V	300
F Nitrogen	800 V	8,000
G Total Utility	Σ (C, D, E, F)	62,300
H Total O & M	Σ (A, B, G)	82,700
J Insurance and Taxes (@ 20% of Investment)	.02 I	52,800
K Capital Charges (@ 20% of Investment)	.2 I	527,600
Total Annual Costs	Σ (H, J, K)	663,100
Credit for Recovered VCM	2,000 V	(20,000)
Total Net Operating Costs		\$ 643,100

*V = Reactor Volume expressed in 1000 gallons.

The knock-out system required between the reactor and any containment system to trap entrained liquid VCM and water would be the same for each of the three alternative containment systems discussed below and would be similar to that described in paragraph 4.3.2 above, but without the condensing system equipment. It would consist of a stainless steel manifold connecting the individual reactor vent systems and leading into a surge vessel of about 40,000 gallons capacity, with a back pressure controller discharging to the inlet of the containment system. The installed cost of just the knock-out system is estimated to be about \$821,000 and is included in the capital estimates for the three alternative containment schemes. The sizing of the piping to and from the containment system is dependent on the available space and plant layout but is assumed to cost an additional \$600,000 in these examples. The accuracy of the cost estimates are $\pm 30\%$.

4.4.1 Gasholder Capital, Operating, and Energy Costs

The gasholder to be used for containment of VCM released from a reactor during a major event should be dedicated to that service unless it is shown that additional capacity is available for "normal" recovery operations in excess of that needed for containment of one reactor charge. A separate, smaller, gasholder is currently provided by many plants for the containment of VCM emissions from normal operations.

A proposed schematic flow diagram is shown in Figure 4-9 for incorporating the large gasholder and its auxiliary equipment into the plant. The piping and valving should be designed to be fail-safe and preclude the creation of an explosive mixture in the gasholder, the auxiliary equipment, or the piping. The actual flow scheme of the monomer recovery system is not shown inasmuch as there are numerous configurations and techniques that may be used affectively.

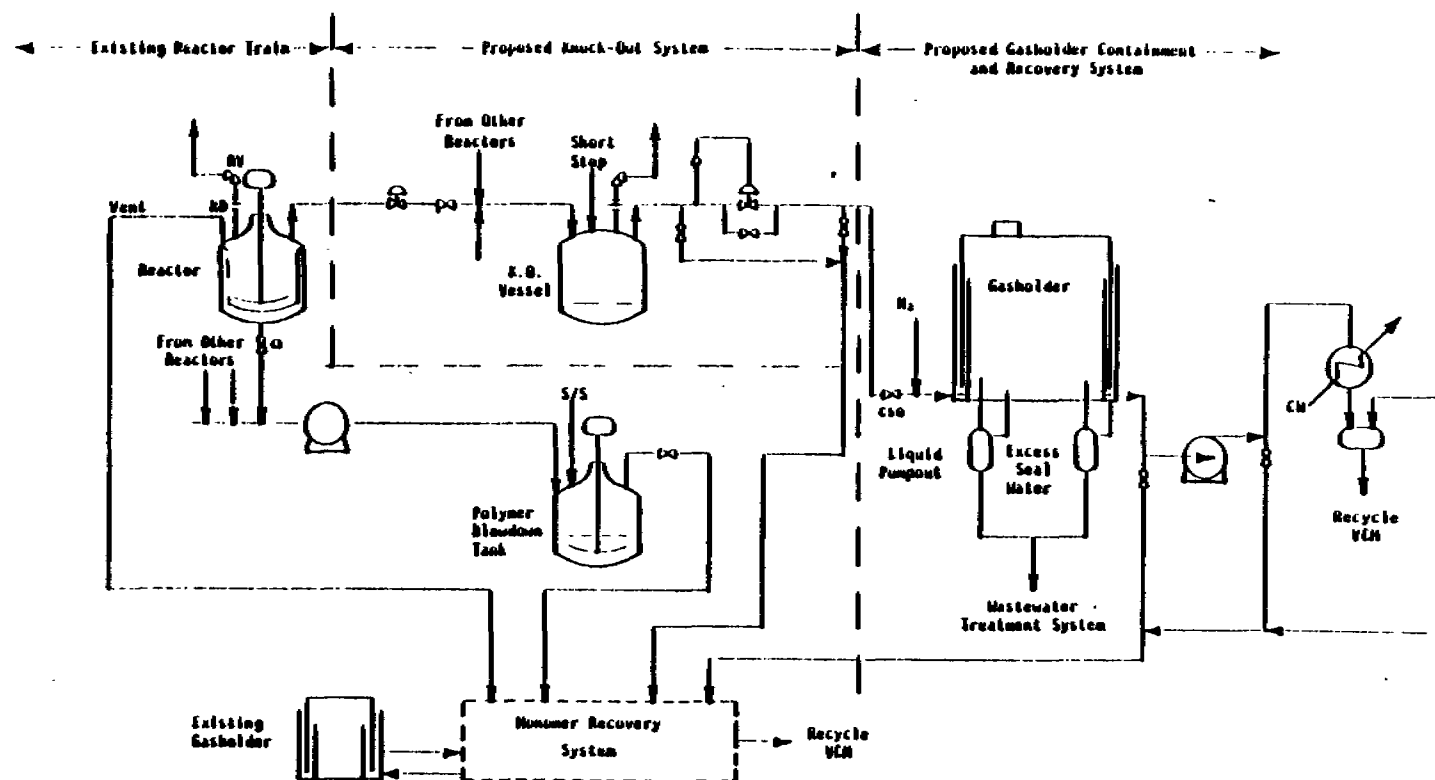


Figure 4-9. Schematic flow diagram of gasholder containment system for major event releases.

From the knock-out vessel a line goes directly to the monomer recovery system for processing of minor releases. However, in the proposed scheme, the vessel would also be provided with a back pressure valve set for about 30 to 60 psig that would open to the large gasholder inlet manifold in the event of a major release. The back pressure should be less than one-half of the setting on the polymerization vessel relief valve to ensure unrestricted flow during major event releases.

4.4.1.1 Capital Requirements—

The following are the normal specifications of a gasholder to contain the entire 4150 gallon VCM charge to one 10,000 gallon reactor (i.e., assuming it is operated with a 1.4/1 H₂O/VCM ratio).

Volume, cu ft	200,000
Diameter, ft	75
Height, ft	48
Material of Construction	Carbon Steel
Type of Seal	Water
Number of stages	1

The gasholder should be designed so that the guides and counterweights may be easily maintained to prevent "freezing" in one position during long periods of nonuse. Nitrogen or other inert gas connections are required to purge the system. A procedure is needed to periodically demonstrate the operability of the gasholder, auxiliary equipment, and piping.

The capital costs for a plant with a reactor size between 3,000 and 40,000 gallons may be estimated using the cost factors shown in Table 4-3. The costs for a system to accommodate a 10,000 gallon reaction are shown as an example.

TABLE 4-8. CAPITAL COST FACTORS FOR GASHOLDER CONTAINMENT SYSTEM
(December 1979 Dollars)

		Cost Factor* \$/1000 gal	Example Cost for 10,000 gal Reactor System
A	Gas Holder		
A ₁	Tank	\$ 70,000 V ⁻¹	\$ 441,700
A ₂	Erection, fdn.	70,000 V ⁻¹	441,700
	Total	(A ₁ + A ₂) = 140,000 V ⁻¹	\$ 883,400
B	Recovery Equipment		
B ₁	Compressor	6,340 V ⁻¹	26,000
B ₂	Motor	360 V ⁻¹	2,800
B ₃	Condenser	3,240 V ⁻¹	16,240
B ₄	Accumulator	4,000 V ⁻¹	15,930
B ₅	Misc. Vessels	4,000 V ⁻¹	15,930
B ₆	Pumps	1,700 V ⁻¹	6,800
B ₇	Sub Total Recovery	$\Sigma(B_1 - B_6)$	\$ 83,700
B ₈	Installation	2 x B ₇	167,400
B ₉	Total Recovery Installed	(B ₇ + B ₈) = 3 B ₇	251,100
C	Total Installed Equip.	(A ₂ + B ₉)	1,134,500
D	Other		
D ₁	Piping	96,000 V ⁻¹	382,200
D ₂	Instr. & Safety	23,300 V ⁻¹	70,400
D ₃	Buildings & Site Devel.	58,300 V ⁻¹	232,900
D ₄	Total Other	$\Sigma(D_1, D_2, D_3)$	685,500
E	Total Containment System	$\Sigma(C + D_4)$	1,820,000
F ₁	Knock-out System	Table 4-6	821,000
F ₂	Header Extension**	150,000 LV ⁻¹	600,000
G	Total Physical Cost	$\Sigma(E, F_1, F_2)$	3,241,000
H ₁	Engineering & Construction	13% G	1,070,000
H ₂	Contingency	20% G	648,000
I	Total System Cost	$\Sigma(G, H_1, H_2)$	\$4,959,000
		Say	\$5,000,000

*V = Reactor Volume expressed in 1000 gallons.

**L = Header extension length, 1000 feet.

4.4.1.2 Operating and Maintenance Costs—

The operating requirements of a gasholder system are minimal, yet strict adherence to operating and maintenance procedures is necessary to ensure the effective response of the system during an emergency release.

Operating Requirements—One person should be designated on each shift to be responsible to see that the gasholder is operational at all times. Tasks to be performed would be 1) log the actual level of the gasholder tank, 2) check the line-up of valving to and from the holder, 3) check water seal on gasholder, 4) check level of overflow water collection pit, and 5) periodically raise and lower the tank to demonstrate its operability. Time to perform these duties is estimated to average one hour per day. Nitrogen is required for purging the system and steam for heating the seal system in winter months.

Maintenance Requirements—To further assure the operability of the system, the following routine maintenance would be required:

- 1) Lubricate the guides and rollers, i.e., all moving parts, to prevent a mechanical "freeze-up" or locking of the floating chamber.
- 2) Inspect, and repair as required, the instrumentation and automatic control devices.
- 3) Perform routine maintenance on pumps and compressors.
- 4) Perform scheduled major inspections of entire system on annual and/or biannual basis.

The time required to perform these tasks is estimated to average 300 man-hours/yr. Maintenance materials required for the pump and compressor includes spare parts, lubricants, seals, etc.

4.4.1.3 Energy Requirements--

The energy costs for the gasholder containment system are negligible and are primarily for recovery of the VCM by compression and condensation of the vapors. If it is assumed that the gasholder is filled three times a year, the volume to be recovered over a total of 72 hours would be 600,000 cu ft of VCM vapor for a reactor of 10,000 gallon capacity. The compression would require about 2000 kWh and the condensation would consume about 120,000 gallons of cooling water. The rainwater runoff via the seal water systems adds about 200,000 gal/yr to the wastewater stripping operations. The incremental steam and cooling water requirements would therefore be about 4,200,000 lbs/yr, and 1,000,000 gal/yr, respectively.

4.4.1.4 Total Annualized Cost of Gasholder--

The approximate annualized cost for operating a gasholder to provide containment of VCM from a reactor of any capacity may be estimated using the engineering factors in Table 4-9. An example is given for a 10,000 gallon reactor case.

The major expense of capital charges and the low expectation of VCM quantity recovered makes the containment of major discharges by a gasholder uneconomic and not cost effective.

4.4.2 Absorption System Capital, Operating, and Energy Costs

An absorption system can be used to effectively contain the reactor major releases. The system should be able to recover almost all of the VCM released and reduce the VCM concentration in the air emission stream to acceptable levels.

TABLE 4-9. ANNUAL OPERATING COST FACTORS FOR GASHOLDER
CONTAINMENT SYSTEM (December 1979 Dollars)

Investment** = \$5,000,000 = I

		Engrg. Factor* \$/yr/1000 gal Reactor	Example Cost for 10,000 gal Reactor System
<u>Operating & Maintenance</u>			
A	Labor & Supervision	\$ 25,000 V ¹	\$ 31,300
B	Supplies, Chemicals, Utilities	5,630 V ²	22,500
C	Power	130 V	1,300
D	Steam	3,350 V	33,500
E	Cooling Water	20 V	200
F	Nitrogen Purge	520 V	5,200
G	Total Utilities	$\Sigma(C, D, E, F)$	40,200
H	Total O & M	$\Sigma(A, B, G)$	94,200
J	Insurance & Taxes	2% I	100,000
K	Capital Charge	20% I	1,000,000
L	Total Annual Costs	$\Sigma(H, J, K)$	1,194,200
M	Credit for Recovered VCM	(2,000 V)	(20,000)
N	Total Net Annual Operating Cost (L-M)	(L-M)	\$1,174,200

*V = Reactor Volume expressed in 1000 gallons.

**From item I, Table 4-8.

A schematic flow diagram for an absorption system using 1, 2-Dichloroethane as the absorbing solvent is shown in Figure 4-10. The piping and valving should be designed to be fail-safe and preclude the creation of an explosive mixture at any point in the system.

The operation of the knock-out vessel ahead of the absorber is described in Section 4.3.2. The discharge from each knock-out vessel is piped directly to the absorption system manifold and also to the plant's normal VCM vapor recovery system during routine operations.

The solvent supply tank should be elevated to provide a sufficient head to supply solvent to the absorption system in case of a power failure. Controls on the solvent supply tank should be designed to permit operation during a power failure. The stripping column is designed to recover the lean solvent and send all VCM to recovery or disposal in a 24-hour period.

<u>Absorber/Stripper</u>	<u>Absorber</u>	<u>Stripper</u>
Type	Packed Tower	Tray Tower
Number of Units	4	1
Height, ft	48	48
Diameter, ft	4.75	3.0
Material of Construction	Carbon Steel	Carbon Steel
Solvent Used	1,2-Dichloroethane	—
Quantity of Solvent Needed, gal	48,000	—

Rich Solvent Storage Tank

Type	Cylindrical
Volume, cu ft	7,800
Material of Construction	Carbon Steel

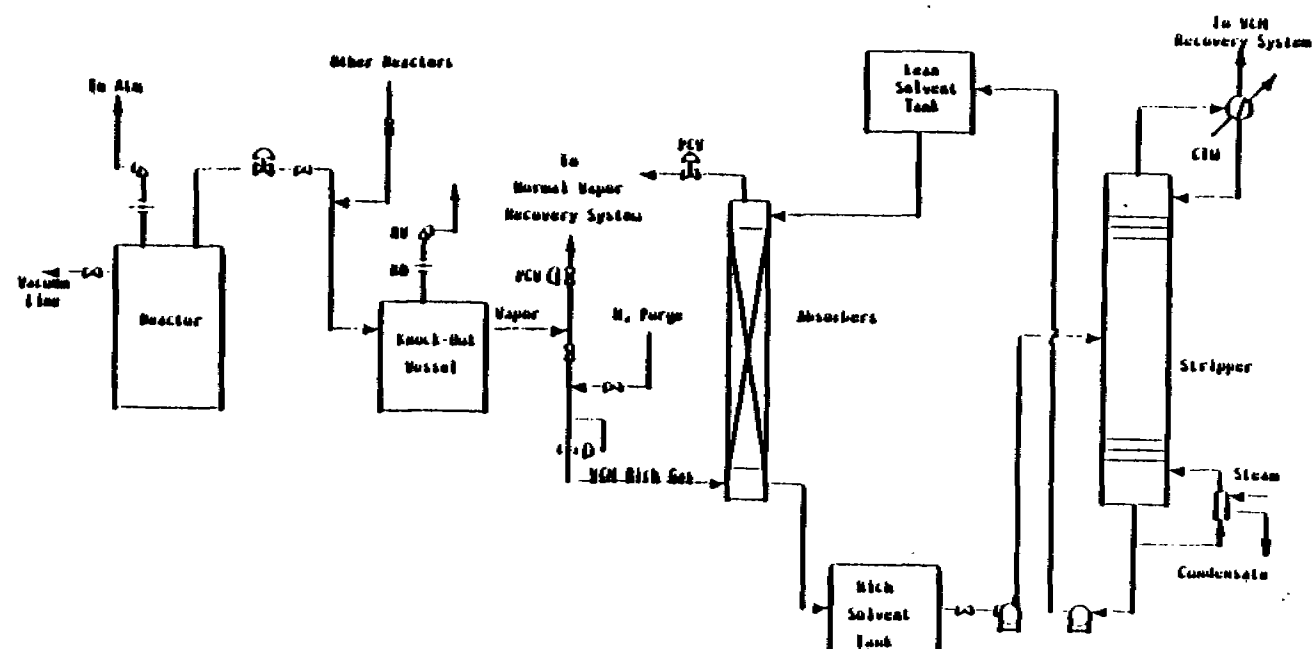


Figure 4-10. Absorption system schematic flow diagram.

Lean Solvent Storage Tank

Type	Cylindrical
Volume, cu ft	7,200
Elevation, ft	100
Material of Construction	Carbon Steel

4.4.2.1 Capital Requirements--

The capital costs for an absorber/stripper designed to handle the entire discharge from a reactor, in the 3,000 to 40,000 gallon range, may be estimated using the cost factors shown in Table 4-10. An example is given for a 10,000 gallon reactor case.

4.4.2.2 Operating, Maintenance, and Energy Costs--

Operating costs for the absorption system are minimal since the system is normally not in use. An operator on each shift should be responsible for keeping the system operational at all times.

The absorption and stripping equipment should be provided with a continuous purge of inert gas (such as nitrogen). The operability of the pump, controls and instrumentation should be demonstrated periodically.

Energy costs for the absorption stripping system are small. The main energy uses are pumping the rich, VCM laden, solvent through the solvent stripper and into the lean solvent storage tank; and the steam and cooling water required to strip the solvent to VCM in the stripper.

Scheduled maintenance inspections and necessary routine maintenance on the operating equipment should be performed. Inspection and repair of instrumentation and control devices should also be performed on a regular basis.

TABLE 4-10. CAPITAL COST FACTORS FOR SOLVENT ABSORPTION
CONTAINMENT SYSTEM (December 1979 Dollars)

		Cost Factor *	Example Cost for 10,000 gal Reactor System
		\$/1000 gal	
Equipment			
A ₁	Absorbers	\$ 43,900 V ⁻⁷	\$ 220,000
A ₂	Stripper	20,800 V ⁻⁷	104,300
A ₃	Auxiliary Vessels (Storage tanks, pumps, compressors)	25,500 V ⁻³	101,400
A ₄	Total Installed Equipment	$\Sigma(A_1, A_2, A_3)$	425,700
B	Piping	34,200 V ⁻³	136,200
C	Instrumentation and Safety	25,400 V ⁻¹	32,000
D	Buildings and Site Development	28,400 V ⁻⁶	71,400
E	Total Containment System	$\Sigma(A_4, B, C, D)$	665,300
F ₁	Knock-Out System	Table 4-6	321,000
F ₂	Header Extension**	150,000 LV ⁻⁴	600,000
G	Total Physical Cost	$\Sigma(E, F_1, F_2)$	2,086,300
H ₁	Engineering and Construction	33% G	688,300
H ₂	Contingency and Fee	20% G	417,300
H ₃	Initial EDC Charge	6,920 V	69,200
I	Total System Cost	$\Sigma(G, H_1, H_2, H_3)$	\$3,261,300
			Say \$3,300,000

*V = Reactor Volume expressed in 1000 gallons

**L = Header extension length, 1000 feet.

The annualized operating costs for an absorption system may be estimated as shown in Table 4-11.

The major expense of capital charges and the low expectation of VCM quantity recovered makes the containment of major discharges by absorption uneconomic and not cost effective.

4.4.3 Adsorption System Capital, Operating, and Energy Costs

A carbon adsorption system can be used to contain reactor major releases. The system should be able to recover almost all of the VCM released and reduce the VCM concentration in the gas emission stream to acceptable levels.

A schematic flow diagram for a carbon adsorption system is shown in Figure 4-11. A typical four-bed vertical carbon adsorption unit is depicted in Figure 4-12. The piping and valving should be designed to be fail-safe and precluded the creation of an explosive mixture at any point in the system.

The operation of the knock-out vessel is described in Section 4.3.2. The discharge from each knock-out vessel should be piped directly to the inlet manifold of the carbon adsorption system and also, to the plant's normal VCM vapor recovery system during routine operations.

4.4.3.1 Capital Requirements--

The carbon adsorption system should be designed to handle the entire discharge of VCM from the plant's largest reactor. Assuming an initial charge of 4150 gallons of VCM and 5820 gallons of H₂O to a 10,000 gallon reactor, the specifications are:

TABLE 4-11. ANNUAL OPERATING COST FACTORS FOR SOLVENT ABSORBER
CONTAINMENT SYSTEM (December 1979 Dollars)

Investment** = \$3,300,000 = I

Item	Engrg. Factor* \$/yr/1000 gal Reactor	Example Cost for 10,000 gal Reactor System
Operating & Maintenance		
A Labor & Supervision	\$ 43,800 V ^{0.1}	\$ 37,700
B Supplies & Chemicals	3,350 V ^{0.4}	13,300
Utilities		
C Power	340 V	3,400
D Steam	80 V	800
E Cooling Water	40 V	400
F Nitrogen Purge	250 V	2,500
G Total Utilities	$\Sigma(C, D, E, F)$	9,100
H Total O & M	$\Sigma(A, B, G)$	80,100
J Insurance & Taxes	2% I	66,000
K Capital Charge	20% I	660,000
L Total Annual Costs	$\Sigma(H, J, K)$	806,100
M Credit for Recycled VCM (6480 gal)	2,000 V	(20,000)
N Total Net Operating Cost	(L-M)	\$ 786,100/yr

*V = Reactor Volume in 1000 gals.

**From item I, Table 4-10.

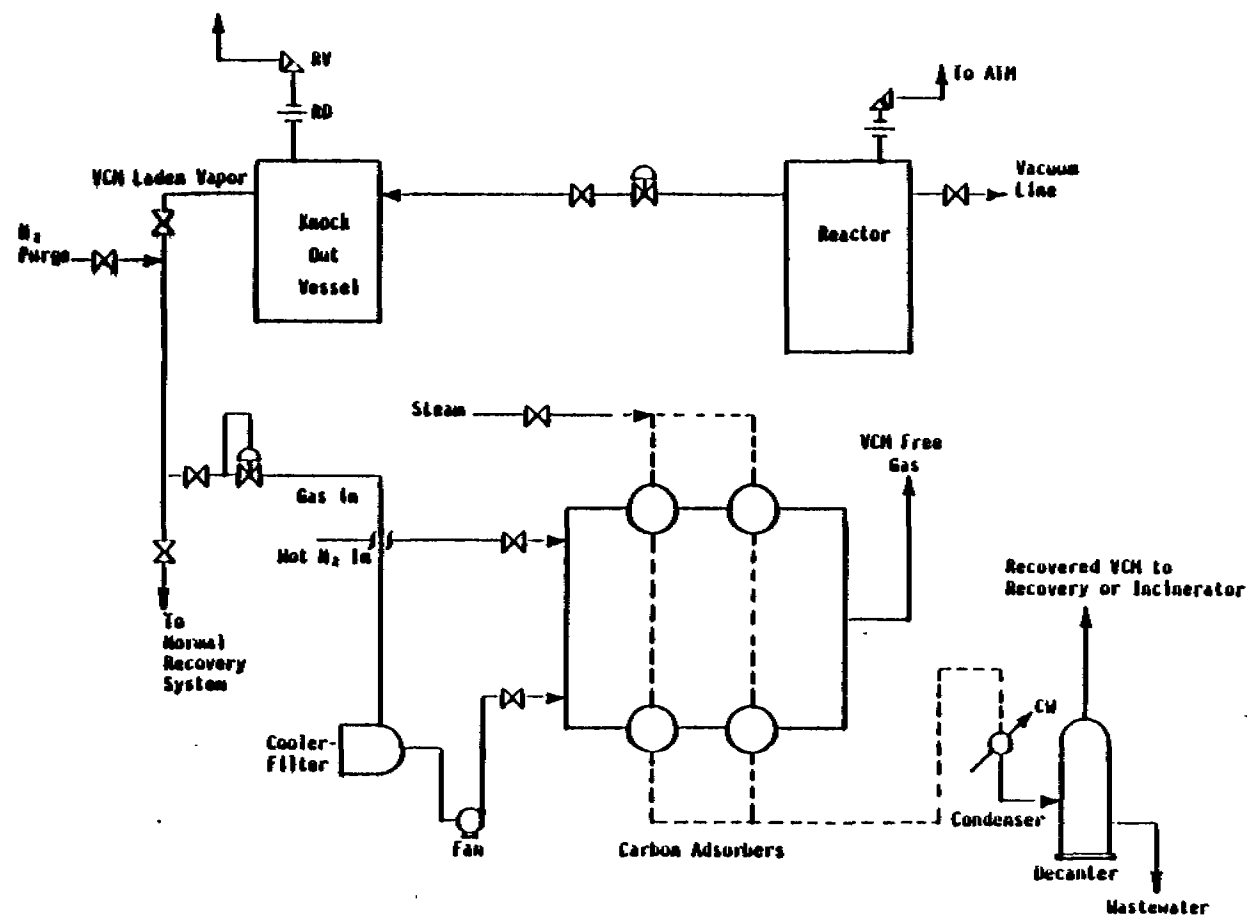


Figure 4-11. Carbon adsorption system schematic flow diagram.

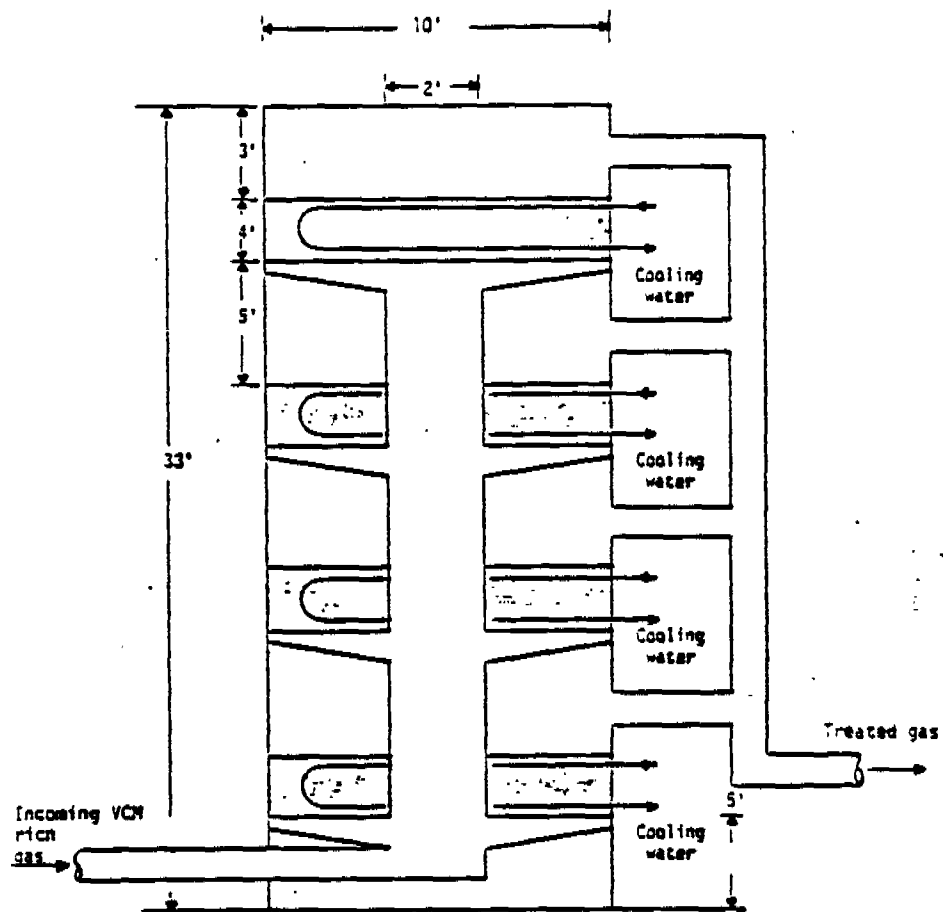


Figure 4-12. A four-bed vertical carbon adsorption tower.

Type	4 bed vertical absorber
Number	8
Height, ft	33
Diameter, ft	10
Bed area, sq ft	314

The carbon adsorption system should be designed with an inert gas (such as nitrogen) purge system. A procedure is needed to periodically demonstrate the operability of the system.

The capital costs may be estimated using the engineering factors presented in Table 4-12.

4.4.3.2 Operating, Maintenance, and Energy Costs--

Operating costs for the carbon adsorption system are minimal since the system is normally not in use. An operator on each shift should be responsible for keeping the system operational at all times.

Energy requirements are mainly for cooling the carbon beds, supplying and condensing steam during regeneration, heating the drying nitrogen, and operating the N₂ blower after regeneration.

Scheduled maintenance inspections of the carbon adsorption system should be performed. Maintenance and repair of all operating equipment, instrumentation, and control devices should also be performed on a regular basis.

The annual operating costs are estimated as shown in Table 4-13. The major expense of capital charges and the low expectation of VCM quantity recovered makes the containment of major discharges by adsorption uneconomic and not cost effective.

TABLE 4-12. CAPITAL COST FACTORS FOR CARBON ADSORBER CONTAINMENT SYSTEM (December 1979 Dollars)

	Cost Factor* \$/1000 gal	Cost of System for V = 10
Equipment		
A ₁ Absorbers	\$ 126,180 V. ⁷	\$ 632,200
A ₂ Auxiliary Vessels (compressor, condensers, etc.)	100,400 V. ⁶	400,000
A ₃ Total Installed Equipment	$\Sigma(A_1 + A_2)$	1,032,200
B Piping (Vapor handling manifold, recovery, utility)	126,400 V. ⁶	503,400
C Instrument and Safety	67,800 V. ¹	85,400
D Buildings & Site Development	77,700 V. ⁴	195,100
E Total Containment Equipment	$\Sigma(A_3, B, C, D)$	1,816,100
F ₁ Knock-Out System	Table 4-6	821,000
F ₂ Header Extension**	150,000 LV. ⁶	600,000
G Total Physical Cost	$\Sigma(E, F_1, F_2)$	3,237,100
H ₁ Engineering and Construction (33%)	33% G	1,073,000
H ₂ Contingency and Fee (20%)	20% G	650,400
H ₃ Initial Carbon Charge	33,800 V	338,000
I Total System Cost	$\Sigma(G, H_1, H_2, H_3)$	\$5,298,500
		Say \$5,300,000

*V = Reactor Volume in 1000 gallons.

**L = Header extension length, 1000 feet.

TABLE 4-13. ANNUAL OPERATING COST FACTORS FOR CARBON ADSORPTION
CONTAINMENT SYSTEM (December 1979 Dollars)

Investment ** = \$5,300,000 = I

Item	Engrg. Factor* \$/yr/1000 gal Reactor	Cost of System for V = 10
Operating & Maintenance		
A Labor & Supervision	\$ 8,300 V ^{.1}	\$ 10,500
B Supplies, Chemicals	13,100 V ^{0.6}	52,100
Utilities		
C Power (37,500 kWh @ 4c)	300 V	3,000
D Steam	630 V	6,300
E Cooling Water	40 V	400
F Nitrogen	200 V	2,000
G Total Utilities	$\Sigma(C, D, E, F)$	11,700
H Total O & M	$\Sigma(A, B, G)$	74,300
J Insurance and Taxes (@ 2% of Investment)	2% I	106,000
K Capital Charges (@ 20% of Investment)	20% I	1,060,000
L Total Annual Costs	$\Sigma(H, J, K)$	1,240,300
M Credit for Recycled VCM (6,480 gals)	2,000 V	(20,000)
N Total Net Annual Operating Cost	(L-M)	\$1,220,300/yr

*V = Reactor Volume in 1000 gallons.

**From item I, Table 4-12.

SECTION 5

REACTOR OPENING EMISSIONS

5.1 VARIABLES AFFECTING EMISSIONS

40 CFR 61 § 61.64(a)(2) provides that the reactor opening loss (ROL) from each reactor opened is not to exceed 0.02 g VCM/Kg PVC produced. The reactors are opened for maintenance and to remove degraded polymer which would otherwise contaminate product and interfere with heat transfer to cooling water in the reactor shell. At the end of each polymerization cycle, the reactor is vented to a gas holder and the polymer slurry is transferred from the reactor. Another batch may then be started after flushing and treatment or the reactor may be opened. The major variable affecting reactor opening loss is the number of batches run between openings.

When a reactor is to be opened, hot water is added, the jacket is heated and the reactor is evacuated. The VCM vapor remaining in the reactor after venting to the gas holder and dumping of the slurry is quickly purged by the steam produced from the boiling water under evacuation conditions. The VCM trapped in the polymer particles, however, diffuses slowly into the water. Diffusion rate of the VCM out of the polymer depends on the temperature and the type of polymer involved (See Section 7.2). The temperature of the water and polymer in the reactor depends on the pressure (vacuum) and the jacket temperature. A very high jacket temperature may result in further degradation of the polymer making it more difficult to remove after the reactor is opened. Sufficient heating is needed to maintain a good boiling rate so that the VCM is stripped from the water.

Higher temperatures increase the diffusion rate of VCM into the water but the amount and the characteristics of the polymer adhering to the walls are both unpredictable. A low pressure will allow boiling of the water at low temperature but results in slow diffusion of VCM from the polymer. Alternately, a reduced heating rate will produce little stripping steam and will allow VCM to remain in the water phase of the reactor unless a very long time is spent at the low boiling rate. The boiling must be continued until the VCM content of the polymer and water is reduced to the extent that when the reactor is cooled down for entry, the VCM remaining in the vapor space will be below the allowable limits.

The rate of diffusion of VCM from polymer depends so much on polymer characteristics that only field testing can establish the time-temperature-pressure-heat rate required to achieve the allowable limits on reactor opening emissions. Many field tests at various temperatures and heat rates are needed since the amount and characteristics of polymer remaining in the vessel varies from batch to batch. A portable flame ionization detector or other analyzer may be inserted through a small nozzle or samples may be taken to determine the VCM content of the vapor space in the reactor. These field tests should be made for each formulation and repeated at least seasonably to update the data. The regulations require periodic reports of the actual ROL emissions experienced in operation so these measurements must be made.

5.2 PROBLEMS ENCOUNTERED

Typical problems encountered are inability to achieve the needed heating of the water in the reactor and failure to achieve the needed evacuation pressure.

Fouling of heat exchangers and reactor jacket walls are the major causes of inadequate heating which reduces both the diffusion of VCM from the polymer and the stripping of VCM from the water. These conditions result from insufficient redundancy and maintenance of heat exchange and vacuum equipment.

Companies have reported problems in maintaining efficient vacuum pump operations which were solved in one instance when maintenance personnel received special training from manufacturers representatives. The VCM vent service for vacuum pumps is a particularly difficult one since a corrosion potential and polymer particles exist in this system. Adequate redundancy is necessary to permit the needed overhauls without affecting the vacuum available for the needed time-temperature-pressure-heat rate required to achieve allowable ROL emissions.

Heat exchanger fouling and or steam supply problems are normal experiences in any chemical plant. There are usually predictable and corrective actions that can be taken to prevent this interference with operations by proper planning, maintenance, and operations scheduling. Reactor jacket fouling does occur unexpectedly in some cases but this effect is detectable and can be handled with alternate operating procedures to ensure the needed time-temperature-pressure-heat rate does occur in the reactor.

5.3 ALTERNATES FOR MEETING ALLOWABLE ROL

Since a major variable involved in computing ROL emissions is the amount of PVC made, a technique which allows several batches to be produced before the reactor is opened will minimize the amount of reactor purging required. "Closed Cleaning" technology such as high pressure sprays and solvent cleaning is used by some PVC producers. Other producers have developed special formulations which give little or no wall deposits. Some manufacturers have developed reagents which condition the surfaces of the reactor walls so that polymer does not adhere to the surfaces. Many patents cover special chemicals and nozzle designs for these purposes and some of these are available for license. Although, depending on the technique involved, these may be quite costly in terms of additional equipment needed as well as license fees, they have other advantages which make them more valuable than just achieving the allowable ROL. The turnaround time will undoubtedly be reduced giving additional production and the labor for manual cleaning operations will also be lower.

A procedure reported for suspension resin reactor cleaning used 4000 to 6000 psi water in an ERC water jet cleaning system with the water jet collar fitted directly into the reactor manway. This equipment allowed 25 to 30 batches to be run between reactor openings instead of opening between each batch. An identical system for dispersion resin reactors allowed 5 to 15 batches between openings. With some development expense a spray system of the type could be developed by any PVC producer. The ERC technology was developed by Goodrich and is undoubtedly available for licensing.

A solvent cleaning process was developed by Air Products and Chemicals, Inc. utilizing Di-methylformamide (DMF) as the solvent. The reactor is filled with solvent under an inert atmosphere and the reactor is heated and stirred while a small continuous flow of solvent overflows the reactor top. After sufficient time elapses, the solvent is transferred to storage and the reactor is rinsed several times with water. The reactor is then ready for another polymerization cycle. Solvent regeneration includes precipitation of solids, centrifuging to remove solids and distillation to purify the solvent. This process is patented and probably available for license. Other solvents are useable for cleaning the reactor. If the PVC plant is associated with a VCM plant, dichloroethane would be an obvious choice since solvent recovery equipment would be already in place. If a spent solvent was useable as raw material for some other adjoining operation or had a ready market, the economics of purification could be affected favorably.

A Shin-Etsu brochure indicates use of special techniques which prevent the accumulation of deposits on reactor walls, eliminating the need for men to enter the reactor for cleaning. B. F. Goodrich Company also reports the use of a chemical solution which is sprayed on the reactor walls after water flushing the reactor. This treatment after each batch of polymer has allowed more than 50 batches to be made before opening the reactor. Both the Shin-Etsu and Goodrich processes appear to be available for license.

The patent literature indicates several special formulations consisting of dispersants, catalysts, and additives which minimize wall deposits during PVC reactor operation. The majority of these are based on relatively small scale tests so their applicability to commercial use may be questionable.

The ultimate means of ensuring that the ROL limitations are met is to analyze the vapor space for VCM and compute the results in terms of g VCM/Kg PVC. If the figure is higher than the ROL allowable, purging should be continued until the results show that the reactor can be legally opened. There should be relatively few cases (< 3%) if the time-temperature-pressure-heat rate conditions are fulfilled. If excessive numbers of cases requiring continuation of the purging occurs, a new set of field tests should be carried out to reestablish the requirements for meeting the ROL allowables.

SECTION 6
FUGITIVE EMISSIONS

Sections 1 through 6 of 40 CFR 61.65(b) are the items designated for consideration in this project. These items cover fugitive emissions from loading-unloading lines, slip-gauges, seals on pumps, compressors, and agitators, relief valve-rupture disc systems, manual venting of equipment and equipment openings. A review was made of the regulations themselves and of the material presented in Volumes 1 and 2 of the Standard Support and Environmental Impact Statements: Promulgated Emission Standard for Vinyl Chloride and other literature.

6.1 LOADING-UNLOADING LINES

The regulations require that VCM content of lines to be opened will be reduced to less than $.0038 \text{ m}^3$ (0.13 ft^3) at standard temperature and pressure and that the VCM removed by this operation be ducted through a control system from which the vent contains less than 10 ppm VCM or that use of equipment and/or procedures which have been demonstrated to be equivalent in terms of reducing VCM emissions to the atmosphere be proposed in writing to the administrator and he approves the proposal.

In the usual case of transferring VCM from tank cars to storage, at completion the tank car is evacuated to remove all the VCM by vaporization. Under these conditions the line will contain only VCM vapors. When liquid VCM is being transferred to tank cars or other storage vessels, the lines are generally blocked at the vessels and the liquid present is allowed to vaporize into a gasholder.

Either a water displacement or a vacuum system can be provided for the loading-unloading lines. Vacuum pumps can provide adequately low pressure needed to achieve the allowable VCM remaining in the lines. The gases displaced and the vacuum pump discharge must enter a VCM recovery system which achieves the < 10 ppm VCM content of the vent, and operating procedures must specify the use of vacuum operation or water flush at each time the lines are opened.

6.2 SLIP-GAUGES

There are no known cases in which slip-gauges are used. Most gauges are a sealed type (magnetic) and do not have any VCM leakage. This is considered to be a satisfactory alternate to a connection to a VCM recovery system, which must be used with any slip-gauge. The magnetic gauges are considerably less costly than venting systems.

6.3 SEALS ON PUMPS, COMPRESSORS, AND AGITATORS

The regulations require that VCM emissions from pumps, compressors, and agitators be minimized by installing seal-less equipment, or by using double mechanical seals with either a seal fluid, at pressure such that the leakage will be seal fluid into the equipment, or by collecting and ducting any VCM seal leakage through a control system from which the VCM in the exhaust gas is less than 10 ppm or equivalent, or by using demonstrated equipment and procedures which are approved by the administrator.

The most severe service for seals on rotating equipment is the agitator seals on PVC reactors. Several plants indicated use of a double seal with fluid pressurized to ensure seal fluid leakage into the vessel for agitators. Some plants also use similar double seal systems on pumps and compressors. A Continental Oil Company article indicated use of canned or magnetic drive pumps. A Dow Chemical Company presentation indicated some success in use of a seal-less "Kontro" pump in intermittent VCM service handling VCM.

6.4 RELIEF VALVE - RUPTURE DISC SYSTEMS

It is standard practice for rupture discs to be installed on all relief valves in VCM service as required by the regulations. Routine maintenance procedures are needed and a continuing program of studies of materials of construction and supplier review are worthwhile.

6.4.1 General

The primary purpose for installing a rupture disc is to ensure that the pressure relief valve installed just downstream of it will function properly in case of an overpressurization. The rupture disc (RD) serves to isolate the relief valve (RV) from the environment of the vessel and thereby prevent corrosion and fouling of the RV.

Because vinyl chloride monomer (VCM) is both toxic and flammable it is highly desirable that the flow of material from the relief system be stopped as quickly as possible after a safe working pressure has been attained following a release. This shut-off is provided by the RV.

A significant potential problem is that the RV will not fully reseal because entrained solids or a piece of the RD may be lodged in the valve. This situation may be resolved in one or more ways.

1. Open a valve to a parallel RD/RV and block in the malfunctioning valve.
2. Pump out the remaining vessel contents as quickly as possible to a holding tank.
3. Release vapor to the normal vapor recovery system.

6.4.2 Premature Failure of Rupture Discs

Another potential problem, but small and easily resolved, is the premature failure of rupture discs. When this occurs it does not normally result in the release of VCM if the RV is well seated. It is a matter of loss in production, if any, during the time the vessel is out of service for replacement of the RD and cleaning and inspection of the RV. Whether the premature failure of RD's is the result of corrosion or improper fabrication and testing procedures by the manufacturer is still open to question.

In some PVC plants there is no known problem of premature failure of RD's due to corrosion or unexplained reasons whereas in other plants it has been a real problem and use of teflon coated discs and/or special maintenance procedures have been established to resolve it.

It is conceivable that the reason some PVC plants are experiencing problems and others not is that the fabrication and/or inspection procedures are inadequate. It would be reasonable for these PVC producers to discuss this with their RD suppliers, and/or seek new suppliers in order to minimize maintenance costs.

In one plant, after experiencing some problems a few years ago, they switched to other suppliers and now obtain over one year life with uncoated, stainless steel RD's. When the RV is pulled for its annual shop inspection, the RD is cleaned and inspected and then returned to service. They do not experience any RD failure with this approach.

In some plants, the RD's are replaced quarterly to minimize chances of premature failure. Teflon coated disc are used in corrosive service, but it is not known whether this includes the reactor RD's. This approach is acceptable, but it might be more costly than is really necessary.

6.5 MANUAL VENTING OF EQUIPMENT AND EQUIPMENT OPENING

The regulations require manual venting of equipment with the VCM being ducted through a control system from which the exhaust gas is less than 10 ppm. It is also required that residual VCM vapor in the equipment to be opened is less than 2.0 percent by volume at standard temperature and pressure. The standard practice is depressuring the equipment through a VCM recovery system of adequate performance followed by use of steam sweep to remove remaining VCM vapors to the recovery system before opening any vessel in VCM service other than reactors. This procedure can meet all regulatory requirements. Reactor opening procedures are described in Section 5.

SECTION 7

DEGASSING TECHNIQUES

When a suspension or emulsion vinyl chloride polymerization reaction reaches the desired conversion, a water/polymer slurry containing between 5% and 25% unreacted VCM remains. The reactor is then vented to near atmospheric pressure so that the liquid monomer volatilizes into a VCM recovery or destruction system. The remaining monomer constituting approximately 0.1% by weight of the slurry or 1-3% of the dewatered resin, is either dissolved in the water phase of the batch or trapped within the polymer particles themselves. This residual monomer must be captured for reuse or destroyed in order to meet EPA regulations. If a polymer stripping process is used and residual VCM (RVCM) contents of 400 ppm in suspension resin and 2000 ppm in dispersion resin are achieved, only the stripper vent must be connected into the VCM recovery or destruction system. If the polymer is not stripped to these levels, regulations require all subsequent polymer handling vents to be connected into this system.

Suspension resin slurry is usually dumped to a hold tank for processing in a continuous stripper. Dispersion resin slurry is either vacuum stripped in the reactor or transferred to a special stripping vessel. After stripping, the PVC slurry must be dewatered and dried for further processing.

7.1 PROCESS DESCRIPTION

Vinyl chloride monomer is usually removed from the reaction slurry by either vacuum stripping in the reactor or steam stripping in a separate stripping vessel. Suspension PVC resins are frequently processed in continuous operating steam stripping columns while emulsion (dispersion) resins

must usually be processed batchwise under vacuum because of the sensitivity of these resins to excessive heating. Inert-gas sparging can be used in place of steam where dilution of the emulsion must be avoided. In addition, degassing may be accomplished using proprietary stripping devices such as the agitated thin-film evaporator or the Parkson stripper. These are dissimilar short-residence-time devices which are intrinsically adaptable to continuous processing. Monomer recovered is compressed and condensed for reuse.

