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VCM RELEASE WHICH OCCURRED FEBRUARY 2, 1979 FROM REACTOR D-300

Summary:

This release occurred due to an uncontrolled pressure build-up in reactor D-300. Corrective actions to reduce the possibility of reoccurance of this type of event include revised kill procedures, installation of an effective emergency AMS kill system and installation of emergency cooling and emergency instrument air systems.

QUESTION 1: FOR EACH RELIEF VALVE OR MANUAL VENT VALVE DISCHARGE OF VINYL CHLORIDE ("VC") WHICH OCCURRED FOR THE PERIOD FROM JANUARY 1, 1979 TO JANUARY 1, 1985, A DESCRIPTION OF THE NATURE AND CAUSE OF THE DISCHARGE, INCLUDING PRIMARY AND/OR RELATED CAUSES(S).

Response:

Descriptions giving the nature and cause of the discharge, including primary and/or related cause(s) have been submitted to the EPA. These are listed below.

1. The initial discharge report was sent to EPA-Region IV in a letter dated February 9, 1979 which is attached as reference A-1, Appendix A.

2. Mr. Leon Folsom, EPA-Region IV, visited the Aberdeen Plant on February 21, 1979 to obtain information on this and other releases. As a result of his visit, requested additional information was supplied in a letter dated March 5, 1979 which is attached as reference A-2, Appendix A.

3. On August 21, 1979, Wayne Aronson of EPA Region IV and an EPA contractor (PEDCo Environmental, Inc.) conducted an inspection of the plant. Records were searched and relevant information was copied. As a result of this inspection, a report dated August 31, 1979 was issued by PEDCo. which contains details on the February 2, 1979 discharge. (Reference 1)

4. On October 15, 1980, Mr. Curry L. Miller, Plant Manager, responded to items in the PEDCo inspection report, correcting misleading and incorrect statements in this report. This correspondence, sent to Mr. Wayne Aronson, is attached as reference A-3, Appendix A.

QUESTION 2: FOR EACH DISCHARGE DESCRIBED IN RESPONSE TO III.A.1. A DETAILED DESCRIPTION OF ALL RELEVANT CORRECTIVE STEPS TAKEN BEFORE AND DURING EACH DISCHARGE TO PREVENT AND/OR MINIMIZE THE RELEASE OF VC TO THE ATMOSPHERE INCLUDING, BUT NOT LIMITED TO, SUCH STEPS AS REROUTING VCM EMISSION VENTS TO A COLLECTION VESSEL OR INCINERATOR.

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Question 2: (Continued)

Response:

In addition to the correspondence mentioned in question 1 above, the following information has been supplied to the EPA Atlanta office relevant to corrective action taken to prevent or minimize the release.

1. Pursuant to the April 11, 1979 show cause conference, Mr. Curry L. Miller,Plant Manager, submitted a list of measures to reduce the potential for relief valve discharges at Aberdeen. The correspondence was sent to Mr.James T. Wilburn in a document dated April 23, 1979 which is attached as reference A-4, Appendix A.

The following additional information is submitted relevant to corrective action taken before and after February 2, 1979 to prevent and/or minimize the release of VCM due to uncontrolled pressure build-up in reactors.

I. OPERATING PHILOSOPHY

It has been the plant's operating philosophy that the polymerization reaction in a PVC reactor must be stopped during an upset condition in order to prevent uncontrolled pressure buildup in the reactor and subsequent relief discharge of VCM. Various systems could be employed to handle specific upset conditions, e.g.back up power generation in case of power failure. However, these systems will not be necessary if the polymerization reaction is stopped because there can be no pressure buildup in the absence of a polymerization reaction. Additionally, backup power would be of no use in certain upsets, e.g. loss of agitation. The following material will show that the plant took appropriate action both before and after the release of February 2, 1979 to minimize the possibility of a relief valve discharge occurring from uncontrolled reactor pressure buildup. This is evidenced by the fact that since February 2, 1979 in which the Nitric Oxide (NO) Kill System tubing failed unpredictably, there has not been another relief valve discharge for this reason. This information will also show that the plant has been constantly improving procedures and adding equipment and instrumentation as new ideas and process development has become available to further insure that there will be no uncontrolled pressure buildup in the reactors resulting in the release of vinyl chloride.

