COPY No. 1

CONDEA VISTA COMPANY

ABERDEEN EXPRESS, PHASE 3
ABERDEEN, MS

PROCESS HAZARD ANALYSIS REPORT

RAYTHEON ENGINEERS & CONSTRUCTORS

RUST DIVISION

PROCESS TECHNOLOGY DEPARTMENT

September/October, 1996

SUMMARY

1. Objectives and Scope

The objective of this Process Hazard Analysis (PHA) was to identify potential hazards associated with the Phase 3 of the Aberdeen Express Project of the Aberdeen facility of the Condea Vista Co. The analysis was performed so as to satisfy corporate and plant safety goals.

The scope of this PHA covers the expansion to the existing plant, known as Aberdeen Express, Phase 3. This project includes upgrading of the VCM unloading facilities, the addition of two reactors, a resin dryer, a centrate water treatment system, and a two-cell cooling tower, plus upgrading of other equipment as required.

2. Techniques

The technique selected for the analysis is the HAZard and OPerability Analysis (HAZOP), which is considered the best identification technique for chemical process systems. It was used to determine the consequences of deviations in the process conditions. The assumptions made for the study are the usual ones in this type of analysis, i.e., the system (including the process, equipment, operating procedures, etc.) has been designed correctly and is suitable for its purpose except for the deviation under consideration, its causes and consequences. This technique, thus, will address, in a systematic manner, only single failure events.

Additionally, Siting/Layout and Human Factors were addressed by means of specific checklists, to ensure more complete coverage of these important issues. Previous incidents and deviations of a general nature were also addressed during the meetings.

The study addressed both batch processes and steady state operation, and hazards which could arise during other modes such as startup, shutdown, emergency situations, were also identified and analyzed.

3. Conclusions

No major hazardous scenarios without significant safeguards were identified by the PHA team. In cases where the potential for fire, explosion, or toxic release exists, the design incorporates safeguards to either reduce the probability or mitigate the consequences of such scenario. Nevertheless, a number of action items are recommended.

The number of action items recommended for each priority level are summarized in the following table:

ACTION ITEMS STATISTICS		
SOURCE	RISK (RANKING)	QUANTITY
HAZOP Table	Extreme (2)	0
	Excessive (3)	1 (*)
	Undesirable (4)	1
	Intermediate (5)	0
	Low (>5)	11
Previous incidents report		2
Siting/layout checklist		5
Human factors checklist		8
General deviations		6
TOTAL		34

The recommendation associated with the only excessive risk scenarios (*) is the following:

> "Review SOP for recirculating HPSW through initiator pots in the winter to prevent freezing. The concern is that an operator may fail to close the manual valve before charging the initiator pot."

A significant number of hazards identified by the PHA team, had a potential cause in "operational error", i.e., error of the operator while performing his duties. In these cases, the PHA team took credit for the operating procedures and the training as safeguards against the hazard. It is important to ascertain that in the operating procedures adequate consideration is given to all the hazardous scenarios identified during the analysis.

An adequate mechanism is now required to address all the action items recommended by the PHA team, before start-up of the process.

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1. INTRODUCTION

1.0. INTRODUCTION

1.1. Objectives

The objective of this Process Hazard Analysis (PHA) is to identify potential hazards associated with the Phase 3 of the Aberdeen Express Project of the Aberdeen facility of the Condea Vista Co.

The analysis was performed so as to satisfy corporate and plant safety goals.

1.2. General Scope

The scope of this PHA covers the expansion to the existing plant, known as Aberdeen Express, Phase 3.

2. PROCESS DESCRIPTION

2.0. PROCESS DESCRIPTION

2.1. General Description

The polymerization reaction of vinyl chloride monomer (VCM) to form polyvinyl chloride (PVC) resin is a batch suspension process in which VCM, water, suspension agents, and reaction initiator are the primary constituents. The exothermic reaction takes place under pressure and is held at a constant temperature throughout the reaction. The mixture is kept in suspension by mechanical agitation. At the conclusion of the reaction, unused VCM is drawn off, compressed, condensed, and stored for reuse. The slurry is steam stripped to decrease the amount of residual VCM. Resin properties can be varied by modifying reaction temperature, suspension agents, initiators, and recovery pressure.

This project, Phase 3 of the Aberdeen expansion, includes upgrading of the VCM unloading facilities, the addition of two reactors, a resin dryer, a centrate water treatment system, and a two-cell cooling tower, plus upgrading of other equipment as required.

2.2. Physical Scope

The physical scope of the study comprises all the nodes shown colored and numbered in the P&ID's enclosed in the Appendices.

2.3. Process Safety Information

The availability of the required process safety information was confirmed by the team leader, as detailed in this section.

PROCESS SAFETY INFORMATION				
#	INFORMATION	LOCATION	DATE	RESPONSIBLE
1. PERTAINING TO THE HAZARDS OF THE HIGHLY HAZARDOUS CHEMICALS				
1.1	Toxicity information	Safety supervisors office		G.Uptain
1.2	Permissible exposure limits	"		"
1.3	Physical data	"		"
1.4	Reactivity data	"		"
1.5	Corrosivity data	"		"
1.6	Thermal and chemical stability data	"		"
1.7	Hazardous effects of inadvertent mixing	No mixing hazards identified		
2. PERTAINING TO THE TECHNOLOGY OF THE PROCESS				
2.1	Block flow diagram or simplified proc. flow diag.	Process safety information manual		J.Minga

PROCESS SAFETY INFORMATION				
#	INFORMATION	LOCATION	DATE	RESPONSIBLE
2.2	Process chemistry	"		"
2.3	Maximum intended inventory	"		"
2.4	Safe upper and lower limits for process parameters	Operating procedures, Control room		J.Olson/ T.Nolen
2.5	An evaluation of the consequences of deviations	See HAZOP table		
3. PERTAINING TO THE EQUIPMENT IN THE PROCESS				
3.1	Materials of construction	Equipment files, PSM room		
3.2	Piping and instrument diagrams	Plant eng. design, drawing file room		J.Heywood
3.3	Electrical classification	"		"
3.4	Relief system design and design basis	Equipment files, PSM room		D.Whatey
3.5	Ventilation system design	N/A (*)		
3.6	Design codes and standards employed	Equipment files, PSM room		
3.7	Material & energy balances for process built after 05-26-92	PSM file room		
3.8	Safety systems	Process safety inform. manual, PSM room		
NOTES: (*) Compound and lab not covered.				

The drawings used in the analysis are listed in the following table. Marked-up copies of these drawings are enclosed in the Appendices.

LIST OF DRAWINGS			
NUMBER	REV	DATE	TITLE
DY-093100-PID-D	F	09-20-96	Large Slurry Blend Tanks
DY-093119-PID-D	H	NO DATE	Recycled Centrate Processing
DY-093128-PID-D	D	05-06-96	Product Storage - 600 Series Silos
DY-093129-PID-D	D	05-06-96	Product Storage - 600 Series Silos
DY-093130-PID-D	D	05-06-96	Product Storage - 600 Series Silos

LIST OF DRAWINGS			
NUMBER	REV	DATE	TITLE
DY-093134-PID-D	C	09-20-96	Plant Cooling Water System
DY-093137-PID-D	F	09-20-96	Centrifuges and Centrate
DY-093140-PID-D	E	07-12-96	Screening and Transfer
DY-093141-PID-D	F	09-20-96	Centrifuges and Centrate
DY-093142-PID-D	E	09-20-96	Dryer and Separator
DY-093143-PID-D	F	09-20-96	Dryer 10 Scrubber
DY-093144-PID-D	F	09-20-96	Dryer 10 Transfer
DY-094145-PID-D	D	05-06-96	Dryer 10
DY-093146-PID-D	E	09-20-96	Dryer 11
DY-093147-PID-D	B	05-06-96	Product Storage - 600 Series Silos
DY-093148-PID-D	C	NO DATE	Recycled Centrate Processing
DY-093149-PID-D	C	NO DATE	Recycled Centrate Processing
DY-093150-PID-D	B	NO DATE	Recycled Centrate Processing
NM-093107-PID-D	E	08-02-96	NM Reactor RX-745
NM-093108-PID-D	D	08-02-96	NM BME Metering Pot
NM-093109-PID-D	D	06-07-96	NM Recovery Knock-Out Drums
NM-093119-PID-D	E	08-02-96	NM MSPW System
NM-093120-PID-D	D	06-06-96	NM Emergency Kill Systems
NM-093121-PID-D	D	08-02-96	Steam & Reactor Evac. Systems
NM-093122-PID-D	E	08-02-96	NM Steam & Reactor Evac. Systems
NM-093126-PID-D	E	08-02-96	NM Seal Oil System
NM-093127-PID-D	E	08-02-96	NM Normal Kill Systems
NM-093128-PID-D	E	08-02-96	NM Clean Wall Supply Systems
NM-093133-PID-D	D	08-02-96	Stripper Rinse and Flush System
NM-093136-PID-D	D	06-06-96	NM Emergency Kill Systems
NM-093139-PID-D	A	08-02-96	NM Dump Pumps and Strainers
NM-093141-PID-D	A	08-02-96	NM Low Mole Stripper Feed Tank
NM-093143-PID-D	E	08-02-96	NM Reactor RX-746
NM-093144-PID-D	E	08-02-96	NM Reactor RX-747
NM-093147-PID-D	E	08-02-96	Catalyst Injection Pots
NM-093149-PID-D	B	08-02-96	Hot Water Charge and Rinse Systems
OM-093101-PID-D	E	08-02-96	OM Hot Water Charge and Rinse Systems

LIST OF DRAWINGS			
NUMBER	REV	DATE	TITLE
OM-093137-PID-D	E	08-02-96	Recycled Centrate Distribution
UT-093113-PID-D	E	08-02-96	Plant Cooling Water System
UT-093118-PID-D	B	NO DATE	Fire Water Deluge System
UT-093122-PID-D	F	08-02-96	Plant Cooling Water System
VS-093105-PID-D	C	08-02-96	VCM Sphere
VS-093107-PID-D	D	06-06-96	East VCM Tank Farm Compressors
VS-093108-PID-D	E	08-02-96	East VCM Tank Car Unloading
VS-093110-PID-D	C	06-06-96	East VCM Unloading KO Tanks

2.4. Procedures

Operating and maintenance procedures are currently in use in the existing facilities.

3. METODOLOGY

3.0. METHODOLOGY

3.1. Techniques

The technique selected for the analysis is the HAZard and OPerability Analysis (HAZOP), which is considered the best identification technique for chemical process systems. It was used to determine the consequences of deviations in the process conditions.

The HAZOP technique was specifically developed for chemical processes, such as the one being considered here. The P&ID's are divided in nodes or sections, colored and numbered for easy identification. A set of deviations is then postulated for each type of node by the team. These deviations are obtained by application of the HAZOP guidewords to the design intention of each node and to its attributes. Each deviation is then analyzed by the team to determine if there is a credible cause for it, and if so, to determine if the consequences are of concern. When both probable cause and consequences of concern are present, a potential hazard is identified. Safeguards for reducing the probability associated with the causes, or mitigating the consequences are then identified. If these safeguards are deemed insufficient by the PHA team, then recommendations or "action items" are listed to reduce the risk associated with the hazard.

The following are the guidelines used for the definition of nodes and deviations:

1. Each major process component is defined as a node.
2. Any component in which a level has to be maintained is defined as a node.
3. Each tank or vessel with considerable volume is defined as a node.
4. Each component in which a motor is attached (e.g., for an agitator) is defined as a node (with exception of fans and pumps).
5. At least a line node is defined between component nodes.
6. Each line with a process stream is defined as a node.
7. Only one line node is defined for a series of components if there are no other flow paths (thus the line node may include pumps, fans, heat exchangers, valves, condensers, etc., unless any of these components must be defined as a node due to other guidelines.
8. Each line branching off a process line is defined as a node.
9. Only one node is defined for multiple equipment in identical service. Nevertheless, note that any action items recommended for the equipment analyzed will also apply to the other which were not analyzed for being in identical service.
10. If two or more streams of different substances come together, the resulting stream is defined as a node, unless one of the lines is water for dilution, in which case the resulting stream is considered continuation of the non water stream.
11. If two or more streams of similar substances come together, the resulting stream is not defined as a new node, but it is considered as continuation of one of the converging streams.
12. Lines representing feeds of a given substance to different points of a piece of equipment are considered a single node.
13. Utilities lines are not defined as nodes.
14. For each type of node, at least a set of applicable deviations is defined, but more than one set may be defined for a given type of node, if there are substantial differences between sub-types, e.g., a set may be defined for a simple line (without pumps or heat exchangers) and a different set for a complex line (which includes pumps,...).
15. In addition to the deviations obtained from applying the guidewords to the design intention and to its attributes, deviations of a general nature are also used (e.g., internal/external leak/rupture, external fire, sampling, thermal expansion in long lines, venting systems, etc.).
16. The application of these guidelines leads, in some cases, to redundant

nodes which are the "same as" other nodes, and do not need to be analyzed. These nodes are identified by the HAZOP team during the team meetings.

17. The initial definitions of nodes and deviations prepared by the facilitator constitute a proposal. These definitions were modified by the HAZOP team as needed, based on their knowledge and experience on the process.

To further facilitate the selection of deviations, and ensuring that no relevant deviations were missed, the team members were issued one form for each type of node with the default deviations shaded, and were encouraged to add other deviations as needed. A copy of this form is shown in the next page.

In the case of the reactor, since its operation is of the batch type, each step of the sequence was analyzed together with the physical nodes involved in such step.

Additionally, Siting/Layout and Human Factors were addressed by means of specific checklists, to ensure more complete coverage of these important issues.

HAZOP DEVIATIONS

TYPE OF NODE:

ATTRIBUTES OF THE DESIGN INTENTION	GUIDEWORDS						
	NO (not, skipped, ommitted)	LESS (lower, sooner, shorter, slower)	MORE (higher, later, longer, faster)	PART OF (incomplete)	AS WELL AS (simultaneously, also)	OTHER THAN (misdirected, elsewhere)	REVERSE (out of sequence, another way)
Flow, from/to	No flow	Low flow	High flow		Loss of containm.	Misdirected flow	Reverse flow
Material, composition				Missing component	Extra comp./Cont.	Wrong substance	
Concentration		Low concentration	High concentration				
Phase				Missing phase	Additional phase	Wrong phase	
Pressure	Vacuum	Low pressure	High pressure	Partial pressure			Reverse pressure
Temperature		Low temperature	High temperature				
Level	No level	Low level	High level				
Interface		Low interface	High interface				
Reaction	No reaction	Low reaction rate	High reaction rate	Incompl. reaction	Side reaction		Reverse reaction
Mixing	No mixing	Low mixing	High mixing				
Agitation	No agitation	Low agitation	High agitation				
Speed, motion, rotation	No motion	Low speed	High speed				Inverse motion
pH		Low pH	High pH				
Viscosity		Low viscosity	High viscosity				
Time	No time	Short time	Long time			Wrong time	
Step, sequence	Step omitted	Step too early	Step too late		Extra step	Wrong step	Step out of seq.

GENERAL DEVIATIONS		
	External leak	External rupture
	Internal leak	Internal rupture
	Corrosion	Erosion
	Utilities failure	
	Sampling	
	External events	

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CONSIDER:
* Initial startup
* Normal operation
* Temporary operation
* Normal shutdown
* Startup following a turnaround
* Startup following an emergency shutdown
* Emergency operation
* Emergency shutdown

3.2. Analytical Scope

The study addressed both batch processes and steady state operation, and hazards which could arise during other modes such as startup, shutdown, emergency situations, were also identified and analyzed.

The assumptions made for the study are the usual ones in this type of analysis, i.e., the system (including the process, equipment, operating procedures, etc.) has been designed correctly and is suitable for its purpose except for the deviation under consideration, its causes and consequences. This technique, thus, will address, in a systematic manner, only single failure events.

3.3. Risk Assessment

The categories used for estimating frequencies of the possible causes for the deviations, and magnitude of the consequences of those deviations are shown in the enclosed table.

RISK ASSESSMENT		
CRITICALITY RANKING		
1	MAJOR	Loss of life. Severe injury or health effects. Damage or losses in excess of $1,000,000. Damage or injuries to community and/or environment, widespread evacuation.
2	HIGH	Moderate injury or health effects. Damage or losses of $100,000 to $1,000,000. Minor damage or health effects on community. Large reportable release.
3	MEDIUM	Minor injury or health effects. Damage or losses of $10,000 to $100,000, significant operating nuisance or problem. Irritant / nuisance. Small reportable release.
4	LOW/NONE	No impact on employee safety, community, environment. Less than $10,000 in equipment / production losses.
FREQUENCY RANKING		
1	FREQUENT	Expected to occur once per year or more.
2	PROBABLE	Expected to occur a number of times during the life of a facility. The chance of it occurring this year is between 1 in 2 and 1 in 100.
3	POSSIBLE	Expected to occur no more than once during the life of a facility. The chance of it occurring this year is between 1 in 100 and 1 in 10,000.
4	REMOTE	Unlikely to occur in the life of the facility. Less than 1 in 10,000 chance of occurring this year.
RISK RANKING		
2	EXTREME	Immediate mitigation is required or shutdown is required.

3	EXCESSIVE	Mitigation planning should begin immediately. Corrective action should be taken within three months.
4	UNDESIRABLE	Mitigation should be initiated within 12 months.
5	INTERMEDIATE	Review existing safety controls and/or procedures to ensure their proper use and adequacy.
>5	LOW	No mitigation required.

Where the risk is determined as a function of criticality and frequency by means of the following risk matrix:

RISK MATRIX		**FREQUENCY**			
		1	2	3	4
CRITICALITY	1	2	3	4	5
	2	3	4	5	6
	3	4	5	6	7
	4	5	6	7	8

4. REVIEWS

4.0. REVIEWS

4.1. Meetings

The meetings were conducted at the Aberdeen, MS, plant of the Condea Vista Co., from September 30th to October 3rd, 1996.

4.2. PHA Team

The participants in a PHA team are the following:

* LEADER (or CHAIRMAN), representative of the owner of the process or plant, who assumes the responsibility for determining the physical and analytical scope of the study, for the availability of the process safety information, and for the final report.
* FACILITATORS/SCRIBES, the persons knowledgeable in the methodology to be used, and who will record the proceedings of the PHA.
* MEMBERS, selected by the leader, who, together with those mentioned above, brainstorms about ways in which the process can generate hazardous scenarios.

The following table lists the team members (not all the team members were present at all meetings).

MEMBERS OF HAZOP TEAM			
FUNCTION	**NAME**	**COMPANY**	**DEPARTMENT/FUNCTION**
Chairman	Reed MacKay	Condea Vista Co.	Engineering
Facilitators /Scribes	Enrique Susemihl	Raytheon E. & C.	Process Technology
	Bharat Shah	"	Process Technology
Members	Houston Smith	Condea Vista Co.	Lead Operator
	Ken Campbell	"	Field operator
	Deevie Rambus	"	Instrument technician
	Luke Threadgill	"	Maintenance
	Steve Wilkes	"	Field operator
	Rodney Strickland	"	Field operator
	Dean Honeycutt	"	Yard supervisor
	Janice Minga	"	PSM coordinator

4.3. Analysis Aids

To facilitate the recording of the proceedings and the participation of all team members in the preparation of the tables, a special purpose software was used. This software is LEADER V2.3, from JBF Associates. The software was run on a laptop computer, and the computer screen was projected on a wall screen by means of a projection device. In this way all team members could see and participate in the edition of the tables as they were being prepared.

An initial proposal for all nodes and deviations was prepared before the start of the meetings. The software was also set up with these nodes and deviations in

preparation for the meetings.

Team members were provided with a package containing copies of the marked up P&ID's, with the nodes, as initially defined, colored and numbered. This initial definition of nodes was modified by the PHA team as deemed adequate. The package also included preliminary answers from the client on the "human factors" and "siting and layout" checklist, to be reviewed by the team.

This careful preaparation for the meeetings allowed for a very efficient discussion and analysis of the process.

5. ANALYSIS

5.0. ANALYSIS

5.1. Hazards of the Process

The hazards associated with the process are the usual ones, i.e.,

* Loss of containment of a potentially hazardous chemical, with consequent exposure of personnel.
* Loss of containment of a flammable and/or explosive chemicals, with consequent fire and/or explosion.
* Loss of containment of a environmentally hazardous chemical, with the consequent environmental impact.

There are a number of chemicals, part of the process, which were identified as potentially hazardous from a safety and/or environmental point of view. The hazards associated with each of these chemicals is summarized in the next section.

The potential scenarios leading to the hazards shown above were extensively analyzed during the formal HAZOP sessions, and their causes and consequences are shown in the HAZOP table.

5.2. Potential Safety and Health Effects

In estimating the effects of the potential hazards, the properties of the chemicals involved were considered. These properties are shown in the Material Safety Data Sheets included in the Appendices of this report.

The effects of inadvertent mixing of the chemicals has also been analyzed, but no hazards were identified.

5.3. Background

This expansion is similar to currently existing facilities. These existing facilities have undergone several process hazard analyses, and there is considerable experience in their operation. The design of the expansion incorporates all the previous experience, and the recommendations of the previous hazard analyses.

5.4. Engineering and Administrative Controls

The following engineering controls were identified as relevant:

* Instrumentation, controls, alarms, interlocks
* Area detection and analyzer devices
* Emergency shutdown system of the generating facility, to a safe condition
* Emergency shutdown button
* Relief system to safe header (in some places)
* Ventilation system in control room
* Fire fighting equipment (both within the plant, and from the local fire department)
* HAZMAT gear
* Dikes on storage area
* Explosion hatches on the storage tanks, bag houses
* Overflow lines on storage tanks
* Vent lines to safe location
* Deluge systems
* Backup emergency power system
* Breathing equipment throughout the plant

* Backup cooling water (firewater)

A number of administrative controls intended to provide a safe work place were identified, such as:

* Safe work practices (lockout/tagout, hot work permit, use of respirators in hazardous areas, use of personal detection badges, etc.)
* Emergency response plan/team
* Preventive/predictive/proactive maintenance program and procedures
* Operating procedures
* Maintenance procedures
* Training program for operators, maintenance personnel, contractors, firefighting activities, emergency personnel, etc
* Restricted access to hazardous areas, thus reducing potential exposure
* HAZMAT training and procedures
* Management of change system
* Evacuation procedures after maintenance
* Color coding of utilities lines
* Use of generally accepted standards (for engineering, piping, painting, etc.)
* Company standards, based in years of experience in working with the chemicals involved in this process, for its safe handling, storage, and processing.
* Annual physicals for all employees
* Use of hand held detection devices
* Periodic noise surveys

During the PHA meetings, credit was taken for the safeguards provided by specific and generic controls, as shown in the HAZOP table.

5.5. Consequence of Failure of Controls

The potentially hazardous conditions which could lead to the hazards identified in 5.1 are systematically addressed in the formal HAZOP processes, and listed in the table shown in the Appendices of this report. The consequences listed in this table assumes failure of controls, which are then listed as safeguards for either reducing the probability of the event or mitigating its consequences. Whenever these safeguards were deemed insufficient by the team members, action items were included to further improve the safety of the system. Refer to the enclosed HAZOP table for specific scenarios of potential hazards, the risk associated with them, and the engineering and administrative controls, listed under safeguards, which reduce the associated risk.

5.6. Reactor Operation

Since the reactor operation is a batch operation, each of the steps involved was analyzed together with the nodes involved in the step. The following is a description of the operation used during the analysis:

* STEP 1: EVACUATION
  Design intent: To remove air from the reactor.
  Activity: By means of steam jet eductors, the reactor is evacuated to 27-28" Hg in about 8 minutes.
  Parameters: Flow, pressure.
  Nodes: 201A, 216
  Notes: Skip this step in the case of "closed dump".

* STEP 2: CHARGE
  Design intent: To charge ingredients to the reactor.
  Activity: Reaction ingredients are charged into the reactor using an automatic sequencing control system, as follows:

1. Water (continues to the end of the step)
2. Suspending agents
3. Fresh VCM
4. Recovered VCM

Parameters: Flow, time, composition, sequence (all considered for each ingredient), pressure, temperature, agitation.
Nodes: 201B, 203, 204, 205, 206, 207, 208, 210

* STEP 3: INITIATION
Design intent: To initiate the polymerization reaction.
Activity: When the charge of the ingredients is complete, the initiator is manually charged to the reactor.
Parameters: Flow, composition, temperature, pressure.
Nodes: 201C, 211

* STEP 4: REACTOR HEATUP
Design intent: To heat reactor contents to reaction temperature.
Activity: Steam is mixed to the reactor jacket cooling water in external eductors. Steam flow is stopped once the desired temperature has been reached.
Parameters: Temperature, pressure.
Nodes: 201D

* STEP 5: POLYMERIZATION
Design intent: To polymerize the VCM into PVC.
Activity: The exothermic reaction is kept under control, by monitoring and controlling the following:
1. Temperature in the reactor
2. Temperature in the condenser
3. Agitation
4. Inert venting
5. Chain transfer addition
6. Post addition of suspending agents

Parameters: The above, composition of added chemicals, time, reaction.
Nodes: 201E, 205, 208, 213

* STEP 6: NORMAL KILL
Design intent: To stop the polymerization reaction.
Activity: When the polymerization slows down, as signaled by the reactor pressure dropping off, a chain terminating kill agent is transferred to the reactor.
Parameters: Flow, composition, pressure, temperature.
Nodes: 201F, 214

* STEP 7: IN REACTOR RECOVERY AND STRIPPING
Design intent: To recover excess monomer for later use, and to reduce residual VCM to an acceptable level.
Activity: The reactor is vented to the vinyl recovery system, and when the reactor pressure drops below 40 psig, steam is added to the slurry to raise its temperature and vaporize more vinyl. This recovery process is continued until the slurry has reached 160F, and then the temperature is held for a designated time.
Parameters: Flow, pressure, temperature.
Nodes: 201G, 202, 215
Notes: Skip this step in the case of "closed dump".

* STEP 8a: ATMOSPHERIC DUMP
Design intent: To transfer slurry to the blend tank.
Activity: The atmospheric vent valve of the reactor is opened, the slurry drains by gravity to a head tank, and is pumped

to the blend tank.
Parameters: Flow, pressure.
Nodes: 201H, 217, 217a
Notes: Alternative to step 8b, "closed dump".

* STEP 8b: CLOSED DUMP
Design intent: To transfer unstripped slurry to dump tank for continuous stripping operation.
Activity: The slurry is transferred from the reactor to the dump tank by means of the dump pump.
Parameters: Flow, pressure.
Nodes: 201I, 218
Notes: Alternative to step 8a, "atmospheric dump".

* STEP 9: RINSE
Design intent: To clean the reactor for the next batch.
Activity: Typically three complete cycles of rinsing and draining are performed. The need for additional rinses is determined by visual inspection.
Parameters: Flow, pressure.
Nodes: 201J, 219

* STEP 10: CLEAN WALL
Design intent: To prevent polymer buildup on the internal surfaces.
Activity: A buildup suppresant solution is injected with steam to the reactor and to the condenser.
Parameters: Flow, composition
Nodes: 201K, 219, 220

* STEP 11: EMERGENCY KILL
Design intent: Kill the reaction to prevent a release.
Activity: AMS is injected to the reactor.
Parameters: Flow, composition, pressure, temperature
Nodes: 201L, 221, 223
Notes: This is an emergency procedure, typically in case of power failure affecting agitation, loss of cooling water, or excess initiator.

* GENERAL PARAMETERS/DEVIATIONS:
Deviations: Step/sequence, internal leak/rupture
Nodes: 201M

5.7. Previous Relevant Incidents

A list of previous relevant incidents is enclosed in Appendices of this report. The action items arising from the analysis of the previous incidents are included in the Action Items Tables.

5.8. Siting and Layout

The possible safety considerations associated with layout and siting were addressed by means of a Siting Checklist. The completed checklist is shown in the Appendices of this report. The action items arising from the analysis of this checklist are included in the Action Items Tables.

5.9. Human Factors

Human factors and their impact on the safe operation and maintenance of the process were addressed at all stages of the analysis. To insure more complete

coverage of this important issue, two human factors checklists were also used and are shown in the Appendices of this report. The action items arising from the analysis of these checklists are included in the Action Items Tables.

5.10. General Deviations

In addition to the deviations listed in the HAZOP table, some deviations of a general nature were also considered, e.g., compatibility of vent streams, external leak and rupture, contamination, external fire, external events, effects of emergency operation, shutdown, etc. The team discussion led to the recommendation of some action items, which are listed in the Action Items Table.

5.11. Formal Analysis

The software generated tables for the formal analysis using the HAZOP technique are shown in the Appendices.

5.12. Action Items

The action items identified during the HAZOP procedure are listed in the tables generated by the software LEADER V2.3. Also shown are tables for additional action items identified as follows:

* analysis of previous incidents
* analysis of the siting checklist
* analysis of the human factors checklists
* analysis of general deviations

Two types of action items were identified during the meetings: those which are project (Phase III) specific, and those which are general plant issues involving existing processes and/or procedures.

Project issues will be addressed by Reed MacKay, whereas the remaining issues not related to the project will be communicated to the plant for review by the Plant Safety Committee. The responsible party is shown next to each action item in the tables enclosed.

ADDITIONAL ACTION ITEMS TABLE			
REF. #	DESCRIPTION	P	RESPONS.
ANALYSIS OF PREVIOUS INCIDENTS			
PI-1	Consider catches on bottom manways on all reactors.		Plant Safety Committee
PI-2	Consider emergency backup power for walk-in freezers.		Plant Safety Committee
ANALYSIS OF THE SITING/LAYOUT CHECKLIST			
SL-1.7	Overpressure design parameters for control room was not available. Review parameters.		Plant Safety Committee
SL-7.7	Consider better enforcement of applicable vehicle procedures to prevent accidents and near misses.		Plant Safety Committee
SL-10.2	Review equiment and capability of existing first aid station to determine if it is adequate for its purpose.		Plant Safety Committee
SL-11.3	Adequate documentation related to facility siting and unit layout was not available. It should be prepared and maintained.		Plant Safety Committee
SL-11.8	Review emergency lighting to insure that it is adequate.		Reed MacKay
ANALYSIS OF THE HUMAN FACTORS CHECKLIST (1)			
HF-1.03	Consider more appropriate summer clothing. Nomex clothing is too hot in summer.		Plant Safety Committee
HF-1.05	Consider reducing electrical lights during daytime. Automatic detectors often fail.		Plant Safety Committe
HF-2.03	Review maintenance tool availability. Determine whether a better system than the one presently used should be developed to insure availability of proper tools for field work. Also determine whether the check out system in the tool room is working as intended.		Plant Safety Committee
HF-3.02	Consider better labeling of equipment, instruments and piping. Not all equipment and lines are currently labeled.		Plant Safety Committee
HF-3.05	A system should be in place to install, maintain, and update equipment and instrument labels.		Plant Safety Committee
HF-5.03	Consider better training on DCS equipment, specifically about the different screens: diagnostic screens, controller screens, trio screens.		Plant Safety Committee

ADDITIONAL ACTION ITEMS TABLE			
REF. #	**DESCRIPTION**	**P**	**RESPONS.**
HF-7.01	Review panel operator activities and requirements in view of current expansion. Determine whether the operator has enough screens to monitor all equipment, the kind and quantity of new tasks, whether more automation and safeguards can be added to reduce tha amount of input required to run the new equipment.		Plant Safety Committee
HF-7.05	Consider whether a better system than the one currently in place is required to handle operator overtime.		Plant Safety Committee
ANALYSIS OF GENERAL DEVIATIONS			
GD-1	Loss of instrument and plant air: Consider adding secondary backup for instrument air dryer, considering this summer incident with the instrument air dryer and the dessicant getting into the instrument air system.		Plant Safety Committee
GD-2	Loss of instrument and plant air: Consider adding backup filter for maintenance.		Plant Safety Committee
GD-3	Loss of instrument and plant air: Consider new solutions to prevent PVC settling down and getting into piping on loss of sparging in blend tanks.		Plant Safety Committee
GD-4	Loss of steam: Consider adding emergency power to the boiler area to keep boilers running during power failures.		Plant Safety Committee
GD-5	Loss of seal oil: Review level control on seal oil storage tanks (reactor seal oil system).		Plant Safety Committee
GD-6	Communications: Review internal communications systems. PA system does not reach some areas.		Plant Safety Committee

Reference Number	Priority	Action	Responsibility	Status
201D-1	8	Consider using firewater as secondary backup for cooling water supply, in addition to emergency generator (Item: 201D.2)	Reed MacKay	
201E-1	7	Consider new preventive maintenance procedures for agitator (inspection of shafts to detect cracks) (Item: 201E.5)	Plant Safety Comm.	
212B-1	3	Review SOP for recirculating HPSW through initiator pots in the winter to prevent freezing. The concern is that an operator may close the manual valve before charging the initiator pot. (Item: 212B.1)	Plant Safety Comm.	
213 -1	6	Consider applying a small amount of cleanwall to the 1" reactor vent line to reduce/prevent build up. (Item: 213.1)	Reed MacKay	
214 -1	7	Check ISONOX kill lines for adequate heat tracing and insulation to prevent winter freezing. Also check temperature settings on heat tracing to avoid high temperature crystallization. (Item: 214.1)	Reed MacKay	
214 -2	4	Same as Recommendation 214 -1 (Item: 214.11)	Reed MacKay	
217 -1	7	Reactor hydrotest water and rinse water after hydro blast for the two new reactors will go to the high mole SWECO. Determine if this will cause a problem. (Item: 217.1)	Reed MacKay	
217 -2	6	Consider adding high level signal and level control in the DCS for head tanks in the atomospheric dump system. (Item: 217.2)	Plant Safety Comm.	
220 -1	7	Consider adding BUS-80 on slow vent line (see recommendation 213 -1) (Item: 220.1)	Reed MacKay	

Reference Number	Priority	Action	Responsibility	Status
328 -1	6	For water recycle chemical additives, consider some type of coding system or operating method to prevent an operator from hooking the wrong tote. (Item: 328.5)	Reed MacKay	
329 -1	8	Verify freezing point of sodium hypochlorite and determine if freezing could be a problem (Item: 329.5)	Reed MacKay	
334 -1	8	Review MSDS of water recycle chemicals to determine proper handling procedure. (Item: 334.1)	Reed MacKay	
339 -1	7	When writing the program for the media filter system consider operation in case of loss of air during the air scouring step. (Item: 339.3)	Reed MacKay	

6. SUMMARY AND CONCLUSIONS

6.0. SUMMARY AND CONCLUSIONS

No major hazardous scenarios without significant safeguards were identified by the PHA team. In cases where the potential for fire, explosion, or toxic release exists, the design incorporates safeguards to either reduce the probability or mitigate the consequences of such scenario. Nevertheless, a number of action items are recommended.

The number of action items recommended for each priority level are summarized in the following table:

ACTION ITEMS STATISTICS		
SOURCE	RISK (RANKING)	QUANTITY
HAZOP Table	Extreme (2)	0
	Excessive (3)	1 (*)
	Undesirable (4)	1
	Intermediate (5)	0
	Low (>5)	11
Previous incidents report		2
Siting/layout checklist		5
Human factors checklist		8
General deviations		6
	TOTAL	34

The recommendation associated with the only excessive risk scenarios (*) is the following:

> "Review SOP for recirculating HPSW through initiator pots in the winter to prevent freezing. The concern is that an operator may fail to close the manual valve before charging the initiator pot."

A significant number of hazards identified by the PHA team, had a potential cause in "operational error", i.e., error of the operator while performing his duties. In these cases, the PHA team took credit for the operating procedures and the training as safeguards against the hazard. It is now important to ascertain that in the operating procedures adequate consideration is given to all the hazardous scenarios identified during the analysis.

An adequate mechanism is now required to address all the action items recommended by the PHA team, before start-up of the process. Addressing the action items does not necessarily require following the recommendation of the team, but rather giving it adequate consideration and documenting the decisions taken.

A. PREVIOUS RELEVANT INCIDENTS

APPENDIX A

PREVIOUS RELEVANT INCIDENTS

INCIDENTS AT CONDEA VISTA ABERDEEN PLANT:

1. Incident: Worker got something in his eye while opening bottom reactor manway.
   Date: February 6, 1987.
   Cause: Insufficient eye protection.
   Injuries: One, eye irritation.
   Mitigation: Eye goggles must be worn while opening reactor bottom manways.
   Reference: Herbert Jackson eye injury, March 23, 1987.

2. Incident: Near miss crane accident on 501 blend tank.
   Date: May 28, 1986.
   Cause: Lack of communication and planning.
   Injuries: None.
   Mitigation: A Vista maintenance supervisor oversees all personnel lifting operations.
   Reference: Near miss accident, 501 Blend Tank cleaning, June 26, 1986.

3. Incident: Worker pinched the skin on his finger while repositioning the global drilling rig on RX-745.
   Date: September 22, 1983.
   Cause: Inadequate procedure for safely setting up the drilling rig.
   Injuries: One, pinched skin on finger.
   Mitigation: 1) Install secondary lifting davit on RX-700 and RX-745; 2) Discuss incident with employees; and 3) Modify lighting for crane operator visibility.
   Reference: Accident investigation, William Moore, October 14, 1983.

4. Incident: Catalyst bottles melted down while in a storage freezer.
   Date: July 24, 1984.
   Cause: Improper freezer upkeep, freezer location in direct sunlight, and freezer abuse.
   Injuries: None.
   Mitigation: Freezer were put underneath open-side awnings to get the freezers out of direct sunlight. New freezer maintenance procedure.
   Reference:

5. Incident: An air hose connected to a jackhammer came loose, and as it whipped around uncontrollably, hit a bystander in the knee.
   Date: April 11, 1983.
   Cause: Equipment failure.
   Injuries: One, bruised knee.
   Mitigation: Ban all non-locking Thor air fittings from the plant.
   Reference: Lander Keaton injury, April 22, 1983.

6. Incident: Worker cut finger on rupture disk tag while opening a valve.
   Date: July 6, 1991.
   Cause: Employee was not wearing gloves and all rupture disks tags have sharp edges.
   Injuries: One, cut finger.
   Mitigation: 1) Check all safety disks to see if they can be arranged more safely; and 2) Wear gloves while working in the field.
   Reference: Accident investigation report # 91-3.

7. Incident: Worker was loading empty catalyst cardboard boxes in a dumpster. Instead of folding the empty boxes up before

disposal, the worker was throwing several unfolded boxes in at a time. While doing so, a box knocked his glasses off. In his attempt to catch the glasses a box flap hit him in the eye cutting the lens.

Date: March 2, 1991.
Cause: The worker was in a hurry to beat the rain. In addition, he did not want his glasses to hit the ground.
Injuries: One, eye.
Mitigation: 1) Fold boxes before disposal; 2) Do not hurry doing a job; 3) Inform employees and discuss accident.
Reference: Accident investigation report # 91-2.

8. Incident: Worker pinched a nerve in his back while working on a pump from a squatting position.
Date: July 3, 1989.
Cause: Excessive pulling and straining while trying to loosen some bolts.
Injuries: One, pinched nerve in worker's back.
Mitigation: 1) Pump couplings halves are to be sprayed with an anti-seize solution at all subsequent similar maintenance; and 2) if more than normal effort is required to do a job of this nature, the pump is to be pulled and taken to the shop.
Reference: Herbert Jackson back injury, July 21, 1989.

9. Incident: RX-700 evacuation valve failed to close resulting in a VCM release.
Date: February 20, 1992.
Cause: This particular type of actuator and valve stem connection was not properly assembled. The type in question has a recessed valve stem and a transition piece between the valve stem and actuator.
Injuries: None.
Mitigation: 1) Identify, check, all valves of this type. Eventually replacing them with valves without recessed stems and transition pieces during shutdowns and downtime; 2) Added and interlock to shut the reactor evacuation valve if more than 8 psig is seen on the reactor; and 3) Add pressure switches and interlocks on evacuation header to look for leaking valves.
Reference: Investigation of RX-700 evacuation valve malfunction. March 23, 1992.

INCIDENTS AT OTHER CONDEA VISTA PLANTS:

1. Incident: A 695 lb release occurred when a threaded pipe spool sheared off an unloading compressor head in the tank farm.
Date: May 20, 1996
Cause: Fatigue induced by compressor vibration.
Injuries: None
Mitigation: Replace Sch. 80 piping with Sch. 160. Include pipe spools in inspection program.
Reference: C-102 VCM release.

2. Incident: A reactor was not fully drained after a test and was overfilled during charge. The safety pressure interlock shut down the charge and prevented a release.
Date: May 15, 1996
Cause: Too many activities in progress at the same time. Panel operator was distracted and did not answer the DCS question to rerinse or continue.

	Injuries:	None
	Mitigation:	Evaluate need for low level switch and permissive to ensure the reactor is liquid empty.
	Reference:	D-306 charge.
3.	Incident:	Near miss accident when operator steamed a line and a valve containing organic peroxide. The organic peroxide rapidly decomposed and split the piping.
	Date:	January 21, 1996
	Cause:	A valve started to open but closed immediately due to low pressure on the HPSW line. A small amount of organic peroxide was trapped between two valves.
	Injuries:	None
	Mitigation:	Various, such as modifying DCS graphic to show low pressure on the HPSW.
	Reference:	F-364 organic peroxide piping
4.	Incident:	Electrical fire in the New control room mechanical room.
	Date:	June 28, 1995
	Cause:	A ground fault occurred at a motor. The surge suppressors were the wrong type for this application.
	Injuries:	None
	Mitigation:	Remove surge suppressors, follow up with manufacturer regarding inspection and testing, ensure that the Management of Change System addresses electrical components for future installations and modifications.
	Reference:	New control room mechanical room electrical fire.
5.	Incident:	46 lb of VCM were released to the atmosphere when the anti foam injection line failed and pulled away from the slurry feed line.
	Date:	January 7, 1996
	Cause:	Failure of the weld connecting the anti foam line and the slurry feed line.
	Injuries:	None
	Mitigation:	Various procedural, design and maintenance actions (see original report).
	Reference:	W-622 VCM release
6.	Incident:	A small flash fire occurred while welding on a stripper feed line at the stripper area.
	Date:	July 29, 1996
	Cause:	The piping contained VCM vapor residue, which collected and created a flammable vapor/air mixture.
	Injuries:	None
	Mitigation:	Operations personned to check jobs closer to the actual performance of hot work, permit writers to be aware of long runs of piping which may allow residual vapors to build up, include requirements for accessible flanges and bleeders for long runs of piping.
	Reference:	Stripper feed line flash fire

B. MATERIAL SAFETY DATA SHEETS

APPENDIX B

MATERIAL SAFETY DATA SHEETS

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved OMB No. 44-R1367

MATERIAL SAFETY DATA SHEET

received 9-14-85

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME	EMERGENCY TELEPHONE NO.
The Nippon Synthetic Chemical Industry Co., Ltd.	06-314-1962
ADDRESS (Number, Street, City, State, and ZIP Code) 0-6, Nozaki-cho, Kita-ku, Osaka, 530 Japan	
CHEMICAL NAME AND SYNONYMS Polyvinyl Alcohol	TRADE NAME AND SYNONYMS GOHSENOL GH-20
CHEMICAL FAMILY Polymer	FORMULA

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS	N/A		BASE METAL	N/A	
CATALYST	"		ALLOYS	"	
VEHICLE	"		METALLIC COATINGS	"	
SOLVENTS	"		FILLER METAL PLUS COATING OR CORE FLUX	"	
ADDITIVES	"		OTHERS	"	
OTHERS	"			"	

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
None		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	-	SPECIFIC GRAVITY (H_2O=1)	1.2-1.3 at 20°C
VAPOR PRESSURE (mm Hg.)	-	PERCENT, VOLATILE BY VOLUME (%)	less than 5%
VAPOR DENSITY (AIR=1)	-	EVAPORATION RATE (_____=1)	
SOLUBILITY IN WATER	No Limit		
APPEARANCE AND ODOR	White powder with no odor		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	LEL	UEL

EXTINGUISHING MEDIA: Water alcohol foam, dry chemical

SPECIAL FIRE FIGHTING PROCEDURES: None especially

UNUSUAL FIRE AND EXPLOSION HAZARDS: None especially

(Continued on reverse side)

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: None determined

EFFECTS OF OVEREXPOSURE: It may happen to effect the respiratorvorgans as sam-
as dust in case of inhaling fine powder for a long time.

EMERGENCY AND FIRST AID PROCEDURES: It is not considered a toxic hazard.
Eyes: to wash out without rubbing
Skin: to eliminate after handling

SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	

INCOMPATABILITY (Materials to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: PVA is water soluble and makes a sticky solution, so scattered or spilled PVA powder should be swept up (not be washed out with water).

WASTE DISPOSAL METHOD: to burn up

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): It is desireble to wear filter mask, when the very dusty grade is used

VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL (General)	OTHER

PROTECTIVE GLOVES: None especially

EYE PROTECTION: None especially

OTHER PROTECTIVE EQUIPMENT: None especially

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: None generally. Quality does not chemically change at room temperature and humidity.

OTHER PRECAUTIONS: None generally

THE NIPPON SYNTHETIC CHEMICAL INDUSTRY CO.,LTD.
NO.9-ENOZAKI-CHO, KITA-KU
OSAKA, JAPAN

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1367

MATERIAL SAFETY DATA SHEET

received
9-16-85

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: The Nippon Synthetic Chemical Industry Co., Ltd.	EMERGENCY TELEPHONE NO.: 06-314-1962
ADDRESS (Number, Street, City, State, and ZIP Code): 0-6, Nozaki-cho, Kita-ku, Osaka, 530 Japan	
CHEMICAL NAME AND SYNONYMS: Polyvinyl Alcohol	TRADE NAME AND SYNONYMS: GOHSENOL GH-20
CHEMICAL FAMILY: Polymer	FORMULA

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS	N/A		BASE METAL	N/A	
CATALYST	"		ALLOYS	"	
VEHICLE	"		METALLIC COATINGS	"	
SOLVENTS	"		FILLER METAL PLUS COATING OR CORE FLUX	"	
ADDITIVES	"		OTHERS	"	
OTHERS	"			"	

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
None		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	-	SPECIFIC GRAVITY (H2O=1)	1.2-1.3 at 20°C
VAPOR PRESSURE (mm Hg.)	-	PERCENT, VOLATILE BY VOLUME (%)	less than 5%
VAPOR DENSITY (AIR=1)	-	EVAPORATION RATE (_____=1)	
SOLUBILITY IN WATER	No Limit		
APPEARANCE AND ODOR	White powder with no odor		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	LEL	UEL

EXTINGUISHING MEDIA: Water alcohol foam, dry chemical

SPECIAL FIRE FIGHTING PROCEDURES: None especially

UNUSUAL FIRE AND EXPLOSION HAZARDS: None especially

(Continued on reverse side)

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: None determined

EFFECTS OF OVEREXPOSURE: It may happen to effect the respiratorvorgans as sam - as dust in case of inhaling fine powder for a long time.

EMERGENCY AND FIRST AID PROCEDURES: It is not considered a toxic hazard.

Eyes: to wash out without rubbing

Skin: to eliminate after handling

SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	x	

INCOMPATABILITY (Materials to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	x	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: PVA is water soluble and makes a sticky solution, so scattered or spilled PVA powder should be swept up (not be washed out with water).

WASTE DISPOSAL METHOD: to burn up

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): It is desireble to wear filter mask, when the very dusty grade is used

VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL (General)	OTHER

PROTECTIVE GLOVES: None especially

EYE PROTECTION: None especially

OTHER PROTECTIVE EQUIPMENT: None especially

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: None generally. Quality does not chemically change, at room temperature and humidity.

OTHER PRECAUTIONS: None generally

THE NIPPON SYNTHETIC CHEMICAL INDUSTRY CO.,LTD.
NO.5-SHOZAKI-CHO. KITA-KU
OSAKA. JAPAN

Material Safety Data Sheet

The Dow Chemical Company
Midland, Michigan 48674

The Dow Chemical Company, Midland, MI 48674 Emergency Phone:517-636-4400

Product Code: 53940 Page: 1

Product Name: METHOCEL (R) F50 HYDROXYPROPYL METHYLCELLULOSE

Effective Date: 02/10/92 Date Printed: 04/14/95 MSDS:000055

1. INGREDIENTS: (% w/w, unless otherwise noted)

Hydroxypropyl methylcellulose	CAS# 009004-65-3	85-99%
Water	CAS# 007732-18-5	1-10%
Sodium chloride	CAS# 007647-14-5	0.5-5%

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

2. PHYSICAL DATA:

BOILING POINT: Not applicable.
VAP PRESS: Not applicable.
VAP DENSITY: Not applicable.
SOL. IN WATER: See section 9.
SP. GRAVITY: Not applicable.
APPEARANCE: White to slightly off-white free-flowing powder.
ODOR: Not available.

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: N/A
METHOD USED: N/A

FLAMMABLE LIMITS
LFL: Not deter.
UFL: Not deter.

EXTINGUISHING MEDIA: Water fog.

FIRE & EXPLOSION HAZARDS: Minimum explosive dust concentration 0.03 oz/cu ft. Similar to flour or grain dusts; keep clouds of such dust away from possible ignition sources.

FIRE-FIGHTING EQUIPMENT: Use positive-pressure, self-contained breathing apparatus.

(Continued on page 2 , over)

4. REACTIVITY DATA:

STABILITY: (CONDITIONS TO AVOID) Avoid dust clouds or layers.

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) Oxidizing material.

HAZARDOUS DECOMPOSITION PRODUCTS: Same as for wood or paper.

HAZARDOUS POLYMERIZATION: Will not occur.

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

ACTION TO TAKE FOR SPILLS/LEAKS: Sweep up and use if possible, or discard using disposal method listed below.

DISPOSAL METHOD: Preferable method is to dispose in landfill. Disposal can also be accomplished by incineration under controlled conditions to eliminate dust explosions. In both methods, disposal techniques should be in compliance with applicable federal, state, and local laws and regulations regarding management, use, handling, treatment, storage, disposal, and transportation of used chemicals.

6. HEALTH HAZARD DATA:

EYE: Solid or dust may cause irritation or corneal injury due to mechanical action.

SKIN CONTACT: Essentially nonirritating to skin.

SKIN ABSORPTION: A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts.

INGESTION: Single dose oral toxicity is low. No hazards anticipated from ingestion incidental to industrial exposure. The oral LD50 for rats is >10,000 mg/kg.

INHALATION: Single exposure to dust is not likely to be hazardous.

SYSTEMIC & OTHER EFFECTS: Based on available data, repeated exposures are not anticipated to cause any significant adverse effects. Birth defects are unlikely. Exposures having no

(Continued on page 3)

6. HEALTH HAZARD DATA: (CONTINUED)

adverse effects on the mother should have no effect on the fetus.

7. FIRST AID:

EYES: Irrigate immediately with water for at least five minutes. Mechanical effects only.