Batchwise flashing of a PVC reaction slurry has three basic steps: (1) vent the VCM to the recovery system until the reaction pressure is approximately atmospheric; (2) heat the batch to 20 to 25°C above the polymerization temperature; and (3) evacuate the reactor to an absolute pressure of approximately 400 mmHg. The reactor or stripping vessel is held at this temperature and reduced pressure for a specified time to achieve desired degassing. The slurry may be sparged with steam or inert gas while heat is simultaneously applied by circulating hot water through the heating jacket.

E F Goodrich has developed a continuous slurry stripping system which is widely used in the processing of suspension PVC resins. This process utilizes a pressurized stripping column feed tank to release excess VCM and to form a transition from the batch reactor to the continuous stripping column. The hot slurry is pumped from the feed tank to the stripping column through a small vapor-liquid separator. The liquid slurry enters the top of a counter-current steam stripping column and the vapor streams from the feed tank separator and column are sent to the VCM recovery system.

Removal of residual monomer which is trapped within the polymer particles is a mass-transfer limiting process which becomes more difficult with increasing viscosity. The wiped-film or agitated thin-film evaporator is a proprietary stripping device which reportedly exhibits diffusivities of 1000 to 10,000 times greater than those for simple molecular diffusion and can be used to process slurries for which the viscosity of the mixture

ranges from 1000 to 100,000 cp. In this unit, heat is transferred through a metallic wall to a thin film of liquid. A mechanical agitator distributes the liquid evenly over the heat-transfer surface. Disadvantages of this device are: design criteria limits heat transfer area of each unit, more maintenance is required than for a non-mechanical device, and foaming problems may occur.

The patented Parkson device is a non-mechanical, plate-type, dispersed-flow contactor. The latex is dispersed into a controlled, high velocity stream of steam and the resulting two phase flow passes turbulently through a plate-type stripper. The stripped latex then discharges into a cyclone separator—usually operated under vacuum—where the latex is disengaged from the vapor. Multistage units may be used to achieve desired residual monomer level. This unit is applicable to foamy, heat-sensitive or viscous products. Its advantages are: complete absence of foam, lack of moving parts, low holdup, low residence time, reduced surface fouling, and reduced coagulum formation. The main disadvantage is that the plate design permits only a limited capacity range. Also, maximum design pressure cannot normally exceed 8500 mmHg. Typical production rates range from 80 to 250 m³/hr and fluids with viscosities as high as 50,000 cp can be processed.

7.2 THEORY OF STRIPPING PROCESS

The unreacted vinyl chloride in PVC reaction slurry is present in three forms: (1) as a separate liquid VCM phase, (2) dissolved in the water phase, and (3) trapped within the PVC particles. The immiscible liquid VCM vaporizes when the reactor is vented to the recovery system at approximately atmospheric pressure. The monomer remaining in the water and in the polymer particles must be stripped from the slurry.

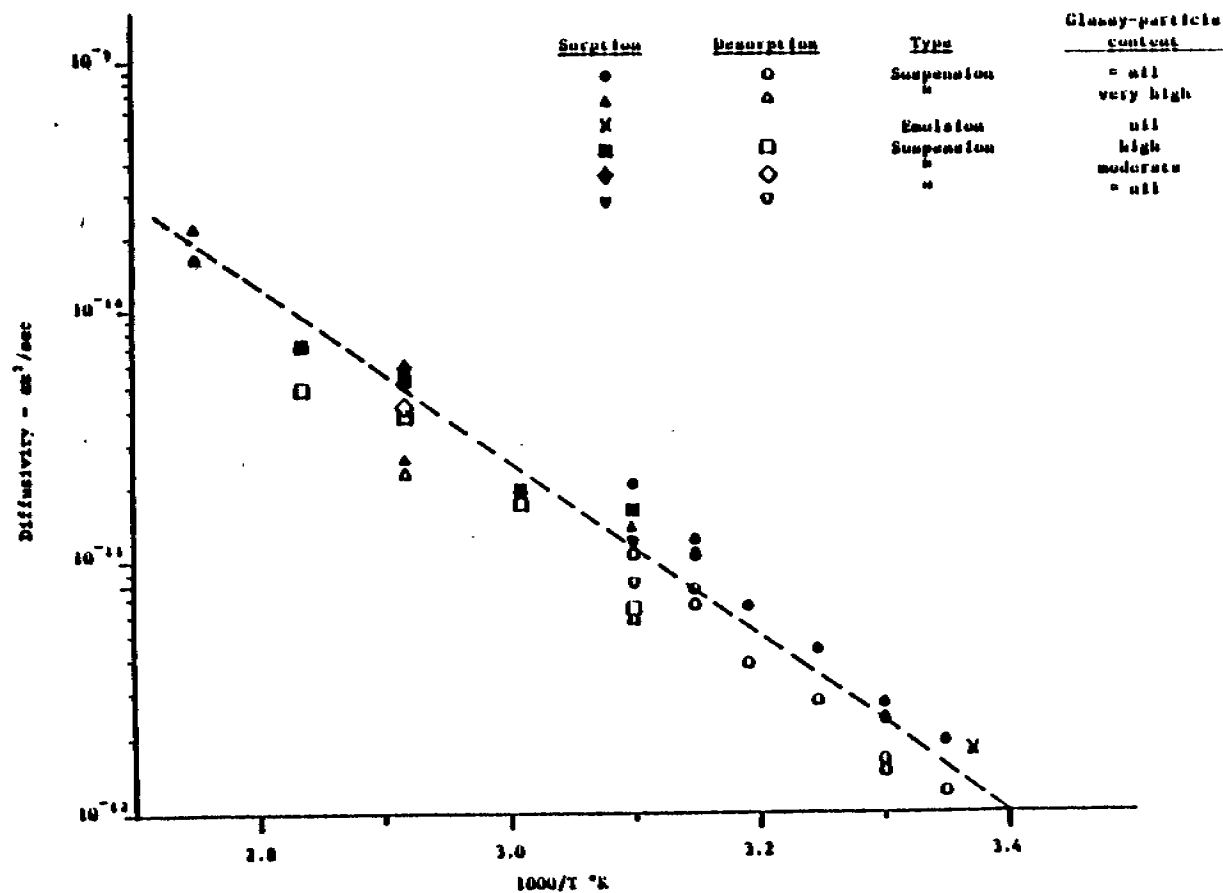
Removal of the VCM which is dissolved in the water is a simple binary distillation problem. The water entering the tower is saturated with VCM, thus, the VCM concentration will be in the range of 0.13% VCM at 50°C and

atmospheric pressure to 0.03% VCM at 30°C and 100 mmHg. This separation may be accomplished with ease because the vapor pressure of VCM is much greater than that of water; the relative volatility of VCM to H₂O is between 25 and 100. In addition, these two components form a minimum-boiling azeotrope which goes overhead with the water vapor and, thus, enhances the removal.

The monomer which is trapped within the polymer particles is much more difficult to remove. This process is limited by mass-transfer within the polymer which takes place by simple Fickian diffusion plus relaxation-controlled swelling. VCM migration occurs by jumps between holes in the polymer structure with a diffusivity of 2×10^{-12} cm²/s $\pm$ 50% at 30°C in both suspension and emulsion resins. The diffusivity is a strong function of temperature but is fairly insensitive to the molecular weight of the polymer. It varies from 2×10^{-10} cm²/s at 90°C to 1.5×10^{-12} cm²/s at 25°C (Refer to Figure 7-1). The rate-controlling dimension is the size of the primary polymer particles, rather than the overall diameter. Thus, removal is improved if the polymer grains are small and porous, but is retarded by the presence of non-porous, glassy particles. At higher temperatures the removal rate is improved remarkably by the onset of "pseudo-boiling", or nucleation of a high liquid/vapor interface. This occurs at approximately 95°C under atmospheric conditions and at 70°C in vacuum stripping with steam. Very rapid removal of monomer can cause a marked increase in resin porosity because the expansion of VCM puts swelling stress on the polymer structure.

7.3 STRIPPING EQUIPMENT AND COSTS

As discussed in the previous sections, VCM can be stripped from PVC reaction slurry by a variety of different techniques. Some resins are more difficult to strip than others due to low porosity and/or heat sensitivity. Special precautions must be taken in handling emulsion resins because relative instability caused by heat or work inputs can form coagulum and foul equipment lines. Emulsion resins are usually stripped within the reactor or in separate batch flash tanks while suspension resins may be stripped continuously.



Ref: M-4

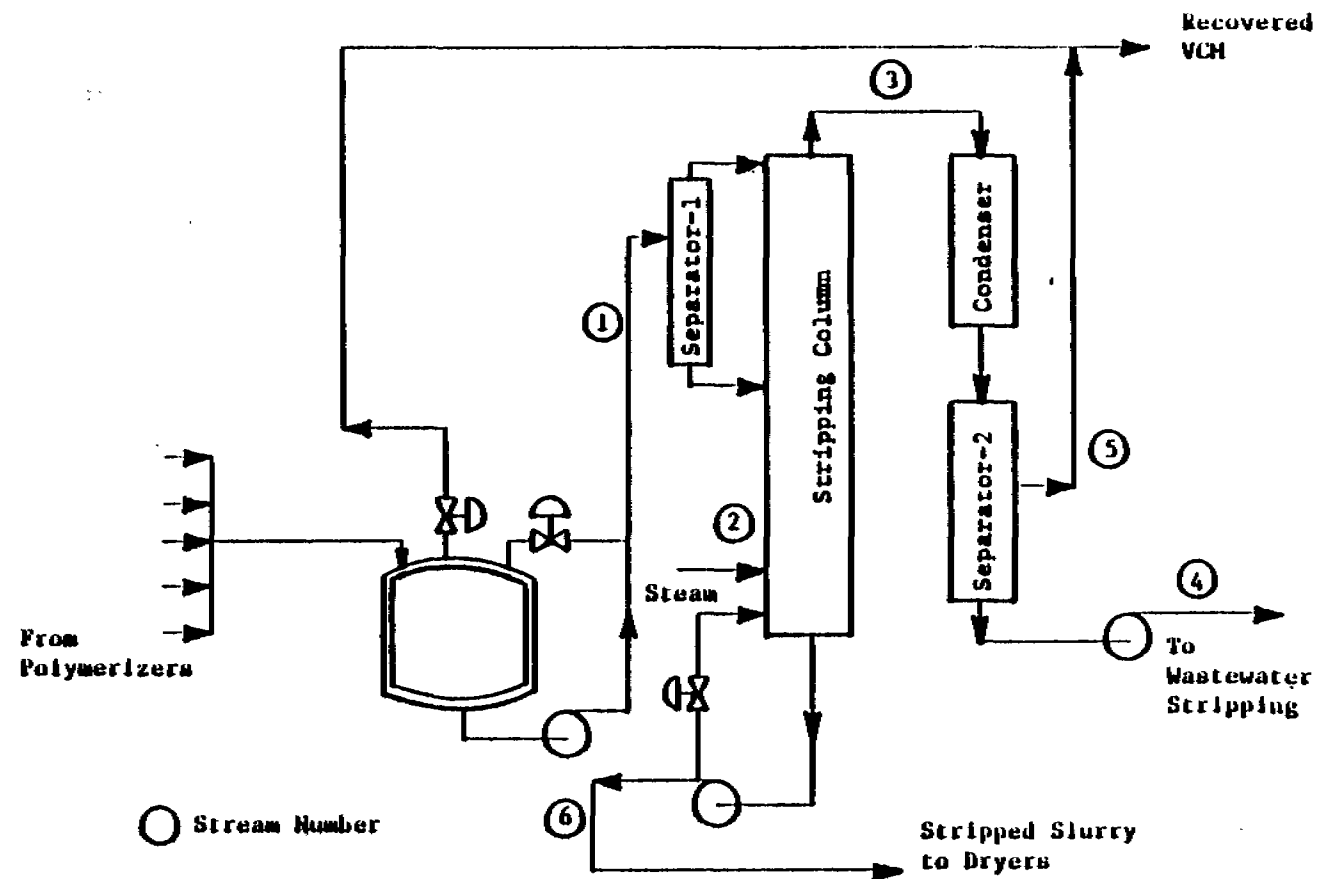
Figure 7-1. Diffusivity of VCM in PVC as a function of temperature.

Flash tanks are normally vertical vessels which are at least 30% larger than the reactor. This facilitates discharge of the viscous or slurry-type reaction products and helps reduce foaming at the vapor outlet. One tank may be used for several reactor batches and stainless steel construction is usually satisfactory. A vacuum system suitable for resin stripping in a 90 MM kg/yr plant, capable of pulling 700 mmHg vacuum and compressing to 4600 mmHg, can be purchased for \$230,000 to \$315,000. Installed cost, including condenser will amount to approximately \$1,050,000. The power and cooling water requirements for this unit are 80 kwh/hr and 3 m³/hr, respectively.

Suspension resins can be stripped in continuous, multi-stage, steam stripping columns. Many companies utilize a configuration developed by B F Goodrich (See Figure 7-2). When the polymerization reaction is complete, the batch is transferred to a pressurized stripping column feed tank. The slurry is then pumped continually through a small vapor-liquid separator and into the stripping column. The vapor leaving the top of the column passes through a condenser into a second vapor-liquid separator. The liquid from the separator is returned to the column while the vapor is piped to the VCM recovery or destruction system. This system reduces RVC in the PVC slurry to a level so that the dried finished product resin contains less than 1 ppm VCM (dry resin basis) and can be designed to handle porous or non-porous slurry feed with RVC content ranging from 5,000 to 200,000 ppm.

Table 7-1 and Table 7-2 show the percentage increase in plant capital required to achieve particular levels of residual monomer in the stripped slurry for suspension and dispersion resins, respectively. In addition, the percentage increase in product price required to maintain the pre-control return on investment is given for each case.

For suspension resin, an overall control efficiency of 95% can be achieved in two ways. Case A involves stripping the reaction slurry to 400 ppm RVC and reusing the monomer, while Case B utilizes collection and



Ref: M-7

Figure 7-2. B F Goodrich continuous slurry stripping system.

TABLE 7-1. SUSPENSION RESIN RESIDUAL MONOMER CONTROL COST INCREASES
68 MM KG/YEAR PLANT

% Increase	Case A	Case B
Plant Capital	19	27
Product Price	8.8	21.9
(base price: 24c/lb)		

Ref: A-1

TABLE 7-2. DISPERSION RESIN RESIDUAL MONOMER CONTROL COST INCREASES

% Increase	Alt 1	Alt 2-A	Alt 2-B
<u>14 MM kg/yr Plant</u>			
Plant Capital	15.	21.	33.
Product Price	11.	17.	32.9
<u>45 MM kg/yr Plant</u>			
Plant Capital	9.	14.	34.
Product Price	6.2	10.6	40.3
(base price: 34¢/lb)			

Ref: A-1

incineration of the vent gases from the centrifuges, driers, etc. Typical new and existing suspension process PVC plants are judged able to afford Case A, but not Case B.

Two plant sizes were considered in assessment of control costs for dispersion resin production. For both a 14 MM kg/yr plant and a 45 MM kg/yr plant three alternatives were evaluated. Alternative 1 involves stripping the reaction resin to 30,000 ppm, at an overall control efficiency of 52%. Case A and B for Alternative II correspond, respectively, to improved stripping to 2,000 ppm and incineration. From Table 7-2, it is judged that Alternative 1 should not be a deterrent for new or existing dispersion resin plants and that Alternative 2-A should be realizable for plants with capacity greater than 45 MM kg/hr. Alternative 2-B was considered to be a serious deterrent for all sizes of emulsion resin plants.

Following stripping, polymer is blended, pumped to centrifuges for partial dewatering and dried in either cocurrent rotary kiln driers or fluid bed driers. In most cases, by the completion of processing, or shortly thereafter, flexible PVC resins are essentially free of VCM but monomer stripping of rigid or non-porous resins is far slower. However, it is now possible for all manufacturers to reach 10 ppm maximum residual VCM in all finished resins and most are doing so. One ppm residual is routine for some grades produced by particular manufacturers.

APPENDIX A
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APPENDIX B

Calculation Procedure and
Computer Program for Reactor
and Venting Dynamics

Calculation Procedure:

The governing equations are as follows:

Orifice Flow Equations

$$Q_j = \frac{60 C \psi_j A_j}{MW_j} \sqrt{2g_c \Delta P \rho_j} \quad (1)$$

where: j = phase (liquid water, liquid VCM, or gas)
 Q_j = flow in lb mole/min
 A_j = effective area for the flow of phase j
 g_c = gravitational constant
 ΔP = pressure drop across orifice
 ρ_j = density of phase j
 C = orifice coefficient = 0.61
 ψ_j = expansion coefficient for phase j
 MW_j = molecular weight of phase j

$$\left\{ \begin{array}{l} \psi_j = 1.0 \text{ for liquids} \\ \psi_j = 1.0 - \frac{0.35 \Delta P}{P} \text{ for gas} \end{array} \right.$$

Heat Liberated across Orifice for Flash

$$H_{Rel} = \sum Q_i (H_i - H_{i,out}) \quad (2)$$

where: i - component (liquid water, liquid VCM, gaseous water, and gaseous VCM)

H_{Rel} = heat liberated to flash water and VCM in Btu/min

$H_i, H_{i,out}$ = enthalpy of component i at orifice inlet and exit, respectively

In addition,

$$H_{Rel} = F_{V, H_2O} \Delta H_{V, H_2O} + F_{V, VCM} \Delta H_{V, VCM} \quad (3)$$

RADIAN

where: $\dot{F}_{V, H_2O}$, $\dot{F}_{V, VCM}$ = quantity of H_2O and VCM which flashes across valve, respectively.

$\Delta H_{V, H_2O}$, $\Delta H_{V, VCM}$ = enthalpy of vaporization of H_2O and VCM, respectively.

and, since liquid VCM is immiscible with liquid water,

$$\frac{Y_V}{Y_W} = \frac{P_V^*}{P_W^*} \quad (4)$$

where: Y_V , Y_W = molar fractions of VCM and H_2O in gas phase at the orifice outlet

P_V^* , P_W^* = vapor pressures of VCM and H_2O , respectively, at the orifice outlet.

This relationship holds true unless all of the liquid VCM leaving through the orifice flashes and the amount of water which flashes is very small compared to the VCM. Equations (3) and (4) may be solved for the flashed flow rates and compositions.

Critical Pressure

$$P_{sonic} = 0.53 P \quad (5)$$

where: P_{sonic} = critical pressure
 P = reactor pressure
 P_{out} = pressure downstream of relief valve

If P_{sonic} is greater than P_{out} then there is a possibility that the flow through the orifice reaches sonic velocity.

Critical Flow Equation

$$Q_{crit} = \sqrt{-g_c \frac{\Delta P}{v_{in} - v_{out}}} \quad (6)$$

where: v_{in} , v_{out} = molar average specific volume at inlet and outlet of valve, respectively.

If the sum of the flows calculated using equation (1) is greater than Q_{crit} , then the flow is critical and equations (2) through (4) must be solved iteratively so that the sum of the liquid and gas phase flow rates do not exceed Q_{crit} .

Boiling Equation

If the reactor pressure is less than the sum of the vapor pressures of the components in the reactor, liquid vaporizes.

$$V_{tot} = Q_g + \rho_g \left(\frac{Q_{LV}}{\rho_{LV}} + \frac{Q_{LW}}{\rho_{LW}} \right) \quad (7)$$

where: V_{tot} = moles of gas which must vaporize
 Q_g , Q_{LV} , Q_{LW} = flow rates of gas, liquid VCM, and liquid water leaving the reactor, respectively.
 ρ_g , ρ_{LV} , ρ_{LW} = densities of gas, liquid VCM, and liquid water within the reactor, respectively.

Material Balances within the Reactor

$$\frac{dM_{PVC}}{dt} = K_R M_{LV} R_{XF} \quad (8)$$

$$\frac{dM_{LV}}{dt} = -(Q_{LV} + Y_V V_{tot} + \frac{dM_{PVC}}{dt}) \quad (9)$$

RADIAN

$$\frac{dM_G}{dt} = V_{tot} - Q_G \quad (10)$$

$$\frac{dM_{LW}}{dt} = -(Q_{LW} + Y_W V_{tot}) \quad (11)$$

where: K_R = reaction rate constant
 R_{KF} = factor which may be changed by user to adjust reaction rate

M_{PVC} , M_{LV} , M_G , M_{LW} = masses of PVC, liquid VCM, gas, and liquid water in the reactor, respectively.

Y_V , Y_W = mole fractions of VCM and water in the reactor vapor.

Heat Balance

$$\frac{dB_{tu}}{dt} = B_{rxn} - (B_J + Q_{LV}H_{LV} + Q_{LW}H_{LW} + Q_{GV}H_{GV} + Q_{GW}H_{GW}) \quad (12)$$

$$B_{tu} = M_{LV}H_{LV} + M_{LW}H_{LW} + M_{GV}H_{GV} + M_{GW}H_{GW} \quad (13)$$

where: B_{tu} = total reactor heat content
 B_{rxn} = heat released by reaction
 B_J = heat removed through cooling jacket.

and: $B_{rxn} = H_{rxn} \frac{dM_{PVC}}{dt} \quad (14)$

$$B_J = UA (T_R - T_J) H_{JT} \quad (15)$$

where: H_{rxn} = heat of reaction in Btu/lb mole
 U = overall-heat-transfer coefficient
 A = area for heat transfer
 T_R = reactor temperature

T_J = jacket temperature

H_{JF} = Factor which may be changed by user to adjust heat removal.

The enthalpies of water and VCM are functions of temperature with a basis of liquid state at 157°F. Equation (13) is used to compute the initial heat content, the derivatives are calculated using equations (8) through (12), by the integration routine, then equation (13) is used to solve for the temperature by the Newton-Raphson root solving technique. The new temperature is then used to calculate enthalpies, vapor pressures, mole fractions and densities. Additional water or VCM is either vaporized or condensed due to the enthalpy change of the reactor contents.

$$H_C = \sum M_i (H_i - H_{i, \text{new}}) \quad (16)$$

where: H_C = heat released due to temperature change

$H_i, H_{i, \text{new}}$ = enthalpy of component i before and after temperature change, respectively.

In addition,

$$H_C = M_{GV, \text{new}} \Delta H_{V, \text{VCM}} + M_{GW, \text{new}} \Delta H_{V, \text{H}_2\text{O}} \quad (17)$$

where: $M_{GV, \text{new}}, M_{GW, \text{new}}$ = masses of VCM and water which are vaporized, respectively.

The liquid and vapor masses are adjusted using equations (17) and (4) to establish a new vapor-liquid equilibrium for the beginning of the next time step.

COMPONENT

FOR:SI CH.VEN
FOR S 481 T -07/21/30-11:52119 (10)

MAIN PROGRAM

STORAGE USED: (CODE(1) 0020061 DATA(0) 0011121 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 LCINT 000001
0004 PAGE 000001
0005 CSTORE 000012

EXTERNAL REFERENCES (BLOCK, NAME)

3-7
0006 INT
0007 LINEAR
0010 PROF2
0011 PROF
0012 INT
0013 TINT
0014 TINT
0015 TINT
0016 TINT
0017 TINT
0020 AL00
0021 EXP
0022 XPR
0023 TINT
0024 TINT
0025 TINT
0026 TINT
0027 TINT
0030 TINT

STORAGE ASSIGNED (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000491 1L	0000	000165 1001	0001	000766 11L	0001	000773 12L	0000	00
0001	001165 13L	0000	000617 1461	0000	000627 1450	0000	000637 1520	0000	00
0000	000660 165L	0001	001633 151	0001	000461 2L	0001	001637 20L	0000	00
0001	00670 21L	0000	000372 2501	0001	001405 266L	0001	001592 267L	0000	00

UCC
020004

CORPORATION

0001	001204	SL	0000	000455	3001	0000	000707	3070	0000	000720	3160	0000	00
0000	000737	3350	0000	000743	3400	0000	000747	3430	0001	001311	41	0000	00
0001	001751	51	0000	000161	501	0001	001777	511	0000	000572	52F	0001	00
0001	001772	61	0000	000753	6230	0000	000757	6270	0001	000712	71	0000	R 001
0000	R 000113	A6	0000	R 000111	ALV	0000	R 000112	ALW	0000	R 000102	A0	0000	R 001
0000	R 000143	B6	0000	R 000137	B3	0000	R 000141	BLV	0000	R 000142	BLW	0000	R 001
0000	R 000140	REACT	0000	R 000106	BTU	0000	R 000030	C	0000	R 000130	(1	0000	R 001
0000	R 000152	C3	0000	R 000040	D	0000	R 000153	DBM	0000	R 000144	ERTU	0000	R 001
0000	R 000132	DLV	0000	R 000131	DLV	0000	R 000135	DMG	0000	R 000134	ELV	0000	R 001
0000	R 000133	ELVC	0003	R 000000	01	0000	R 000110	F	0000	R 000036	ENTMIN	0000	R 001
0000	R 000016	HA	0000	R 000037	HEMIL	0000	R 000067	HGVF	0000	R 000137	HGVN	0000	R 001
0000	R 000071	HGVF	0000	R 000160	HGWF	0000	R 000075	HGWD	0000	R 000045	HJF	0000	R 001
0000	R 000155	HLVN	0000	R 000072	HLVD	0000	R 000070	HLWF	0000	R 000136	HLWN	0000	R 001
0000	R 000121	HKEL	0000	R 000017	HKXH	0000	I 000117	ITEK	0004	I 000000	ITIL	0000	R 001
0000	R 000013	MGH	0000	R 000007	HGV	0000	R 000011	HGVN	0000	R 000010	HGW	0000	R 001
0000	R 000004	MLV	0000	R 000014	MLVN	0000	R 000005	MLW	0000	I 000145	NF	0000	R 001
0000	R 000025	PE T	0000	R 000025	POUT	0000	R 000120	PSONIC	0000	R 000000	PTOTAL	0000	R 001
0005	R 000007	PVC	0000	R 000013	PVF	0000	R 000057	PW	0000	R 000004	PWF	0000	R 001
0005	R 000001	QG	0005	R 000004	QGI	0000	R 000115	QGV	0000	R 000122	QGVF	0005	R 001
0000	R 000116	QGW	0000	R 000123	QGW	0005	R 000002	QLV	0000	R 000005	QLVF	0005	R 001
0005	R 000003	QLW	0005	R 000006	QLW	0000	R 000114	QTF	0000	R 000045	RCONST	0000	R 001
0000	R 000107	RHOG	0000	R 000054	RHOLV	0000	R 000050	RHOLW	0000	R 000035	RR	0000	R 001
0000	R 000051	RLWF	0000	R 000044	RXF	0000	R 000124	SVL	0000	R 000125	SVLF	0005	R 001
0000	R 000104	TAD	0000	R 000105	TA1	0000	R 000046	TEMP	0000	R 000023	TFMPF	0000	R 001
0000	R 000031	TILASH	0000	R 000032	TJ	0000	R 000033	TJMIN	0000	R 000034	TJMINH	0000	R 001
0000	R 000147	T1	0000	R 000154	T2	0000	R 000026	V	0000	R 000101	VFLMIN	0000	R 001
0000	R 000100	VG	0000	R 000076	VIV	0000	R 000077	VLW	0000	R 000020	VV	0000	R 001
0000	R 000021	V6	0000	R 000126	WT	0000	R 000000	Y	0000	R 000127	XFACT	0000	R 001
0000	R 000061	YV	0000	R 000022	YH								

1101	10	UCC	026665	01M, HISTOF X(2), Y(2)	000000
1103	20			COM, ON/CLINT/DT	000001
1104	30			COM, ON/PALE/LINE	000001
1105	40			COM, ON/ESTORE/T, DG, QLV, QLV, QGVF, QLVF, QLVF, PVC, QGVTCF, QLV101	000001
1106	50			REA1 MLV, MLW, MG, HGV, FGL	000001
1107	60			REA1 HGVF, HGVN, HGW, HGV	000001
1110	70			REA1 HJF, HA, HKXH	000001
1110	80	C			000001
1110	90	C		THE MODEL SIMULATES DISCHARGE FROM A PVC BATCH REAC-	000001
1110	1	C		TOR. THE REACTION MIXTURE IS CH AND H2O-TWO IMMISCIBLE PHASES	000001

COMPARATION

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0110 11* C AND THE CORRESPONDING VAPOR PRESENT ABOVE THE MIXTURE. 000001
0110 12* C THE REACTOR IS ASSUMED TO BE WELL MIXED SUCH THAT A DISCHARGE LEAV- 000001
0110 13* C -ING THE REACTOR WILL CONSIST OF ALL THREE PHASES IN AMOUNTS PRO- 000001
0110 14* C PORTIONAL TO THE VOLUME OF EACH IN THE REACTOR. 000001
0110 15* C IT IS FURTHER ASSUMED THAT NO PVC (SOLID) LEAVES THE REACTOR. 000001
0110 16* C 000001
0110 17* C THE CONSTANTS USED IN THIS MODEL ARE: 000001
0110 18* C TEMP,TEMP1,TEMP2,TEMP3 = THE REACTOR TEMPERATURE IN R,F,C,AND K. 000001
0110 19* C RCONST = UNIVERSAL GAS CONSTANT IN PSI-FT**3/(LB-MOL-DEG R) 000001
0110 20* C G = GRAVITATIONAL ACCELERATION IN FT/SEC**2 000001
0110 21* C POUT = THE PRESSURE DOWNSTREAM OF THE ORIFICE IN PSI 000001
0110 22* C C = THE ORIFICE COEFFICIENT 000001
0110 23* C A = AREA OF THE ORIFICE OPENING IN SQ FT 000001
0110 24* C RHOH2O = DENSITY OF LIQUID H2O AT TEMP IN LB-MOL/CU FT 000001
0110 25* C V = REACTOR VOLUME IN CU FT 000001
0110 26* C 000001
0110 27* C VARIABLES IN THIS PROGRAM INCLUDE: 000001
0110 28* C MG,MLV,MLW = THE THROTS OF VAPOR,VCH LIQ.,AND H2O LIQ. IN REACTOR 000001
0110 29* C BIO = THE HEAT CONTENT OF THE REACTOR IN BTU 000001
0110 30* C PVC = THE LB-MOL OF PVC PRODUCED IN THE REACTOR. 000001
0110 31* C HGW0,HGW1,HGV0,HGV1-- ENTHALPY OF H2O VAPOR @LAST TEMP,H2O VAPOR @ 000001
0110 32* C NEW TEMP,VCH VAPOR @ LAST TEMP, VCH VAPOR @ NEW TEMP. 000001
0110 33* C HLW0,HLW1,HLV0,HLV1-- ENTHALPY DATA CORRESPONDING TO VAPOR DATA 000001
0110 34* C PV = PARTIAL PRESSURE OF VCH AT TEMP IN PSIA 000001
0110 35* C PW = PARTIAL PRESSURE OF H2O AT TEMP IN PSIA 000001
0110 36* C RHO,V = DENSITY OF LIQUID VCH AT TEMP IN LB-MOL/CU FT 000001
0110 37* C 000001
0110 38* C 000001
0110 39* C ENTHALPY AND VAPOR PRESSURE EQUATIONS: 000001
0110 40* C 000001
0111 41* ELV(AT)=9.3875*AT**1.208-4155.4 000001
0112 42* ELW(AT)=1794.*ALOG(AT)-9070.9 000001
0113 43* EGV(AT)=6521.9*AT**0.1111-4155.4 000001
0114 44* ELW(AT)=756.57*ALOG(AT)+14251. 000001
0115 45* VPV(AT)=19.027*EXP(0.03422*AT) 000001
0116 46* VPW(AT)=0.0507*EXP(0.0212*AT) 000001
0117 47* DE, LV(AT)=0.9093*LV1 (-1.001267*AT) 000001
0117 48* C 000001
0117 49* C INPUT DATA: 000001
0117 50* C 000001
0120 51* DATA PVC,OGVTOT,OVVTOT,VV,VH,VV1/G*0.7 000001
0127 52* READ(5,50) TEMP1,P,POUT,V,VH,MLW,MG 000001
0140 53* READ(5,50) A,C,FLASH 000001

```

WPA AEROSPACE CORPORATION

COMMON/LINI/T, JS, JN, DXA(500), XA(500), IO, JS4

COMMON/LCINT/DT

JN=JN+1

GO TO (9,8,3,3), IO

9 X=X+DX+DT

RETURN

8 GO TO (1,2), JS

1 DXA(JN)=DX

X=X+DX+DT

RETURN

2 X=X+(DX-DXA(JN))*DT/2.

RETURN

3 GO TO (4,5,6,7), JS4

4 XA(JN)=X

DXA(JN)=DX

X=X+DX+DT

RETURN

5 DXA(JN)=DXA(JN)+2.*DX

X=XA(JN)+DX+DT

RETURN

6 DXA(JN)=DXA(JN)+2.*DX

X=XA(JN)+DX+DT

RETURN

7 DXA(JN)=(DXA(JN)+DX)/6.

X=XA(JN)+DXA(JN)+DT

RETURN

END

@FOR, N1 PRNTE, PRNTE

SUBROUTINE PRNTE(PRI, FNR, NF, A, B, C, D, E, F, G, O, P, Q)

C

C

THIS SUBROUTINE KEEPS TRACK OF THE NUMBER OF LINES ON EACH PAGE AND

C

DETERMINES WHETHER TO PRINT

C

COMMON/CCINT/DT

COMMON/CINT/T, JS, JN, DXA(500), XA(500), IO, JS4

COMMON/CPH/NPH

COMMON/PAGE/LINE

NPH=0

IF((IPRNT, LI, PRI) GO TO 4

IF((1, GE, FNR-DT/2.), AND. ((JS, EQ, 2), OR, (JS4, EQ, 4))) GO TO 6

IF((1, GE, IPRNT-DT/2.), AND. ((JS, EQ, 2), OR, (JS4, EQ, 4))) GO TO 5

RETURN

4 NF=1

5 IPRNT=IPRNT+PRI

8 PRINT 100, A, B, C, D, E, F, G, O, P, Q

COMPUTATION

0241	97*	C	THE VOLUMES TAKEN UP BY EACH PHASE ARE CALCULATED:	000274
0241	98*	C		000274
0242	99*		$VLV=MLV/RIIOLV$	000300
0243	100*		$VLW=MLW/RIIOLW$	000303
0244	101*		$VG=V-VLV-VLW$	000306
0245	102*		$VELHIN=V-VEPIN$	000311
0246	103*		$A=A/144.$	000313
0247	104*		$MGV=YV+MG$	000316
0250	105*		$MGW=MG-MGV$	000321
0251	106*		$IF(P.LE.0.) P=MC*RCNST*TEMP/VG$	000323
0253	107*		$IF(P.LE.PTOTAL) P=PTOTAL$	000333
0255	108*		$IF(P.GT.0.) MG=P*VG/(PCNST*TEMP)$	000341
0255	109*	C		000341
0255	110*	C	ENTHALPY AND WATER JACKET TEMPERATURE ARE CALCULATED BY	000341
0255	111*	C	LINEAR REGRESSION:	000341
0255	112*	C		000341
0257	113*		$X(1)=VLV+VLW$	000352
0260	114*		$Y(1)=X(1)/V$	000355
0261	115*		$X(2)=V-VELHIN$	000357
0262	116*		$Y(2)=ENTHIN$	000361
0263	117*		$CALL LINEAR(X,Y,2,A0,A1)$	000363
0264	118*		$X(1)=0.$	000371
0265	119*		$X(2)=TJMIN$	000372
0266	120*		$Y(1)=TJ$	000374
0267	121*		$Y(2)=TJMIN$	000376
0270	122*		$CALL LINEAR(X,Y,2,(A0,1)/1)$	000400
0270	123*	C		000400
0270	124*	C	HEAT CONTENT OF REACTOR:	000400
0270	125*	C		000400
0271	126*		$ETD=INVO*MLV+VELHIN*MLW+VG*MGV+MGW*MGW$	000406
0271	127*	C		000406
0271	128*	C	HEATINGS	000406
0271	129*	C		000406
0272	130*		$WRITE(6,100)P,PGHT,TEMP,TJ,V,INRXN,MLV,MLW,MG,HA$	000422
0306	131*	100	FOR AT(11)=56X+4.71 DISCHARGE FROM A PVC BATCH REACTOR,	
0306	132*		1 77.52,40 REACTOR PRESSURE AT TIME OF DISCHARGE = 17.2,51 PSIA,	
0306	133*		2 5X,310 PRESSURE DOWNSTREAM OF VALVE = 17.2,51 PSIA,	
0306	134*		3 7.5X,40 REACTOR TEMP AT TIME OF DISCHARGE = 17.2,21 F,	
0306	135*		4 8X,32 WATER JACKET TEMP AT DISCHARGE = 17.2,21 F,	
0306	136*		5 7.5X,17 REACTOR VOLUME = 110.3,60 CU FT, 24X,19 HEAT OF REACTION	
0306	137*		6 = 110.3,110 BTU/DMOL, 7,	
0306	138*		7 5X,340 ICUID VCR INITIALLY IN REACTOR = 130.2,70 LBMOLE, 6X,	
0306	139*		8 310.10 H2O INITIALLY IN REACTOR = 17.1,70 LBMOLE,	

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00306 140* 9 7.5X,34H VAPOR INITIALLY IN REACTOR = ,F10.4,7H LBMOLE.
00306 141* 1 6X,25H JACKET COEF TIPS AREA = ,F6.1,0H BTU/H-F)
00307 142* WRITE(6,200) RHOLDW,RHOLDV,A,L
00315 143* 200 FORMAT(5X,30H DENSITY OF WATER (CONSTANT) = ,F7.4,13H LBMOLE/CU FT,
00315 144* 1 7X,25H INITIAL DENSITY OF VCM = ,F7.5,13H LBMOLE/CU FT,/,
00315 145* 1,5X,39H AREA OF RELIEF VALVE ORIFICE OPENING = ,F6.4,6H SQ FT,
00315 146* 7 6X,27H ORIFICE FLOW COEFFICIENT = ,F5.3)
00316 147* WRITE(6,250) ENTMIN,TJMIN,VCLMIN,IJMIN,HJF,RXF
00326 148* 250 FORMAT(5X,29H MINIMUM LIQUID ENTRAINMENT = ,F5.4,
00326 149* 120H CU FT LIQ/CU FT GAS,3X,20H MINIMUM WATER JACKET TEMP = ,F7.2,
00326 150* 2 2H F,/, 5X,42H LIQ VOL WHEN MIN ENTRAINMENT IS REACHED = ,
00326 151* 3 F7.1,6H CU FT,2X,34H TIME MIN JACKET TEMP IS REACHED = ,F7.2,
00326 152* 4 4H MIN,/,5X,24H WATER JACKET FACTOR = ,F4.2,29X,
00326 153* 5 23H REACTION RATE FACTOR = ,F4.2)
00326 154* C
00327 155* PRINT 300
00331 156* 300 FORMAT(//,57X,5H WATER,4X,7H REACTOR,5X,3H GAS,5X,8H VCM LIQ,2X,
00331 157* 1 8H,20 LIQ,2(2X,7H REACTOR),/,
00331 158* 2 16V,2(7H REACTOR,3X),1X,6H JACKET,5X,4H HEAT,4X,3(7H,FFT IN,3X),
00331 159* 3 8H VCM LIQ,2X,8H,20 LIQ,/,
00331 160* 4 8X,4H TIME,4X,8H PRESSURE,4X,4H TEMP,6X,4H TEMP,4X,7H CONTENT,5(3X,
00331 161* 5 7H REACTOR),2(4X,6H VOL LPT),/,
00331 162* 6 8X,3H MIN,7X,4H,STA,4Y,2(6H,LBMOLE F,2X),2X,3H BTU,6X,3(6H,LBMOLE,4X)
00331 163* 7 12(5H CU FT,5X),/,5X, 100H
00331 164* 9-----
00331 165* A-----,/)
00331 166* C
00331 167* C THE MODEL
00331 168* C
00332 169* LINI=21
00333 170* 1 IF (LINE.LT.40) GO TO 2
00335 171* PRINT 400
00337 172* CALL PRNTF2
00340 173* PRINT 400
00342 174* 400 FORMAT(1H)
00343 175* PRINT 300
00345 176* LINI=7
00345 177* C
00346 178* 2 IF (MLV.LT.0.) MLV=0.
00350 179* IF (PLW.LT.0.) PLW=0.
00350 180* C
00350 181* C GAS DENSITY IS CALCULATED:
00350 182* C

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000441

000444

000451

000461

000464

000464

000464

000464

COMPARATION

0352	183+		$RHO_0 = P / (PCONST + TEMP)$	000476
0352	184+	C		000476
0352	185+	C	CHECK TO SEE IF THERE IS STILL A PRESSURE GRADIENT TO CAUSE THIS-	000476
0352	186+	C	STOP. IF NOT, STOP LOOP. IF SO, CONTINUE.	000476
0352	187+	C		000476
0353	188+		$IF ((P - 1.01 * POUT) .LT. 0.)$ GO TO 5	000503
0353	189+	C		000503
0353	190+	C	AN (EXPERIMENTAL, LINEAR) ENTRAINMENT RELATIONSHIP IS USED HERE:	000503
0353	191+	C		000503
0355	192+		$F = AG + A1 * (VLV + VLW)$	000510
0356	193+		$IF (1.0 \leq VEMIN) F = F * VEMIN$	000514
0356	194+	C		000514
0356	195+	C	THE EFFECTIVE AREA OF FLOW THROUGH THE ORIFICE OF EACH PHASE IS	000514
0356	196+	C	ASSUMED TO BE PROPORTIONAL TO THE VOLUME OF EACH PHASE IN THE	000514
0356	197+	C	REACTOR. $Y =$ THE EXPANSION FACTOR FOR COMPRESSIBLE GAS FLOW:	000514
0356	198+	C		000514
0360	199+		$ALV = A * F * VLV / (VLV + VLW)$	000531
0361	200+		$ALW = A * F * VLW / (VLV + VLW)$	000537
0362	201+		$AG = A - ALV - ALW$	000543
0363	202+		$Y = 1. - 0.35 * (P - POUT) / P$	000546
0363	203+	C		000546
0363	204+	C	THE FLOW THROUGH THE ORIFICE IS CALCULATED:	000546
0363	205+	C		000546
0364	206+		$QV = 91.07 * C * Y * AG * \text{SQRT}(2. * G * (P - POUT) * RHO_0)$	000553
0365	207+		$QLV = 91.07 * C * ALV * \text{SQRT}(2. * G * (P - POUT) * RHO_0)$	000566
0366	208+		$QLW = 91.07 * C * ALW * \text{SQRT}(2. * G * (P - POUT) * RHO_0)$	000601
0367	209+		$IF (1.0 \leq 0.)$ GO TO 21	000615
0367	210+	C		000615
0367	211+	C	A CHECK IS MADE TO BE SURE THAT THE FLOW OUT OF THE REACTOR IS NOT	000615
0367	212+	C	GREATER THAN THE MATERIAL IN THE REACTOR. IF P IS ALMOST POUT,	000615
0367	213+	C	THE FLOW IS SET TO ZERO.	000615
0367	214+	C		000615
0371	215+		$IF (1.0 \leq 0.) (RHO_0 / (VLV + VLW)) * QV = QV / (VLV + VLW)$	000617
0373	216+		$IF (1.0 \leq 0.) (RHO_0 / (VLV + VLW)) * QLV = QLV / (VLV + VLW)$	000633
0375	217+		$IF (1.0 \leq 0.) (RHO_0 / (VLV + VLW)) * QLW = QLW / (VLV + VLW)$	000646
0377	218+		$IF (1.0 \leq 0.) QLV = 0.$	000661
0401	219+		$IF (1.0 \leq 0.) QLW = 0.$	000664
0403	220+	21	$QTF = QV + QLV + QLW$	000670
0404	221+		$QGV = 0.$	000673
0405	222+		$IF (1.0 \leq 0.) QGV = YV * C$	000674
0407	223+		$QGW = 0. - QGV$	000702
0410	224+		$IF P = 0$	000705
0411	22		$PSORIC = 0.53 * P$	000706

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00411	226*	C		000706
00411	227*	C	FLASH CALCULATION ACROSS ORIFICE	000706
00411	228*	C		000706
00411	229*	C		000706
00411	230*	C	HEAT LIBERATED DUE TO PRESSURE DROP ACROSS ORIFICE IS USED TO CALCULATE	000706
00411	231*	C	FLOWRATE AND COMPOSITION OF FLASHED VAPOR	000706
00411	232*	C		000706
00412	233*	7	$HREL = QLV + (HLVO - HLVF) + QLV + (HLWO - HLWF) + QGV + (HGVO - HGVF) + QGW +$	000712
00412	234*		$+(HGW - HGWF)$	000712
00413	235*		$ITEL = ITEL + 1$	000731
00414	236*		$QGVF = HREL / (PMF / PVF + (HGW - HLWF) + (HGVO - HGVF))$	000734
00415	237*	9	IF (QGVF, LE, QLV) GO TO 11	000746
00417	238*		$QGV = QLV$	000751
00420	239*		$QGVF = (HREL - QGVF + (HGVO - HLVO)) / (HGW - HLWO) + QGW$	000753
00421	240*		GO TO 12	000764
00422	241*	11	$QGVF = PMF / PVF + QGVF + QGW$	000766
00423	242*	12	$QLVF = QLV - QGVF$	000773
00424	243*		$QGV = QGVF + QGV$	000775
00425	244*		$QGF = QGVF + QGVF$	001000
00426	245*		IF (QLVF, LT, 0.) QLVF = 0.	001002
00430	246*		IF (QGF, LT, 0.) QGF = 0.	001006
00432	247*		$QLWF = QTF - QGF - QLVF$	001012
00433	248*		IF (QLWF, LT, 0.) QLWF = 0.	001016
00433	249*	C		001016
00433	250*	C	CRITICAL FLOW CALCULATION:	001016
00433	251*	C		001016
00435	252*		IF (PSONIC, LE, POUT) GO TO 13	001022
00437	253*		$SVL = (QLV / PHOLV + QLV / KHOLV + QG / KHOG) / QTF$	001026
00440	254*		$SVLF = (QLVF / RLVF + QLWF / LRF + QGF / RGF) / QTF$	001040
00441	255*		$WT = QTF / ((QGV + QLV) * 62.5 + (QGW + QLW) * 18.02)$	001052
00442	256*		$XFACT = -G + (POUT - P) / (SVLF - SVL) + WT$	001064
00443	257*		IF (XFACT, LT, 0.) GO TO 51	001073
00445	258*		$QCRIT = 720. * A * SQRT(XFACT)$	001075
00446	259*		IF (ABS(QCRIT - QTF) / QCRIT, LE, 0.01) GO TO 13	001105
00450	260*		IF (QTF, LE, QCRIT) GO TO 12	001113
00450	261*	C		001113
00450	262*	C	IF FLOW IS CRITICAL, THE FLOW RATES OF THE COMPONENTS ARE ADJUSTED:	001113
00450	263*	C		001113
00452	264*		$QG = QG * QCRIT / QTF$	001117
00453	265*		$QLV = QLV * QCRIT / QTF$	001123
00454	266*		$QLW = QCRIT - QG - QLV$	001127
00455	267*		$QTF = QCRIT$	001132
00456	268*		$QGV = QV + QG$	001134

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0457	269*		$QGV=QGL-QGV$	001137
0460	270*		GO TO 7	001141
0460	271*	C		001141
0460	272*	C	THE TOTAL EMISSION OF VCH VAPOR AND LIQUID IS SUMMED:	001141
0460	273*	C		001141
0461	274*	13	$QLV=QLVF$	001143
0462	275*		$QGV=QLV-QLVF+QGV$	001144
0462	276*	C		001144
0462	277*	C	CHECK TO SEE IF THE LIQUID WILL BEGIN BOILING AT P:	001144
0462	278*	C		001144
0463	279*		$VV=0.$	001147
0464	280*		$VW=0.$	001150
0465	281*		$VVG=0.$	001151
0466	282*		IF (P.GT.PTOTAL) GO TO 3	001152
0466	283*	C		001152
0466	284*	C	IF BOILING, THE RATE OF VAPORIZATION (VV,VW) IS CALCULATED:	001152
0466	285*	C		001152
0470	286*		$VVG=QGV/H106+(QLV/PH1V+GLW/PH10LW)$	001156
0471	287*		$VV=VV+VVG$	001166
0472	288*		IF (VV.GT.(MLV/D1)) VV=MLV/D1	001170
0474	289*		$VW=VVG-VV$	001200
0474	290*	C		001200
0474	291*	C	MASS BALANCES OF THE REACTOR FOR MLV,MLW,NG, AND PVC:	001200
0474	292*	C		001200
0475	293*	3	$DPVC=MK+MLV+RXF$	001204
0476	294*		$DMLV=- (QLV+VV+D1-VG)$	001207
0477	295*		$DMG=VVG-QG$	001213
0500	296*		$DMLW=- (QLW+VW)$	001216
0500	297*	C		001216
0500	298*	C		001216
0500	299*	C	THE WATER JACKET TEMPERATURE PROFILE IS:	001216
0500	300*	C		001216
0501	301*		$TJ=TAH1A1+1$	001221
0502	302*		IF (TJ.LE.(JWTH)) TJ=TJ+1	001225
0502	303*	C	THE HEAT TRANSFER WITH THE WATER JACKET IS CALCULATED:	001225
0502	304*	C		001225
0504	305*		$HJ=HA*(TJ+1)-(TJ+1)HJ$	001233
0504	306*	C		001233
0504	307*	C	THE HEAT GIVEN OFF BY REACTION IS FOUND USING HXCH AND AMOUNT OF	001233
0504	308*	C	PVC PRODUCED. THE HEAT LEAVING THE REACTOR THROUGH THE ORIFICE IS	001233
0504	309*	C	THEO CALCULATED. IF THE MIXTURE IS BOILING, THE HEAT OF VAP.	001233
0504	310*	C	IS USED FOR THE VAPOR LEAVING, OTHERWISE THE ENTHALPY OF VAPOR:	001233
0504	311*	C		001233

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10505	312*		HREACT=HRRXN+H1'VC	001240
10506	313*		HLV=HLV0+QLV	001243
10507	314*		HLW=HLW0+QLW	001246
10510	315*		HG=HGVO+QGV+HGW0+QGW	001251
10510	316*	C		001251
10510	317*	C		001251
10510	318*	C	HEAT BALANCE WITHIN THE REACTOR TO DETERMINE TEMPERATURE	001251
10510	319*	C		001251
10511	320*		DBTU=HREACT-(QLV+BLW+PC+BC)	001257
10511	321*	C		001257
10511	322*	C	CALL PRINT ROUTINE THEN INTEGRATION ROUTINE FOR EACH DEM:	001257
10511	323*	C		001257
10512	324*		CALL PRNTE(TPRNT,TEND,NF,1,P,TEMPF,1J,DBTU,MG,MLV,MLW,VLV,VLW)	001264
10513	325*		GO TO (4,6),NF	001302
10514	326*	4	CALL INT1(T,DEL1,3)	001311
10515	327*		CALL INT1(QG,DMG)	001314
10516	328*		CALL INT1(MLV,DMLV)	001317
10517	329*		CALL INT1(MLW,DMLW)	001322
10520	330*		CALL INT1(QGVTOT,QGV)	001325
10521	331*		CALL INT1(QLVTOT,QLV)	001330
10522	332*		CALL INT1(DBTU,DBTU)	001333
10523	333*		CALL INT1(PVC,DPVC)	001336
10523	334*	C		001336
10523	335*	C	THIS SECTION IS USED IF THE HEAT BALANCE CALCULATIONS AROUND THE	001336
10523	336*	C	REACTOR, THE JACKET, AND THE FLUID LEAVING THE VESSEL:	001336
10523	337*	C	FIRST, THE TEMPERATURE OF THE REACTOR IS CALC. FROM ITS HEAT CONT.	001336
10523	338*	C		001336
10524	339*		MGV=0.	001341
10525	340*		IF (MLV.GT.0.) MGV=YV+PC	001342
10527	341*		MGW=MG-MGV	001350
10530	342*		HNU=HLV0+MLV+HLW0+MLW+HLV0+QGV+HGW0+QGW	001353
10531	343*		T1=TEMPF	001366
10532	344*		C1=11.312+MLV	001370
10533	345*		C2=1794.+MLW+756.57+MGL	001373
10534	346*		C3=770.24+MGV	001401
10535	347*	266	DBNM=C1+T1**0.205+C2/T1+(C3+T1**(-0.0819))	001405
10536	348*		T2=T1+(DBTU-DBNM)/DBNM	001425
10537	349*		IF (ABS(T2-T1).LT.0.01) GO TO 267	001432
10541	350*		HNU=HLV(T2)*MLV+HLW(T2)*MLW+QGV(T2)*MGV+QGV(T2)*MGW	001437
10542	351*		T1=T2	001476
10543	352*		GO TO 266	001500
10544	353*	267	TEMPF=T1	001502
10545	354*		TEMP=TEMPF+460.	001503

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0545	355.	C		001503
0545	356.	C	ENTHALPY IS CALCULATED FROM CP AND THE TEMPERATURE CHANGE:	001503
0545	357.	C		001503
0546	358.		$HLV_1 = FLV(TEMPF)$	001505
0547	359.		$HLW_1 = FLW(TEMPF)$	001514
0550	360.		$HGV_1 = EGV(TEMPF)$	001523
0551	361.		$HGW_1 = EGW(TEMPF)$	001532
0552	362.		$PV = VPV(TEMPF)$	001536
0553	363.		$PW = VPW(TEMPF)$	001546
0554	364.		$PTOTAL = PV + PW$	001556
0555	365.		$YV = PV / PTOTAL$	001560
0556	366.		$YW = 1. - YV$	001563
0556	367.	C		001563
0556	368.	C	HEAT RELEASED DUE TO PRESSURE DROP WITHIN THE REACTOR VAPORIZES	001563
0556	369.	C	ADDITIONAL WATER AND VAPOR	001563
0556	370.	C		001563
0557	371.		$HRL_1 = HLV_1 + (HLVD - HLVN) + FLV + (HLVD - HLWN) + HGV_1 + (HGVN - HGVN) + HGW_1 + (HGWN -$	001565
0557	372.		$HLWN)$	001565
0560	373.		$HGV_1 = HRL_1 / ((HLV_1 - HLVN) + PW / PV + (HGVN - HLWN))$	001611
0561	374.		$IF (HGVN - LG * HLV) GO TO 19$	001617
0563	375.		$HGV_1 = HLV$	001622
0564	376.		$HGW_1 = (HRL_1 - HGVN + (HGVN - HLVN)) / (HGVN - HLWN) + HGW$	001629
0565	377.		GO TO 20	001631
0566	378.	19	$HGW_1 = PW / PV + HGVN$	001633
0567	379.	20	$HLV_1 = FLV - HGVN$	001637
0570	380.		$HLV = HGVN + HGV$	001641
0571	381.		$HGW = HGW_1 + HGW$	001644
0572	382.		$HGH = HGV + HGW$	001647
0573	383.		IF (HLVN - LT, 0.) $TMV_1 = 0.$	001651
0575	384.		IF (HGH - LT, 0.) $TMG = 0.$	001655
0575	385.	C		001655
0575	386.	C	NEW VAPOR-LIQUID EQUILIBRIUM IS ESTABLISHED TO SATISFY THE HEAT	001655
0575	387.	C	BALANCE OF THE VESSEL:	001655
0575	388.	C		001655
0577	389.		$HLW = HGV + HGW + HGH - FLVN - HGL$	001661
0600	390.		$HG = HGL$	001667
0601	391.		$HLV = HLVN$	001671
0602	392.		$HLV_1 = HLV$	001673
0603	393.		$HLW_1 = HLW$	001675
0604	394.		$HGV_1 = HGVN$	001677
0605	395.		$HGW_1 = HGWN$	001701
0605	396.	C		001701
0605	397.	C		001701

END OF CONFERENCE:

NO DIAGNOSTICS.

Line	Column	Program	Page
00605	490*	C NEW VAPOR PRESSURES, VCV DENSITY, AND REACTION RATE CONSTANT	001701
00605	499*	C ARE CALCULATED FOR THE NEW TEMPERATURE IN THE REACTOR:	001701
00605	400*	C	001701
00605	401*	C	001701
00606	402*	RIIOLV=RHOLV(TEMPF)	001703
00607	403*	RK=7.746E-06*EXP(10.038500/TEMPF)	001713
00610	404*	VLV=RLV/RIIOLV	001723
00611	405*	VLW=RLW/RIIOLW	001726
00612	406*	VG=V-VLV-VLW	001731
00613	407*	P=M0*(RCONST+TEMPF/VG	001734
00614	408*	IF(1,LE,PTOTAL) P=PTOTAL	001741
00614	409*	C	001741
00614	410*	C RETURN TO BEGINNING OF THE LOOP FOR THE NEXT TIME STEP:	001741
00614	411*	C	001741
00616	412*	GO TO 1	001747
00616	413*	C	001747
00616	414*	C EQUILIBRIUM IS ESTABLISHED (NO MORE FLOW OUT OF REACTOR)--STOP:	001747
00616	415*	C	001747
00617	416*	5 QGF=0.	001751
00620	417*	QLVF=0.	001751
00621	418*	QLWF=0.	001752
00622	419*	CALL PRNTE(50, , 50, ,NF+1,P,TEMPF,I,DTU,MG,RLV,RLW,VLV,VLW)	001753
00623	420*	6 PRINT 400	001772
00625	421*	CALL PRNTE 2	
00626	422*	GO TO 53	001776
00627	423*	51 WRITE(6,52) ITER,XFACT,SVL,SVLF,HI,HREL,QTF,TEMPF,P,QLV,QLW,QG,	001777
00627	424*	2 QLVF,QLWF,QGF,YV,RIIOLV,RIIOLW,RIIOLV,RIIOLW,RLVF,RLWF,RGF,HLVO,HLVF,HLWO,	001777
00627	425*	3 HLWF,HGVO,HGVF,HGWO,HGVF	001777
00667	426*	52 FOR AT(1),1X,13.7E12.5/,1X,7E12.5/,1X,7E12.5/,1X,8E12.5)	002002
00670	427*	53 STOP	002002
00671	428*	END	002005

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SUBROUTINE INTI(TD,DTD,TDI)

C THIS SUBROUTINE SETS UP THE ORDINARY DIFFERENTIAL EQUATIONS

C COMMON/CINT/T, JS,JN,DYA(500),XA(500),TD,JS4
COMMON/LCINT/DT

TD=TDI

JN=0

GO TO (4,5,1,1),TD

6 JS=2

GO TO 7

5 JS=JS+1

IF(JS,4,3) JS=1

IF(JS,4,2) RETURN

7 DT=DTD

3 TD=TDI

T=TD

RETURN

1 JS4=JS4+1

IF(JS4,4,5) JS4=1

IF(JS4,4,1) GO TO 2

IF(JS4,4,3) GO TO 4

RETURN

2 DT=DTD/2.

GO TO 3

4 TD=TD+TD

DT=2.*DT

T=TD

RETURN

END

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SUBROUTINE INT(X,DX)

C ORDINARY DIFFERENTIAL EQUATION SOLVER

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```

COMMON/LINI/T, JS,JN,DXA(500),XA(500),IO,JS4
COMMON/LCINT/DT
JN=JN+1
GO TO (1,3,5),IO
9 X=X+DX+DT
RETURN
8 GO TO (1,2),JS
1 DXA(JN)=DX
X=X+DX+DT
RETURN
2 X=X+(DX-DXA(JN))*DT/2.
RETURN
3 GO TO (4,5,6,7),JS4
4 XA(JN)=X
DXA(JN)=DX
X=X+DX+DT
RETURN
5 DXA(JN)=DXA(JN)+2.*DX
X=XA(JN)+DX+DT
RETURN
6 DXA(JN)=DXA(JN)+2.*DX
X=XA(JN)+DX+DT
RETURN
7 DXA(JN)=(DXA(JN)+DX)/6.
X=XA(JN)+DXA(JN)*DT
RETURN
END