Following is information which describes the equipment, instrumentation and procedures which were in use in the plant prior to the February 2, 1979 release. Since the release, the following improvements have been made to further reduce the likelihood of a relief valve discharge due to over-pressurization of a polymerization reactor:

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1. Additional reactors instrumentation
2. Additional reactor interlocks
3. Procedures have been improved
4. An improved emergency kill system has been installed
5. An emergency reactor cooling system to supply cooling water in case of a power failure has been installed
6. An emergency diesel generator has been installed to supply power to operate two of the plant's instrument air compressors in case of a power failure
7. A chain transfer agent was developed and is now used in the production of low molecular weight resins
8. The expansion reactors were designed with a pressure rating of 25 pounds per square inch greater than the previously installed reactors

These improvements are described in detail in the following sections. The procedures and equipment are designed to control the reactors during the polymerization stage, and to insure that the kill system will be effective 100% of the time.

II. REACTOR INSTRUMENTATION TO DETECT UPSET CONDITIONS

A. Prior To February 2, 1979

Prior to February 2, 1979, the following instrumentation was available to detect upset conditions in the reactor.

1. Reactor temperature and pressure readouts were available in the control room. The temperature and pressure were also continuously recorded on the control panel recorder for each reactor.

2. High reactor pressure and temperature alarms that sound in the control room were available in the control room. These alarms must be acknowledged by the control panel operator to silence the alarms.

3. Cooling water flow to the jacket and the condenser was indicated and recorded on the control panel.

4. Local instrumentation (pressure gauges, flow meters, etc.) were available to the outside operator in detecting upset conditions or malfunctions that could lead to upset conditions.

5. The outside operator was equipped with a two-way radio to keep in constant communication with the panel operator and the shift supervisor.

6. Reactor instrumentation in the control room was supplied with 24 volt D.C. backup power from batteries.

7. Numerous interlocks were installed that prevent an operator from making errors or opening valves that would result in a runaway reaction or other upset condition. (See Reactor Interlock Section, page 14)

8. Reactor agitator amperage indicators were available in the control room for each reactor.

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B. Since February 2, 1979

The following instrumentation has been added since February 2, 1979 in order to increase the capability to detect upset conditions in the reactor.

1. Reactor agitator amperage recorders have been added in the control room.

2. A severe weather radio is available in the control room to warn of approaching storms that could interfere with normal operations.

III. REACTOR KILL SYSTEMS

A. General Description

On February 2, 1979, the plant employed two reactor kill systems--the normal kill system and the emergency Nitric Oxide (NO) kill system. The normal kill system uses a small pot dedicated to each reactor. Alpha methyl styrene (AMS) is poured into the pot and the contents of the pot are then injected into the reactor using high pressure service water. This system is used to terminate the polymerization reaction at the end of each batch. This is typically done with the addition of a small amount of AMS (1½-2 gallons). This system can be used to inject larger amounts of AMS during non-power-failure emergency situations to terminate reactions. As a backup system to the normal kill system, an emergency nitric oxide (NO) kill system was available on each reactor. This system was activated by opening valves on high pressure NO cylinders connected to the reactors.

Through efforts to further reduce the possibility of a discharge of VCM due to uncontrolled reactor pressure buildup, new reactor kill system technology was developed. This new technology also utilizes AMS as a kill agent. This superior kill system is currently utilized at both the Oklahoma City PVC Plant and the Aberdeen Plant.