SKIN: No adverse effects anticipated by this route of exposure.

INGESTION: No adverse effects anticipated by this route of exposure.

INHALATION: No adverse effects anticipated by this route of exposure.

8. HANDLING PRECAUTIONS:

EXPOSURE GUIDELINE(S): Dow Industrial Hygiene Guide is 10 mg/m3.

VENTILATION: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

RESPIRATORY PROTECTION: In dusty atmospheres, use an approved dust respirator.

SKIN PROTECTION: No precautions other than clean body-covering clothing should be needed.

EYE PROTECTION: Use safety glasses. If there is a potential for exposure to particles which could cause mechanical injury to the eye, wear chemical goggles.

9. ADDITIONAL INFORMATION:

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Use reasonable caution and personal cleanliness. Cellulose ethers are water-soluble polymers which form aqueous dispersions by swelling and by successive hydration of their structural layers. There is no sharp solubility limit. CAUTION: (1) Under certain conditions a fine dust of this material in

(Continued on page 4 , over)

9. ADDITIONAL INFORMATION: (CONTINUED)

air may cause a dust explosion when exposed to heat, sparks, and open flame. (2) If material spills and gets wet, could cause slipping hazard.

MSDS STATUS: Revised regsheet (WHMIS) information.

For information regarding state/provincial and federal regulations see The Regulatory Information Section.
(R) Indicates a trademark of The Dow Chemical Company

The Dow Chemical Company, Midland, MI 48674 Emergency Phone:517-636-4400

Product Code: 53940 Page: R-1

Product Name: METHOCEL (R) F50 HYDROXYPROPYL METHYLCELLULOSE

Effective Date: 02/10/92 Date Printed: 04/14/95 MSDS:000055

REGULATORY INFORMATION: (Not meant to be all-inclusive--selected regulations represented.)

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See MSD Sheet for health and safety information.

U.S. REGULATIONS

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

A fire hazard
Hazard categories are listed solely to assist with federal reporting under Title III. They are not intended and are not appropriate for evaluating safe product handling and use. To review health and safety information, refer to the body of this material safety data sheet.

CANADIAN REGULATIONS

WHMIS INFORMATION: The Canadian Workplace Hazardous Materials Information System (WHMIS) Classification for this product is:

This product is not a "Controlled Product" under WHMIS.

CANADIAN TDG INFORMATION: For guidance, the Transportation of Dangerous Goods Classification for this product is:

Not regulated.

The Dow Chemical Company, Midland, MI 48674 Emergency Phone:517-636-4400

Product Code: 53940 Page: R-1

Product Name: METHOCEL (R) F50 HYDROXYPROPYL METHYLCELLULOSE

Effective Date: 02/10/92 Date Printed: 04/14/95 MSDS:000055

REGULATORY INFORMATION: (Not meant to be all-inclusive--selected regulations represented.)

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See MSD Sheet for health and safety information.

U.S. REGULATIONS

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

A fire hazard
Hazard categories are listed solely to assist with federal reporting under Title III. They are not intended and are not appropriate for evaluating safe product handling and use. To review health and safety information, refer to the body of this material safety data sheet.

CANADIAN REGULATIONS

WHMIS INFORMATION: The Canadian Workplace Hazardous Materials Information System (WHMIS) Classification for this product is:

This product is not a "Controlled Product" under WHMIS.

CANADIAN TDG INFORMATION: For guidance, the Transportation of Dangerous Goods Classification for this product is:

Not regulated.

Harco

MATERIAL SAFETY DATA SHEET
Conforms to EC Directive 91/155/EEC

Alcotex 78

1. CHEMICAL IDENTITY
Alcotex 78 is a 78% hydrolysed poly(vinyl alcohol) : CAS NO. 25213-24-5.
CHEMICAL FORMULA:- $-(CH_2\text{-}CHOH)_{0.78}(CH_2\text{-}CH(OCOCH_3)_{0.22}$

2. COMPOSITION
Poly(vinyl acetate, vinyl alcohol) total solids content 98.5% (min).

3. HAZARD IDENTIFICATION
Alcotex 78 should be treated as a low hazard product and requires no specific precautions for transport or handling. Spill Alcotex 78 is slippery under wet conditions.

4. FIRST AID MEASURES
SKIN:- Wash thoroughly with warm soapy water.
EYES:- Wash eyes with running water for at least 10 minutes gently prising open eyelids to ensure sufficient washing. Eye injuries from chemicals should be referred to a doctor.
INGESTION:- Wash mouth with water. Seek immediate medical help. Show this data sheet to the doctor.
INHALATION: Remove the person from exposure.

5. FIREFIGHTING MEASURES
No special fire precautions are necessary. In case of fire use water, foam or dry powder extinguishers.

6. ACCIDENTAL RELEASE MEASURES
POWDER: Sweep up if dry or if wet clean up with hot or cold water.
SOLUTIONS: Soak up with inert absorbent.

7. HANDLING AND STORAGE
Alcotex 78 should be treated as a low hazard product but local exhaust ventilation is recommended where generation of dust is unavoidable. If a pneumatic conveying system is employed the equipment should be grounded to avoid build up of static electricity. Alcotex 78 should be stored indoors away from wet areas and naked flames.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION
Local exhaust ventilation is recommended as in 7 above.
PERSONAL PROTECTION
RESPIRATORY: If local exhaust ventilation is impractical and dust generation unavoidable a suitable dust mask should be worn.
HAND: PVC or rubber gloves.
EYE: If dust generation is unavoidable wear dust tight goggles.
SKIN: Standard industrial overalls.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Pale yellow powder.
ODOUR	Slight characteristic.
pH	6-7 (4% aqueous solution)
BOILING POINT:	-
MELTING POINT:	About 165°C (decomposes)
FLASH POINT:	>40°C (Pensky Marten Closed Cup).*
FLAMMABILITY:	Does not support combustion as measured by SI 917/1972 Test Method Schedule 2 Rg. 2(2).*
AUTO FLAMMABILITY:-	
EXPLOSIVE PROPERTIES:	St Class 1 (Kst approx 20 bar m/s)*
VAPOUR PRESSURE:	-
BULK DENSITY:	0.7g cm ^{3}
SOLUBILITY IN WATER:	Soluble.
OTHER SOLVENTS:	Not soluble.

10. STABILITY AND REACTIVITY
Hazardous decomposition products at temperatures above 200°C include aldehydes and acetic acid.

11. TOXICOLOGICAL INFORMATION
Polyvinyl alcohol is of a low order of acute toxicity.
Similar products have been shown to have LD 50 (RAT) > 2 g/kg.
Experience in manufacture and handling and by comparison with similar materials does not indicate any long term health hazards related to inhalation, skin and eye contact.
* Values are actual results for analagous material Alcotex 72.5

12. ECOLOGICAL INFORMATION
Polyvinyl alcohol is readily degraded by adapted sewage sludges.

13. DISPOSAL CONSIDERATIONS
Solid waste of polyvinyl alcohol or packaging should be disposed of by incineration or landfill in accordance with national or local regulations. In biological purification plants, polyvinyl alcohol solutions can also be degraded into carbon dioxide and water by adapted micro-organisms. Tests with dilute polyvinyl alcohol solutions have also shown that sensitive fish varieties (golden orfe and guppies) are not affected even at polyvinyl alcohol concentrations of 500 mg/litre of water.

14. TRANSPORT INFORMATION
Not classified as dangerous for transport purposes.

15. REGULATORY INFORMATION
This material is not classified as dangerous under EC labelling directives.
WORKER EXPOSURE LIMIT: Material should be considered as a nuisance dust.
Polyvinyl alcohol is listed in the USA TSCA inventory but being a polymer was exempted from inclusion in EINECS.

The information contained herein does not constitute the user's own assessment of workplace risk required by other health and safety legislation.

16. OTHER INFORMATION
CONTACT:
Dr S Ormondroyd
Harlow Chemical Company Ltd
Templefields
Harlow
Essex
CM20 2BH
England
Tel No. International + 44 279 436211
Fax: + 44 279 444025

DATE OF ISSUE 25/06/93 ISSUE NO. 1

The information contained herein is based on the present state of our knowledge and is intended to describe our products from the point of view of health and safety requirements. It should not be construed as guaranteeing specific properties.

Material Safety Data Sheet

SECTION 1: PRODUCT INFORMATION

NAME:	2-MERCAPTOETHANOL
DESCRIPTION:	2-MERCAPTOETHANOL
CAS NUMBER:	60-24-2
USE:	CHEMICAL INTERMEDIATE
MSDS NUMBER:	P001249-MCDWDK
APPEARANCE AND ODOR:	WATER-WHITE LIQUID; MERCAPTAN ODOR
EMERGENCY TELEPHONE:	800-424-9300 24-HOURS - CHEMTREC
PRODUCT INFORMATION:	800-251-5952
EFFECTIVE DATE:	01/27/92
SUPERCEDES DATE:	04/15/91
PRODUCT CODE:	1217000019

SECTION 2: HAZARDOUS INGREDIENTS

A HAZARD EVALUATION OF THIS PRODUCT HAS BEEN PERFORMED. THE COMPONENT LISTED BELOW IS IDENTIFIED AS A HAZARDOUS CHEMICAL UNDER THE CRITERIA OF THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200).

COMMON NAME/CHEMICAL NAME	CAS NUMBER	APPROXIMATE %
2-MERCAPTOETHANOL/THIOGLYCOL	60-24-2	90 - 100

SECTION 3: EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT:

FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES. LIFT EYE LIDS FREQUENTLY. GET PROMPT MEDICAL ATTENTION.

SKIN CONTACT:

PROMPTLY REMOVE CONTAMINATED CLOTHING AND SHOES. FLUSH AFFECTED AREA WITH WATER FOR 15 MINUTES. CLEANSE SKIN WITH SOAP AND WATER. GET PROMPT MEDICAL ATTENTION. WASH CONTAMINATED CLOTHING SEPARATELY BEFORE REUSE.

INHALATION:

REMOVE TO FRESH AIR. IF SYMPTOMS DEVELOP, SEEK IMMEDIATE MEDICAL ATTENTION. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH TO MOUTH.

INGESTION:

SEEK MEDICAL ATTENTION. UNLESS ADVISED OTHERWISE, INDUCE VOMITING BY GIVING EITHER SYRUP OF IPECAC FOLLOWED BY 2 GLASSES OF WATER OR BY STICKING FINGER DOWN THROAT.

DO NOT GIVE ANYTHING BY MOUTH IF THE PERSON IS DROWSY, UNCONSCIOUS, OR HAS NO GAG REFLEX.

NOTE TO PHYSICIAN:

TREATMENT SHOULD BE DIRECTED AT PREVENTING ABSORPTION, ADMINISTERING TO THE SYMPTOMS AS THEY OCCUR, AND PROVIDING SUPPORTIVE THERAPY.

SECTION 4: HEALTH EFFECTS SUMMARY

PRIMARY ROUTE(S) OF EXPOSURE: EYE - YES SKIN - YES INHALATION - YES

EYE CONTACT:
CAUSES SEVERE IRRITATION.

VAPORS AND/OR MISTS CAN CAUSE MILD TO MODERATE IRRITATION.

THE SEVERITY OF REACTION DEPENDS ON DURATION OF EXPOSURE AND FIRST AID PROCEDURES ADMINISTERED.

SKIN CONTACT:
CAUSES SEVERE IRRITATION.

HARMFUL WHEN ABSORBED THROUGH THE SKIN IN SUFFICIENT AMOUNTS.

THE SEVERITY OF REACTION DEPENDS ON DURATION OF EXPOSURE AND FIRST AID PROCEDURES ADMINISTERED.

INHALATION:
CAN BE IRRITATING TO MUCOUS MEMBRANES, ESPECIALLY FOLLOWING PROLONGED EXPOSURE TO MISTS AND/OR VAPORS.

INHALATION CAN CAUSE DIZZINESS, HEADACHES, AND INCOORDINATION.

NAUSEA, VOMITING, AND GASTROINTESTINAL UPSET CAN OCCUR.

INGESTION:
INGESTION CAUSES SEVERE IRRITATION OF THE MOUTH, THROAT, AND ESOPHAGUS.

CAN CAUSE NAUSEA, VOMITING, AND GASTROINTESTINAL UPSET.

ADDITIONAL EFFECTS:
DEPENDING ON THE ROUTE, FREQUENCY, AND DURATION OF EXPOSURE, TOXICITY MAY EFFECT IN THE FOLLOWING ORGANS AND/OR SYSTEMS:
- RESPIRATORY SYSTEM.
- EYE.
- SKIN.

AGGRAVATION OF EXISTING CONDITIONS:
SOME OF THE COMPONENTS IN THIS PRODUCT MAY AGGRAVATE EXISTING MEDICAL CONDITIONS. INDIVIDUALS WITH MEDICAL CONDITIONS INVOLVING THE FOLLOWING ORGAN(S) AND/OR SYSTEM(S) SHOULD TAKE APPROPRIATE PRECAUTIONS WHEN HANDLING THIS PRODUCT:
- LIVER.
- KIDNEY.

ALWAYS WEAR APPROPRIATE PROTECTIVE EQUIPMENT, AS RECOMMENDED BY YOUR

INDUSTRIAL HYGIENE OR SAFETY PERSONNEL, WHEN EXPOSURE TO THIS PRODUCT CAN OCCUR.

SECTION 5: TOXICOLOGIC INFORMATION

THE INFORMATION IN THIS SECTION, THOUGH DETAILED, CAN BE SUBJECT TO MISINTERPRETATION. THEREFORE, IT IS ESSENTIAL THE FOLLOWING INFORMATION BE INTERPRETED BY INDIVIDUALS TRAINED IN ITS EVALUATION.

2-MERCAPTOETHANOL/THIOGLYCOL

TOXIC EFFECTS:

EYE AND SKIN CONTACT CAN CAUSE SEVERE IRRITATION. MAY BE ABSORBED CAUSING HEADACHE, DIZZINESS, NAUSEA, VOMITING, WHEEZING. INGESTION MAY CAUSE GASTROINTESTINAL IRRITATION, CNS DEPRESSION. INHALATION OF VAPORS MAY PRODUCE SEVERE IRRITATION OF THE UPPER RESPIRATORY TRACT AND SYMPTOMS AS FOR ABSORPTION. RENAL AND HEPATIC DAMAGE AND HEMOLYTIC ANEMIA HAVE BEEN REPORTED.

ACUTE TOXICITY STUDIES:

ORAL-RAT	LD50: 300 mg/kg
ORAL-MOUSE	LD50: 345 mg/kg
DERMAL-RABBIT	LD50: 150 mg/kg
DERMAL-GUINEA PIG	LD50: 300 mg/kg
INHALATION-MOUSE	LC50: 13,200 mg/m3

OTHER TOXICITY STUDIES:

2-ME WAS FOUND TO BE MUTAGENIC IN SEVERAL TEST SYSTEMS, INCLUDING THE MICRONUCLEUS TEST(MOUSE), DNA INHIBITION(RAT-LIVER), UNSCHEDULED DNA SYNTHESIS(MOUSE), AND CYTOGENIC ANALYSIS(HUMAN LEUKOCYTE). HOWEVER, 2-ME WAS FOUND NOT TO BE MUTAGENIC IN THE AMES TEST OR THE MOUSE LYMPHOMA ASSAY.

CARCINOGENICITY - LISTED BY:

ACGIH: NO IARC MONOGRAPHS: NO NTP ANNUAL REPORT: NO OSHA: NO

SECTION 6: OCCUPATIONAL CONTROL PROCEDURES

EYE PROTECTION:

WEAR CHEMICAL SPLASH GOGGLES.

AN EYE WASH FACILITY SHOULD BE READILY AVAILABLE.

SKIN PROTECTION:

WEAR RUBBER BOOTS AND APRON, PROTECTIVE CLOTHING, AND IMPERVIOUS GLOVES. BECAUSE A VARIETY OF PROTECTIVE GLOVES EXIST, ALWAYS CONSULT GLOVE MANUFACTURER TO DETERMINE THE PROPER TYPE FOR SPECIFIC OPERATION.

RESPIRATORY PROTECTION:
WHEN AIRBORNE CONCENTRATIONS ARE EXCESSIVE, WEAR NIOSH/MSHA APPROVED EQUIPMENT. DETERMINE THE APPROPRIATE TYPE BY CONSULTING THE RESPIRATOR MANUFACTURER. OBSERVE THE RESPIRATOR USE LIMITATIONS SPECIFIED BY NIOSH/MSHA OR THE MANUFACTURER.

HIGH AIRBORNE CONCENTRATIONS MAY NECESSITATE THE USE OF SELF-CONTAINED BREATHING APPARATUS (SCBA) OR A SUPPLIED AIR RESPIRATOR. IN ADDITION, RESPIRATORY PROTECTION PROGRAMS MUST BE IN COMPLIANCE WITH 29 CFR 1910.134.

VENTILATION:
MINIMIZE EXPOSURE BY PROVIDING ADEQUATE VENTILATION. GENERAL (DILUTION) VENTILATION MAY BE ACCEPTABLE. HOWEVER, LOCAL EXHAUST VENTILATION IS RECOMMENDED WHEN VAPORS, MISTS, OR DUSTS CAN BE RELEASED.

PERSONAL HYGIENE:
WASH THOROUGHLY AFTER HANDLING, ESPECIALLY BEFORE EATING, DRINKING, SMOKING, OR USING RESTROOM FACILITIES. CONTAMINATED CLOTHING AND SHOES SHOULD BE THOROUGHLY CLEANED AND DRIED BEFORE REUSE.

AIRBORNE EXPOSURE LIMITS

2-MERCAPTOETHANOL/THIOGLYCOL

ACGIH TLV-TWA: NOT ESTABLISHED
OSHA PEL: NOT ESTABLISHED

SECTION 7: FIRE PROTECTION INFORMATION

FLASH POINT: 150 F, 66 C TEST METHOD: SETAFLASH CLOSED CUP

EXPLOSIVE LIMITS: LEL (%) - NOT ESTABLISHED UEL (%) - NOT ESTABLISHED

AUTOIGNITION TEMPERATURE: NOT ESTABLISHED

EXTINGUISHING MEDIA:
SMALL FIRES: USE AGENTS APPROVED FOR CLASS B HAZARDS (E.G. DRY CHEMICAL, CARBON DIOXIDE, HALON, FOAM, STEAM) OR WATER FOG.
LARGE FIRES: USE WATER SPRAY, FOG, OR ALCOHOL FOAM.

SPECIAL FIRE FIGHTING PROCEDURES:
FIRE FIGHTERS AND OTHERS WHO MAY BE EXPOSED TO THE PRODUCTS OF COMBUSTION SHOULD BE EQUIPPED WITH NIOSH APPROVED POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS (SCBA) AND FULL PROTECTIVE CLOTHING.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
WHEN EXPOSED TO FLAMES OR HIGH TEMPERATURES ENCOUNTERED DURING FIRE

Material Safety Data Sheet

CONDITIONS, SEALED CONTAINERS MAY RUPTURE BECAUSE OF THE BUILD UP OF INTERNAL PRESSURE. COOL CONTAINERS WITH WATER.

VAPORS MAY BE HEAVIER THAN AIR AND MAY TRAVEL CONSIDERABLE DISTANCES FROM THE MATERIAL HANDLING POINT. VAPORS CAN BE IGNITED BY A SPARK, FLAME, CIGARETTE, ELECTRIC MOTOR, STATIC DISCHARGE, ENGINE, PILOT LIGHT, HOT SURFACE, OR OTHER IGNITION SOURCE.

SECTION 8: REACTIVITY DATA

STABLE UNDER NORMAL CONDITIONS OF STORAGE AND USE: YES

MATERIALS TO AVOID:
OXIDIZING AGENTS.
STRONG BASES.
CHEMICALLY ACTIVE METALS(E.G., NICKEL, COBALT, IRON, COPPER)

HAZARDOUS POLYMERIZATION:
HAZARDOUS POLYMERIZATION WILL NOT OCCUR.

THERMAL DECOMPOSITION PRODUCTS:
IF HEATED TO HIGH TEMPERATURES, THIS PRODUCT MAY EMIT THE FOLLOWING COMPOUNDS:
OXIDES OF SULFUR.
SMOKE, SOOT, & TOXIC FUMES (e.g. CARBON DIOXIDE & CARBON MONOXIDE).

SUPPLEMENTAL SECTION 8 INFORMATION:
2-ME DECOMPOSES AT 157-158 DEGREES C AT 742 mm Hg.

SECTION 9: SPILL AND LEAK PROCEDURES

RESPONSE TO SPILLS:
STOP DISCHARGE, IF IT CAN BE PERFORMED SAFELY, AND CONTAIN MATERIAL. IF A SUBSTANTIAL QUANTITY IS SPILLED, RECOVER WITH PUMP OR VACUUM TRUCK. EXPLOSION-PROOF EQUIPMENT SHOULD BE USED IF THIS PRODUCT IS FLAMMABLE OR COMBUSTIBLE(SEE SECTION 7). OTHERWISE, USE AN ABSORBENT SUCH AS FULLER'S EARTH, CLAY, OR OTHER APPROPRIATE SYNTHETIC ABSORBENT. PLACE CONTAMINATED MATERIAL IN A SUITABLE CONTAINER FOR DISPOSAL. APPROPRIATE SAFETY MEASURES AND PROTECTIVE EQUIPMENT SHOULD BE USED (SEE SECTION 6).

DO NOT FLUSH TO SEWER, STREAM, OR OTHER BODIES OF WATER.

PRECAUTIONS:
ELIMINATE ALL SOURCES OF IGNITION.

DISPOSAL METHODS:
IF DISCARDED IN ITS ORIGINAL UNUSED FORM, THIS PRODUCT DOES NOT MEET THE DEFINITION OF A RCRA HAZARDOUS WASTE UNDER 40 CFR 261.

NEVERTHELESS, IT SHOULD BE MANAGED (STORED/TREATED/DISPOSED/ETC.) AT AN AUTHORIZED FACILITY, IN COMPLIANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL REQUIREMENTS. BE SURE TO CONTACT APPROPRIATE GOVERNMENT ENVIRONMENTAL AGENCIES IF FURTHER DISPOSAL GUIDANCE IS REQUIRED.

OF THE METHODS OF DISPOSAL CURRENTLY AVAILABLE, IT IS RECOMMENDED THAT AN ALTERNATIVE BE SELECTED ACCORDING TO THE FOLLOWING ORDER OF PREFERENCE, BASED UPON ENVIRONMENTAL ACCEPTABILITY:

(1) RECYCLE OR REWORK IF AT ALL FEASIBLE,
(2) INCINERATE AT AN AUTHORIZED FACILITY, OR
(3) TREAT AT AN ACCEPTABLE WASTE TREATMENT FACILITY.

SECTION 10: SPECIAL PRECAUTIONS

RECOMMENDED STORAGE PRACTICE AND CONDITIONS:

STORE IN COOL, DRY, WELL VENTILATED AREA. DO NOT STORE NEAR HEAT OR IGNITION SOURCES, OR IN DIRECT SUNLIGHT. ALWAYS KEEP CONTAINERS TIGHTLY CLOSED TO AVOID CONTAMINATION.

SPECIAL WARNING: HOT ORGANIC CHEMICAL VAPORS OR MISTS CAN SUDDENLY AND WITHOUT WARNING COMBUST WHEN MIXED WITH AIR. IGNITION CAN OCCUR AT TYPICAL ELEVATED TEMPERATURE PROCESS CONDITIONS. ANY PROPOSED USE IN SUCH PROCESSES SHOULD BE EVALUATED THOROUGHLY TO ASSURE SAFE OPERATING CONDITIONS.

DO NOT STORE ABOVE: 150 F, 66 C

CONTAINER USE PROCEDURES:

CONTAINERS SHOULD BE SUPPORTED AND GROUNDED BEFORE OPENING, DISPENSING, MIXING, POURING, AND EMPTYING. OPEN WITH NON-SPARKING TOOLS. IF THE CONTAINER IS WARM, OPEN BUNG SLOWLY TO RELEASE INTERNAL PRESSURE.

EMPTY CONTAINER PRECAUTIONS:

THIS CONTAINER IS HAZARDOUS WHEN EMPTY. DO NOT USE HEAT, SPARKS, OPEN FLAMES, TORCHES, OR CIGARETTES ON OR NEAR EMPTY CONTAINER. EMPTY CONTAINERS CAN RETAIN PRODUCT RESIDUES. DO NOT REUSE EMPTY CONTAINER FOR FOOD, CLOTHING, OR PRODUCTS FOR HUMAN OR ANIMAL CONSUMPTION OR WHERE SKIN CONTACT MAY OCCUR.

SECTION 11: PHYSICAL DATA

% NON-VOLATILES (BY WEIGHT):	< 0.1
pH:	7.0
VAPOR DENSITY (AIR=1):	NOT ESTABLISHED
SOLUBILITY IN WATER:	DISPERSIBLE
EVAPORATION RATE (n-BUTYL ACETATE=1):	< 1

VAPOR PRESSURE (mmHg @ 25 DEGREES C): 1.6-1.8
SPECIFIC GRAVITY (WATER=1): 1.12
APPROXIMATE BOILING POINT: NOT ESTABLISHED

SUPPLEMENTAL SECTION 11 INFORMATION:
PURITY: TYPICALLY > 99%

NOTE: THE PHYSICAL DATA PRESENTED ABOVE ARE TYPICAL VALUES AND SHOULD NOT BE CONSTRUED AS A SPECIFICATION.

SECTION 12: LABEL AND TRANSPORTATION INFORMATION

DOT SHIPPING NAME: POISONOUS LIQUID N.O.S. (THIOGLYCOL)
DOT LABEL: POISON
DOT IDENTIFICATION NO.: UN 2810
MORTON PRECAUTIONARY LABEL NO.: L483
SUPPLEMENTAL SECTION 12 INFORMATION:
FOR CANADIAN SHIPMENTS: F483.

SHIPMENTS BY AIR UNDER 49 CFR - PROPER SHIPPING NAME: POISONOUS LIQUID, N.O.S. (THIOGLYCOL); HAZARD CLASS: POISON; SUBSIDIARY RISK: NONE; UN NO.: 2810; LABEL(S): POISON.

HM-181, IATA/ICAO AND IMO - PROPER SHIPPING NAME: THIOGLYCOL; HAZARD CLASS: 6.1; SUBSIDIARY RISK: NONE; UN NO.: 2966; PACKAGING GROUP: II; LABEL(S): POISON.

SECTION 13: REGULATORY INFORMATION

TOXIC SUBSTANCE CONTROL ACT (TSCA)
THE CHEMICAL COMPONENTS OF THIS PRODUCT ARE CONTAINED ON THE SECTION 8(B) CHEMICAL SUBSTANCE INVENTORY LIST (40 CFR 710).

SARA TITLE III INFORMATION

SECTION 313 - TOXIC CHEMICALS
PURSUANT TO SECTION 313 OF SARA TITLE III, THIS PRODUCT DOES NOT CONTAIN A TOXIC CHEMICAL IN EXCESS OF 1 PERCENT OF THE MIXTURE (0.1 PERCENT, IF THE LISTED TOXIC CHEMICAL IS A CARCINOGEN).

SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES
PURSUANT TO SECTION 302 OF SARA TITLE III, THIS PRODUCT DOES NOT CONTAIN AN EXTREMELY HAZARDOUS SUBSTANCE.

SECTION 311/312 - HAZARD CATEGORIES
PURSUANT TO SECTION 311/312 OF SARA TITLE III, THE PHYSICAL AND HEALTH HAZARD CATEGORIES FOR THIS PRODUCT ARE IDENTIFIED BELOW:

FIRE HAZARD: YES
SUDDEN RELEASE OF PRESSURE HAZARD: NO
REACTIVITY HAZARD: NO
IMMEDIATE (ACUTE) HEALTH HAZARD: YES
DELAYED (CHRONIC) HEALTH HAZARD: NO

HAZARDOUS MATERIALS INFORMATION REVIEW REGULATIONS - CANADA

THIS MATERIAL SAFETY DATA SHEET PROVIDES INFORMATION THAT COMPLIES WITH THE REQUIREMENTS SETFORTH UNDER THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS).

CLAIM FOR EXEMPTION REGISTRY NO.: NOT APPLICABLE
EXPIRATION DATE: NOT APPLICABLE

SECTION 14: USERS RESPONSIBILITY

A BULLETIN SUCH AS THIS CANNOT BE EXPECTED TO COVER ALL POSSIBLE INDIVIDUAL SITUATIONS. AS THE USER HAS THE RESPONSIBILITY TO PROVIDE A SAFE WORKPLACE, ALL ASPECTS OF AN INDIVIDUAL OPERATION SHOULD BE EXAMINED TO DETERMINE IF, OR WHERE, PRECAUTIONS - IN ADDITION TO THOSE DESCRIBED HEREIN - ARE REQUIRED. ANY HEALTH HAZARD AND SAFETY INFORMATION CONTAINED HEREIN SHOULD BE PASSED ON TO YOUR CUSTOMERS OR EMPLOYEES, AS THE CASE MAY BE.

DISCLAIMER OF LIABILITY

THE INFORMATION CONTAINED HEREIN IS, TO THE BEST OF OUR KNOWLEDGE AND BELIEF, ACCURATE. HOWEVER, SINCE THE CONDITIONS OF HANDLING AND USE ARE BEYOND OUR CONTROL, WE MAKE NO GUARANTEE OF RESULTS, AND ASSUME NO LIABILITY FOR DAMAGES INCURRED BY USE OF THIS MATERIAL. ALL CHEMICALS MAY PRESENT UNKNOWN HEALTH HAZARDS AND SHOULD BE USED WITH CAUTION. ALTHOUGH CERTAIN HAZARDS ARE DESCRIBED HEREIN, WE CANNOT GUARANTEE THAT THESE ARE THE ONLY HAZARDS WHICH EXIST. FINAL DETERMINATION OF SUITABILITY OF THE CHEMICAL IS THE SOLE RESPONSIBILITY OF THE USER. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESSED OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO THE INFORMATION CONTAINED HEREIN OR THE CHEMICAL TO WHICH THE INFORMATION REFERS. IT IS THE RESPONSIBILITY OF THE USER TO COMPLY WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL LAWS AND REGULATIONS.

IF YOU HAVE QUESTIONS WITH REGARD TO HEALTH EFFECTS, OR OTHER INFORMATION PRESENTED IN THIS DOCUMENT, CONTACT:

DAVID B. WIENCKOWSKI, D.A.B.T.
MANAGER, PRODUCT SAFETY AND TOXICOLOGY
MORTON INTERNATIONAL, INC.
100 N. RIVERSIDE PLAZA

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Material Safety Data Sheet

CHICAGO, IL 60606
312-807-3422

7 3M

ATERIAL SAFETY DATA SHEET 01.17.95 01/04

3M INC.-P.O.DRAW.Y PENNY ROYAL RD-GEORGETOWN SC 29440,(803)546-8556

P UCT NAME: POLIVIC S 202 35%

1.00 SECTION I. IDENTIFICATION

CHEMICAL CHARACTERIZATION: Vinyl alcohol-vinyl acetate copolymer in methanol solution.
Form : Liquid
Color: Limpid-yellow
Odor : Sweet

2.00 SECTION II. INGREDIENTS/HAZARD STATEMENTS

CHEMICAL IDENTITY	CAS NO.	PEL	TLV	PERCENT
*Methanol	67-56-1		200 ppm	47% max
Methyl Acetate	79-20-9		200 ppm	12%
Proprietary				

WARNING STATEMENTS:
The product is toxic by inhalation, ingestion and repeated or prolonged skin contact. After 6-30 hours, dizziness, headache, nausea, abdominal pains, visual disturbances may occur. A 30-120 ml ingestion dose can be lethal. Irritating effect on mucous membranes may occur. *This component is listed under Section 313 SARA TITLE III. The maximum concentration in the product is 47%.

3.00 SECTION III. PHYSICAL DATA

MELTING POINT ('C)	: Liquid	BOILING POINT ('C)	: 57-64
DENSITY (g/ml)	: 0.88-0.93	BULK DENSITY (g/ml)	: n.d.
VAPOR PRESSURE (mm Hg at 20'C)	: 114	VISCOSITY (cp at 20"C)	: 60-120
pH	: 6-7	SOLUBILITY IN WATER	: Incomplete

4.00 SECTION IV. FIRE AND EXPLOSION HAZARDS

FLASH POINT(METHOD): -1.89 'C(TCC) LEL: 6.7% UEL: 36%

EXTINGUISHING MEDIA: (X) CO2 (X) Dry chemical
(X) Alcohol-resistant Foam
(X) Water spray

SPECIAL FIRE FIGHTING PROCEDURES: Fire fighters should wear full protective clothing and SCBA when potential for exposure to products of combustion exists. In case of fire, keep containers cool by spraying water.

PROTECTIVE MEASURES TO AVOID FIRE/EXPLOSION: Do not store or mix with oxidizers. This product is flammable. Keep away from sources of ignition and heat. Do not smoke. Take precautionary measures against static discharges. Vapor/air mixture can be explosive. Vapor is heavier than air and can travel a

73V

MATERIAL SAFETY DATA SHEET 01.17.95 02/04

PRODUCT NAME: POLIVIC S 202 35%

considerable distance to a source of ignition and flashback.

NFPA HAZARD RATING INDEX: (1) Health (3) Flammability
(0) Reactivity (NA) Special

5.00 SECTION V. REACTIVITY DATA

STABILITY: (x) Stable ( ) Unstable

CONDITIONS TO AVOID: None under normal conditions of use.

INCOMPATIBILITY: ( ) water ( ) strong acids ( ) strong bases
(x) oxidizers ( ) reducers ( ) combustibles
(x) other: Keep away from alcohol reacting substances.

HAZARDOUS DECOMPOSITION PRODUCTS: On burning carbon oxides can be evolved.

6.00 SECTION VI. HEALTH HAZARD INFORMATION

ACUTE EFFECTS: Skin irritation (rabbit): 500 mg/24H
eye irritation (rabbit): 40 mg
LDLO (oral, man): 5422 mg/kg
Above health effects are for methanol.

CHRONIC EFFECTS: The product is toxic by inhalation, ingestion and repeated or prolonged skin contact. After 6-30 hours dizziness, headache, nausea, abdominal pains, visual disturbances may occur.

MEDICAL CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE: Unknown

FIRST AID PROCEDURES:

SWALLOWING: Wash out mouth with water. If conscious, induce vomiting with a spoon of lukewarm salted water. Then drink bicarbonate in solution. Keep person warm and in a lying position.

DERMAL EXPOSURE: Immediately remove contaminated clothing. wash with soap and water. Contact a physician if irritation develops.

EYE EXPOSURE: Rinse eyes under flowing water for 15 minutes. If irritation develops, contact a physician.

INHALATION: Move to fresh air. Administer oxygen and seek medical assistance if difficulty breathing.

7.00 SECTION VII. PRECAUTION FOR SAFE HANDLING AND USE

PRODUCT NAME: POLIVIC S 202 35%

STEPS TO TAKE IN CASE OF SPILL OR RELEASE: Absorb with sawdust, sand, or similar and collect in a suitable container, wash residues with water. Do not breathe vapors due to residual methanol content.

WASTE DISPOSAL METHODS: Dispose in accordance with federal, state and local regulations.

HANDLING AND STORAGE: Keep containers tightly closed. Ensure good ventilation and exhaustion of the working area. Protect from frost. Store in a cool place.

OTHER PRECAUTIONS: Do not breathe vapors due to residual methanol content. Particular care should be taken when containers are opened after prolonged storage due to vapors from residual methanol content. Do not open containers in proximity of flame and sparks. Do not smoke. Do not use compressed air to empty containers.

8.00 SECTION VIII. CONTROL MEASURES

RESPIRATORY PROTECTION: No respirator is required at methanol concentrations below 200ppm. Supplied air respirator is required at methanol concentrations above 200ppm. Refer to NIOSH "Pocket Guide to Chemical Hazards" for proper selection for methanol.

DERMAL PROTECTION: Rubber gloves, rubber apron and boots

EYE PROTECTION: Chemical safety goggles

VENTILATION: Ensure good ventilation and exhaustion for the working area.

PROTECTIVE EQUIPMENT: Eye wash safety shower within 25 ft.

9.00 SECTION IX. ENVIROMENTAL AND REGULATORY INFORMATION

ECOLOGICAL EFFETS: Do not discharge into drains or waterways.
CERCLA RQ (lbs): 5000 for methanol
TSCA STATUS: On Inventory
SARA 313 LIST: Methanol is listed on SARA 313 list
SARA 304 LIST: Not listed
DOT STATUS: Not listed
NEW JERSEY RIGHT TO KNOW: Methanol is listed
MASSACHUSETTS RIGHT TO KNOW: Methanol is listed
PENNSYLVANIA RIGHT TO KNOW: Methanol is listed.

n.a. = not applicable n.d. = not determined

"FOR CHEMICAL EMERGENCY"
Spill, Leak, Fire, Exposure or Accident
Call CHEMTREC - Day or Night 1-800-424-9300

The statements made herein are intended to provide product safety

7 3V

P DUCT NAME: POLIVIC S 202 35%

ormation. This material safety data sheet has been prepared with information currently available. Although care has been taken to provide accurate information, no warranties either expressed or implied are being made as a result of the presentation of this information.

Vista Chemical Company
P. O. Box 19029
Houston, Texas 77224-9029

VISTA

VINYL CHLORIDE MONOMER

MSDSCODE: VCM
REVISION: 01/96

REVISION DATE: 03/03/96
PRINT DATE: 03/21/96

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME:	VINYL CHLORIDE MONOMER
SYNONYMS:	VCM, Chloroethene
MANUFACTURER:	Vista Chemical Company
ADDRESS:	900 Threadneedle Houston, TX 77079

TELEPHONE NUMBERS:	CHEMTREC - Transportation Emergency (24-hr)	(800) 424-9300
	Other Emergencies (24-hrs)	(318) 494-5142
	MSDS and Product Information (8:00am-4:30pm CST)	(713) 588-3491
	Health and Safety Information (7:30am-5:00pm CST)	(318) 494-5039

2. COMPOSITION / INFORMATION ON INGREDIENTS

Components	CAS Number	Weight%
VINYL CHLORIDE	75-01-4	99.99

See Section 8 for Exposure Guidelines and Section 15 for OSHA Classification

3. HAZARDS IDENTIFICATION

Emergency Overview

Colorless gas. Liquid under pressure. Faint, sweet odor.
CANCER SUSPECT AGENT.
FIRE OR EXPLOSION: DANGER! EXTREMELY FLAMMABLE GAS UNDER PRESSURE. MAY CAUSE FLASH FIRE. Keep away from heat, sparks and flame. Keep container closed. In case of fire, allow gas to burn if flow cannot be shut off immediately. Apply water from a safe distance.
HEALTH HAZARDS: Exposure to gas may cause irritation of eyes. Asphyxiant and anesthetic at high concentrations. Contact with liquid form may cause burns or frostbite of eyes and skin.

Potential Health Effects

EYES:

Excessive exposure to gas may cause irritation. Contact with liquid may cause burns or frostbite.

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SKIN:

Prolonged exposure may cause hardening of the skin (scleroderma). Contact with liquid vinyl chloride may cause burns or frostbite.

INHALATION:

Short-term, high level exposure may lead to smothering (asphyxia), inability to sense pain (anesthesia), dryness of nose and throat, headache, rapid respiration, mental dullness, incoordination, nausea, unconsciousness and death. Damage to the liver and kidneys has been reported in animals following short term, high level exposure to vinyl chloride. Prolonged exposure of animals or people to vinyl chloride has been associated with toxicity to the liver, kidney, brain, bones of the hands, circulatory system, testis and lungs. Vinyl chloride can also cause cancer in humans (see Cancer below).

Cancer: There is evidence that repeated, high level exposure to vinyl chloride can cause angiosarcoma (blood vessel tumors) to the liver in humans. Certain studies of vinyl chloride exposed individuals have also shown an increased incidence of other forms of cancer, i.e., hepatocellular carcinoma, brain tumors, lung tumors, gastric and gastrointestinal cancer, melanoma, and malignancies of the lymphatic and hemtopoietic system. However, for various reasons, these studies do not conclusively link these tumor increases directly with vinyl chloride exposure.

INGESTION:

This product is a gas at room temperature and should not be a significant hazard via ingestion.

(See Section 11 for Toxicological Information)

4. FIRST AID MEASURES

EYES:

Immediately flush eyes with large amounts of water for 15 to 30 minutes. Seek medical attention. Remove contaminated clothing. Apply loose, dry, sterile bandages. Call a physician.

SKIN:

Immediately flush skin with plenty of water. Remove contaminated clothing. Wash affected area with mild soap. Call a physician if irritation occurs.

INHALATION:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately. (Medical Toxicology, 1988).

INGESTION:

If swallowed, call a physician immediately. ONLY induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.

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5. FIRE FIGHTING MEASURES

Flammable Properties

FLASH POINT / METHOD:
-108°F (-78°C) / PM

AUTOIGNITION TEMPERATURE:
882°F (472°C)

FLAMMABLE LIMITS IN AIR % BY VOLUME:
LOWER: 4.0
UPPER: 22.0

FIRE AND EXPLOSION HAZARD:
Vapors can form flammable mixtures in air at normal ambient conditons. Burning VCM generates hydrogen chloride gas.

EXTINGUISHING MEDIA:
Water spray, CO_2, dry chemical.

FIRE FIGHTING INSTRUCTIONS:
Stop flow of gas. Cool exposed equipment with water spray until well after fire is out. Use self-contained breathing apparatus (SCBA) if fighting fires in confined spaces.

6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE OF SPILL OR LEAK:
Evacuate the area and eliminate ignition sources. Contain the spill. Wet down the area with large quantities of water. Dissipate vapor with water spray. Increase ventilation if in an enclosed area. Stop leak or remove leaking cylinders. Do not attempt recovery of spilled material. Material will vaporize rapidly. Prevent liquid or vapors from entering sewers or other low areas.

CERCLA HAZARDOUS SUBSTANCE:

Component	CERCLA RQ	Maximum Wt. %
VINYL CHLORIDE	1 lb.	99.99

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7. HANDLING AND STORAGE

ELECTROSTATIC ACCUMMULATION HAZARD:
None.

USUAL SHIPPING CONTAINERS:
Tank cars, ships and barges.

STORAGE / TRANSPORT TEMPERATURE:
Ambient.

STORAGE / TRANSPORT PRESSURE:
Dependent on ambient temperature. See Section 9.

LOAD / UNLOAD TEMPERATURE:
Ambient.

STORAGE AND HANDLING MATERIALS:
Carbon steel is suitable. Aluminum or aluminum alloys, and other acetylide-forming metals are unsuitable.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls

Provide adequate explosion-proof, general and exhaust ventilation to meet TLV requirements and keep out of explosive range. Ventilate low-lying areas such as sumps and confined spaces.

Personal Protective Equipment

EYES:
Chemical goggles or safety shield.

SKIN:
Full protective clothing, boots, and gloves.

RESPIRATORY PROTECTION:
Wear NIOSH-approved air-supplied or self-contained breathing apparatus for non-routine and emergency work.

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Exposure Guidelines:

Component	OSHA PEL	ACGIH TLV
VINYL CHLORIDE	1.0 ppm, 8-hour TWA 5.0 ppm peak exposure for 15-min.	5.0 ppm, 8-hour TWA

PEL = Permissible Exposure Limits
TLV = Threshold Limit Value

TWA = Time Weighted Average (8 hr.)
STEL = Short Term Exposure Limit (15 min.)

Carcinogenicity

VINYL CHLORIDE

- Carcinogen according to the NTP Annual Report.
- Carcinogen according to OSHA.
- Carcinogenic to humans according to IARC.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:
Colorless gas. Liquid under pressure.

ODOR:
Faint, sweet odor.

VAPOR PRESSURE (mm Hg.):
1,293 @ 32°F/0°C
2,943 @ 77°F/25°C

VAPOR DENSITY (Air = 1):
2.15

SOLUBILITY IN WATER:
1.1 ml/l @ 77°F/25°C

VISCOSITY:
0.281 cp @ -4°F/-20°C

PHYSICAL STATE:
Gas, liquid under pressure.

BOILING POINT:
7.0°F (-14°C)

MELTING POINT:
-245°F (-153°C)

SPECIFIC GRAVITY (H_2O = 1):
0.912 @ 68°F/20°C

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:
Exposure to air, oxygen, sunlight, moisture, heat, and all sources of ignition.

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VINYL CHLORIDE MONOMER

INCOMPATABILITY WITH OTHER MATERIALS:

Oxidizing materials, copper or copper alloys, aluminum or aluminum alloys, other metals which form acetylides.

HAZARDOUS DECOMPOSITION PRODUCTS:

Hydrogen chloride, carbon monoxide.

HAZARDOUS POLYMERIZATION:

Polymerizes slowly in presence of air, sunlight, or oxygen and rapidly in the presence of peroxides, generates considerable heat.

11. TOXICOLOGICAL INFORMATION

EYES:

Dryness of eyes has been reported in humans exposed to 500 ppm vinyl chloride.

SKIN:

No known data.

INHALATION:

Short-term inhalation exposure to high concentrations (>500 ppm) of vinyl chloride has been shown to cause mucosal irritation and impairment of the central nervous system in humans and liver damage in mice.

INGESTION:

Ingestion is not an expected route of exposure.

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION:

Not available.

CHEMICAL FATE INFORMATION:

Not available.

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13. DISPOSAL CONSIDERATIONS

SPECIAL INSTRUCTIONS:

Evacuate the area and eliminate ignition sources. Contain the spill. Wet down the area with large quantities of water. Dissipate vapor with water spray. Increase ventilation if in an enclosed area. Stop leak or remove leaking cylinders. Do not attempt recovery of spilled material. Material will vaporize rapidly. Prevent liquid or vapors from entering sewers or other low areas.

WASTE CLASSIFICATION:

If discarded in its purchased form, this product would have the EPA Hazardous Waste Number of U043. Re-evaluation of the product may be required by the user at the time of disposal, since the product uses, transformations, and mixtures may change the classifications.

EMPTY CONTAINERS:

Empty containers retain product residue (liquid and/or vapor) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner, or properly disposed of.

(See Section 6 for CERCLA Reporting Requirements)

14. TRANSPORT INFORMATION

DOT DESCRIPTION:

This product is regulated as a hazardous material as defined by the Department of Transportation.

PROPER SHIPPING NAME: Vinyl Chloride
HAZARD CLASS: 2.1
IDENTIFICATION NUMBER: NA 1086
PACKING GROUP: None
ADDITIONAL INFORMATION: RQ (Vinyl Chloride) = 1 lb.

ICAO / IATA DESCRIPTION:

This product is regulated as a dangerous good as defined by IATA for air transportation.

PROPER SHIPPING NAME: Liquefied gas, flammable, n.o.s. (vinyl chloride)
HAZARD CLASS: 2.1
UN NUMBER: UN 3161
PACKING GROUP: None
ADDITIONAL INFORMATION: RQ (Vinyl Chloride) = 1 lb.

Vista Chemical Company
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Houston, Texas 77224-9029

VISTA

VINYL CHLORIDE MONOMER

MSDSCODE: VCM
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IMO DESCRIPTION (IMDG CODE):
This product is regulated as a dangerous good as defined by the IMDG Code for marine transport.

PROPER SHIPPING NAME: Vinyl Chloride, inhibited
HAZARD CLASS: Class 2.1
IDENTIFICATION NUMBER: UN 1086
PACKING GROUP: None
ADDITIONAL INFORMATION: RQ (Vinyl Chloride) = 1 lb.

15. REGULATORY INFORMATION

U.S. Federal Regulations

OSHA HAZARD COMMUNICATION STANDARD CLASSIFICATION:
Toxic, carcinogen, pyrophoric, and compressed gas as defined by the OSHA Hazard Communication Standard.

TSCA INVENTORY LISTING:

Component	CAS Number
Vinyl Chloride	75-01-4

SARA 302 STATUS:

Component	CAS Number	Maximum Wt. %

Contains no chemicals subject to SARA 302 reporting.

SARA 311/312 CLASSIFICATION:
SARA 311/312 "Immediate (acute) health hazard", "Delayed (chronic) health hazard", "Fire hazard", "Pressure hazard".

SARA 313 CHEMICALS:

Component	CAS Number	Maximum Wt. %
VINYL CHLORIDE	75-01-4	99.99

(See Section 6 for CERCLA Reporting Requirements.)

Vista Chemical Company
P. O. Box 19029
Houston, Texas 77224-9029

VISTA

VINYL CHLORIDE MONOMER

MSDSCODE: VCM
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PRINT DATE: 03/21/96

International Regulations

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) CLASSIFICATION:

Class D, Division 2, Subdivision A: Very toxic material.
Class D, Division 2, Subdivision B: Toxic material.
Class A, Compressed Gas
Class B, Division 6: Reactive flammable material.

CANADIAN DOMESTIC SUBSTANCE LIST (DSL) INVENTORY LISTING:

Chemical Name	CAS Number
Vinyl Chloride	75-01-4

EUROPEAN INVENTORY OF EXISTING COMMERCIAL CHEMICAL SUBSTANCES (EINECS) LISTING:

Chemical Name	EINECS Number
Ethene, Chloro- (C_2H_3CL)	2008310

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) INVENTORY LISTING:

Chemical Name	SECTION STRUCTURE #
Vinyl Chloride	2-117

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) LISTING:

Chemical Name	CAS Number
Vinyl Chloride	75-01-4

State Regulations

CALIFORNIA SAFE DRINKING WATER ACT (PROP 65) LISTING:

Component	CAS Number
VINYL CHLORIDE	75-01-4

Vista Chemical Company
P. O. Box 19029
Houston, Texas 77224-9029

VISTA

VINYL CHLORIDE MONOMER

MSDSCODE: VCM
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PRINT DATE: 03/21/96

16. OTHER INFORMATION

Hazard Ratings	NFPA	HMIS
HEALTH:	4	4
FLAMMABILITY:	4	4
REACTIVITY:	1	1

THE DATA AND INFORMATION CONTAINED HEREIN ARE BEING FURNISHED FOR INFORMATIONAL PURPOSES ONLY, UPON THE EXPRESS CONDITION THAT EACH CUSTOMER SHALL MAKE ITS OWN ASSESSMENT OF APPROPRIATE USE AND APPROPRIATE SHIPPING, TRANSFER AND STORAGE MATERIALS AND PROCEDURES FOR VISTA CHEMICAL COMPANY'S PRODUCTS. ALTHOUGH BASED ON INFORMATION SOURCES WHICH VISTA CONSIDERS ACCURATE AND RELIABLE, VISTA MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, REGARDING THE VALIDITY OF THIS INFORMATION, THE INFORMATION SOURCES UPON WHICH THE SAME ARE BASED, OR THE RESULTS TO BE OBTAINED, AND EXPRESSLY DISCLAIMS LIABILITIES FOR DAMAGES OR INJURIES RESULTING FROM THE USE THEREOF.