```

```

@FOR,N1 PRNTF,PRNTF
SUBROUTINE PRNTF(PRI,FNR,NF,A,B,C,D,E,F,G,O,P,Q)

```

```

C
C THIS SUBROUTINE KEEPS TRACK OF THE NUMBER OF LINES ON EACH PAGE AND
C DETERMINES WHETHER TO PRINT
C

```

```

COMMON/CCINT/DT
COMMON/CINT/T, JS,JN,DXA(500),XA(500),IO,JS4
COMMON/CPK/NPK
COMMON/PAGE/LINE
NPK=0
IF((IPRNT,LI,PRI) GO TO 4
IF((1,GE,FNR-DT/2.)AND.((JS,EQ,2).OR.(JS4,EQ,4))) GO TO 6
IF((1,GE,IPRNT-DT/2.)AND.((JS,EQ,2).OR.(JS4,EQ,4))) GO TO 5
RETURN
4 NF=1
5 IPRNT=IPRNT+PRI
6 PRINT 100,A,B,C,D,E,F,G,O,P,Q

```

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HYDRODYNAMIC COMPARISON

```
100  FORMAT(5X,1PE10.2,9E10.2)
      LINE=LINE+1
      CALL STORE(10)
      NPR=1
      RETURN
```

```
6    T=0.
      IPNT=0.
      NF=2
      DO 7 J=1,500
7    KA(J)=0.
      GO TO 8
      END
```

```
2FOR,N1 PRNTF2,PRNTF2
      SUBROUTINE PRNTF2
```

```
C
C    THIS SUBROUTINE PRINTS VARIABLES ON THE SECOND PAGE
C
```

```
      COMMON/CPRINT/S(10,40),KOUNT
      PRINT 1
```

```
1    FORMAT(//,16X,3(BHPREFLASH,2X),3(7HFLASHED,3X),1X,3(5HTOTAL,5X),/,
1    19X,2(3HGAS,4X,8HVCH LIQ.,4X,8H2O LIQ.,4X),3HPVC,5X,7HVCH GAS,3X
2    ,8HVCH LIQ.,/,
3    8X,4HTIME, 616X,4HFLOW),4X,8HPRODUCED,2(2X,8HEMISSION),/,
4    8X,3HMIN,5X,6(8HOLE/HIN,2X),1X,3(6HLMOLF,4X),/,5X, 100H
9-----
A-----,/)
```

```
      DO 2 I=1,KOUNT
```

```
2    PRINT 3,S(1,I),S(2,I),S(3,I),S(4,I),S(5,I),S(6,I),S(7,I),S(8,I)
      * ,S(9,I),S(10,I)
```

```
3    FORMAT(5X,1PE10.4,9E10.4)
      KOUNT=0
      RETURN
      END
```

```
2FOR,N1 STORE,STORE
      SUBROUTINE STORE(N)
```

```
C
C    THIS SUBROUTINE STORES THE VARIABLES FROM EACH TIMESTEP TO BE PRINTED
C    ON THE SECOND PAGE OF TABLE
C
```

```
      COMMON/LSTORE/A(10)
      COMMON/LPRINT/S(10,40),KOUNT
      KOUNT=KOUNT+1
      DO 1 I=1,N
1    S(I,KOUNT)=A(I)
      RETURN
```