B. Emergency NO Kill System

1. General Description of Emergency NO Kill System

The emergency Nitric Oxide (NO) kill system consisted of several pressurized cylinders containing NO connected to each reactor through valves and high pressure tubing. Each reactor had its own bank of NO cylinders. The cylinders were equipped with individual valves as supplied by the vendor. High pressure tubing was connected to these valves and extended to the reactor lip seal flush inlet. At all times, pressurized water flows into the reactor through the seal flush line. When the Emergency NO kill system was to be activated, a valve at the reactor agitator lip seal flush was opened and the individual valves at the NO cylinders were opened. This allowed NO to flow into the reactor and terminate the polymerization reaction.

2. Training and Instructions On Emergency NO Kill Systems and Power Failure Procedures

a. Prior To February 2, 1979

Plant personnel were trained in the use of the emergency NO kill system and were trained in emergency operating procedures. Note that records are not required to be kept for this time period. Training records and documentation of the exact instructions are not complete for this time period since it was so long ago. However, it is strongly believed that operators were thoroughly trained in responding to emergency situations as evidenced by the records that have been kept. It is certain that much more training took place than the documentation shows. Plant records show formal training of operators in emergency procedures took place on 4/22/77, 7/22/77, 3/20/78 and 6/12/78. These records are attached as references A-5 thru A-8, Appendix A. In addition to this, on the job training was also received by plant operating personnel.

b. Since February 2, 1979

1. On February 8, 1979, revisions to the operating manuals were issued which included pressure and temperature limits for killing runaway reactions and wearing of Scott Air Paks, which are positive pressure full face respirators, during use of the Emergency NO kill system. Copies of these procedures were posted on Bulletin Boards and covered with all appropriate operating personnel in February and March, 1979. The revised Operating Manual section is attached as reference A-9, Appendix A. Plant records showing formal training of operators in emergency procedures are attached as references A-10 thru A-13, Appendix A.

2. On March 20, 1979, further instructions were issued regarding emergency kill procedures, checking of the emergency NO kill system, inspection of the reactor condensers after a coarse batch, and several other items relative to relief valve discharge prevention. This is attached as reference A-14, Appendix A. Plant records showing formal training of the operators in the revised emergency procedures are attached as references A-15 through A-18, Appendix A. A coarse batch can occur as a result of a suspension system failure. When a coarse batch occurs, large chunks of polymer can form. These chunks can reduce the effectiveness of the reactor heat transfer surfaces on subsequent batches. On April 10, 1979, these instructions were expanded to include reducing catalyst loading to the reactor on the batch after a coarse batch. In effect, this slows reaction rate which reduces the possibility of uncontrolled pressure buildup in a reactor. These instructions were given to the shift supervisors who give instruction to operators on catalyst loading. The expanded procedure is attached as reference A-19, Appendix A.

b. Since February 2, 1979 (Continued)

3. Other training to the operators in use of the Emergency NO kill system was given on 7/7/79 and 7/14/79. Training meeting records are attached as references A-20 through A-23, Appendix A.

4. On October 25, 1979 and October 30, 1979, the emergency procedures were revised to include injection of large amounts of AMS at specified temperature and pressure increases. Also, specific instructions for power failure operations were given. These are attached as references A-24 and A-25, Appendix A. Plant records showing formal training of operators in the revised procedures are attached as references A-26 through A-30, Appendix A.

5. Another specific memo regarding emergency NO kill procedures was issued March 4, 1981. This is attached as reference A-31, Appendix A. Additional specific training on emergency kill procedures was given on June 29, 1980, July 15, 1980 and April 9, 1981. These are attached as references A-32 through A-34, Appendix A.

3. Emergency NO kill system inspections

a. Prior To February 2, 1979

Prior to February 2, 1979, the NO kill systems were checked on a routine basis by operating personnel who daily monitor equipment and especially emergency equipment. There is no documentation of this daily monitoring, but the monitoring occurred just as all other equipment is monitored to keep it operational. Formal checks of the NO kill systems took place on a less frequent basis and documentation of such inspections is sketchy. One such inspection took place on March 13, 1978, in which all the NO kill systems were checked. This inspection was noted in the the supervisors log book. The item is entry number 5 of the 1500-2300 log dated 3/13/78 which is attached as reference A-35, Appendix A.