PREPARED BY: Vista Safety, Health and Environmental Department
PHONE NUMBER: (713) 588-3491

HARCROS CHEMICALS INC
KANSAS CITY, KANSAS

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: ALPHA METHYL STYRENE 420# DATE: 05/05/93 PAGE 01
PRODUCT CODE: 16-00446-02

CAS # 000098-83-9

FORMULA: C(6)H(5)C(CH(3)):CH(2)

CHEMICAL FAMILY: Aromatic Hydrocarbon

CHEMICAL NAME AND SYNONYMS: Alpha-Methylstyrene; Isopropenylbenzene; 1-Methyl-1-Phenylethylene; 2-Phenylpropylene.

MANUFACTURERS NAME: Allied Corporation

SUPPLIERS NAME: Harcros Chemicals Inc
5200 Speaker Rd
Kansas City Ks 66106

SUPPLIERS PHONE NUMBER: 913-321-3131
TRANSPROTATION EMERGENCY PHONE NUMBER: 1-800-424-9300

S.A.R.A. INFORMATION

HAZARDS: Fire:Yes Pressure:No Reactivity:No Acute: Yes Chronic:Yes
PHYSICAL DATA: Mixture:No Pure:Yes Solid:No Liquid:Yes Gas:No

SECTION I Hazardous Ingredients

INGREDIENTS	PERCENT	AIR CONTAMINANT LEVELS
Alpha Methyl Styrene	Approx 100	TLV/TWA 8Hr 50 ppm STEL 8Hr 100 ppm ACGIH/OSHA

SECTION II Health Hazards

Threshold Limit Value: As given in Section I.

Potential Effects of Exposure (listed by primary routes of entry)
Unusual Chronic Toxicity:

Systemic Effects: No systemic effects have been noted in workers repeatedly exposed to low concentrations of alpha-methylstyrene monomer.

Eyes: Liquid alpha-methylstyrene monomer and concentrated vapors are extremely irritating to the eyes. IRDS: Eye-Rabbit 91 mg MLD.

Skin:

Prolonged skin contact can cause severe irritation, rashes swelling and blistering.

Repeated skin contact with alpha-methylstyrene monomer may produce dermatitis.

Inhalation; In concentration above 400 ppm, alpha-methylstyrene monomer is irritating to all parts of the respiratory tract. TXDS: INH-HMN TCL(o)=600 ppm, LC(50) (Mouse):3020 mg/m(3).

Ingestion: When taken by mouth, alpha-methylstyrene monomer causes a pronounced irritation of mouth, esophagus and stomach. Oral LD(50) (Rat): 4900 g/kg.

CONTINUED ON PAGE 02

HARCROS CHEMICALS INC
KANSAS CITY, KANSAS

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: ALPHA METHYL STYRENE 420# DATE: 05/05/93 PAGE 02
PRODUCT CODE: 16-00446-02

SECTION II Health Hazards CONTINUED

First aid:

Eyes: Wash eyes copiously with water for 15 minutes occasionally lifting the lower and upper lids. Obtain medical attention promptly.

Skin: Immediately wash skin with soap and water while removing contaminated clothing. Launder contaminated clothing before reuse. Obtain medical attention promptly.

Inhalation: Remove the patient from contaminated atmosphere to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen which is administered only by trained personnel. Obtain medical attention promptly.

Ingestion: If swallowed, DO NOT INDUCE VOMITING. Get medical attention immediately. Keep patient warm and quiet.

Other Information: None

SECTION III Special Protection Information

Respiratory Protection:

Less than 1,000 ppm: Chemical cartridge respirator with an organic vapor cartridge and with a full face piece.

More than 1,000 ppm: Self-contained breathing apparatus with a full face piece.

Escape: Self-contained breathing apparatus.

Ventilation Required: Ventilation must be adequate to keep the atmospheric concentration of alpha-methylstyrene monomer below PEL/TLV limitations

Protective Clothing:

Eyes:

If liquid contact likely: Wear safety glasses with cup-type side shields or chemical goggles, and face shield.

If vapor contact likely: Wear personal protective equipment described under "respiratory protection."

Skin: Natural rubber gloves; safety shoes and hard hat, where gross contact with liquid unavoidable the handler should also include a natural rubber jacket, trousers, as well as the above.

Additional Protective Measures:

Rubber carrier for glass containers. Natural rubber jacket, trousers and shoes or boots. Emergency showers, emergency eye wash fountains and fire blankets.

CONTINUED ON PAGE 03

HARCROS CHEMICALS INC
KANSAS CITY, KANSAS

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: ALPHA METHYL STYRENE 420# DATE: 05/05/93 PAGE 03
PRODUCT CODE: 16-00446-02

SECTION IV Fire & Explosion Hazard Data

Flash Point (Method): 118 deg. F. (Closed cup)

Autoignition Temperature: 574 deg. C.

Flammable Limits (% Volume in Air):

Upper: 6.1%

Lower: 1.9%

Extinguishing Media:

Agents Recommended:

Small Fire: Use dry chemical or carbon dioxide

Large Fire: Use water spray or foams.

Agents to Avoid:

No standard agent.

Special Fire Fighting Procedures: Wear self-contained breathing apparatus approved by NIOSH. Use water spray to cool tanks. Fight fire from safe distance or from a protected location.

BEWARE: Vapor is heavier than air and may travel (i.e., crawl) along the ground to a source of ignition and flash back.

Unusual Fire and Explosion Hazards: Alpha-methylstyrene monomer is a combustible liquid and can form explosive mixtures with air. Open flames, local hot spots, friction, static electricity and all other sources of ignition are to be avoided when working with this material.

SECTION V Physical Data

Boiling Point: 329 deg. F.

Melting Point: 9.4 deg. F.

Specific Gravity (H(2)O=1): 0.914 @ 60/60 deg. F.

Vapor Pressure (MM HG.): 1.9

Vapor Density (AIR=1): 4.1

Evaporation Rate (Butyl Acetate=1): Approx. 0.4

Solubility in Water: 0.043 wt. % @ 77 deg. F.

Percent Volatile by Volume: (@ 68 deg. F.): Approx. 7

pH: Approx. 7.0

Molecular Weight: 118.19

CONTINUED ON PAGE 04

HARCROS CHEMICALS INC
KANSAS CITY, KANSAS

MATERIAL SAFETY DATA SHEET

SECTION V Physical Data CONTINUED

Material is (At Normal Conditions): Liquid

Appearance and Odor: Water white liquid - characteristic sharp, aromatic odor.

SECTION VI Reactivity Data

Stability: Stable

Conditions to Avoid: Combustible liquid. Keep away from heat, sparks and flame. Electrically ground all handling equipment.

Incompatibility:

Materials to Avoid; Strong oxidizing agents (including halogens and peroxides); oleum; sulfuric acid.

Hazardous Decomposition Products: Complete combustion results in formation of carbon dioxide and water vapor; incomplete combusion can yield carbon monoxide. Avoid breathing vapors or gases released on exposure to high temperature or fire.

Hazardous Polymerization:

May Occur

Exhibits little tendency to polymerize thermally at temperatures up to 392 deg. F. Strong acids (e.g., concentrated sulfuric acid) cause polymerization at room temperature.

SECTION VII Spill and Leak Procedures

Steps to be taken if material is released or spilled:

Eliminate all sources of ignition in the vicinity of spill or released vapors. Isolate and adequately ventilate the spill area. Permit only trained personnel wearing full personal protective clothing and equipment (see "NORMAL HANDLING" in Sec. X) to enter the spill area. Terminate the leak immediately, if possible. Contain the spill; do not allow alpha-methylstyrene to enter sewer or waterway. If necessary, dike with dry sand, earth or vermiculite. Spills of alpha-methylstyrene should be reported to appropriate federal, state and local Environmental Agencies, including The National Response Center (800-424-8802). If absorbed with earth, dry sand or vermiculite, place in drums, seal drums and label drums and dispose of in approved hazardous waste disposal site.

Waste Disposal Method:

The waste material should be treated and/or disposed of at a site authorized to handle hazardous chemical waste. Appropriate federal, state and local regulatory authorities should be contacted before discharge, treatment or disposal of waste material. Disposer must comply with federal, state and local disposal or discharge laws. If disposed of as shipped, this material is a RCRA ignitable waste having a hazardous

CONTINUED ON PAGE 05

HARCROS CHEMICALS INC
KANSAS CITY, KANSAS

MATERIAL SAFETY DATA SHEET

SECTION VII Spill and Leak Procedures CONTINUED
waste ID No. D001 (40 CFR 261.21).

SECTION VIII D.O.T. Shipping Information

Proper Shipping Name:	NONE
Hazard Class:	NONE
ID Number:	NONE
Label Requirements:	NONE
Reportable Quantity:	NONE
Other Information:	

SECTION IX Additional Information

This information may be of importance to you:

NORMAL HANDLING:

CAUTION! Combustible liquid. Keep away from heat, sparks and flame. Electrically ground all handling equipment. Keep container closed. Use adequate ventilation (cf. Section III - Respiratory protection). Observe OSHA Regulations on exposure limits. Avoid prolonged or frequently repeated breathing of vapors. Avoid prolonged or frequent contact with skin. Wear protective gear as described in Section III.

STORAGE:

Protect container against physical damage. Store in accordance with OSHA Regulation 29 CFR 1910.106 in a cool, well-ventilated location equipped with automatic sprinklers or fire extinguishing system. Keep away from sources of ignition and oxidizing materials. "Empty" containers, unless thoroughly cleaned, must be assumed to have the same hazards as full ones.

Allied Corporation Product Label Wording.

CAUTION! COMBUSTIBLE

Empty Container Warning Label.

SPECIAL PRECAUTIONS/PROCEDURES:

Care should be exercised when transporting material to prevent leaks. Keep drums containing alpha-methylstyrene tightly closed and away from heat, sparks and open flames. Vent drum or shipping tank before unloading. Wear protective clothing and equipment (see Section III.) when unloading.

DEGRADABILITY: No pertinent data on file.

CONTINUED ON PAGE 06

HARCROS CHEMICALS INC
KANSAS CITY, KANSAS

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: ALPHA METHYL STYRENE 420# DATE: 05/05/93 PAGE 06
PRODUCT CODE: 16-00446-02

SECTION IX Additional Information CONTINUED

OCTANOL/WATER PARTITION COEFFICIENT: 2,238

REFERENCES:

Permissible Concentration References; OSHA Regulation 29 CFR 1910.1000. TLV and STEL recommendations - ACGIH 86/87.

Regulatory Standards: OSHA Regulation 29 CFR 1910.106.

D.O.T. Regulations 49 CFR 172.544 and 49 CFR 172.402

MANUFACTURER'S NAME:
Allied Corporation
Chemical Sector

ADDRESS:
Morristown, N.J. 07960

EMERGENCY PHONE NUMBER:
(201) 455-4157

********* E N D O F R E P O R T *********

NAME: GENE TURNER DATE ISSUED: 01/02/1986
DATE REVISED: 08/23/1989

< = LESS THAN N/A = NOT APPLICABLE UNK = UNKNOWN
> = MORE THAN N/D = NOT DETERMINED
N/E = NOT ESTABLISHED

The information provided in this Material Safety Data Sheet has been obtained from sources believed to be reliable. Harcros Chemicals Inc provides no warranties, either expressed or implied and assumes no responsibility for the accuracy or completeness of the data contained herein. This information is offered for your information, consideration and investigation. You should satisfy yourself that you have all current data relevant to your particular use. Harcros Chemicals Inc knows of no medical condition, other than those noted on this material safety data sheet, which aregenerally recognized as being aggravated by exposure to this product.

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
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SCHENECTADY, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

NO. 115

SODIUM HYPOCHLORITE AQUEOUS SOLUTION (5-12%)

DATE February 1983

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: SODIUM HYPOCHLORITE, AQUEOUS SOLUTION (5-12%)
OTHER DESIGNATIONS: Soda Bleach Liquor Bleach Solution, Hypochlorite Solution, NaOCl Solution, SUNNY SOL Bleach (Jones Chemicals), Household Bleach (i.e. CLOROX®, PUREX®)
MANUFACTURER: Available from many suppliers, including:

Canadian Industries Limited Chemicals
Box 10
Montreal, Quebec H3C 2R3

Jones Chemicals, Inc.
100 Sunny Sol Blvd
Caladonia, NY 14423
Tel: (716) 538-2311

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Sodium hypochlorite (CAS #007 681 529) Water, sodium chloride and sodium hydroxide (if present in excess). (Excess NaOH will pose an increased alkalinity hazard.)	ca 5-12 Balance	No TLV Established
*Solution concentration can also be stated in terms of "available chlorine" which is about 95% of NaOCl content by weight.		Rat, Oral (12% Solution) LD_{50} ca 12 mg/kg
		*5% soln is reported to be much less toxic.

SECTION III. PHYSICAL DATA

Boiling point --- decomposes (see Sect V)
Vapor pressure, 20 C, mm Hg ------- 17.5
Water solubility ---------- complete
pH ("neutral" solution)* ---------- 9-10
Molecular weight ---------- 74.4

Specific gravity (20/4C):
5.25% (Household bleach) - 1.09
8.0% ---------- 1.15
12.0% ---------- 1.21
Freezing point, 12.0%, deg C - ca -25

Appearance & Odor: Clear, pale yellow or greenish liquid with a chlorine odor.
*Some products may contain an excess of NaOH and have a higher pH.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
Nonflammable			--	--

Use extinguishing media that is appropriate for surrounding fire. Use water spray from a safe distance to cool fire-exposed containers, to dilute liquid, and control vapors. It is an oxidizing agent. Vigorous reactions can occur with oxidizable materials in a fire situation. It can be decomposed by heat. Chlorine liberated on contact with acid.
If safe, remove containers from fire area to prevent pressure rupture.
Firefighters should wear full protective clothing and self-contained breathing apparatus. (Protection is needed against corrosive fumes and liquid if released.)

SECTION V. REACTIVITY DATA

Anhydrous material is unstable, but these water solutions can be satisfactorily stable for months under proper storage conditions. Rate of decomposition increases with the concentration and with the temperature. (12% NaOCl solution decomposes slowly at 40 C to yield NaCl and $NaClO_3$). Exposure to sunlight accelerates decomposition.
It is incompatible with acids (liberates chlorine), ammonia, urea, oxidizable materials, and metals such as nickel, copper, tin, manganese and iron (which cause liberation of oxygen).

NO. 115

SECTION VI. HEALTH HAZARD INFORMATION

TLV None Established

Toxicity due to alkalinity, possible chlorine generation, and the oxidant properties. Ingestion of a few ounces at 12% conc. can cause corrosion of mucous membranes, perforation of esophagus and stomach, and laryngeal edema; may lead to convulsion, coma, death. (At 5% conc. effects are much less damaging.) Inhalation of mist or fumes can cause bronchial irritation, cough, difficult breathing, stomatitis, nausea, and pulmonary edema. Additional effects have included circulatory collapse and delirium. Liquid contact can produce irritation of the the eyes or skin with blistering and eczema (especially at 12%).

FIRST AID:

Eye Contact: Irrigate eyes with running water for at least 15 minutes, including under eyelids. Then contact physician at once (ophthalmologist preferred).

Skin Contact: Remove contaminated clothing. Flush affected areas with copious amounts of water, or shower. If irritation persists or if large areas of body are affected, contact physician. Treat burns as needed.

Inhalation: Remove to fresh air and obtain medical help.

Ingestion: Have physician contacted immediately. Rinse mouth with water. Give large quantities of water or milk to drink. Induce vomiting. Repeat. Do not use acidic antidotes or sodium bicarbonate. An ounce of 1% sodium thiosulfate or milk of magnesia is helpful.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of major spill. Clean-up personnel need protection against contact with liquid and inhalation of mists and fumes. Contain spill and pick up when possible for recovery or disposal. Keep concentrated hypochlorite solutions out of sewers and waterways. Do not use combustible absorbants (such as sawdust) to pick up hypochlorite solutions.

Small spills and residues can usually be flushed to a suitable holding area, and then with high dilution to the sewer.

DISPOSAL: When necessary hypochlorite can be neutralized with weak reducing agents, and then the waste landfilled. Follow Federal, State and Local regulations.

EPA (CWA) RQ is 100 lb. (40 CFR 117). Hypochlorite can be harmful to aquatic life.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation in the workplace to maintain fumes and mists at a minimum. (Workers should not have irritation effects from exposure.) Respiratory devices should be available for use in non-routine or emergency situations. Use canister-type respirators suitable for chlorine (See MSDS 53) with mist filters.

Avoid eye contact by use of chemical safety goggles. Use rubber gloves, apron, and other protective clothing appropriate for the work situation to prevent skin contact. Clothing contaminated with liquid to be removed promptly and rinsed with water. Launder before reuse.

Eyewash fountains, washing facilities and safety showers should be available in areas of handling and use.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed, vented containers in a cool, (below 85F), dry, well-ventilated area away from direct sunlight, heat and incompatible materials (see Sect V). Keep separate from acids and organics.

Use adequate ventilation. Protect containers from physical damage.

Do not mix with acidic cleaning agents which can liberate chlorine gas.+ Avoid inhalation of vapors, mists and fumes. Prevent eye and skin contact.

DOT Classification: <7% Available Chlorine,* ORM-B I.D. No. NA 1791 Label: None
(49 CFR 172.101) >7% Available Chlorine, CORROSIVE. I.D. No UN 1791 Label: CORROSIVE
*% Available Chlorine is about 7.35% NaOCl. +Incompatible with bowl cleaners containing bisulfates.

DATA SOURCE(S) CODE: 1,3-11,14,25,34,37,48,49

APPROVALS: MIS/CRD J. M. Nelson

INDUST. HYGIENE/SAFETY [signature] 2-22-83

MEDICAL REVIEW: 9 March 1983

C. NODE DEFINITION TABLES

APPENDIX C

NODE DEFINITION TABLES

HAZOP DEVIATIONS

TYPE OF NODE: CONVEYOR / FEEDER / SCREENER

ATTRIBUTES OF THE DESIGN INTENTION	GUIDEWORDS						
	NO (not, skipped, ommitted)	LESS (lower, sooner, shorter, slower)	MORE (higher, later, longer, faster)	PART OF (incomplete)	AS WELL AS (simultaneously, also)	OTHER THAN (misdirected, elsewhere)	REVERSE (out of sequence, another way)
1 Flow, from/to	No flow	Low flow	High flow		Loss of containm.	Misdirected flow	Reverse flow
2 Material, composition				Missing component	Extra comp./Contam.	Wrong substance	
3 Concentration		Low concentration	High concentration				
4 Phase				Missing phase	Additional phase	Wrong phase	
5 Pressure	Vacuum	Low pressure	High pressure	Partial pressure			Reverse pressure
6 Temperature		Low temperature	High temperature				
7 Level	No level	Low level	High level				
8 Interface		Low interface	High interface				
9 Reaction	No reaction	Low reaction rate	High reaction rate	Incomplete reaction	Side reaction		Reverse reaction
10 Mixing	No mixing	Low mixing	High mixing				
11 Agitation	No agitation	Low agitation	High agitation				
12 Speed, motion	No motion	Low speed	High speed				Inverse motion
13 pH		Low pH	High pH				
14 Viscosity		Low viscosity	High viscosity				
15 Time	No time	Short time	Long time			Wrong time	
16 Step, sequence	Step omitted	Step too early	Step too late		Extra step	Wrong step	Step out of seq.
17 Frequency	Zero frequency	Low frequency	High frequency				
18 Information	No information			Incomplete inform.		Wrong information	
19							
20							
21							
22							
23							
24							
25							

GENERAL DEVIATIONS		
	1 External leak	2 External rupture
	3 Internal leak	4 Internal rupture
	5 Corrosion	6 Erosion
	7 Utilities failure	8 Maintenance
	9 Relief	10 Venting
	11	12
	13	14
	15	16
	17	18
	19	20

RAYTHEON

Rust Division

CONSIDER: Initial startup
Normal operation
Temporary operation
Normal shutdown
Startup following a turnaround
Startup following an emergency shutdown
Emergency operation
Emergency shutdown

NOTE: This table shows some HAZOP deviations to illustrate their selection. It is not a complete table, and the analyst should prepare *his own list, appropriate for his particular* process and node definition.

HAZOP DEVIATIONS

TYPE OF NODE: REACTOR

ATTRIBUTES OF THE DESIGN INTENTION	GUIDEWORDS						
	NO (not, skipped, ommitted)	LESS (lower, sooner, shorter, slower)	MORE (higher, later, longer, faster)	PART OF (incomplete)	AS WELL AS (simultaneously, also)	OTHER THAN (misdirected, elsewhere)	REVERSE (out of sequence, another way)
1 Flow, from/to	No flow	Low flow	High flow		Loss of containm.	Misdirected flow	Reverse flow
2 Material, composition				Missing component	Extra comp./Contam.	Wrong substance	
3 Concentration		Low concentration	High concentration				
4 Phase				Missing phase	Additional phase	Wrong phase	
5 Pressure	Vacuum	Low pressure	High pressure	Partial pressure			Reverse pressure
6 Temperature		Low temperature	High temperature				
7 Level	No level	Low level	High level				
8 Interface		Low interface	High interface				
9 Reaction	No reaction	Low reaction rate	High reaction rate	Incomplete reaction	Side reaction		Reverse reaction
10 Mixing	No mixing	Low mixing	High mixing				
11 Agitation	No agitation	Low agitation	High agitation				
12 Speed, motion	No motion	Low speed	High speed				Inverse motion
13 pH		Low pH	High pH				
14 Viscosity		Low viscosity	High viscosity				
15 Time	No time	Short time	Long time			Wrong time	
16 Step, sequence	Step omitted	Step too early	Step too late		Extra step	Wrong step	Step out of seq.
17 Frequency	Zero frequency	Low frequency	High frequency				
18 Information	No information			Incomplete inform.		Wrong information	
19							
20							
21							
22							
23							
24							
25							

GENERAL DEVIATIONS		
	1 External leak	2 External rupture
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	5 Corrosion	6 Erosion
	7 Utilities failure	8 Maintenance
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	15	16
	17	18
	19	20

RAYTHEON

Rust Division

CONSIDER: Initial startup
Normal operation
Temporary operation
Normal shutdown
Startup following a turnaround
Startup following an emergency shutdown
Emergency operation
Emergency shutdown

NOTE: This table shows some HAZOP deviations to illustrate their selection. It is not a complete table, and the analyst should prepare his own list, appropriate for his particular process and node definition.

HAZOP DEVIATIONS

TYPE OF NODE: TANK / VESSEL

ATTRIBUTES OF THE DESIGN INTENTION	GUIDEWORDS						
	NO (not, skipped, ommitted)	LESS (lower, sooner, shorter, slower)	MORE (higher, later, longer, faster)	PART OF (incomplete)	AS WELL AS (simultaneously, also)	OTHER THAN (misdirected, elsewhere)	REVERSE (out of sequence, another way)
1 Flow, from/to	No flow	Low flow	High flow		Loss of containm.	Misdirected flow	Reverse flow
2 Material, composition				Missing component	Extra comp./Contam.	Wrong substance	
3 Concentration		Low concentration	High concentration				
4 Phase				Missing phase	Additional phase	Wrong phase	
5 Pressure	Vacuum	Low pressure	High pressure	Partial pressure			Reverse pressure
6 Temperature		Low temperature	High temperature				
7 Level	No level	Low level	High level				
8 Interface		Low interface	High interface				
9 Reaction	No reaction	Low reaction rate	High reaction rate	Incomplete reaction	Side reaction		Reverse reaction
10 Mixing	No mixing	Low mixing	High mixing				
11 Agitation	No agitation	Low agitation	High agitation				
12 Speed, motion	No motion	Low speed	High speed				Inverse motion
13 pH		Low pH	High pH				
14 Viscosity		Low viscosity	High viscosity				
15 Time	No time	Short time	Long time			Wrong time	
16 Step, sequence	Step omitted	Step too early	Step too late		Extra step	Wrong step	Step out of seq.
17 Frequency	Zero frequency	Low frequency	High frequency				
18 Information	No information			Incomplete inform.		Wrong information	
19							
20							
21							
22							
23							
24							
25							

GENERAL DEVIATIONS		
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	7 Utilities failure	8 Maintenance
	9 Relief	10 Venting
	11	12
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	15	16
	17	18
	19	20

RAYTHEON

Rust Division

CONSIDER: Initial startup
Normal operation
Temporary operation
Normal shutdown
Startup following a turnaround
Startup following an emergency shutdown
Emergency operation
Emergency shutdown

NOTE: This table shows some HAZOP deviations to illustrate their selection. It is not a complete table, and the analyst should prepare his own list, appropriate for his particular process and node definition.

HAZOP DEVIATIONS

TYPE OF NODE: PROCESS LINE

ATTRIBUTES OF THE DESIGN INTENTION	GUIDEWORDS						
	NO (not, skipped, ommitted)	LESS (lower, sooner, shorter, slower)	MORE (higher, later, longer, faster)	PART OF (incomplete)	AS WELL AS (simultaneously, also)	OTHER THAN (misdirected, elsewhere)	REVERSE (out of sequence, another way)
1 Flow, from/to	No flow	Low flow	High flow		Loss of containm.	Misdirected flow	Reverse flow
2 Material, composition				Missing component	Extra comp./Contam.	Wrong substance	
3 Concentration		Low concentration	High concentration				
4 Phase				Missing phase	Additional phase	Wrong phase	
5 Pressure	Vacuum	Low pressure	High pressure	Partial pressure			Reverse pressure
6 Temperature		Low temperature	High temperature				
7 Level	No level	Low level	High level				
8 Interface		Low interface	High interface				
9 Reaction	No reaction	Low reaction rate	High reaction rate	Incomplete reaction	Side reaction		Reverse reaction
10 Mixing	No mixing	Low mixing	High mixing				
11 Agitation	No agitation	Low agitation	High agitation				
12 Speed, motion	No motion	Low speed	High speed				Inverse motion
13 pH		Low pH	High pH				
14 Viscosity		Low viscosity	High viscosity				
15 Time	No time	Short time	Long time			Wrong time	
16 Step, sequence	Step omitted	Step too early	Step too late		Extra step	Wrong step	Step out of seq.
17 Frequency	Zero frequency	Low frequency	High frequency				
18 Information	No information			Incomplete inform.		Wrong information	
19							
20							
21							
22							
23							
24							
25							

GENERAL DEVIATIONS		
	1 External leak	2 External rupture
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	5 Corrosion	6 Erosion
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	11	12
	13	14
	15	16
	17	18
	19	20

RAYTHEON

Rust Division

CONSIDER: Initial startup
Normal operation
Temporary operation
Normal shutdown
Startup following a turnaround
Startup following an emergency shutdown
Emergency operation
Emergency shutdown

NOTE: This table shows some HAZOP deviations to *illustrate their selection. It is not a* complete table, and the analyst should prepare his own list, appropriate for his particular process and node definition.

HAZOP DEVIATIONS

TYPE OF NODE: DRYER

ATTRIBUTES OF THE DESIGN INTENTION	GUIDEWORDS						
	NO (not, skipped, ommitted)	LESS (lower, sooner, shorter, slower)	MORE (higher, later, longer, faster)	PART OF (incomplete)	AS WELL AS (simultaneously, also)	OTHER THAN (misdirected, elsewhere)	REVERSE (out of sequence, another way)
1 Flow, from/to	No flow	Low flow	High flow		Loss of containm.	Misdirected flow	Reverse flow
2 Material, composition				Missing component	Extra comp./Contam.	Wrong substance	
3 Concentration		Low concentration	High concentration				
4 Phase				Missing phase	Additional phase	Wrong phase	
5 Pressure	Vacuum	Low pressure	High pressure	Partial pressure			Reverse pressure
6 Temperature		Low temperature	High temperature				
7 Level	No level	Low level	High level				
8 Interface		Low interface	High interface				
9 Reaction	No reaction	Low reaction rate	High reaction rate	Incomplete reaction	Side reaction		Reverse reaction
10 Mixing	No mixing	Low mixing	High mixing				
11 Agitation	No agitation	Low agitation	High agitation				
12 Speed, motion	No motion	Low speed	High speed				Inverse motion
13 pH		Low pH	High pH				
14 Viscosity		Low viscosity	High viscosity				
15 Time	No time	Short time	Long time			Wrong time	
16 Step, sequence	Step omitted	Step too early	Step too late		Extra step	Wrong step	Step out of seq.
17 Frequency	Zero frequency	Low frequency	High frequency				
18 Information	No information			Incomplete inform.		Wrong information	
19 Moisture content		Low humidity	High humidity				
20							
21							
22							
23							
24							
25							

GENERAL DEVIATIONS		
	1 External leak	2 External rupture
	3 Internal leak	4 Internal rupture
RAYTHEON	5 Corrosion	6 Erosion
Rust Division	7 Utilities failure	8 Maintenance
	9 Relief	10 Venting
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	13	14
	15	16
	17	18
	19	20

CONSIDER: Initial startup
Normal operation
Temporary operation
Normal shutdown
Startup following a turnaround
Startup following an emergency shutdown
Emergency operation
Emergency shutdown

NOTE: This table shows some HAZOP deviations to illustrate their selection. It is not a complete table, and the analyst should prepare his own list, appropriate for his particular process and node definition.

HAZOP DEVIATIONS

TYPE OF NODE: CENTRIFUGE

ATTRIBUTES OF THE DESIGN INTENTION	GUIDEWORDS						
	NO (not, skipped, ommitted)	LESS (lower, sooner, shorter, slower)	MORE (higher, later, longer, faster)	PART OF (incomplete)	AS WELL AS (simultaneously, also)	OTHER THAN (misdirected, elsewhere)	REVERSE (out of sequence, another way)
1 Flow, from/to	No flow	Low flow	High flow		Loss of containm.	Misdirected flow	Reverse flow
2 Material, composition				Missing component	Extra comp./Contam.	Wrong substance	
3 Concentration		Low concentration	High concentration				
4 Phase				Missing phase	Additional phase	Wrong phase	
5 Pressure	Vacuum	Low pressure	High pressure	Partial pressure			Reverse pressure
6 Temperature		Low temperature	High temperature				
7 Level	No Level	Low level	High level				
8 Interface		Low interface	High interface				
9 Reaction	No reaction	Low reaction rate	High reaction rate	Incomplete reaction	Side reaction		Reverse reaction
10 Mixing	No mixing	Low mixing	High mixing				
11 Agitation	No agitation	Low agitation	High agitation				
12 Speed, motion	No motion	Low speed	High speed				Inverse motion
13 pH		Low pH	High pH				
14 Viscosity		Low viscosity	High viscosity				
15 Time	No time	Short time	Long time			Wrong time	
16 Step, sequence	Step omitted	Step too early	Step too late		Extra step	Wrong step	Step out of seq.
17 Frequency	Zero frequency	Low frequency	High frequency				
18 Information	No information			Incomplete inform.		Wrong information	
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23							
24							
25							

GENERAL DEVIATIONS		
	1 External leak	2 External rupture
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	7 Utilities failure	8 Maintenance
	9 Relief	10 Venting
	11	12
	13	14
	15	16
	17	18
	19	20

RAYTHEON

Rust Division

CONSIDER: Initial startup
Normal operation
Temporary operation
Normal shutdown
Startup following a turnaround
Startup following an emergency shutdown
Emergency operation
Emergency shutdown

NOTE: This table shows some HAZOP deviations to illustrate their selection. It is not a complete table, and the analyst should prepare his own list, appropriate for his particular process and node definition.

D. SITING/LAYOUT CHECKLIST

APPENDIX D

SITING/LAYOUT CHECKLIST

CHECKLIST 23: LAYOUT AND SITTING

1. SPACING BETWEEN PROCESS COMPONENTS

1. Have adequate provisions been made for relieving explosions in process components?

   Individual pieces of equipment and connecting systems are designed to prevent over pressure situations and/or relief if high pressure occurs.

2. Are operating units and equipment within units spaced to minimize potential damage from fires or explosions in adjacent areas?

   Yes, the PVC plant is divided into three operating areas. These areas are spaced to minimize disruption from one another.

3. Are there safe exit routes from each unit?

   Yes, the units are open.

4. Has equipment been adequately spaced and located to safely permit anticipated maintenance (e.g., pulling heat exchanger bundles, dumping catalyst, lifting with cranes) and hot work?

   Yes, part of design review is a review of the 3D model to check equipment for maintenance access.

5. Are vessels containing highly hazardous chemicals located sufficiently far apart? If not what hazards are introduced?

   Yes

6. Is there adequate access for emergency vehicles (e.g., fire trucks)?

   Roadways are kept clear.

7. Can adjacent equipment and facilities withstand the overpressure generated by potential explosions?

8. Can adjacent equipment and facilities (e.g. support structures) withstand flame impingement?

   Fire protection has been reviewed and approved by insurance carrier.

2. LOCATION OF LARGE INVENTORIES

1. Are large inventories of highly hazardous chemicals located away from the process area?

   Yes, plant lay out has the unloading and storage area away from process areas. Units are designed to hold less VCM than is needed for a reactor change.

2. Is temporary storage provided for raw materials and finished products at appropriate locations?

   Yes

3. Are the inventories for highly hazardous chemicals held to a minimum?

   Yes

4. Where applicable, are reflux tanks, surge drums and rundown tanks located in a way that avoids large volume concentration of highly hazardous chemicals in any one area?

   Yes, receivers minimize the amount of VCM stored in each unit.

5. Where applicable, has special consideration been given to storage and transportation of explosives?

   Yes, catalysts are not explosives, but because of their exothermic decomposition properties special handling and storage is required.

6. Have the following been considered in the location of material handling areas:

- Fire hazards	**Yes**
- Location relative to important buildings	**Yes**
- Safety devices (e.g., sprinklers)	**Yes**
- Slope of area (is it level?)	**Yes**

3. LOCATION OF MOTOR CONTROL CENTER

1. Is the motor control center located so that it is easily accessible to operators?

   Yes

2. Are circuit breakers easy to identify?

   Yes, for the Express Project.

3. Can operators safety open circuit breakers? Have they been trained?

Only qualified electricians.

4. Is the motor control center designed such that it could not be an ignition source?

Yes

Are the doors always closed?

No, some of existing buildings do not have adequate ventilation.

Is a no smoking policy strictly enforced?

Yes

5. Is the motor control center designed and meant to be a safe haven?

No

4. LOCATION AND CONSTRUCTION OF CONTROL ROOM(S)

Express Phase 3 does not have any effect on the design of the existing control room. Hazoping of the control room is not in the scope of this project. This section is left for a plant hazop. Earlier the location of the new unloading station relative to the control room was examined. The method in the dow fire and explosion index was used. The new unloading stations do not pose an increased risk.

1. Is the control room built to satisfy current corporate overpressure and safe-haven standards?

2. Does the construction basis for the control room satisfy acceptable criteria (e.g., the Factory Mutual recommendations)?

3. Are workers protected in the control room (or their escape routes) from all of the following:

- Toxic, corrosive or flammable sprays, fumes, mists or vapors
- Thermal radiation from fires (including flares)
- Overpressure and projectiles from explosions
- Contamination from spills or runoff
- Noise
- Contamination of utilities (e.g., breathing air)
- Transport of hazardous materials from other sites
- Possibility of long-term exposure of employees to low concentration of process material

- Odors
- Impacts (e.g., from a forklift)
- Flooding (e.g., ruptured storage tank)

5. Were the following characteristics considered when the control room location was determined:

   - Types of room construction
   - Types/quantities of materials
   - Direction and velocity of prevailing winds
   - Types of reactions and processes
   - Operating pressures and temperatures
   - Ignition sources
   - Fire protection facilities
   - Drainage facilities

6. If windows are installed, are they of rigid construction with sturdy panes (e.g., woven wire reinforced glass)?

7. Is at least one exit located in a direction away from the process area?

   Do exit doors open outward?

   Are emergency exits provided for multistoried control buildings?

8. Are ends of horizontal vessels facing away from control rooms?

9. Are critical pieces of equipment in the control room well protected?

   Is adequate barricading provided for the control room?

10. Are open pits, trenches or other pockets where inert, toxic or flammable vapors could collect located away from the control buildings or equipment handling flammable fluids?

11. Where piping, wiring and conduit enter the building, is the building sealed at the point of entry?

    Have other potential leakage points into the building been adequately sealed?

12. Is the control room located a sufficient distance from excessive vibration sources?

13. Is positive pressure maintained in control rooms located in hazardous areas?

14. Could any structures fall on the control room in an accident?

15. Is the control room roof free from heavy equipment and machinery?

5. LOCATION OF MACHINE SHOPS, WELDING SHOPS, ELECTRICAL SUBSTATIONS AND OTHER LIKELY IGNITION SOURCES

1. Are likely ignition sources (e.g., maintenance shops, roads, rail spurs) located away from release points for volatile substances (both liquid and vapor)?

Yes

2. Are process sewers located away from likely ignition sources?

Yes

3. Are all vessels containing highly hazardous chemicals or components containing material above its flash point located away from likely ignition sources?

Yes

4. Are the flare and fired-heater systems located to minimize hazards to personnel and equipment, with consideration given to normal wind direction and wind velocity and heat potential?

Yes

6. LOCATION OF ENGINEERING, LAB, ADMINISTRATION OR OTHER BUILDINGS

1. Are administration buildings located away from inventories of highly hazardous chemicals?

Yes

2. Are administration buildings located away from release points for highly hazardous chemicals?

Yes

3. Are workers in administration buildings protected from all of the following?

- Toxic, corrosive or flammable sprays, fumes, mists, or vapors	**Yes**
- Thermal radiation from fires (including flares)	**Yes**
- Overpressure and projectiles from explosions	**Yes**
- Contamination of utilities (e.g., water)	**Yes**
- Contamination from spills or runoff	**Yes**
- Noise	**Yes**

- Transport of hazardous materials from other sites **Yes**
- Flooding (e.g., ruptured storage tank) **Yes**
- Odors **Yes**

7. UNIT LAYOUT AND LOCATION OF FACILITY RELATIVE TO NEIGHBORS

1. Are large inventories or release points for highly hazardous chemicals located away

- from public access roads? **Yes**
- vehicular traffic within the plant? **Yes**

2. Is the unit, or can the unit be, located to minimize the need for offsite or intrasite transportation of hazardous materials?

VCM comes from the Lake Charles plant. It is unloaed safely.

3. Are workers in adjacent units protected and workers in this unit protected from the effects of adjacent units or facilities from all of the following?

- Releases of highly hazardous chemicals **Yes**
- Toxic, corrosive or flammable sprays, fumes, mists or vapors **Yes**
- Thermal radiation from fires (including flares) **Yes**
- Overpressure from explosions **Yes**
- Contamination from spills or runoff **Yes**
- Odors **Yes**
- Noise **Yes**
- Contamination of utilities (e.g., sewers) **Yes**
- Transport of hazardous materials from other sites **Yes**
- Impacts (e.g., airplane crashes, derailments) **Yes**
- Flooding (e.g., ruptured storage tanks) **Yes**

4. Could specific siting hazards be posed to the site from credible external forces such as high winds, earth movement, utility failure from outside sources, flooding, natural fires and fog?

This area is susceptible to high winds and tornadoes. Designs are per applicable codes, e.g., ASCE.

5. Is there adequate access for emergency vehicles (e.g., fire trucks)?

Yes

Are access roads free of the possibility of being blocked by trains, highway congestion, spotting of rail cars, etc?

Railcars do cross some roads and at certain times of day could block roads.

6. Are access roads well engineered to avoid sharp curves?

Yes, there are no sharp curves. Roads and plant layout are designed to allow crane access to equipment in the units.

Are traffic signs provided?

Yes

7. Is vehicular traffic appropriately restricted from areas where pedestrians could be injured or equipment damaged?

Roads going into the unit have swing gates. A permit is required for vehicle to enter the operating unit. Contractors do not always follow procedures.

8. Are cooling towers located such that fog, generated by them, will not be a hazard?

Yes

9. Are the ends of horizontal vessels facing away from personnel areas?

Yes

10. Is hydrocarbon-handling equipment located outdoors?

All equipment is out doors.

11. Are pipe bridges located such that they are not over equipment, including control rooms and administration buildings?

Yes, away from major equipment.

12. Is piping design adequate to withstand potential liquid loads?

Yes

8. LOCATION OF FIREWATER MAINS AND BACKUP (E.G., DIESEL PUMPS)

1. Are firewater mains easily accessible?

Firewater mains are located throughout the plant.

2. Are firewater mains and pumps protected from overpressure and blast debris impact?

Yes, firewater pumps are in buildings and located away from units.

3. Is an adequate water supply available for fire-fighting?

Yes, a study was done to determine present flow rates and plan for needs of the expansion.

4. Are the firehouse doors pinged away from the process area so that doors will not be damaged by an explosion overpessure?

There is not a firehouse in the plant.

9. LOCATION AND ADEQUACY OF DRAINS, SPILLS, BASINS, DIKES AND SEWER

1. Are spill containments sloped away from process inventories and potential fire sources?

Dike areas contain a spill and can be collected or drained to the process sewer. Non tank areas have concrete surfaces that slope to the process sewer. Tanks have dikes.

2. Have precautions been taken to avoid open ditches, pits, sumps or pockets where inert, toxic or flammable vapors could collect?

Pits, sumps, etc., are kept to a minimum. Where there are pits and sumps procedures are in place to manage activities in these areas.

3. Are process sewers that transport hydrocarbons closed systems?

Yes

4. Are concrete bulkheads, barricades or berms installed to protect personnel and adjacent equipment from explosion and/or fire hazards?

Barricades and berms are not used in this plant.

5. Are vehicle barriers installed to prevent impact to critical equipment adjacent to high traffic areas?

Yes, vehicle barriers are placed anywere a vehicle may run into equipment or structures.

6. Do drains empty to areas where material cannot pool?

Yes

7. Can dikes hold the largest tank's capacity?

Yes, dikes are sized based on tank capacity and rainfall.

8. Is there access in and out of dikes, pits, etc.?

Yes, ramps are used to provide access in and out of diked areas.

10. LOCATION OF EMERGENCY STATIONS (SHOWERS, RESPIRATORS, PERSONNEL PROTECTIVE EQUIPMENT, ETC.)

1. Are emergency stations easily accessible?

Yes

2. Are first-aid stations prudently located and adequately equipped?

Yes, there is one station at the Lab.

3. Are safety showers heated/freeze-protected/wind-protected?

Plant is discussing ways to adequately protect safety showers during cool weather.

4. Is there a control room alarm for water flow from a safety shower and eyewash station?

No

Is there a need for such an alarm?

No

11. PLANNING

1. What expansion or modification plans are there for the facility?

Express Phase 1 added an external stripping columns, a new dryer and additional unloading capacity. Express Phase 2 adds two more stripping columns. External stripping lowers hydrocarbon emissions. Express Phase 3 adds two more reactors, another dryer, and utilities such as water recycle and cooling water.

2. Can the unit be built and maintained without lifting heavy items over operating equipment and piping?

All except for the OM stripper. Extra precautions were taken during construction.

3. Are calculations, charts and other documents available that verify facility siting has been considered in the unit layout?

Facility siting was done but the documentation was not kept.

Do these documents show that consideration has been given to the following:
- Normal direction and velocity of wind
- Atmospheric dispersion of gases and vapors
- Estimated radiant heat density that might exist during a fire
- estimated overpressure

4. Are appropriate security safeguards in place (e.g., fences, guard stations)?

Yes

5. Are gates located away from the public roadway so that the largest truck can move completely of the roadway while waiting for the gates to be opened?

Yes

6. Where applicable, are safeguards in place to protect high structures against low flying aircraft?

Not required by Code.

7. Are adequate safeguards in place to protect employees against exposure to excessive noise, considering the commutative effect of equipment items located close together?

Noise is considered in equipment design. Efforts are made to design and purchase equipment with low noise levels. The plant does noise level surveys, where necessary signs are posted requiring ear plugs.

8. Is adequate emergency lighting provided?

Is there adequate redundant backup power for this lighting?

9. Are procedures in place to restrict nonessential or untrained personnel from entering hazardous areas?

Yes, plant policy requires training before entering units.

10. Are indoor safety-control systems such as sprinklers and fire walls provided in buildings where personnel will frequently be located, such as control rooms and administrative buildings?

Yes

11. Are evacuation plans (from buildings, units, etc.) adequate and accessible to personnel?

Yes

12. Are evacuation drills conducted routinely?

Yes

E. HUMAN FACTORS CHECKLIST

APPENDIX E

HUMAN FACTORS CHECKLISTS

CHECKLIST 24: HUMAN FACTORS

HOUSEKEEPING AND GENERAL WORK ENVIRONMENT

1.01 Are working areas generally clean?

Yes, employees are responsible for keeping their area clean. Work areas are regularly checked and feedback given.

1.02 Are adequate signs posted in cleanup and maintenance?

Yes, housekeeping notices in specific areas are posted.

1.03 Is the ambient temperature normally within comfortable bounds?

Special winter clothing is provided when appropriate.

1.04 Is noise maintained at a tolerable level?

Yes, noise us considered when purchasing new equipment. Safety periodically does a noise level survey throughout the plant. Hearing protection is provided and required in certain areas of plant. These areas are clearly marked.

1.05 Is the lighting sufficient for all facility operations?

Yes, adequate lighting was addressed as part of the design.

1.06 Is the general environment conducive to efficient performance?

Yes.

ACCESSIBILITY/AVAILABILITY OF CONTROLS AND EQUIPMENT

2.01 Are adequate supplies of protective gear readily available for routine and emergency use?

Yes, there are procedures for employees to get personal protective equipment to perform tasks. Procedures state what PPE is required for given tasks. Policies require when PPE is to be replaced.

There are procedures for maintaining emergency gear and having it located at appropriate locations throughout the plant.

2.02 Is communications equipment adequate and easily accessible? How would others know that a worker is incapacitated in the process area?

There are several types of communication systems: radios, phones and gaitronics. Operators in the field carry radios to coordinate tasks with panel operations and request assistance when necessary. Permit systems coordinates maintenance acitivies in the field.

2.03 Are the right tools available and used when needed?

Maintenance procedures cover proper tools and procedures for using tools.

2.04 Are special tools required to perform any tasks safely or efficiently?

Yes, the plant has purchased special tools when appropriate to improve safety. Examples are: power torque wrench for working on reactor condenser seals. Process safety information is kept updated and available.

2.05 What steps are taken to identify and provide special tools?

When problems are identified they are brought to supervisors and possible solutions are discussed. Or employees come to supervisors with suggestions for improvements in doing routine tasks.

2.06 Is the whole workplace arranged so that the workers can maintain a good working posture and perform a variety of movements?

Project Designs are reviewed to ensure accessibility in and around equipment. Safety training is used to teach and reinforce proper methods for bending, lifting and carrying.

2.07 Are all controls accessible?

Yes, controls are designed and constructed for accessibility.

2.08 Is access adequate for routine operation and maintenance of all equipment?

Yes.

COMPONENT LABELING

3.01 Is all important equipment (vessels, pipes, valves, instruments, controls, etc.) clearly and unambiguously labeled?

During commissioning and start up the project has labeled equipment, instruments and piping.

3.02 Does the labeling program include components (e.g., small valves) that are mentioned in the procedures event if they are not assigned an equipment number?

No, generally not.

3.03 Are plant instruments and controls clearly labeled?

Field labels are put on each instrument. Additionally all instruments are provided with permanent metal tags.

3.04 Are the labels accurate?

Yes

3.05 Who is responsible for maintaining and updating the labels?

Labels are installed as part of projects. There is no system for maintaining labels.

3.06 Are emergency exit and response signs clearly visible and easily understood?

N/A. These units are outdoors.

FEEDBACK/DISPLAYS

4.01 Is adequate information about normal and upset process conditions displayed in control room?

Yes, process reading and alarms are displayed on the distributive control system.

4.02 Are the controls and displays arranged logically to match the expectations of the operators?

Operators review new displays and graphics for comments during a project.

4.03 Are the displays adequately visible from all relevant working positions?

Control room layout was designed for optimum visibility for all operators.

4.05 Do separate displays present information in a consistent manner?

Programming standards were developed as guidelines for consistency in developing displays.

4.06 Are related displays and controls grouped together?

Yes

4.07 Is the information displayed in ways the operator can understand?

Yes, operator training explains new controls and how they operate. Operator comments are used as feedback for making improvements on displays.

4.08 Are the operators provided with enough information to diagnose an upset when an alarm sounds?

Yes, instrument alarms and program messages are used to help the operator understand how the unit is operating.

4.09 Are the alarms displayed by priority? Are critical safety alarms separate from control alarms?

Yes. Alarms mainly indicate control alarms. Unsafe conditions are programmed to cause action by interlocking instruments and equipment to bring conditions back to a safe state. Interlocks happen automatically without being initiated by operators.

4.10 Is an alarm summary permanently on display?

No, when an alarm occurs a sound is activated and a message flashes on the lower right hand corner of the screen. Selecting the flashing message brings up the alarm.

4.11 What kinds of calculations do the operators perform when reading displays, and how are these calculations checked?

None

4.12 Do the displays provide an adequate view of the entire process as well as essential details of individual systems?

Yes, there are overview graphics and detail graphics.

4.13 Do the displays give rapid feedback for all operational actions?

Yes

4.14 Do all mimic displays (board or screen) match the actual equipment configuration?

Yes, graphics are updated when systems are changed.

CONTROLS

5.01 Is the layout of the consoles logical, consistent, and effective?

Yes, the layout was intended to maximize communication and effectiveness.

5.02 Are the controls distinguishable and easy to use?

Yes, programming standards describe how controls are to be configured.

5.03 Do any controls violate strong expectations (color, direction of movements, etc.)?

No, if there is any confusion a change order is written to correct the display.

5.04 Do the control panel layouts reflect the functional aspects of the process or equipment?

Yes, control panels are flow diagrams of the process and include the main control loops.

5.05 Does the control arrangement logically follow the normal sequence of operation?

Yes

5.06 What are the consequences of operator intervention in computer-controlled equipment?

Operations can stop and start the automation sequences at any time. The programming brings equipment to a safe condition when stopped and start the equipment safely bringing it up to normal operating conditions. Interlocks prevent operators from opening valves or starting equipment at inappropriate times.

5.07 Are any process variables difficult to control with the existing equipment?

No

5.08 Does the control logic seem adequate?

Yes

5.09 Is there a dedicated emergency shutdown panel, and where is it located?

Yes, it is located by the DCS consoles.

PROCEDURES

6.01 Is a complete, current set of procedures for startup, shutdown, normal operation, and emergencies available for workers to use?

Yes, they are kept in the vinyl control room.

6.02 Are procedures written for the workers, considering their education, background, experience, native language, etc.?

Yes, operations helped write and review the procedures.