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```

      END
@FOR.NI LINEAR,LINEAR
C
C   LINEAR REGRESSION SUBROUTINE
C
      SUBROUTINE LINEAR(X,Y,N,A,D)
      DIMENSION X(N),Y(N),F(4)
      DO 1 I=1,4
1      F(I)=0.
      P=0.
      DO 2 I=1,N
      F(1)=F(1)+X(I)+Y(I)
      F(2)=F(2)+X(I)
      F(3)=F(3)+Y(I)
      F(4)=F(4)+X(I)*X(I)
2      P=P+1.
      U=(F(1)-F(2)*F(3)/P)/(F(4)-F(2)*F(2)/P)
      A=F(3)/P-U*F(2)/P
      RETURN
      END

```

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APPENDIX C

Example Runs on 10,000 Gallon
and 20,000 Gallon Reactors

COMPARISON

DISCHARGE FROM A PVC BATCH REACTOR

Case 1. High Reaction Rate - Zero Heat Removal

REACTOR PRESSURE AT TIME OF DISCHARGE = 194.79 PSIA	PRESSURE DOWNSTREAM OF VALVE = 64.70 PSIA
REACTOR TEMP AT TIME OF DISCHARGE = 161.80 F	WATER JACKET TEMP AT DISCHARGE = 90.00 F
REACTOR VOLUME = 1337.000 CU FT	HEAT OF REACTION = 45516.000 BTU/LBMOLE
LIQUID VCM INITIALLY IN REACTOR = 460.90 LBMOLE	LIQ H2O INITIALLY IN REACTOR = 2465.7 LBMOLE
VAPOR INITIALLY IN REACTOR = 1.5142 LBMOLE	JACKET COEF TIMES AREA = 564.2 BTU/MIN-F
DENSITY OF WATER (CONSTANT) = 3.4570 LBMOLE/CU FT	INITIAL DENSITY OF VCM = .80593 LBMOLE/CU FT
AREA OF RELIEF VALVE ORIFICE OPENING = .0694 SQ FT	ORIFICE FLOW COEFFICIENT = .610
MINIMUM LIQUID ENTRAINMENT = .0100 CU FT LIQ/CU FT GAS	MINIMUM WATER JACKET TEMP = 48.00 F
LIQ VOL WHEN MIN ENTRAINMENT IS REACHED = 1219.4 CU FT	TIME MIN JACKET TEMP IS REACHED = 5.00 MIN
HEATING JACKET FACTOR = .00	REACTION RATE FACTOR = 2.40

C-2

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTION HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTION H2O LIQ. VOLUME CU FT
.00	1.95+02	1.62+02	9.00+01	2.04+05	1.51+00	4.61+02	2.47+03	5.72+02	7.13+02
1.00-01	1.95+02	1.62+02	8.92+01	2.18+05	1.73+00	4.57+02	2.45+03	5.67+02	7.09+02
2.00-01	1.96+02	1.62+02	8.83+01	2.31+05	1.95+00	4.54+02	2.44+03	5.63+02	7.05+02
3.00-01	1.97+02	1.62+02	8.75+01	2.43+05	2.16+00	4.50+02	2.42+03	5.59+02	7.01+02
4.00-01	1.97+02	1.63+02	8.66+01	2.52+05	2.36+00	4.46+02	2.41+03	5.54+02	6.98+02
5.00-01	1.98+02	1.63+02	8.58+01	2.59+05	2.54+00	4.42+02	2.40+03	5.49+02	6.94+02
6.00-01	1.98+02	1.63+02	8.50+01	2.61+05	2.70+00	4.38+02	2.39+03	5.44+02	6.91+02
7.00-01	1.98+02	1.63+02	8.41+01	2.58+05	2.83+00	4.34+02	2.38+03	5.39+02	6.89+02
8.00-01	1.97+02	1.62+02	8.33+01	2.45+05	2.90+00	4.29+02	2.38+03	5.32+02	6.88+02
9.00-01	1.95+02	1.62+02	8.24+01	2.24+05	2.91+00	4.24+02	2.38+03	5.26+02	6.88+02
1.00+00	1.94+02	1.61+02	8.16+01	2.02+05	2.92+00	4.19+02	2.38+03	5.19+02	6.87+02
1.10+00	1.92+02	1.61+02	8.08+01	1.80+05	2.93+00	4.14+02	2.38+03	5.13+02	6.87+02
1.20+00	1.91+02	1.60+02	7.99+01	1.59+05	2.94+00	4.09+02	2.37+03	5.07+02	6.87+02
1.30+00	1.89+02	1.60+02	7.91+01	1.37+05	2.95+00	4.04+02	2.37+03	5.00+02	6.87+02
1.40+00	1.88+02	1.59+02	7.82+01	1.15+05	2.96+00	4.00+02	2.37+03	4.94+02	6.87+02
1.50+00	1.86+02	1.59+02	7.74+01	9.24+04	2.97+00	3.95+02	2.37+03	4.88+02	6.86+02
1.60+00	1.85+02	1.58+02	7.66+01	7.01+04	2.98+00	3.90+02	2.37+03	4.82+02	6.86+02
1.70+00	1.83+02	1.58+02	7.57+01	4.78+04	2.99+00	3.86+02	2.37+03	4.76+02	6.86+02
1.80+00	1.82+02	1.57+02	7.49+01	2.55+04	3.00+00	3.81+02	2.37+03	4.70+02	6.86+02

UCC
026681

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIQ. EMISSION L/MOLE
.00	3.96-01	2.99+01	1.44+02	2.63+01	4.26+00	1.44+02	.00	.00	.00
1.00-01	1.87+00	2.90+01	1.40+02	2.71+01	3.93+00	1.39+02	3.60-01	2.68+00	4.20-01
2.00-01	3.66+00	2.79+01	1.35+02	2.82+01	3.49+00	1.34+02	7.21-01	5.42+00	7.92-01
3.00-01	5.94+00	2.65+01	1.28+02	2.96+01	2.97+00	1.28+02	1.08+00	8.28+00	1.12+00
4.00-01	8.95+00	2.46+01	1.20+02	3.14+01	2.34+00	1.19+02	1.45+00	1.13+01	1.30+00
5.00-01	1.31+01	2.21+01	1.08+02	3.30+01	1.54+00	1.08+02	1.81+00	1.45+01	1.58+00
6.00-01	1.91+01	1.85+01	9.07+01	3.73+01	4.48-01	9.05+01	2.17+00	1.80+01	1.68+00
7.00-01	2.81+01	1.29+01	6.39+01	4.28+01	.00	6.21+01	2.53+00	2.18+01	1.69+00
8.00-01	4.55+01	3.47+00	1.73+01	5.13+01	.00	1.50+01	2.88+00	2.62+01	1.69+00
9.00-01	4.59+01	1.38+00	6.94+00	4.95+01	.00	4.70+00	3.22+00	3.08+01	1.69+00
1.00+00	4.55+01	1.36+00	6.93+00	4.91+01	.00	4.73+00	3.55+00	3.54+01	1.69+00
1.10+00	4.51+01	1.34+00	6.93+00	4.87+01	.00	4.75+00	3.87+00	4.00+01	1.69+00
1.20+00	4.48+01	1.33+00	6.92+00	4.82+01	.00	4.77+00	4.18+00	4.45+01	1.69+00
1.30+00	4.44+01	1.31+00	6.92+00	4.78+01	.00	4.80+00	4.48+00	4.90+01	1.69+00
1.40+00	4.40+01	1.29+00	6.91+00	4.74+01	.00	4.82+00	4.77+00	5.34+01	1.69+00
1.50+00	4.37+01	1.28+00	6.90+00	4.70+01	.00	4.84+00	5.05+00	5.78+01	1.69+00
1.60+00	4.33+01	1.26+00	6.90+00	4.66+01	.00	4.86+00	5.32+00	6.22+01	1.69+00
1.70+00	4.29+01	1.24+00	6.89+00	4.62+01	.00	4.88+00	5.58+00	6.65+01	1.69+00
1.80+00	4.25+01	1.23+00	6.88+00	4.57+01	.00	4.90+00	5.84+00	7.08+01	1.69+00

C-3

UCC
026682

2011/11/16

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
1.20+00	1.80+02	1.56+02	7.40+01	3.04+03	3.01+00	3.77+02	2.37+03	4.64+02	6.85+02
2.00+00	1.79+02	1.56+02	7.32+01	-1.94+04	3.02+00	3.72+02	2.37+03	4.58+02	6.85+02
2.10+00	1.77+02	1.55+02	7.24+01	-4.19+04	3.03+00	3.68+02	2.37+03	4.52+02	6.85+02
2.20+00	1.76+02	1.55+02	7.15+01	-6.44+04	3.04+00	3.63+02	2.37+03	4.47+02	6.85+02
2.30+00	1.74+02	1.54+02	7.07+01	-8.70+04	3.05+00	3.59+02	2.37+03	4.41+02	6.84+02
2.40+00	1.73+02	1.54+02	6.98+01	-1.09+05	3.05+00	3.55+02	2.37+03	4.36+02	6.84+02
2.50+00	1.71+02	1.53+02	6.90+01	-1.32+05	3.06+00	3.50+02	2.36+03	4.30+02	6.84+02
2.60+00	1.70+02	1.52+02	6.82+01	-1.55+05	3.07+00	3.46+02	2.36+03	4.25+02	6.84+02
2.70+00	1.68+02	1.52+02	6.73+01	-1.77+05	3.08+00	3.42+02	2.36+03	4.19+02	6.84+02
2.80+00	1.67+02	1.51+02	6.65+01	-1.99+05	3.09+00	3.38+02	2.36+03	4.14+02	6.83+02
2.90+00	1.65+02	1.51+02	6.56+01	-2.22+05	3.10+00	3.34+02	2.36+03	4.08+02	6.83+02
3.00+00	1.64+02	1.50+02	6.48+01	-2.44+05	3.11+00	3.30+02	2.36+03	4.03+02	6.83+02
3.10+00	1.63+02	1.49+02	6.40+01	-2.66+05	3.11+00	3.26+02	2.36+03	3.98+02	6.83+02
3.20+00	1.61+02	1.49+02	6.31+01	-2.89+05	3.12+00	3.22+02	2.36+03	3.93+02	6.83+02
3.30+00	1.60+02	1.48+02	6.23+01	-3.11+05	3.13+00	3.18+02	2.36+03	3.88+02	6.82+02
3.40+00	1.58+02	1.48+02	6.14+01	-3.33+05	3.14+00	3.14+02	2.36+03	3.83+02	6.82+02
3.50+00	1.57+02	1.47+02	6.06+01	-3.55+05	3.14+00	3.10+02	2.36+03	3.78+02	6.82+02
3.60+00	1.56+02	1.46+02	5.98+01	-3.77+05	3.15+00	3.07+02	2.36+03	3.73+02	6.82+02
3.70+00	1.54+02	1.46+02	5.89+01	-3.99+05	3.16+00	3.03+02	2.36+03	3.68+02	6.81+02
3.80+00	1.53+02	1.45+02	5.81+01	-4.20+05	3.17+00	2.99+02	2.35+03	3.63+02	6.81+02
3.90+00	1.52+02	1.45+02	5.72+01	-4.42+05	3.17+00	2.96+02	2.35+03	3.59+02	6.81+02
4.00+00	1.50+02	1.44+02	5.64+01	-4.64+05	3.18+00	2.92+02	2.35+03	3.54+02	6.81+02
4.10+00	1.49+02	1.43+02	5.56+01	-4.85+05	3.19+00	2.88+02	2.35+03	3.50+02	6.81+02
4.20+00	1.48+02	1.43+02	5.47+01	-5.06+05	3.19+00	2.85+02	2.35+03	3.45+02	6.80+02
4.30+00	1.46+02	1.42+02	5.39+01	-5.27+05	3.20+00	2.81+02	2.35+03	3.40+02	6.80+02
4.40+00	1.45+02	1.42+02	5.30+01	-5.49+05	3.21+00	2.78+02	2.35+03	3.36+02	6.80+02
4.50+00	1.44+02	1.41+02	5.22+01	-5.70+05	3.21+00	2.74+02	2.35+03	3.32+02	6.80+02
4.60+00	1.43+02	1.40+02	5.14+01	-5.90+05	3.22+00	2.71+02	2.35+03	3.27+02	6.80+02
4.70+00	1.41+02	1.40+02	5.05+01	-6.11+05	3.23+00	2.68+02	2.35+03	3.23+02	6.79+02
4.80+00	1.40+02	1.39+02	4.97+01	-6.32+05	3.23+00	2.64+02	2.35+03	3.19+02	6.79+02
4.90+00	1.39+02	1.39+02	4.88+01	-6.52+05	3.24+00	2.61+02	2.35+03	3.15+02	6.79+02
5.00+00	1.38+02	1.38+02	4.80+01	-6.72+05	3.24+00	2.58+02	2.35+03	3.10+02	6.79+02
5.10+00	1.37+02	1.37+02	4.80+01	-6.92+05	3.25+00	2.55+02	2.35+03	3.06+02	6.79+02

C-4

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028883

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LTO. FLOW MOLE/MIN	PREFLASH H2O LTO. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LTO. FLOW MOLE/MIN	FLASHED H2O LTO. FLOW MOLE/MIN	TOTAL PVL PRODUCED LUMOLE	TOTAL VCM GAS EMISSION LUMOLE	TOTAL VCM LTO. EMISSION LUMOLE
1.90+00	4.22+01	1.21+00	6.87+00	4.53+01	.00	4.92+00	6.08+00	7.51+01	1.69+00
2.00+00	4.18+01	1.19+00	6.86+00	4.49+01	.00	4.94+00	6.32+00	7.93+01	1.69+00
2.10+00	4.14+01	1.18+00	6.84+00	4.45+01	.00	4.96+00	6.55+00	8.35+01	1.69+00
2.20+00	4.10+01	1.16+00	6.83+00	4.41+01	.00	4.97+00	6.77+00	8.76+01	1.69+00
2.30+00	4.07+01	1.14+00	6.82+00	4.36+01	.00	4.99+00	6.98+00	9.18+01	1.69+00
2.40+00	4.03+01	1.13+00	6.81+00	4.32+01	.00	5.01+00	7.19+00	9.58+01	1.69+00
2.50+00	3.99+01	1.11+00	6.79+00	4.28+01	.00	5.02+00	7.39+00	9.99+01	1.69+00
2.60+00	3.95+01	1.10+00	6.78+00	4.24+01	.00	5.03+00	7.58+00	1.04+02	1.69+00
2.70+00	3.92+01	1.08+00	6.76+00	4.20+01	.00	5.05+00	7.77+00	1.08+02	1.69+00
2.80+00	3.88+01	1.07+00	6.74+00	4.16+01	.00	5.06+00	7.95+00	1.12+02	1.69+00
2.90+00	3.84+01	1.05+00	6.73+00	4.11+01	.00	5.07+00	8.12+00	1.16+02	1.69+00
3.00+00	3.81+01	1.04+00	6.71+00	4.07+01	.00	5.08+00	8.29+00	1.19+02	1.69+00
3.10+00	3.77+01	1.02+00	6.69+00	4.03+01	.00	5.09+00	8.45+00	1.23+02	1.69+00
3.20+00	3.73+01	1.00+00	6.68+00	3.99+01	.00	5.10+00	8.61+00	1.27+02	1.69+00
3.30+00	3.70+01	9.90-01	6.66+00	3.95+01	.00	5.11+00	8.76+00	1.31+02	1.69+00
3.40+00	3.66+01	9.75-01	6.64+00	3.91+01	.00	5.12+00	8.90+00	1.34+02	1.69+00
3.50+00	3.63+01	9.60-01	6.62+00	3.87+01	.00	5.12+00	9.04+00	1.38+02	1.69+00
3.60+00	3.59+01	9.46-01	6.60+00	3.83+01	.00	5.13+00	9.18+00	1.42+02	1.69+00
3.70+00	3.56+01	9.31-01	6.58+00	3.79+01	.00	5.14+00	9.31+00	1.45+02	1.69+00
3.80+00	3.52+01	9.17-01	6.56+00	3.76+01	.00	5.14+00	9.44+00	1.49+02	1.69+00
3.90+00	3.49+01	9.03-01	6.54+00	3.72+01	.00	5.15+00	9.56+00	1.52+02	1.69+00
4.00+00	3.45+01	8.89-01	6.52+00	3.68+01	.00	5.15+00	9.67+00	1.56+02	1.69+00
4.10+00	3.42+01	8.75-01	6.50+00	3.64+01	.00	5.15+00	9.79+00	1.59+02	1.69+00
4.20+00	3.39+01	8.61-01	6.47+00	3.60+01	.00	5.16+00	9.90+00	1.63+02	1.69+00
4.30+00	3.35+01	8.48-01	6.45+00	3.57+01	.00	5.16+00	1.00+01	1.66+02	1.69+00
4.40+00	3.32+01	8.34-01	6.43+00	3.53+01	.00	5.16+00	1.01+01	1.70+02	1.69+00
4.50+00	3.29+01	8.21-01	6.41+00	3.49+01	.00	5.16+00	1.02+01	1.73+02	1.69+00
4.60+00	3.25+01	8.08-01	6.38+00	3.46+01	.00	5.16+00	1.03+01	1.76+02	1.69+00
4.70+00	3.22+01	7.95-01	6.36+00	3.42+01	.00	5.16+00	1.04+01	1.79+02	1.69+00
4.80+00	3.19+01	7.82-01	6.34+00	3.39+01	.00	5.16+00	1.05+01	1.83+02	1.69+00
4.90+00	3.16+01	7.70-01	6.31+00	3.35+01	.00	5.16+00	1.06+01	1.86+02	1.69+00
5.00+00	3.13+01	7.57-01	6.29+00	3.32+01	.00	5.16+00	1.06+01	1.89+02	1.69+00
5.10+00	3.10+01	7.45-01	6.27+00	3.28+01	.00	5.15+00	1.07+01	1.92+02	1.69+00

C-5

UCC
026684

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCN LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCN LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
5.20+00	1.36+02	1.37+02	4.80+01	-7.12+05	3.25+00	2.51+02	2.35+03	3.02+02	6.78+02
5.30+00	1.34+02	1.36+02	4.80+01	-7.32+05	3.26+00	2.48+02	2.34+03	2.98+02	6.78+02
5.40+00	1.33+02	1.36+02	4.80+01	-7.52+05	3.27+00	2.45+02	2.34+03	2.94+02	6.78+02
5.50+00	1.32+02	1.35+02	4.80+01	-7.72+05	3.27+00	2.42+02	2.34+03	2.90+02	6.78+02
5.60+00	1.31+02	1.35+02	4.80+01	-7.91+05	3.28+00	2.39+02	2.34+03	2.87+02	6.78+02
5.70+00	1.30+02	1.34+02	4.80+01	-8.10+05	3.28+00	2.36+02	2.34+03	2.83+02	6.77+02
5.80+00	1.29+02	1.33+02	4.80+01	-8.29+05	3.29+00	2.33+02	2.34+03	2.79+02	6.77+02
5.90+00	1.28+02	1.33+02	4.80+01	-8.48+05	3.29+00	2.30+02	2.34+03	2.75+02	6.77+02
6.00+00	1.27+02	1.32+02	4.80+01	-8.67+05	3.30+00	2.27+02	2.34+03	2.71+02	6.77+02
6.10+00	1.26+02	1.32+02	4.80+01	-8.86+05	3.30+00	2.24+02	2.34+03	2.68+02	6.77+02
6.20+00	1.25+02	1.31+02	4.80+01	-9.05+05	3.31+00	2.21+02	2.34+03	2.64+02	6.76+02
6.30+00	1.24+02	1.31+02	4.80+01	-9.23+05	3.31+00	2.19+02	2.34+03	2.61+02	6.76+02
6.40+00	1.23+02	1.30+02	4.80+01	-9.41+05	3.32+00	2.16+02	2.34+03	2.57+02	6.76+02
6.50+00	1.22+02	1.30+02	4.80+01	-9.59+05	3.32+00	2.13+02	2.34+03	2.54+02	6.76+02
6.60+00	1.21+02	1.29+02	4.80+01	-9.77+05	3.33+00	2.10+02	2.34+03	2.50+02	6.76+02
6.70+00	1.20+02	1.29+02	4.80+01	-9.95+05	3.33+00	2.07+02	2.34+03	2.47+02	6.76+02
6.80+00	1.19+02	1.28+02	4.80+01	-1.01+06	3.34+00	2.05+02	2.33+03	2.43+02	6.75+02
6.90+00	1.19+02	1.28+02	4.80+01	-1.03+06	3.34+00	2.02+02	2.33+03	2.40+02	6.75+02
7.00+00	1.18+02	1.27+02	4.80+01	-1.05+06	3.34+00	1.99+02	2.33+03	2.37+02	6.75+02
7.10+00	1.17+02	1.27+02	4.80+01	-1.06+06	3.35+00	1.97+02	2.33+03	2.34+02	6.75+02
7.20+00	1.16+02	1.26+02	4.80+01	-1.08+06	3.35+00	1.94+02	2.33+03	2.30+02	6.75+02
7.30+00	1.15+02	1.26+02	4.80+01	-1.10+06	3.36+00	1.92+02	2.33+03	2.27+02	6.74+02
7.40+00	1.14+02	1.25+02	4.80+01	-1.12+06	3.36+00	1.89+02	2.33+03	2.24+02	6.74+02
7.50+00	1.14+02	1.25+02	4.80+01	-1.13+06	3.36+00	1.87+02	2.33+03	2.21+02	6.74+02
7.60+00	1.13+02	1.24+02	4.80+01	-1.15+06	3.37+00	1.84+02	2.33+03	2.18+02	6.74+02
7.70+00	1.12+02	1.24+02	4.80+01	-1.16+06	3.37+00	1.82+02	2.33+03	2.15+02	6.74+02
7.80+00	1.11+02	1.23+02	4.80+01	-1.18+06	3.38+00	1.79+02	2.33+03	2.12+02	6.74+02
7.90+00	1.10+02	1.23+02	4.80+01	-1.20+06	3.38+00	1.77+02	2.33+03	2.09+02	6.73+02
8.00+00	1.10+02	1.22+02	4.80+01	-1.21+06	3.38+00	1.74+02	2.33+03	2.06+02	6.73+02
8.10+00	1.09+02	1.22+02	4.80+01	-1.23+06	3.39+00	1.72+02	2.33+03	2.03+02	6.73+02
8.20+00	1.08+02	1.21+02	4.80+01	-1.24+06	3.39+00	1.70+02	2.33+03	2.00+02	6.73+02
8.30+00	1.07+02	1.21+02	4.80+01	-1.26+06	3.39+00	1.67+02	2.33+03	1.97+02	6.73+02
8.40+00	1.07+02	1.20+02	4.80+01	-1.28+06	3.40+00	1.65+02	2.33+03	1.94+02	6.73+02

C-6

UCC
026685

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PYC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIQ. EMISSION L/MOLE
5.20+00	3.07+01	7.32-01	6.24+00	3.25+01	.00	5.15+00	1.08+01	1.95+02	1.69+00
5.30+00	3.04+01	7.20-01	6.22+00	3.22+01	.00	5.15+00	1.09+01	1.98+02	1.69+00
5.40+00	3.01+01	7.08-01	6.19+00	3.18+01	.00	5.14+00	1.09+01	2.01+02	1.69+00
5.50+00	2.98+01	6.97-01	6.17+00	3.15+01	.00	5.14+00	1.10+01	2.04+02	1.69+00
5.60+00	2.95+01	6.85-01	6.14+00	3.12+01	.00	5.13+00	1.11+01	2.07+02	1.69+00
5.70+00	2.92+01	6.74-01	6.12+00	3.08+01	.00	5.12+00	1.12+01	2.10+02	1.69+00
5.80+00	2.89+01	6.62-01	6.09+00	3.05+01	.00	5.12+00	1.12+01	2.13+02	1.69+00
5.90+00	2.86+01	6.51-01	6.07+00	3.02+01	.00	5.11+00	1.13+01	2.16+02	1.69+00
6.00+00	2.83+01	6.40-01	6.04+00	2.99+01	.00	5.10+00	1.13+01	2.19+02	1.69+00
6.10+00	2.81+01	6.29-01	6.01+00	2.96+01	.00	5.10+00	1.14+01	2.22+02	1.69+00
6.20+00	2.78+01	6.18-01	5.99+00	2.93+01	.00	5.09+00	1.14+01	2.25+02	1.69+00
6.30+00	2.75+01	6.08-01	5.96+00	2.90+01	.00	5.08+00	1.15+01	2.27+02	1.69+00
6.40+00	2.72+01	5.97-01	5.93+00	2.87+01	.00	5.07+00	1.15+01	2.30+02	1.69+00
6.50+00	2.70+01	5.87-01	5.91+00	2.84+01	.00	5.06+00	1.16+01	2.33+02	1.69+00
6.60+00	2.67+01	5.76-01	5.88+00	2.81+01	.00	5.05+00	1.16+01	2.36+02	1.69+00
6.70+00	2.64+01	5.66-01	5.85+00	2.78+01	.00	5.04+00	1.17+01	2.38+02	1.69+00
6.80+00	2.62+01	5.56-01	5.83+00	2.75+01	.00	5.03+00	1.17+01	2.41+02	1.69+00
6.90+00	2.59+01	5.47-01	5.80+00	2.73+01	.00	5.02+00	1.18+01	2.44+02	1.69+00
7.00+00	2.57+01	5.37-01	5.77+00	2.70+01	.00	5.01+00	1.18+01	2.46+02	1.69+00
7.10+00	2.54+01	5.27-01	5.75+00	2.67+01	.00	5.00+00	1.19+01	2.49+02	1.69+00
7.20+00	2.52+01	5.18-01	5.72+00	2.64+01	.00	4.98+00	1.19+01	2.51+02	1.69+00
7.30+00	2.49+01	5.09-01	5.69+00	2.62+01	.00	4.97+00	1.19+01	2.54+02	1.69+00
7.40+00	2.47+01	4.99-01	5.67+00	2.59+01	.00	4.96+00	1.20+01	2.56+02	1.69+00
7.50+00	2.45+01	4.90-01	5.64+00	2.56+01	.00	4.95+00	1.20+01	2.59+02	1.69+00
7.60+00	2.42+01	4.82-01	5.61+00	2.54+01	.00	4.93+00	1.20+01	2.61+02	1.69+00
7.70+00	2.40+01	4.73-01	5.58+00	2.51+01	.00	4.92+00	1.21+01	2.64+02	1.69+00
7.80+00	2.38+01	4.64-01	5.56+00	2.49+01	.00	4.90+00	1.21+01	2.66+02	1.69+00
7.90+00	2.35+01	4.56-01	5.53+00	2.46+01	.00	4.89+00	1.21+01	2.68+02	1.69+00
8.00+00	2.33+01	4.47-01	5.50+00	2.44+01	.00	4.88+00	1.22+01	2.71+02	1.69+00
8.10+00	2.31+01	4.39-01	5.47+00	2.41+01	.00	4.86+00	1.22+01	2.73+02	1.69+00
8.20+00	2.29+01	4.31-01	5.44+00	2.39+01	.00	4.84+00	1.22+01	2.75+02	1.69+00
8.30+00	2.26+01	4.23-01	5.42+00	2.36+01	.00	4.83+00	1.23+01	2.78+02	1.69+00
8.40+00	2.24+01	4.15-01	5.39+00	2.34+01	.00	4.81+00	1.23+01	2.80+02	1.69+00

C-7

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026686

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCH LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCH LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
8'50+00	1.06+02	1.20+02	4.80+01	-1.29+06	3.40+00	1.63+02	2.32+03	1.92+02	6.72+02
8'60+00	1.05+02	1.19+02	4.60+01	-1.31+06	3.41+00	1.61+02	2.32+03	1.89+02	6.72+02
8'70+00	1.05+02	1.19+02	4.80+01	-1.32+06	3.41+00	1.58+02	2.32+03	1.86+02	6.72+02
8'80+00	1.04+02	1.18+02	4.80+01	-1.34+06	3.41+00	1.56+02	2.32+03	1.83+02	6.72+02
8'90+00	1.03+02	1.18+02	4.80+01	-1.35+06	3.42+00	1.54+02	2.32+03	1.81+02	6.72+02
9'00+00	1.03+02	1.18+02	4.80+01	-1.36+06	3.42+00	1.52+02	2.32+03	1.78+02	6.72+02
9'10+00	1.02+02	1.17+02	4.80+01	-1.38+06	3.42+00	1.50+02	2.32+03	1.76+02	6.71+02
9'20+00	1.01+02	1.17+02	4.80+01	-1.39+06	3.43+00	1.48+02	2.32+03	1.73+02	6.71+02
9'30+00	1.01+02	1.16+02	4.80+01	-1.41+06	3.43+00	1.46+02	2.32+03	1.70+02	6.71+02
9'40+00	1.00+02	1.16+02	4.80+01	-1.42+06	3.43+00	1.43+02	2.32+03	1.68+02	6.71+02
9'50+00	9.96+01	1.15+02	4.80+01	-1.43+06	3.43+00	1.41+02	2.32+03	1.65+02	6.71+02
9'60+00	9.90+01	1.15+02	4.80+01	-1.45+06	3.44+00	1.39+02	2.32+03	1.63+02	6.71+02
9'70+00	9.84+01	1.15+02	4.80+01	-1.46+06	3.44+00	1.37+02	2.32+03	1.61+02	6.71+02
9'80+00	9.78+01	1.14+02	4.80+01	-1.48+06	3.44+00	1.35+02	2.32+03	1.58+02	6.70+02
9'90+00	9.73+01	1.14+02	4.80+01	-1.49+06	3.45+00	1.33+02	2.32+03	1.56+02	6.70+02
1'00+01	9.67+01	1.13+02	4.80+01	-1.50+06	3.45+00	1.31+02	2.32+03	1.53+02	6.70+02

C-8

COMBUSTION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIT. FLOW MOLE/MIN	PREFLASH H2O LIT. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIT. FLOW MOLE/MIN	FLASHED H2O LIT. FLOW MOLE/MIN	TOTAL PVL PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIT. EMISSION L/MOLE
0.50+00	2.22+01	4.07-01	5.36+00	2.32+01	.00	4.80+00	1.23+01	2.82+02	1.69+00
0.60+00	2.20+01	3.99-01	5.33+00	2.29+01	.00	4.78+00	1.23+01	2.84+02	1.69+00
0.70+00	2.18+01	3.91-01	5.30+00	2.27+01	.00	4.76+00	1.24+01	2.87+02	1.69+00
0.80+00	2.16+01	3.84-01	5.28+00	2.25+01	.00	4.75+00	1.24+01	2.89+02	1.69+00
0.90+00	2.14+01	3.76-01	5.25+00	2.23+01	.00	4.73+00	1.24+01	2.91+02	1.69+00
1.00+00	2.12+01	3.69-01	5.22+00	2.20+01	.00	4.71+00	1.24+01	2.93+02	1.69+00
1.10+00	2.10+01	3.62-01	5.19+00	2.18+01	.00	4.70+00	1.24+01	2.95+02	1.69+00
1.20+00	2.08+01	3.55-01	5.16+00	2.16+01	.00	4.68+00	1.25+01	2.97+02	1.69+00
1.30+00	2.06+01	3.48-01	5.13+00	2.14+01	.00	4.66+00	1.25+01	2.99+02	1.69+00
1.40+00	2.04+01	3.41-01	5.11+00	2.12+01	.00	4.64+00	1.25+01	3.01+02	1.69+00
1.50+00	2.02+01	3.34-01	5.08+00	2.10+01	.00	4.62+00	1.25+01	3.03+02	1.69+00
1.60+00	2.00+01	3.28-01	5.05+00	2.07+01	.00	4.60+00	1.25+01	3.05+02	1.69+00
1.70+00	1.98+01	3.21-01	5.02+00	2.05+01	.00	4.58+00	1.26+01	3.07+02	1.69+00
1.80+00	1.96+01	3.15-01	4.99+00	2.03+01	.00	4.57+00	1.26+01	3.09+02	1.69+00
1.90+00	1.94+01	3.08-01	4.96+00	2.01+01	.00	4.55+00	1.26+01	3.11+02	1.69+00
1.00+01	1.92+01	3.02-01	4.93+00	1.99+01	.00	4.53+00	1.26+01	3.13+02	1.69+00

C-9

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026688

CORPORATION

DISCHARGE FROM A PVC BATCH REACTOR

Case 2. High Reaction Rate - Cold Water on Jacket

REACTOR PRESSURE AT TIME OF DISCHARGE = 154.79 PSIA	PRESSURE DOWNSTREAM OF VALVE = 64.70 PSIA
REACTOR TEMP AT TIME OF DISCHARGE = 161.80 F	WATER JACKET TEMP AT DISCHARGE = 90.00 F
REACTOR VOLUME = 1337.000 CU FT	HEAT OF REACTION = 45516.000 BTU/LBMOLE
LIQUID VCM INITIALLY IN REACTOR = 460.90 LBMOLE	LIQ H2O INITIALLY IN REACTOR = 2465.7 LBMOLE
VAPOR INITIALLY IN REACTOR = 1.5142 LBMOLE	JACKET COEF TIMES AREA = 564.2 BTU/MIN F
DENSITY OF WATER (CONSTANT) = 3.4570 LB/OLF/CU FT	INITIAL DENSITY OF VCM = .80593 LBMOLE/CU FT
AREA OF RELIEF VALVE ORIFICE OPENING = .0694 SQ FT	ORIFICE FLOW COEFFICIENT = .610
MINIMUM LIQUID ENTRAINMENT = .0100 CU FT LIQ/CU FT GAS	MINIMUM WATER JACKET TEMP = 48.00 F
LIQ MOL WHEN MIN ENTRAINMENT IS REACHED = 1219.4 CU FT	TIME MIN JACKET TEMP IS REACHED = 5.00 MIN
HEATING JACKET FACTOR = 1.00	REACTION RATE FACTOR = 2.00

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
0.00	1.95+02	1.62+02	9.00+01	2.04+05	1.51+00	4.61+02	2.47+03	5.72+02	7.13+02
1.00-01	1.95+02	1.62+02	8.92+01	2.14+05	1.73+00	4.57+02	2.45+03	5.67+02	7.09+02
2.00-01	1.95+02	1.62+02	8.83+01	2.23+05	1.95+00	4.54+02	2.44+03	5.63+02	7.05+02
3.00-01	1.96+02	1.62+02	8.75+01	2.30+05	2.16+00	4.50+02	2.42+03	5.58+02	7.01+02
4.00-01	1.96+02	1.62+02	8.66+01	2.35+05	2.35+00	4.46+02	2.41+03	5.54+02	6.98+02
5.00-01	1.96+02	1.62+02	8.58+01	2.37+05	2.53+00	4.42+02	2.40+03	5.49+02	6.94+02
6.00-01	1.96+02	1.62+02	8.50+01	2.35+05	2.69+00	4.38+02	2.39+03	5.44+02	6.92+02
7.00-01	1.95+02	1.62+02	8.41+01	2.27+05	2.81+00	4.34+02	2.38+03	5.38+02	6.89+02
8.00-01	1.94+02	1.62+02	8.33+01	2.00+05	2.88+00	4.29+02	2.38+03	5.32+02	6.88+02
9.00-01	1.92+02	1.61+02	8.24+01	1.83+05	2.89+00	4.24+02	2.38+03	5.25+02	6.88+02
1.00+00	1.91+02	1.60+02	8.16+01	1.57+05	2.90+00	4.19+02	2.38+03	5.19+02	6.88+02
1.10+00	1.89+02	1.60+02	8.08+01	1.31+05	2.91+00	4.14+02	2.38+03	5.13+02	6.87+02
1.20+00	1.87+02	1.59+02	7.99+01	1.05+05	2.92+00	4.10+02	2.38+03	5.06+02	6.87+02
1.30+00	1.85+02	1.58+02	7.91+01	7.83+04	2.93+00	4.05+02	2.37+03	5.00+02	6.87+02
1.40+00	1.84+02	1.58+02	7.82+01	5.20+04	2.94+00	4.00+02	2.37+03	4.94+02	6.87+02
1.50+00	1.82+02	1.57+02	7.74+01	2.56+04	2.95+00	3.96+02	2.37+03	4.88+02	6.87+02
1.60+00	1.80+02	1.56+02	7.66+01	-9.35+02	2.96+00	3.91+02	2.37+03	4.82+02	6.86+02
1.70+00	1.78+02	1.56+02	7.57+01	-2.75+04	2.97+00	3.87+02	2.37+03	4.76+02	6.86+02
1.80+00	1.77+02	1.55+02	7.49+01	-5.40+04	2.98+00	3.82+02	2.37+03	4.70+02	6.86+02

C-10

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026689

COMPANION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED LB/MOLE	TOTAL VCM GAS EMISSION LB/MOLE	TOTAL VCM LIQ. EMISSION LB/MOLE
.00	3.96-01	2.99+01	1.44+02	2.63+01	4.26+00	1.44+02	.00	.00	.00
1.00-01	1.08+00	2.89+01	1.39+02	2.71+01	3.95+00	1.39+02	3.59-01	2.68+00	4.21-01
2.00-01	3.68+00	2.78+01	1.34+02	2.82+01	3.54+00	1.34+02	7.18-01	5.42+00	7.96-01
3.00-01	5.98+00	2.64+01	1.28+02	2.95+01	3.03+00	1.28+02	1.08+00	8.26+00	1.13+00
4.00-01	9.02+00	2.45+01	1.19+02	3.13+01	2.42+00	1.19+02	1.43+00	1.13+01	1.40+00
5.00-01	1.32+01	2.19+01	1.07+02	3.37+01	1.62+00	1.07+02	1.79+00	1.45+01	1.60+00
6.00-01	1.92+01	1.83+01	8.97+01	3.71+01	5.21-01	8.95+01	2.14+00	1.79+01	1.71+00
7.00-01	2.85+01	1.26+01	6.22+01	4.28+01	.00	6.05+01	2.49+00	2.18+01	1.72+00
8.00-01	4.51+01	2.78+00	1.39+01	5.01+01	.00	1.16+01	2.83+00	2.62+01	1.72+00
9.00-01	4.52+01	1.36+00	6.86+00	4.87+01	.00	4.69+00	3.16+00	3.07+01	1.72+00
1.00+00	4.47+01	1.34+00	6.85+00	4.82+01	.00	4.72+00	3.48+00	3.52+01	1.72+00
1.10+00	4.43+01	1.32+00	6.84+00	4.77+01	.00	4.74+00	3.78+00	3.97+01	1.72+00
1.20+00	4.39+01	1.31+00	6.82+00	4.72+01	.00	4.76+00	4.08+00	4.42+01	1.72+00
1.30+00	4.34+01	1.29+00	6.81+00	4.67+01	.00	4.78+00	4.36+00	4.85+01	1.72+00
1.40+00	4.30+01	1.27+00	6.79+00	4.62+01	.00	4.80+00	4.64+00	5.29+01	1.72+00
1.50+00	4.25+01	1.25+00	6.78+00	4.58+01	.00	4.82+00	4.90+00	5.72+01	1.72+00
1.60+00	4.21+01	1.24+00	6.76+00	4.53+01	.00	4.83+00	5.15+00	6.14+01	1.72+00
1.70+00	4.17+01	1.22+00	6.74+00	4.48+01	.00	4.85+00	5.40+00	6.57+01	1.72+00
1.80+00	4.12+01	1.20+00	6.72+00	4.43+01	.00	4.86+00	5.64+00	6.98+01	1.72+00

C-11

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTION HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTION H2O LIQ. VOLUME CU FT
1.90+00	1.75+02	1.54+02	7.40+01	-8.06+04	2.99+00	3.78+02	2.37+03	4.65+02	6.86+02
2.00+00	1.73+02	1.54+02	7.32+01	-1.07+05	3.00+00	3.74+02	2.37+03	4.59+02	6.85+02
2.10+00	1.71+02	1.53+02	7.24+01	-1.34+05	3.01+00	3.69+02	2.37+03	4.53+02	6.85+02
2.20+00	1.70+02	1.52+02	7.15+01	-1.60+05	3.01+00	3.65+02	2.37+03	4.48+02	6.85+02
2.30+00	1.68+02	1.52+02	7.07+01	-1.67+05	3.02+00	3.61+02	2.37+03	4.42+02	6.85+02
2.40+00	1.66+02	1.51+02	6.98+01	-2.13+05	3.03+00	3.57+02	2.37+03	4.37+02	6.85+02
2.50+00	1.65+02	1.50+02	6.90+01	-2.40+05	3.04+00	3.53+02	2.37+03	4.31+02	6.84+02
2.60+00	1.63+02	1.50+02	6.82+01	-2.66+05	3.05+00	3.49+02	2.36+03	4.26+02	6.84+02
2.70+00	1.61+02	1.49+02	6.73+01	-2.93+05	3.05+00	3.45+02	2.36+03	4.21+02	6.84+02
2.80+00	1.60+02	1.48+02	6.65+01	-3.19+05	3.06+00	3.41+02	2.36+03	4.16+02	6.84+02
2.90+00	1.58+02	1.47+02	6.56+01	-3.45+05	3.07+00	3.37+02	2.36+03	4.11+02	6.83+02
3.00+00	1.56+02	1.47+02	6.48+01	-3.71+05	3.08+00	3.33+02	2.36+03	4.06+02	6.83+02
3.10+00	1.55+02	1.46+02	6.40+01	-3.97+05	3.08+00	3.29+02	2.36+03	4.01+02	6.83+02
3.20+00	1.53+02	1.45+02	6.31+01	-4.23+05	3.09+00	3.26+02	2.36+03	3.96+02	6.83+02
3.30+00	1.52+02	1.45+02	6.23+01	-4.49+05	3.10+00	3.22+02	2.36+03	3.91+02	6.83+02
3.40+00	1.50+02	1.44+02	6.14+01	-4.75+05	3.11+00	3.18+02	2.36+03	3.86+02	6.82+02
3.50+00	1.49+02	1.43+02	6.06+01	-5.00+05	3.11+00	3.15+02	2.36+03	3.82+02	6.82+02
3.60+00	1.47+02	1.43+02	5.98+01	-5.26+05	3.12+00	3.11+02	2.36+03	3.77+02	6.82+02
3.70+00	1.46+02	1.42+02	5.89+01	-5.51+05	3.13+00	3.08+02	2.36+03	3.72+02	6.82+02
3.80+00	1.44+02	1.41+02	5.81+01	-5.76+05	3.13+00	3.04+02	2.36+03	3.68+02	6.82+02
3.90+00	1.43+02	1.41+02	5.72+01	-6.02+05	3.14+00	3.01+02	2.36+03	3.63+02	6.81+02
4.00+00	1.42+02	1.40+02	5.64+01	-6.27+05	3.15+00	2.98+02	2.36+03	3.59+02	6.81+02
4.10+00	1.40+02	1.39+02	5.56+01	-6.51+05	3.15+00	2.94+02	2.35+03	3.55+02	6.81+02
4.20+00	1.39+02	1.38+02	5.47+01	-6.76+05	3.16+00	2.91+02	2.35+03	3.50+02	6.81+02
4.30+00	1.37+02	1.38+02	5.39+01	-7.01+05	3.16+00	2.88+02	2.35+03	3.46+02	6.81+02
4.40+00	1.36+02	1.37+02	5.30+01	-7.25+05	3.17+00	2.84+02	2.35+03	3.42+02	6.80+02
4.50+00	1.35+02	1.36+02	5.22+01	-7.49+05	3.17+00	2.81+02	2.35+03	3.38+02	6.80+02
4.60+00	1.34+02	1.36+02	5.14+01	-7.73+05	3.18+00	2.78+02	2.35+03	3.34+02	6.80+02
4.70+00	1.32+02	1.35+02	5.05+01	-7.97+05	3.19+00	2.75+02	2.35+03	3.30+02	6.80+02
4.80+00	1.31+02	1.34+02	4.97+01	-8.21+05	3.19+00	2.72+02	2.35+03	3.26+02	6.80+02
4.90+00	1.30+02	1.34+02	4.88+01	-8.45+05	3.20+00	2.69+02	2.35+03	3.22+02	6.80+02
5.00+00	1.29+02	1.33+02	4.80+01	-8.68+05	3.20+00	2.66+02	2.35+03	3.18+02	6.79+02
5.10+00	1.27+02	1.33+02	4.80+01	-8.91+05	3.21+00	2.63+02	2.35+03	3.14+02	6.79+02

C-12

UCC
026891

COMPORATION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVL PRODUCED LBMOLE	TOTAL VCM GAS EMISSION LBMOLE	TOTAL VCM LIQ. EMISSION LBMOLE
1.90+00	4.00+01	1.10+00	6.70+00	4.30+01	.00	4.00+00	5.86+00	7.40+01	1.72+00
2.00+00	4.04+01	1.17+00	6.60+00	4.33+01	.00	4.09+00	6.00+00	7.80+01	1.72+00
2.10+00	3.99+01	1.15+00	6.66+00	4.28+01	.00	4.91+00	6.29+00	8.21+01	1.72+00
2.20+00	3.95+01	1.13+00	6.64+00	4.24+01	.00	4.92+00	6.50+00	8.61+01	1.72+00
2.30+00	3.91+01	1.11+00	6.61+00	4.19+01	.00	4.93+00	6.69+00	9.00+01	1.72+00
2.40+00	3.87+01	1.10+00	6.59+00	4.14+01	.00	4.94+00	6.80+00	9.40+01	1.72+00
2.50+00	3.82+01	1.08+00	6.57+00	4.09+01	.00	4.95+00	7.06+00	9.70+01	1.72+00
2.60+00	3.78+01	1.06+00	6.54+00	4.05+01	.00	4.96+00	7.24+00	1.02+02	1.72+00
2.70+00	3.74+01	1.05+00	6.52+00	4.00+01	.00	4.96+00	7.40+00	1.05+02	1.72+00
2.80+00	3.70+01	1.03+00	6.49+00	3.95+01	.00	4.97+00	7.56+00	1.09+02	1.72+00
2.90+00	3.66+01	1.02+00	6.47+00	3.91+01	.00	4.97+00	7.72+00	1.13+02	1.72+00
3.00+00	3.62+01	1.00+00	6.44+00	3.86+01	.00	4.98+00	7.87+00	1.17+02	1.72+00
3.10+00	3.57+01	9.85-01	6.41+00	3.82+01	.00	4.98+00	8.01+00	1.20+02	1.72+00
3.20+00	3.53+01	9.70-01	6.39+00	3.77+01	.00	4.99+00	8.15+00	1.24+02	1.72+00
3.30+00	3.49+01	9.54-01	6.36+00	3.73+01	.00	4.99+00	8.29+00	1.27+02	1.72+00
3.40+00	3.46+01	9.39-01	6.33+00	3.68+01	.00	4.99+00	8.41+00	1.31+02	1.72+00
3.50+00	3.42+01	9.24-01	6.30+00	3.64+01	.00	4.99+00	8.54+00	1.34+02	1.72+00
3.60+00	3.38+01	9.10-01	6.27+00	3.60+01	.00	4.99+00	8.66+00	1.38+02	1.72+00
3.70+00	3.34+01	8.95-01	6.24+00	3.55+01	.00	4.99+00	8.77+00	1.41+02	1.72+00
3.80+00	3.30+01	8.81-01	6.21+00	3.51+01	.00	4.98+00	8.80+00	1.44+02	1.72+00
3.90+00	3.26+01	8.66-01	6.18+00	3.47+01	.00	4.98+00	8.99+00	1.48+02	1.72+00
4.00+00	3.23+01	8.52-01	6.15+00	3.43+01	.00	4.98+00	9.09+00	1.51+02	1.72+00
4.10+00	3.19+01	8.38-01	6.12+00	3.39+01	.00	4.97+00	9.19+00	1.54+02	1.72+00
4.20+00	3.15+01	8.25-01	6.09+00	3.35+01	.00	4.97+00	9.28+00	1.57+02	1.72+00
4.30+00	3.12+01	8.11-01	6.06+00	3.31+01	.00	4.96+00	9.37+00	1.61+02	1.72+00
4.40+00	3.08+01	7.98-01	6.03+00	3.27+01	.00	4.96+00	9.46+00	1.64+02	1.72+00
4.50+00	3.05+01	7.85-01	6.00+00	3.23+01	.00	4.95+00	9.55+00	1.67+02	1.72+00
4.60+00	3.01+01	7.71-01	5.96+00	3.19+01	.00	4.94+00	9.63+00	1.70+02	1.72+00
4.70+00	2.98+01	7.59-01	5.93+00	3.15+01	.00	4.93+00	9.71+00	1.73+02	1.72+00
4.80+00	2.94+01	7.46-01	5.90+00	3.11+01	.00	4.92+00	9.78+00	1.76+02	1.72+00
4.90+00	2.91+01	7.33-01	5.87+00	3.08+01	.00	4.91+00	9.86+00	1.79+02	1.72+00
5.00+00	2.87+01	7.21-01	5.83+00	3.04+01	.00	4.90+00	9.93+00	1.82+02	1.72+00
5.10+00	2.84+01	7.09-01	5.80+00	3.00+01	.00	4.89+00	1.00+01	1.85+02	1.72+00

C-13

UCC
026692

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
5.20+00	1.26+02	1.32+02	4.80+01	-9.14+05	3.21+00	2.60+02	2.35+03	3.11+02	6.79+02
5.30+00	1.25+02	1.31+02	4.80+01	-9.37+05	3.22+00	2.57+02	2.35+03	3.07+02	6.79+02
5.40+00	1.24+02	1.31+02	4.80+01	-9.60+05	3.22+00	2.54+02	2.35+03	3.03+02	6.79+02
5.50+00	1.23+02	1.30+02	4.80+01	-9.82+05	3.23+00	2.51+02	2.35+03	3.00+02	6.78+02
5.60+00	1.22+02	1.29+02	4.80+01	-1.00+06	3.23+00	2.49+02	2.34+03	2.96+02	6.78+02
5.70+00	1.21+02	1.29+02	4.80+01	-1.03+06	3.24+00	2.46+02	2.34+03	2.93+02	6.78+02
5.80+00	1.20+02	1.28+02	4.80+01	-1.05+06	3.24+00	2.43+02	2.34+03	2.89+02	6.78+02
5.90+00	1.19+02	1.28+02	4.80+01	-1.07+06	3.24+00	2.41+02	2.34+03	2.86+02	6.78+02
6.00+00	1.18+02	1.27+02	4.80+01	-1.09+06	3.25+00	2.38+02	2.34+03	2.82+02	6.78+02
6.10+00	1.17+02	1.26+02	4.80+01	-1.11+06	3.25+00	2.35+02	2.34+03	2.79+02	6.77+02