These checks of the NO systems consisted of manual inspection of the systems to assure valves were in the correct open and closed positions and nitrogen was injected into the reactor to assure there was no blockage of the tubing. Since NO is an extremely toxic gas, pressurization of the tubing which was used to inject the NO into the reactor was not done with NO as this could result in employee exposure to NO. There was no reason to expect that a pressurized check of the tubing was necessary as the pressure rating of the tubing was in excess of 7000 pounds per square inch and the pressure in the NO cylinders was approximately only 500 pounds per square inch. Failure of the tubing was such an unlikely event that it could not be anticipated.

3. Emergency NO kill system inspections (Continued)

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a. Prior to February 2, 1979 (Continued)

The NO entered the reactor through the water lip seal flush line to the reactor agitator seal. The lip seal flush must be maintained at all times to prevent damage to the agitator seal. A flow meter is provided on each lip seal flush line and this flow is monitored at least once per batch to assure proper flow. Thus, since the NO injection point into the reactor is through a port that always has water flowing through it, the port is always open and NO can be injected into the reactor when needed. Using this port prevents the possibility of trying to inject NO into a reactor through a seldom used port which would likely be plugged with polymer when an emergency exists.

b. Since February 2, 1979

After the February 2, 1979 incident, the plant instituted a formal procedure to check the NO kill systems every six months. In addition to the visual check to assure proper valve alignment and the addition of N_2 into the reactor to assure no pluggage which were previously done, the systems were also pressured with N_2 to check the physical integrity of the system. This pressure check of the system was done to prevent a mechanical failure of the system as occurred in the February 2, 1979 incident if the systems were to be needed in an emergency.

Records of the six-month inspections of the NO kill systems were kept on large check-off sheets by the Vinyl Operations Department. Copies of these sheets for 1980 and 1981 are available at the plant for inspection. The dates of the inspections of the NO kill systems during this period are shown in the attached two tables. This six-month check of the NO kill systems was continued until the systems were removed in mid 1984. The large check-off sheets for the period 1982 to 1984 have been discarded and therefore a listing of the dates the systems were checked during this period cannot be provided. The Vinyl Operations supervisors have stated such inspections and records were kept during this period but the check-off sheets were not saved.

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EMERGENCY NO KILL SYSTEM CHECKS

NEW REACTOR MODULE

REACTOR D- 741	REACTOR D-742	REACTOR D-743	REACTOR D-744
1st Week - April 1980	3rd Week - April 1980	1st Week - February 1980	2nd Week - March 1980
1st Week - May 1980	2nd Week - May 1980	4th Week - February 1980	3rd Week - April 1980
1st Week - July 1980	3rd Week - June 1980	2nd Week - May 1980	2nd Week - May 1980
1st Week - September 1980	2nd Week - July 1980	3rd Week - June 1980	4th Week - May 1980
2nd Week - January 1981	2nd Week - January 1981	4th Week - July 1980	3rd Week - June 1980
3rd Week - February 1981	3rd Week - February 1981	2nd Week - September 1980	2nd Week - September 1980
2nd Week - May 1981	2nd Week - April 1981	4th Week - November 1980	2nd Week - January 1981
		2nd Week - January 1981	1st Week - February 1981
		3rd Week - February 1981	3rd Week - April 1981
		3rd Week - April 1981	4th Week - September 1981
		3rd Week - September 1981	
		3rd Week - October 1981	
		2nd Week - November 1981	

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EMERGENCY NO KILL SYSTEM CHECKS

OLD REACTOR MODULE

REACTOR D-300	REACTOR D-400	REACTOR D-500	REACTOR D-600
3rd Week - January 1980	1st Week - March 1980	1st Week - February 1980	4th Week - February 1980
1st Week - July 1980	1st Week - July 1980	1st Week - July 1980	2nd Week - July 1980
3rd Week - September 1980	2nd Week - September 1980	1st Week - October 1980	2nd Week - January 1981
2nd Week - January 1981	2nd Week - January 1981	2nd Week - January 1981	3rd Week - February 1981
1st Week - March 1981	3rd Week - February 1981	3rd Week - February 1981	3rd Week - April 1981
1st Week - September 1981	3rd Week - April 1981	2nd Week - October 1981	2nd Week - October 1981
2nd Week - October 1981	2nd Week - October 1981		