6.03 Is a step-by-step format used and are the steps in the correct order?

Yes

6.04 Are diagrams, photographs, drawings, etc., used to clarify the written text?

Diagrams, drawings and flow sheets are used in training but are not part of the written procedures.

6.05 Are cautions and warnings clearly stated in prominent locations before the potentially dangerous action?

Yes, the format for writing procedures tells how warnings and cautions should be shown to attract readers attention.

6.06 Are checklists used for critical procedures with only one action specified per numbered step?

Yes

6.07 Do steps requiring control actions also specify the correct system response?

Yes

WORKLOAD AND STRESS FACTORS

7.01 Are the operators only in the control room, or do they work in a variety of locations?

Reactor panel operators stay in the control room. Dryer operators must do some field work throughout the day. Reactor operators must cover the dryer panel when dryer operators are out in the field.

7.02 How many manual adjustments must a worker perform during normal and emergency operations?

Operators must monitor process and keep parameters within right ranges. During emergency power loss operators must manually open emergency cooling water valves and sometimes manually add stop agent to reactors.

7.03 What is the normal operating shift duration? Is this duration appropriate based on its impact on alertness/fatigue?

12 Hour shifts. Yes

7.04 How many extra hours must an operator work if his/her relief fails to show up?

Maximum 4 extra hours.

7.05 How many hours to operators/maintenance personnel typically work on a shift during startup or turnarounds?

12 Hour shifts. The number of consecutive days worked is monitored so as not to cause problems.

7.06 Has the operator's mobility been considered in selecting the design of protective gear for certain tasks, including emergency response?

Yes

GENERAL Issues

8.01 Have the operators made any modifications to the displays, controls, or equipment to better suit their needs?

Operators don't make the modifications, they make the formal request and a controls engineer executes the change.

8.02 Is there formal mechanism for correcting human factors deficiencies in the human/machine interface?

Yes

8.03 What means are provided to allow personnel to compensate for errors? Can personnel detect an error they or someone else makes with sufficient time to correct the error?

Different alarm levels allow operators to take corrective action before automatic shutdown. Also the system will check whether parameters are within correct range before accepting them.

8.04 Is the control room adequately located relative to the process?

The control room is located in proximity of the unit and at a safe distance from equipment that contains volatile liquids or gases.

F. HAZOP TABLE

APPENDIX F

HAZOP TABLE

NOTE:

The following are the frequency and consequence categories shown in the HAZOP table:

FC: FREQUENCY CATEGORY

F : CONSEQUENCE - SAFETY

X : CONSEQUENCE - BUSINESS LOSS

NOTE

TO AVOID REPETITION IN THE HAZOP TABLE, THE WORDS "NONE" AND "NONE OTHER" ARE USED TO QUALIFY THE CAUSES AND CONSEQUENCES. THE MEANING OF THESE EXPRESSIONS IS PRESENTED BELOW.

UNDER CAUSES

WHERE IT SAYS:
"NONE"

IT MEANS:
"NO CREDIBLE CAUSE WAS IDENTIFIED BY THE HAZOP TEAM FOR THIS DEVIATION"

UNDER CONSEQUENCES

WHERE IT SAYS:
"NONE"

IT MEANS:
"NO CONSEQUENCE OF CONCERN (I.E., SAFETY RELATED) WAS IDENTIFIED BY THE HAZOP TEAM FOR THIS DEVIATION"

WHERE IT SAYS:
"NONE OTHER"

IT MEANS:
"NO SCENARIO OF CONCERN WAS IDENTIFIED BY THE HAZOP TEAM OTHER THAN THOSE CONSIDERED ELSEWHERE IN THIS STUDY"

Item Number	Deviation	Causes	F C	Consequences	PXETIBO	Safeguards	Actions
		101.0 TANK / VESSEL - VCM STORAGE SPHERE (dwg: VS-093105-PID-D)					
		DESIGN INTENTION: STORAGE OF VCM					
101.1	LOW CONCENTRATION			None	.....		
101.2	HIGH CONCENTRATION	None					
101.3	NO / LOW PRESSURE	Low ambient temperature	2	Extended unloading time	.4.....	Heat tracing on lines Low pressure alarm on compressor KO drum ((00-PSL-262) DCS interlock will shut down system on low pressure	
101.4	HIGH PRESSURE	High level High concentration of inerts	3 3	Overpressure, release	3.....	Relief valves (PSV-PV-001) Emmission recovery vent Level and pressure indications and alarms (00-LT-107/109, 00-PT-108/110)	
101.5	LOW TEMPERATURE			None other (see low pressure)	.....		
101.6	HIGH TEMPERATURE	None					
101.7	NO / LOW LEVEL	Late delivery	2	Production loss	.3.....		
101.8	HIGH LEVEL			None other (see high pressure)	.....		
101.9	LOW INTERFACE	None					
101.10	HIGH INTERFACE	None					

(continued)

Item Number	Deviation	Causes	P C	Consequences	FXETIBO	Safeguards	Actions
				101.0 TANK / VESSEL - VCM STORAGE SPHERE (continued)			
				DESIGN INTENTION: STORAGE OF VCM			
101.11	EXTERNAL LEAK / RUPTURE	None	.				
101.12	INTERNAL LEAK / RUPTURE	None	.				
101.13	EXTRA / WRONG COMPONENT	Presence of inerts	2	High pressure, potential release	3.....	See high pressure	
				Poor product quality	.3.....		
				102.0 PROCESS LINE - VCM VAPORS FROM STORAGE SPHERE TO KO POT (dwg: VS-093105-PID-D)			
				DESIGN INTENTION: TRANSFER OF VCM VAPORS TO UNLOAD RAILCARS			
102.1	NO / LOW FLOW	Operator error: manual valve closed	3	Extended unloading time	.3.....	SOP, training	
		Low temperature	2			Electrically traced line	
		Low liquid level	3			Pressure indication (00-PI-51139)	
						DCS interlock will shut down system on high pressure	
102.2	HIGH FLOW	None	.				
102.3	MISDIRECTED / REVERSE FLOW	None	.				
102.4	MISSING COMPONENT	None	.				
102.5	EXTRA / WRONG COMPONENT			None other (see node 101)	.....		
102.6	LOW CONCENTRATION	None	.				
102.7	HIGH CONCENTRATION	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	PXETIBO	Safeguards	Actions
		102.0 PROCESS LINE - VCM VAPORS FROM STORAGE SPHERE TO KO POT (continued)					
		DESIGN INTENTION: TRANSFER OF VCM VAPORS TO UNLOAD RAILCARS					
102.8	NO / LOW PRESSURE			None other (see low flow)	.....		
102.9	HIGH PRESSURE	None					
102.10	LOW TEMPERATURE			None other (see low flow)	.....		
102.11	HIGH TEMPERATURE	None					
		103.0 TANK / VESSEL - VCM KNOCK OUT POT (dwg: VS-093110-PID-D)					
		DESIGN INTENTION: REMOVE LIQUID VCM FROM VAPOR STREAM					
103.1	LOW CONCENTRATION	None					
103.2	HIGH CONCENTRATION	None					
103.3	NO / LOW PRESSURE			None other (see node 102)	.....		
103.4	HIGH PRESSURE			None other (see node 102)	.....	Relief valve on KO pot (PSV-DM-326)	
103.5	LOW TEMPERATURE			None other (see node 102)	.....		
103.6	HIGH TEMPERATURE			None other (see node 102)	.....		
103.7	NO / LOW LEVEL	None					

(continued)

Item Number	Deviation	Causes	P C	Consequences	FXETIBO	Safeguards	Actions
		103.0 TANK / VESSEL - VCM KNOCK OUT POT (continued)					
		DESIGN INTENTION: REMOVE LIQUID VCM FROM VAPOR STREAM					
103.8	HIGH LEVEL	Mechanical failure: pump	3	Liquid carryover, compressor shut down	33.....	High level indication and alarm (00-LSH-222)	
		Mechanical failure: level switch malfunction	3	Liquid in the recovery KO pot	.3.....	Pump running indication	
						Pressure shut down switch on recovery KO pot and compressor KO pot	
						By-pass line around pump and KO pot	
103.9	LOW INTERFACE	None					
103.10	HIGH INTERFACE			None other (see high level)	.....		
		104.0 PROCESS LINE -- VCM VAPOR FROM KO POT TO TANK CAR (dwg: VS-093110-PID-D)					
		DESIGN INTENTION: TRANSFER OF VCM VAPORS TO UNLOAD RAIL CAR					
104.1	NO / LOW FLOW	See node 102		Extended unloading time	.3.....	See node 102	
		Compressor failure	2				
104.2	HIGH FLOW	None					
104.3	MISDIRECTED / REVERSE FLOW	None					
104.4	MISSING COMPONENT	None					
104.5	EXTRA / WRONG COMPONENT	None					
104.6	LOW CONCENTRATION	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		104.0 *PROCESS LINE - VCM VAPOR FROM KO POT TO TANK CAR (continued)*					
		DESIGN INTENTION: TRANSFER OF VCM VAPORS TO UNLOAD RAIL CAR					
104.7	HIGH CONCENTRATION	None					
104.8	NO / LOW PRESSURE			None other (see low flow)	.....		
104.9	HIGH PRESSURE	Line restriction	3	High pressure in line, release	3.....	Relief valve on line (PSV-CP-123) High pressure switch shut down Pressure indication (00-PI-261)	
104.10	LOW TEMPERATURE	Low ambient temperature	2	Liquid condensation, liquid gets in compressor	23.....	KO pots upstream of compressor High level switches on both pots (00-LSH-222/263) Electrically traced line Low pressure indication	
104.11	HIGH TEMPERATURE	Mechanical failure: compressor	3	Damage to compressor	22.....	Temperature indication and transmitter (00-TT-260, 00-TSH-264)	
		Line restriction	3	Extended unloading time	.3.....	Pressure indication and transmitter (00-PT-261) DCS interlock will shut down on high temperature and/or high pressure	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		105.0 TANK / VESSEL - VCM TANK CAR (dwg: VS-093108-PID-D)					
		DESIGN INTENTION: TRANSPORT LIQUID VCM TO PLANT					
105.1	LOW CONCENTRATION	None	.				
105.2	HIGH CONCENTRATION	None	.				
105.3	NO / LOW PRESSURE			None other (see node 104)	.....		
105.4	HIGH PRESSURE	Liquid outlet valve closed	3	Overpressure, potential release	4.....	Relief valve on tank car	
		Excess flow check valve closed	3			See node 104	
		Inesrts in the car	3			ERS system used to pull down the car	
		High ambient temperature	3				
105.5	LOW TEMPERATURE			None other (see node 104)	.....		
105.6	HIGH TEMPERATURE	None	.				
105.7	NO / LOW LEVEL	None	.				
105.8	HIGH LEVEL	None	.				
105.9	LOW INTERFACE	None	.				
105.10	HIGH INTERFACE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		105.0 TANK / VESSEL - VCM TANK CAR (continued)					
		DESIGN INTENTION: TRANSPORT LIQUID VCM TO PLANT					
105.11	EXTERNAL LEAK / RUPTURE	Damage valves	3	VCM release	3.....	Chocked rail car	
		Broken flexhose, leaking flexhose	2			Snappy joe	
						VCM area monitor,LEL GC	
						Camera	
						Air line safety link	
						DCS emergency shut down	
						Deluge system	
		106.0 PROCESS LINE - LIQUID VCM FROM TANK CAR TO STORAGE SPHERE (dwg: VS-093108-PID-D)					
		DESIGN INTENTION: UNLOADING LIQUID VCM FROM TANK CAR TO SPHERE					
106.1	NO / LOW FLOW	Mechanical failure: valve closed (00-CV-51050)	3	Extended unloading time	.3.....	Flow indication/switch (00-FI-204A, 00-FS-203A)	
		Line restriction	3				
		Empty rail car	3				
		See also node 104					
106.2	HIGH FLOW	Broken line	3	VCM release	3.....	Excess flow check valve and snappy joe	
						See node 105, external leak/rupture	
106.3	MISDIRECTED / REVERSE FLOW	None					
106.4	MISSING COMPONENT	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		106.0 PROCESS LINE - LIQUID VCM FROM TANK CAR TO STORAGE SPHERE (continued)					
		DESIGN INTENTION: UNLOADING LIQUID VCM FROM TANK CAR TO SPHERE					
106.5	EXTRA / WRONG COMPONENT	None					
106.6	LOW CONCENTRATION	None					
106.7	HIGH CONCENTRATION	None					
106.8	NO / LOW PRESSURE			None other (see low flow)	.....		
106.9	HIGH PRESSURE	Same as node 105, deviation 4		Overpressure, release	4.....	Relief valve on line (PSV-VC-407)	
		Liquid thermal expansion	4			Pressure transmitter (00-PT-206)	
106.10	LOW TEMPERATURE	None					
106.11	HIGH TEMPERATURE	None					
		107.0 PROCESS LINE - LIQUID VCM FROM STORAGE SPHERE TO NEW MODULE (dwg: VS-093105-PID-D)					
107.1	----------			NODE DELETED	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
108.0 PROCESS LINE - VCM STORAGE SPHERE RECIRCULATION (dwg: VS-093105-PID-D)							
108.1	----------			NODE DELETED	.....		

Item Number	Deviation	Causes	P C	Consequences	FXETIBO	Safeguards	Actions
		201A.0 REACTOR - REACTOR, STEP1: EVACUATION (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: EVACUATE REACTOR IN PREPARATION FOR CHARGE					
201A.1	NO / LOW PRESSURE			None	.....		
201A.2	HIGH PRESSURE			None other (see high pressure in node 216)	.....		
201A.3	NO / SHORT TIME			None	.....		
201A.4	LONG TIME	Mechanical failure: gasket failure	4	Possible leakage	.3.....	SOP, training	
		Reactor not empty	4			DCS time-out will prevent system from continuing the sequence	
		Low steam	3				
		201B.0 REACTOR LINE - REACTOR, STEP 2: CHARGE OF INGREDIENTS (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF INGREDIENTS FOR POLYMERIZATION REACTION					
201B.1	NO / LOW PRESSURE	None					
201B.2	HIGH PRESSURE			None other (see high pressure in node 203)	.....		
201B.3	LOW TEMPERATURE	None					
201B.4	HIGH TEMPERATURE	None					
201B.5	MISSING COMPONENT	None					
201B.6	EXTRA / WRONG COMPONENT	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		201B.0 REACTOR LINE - REACTOR, STEP 2: CHARGE OF INGREDIENTS (continued)					
		DESIGN INTENTION: CHARGE OF INGREDIENTS FOR POLYMERIZATION REACTION					
201B.7	NO / LESS AGITATION	Mechanical failure: agitator	3	Off spec product, business loss	.3.....	Low amp alarm and signal to DCS on agitator motor (92-IT-772)	
		Power failure	2			Interlock requires agitator running before charge	
		Mechanical failure: agitator seals	2				
201B.8	MORE AGITATION	None					
201B.9	NO / SHORT TIME			None other (see low flow in node 204)	.....		
201B.10	LONG TIME			None other (see high flow in node 204)	.....		
		201C.0 REACTOR LINE - REACTOR, STEP 3: INITIATION (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: ADD INITIATOR TO REACTOR TO START REACTION					
201C.1	NO / LOW PRESSURE	None					
201C.2	HIGH PRESSURE			None other (see high pressure in node 211)	.....		
201C.3	LOW TEMPERATURE			None	.....		
201C.4	HIGH TEMPERATURE			None	.....		
201C.5	NO / SHORT TIME			None	.....		
201C.6	LONG TIME			None other (see high pressure in node 211)	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		201D.0 REACTOR LINE - REACTOR, STEP 4: HEATUP (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: HEATUP OF REACTOR TO REACTION TEMPERATURE					
201D.1	NO / LOW PRESSURE			None	.....		
201D.2	HIGH PRESSURE	Failure of automatic system, inert accumulation in reactor condenser, plugged vent line (92-HSV-730)	4	Potential release through relief system	34.....	Pressure indicator and tranmsitter (92-PT-862) Position indicator on automatic valve Two recovery lines Emergency and manual kill systems Backup power for cooling water pumps Multiple cooling water pumps	201D-1
		Loss of cooling water	3				
		Power failure	3				
201D.3	LOW TEMPERATURE			None	.....		
201D.4	HIGH TEMPERATURE			None other (see high pressure)	.....		
201D.5	NO / SHORT TIME			None	.....		
201D.6	LONG TIME			None	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		201E.0 REACTOR - REACTOR, STEP 5: POLYMERIZATION (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: POLYMERIZATION REACTION					
201E.1	NO / LOW PRESSURE	None					
201E.2	HIGH PRESSURE	High temperature due to insufficient cooling water, high level, inerts not vented		None other (see less agitation)	.....		
201E.3	LOW TEMPERATURE	Mechanical failure: control valve fails (92-FV-797/798), too much water sent to reactor	3	Off spec product, business loss	.4.....	Position indication on control valve Dual temperature indicator and transmitter (92-TT-756A, 92-TT-761) SOP, training Preventive maintenance program	
201E.4	HIGH TEMPERATURE	Loss of cooling water	3	None other (leads to high pressure, see less agitation)	.4.....	Same as for high pressure	
		Steam line valve stays open (92-HSV-726)	4			Backup cooling water Emergency and manual kill systems	
		Excessive initiator load	4			Dual meters on charge lines	
		Charge water temperature too high	3			Preventive maintenance program	
		High level in the reactor	3			SOP, training	
		Fouling of reactor condenser	2				
201E.5	NO / LESS AGITATION	Power failure	3	High pressure, high temperature, relief through relief system	34.....	SOP, training Preventive maintenance program	201E-1
		Mechanical failure: agitator system	3				
				Off spec product	.4.....	Same as for high pressure Low amp indicator/transmitter on agitator motor (92-IT-772)	

(continued)

Item Number	Deviation	Causes	FC	Consequences	FXETIBO	Safeguards	Actions
				201E.0 REACTOR - REACTOR, STEP 5: POLYMERIZATION (continued)			
				DESIGN INTENTION: POLYMERIZATION REACTION			
201E.6	MORE AGITATION	None					
201E.7	LOW LEVEL			None other (see low flow in node 210)	.....		
201E.8	HIGH LEVEL	Incomplete draining	3	Overfilling, potential release or off spec product	33.....	Sight glass on the drain line High pressure shut off during the charge SOP, training	
201E.9	NO / LOW REACTION RATE			None other (see long time)	.....		
201E.10	HIGH REACTION RATE			None other (see high pressure, high temperature, less agitation)	.....		
201E.11	INCOMPLETE / SIDE / REVERSE REACTION	None					
201E.12	NO / SHORT TIME	None					
201E.13	LONG TIME	Kill material carryover	3	Off spec product	.4.....	Automatic program SOP, training	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		201F.0 REACTOR - REACTOR, STEP 6: NORMAL KILL (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: NORMAL KILL AT END OF REACTION					
201F.1	NO / LOW PRESSURE			None	.....		
201F.2	HIGH PRESSURE			None other (see high pressure in node 201E)	.....		
201F.3	LOW TEMPERATURE	None					
201F.4	HIGH TEMPERATURE	None					
201F.5	NO / LOW REACTION RATE			None	.....		
201F.6	HIGH REACTION RATE			None other (see no flow in kill lines)	.....		
201F.7	INCOMPLETE/SIDE/REVERSE REACTION	None					
201F.8	NO / SHORT TIME	None					
201F.9	LONG TIME	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		201G.0 REACTOR - REACTOR: STEP 7: RECOVERY AND STRIPPING (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: IN REACTOR STRIPPING AND RECOVERY OF VCM					
201G.1	NO / LOW PRESSURE			None	.....		
201G.2	HIGH PRESSURE			None other (see no flow in node 202)	.....		
201G.3	LOW TEMPERATURE			None other (see no flow in node 215)	.....		
201G.4	HIGH TEMPERATURE			None other (see high flow in node 215)	.....		
201G.5	NO / SHORT TIME			None other (see no flow in node 215)	.....		
201G.6	LONG TIME			None	.....		
		201H.0 REACTOR - REACTOR, STEP 8A: ATMOSPHERIC DUMP (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: ATMOSPHERIC DUMP OF POLYMER					
201H.1	NO / LOW PRESSURE	None					
201H.2	HIGH PRESSURE			None other (see high pressure in node 217)	.....		
201H.3	LOW TEMPERATURE	None					
201H.4	HIGH TEMPERATURE	None					
201H.5	NO / SHORT TIME	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		201H.0 REACTOR - REACTOR, STEP 8A: ATMOSPHERIC DUMP (continued)					
		DESIGN INTENTION: ATMOSPHERIC DUMP OF POLYMER					
201H.6	LONG TIME			None other (see low flow in node 217)	.....		
		201I.0 REACTOR - REACTOR, STEP 8B: CLOSED DUMP (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: CLOSED DUMP OF POLYMER					
201I.1	NO / LOW PRESSURE	None					
201I.2	HIGH PRESSURE	None					
201I.3	LOW TEMPERATURE	none					
201I.4	HIGH TEMPERATURE	None					
201I.5	NO / SHORT TIME	None					
201I.6	LONG TIME			None other (see low flow in line 218)	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		201J.0 REACTOR - REACTOR, STEP 9: RINSE (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: RINSE OF REACTOR AFTER POLYMERIZATION REACTION					
201J.1	NO / LOW PRESSURE			None other (see low flow in node 219)	.....		
201J.2	HIGH PRESSURE	None					
201J.3	LOW TEMPERATURE	None					
201J.4	HIGH TEMPERATURE	None					
201J.5	NO / SHORT TIME	Incomplete draining	3	Material left inside the reactor, possibility of overfilling the next batch and potential release, or off-spec material	33.....	Sight glass on the drain line High pressure shut off during the charge Rinse water timer, flow meter SOP, training	
201J.6	LONG TIME			None other (see low flow in node 218)	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		201K.0 REACTOR - REACTOR, STEP 10: CLEAN WALL ADDITION (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: ADDITION OF CLEAN WALL TO PREVENT BUIDUP					
201K.1	NO / LOW PRESSURE	None					
201K.2	HIGH PRESSURE	None					
201K.3	LOW TEMPERATURE			None other (see missing component in node 220)	.....		
201K.4	HIGH TEMPERATURE	None					
201K.5	NO / SHORT TIME	None					
201K.6	LONG TIME			None other (see low flow in node 220)	.....		
		201L.0 REACTOR - REACTOR, STEP 11: EMERGENCY KILL (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: REACTION KILL IN EMERGENCY SITUATION					
201L.1	NO / LOW PRESSURE	None					
201L.2	HIGH PRESSURE	None					
201L.3	LOW TEMPERATURE	None					
201L.4	HIGH TEMPERATURE	None					
201L.5	NO / LOW REACTION RATE	None					
201L.6	HIGH REACTION RATE			None other (see low flow in node 221)	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		201L.0 REACTOR - REACTOR, STEP 11: EMERGENCY KILL (continued)					
		DESIGN INTENTION: REACTION KILL IN EMERGENCY SITUATION					
201L.7	INCOMPLETE/SIDE/REVERSE REACTION	None					
201L.8	NO / SHORT TIME	None					
201L.9	LONG TIME			None other (see low flow in node 221)	.....		
201L.10	HIGH LEVEL	Excess water during the polymerization results in high pressure, and operator adds AMS	3	High pressure in the reactor, potential release through relief system	34.....	Relief valves Using charge water header divide the batch with empty reactor	
		201M.0 REACTOR - REACTOR, GENERAL SEQUENCE OF STEPS (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: NOT A STEP - GENERAL SEQUENCE DEVIATIONS FOR REACTOR					
201M.1	STEP OMITTED / TOO LATE			Interlock will allow operator to override sequence, but not to affect safety	.....		
201M.2	EXTRA STEP / TOO EARLY			None other (see step too late)	.....		
201M.3	WRONG STEP / OUT OF SEQUENCE			None other (see step too late)	.....		
201M.4	INTERNAL LEAK / RUPTURE	Mechanical failure: corrosion in the condenser Mechanical failure: gasket	3 3	VCM gets from reactor to cooling water line and to cooling tower	33.....	Area VCM monitors Water sampling and analysis Preventive maintenance program	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		202.0 PROCESS LINE - REACTOR TO RECOVERY SYSTEM (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: VCM RECOVERY FROM REACTOR TO RECOVERY SYSTEM					
202.1	NO / LOW FLOW	Mechanical failure: valves (92-HSV-731/729)	4	Loss of time	.4.....	DCS interlock prevents improper sequence	
		Mechanical failure: compressor on recovery line	3			Position indicator/transmitter on automatic valve	
		Loss of cooling water on recovery condenser	3			Pressure indicator/transmitter in the recovery header (82-P-756)	
		Excessive VCM in seal water in recovery line KO tanks	3				
202.2	HIGH FLOW	Mechanical failure: control valve	4	Carryover of PVC into the recovery system, plugging of equipment downstream	.3.....	Position indicator/transmitter on automatic valve	
		High level in the reactor due to lack of antifoam\	3			Pressure indicator/transmitter on the recovery line (82-P-756)	
						KO pot downstream	
						Sight glass on recovery line	
202.3	MISDIRECTED / REVERSE FLOW	None					
202.4	MISSING COMPONENT	None					
202.5	EXTRA / WRONG COMPONENT			None other (see high flow, carryover of PVC)	.....		
202.6	LOW CONCENTRATION	None					
202.7	HIGH CONCENTRATION	None					
202.8	NO / LOW PRESSURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		202.0 PROCESS LINE - REACTOR TO RECOVERY SYSTEM (continued)					
		DESIGN INTENTION: VCM RECOVERY FROM REACTOR TO RECOVERY SYSTEM					
202.9	HIGH PRESSURE	None					
202.10	LOW TEMPERATURE	None					
202.11	HIGH TEMPERATURE	None					
		203.0 PROCESS LINE - VCM CHARGE LINE TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF VCM TO REACTOR					
203.1	NO / LOW FLOW	Mechanical failure: pump, valve (92-HSV-702/703)	3	Incorrect recipe, product loss	.4.....	SOP, training	
		Plugged filter	3			DCS time-out will shut down system if charge takes too long	
		Line pluggage	4			Two totalizers (82-F-748A/B)	
						Relief valves on filters (PSV-FL-718/742)	
203.2	HIGH FLOW	Mechanical failure: meter mulfunction	3	Incorrect recipe, product loss	.4.....	Pressure indicator / transmitter on reactor (92-PT-763), DCS will shut down on high pressure	
				Overfilling of reactor, release through relief system	3.....		
						Dual flow totalizers (82-F-748A/B)	
203.3	MISDIRECTED / REVERSE FLOW	Mechanical failure: VCM pump fails during charge	3	Reverse flow, reactor charge flows through VCM line	.3.....	Check valve	
						DCS time-out will shut down valves in charge is not completed in time	
203.4	MISSING COMPONENT	None					
203.5	EXTRA / WRONG COMPONENT			None	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		203.0 PROCESS LINE - VCM CHARGE LINE TO REACTOR (continued)					
		DESIGN INTENTION: CHARGE OF VCM TO REACTOR					
203.6	LOW CONCENTRATION	None					
203.7	HIGH CONCENTRATION	None					
203.8	NO / LOW PRESSURE			None other (see no flow)	.....		
203.9	HIGH PRESSURE	Valve closes before pump shuts down	3	Water hammer, impact loading, relief valve may open	34....	Rupture disk to safe place DCS sequencing Valve action is dampened	
203.10	LOW TEMPERATURE	None					
203.11	HIGH TEMPERATURE	None					
		204.0 PROCESS LINE - GH-20 CHARGE TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF GH-20 TO REACTOR					
204.1	NO / LOW FLOW	Mechanical failure: pump	3	Incorrect recipe, off spec product	.4....	Level indicator/transmitter in tank (84-L-053)	
		Operator error: manual valve left closed after maintenance	3			Dual flow meter (82-F-982A/B, 82-F-962A/B for ALCOTEX, 82-F-992A/B for F-50, 82-F-953A/B for POLIVIC)	
		Empty tank	4			Status indication lights for pumps	
		Frozen line	3			No flow alarm	
						DCS time-out will shut down if charge takes too long	
						Electric heat tracing	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		204.0 PROCESS LINE - GH-20 CHARGE TO REACTOR (continued)					
		DESIGN INTENTION: CHARGE OF GH-20 TO REACTOR					
204.2	HIGH FLOW	Mechanical failure: meter	3	Incorrect recipe, off spec product	.3.....	Dual meters	
204.3	MISDIRECTED / REVERSE FLOW	Operator error: bleeder open	3	GH-20 spilled to the ground	.4.....	SOP, training, area inspection	
		Mechanical failure: gasket	3	Incorrect recipe, off spec product	.4.....	SOP, training, verify charge in the field	
204.4	MISSING COMPONENT	None					
204.5	EXTRA / WRONG COMPONENT	None					
204.6	LOW CONCENTRATION	Operator error: incorrect make up in the tank, low concentration solution	4	Off spec product	.4.....	SOP, training, to prepare solution and verify concentration	
204.7	HIGH CONCENTRATION			None other (see low concentration)	.....		
204.8	NO / LOW PRESSURE			None other (see low concentration)	.....		
204.9	HIGH PRESSURE			None other (see no flow)	.....		
204.10	LOW TEMPERATURE	None					
204.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		205.0 PROCESS LINE - ALCOTEX CHARGE TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF ALCOTEX TO REACTOR					
205.1	ALL LINE DEVIATIONS			None other (see node 204 for all deviations of this node)	.....		
		206.0 PROCESS LINE - F-50 CHARGE TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF F-50 TO REACTOR					
206.1	ALL LINE DEVIATIONS			None other (see node 204 for all deviations of this node)	.....		
		207.0 PROCESS LINE - POLIVIC CHARGE TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF POLIVIC TO REACTOR					
207.1	ALL LINE DEVIATIONS			None other (see node 204 for all deviations of this node)	.....		
		208.0 PROCESS LINE - BME CHARGE TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF BME TO REACTOR					
208.1	NO / LOW FLOW	Operator error: manual valve left open	3	Off spec product	.4.....	SOP, training	
						Flow meters	
		Low pressure in HPSW line	3			DCS time-out	
		Operator error: empty pot	3			DCS interlock will shut down system on low pressure	
		HPSW recirculation valve left open to prevent freezing	3				
208.2	HIGH FLOW	None					
208.3	MISDIRECTED / REVERSE FLOW	Operator error: manual valve left open	3	Flow to sewer, off spec product	.4.....	SOP, training	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		208.0 PROCESS LINE - BME CHARGE TO REACTOR (continued)					
		DESIGN INTENTION: CHARGE OF BME TO REACTOR					
208.4	MISSING COMPONENT	None					
208.5	EXTRA / WRONG COMPONENT	None					
208.6	LOW CONCENTRATION	None					
208.7	HIGH CONCENTRATION	None					
208.8	NO / LOW PRESSURE			None other (see low flow)	.....		
208.9	HIGH PRESSURE	None					
208.10	LOW TEMPERATURE			None other (see low flow)	.....		
208.11	HIGH TEMPERATURE	None					
		209.0 TANK / VESSEL - BME CHARGE POT (dwg: NM-093108-PID-D)					
209.1	----------			NODE DELETED	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		210.0 PROCESS LINE - HOT WATER CHARGE (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF HOT WATER TO REACTOR					
210.1	NO / LOW FLOW	Operator error: manual valva left closed	3	Off spec product	.4.....	SOP, training	
		Mechanical failure: pump	3			Run indication/transmitter on pump	
						Indication on valve	
						Dual meters	
						DCS time-out	
210.2	HIGH FLOW			None other (see high flow in node 203)	.....		
210.3	MISDIRECTED / REVERSE FLOW	Mechanical failure: pump failure during charge (both pumps fail due to a common cause, eg. power loss)	3	VCM can back through water line to water tank, sudden expansion with VCM release and equipment damage	33.....	Check valves	
						DCS time-out	
						Preventive maintenance program	
						Two charge pumps operating simultaneously (requires common cause)	
210.4	MISSING COMPONENT	None					
210.5	EXTRA / WRONG COMPONENT	None					
210.6	LOW CONCENTRATION	None					
210.7	HIGH CONCENTRATION	None					
210.8	NO / LOW PRESSURE			None other (see low flow)	.....		
210.9	HIGH PRESSURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		210.0 PROCESS LINE - HOT WATER CHARGE (continued)					
		DESIGN INTENTION: CHARGE OF HOT WATER TO REACTOR					
210.10	LOW TEMPERATURE	Control failure when mixing cold and hot water	4	Longer heat up time	.4.....	Temperature indicators and transmitters	
		Hot water tank temperature too low due to control failure	4			SOP, training	
210.11	HIGH TEMPERATURE	Control failure when mixing hot and cold water	4	Hot water will damage the suspending agent, off spec product	.4.....	Temperature indicators and transmitters	
						SOP, training	
		211.0 PROCESS LINE - INITIATOR CHARGE TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF INITIATOR TO REACTOR					
211.1	NO / LOW FLOW	Operator error: manual valve on HPSW left closed	4	Off spec product, time loss	.4.....	SOP, training	
		Operator error: funnel charge valve left open	3			Flow totalizer in water line (92-F01-51101)	
		Mechanical failure: automatic valve (92-HSV-719A/B)	3			Position indication on automatic valve	
		LOW PRESS ON HPSW	2			DCS time-out, message to panel operator	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		211.0 PROCESS LINE - INITIATOR CHARGE TO REACTOR (continued)					
		DESIGN INTENTION: CHARGE OF INITIATOR TO REACTOR					
211.2	HIGH FLOW	Mechanical failure: automatic valves (92-HSV-719A/B) fail open when HPSW valve is open	4	High level in the reactor, high pressure	.4.....	Seven relief valves with rupture disks Position indication on automatic valve, message to panel operator Pressure transmitter on reactor (92-PT-763), automatic kill Pressure relief through recovery system SOP, training	
211.3	MISDIRECTED / REVERSE FLOW	None					
211.4	MISSING COMPONENT	None					
211.5	EXTRA / WRONG COMPONENT	None					
211.6	LOW CONCENTRATION	None					
211.7	HIGH CONCENTRATION	None					
211.8	NO / LOW PRESSURE			None other (see no flow)	.....		
211.9	HIGH PRESSURE	Initiator left too long in charge pot	3	Exothermic decomposition, high pressure, relief through rupture disks	34.....	SOP, training Pressure indication and transmitter (92-PT-763) Relief valves with rupture disks	
		Mechanical failure: automatic valves fail to open	3				
211.10	LOW TEMPERATURE			None	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		211.0 PROCESS LINE - INITIATOR CHARGE TO REACTOR (continued)					
		DESIGN INTENTION: CHARGE OF INITIATOR TO REACTOR					
211.11	HIGH TEMPERATURE			None other (leads to exothermic decomposition, see high pressure)	.....		
		212.0 TANK / VESSEL - CATALYST CHARGE VESSEL (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CHARGE OF INITIATOR TO REACTOR					
212.1	----------			NODE INCLUDED WITH NODE 211	.....		
		212A.0 TANK / VESSEL - MANUAL CATALYST ADDITION POT (dwg: NM-093147-PID-D)					
		DESIGN INTENTION: CHARGE OF INITIATOR TO REACTOR					
212A.1	----------			NODE INCLUDED WITH NODE 211	.....		
		212B.0 PROCESS LINE - MANUAL KILL LINE (dwg: NM-093147-PID-D)					
		DESIGN INTENTION: MANUAL SUPPLY TO KILL RECTION					
212B.1	NO / LOW FLOW	Mechanical failure: pump Operator error: valve on recirculation line left too open Freezing	3	None other (see no flow in node 214)	.....	See safeguards listed under no flow in node 214	212B-1
212B.2	HIGH FLOW			None	.....		
212B.3	MISDIRECTED / REVERSE FLOW	None					
212B.4	MISSING COMPONENT	Operator error: no AMS leading to higher freezing point	4	Freezing, no flow	.4.....	SOP, training	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		212B.0 PROCESS LINE - MANUAL KILL LINE (continued)					
		DESIGN INTENTION: MANUAL SUPPLY TO KILL RECTION					
212B.5	EXTRA / WRONG COMPONENT	None					
212B.6	LOW CONCENTRATION	None					
212B.7	HIGH CONCENTRATION	None					
212B.8	NO / LOW PRESSURE			None other (see no flow)	.....		
212B.9	HIGH PRESSURE	None					
212B.10	LOW TEMPERATURE			None other (see missing component)	.....		
212B.11	HIGH TEMPERATURE			None other (see crystallization)	.....		
		213.0 PROCESS LINE - INERT VENT LINE (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: VENTING OF INERTS DURING REACTION					
213.1	NO / LOW FLOW	Line plugged	2	Unable to vent, must use large recovery line	3.....	Regular maintenance	213 -1
		Operator error: manual valve left closed	3	Reactor downtime for cleaning	.3.....	Pressure indication and transmitter (92-PT-763)	
213.2	*HIGH FLOW*	*None*					
213.3	MISDIRECTED / REVERSE FLOW	None					
213.4	MISSING COMPONENT	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		213.0 PROCESS LINE - INERT VENT LINE (continued)					
		DESIGN INTENTION: VENTING OF INERTS DURING REACTION					
213.5	EXTRA / WRONG COMPONENT	None					
213.6	LOW CONCENTRATION	None					
213.7	HIGH CONCENTRATION	None					
213.8	NO / LOW PRESSURE			None other (see no flow)	.....		
213.9	HIGH PRESSURE	None					
213.10	LOW TEMPERATURE	None					
213.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		214.0 PROCESS LINE - ISONOX AUTO-KILL LINE TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: AUTOMATIC SUPPLY TO KILL REACTION					
214.1	NO / LOW FLOW	Freezing	2	Continued reaction, usually loss of time and off spec product	.4.....	Tracing on ISONOX line	214 -1
		Mechanical failure: valves (92-HSV-727A/B)	3			Position indication on valve	
		Insufficient nitrogen pressure	3	During power failure, high pressure, high temperature, release	34.....	Relief system	
						Pressure indication on nitrogen, low pressure alarm (84-P-004)	
				Incompletely killed charge is dumped, reaction continues in dump tank, high pressure, release	34.....	Nitrogen bottle backup	
						Low level switches in emergency kill pot (92-L-757)	
						Low level switch on main ISONOX supply tank (84-L-005)	
						Dual meters on autokill *(82-F-976A/B)*	
						Manual backup: hand loading ISONOX to 212A (with buckets)	
						Relief system in dump tank	
						Emergency kill in dump tank	
214.2	HIGH FLOW			None other (off spec product)	.....		
214.3	MISDIRECTED / REVERSE FLOW	None					
214.4	MISSING COMPONENT	None					
214.5	EXTRA / WRONG COMPONENT	None					
214.6	LOW CONCENTRATION	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		214.0 PROCESS LINE - ISONOX AUTO-KILL LINE TO REACTOR (continued)					
		DESIGN INTENTION: AUTOMATIC SUPPLY TO KILL REACTION					
214.7	HIGH CONCENTRATION	None					
214.8	NO / LOW PRESSURE			None other (see low flow)	.....		
214.9	HIGH PRESSURE			None	.....		
214.10	LOW TEMPERATURE	Freezing		None other (see low flow)	.....		
214.11	*HIGH TEMPERATURE*	*High temperature due to* tracing (particularly during summer)		Crystallization, reaction continues, high pressure/temperature, release through relief system	34.....	See safeguards under no flow	214 -2
		215.0 PROCESS LINE - STRIPPING STEAM SUPPLY TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: SUPPLY OF STEAM FOR POLYMER STRIPPING IN REACTOR					
215.1	NO / LOW FLOW	Low steam header pressure	2	Insufficient stripping or long stripping time, high residual VCM	.4.....	Pressure indication and transmitter on steam header (82-P-084, *82-PS-084*)	
		On-off valve failure (92-H-723)	4			DCS time-out will give message to panel operator	
		Plugged steam nozzle	3			Position indication on valve	
		Boiler down, loss of steam	2			DCS interlock shuts valve 723 on low steam header pressure	
215.2	HIGH FLOW	On-off valve open	4	Off spec product	.3.....	Position indication on valve	
		Broken nozzle	3			Flow indication and transmitter on steam line (82-FT-083)	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		215.0 PROCESS LINE - STRIPPING STEAM SUPPLY TO REACTOR (continued)					
		DESIGN INTENTION: SUPPLY OF STEAM FOR POLYMER STRIPPING IN REACTOR					
215.3	MISDIRECTED / REVERSE FLOW	Loss of steam during stripping	3	Slurry gets into steam line, possible release of VCM	34.....	Pressure indication and transmitter on steam line (82-P-084) Spring loaded closing device on steam line under nozzle will operate on low pressure (flow check device) DCS interlock closes valve on low pressure	
215.4	MISSING COMPONENT	None					
215.5	EXTRA / WRONG COMPONENT	None					
215.6	LOW CONCENTRATION	None					
215.7	HIGH CONCENTRATION	None					
215.8	NO / LOW PRESSURE			None other (see no flow)	.....		
215.9	HIGH PRESSURE			None	.....		
215.10	LOW TEMPERATURE			None other (see low flow)	.....		
215.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		216.0 PROCESS LINE - EVACUATION LINE FROM REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: REMOVAL OF AIR FROM THE REACTOR					
216.1	NO / LOW FLOW	Mechanical failure: valve (92-HSV-729/733)	4	No evacuation of air from the reactor, production loss	.3.....	DCS interlock will shut down system on high pressure	
		Loss of plant steam	3	Potential release and fire if the reactor is charge without evacuation	3.....	DCS program will not advance from evacuation step until pressure reaches specified value	
						SOP, training	
						Low pressure alarm on steam (82-PS-084)	
						Position indication on valves	
216.2	HIGH FLOW	Mechanical failure: valve	3	Release of VCM to atmosphere through evacuation system	3.....	Area gas monitors to detect release of VCM	
						Deluge systems (sprinklers)	
						Preventive maintenance program	
						DCS interlock will shut down system on high pressure	
216.3	MISDIRECTED / REVERSE FLOW	Mechanical failure: valve 92H731	3	VCM from header to evacuation system, release	3.....	Pressure indication and transmitter on evacuation line (82-PT-080)	
						Area gas monitors	
						Preventive maintenance program	
						DCS interlock will shut down system on high pressure in evacuation line	
216.4	MISSING COMPONENT	None					
216.5	EXTRA / WRONG COMPONENT	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		216.0 PROCESS LINE - EVACUATION LINE FROM REACTOR (continued)					
		DESIGN INTENTION: REMOVAL OF AIR FROM THE REACTOR					
216.6	LOW CONCENTRATION	None					
216.7	HIGH CONCENTRATION	None					
216.8	NO / LOW PRESSURE			None	.....		
216.9	HIGH PRESSURE	Evacuation step taken after closed dump	4	VCM release	3.....	Pressure transmitter downstream, DCS interlock will shut down system on high pressure Pressure transmitter on reactor (92-PT-763) DCS program will prevent evacuation until reactor has been recovered	
216.10	LOW TEMPERATURE	None					
216.11	HIGH TEMPERATURE	None					
		217.0 PROCESS LINE - LOW MOL ATMOSPHERIC DUMP LINE (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: ATMOSPHERIC DUMP OF POLYMER FROM THE REACTOR					
217.1	NO / LOW FLOW	Plugged line	3	Long dump, loss of time	.4.....	Pump running indication	217 -1
		Mechanical failure: pump	3			DCS time out indication	
		Mechanical failure: pump head tank control valve	2				
		Empty reactor	2				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		217.0 PROCESS LINE - LOW MOL ATMOSPHERIC DUMP LINE (continued)					
		DESIGN INTENTION: ATMOSPHERIC DUMP OF POLYMER FROM THE REACTOR					
217.2	HIGH FLOW	Mechanical failure: dump head tank control valve	2	Slurry spill on the ground	44.....	Level gauge on the dump head tank	217 -2
217.3	MISDIRECTED / REVERSE FLOW	None	.				
217.4	MISSING COMPONENT	None	.				
217.5	EXTRA / WRONG COMPONENT	Oversize particles	3	Particles unable to pass through screen, spill on the ground	34.....	Agitator motor amp indication (92-IT-772)	
217.6	LOW CONCENTRATION	None	.				
217.7	HIGH CONCENTRATION	None	.				
217.8	NO / LOW PRESSURE			None other (see low flow)	.....		
217.9	HIGH PRESSURE	Incomplete stripping	4	Possible spill	33.....	Pressure indication and transmitter on reactor (92-PT-763) DCS interlock will shut down system on high pressure SOP, training	
217.10	LOW TEMPERATURE	None	.				
217.11	HIGH TEMPERATURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		217A.0 PROCESS LINE - VENT LINE TO REACTOR CONDENSER (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: VENTING OF INERTS FROM REACTOR CONDENSER					
217A.1	NO / LOW FLOW	Mechanical failure: valve	3	Long dump, loss of time	.4.....	Valve position indication	
		Plugged line	2				
217A.2	HIGH FLOW	None	.				
217A.3	MISDIRECTED / REVERSE FLOW	Incomplete stripping	3	None	.....	Interlock valve Pressure indication and transmitter (92-PT-763) DCS interlock	
217A.4	MISSING COMPONENT	None	.				
217A.5	EXTRA / WRONG COMPONENT	None	.				
217A.6	LOW CONCENTRATION	None	.				
217A.7	HIGH CONCENTRATION	None	.				
217A.8	NO / LOW PRESSURE	None	.				
217A.9	HIGH PRESSURE			None other (see reverse flow)	.....		
217A.10	LOW TEMPERATURE	None	.				
217A.11	HIGH TEMPERATURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		218.0 PROCESS LINE - LOW MOL CLOSED DUMP (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: CLOSED DUMP OF POLYMER FROM THE REACTOR					
218.1	NO / LOW FLOW	Pressure too low	3	Long dump, loss of time	.4.....	Dump timer	
		Mechanical failure: pump	3			Run indication on pump	
		Plugged line and/or strainers	3			Sight glass in line w/FS with camera (92-FS-943)	
		Mechanical failure: valves # 701, 706	3			Pressure indication and transmitter (92-PI-51015)	
						Differential pressure indication across the strainers (92-PDI-674)	
218.2	HIGH FLOW	None	.				
218.3	MISDIRECTED / REVERSE FLOW			None	.....		
218.4	MISSING COMPONENT	None	.				
218.5	EXTRA / WRONG COMPONENT	None	.				
218.6	LOW CONCENTRATION	None	.				
218.7	HIGH CONCENTRATION	No rinse before dump cycle	3	High solids and foam (same as low flow)	.3.....	Sight glass w/FS (92-FS-943)	
						Pressure indication on the pump discharge line (92-PI-51015)	
						DCS time-out will send message to panel operator	
218.8	NO / LOW PRESSURE			None other (see no flow)	.....		
218.9	HIGH PRESSURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		218.0 PROCESS LINE - LOW MOL CLOSED DUMP (continued)					
		DESIGN INTENTION: CLOSED DUMP OF POLYMER FROM THE REACTOR					
218.10	LOW TEMPERATURE	None					
218.11	HIGH TEMPERATURE	None					
		219.0 PROCESS LINE.- RINSE WATER SUPPLY TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: SUPPLY OF RINSE WATER TO REACTOR					
219.1	NO / LOW FLOW	Plugged line and/or spray nozzle	3	Incomplete rinsing	.3.....	Rinse water flow meter (82-F-021)	
		Mechanical failure: valve (92-HSV-736/738)	3	Off spec material	.3.....	Low flow alarm	
		Plugged filter in rinse water line	3			Valve position indication	
		Mechanical failure: rinse water pump	3			SOP, training	
219.2	HIGH FLOW	None					
219.3	MISDIRECTED / REVERSE FLOW	None					
219.4	MISSING COMPONENT	None					
219.5	EXTRA / WRONG COMPONENT	None					
219.6	LOW CONCENTRATION	None					
219.7	HIGH CONCENTRATION	None					
219.8	NO / LOW PRESSURE			None other (see low flow)	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		219.0 PROCESS LINE - RINSE WATER SUPPLY TO REACTOR (continued)					
		DESIGN INTENTION: SUPPLY OF RINSE WATER TO REACTOR					
219.9	HIGH PRESSURE	None					
219.10	LOW TEMPERATURE	None					
219.11	HIGH TEMPERATURE	None					
		220.0 PROCESS LINE - CLEAN WALL ADDITIVE TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: SUPPLY OF CLEAN WALL TO REACTOR					
220.1	NO / LOW FLOW	Mechanical failure: pump	3	Condenser plugged	.3.....	Meter on clean wall flow (84-F-178)	220 -1
		Plugged line, in-line filter, and/or spray nozzle	2	Polymer build-up on reactor wall	.3.....	Pump running indication	
						Valve position indication	
		Mechanical failure: valve (92-HSV-792/736)	3	Off-spec material	.3.....		
		Low level in clean wall supply tank	4				
220.2	HIGH FLOW	None					
220.3	MISDIRECTED / REVERSE FLOW	None					
220.4	MISSING COMPONENT	Loss of steam	3	None other (see low flow)	.....	Steam header pressure transmitter (82-P-084)	
						Steam flow meter (82-F-083)	
						Temperature indication of the reactor (92-TT-761)	
220.5	EXTRA / WRONG COMPONENT	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		220.0 PROCESS LINE - CLEAN WALL ADDITIVE TO REACTOR (continued)					
		DESIGN INTENTION: SUPPLY OF CLEAN WALL TO REACTOR					
220.6	LOW CONCENTRATION	Overheat causes BUS-80 to separate	3	None other (see low flow)	.....	SOP, training Equipment labelling	
220.7	HIGH CONCENTRATION	None					
220.8	NO / LOW PRESSURE			None other (see low flow)	.....		
220.9	HIGH PRESSURE	None					
220.10	LOW TEMPERATURE	None					
220.11	HIGH TEMPERATURE			None other (see low concentration)	.....		
		221.0 PROCESS LINE - AUTO EMERGENCY KILL TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: AUTOMATIC SUPPLY TO KILL REACTION IN EMERGENCY					
221.1	*NO / LOW FLOW*	*Low nitrogen pressure*	3	*Inability to kill the reaction, reactor release*	34.....	*Relief valves on reactors*	
		Low level in emergency kill tank	3			Low pressure alarm on tank (92-PSL-758)	
		Mechanical failure: valve	3			Sight glass (92-LG-51107)	
		Op. erroe: manual valve closed	3			Low level alarm in tank (92-LSL-757)	
		Valve closed on nitrogen line	3			Back-up nitrogen	
						SOP, training	
						Secondary back-up system	
						By-pass line to reactor	
						Common juction connects to all kill pots and reactors	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		221.0 PROCESS LINE - AUTO EMERGENCY KILL TO REACTOR (continued)					
		DESIGN INTENTION: AUTOMATIC SUPPLY TO KILL REACTION IN EMERGENCY					
221.2	HIGH FLOW	Mechanical failure: valve malfunction (92-HSV-740B)	3	Coarse batch	.3.....	Level indication and transmitter	
						Valve position indicator	
		Too much addition	3			Automatic time addition	
221.3	MISDIRECTED / REVERSE FLOW	None	.	None other	.....		
221.4	MISSING COMPONENT	None	.				
221.5	EXTRA / WRONG COMPONENT	Water in the system	3	Freezing, line plugging	3.....	SOP, training	
						Common jumper connection	
						Back-up auto/manual kill system	
221.6	LOW CONCENTRATION	None	.				
221.7	HIGH CONCENTRATION	None	.				
221.8	NO / LOW PRESSURE			None other (see low flow)	.....		
221.9	HIGH PRESSURE	Nitrogen pressure regulator wide open (PCV-51006)	3	High pressure in the tank, potential release/spill	3.....	Rupture disk and relief valve on the tank (PSV-DM-208, PSE-DM-208)	
						Pressure indicator (92-PI-51105)	
221.10	LOW TEMPERATURE	None	.				
221.11	HIGH TEMPERATURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		222.0 TANK / VESSEL - EMERGENCY KILL (AMS) POT (dwg: NM-093120-PID-D)					
222.1	LOW CONCENTRATION			NODE DELETED	.....		
		222A.0 PROCESS LINE - AMS SUPPLY TO EMERGENCY KILL POT (dwg: NM-093120-PID-D)					
222A.1	----------			NODE DELETED	.....		
		223.0 PROCESS LINE - MANUAL EMERGENCY KILL TO REACTOR (dwg: NM-093143-PID-D)					
		DESIGN INTENTION: MANUAL SUPPLY TO KILL REACTION IN EMERGENCY					
223.1	ALL LINE DEVIATIONS			SEE NODE 221 FOR ALL DEVIATIONS	.....		