6.20+00	1.16+02	1.26+02	4.80+01	-1.13+06	3.26+00	2.33+02	2.34+03	2.76+02	6.77+02
6.30+00	1.15+02	1.25+02	4.80+01	-1.15+06	3.26+00	2.30+02	2.34+03	2.73+02	6.77+02
6.40+00	1.14+02	1.25+02	4.80+01	-1.18+06	3.27+00	2.28+02	2.34+03	2.69+02	6.77+02
6.50+00	1.13+02	1.24+02	4.80+01	-1.20+06	3.27+00	2.25+02	2.34+03	2.66+02	6.77+02
6.60+00	1.12+02	1.23+02	4.80+01	-1.22+06	3.27+00	2.23+02	2.34+03	2.63+02	6.77+02
6.70+00	1.11+02	1.23+02	4.80+01	-1.24+06	3.28+00	2.20+02	2.34+03	2.60+02	6.76+02
6.80+00	1.10+02	1.22+02	4.80+01	-1.26+06	3.28+00	2.18+02	2.34+03	2.57+02	6.76+02
6.90+00	1.09+02	1.22+02	4.80+01	-1.28+06	3.28+00	2.15+02	2.34+03	2.54+02	6.76+02
7.00+00	1.08+02	1.21+02	4.80+01	-1.30+06	3.29+00	2.13+02	2.34+03	2.51+02	6.76+02
7.10+00	1.07+02	1.21+02	4.80+01	-1.31+06	3.29+00	2.11+02	2.34+03	2.48+02	6.76+02
7.20+00	1.07+02	1.20+02	4.80+01	-1.33+06	3.30+00	2.08+02	2.34+03	2.45+02	6.76+02
7.30+00	1.06+02	1.20+02	4.80+01	-1.35+06	3.30+00	2.06+02	2.34+03	2.42+02	6.75+02
7.40+00	1.05+02	1.19+02	4.80+01	-1.37+06	3.30+00	2.04+02	2.33+03	2.40+02	6.75+02
7.50+00	1.04+02	1.19+02	4.80+01	-1.39+06	3.31+00	2.02+02	2.33+03	2.37+02	6.75+02
7.60+00	1.03+02	1.18+02	4.80+01	-1.41+06	3.31+00	1.99+02	2.33+03	2.34+02	6.75+02
7.70+00	1.03+02	1.18+02	4.80+01	-1.43+06	3.31+00	1.97+02	2.33+03	2.31+02	6.75+02
7.80+00	1.02+02	1.17+02	4.80+01	-1.44+06	3.32+00	1.95+02	2.33+03	2.29+02	6.75+02
7.90+00	1.01+02	1.17+02	4.80+01	-1.46+06	3.32+00	1.93+02	2.33+03	2.26+02	6.75+02
8.00+00	1.00+02	1.16+02	4.80+01	-1.48+06	3.32+00	1.91+02	2.33+03	2.23+02	6.74+02
8.10+00	9.98+01	1.16+02	4.80+01	-1.50+06	3.32+00	1.89+02	2.33+03	2.21+02	6.74+02
8.20+00	9.91+01	1.15+02	4.80+01	-1.51+06	3.33+00	1.87+02	2.33+03	2.18+02	6.74+02
8.30+00	9.84+01	1.15+02	4.80+01	-1.53+06	3.33+00	1.85+02	2.33+03	2.16+02	6.74+02
8.40+00	9.78+01	1.14+02	4.80+01	-1.55+06	3.33+00	1.83+02	2.33+03	2.13+02	6.74+02

C-14

UCC
026693

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVL PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIQ. EMISSION L/MOLE
5.20+00	2.81+01	6.97-01	5.77+00	2.97+01	.00	4.88+00	1.01+01	1.87+02	1.72+00
5.30+00	2.78+01	6.85-01	5.73+00	2.93+01	.00	4.87+00	1.01+01	1.90+02	1.72+00
5.40+00	2.75+01	6.73-01	5.70+00	2.90+01	.00	4.86+00	1.02+01	1.93+02	1.72+00
5.50+00	2.71+01	6.62-01	5.67+00	2.86+01	.00	4.84+00	1.02+01	1.96+02	1.72+00
5.60+00	2.68+01	6.51-01	5.63+00	2.83+01	.00	4.83+00	1.03+01	1.99+02	1.72+00
5.70+00	2.65+01	6.40-01	5.60+00	2.79+01	.00	4.82+00	1.04+01	2.01+02	1.72+00
5.80+00	2.62+01	6.29-01	5.56+00	2.76+01	.00	4.80+00	1.04+01	2.04+02	1.72+00
5.90+00	2.59+01	6.18-01	5.53+00	2.73+01	.00	4.79+00	1.05+01	2.06+02	1.72+00
6.00+00	2.56+01	6.07-01	5.50+00	2.70+01	.00	4.77+00	1.05+01	2.09+02	1.72+00
6.10+00	2.53+01	5.97-01	5.46+00	2.66+01	.00	4.76+00	1.06+01	2.12+02	1.72+00
6.20+00	2.51+01	5.86-01	5.43+00	2.63+01	.00	4.74+00	1.06+01	2.14+02	1.72+00
6.30+00	2.48+01	5.76-01	5.39+00	2.60+01	.00	4.72+00	1.07+01	2.17+02	1.72+00
6.40+00	2.45+01	5.66-01	5.36+00	2.57+01	.00	4.71+00	1.07+01	2.19+02	1.72+00
6.50+00	2.42+01	5.56-01	5.33+00	2.54+01	.00	4.69+00	1.07+01	2.22+02	1.72+00
6.60+00	2.39+01	5.47-01	5.29+00	2.51+01	.00	4.67+00	1.08+01	2.24+02	1.72+00
6.70+00	2.37+01	5.37-01	5.26+00	2.48+01	.00	4.65+00	1.08+01	2.26+02	1.72+00
6.80+00	2.34+01	5.28-01	5.22+00	2.45+01	.00	4.63+00	1.09+01	2.29+02	1.72+00
6.90+00	2.31+01	5.19-01	5.19+00	2.42+01	.00	4.62+00	1.09+01	2.31+02	1.72+00
7.00+00	2.29+01	5.09-01	5.16+00	2.40+01	.00	4.60+00	1.09+01	2.34+02	1.72+00
7.10+00	2.26+01	5.00-01	5.12+00	2.37+01	.00	4.58+00	1.10+01	2.36+02	1.72+00
7.20+00	2.24+01	4.92-01	5.09+00	2.34+01	.00	4.56+00	1.10+01	2.38+02	1.72+00
7.30+00	2.21+01	4.83-01	5.05+00	2.31+01	.00	4.54+00	1.10+01	2.40+02	1.72+00
7.40+00	2.19+01	4.74-01	5.02+00	2.29+01	.00	4.52+00	1.11+01	2.43+02	1.72+00
7.50+00	2.16+01	4.66-01	4.99+00	2.26+01	.00	4.50+00	1.11+01	2.45+02	1.72+00
7.60+00	2.14+01	4.58-01	4.95+00	2.23+01	.00	4.48+00	1.11+01	2.47+02	1.72+00
7.70+00	2.12+01	4.50-01	4.92+00	2.21+01	.00	4.45+00	1.12+01	2.49+02	1.72+00
7.80+00	2.09+01	4.42-01	4.88+00	2.18+01	.00	4.43+00	1.12+01	2.51+02	1.72+00
7.90+00	2.07+01	4.34-01	4.85+00	2.16+01	.00	4.41+00	1.12+01	2.53+02	1.72+00
8.00+00	2.05+01	4.26-01	4.82+00	2.13+01	.00	4.39+00	1.12+01	2.55+02	1.72+00
8.10+00	2.02+01	4.18-01	4.78+00	2.11+01	.00	4.37+00	1.13+01	2.57+02	1.72+00
8.20+00	2.00+01	4.11-01	4.75+00	2.08+01	.00	4.34+00	1.13+01	2.59+02	1.72+00
8.30+00	1.98+01	4.03-01	4.71+00	2.06+01	.00	4.32+00	1.13+01	2.61+02	1.72+00
8.40+00	1.96+01	3.96-01	4.68+00	2.03+01	.00	4.30+00	1.13+01	2.63+02	1.72+00

C-15

UCC
026694

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
8.50+00	9.71+01	1.14+02	4.80+01	-1.57+06	3.34+00	1.81+02	2.33+03	2.11+02	6.74+02
8.60+00	9.65+01	1.13+02	4.80+01	-1.58+06	3.34+00	1.79+02	2.33+03	2.09+02	6.74+02
8.70+00	9.58+01	1.13+02	4.80+01	-1.60+06	3.34+00	1.77+02	2.33+03	2.06+02	6.73+02
8.80+00	9.52+01	1.12+02	4.80+01	-1.61+06	3.34+00	1.75+02	2.33+03	2.04+02	6.73+02
8.90+00	9.46+01	1.12+02	4.80+01	-1.63+06	3.35+00	1.73+02	2.33+03	2.01+02	6.73+02
9.00+00	9.40+01	1.11+02	4.80+01	-1.65+06	3.35+00	1.71+02	2.33+03	1.99+02	6.73+02
9.10+00	9.34+01	1.11+02	4.80+01	-1.66+06	3.35+00	1.69+02	2.33+03	1.97+02	6.73+02
9.20+00	9.28+01	1.11+02	4.80+01	-1.68+06	3.36+00	1.67+02	2.33+03	1.95+02	6.73+02
9.30+00	9.22+01	1.10+02	4.80+01	-1.69+06	3.36+00	1.66+02	2.33+03	1.92+02	6.73+02
9.40+00	9.17+01	1.10+02	4.80+01	-1.71+06	3.36+00	1.64+02	2.32+03	1.90+02	6.72+02
9.50+00	9.11+01	1.09+02	4.80+01	-1.72+06	3.36+00	1.62+02	2.32+03	1.88+02	6.72+02
9.60+00	9.06+01	1.09+02	4.80+01	-1.74+06	3.37+00	1.60+02	2.32+03	1.86+02	6.72+02
9.70+00	9.01+01	1.08+02	4.80+01	-1.75+06	3.37+00	1.59+02	2.32+03	1.84+02	6.72+02
9.80+00	8.95+01	1.08+02	4.80+01	-1.77+06	3.37+00	1.57+02	2.32+03	1.82+02	6.72+02
9.90+00	8.90+01	1.08+02	4.80+01	-1.78+06	3.37+00	1.55+02	2.32+03	1.80+02	6.72+02
1.00+01	8.85+01	1.07+02	4.80+01	-1.80+06	3.37+00	1.54+02	2.32+03	1.78+02	6.72+02

C-16

UCC
026695

CORPORATION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIQ. EMISSION L/MOLE
8.50+00	1.93+01	3.89-01	4.64+00	2.01+01	.00	4.27+00	1.14+01	2.66+02	1.72+00
8.60+00	1.91+01	3.82-01	4.61+00	1.99+01	.00	4.25+00	1.14+01	2.67+02	1.72+00
8.70+00	1.89+01	3.75-01	4.58+00	1.96+01	.00	4.23+00	1.14+01	2.69+02	1.72+00
8.80+00	1.87+01	3.68-01	4.54+00	1.94+01	.00	4.20+00	1.14+01	2.71+02	1.72+00
8.90+00	1.85+01	3.61-01	4.51+00	1.92+01	.00	4.18+00	1.14+01	2.73+02	1.72+00
9.00+00	1.83+01	3.54-01	4.47+00	1.90+01	.00	4.15+00	1.15+01	2.75+02	1.72+00
9.10+00	1.81+01	3.48-01	4.44+00	1.87+01	.00	4.13+00	1.15+01	2.77+02	1.72+00
9.20+00	1.79+01	3.42-01	4.41+00	1.85+01	.00	4.10+00	1.15+01	2.78+02	1.72+00
9.30+00	1.77+01	3.35-01	4.37+00	1.83+01	.00	4.08+00	1.15+01	2.80+02	1.72+00
9.40+00	1.75+01	3.29-01	4.34+00	1.81+01	.00	4.05+00	1.15+01	2.82+02	1.72+00
9.50+00	1.73+01	3.23-01	4.30+00	1.79+01	.00	4.03+00	1.15+01	2.84+02	1.72+00
9.60+00	1.71+01	3.17-01	4.27+00	1.77+01	.00	4.00+00	1.16+01	2.86+02	1.72+00
9.70+00	1.69+01	3.11-01	4.24+00	1.75+01	.00	3.98+00	1.16+01	2.87+02	1.72+00
9.80+00	1.67+01	3.05-01	4.20+00	1.73+01	.00	3.95+00	1.16+01	2.89+02	1.72+00
9.90+00	1.65+01	2.99-01	4.17+00	1.71+01	.00	3.93+00	1.16+01	2.91+02	1.72+00
1.00+01	1.63+01	2.94-01	4.13+00	1.69+01	.00	3.90+00	1.16+01	2.92+02	1.72+00

C-17

4FIN

UCC
026696

CORPORATION

DISCHARGE FROM A PVC BATCH REACTOR

Case 3. Overfilling - Constant Temperature.

REACTOR PRESSURE AT TIME OF DISCHARGE = 194.70 PSIA	PRESSURE DOWNSTREAM OF VALVE = 64.70 PSIA
REACTOR TEMP AT TIME OF DISCHARGE = 135.00 F	WATER JACKET TEMP AT DISCHARGE = 90.00 F
REACTOR VOLUME = 1337.000 CU FT	HEAT OF REACTION = 45516.000 BTU/LBMOLE
LIQUID VCM INITIALLY IN REACTOR = 487.00 LBMOLE	LIQ H2O INITIALLY IN REACTOR = 2603.0 LBMOLE
VAPOR INITIALLY IN REACTOR = .0347 LBMOLE	JACKET COEF TIMES AREA = 564.3 BTU/M-F
DENSITY OF WATER (CONSTANT) = 3.4570 LBMOLE/CU FT	INITIAL DENSITY OF VCM = .03377 LBMOLE/CU FT
AREA OF RELIEF VALVE ORIFICE OPENING = .0894 SQ FT	ORIFICE FLOW COEFFICIENT = .610
MINIMUM LIQUID ENTRAINMENT = .0100 CU FT LIQ/CU FT GAS	MINIMUM WATER JACKET TEMP = 90.00 F
LIQ VOL WHEN MIN ENTRAINMENT IS REACHED = 1219.4 CU FT	TIME MIN JACKET TEMP IS REACHED = 5.00 MIN
HEATING JACKET FACTOR = 1.00	REACTION RATE FACTOR = .40

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTION HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTION VCM LIQ. VOLUME CU FT	REACTION H2O LIQ. VOLUME CU FT
0.00	1.95+02	1.35+02	9.00+01	-1.04+06	3.47-02	4.86+02	2.60+03	5.83+02	7.53+02
1.00-01	1.32+02	1.35+02	9.00+01	-1.04+06	1.53-01	4.83+02	2.59+03	5.79+02	7.49+02
2.00-01	1.32+02	1.35+02	9.00+01	-1.04+06	2.60-01	4.80+02	2.58+03	5.76+02	7.45+02
3.00-01	1.32+02	1.35+02	9.00+01	-1.03+06	3.85-01	4.77+02	2.56+03	5.72+02	7.42+02
4.00-01	1.31+02	1.35+02	9.00+01	-1.03+06	5.17-01	4.75+02	2.55+03	5.69+02	7.38+02
5.00-01	1.31+02	1.35+02	9.00+01	-1.03+06	6.46-01	4.72+02	2.54+03	5.66+02	7.35+02
6.00-01	1.31+02	1.34+02	9.00+01	-1.03+06	7.72-01	4.69+02	2.53+03	5.62+02	7.31+02
7.00-01	1.31+02	1.34+02	9.00+01	-1.03+06	8.94-01	4.66+02	2.52+03	5.59+02	7.28+02
8.00-01	1.30+02	1.34+02	9.00+01	-1.03+06	1.01+00	4.63+02	2.51+03	5.55+02	7.25+02
9.00-01	1.30+02	1.34+02	9.00+01	-1.04+06	1.13+00	4.61+02	2.50+03	5.52+02	7.22+02
1.00+00	1.30+02	1.34+02	9.00+01	-1.04+06	1.24+00	4.56+02	2.49+03	5.48+02	7.19+02
1.10+00	1.29+02	1.34+02	9.00+01	-1.05+06	1.34+00	4.55+02	2.48+03	5.44+02	7.16+02
1.20+00	1.29+02	1.33+02	9.00+01	-1.05+06	1.44+00	4.52+02	2.47+03	5.41+02	7.14+02
1.30+00	1.28+02	1.33+02	9.00+01	-1.06+06	1.53+00	4.49+02	2.46+03	5.37+02	7.11+02
1.40+00	1.28+02	1.33+02	9.00+01	-1.07+06	1.61+00	4.45+02	2.45+03	5.33+02	7.09+02
1.50+00	1.27+02	1.32+02	9.00+01	-1.08+06	1.68+00	4.42+02	2.44+03	5.28+02	7.07+02
1.60+00	1.26+02	1.32+02	9.00+01	-1.10+06	1.74+00	4.39+02	2.44+03	5.24+02	7.05+02
1.70+00	1.25+02	1.31+02	9.00+01	-1.12+06	1.77+00	4.35+02	2.44+03	5.20+02	7.04+02
1.80+00	1.24+02	1.31+02	9.00+01	-1.14+06	1.79+00	4.33+02	2.43+03	5.16+02	7.04+02

C-13

UCC
026697

COMPOSITION

TIME	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LTO. FLOW MOLE/MIN	PREFLASH H2O LTO. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LTO. FLOW MOLE/MIN	FLASHED H2O LTO. FLOW MOLE/MIN	TOTAL PVC PRODUCED LBMOLL	TOTAL VCM GAS EMISSION LBMOLL	TOTAL VCM LTO. EMISSION LBMOLL
00	1.02-02	3.57+01	1.75+02	2.17+01	1.42+01	1.75+02	.00	.00	.00
1'00-01	5.51-01	2.53+01	1.24+02	1.60+01	1.00+01	1.24+02	6.78-03	1.81+00	1.17+00
2'00-01	1.08+00	2.50+01	1.23+02	1.63+01	9.87+00	1.22+02	1.35-02	3.42+00	2.17+00
3'00-01	1.66+00	2.46+01	1.21+02	1.67+01	9.60+00	1.21+02	2.02-02	5.06+00	3.15+00
4'00-01	2.31+00	2.41+01	1.19+02	1.71+01	9.47+00	1.18+02	2.68-02	6.73+00	4.11+00
5'00-01	3.03+00	2.36+01	1.16+02	1.75+01	9.24+00	1.16+02	3.33-02	8.44+00	5.04+00
6'00-01	3.84+00	2.31+01	1.14+02	1.80+01	8.98+00	1.14+02	3.98-02	1.02+01	5.95+00
7'00-01	4.76+00	2.24+01	1.11+02	1.86+01	8.68+00	1.11+02	4.62-02	1.20+01	6.84+00
8'00-01	5.80+00	2.17+01	1.08+02	1.93+01	8.35+00	1.07+02	5.25-02	1.39+01	7.69+00
9'00-01	7.00+00	2.09+01	1.04+02	2.01+01	7.96+00	1.04+02	5.87-02	1.58+01	8.50+00
1'00+00	8.39+00	2.00+01	9.93+01	2.10+01	7.52+00	9.92+01	6.49-02	1.79+01	9.28+00
1'10+00	1.00+01	1.89+01	9.42+01	2.20+01	7.00+00	9.41+01	7.09-02	2.00+01	1.00+01
1'20+00	1.20+01	1.76+01	8.81+01	2.33+01	6.39+00	8.80+01	7.69-02	2.22+01	1.07+01
1'30+00	1.43+01	1.61+01	8.08+01	2.49+01	5.65+00	8.07+01	8.28-02	2.46+01	1.13+01
1'40+00	1.72+01	1.43+01	7.19+01	2.68+01	4.74+00	7.18+01	8.85-02	2.71+01	1.18+01
1'50+00	2.09+01	1.20+01	6.07+01	2.93+01	3.61+00	6.06+01	9.42-02	2.99+01	1.22+01
1'60+00	2.56+01	9.08+00	4.62+01	3.26+01	2.15+00	4.62+01	9.97-02	3.30+01	1.25+01
1'70+00	2.66+01	4.78+00	2.45+01	3.11+01	3.33-01	2.45+01	1.05-01	3.61+01	1.26+01
1'80+00	2.74+01	1.32+00	6.82+00	2.93+01	.00	6.18+00	1.10-01	3.90+01	1.26+01

C-19

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR L/MOLE	VCM LIQ. LEFT IN REACTOR L/MOLE	H2O LIQ. LEFT IN REACTOR L/MOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
1.90+00	1.23+02	1.30+02	9.00+01	-1.17+06	1.79+00	4.30+02	2.43+03	5.12+02	7.04+02
2.00+00	1.22+02	1.30+02	9.00+01	-1.19+06	1.80+00	4.27+02	2.43+03	5.09+02	7.04+02
2.10+00	1.21+02	1.29+02	9.00+01	-1.21+06	1.80+00	4.24+02	2.43+03	5.05+02	7.04+02
2.20+00	1.20+02	1.29+02	9.00+01	-1.23+06	1.81+00	4.22+02	2.43+03	5.01+02	7.03+02
2.30+00	1.19+02	1.28+02	9.00+01	-1.25+06	1.81+00	4.19+02	2.43+03	4.98+02	7.03+02
2.40+00	1.19+02	1.28+02	9.00+01	-1.28+06	1.82+00	4.16+02	2.43+03	4.94+02	7.03+02
2.50+00	1.18+02	1.27+02	9.00+01	-1.30+06	1.82+00	4.14+02	2.43+03	4.91+02	7.03+02
2.60+00	1.17+02	1.27+02	9.00+01	-1.32+06	1.82+00	4.11+02	2.43+03	4.88+02	7.03+02
2.70+00	1.16+02	1.26+02	9.00+01	-1.34+06	1.83+00	4.08+02	2.43+03	4.84+02	7.03+02
2.80+00	1.15+02	1.26+02	9.00+01	-1.36+06	1.83+00	4.06+02	2.43+03	4.81+02	7.03+02
2.90+00	1.14+02	1.25+02	9.00+01	-1.38+06	1.84+00	4.03+02	2.43+03	4.78+02	7.02+02
3.00+00	1.14+02	1.25+02	9.00+01	-1.40+06	1.84+00	4.01+02	2.43+03	4.74+02	7.02+02
3.10+00	1.13+02	1.24+02	9.00+01	-1.42+06	1.84+00	3.98+02	2.43+03	4.71+02	7.02+02
3.20+00	1.12+02	1.24+02	9.00+01	-1.44+06	1.85+00	3.96+02	2.43+03	4.68+02	7.02+02
3.30+00	1.11+02	1.23+02	9.00+01	-1.46+06	1.85+00	3.93+02	2.43+03	4.65+02	7.02+02
3.40+00	1.10+02	1.23+02	9.00+01	-1.48+06	1.86+00	3.91+02	2.43+03	4.62+02	7.02+02
3.50+00	1.10+02	1.22+02	9.00+01	-1.50+06	1.86+00	3.89+02	2.43+03	4.59+02	7.02+02
3.60+00	1.09+02	1.22+02	9.00+01	-1.52+06	1.86+00	3.86+02	2.42+03	4.55+02	7.01+02
3.70+00	1.08+02	1.21+02	9.00+01	-1.53+06	1.87+00	3.84+02	2.42+03	4.52+02	7.01+02
3.80+00	1.08+02	1.21+02	9.00+01	-1.55+06	1.87+00	3.81+02	2.42+03	4.49+02	7.01+02
3.90+00	1.07+02	1.20+02	9.00+01	-1.57+06	1.87+00	3.79+02	2.42+03	4.46+02	7.01+02
4.00+00	1.06+02	1.20+02	9.00+01	-1.59+06	1.88+00	3.77+02	2.42+03	4.44+02	7.01+02
4.10+00	1.06+02	1.20+02	9.00+01	-1.61+06	1.88+00	3.75+02	2.42+03	4.41+02	7.01+02
4.20+00	1.05+02	1.19+02	9.00+01	-1.62+06	1.89+00	3.72+02	2.42+03	4.38+02	7.01+02
4.30+00	1.04+02	1.19+02	9.00+01	-1.64+06	1.89+00	3.70+02	2.42+03	4.35+02	7.01+02
4.40+00	1.04+02	1.18+02	9.00+01	-1.66+06	1.89+00	3.68+02	2.42+03	4.32+02	7.00+02
4.50+00	1.03+02	1.18+02	9.00+01	-1.68+06	1.90+00	3.66+02	2.42+03	4.29+02	7.00+02
4.60+00	1.02+02	1.17+02	9.00+01	-1.69+06	1.90+00	3.64+02	2.42+03	4.27+02	7.00+02
4.70+00	1.02+02	1.17+02	9.00+01	-1.71+06	1.90+00	3.61+02	2.42+03	4.24+02	7.00+02
4.80+00	1.01+02	1.17+02	9.00+01	-1.73+06	1.91+00	3.59+02	2.42+03	4.21+02	7.00+02
4.90+00	1.01+02	1.16+02	9.00+01	-1.74+06	1.91+00	3.57+02	2.42+03	4.18+02	7.00+02
5.00+00	1.00+02	1.16+02	9.00+01	-1.76+06	1.91+00	3.55+02	2.42+03	4.16+02	7.00+02
5.10+00	9.95+01	1.15+02	9.00+01	-1.77+06	1.91+00	3.53+02	2.42+03	4.13+02	6.99+02

C-20

COMPARISON

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIQ. EMISSION L/MOLE
1.90+00	2.72+01	9.12-01	4.74+00	2.68+01	.00	4.05+00	1.15-01	4.18+01	1.26+01
2.00+00	2.69+01	9.01-01	4.71+00	2.65+01	.00	4.04+00	1.20-01	4.46+01	1.26+01
2.10+00	2.67+01	8.91-01	4.69+00	2.62+01	.00	4.03+00	1.25-01	4.73+01	1.26+01
2.20+00	2.64+01	8.80-01	4.66+00	2.79+01	.00	4.02+00	1.30-01	5.00+01	1.26+01
2.30+00	2.62+01	8.70-01	4.64+00	2.77+01	.00	4.01+00	1.34-01	5.27+01	1.26+01
2.40+00	2.59+01	8.60-01	4.62+00	2.74+01	.00	4.00+00	1.39-01	5.53+01	1.26+01
2.50+00	2.57+01	8.50-01	4.59+00	2.71+01	.00	3.99+00	1.43-01	5.80+01	1.26+01
2.60+00	2.54+01	8.40-01	4.57+00	2.68+01	.00	3.98+00	1.47-01	6.05+01	1.26+01
2.70+00	2.52+01	8.30-01	4.54+00	2.66+01	.00	3.97+00	1.51-01	6.31+01	1.26+01
2.80+00	2.49+01	8.20-01	4.52+00	2.63+01	.00	3.96+00	1.55-01	6.57+01	1.26+01
2.90+00	2.47+01	8.11-01	4.49+00	2.61+01	.00	3.95+00	1.59-01	6.82+01	1.26+01
3.00+00	2.45+01	8.01-01	4.47+00	2.58+01	.00	3.94+00	1.63-01	7.07+01	1.26+01
3.10+00	2.42+01	7.92-01	4.45+00	2.55+01	.00	3.93+00	1.67-01	7.32+01	1.26+01
3.20+00	2.40+01	7.83-01	4.42+00	2.53+01	.00	3.92+00	1.70-01	7.56+01	1.26+01
3.30+00	2.38+01	7.74-01	4.40+00	2.50+01	.00	3.91+00	1.74-01	7.81+01	1.26+01
3.40+00	2.36+01	7.65-01	4.37+00	2.48+01	.00	3.90+00	1.77-01	8.05+01	1.26+01
3.50+00	2.33+01	7.56-01	4.35+00	2.46+01	.00	3.89+00	1.81-01	8.29+01	1.26+01
3.60+00	2.31+01	7.47-01	4.33+00	2.43+01	.00	3.88+00	1.84-01	8.52+01	1.26+01
3.70+00	2.29+01	7.36-01	4.30+00	2.41+01	.00	3.86+00	1.87-01	8.76+01	1.26+01
3.80+00	2.27+01	7.30-01	4.28+00	2.39+01	.00	3.85+00	1.90-01	8.99+01	1.26+01
3.90+00	2.25+01	7.21-01	4.25+00	2.36+01	.00	3.84+00	1.93-01	9.22+01	1.26+01
4.00+00	2.23+01	7.13-01	4.23+00	2.34+01	.00	3.83+00	1.96-01	9.45+01	1.26+01
4.10+00	2.21+01	7.05-01	4.21+00	2.32+01	.00	3.81+00	1.99-01	9.67+01	1.26+01
4.20+00	2.19+01	6.96-01	4.18+00	2.30+01	.00	3.80+00	2.02-01	9.90+01	1.26+01
4.30+00	2.17+01	6.88-01	4.16+00	2.27+01	.00	3.79+00	2.05-01	1.01+02	1.26+01
4.40+00	2.15+01	6.80-01	4.14+00	2.25+01	.00	3.77+00	2.08-01	1.03+02	1.26+01
4.50+00	2.13+01	6.72-01	4.11+00	2.23+01	.00	3.76+00	2.10-01	1.06+02	1.26+01
4.60+00	2.11+01	6.65-01	4.09+00	2.21+01	.00	3.75+00	2.13-01	1.08+02	1.26+01
4.70+00	2.09+01	6.57-01	4.07+00	2.19+01	.00	3.73+00	2.16-01	1.10+02	1.26+01
4.80+00	2.07+01	6.49-01	4.04+00	2.17+01	.00	3.72+00	2.18-01	1.12+02	1.26+01
4.90+00	2.05+01	6.42-01	4.02+00	2.15+01	.00	3.71+00	2.21-01	1.14+02	1.26+01
5.00+00	2.03+01	6.34-01	4.00+00	2.13+01	.00	3.69+00	2.23-01	1.16+02	1.26+01
5.10+00	2.01+01	6.27-01	3.98+00	2.11+01	.00	3.68+00	2.25-01	1.18+02	1.26+01

C-22

UCC
026700

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIO. LEFT IN REACTOR LBMOLE	H2O LIO. LEFT IN REACTOR LBMOLE	REACTOR VCM LIO. VOLUME CU FT	REACTOR H2O LIO. VOLUME CU FT
5.20+00	9.90+01	1.15+02	9.00+01	-1.79+06	1.92+00	3.51+02	2.42+03	4.11+02	6.99+02
5.30+00	9.84+01	1.15+02	9.00+01	-1.81+06	1.92+00	3.49+02	2.42+03	4.08+02	6.99+02
5.40+00	9.79+01	1.14+02	9.00+01	-1.82+06	1.92+00	3.47+02	2.42+03	4.05+02	6.99+02
5.50+00	9.74+01	1.14+02	9.00+01	-1.84+06	1.93+00	3.45+02	2.42+03	4.03+02	6.99+02
5.60+00	9.68+01	1.14+02	9.00+01	-1.85+06	1.93+00	3.43+02	2.42+03	4.00+02	6.99+02
5.70+00	9.63+01	1.13+02	9.00+01	-1.67+06	1.93+00	3.41+02	2.42+03	3.98+02	6.99+02
5.80+00	9.58+01	1.13+02	9.00+01	-1.88+06	1.93+00	3.39+02	2.42+03	3.95+02	6.99+02
5.90+00	9.53+01	1.12+02	9.00+01	-1.90+06	1.94+00	3.37+02	2.41+03	3.93+02	6.99+02
6.00+00	9.48+01	1.12+02	9.00+01	-1.91+06	1.94+00	3.35+02	2.41+03	3.91+02	6.98+02
6.10+00	9.43+01	1.12+02	9.00+01	-1.93+06	1.94+00	3.33+02	2.41+03	3.88+02	6.98+02
6.20+00	9.39+01	1.11+02	9.00+01	-1.94+06	1.95+00	3.32+02	2.41+03	3.86+02	6.98+02
6.30+00	9.34+01	1.11+02	9.00+01	-1.95+06	1.95+00	3.30+02	2.41+03	3.84+02	6.98+02
6.40+00	9.29+01	1.11+02	9.00+01	-1.97+06	1.95+00	3.28+02	2.41+03	3.81+02	6.98+02
6.50+00	9.25+01	1.10+02	9.00+01	-1.98+06	1.95+00	3.26+02	2.41+03	3.79+02	6.98+02
6.60+00	9.20+01	1.10+02	9.00+01	-2.00+06	1.96+00	3.24+02	2.41+03	3.77+02	6.98+02
6.70+00	9.16+01	1.10+02	9.00+01	-2.01+06	1.96+00	3.22+02	2.41+03	3.75+02	6.98+02
6.80+00	9.11+01	1.09+02	9.00+01	-2.02+06	1.96+00	3.21+02	2.41+03	3.72+02	6.98+02
6.90+00	9.07+01	1.09+02	9.00+01	-2.04+06	1.96+00	3.19+02	2.41+03	3.70+02	6.97+02
7.00+00	9.03+01	1.09+02	9.00+01	-2.05+06	1.97+00	3.17+02	2.41+03	3.68+02	6.97+02
7.10+00	8.99+01	1.08+02	9.00+01	-2.06+06	1.97+00	3.15+02	2.41+03	3.66+02	6.97+02
7.20+00	8.95+01	1.08+02	9.00+01	-2.08+06	1.97+00	3.14+02	2.41+03	3.64+02	6.97+02
7.30+00	8.90+01	1.08+02	9.00+01	-2.09+06	1.97+00	3.12+02	2.41+03	3.62+02	6.97+02
7.40+00	8.86+01	1.07+02	9.00+01	-2.10+06	1.97+00	3.10+02	2.41+03	3.59+02	6.97+02
7.50+00	8.83+01	1.07+02	9.00+01	-2.11+06	1.98+00	3.09+02	2.41+03	3.57+02	6.97+02
7.60+00	8.79+01	1.07+02	9.00+01	-2.13+06	1.98+00	3.07+02	2.41+03	3.55+02	6.97+02
7.76+00	8.75+01	1.06+02	9.00+01	-2.14+06	1.98+00	3.05+02	2.41+03	3.53+02	6.97+02
7.80+00	8.71+01	1.06+02	9.00+01	-2.15+06	1.98+00	3.04+02	2.41+03	3.51+02	6.96+02
7.90+00	8.67+01	1.06+02	9.00+01	-2.16+06	1.99+00	3.02+02	2.41+03	3.49+02	6.96+02
8.00+00	8.64+01	1.06+02	9.00+01	-2.17+06	1.99+00	3.01+02	2.41+03	3.47+02	6.96+02
8.10+00	8.60+01	1.05+02	9.00+01	-2.19+06	1.99+00	2.99+02	2.41+03	3.45+02	6.96+02
8.20+00	8.57+01	1.05+02	9.00+01	-2.20+06	1.99+00	2.98+02	2.41+03	3.44+02	6.96+02
8.30+00	8.53+01	1.05+02	9.00+01	-2.21+06	1.99+00	2.96+02	2.41+03	3.42+02	6.96+02
8.40+00	8.50+01	1.04+02	9.00+01	-2.22+06	2.00+00	2.94+02	2.41+03	3.40+02	6.96+02

C-22

UCC
026701

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LTO. FLOW MOLE/MIN	PREFLASH H2O LTO. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LTO. FLOW MOLE/MIN	FLASHED H2O LTO. FLOW MOLE/MIN	TOTAL PVC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LTO. EMISSION L/MOLE
5.20+00	2.00+01	6.20-01	3.95+00	2.09+01	.00	3.66+00	2.28-01	1.20+02	1.26+01
5.30+00	1.98+01	6.12-01	3.93+00	2.07+01	.00	3.65+00	2.30-01	1.22+02	1.26+01
5.40+00	1.96+01	6.05-01	3.91+00	2.05+01	.00	3.63+00	2.32-01	1.24+02	1.26+01
5.50+00	1.94+01	5.98-01	3.88+00	2.03+01	.00	3.62+00	2.34-01	1.26+02	1.26+01
5.60+00	1.93+01	5.91-01	3.86+00	2.01+01	.00	3.60+00	2.36-01	1.28+02	1.26+01
5.70+00	1.91+01	5.85-01	3.84+00	1.99+01	.00	3.59+00	2.38-01	1.30+02	1.26+01
5.80+00	1.89+01	5.78-01	3.82+00	1.97+01	.00	3.57+00	2.41-01	1.32+02	1.26+01
5.90+00	1.87+01	5.71-01	3.79+00	1.95+01	.00	3.56+00	2.43-01	1.34+02	1.26+01
6.00+00	1.86+01	5.64-01	3.77+00	1.94+01	.00	3.54+00	2.44-01	1.36+02	1.26+01
6.10+00	1.84+01	5.58-01	3.75+00	1.92+01	.00	3.53+00	2.46-01	1.38+02	1.26+01
6.20+00	1.82+01	5.51-01	3.73+00	1.90+01	.00	3.51+00	2.48-01	1.40+02	1.26+01
6.30+00	1.81+01	5.45-01	3.70+00	1.88+01	.00	3.50+00	2.50-01	1.42+02	1.26+01
6.40+00	1.79+01	5.39-01	3.68+00	1.87+01	.00	3.48+00	2.52-01	1.43+02	1.26+01
6.50+00	1.78+01	5.32-01	3.66+00	1.85+01	.00	3.46+00	2.54-01	1.45+02	1.26+01
6.60+00	1.76+01	5.26-01	3.64+00	1.83+01	.00	3.45+00	2.55-01	1.47+02	1.26+01
6.70+00	1.74+01	5.20-01	3.61+00	1.81+01	.00	3.43+00	2.57-01	1.49+02	1.26+01
6.80+00	1.73+01	5.14-01	3.59+00	1.80+01	.00	3.42+00	2.59-01	1.51+02	1.26+01
6.90+00	1.71+01	5.08-01	3.57+00	1.78+01	.00	3.40+00	2.61-01	1.52+02	1.26+01
7.00+00	1.70+01	5.02-01	3.55+00	1.76+01	.00	3.38+00	2.62-01	1.54+02	1.26+01
7.10+00	1.68+01	4.96-01	3.53+00	1.75+01	.00	3.37+00	2.64-01	1.56+02	1.26+01
7.20+00	1.67+01	4.90-01	3.50+00	1.73+01	.00	3.35+00	2.65-01	1.57+02	1.26+01
7.30+00	1.65+01	4.85-01	3.46+00	1.72+01	.00	3.33+00	2.67-01	1.59+02	1.26+01
7.40+00	1.64+01	4.79-01	3.46+00	1.70+01	.00	3.32+00	2.68-01	1.61+02	1.26+01
7.50+00	1.62+01	4.73-01	3.44+00	1.68+01	.00	3.30+00	2.70-01	1.62+02	1.26+01
7.60+00	1.61+01	4.68-01	3.41+00	1.67+01	.00	3.28+00	2.71-01	1.64+02	1.26+01
7.70+00	1.59+01	4.62-01	3.39+00	1.65+01	.00	3.27+00	2.73-01	1.66+02	1.26+01
7.80+00	1.58+01	4.57-01	3.37+00	1.64+01	.00	3.25+00	2.74-01	1.67+02	1.26+01
7.90+00	1.57+01	4.51-01	3.35+00	1.62+01	.00	3.23+00	2.76-01	1.69+02	1.26+01
8.00+00	1.55+01	4.46-01	3.33+00	1.61+01	.00	3.22+00	2.77-01	1.71+02	1.26+01
8.10+00	1.54+01	4.41-01	3.31+00	1.59+01	.00	3.20+00	2.78-01	1.72+02	1.26+01
8.20+00	1.52+01	4.36-01	3.28+00	1.58+01	.00	3.18+00	2.80-01	1.74+02	1.26+01
8.30+00	1.51+01	4.30-01	3.26+00	1.56+01	.00	3.16+00	2.81-01	1.75+02	1.26+01
8.40+00	1.50+01	4.25-01	3.24+00	1.55+01	.00	3.15+00	2.82-01	1.77+02	1.26+01

C-23

UCC
026702

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	N ₂ ACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H ₂ O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H ₂ O LIQ. VOLUME CU FT
0.50+00	8.46+01	1.04+02	9.00+01	-2.23+06	2.00+00	2.93+02	2.41+03	3.38+02	6.96+02
0.60+00	8.43+01	1.04+02	9.00+01	-2.24+06	2.00+00	2.91+02	2.40+03	3.36+02	6.96+02
0.70+00	8.39+01	1.04+02	9.00+01	-2.25+06	2.00+00	2.90+02	2.40+03	3.34+02	6.96+02
0.80+00	8.36+01	1.03+02	9.00+01	-2.26+06	2.00+00	2.88+02	2.40+03	3.32+02	6.95+02
0.90+00	8.33+01	1.03+02	9.00+01	-2.28+06	2.01+00	2.87+02	2.40+03	3.31+02	6.95+02
1.00+00	8.30+01	1.03+02	9.00+01	-2.29+06	2.01+00	2.86+02	2.40+03	3.29+02	6.95+02
1.10+00	8.27+01	1.03+02	9.00+01	-2.30+06	2.01+00	2.84+02	2.40+03	3.27+02	6.95+02
1.20+00	8.24+01	1.02+02	9.00+01	-2.31+06	2.01+00	2.83+02	2.40+03	3.25+02	6.95+02
1.30+00	8.21+01	1.02+02	9.00+01	-2.32+06	2.01+00	2.81+02	2.40+03	3.24+02	6.95+02
1.40+00	8.18+01	1.02+02	9.00+01	-2.33+06	2.01+00	2.80+02	2.40+03	3.22+02	6.95+02
1.50+00	8.15+01	1.02+02	9.00+01	-2.34+06	2.02+00	2.78+02	2.40+03	3.20+02	6.95+02
1.60+00	8.12+01	1.01+02	9.00+01	-2.35+06	2.02+00	2.77+02	2.40+03	3.18+02	6.95+02
1.70+00	8.09+01	1.01+02	9.00+01	-2.36+06	2.02+00	2.76+02	2.40+03	3.17+02	6.95+02
1.80+00	8.06+01	1.01+02	9.00+01	-2.37+06	2.02+00	2.74+02	2.40+03	3.15+02	6.95+02
1.90+00	8.03+01	1.01+02	9.00+01	-2.38+06	2.02+00	2.73+02	2.40+03	3.14+02	6.94+02
1.00+01	8.01+01	1.00+02	9.00+01	-2.39+06	2.03+00	2.72+02	2.40+03	3.12+02	6.94+02

C-24

UCC
026703

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LTO. FLOW MOLE/MIN	PREFLASH H2O LTO. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LTO. FLOW MOLE/MIN	FLASHED H2O LTO. FLOW MOLE/MIN	TOTAL PVL PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LTO. EMISSION L/MOLE
8.50+00	1.48+01	4.20-01	3.22+00	1.53+01	.00	3.13+00	2.85-01	1.78+02	1.26+01
8.60+00	1.47+01	4.15-01	3.20+00	1.52+01	.00	3.11+00	2.85-01	1.80+02	1.26+01
8.70+00	1.46+01	4.10-01	3.16+00	1.51+01	.00	3.09+00	2.86-01	1.81+02	1.26+01
8.80+00	1.44+01	4.06-01	3.15+00	1.49+01	.00	3.08+00	2.87-01	1.83+02	1.26+01
8.90+00	1.43+01	4.01-01	3.13+00	1.46+01	.00	3.06+00	2.88-01	1.84+02	1.26+01
9.00+00	1.42+01	3.96-01	3.11+00	1.46+01	.00	3.04+00	2.89-01	1.86+02	1.26+01
9.10+00	1.40+01	3.91-01	3.09+00	1.45+01	.00	3.02+00	2.91-01	1.87+02	1.26+01
9.20+00	1.39+01	3.86-01	3.07+00	1.44+01	.00	3.00+00	2.92-01	1.88+02	1.26+01
9.30+00	1.38+01	3.82-01	3.05+00	1.42+01	.00	2.99+00	2.93-01	1.90+02	1.26+01
9.40+00	1.37+01	3.77-01	3.02+00	1.41+01	.00	2.97+00	2.94-01	1.91+02	1.26+01
9.50+00	1.35+01	3.73-01	3.00+00	1.40+01	.00	2.95+00	2.95-01	1.93+02	1.26+01
9.60+00	1.34+01	3.68-01	2.98+00	1.38+01	.00	2.93+00	2.96-01	1.94+02	1.26+01
9.70+00	1.33+01	3.64-01	2.96+00	1.37+01	.00	2.91+00	2.97-01	1.95+02	1.26+01
9.80+00	1.32+01	3.59-01	2.94+00	1.36+01	.00	2.89+00	2.98-01	1.97+02	1.26+01
9.90+00	1.30+01	3.55-01	2.92+00	1.34+01	.00	2.88+00	2.99-01	1.98+02	1.26+01
1.00+01	1.29+01	3.51-01	2.90+00	1.33+01	.00	2.86+00	3.00-01	1.99+02	1.26+01

C-25

H 11

UCC
026704

CORPORATION

DISCHARGE FROM A PVC BATCH REACTOR

Case 4. Overfilling - Cold Water on Jacket

REACTOR PRESSURE AT TIME OF DISCHARGE = 194.70 PSIA	PRESSURE DOWNSTREAM OF VALVE = 64.70 PSIA
REACTOR TEMP AT TIME OF DISCHARGE = 135.00 F	WATER JACKET TEMP AT DISCHARGE = 90.00 F
REACTOR VOLUME = 1337.000 CU FT	HEAT OF REACTION = 45516.000 BTU/LBMOLE
LIQUID VCM INITIALLY IN REACTOR = 486.00 LBMOLE	LIQ H2O INITIALLY IN REACTOR = 2603.0 LBMOLE
VAPOR INITIALLY IN REACTOR = .0347 LBMOLE	JACKET COEF TIMES AREA = 564.3 BTU/M-F
DENSITY OF WATER (CONSTANT) = 3.4570 LBMOLE/CU FT	INITIAL DENSITY OF VCM = .83377 LBMOLE/CU FT
AREA OF RELIEF VALVE ORIFICE OPENING = .0694 SQ FT	ORIFICE FLOW COEFFICIENT = .610
MINIMUM LIQUID ENTRAINMENT = .0100 CU FT LIQ/CU FT GAS	MINIMUM WATER JACKET TEMP = 48.00 F
LIQ COL WHEN MIN ENTRAINMENT IS REACHED = 1219.4 CU FT	TIME MIN JACKET TEMP IS REACHED = 5.00 MIN
HEATING JACKET FACTOR = 1.00	REACTION RATE FACTOR = .40

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
0.00	1.95+02	1.35+02	9.00+01	-1.04+06	3.47-02	4.06+02	2.60+03	5.83+02	7.53+02
1.00-01	1.32+02	1.35+02	8.92+01	-1.04+06	1.53-01	4.03+02	2.59+03	5.79+02	7.49+02
2.00-01	1.32+02	1.35+02	8.83+01	-1.04+06	2.60-01	4.00+02	2.58+03	5.76+02	7.45+02
3.00-01	1.32+02	1.35+02	8.75+01	-1.03+06	3.05-01	4.77+02	2.56+03	5.72+02	7.42+02
4.00-01	1.31+02	1.35+02	8.66+01	-1.03+06	5.17-01	4.75+02	2.55+03	5.69+02	7.38+02
5.00-01	1.31+02	1.35+02	8.58+01	-1.03+06	6.46-01	4.72+02	2.54+03	5.66+02	7.35+02
6.00-01	1.31+02	1.34+02	8.50+01	-1.03+06	7.71-01	4.69+02	2.53+03	5.62+02	7.31+02
7.00-01	1.31+02	1.34+02	8.41+01	-1.03+06	8.94-01	4.66+02	2.52+03	5.59+02	7.28+02
8.00-01	1.30+02	1.34+02	8.33+01	-1.04+06	1.01+00	4.63+02	2.51+03	5.55+02	7.25+02
9.00-01	1.30+02	1.34+02	8.24+01	-1.04+06	1.13+00	4.61+02	2.50+03	5.52+02	7.22+02
1.00+00	1.30+02	1.34+02	8.16+01	-1.04+06	1.24+00	4.58+02	2.49+03	5.48+02	7.19+02
1.10+00	1.29+02	1.33+02	8.08+01	-1.05+06	1.34+00	4.55+02	2.48+03	5.44+02	7.16+02
1.20+00	1.29+02	1.33+02	7.99+01	-1.05+06	1.44+00	4.52+02	2.47+03	5.40+02	7.14+02
1.30+00	1.28+02	1.33+02	7.91+01	-1.06+06	1.53+00	4.49+02	2.46+03	5.37+02	7.11+02
1.40+00	1.27+02	1.33+02	7.82+01	-1.08+06	1.61+00	4.45+02	2.45+03	5.33+02	7.09+02
1.50+00	1.27+02	1.32+02	7.74+01	-1.09+06	1.68+00	4.42+02	2.44+03	5.28+02	7.07+02
1.60+00	1.26+02	1.32+02	7.66+01	-1.11+06	1.73+00	4.39+02	2.44+03	5.24+02	7.05+02
1.70+00	1.25+02	1.31+02	7.57+01	-1.13+06	1.77+00	4.35+02	2.44+03	5.20+02	7.04+02
1.80+00	1.24+02	1.31+02	7.49+01	-1.15+06	1.78+00	4.33+02	2.43+03	5.16+02	7.04+02

C-26

UCC
026705

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIQ. EMISSION L/MOLE
.00	1.02-02	3.67+01	1.75+02	2.17+01	1.42+01	1.75+02	.00	.00	.00
1.00-01	5.51-01	2.53+01	1.24+02	1.60+01	1.00+01	1.24+02	6.78-03	1.81+00	1.17+00
2.00-01	1.08+00	2.50+01	1.23+02	1.63+01	9.87+00	1.22+02	1.35-02	3.42+00	2.17+00
3.00-01	1.66+00	2.46+01	1.21+02	1.67+01	9.60+00	1.21+02	2.02-02	5.06+00	3.15+00
4.00-01	2.31+00	2.41+01	1.19+02	1.71+01	9.47+00	1.18+02	2.68-02	6.73+00	4.11+00
5.00-01	3.03+00	2.36+01	1.16+02	1.75+01	9.24+00	1.16+02	3.33-02	8.44+00	5.04+00
6.00-01	3.84+00	2.31+01	1.14+02	1.60+01	8.98+00	1.14+02	3.98-02	1.02+01	5.95+00
7.00-01	4.76+00	2.24+01	1.11+02	1.86+01	8.69+00	1.11+02	4.62-02	1.20+01	6.84+00
8.00-01	5.00+00	2.17+01	1.07+02	1.93+01	8.35+00	1.07+02	5.25-02	1.39+01	7.69+00
9.00-01	7.00+00	2.09+01	1.04+02	2.00+01	7.97+00	1.04+02	5.87-02	1.58+01	8.51+00
1.00+00	8.40+00	2.00+01	9.93+01	2.09+01	7.53+00	9.92+01	6.48-02	1.79+01	9.28+00
1.10+00	1.00+01	1.89+01	9.41+01	2.20+01	7.01+00	9.40+01	7.09-02	2.60+01	1.00+01
1.20+00	1.20+01	1.76+01	8.80+01	2.33+01	6.39+00	8.79+01	7.68-02	2.22+01	1.07+01