4. Removal of Emergency NO Kill System

Initially, the plant's NO emergency kill system was installed to stop the polymerization reaction in a PVC reactor during an emergency in order to reduce the possibility of an uncontrolled pressure buildup in a reactor. However, since these original installations, the plant installed a superior emergency kill system that uses AMS as the kill agent. The installation of these kill systems was complete in 1982. A description of this system is given later. Since the installation of this system, the plant has successfully used the emergency AMS kill system several times and had not had occasion to use the NO kill system. Because of our experience with this system and our concern for the health and safety of our employees, a decision was made to remove the emergency NO kill system. Notification of this decision was given to the Mississippi Bureau of Pollution Control in a letter dated June 11, 1984. This is attached as reference A-36, Appendix A. On July 3, 1984, the Bureau responded that it concurred with the decision . The response is attached as reference A-37, Appendix A. The emergency NO kill system was removed in mid 1984.

C. Emergency AMS Kill System

As an added measure to assure that polymerization reactions could be terminated in emergency situations, a superior kill system was developed by Conoco which utilizes AMS as the kill agent. Funds to install this type kill system at Aberdeen were approved in November of 1980 for the existing eight reactors. The design for the two expansion reactors, one of which started up in late 1981 and the other in early 1982, included this type AMS kill system for each reactor. Installation of the AMS emergency kill system was complete on the existing eight reactors in mid 1982. Following is a description of the development of this system and a description of the system as it exists today.

Large Reactor Pilot Plant AMS Injection Tests

In order to confirm that AMS was effective in killing the polymerization reaction in an emergency situation, test runs were made at Conoco's large reactor pilot plant in Oklahoma City, Oklahoma. The 1600-gallon pilot plant reactor with its condenser, agitator and general configuration is similar to that of the plant's commercial reactors. More than 1000 test batches of PVC made in this pilot plant reactor show that it does simulate the plant's commercial reactors.

The pilot plant AMS test runs were carefully planned to simulate concurrent loss of reactor agitation and normal cooling water flow as could occur during a power failure. Every effort was made to simulate a realistic, worst case situation. In each case the simulated power failure (shutdown of agitator and stop cooling water flow) was started three hours into the polymerization to insure that the polymerization rate was near maximum. Also the reactor pressure was allowed to increase from 120 psig, the normal run pressure, to 140 psig before injecting AMS to the reactor. The seven to eleven minutes required to reach 140 psig provided sufficient time for the swirling inside the reactor to stop thereby minimizing the AMS

C. Emergency AMS Kill System (Cont.)

Large Reactor Pilot Plant AMS Injection Tests (Cont.)

mixing that could occur due to residual swirling.

This was done to test the ability of the AMS to deactivate the free radical polymerization initiators with minimum mixing. AMS is soluble in VCM.

The results of the first test are displayed graphically as Curve A on the graph attached as reference A-38, Appendix A. After AMS injection the reactor pressure increased 6 psi to a maximum of 146 psi and then decreased. Sixty minutes into the test, the reactor pressure had fallen to 139 psig. At that point maximum cooling water flow was started through the reactor's condenser. This caused the reactor pressure to drop quickly and is a good demonstration of the pressure control capabilities of a system combining AMS injection with back-up cooling water flow.

While this test did show that AMS injection would stop the polymerization, it appears that there must have been some cooling water flow leaking through the reactor's condenser and jacket during the test since the reactor pressure decreased from 146 psig to 139 psig while the cooling water was supposedly shut off. This may have masked a slow reactor rate if the AMS was not 100% effective. Therefore, the test was repeated with the cooling water valve and main supply header valve blocked in and the condenser and jacket drain plugs removed at three hours into the polymerization run. The results of this test are shown by Curve B on the reference A-38, Appendix A. After AMS injection, reactor pressure increased from 140 psig to a maximum of 150 psig. It then slowly lowered to 147 psig seventy minutes into the test. This gradual pressure drop was probably due to atmospheric heat losses from the reactor and condenser.