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		301.0 PROCESS LINE - SLURRY DUMP TO BLEND TANK (dwg: DY-093100-PID-D)					
		DESIGN INTENTION: TRANSFER OF SLURRY TO BLEND TANK					
301.1	NO / LOW FLOW			None	.....		
301.2	HIGH FLOW	None					
301.3	MISDIRECTED / REVERSE FLOW	Operator error: opening wrong valve	4	Misdirected flow to TK-747, off spec product	.4.....	SOP, training DCS interlock (82-H-659)	
301.4	MISSING COMPONENT	None					
301.5	EXTRA / WRONG COMPONENT	Build up in stripper Contamination in reactor	3 3	Contamination, off spec product	.4.....	SOP: regular quality samples Strainers in dump system	
301.6	LOW CONCENTRATION			None	.....		
301.7	HIGH CONCENTRATION			None	.....		
301.8	NO / LOW PRESSURE			None	.....		
301.9	HIGH PRESSURE			None	.....		
301.10	LOW TEMPERATURE			None	.....		
301.11	HIGH TEMPERATURE			None	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		302.0 TANK / VESSEL - SLURRY BLEND TANK (dwg: DY-093100-PID-D)					
		DESIGN INTENTION: STORAGE OF SLURRY					
302.1	LOW CONCENTRATION			None	.....		
302.2	HIGH CONCENTRATION			None	.....		
302.3	NO / LOW PRESSURE	None					
302.4	HIGH PRESSURE	None					
302.5	LOW TEMPERATURE	None					
302.6	HIGH TEMPERATURE			None	.....		
302.7	NO / LOW LEVEL	Operator error: drain valve open	4	Plugged line, operating loss	.4.....	Flush line to suction of pump Level transmitter (83-L-601)	
302.8	HIGH LEVEL	Operator error: overfilling	4	Tank overflow, loss of product	.4.....	High level alarm, level transmitter (83-L-601) DCS interlock	
302.9	LOW INTERFACE	None					
302.10	HIGH INTERFACE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		303.0 PROCESS LINE - SLURRY FROM BLEND TANK TO CENTRIFUGE (dwg: DY-093100-PID-D)					
		DESIGN INTENTION: TRANSFER OF SLURRY FROM BLEND TANK TO CENTRIFUGE					
303.1	NO / LOW FLOW	Mechanical failure: pump failure (PP-147) Operator error: valve not open	2	Line plugged, downtime, business loss	.4.....	Flush water In line spare pump	
303.2	HIGH FLOW	None					
303.3	MISDIRECTED / REVERSE FLOW	None					
303.4	MISSING COMPONENT	None					
303.5	EXTRA / WRONG COMPONENT	None					
303.6	LOW CONCENTRATION	None					
303.7	HIGH CONCENTRATION	None					
303.8	NO / LOW PRESSURE			None other (see low flow)	.....		
303.9	HIGH PRESSURE			None	.....		
303.10	LOW TEMPERATURE	None					
303.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		304.0 PROCESS LINE - RECYCLE SLURRY TO BLEND TANK (dwg: DY-093100-PID-D)					
		DESIGN INTENTION: MAINTAIN CONTINUOUS FLOW TO PREVENT SETTLING					
304.1	NO / LOW FLOW			None other (see low flow in node 303)	.....		
304.2	HIGH FLOW	None					
304.3	MISDIRECTED / REVERSE FLOW	None					
304.4	MISSING COMPONENT	None					
304.5	EXTRA / WRONG COMPONENT	None					
304.6	LOW CONCENTRATION	Noen					
304.7	HIGH CONCENTRATION	None					
304.8	NO / LOW PRESSURE	None					
304.9	HIGH PRESSURE	None					
304.10	LOW TEMPERATURE	None					
304.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		305.0 CENTRIFUGE - SLURRY CENTRIFUGE (dwg: DY-093141-PID-D)					
		DESIGN INTENTION: DEWATERING PRODUCT					
305.1	NO / LOW FLOW			None	.....		
305.2	HIGH FLOW	Operator error: control valve on manual left closed	3	Increased feed to dryer, increased inlet temperature, dryer can shut down, business loss	.4....	SOP, training Temperature interlock in dryer (93-TI-51031)	
		Mechanical failure: control valve fails closed (93-YV-228)	3				
305.3	MISDIRECTED / REVERSE FLOW	None	.				
305.4	LOW CONCENTRATION	None	.				
305.5	HIGH CONCENTRATION	Operator error: flush line valve left closed	4	High solids concentration at start up, requires flushing	.4....	Automatic 2 min flush after stopping feed SOP, training	
305.6	NO / LOW LEVEL	None	.				
305.7	HIGH LEVEL	None	.				
305.8	NO / LOW SPEED	Mechanical failure: centrifuge malfunction	.	None other (see high concentration)	.....		
305.9	HIGH SPEED	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		306.0 PROCESS LINE - PRODUCT FROM CENTRIFUGE TO FLASH DRYER (dwg: DY-093141-PID-D)					
		DESIGN INTENTION: TRANSFER PRODUCT FROM CENTRIFUGE TO DRYER					
306.1	NO / LOW FLOW	Build up reduces flow	3	Intermittent feed to dryer, temperature swings	.4.....	Temperature interlock / transmitter (93-T-992)	
				Back up into the centrifuge, plugging	.4.....	Torque interlock (93-H-984)	
						Shear pin	
306.2	HIGH FLOW			None	.....		
306.3	MISDIRECTED / REVERSE FLOW	None	.				
306.4	MISSING COMPONENT	None	.				
306.5	EXTRA / WRONG COMPONENT	None	.				
306.6	LOW CONCENTRATION	None	.				
306.7	HIGH CONCENTRATION	None	.				
306.8	NO / LOW PRESSURE	None	.				
306.9	HIGH PRESSURE	None	.				
306.10	LOW TEMPERATURE	None	.				
306.11	HIGH TEMPERATURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		306a.0 CONVEYOR / FEEDER / SCREENER - PRODUCT VIBRATING AND PADDLE FEEDERS (dwg: DY-093146-PID-D)					
		DESIGN INTENTION: TRANSFER AND FEED OF PRODUCT TO DRYER					
306a.1	NO / LOW FLOW	Mechanical failure in vibrating conveyor	3	Product backup to centrifuge, operating problem, business loss	.4.....	Interlock will stop slurry feed if either the vibrating conveyor or the paddle feeder stop	
		Mechanical failure in paddle feeder	3				
306a.2	HIGH FLOW	None					
306a.3	MISDIRECTED / REVERSE FLOW	None					
306a.4	MISSING COMPONENT	None					
306a.5	EXTRA / WRONG COMPONENT	None					
306a.6	NO / LOW LEVEL	None					
306a.7	HIGH LEVEL	None					
306a.8	NO / LOW SPEED			None other (see low flow)	.....		
306a.9	HIGH SPEED	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		307.0 PROCESS LINE - WATER FROM CENTRIFUGE TO CENTRATE TANK (dwg: DY-093141-PID-D)					
		DESIGN INTENTION: TRANSFER WATER FROM CENTRIFUGE TO CENTRATE TREATMENT					
307.1	NO / LOW FLOW			None other (see low flow in node 306)	.....		
307.2	HIGH FLOW			None	.....		
307.3	MISDIRECTED / REVERSE FLOW	None					
307.4	MISSING COMPONENT	None					
307.5	EXTRA / WRONG COMPONENT	None					
307.6	LOW CONCENTRATION	None					
307.7	HIGH CONCENTRATION	None					
307.8	NO / LOW PRESSURE	None					
307.9	HIGH PRESSURE	None					
307.10	LOW TEMPERATURE	None					
307.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		308.0 PROCESS LINE - HPSW TO CENTRIFUGE (dwg: DY-093141-PID-D)					
		DESIGN INTENTION: SUPPLY OF HPSW TO CENTRIFUGE					
308.1	NO / LOW FLOW	Operator error: manual valve left closed	3	Pluggage of centrifuge	.4.....	Pressure transmitter will detect pump failure and give message to panel operator	
		Mechanical failure: pump failure	3			SOP, training	
		Low ambient temp, freezing	3			DCS operator monitoring	
						Electric tracing of line	
308.2	HIGH FLOW			None	.....		
308.3	MISDIRECTED / REVERSE FLOW	Mechanical failure: valve failure	4	Blend tank is filled with water, reduced production rate	.4.....	SOP, training	
						Preventive maintenance program	
		DCS looses programming information during rebooting	4				
308.4	MISSING COMPONENT	None	.				
308.5	EXTRA / WRONG COMPONENT	None	.				
308.6	LOW CONCENTRATION	None	.				
308.7	HIGH CONCENTRATION	None	.				
308.8	NO / LOW PRESSURE			None other (see low flow)	.....		
308.9	HIGH PRESSURE	None	.				
308.10	LOW TEMPERATURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		308.0 PROCESS LINE - HPSW TO CENTRIFUGE (continued)					
		DESIGN INTENTION: SUPPLY OF HPSW TO CENTRIFUGE					
308.11	HIGH TEMPERATURE	None					
		309.0 PROCESS LINE - WATER TO CYCLONE DRYER (dwg: DY-093141-PID-D)					
		DESIGN INTENTION: SUPPLY OF WATER TO DRYER FOR TEMPERATURE CONTROL					
309.1	----------			NODE DELETED	.....		
		310.0 PROCESS LINE - DRYING AIR SUPPLY TO CYCLONE DRYER (dwg: DY-093146-PID-D)					
		DESIGN INTENTION: SUPPLY OF HOT FILTERED AIR TO DRYER					
310.1	NO / LOW FLOW	Operator error: fan vanes closed	3	Reduced rates through dryer, production loss	.4.....	SOP, training on vane operation	
		Mechanical failure: fan failure	3			High pressure drop accross filter alarm (DAH 93-P-976/93-P-977)	
		Filter plugged	3			High differential pressure accross fan alarm (DIAHL 93-P-980)	
						Preventive maintenance program	
310.2	HIGH FLOW			None	.....		
310.3	MISDIRECTED / REVERSE FLOW	None					
310.4	MISSING COMPONENT	None					
310.5	EXTRA / WRONG COMPONENT	None					
310.6	LOW CONCENTRATION	None					
310.7	HIGH CONCENTRATION	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		310.0 PROCESS LINE - DRYING AIR SUPPLY TO CYCLONE DRYER (continued)					
		DESIGN INTENTION: SUPPLY OF HOT FILTERED AIR TO DRYER					
310.8	NO / LOW PRESSURE			None other (see low flow)	.....		
310.9	HIGH PRESSURE	None	.				
310.10	LOW TEMPERATURE	Operator error: Incorrect set point	.2	High moisture in product, production loss	.3.....	SOP, training: operator to notice and reduce feed	
		Mechanical failure: burner malfunction	3				
		Loss of gas	3				
310.11	HIGH TEMPERATURE	Operator error: attempt to run dryer above design rate	3	Off spec product, business loss	.4.....	Interlock will shut down burner on high temperature	
		311.0 DRYER - FLASH DRYER (dwg: DY-093146-PID-D)					
		DESIGN INTENTION: DRY THE PRODUCT					
311.1	NO / LOW FLOW			None other (see low flow in node 306a)	.....		
311.2	HIGH FLOW	None	.				
311.3	MISDIRECTED / REVERSER FLOW	None	.				
311.4	CONTAMINATION	None	.				
311.5	NO / LOW PRESSURE			None	.....		
311.6	HIGH PRESSURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
				311.0 DRYER - FLASH DRYER (continued)			
				DESIGN INTENTION: DRY THE PRODUCT			
311.7	LOW TEMPERATURE			None other (see low temperature in node 310)	.....		
311.8	HIGH TEMPERATURE			None other (see high temperature in node 310)	.....		
311.9	LOW HUMIDITY			None	.....		
311.10	HIGH HUMIDITY			None other (see low temperature in node 310)	.....		
311.13	HIGH PRODUCT FLOW	Operator error: feed rate too high	3	High inlet temp, shutdown of dryer, business loss	.3....	SOP,training	
				Off spec product, business loss	.3....		
				312.0 PROCESS LINE - CYCLONE DRYER WATER RECIRCULATION (dwg: DY-093142-PID-D)			
				DESIGN INTENTION: KEEP CONTINUOUS WATER FLOW IN THE CYCLONE DRYER			
312.1	NO / LOW FLOW	Mechanical failure: pump failure	3	Condensation on dryer wall, off spec products, wall corrosion	.3....	Temperature indication (93-TI-993)	
		Line blockage	4			Pump pressure indication (93-PI-51003)	
		Operator error: manual valve closed	3				
312.2	HIGH FLOW			None	.....		
312.3	MISDIRECTED / REVERSE FLOW	None					
312.4	MISSING COMPONENT	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		312.0 PROCESS LINE - CYCLONE DRYER WATER RECIRCULATION (continued)					
		DESIGN INTENTION: KEEP CONTINUOUS WATER FLOW IN THE CYCLONE DRYER					
312.5	EXTRA / WRONG COMPONENT	None					
312.6	LOW CONCENTRATION	None					
312.7	HIGH CONCENTRATION	None					
312.8	NO / LOW PRESSURE			None other (see low flow)	.....		
312.9	HIGH PRESSURE	None					
312.10	LOW TEMPERATURE			None other (see low flow)	.....		
312.11	HIGH TEMPERATURE			None	.....		
		313.0 TANK / VESSEL - CYCLONE SEPARATOR AND PRODUCT RECEIVERS (dwg: DY-093142-PID-D)					
		DESIGN INTENTION: SEPARATE PRODUCT FROM AIR STREAM AND STORAGE					
313.1	LOW CONCENTRATION	None					
313.2	HIGH CONCENTRATION	None					
313.3	NO / LOW PRESSURE			None	.....		
313.4	HIGH PRESSURE			None	.....		
313.5	LOW TEMPERATURE			None other (see low temperature in node 311)	.....		
313.6	HIGH TEMPERATURE			None	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		313.0 TANK / VESSEL - CYCLONE SEPARATOR AND PRODUCT RECEIVERS (continued)					
		DESIGN INTENTION: SEPARATE PRODUCT FROM AIR STREAM AND STORAGE					
313.7	NO / LOW LEVEL			None	.....		
313.8	HIGH LEVEL	Mechanical failure: product rotary valve (RT-015)	2	Product receiver or cyclone separator are overfilled, business loss	.3.....	High level alarms (93-LSH-052, 93-LSH-997)	
		Rotary valve remained closed too long.	3	Carry over to the scrubber, business loss	.3.....	High level shut down	
313.9	LOW INTERFACE	None					
313.10	HIGH INTERFACE	None					
		314.0 PROCESS LINE - OFF AIR FROM PRODUCT SEPARATOR TO ID FAN (dwg: DY-093142-PID-D)					
		DESIGN INTENTION: TRANSFER OF AIR TO FAN					
314.1	NO / LOW FLOW			None other (see low flow in node 306a)	.....		
314.2	HIGH FLOW			None	.....		
314.3	MISDIRECTED / REVERSE FLOW			None	.....		
314.4	MISSING COMPONENT	None					
314.5	EXTRA / WRONG COMPONENT	None					
314.6	LOW CONCENTRATION	None					
314.7	HIGH CONCENTRATION	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		314.0 PROCESS LINE - OFF AIR FROM PRODUCT SEPARATOR TO ID FAN (continued)					
		DESIGN INTENTION: TRANSFER OF AIR TO FAN					
314.8	NO / LOW PRESSURE	None					
314.9	HIGH PRESSURE			None	.....		
314.10	LOW TEMPERATURE			None	.....		
314.11	HIGH TEMPERATURE			None other (see high temperature in node 311)	.....		
		315.0 PROCESS LINE - PRODUCT FROM RECEIVER TO SCREENER (dwg: DY-093142-PID-D)					
		DESIGN INTENTION: TRANSFER OF PRODUCT TO SCREENER					
315.1	NO / LOW FLOW			None other (see high level in node 313)	.....		
315.2	HIGH FLOW	Operator error: manual valve open too wide	3	Overflow of screener, business loss	.4.....	SOP, training	
315.3	MISDIRECTED / REVERSE FLOW	None					
315.4	MISSING COMPONENT	None					
315.5	EXTRA / WRONG COMPONENT	None					
315.6	LOW CONCENTRATION	None					
315.7	HIGH CONCENTRATION	None					
315.8	NO / LOW PRESSURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		315.0 PROCESS LINE - PRODUCT FROM RECEIVER TO SCREENER (continued)					
		DESIGN INTENTION: TRANSFER OF PRODUCT TO SCREENER					
315.9	HIGH PRESSURE	None					
315.10	LOW TEMPERATURE	None					
315.11	HIGH TEMPERATURE	None					
		316.0 *PROCESS LINE - PRODUCT RECYLCLE FROM SCREENER TO RECEIVER (dwg: DY-093142-PID-D)*					
		DESIGN INTENTION: RECYCLE PRODUCT FROM SCREENER					
316.1	NO / LOW FLOW			None	.....		
316.2	HIGH FLOW	Static electricity in product	2	Overflow of good product to oversize collection tank, business loss	.4....	Camera survillance	
		Torn screen	3			Anti-static material addition	
316.3	MISDIRECTED / REVERSE FLOW	None					
316.4	MISSING COMPONENT	None					
316.5	EXTRA / WRONG COMPONENT	None					
316.6	LOW CONCENTRATION	None					
316.7	HIGH CONCENTRATION	None					
316.8	NO / LOW PRESSURE	None					
316.9	HIGH PRESSURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		316.0 PROCESS LINE - PRODUCT RECYLCLE FROM SCREENER TO RECEIVER (continued)					
		DESIGN INTENTION: RECYCLE PRODUCT FROM SCREENER					
316.10	LOW TEMPERATURE	None					
316.11	HIGH TEMPERATURE	None					
		317.0 CONVEYOR / FEEDER / SCREENER - PRODUCT SCREENER (dwg: DY-093144-PID-D)					
		DESIGN INTENTION: SCREEN PRODUCT AND CLASSIFY PER SIZE					
317.1	NO / LOW FLOW	Static electricity in material, material too dry	2	Overflow into oversize tank, business loss	.4.....	Anti-static material addition Preventive maintenance program	
		Material too wet and sticky	3	Material back up into chute, production loss	.4.....	High level in product receiver will detect backing up of material (93-LSH-052)	
		Mechanical failure: screener motor failure	3				
317.2	HIGH FLOW	None					
317.3	MISDIRECTED / REVERSE FLOW			None other (see low flow)	.....		
317.4	MISSING COMPONENT	None					
317.5	EXTRA / WRONG COMPONENT	None					
317.6	NO / LOW LEVEL	None					
317.7	HIGH LEVEL			None other (see low flow)	.....		
317.8	NO / LOW SPEED			None other (see low flow)	.....		
317.9	HIGH SPEED	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		318.0 PROCESS LINE - OVERSIZE PRODUCT TO COLLECTION TANK (dwg: DY-093144-PID-D)					
		DESIGN INTENTION: TRANSFER OVERSIZE PRODUCT TO COLLECTION TANK					
318.1	NO / LOW FLOW	Operator error: full bin backs up into overflow line	2	Overflow of screener, production loss	.4.....	SOP, training Camera surveillance	
318.2	HIGH FLOW			None other (see low flow in node 317)	.....		
318.3	MISDIRECTED / REVERSE FLOW	None	.				
318.4	MISSING COMPONENT	None	.				
318.5	EXTRA / WRONG COMPONENT	None	.				
318.6	*LOW CONCENTRATION*	*None*	.				
318.7	HIGH CONCENTRATION	None	.				
318.8	NO / LOW PRESSURE	None	.				
318.9	HIGH PRESSURE	None	.				
318.10	LOW TEMPERATURE	None	.				
318.11	HIGH TEMPERATURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		319.0 PROCESS LINE - PRODUCT FROM SCREENER TO STORAGE SILO (dwg: DY-093144-PID-D)					
		DESIGN INTENTION: TRANSFER ACCEPTABLE PRODUCT TO STORAGE SILO					
319.1	NO / LOW FLOW	Low plant air flow	2	Line plugging, production loss	.4.....	Interlock will shut down feed and transfer system on high level in transfer pot (93-L-966)	
		Mechanical failure: rotary valve failure (RT-014)	3				
319.2	HIGH FLOW	Mechanical failure: air flow control valve not operating properly (93-PV-51018)	3	Dusting in silo, bypassing of filter, loss of product	.4.....	Preventive maintenance program	
		Operator error: by pass line open	3			*SOP, training*	
319.3	MISDIRECTED / REVERSE FLOW	Operator error: diverter valve in wrong position	3	Mixing of products, off spec product	.4.....	High level alarm (IAH-83L861)	
						SOP, training	
				Overfeeding a silo, overflowing	.4.....		
319.4	MISSING COMPONENT	None					
319.5	EXTRA / WRONG COMPONENT	None					
319.6	LOW CONCENTRATION	None					
319.7	HIGH CONCENTRATION	None					
319.8	NO / LOW PRESSURE			None other (see low flow)	.....		
319.9	HIGH PRESSURE			None other (see high flow)	.....		
319.10	LOW TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		319.0 PROCESS LINE - PRODUCT FROM SCREENER TO STORAGE SILO (continued)					
		DESIGN INTENTION: TRANSFER ACCEPTABLE PRODUCT TO STORAGE SILO					
319.11	HIGH TEMPERATURE	None					
		320.0 TANK / VESSEL - STORAGE SILO (dwg: DY-093129-PID-D)					
		DESIGN INTENTION: STORAGE OF ACCEPTABLE PRODUCT					
320.1	LOW CONCENTRATION	None					
320.2	HIGH CONCENTRATION	None					
320.3	NO / LOW PRESSURE	None					
320.4	HIGH PRESSURE			None other (see high flow in node 319)	.....		
320.5	LOW TEMPERATURE	None					
320.6	HIGH TEMPERATURE	None					
320.7	NO / LOW LEVEL			None	.....		
320.8	HIGH LEVEL	Operator error: not switching to other silo on high level alarm	2	Silo overflow, production loss	.3....	SOP, training High level alarm (IAH-83L861)	
320.9	LOW INTERFACE	None					
320.10	HIGH INTERFACE	None					
320.12	INTERNAL LEAK / RUPTURE	Torn bag in vent	3	Dusting of product, product loss	.3....	Preventive maintenance program	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
321.0 PROCESS LINE - PRODUCT FROM STORAGE SILO TO RAIL CAR (dwg: DY-093129-PID-D)							
DESIGN INTENTION: TRANSFER PRODUCT TO RAIL CAR							
321.1	NO / LOW FLOW	Bridging in storage silo	3	Operational, business loss	.4.....	Air lines to silo to fluidize product	
321.2	HIGH FLOW	None	.				
321.3	MISDIRECTED / REVERSE FLOW	None	.				
321.4	MISSING COMPONENT	None	.				
321.5	EXTRA / WRONG COMPONENT	None	.				
321.6	LOW CONCENTRATION	None	.				
321.7	HIGH CONCENTRATION	None	.				
321.8	NO / LOW PRESSURE	None	.				
321.9	HIGH PRESSURE	None	.				
321.10	LOW TEMPERATURE	None	.				
321.11	HIGH TEMPERATURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		322.0 TANK / VESSEL - CYCLONE SCRUBBER (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: SCRUBBING OF AIR USED IN DRYER					
322.1	LOW CONCENTRATION	None	.				
322.2	HIGH CONCENTRATION	None	.				
322.3	NO / LOW PRESSURE	None	.				
322.4	HIGH PRESSURE	None	.				
322.5	LOW TEMPERATURE			None	.....		
322.6	HIGH TEMPERATURE	Loss of water circulation	3	Damage to FRP vessel	.2.....	High temperature shutdown in dryer (93-TI/TT-992)	
		High outlet temperature in dryer	3			In line spare pump	
						Low level alarm in scrubber (93-L-059)	
						Temperature indication in inlet (93-T-2088)	
322.7	NO / LOW LEVEL	Low pressure in HPSW line	3	Operational problem, time loss	.4.....	Pressure indicator (93-PI-51013)	
		Operator error: manual valva closed	3	Pump damage	.4.....	Flow indicator (93-FI-51012)	
322.8	HIGH LEVEL	Mechanical failure: make up water valve fails open (93-LV-059)	4	Operational, minor business loss	.4.....	Overflow to sump	
		Operator error: bypass line open	3				
322.9	LOW INTERFACE	None	.				

(continued)

Item Number	Deviation	Causes	FC	Consequences	FXETIBO	Safeguards	Actions
		322.0 TANK / VESSEL - CYCLONE SCRUBBER (continued)					
		DESIGN INTENTION: SCRUBBING OF AIR USED IN DRYER					
322.10	HIGH INTERFACE	None					
		323.0 PROCESS LINE - CYCLONE SCRUBBER WATER RECIRCULATION (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: KEEPING CONTINUOUS FLOW AT SCRUBBER					
323.1	NO / LOW FLOW			None other (see low level in node 322)	.....		
323.2	HIGH FLOW			None	.....		
323.3	MISDIRECTED / REVERSE FLOW	None					
323.4	MISSING COMPONENT	None					
323.5	EXTRA / WRONG COMPONENT	None					
323.6	LOW CONCENTRATION	None					
323.7	HIGH CONCENTRATION	None					
323.8	NO / LOW PRESSURE			None other (see low level in node 322)	.....		
323.9	HIGH PRESSURE	None					
323.10	LOW TEMPERATURE	None					
323.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		324.0 PROCESS LINE - OFF AIR FROM CYCLONE SCRUBBER THROUGH STACK TO ATMOSPHERE (dwg: DY-093143-PID-D)					
		DESIGN INTENTION: TRANSFER AND RELEASE OF SCRUBBER AIR IT					
324.1	NO / LOW FLOW	Secondary droplet separator plugged	4	Loss of efficiency accross scrubber, reduced rate through dryer	.4.....	Pressure differential indication (93-PDI-999) Demister flush line	
324.2	HIGH FLOW	None					
324.3	MISDIRECTED / REVERSE FLOW	None					
324.4	MISSING COMPONENT	None					
324.5	EXTRA / WRONG COMPONENT			None	.....		
324.6	LOW CONCENTRATION	None					
324.7	HIGH CONCENTRATION	None					
324.8	NO / LOW PRESSURE	None					
324.9	HIGH PRESSURE	None					
324.10	LOW TEMPERATURE	None					
324.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	FC	Consequences	FXETIBO	Safeguards	Actions
		325.0 TANK / VESSEL - CYCLONE CENTRATE TANK (dwg: DY-093137-PID-D)					
		DESIGN INTENTION: STORAGE OF CENTRATE WATER					
325.1	LOW CONCENTRATION	None					
325.2	HIGH CONCENTRATION			None	.....		
325.3	NO / LOW PRESSURE	None					
325.4	HIGH PRESSURE	None					
325.5	LOW TEMPERATURE	None					
325.6	HIGH TEMPERATURE			None	.....		
325.7	*NO / LOW LEVEL*	Mechanical failure: switch failure	4	Running pump dry, pump failure	.4....	Low level switch (83-LS-950) Level indication (83-LG-51036/37) Pressure indication at pump outlet (83-PI-51038)	
325.8	HIGH LEVEL	Mechanical failure: switch failure Operator error: switch the pump off Mechanical failure: pump failure	4 4 4	Overflow of centrate tank, business loss	.4....	SOP, training High level alarm (83-LSH-949) Level indication (83-LG-51036/37)	
325.9	LOW INTERFACE	None					
325.10	HIGH INTERFACE	None					

(continued)

Item Number	Deviation	Causes	FC	Consequences	FXETIBO	Safeguards	Actions
	326.0 PROCESS LINE - CENTRATE FROM TANK TO HEAT RECOVERY COLLECTION TANK (dwg: DY-093137-PID-D)						
	DESIGN INTENTION: TRANSFER OF CENTRATE TO CENTRAL STORAGE TANK						
326.1	NO / LOW FLOW			None other (see high level in node 325)	.....		
326.2	HIGH FLOW	None					
326.3	MISDIRECTED / REVERSE FLOW	None					
326.4	MISSING COMPONENT	None					
326.5	EXTRA / WRONG COMPONENT	None					
326.6	LOW CONCENTRATION	None					
326.7	HIGH CONCENTRATION	None					
326.8	NO / LOW PRESSURE	None					
326.9	HIGH PRESSURE	None					
326.10	LOW TEMPERATURE	None					
326.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		327.0 TANK / VESSEL - COAGULANT TANK (dwg: DY-093148-PID-D)					
		DESIGN INTENTION: STORAGE OF COAGULANT FOR CENTRATE TREATMENT					
327.1	LOW CONCENTRATION	Off spec material from supplier	3	Inefficient filtering, business loss	.4.....	SOP, training QA program	
327.2	HIGH CONCENTRATION			None other (see low concentration)	.....		
327.3	NO / LOW PRESSURE	None					
327.4	HIGH PRESSURE	None					
327.5	LOW TEMPERATURE	Low ambient temperature	3	Freezing material, inefficient filtering, business loss	.3.....	Tank located inside heated building	
327.6	HIGH TEMPERATURE	None					
327.7	NO / LOW LEVEL	Operator error: failure to fill the tank	4	Inefficient filtering, business loss	.4.....	Ground surface sloped and drained Level indication (84-LG-51020)	
		Mechanical failure: leakage in the system	4	Spill of material on the ground	3.....	SOP, training	
		No material supply from the supplier	4				
327.8	HIGH LEVEL	Operator error: overfilling	3	Spill	34.....	SOP, training	
327.9	LOW INTERFACE	None					
327.10	HIGH INTERFACE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		328.0 PROCESS LINE - COAGULANT FROM TANK TO RECIRCULATION LINE (dwg: DY-093148-PID-D)					
		DESIGN INTENTION: SUPPLY OF COAGULANT FOR CENTRATE TREATMENT					
328.1	NO / LOW FLOW	Low level in the tank	.	None other (see low flow in node 327)	.....		
		Mechanical failure: pump failure	.				
		Line plugged	.				
328.2	HIGH FLOW			None	.....		
328.3	MISDIRECTED / REVERSE FLOW	None	.				
328.4	MISSING COMPONENT	None	.				
328.5	EXTRA / WRONG COMPONENT	Wrong material supplied by vendor	4	Unkown	2.....	SOP, training	328 -1
		Operator error: filling with wrong chemical	4			QA program	
328.6	LOW CONCENTRATION			None other (see low concentration in node 327)	.....		
328.7	HIGH CONCENTRATION			None other (see low concentration in node 327)	.....		
328.8	NO / LOW PRESSURE	Mechanical failure: pump failure	4	Inefficient filtering, business loss	.4.....	Pressure indicator (84-PI-51059)	
		Mechanical failure: line leakage	4	Spill	4.....	Level indicator (84-LG-51020)	
						Callibrator cylinder	
328.9	HIGH PRESSURE	Operator error: manual valve closed	4	Poor filtering system	.4.....	SOP, training	
						Pressure indicator (84-PI-51059)	

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		328.0 PROCESS LINE - COAGULANT FROM TANK TO RECIRCULATION LINE (continued)					
		DESIGN INTENTION: SUPPLY OF COAGULANT FOR CENTRATE TREATMENT					
328.10	LOW TEMPERATURE			None other (see low temperature in node 327)	.....	Line is electrically traced	
328.11	HIGH TEMPERATURE	None					
		329.0 TANK / VESSEL - HYPOCHLORITE STORAGE TANK (dwg: DY-093148-PID-D)					
		DESIGN INTENTION: STORAGE OF SODIUM HYPOCHLORITE FOR CENTRATE TREATMENT					
329.1	LOW CONCENTRATION	Old material	3	Incomplete oxidation	.4.....	SOP, rotation of stock SOP, training QA program	
329.2	HIGH CONCENTRATION	Off spec material supplied by vendor	4	Higher concentration down stream, business loss	.4.....	SOP, training	
329.3	NO / LOW PRESSURE	None					
329.4	HIGH PRESSURE	None					
329.5	LOW TEMPERATURE	Low ambient temperature	4	Incomplete water treatment, business loss	.4.....		329 -1
329.6	HIGH TEMPERATURE	None					
329.7	NO / LOW LEVEL	No supply from vendor	4	No supply to centrate tk, filtering problem	.4.....	Level indication (84-LT-707) SOP	

(continued)

Item Number	Deviation	Causes	FC	Consequences	FXETIBO	Safeguards	Actions
		329.0 TANK / VESSEL - HYPOCHLORITE STORAGE TANK (continued)					
		DESIGN INTENTION: STORAGE OF SODIUM HYPOCHLORITE FOR CENTRATE TREATMENT					
329.8	HIGH LEVEL	Tank overfilled by vendor	4	Spill of material	4.....	Level indication (84-LG-707) SOP, training	
329.9	LOW INTERFACE	None					
329.10	HIGH INTERFACE	None					
		330.0 PROCESS LINE - HYPOCHLORITE FROM TANK TO PUMP SUCTION (dwg: DY-093148-PID-D)					
		DESIGN INTENTION: SUPPLY OF SODIUM HYPOCHLORITE FOR CENTRATE TREATMENT					
330.1	NO / LOW FLOW			None other (see low level in node 329)	.....		
330.2	HIGH FLOW			None	.....		
330.3	MISDIRECTED / REVERSE FLOW	None					
330.4	MISSING COMPONENT	None					
330.5	EXTRA / WRONG COMPONENT	None					
330.6	LOW CONCENTRATION			None other (see low concentration in node 329)	.....		
330.7	HIGH CONCENTRATION			None other (see high concentration in node 329)	.....		
330.8	NO / LOW PRESSURE			None other (see low level in node 329)	.....		

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		330.0 PROCESS LINE - HYPOCHLORITE FROM TANK TO PUMP SUCTION (continued)					
		DESIGN INTENTION: SUPPLY OF SODIUM HYPOCHLORITE FOR CENTRATE TREATMENT					
330.9	HIGH PRESSURE			None	.....		
330.10	LOW TEMPERATURE	None					
330.11	HIGH TEMPERATURE	None					
		331.0 TANK / VESSEL - CENTRAL HEAT RECOVERY COLLECTION TANK (dwg: DY-093119-PID-D)					
		DESIGN INTENTION: STORAGE AND COLLECTION OF CENTRATE					
331.1	LOW CONCENTRATION	None					
331.2	HIGH CONCENTRATION	None					
331.3	NO / LOW PRESSURE	None					
331.4	HIGH PRESSURE	None					
331.5	LOW TEMPERATURE			None	.....		
331.6	HIGH TEMPERATURE	None					
331.7	NO / LOW LEVEL	No centrate water from the dryer	4	None	.....		
331.8	HIGH LEVEL			None	.....		
331.9	LOW INTERFACE	None					
331.10	HIGH INTERFACE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		332.0 PROCESS LINE - CENTRATE TO TREATMENT PACKAGE (dwg: DY-093119-PID-D)					
		DESIGN INTENTION: TRANSFER OF COLLECTED CENTRATE TO TREATMENT PACKAGE					
332.1	NO / LOW FLOW			None	.....		
332.2	HIGH FLOW			None	.....		
332.3	MISDIRECTED / REVERSE FLOW			None	.....		
332.4	*MISSING COMPONENT*	None					
332.5	EXTRA / WRONG COMPONENT	None					
332.6	LOW CONCENTRATION	None					
332.7	*HIGH CONCENTRATION*			None other (see high pressure in node 335)	.....		
332.8	NO / LOW PRESSURE	Mechanical failure: pump failure	4	Inefficient filtering	.4....	Pressure indication (84-PI-51014)	
		Tank empty	4			Level indication (84-LT-138)	
332.9	HIGH PRESSURE	Operator error: manual valve closed	4	None	.....		
332.10	LOW TEMPERATURE			None	.....		
332.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		332a.0 PROCESS LINE - CENTRATE RECIRCULATION LINE (dwg: DY-093119-PID-D)					
		DESIGN INTENTION: PROVIDE CONTINUOUS FLOW TO PREVENT SETTLING					
332a.1	NO / LOW FLOW	Mechanical failure: pump failure	4	Poor mixing of coagulant	.4.....	SOP, training	
		Operator error: manual valve closed	4	Inefficient filtering	.4.....	Run indication on the pump (84-HS-160)	
		Mechanical failure: check valve malfunction	4				
332a.2	HIGH FLOW			None	.....		
332a.3	MISDIRECTED / REVERSE FLOW	None	.				
332a.4	MISSING COMPONENT	None	.				
332a.5	EXTRA / WRONG COMPONENT	None	.				
332a.6	LOW CONCENTRATION			None	.....		
332a.7	HIGH CONCENTRATION			None other (see high concentration in node 332)	.....		
332a.8	NO / LOW PRESSURE			None other (see low pressure in node 332)	.....		
332a.9	HIGH PRESSURE			None other (see high pressure in node 332)	.....		
332a.10	LOW TEMPERATURE	None	.				
332a.11	HIGH TEMPERATURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		333.0 TANK / VESSEL - FLOCCULANT TANK (dwg: DY-093148-PID-D)					
		DESIGN INTENTION: STORAGE OF FLOCCULANT FOR CENTRATE TREATMENT					
333.1	LOW CONCENTRATION	Operator error: improper ratio of flocculant to water	4	Inefficient filtering	.4.....	SOP, training	
333.2	HIGH CONCENTRATION			None other (see low concentration)	.....		
333.3	NO / LOW PRESSURE	None	.				
333.4	HIGH PRESSURE	None	.				
333.5	LOW TEMPERATURE	Low ambient temperature	4	Freezing, inefficient filtering	.4.....	Tank is located inside heated building	
333.6	HIGH TEMPERATURE	None	.				
333.7	NO / LOW LEVEL	None	.				
333.8	HIGH LEVEL	Operator error: tank overfilled	4	Spill	4.....	Sight glass (84-LG-51021) Dike SOP, training	
333.9	LOW INTERFACE	None	.				
333.10	HIGH INTERFACE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		334.0 PROCESS LINE - FLOCCULANT FROM TANK TO CENTRATE LINE (dwg: DY-093148-PID-D)					
		DESIGN INTENTION: SUPPLY FLOCCULANT FOR CENTRATE TREATMENT					
334.1	NO / LOW FLOW	Mechanical failure: pump failure	4	Spill due to broken line	4.....	Pressure indication (84-PI-51060)	334 -1
				Inefficient filtration	.4.....	Dike	
		Tank empty	4			Preventive maintenance program	
		Mechanical failure: broken line	4			SOP, training	
334.2	HIGH FLOW			None	.....		
334.3	MISDIRECTED / REVERSE FLOW	None	.				
334.4	MISSING COMPONENT	None	.				
334.5	EXTRA / WRONG COMPONENT	None	.				
334.6	LOW CONCENTRATION			None other (see low concentration in node 333)	.....		
334.7	HIGH CONCENTRATION			None other (see high concentration in node 333)	.....		
334.8	NO / LOW PRESSURE	Mechanical failure: pump	3	Inefficient filtering	.4.....	Pressure indication	
334.9	HIGH PRESSURE	None	.				
334.10	LOW TEMPERATURE	None	.			Line is electrically traced	
334.11	HIGH TEMPERATURE	None	.				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		335.0 TANK / VESSEL - CENTRATE FILTER (dwg: DY-093149-PID-D)					
		DESIGN INTENTION: FILTER CENTRATE WATER					
335.1	LOW CONCENTRATION	None					
335.2	HIGH CONCENTRATION	None					
335.3	NO / LOW PRESSURE			None	.....		
335.4	HIGH PRESSURE	Plugged filter	3	Reduced flow, inefficient filtering	.3.....	Pump head design Differential pressure indication (84-PDI-704) Automatic backwash of filters based on differential pressure Relief valve on filter (PSV-DM-336)	
335.5	LOW TEMPERATURE			None	.....		
335.6	HIGH TEMPERATURE	None					
335.7	NO / LOW LEVEL	None					
335.8	HIGH LEVEL	None					
335.9	LOW INTERFACE	None					
335.10	HIGH INTERFACE	None					

(continued)

Item Number	Deviation	Causes	FC	Consequences	FXETIBO	Safeguards	Actions
		335.0 TANK / VESSEL - CENTRATE FILTER (continued)					
		DESIGN INTENTION: FILTER CENTRATE WATER					
335.13	NO / LOW FLOW	Mechanical failure: sewer valve stuck open after backwash step	4	Low efficiency in filtering	.4.....	Position indication of valve	
		Plugged filter	3			Differential pressure indication/transmitter and backwash sequence (84-PDI-704)	
		Mechanical failure: pump failure	3			Inline spare pump	
335.14	HIGH FLOW	Loss of filtering media	3	High solids concentration downstream	.3.....	SOP, training, inspection through sight glass	
						Differential pressure indication/transmitter accross filters (84-PDI-704)	
						Flow indication (84-FI-706)	
		336.0 PROCESS LINE - FILTERED CENTRATE TO OM NEW TANK (dwg: DY-093149-PID-D)					
		DESIGN INTENTION: TRANSFER OF TREATED/FILTERED CENTRATE TO OM NEW TANK					
336.1	NO / LOW FLOW	Plugged filter	3	Operational	.4.....	Flow indication (84-FT-706)	
		Plugged spiral heat exchanger	3			Pressure indication (84-FT-703)	
		Operator error: manual valve left closed	3			SOP, training	
336.2	HIGH FLOW	None					
336.3	MISDIRECTED / REVERSE FLOW	None					
336.4	MISSING COMPONENT	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		336.0 PROCESS LINE - FILTERED CENTRATE TO OM NEW TANK (continued)					
		DESIGN INTENTION: TRANSFER OF TREATED/FILTERED CENTRATE TO OM NEW TANK					
336.5	EXTRA / WRONG COMPONENT	None					
336.6	LOW CONCENTRATION	None					
336.7	HIGH CONCENTRATION	Mechanical failure: filter, media in the line	4	Operational	.4.....	SOP, training	
336.8	NO / LOW PRESSURE			None other (see low flow)	.....		
336.9	HIGH PRESSURE	None					
336.10	LOW TEMPERATURE	None					
336.11	HIGH TEMPERATURE	None					
		337.0 PROCESS LINE - CENTRATE FILTER BACKWASH LINE (dwg: DY-093149-PID-D)					
		DESIGN INTENTION: FILTER BACKWASHING					
337.1	NO / LOW FLOW	Operator error: manual valve not totally open during backwashing	3	Incomplete backwashing	.4.....	SOP, training DCS program	
		Lack of air scouring before backwashing	4				
		Low pressure on outlet line	3				
337.2	HIGH FLOW	Operator error: manual valve open too wide	4	Loss of media	.4.....	SOP, training Preventive maintenance program	
		Mechanical failure: valve failure	4				

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		337.0 PROCESS LINE - CENTRATE FILTER BACKWASH LINE (continued)					
		DESIGN INTENTION: FILTER BACKWASHING					
337.3	MISDIRECTED / REVERSE FLOW	None					
337.4	MISSING COMPONENT	None					
337.5	EXTRA / WRONG COMPONENT	Operator error: layered media not filled properly in filter	4	Media in backwash water	.4.....	SOP, training	
337.6	LOW CONCENTRATION	None					
337.7	HIGH CONCENTRATION	None					
337.8	NO / LOW PRESSURE	None					
337.9	HIGH PRESSURE			None other (see high flow)	.....		
337.10	LOW TEMPERATURE	None					
337.11	HIGH TEMPERATURE	None					

(continued)

Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		338.0 PROCESS LINE - CENTRATE FILTER SCOUR OUTLET LINE (dwg: DY-093149-PID-D)					
		DESIGN INTENTION: DRAIN AND VENT FILTER DURING SCOURING					
338.1	NO / LOW FLOW	Mechanical failure: valve failure (84-HSV-713)	4	No scouring, incomplete backwashing	.4.....	Preventive maintenance program Valve position indication DCS protection	
338.2	HIGH FLOW	Mechanical failure: valve fails open (84-HSV-713)	4	Inefficient filtering	.4.....	Valve position indication/transmitter and DCS protection	
338.3	MISDIRECTED / REVERSE FLOW	None					
338.4	MISSING COMPONENT	None					
338.5	EXTRA / WRONG COMPONENT			None	.....		
338.6	LOW CONCENTRATION	None					
338.7	HIGH CONCENTRATION	None					
338.8	NO / LOW PRESSURE	None					
338.9	HIGH PRESSURE	None					
338.10	LOW TEMPERATURE	None					
338.11	HIGH TEMPERATURE	None					

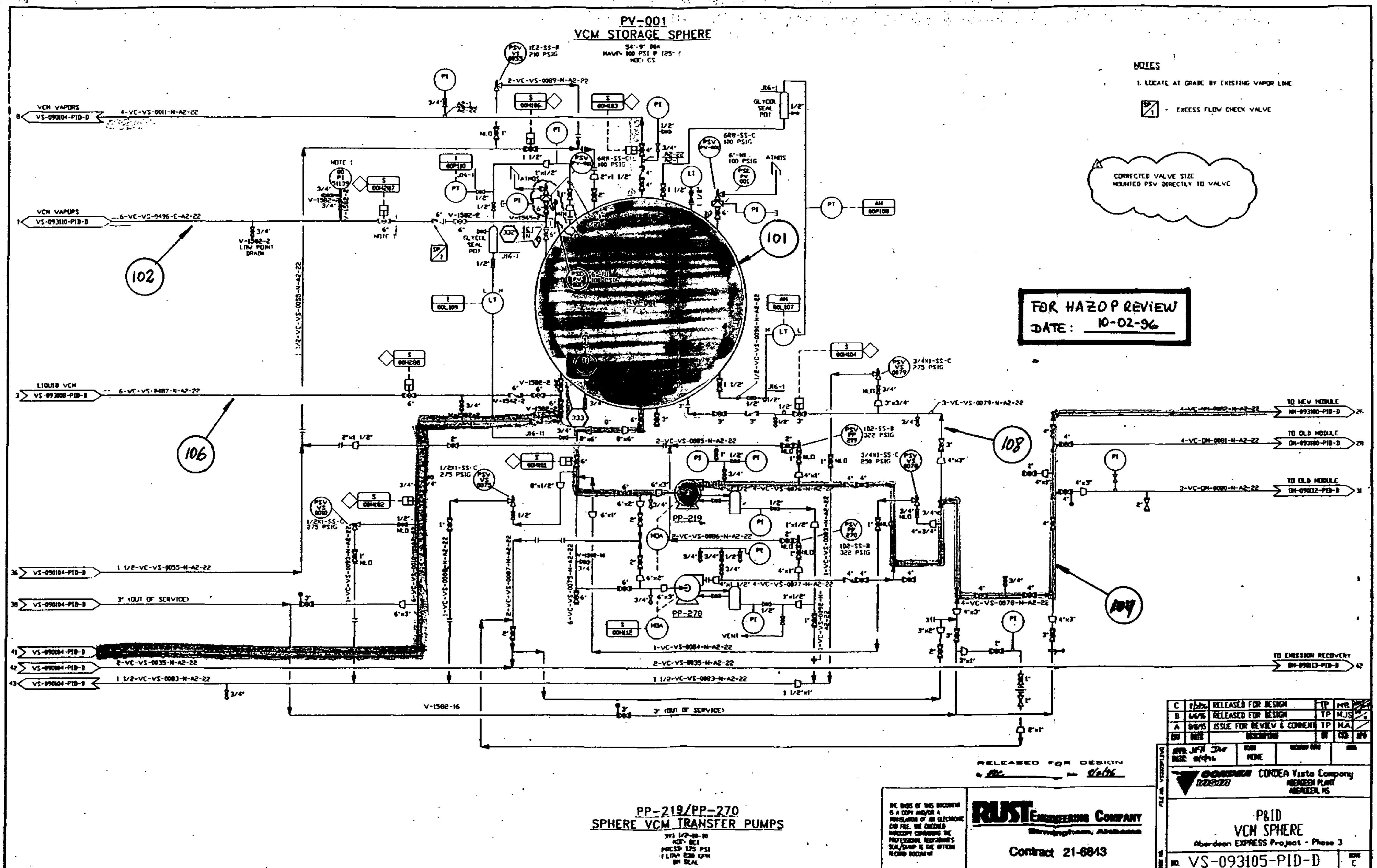
(continued)

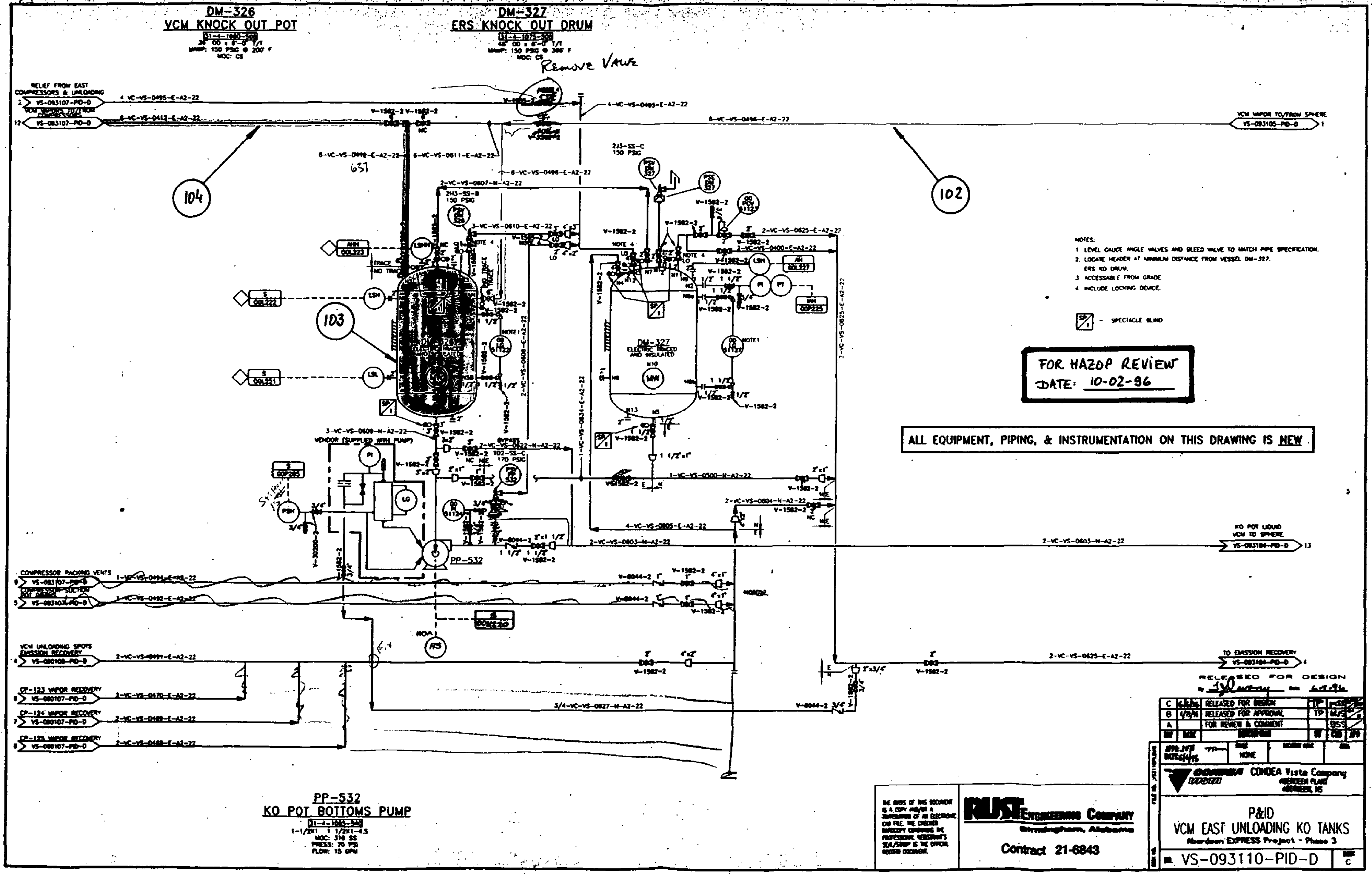
Item Number	Deviation	Causes	F C	Consequences	FXETIBO	Safeguards	Actions
		339.0 PROCESS LINE - PLANT AIR FOR SCOUR (dwg: DY-093149-PID-D)					
		DESIGN INTENTION: SUPPLY AIR FOR FILTER BED SCOURING					
339.1	NO / LOW FLOW	Operator error: manual valve closed	4	Loss of scouring, incomplete backwashing	.4.....	SOP, training	
						Pressure indication (84-PI-51002)	
		Loss of plant air	2				
339.2	HIGH FLOW	Mechanical failure: pressure regulator	4	Operational, disturbed layered media	.4.....	Pressure indication (84-PI-51006)	
						SOP, training	
339.3	MISDIRECTED / REVERSE FLOW	Loss of plant air during scouring	3	Water in filter will get into air line	.4.....	Two checkvalves	339 -1
						Pressure regulation (84-PCV-51008)	
						Pressure indication	
339.4	MISSING COMPONENT	None	.				
339.5	EXTRA / WRONG COMPONENT	None	.				
339.6	*LOW CONCENTRATION*	*None*	.				
339.7	HIGH CONCENTRATION	None	.				
339.8	NO / LOW PRESSURE			None other (see low flow)	.....		
339.9	HIGH PRESSURE			None other (see high flow)	.....		
339.10	LOW TEMPERATURE	None	.				
339.11	HIGH TEMPERATURE	None	.				