1.30+00	1.43+01	1.61+01	8.07+01	2.49+01	5.65+00	8.06+01	8.27-02	2.46+01	1.13+01
1.40+00	1.72+01	1.42+01	7.17+01	2.60+01	4.75+00	7.17+01	8.84-02	2.71+01	1.18+01
1.50+00	2.09+01	1.20+01	6.05+01	2.93+01	3.61+00	6.05+01	9.40-02	2.99+01	1.22+01
1.60+00	2.55+01	9.01+00	4.59+01	3.25+01	2.14+00	4.58+01	9.95-02	3.29+01	1.25+01
1.70+00	2.65+01	4.73+00	2.43+01	3.10+01	3.28-01	2.42+01	1.05-01	3.61+01	1.26+01
1.80+00	2.73+01	1.29+00	6.65+00	2.92+01	.00	6.01+00	1.10-01	3.90+01	1.26+01

C-27

UCC
026706

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
1.00+00	1.23+02	1.30+02	7.40+01	-1.17+06	1.79+00	4.30+02	2.43+03	5.12+02	7.04+02
2.00+00	1.22+02	1.29+02	7.32+01	-1.20+06	1.79+00	4.27+02	2.43+03	5.09+02	7.04+02
2.10+00	1.21+02	1.29+02	7.24+01	-1.22+06	1.80+00	4.24+02	2.43+03	5.05+02	7.04+02
2.20+00	1.20+02	1.28+02	7.15+01	-1.24+06	1.80+00	4.22+02	2.43+03	5.01+02	7.03+02
2.30+00	1.19+02	1.28+02	7.07+01	-1.27+06	1.81+00	4.19+02	2.43+03	4.98+02	7.03+02
2.40+00	1.18+02	1.27+02	6.96+01	-1.29+06	1.81+00	4.16+02	2.43+03	4.94+02	7.03+02
2.50+00	1.17+02	1.27+02	6.90+01	-1.31+06	1.82+00	4.14+02	2.43+03	4.91+02	7.03+02
2.60+00	1.16+02	1.26+02	6.82+01	-1.33+06	1.82+00	4.11+02	2.43+03	4.88+02	7.03+02
2.70+00	1.15+02	1.26+02	6.73+01	-1.35+06	1.83+00	4.08+02	2.43+03	4.84+02	7.03+02
2.80+00	1.15+02	1.25+02	6.65+01	-1.38+06	1.83+00	4.06+02	2.43+03	4.81+02	7.03+02
2.90+00	1.14+02	1.25+02	6.56+01	-1.40+06	1.83+00	4.03+02	2.43+03	4.78+02	7.02+02
3.00+00	1.13+02	1.24+02	6.48+01	-1.42+06	1.84+00	4.01+02	2.43+03	4.74+02	7.02+02
3.10+00	1.12+02	1.24+02	6.40+01	-1.44+06	1.84+00	3.98+02	2.43+03	4.71+02	7.02+02
3.20+00	1.11+02	1.23+02	6.31+01	-1.46+06	1.85+00	3.96+02	2.43+03	4.68+02	7.02+02
3.30+00	1.10+02	1.23+02	6.23+01	-1.48+06	1.85+00	3.94+02	2.43+03	4.65+02	7.02+02
3.40+00	1.10+02	1.22+02	6.14+01	-1.50+06	1.85+00	3.91+02	2.43+03	4.62+02	7.02+02
3.50+00	1.09+02	1.22+02	6.06+01	-1.52+06	1.86+00	3.89+02	2.43+03	4.59+02	7.02+02
3.60+00	1.08+02	1.21+02	5.98+01	-1.54+06	1.86+00	3.86+02	2.42+03	4.56+02	7.01+02
3.70+00	1.07+02	1.21+02	5.89+01	-1.56+06	1.86+00	3.84+02	2.42+03	4.52+02	7.01+02
3.80+00	1.07+02	1.20+02	5.81+01	-1.58+06	1.87+00	3.82+02	2.42+03	4.50+02	7.01+02
3.90+00	1.06+02	1.20+02	5.72+01	-1.60+06	1.87+00	3.80+02	2.42+03	4.47+02	7.01+02
4.00+00	1.05+02	1.19+02	5.64+01	-1.62+06	1.88+00	3.77+02	2.42+03	4.44+02	7.01+02
4.10+00	1.05+02	1.19+02	5.56+01	-1.64+06	1.88+00	3.75+02	2.42+03	4.41+02	7.01+02
4.20+00	1.04+02	1.18+02	5.47+01	-1.66+06	1.88+00	3.73+02	2.42+03	4.38+02	7.01+02
4.30+00	1.03+02	1.18+02	5.39+01	-1.68+06	1.89+00	3.71+02	2.42+03	4.35+02	7.01+02
4.40+00	1.02+02	1.17+02	5.30+01	-1.70+06	1.89+00	3.69+02	2.42+03	4.32+02	7.00+02
4.50+00	1.02+02	1.17+02	5.22+01	-1.72+06	1.89+00	3.66+02	2.42+03	4.30+02	7.00+02
4.60+00	1.01+02	1.17+02	5.14+01	-1.74+06	1.89+00	3.64+02	2.42+03	4.27+02	7.00+02
4.70+00	1.00+02	1.16+02	5.05+01	-1.76+06	1.90+00	3.62+02	2.42+03	4.24+02	7.00+02
4.80+00	0.99+01	1.16+02	4.97+01	-1.77+06	1.90+00	3.60+02	2.42+03	4.21+02	7.00+02
4.90+00	0.99+01	1.15+02	4.88+01	-1.79+06	1.90+00	3.58+02	2.42+03	4.19+02	7.00+02
5.00+00	0.98+01	1.15+02	4.80+01	-1.81+06	1.91+00	3.56+02	2.42+03	4.16+02	7.00+02
5.10+00	0.98+01	1.14+02	4.80+01	-1.83+06	1.91+00	3.54+02	2.42+03	4.14+02	7.00+02

C-28

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026707

COMPOSITION

	PREFLASH GAS FLOW MOLE/HR.	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED LB/MOLE	TOTAL VCM GAS EMISSION LB/MOLE	TOTAL VCM LIQ. EMISSION LB/MOLE
1.90+00	2.71+01	9.10-01	4.73+00	2.87+01	.00	4.04+00	1.15-01	4.10+01	1.26+01
2.00+00	2.69+01	8.99-01	4.70+00	2.84+01	.00	4.03+00	1.20-01	4.45+01	1.26+01
2.10+00	2.66+01	8.88-01	4.67+00	2.81+01	.00	4.02+00	1.25-01	4.72+01	1.26+01
2.20+00	2.63+01	8.77-01	4.65+00	2.78+01	.00	4.01+00	1.29-01	4.99+01	1.26+01
2.30+00	2.60+01	8.67-01	4.62+00	2.75+01	.00	4.00+00	1.34-01	5.26+01	1.26+01
2.40+00	2.58+01	8.56-01	4.60+00	2.72+01	.00	3.99+00	1.38-01	5.52+01	1.26+01
2.50+00	2.55+01	8.46-01	4.57+00	2.70+01	.00	3.98+00	1.43-01	5.78+01	1.26+01
2.60+00	2.53+01	8.36-01	4.54+00	2.67+01	.00	3.97+00	1.47-01	6.04+01	1.26+01
2.70+00	2.50+01	8.26-01	4.52+00	2.64+01	.00	3.96+00	1.51-01	6.30+01	1.26+01
2.80+00	2.46+01	8.16-01	4.49+00	2.61+01	.00	3.95+00	1.55-01	6.55+01	1.26+01
2.90+00	2.45+01	8.06-01	4.46+00	2.58+01	.00	3.94+00	1.59-01	6.80+01	1.26+01
3.00+00	2.43+01	7.96-01	4.44+00	2.56+01	.00	3.93+00	1.62-01	7.05+01	1.26+01
3.10+00	2.40+01	7.86-01	4.41+00	2.53+01	.00	3.91+00	1.66-01	7.30+01	1.26+01
3.20+00	2.38+01	7.77-01	4.39+00	2.50+01	.00	3.90+00	1.69-01	7.54+01	1.26+01
3.30+00	2.35+01	7.67-01	4.36+00	2.48+01	.00	3.89+00	1.73-01	7.77+01	1.26+01
3.40+00	2.33+01	7.58-01	4.33+00	2.45+01	.00	3.87+00	1.76-01	8.02+01	1.26+01
3.50+00	2.31+01	7.49-01	4.31+00	2.43+01	.00	3.86+00	1.80-01	8.26+01	1.26+01
3.60+00	2.29+01	7.40-01	4.28+00	2.40+01	.00	3.85+00	1.83-01	8.49+01	1.26+01
3.70+00	2.26+01	7.31-01	4.26+00	2.38+01	.00	3.83+00	1.86-01	8.72+01	1.26+01
3.80+00	2.24+01	7.22-01	4.23+00	2.35+01	.00	3.82+00	1.89-01	8.95+01	1.26+01
3.90+00	2.22+01	7.13-01	4.20+00	2.33+01	.00	3.81+00	1.92-01	9.18+01	1.26+01
4.00+00	2.20+01	7.04-01	4.18+00	2.30+01	.00	3.79+00	1.95-01	9.40+01	1.26+01
4.10+00	2.17+01	6.95-01	4.15+00	2.28+01	.00	3.78+00	1.98-01	9.62+01	1.26+01
4.20+00	2.15+01	6.87-01	4.12+00	2.26+01	.00	3.76+00	2.01-01	9.84+01	1.26+01
4.30+00	2.13+01	6.78-01	4.10+00	2.23+01	.00	3.75+00	2.03-01	1.01+02	1.26+01
4.40+00	2.11+01	6.70-01	4.07+00	2.21+01	.00	3.73+00	2.06-01	1.03+02	1.26+01
4.50+00	2.09+01	6.62-01	4.04+00	2.19+01	.00	3.71+00	2.09-01	1.05+02	1.26+01
4.60+00	2.07+01	6.54-01	4.02+00	2.16+01	.00	3.70+00	2.11-01	1.07+02	1.26+01
4.70+00	2.05+01	6.45-01	3.99+00	2.14+01	.00	3.68+00	2.14-01	1.09+02	1.26+01
4.80+00	2.03+01	6.37-01	3.97+00	2.12+01	.00	3.67+00	2.16-01	1.11+02	1.26+01
4.90+00	2.00+01	6.30-01	3.94+00	2.10+01	.00	3.65+00	2.18-01	1.13+02	1.26+01
5.00+00	1.98+01	6.22-01	3.91+00	2.07+01	.00	3.63+00	2.21-01	1.15+02	1.26+01
5.10+00	1.96+01	6.14-01	3.89+00	2.05+01	.00	3.61+00	2.23-01	1.17+02	1.26+01

C-29

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026708

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
5.20+00	9.74+01	1.14+02	4.80+01	-1.85+06	1.91+00	3.52+02	2.42+03	4.11+02	6.99+02
5.30+00	9.68+01	1.14+02	4.80+01	-1.86+06	1.92+00	3.50+02	2.42+03	4.09+02	6.99+02
5.40+00	9.62+01	1.13+02	4.80+01	-1.88+06	1.92+00	3.48+02	2.42+03	4.06+02	6.99+02
5.50+00	9.57+01	1.13+02	4.80+01	-1.90+06	1.92+00	3.46+02	2.42+03	4.04+02	6.99+02
5.60+00	9.51+01	1.12+02	4.80+01	-1.92+06	1.92+00	3.44+02	2.42+03	4.01+02	6.99+02
5.70+00	9.46+01	1.12+02	4.80+01	-1.93+06	1.93+00	3.42+02	2.42+03	3.99+02	6.99+02
5.80+00	9.40+01	1.11+02	4.80+01	-1.95+06	1.93+00	3.40+02	2.42+03	3.96+02	6.99+02
5.90+00	9.35+01	1.11+02	4.80+01	-1.97+06	1.93+00	3.39+02	2.42+03	3.94+02	6.99+02
6.00+00	9.29+01	1.11+02	4.80+01	-1.98+06	1.93+00	3.37+02	2.41+03	3.92+02	6.99+02
6.10+00	9.24+01	1.10+02	4.80+01	-2.00+06	1.94+00	3.35+02	2.41+03	3.89+02	6.98+02
6.20+00	9.19+01	1.10+02	4.80+01	-2.01+06	1.94+00	3.33+02	2.41+03	3.87+02	6.98+02
6.30+00	9.14+01	1.10+02	4.80+01	-2.03+06	1.94+00	3.31+02	2.41+03	3.85+02	6.98+02
6.40+00	9.09+01	1.09+02	4.80+01	-2.05+06	1.94+00	3.30+02	2.41+03	3.83+02	6.98+02
6.50+00	9.04+01	1.09+02	4.80+01	-2.06+06	1.95+00	3.28+02	2.41+03	3.80+02	6.98+02
6.60+00	9.00+01	1.08+02	4.80+01	-2.08+06	1.95+00	3.26+02	2.41+03	3.78+02	6.98+02
6.70+00	8.95+01	1.08+02	4.80+01	-2.09+06	1.95+00	3.24+02	2.41+03	3.76+02	6.98+02
6.80+00	8.90+01	1.08+02	4.80+01	-2.11+06	1.95+00	3.23+02	2.41+03	3.74+02	6.98+02
6.90+00	8.86+01	1.07+02	4.80+01	-2.12+06	1.96+00	3.21+02	2.41+03	3.72+02	6.98+02
7.00+00	8.81+01	1.07+02	4.80+01	-2.14+06	1.96+00	3.19+02	2.41+03	3.70+02	6.97+02
7.10+00	8.77+01	1.07+02	4.80+01	-2.15+06	1.96+00	3.18+02	2.41+03	3.68+02	6.97+02
7.20+00	8.72+01	1.06+02	4.80+01	-2.17+06	1.96+00	3.16+02	2.41+03	3.66+02	6.97+02
7.30+00	8.68+01	1.06+02	4.80+01	-2.18+06	1.97+00	3.15+02	2.41+03	3.64+02	6.97+02
7.40+00	8.64+01	1.06+02	4.80+01	-2.19+06	1.97+00	3.13+02	2.41+03	3.62+02	6.97+02
7.50+00	8.60+01	1.05+02	4.80+01	-2.21+06	1.97+00	3.11+02	2.41+03	3.60+02	6.97+02
7.60+00	8.56+01	1.05+02	4.80+01	-2.22+06	1.97+00	3.10+02	2.41+03	3.58+02	6.97+02
7.70+00	8.52+01	1.05+02	4.80+01	-2.24+06	1.97+00	3.08+02	2.41+03	3.56+02	6.97+02
7.80+00	8.48+01	1.04+02	4.80+01	-2.25+06	1.98+00	3.07+02	2.41+03	3.54+02	6.97+02
7.90+00	8.44+01	1.04+02	4.80+01	-2.26+06	1.98+00	3.05+02	2.41+03	3.52+02	6.97+02
8.00+00	8.40+01	1.04+02	4.80+01	-2.28+06	1.98+00	3.04+02	2.41+03	3.50+02	6.96+02
8.10+00	8.36+01	1.03+02	4.80+01	-2.29+06	1.98+00	3.02+02	2.41+03	3.48+02	6.96+02
8.20+00	8.32+01	1.03+02	4.80+01	-2.30+06	1.98+00	3.01+02	2.41+03	3.46+02	6.96+02
8.30+00	8.29+01	1.03+02	4.80+01	-2.32+06	1.99+00	2.99+02	2.41+03	3.45+02	6.96+02
8.40+00	8.25+01	1.02+02	4.80+01	-2.33+06	1.99+00	2.98+02	2.41+03	3.43+02	6.96+02

C-30

UCC
026709

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LTO. FLOW MOLE/MIN	PREFLASH H2O LTO. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LTO. FLOW MOLE/MIN	FLASHED H2O LTO. FLOW MOLE/MIN	TOTAL PVL PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LTO. EMISSION L/MOLE
5.20+00	1.94+01	6.06-01	3.86+00	2.03+01	.00	3.60+00	2.25-01	1.19+02	1.26+01
5.30+00	1.92+01	5.99-01	3.83+00	2.01+01	.00	3.58+00	2.27-01	1.21+02	1.26+01
5.40+00	1.91+01	5.91-01	3.81+00	1.99+01	.00	3.56+00	2.30-01	1.23+02	1.26+01
5.50+00	1.89+01	5.84-01	3.78+00	1.97+01	.00	3.54+00	2.32-01	1.25+02	1.26+01
5.60+00	1.87+01	5.76-01	3.75+00	1.95+01	.00	3.53+00	2.34-01	1.27+02	1.26+01
5.70+00	1.85+01	5.69-01	3.73+00	1.93+01	.00	3.51+00	2.36-01	1.29+02	1.26+01
5.80+00	1.83+01	5.62-01	3.70+00	1.91+01	.00	3.49+00	2.38-01	1.31+02	1.26+01
5.90+00	1.81+01	5.55-01	3.68+00	1.89+01	.00	3.47+00	2.39-01	1.33+02	1.26+01
6.00+00	1.79+01	5.48-01	3.65+00	1.87+01	.00	3.45+00	2.41-01	1.34+02	1.26+01
6.10+00	1.77+01	5.41-01	3.62+00	1.85+01	.00	3.43+00	2.43-01	1.36+02	1.26+01
6.20+00	1.76+01	5.34-01	3.60+00	1.83+01	.00	3.42+00	2.45-01	1.38+02	1.26+01
6.30+00	1.74+01	5.27-01	3.57+00	1.81+01	.00	3.40+00	2.47-01	1.40+02	1.26+01
6.40+00	1.72+01	5.21-01	3.54+00	1.79+01	.00	3.38+00	2.48-01	1.42+02	1.26+01
6.50+00	1.70+01	5.14-01	3.52+00	1.77+01	.00	3.36+00	2.50-01	1.43+02	1.26+01
6.60+00	1.69+01	5.08-01	3.49+00	1.75+01	.00	3.34+00	2.52-01	1.45+02	1.26+01
6.70+00	1.67+01	5.01-01	3.47+00	1.73+01	.00	3.32+00	2.53-01	1.47+02	1.26+01
6.80+00	1.65+01	4.95-01	3.44+00	1.72+01	.00	3.30+00	2.55-01	1.49+02	1.26+01
6.90+00	1.64+01	4.88-01	3.41+00	1.70+01	.00	3.28+00	2.57-01	1.50+02	1.26+01
7.00+00	1.62+01	4.82-01	3.39+00	1.68+01	.00	3.26+00	2.58-01	1.52+02	1.26+01
7.10+00	1.60+01	4.76-01	3.36+00	1.66+01	.00	3.24+00	2.60-01	1.53+02	1.26+01
7.20+00	1.59+01	4.70-01	3.34+00	1.64+01	.00	3.22+00	2.61-01	1.55+02	1.26+01
7.30+00	1.57+01	4.64-01	3.31+00	1.63+01	.00	3.20+00	2.63-01	1.57+02	1.26+01
7.40+00	1.55+01	4.58-01	3.29+00	1.61+01	.00	3.18+00	2.64-01	1.58+02	1.26+01
7.50+00	1.54+01	4.52-01	3.26+00	1.59+01	.00	3.16+00	2.65-01	1.60+02	1.26+01
7.60+00	1.52+01	4.46-01	3.23+00	1.57+01	.00	3.14+00	2.67-01	1.61+02	1.26+01
7.70+00	1.50+01	4.40-01	3.21+00	1.56+01	.00	3.12+00	2.68-01	1.63+02	1.26+01
7.80+00	1.49+01	4.35-01	3.18+00	1.54+01	.00	3.10+00	2.69-01	1.64+02	1.26+01
7.90+00	1.47+01	4.29-01	3.16+00	1.52+01	.00	3.08+00	2.71-01	1.66+02	1.26+01
8.00+00	1.46+01	4.23-01	3.13+00	1.51+01	.00	3.05+00	2.72-01	1.67+02	1.26+01
8.10+00	1.44+01	4.18-01	3.11+00	1.49+01	.00	3.03+00	2.73-01	1.69+02	1.26+01
8.20+00	1.43+01	4.12-01	3.08+00	1.48+01	.00	3.01+00	2.75-01	1.70+02	1.26+01
8.30+00	1.41+01	4.07-01	3.05+00	1.46+01	.00	2.99+00	2.76-01	1.72+02	1.26+01
8.40+00	1.40+01	4.02-01	3.03+00	1.44+01	.00	2.97+00	2.77-01	1.73+02	1.26+01

C-31

UCC
026710

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
0.50+00	8.21+01	1.02+02	4.80+01	-2.34+06	1.99+00	2.96+02	2.41+03	3.41+02	6.96+02
0.60+00	8.18+01	1.02+02	4.80+01	-2.36+06	1.99+00	2.95+02	2.41+03	3.39+02	6.96+02
0.70+00	8.14+01	1.01+02	4.80+01	-2.37+06	1.99+00	2.94+02	2.41+03	3.38+02	6.96+02
0.80+00	8.11+01	1.01+02	4.80+01	-2.38+06	1.99+00	2.92+02	2.41+03	3.36+02	6.96+02
0.90+00	8.08+01	1.01+02	4.60+01	-2.39+06	2.00+00	2.91+02	2.40+03	3.34+02	6.96+02
1.00+00	8.04+01	1.01+02	4.80+01	-2.40+06	2.00+00	2.90+02	2.40+03	3.33+02	6.96+02
1.10+00	8.01+01	1.00+02	4.80+01	-2.42+06	2.00+00	2.88+02	2.40+03	3.31+02	6.95+02
1.20+00	7.98+01	1.00+02	4.80+01	-2.43+06	2.00+00	2.87+02	2.40+03	3.29+02	6.95+02
1.30+00	7.95+01	9.98+01	4.80+01	-2.44+06	2.00+00	2.86+02	2.40+03	3.28+02	6.95+02
1.40+00	7.92+01	9.95+01	4.80+01	-2.45+06	2.00+00	2.84+02	2.40+03	3.26+02	6.95+02
1.50+00	7.88+01	9.92+01	4.80+01	-2.46+06	2.01+00	2.83+02	2.40+03	3.25+02	6.95+02
1.60+00	7.85+01	9.90+01	4.80+01	-2.47+06	2.01+00	2.82+02	2.40+03	3.23+02	6.95+02
1.70+00	7.82+01	9.87+01	4.80+01	-2.49+06	2.01+00	2.81+02	2.40+03	3.21+02	6.95+02
1.80+00	7.80+01	9.84+01	4.80+01	-2.50+06	2.01+00	2.79+02	2.40+03	3.20+02	6.95+02
1.90+00	7.77+01	9.82+01	4.80+01	-2.51+06	2.01+00	2.78+02	2.40+03	3.18+02	6.95+02
1.00+01	7.74+01	9.79+01	4.80+01	-2.52+06	2.01+00	2.77+02	2.40+03	3.17+02	6.95+02

C-32

UCC
028711

COMPORATION

TIME	PREFLASH GAS FLOW	PREFLASH VCM LIQ. FLOW	PREFLASH H2O LIQ. FLOW	FLASHED GAS FLOW	FLASHED VCM LIQ. FLOW	FLASHED H2O LIQ. FLOW	TOTAL PVC PRODUCED	TOTAL VCM GAS EMISSION	TOTAL VCM LIQ. EMISSION
MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	LBMOLE	LBMOLE	LBMOLE
8.50+00	1.38+01	3.96-01	3.00+00	1.43+01	.00	2.95+00	2.78-01	1.75+02	1.26+01
8.60+00	1.37+01	3.91-01	2.98+00	1.41+01	.00	2.93+00	2.79-01	1.76+02	1.26+01
8.70+00	1.35+01	3.86-01	2.95+00	1.40+01	.00	2.91+00	2.80-01	1.77+02	1.26+01
8.80+00	1.34+01	3.81-01	2.93+00	1.38+01	.00	2.88+00	2.82-01	1.79+02	1.26+01
8.90+00	1.32+01	3.76-01	2.90+00	1.36+01	.00	2.86+00	2.83-01	1.80+02	1.26+01
9.00+00	1.31+01	3.70-01	2.88+00	1.35+01	.00	2.84+00	2.84-01	1.82+02	1.26+01
9.10+00	1.29+01	3.66-01	2.85+00	1.33+01	.00	2.82+00	2.85-01	1.83+02	1.26+01
9.20+00	1.28+01	3.61-01	2.82+00	1.32+01	.00	2.80+00	2.86-01	1.84+02	1.26+01
9.30+00	1.27+01	3.56-01	2.80+00	1.30+01	.00	2.77+00	2.87-01	1.85+02	1.26+01
9.40+00	1.25+01	3.51-01	2.77+00	1.29+01	.00	2.75+00	2.88-01	1.87+02	1.26+01
9.50+00	1.24+01	3.46-01	2.75+00	1.27+01	.00	2.73+00	2.89-01	1.88+02	1.26+01
9.60+00	1.22+01	3.41-01	2.72+00	1.26+01	.00	2.71+00	2.90-01	1.89+02	1.26+01
9.70+00	1.21+01	3.37-01	2.70+00	1.25+01	.00	2.68+00	2.91-01	1.91+02	1.26+01
9.80+00	1.20+01	3.32-01	2.67+00	1.23+01	.00	2.66+00	2.92-01	1.92+02	1.26+01
9.90+00	1.18+01	3.27-01	2.65+00	1.22+01	.00	2.64+00	2.93-01	1.93+02	1.26+01
1.00+01	1.17+01	3.23-01	2.62+00	1.20+01	2.52-03	2.62+00	2.94-01	1.94+02	1.26+01

C-33

MIN

UCC
026712

CORPORATION

DISCHARGE FROM A PVC BATCH REACTOR

Case 5. High Reactor Rate - Zero Heat Removal

REACTOR PRESSURE AT TIME OF DISCHARGE = 214.79 PSIA	PRESSURE DOWNSTREAM OF VALVE = 64.70 PSIA
REACTOR TEMP AT TIME OF DISCHARGE = 166.50 F	WATER JACKET TEMP AT DISCHARGE = 90.00 F
REACTOR VOLUME = 2673.000 CU FT	HEAT OF REACTION = 45516.000 BTU/LBMOLE
LIQUID VCM INITIALLY IN REACTOR = 921.50 LBMOLE	LIQ H2O INITIALLY IN REACTOR = 4929.6 LBMOLE
VAPOR INITIALLY IN REACTOR = 2.9699 LBMOLE	JACKET COEF TIMES AREA = 895.6 BTU/R-F
DENSITY OF WATER (CONSTANT) = 3.4570 LBMOLE/CU FT	INITIAL DENSITY OF VCM = .79912 LBMOLE/CU FT
AREA OF RELIEF VALVE ORIFICE OPENING = .1289 SQ FT	ORIFICE FLOW COEFFICIENT = .610
MINIMUM LIQUID ENTRAINMENT = .0100 CU FT LIQ/CU FT GAS	MINIMUM WATER JACKET TEMP = 48.00 F
LIQ VOL WHEN MIN ENTRAINMENT IS REACHED = 2438.0 CU FT	TIME MIN JACKET TEMP IS REACHED = 5.00 MIN
HEATING JACKET FACTOR = .00	REACTION RATE FACTOR = 1.20

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
.00	2.15+02	1.60+02	9.00+01	9.66+05	2.99+00	9.21+02	4.93+03	1.15+03	1.43+03
1.00-01	2.15+02	1.69+02	8.92+01	9.69+05	3.48+00	9.14+02	4.90+03	1.14+03	1.42+03
2.00-01	2.16+02	1.69+02	8.83+01	1.01+06	3.90+00	9.06+02	4.87+03	1.13+03	1.41+03
3.00-01	2.17+02	1.69+02	8.75+01	1.03+06	4.46+00	8.98+02	4.84+03	1.13+03	1.40+03
4.00-01	2.17+02	1.69+02	8.66+01	1.04+06	4.91+00	8.90+02	4.82+03	1.12+03	1.39+03
5.00-01	2.16+02	1.69+02	8.58+01	1.05+06	5.33+00	8.82+02	4.79+03	1.11+03	1.39+03
6.00-01	2.18+02	1.70+02	8.50+01	1.05+06	5.70+00	8.74+02	4.77+03	1.10+03	1.38+03
7.00-01	2.18+02	1.69+02	8.41+01	1.05+06	6.00+00	8.65+02	4.76+03	1.00+03	1.38+03
8.00-01	2.17+02	1.69+02	8.33+01	1.02+06	6.19+00	8.55+02	4.74+03	1.07+03	1.37+03
9.00-01	2.15+02	1.69+02	8.24+01	9.68+05	6.23+00	8.45+02	4.74+03	1.06+03	1.37+03
1.00+00	2.13+02	1.68+02	8.16+01	9.15+05	6.26+00	8.34+02	4.74+03	1.04+03	1.37+03
1.10+00	2.11+02	1.67+02	8.08+01	8.62+05	6.28+00	8.23+02	4.74+03	1.03+03	1.37+03
1.20+00	2.09+02	1.67+02	7.99+01	8.09+05	6.31+00	8.13+02	4.74+03	1.01+03	1.37+03
1.30+00	2.07+02	1.66+02	7.91+01	7.56+05	6.33+00	8.02+02	4.74+03	1.00+03	1.37+03
1.40+00	2.05+02	1.65+02	7.82+01	7.02+05	6.35+00	7.92+02	4.73+03	9.87+02	1.37+03
1.50+00	2.03+02	1.65+02	7.74+01	6.49+05	6.38+00	7.82+02	4.73+03	9.74+02	1.37+03
1.60+00	2.01+02	1.64+02	7.66+01	5.96+05	6.40+00	7.72+02	4.73+03	9.60+02	1.37+03
1.70+00	1.99+02	1.63+02	7.57+01	5.42+05	6.42+00	7.62+02	4.73+03	9.47+02	1.37+03
1.80+00	1.97+02	1.63+02	7.49+01	4.89+05	6.44+00	7.52+02	4.73+03	9.34+02	1.37+03

C-34

UCC
026713

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIG. FLOW MOLE/MIN	PREFLASH H2O LIG. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIG. FLOW MOLE/MIN	FLASHED H2O LIG. FLOW MOLE/MIN	TOTAL PYC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIG. EMISSION L/MOLE
00	7.65+01	6.23+01	2.98+02	5.83+01	5.20+00	2.98+02	.00	.00	.00
1.00-01	3.82+00	6.03+01	2.90+02	6.00+01	4.63+00	2.89+02	6.98-01	5.95+00	5.07-01
2.00-01	7.49+00	5.81+01	2.80+02	6.22+01	3.84+00	2.79+02	1.40+00	1.20+01	9.32-01
3.00-01	1.21+01	5.52+01	2.67+02	6.49+01	2.91+00	2.66+02	2.10+00	1.83+01	1.27+00
4.00-01	1.82+01	5.15+01	2.50+02	6.84+01	1.82+00	2.49+02	2.80+00	2.48+01	1.51+00
5.00-01	2.64+01	4.66+01	2.27+02	7.29+01	4.53-01	2.26+02	3.50+00	3.18+01	1.63+00
6.00-01	3.69+01	3.89+01	1.90+02	8.03+01	.00	1.86+02	4.20+00	3.91+01	1.63+00
7.00-01	5.45+01	2.95+01	1.45+02	8.09+01	.00	1.40+02	4.89+00	4.69+01	1.63+00
8.00-01	8.60+01	1.31+01	6.48+01	1.04+02	.00	5.95+01	5.57+00	5.58+01	1.63+00
9.00-01	1.01+02	2.95+00	1.48+01	1.10+02	.00	9.47+00	6.23+00	6.59+01	1.63+00
1.00+00	1.00+02	2.91+00	1.48+01	1.09+02	.00	9.53+00	6.86+00	7.60+01	1.63+00
1.10+00	9.94+01	2.87+00	1.48+01	1.07+02	.00	9.60+00	7.47+00	8.60+01	1.63+00
1.20+00	9.84+01	2.83+00	1.48+01	1.66+02	.00	9.66+00	8.06+00	9.59+01	1.63+00
1.30+00	9.75+01	2.79+00	1.48+01	1.05+02	.00	9.72+00	8.63+00	1.06+02	1.63+00
1.40+00	9.65+01	2.75+00	1.48+01	1.04+02	.00	9.78+00	9.18+00	1.15+02	1.63+00
1.50+00	9.56+01	2.71+00	1.47+01	1.03+02	.00	9.84+00	9.70+00	1.25+02	1.63+00
1.60+00	9.46+01	2.67+00	1.47+01	1.02+02	.00	9.89+00	1.02+01	1.35+02	1.63+00
1.70+00	9.37+01	2.63+00	1.47+01	1.01+02	.00	9.95+00	1.07+01	1.44+02	1.63+00
1.80+00	9.27+01	2.59+00	1.47+01	1.00+02	.00	1.00+01	1.12+01	1.53+02	1.63+00

C-35

UCC
026714

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT (CONTENT) BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
1.90+00	1.95+02	1.62+02	7.40+01	4.35+05	6.47+00	7.42+02	4.72+03	9.21+02	1.37+03
2.00+00	1.93+02	1.61+02	7.32+01	3.82+05	6.49+00	7.33+02	4.72+03	9.08+02	1.37+03
2.10+00	1.91+02	1.61+02	7.24+01	3.28+05	6.51+00	7.23+02	4.72+03	8.96+02	1.37+03
2.20+00	1.90+02	1.60+02	7.15+01	2.75+05	6.53+00	7.14+02	4.72+03	8.83+02	1.37+03
2.30+00	1.88+02	1.59+02	7.07+01	2.22+05	6.55+00	7.04+02	4.72+03	8.71+02	1.36+03
2.40+00	1.86+02	1.59+02	6.98+01	1.69+05	6.57+00	6.95+02	4.72+03	8.59+02	1.36+03
2.50+00	1.84+02	1.58+02	6.90+01	1.17+05	6.59+00	6.86+02	4.71+03	8.47+02	1.36+03
2.60+00	1.82+02	1.57+02	6.82+01	6.48+04	6.61+00	6.77+02	4.71+03	8.35+02	1.36+03
2.70+00	1.80+02	1.56+02	6.73+01	1.16+04	6.63+00	6.68+02	4.71+03	8.24+02	1.36+03
2.80+00	1.78+02	1.56+02	6.65+01	-4.05+04	6.65+00	6.60+02	4.71+03	8.12+02	1.36+03
2.90+00	1.77+02	1.55+02	6.56+01	-9.24+04	6.67+00	6.51+02	4.71+03	8.01+02	1.36+03
3.00+00	1.75+02	1.54+02	6.48+01	-1.44+05	6.68+00	6.42+02	4.71+03	7.90+02	1.36+03
3.10+00	1.73+02	1.54+02	6.40+01	-1.95+05	6.70+00	6.34+02	4.71+03	7.79+02	1.36+03
3.20+00	1.71+02	1.53+02	6.31+01	-2.46+05	6.72+00	6.26+02	4.70+03	7.68+02	1.36+03
3.30+00	1.70+02	1.52+02	6.23+01	-2.97+05	6.74+00	6.17+02	4.70+03	7.57+02	1.36+03
3.40+00	1.68+02	1.52+02	6.14+01	-3.48+05	6.75+00	6.09+02	4.70+03	7.46+02	1.36+03
3.50+00	1.66+02	1.51+02	6.06+01	-3.98+05	6.77+00	6.01+02	4.70+03	7.36+02	1.36+03
3.60+00	1.65+02	1.50+02	5.98+01	-4.48+05	6.79+00	5.93+02	4.70+03	7.25+02	1.36+03
3.70+00	1.63+02	1.50+02	5.89+01	-4.97+05	6.80+00	5.85+02	4.70+03	7.15+02	1.36+03
3.80+00	1.61+02	1.49+02	5.81+01	-5.46+05	6.82+00	5.78+02	4.69+03	7.05+02	1.36+03
3.90+00	1.60+02	1.48+02	5.72+01	-5.95+05	6.83+00	5.70+02	4.69+03	6.95+02	1.36+03
4.00+00	1.58+02	1.47+02	5.64+01	-6.44+05	6.85+00	5.62+02	4.69+03	6.85+02	1.36+03
4.10+00	1.57+02	1.47+02	5.56+01	-6.92+05	6.86+00	5.55+02	4.69+03	6.75+02	1.36+03
4.20+00	1.55+02	1.46+02	5.47+01	-7.40+05	6.88+00	5.47+02	4.69+03	6.66+02	1.36+03
4.30+00	1.54+02	1.45+02	5.39+01	-7.87+05	6.89+00	5.40+02	4.69+03	6.56+02	1.36+03
4.40+00	1.52+02	1.45+02	5.30+01	-8.34+05	6.91+00	5.33+02	4.69+03	6.47+02	1.36+03
4.50+00	1.51+02	1.44+02	5.22+01	-8.81+05	6.92+00	5.26+02	4.68+03	6.38+02	1.35+03
4.60+00	1.49+02	1.43+02	5.14+01	-9.27+05	6.93+00	5.19+02	4.68+03	6.29+02	1.35+03
4.70+00	1.48+02	1.43+02	5.05+01	-9.73+05	6.95+00	5.12+02	4.68+03	6.20+02	1.35+03
4.80+00	1.46+02	1.42+02	4.97+01	-1.02+06	6.96+00	5.05+02	4.68+03	6.11+02	1.35+03
4.90+00	1.45+02	1.41+02	4.88+01	-1.06+06	6.97+00	4.98+02	4.68+03	6.02+02	1.35+03
5.00+00	1.44+02	1.41+02	4.80+01	-1.11+06	6.99+00	4.91+02	4.68+03	5.93+02	1.35+03
5.10+00	1.42+02	1.40+02	4.80+01	-1.15+06	7.00+00	4.84+02	4.67+03	5.85+02	1.35+03

C-36

UCC
026715

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIQ. EMISSION L/MOLE
1.90+00	9.18+01	2.56+00	1.46+01	9.09+01	.00	1.01+01	1.16+01	1.63+02	1.63+00
2.00+00	9.08+01	2.52+00	1.46+01	9.78+01	.00	1.01+01	1.20+01	1.72+02	1.63+00
2.10+00	8.99+01	2.48+00	1.46+01	9.60+01	.00	1.01+01	1.25+01	1.81+02	1.63+00
2.20+00	8.89+01	2.44+00	1.45+01	9.57+01	.00	1.02+01	1.29+01	1.90+02	1.63+00
2.30+00	8.80+01	2.40+00	1.45+01	9.47+01	.00	1.02+01	1.32+01	1.99+02	1.63+00
2.40+00	8.71+01	2.37+00	1.45+01	9.36+01	.00	1.03+01	1.36+01	2.08+02	1.63+00
2.50+00	8.61+01	2.33+00	1.44+01	9.26+01	.00	1.03+01	1.40+01	2.16+02	1.63+00
2.60+00	8.52+01	2.29+00	1.44+01	9.16+01	.00	1.03+01	1.43+01	2.25+02	1.63+00
2.70+00	8.43+01	2.26+00	1.44+01	9.05+01	.00	1.04+01	1.46+01	2.33+02	1.63+00
2.80+00	8.34+01	2.22+00	1.43+01	8.95+01	.00	1.04+01	1.50+01	2.42+02	1.63+00
2.90+00	8.25+01	2.19+00	1.43+01	8.85+01	.00	1.04+01	1.53+01	2.50+02	1.63+00
3.00+00	8.16+01	2.15+00	1.42+01	8.75+01	.00	1.05+01	1.55+01	2.58+02	1.63+00
3.10+00	8.07+01	2.12+00	1.42+01	8.65+01	.00	1.05+01	1.58+01	2.66+02	1.63+00
3.20+00	7.99+01	2.08+00	1.41+01	8.56+01	.00	1.05+01	1.61+01	2.74+02	1.63+00
3.30+00	7.90+01	2.05+00	1.41+01	8.46+01	.00	1.05+01	1.63+01	2.82+02	1.63+00
3.40+00	7.81+01	2.01+00	1.41+01	8.36+01	.00	1.06+01	1.66+01	2.90+02	1.63+00
3.50+00	7.73+01	1.98+00	1.40+01	8.27+01	.00	1.06+01	1.68+01	2.98+02	1.63+00
3.60+00	7.64+01	1.95+00	1.40+01	8.16+01	.00	1.06+01	1.71+01	3.06+02	1.63+00
3.70+00	7.56+01	1.91+00	1.39+01	8.08+01	.00	1.06+01	1.73+01	3.14+02	1.63+00
3.80+00	7.48+01	1.88+00	1.39+01	7.99+01	.00	1.06+01	1.75+01	3.21+02	1.63+00
3.90+00	7.40+01	1.85+00	1.38+01	7.90+01	.00	1.06+01	1.77+01	3.29+02	1.63+00
4.00+00	7.32+01	1.82+00	1.38+01	7.81+01	.00	1.07+01	1.79+01	3.36+02	1.63+00
4.10+00	7.24+01	1.79+00	1.37+01	7.72+01	.00	1.07+01	1.81+01	3.43+02	1.63+00
4.20+00	7.16+01	1.76+00	1.37+01	7.63+01	.00	1.07+01	1.83+01	3.50+02	1.63+00
4.30+00	7.08+01	1.73+00	1.36+01	7.55+01	.00	1.07+01	1.84+01	3.58+02	1.63+00
4.40+00	7.00+01	1.70+00	1.36+01	7.46+01	.00	1.07+01	1.86+01	3.65+02	1.63+00
4.50+00	6.93+01	1.67+00	1.35+01	7.38+01	.00	1.07+01	1.88+01	3.72+02	1.63+00
4.60+00	6.85+01	1.64+00	1.35+01	7.29+01	.00	1.07+01	1.89+01	3.79+02	1.63+00
4.70+00	6.78+01	1.61+00	1.34+01	7.21+01	.00	1.07+01	1.91+01	3.85+02	1.63+00
4.80+00	6.71+01	1.58+00	1.33+01	7.13+01	.00	1.07+01	1.92+01	3.92+02	1.63+00
4.90+00	6.63+01	1.55+00	1.33+01	7.05+01	.00	1.07+01	1.93+01	3.99+02	1.63+00
5.00+00	6.56+01	1.52+00	1.32+01	6.97+01	.00	1.07+01	1.95+01	4.06+02	1.63+00
5.10+00	6.49+01	1.50+00	1.32+01	6.89+01	.00	1.07+01	1.96+01	4.12+02	1.63+00

C-37

UCC
026716

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIO. LEFT IN REACTOR LBMOLE	H2O LIO. LEFT IN REACTOR LBMOLE	REACTOR VCM LIO. VOLUME CU FT	REACTOR H2O LIO. VOLUME CU FT
5.20+00	1.41+02	1.40+02	4.80+01	-1.20+06	7.01+00	4.78+02	4.67+03	5.76+02	1.35+03
5.30+00	1.40+02	1.39+02	4.30+01	-1.24+06	7.02+00	4.71+02	4.67+03	5.68+02	1.35+03
5.40+00	1.38+02	1.38+02	4.80+01	-1.20+06	7.03+00	4.65+02	4.67+03	5.60+02	1.35+03
5.50+00	1.37+02	1.38+02	4.80+01	-1.33+06	7.05+00	4.58+02	4.67+03	5.51+02	1.35+03
5.60+00	1.36+02	1.37+02	4.80+01	-1.37+06	7.06+00	4.52+02	4.67+03	5.43+02	1.35+03
5.70+00	1.35+02	1.36+02	4.80+01	-1.41+06	7.07+00	4.46+02	4.67+03	5.35+02	1.35+03
5.80+00	1.34+02	1.36+02	4.80+01	-1.45+06	7.08+00	4.39+02	4.66+03	5.28+02	1.35+03
5.90+00	1.32+02	1.35+02	4.80+01	-1.49+06	7.09+00	4.33+02	4.66+03	5.20+02	1.35+03
6.00+00	1.31+02	1.35+02	4.80+01	-1.53+06	7.10+00	4.27+02	4.66+03	5.12+02	1.35+03
6.10+00	1.30+02	1.34+02	4.80+01	-1.58+06	7.11+00	4.21+02	4.66+03	5.05+02	1.35+03
6.20+00	1.29+02	1.33+02	4.80+01	-1.62+06	7.12+00	4.15+02	4.66+03	4.97+02	1.35+03
6.30+00	1.28+02	1.33+02	4.80+01	-1.66+06	7.13+00	4.10+02	4.66+03	4.90+02	1.35+03
6.40+00	1.27+02	1.32+02	4.80+01	-1.69+06	7.14+00	4.04+02	4.66+03	4.82+02	1.35+03
6.50+00	1.26+02	1.32+02	4.80+01	-1.73+06	7.15+00	3.98+02	4.66+03	4.75+02	1.35+03
6.60+00	1.25+02	1.31+02	4.80+01	-1.77+06	7.16+00	3.92+02	4.65+03	4.68+02	1.35+03
6.70+00	1.24+02	1.30+02	4.80+01	-1.81+06	7.17+00	3.87+02	4.65+03	4.61+02	1.35+03
6.80+00	1.23+02	1.30+02	4.80+01	-1.85+06	7.18+00	3.81+02	4.65+03	4.54+02	1.35+03
6.90+00	1.22+02	1.29+02	4.80+01	-1.89+06	7.19+00	3.76+02	4.65+03	4.47+02	1.35+03
7.00+00	1.21+02	1.29+02	4.80+01	-1.92+06	7.20+00	3.70+02	4.65+03	4.41+02	1.34+03
7.10+00	1.20+02	1.28+02	4.80+01	-1.96+06	7.21+00	3.65+02	4.65+03	4.34+02	1.34+03
7.20+00	1.19+02	1.28+02	4.80+01	-2.00+06	7.22+00	3.60+02	4.65+03	4.27+02	1.34+03
7.30+00	1.18+02	1.27+02	4.80+01	-2.03+06	7.23+00	3.54+02	4.65+03	4.21+02	1.34+03
7.40+00	1.17+02	1.27+02	4.80+01	-2.07+06	7.24+00	3.49+02	4.64+03	4.14+02	1.34+03
7.50+00	1.16+02	1.26+02	4.80+01	-2.10+06	7.24+00	3.44+02	4.64+03	4.08+02	1.34+03
7.60+00	1.15+02	1.26+02	4.80+01	-2.14+06	7.25+00	3.39+02	4.64+03	4.02+02	1.34+03
7.70+00	1.14+02	1.25+02	4.80+01	-2.17+06	7.26+00	3.34+02	4.64+03	3.95+02	1.34+03
7.80+00	1.13+02	1.25+02	4.80+01	-2.21+06	7.27+00	3.29+02	4.64+03	3.89+02	1.34+03
7.90+00	1.13+02	1.24+02	4.80+01	-2.24+06	7.28+00	3.24+02	4.64+03	3.83+02	1.34+03
8.00+00	1.12+02	1.23+02	4.80+01	-2.28+06	7.28+00	3.19+02	4.64+03	3.77+02	1.34+03
8.10+00	1.11+02	1.23+02	4.80+01	-2.31+06	7.29+00	3.14+02	4.64+03	3.71+02	1.34+03
8.20+00	1.10+02	1.22+02	4.80+01	-2.34+06	7.30+00	3.09+02	4.63+03	3.65+02	1.34+03
8.30+00	1.09+02	1.22+02	4.80+01	-2.37+06	7.31+00	3.05+02	4.63+03	3.59+02	1.34+03
8.40+00	1.09+02	1.21+02	4.80+01	-2.41+06	7.31+00	3.00+02	4.63+03	3.54+02	1.34+03

C-38

UCC
026717

COMPOSITION

TIME	PREFLASH GAS FLOW	PREFLASH VCM LTO. FLOW	PREFLASH H2O LTO. FLOW	FLASHED GAS FLOW	FLASHED VCM LTO. FLOW	FLASHED H2O LTO. FLOW	TOTAL PVL PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LTO. EMISSION L/MOLE
MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN			
5.20+00	6.42+01	1.47+00	1.31+01	6.81+01	.00	1.07+01	1.97+01	4.19+02	1.63+00
5.30+00	6.35+01	1.44+00	1.31+01	6.74+01	.00	1.07+01	1.98+01	4.25+02	1.63+00
5.40+00	6.29+01	1.42+00	1.30+01	6.66+01	.00	1.07+01	1.99+01	4.31+02	1.63+00
5.50+00	6.22+01	1.39+00	1.30+01	6.59+01	.00	1.07+01	2.01+01	4.38+02	1.63+00
5.60+00	6.15+01	1.37+00	1.29+01	6.51+01	.00	1.06+01	2.02+01	4.44+02	1.63+00
5.70+00	6.09+01	1.34+00	1.28+01	6.44+01	.00	1.06+01	2.03+01	4.50+02	1.63+00
5.80+00	6.02+01	1.32+00	1.28+01	6.37+01	.00	1.06+01	2.04+01	4.56+02	1.63+00
5.90+00	5.96+01	1.29+00	1.27+01	6.30+01	.00	1.06+01	2.05+01	4.62+02	1.63+00
6.00+00	5.90+01	1.27+00	1.27+01	6.23+01	.00	1.06+01	2.05+01	4.68+02	1.63+00
6.10+00	5.83+01	1.25+00	1.26+01	6.16+01	.00	1.06+01	2.06+01	4.74+02	1.63+00
6.20+00	5.77+01	1.22+00	1.26+01	6.09+01	.00	1.06+01	2.07+01	4.80+02	1.63+00
6.30+00	5.71+01	1.20+00	1.25+01	6.03+01	.00	1.05+01	2.08+01	4.86+02	1.63+00
6.40+00	5.65+01	1.16+00	1.24+01	5.96+01	.00	1.05+01	2.09+01	4.91+02	1.63+00
6.50+00	5.59+01	1.15+00	1.24+01	5.90+01	.00	1.05+01	2.09+01	4.97+02	1.63+00
6.60+00	5.53+01	1.13+00	1.23+01	5.83+01	.00	1.05+01	2.10+01	5.02+02	1.63+00
6.70+00	5.48+01	1.11+00	1.23+01	5.77+01	.00	1.05+01	2.11+01	5.08+02	1.63+00
6.80+00	5.42+01	1.09+00	1.22+01	5.71+01	.00	1.04+01	2.12+01	5.13+02	1.63+00
6.90+00	5.36+01	1.07+00	1.21+01	5.64+01	.00	1.04+01	2.12+01	5.19+02	1.63+00
7.00+00	5.31+01	1.05+00	1.21+01	5.58+01	.00	1.04+01	2.13+01	5.24+02	1.63+00
7.10+00	5.25+01	1.03+00	1.20+01	5.52+01	.00	1.04+01	2.13+01	5.30+02	1.63+00
7.20+00	5.20+01	1.01+00	1.20+01	5.46+01	.00	1.03+01	2.14+01	5.35+02	1.63+00
7.30+00	5.15+01	9.88-01	1.19+01	5.40+01	.00	1.03+01	2.15+01	5.40+02	1.63+00
7.40+00	5.09+01	9.68-01	1.18+01	5.35+01	.00	1.03+01	2.15+01	5.45+02	1.63+00
7.50+00	5.04+01	9.49-01	1.18+01	5.29+01	.00	1.03+01	2.16+01	5.50+02	1.63+00
7.60+00	4.99+01	9.30-01	1.17+01	5.23+01	.00	1.02+01	2.16+01	5.55+02	1.63+00
7.70+00	4.94+01	9.12-01	1.17+01	5.18+01	.00	1.02+01	2.17+01	5.60+02	1.63+00
7.80+00	4.89+01	8.93-01	1.16+01	5.12+01	.00	1.02+01	2.17+01	5.65+02	1.63+00
7.90+00	4.84+01	8.75-01	1.15+01	5.07+01	.00	1.01+01	2.18+01	5.70+02	1.63+00
8.00+00	4.79+01	8.57-01	1.15+01	5.01+01	.00	1.01+01	2.18+01	5.75+02	1.63+00