In past work, Conoco's research group evaluated nine other polymerization stopping chemicals or chemical mixtures and has found none to be better than AMS.

System Description

The emergency AMS kill system consists of a pressurized pot filled with AMS for each reactor with piping and valves to inject the AMS into the reactor. The pressurized pot is maintained at above 250 PSIG with bottled nitrogen. Piping runs from the bottom of the AMS kill pot to the top of the reactors. AMS can be injected into the reactor by either of two nozzles. One nozzle has remote operated valves that can be operated from the vinyl control room panel. The other nozzle has manual valves that can be operated manually from the platform at the top of the reactor. Both nozzles inject the AMS into the reactor vapor space. Bottled nitrogen is used to pressurize the injection pot. The pressure in the injection pot and in

C. Emergency AMS Kill System (Continued)

System Description (Continued)

the nitrogen bottle is checked before each reactor charge. If the pressure in either the bottle or the pot is low, the problems must be corrected before the reactor is charged. The remote operated valves are also operated with bottled nitrogen. This not only assures that these valves can be activated during a power failure, but also eliminates possible freezing problems that might occur with instrument air. The pressure in this nitrogen bottle is also checked before each charge to insure enough pressure is available to operate the valves. If the pressure in the nitrogen cylinder is too low, the cylinder must be changed before the reactor is charged. The remote operated valve switches also are connected to the plant's emergency power to insure their operability during a power failure.

Each AMS injection pot is equipped with a local level gauge to monitor the amount of AMS available for stopping polymerization. This level is checked before each charge. Each pot also has a low level alarm that will sound in the vinyl control room and light a beacon on top of the reactor if the level in the pot is below a certain point. This level alarm system serves several functions. If the vinyl panel alarm is activated before charge, AMS must be added to the pot before the reactor can be charged. During AMS injection, the low level switch will close the automatic valves. If AMS is injected into the reactor with the manual valves, the beacon on the reactor will alert the operator to close the valves so that nitrogen will not be injected into the reactor. In either the manual or automatic AMS addition, the level alarms are evidence that AMS has actually been injected into the reactor.

There are also several other items that insure the operability of the emergency AMS kill system in almost any conceivable situation. 1) Each injection pot is equipped with a low pressure alarm that is activated when the pressure in the pot is below 250 PSIG. If the alarm should sound, the low pressure problem must be immediately corrected. 2) There is also a low pressure alarm on the nitrogen supply to the automatic valve actuators. This alarm will sound if the pressure in the cylinder is below 600 PSIG and the cylinder must then be changed. 3) All the AMS kill pots in each reactor module are connected with a flexible hose in such a manner as to allow AMS to be injected manually to any reactor from any injection pot. For example, AMS can be injected into new module reactor D-741 with AMS from the injection pots for reactors D-742, D-743, D-744, or D-745. 4) The AMS injection nozzles on each reactor are checked weekly to assure they are open. This frequency adequately ensures that AMS can be added to the reactor when required. 5) When the ambient temperature is below 20°F AMS is injected into each reactor once per shift to assure the AMS injection lines are not frozen. 6) In addition to the checks made by the operator before each reactor batch, an independent audit of the emergency AMS kill system is conducted weekly. Among the items checked weekly are AMS pot pressure, nitrogen bottle pressure, AMS level, and valve position.

Successful Emergency AMS Utilization

The emergency AMS kill system has been used successfully on numerous occasions since its installation. Listed below are a number of occasions on which it has been successfully used. It should be noted that this list is not meant to be all inclusive, rather representative of the effectiveness of this system. It should also be pointed out that the emergency AMS kill system has never failed to fulfill its intended function of killing a reactor in an emergency situation, thereby preventing releases of vinyl chloride.