G. DRAWINGS

APPENDIX G

DRAWINGS


PV-001
VCM STORAGE SPHERE
NOTES
1. LOCATE AT GRADE BY EXISTING VAPOR LINE.
- EXCESS FLOW CHECK VALVE
CORRECTED VALVE SIZE
MOUNTED PSV DIRECTLY TO VALVE
FOR HAZOP REVIEW
DATE: 10-02-96
VCM VAPORS
VS-090104-PID-D
4-VC-VS-0011-N-A2-22
VCM VAPORS
VS-093110-PID-D
6-VC-VS-0496-E-A2-22
LIQUID VCM
VS-093108-PID-D
6-VC-VS-0487-N-A2-22
101
102
106
108
PP-219
PP-270
TO NEW MODULE
TO OLD MODULE
TO OLD MODULE
TO EMISSION RECOVERY
3-VC-VS-0079-N-A2-22
4-VC-VS-0078-N-A2-22
2-VC-VS-0035-N-A2-22
1 1/2-VC-VS-0083-N-A2-22
1 1/2-VC-VS-0055-N-A2-22
3" (OUT OF SERVICE)
V-1582-16
PP-219/PP-270
SPHERE VCM TRANSFER PUMPS
RELEASED FOR DESIGN
RELEASED FOR DESIGN
ISSUE FOR REVIEW & COMMENT
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
P&ID
VCM SPHERE
Aberdeen EXPRESS Project - Phase 3
VS-093105-PID-D
C


DM-326
VCM KNOCK OUT POT
DM-327
ERS KNOCK OUT DRUM
Remove Valve
RELIEF FROM EAST COMPRESSORS & UNLOADING
VCM VAPOR TO/FROM SPHERE
104
102
103
NOTES:
1 LEVEL GAUGE ANGLE VALVES AND BLEED VALVE TO MATCH PIPE SPECIFICATION.
2. LOCATE HEADER AT MINIMUM DISTANCE FROM VESSEL DM-327. ERS KO DRUM.
3 ACCESSABLE FROM GRADE.
4 INCLUDE LOCKING DEVICE.
- SPECTACLE BLIND
FOR HAZOP REVIEW
DATE: 10-02-96
ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW
DM-327
ELECTRIC TRACED AND INSULATED
KO POT LIQUID VCM TO SPHERE
PP-532
COMPRESSOR PACKING VENTS
VCM UNLOADING SPOTS EMISSION RECOVERY
CP-123 VAPOR RECOVERY
CP-124 VAPOR RECOVERY
CP-125 VAPOR RECOVERY
TO EMISSION RECOVERY
RELEASED FOR DESIGN
RELEASED FOR DESIGN
RELEASED FOR APPROVAL
FOR REVIEW & COMMENT
PP-532
KO POT BOTTOMS PUMP
MOC: 316 SS
PRESS: 70 PSI
FLOW: 15 GPM
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
CONDEA Vista Company
P&ID
VCM EAST UNLOADING KO TANKS
Aberdeen EXPRESS Project - Phase 3
VS-093110-PID-D
C

CP-123
VCM UNLOADING COMPRESSOR
31-4-1010-524

CP-124
VCM UNLOADING COMPRESSOR
31-4-1030-524

CP-125
VCM UNLOADING COMPRESSOR
31-4-1050-524

104

FOR HAZOP REVIEW
DATE: 10-02-96

NOTES
1. DELETED.
2. DELETED.
3. ELECTRIC TRACING IS FOR TEMPERATURE MAINTENANCE AT 80°F.
4. RELIEF VALVE DISCHARGE TO BE AT HIGH POINT OF SYSTEM. MINIMIZE VAL PIPE TO HEADER 4-VC-VS-0485-H-A2-22.
5. MAINTAIN SLOPE TUBING RUN.
6. SET POINT @ PSIG.
7. ACCESSIBLE- ROUTINELY OPERATED.
8. INLET & OUTLET CONNECTIONS TO BE FLANGED.
9. INSTRUMENTS MOUNTED ON LOCAL PANEL WITH FLEXHOSES TO BLOCK & BLEED VALVES.
10. ROUTE ABOVE ROOF WITH GOOSENECK.
11. ALL LINES TO/FROM COMPRESSOR SHED TO HAVE 3/4" V-1562-2 PLUG VALVE WITH FLANGE AND DRAIN PLUG.

LEGEND
SP/1 – SS BRAIDED FLEXHOSE
SP/2 – SPECTACLE BLIND
SP/3 – 4 WAY VALVE

ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW

RELEASED FOR DESIGN

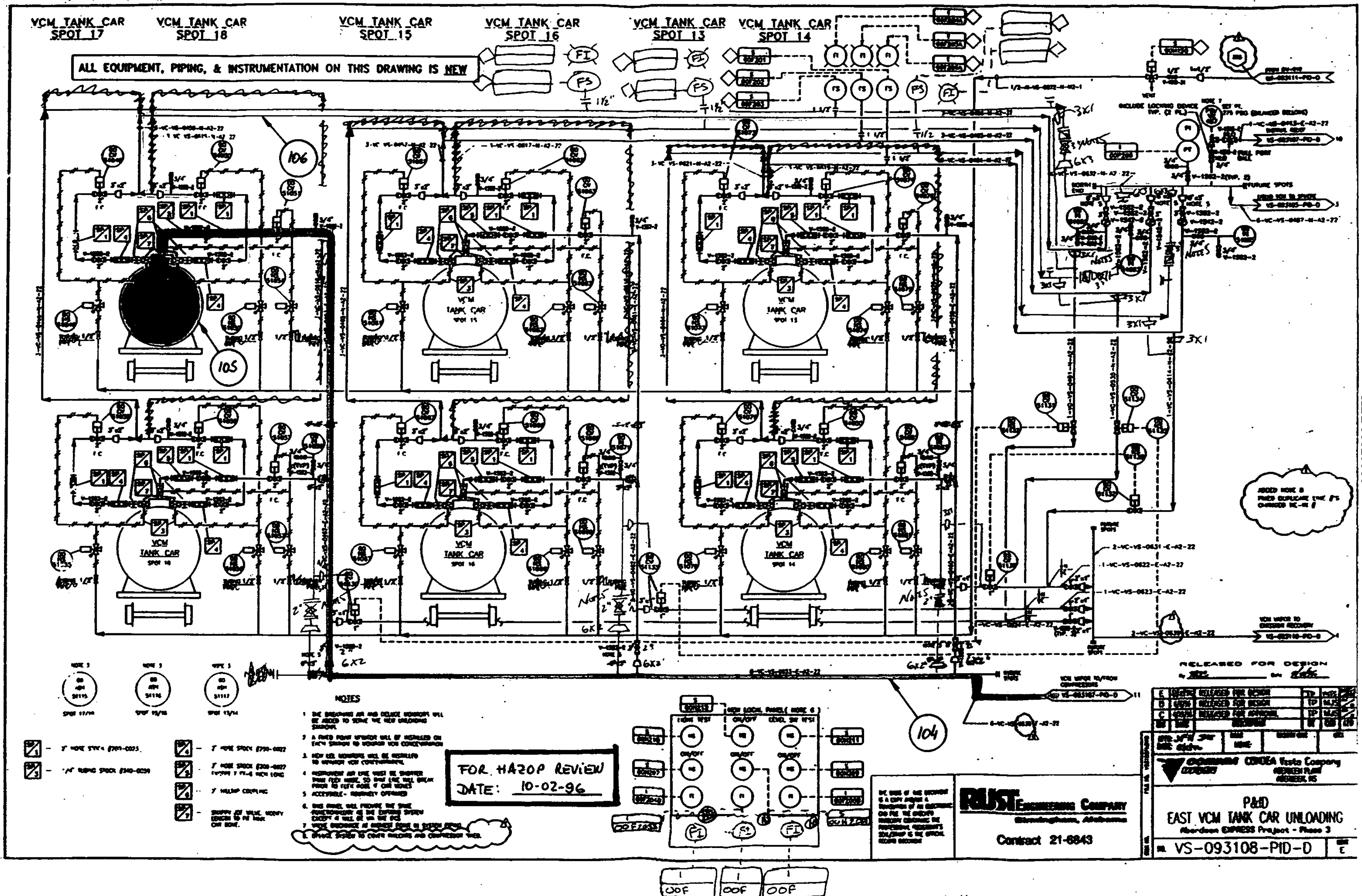
D	6-7-96	RELEASED FOR DESIGN	TP	MJS	
C	4/19/96	RELEASED FOR APPROVAL	TP	MJS	
B		FOR REVIEW & COMMENT		MJS	
REV	DATE	DESCRIPTION	BY	CHK	APP

CONOCO Vista Company
ABERDEEN PLANT
ABERDEEN, MS

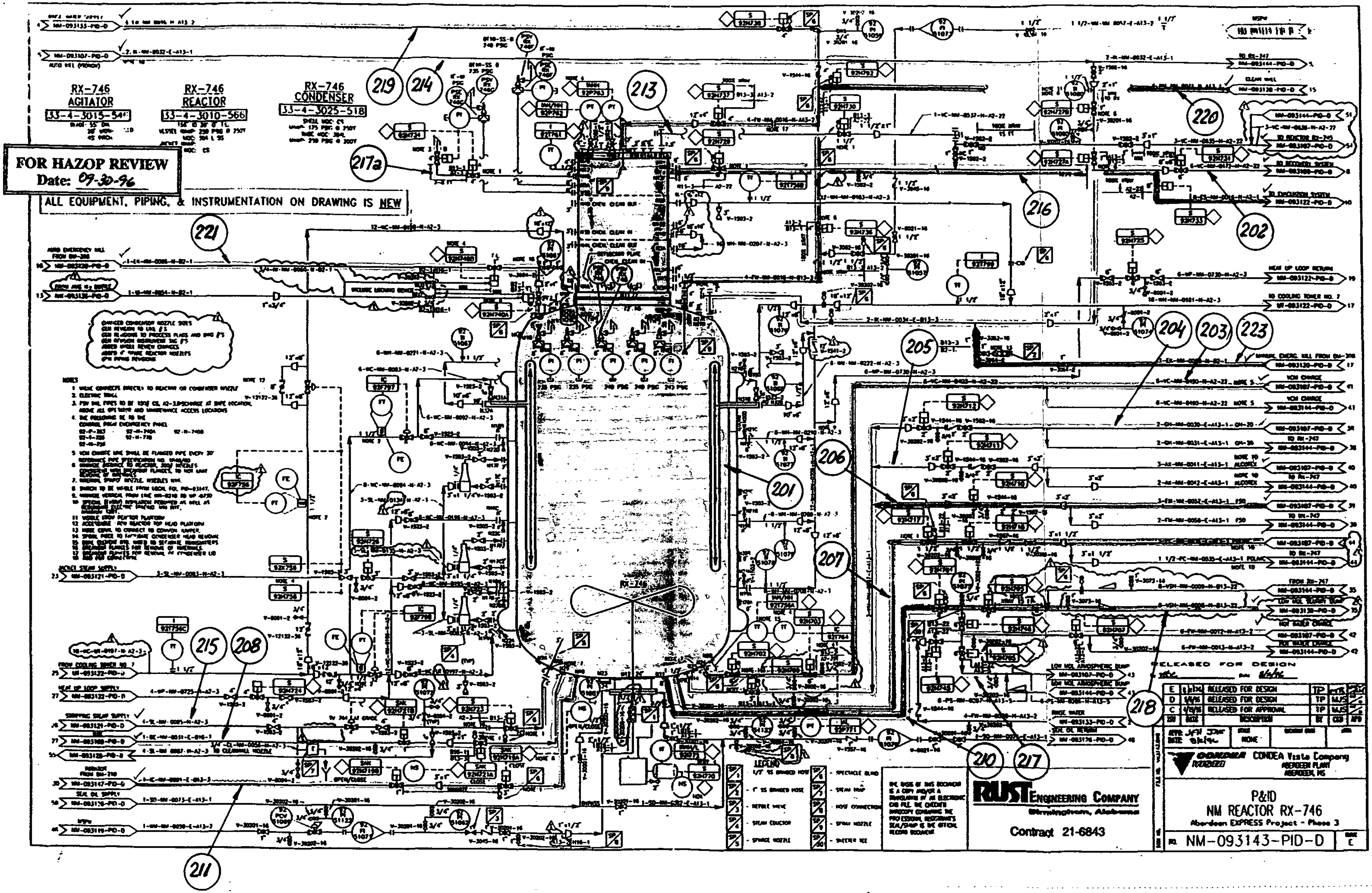
RUST Engineering Company
Birmingham, Alabama
Contract 21-6843

P&ID
VCM TANK FARM COMPRESSORS
Aberdeen EXPRESS Project - Phase 3

DWG. VS-093107-PID-D REV D



ABD00029959


RX-746
AGITATOR
33-4-3015-54
RX-746
REACTOR
33-4-3010-566
RX-746
CONDENSER
33-4-3025-518
FOR HAZOP REVIEW
Date: 09-30-96
ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON DRAWING IS NEW
219
214
213
217a
221
220
216
202
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223
206
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211
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217
218
RELEASED FOR DESIGN
E RELEASED FOR DESIGN
D RELEASED FOR DESIGN
C RELEASED FOR APPROVAL
LEGEND
RUST ENGINEERING COMPANY
Contract 21-6843
CONDEA Vista Company
P&ID
NM REACTOR RX-746
Aberdeen EXPRESS Project - Phase 3
NM-093143-PID-D

DM-760
RECOVERY K.O. DRUM

DM-761
RECOVERY K.O. DRUM

EX-335
WATER RECIRCULATION COOLER

PP-158
WATER RECIRCULATION PUMP

PP-889
WATER RECIRCULATION PUMP

FOR HAZOP REVIEW
Date: 09-30-96

RELEASED FOR DESIGN
By JPW Date 6-7-96

ISO	DATE	DESCRIPTION	BY	CKD	APP'D
D	6/6/96	RELEASED FOR DESIGN	TP	MJS	
C	5/13/96	RELEASED FOR APPROVAL	TP	MJS	
B		FOR REVIEW & COMMENT			

APP'D JWW DATE 6/6/96 | SCALE NONE

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

P&ID
NM RECOVERY KNOCK-OUT DRUMS
Aberdeen EXPRESS Project - Phase 3

NO. NM-093109-PID-D | ISSUE D

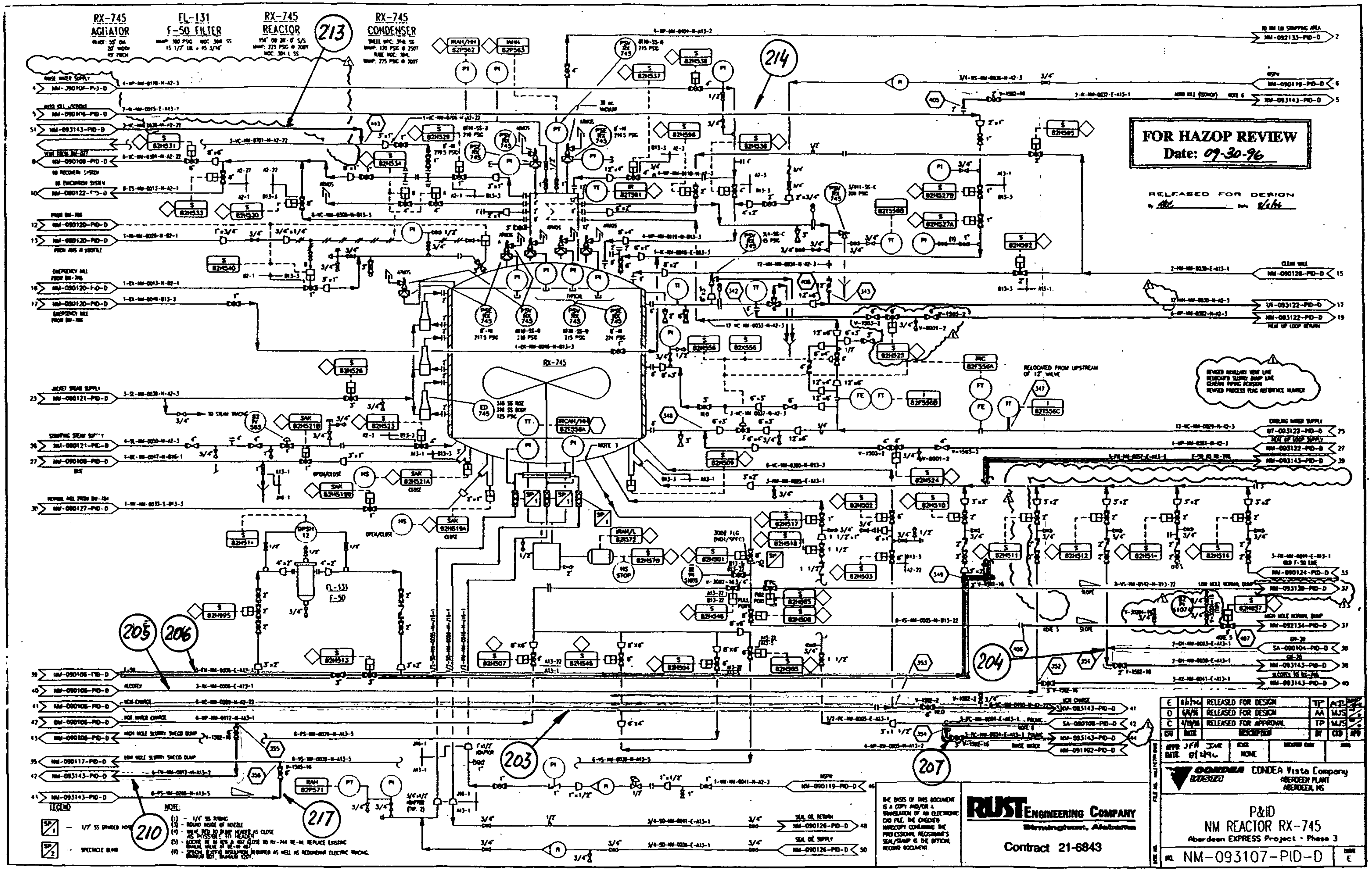
THE BASIS OF THIS DRAWING IS A COPY AND/OR A TRANSLATION OF AN ELECTRONIC CAD FILE. THE CHECKED HARDCOPY CONTAINING THE PROFESSIONAL ENGINEER'S SEAL/STAMP IS THE OFFICIAL RECORD DOCUMENT

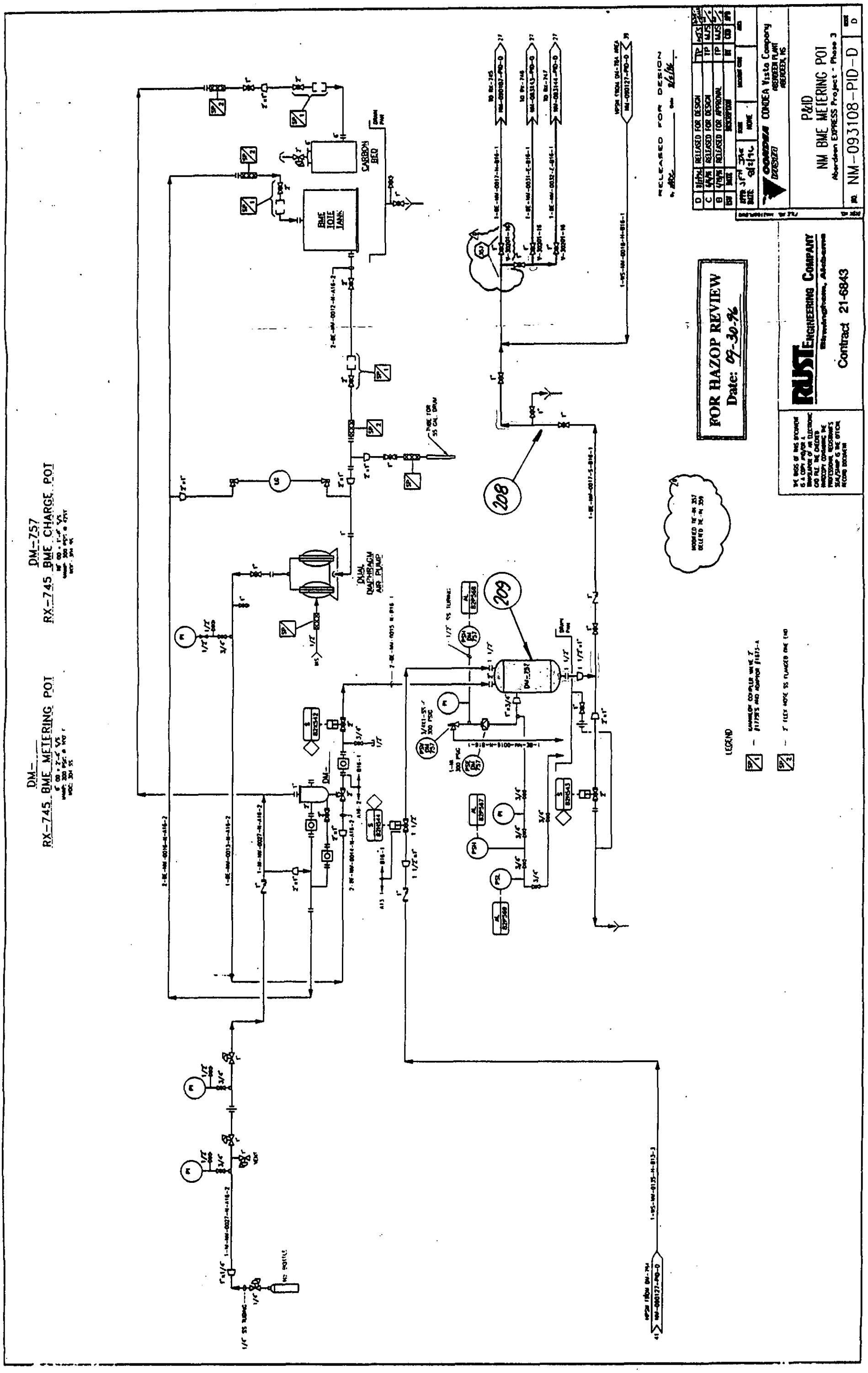
RUST ENGINEERING COMPANY
Birmingham, Alabama

Contract 21-6843

ABD00029961

ABD00029962




DM-757
RX-745 BME METERING POT
DM-757
RX-745 BME CHARGE POT
BME TOTE TANK
CARBON BED
DRUM PUMP
DUAL DIAPHRAGM AIR PUMP
208
209
FOR HAZOP REVIEW
Date: 9-30-96
RELEASED FOR DESIGN
D RELEASED FOR DESIGN
C RELEASED FOR DESIGN
B RELEASED FOR APPROVAL
CONOCO Ponca City
CONOCO Viste Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
NM BME METERING POI
Aberdeen EXPRESS Project - Phase 3
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
NM-093108-PID-D
D
LEGEND
SP/1 – SAMPLEPORT COUPLER VALVE 7
FITTERS AND NIPPLES #1613-A
SP/2 – 3' FLEX HOSE SS FLANGED ONE END

DM-210 CATALYST CHARGE POT

53-4-3200-508

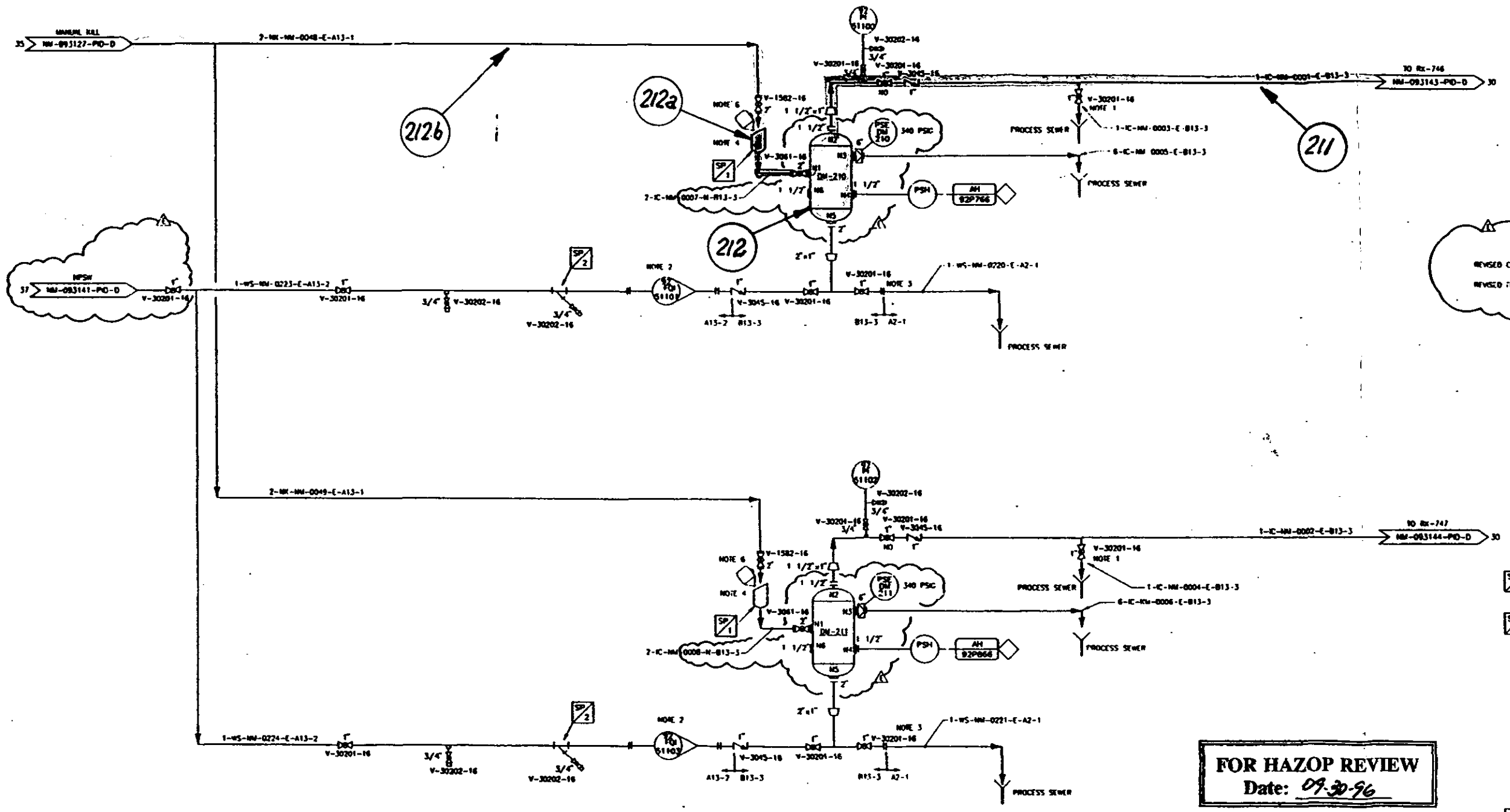
16" OD x 2'-0" T/T
shop: 450 PSIG @ 300° F
MOC: 304 L SS

DM-211 CATALYST CHARGE POT

53-4-3210-508

16" OD x 2'-0" T/T
shop: 450 PSIG @ 300° F
MOC: 304 L SS

NOTES:
1. MINIMIZE DISTANCE BETWEEN DRAIN & NEW REACTOR
2. READABLE FROM POT
3. VALVE OPERATED BY FOOT.
4. MANUAL CATALYST ADDITION BY OPERATOR.
5. ELECTRIC TRACE INCLUDES DRAIN, STRAINER AND PI ISOLATION VALVES.
6. VALVE LOCATED AT FUNNEL.



ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW

FOR HAZOP REVIEW
Date: 09-30-96

RELEASED FOR DESIGN
by _____ Date 9/24/96

ISS	DATE	DESCRIPTION	BY	CHD	APD
E	9/25/96	RELEASED FOR DESIGN	TP	MJS	
D	9/9/96	RELEASED FOR DESIGN	TP	MJS	
C	4/19/96	RELEASE FOR APPROVAL	TP	MJS	

APP: JFH DATE: 9/24/96 | SCALE: NONE | WORKING CODE: | AREA:

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

P&ID
CATALYST INJECTION POTS
Aberdeen EXPRESS Project - Phase 3

NO. NM-093147-PID-D | ISSUE E

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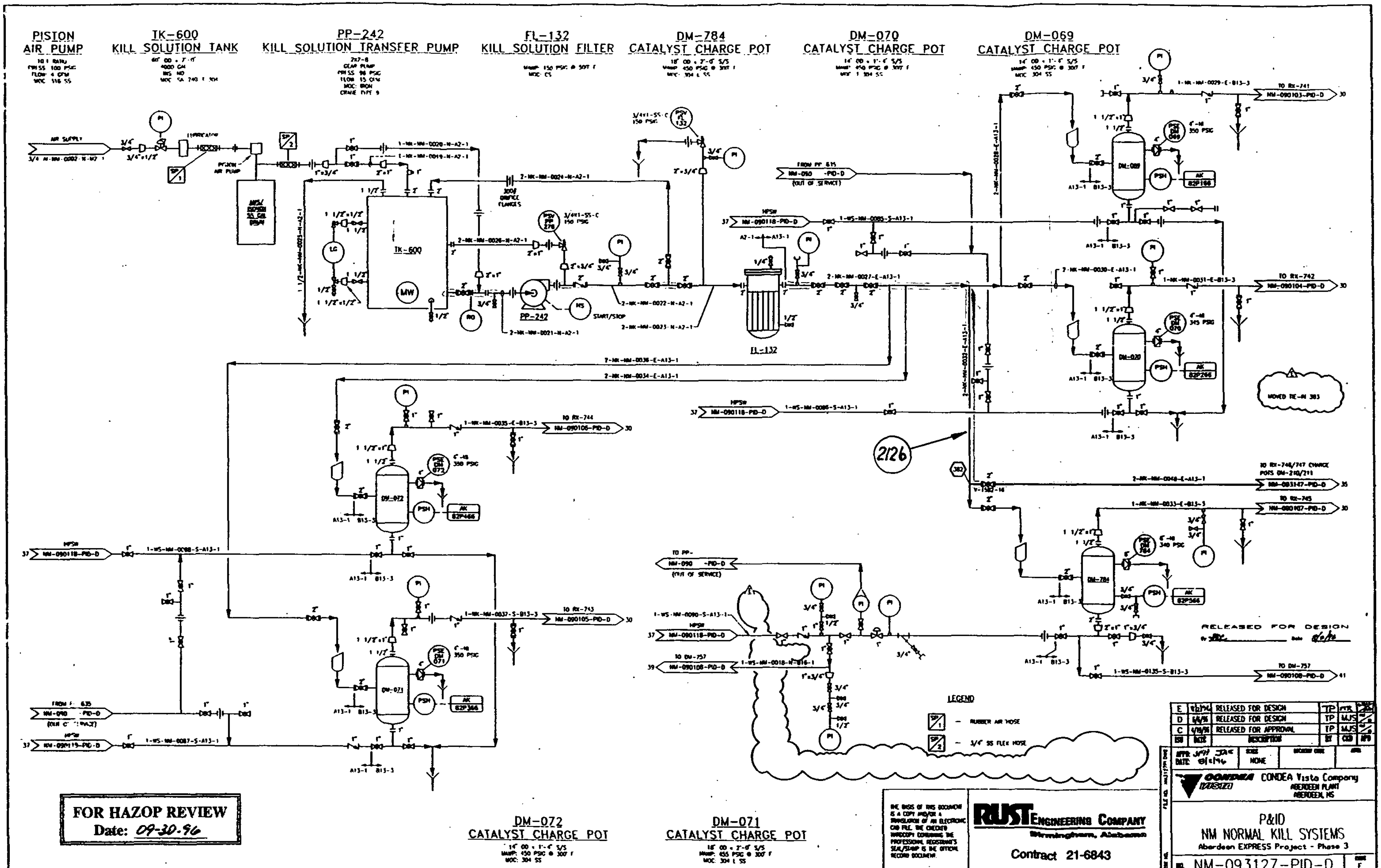
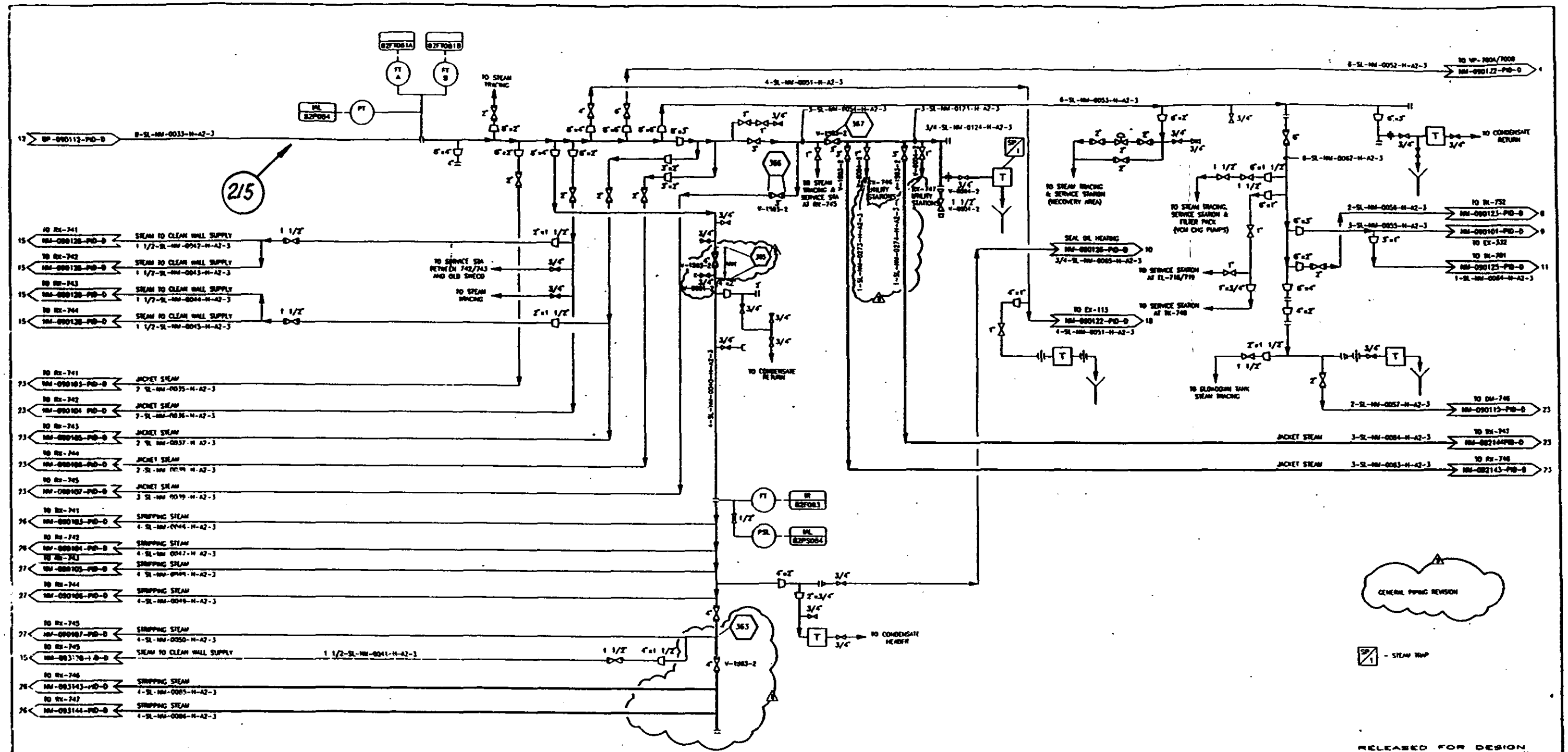
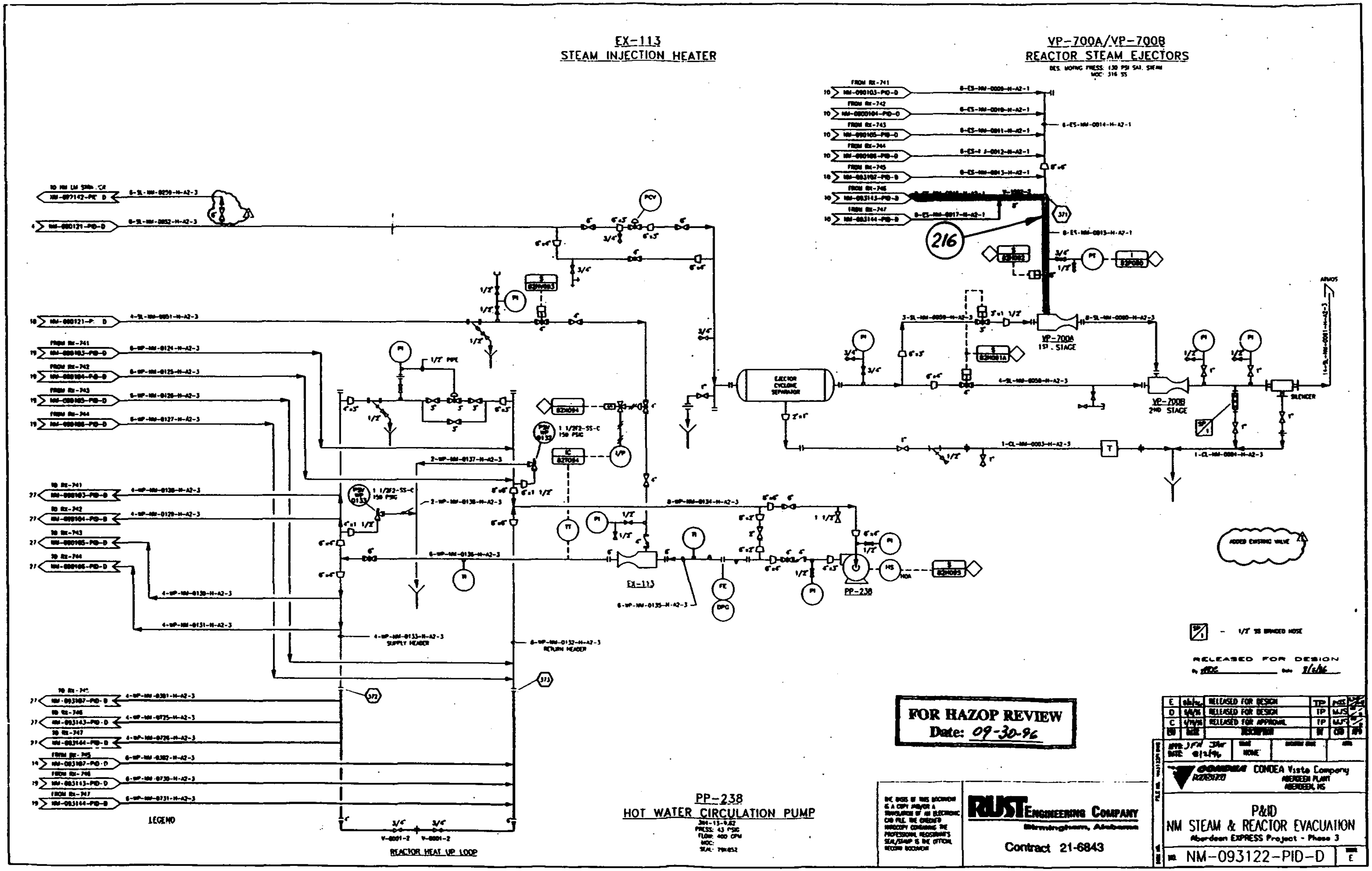
RUST ENGINEERING COMPANY
Birmingham, Alabama

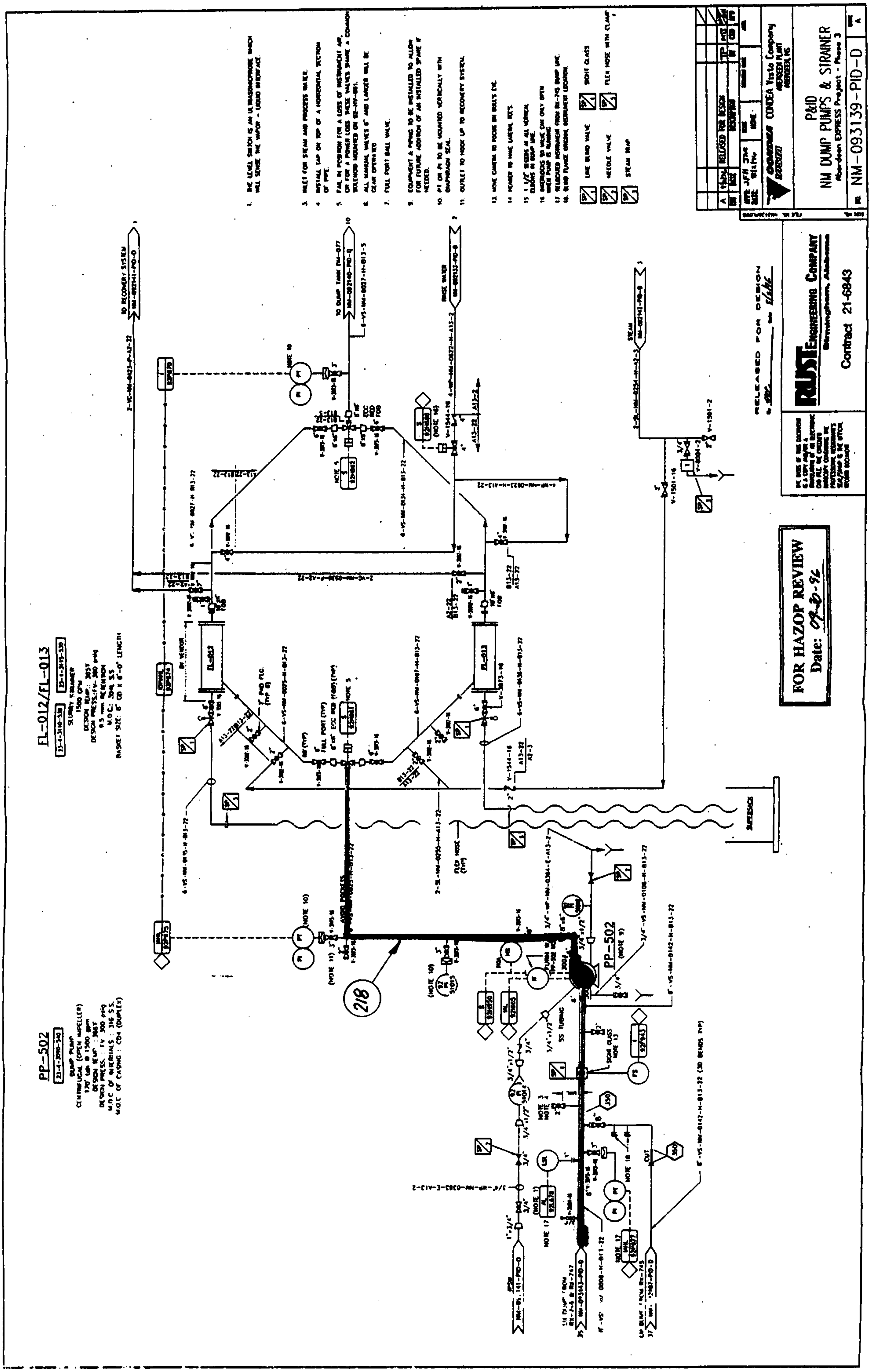
Contract 21-6843

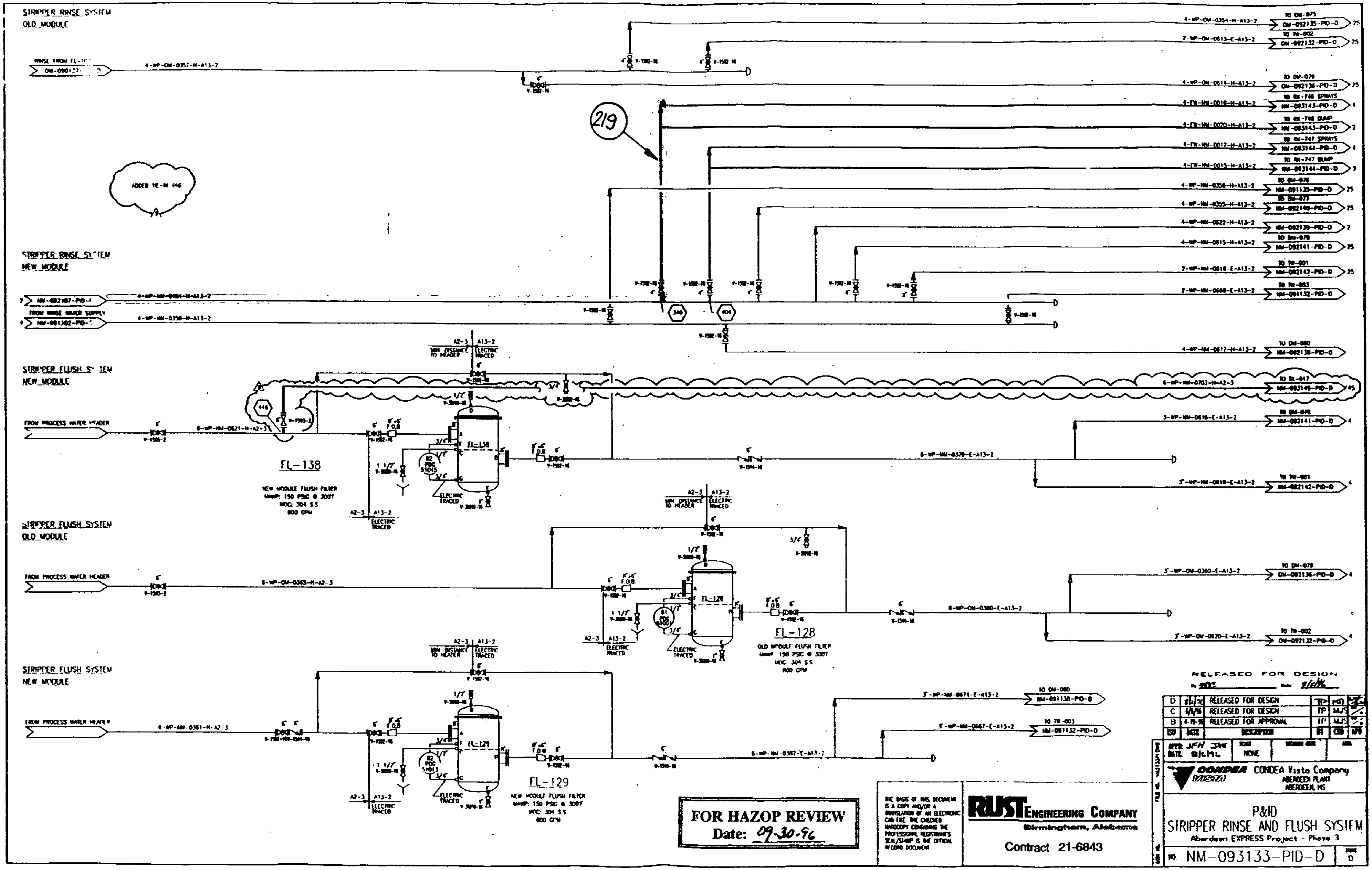
ABD00029964

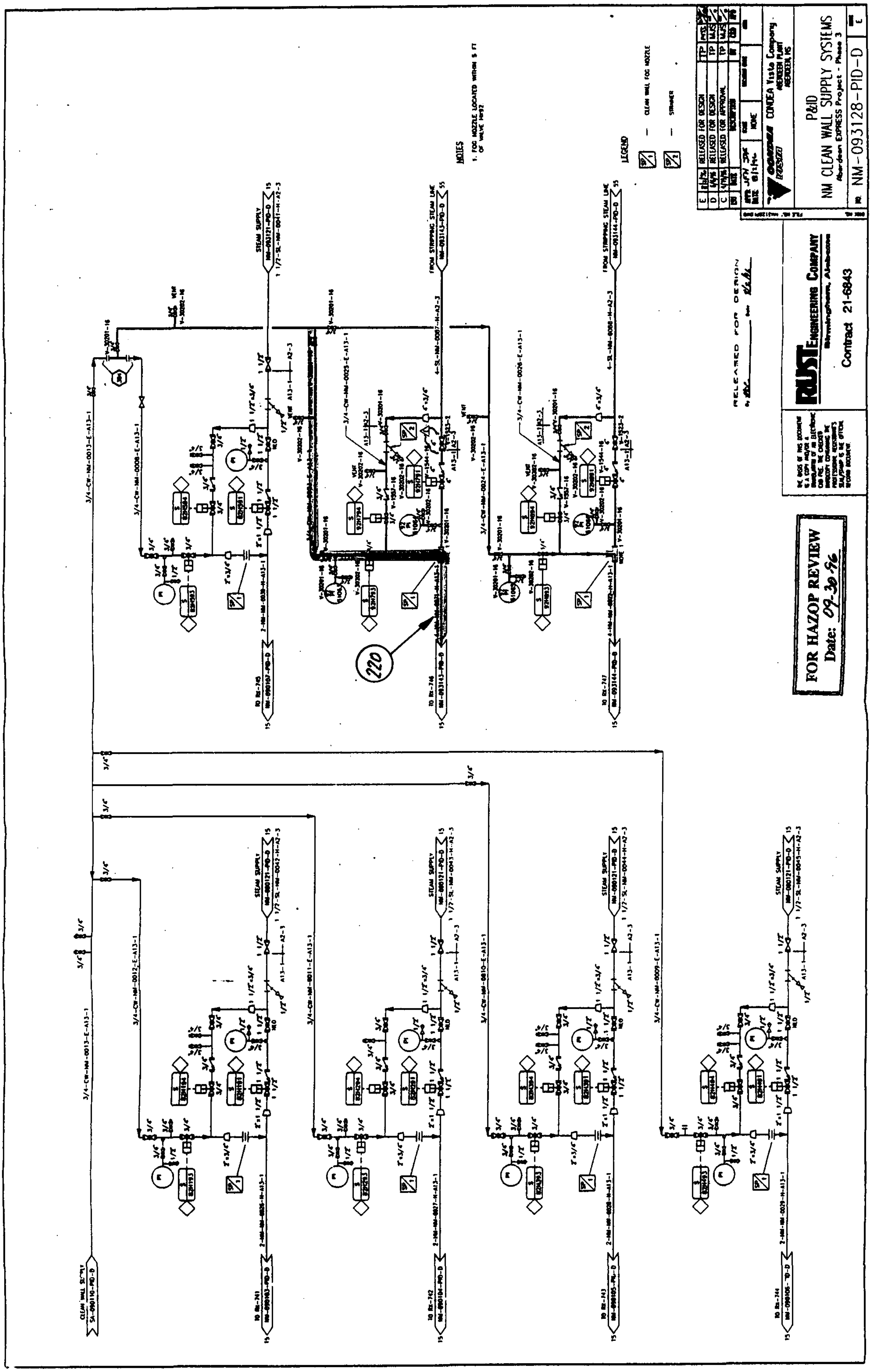

PISTON AIR PUMP
TK-600 KILL SOLUTION TANK
PP-242 KILL SOLUTION TRANSFER PUMP
FL-132 KILL SOLUTION FILTER
DM-784 CATALYST CHARGE POT
DM-070 CATALYST CHARGE POT
DM-069 CATALYST CHARGE POT
DM-072 CATALYST CHARGE POT
DM-071 CATALYST CHARGE POT
AIR SUPPLY
TK-600
PP-242
FL-132
START/STOP
TO RX-741
TO RX-742
TO RX-743
TO RX-744
TO RX-745
TO DM-757
FROM PP 615
(OUT OF SERVICE)
MOVED TE-M 383
2126
LEGEND
RUBBER AIR HOSE
3/4" SS FLEX HOSE
RELEASED FOR DESIGN
E RELEASED FOR DESIGN
D RELEASED FOR DESIGN
C RELEASED FOR APPROVAL
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
NM NORMAL KILL SYSTEMS
Aberdeen EXPRESS Project - Phase 3
NM-093127-PID-D
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
FOR HAZOP REVIEW
Date: 09-30-96