8.10+00	4.74+01	8.40-01	1.14+01	4.96+01	.00	1.01+01	2.18+01	5.80+02	1.63+00
8.20+00	4.69+01	8.23-01	1.14+01	4.91+01	.00	1.00+01	2.19+01	5.84+02	1.63+00
8.30+00	4.65+01	8.06-01	1.13+01	4.86+01	.00	1.00+01	2.19+01	5.89+02	1.63+00
8.40+00	4.60+01	7.89-01	1.12+01	4.81+01	.00	9.98+00	2.20+01	5.94+02	1.63+00

C-39

UCC
026718

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIO. LEFT IN REACTOR LBMOLE	H2O LIO. LEFT IN REACTOR LBMOLE	REACTOR VCM LIO. VOLUME CU FT	REACTOR H2O LIO. VOLUME CU FT
8.50+00	1.08+02	1.21+02	4.80+01	-2.44+06	7.32+00	2.95+02	4.63+03	3.48+02	1.34+03
8.60+00	1.07+02	1.21+02	4.80+01	-2.47+06	7.33+00	2.91+02	4.63+03	3.42+02	1.34+03
8.70+00	1.06+02	1.20+02	4.80+01	-2.50+06	7.34+00	2.86+02	4.63+03	3.37+02	1.34+03
8.80+00	1.06+02	1.20+02	4.80+01	-2.53+06	7.34+00	2.82+02	4.63+03	3.31+02	1.34+03
8.90+00	1.05+02	1.19+02	4.80+01	-2.56+06	7.35+00	2.77+02	4.63+03	3.26+02	1.34+03
9.00+00	1.04+02	1.19+02	4.80+01	-2.59+06	7.36+00	2.73+02	4.62+03	3.21+02	1.34+03
9.10+00	1.04+02	1.18+02	4.50+01	-2.62+06	7.36+00	2.69+02	4.62+03	3.15+02	1.34+03
9.20+00	1.03+02	1.18+02	4.80+01	-2.65+06	7.37+00	2.64+02	4.62+03	3.10+02	1.34+03
9.30+00	1.02+02	1.17+02	4.80+01	-2.68+06	7.38+00	2.60+02	4.62+03	3.05+02	1.34+03
9.40+00	1.02+02	1.17+02	4.80+01	-2.71+06	7.38+00	2.56+02	4.62+03	3.00+02	1.34+03
9.50+00	1.01+02	1.16+02	4.80+01	-2.74+06	7.39+00	2.52+02	4.62+03	2.95+02	1.34+03
9.60+00	1.00+02	1.16+02	4.80+01	-2.77+06	7.39+00	2.47+02	4.62+03	2.90+02	1.34+03
9.70+00	9.97+01	1.16+02	4.80+01	-2.80+06	7.40+00	2.43+02	4.62+03	2.85+02	1.34+03
9.80+00	9.91+01	1.15+02	4.80+01	-2.83+06	7.41+00	2.39+02	4.62+03	2.80+02	1.34+03
9.90+00	9.85+01	1.15+02	4.80+01	-2.85+06	7.41+00	2.35+02	4.61+03	2.75+02	1.33+03
1.00+01	9.79+01	1.14+02	4.80+01	-2.88+06	7.42+00	2.31+02	4.61+03	2.70+02	1.33+03

C-40

COMPOSITION

	PREFLASH GAS FLOW MIN MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVL PRODUCED LBMOLE	TOTAL VCM GAS EMISSION LBMOLE	TOTAL VCM LIQ. EMISSION LBMOLE
0.50+00	4.55+01	7.73-01	1.12+01	4.75+01	.00	9.94+00	2.20+01	5.98+02	1.63+00
0.60+00	4.51+01	7.57-01	1.11+01	4.70+01	.00	9.91+00	2.20+01	6.03+02	1.63+00
0.70+00	4.46+01	7.41-01	1.11+01	4.66+01	.00	9.87+00	2.21+01	6.07+02	1.63+00
0.80+00	4.42+01	7.25-01	1.10+01	4.61+01	.00	9.84+00	2.21+01	6.12+02	1.63+00
0.90+00	4.37+01	7.10-01	1.09+01	4.56+01	.00	9.80+00	2.21+01	6.16+02	1.63+00
1.00+00	4.33+01	6.94-01	1.09+01	4.51+01	.00	9.77+00	2.22+01	6.21+02	1.63+00
1.10+00	4.29+01	6.79-01	1.08+01	4.46+01	.00	9.73+00	2.22+01	6.25+02	1.63+00
1.20+00	4.25+01	6.65-01	1.08+01	4.42+01	.00	9.69+00	2.22+01	6.29+02	1.63+00
1.30+00	4.20+01	6.50-01	1.07+01	4.37+01	.00	9.65+00	2.23+01	6.33+02	1.63+00
1.40+00	4.16+01	6.36-01	1.06+01	4.33+01	.00	9.61+00	2.23+01	6.38+02	1.63+00
1.50+00	4.12+01	6.22-01	1.06+01	4.28+01	.00	9.57+00	2.23+01	6.42+02	1.63+00
1.60+00	4.08+01	6.08-01	1.05+01	4.24+01	.00	9.53+00	2.23+01	6.46+02	1.63+00
1.70+00	4.04+01	5.95-01	1.04+01	4.19+01	.00	9.49+00	2.24+01	6.50+02	1.63+00
1.80+00	4.00+01	5.81-01	1.04+01	4.15+01	.00	9.45+00	2.24+01	6.54+02	1.63+00
1.90+00	3.96+01	5.68-01	1.03+01	4.11+01	.00	9.41+00	2.24+01	6.58+02	1.63+00
1.00+01	3.92+01	5.55-01	1.03+01	4.06+01	.00	9.37+00	2.24+01	6.62+02	1.63+00

C-41

H IN

CORPORATION

DISCHARGE FROM A PVC BATCH REACTOR

Case 6. High Reactor Rate - Cold Water in Jacket

REACTOR PRESSURE AT TIME OF DISCHARGE = 214.79 PSIA	PRESSURE DOWNSTREAM OF VALVE = 64.70 PSIA
REACTOR TEMP AT TIME OF DISCHARGE = 116.50 F	WATER JACKET TEMP AT DISCHARGE = 90.00 F
REACTOR VOLUME = 2673.000 CU FT	HEAT OF REACTION = 45516.000 BTU/LBMOLE
LIQUID VCM INITIALLY IN REACTOR = 921.50 LBMOLE	LIQ H2O INITIALLY IN REACTOR = 4929.6 LBMOLE
VAPOR INITIALLY IN REACTOR = 2.9199 LBMOLE	JACKET COEF TIMES AREA = 895.6 BTU/M-F
DENSITY OF WATER (CONSTANT) = 3.4570 LBMOLE/CU FT	INITIAL DENSITY OF VCM = .79912 LBMOLE/CU FT
AREA OF RELIEF VALVE ORIFICE OPENING = .1369 SQ FT	ORIFICE FLOW COEFFICIENT = .610
MINIMUM LIQUID ENTRAINMENT = .0100 CU FT LIQ/CU FT GAS	MINIMUM WATER JACKET TEMP = 40.00 F
LIQ VOL WHEN MIN ENTRAINMENT IS REACHED = 2438.0 CU FT	TIME FOR JACKET TEMP IS REACHED = 5.00 MIN
HEATING JACKET FACTOR = 1.00	REACTION RATE FACTOR = 1.00

C-42

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
.00	2.15+02	1.68+02	9.00+01	9.66+05	2.99+00	9.21+02	4.93+03	1.15+03	1.43+03
1.00-01	2.15+02	1.68+02	8.92+01	9.62+05	3.48+00	9.14+02	4.90+03	1.14+03	1.42+03
2.00-01	2.15+02	1.69+02	8.83+01	9.97+05	3.97+00	9.06+02	4.87+03	1.13+03	1.41+03
3.00-01	2.15+02	1.69+02	8.75+01	1.01+06	4.45+00	8.98+02	4.84+03	1.12+03	1.40+03
4.00-01	2.15+02	1.69+02	8.66+01	1.01+06	4.91+00	8.91+02	4.82+03	1.11+03	1.39+03
5.00-01	2.16+02	1.69+02	8.58+01	1.02+06	5.37+00	8.82+02	4.79+03	1.10+03	1.39+03
6.00-01	2.16+02	1.69+02	8.50+01	1.01+06	5.68+00	8.74+02	4.77+03	1.09+03	1.38+03
7.00-01	2.16+02	1.69+02	8.41+01	9.92+05	5.97+00	8.65+02	4.76+03	1.08+03	1.38+03
8.00-01	2.14+02	1.68+02	8.33+01	9.56+05	6.16+00	8.56+02	4.75+03	1.07+03	1.37+03
9.00-01	2.12+02	1.68+02	8.24+01	8.97+05	6.19+00	8.45+02	4.74+03	1.06+03	1.37+03
1.00+00	2.10+02	1.67+02	8.16+01	8.37+05	6.22+00	8.34+02	4.74+03	1.04+03	1.37+03
1.10+00	2.08+02	1.66+02	8.08+01	7.77+05	6.24+00	8.24+02	4.74+03	1.03+03	1.37+03
1.20+00	2.05+02	1.65+02	7.99+01	7.16+05	6.27+00	8.13+02	4.74+03	1.01+03	1.37+03
1.30+00	2.03+02	1.65+02	7.91+01	6.56+05	6.29+00	8.03+02	4.74+03	1.00+03	1.37+03
1.40+00	2.01+02	1.64+02	7.82+01	5.95+05	6.31+00	7.93+02	4.73+03	9.87+02	1.37+03
1.50+00	1.99+02	1.63+02	7.74+01	5.35+05	6.34+00	7.83+02	4.73+03	9.73+02	1.37+03
1.60+00	1.97+02	1.62+02	7.66+01	4.74+05	6.36+00	7.73+02	4.73+03	9.60+02	1.37+03
1.70+00	1.94+02	1.62+02	7.57+01	4.14+05	6.38+00	7.64+02	4.73+03	9.47+02	1.37+03
1.80+00	1.92+02	1.61+02	7.49+01	3.54+05	6.40+00	7.54+02	4.73+03	9.35+02	1.37+03

CONFORMATION

TIME MIN	PREFLASH GAS FLOW MOLE/HR	PREFLASH VCM LTO. FLOW MOLE/HR	PREFLASH H2O LTO. FLOW MOLE/HR	FLASHED GAS FLOW MOLE/HR	FLASHED VCM LTO. FLOW MOLE/HR	FLASHED H2O LTO. FLOW MOLE/HR	TOTAL PVC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LTO. EMISSION L/MOLE
.00	7.65+01	6.23+01	2.90+02	5.83+01	5.20+00	2.98+02	.00	.00	.00
1.00-01	5.64+00	6.03+01	2.89+02	5.99+01	4.67+00	2.89+02	6.97-01	5.95+00	5.09-01
2.00-01	7.53+00	5.80+01	2.79+02	6.21+01	3.92+00	2.79+02	1.39+00	1.20+01	9.40-01
3.00-01	1.22+01	5.51+01	2.66+02	1.47+01	3.03+00	2.65+02	2.09+00	1.82+01	1.29+00
4.00-01	1.63+01	5.13+01	2.49+02	2.81+01	1.96+00	2.48+02	2.78+00	2.40+01	1.54+00
5.00-01	2.65+01	4.63+01	2.25+02	7.26+01	6.18-01	2.25+02	3.47+00	3.17+01	1.67+00
6.00-01	3.72+01	3.85+01	1.80+02	8.61+01	.00	1.84+02	4.15+00	3.90+01	1.60+00
7.00-01	5.51+01	2.89+01	1.42+02	8.67+01	.00	1.38+02	4.83+00	4.66+01	1.68+00
8.00-01	8.73+01	1.21+01	6.00+01	1.05+02	.00	5.48+01	5.49+00	5.57+01	1.68+00
9.00-01	9.99+01	2.92+00	1.47+01	1.08+02	.00	9.46+00	6.13+00	6.58+01	1.68+00
1.00+00	9.80+01	2.88+00	1.47+01	1.07+02	.00	9.53+00	6.74+00	7.57+01	1.68+00
1.10+00	9.78+01	2.84+00	1.46+01	1.06+02	.00	9.59+00	7.33+00	8.56+01	1.68+00
1.20+00	9.67+01	2.80+00	1.46+01	1.04+02	.00	9.65+00	7.89+00	9.53+01	1.68+00
1.30+00	9.56+01	2.75+00	1.46+01	1.03+02	.00	9.70+00	8.43+00	1.05+02	1.68+00
1.40+00	9.45+01	2.71+00	1.45+01	1.02+02	.00	9.76+00	8.95+00	1.15+02	1.68+00
1.50+00	9.35+01	2.67+00	1.45+01	1.01+02	.00	9.81+00	9.45+00	1.24+02	1.68+00
1.60+00	9.24+01	2.63+00	1.45+01	9.96+01	.00	9.86+00	9.93+00	1.33+02	1.68+00
1.70+00	9.13+01	2.59+00	1.44+01	9.84+01	.00	9.90+00	1.04+01	1.42+02	1.68+00
1.80+00	9.02+01	2.55+00	1.44+01	9.72+01	.00	9.95+00	1.08+01	1.52+02	1.68+00

C-43

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CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT COEFFICIENT	GAS LEFT IN REACTOR LB MOLE	VCM LIQ. LEFT IN REACTOR LB MOLE	H2O LIQ. LEFT IN REACTOR LB MOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
1.90+00	1.90+02	1.60+02	7.40+01	2.93+05	6.42+00	7.45+02	4.75+03	9.22+02	1.37+03
2.00+00	1.86+02	1.59+02	7.32+01	2.33+05	6.44+00	7.35+02	4.72+03	9.10+02	1.37+03
2.10+00	1.86+02	1.59+02	7.24+01	1.73+05	6.46+00	7.26+02	4.72+03	8.97+02	1.37+03
2.20+00	1.84+02	1.58+02	7.15+01	1.14+05	6.48+00	7.17+02	4.72+03	8.85+02	1.37+03
2.30+00	1.82+02	1.57+02	7.07+01	5.41+04	6.50+00	7.08+02	4.72+03	8.73+02	1.37+03
2.40+00	1.80+02	1.56+02	6.98+01	-5.23+03	6.52+00	6.99+02	4.72+03	8.62+02	1.36+03
2.50+00	1.78+02	1.55+02	6.90+01	-6.43+04	6.54+00	6.90+02	4.72+03	8.50+02	1.36+03
2.60+00	1.76+02	1.55+02	6.82+01	-1.23+05	6.56+00	6.82+02	4.72+03	8.38+02	1.36+03
2.70+00	1.74+02	1.54+02	6.73+01	-1.02+05	6.58+00	6.73+02	4.71+03	8.27+02	1.36+03
2.80+00	1.72+02	1.53+02	6.65+01	-2.40+05	6.59+00	6.65+02	4.71+03	8.16+02	1.36+03
2.90+00	1.70+02	1.52+02	6.56+01	-2.98+05	6.61+00	6.57+02	4.71+03	8.05+02	1.36+03
3.00+00	1.68+02	1.52+02	6.48+01	-3.55+05	6.63+00	6.48+02	4.71+03	7.94+02	1.36+03
3.10+00	1.66+02	1.51+02	6.40+01	-4.12+05	6.64+00	6.40+02	4.71+03	7.84+02	1.36+03
3.20+00	1.64+02	1.50+02	6.31+01	-4.69+05	6.66+00	6.32+02	4.71+03	7.73+02	1.36+03
3.30+00	1.62+02	1.49+02	6.23+01	-5.26+05	6.68+00	6.25+02	4.70+03	7.63+02	1.36+03
3.40+00	1.61+02	1.49+02	6.14+01	-5.82+05	6.69+00	6.17+02	4.70+03	7.53+02	1.36+03
3.50+00	1.59+02	1.48+02	6.06+01	-6.38+05	6.71+00	6.09+02	4.70+03	7.42+02	1.36+03
3.60+00	1.57+02	1.47+02	5.98+01	-6.93+05	6.72+00	6.02+02	4.70+03	7.33+02	1.36+03
3.70+00	1.55+02	1.46+02	5.89+01	-7.48+05	6.74+00	5.94+02	4.70+03	7.23+02	1.36+03
3.80+00	1.54+02	1.45+02	5.81+01	-8.03+05	6.75+00	5.87+02	4.70+03	7.13+02	1.36+03
3.90+00	1.52+02	1.45+02	5.72+01	-8.57+05	6.77+00	5.79+02	4.70+03	7.04+02	1.36+03
4.00+00	1.50+02	1.44+02	5.64+01	-9.11+05	6.78+00	5.72+02	4.69+03	6.94+02	1.36+03
4.10+00	1.49+02	1.43+02	5.56+01	-9.64+05	6.79+00	5.65+02	4.69+03	6.85+02	1.36+03
4.20+00	1.47+02	1.43+02	5.47+01	-1.02+06	6.81+00	5.58+02	4.69+03	6.76+02	1.36+03
4.30+00	1.46+02	1.42+02	5.39+01	-1.07+06	6.82+00	5.51+02	4.69+03	6.67+02	1.36+03
4.40+00	1.44+02	1.41+02	5.30+01	-1.12+06	6.83+00	5.44+02	4.69+03	6.58+02	1.36+03
4.50+00	1.43+02	1.40+02	5.22+01	-1.17+06	6.85+00	5.38+02	4.69+03	6.49+02	1.36+03
4.60+00	1.41+02	1.40+02	5.14+01	-1.23+06	6.86+00	5.31+02	4.69+03	6.41+02	1.36+03
4.70+00	1.40+02	1.39+02	5.05+01	-1.28+06	6.87+00	5.24+02	4.68+03	6.32+02	1.35+03
4.80+00	1.38+02	1.38+02	4.97+01	-1.33+06	6.88+00	5.18+02	4.68+03	6.24+02	1.35+03
4.90+00	1.37+02	1.37+02	4.88+01	-1.38+06	6.89+00	5.12+02	4.68+03	6.15+02	1.35+03
5.00+00	1.35+02	1.37+02	4.80+01	-1.43+06	6.90+00	5.05+02	4.68+03	6.07+02	1.35+03
5.10+00	1.34+02	1.36+02	4.70+01	-1.48+06	6.92+00	4.99+02	4.68+03	5.99+02	1.35+03

C-44

UCC
026723

COMPORATION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED LB/MOLE	TOTAL VCM GAS EMISSION LB/MOLE	TOTAL VCM LIQ. EMISSION LB/MOLE
1.90+00	8.92+01	2.51+00	1.43+01	9.41+01	.00	9.99+00	1.12+01	1.61+02	1.60+00
2.00+00	8.82+01	2.47+00	1.43+01	9.49+01	.00	1.00+01	1.16+01	1.69+02	1.60+00
2.10+00	8.71+01	2.43+00	1.42+01	9.57+01	.00	1.01+01	1.20+01	1.78+02	1.60+00
2.20+00	8.61+01	2.39+00	1.42+01	9.66+01	.00	1.01+01	1.24+01	1.87+02	1.68+00
2.30+00	8.51+01	2.35+00	1.41+01	9.74+01	.00	1.01+01	1.28+01	1.96+02	1.68+00
2.40+00	8.40+01	2.31+00	1.41+01	9.83+01	.00	1.02+01	1.31+01	2.04+02	1.68+00
2.50+00	8.30+01	2.28+00	1.40+01	9.92+01	.00	1.02+01	1.34+01	2.12+02	1.68+00
2.60+00	8.20+01	2.24+00	1.40+01	1.00+01	.00	1.02+01	1.37+01	2.21+02	1.68+00
2.70+00	8.11+01	2.20+00	1.39+01	1.09+01	.00	1.02+01	1.40+01	2.29+02	1.68+00
2.80+00	8.01+01	2.16+00	1.39+01	1.18+01	.00	1.03+01	1.43+01	2.37+02	1.68+00
2.90+00	7.91+01	2.13+00	1.38+01	1.27+01	.00	1.03+01	1.46+01	2.45+02	1.68+00
3.00+00	7.81+01	2.09+00	1.38+01	1.37+01	.00	1.03+01	1.49+01	2.53+02	1.68+00
3.10+00	7.72+01	2.06+00	1.37+01	1.46+01	.00	1.03+01	1.51+01	2.61+02	1.68+00
3.20+00	7.63+01	2.02+00	1.36+01	1.56+01	.00	1.03+01	1.54+01	2.68+02	1.68+00
3.30+00	7.53+01	1.99+00	1.36+01	1.66+01	.00	1.03+01	1.56+01	2.76+02	1.68+00
3.40+00	7.44+01	1.95+00	1.35+01	1.75+01	.00	1.04+01	1.58+01	2.84+02	1.68+00
3.50+00	7.35+01	1.92+00	1.34+01	1.85+01	.00	1.04+01	1.60+01	2.91+02	1.68+00
3.60+00	7.26+01	1.89+00	1.34+01	1.95+01	.00	1.04+01	1.62+01	2.98+02	1.68+00
3.70+00	7.17+01	1.85+00	1.33+01	2.05+01	.00	1.04+01	1.64+01	3.06+02	1.68+00
3.80+00	7.09+01	1.82+00	1.33+01	2.16+01	.00	1.04+01	1.66+01	3.13+02	1.68+00
3.90+00	7.00+01	1.79+00	1.32+01	2.27+01	.00	1.04+01	1.68+01	3.20+02	1.68+00
4.00+00	6.92+01	1.76+00	1.31+01	2.37+01	.00	1.04+01	1.70+01	3.27+02	1.68+00
4.10+00	6.83+01	1.73+00	1.31+01	2.47+01	.00	1.04+01	1.71+01	3.34+02	1.68+00
4.20+00	6.75+01	1.70+00	1.30+01	2.58+01	.00	1.04+01	1.73+01	3.41+02	1.68+00
4.30+00	6.67+01	1.67+00	1.29+01	2.69+01	.00	1.04+01	1.75+01	3.47+02	1.68+00
4.40+00	6.59+01	1.64+00	1.29+01	2.80+01	.00	1.03+01	1.76+01	3.54+02	1.68+00
4.50+00	6.51+01	1.61+00	1.28+01	2.91+01	.00	1.03+01	1.77+01	3.61+02	1.68+00
4.60+00	6.43+01	1.58+00	1.27+01	3.03+01	.00	1.03+01	1.79+01	3.67+02	1.68+00
4.70+00	6.35+01	1.55+00	1.27+01	3.14+01	.00	1.03+01	1.80+01	3.74+02	1.68+00
4.80+00	6.26+01	1.52+00	1.27+01	3.26+01	.00	1.03+01	1.81+01	3.80+02	1.68+00
4.90+00	6.18+01	1.50+00	1.25+01	3.37+01	.00	1.03+01	1.83+01	3.86+02	1.68+00
5.00+00	6.10+01	1.47+00	1.24+01	3.49+01	.00	1.03+01	1.84+01	3.92+02	1.68+00
5.10+00	6.02+01	1.44+00	1.24+01	3.61+01	.00	1.03+01	1.85+01	3.99+02	1.68+00

C-45

UCC
026724

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
5.20+00	1.33+02	1.35+02	4.80+01	-1.52+06	6.93+00	4.93+02	4.68+03	5.91+02	1.35+03
5.30+00	1.31+02	1.35+02	4.80+01	-1.57+06	6.94+00	4.87+02	4.68+03	5.83+02	1.35+03
5.40+00	1.30+02	1.34+02	4.80+01	-1.62+06	6.95+00	4.81+02	4.67+03	5.76+02	1.35+03
5.50+00	1.29+02	1.33+02	4.80+01	-1.67+06	6.96+00	4.75+02	4.67+03	5.68+02	1.35+03
5.60+00	1.28+02	1.33+02	4.80+01	-1.71+06	6.97+00	4.69+02	4.67+03	5.61+02	1.35+03
5.70+00	1.26+02	1.32+02	4.80+01	-1.76+06	6.98+00	4.63+02	4.67+03	5.53+02	1.35+03
5.80+00	1.25+02	1.31+02	4.80+01	-1.81+06	6.99+00	4.57+02	4.67+03	5.46+02	1.35+03
5.90+00	1.24+02	1.31+02	4.80+01	-1.85+06	7.00+00	4.52+02	4.67+03	5.39+02	1.35+03
6.00+00	1.23+02	1.30+02	4.80+01	-1.90+06	7.01+00	4.46+02	4.67+03	5.32+02	1.35+03
6.10+00	1.22+02	1.29+02	4.80+01	-1.94+06	7.02+00	4.41+02	4.67+03	5.25+02	1.35+03
6.20+00	1.21+02	1.29+02	4.80+01	-1.99+06	7.03+00	4.35+02	4.66+03	5.18+02	1.35+03
6.30+00	1.20+02	1.28+02	4.80+01	-2.03+06	7.04+00	4.30+02	4.66+03	5.11+02	1.35+03
6.40+00	1.19+02	1.28+02	4.80+01	-2.07+06	7.04+00	4.24+02	4.66+03	5.04+02	1.35+03
6.50+00	1.18+02	1.27+02	4.80+01	-2.11+06	7.05+00	4.19+02	4.66+03	4.98+02	1.35+03
6.60+00	1.17+02	1.26+02	4.80+01	-2.16+06	7.06+00	4.14+02	4.66+03	4.91+02	1.35+03
6.70+00	1.16+02	1.26+02	4.80+01	-2.20+06	7.07+00	4.09+02	4.66+03	4.85+02	1.35+03
6.80+00	1.15+02	1.25+02	4.80+01	-2.24+06	7.08+00	4.04+02	4.66+03	4.78+02	1.35+03
6.90+00	1.14+02	1.25+02	4.80+01	-2.28+06	7.09+00	3.99+02	4.66+03	4.72+02	1.35+03
7.00+00	1.13+02	1.24+02	4.80+01	-2.32+06	7.09+00	3.94+02	4.65+03	4.66+02	1.35+03
7.10+00	1.12+02	1.23+02	4.80+01	-2.36+06	7.10+00	3.89+02	4.65+03	4.60+02	1.35+03
7.20+00	1.11+02	1.23+02	4.80+01	-2.40+06	7.11+00	3.84+02	4.65+03	4.53+02	1.35+03
7.30+00	1.10+02	1.22+02	4.80+01	-2.44+06	7.12+00	3.79+02	4.65+03	4.47+02	1.35+03
7.40+00	1.09+02	1.22+02	4.80+01	-2.48+06	7.13+00	3.74+02	4.65+03	4.42+02	1.35+03
7.50+00	1.08+02	1.21+02	4.80+01	-2.52+06	7.13+00	3.70+02	4.65+03	4.36+02	1.34+03
7.60+00	1.07+02	1.21+02	4.80+01	-2.55+06	7.14+00	3.65+02	4.65+03	4.30+02	1.34+03
7.70+00	1.06+02	1.20+02	4.80+01	-2.59+06	7.15+00	3.61+02	4.65+03	4.24+02	1.34+03
7.80+00	1.06+02	1.20+02	4.80+01	-2.63+06	7.15+00	3.56+02	4.65+03	4.19+02	1.34+03
7.90+00	1.05+02	1.19+02	4.80+01	-2.67+06	7.16+00	3.52+02	4.64+03	4.13+02	1.34+03
8.00+00	1.04+02	1.19+02	4.80+01	-2.70+06	7.17+00	3.47+02	4.64+03	4.08+02	1.34+03
8.10+00	1.03+02	1.18+02	4.80+01	-2.74+06	7.17+00	3.43+02	4.64+03	4.02+02	1.34+03
8.20+00	1.03+02	1.18+02	4.80+01	-2.77+06	7.18+00	3.38+02	4.64+03	3.97+02	1.34+03
8.30+00	1.02+02	1.17+02	4.80+01	-2.81+06	7.19+00	3.34+02	4.64+03	3.92+02	1.34+03
8.40+00	1.01+02	1.17+02	4.80+01	-2.84+06	7.19+00	3.30+02	4.64+03	3.87+02	1.34+03

C-46

UCC
026725

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED LBMOL	TOTAL VCM GAS EMISSION LBMOL	TOTAL VCM LIQ. EMISSION LBMOL
5.20+00	5.90+01	1.42+00	1.23+01	6.33+01	.00	1.02+01	1.86+01	4.05+02	1.60+00
5.30+00	5.91+01	1.39+00	1.22+01	6.25+01	.00	1.02+01	1.87+01	4.11+02	1.60+00
5.40+00	5.84+01	1.37+00	1.22+01	6.17+01	.00	1.02+01	1.88+01	4.17+02	1.60+00
5.50+00	5.77+01	1.34+00	1.21+01	6.10+01	.00	1.02+01	1.89+01	4.22+02	1.60+00
5.60+00	5.70+01	1.32+00	1.20+01	6.02+01	.00	1.01+01	1.90+01	4.28+02	1.60+00
5.70+00	5.63+01	1.29+00	1.19+01	5.95+01	.00	1.01+01	1.91+01	4.34+02	1.60+00
5.80+00	5.57+01	1.27+00	1.19+01	5.87+01	.00	1.01+01	1.92+01	4.39+02	1.60+00
5.90+00	5.50+01	1.25+00	1.18+01	5.80+01	.00	1.01+01	1.92+01	4.45+02	1.60+00
6.00+00	5.44+01	1.22+00	1.17+01	5.73+01	.00	1.00+01	1.93+01	4.51+02	1.60+00
6.10+00	5.37+01	1.20+00	1.17+01	5.66+01	.00	1.00+01	1.94+01	4.56+02	1.60+00
6.20+00	5.31+01	1.18+00	1.16+01	5.59+01	.00	9.97+00	1.95+01	4.61+02	1.60+00
6.30+00	5.25+01	1.16+00	1.15+01	5.52+01	.00	9.94+00	1.95+01	4.67+02	1.60+00
6.40+00	5.19+01	1.13+00	1.15+01	5.46+01	.00	9.91+00	1.96+01	4.72+02	1.60+00
6.50+00	5.13+01	1.11+00	1.14+01	5.39+01	.00	9.88+00	1.97+01	4.77+02	1.60+00
6.60+00	5.07+01	1.09+00	1.13+01	5.33+01	.00	9.84+00	1.97+01	4.82+02	1.60+00
6.70+00	5.01+01	1.07+00	1.12+01	5.26+01	.00	9.81+00	1.98+01	4.87+02	1.60+00
6.80+00	4.95+01	1.05+00	1.12+01	5.20+01	.00	9.77+00	1.99+01	4.92+02	1.60+00
6.90+00	4.90+01	1.03+00	1.11+01	5.14+01	.00	9.74+00	1.99+01	4.97+02	1.60+00
7.00+00	4.84+01	1.01+00	1.10+01	5.08+01	.00	9.70+00	2.00+01	5.02+02	1.60+00
7.10+00	4.79+01	9.93-01	1.10+01	5.01+01	.00	9.66+00	2.00+01	5.07+02	1.60+00
7.20+00	4.73+01	9.75-01	1.09+01	4.95+01	.00	9.62+00	2.01+01	5.12+02	1.60+00
7.30+00	4.68+01	9.56-01	1.08+01	4.90+01	.00	9.58+00	2.01+01	5.17+02	1.60+00
7.40+00	4.62+01	9.38-01	1.07+01	4.84+01	.00	9.54+00	2.02+01	5.21+02	1.60+00
7.50+00	4.57+01	9.20-01	1.07+01	4.78+01	.00	9.50+00	2.02+01	5.26+02	1.60+00
7.60+00	4.52+01	9.02-01	1.06+01	4.72+01	.00	9.46+00	2.03+01	5.30+02	1.60+00
7.70+00	4.47+01	8.85-01	1.05+01	4.67+01	.00	9.42+00	2.03+01	5.35+02	1.60+00
7.80+00	4.42+01	8.68-01	1.05+01	4.61+01	.00	9.38+00	2.03+01	5.39+02	1.60+00
7.90+00	4.37+01	8.51-01	1.04+01	4.56+01	.00	9.34+00	2.04+01	5.44+02	1.60+00
8.00+00	4.32+01	8.35-01	1.03+01	4.51+01	.00	9.29+00	2.04+01	5.48+02	1.60+00
8.10+00	4.27+01	8.18-01	1.02+01	4.45+01	.00	9.25+00	2.05+01	5.52+02	1.60+00
8.20+00	4.22+01	8.02-01	1.02+01	4.40+01	.00	9.20+00	2.05+01	5.57+02	1.60+00
8.30+00	4.16+01	7.87-01	1.01+01	4.35+01	.00	9.16+00	2.05+01	5.61+02	1.60+00
8.40+00	4.13+01	7.71-01	1.00+01	4.30+01	.00	9.11+00	2.06+01	5.65+02	1.60+00

C-47

UCC
026726

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT COEFFICIENT	GAS LEFT IN REACTOR LBMOLE	VCN LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCN LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
8.50+00	1.00+02	1.16+02	4.80+01	-2.88+06	7.20+00	3.26+02	4.64+03	3.81+02	1.34+03
8.60+00	9.97+01	1.16+02	4.80+01	-2.91+06	7.21+00	3.22+02	4.64+03	3.76+02	1.34+03
8.70+00	9.90+01	1.15+02	4.80+01	-2.95+06	7.21+00	3.18+02	4.64+03	3.71+02	1.34+03
8.80+00	9.83+01	1.15+02	4.80+01	-2.98+06	7.22+00	3.14+02	4.63+03	3.67+02	1.34+03
8.90+00	9.76+01	1.14+02	4.80+01	-3.01+06	7.22+00	3.10+02	4.63+03	3.62+02	1.34+03
9.00+00	9.70+01	1.14+02	4.80+01	-3.04+06	7.23+00	3.06+02	4.63+03	3.57+02	1.34+03
9.10+00	9.63+01	1.13+02	4.80+01	-3.08+06	7.23+00	3.02+02	4.63+03	3.52+02	1.34+03
9.20+00	9.57+01	1.13+02	4.80+01	-3.11+06	7.24+00	2.98+02	4.63+03	3.47+02	1.34+03
9.30+00	9.51+01	1.12+02	4.80+01	-3.14+06	7.25+00	2.94+02	4.63+03	3.43+02	1.34+03
9.40+00	9.45+01	1.12+02	4.80+01	-3.17+06	7.25+00	2.90+02	4.63+03	3.38+02	1.34+03
9.50+00	9.39+01	1.11+02	4.80+01	-3.20+06	7.26+00	2.87+02	4.63+03	3.34+02	1.34+03
9.60+00	9.33+01	1.11+02	4.80+01	-3.23+06	7.26+00	2.83+02	4.63+03	3.29+02	1.34+03
9.70+00	9.27+01	1.10+02	4.80+01	-3.26+06	7.27+00	2.79+02	4.63+03	3.25+02	1.34+03
9.80+00	9.21+01	1.10+02	4.80+01	-3.29+06	7.27+00	2.76+02	4.63+03	3.20+02	1.34+03
9.90+00	9.16+01	1.10+02	4.80+01	-3.32+06	7.28+00	2.72+02	4.62+03	3.16+02	1.34+03
1.00+01	9.10+01	1.09+02	4.80+01	-3.35+06	7.28+00	2.69+02	4.62+03	3.12+02	1.34+03

C-48

COMPOSITION

TIME MIN	PREFLASH GAS FLOW	PREFLASH VCM L10. FLOW	PREFLASH H2O L10. FLOW	FLASHED GAS FLOW	FLASHED VCM L10. FLOW	FLASHED H2O L10. FLOW	TOTAL PVL PRODUCED	TOTAL VCM GAS EMISSION	TOTAL VCM L10. EMISSION
	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	LBMOLE	LBMOLE	LBMOLE
8.50+00	4.06+01	7.56-01	9.97+00	4.25+01	.00	9.07+00	2.06+01	5.69+02	1.60+00
8.60+00	4.04+01	7.41-01	9.89+00	4.20+01	.00	9.02+00	2.06+01	5.73+02	1.60+00
8.70+00	3.99+01	7.27-01	9.82+00	4.15+01	.00	8.97+00	2.07+01	5.77+02	1.60+00
8.80+00	3.95+01	7.12-01	9.75+00	4.10+01	.00	8.93+00	2.07+01	5.81+02	1.60+00
8.90+00	3.90+01	6.98-01	9.68+00	4.05+01	.00	8.88+00	2.07+01	5.85+02	1.60+00
9.00+00	3.86+01	6.84-01	9.61+00	4.01+01	.00	8.83+00	2.08+01	5.89+02	1.60+00
9.10+00	3.82+01	6.71-01	9.54+00	3.96+01	.00	8.78+00	2.08+01	5.93+02	1.60+00
9.20+00	3.77+01	6.57-01	9.47+00	3.91+01	.00	8.73+00	2.08+01	5.97+02	1.60+00
9.30+00	3.73+01	6.44-01	9.40+00	3.87+01	.00	8.68+00	2.08+01	6.01+02	1.60+00
9.40+00	3.69+01	6.31-01	9.33+00	3.82+01	.00	8.63+00	2.09+01	6.04+02	1.60+00
9.50+00	3.65+01	6.18-01	9.26+00	3.78+01	.00	8.58+00	2.09+01	6.08+02	1.60+00
9.60+00	3.61+01	6.06-01	9.19+00	3.73+01	.00	8.53+00	2.09+01	6.12+02	1.60+00
9.70+00	3.57+01	5.93-01	9.12+00	3.69+01	.00	8.48+00	2.09+01	6.15+02	1.60+00
9.80+00	3.53+01	5.81-01	9.05+00	3.65+01	.00	8.43+00	2.10+01	6.19+02	1.60+00
9.90+00	3.49+01	5.69-01	8.98+00	3.61+01	.00	8.37+00	2.10+01	6.22+02	1.60+00
1.00+01	3.45+01	5.57-01	8.91+00	3.56+01	.00	8.32+00	2.10+01	6.26+02	1.60+00

C-49

#14

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CORPORATION

DISCHARGE FROM A PVC BATCH REACTOR

Case 7. High Reactor Rate - Zero Heat Removal

REACTOR PRESSURE AT TIME OF DISCHARGE = 214.79 PSIA	PRESSURE DOWNSTREAM OF VALVE = 64.70 PSIA
REACTOR TEMP AT TIME OF DISCHARGE = 168.50 F	WATER JACKET TEMP AT DISCHARGE = 70.00 F
REACTOR VOLUME = 2673.000 CU FT	HEAT OF REACTION = 45516.000 BTU/LBMOLE
LIQUID VCM INITIALLY IN REACTOR = 921.50 LBMOLE	LIO H2O INITIALLY IN REACTOR = 4929.6 LBMOLE
VAPOR INITIALLY IN REACTOR = 2.9699 LBMOLE	JACKET COEF TIMES AREA = 895.6 BTU/MIN F
DENSITY OF WATER (CONSTANT) = 3.4570 LBMOLE/CU FT	INITIAL DENSITY OF VCM = .79912 LBMOLE/CU FT
AREA OF RELIEF VALVE ORIFICE OPENING = .2776 SQ FT	ORIFICE FLOW COEFFICIENT = .610
MINIMUM LIQUID ENTRAINMENT = .0100 CU FT LIO/CU FT GAS	MINIMUM WATER JACKET TEMP = 40.00 F
LIQ VOL WHEN MIN ENTRAINMENT IS REACHED = 2438.0 CU FT	TIME MIN JACKET TEMP IS REACHED = 5.00 MIN
HEATING JACKET FACTOR = .00	REACTION RATE FACTOR = 1.50

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIO. LEFT IN REACTOR LBMOLE	H2O LIO. LEFT IN REACTOR LBMOLE	REACTOR VCM LIO. VOLUME CU FT	REACTOR H2O LIO. VOLUME CU FT
0.00	2.15+02	1.68+02	9.00+01	9.66+05	2.99+00	9.21+02	4.93+03	1.15+03	1.43+03
1.00-01	2.15+02	1.68+02	8.92+01	9.79+05	3.94+00	9.07+02	4.87+03	1.13+03	1.41+03
2.00-01	2.15+02	1.68+02	8.83+01	9.80+05	4.87+00	8.92+02	4.82+03	1.12+03	1.39+03
3.00-01	2.14+02	1.68+02	8.75+01	9.59+05	5.65+00	8.76+02	4.77+03	1.10+03	1.38+03
4.00-01	2.12+02	1.68+02	8.66+01	8.96+05	6.14+00	8.59+02	4.74+03	1.07+03	1.37+03
5.00-01	2.07+02	1.66+02	8.58+01	7.66+05	6.22+00	8.38+02	4.74+03	1.05+03	1.37+03
6.00-01	2.02+02	1.64+02	8.50+01	6.57+05	6.26+00	8.18+02	4.74+03	1.02+03	1.37+03
7.00-01	1.98+02	1.63+02	8.41+01	5.09+05	6.31+00	7.99+02	4.73+03	9.93+02	1.37+03
8.00-01	1.93+02	1.61+02	8.33+01	3.83+05	6.35+00	7.80+02	4.73+03	9.67+02	1.37+03
9.00-01	1.89+02	1.60+02	8.24+01	2.59+05	6.39+00	7.61+02	4.73+03	9.42+02	1.37+03
1.00+00	1.85+02	1.58+02	8.16+01	1.38+05	6.43+00	7.43+02	4.72+03	9.18+02	1.37+03
1.10+00	1.81+02	1.57+02	8.08+01	1.89+04	6.47+00	7.26+02	4.72+03	8.95+02	1.37+03
1.20+00	1.77+02	1.55+02	7.99+01	-9.80+04	6.51+00	7.09+02	4.72+03	8.72+02	1.36+03
1.30+00	1.73+02	1.54+02	7.91+01	-2.13+05	6.55+00	6.92+02	4.71+03	8.50+02	1.36+03
1.40+00	1.69+02	1.52+02	7.82+01	-3.25+05	6.58+00	6.76+02	4.71+03	8.28+02	1.36+03
1.50+00	1.65+02	1.51+02	7.74+01	-4.35+05	6.61+00	6.60+02	4.71+03	8.07+02	1.36+03
1.60+00	1.62+02	1.49+02	7.66+01	-5.43+05	6.64+00	6.44+02	4.70+03	7.86+02	1.36+03
1.70+00	1.59+02	1.48+02	7.57+01	-6.49+05	6.68+00	6.29+02	4.70+03	7.67+02	1.36+03
1.80+00	1.55+02	1.46+02	7.49+01	-7.53+05	6.71+00	6.14+02	4.70+03	7.47+02	1.36+03

C-50

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CORPORATION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIO. FLOW MOLE/MIN	PREFLASH H2O LIO. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIO. FLOW MOLE/MIN	FLASHED H2O LIO. FLOW MOLE/MIN	TOTAL PVL PRODUCED LBMOL	TOTAL VCM GAS EMISSION LBMOL	TOTAL VCM LIO. EMISSION LBMOL
00	1.53+00	1.25+02	5.97+02	1.17+02	1.04+01	5.96+02	.00	.00	.00
1.00-01	1.49+01	1.16+02	5.58+02	1.24+02	8.14+00	5.57+02	6.94-01	1.21+01	9.61-01
2.00-01	3.56+01	1.03+02	4.98+02	1.35+02	4.55+00	4.97+02	1.38+00	2.48+01	1.61+00
3.00-01	7.13+01	7.82+01	3.81+02	1.58+02	.00	3.73+02	2.05+00	3.89+01	1.81+00
4.00-01	1.61+02	3.04+01	1.50+02	2.02+02	.00	1.40+02	2.70+00	5.63+01	1.81+00
5.00-01	1.95+02	5.72+00	2.90+01	2.11+02	.00	1.90+01	3.31+00	7.50+01	1.81+00
6.00-01	1.90+02	5.55+00	2.88+01	2.06+02	.00	1.92+01	3.67+00	9.43+01	1.81+00
7.00-01	1.86+02	5.38+00	2.87+01	2.00+02	.00	1.94+01	4.38+00	1.13+02	1.81+00
8.00-01	1.81+02	5.22+00	2.85+01	1.96+02	.00	1.96+01	4.85+00	1.32+02	1.81+00
9.00-01	1.77+02	5.06+00	2.83+01	1.91+02	.00	1.97+01	5.28+00	1.50+02	1.81+00
1.00+00	1.73+02	4.90+00	2.81+01	1.86+02	.00	1.99+01	5.68+00	1.67+02	1.81+00
1.10+00	1.69+02	4.75+00	2.79+01	1.82+02	.00	2.00+01	6.05+00	1.84+02	1.81+00
1.20+00	1.65+02	4.60+00	2.77+01	1.77+02	.00	2.01+01	6.38+00	2.01+02	1.81+00
1.30+00	1.61+02	4.46+00	2.74+01	1.73+02	.00	2.02+01	6.69+00	2.18+02	1.81+00
1.40+00	1.57+02	4.32+00	2.72+01	1.69+02	.00	2.03+01	6.98+00	2.34+02	1.81+00
1.50+00	1.54+02	4.18+00	2.70+01	1.65+02	.00	2.04+01	7.24+00	2.49+02	1.81+00
1.60+00	1.50+02	4.05+00	2.68+01	1.61+02	.00	2.04+01	7.48+00	2.65+02	1.81+00
1.70+00	1.47+02	3.92+00	2.66+01	1.57+02	.00	2.05+01	7.71+00	2.79+02	1.81+00
1.80+00	1.44+02	3.79+00	2.63+01	1.53+02	.00	2.05+01	7.91+00	2.94+02	1.81+00

C-31

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CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
1.90+00	1.52+02	1.45+02	7.40+01	-8.54+05	6.73+00	6.00+02	4.69+03	7.28+02	1.36+03
2.00+00	1.49+02	1.44+02	7.32+01	-9.54+05	6.76+00	5.85+02	4.69+03	7.10+02	1.36+03
2.10+00	1.46+02	1.42+02	7.24+01	-1.05+06	6.79+00	5.72+02	4.69+03	6.92+02	1.36+03
2.20+00	1.44+02	1.41+02	7.15+01	-1.15+06	6.81+00	5.58+02	4.69+03	6.74+02	1.36+03
2.30+00	1.41+02	1.40+02	7.07+01	-1.24+06	6.84+00	5.45+02	4.68+03	6.57+02	1.35+03
2.40+00	1.38+02	1.38+02	6.98+01	-1.33+06	6.86+00	5.32+02	4.68+03	6.40+02	1.35+03
2.50+00	1.36+02	1.37+02	6.90+01	-1.42+06	6.89+00	5.19+02	4.68+03	6.24+02	1.35+03
2.60+00	1.33+02	1.36+02	6.82+01	-1.51+06	6.91+00	5.07+02	4.68+03	6.08+02	1.35+03
2.70+00	1.31+02	1.35+02	6.73+01	-1.59+06	6.93+00	4.95+02	4.67+03	5.93+02	1.35+03
2.80+00	1.29+02	1.33+02	6.65+01	-1.68+06	6.95+00	4.83+02	4.67+03	5.78+02	1.35+03
2.90+00	1.27+02	1.32+02	6.56+01	-1.76+06	6.97+00	4.71+02	4.67+03	5.63+02	1.35+03
3.00+00	1.25+02	1.31+02	6.48+01	-1.84+06	6.99+00	4.60+02	4.67+03	5.49+02	1.35+03
3.10+00	1.23+02	1.30+02	6.40+01	-1.92+06	7.01+00	4.49+02	4.66+03	5.35+02	1.35+03
3.20+00	1.21+02	1.29+02	6.31+01	-1.99+06	7.03+00	4.38+02	4.66+03	5.21+02	1.35+03
3.30+00	1.19+02	1.28+02	6.23+01	-2.07+06	7.05+00	4.27+02	4.66+03	5.08+02	1.35+03
3.40+00	1.17+02	1.27+02	6.14+01	-2.14+06	7.06+00	4.17+02	4.66+03	4.95+02	1.35+03
3.50+00	1.15+02	1.25+02	6.06+01	-2.22+06	7.08+00	4.07+02	4.65+03	4.82+02	1.35+03
3.60+00	1.13+02	1.24+02	5.98+01	-2.29+06	7.10+00	3.97+02	4.65+03	4.69+02	1.35+03
3.70+00	1.12+02	1.23+02	5.89+01	-2.36+06	7.11+00	3.87+02	4.65+03	4.57+02	1.34+03
3.80+00	1.10+02	1.22+02	5.81+01	-2.42+06	7.13+00	3.77+02	4.65+03	4.45+02	1.34+03
3.90+00	1.09+02	1.21+02	5.72+01	-2.49+06	7.14+00	3.68+02	4.64+03	4.34+02	1.34+03
4.00+00	1.07+02	1.21+02	5.64+01	-2.55+06	7.16+00	3.59+02	4.64+03	4.22+02	1.34+03
4.10+00	1.06+02	1.20+02	5.56+01	-2.62+06	7.17+00	3.50+02	4.64+03	4.11+02	1.34+03
4.20+00	1.04+02	1.19+02	5.47+01	-2.68+06	7.19+00	3.41+02	4.64+03	4.00+02	1.34+03
4.30+00	1.03+02	1.18+02	5.39+01	-2.74+06	7.20+00	3.32+02	4.63+03	3.90+02	1.34+03
4.40+00	1.02+02	1.17+02	5.30+01	-2.80+06	7.21+00	3.24+02	4.63+03	3.79+02	1.34+03
4.50+00	1.00+02	1.16+02	5.22+01	-2.86+06	7.22+00	3.15+02	4.63+03	3.69+02	1.34+03
4.60+00	9.92+01	1.15+02	5.14+01	-2.92+06	7.24+00	3.07+02	4.63+03	3.59+02	1.34+03
4.70+00	9.80+01	1.14+02	5.05+01	-2.97+06	7.25+00	2.99+02	4.63+03	3.49+02	1.34+03
4.80+00	9.68+01	1.14+02	4.97+01	-3.03+06	7.26+00	2.91+02	4.62+03	3.40+02	1.34+03
4.90+00	9.57+01	1.13+02	4.88+01	-3.08+06	7.27+00	2.83+02	4.62+03	3.31+02	1.34+03
5.00+00	9.47+01	1.12+02	4.80+01	-3.13+06	7.28+00	2.76+02	4.62+03	3.21+02	1.34+03
5.10+00	9.36+01	1.11+02	4.80+01	-3.19+06	7.29+00	2.69+02	4.62+03	3.13+02	1.34+03

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CORPORATION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED LUMOLE	TOTAL VCM GAS EMISSION LUMOLE	TOTAL VCM LIQ. EMISSION LUMOLE
1.90+00	1.40+02	3.67+00	2.61+01	1.50+02	.00	2.05+01	8.11+00	3.08+02	1.81+00
2.00+00	1.37+02	3.55+00	2.59+01	1.46+02	.00	2.05+01	8.28+00	3.22+02	1.81+00
2.10+00	1.34+02	3.44+00	2.57+01	1.43+02	.00	2.05+01	8.45+00	3.36+02	1.81+00
2.20+00	1.31+02	3.32+00	2.54+01	1.40+02	.00	2.05+01	8.60+00	3.49+02	1.81+00
2.30+00	1.28+02	3.21+00	2.52+01	1.36+02	.00	2.05+01	8.74+00	3.62+02	1.81+00
2.40+00	1.26+02	3.11+00	2.50+01	1.33+02	.00	2.04+01	8.87+00	3.75+02	1.81+00
2.50+00	1.23+02	3.01+00	2.47+01	1.30+02	.00	2.04+01	8.99+00	3.88+02	1.81+00
2.60+00	1.20+02	2.91+00	2.45+01	1.27+02	.00	2.03+01	9.11+00	4.00+02	1.81+00