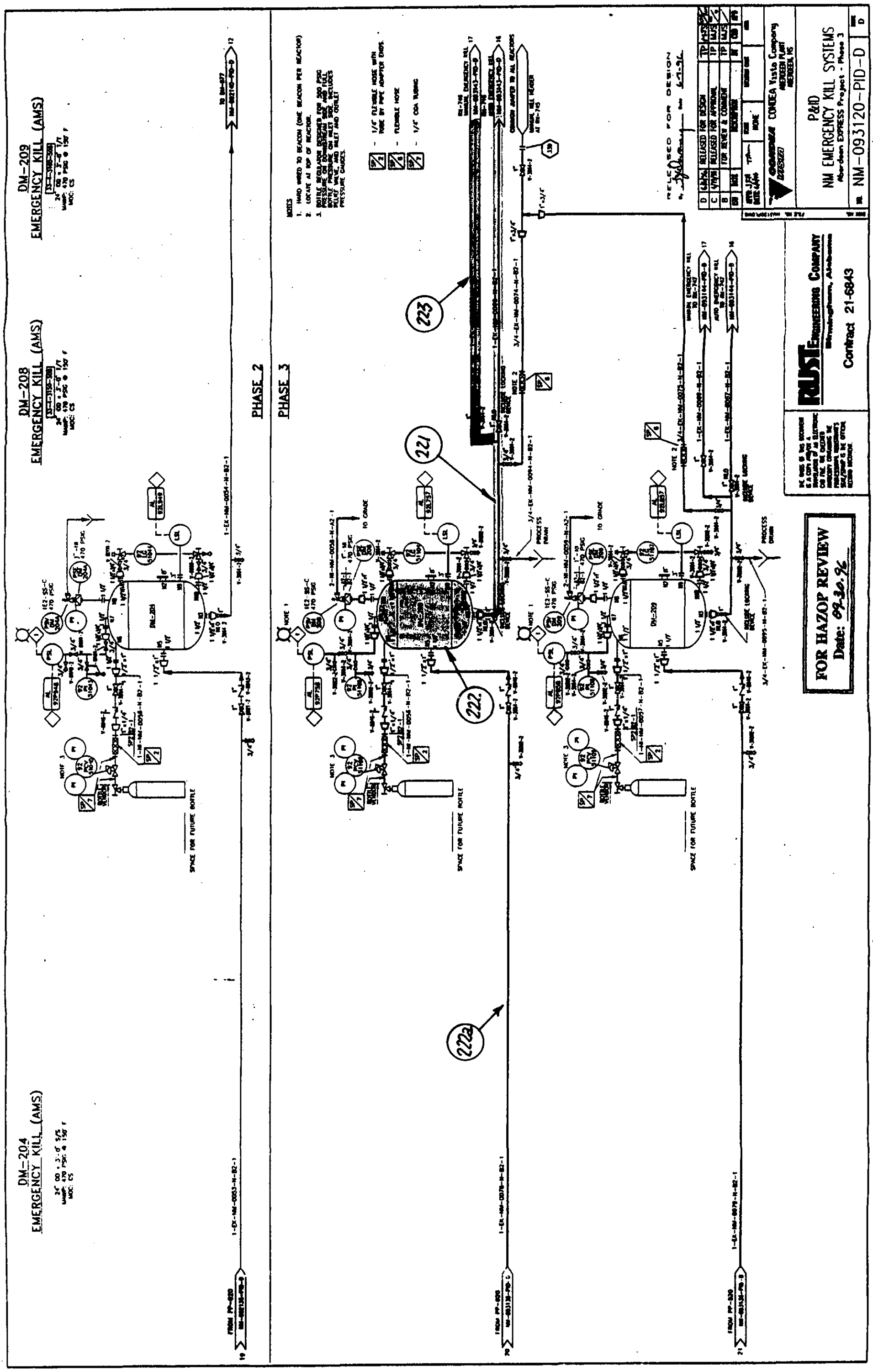



EX-113
STEAM INJECTION HEATER
VP-700A/VP-700B
REACTOR STEAM EJECTORS
216
EJECTOR CYCLONE SEPARATOR
VP-700A
1ST. STAGE
VP-700B
2ND STAGE
SILENCER
ATMOS
EX-113
PP-238
ADDED EXISTING VALVE
1/2" SS BRAIDED HOSE
RELEASED FOR DESIGN
PP-238
HOT WATER CIRCULATION PUMP
REACTOR HEAT UP LOOP
LEGEND
SUPPLY HEADER
RETURN HEADER
FOR HAZOP REVIEW
Date: 09-30-96
RELEASED FOR DESIGN
RELEASED FOR APPROVAL
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
NM STEAM & REACTOR EVACUATION
Aberdeen EXPRESS Project - Phase 3
NM-093122-PID-D
E


P&ID
NM DUMP PUMPS & STRAINER
Aberdeen EXPRESS Project - Phase 3
NM-093139-PID-D
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
RELEASED FOR DESIGN
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
FOR HAZOP REVIEW
Date: 09-20-96
PP-502
FL-012/FL-013
FL-012
FL-013
SUPERSACK
TO RECOVERY SYSTEM
TO DUMP TANK
RINSE WATER
STEAM
218


STRIPPER RINSE SYSTEM
OLD MODULE
STRIPPER RINSE SYSTEM
NEW MODULE
FROM RINSE WATER SUPPLY
STRIPPER FLUSH SYSTEM
NEW MODULE
FROM PROCESS WATER HEADER
STRIPPER FLUSH SYSTEM
OLD MODULE
FROM PROCESS WATER HEADER
STRIPPER FLUSH SYSTEM
NEW MODULE
FROM PROCESS WATER HEADER
219
FL-138
NEW MODULE FLUSH FILTER
MAWP: 150 PSIG @ 300F
MOC: 304 SS
800 GPM
FL-128
OLD MODULE FLUSH FILTER
MAWP: 150 PSIG @ 300F
MOC: 304 SS
800 GPM
FL-129
NEW MODULE FLUSH FILTER
MAWP: 150 PSIG @ 300F
MOC: 304 SS
800 GPM
ELECTRIC TRACED
MIN DISTANCE TO HEADER
FOR HAZOP REVIEW
Date: 09-30-96
RELEASED FOR DESIGN
D RELEASED FOR DESIGN
C RELEASED FOR DESIGN
B RELEASED FOR APPROVAL
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
STRIPPER RINSE AND FLUSH SYSTEM
Aberdeen EXPRESS Project - Phase 3
NM-093133-PID-D


P&ID
NM CLEAN WALL SUPPLY SYSTEMS
Aberdeen EXPRESS Project - Phase 3
NM-093128-PID-D
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
RELEASED FOR DESIGN
RELEASED FOR APPROVAL
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
FOR HAZOP REVIEW
Date: 09-30-96
NOTES
LEGEND
CLEAN WALL FOG NOZZLE
STRAINER
STEAM SUPPLY
FROM STRIPPING STEAM LINE
CLEAN WALL SUPPLY
220


DM-208
EMERGENCY KILL (AMS)
DM-209
EMERGENCY KILL (AMS)
DM-204
EMERGENCY KILL (AMS)
PHASE 2
PHASE 3
NOTES
1. HARD WIRED TO BEACON (ONE BEACON PER REACTOR)
2. LOCATE AT TOP OF REACTOR.
3. RUPTURE DISCS RATED FOR 500 PSIG PRESSURE ON DOWNSTREAM SIDE. INCLUDES RELIEF VALVE AND INLET AND OUTLET PRESSURE GAUGES.
1/4" FLEXIBLE HOSE WITH TUBE BY PIPE ADAPTOR ENDS.
FLEXIBLE HOSE
1/4" OD4 TUBING
RELEASED FOR DESIGN
D RELEASED FOR DESIGN
C RELEASED FOR APPROVAL
B FOR REVIEW & COMMENT
P&ID
NM EMERGENCY KILL SYSTEMS
Aberdeen EXPRESS Project - Phase 3
NM-093120-PID-D
RUST Engineering Company
Contract 21-6843
FOR HAZOP REVIEW
Date: 9-30-96
SPACE FOR FUTURE BOTTLE
221
222
222a
223

PP-020
AMS TRANSFER PUMP

DM-085
EMERGENCY KILL (AMS)

DM-114
EMERGENCY KILL (AMS)

DM-786
EMERGENCY KILL (AMS)

DM-113
EMERGENCY KILL (AMS)

DM-111
EMERGENCY KILL (AMS)

DM-110
EMERGENCY KILL (AMS)

FOR HAZOP REVIEW
Date: 09-30-96

Nb BOTTLES AMS VALVES
EMERGENCY AMS KILL SYSTEM CONTROL
VALVE NITROGEN CYLINDER

NM CYLINDER PRESSURE: 600 PSIG
ACTUATED VALVE REGULATOR
SET PRESSURE 80 PSIG

LEGEND

D	6/6/96	RELEASED FOR DESIGN	TP	MJF	
C	4/19/96	RELEASED FOR APPROVAL	TP	MJF	
B		FOR REVIEW & COMMENT	TP	MJF	
ISS	DATE	DESCRIPTION	BY	CHK	APP'D

CONOCO (UK) LTD — CONOCO Vista Company
ABERDEEN PLANT
ABERDEEN, MS

RUST ENGINEERING COMPANY
Birmingham, Alabama

Contract 21-6843

P&ID
NM EMERGENCY KILL SYSTEMS
Aberdeen EXPRESS Project - Phase 3

DRG. NO. NM-093136-PID-D — ISSUE D

RELEASED FOR DESIGN
By: [signature] Date: 6-7-96

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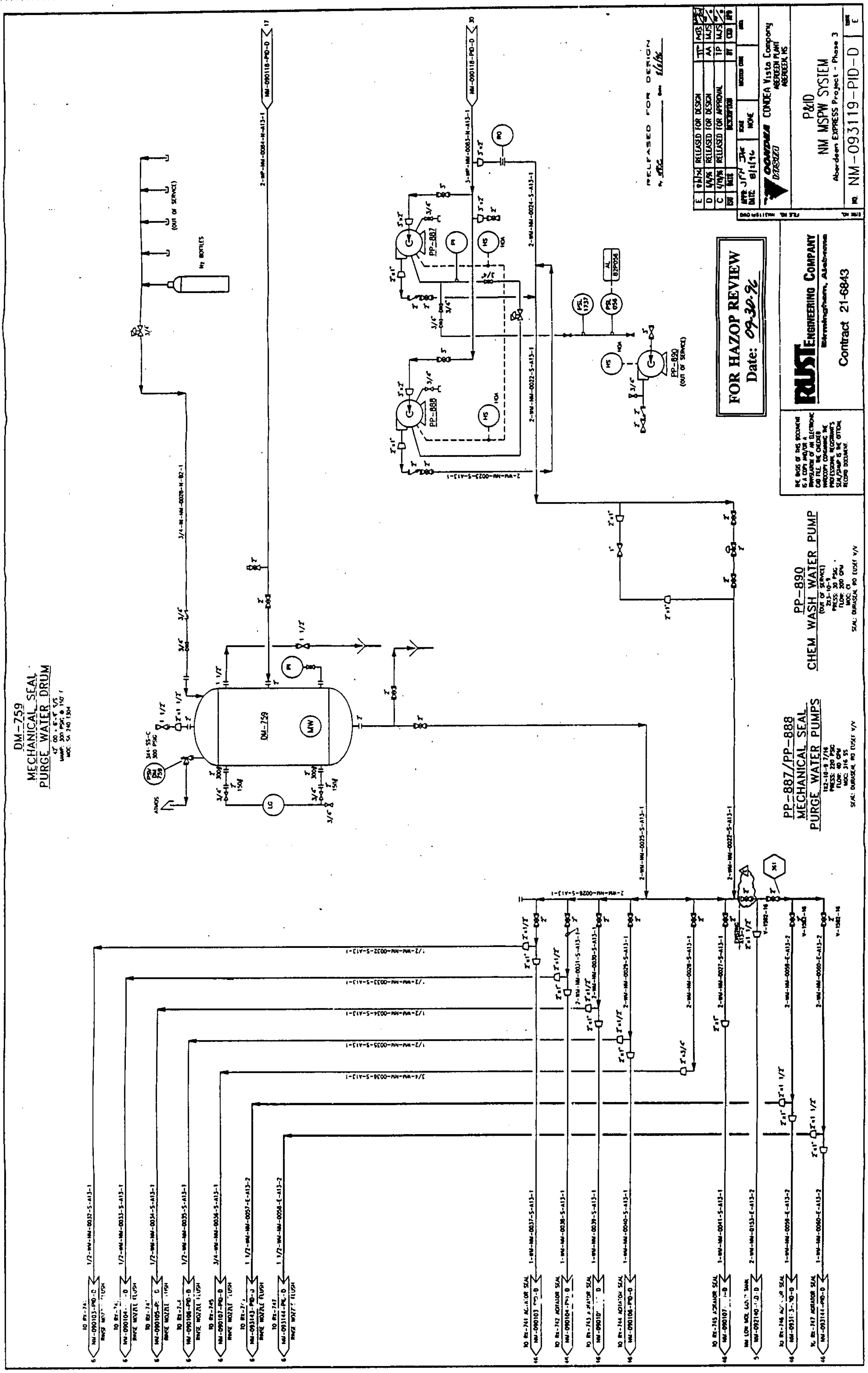
ABD00029972


RELEASED FOR DESIGN
E 9/6/96 RELEASED FOR DESIGN TT MJS
D 6/6/96 RELEASED FOR DESIGN AA MJS
C 4/19/96 RELEASED FOR APPROVAL TP MJS
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
NM MSPW SYSTEM
Aberdeen EXPRESS Project - Phase 3
NM-093119-PID-D
E
FOR HAZOP REVIEW
Date: 09-30-96
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
DM-759
MECHANICAL SEAL
PURGE WATER DRUM
PP-887/PP-888
MECHANICAL SEAL
PURGE WATER PUMPS
PP-890
CHEM WASH WATER PUMP
(OUT OF SERVICE)
N2 BOTTLES
(OUT OF SERVICE)
PP-887
PP-888
PP-890
NM-090118-PID-D
NM-090103-PID-D
NM-090104-PID-D
NM-090105-PID-D
NM-090106-PID-D
NM-090107-PID-D
NM-093143-PID-D
NM-093144-PID-D
NM-092140-PID-D
RINSE NOZZLE FLUSH
TO RX-741 AGITATOR SEAL
TO RX-742 AGITATOR SEAL
TO RX-743 AGITATOR SEAL
TO RX-744 AGITATOR SEAL
TO RX-745 AGITATOR SEAL
TO RX-746 AGITATOR SEAL
TO RX-747 AGITATOR SEAL
NM LOW MOL EAST TANK

DM-754
SEAL OIL TANK
36" OD x 5'-0" S/S
MAWP: ATM @ 150° F
MOC: CS

ME-299/300
SEAL OIL UNIT
RESERVOIR CAPACITY: 44 GAL
16 GAGE SHELL
COOLING COIL: 5/8" ID
MAWP: 175 PSIG @ 380° F
LENGTH: 105'
OUTSIDE AREA: 1.742 ft²/ft

FL-056/FL-057
SEAL OIL OUTLET FILTERS
33-4-3530-530 33-4-3540-530
3" OD x 9"
MAWP: X PSIG @ X° F
MOC: 304 SS
16 GPM, 10 MICRON

NOTES:
1 REPLACE PP-240, PP-241, FL-725, FL-726, FL-727, FL-728

SP/1 - 1/2" RUBBER HOSE
SP/2 - BRAIDED HOSE

PP-534/PP-535
SEAL OIL CIRCULATION PUMPS
33-4-3500-543 33-4-3510-543
1" x 1"
GEAR PUMP
CI & STEEL CONST.
PRESS. X PSIG
FLOW: 16.0 GPM

FL-054/FL-055
SEAL OIL INLET FILTERS
33-4-3520-530 33-4-3525-530
3" OD x 7"
MAWP: 300PSIG @ 250° F
MOC: 304 SS
FLOW: 16.0 GPM, 10 MICRON

FOR HAZOP REVIEW
Date: 09-30-96

RELEASED FOR DESIGN
by JFC Date 6/6/96

ISU	DATE	DESCRIPTION	BY	CKD	APD
E	10/1/96	RELEASED FOR DESIGN	TP	MJS	
D	6/6/96	RELEASED FOR DESIGN	TP	MJS	
C	4/19/96	RELEASED FOR APPROVAL	TP	MJS	

APP'D JFH JAE
DATE 6/6/96
ZONE NONE
LOCATION CODE
AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

P&ID
NM SEAL OIL SYSTEM
Aberdeen EXPRESS Project - Phase 3

NO. NM-093126-PID-D
ISSUE E

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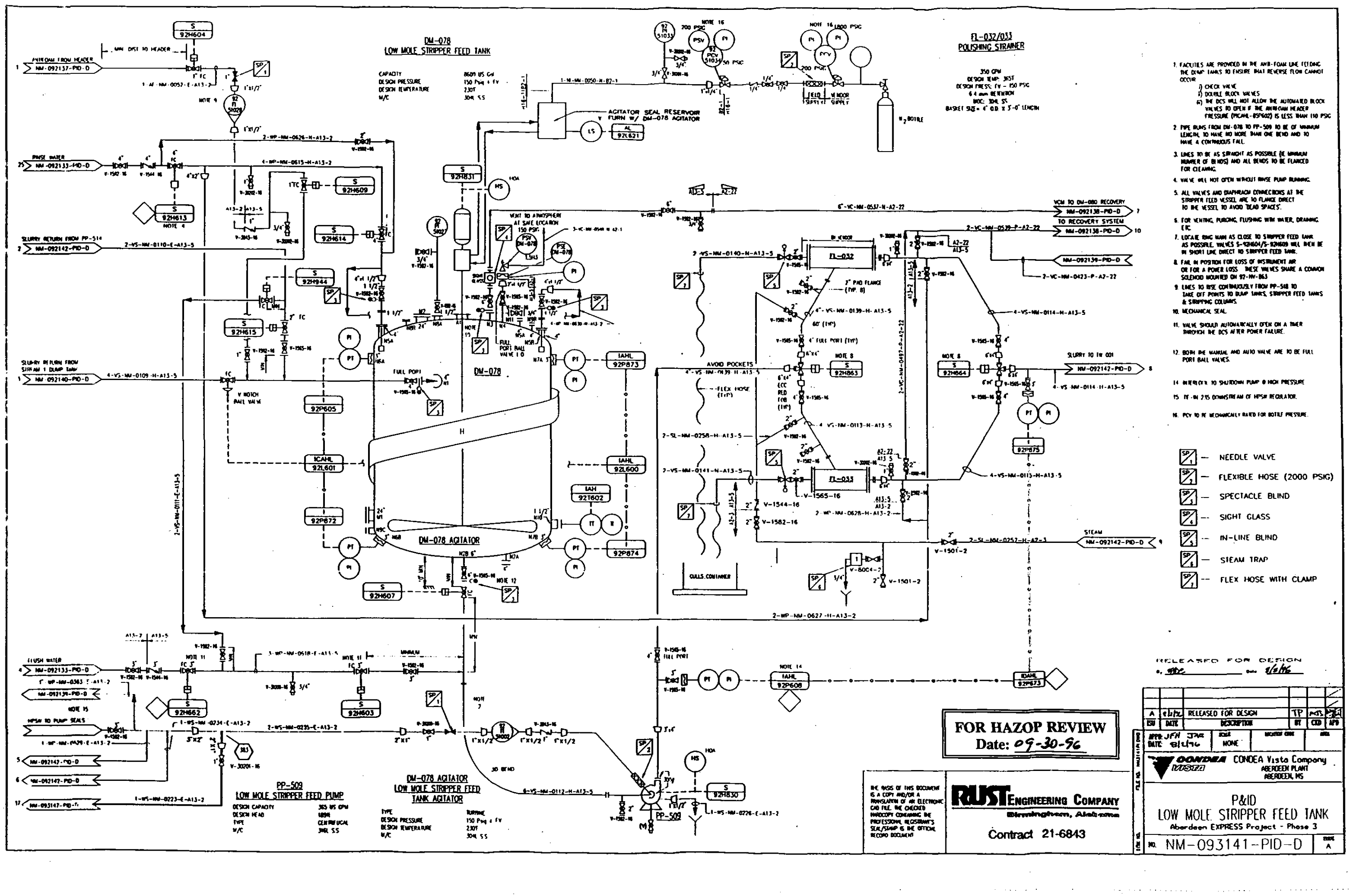
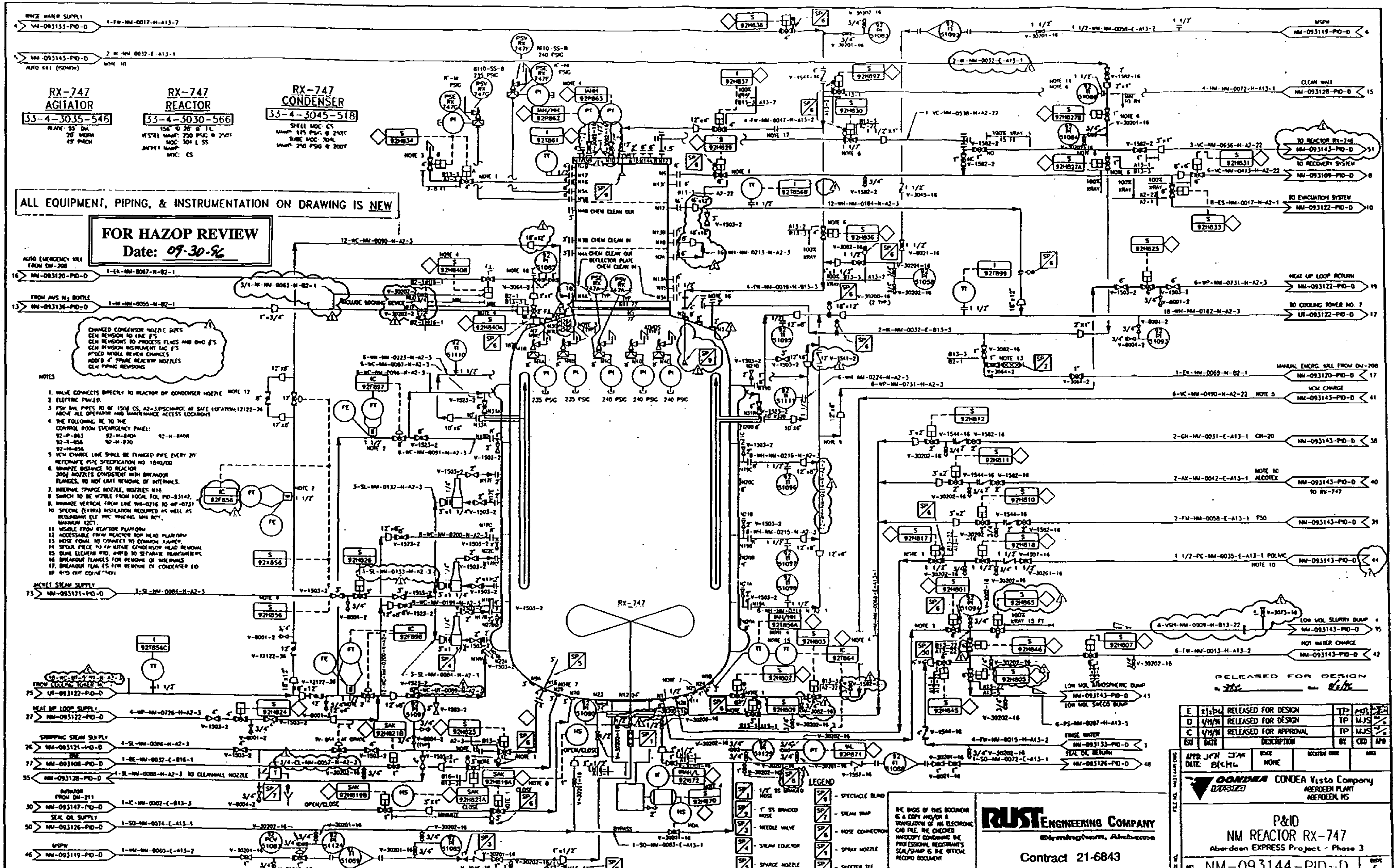
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

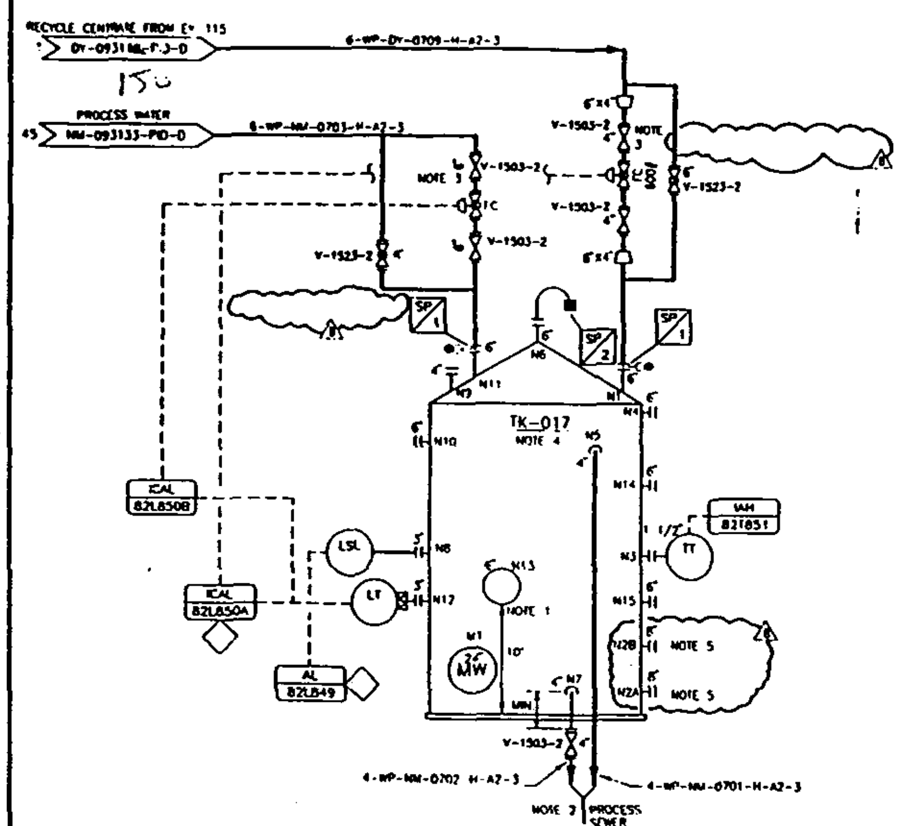
FILE NO. MULTIPLE DWG
ITEM NO.

ABD00029974




RX-747 AGITATOR
33-4-3035-546
RX-747 REACTOR
33-4-3030-566
RX-747 CONDENSER
33-4-3045-518
ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON DRAWING IS NEW
FOR HAZOP REVIEW
Date: 09-30-96
RX-747
LEGEND
RELEASED FOR DESIGN
E RELEASED FOR DESIGN
D 4/19/96 RELEASED FOR DESIGN
C 4/19/96 RELEASED FOR APPROVAL
REV DATE DESCRIPTION
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
P&ID
NM REACTOR RX-747
Aberdeen EXPRESS Project - Phase 3
NO. NM-093144-PID-D

TK-017
NEW MODULE
RECYCLED CENTRATE TANK
56-4-6097-507
18,000 GAL FRP



NOTE:
1 NOZZLE N13 IS FOR INSPECTION, REMOVE BLIND FLANGE
2 DRAIN PIPE TERMINATES 2 INCHES ABOVE GRATING.
3 ACCESSABLE FROM GRADE
4 ALL FLANGED CONNECTIONS TO TK-017 ARE 125# FF
5 RINSE PUMPS BY OTHERS.

SP/1 — SPECTACLE BLIND
SP/2 — BIRD SCREEN

ADDED NOTE 5
REMOVED BYPASS LINE NUMBER

ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW

FOR HAZOP REVIEW
Date: 09-30-96

RELEASED FOR DESIGN

ISU	DATE	DESCRIPTION	BY	CKD	APD
B	8/2/96	RELEASED FOR DESIGN	TP	MTS	
A	6/21/96	RELEASED FOR DESIGN	AA	MJS	

APPR: JFH JAE
DATE: 8/1/96
SCALE: NONE

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

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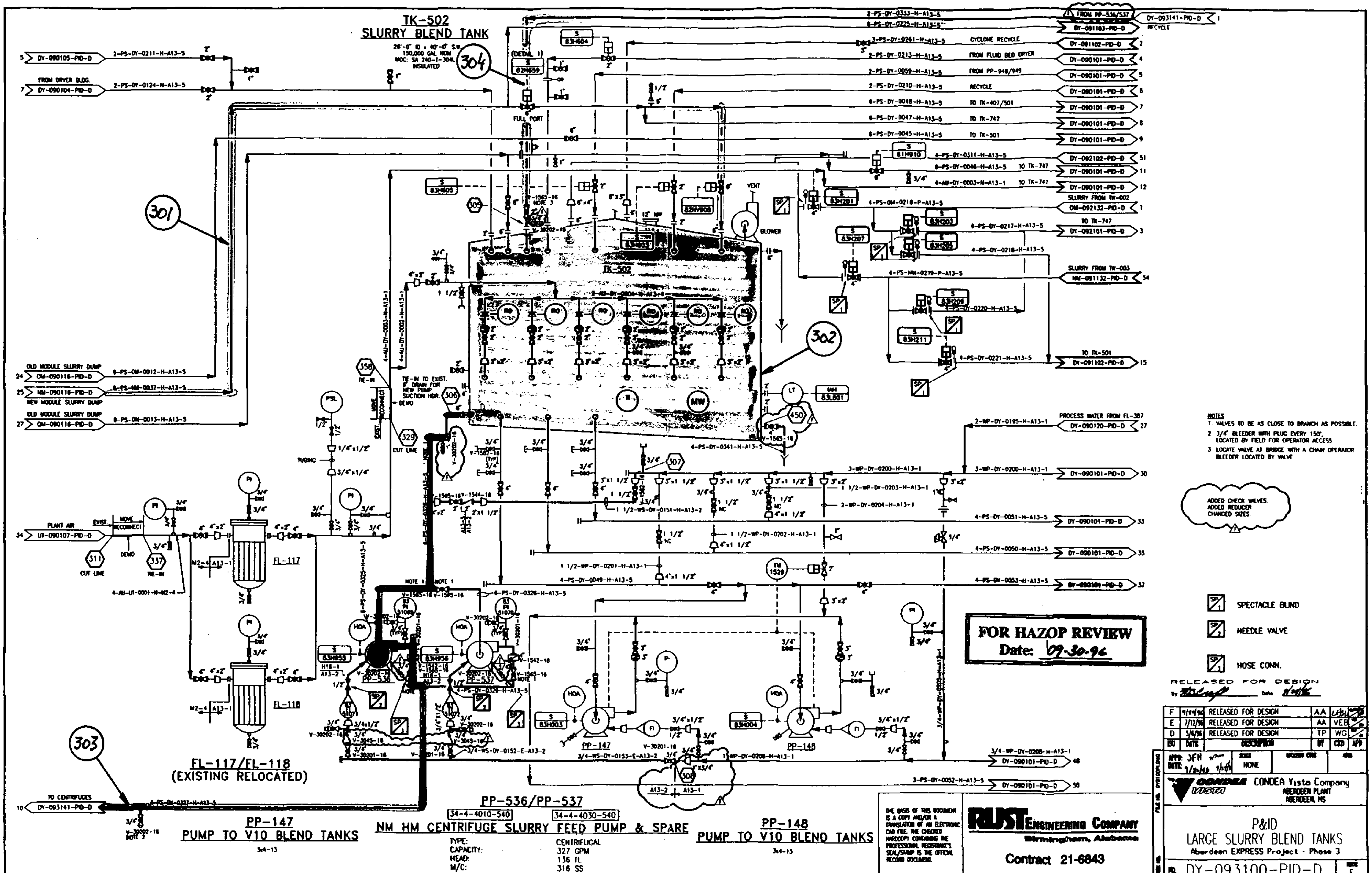
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

P&ID
HOT WATER CHARGE & RINSE SYS.
Aberdeen EXPRESS Project - Phase 3

NO. NM-093149-PID-D
ISSUE B


TK-502
SLURRY BLEND TANK
26'-0" ID x 40'-0" S.W.
150,000 GAL NOM
MOC: SA 240-1-304L
INSULATED
TK-502
FL-117/FL-118
(EXISTING RELOCATED)
PP-147
PUMP TO V10 BLEND TANKS
PP-536/PP-537
34-4-4010-540
34-4-4030-540
NM HM CENTRIFUGE SLURRY FEED PUMP & SPARE
TYPE: CENTRIFUGAL
CAPACITY: 327 GPM
HEAD: 136 ft.
M/C: 316 SS
PP-148
PUMP TO V10 BLEND TANKS
FOR HAZOP REVIEW
Date: 09-30-96
NOTES
1. VALVES TO BE AS CLOSE TO BRANCH AS POSSIBLE.
2. 3/4" BLEEDER WITH PLUG EVERY 150'. LOCATED BY FIELD FOR OPERATOR ACCESS
3. LOCATE VALVE AT BRIDGE WITH A CHAIN OPERATOR BLEEDER LOCATED BY VALVE
ADDED CHECK VALVES. ADDED REDUCER CHANGED SIZES.
SPECTACLE BLIND
NEEDLE VALVE
HOSE CONN.
RELEASED FOR DESIGN
F 9/19/96 RELEASED FOR DESIGN AA
E 7/12/96 RELEASED FOR DESIGN AA VEB
D 5/6/96 RELEASED FOR DESIGN TP WG
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
LARGE SLURRY BLEND TANKS
Aberdeen EXPRESS Project - Phase 3
DY-093100-PID-D
F
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
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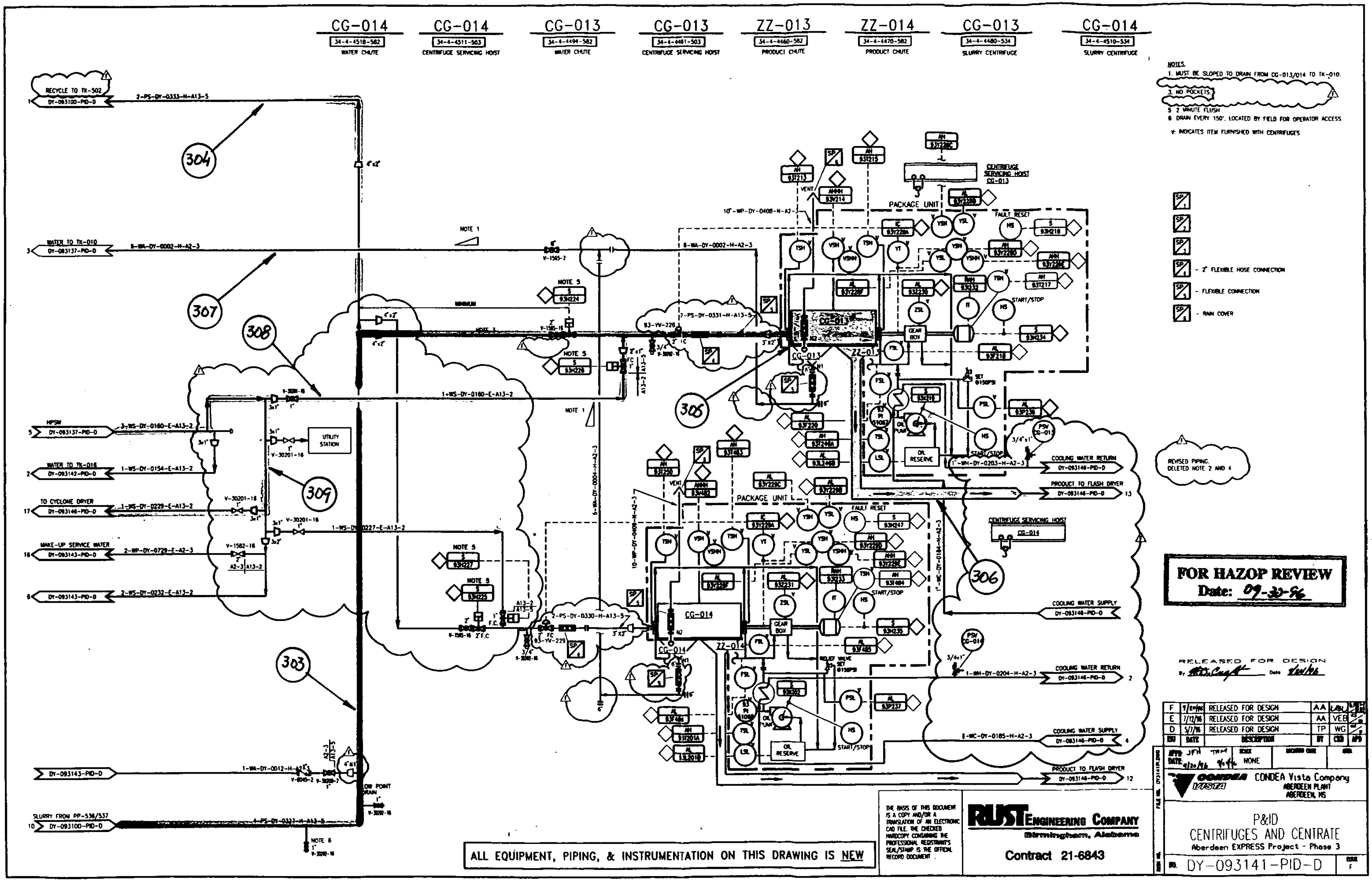
TO CENTRIFUGES
DY-093141-PID-D
PLANT AIR
UT-090107-PID-D
OLD MODULE SLURRY DUMP
OM-090116-PID-D
NEW MODULE SLURRY DUMP
NM-090116-PID-D
FROM DRYER BLDG.
DY-090104-PID-D
DY-090105-PID-D
CYCLONE RECYCLE
FROM FLUID BED DRYER
FROM PP-948/949
RECYCLE
TO TK-407/501
TO TK-747
TO TK-501
SLURRY FROM TW-002
SLURRY FROM TW-003
PROCESS WATER FROM FL-387
301
302
303
304


CG-014
34-4-4518-582
WATER CHUTE
CG-014
34-4-4511-503
CENTRIFUGE SERVICING HOIST
CG-013
34-4-4494-582
WATER CHUTE
CG-013
34-4-4481-503
CENTRIFUGE SERVICING HOIST
ZZ-013
34-4-4460-582
PRODUCT CHUTE
ZZ-014
34-4-4470-582
PRODUCT CHUTE
CG-013
34-4-4480-534
SLURRY CENTRIFUGE
CG-014
34-4-4510-534
SLURRY CENTRIFUGE
NOTES:
1. MUST BE SLOPED TO DRAIN FROM CG-013/014 TO TK-010.
3. NO POCKETS
5. 2 MINUTE FLUSH
6. DRAIN EVERY 150', LOCATED BY FIELD FOR OPERATOR ACCESS
V: INDICATES ITEM FURNISHED WITH CENTRIFUGES
- 2" FLEXIBLE HOSE CONNECTION
- FLEXIBLE CONNECTION
- RAIN COVER
REVISED PIPING.
DELETED NOTE 2 AND 4
RECYCLE TO TK-502
DY-093100-PID-D
WATER TO TK-010
DY-093137-PID-D
HPSW
DY-093137-PID-D
WATER TO TK-016
DY-093142-PID-D
TO CYCLONE DRYER
DY-093146-PID-D
MAKE-UP SERVICE WATER
DY-093143-PID-D
DY-093143-PID-D
DY-093143-PID-D
SLURRY FROM PP-536/537
DY-093100-PID-D
UTILITY STATION
PACKAGE UNIT
CENTRIFUGE SERVICING HOIST CG-013
CENTRIFUGE SERVICING HOIST CG-014
COOLING WATER RETURN
DY-093146-PID-D
PRODUCT TO FLASH DRYER
DY-093146-PID-D
COOLING WATER SUPPLY
DY-093146-PID-D
COOLING WATER RETURN
DY-093146-PID-D
COOLING WATER SUPPLY
DY-093146-PID-D
PRODUCT TO FLASH DRYER
DY-093146-PID-D
FOR HAZOP REVIEW
Date: 09-30-96
RELEASED FOR DESIGN
ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW
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RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
F 9/20/96 RELEASED FOR DESIGN
E 7/12/96 RELEASED FOR DESIGN
D 5/7/96 RELEASED FOR DESIGN
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
CENTRIFUGES AND CENTRATE
Aberdeen EXPRESS Project - Phase 3
DY-093141-PID-D
F

ZZ-010 34-4-4480-582 PRODUCT CHUTE

ZZ-011 34-4-4470-582 PRODUCT CHUTE

CV-032 34-4-4080-501 VIBRATING FEEDERS

CV-033 34-4-4080-501 VIBRATING FEEDERS

CV-034 34-4-4100-505 PADDLE FEEDER

CV-035 34-4-4120-505 PADDLE FEEDER

DR-011 34-4-4150-537 FLASH DRYER

FH-011 34-4-4300-528 DRYING AIR HEATER PACKAGE

FN-018 34-4-4280-526 FORCED DRAFT FAN 64000 SCFM

FL-060 34-4-4260-536 DRYING AIR FILTER

DR-011

311

306

306a

309

310

ZZ-010

ZZ-011

CV-032

CV-033

CV-034

CV-035

FH-011

FN-018

FL-060

DR-011

PACKAGE UNIT

BURNER CONTROL SYSTEM

ALARM

FLAME ON

PURGE-IN PROGRESS

PURGE COMPLETE

START

STOP

FROM CC-014 SEAL OIL PUMP

COOLING WATER RETURN

TO CC-014 OIL PUMP

TO CC-013 OIL PUMP

COOLING WATER SUPPLY

SLURRY FROM CENTRIFUGE CC-014

SLURRY FROM CENTRIFUGE CC-013

PROCESS WATER

PLANT AIR (LP)

NATURAL GAS

FRESH AIR

V-1582-2

DRYING AIR DUCT 48" x 48" (316L SS)

BUTTERFLY DAMPER W/ 48" DIAMETER 34-4-4152-583

INSPECTION

ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW

NOTES

1. MANHOLE WITH PLUG AND DAVIT
2. EXPANSION POINT WITH SEAL
3. MAX. 6.5' ABOVE VESSEL
4. SPRAY NOZZLE
5. SLIDE GATE OR BUTTERFLY VALVE OPEN DURING NORMAL OPERATION
7. DAMPER INCLUDES ACTUATOR TO BE SUPPLY BY FD-FAN VENDOR DAMPER CONTROLLED BY 93PMLS
8. FILTER- MOTOR CONTROL LOCAL ONLY
9. DRYING AIR HEATER PACKAGE UNIT INCLUDING BURNER, BURNER MANAGING AND CONTROL SYSTEM , SAFETY SYSTEM, NATURAL GAS SUPPLY REFERRING TO VENDOR SELECTED BY DETAIL
10. FIELD ROUTE VENT LINES TO SAFE LOCATION AND EXTERIOR OF BUILDING
11. FUEL GAS VALVE AND COMBUSTION AIR FLAP MECHANICAL INTER-LOCK (IF ANY)
12. IGNITION GAS
13. FLAPPER
14. FLEXIBLE SEAL
15. FIELD ROUTE 1/2" LINE TO DRYER AIR PURGE NOZZLES AS REQUIRED
16. NOZZLE STANDOFF 6". INSTRUMENT REQUIRES 6" EXTEND DIAPHRAGM SEAL

V.1. ITEMS FURNISHED WITH DRYING AIR HEATER FH-011

V.2 ITEMS FURNISHED WITH FAN FN-018

SP/1 — NEEDLE VALVE

SP/2 — SPECTACLE BLIND

REVISED PIPING. REVISED INSTRUMENT. DELETED VALVE.

FOR HAZOP REVIEW
Date: 09-30-96

RELEASED FOR DESIGN
By _____ Date 9/16/96

ISU	DATE	DESCRIPTION	BY	CKD	APD
E	9/12/96	RELEASED FOR DESIGN	AA	LMS	
D	7/12/96	RELEASED FOR DESIGN	AA	VEB	
C	5/7/96	RELEASED FOR DESIGN	TP	WG	

APPD: JFH TBM DATE: 5/20/96 9/4/96 | SCALE: NONE | MICROFILM CODE | AREA

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

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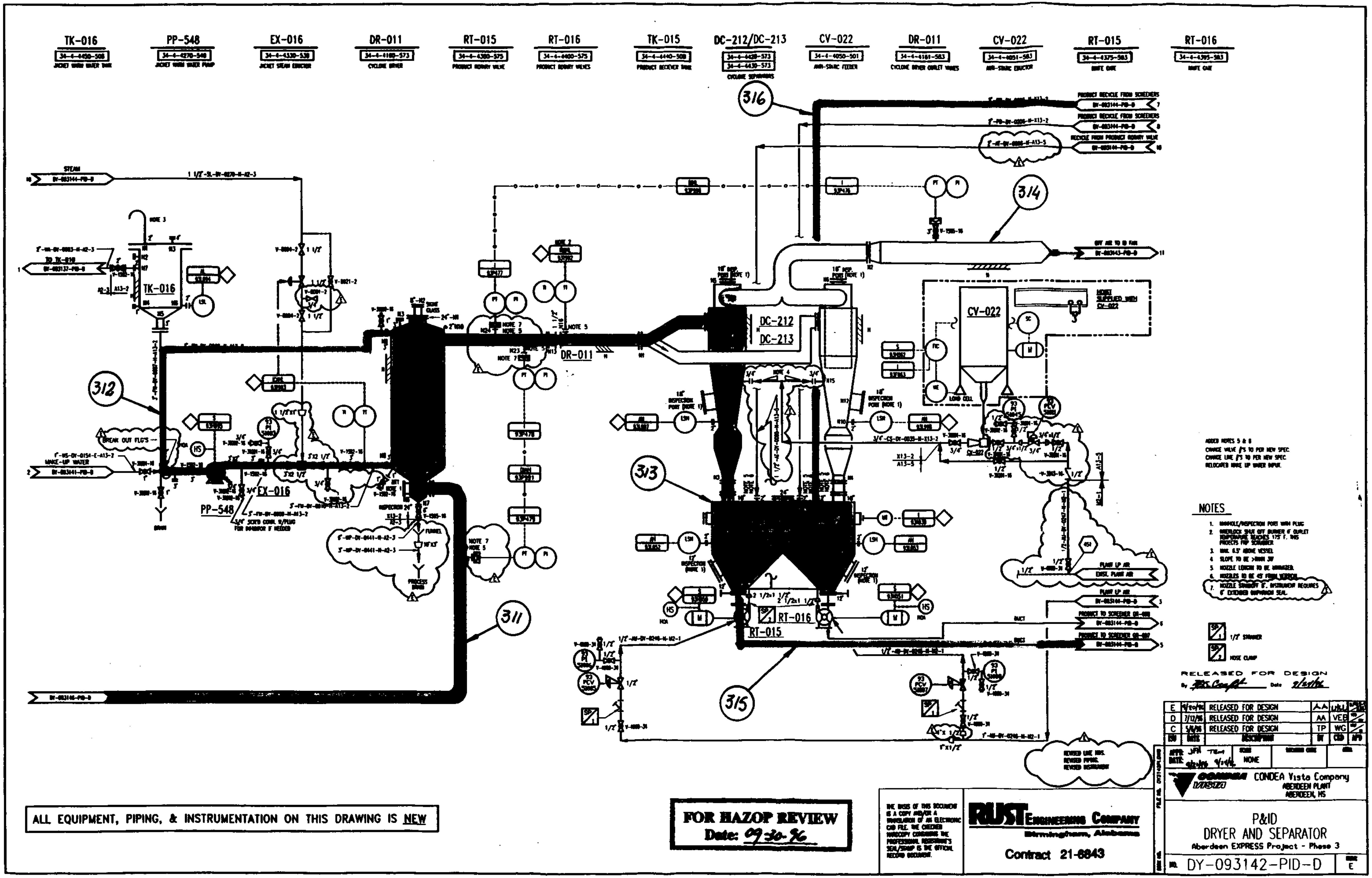
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

P&ID
DRYER 11
Aberdeen EXPRESS Project - Phase 3

NO. DY-093146-PID-D | E

FILE NO. 093146PLDWG | ISSUE NO.

ABD00029980


TK-016
PP-548
EX-016
DR-011
RT-015
RT-016
TK-015
DC-212/DC-213
CV-022
DR-011
CV-022
RT-015
RT-016
311
312
313
314
315
316
NOTES
RELEASED FOR DESIGN
E RELEASED FOR DESIGN
D 7/12/96 RELEASED FOR DESIGN
C RELEASED FOR DESIGN
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
DRYER AND SEPARATOR
Aberdeen EXPRESS Project - Phase 3
DY-093142-PID-D
E
RUST Engineering Company
Birmingham, Alabama
Contract 21-6843
FOR HAZOP REVIEW
Date: 09-30-96
ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW

ME-110 34-4-4670-583 PRODUCT MAGNETS

ME-111 34-4-4680-583 PRODUCT MAGNETS

GR-012 34-4-4240-578 PRODUCT SCREENER

GR-011 34-4-4220-578 PRODUCT SCREENER W/ LUBE SYSTEM

RT-014 34-4-4630-575 34-4-4685-508 PRODUCT ROTARY VALVE/TRANSPORTER VESSEL

GR-011 34-4-4920-583 PRODUCT RECYCLE CONVEYOR EDUCTOR

GR-012 34-4-4925-583 PRODUCT RECYCLE CONVEYOR EDUCTOR

GR-011 34-4-4225-508 OVERSIZE COLLECTION TANK 35 FT.³

GR-012 34-4-4255-508 OVERSIZE COLLECTION TANK 35 FT.³

PRODUCT FROM TK-015 (B) DY-093142-PID-B

PRODUCT FROM TK-015 (A) DY-093142-PID-B

315

316

317

318

319

ME-110

ME-111

GR-011

GR-012

COLLECTOR TRAY

HOSE PKG

PRODUCT SCREENER LUBE OIL SYSTEM

GEAR PUMP

OVERSIZE COLLECTOR DISTRIBUTOR ASSEMBLY (TYP. 7)

OVERSIZE COLLECTION TANK

PRODUCT ROTARY VALVE

RT-014

GR-011 EDUCTOR

GR-012 EDUCTOR

NOTE 3

NOTE 4

NOTE 5

NOTE 6

NOTE 7

UTILITY STATION

STEAM DY-093140-PID-D

STEAM TO EX-018 DY-093142-PID-B

RECYCLE TO CYCLONE SEPARATOR DY-093142-PID-B

DY-093146-PID-B

DY-093142-PID-B

TO SLIDE GATE VALVE

TO CYCLONE SEPARATOR DY-093142-PID-B

TO CYCLONE SEPARATOR DY-093142-PID-B

AIR SUPPLY DY-093140-PID-B

DY-093129-PID-B

STEAM TRAP, SPEC BY WAKE ALLSOP

DEZURIK KNIFE GATE VALVE

HOSE CONN

1/2" STRAINER

NOTES.

1. BY PASS LINE SHALL BE AS CLOSE TO GRADE AS POSSIBLE
3. LOCATE TRAP LOWER THAN INLET LINES THAT CONNECT TO RESIN STREAM SO ALL CONDENSATE DRAINS TO TRAP
4. MAKE EDUCTORS ACCESSABLE
5. 3/4" BALL VALVE EVERY 150 FT. FIELD LOCATED FOR OPER. ACCESS
6. MOUNT TRANSMITTER ON TOP OF LINE
7. DIFFERENTIAL REGULATOR TAPS INTO TRANSMITTER LINE 93PT965.

FOR HAZOP REVIEW
Date: 09-30-96

ADDED AIR TRANSPORT BYPASS LINES
ADDED BALL VALVE TO EDUCTOR.
ADDED VALVE ON OUTLET RT-014.
CHANGED LINE NO.
REVISED PIPING.

RELEASED FOR DESIGN
By _____ Date 11/20/96

ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW

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RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

ISSU	DATE	DESCRIPTION	BY	CKD	APD
F	9/09/96	RELEASED FOR DESIGN	AA	LAL	
E	7/12/96	RELEASED FOR DESIGN	AA	VEB	
D	5/1/96	RELEASED FOR DESIGN	TP	WG	

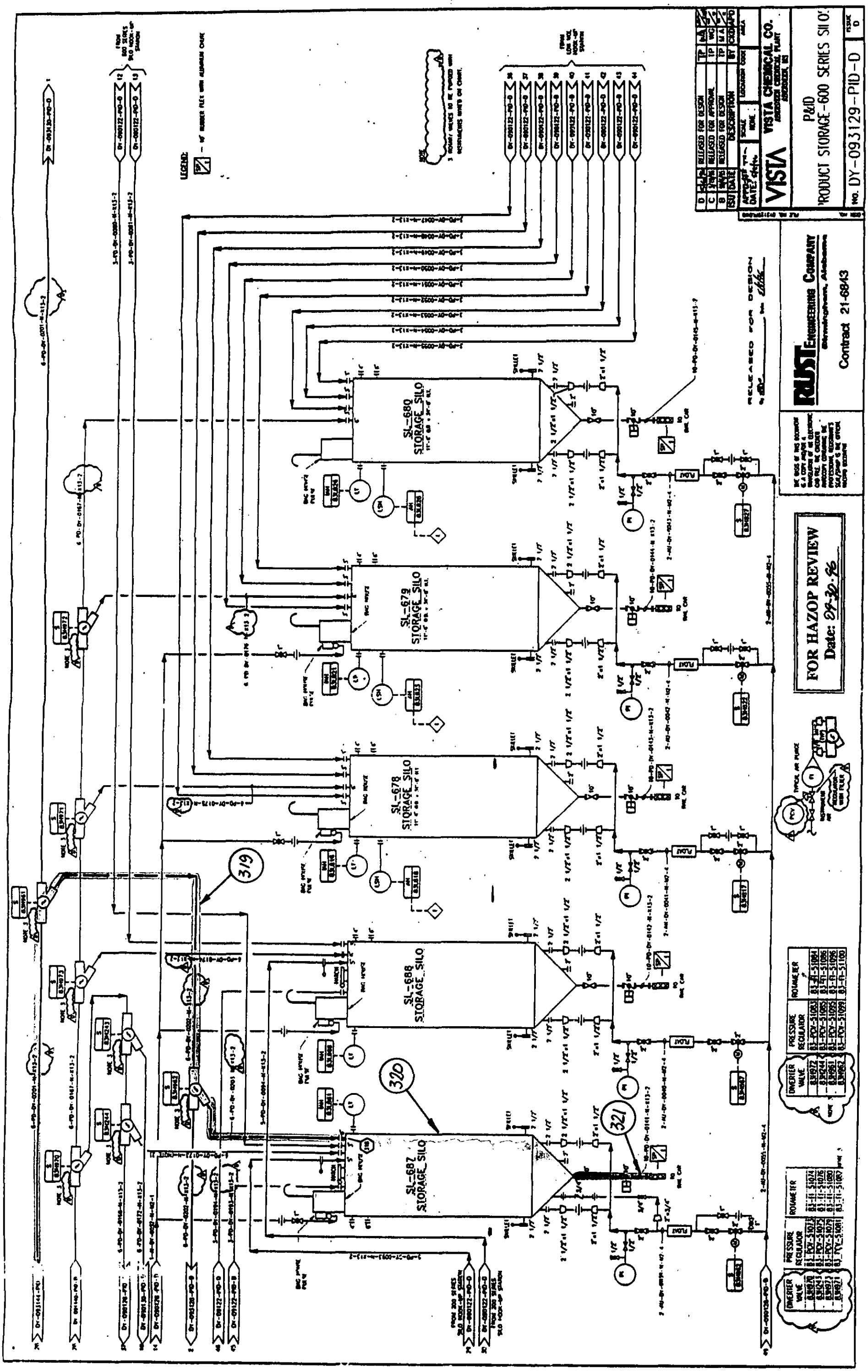
APPD: JFB TBM ISSUE: NONE

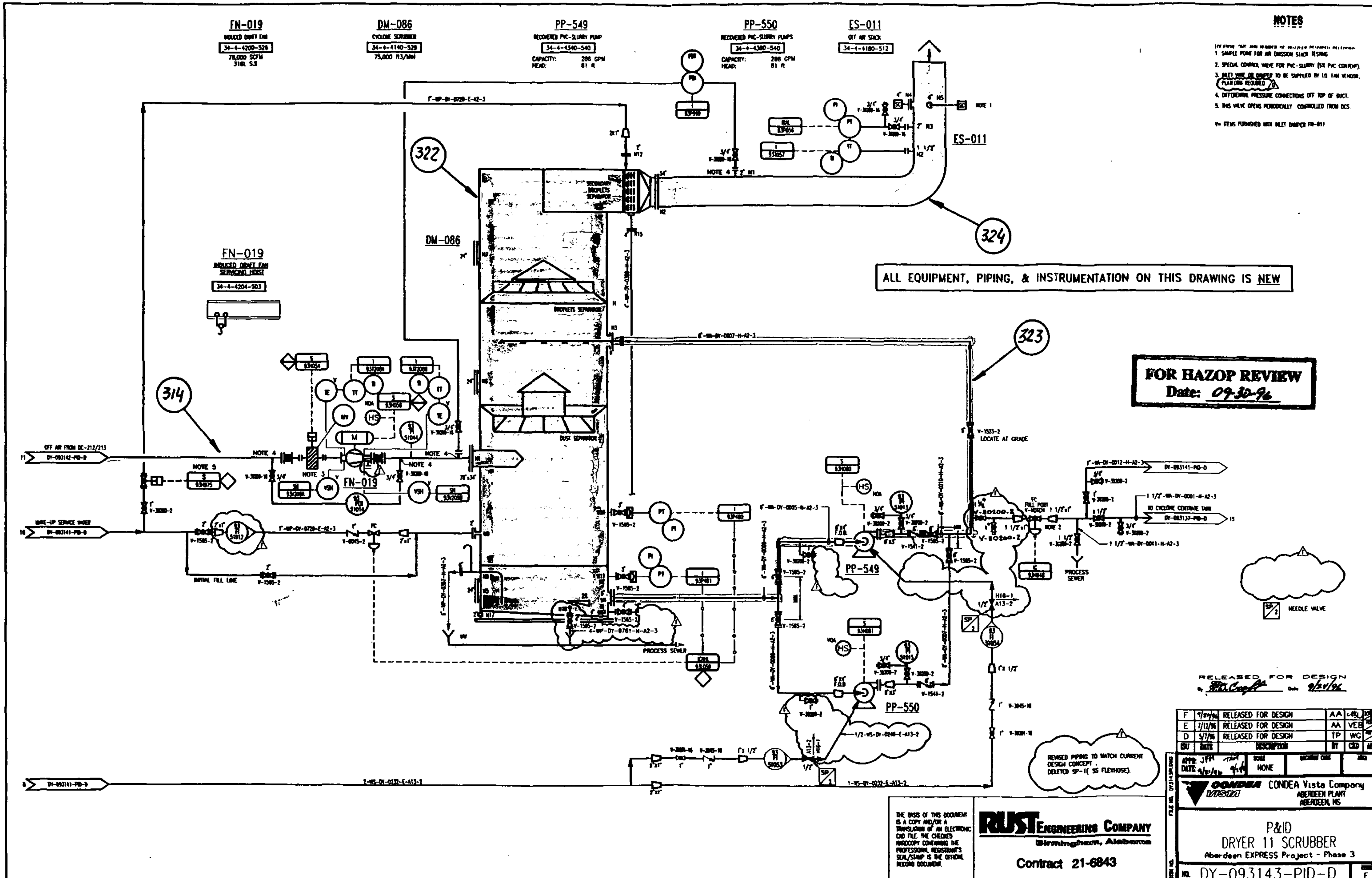
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

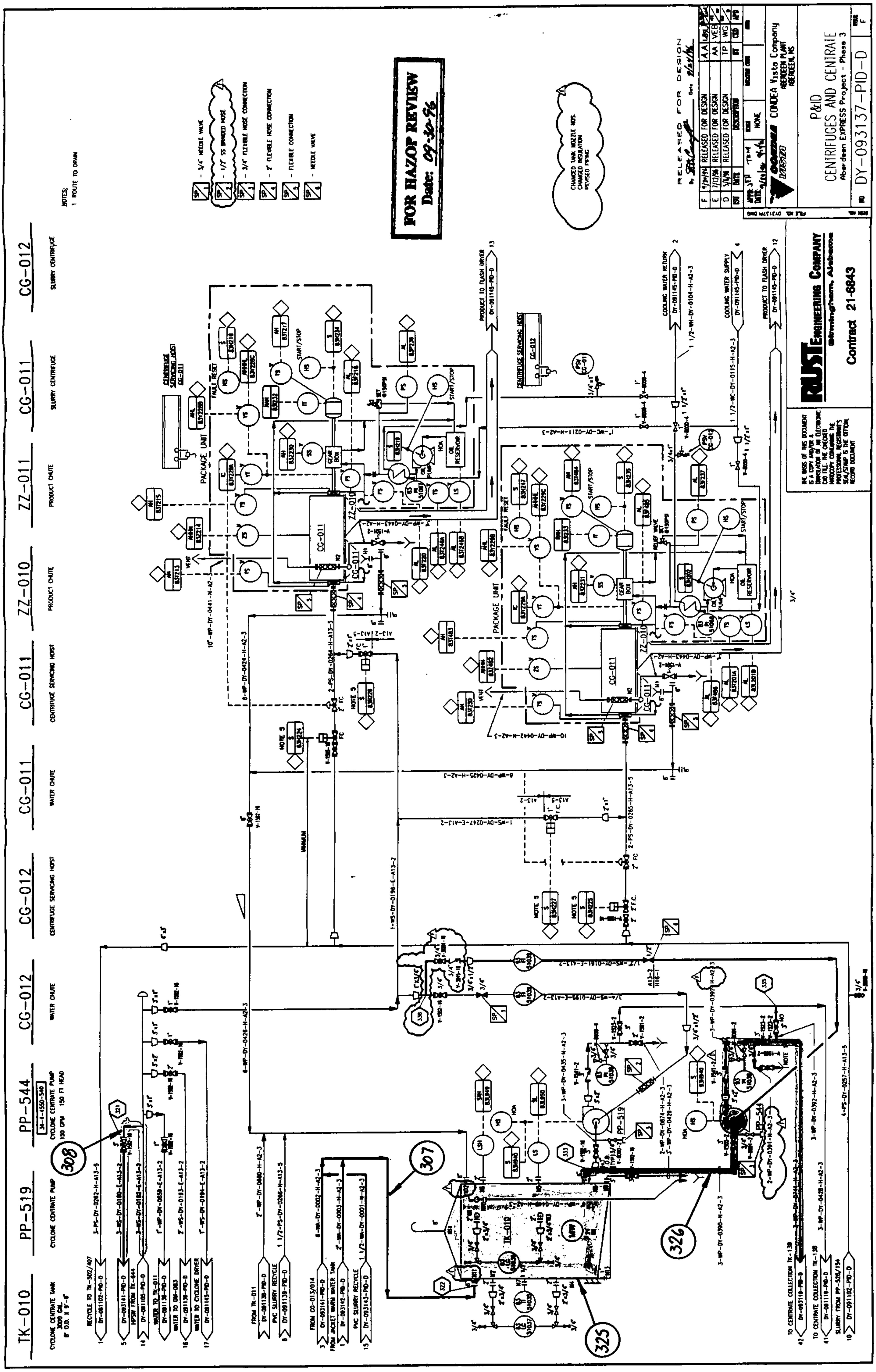
P&ID
DRYER 11 TRANSFER
Aberdeen EXPRESS Project - Phase 3

DWG NO. DY-093144-PID-D ISSUE F

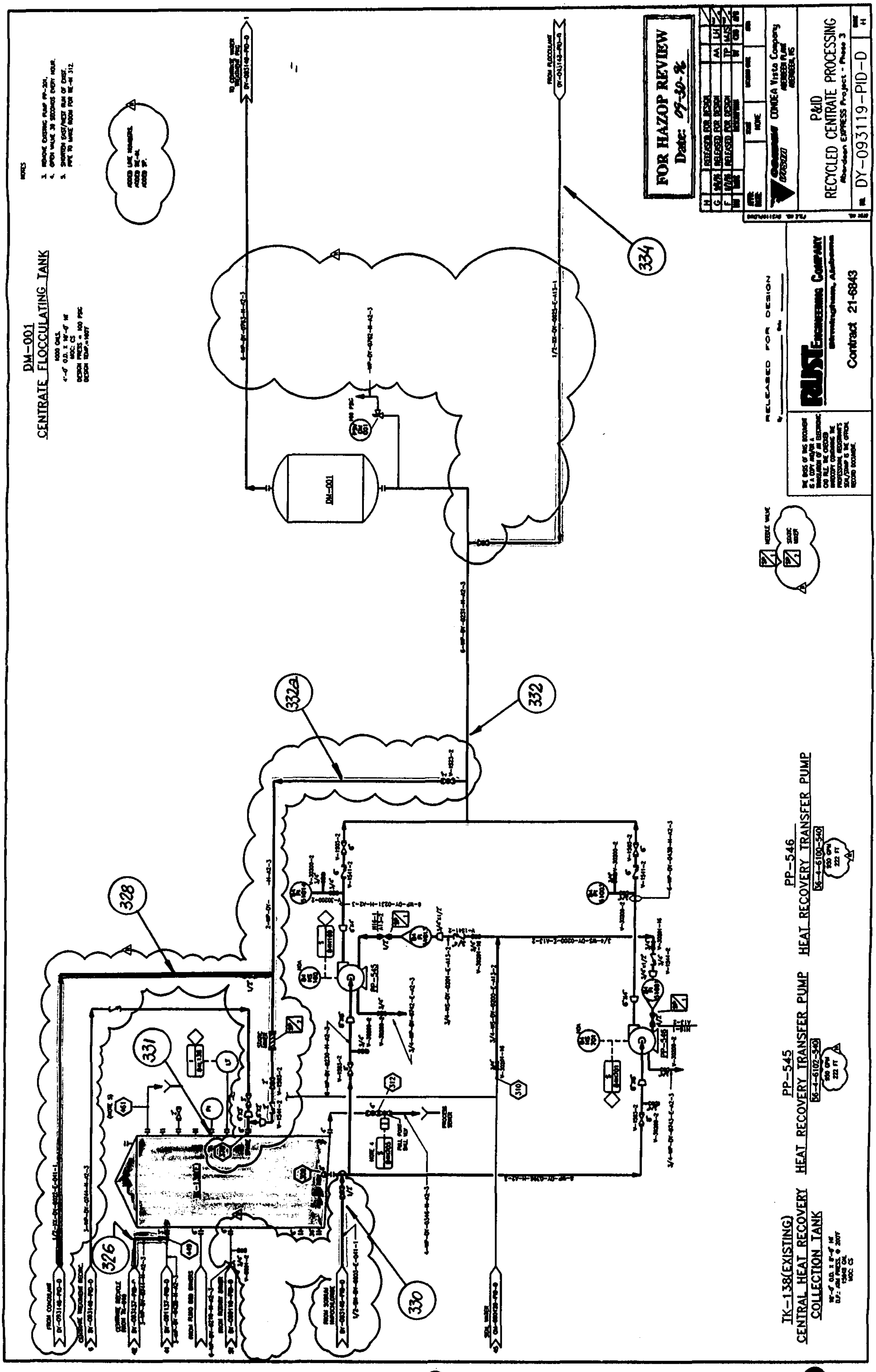
ABD00029982

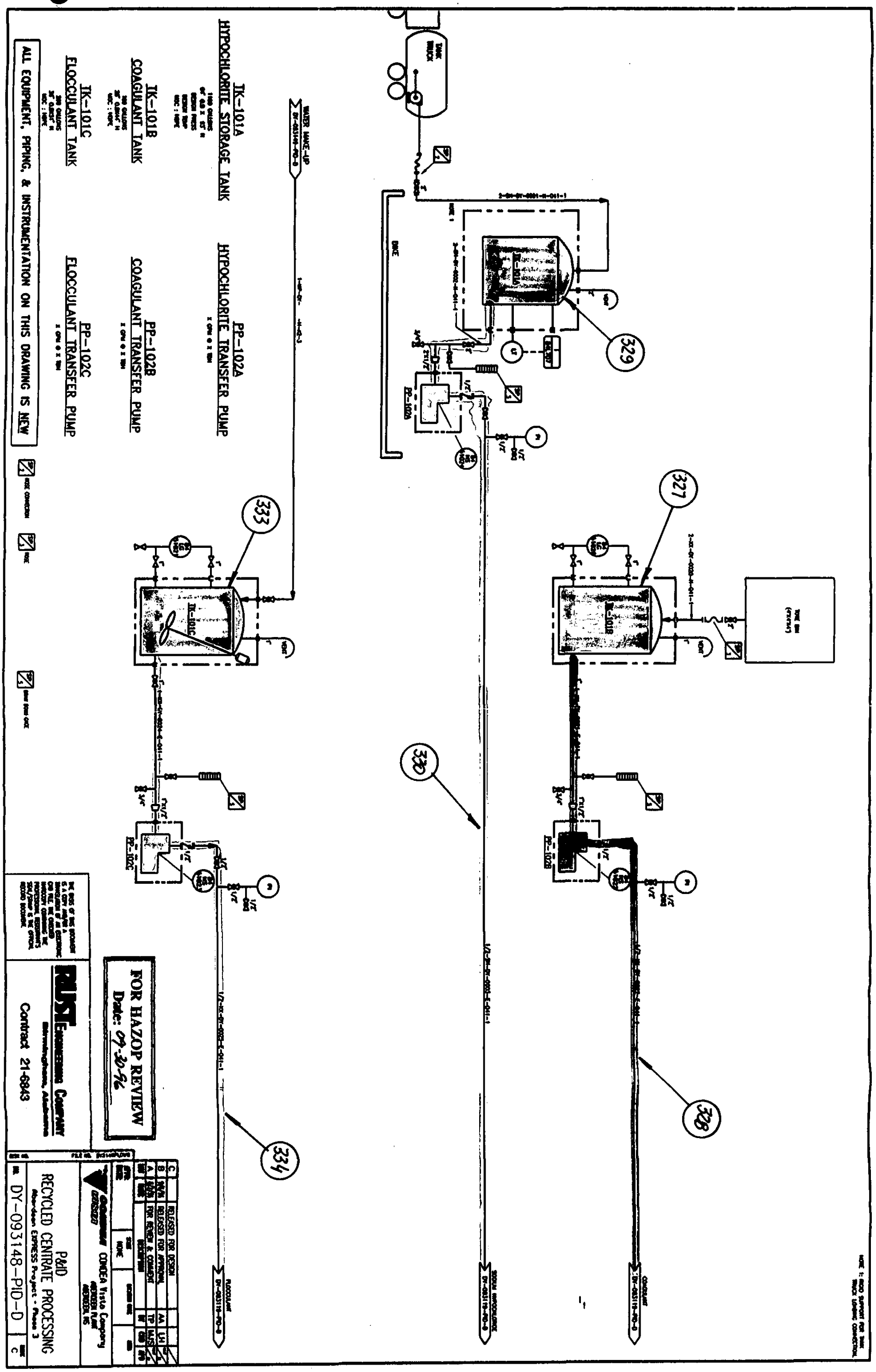

VISTA CHEMICAL CO.
P&ID
PRODUCT STORAGE-600 SERIES SILOS
No. DY-093129-PID-D
ISSUE D
RUST Engineering Company
Contract 21-6843
RELEASED FOR DESIGN
FOR HAZOP REVIEW
Date: 09-20-96
SL-680 STORAGE SILO
SL-679 STORAGE SILO
SL-678 STORAGE SILO
SL-688 STORAGE SILO
SL-687 STORAGE SILO
319
320
321
LEGEND:
FROM 600 SERIES SILO HOOK-UP STATION
FROM 200 SERIES SILO HOOK-UP STATION
DIVERTER VALVE
PRESSURE REGULATOR
ROTAMETER


FN-019
INDUCED DRAFT FAN
34-4-4200-520
DM-086
CYCLONE SCRUBBER
34-4-4140-520
PP-549
RECOVERED PVC-SLURRY PUMP
34-4-4340-540
PP-550
RECOVERED PVC-SLURRY PUMPS
34-4-4380-540
ES-011
OFF AIR STACK
34-4-4180-512
NOTES
322
323
324
314
ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW
FOR HAZOP REVIEW
Date: 09-30-96
FN-019
INDUCED DRAFT FAN SERVICING HOIST
34-4-4204-503
OFF AIR FROM DC-212/213
MAKE-UP SERVICE WATER
INITIAL FILL LINE
PROCESS SEWER
LOCATE AT GRADE
TO CYCLONE CENTRATE TANK
NEEDLE VALVE
REVISED PIPING TO MATCH CURRENT DESIGN CONCEPT. DELETED SP-1(SS FLEXHOSE).
RELEASED FOR DESIGN
F RELEASED FOR DESIGN
E RELEASED FOR DESIGN
D RELEASED FOR DESIGN
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
DRYER 11 SCRUBBER
Aberdeen EXPRESS Project - Phase 3
DY-093143-PID-D


TK-010
CYCLONE CENTRATE TANK
PP-519
CYCLONE CENTRATE PUMP
PP-544
CYCLONE CENTRATE PUMP
150 GPM 150 FT HEAD
CG-012
WATER CHUTE
CG-012
CENTRIFUGE SERVICING HOIST
CG-011
WATER CHUTE
CG-011
CENTRIFUGE SERVICING HOIST
ZZ-010
PRODUCT CHUTE
ZZ-011
PRODUCT CHUTE
CG-011
SLURRY CENTRIFUGE
CG-012
SLURRY CENTRIFUGE
NOTES:
1 ROUTE TO DRAIN
FOR HAZOP REVIEW
Date: 09-30-96
PACKAGE UNIT
PRODUCT TO FLASH DRYER
COOLING WATER RETURN
COOLING WATER SUPPLY
RELEASED FOR DESIGN
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
P&ID
CENTRIFUGES AND CENTRATE
Aberdeen EXPRESS Project - Phase 3
DY-093137-PID-D
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

y3119pi.plt(30157.ps14) plot@ps14. Fri Sep 27 10:39:47 CDT 1996





EX-126
WATER HEATER
EXISTING PICK HEATER
RECEIVES NEW INTERNALS

EX-115(EXISTING)/EX-017
HEAT RECOVERY EXCHANGERS
56-4-6115-517
COUNTER CURRENT FLOW
SPIRAL, 300 GPM
SA-240/ 316L SS
CONTRACT DESIGN 150 PSIG @ 180°F
PROCESS DESIGN 150 PSIG @ 180°F

NOTES
1. SAMPLE POINT.
2. EXISTING, RELOCATED VALVE.

FROM CENTRATE TREATMENT PKG
BY-093149-PID-0
8-WP-DY-0427-H-A2-3
336
FILTERED CENTRATE TO TK-017
MM-093149-PID-0
HOT PROCESS WATER TO FL-125
MM-093101-PID-0
HOT PROCESS WATER TO FL-102
OM-093101-PID-0
STEAM SUPPLY
BP-090111-PID-0
COLD PROCESS WATER
UT-090115-PID-0
FILTERED CENTRATE WATER TO O.M. NEW TANK TK-014
OM-093137-PID-0
EX-115(E)
EX-126(M)
EX-017
PIC HEATER
REVISED PIPING CHANGED SIZES.

FOR HAZOP REVIEW
Date: 09-30-96

RELEASED FOR DESIGN

REV	DATE	DESCRIPTION	BY	CHK	APP
B	11/4/96	RELEASED FOR DESIGN	AA	CMW	
A	8/2/96	RELEASED FOR DESIGN	TP	MJS	

DATE: 9/4/96
SCALE: NONE

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

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P&ID
RECYCLED CENTRATE PROCESSING
Aberdeen EXPRESS Project - Phase 3

NO. DY-093150-PID-D REV 8

ABD00029988

FOR HAZOP REVIEW
Date: 09-30-96

DM-336/337/338/339/340
CENTRATE TREATING PACKAGE

84" O.D. x 64' T/T
MAT'L: CS LINED
DESIGN PRESS: 100 PSIG
DESIGN TEMP: 140°F

FROM CENTRATE TREATMENT CHEMICAL FEED SYSTEM

332

335

DM-336

DM-337

DM-338

DM-339

DM-340

338

337

339

336

PROCESS SEWER (OUTSIDE BLDG.)

EXISTING I/P PLANT AIR

382

(TO MAIN ENGR.)

PS PSH

PI

TO HEAT RECOVERY EXCHANGERS
DY-093150-PID-D

FLOCCULANT MAKE-UP WATER
DY-093148-PID-D

CENTRATE RECIRC TO TK-138
DY-093119-PID-D

C		RELEASED FOR DESIGN			
B	9/9/96	RELEASED FOR APPROVAL	AA	LH	
A	8/9/96	FOR REVIEW & COMMENT	TP	MJS	
NO.	DATE	DESCRIPTION	BY	CHK	APP

ATP/E DATE: NONE

CONOCO Vista Company
DAVISON
ABERDEEN PLANT
ABERDEEN, MS

RELEASED FOR DESIGN
By _____ Date _____

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RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

P&ID
RECYCLED CENTRATE PROCESSING
Aberdeen EXPRESS Project - Phase 3

DWG. NO. DY-093149-PID-D | REV. C

ALL EQUIPMENT, PIPING, & INSTRUMENTATION ON THIS DRAWING IS NEW

FL-714
PROCESS WATER FILTER
16' OD x 3'-11"
MAWP 300 PSIG @ 200° F
MOC: 316 SS

EX-114
MAKE-UP PREHEATER
DESIGN 135 PSIG SAT. STEAM

IK-023
HOT WATER CHARGE TANK
144" OD x 47' 8"
35M GAL
INSULATED
MOC: CS

ADDED PER IM 429
RELOCATED PER IMS 409, 410, 411, 432
IN ORDER TO REPLICATE EXISTING INSTRUMENTATION
WITH OM-131

FOR HAZOP REVIEW
Date: 09-30-96

PHASE 3 SCOPE -
DEMANTLE & REPLICATE OM-130
NEAR OM-131 IN NEW MODULE
AREA (P&ID WF-093102-PID-0)

431 - BLANK OFF EXIST. STEAM SUPPLY NOT SHOWN ON THIS DWG.
FOR DETAILS SEE TIE-IN SKETCH

RELEASED FOR DESIGN
By MDE Date 9/16/96

E	9/23/96	RELEASED FOR DESIGN	TP	MJS	
D	6/5/96	RELEASED FOR DESIGN	TP	MJS	
C	4/19/96	RELEASED FOR APPROVAL	TP	MJS	
ISS	DATE	DESCRIPTION	BY	CKD	APD

APPD. JFH 9/26/96
DATE: 9/16/96
SCALE: NONE

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

P&ID
OM HOT WATER CHARGE & RINSE
Aberdeen EXPRESS Project - Phase 3

DWG NO. OM-093101-PID-D
CODE E

FL-102
HOT WATER MAKE-UP FILTER
16" OD x 4'-6"
MAWP 150 PSIG @ 500° F
MOC: CS

PP-230/PP-231
HOT WATER CHARGE PUMPS
3x4-12A 11
MOC: CAST IRON
NORMAL PRESS: 150 PSIG
NORMAL FLOW: 450 GPM

FL-101
HOT WATER CHARGE FILTER
24" OD x 3'-1"
MAWP 300 PSIG @ 190° F
MOC: 304 L SS

FL-379
DECALCIFIED WATER INLET FILTER
24" OD x 5'-6"
MAWP 300 PSIG @ 190° F
MOC: 304 L SS

FL-002
DECALCIFIED WATER OUTLET FILTER
24" OD x 5'-6"
MAWP 300 PSIG @ 190° F
MOC: 304 L SS

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RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

ABD00029990

RECYCLE CENTRATE
OM-093150-PID-D
6-WP-OM-0423-H-A2-3
V-1503-2
V-1523-2
NOTE 4
SP/2
V-1503-2
V-1523-2
NOTE 4
SP/1
TK-014
NOTE 5
N10
N13
LW
NOTE 1
10'
N1
N11
N6
N5
6"X2"
SP/1
6-WP-OM-0736-H-A2-3
N14
N3
N15
N27
N24
6"X2"
MH
81T860
TT
1/2"
AL
81L859
LSL
LT
ICALLL
81L858A
IC
81L858B
N8
N12
M1
24"
MW
V-12122-36
FPP A2-5
SP/1
N7
MH
V-1503-2
4-WP-OM-0368-H-A2-3
4-WP-OM-0369-N-A2-3
NOTE 2
PROCESS SEWER
4-WP-OM-0371-H-A2-3
8-WP-OM-0373-H-A2-3
FROM HOT WATER TANK TK-023
OM-093101-PID-D
6-WP-OM-0009-S-A2-3
422
V-1503-2
6" N.O.
6"X6"
N.C.
8"X6"
V-1541-2
V-1503-2
NOTE 3
S
81H657
PROCESS WATER
OM-093101-PID-D
V-1503-2
6-WP-OM-0375-H-A2-3
PROCESS WATER
OM-093101-PID-D
6-WP-OM-0027-H-A2-3
V-1503-2
6-WP-OM-0375-H-A2-3
V-1503-2
N.O.
PP-547
V-30200-2
3/4"
S
81H655
HOA
I
81P856
PT
V-30200-2
3/4"
V-1541-2
V-1503-2
V-30200-2
3/4"
3/4-WP-OM-0377-H-A2-1
V-30200-2
3/4"
V-1503-2
421
V-1503-2
N.O.
PP-229
(EXISTING)
3/4"
4-WP-OM-0013-N-A2-3
P1
S
81H018
EXISTING VALVES RELOCATED
V-1523-2
6"X6"
V-1503-2
447
3/4"
S
81H014
FL-103
PSV
FL103
3/4"X1-5/8"
300 PSIG
P1
P1
P1
1/2"
1/2"
1/2"
3/4"
3/4"
S
81H022
FT
O
81F021
448
3/4"
3/4"
S
81H019
7-WP-OM-0720-H-A2-3
4-WP-OM-0357-H-A13-2
TO OLD MODULE STRIPPER
RINSE HEADER
OM-090133-PID-D
A13-2
A2-3
4-WP-OM-0014-H-A2-3
TO OLD MODULE REACTORS
RINSE HEADER
OM-090102-PID-D
ADDED TK-N45
REVISED TK-N 421 & 422
DELETED TK-N 445 AND ADDED TK-N 443
REASSIGNED TK-N 448
ADDED REDUCERS AT CONTROL VALVE
RELOCATED EXISTING VALVES
GENERAL PIPING REVISIONS
MOVED TK-N 425 TO OM-093101-PID-D
CHANGED SIZE OF NEW PUMP SUCTION PIPING
CHANGED TANK INLET LINE SIZE
DELETED BYPASS LINE NUMBERS

NOTES
1. NOZZLE N13 IS FOR INSPECTION, REMOVE BLIND FLANGE.
2. DRAIN PIPES TERMINATE 2" ABOVE GRATING.
3. PUMP DOWN, VALVE OPENS, PUMP ON VALVE CLOSED
4. ACCESSABLE FROM GRADE.
5. ALL FLANGED CONNECTIONS TO TK-014 ARE 125# FF.

SP/1 - SPECTACLE BLIND
SP/2 - BIRD SCREEN

FOR CHARGING
4-WP-OM-0042-H-A2-3
FLOW BOTH WAYS
OM-093101-PID-D
4

FUTURE
CHLORINATION M/U WATER
V-1503-2
4-WP-OM-0377-H-A2-3
MAKEUP TO CT-007
UT-093122-PID-D
1
V-1503-2
6"X6"
6-WP-OM-0375-H-A2-3
MAKE UP WATER,
CT NO. 2,4,6 & INCINERATOR
UT-093113-PID-D
2

FOR HAZOP REVIEW
Date: 09-30-96

RELEASED FOR DESIGN
BY _____ DATE 8/2/96

E	8/7/96	JC	RELEASED FOR DESIGN	TP	MJS	
D	6/6/96		RELEASED FOR DESIGN	TP	MJS	
C	4/19/96		RELEASED FOR APPROVAL	TP	MJS	
ISSUE	DATE		DESCRIPTION	BY	CKD	APP'D

APP'D: JFH JDH
DATE: 8/1/96
SCALE: NONE

CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS

P&ID
RECYCLED CENTRATE DISTRIBUTION
Aberdeen EXPRESS Project - Phase 3

DWG NO. OM-093137-PID-D
ISSUE E

RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

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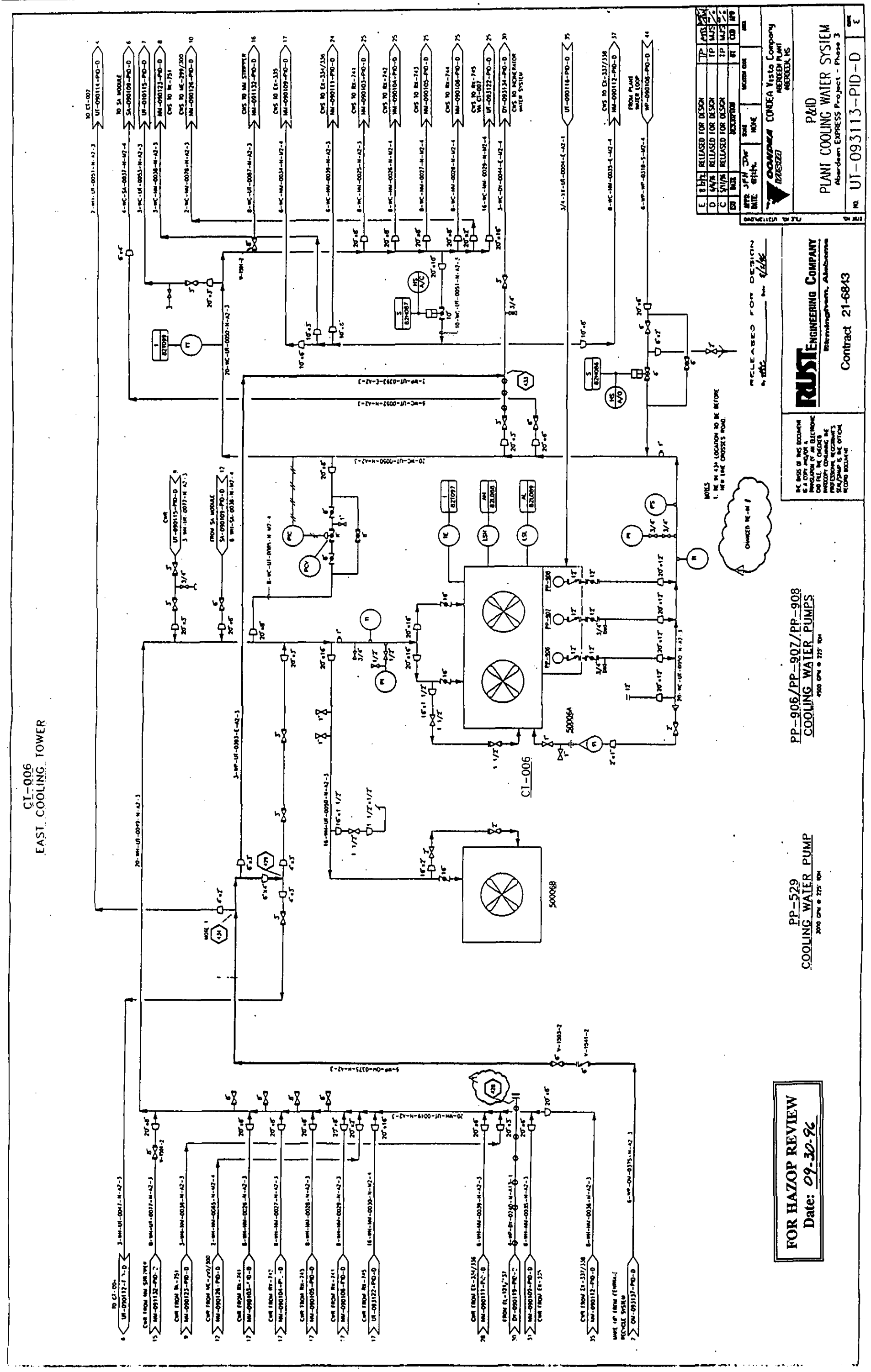
TK-014
OLD MODULE
RECYCLED CENTRATE TANK
36-4-6120-503
19,000 GAL
FRP

PP-229
RINSE WATER PUMP (EXISTING)
3X4 - 11.25-11
MOC: DI CASE/SS IMP
NORMAL PRESS: 220 PSI;
NORMAL FLOW: 800 GPM
SEAL: CRANE 9K0P191

PP-547
RINSE WATER PUMP
36-4-6125-548
6"X4"
450 GPM, 190 FEET

FL-103
RINSE WATER FILTER


P&ID
PLANT COOLING WATER SYSTEM
Aberdeen EXPRESS Project - Phase 3
UT-093113-PID-D
CONDEA Vista Company
ABERDEEN PLANT
ABERDEEN, MS
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
RELEASED FOR DESIGN
RELEASED FOR DESIGN
RELEASED FOR DESIGN
RELEASED FOR DESIGN
CT-006
EAST COOLING TOWER
PP-906/PP-907/PP-908
COOLING WATER PUMPS
4500 GPM @ 225' TDH
PP-529
COOLING WATER PUMP
3000 GPM @ 225' TDH
CONNECTS TO UT-01
FOR HAZOP REVIEW
Date: 09-30-96

FIRE PUMP HOUSE
1

PP-471
PP-472
PP-473
PP-474

UNLOADING STATION
COMPRESSOR SHED
RAILCAR UNLOADING DELUGE
BULLET DELUGE
SPHERE DELUGE
SPHERE FIRE MONITOR

OPEN

NOTE 1

OLD MODULE DELUGE (REACTORS)
OLD MODULE (STRIPPING TRAIN)
NEW MODULE REACTORS RX-746/747
NEW MODULE STRIPPERS (PHASE 2)
NEW MODULE (STRIPPERS (PHASE 1)
NEW MODULE DELUGE (ALL REACTORS)

FIRE PUMP HOUSE
2

PP-644
PP-680

PP-471	PP-472	PP-473	PP-474	PP-644	PP-680
FV PUMP #1	FV PUMP #2	FV PUMP #3	FV PUMP #4	FV PUMP #5	FV PUMP #6

REFERENCE DWG'S
1. GP-003400-PI-D SYMBOL LEGEND
2. GP-003401-PI-D TYP. DTLS SHT #1
3. GP-003402-PI-D TYP. DTLS SHT #2

NOTES
REFER TO FIRE PROTECTION DWGS. FOR DETAILS. TO BE ISSUED LATER.

RELEASED FOR APPROVAL
By _____ Date _____

FOR HAZOP REVIEW
Date: 09-30-96

ISU	DATE	DESCRIPTION	BY	CKD	APD
B		RELEASED FOR APPROVAL			
A		FOR REVIEW & COMMENT	TP	MJS	

APPD:
DATE:
SCALE NONE

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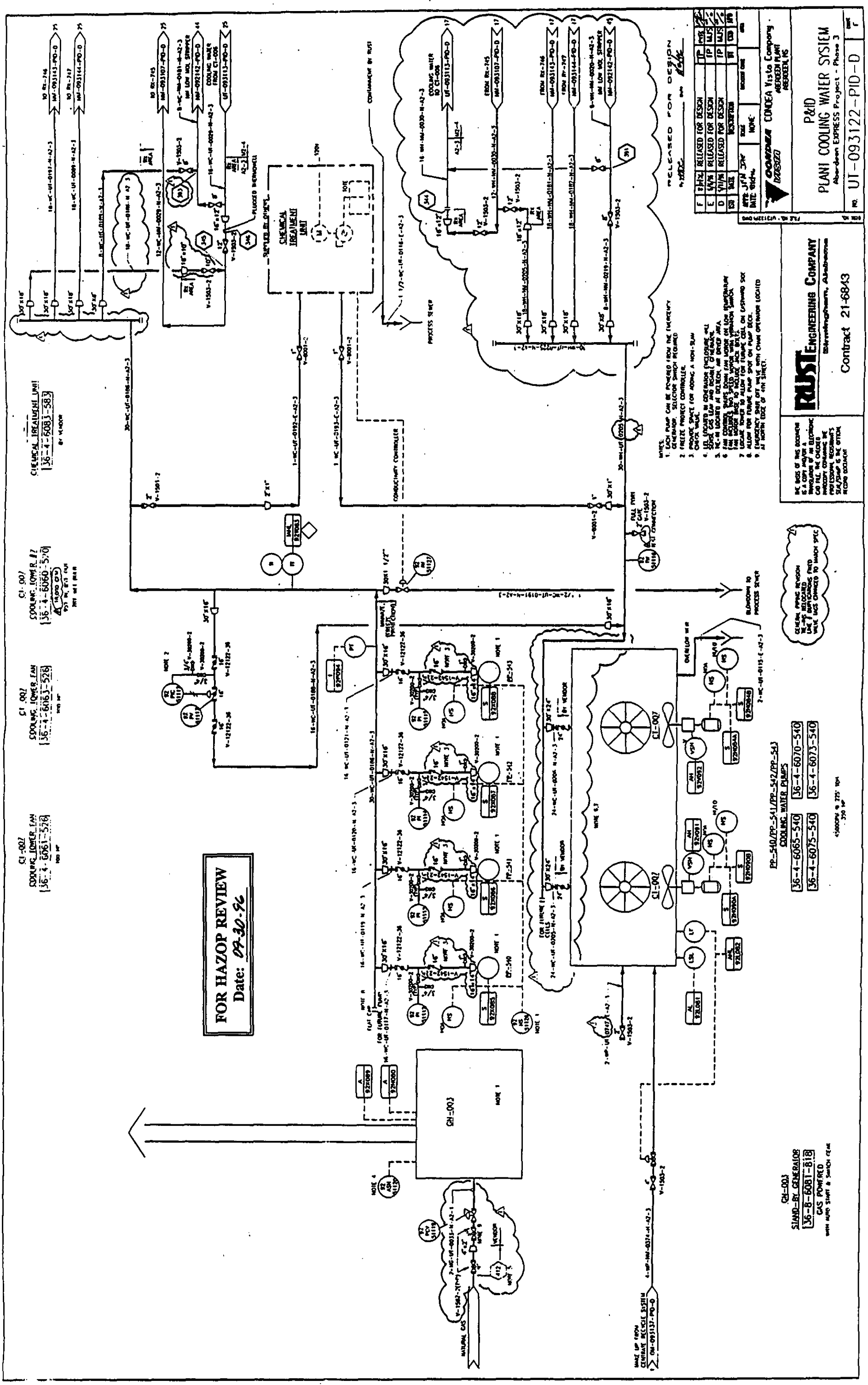
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843

VISTA
CONDEA Vista Chemical Co.
ABERDEEN CHEMICAL PLANT
ABERDEEN, MS

P&ID
FIRE WATER DELUGE SYSTEM

NO. UT-093118-PID-D


P&ID
PLANT COOLING WATER SYSTEM
Aberdeen EXPRESS Project - Phase 3
UT-093122-PID-D
RELEASED FOR DESIGN
RUST ENGINEERING COMPANY
Birmingham, Alabama
Contract 21-6843
CONOCO Vista Company
ABERDEEN PLANT
ABERDEEN, MS
CHEMICAL TREATMENT UNIT
36-4-6083-583
CI-002
COOLING TOWER FAN
36-4-6061-526
CI-001
COOLING TOWER II
36-4-6060-540
CI-001
COOLING TOWER FAN
36-4-6063-526
CI-001
COOLING TOWER FAN
36-4-6061-526
CHEMICAL TREATMENT UNIT
CONDUCTIVITY CONTROLLER
PROCESS SEWER
BLOWDOWN TO PROCESS SEWER
CI-001
CI-002
PP-540/PP-541/PP-542/PP-543
COOLING WATER PUMPS
36-4-6065-540
36-4-6070-540
36-4-6075-540
36-4-6073-540
GN-003
STAND-BY GENERATOR
36-8-6081-818
GAS POWERED
FOR HAZOP REVIEW
Date: 09-30-96