2.70+00	1.18+02	2.81+00	2.43+01	1.25+02	.00	2.03+01	9.21+00	4.12+02	1.81+00
2.80+00	1.15+02	2.71+00	2.40+01	1.22+02	.00	2.02+01	9.31+00	4.24+02	1.81+00
2.90+00	1.13+02	2.62+00	2.38+01	1.19+02	.00	2.01+01	9.40+00	4.35+02	1.81+00
3.00+00	1.11+02	2.53+00	2.36+01	1.17+02	.00	2.01+01	9.49+00	4.46+02	1.81+00
3.10+00	1.08+02	2.45+00	2.33+01	1.14+02	.00	2.00+01	9.57+00	4.57+02	1.81+00
3.20+00	1.06+02	2.36+00	2.31+01	1.12+02	.00	1.99+01	9.65+00	4.68+02	1.81+00
3.30+00	1.04+02	2.28+00	2.29+01	1.09+02	.00	1.98+01	9.71+00	4.79+02	1.81+00
3.40+00	1.02+02	2.20+00	2.26+01	1.07+02	.00	1.97+01	9.78+00	4.89+02	1.81+00
3.50+00	9.97+01	2.13+00	2.24+01	1.05+02	.00	1.96+01	9.84+00	4.99+02	1.81+00
3.60+00	9.77+01	2.05+00	2.22+01	1.02+02	.00	1.95+01	9.90+00	5.09+02	1.81+00
3.70+00	9.57+01	1.98+00	2.19+01	1.00+02	.00	1.93+01	9.95+00	5.19+02	1.81+00
3.80+00	9.38+01	1.91+00	2.17+01	9.82+01	.00	1.92+01	1.00+01	5.28+02	1.81+00
3.90+00	9.20+01	1.84+00	2.15+01	9.62+01	.00	1.91+01	1.01+01	5.38+02	1.81+00
4.00+00	9.02+01	1.78+00	2.12+01	9.42+01	.00	1.90+01	1.01+01	5.47+02	1.81+00
4.10+00	8.84+01	1.71+00	2.10+01	9.23+01	.00	1.88+01	1.01+01	5.56+02	1.81+00
4.20+00	8.67+01	1.65+00	2.08+01	9.04+01	.00	1.87+01	1.02+01	5.65+02	1.81+00
4.30+00	8.50+01	1.59+00	2.05+01	8.85+01	.00	1.85+01	1.02+01	5.73+02	1.81+00
4.40+00	8.33+01	1.53+00	2.03+01	8.67+01	.00	1.84+01	1.02+01	5.82+02	1.81+00
4.50+00	8.17+01	1.48+00	2.01+01	8.50+01	.00	1.83+01	1.03+01	5.90+02	1.81+00
4.60+00	8.01+01	1.42+00	1.98+01	8.33+01	.00	1.81+01	1.03+01	5.98+02	1.81+00
4.70+00	7.85+01	1.37+00	1.96+01	8.16+01	.00	1.79+01	1.03+01	6.06+02	1.81+00
4.80+00	7.70+01	1.32+00	1.94+01	7.99+01	.00	1.78+01	1.04+01	6.14+02	1.81+00
4.90+00	7.55+01	1.27+00	1.91+01	7.83+01	.00	1.76+01	1.04+01	6.22+02	1.81+00
5.00+00	7.41+01	1.22+00	1.89+01	7.67+01	.00	1.75+01	1.04+01	6.29+02	1.81+00
5.10+00	7.26+01	1.17+00	1.87+01	7.52+01	.00	1.73+01	1.04+01	6.36+02	1.81+00

C-53

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CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
5.20+00	9.26+01	1.10+02	4.80+01	-3.24+06	7.30+00	2.61+02	4.62+03	3.04+02	1.34+03
5.30+00	9.16+01	1.10+02	4.80+01	-3.29+06	7.31+00	2.54+02	4.61+03	2.95+02	1.33+03
5.40+00	9.07+01	1.09+02	4.80+01	-3.33+06	7.32+00	2.47+02	4.61+03	2.87+02	1.33+03
5.50+00	8.98+01	1.08+02	4.80+01	-3.38+06	7.33+00	2.40+02	4.61+03	2.79+02	1.33+03
5.60+00	8.89+01	1.08+02	4.80+01	-3.43+06	7.34+00	2.34+02	4.61+03	2.71+02	1.33+03
5.70+00	8.80+01	1.07+02	4.80+01	-3.47+06	7.35+00	2.27+02	4.61+03	2.63+02	1.33+03
5.80+00	8.72+01	1.06+02	4.80+01	-3.52+06	7.36+00	2.21+02	4.60+03	2.55+02	1.33+03
5.90+00	8.64+01	1.06+02	4.80+01	-3.56+06	7.37+00	2.14+02	4.60+03	2.48+02	1.33+03
6.00+00	8.56+01	1.05+02	4.80+01	-3.60+06	7.37+00	2.08+02	4.60+03	2.40+02	1.33+03
6.10+00	8.48+01	1.04+02	4.80+01	-3.65+06	7.38+00	2.02+02	4.60+03	2.33+02	1.33+03
6.20+00	8.41+01	1.04+02	4.80+01	-3.69+06	7.39+00	1.96+02	4.60+03	2.26+02	1.33+03
6.30+00	8.34+01	1.03+02	4.80+01	-3.73+06	7.40+00	1.90+02	4.60+03	2.19+02	1.33+03
6.40+00	8.27+01	1.03+02	4.80+01	-3.77+06	7.40+00	1.85+02	4.59+03	2.13+02	1.33+03
6.50+00	8.20+01	1.02+02	4.80+01	-3.81+06	7.41+00	1.79+02	4.59+03	2.06+02	1.33+03
6.60+00	8.13+01	1.01+02	4.80+01	-3.84+06	7.42+00	1.74+02	4.59+03	2.00+02	1.33+03
6.70+00	8.07+01	1.01+02	4.80+01	-3.88+06	7.43+00	1.68+02	4.59+03	1.93+02	1.33+03
6.80+00	8.01+01	1.00+02	4.80+01	-3.92+06	7.43+00	1.63+02	4.59+03	1.87+02	1.33+03
6.90+00	7.95+01	9.98+01	4.80+01	-3.95+06	7.44+00	1.58+02	4.59+03	1.81+02	1.33+03
7.00+00	7.89+01	9.93+01	4.80+01	-3.99+06	7.44+00	1.53+02	4.59+03	1.75+02	1.33+03
7.10+00	7.84+01	9.88+01	4.80+01	-4.02+06	7.45+00	1.48+02	4.58+03	1.69+02	1.33+03
7.20+00	7.78+01	9.83+01	4.80+01	-4.05+06	7.46+00	1.43+02	4.58+03	1.64+02	1.33+03
7.30+00	7.73+01	9.78+01	4.80+01	-4.08+06	7.46+00	1.38+02	4.58+03	1.58+02	1.33+03
7.40+00	7.68+01	9.74+01	4.80+01	-4.12+06	7.47+00	1.34+02	4.58+03	1.53+02	1.32+03
7.50+00	7.63+01	9.69+01	4.80+01	-4.15+06	7.47+00	1.29+02	4.58+03	1.48+02	1.32+03
7.60+00	7.58+01	9.65+01	4.80+01	-4.18+06	7.48+00	1.25+02	4.58+03	1.43+02	1.32+03
7.70+00	7.53+01	9.60+01	4.80+01	-4.21+06	7.48+00	1.21+02	4.58+03	1.38+02	1.32+03
7.80+00	7.49+01	9.56+01	4.80+01	-4.23+06	7.49+00	1.16+02	4.57+03	1.33+02	1.32+03
7.90+00	7.44+01	9.52+01	4.80+01	-4.26+06	7.49+00	1.12+02	4.57+03	1.28+02	1.32+03
8.00+00	7.40+01	9.48+01	4.80+01	-4.29+06	7.50+00	1.08+02	4.57+03	1.23+02	1.32+03
8.10+00	7.36+01	9.44+01	4.80+01	-4.32+06	7.50+00	1.04+02	4.57+03	1.19+02	1.32+03
8.20+00	7.32+01	9.40+01	4.80+01	-4.34+06	7.51+00	1.00+02	4.57+03	1.14+02	1.32+03
8.30+00	7.28+01	9.37+01	4.80+01	-4.37+06	7.51+00	9.67+01	4.57+03	1.10+02	1.32+03
8.40+00	7.24+01	9.33+01	4.80+01	-4.39+06	7.52+00	9.30+01	4.57+03	1.06+02	1.32+03

C-34

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CONFORMATION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED LBMOL	TOTAL VCM GAS EMISSION LBMOL	TOTAL VCM LIQ. EMISSION LBMOL
5.20+00	7.12+01	1.12+00	1.84+01	7.37+01	.00	1.71+01	1.05+01	6.44+02	1.81+00
5.30+00	6.99+01	1.08+00	1.82+01	7.22+01	.00	1.70+01	1.05+01	6.51+02	1.81+00
5.40+00	6.85+01	1.04+00	1.80+01	7.07+01	.00	1.68+01	1.05+01	6.58+02	1.81+00
5.50+00	6.72+01	9.95-01	1.78+01	6.93+01	.00	1.66+01	1.05+01	6.65+02	1.81+00
5.60+00	6.59+01	9.55-01	1.75+01	6.79+01	.00	1.64+01	1.05+01	6.71+02	1.81+00
5.70+00	6.46+01	9.16-01	1.73+01	6.65+01	.00	1.63+01	1.06+01	6.78+02	1.81+00
5.80+00	6.33+01	8.78-01	1.71+01	6.52+01	.00	1.61+01	1.06+01	6.84+02	1.81+00
5.90+00	6.21+01	8.41-01	1.68+01	6.39+01	.00	1.59+01	1.06+01	6.90+02	1.81+00
6.00+00	6.09+01	8.05-01	1.66+01	6.26+01	.00	1.57+01	1.06+01	6.97+02	1.81+00
6.10+00	5.97+01	7.71-01	1.64+01	6.13+01	.00	1.55+01	1.06+01	7.03+02	1.81+00
6.20+00	5.85+01	7.38-01	1.61+01	6.00+01	.00	1.53+01	1.06+01	7.09+02	1.81+00
6.30+00	5.73+01	7.06-01	1.59+01	5.88+01	.00	1.51+01	1.06+01	7.14+02	1.81+00
6.40+00	5.62+01	6.75-01	1.57+01	5.76+01	.00	1.49+01	1.07+01	7.20+02	1.81+00
6.50+00	5.51+01	6.44-01	1.54+01	5.64+01	.00	1.47+01	1.07+01	7.26+02	1.81+00
6.60+00	5.39+01	6.15-01	1.52+01	5.52+01	.00	1.45+01	1.07+01	7.31+02	1.81+00
6.70+00	5.28+01	5.87-01	1.50+01	5.41+01	.00	1.43+01	1.07+01	7.36+02	1.81+00
6.80+00	5.16+01	5.60-01	1.47+01	5.29+01	.00	1.42+01	1.07+01	7.42+02	1.81+00
6.90+00	5.07+01	5.34-01	1.45+01	5.18+01	.00	1.39+01	1.07+01	7.47+02	1.81+00
7.00+00	4.96+01	5.09-01	1.43+01	5.07+01	.00	1.37+01	1.07+01	7.52+02	1.81+00
7.10+00	4.86+01	4.84-01	1.40+01	4.96+01	.00	1.35+01	1.07+01	7.57+02	1.81+00
7.20+00	4.76+01	4.61-01	1.38+01	4.85+01	.00	1.33+01	1.07+01	7.61+02	1.81+00
7.30+00	4.66+01	4.38-01	1.36+01	4.75+01	.00	1.31+01	1.07+01	7.66+02	1.81+00
7.40+00	4.56+01	4.16-01	1.33+01	4.64+01	.00	1.29+01	1.07+01	7.71+02	1.81+00
7.50+00	4.46+01	3.95-01	1.31+01	4.54+01	.00	1.27+01	1.07+01	7.75+02	1.81+00
7.60+00	4.36+01	3.75-01	1.29+01	4.44+01	.00	1.25+01	1.08+01	7.80+02	1.81+00
7.70+00	4.26+01	3.55-01	1.26+01	4.33+01	.00	1.23+01	1.08+01	7.84+02	1.81+00
7.80+00	4.17+01	3.37-01	1.24+01	4.23+01	.00	1.21+01	1.08+01	7.88+02	1.81+00
7.90+00	4.07+01	3.19-01	1.22+01	4.14+01	.00	1.19+01	1.08+01	7.92+02	1.81+00
8.00+00	3.98+01	3.01-01	1.19+01	4.04+01	.00	1.17+01	1.08+01	7.96+02	1.81+00
8.10+00	3.89+01	2.85-01	1.17+01	3.94+01	.00	1.14+01	1.08+01	8.00+02	1.81+00
8.20+00	3.80+01	2.69-01	1.15+01	3.85+01	.00	1.12+01	1.08+01	8.04+02	1.81+00
8.30+00	3.70+01	2.53-01	1.12+01	3.75+01	.00	1.10+01	1.08+01	8.08+02	1.81+00
8.40+00	3.61+01	2.39-01	1.10+01	3.66+01	.00	1.08+01	1.08+01	8.11+02	1.81+00

C-35

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CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCN L10. LEFT IN REACTOR LBMOLE	H2O L10. LEFT IN REACTOR LBMOLE	REACTOR VCN L10. VOLUME CU FT	REACTOR H2O L10. VOLUME CU FT
8.50+00	7.20+01	9.29+01	4.80+01	-4.42+06	7.52+00	8.94+01	4.57+03	1.02+02	1.32+03
8.60+00	7.17+01	9.26+01	4.80+01	-4.44+06	7.52+00	8.60+01	4.56+03	9.77+01	1.32+03
8.70+00	7.13+01	9.23+01	4.80+01	-4.46+06	7.53+00	8.26+01	4.56+03	9.38+01	1.32+03
8.80+00	7.10+01	9.19+01	4.80+01	-4.48+06	7.53+00	7.93+01	4.56+03	9.00+01	1.32+03
8.90+00	7.07+01	9.16+01	4.80+01	-4.51+06	7.54+00	7.61+01	4.56+03	8.63+01	1.32+03
9.00+00	7.04+01	9.13+01	4.80+01	-4.53+06	7.54+00	7.29+01	4.56+03	8.28+01	1.32+03
9.10+00	7.01+01	9.10+01	4.80+01	-4.55+06	7.54+00	6.99+01	4.56+03	7.93+01	1.32+03
9.20+00	6.98+01	9.07+01	4.80+01	-4.57+06	7.55+00	6.69+01	4.56+03	7.59+01	1.32+03
9.30+00	6.95+01	9.04+01	4.80+01	-4.59+06	7.55+00	6.41+01	4.56+03	7.26+01	1.32+03
9.40+00	6.92+01	9.02+01	4.80+01	-4.61+06	7.55+00	6.13+01	4.56+03	6.94+01	1.32+03
9.50+00	6.90+01	8.99+01	4.80+01	-4.62+06	7.56+00	5.86+01	4.56+03	6.63+01	1.32+03
9.60+00	6.87+01	8.96+01	4.80+01	-4.64+06	7.56+00	5.59+01	4.56+03	6.33+01	1.32+03
9.70+00	6.85+01	8.94+01	4.80+01	-4.66+06	7.56+00	5.34+01	4.55+03	6.04+01	1.32+03
9.80+00	6.82+01	8.92+01	4.80+01	-4.67+06	7.56+00	5.09+01	4.55+03	5.76+01	1.32+03
9.90+00	6.80+01	8.89+01	4.80+01	-4.69+06	7.57+00	4.85+01	4.55+03	5.49+01	1.32+03
1.00+01	6.76+01	8.87+01	4.80+01	-4.71+06	7.57+00	4.62+01	4.55+03	5.23+01	1.32+03

C-56

COMPOSITION

TIME	PREFLASH GAS FLOW	PREFLASH VCM LIT. FLOW	PREFLASH H2O LIT. FLOW	FLASHED GAS FLOW	FLASHED VCM LIT. FLOW	FLASHED H2O LIT. FLOW	TOTAL PVL PRODUCED	TOTAL VCM GAS EMISSION	TOTAL VCM LIT. EMISSION
MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	MOLE/MIN	L/MOLE	L/MOLE	L/MOLE
8.50+00	3.53+01	2.25-01	1.00+01	3.57+01	.00	1.06+01	1.00+01	8.16+02	1.81+00
8.60+00	3.44+01	2.11-01	1.05+01	3.48+01	.00	1.03+01	1.00+01	8.19+02	1.81+00
8.70+00	3.35+01	1.98-01	1.03+01	3.39+01	.00	1.01+01	1.00+01	8.22+02	1.81+00
8.80+00	3.26+01	1.86-01	1.01+01	3.30+01	.00	9.90+00	1.00+01	8.25+02	1.81+00
8.90+00	3.18+01	1.74-01	9.84+00	3.21+01	.00	9.68+00	1.00+01	8.28+02	1.81+00
9.00+00	3.09+01	1.63-01	9.60+00	3.12+01	.00	9.46+00	1.00+01	8.32+02	1.81+00
9.10+00	3.01+01	1.53-01	9.36+00	3.04+01	.00	9.23+00	1.00+01	8.35+02	1.81+00
9.20+00	2.92+01	1.42-01	9.13+00	2.95+01	.00	9.01+00	1.00+01	8.37+02	1.81+00
9.30+00	2.84+01	1.33-01	8.89+00	2.86+01	.00	8.78+00	1.00+01	8.40+02	1.81+00
9.40+00	2.76+01	1.24-01	8.66+00	2.78+01	.00	8.55+00	1.00+01	8.43+02	1.81+00
9.50+00	2.67+01	1.15-01	8.42+00	2.70+01	.00	8.32+00	1.00+01	8.46+02	1.81+00
9.60+00	2.59+01	1.07-01	8.18+00	2.61+01	.00	8.10+00	1.00+01	8.48+02	1.81+00
9.70+00	2.51+01	9.89-02	7.95+00	2.53+01	.00	7.87+00	1.00+01	8.51+02	1.81+00
9.80+00	2.43+01	9.16-02	7.71+00	2.45+01	.00	7.64+00	1.00+01	8.53+02	1.81+00
9.90+00	2.35+01	8.46-02	7.47+00	2.37+01	.00	7.41+00	1.00+01	8.56+02	1.81+00
1.00+01	2.27+01	7.80-02	7.23+00	2.28+01	.00	7.17+00	1.00+01	8.58+02	1.81+00

C-37

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CORPORATION

DISCHARGE FROM A PVC BATCH REACTOR

Case 8. High Reactor Rate - Cold Water on Jacket

REACTION PRESSURE AT TIME OF DISCHARGE = 214.79 PSIA	PRESSURE DOWNSTREAM OF VALVE = 64.70 PSIA
REACTION TEMP AT TIME OF DISCHARGE = 118.50 F	WATER JACKET TEMP AT DISCHARGE = 90.00 F
REACTOR VOLUME = 2673.000 CU FT	HEAT OF REACTION = 45516.000 BTU/LBMOLE
LIQUID VCM INITIALLY IN REACTOR = 921.50 LBMOLE	LIQ H2O INITIALLY IN REACTOR = 4929.6 LBMOLE
VAPOR INITIALLY IN REACTOR = 2.9899 LBMOLE	JACKET COEF TIMES AREA = 895.6 BTU/MIN F
DENSITY OF WATER (CONSTANT) = 3.4570 LB/FT ³	INITIAL DENSITY OF VCM = .79912 LBMOLE/CU FT
AREA OF RELIEF VALVE ORIFICE OPENING = .2776 SQ FT	ORIFICE FLOW COEFFICIENT = .610
MINIMUM LIQUID ENTRAINMENT = .0100 CU FT LIQ/CU FT GAS	MINIMUM WATER JACKET TEMP = 40.00 F
LIQ VOL WHEN MIN ENTRAINMENT IS REACHED = 2438.0 CU FT	TIME MIN JACKET TEMP IS REACHED = 5.00 MIN
HEATING JACKET FACTOR = 1.00	REACTION RATE FACTOR = 1.50

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
0.00	2.15+02	1.68+02	9.00+01	9.66+05	2.99+00	9.21+02	4.93+03	1.15+03	1.43+03
1.00-01	2.14+02	1.68+02	8.92+01	9.72+05	3.01+00	9.07+02	4.87+03	1.13+03	1.41+03
2.00-01	2.14+02	1.68+02	8.83+01	9.66+05	4.73+00	8.92+02	4.82+03	1.12+03	1.39+03
3.00-01	2.13+02	1.68+02	8.75+01	9.38+05	5.51+00	8.76+02	4.77+03	1.10+03	1.38+03
4.00-01	2.11+02	1.67+02	8.66+01	8.67+05	5.99+00	8.59+02	4.74+03	1.07+03	1.37+03
5.00-01	2.06+02	1.66+02	8.58+01	7.31+05	6.06+00	8.39+02	4.74+03	1.05+03	1.37+03
6.00-01	2.01+02	1.64+02	8.50+01	5.94+05	6.11+00	8.19+02	4.74+03	1.02+03	1.37+03
7.00-01	1.96+02	1.62+02	8.41+01	4.60+05	6.16+00	7.99+02	4.73+03	9.93+02	1.37+03
8.00-01	1.91+02	1.61+02	8.33+01	3.29+05	6.20+00	7.81+02	4.73+03	9.67+02	1.37+03
9.00-01	1.87+02	1.59+02	8.24+01	2.00+05	6.24+00	7.62+02	4.73+03	9.43+02	1.37+03
1.00+00	1.82+02	1.57+02	8.16+01	7.29+04	6.28+00	7.45+02	4.72+03	9.19+02	1.37+03
1.10+00	1.78+02	1.56+02	8.08+01	-5.16+04	6.32+00	7.27+02	4.72+03	8.95+02	1.37+03
1.20+00	1.74+02	1.54+02	7.99+01	-1.74+05	6.35+00	7.10+02	4.72+03	8.73+02	1.36+03
1.30+00	1.70+02	1.53+02	7.91+01	-2.93+05	6.39+00	6.94+02	4.71+03	8.51+02	1.36+03
1.40+00	1.66+02	1.51+02	7.82+01	-4.10+05	6.42+00	6.78+02	4.71+03	8.30+02	1.36+03
1.50+00	1.63+02	1.49+02	7.74+01	-5.25+05	6.45+00	6.62+02	4.71+03	8.09+02	1.36+03
1.60+00	1.59+02	1.48+02	7.66+01	-6.37+05	6.49+00	6.47+02	4.70+03	7.89+02	1.36+03
1.70+00	1.56+02	1.46+02	7.57+01	-7.47+05	6.52+00	6.32+02	4.70+03	7.69+02	1.36+03
1.80+00	1.53+02	1.45+02	7.49+01	-8.55+05	6.54+00	6.17+02	4.70+03	7.50+02	1.36+03

C-58

UCC
026737

COMPORATION

TIME	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED LUMOLE	TOTAL VCM GAS EMISSION LUMOLE	TOTAL VCM LIQ. EMISSION LUMOLE
.00	1.53+00	1.25+02	5.97+02	1.17+02	1.04+01	5.96+02	.00	.00	.00
1.00-01	1.48+01	1.16+02	5.58+02	1.24+02	8.22+00	5.57+02	6.93-01	1.21+01	9.66-01
2.00-01	3.56+01	1.03+02	4.90+02	1.35+02	4.70+00	4.97+02	1.38+00	2.48+01	1.62+00
3.00-01	7.13+01	7.80+01	3.80+02	1.57+02	.00	3.72+02	2.05+00	3.88+01	1.84+00
4.00-01	1.62+02	2.99+01	1.48+02	2.02+02	.00	1.38+02	2.69+00	5.52+01	1.84+00
5.00-01	1.94+02	5.70+00	2.89+01	2.09+02	.00	1.90+01	3.29+00	7.49+01	1.84+00
6.00-01	1.89+02	5.52+00	2.87+01	2.04+02	.00	1.92+01	3.83+00	9.40+01	1.84+00
7.00-01	1.84+02	5.35+00	2.85+01	1.99+02	.00	1.94+01	4.33+00	1.13+02	1.84+00
8.00-01	1.80+02	5.18+00	2.83+01	1.93+02	.00	1.95+01	4.79+00	1.31+02	1.84+00
9.00-01	1.75+02	5.02+00	2.80+01	1.89+02	.00	1.97+01	5.21+00	1.49+02	1.84+00
1.00+00	1.71+02	4.86+00	2.78+01	1.84+02	.00	1.98+01	5.60+00	1.66+02	1.84+00
1.10+00	1.67+02	4.71+00	2.76+01	1.79+02	.00	1.99+01	5.95+00	1.83+02	1.84+00
1.20+00	1.63+02	4.56+00	2.73+01	1.74+02	.00	2.00+01	6.28+00	2.00+02	1.84+00
1.30+00	1.59+02	4.41+00	2.71+01	1.70+02	.00	2.01+01	6.58+00	2.16+02	1.84+00
1.40+00	1.55+02	4.27+00	2.69+01	1.66+02	.00	2.02+01	6.85+00	2.32+02	1.84+00
1.50+00	1.51+02	4.13+00	2.66+01	1.62+02	.00	2.02+01	7.11+00	2.47+02	1.84+00
1.60+00	1.47+02	4.00+00	2.64+01	1.58+02	.00	2.03+01	7.34+00	2.62+02	1.84+00
1.70+00	1.44+02	3.87+00	2.61+01	1.54+02	.00	2.03+01	7.55+00	2.77+02	1.84+00
1.80+00	1.41+02	3.74+00	2.59+01	1.50+02	.00	2.03+01	7.75+00	2.91+02	1.84+00

C-39

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTION HEAT (CONTENT) BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
1.90+00	1.49+02	1.44+02	7.40+01	-9.61+05	6.57+00	6.03+02	4.70+03	7.31+02	1.36+03
2.00+00	1.46+02	1.42+02	7.32+01	-1.06+06	6.60+00	5.89+02	4.69+03	7.13+02	1.36+03
2.10+00	1.43+02	1.41+02	7.24+01	-1.16+06	6.62+00	5.76+02	4.69+03	6.96+02	1.36+03
2.20+00	1.41+02	1.39+02	7.15+01	-1.26+06	6.65+00	5.63+02	4.69+03	6.79+02	1.36+03
2.30+00	1.38+02	1.38+02	7.07+01	-1.36+06	6.67+00	5.50+02	4.68+03	6.62+02	1.36+03
2.40+00	1.35+02	1.37+02	6.98+01	-1.46+06	6.70+00	5.37+02	4.68+03	6.46+02	1.35+03
2.50+00	1.33+02	1.35+02	6.90+01	-1.55+06	6.72+00	5.25+02	4.68+03	6.30+02	1.35+03
2.60+00	1.30+02	1.34+02	6.82+01	-1.64+06	6.74+00	5.13+02	4.68+03	6.14+02	1.35+03
2.70+00	1.28+02	1.33+02	6.73+01	-1.73+06	6.76+00	5.01+02	4.67+03	5.99+02	1.35+03
2.80+00	1.26+02	1.32+02	6.65+01	-1.81+06	6.78+00	4.89+02	4.67+03	5.85+02	1.35+03
2.90+00	1.24+02	1.30+02	6.56+01	-1.90+06	6.80+00	4.78+02	4.67+03	5.70+02	1.35+03
3.00+00	1.21+02	1.29+02	6.48+01	-1.98+06	6.82+00	4.67+02	4.67+03	5.56+02	1.35+03
3.10+00	1.19+02	1.28+02	6.40+01	-2.06+06	6.84+00	4.56+02	4.66+03	5.43+02	1.35+03
3.20+00	1.18+02	1.27+02	6.31+01	-2.14+06	6.85+00	4.46+02	4.66+03	5.29+02	1.35+03
3.30+00	1.16+02	1.26+02	6.23+01	-2.22+06	6.87+00	4.36+02	4.66+03	5.16+02	1.35+03
3.40+00	1.14+02	1.25+02	6.14+01	-2.30+06	6.89+00	4.26+02	4.66+03	5.04+02	1.35+03
3.50+00	1.12+02	1.24+02	6.06+01	-2.37+06	6.90+00	4.16+02	4.65+03	4.91+02	1.35+03
3.60+00	1.10+02	1.23+02	5.98+01	-2.45+06	6.92+00	4.06+02	4.65+03	4.79+02	1.35+03
3.70+00	1.09+02	1.22+02	5.89+01	-2.52+06	6.93+00	3.97+02	4.65+03	4.68+02	1.35+03
3.80+00	1.07+02	1.21+02	5.81+01	-2.59+06	6.95+00	3.87+02	4.65+03	4.56+02	1.34+03
3.90+00	1.06+02	1.20+02	5.72+01	-2.66+06	6.96+00	3.78+02	4.65+03	4.45+02	1.34+03
4.00+00	1.04+02	1.19+02	5.64+01	-2.73+06	6.98+00	3.69+02	4.64+03	4.34+02	1.34+03
4.10+00	1.03+02	1.18+02	5.56+01	-2.79+06	6.99+00	3.61+02	4.64+03	4.23+02	1.34+03
4.20+00	1.01+02	1.17+02	5.47+01	-2.86+06	7.00+00	3.52+02	4.64+03	4.13+02	1.34+03
4.30+00	1.00+02	1.16+02	5.39+01	-2.92+06	7.01+00	3.44+02	4.64+03	4.03+02	1.34+03
4.40+00	9.87+01	1.15+02	5.30+01	-2.98+06	7.03+00	3.36+02	4.64+03	3.93+02	1.34+03
4.50+00	9.75+01	1.14+02	5.22+01	-3.05+06	7.04+00	3.28+02	4.63+03	3.83+02	1.34+03
4.60+00	9.63+01	1.13+02	5.14+01	-3.10+06	7.05+00	3.20+02	4.63+03	3.73+02	1.34+03
4.70+00	9.51+01	1.12+02	5.05+01	-3.16+06	7.06+00	3.12+02	4.63+03	3.64+02	1.34+03
4.80+00	9.40+01	1.11+02	4.97+01	-3.22+06	7.07+00	3.05+02	4.63+03	3.55+02	1.34+03
4.90+00	9.29+01	1.11+02	4.88+01	-3.28+06	7.08+00	2.98+02	4.63+03	3.46+02	1.34+03
5.00+00	9.19+01	1.10+02	4.80+01	-3.33+06	7.09+00	2.91+02	4.62+03	3.38+02	1.34+03
5.10+00	9.08+01	1.09+02	4.80+01	-3.39+06	7.10+00	2.84+02	4.62+03	3.29+02	1.34+03

C-60

UCC
026739

COMPOSITION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVL PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIQ. EMISSION L/MOLE
1.90+00	1.37+02	3.62+00	2.56+01	1.46+02	.00	2.03+01	7.94+00	3.06+02	1.84+00
2.00+00	1.34+02	3.50+00	2.54+01	1.43+02	.00	2.03+01	8.11+00	3.19+02	1.84+00
2.10+00	1.31+02	3.39+00	2.51+01	1.39+02	.00	2.02+01	8.26+00	3.32+02	1.84+00
2.20+00	1.28+02	3.28+00	2.49+01	1.36+02	.00	2.02+01	8.41+00	3.45+02	1.84+00
2.30+00	1.25+02	3.17+00	2.46+01	1.33+02	.00	2.02+01	8.54+00	3.58+02	1.84+00
2.40+00	1.22+02	3.06+00	2.44+01	1.30+02	.00	2.01+01	8.67+00	3.70+02	1.84+00
2.50+00	1.20+02	2.96+00	2.41+01	1.27+02	.00	2.01+01	8.78+00	3.82+02	1.84+00
2.60+00	1.17+02	2.86+00	2.39+01	1.24+02	.00	2.00+01	8.89+00	3.94+02	1.84+00
2.70+00	1.14+02	2.77+00	2.36+01	1.21+02	.00	1.99+01	8.99+00	4.06+02	1.84+00
2.80+00	1.12+02	2.67+00	2.34+01	1.18+02	.00	1.98+01	9.09+00	4.17+02	1.84+00
2.90+00	1.09+02	2.58+00	2.31+01	1.15+02	.00	1.97+01	9.17+00	4.29+02	1.84+00
3.00+00	1.07+02	2.49+00	2.29+01	1.13+02	.00	1.96+01	9.25+00	4.39+02	1.84+00
3.10+00	1.05+02	2.41+00	2.26+01	1.10+02	.00	1.95+01	9.33+00	4.50+02	1.84+00
3.20+00	1.02+02	2.33+00	2.24+01	1.08+02	.00	1.94+01	9.40+00	4.61+02	1.84+00
3.30+00	1.00+02	2.25+00	2.21+01	1.05+02	.00	1.93+01	9.47+00	4.71+02	1.84+00
3.40+00	9.82+01	2.17+00	2.19+01	1.03+02	.00	1.92+01	9.53+00	4.81+02	1.84+00
3.50+00	9.61+01	2.09+00	2.16+01	1.01+02	.00	1.90+01	9.59+00	4.91+02	1.84+00
3.60+00	9.41+01	2.02+00	2.14+01	9.86+01	.00	1.89+01	9.64+00	5.00+02	1.84+00
3.70+00	9.21+01	1.95+00	2.11+01	9.64+01	.00	1.88+01	9.69+00	5.10+02	1.84+00
3.80+00	9.02+01	1.88+00	2.09+01	9.43+01	.00	1.86+01	9.74+00	5.19+02	1.84+00
3.90+00	8.83+01	1.82+00	2.06+01	9.22+01	.00	1.85+01	9.79+00	5.28+02	1.84+00
4.00+00	8.65+01	1.75+00	2.03+01	9.02+01	.00	1.83+01	9.83+00	5.37+02	1.84+00
4.10+00	8.47+01	1.69+00	2.01+01	8.83+01	.00	1.82+01	9.87+00	5.45+02	1.84+00
4.20+00	8.29+01	1.63+00	1.98+01	8.64+01	.00	1.80+01	9.91+00	5.54+02	1.84+00
4.30+00	8.12+01	1.57+00	1.96+01	8.45+01	.00	1.79+01	9.94+00	5.62+02	1.84+00
4.40+00	7.95+01	1.51+00	1.93+01	8.27+01	.00	1.77+01	9.98+00	5.70+02	1.84+00
4.50+00	7.79+01	1.46+00	1.91+01	8.09+01	.00	1.75+01	1.00+01	5.78+02	1.84+00
4.60+00	7.63+01	1.40+00	1.88+01	7.92+01	.00	1.73+01	1.00+01	5.86+02	1.84+00
4.70+00	7.47+01	1.35+00	1.86+01	7.75+01	.00	1.72+01	1.01+01	5.93+02	1.84+00
4.80+00	7.32+01	1.30+00	1.83+01	7.58+01	.00	1.70+01	1.01+01	6.01+02	1.84+00
4.90+00	7.17+01	1.25+00	1.81+01	7.42+01	.00	1.68+01	1.01+01	6.08+02	1.84+00
5.00+00	7.02+01	1.21+00	1.78+01	7.26+01	.00	1.66+01	1.01+01	6.17+02	1.84+00
5.10+00	6.87+01	1.16+00	1.76+01	7.10+01	.00	1.64+01	1.02+01	6.22+02	1.84+00

C-61

UCC
026740

CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
5.20+00	8.98+01	1.08+02	4.80+01	-3.44+06	7.11+00	2.77+02	4.62+03	3.21+02	1.34+03
5.30+00	8.89+01	1.08+02	4.80+01	-3.49+06	7.12+00	2.70+02	4.62+03	3.13+02	1.34+03
5.40+00	8.80+01	1.07+02	4.80+01	-3.54+06	7.13+00	2.63+02	4.62+03	3.05+02	1.34+03
5.50+00	8.71+01	1.06+02	4.80+01	-3.59+06	7.14+00	2.57+02	4.61+03	2.97+02	1.33+03
5.60+00	8.62+01	1.05+02	4.80+01	-3.64+06	7.15+00	2.51+02	4.61+03	2.90+02	1.33+03
5.70+00	8.54+01	1.05+02	4.80+01	-3.69+06	7.15+00	2.44+02	4.61+03	2.82+02	1.33+03
5.80+00	8.45+01	1.04+02	4.80+01	-3.73+06	7.16+00	2.38+02	4.61+03	2.75+02	1.33+03
5.90+00	8.38+01	1.03+02	4.80+01	-3.78+06	7.17+00	2.33+02	4.61+03	2.68+02	1.33+03
6.00+00	8.30+01	1.03+02	4.80+01	-3.82+06	7.18+00	2.27+02	4.61+03	2.61+02	1.33+03
6.10+00	8.23+01	1.02+02	4.80+01	-3.87+06	7.18+00	2.21+02	4.60+03	2.54+02	1.33+03
6.20+00	8.15+01	1.02+02	4.80+01	-3.91+06	7.19+00	2.16+02	4.60+03	2.46+02	1.33+03
6.30+00	8.09+01	1.01+02	4.80+01	-3.95+06	7.20+00	2.10+02	4.60+03	2.41+02	1.33+03
6.40+00	8.02+01	1.00+02	4.80+01	-3.99+06	7.20+00	2.05+02	4.60+03	2.35+02	1.33+03
6.50+00	7.95+01	9.98+01	4.80+01	-4.03+06	7.21+00	2.00+02	4.60+03	2.29+02	1.33+03
6.60+00	7.89+01	9.93+01	4.60+01	-4.07+06	7.22+00	1.95+02	4.60+03	2.23+02	1.33+03
6.70+00	7.83+01	9.87+01	4.80+01	-4.11+06	7.22+00	1.90+02	4.60+03	2.17+02	1.33+03
6.80+00	7.77+01	9.82+01	4.80+01	-4.15+06	7.23+00	1.85+02	4.59+03	2.12+02	1.33+03
6.90+00	7.71+01	9.77+01	4.80+01	-4.18+06	7.24+00	1.80+02	4.59+03	2.06+02	1.33+03
7.00+00	7.66+01	9.72+01	4.80+01	-4.22+06	7.24+00	1.76+02	4.59+03	2.01+02	1.33+03
7.10+00	7.60+01	9.67+01	4.80+01	-4.25+06	7.25+00	1.71+02	4.59+03	1.96+02	1.33+03
7.20+00	7.55+01	9.62+01	4.80+01	-4.29+06	7.25+00	1.67+02	4.59+03	1.90+02	1.33+03
7.30+00	7.50+01	9.58+01	4.80+01	-4.32+06	7.26+00	1.63+02	4.59+03	1.85+02	1.33+03
7.40+00	7.45+01	9.53+01	4.80+01	-4.35+06	7.26+00	1.58+02	4.59+03	1.81+02	1.33+03
7.50+00	7.41+01	9.49+01	4.80+01	-4.38+06	7.27+00	1.54+02	4.59+03	1.76+02	1.33+03
7.60+00	7.36+01	9.44+01	4.80+01	-4.42+06	7.27+00	1.50+02	4.58+03	1.71+02	1.33+03
7.70+00	7.32+01	9.40+01	4.80+01	-4.45+06	7.28+00	1.46+02	4.58+03	1.67+02	1.33+03
7.80+00	7.27+01	9.36+01	4.80+01	-4.47+06	7.28+00	1.43+02	4.58+03	1.62+02	1.33+03
7.90+00	7.23+01	9.32+01	4.80+01	-4.50+06	7.28+00	1.39+02	4.58+03	1.58+02	1.33+03
8.00+00	7.19+01	9.28+01	4.80+01	-4.53+06	7.29+00	1.36+02	4.58+03	1.54+02	1.32+03
8.10+00	7.15+01	9.24+01	4.80+01	-4.56+06	7.29+00	1.32+02	4.58+03	1.50+02	1.32+03
8.20+00	7.12+01	9.21+01	4.80+01	-4.58+06	7.30+00	1.29+02	4.58+03	1.46+02	1.32+03
8.30+00	7.08+01	9.17+01	4.80+01	-4.61+06	7.30+00	1.25+02	4.58+03	1.42+02	1.32+03
8.40+00	7.04+01	9.14+01	4.80+01	-4.64+06	7.30+00	1.22+02	4.58+03	1.39+02	1.32+03

C-62

UCC
026741

CORPORATION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVC PRODUCED L/MOLE	TOTAL VCM GAS EMISSION L/MOLE	TOTAL VCM LIQ. EMISSION L/MOLE
5.20+00	6.75+01	1.12+00	1.73+01	6.95+01	.00	1.62+01	1.02+01	6.29+02	1.84+00
5.30+00	6.59+01	1.07+00	1.71+01	6.80+01	.00	1.61+01	1.02+01	6.35+02	1.84+00
5.40+00	6.45+01	1.03+00	1.68+01	6.65+01	.00	1.59+01	1.02+01	6.42+02	1.84+00
5.50+00	6.31+01	9.91-01	1.66+01	6.51+01	.00	1.57+01	1.02+01	6.48+02	1.84+00
5.60+00	6.18+01	9.52-01	1.63+01	6.36+01	.00	1.55+01	1.03+01	6.55+02	1.84+00
5.70+00	6.05+01	9.14-01	1.61+01	6.22+01	.00	1.53+01	1.03+01	6.61+02	1.84+00
5.80+00	5.92+01	8.78-01	1.58+01	6.09+01	.00	1.51+01	1.03+01	6.67+02	1.84+00
5.90+00	5.80+01	8.43-01	1.56+01	5.95+01	.00	1.49+01	1.03+01	6.73+02	1.84+00
6.00+00	5.67+01	8.09-01	1.53+01	5.82+01	.00	1.46+01	1.03+01	6.78+02	1.84+00
6.10+00	5.55+01	7.76-01	1.51+01	5.69+01	.00	1.44+01	1.03+01	6.84+02	1.84+00
6.20+00	5.43+01	7.44-01	1.48+01	5.56+01	.00	1.42+01	1.03+01	6.90+02	1.84+00
6.30+00	5.31+01	7.13-01	1.46+01	5.44+01	.00	1.40+01	1.04+01	6.95+02	1.84+00
6.40+00	5.19+01	6.83-01	1.43+01	5.31+01	.00	1.38+01	1.04+01	7.00+02	1.84+00
6.50+00	5.08+01	6.54-01	1.41+01	5.19+01	.00	1.36+01	1.04+01	7.05+02	1.84+00
6.60+00	4.96+01	6.26-01	1.38+01	5.07+01	.00	1.34+01	1.04+01	7.10+02	1.84+00
6.70+00	4.85+01	5.99-01	1.36+01	4.95+01	.00	1.31+01	1.04+01	7.15+02	1.84+00
6.80+00	4.74+01	5.73-01	1.33+01	4.84+01	.00	1.29+01	1.04+01	7.20+02	1.84+00
6.90+00	4.63+01	5.48-01	1.31+01	4.72+01	.00	1.27+01	1.04+01	7.25+02	1.84+00
7.00+00	4.52+01	5.24-01	1.28+01	4.61+01	.00	1.25+01	1.04+01	7.29+02	1.84+00
7.10+00	4.41+01	5.01-01	1.26+01	4.50+01	.00	1.23+01	1.04+01	7.34+02	1.84+00
7.20+00	4.31+01	4.78-01	1.23+01	4.39+01	.00	1.20+01	1.04+01	7.38+02	1.84+00
7.30+00	4.20+01	4.56-01	1.21+01	4.28+01	.00	1.18+01	1.05+01	7.43+02	1.84+00
7.40+00	4.10+01	4.35-01	1.18+01	4.17+01	.00	1.16+01	1.05+01	7.47+02	1.84+00
7.50+00	4.00+01	4.15-01	1.16+01	4.06+01	.00	1.13+01	1.05+01	7.51+02	1.84+00
7.60+00	3.89+01	3.96-01	1.13+01	3.96+01	.00	1.11+01	1.05+01	7.55+02	1.84+00
7.70+00	3.79+01	3.77-01	1.11+01	3.85+01	.00	1.09+01	1.05+01	7.59+02	1.84+00
7.80+00	3.69+01	3.59-01	1.08+01	3.75+01	.00	1.06+01	1.05+01	7.62+02	1.84+00
7.90+00	3.59+01	3.42-01	1.06+01	3.65+01	.00	1.04+01	1.05+01	7.66+02	1.84+00
8.00+00	3.50+01	3.25-01	1.03+01	3.54+01	.00	1.02+01	1.05+01	7.69+02	1.84+00
8.10+00	3.40+01	3.09-01	1.01+01	3.44+01	.00	9.92+00	1.05+01	7.73+02	1.84+00
8.20+00	3.30+01	2.93-01	9.80+00	3.34+01	.00	9.68+00	1.05+01	7.76+02	1.84+00
8.30+00	3.21+01	2.78-01	9.55+00	3.25+01	.00	9.44+00	1.05+01	7.79+02	1.84+00
8.40+00	3.11+01	2.64-01	9.29+00	3.15+01	.00	9.19+00	1.05+01	7.83+02	1.84+00

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CORPORATION

TIME MIN	REACTOR PRESSURE PSIA	REACTOR TEMP DEGREE F	WATER JACKET TEMP DEGREE F	REACTOR HEAT CONTENT BTU	GAS LEFT IN REACTOR LBMOLE	VCM LIQ. LEFT IN REACTOR LBMOLE	H2O LIQ. LEFT IN REACTOR LBMOLE	REACTOR VCM LIQ. VOLUME CU FT	REACTOR H2O LIQ. VOLUME CU FT
8.50+00	7.01+01	9.10+01	4.80+01	-4.66+06	7.31+00	1.19+02	4.57+03	1.35+02	1.32+03
8.60+00	6.98+01	9.07+01	4.80+01	-4.66+06	7.31+00	1.16+02	4.57+03	1.32+02	1.32+03
8.70+00	6.95+01	9.04+01	4.80+01	-4.71+06	7.31+00	1.13+02	4.57+03	1.28+02	1.32+03
8.80+00	6.92+01	9.01+01	4.80+01	-4.73+06	7.32+00	1.11+02	4.57+03	1.25+02	1.32+03
8.90+00	6.89+01	8.98+01	4.80+01	-4.75+06	7.32+00	1.08+02	4.57+03	1.22+02	1.32+03
9.00+00	6.86+01	8.95+01	4.80+01	-4.77+06	7.32+00	1.05+02	4.57+03	1.19+02	1.32+03
9.10+00	6.83+01	8.92+01	4.80+01	-4.79+06	7.33+00	1.03+02	4.57+03	1.16+02	1.32+03
9.20+00	6.80+01	8.90+01	4.80+01	-4.81+06	7.33+00	1.00+02	4.57+03	1.14+02	1.32+03
9.30+00	6.78+01	8.87+01	4.80+01	-4.83+06	7.33+00	9.80+01	4.57+03	1.11+02	1.32+03
9.40+00	6.75+01	8.85+01	4.80+01	-4.85+06	7.33+00	9.58+01	4.57+03	1.08+02	1.32+03
9.50+00	6.73+01	8.82+01	4.80+01	-4.87+06	7.34+00	9.37+01	4.57+03	1.06+02	1.32+03
9.60+00	6.71+01	8.80+01	4.80+01	-4.88+06	7.34+00	9.16+01	4.57+03	1.04+02	1.32+03
9.70+00	6.69+01	8.78+01	4.80+01	-4.90+06	7.34+00	8.97+01	4.57+03	1.01+02	1.32+03
9.80+00	6.67+01	8.76+01	4.80+01	-4.92+06	7.34+00	8.78+01	4.56+03	9.92+01	1.32+03
9.90+00	6.65+01	8.74+01	4.80+01	-4.93+06	7.34+00	8.60+01	4.56+03	9.72+01	1.32+03
1.00+01	6.63+01	8.72+01	4.80+01	-4.95+06	7.35+00	8.44+01	4.56+03	9.52+01	1.32+03

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COMPORATION

TIME MIN	PREFLASH GAS FLOW MOLE/MIN	PREFLASH VCM LIQ. FLOW MOLE/MIN	PREFLASH H2O LIQ. FLOW MOLE/MIN	FLASHED GAS FLOW MOLE/MIN	FLASHED VCM LIQ. FLOW MOLE/MIN	FLASHED H2O LIQ. FLOW MOLE/MIN	TOTAL PVL PRODUCED LBMOL	TOTAL VCM GAS EMISSION LBMOL	TOTAL VCM LIQ. EMISSION LBMOL
8.50+00	3.02+01	2.50-01	9.03+00	3.05+01	.00	8.95+00	1.05+01	7.86+02	1.84+00
8.60+00	2.92+01	2.37-01	8.74+00	2.95+01	.00	8.70+00	1.05+01	7.89+02	1.84+00
8.70+00	2.83+01	2.24-01	8.52+00	2.86+01	.00	8.45+00	1.05+01	7.92+02	1.84+00
8.80+00	2.74+01	2.12-01	8.26+00	2.76+01	.00	8.20+00	1.05+01	7.94+02	1.84+00
8.90+00	2.64+01	2.01-01	8.00+00	2.67+01	.00	7.95+00	1.05+01	7.97+02	1.84+00
9.00+00	2.55+01	1.89-01	7.74+00	2.57+01	.00	7.70+00	1.05+01	8.00+02	1.84+00
9.10+00	2.46+01	1.79-01	7.48+00	2.48+01	.00	7.44+00	1.06+01	8.02+02	1.84+00
9.20+00	2.37+01	1.68-01	7.21+00	2.39+01	.00	7.19+00	1.06+01	8.06+02	1.84+00
9.30+00	2.27+01	1.58-01	6.95+00	2.29+01	.00	6.93+00	1.06+01	8.07+02	1.84+00
9.40+00	2.18+01	1.49-01	6.68+00	2.20+01	.00	6.67+00	1.06+01	8.09+02	1.84+00
9.50+00	2.09+01	1.40-01	6.42+00	2.11+01	.00	6.41+00	1.06+01	8.11+02	1.84+00
9.60+00	2.00+01	1.31-01	6.15+00	2.01+01	.00	6.14+00	1.06+01	8.13+02	1.84+00
9.70+00	1.91+01	1.23-01	5.88+00	1.92+01	.00	5.88+00	1.06+01	8.15+02	1.84+00
9.80+00	1.82+01	1.14-01	5.61+00	1.83+01	5.29-03	5.61+00	1.06+01	8.17+02	1.84+00
9.90+00	1.73+01	1.07-01	5.35+00	1.74+01	1.07-02	5.35+00	1.06+01	8.19+02	1.84+00
1.00+01	1.64+01	9.94-02	5.07+00	1.65+01	1.57-02	5.07+00	1.06+01	8.20+02	1.84+00

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Metric Units Conversion Table

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APPENDIX D

Metric Units Conversion Table

Multiply (English Units)		by	To Obtain (Metric Units)	
English Unit	Abbreviation	Conversion	Abbreviation	Metric Unit
	<u>Symbol</u>		<u>Symbol</u>	
British Thermal Unit	BTU	0.252	kg cal	kilogram-calories
cubic feet	cu ft	0.028	cu m	cubic meters
degrees Fahrenheit	°F	0.555(°F-32)*	°C	degrees Celsius
feet	ft	0.3048	m	meters
gallon	gal	0.003785	cu m	cubic meters
kilowatt-hour	kwh	3.6 x 10 ⁶	j	joules
pounds	lb	0.454	kg	kilograms
pound per square inch	psi	6.8948	kPa	kilopascals
square feet	sq ft	0.0929	sq m	square meters
square inches	sq in	6.452	sq cm	square centimeters

*Actual Conversion, not a multiplier.