Date	Number Of Reactors	Emergency Type
9/21/83	1	Agitator Failure
11/2/83	1	Cooling Water Valve Failure
11/14/83	3	Power Failure
7/17/84	3	Power Failure
8/28/84	7	Power Failure
9/28/84	2	Power Failure
1/2/85	1	Agitator Failure
6/4/85	7	Power Failure

Changes to Standard Operating Procedure

Mr. Curry L. Miller's letter to Mr. James T. Wilburn, dated April 23, 1979 is attached as reference A-4, Appendix A. The letter listed measures which would be taken at the plant to reduce the potential of relief valve discharges. Two of the items listed are no longer part of the plant standard operating procedure. These items are:

"6. The standard operating procedure has been changed so that after every coarse batch, the reactor condenser will be inspected to determine if it is plugged. If it is found to be plugged, it will be cleaned prior to charging the next batch in that reactor.

7. The standard operating procedure has been changed to require a reduction in initiator loading for any batch following a coarse batch in order to slow down the reaction rate."

These practices have been discontinued because the reactor condensers have not been found to be plugged after coarse batches and temperature control has not been a problem after coarse batches. With the proven effectiveness of the emergency AMS kill system and the lack of fouling due to coarse batches these two items are no longer necessary and are therefore no longer part of plant practice.

Item 9 of this same letter pertains to operator training. The current operator training procedures will be detailed in the compliance plan which will be submitted at a later date as required by Section III.B. of the Consent Decree.

IV. REACTOR INTERLOCKS

To reduce the possibility of a reactor panel operator error causing an emergency situation that could result in the discharge of vinyl chloride, the plant uses an extensive reactor interlock system. A programmable controller is utilized to accomplish this function. The main interlocks prevent certain valves from opening in specific reactor operating modes. These modes of operation are those that are required to produce a reactor batch and are listed below.

Evacuation
Charge
Polymerization
Recovery/Steam Stripping
Dump
Clean/Rinse
Swirl

A typical reactor interlock listing is attached as reference A-39, Appendix A. A "N" indicates that a valve cannot be opened in a specific mode. A "Y" indicates that the valve can be opened in the specific mode. For example, the steam stripping valve (valve 712B) cannot be opened in the polymerization mode.

There are also other specific interlocks which preclude operators from opening certain valves or doing certain operations when permissive conditions are not met. There are numerous other interlocks that are provided to prevent certain combinations of valves from being opened which would result in undesirable operating conditions. There are also interlocks provided specifically to reduce the possibility of relief valve discharges. These are listed below.

1. A reactor cannot be charged unless the agitator is running and the amperage indicates that the reactor is empty.

2. The quantities necessary to charge the expansion reactors cannot be charged to the other reactors. The quantities charged in the expansion reactors are much larger than those charged to the other reactors in the module. If this interlock were not present, reactors could be overfilled with the wrong charge size.

3. There are precharge interlocks that prevent more than a total quantity of ingredients to be charged to the reactor to prevent overfilling the reactor due to overcharging.

V. EMERGENCY REACTOR COOLING AND EMERGENCY INSTRUMENT AIR SYSTEMS

In order to further increase capabilities to control emergency situations dealing with power outages, the plant has installed an emergency reactor cooling system and an emergency instrument air system. The cooling can aid the effectiveness of the emergency AMS kill system by creating some mixing in the reactor. The mixing occurs due to the boiling action resulting from condensing vapors in the reactors with the reflux condensers on each reactor. The emergency cooling water system provides cooling water to the reactor condensers from the plant fire water loop. The water supply to the fire water loop is provided by diesel driven pumps. This emergency cooling system provides 2,000 gallons per minute of cooling to each reactor module. With this cooling water available, water can be directed from reactor condenser to reactor condenser to control the reactors as necessary.

The emergency instrument air system uses a diesel driven electric generator to supply power for two plant reciprocating air compressors that are dedicated to supplying air to both reactor modules. This system provides air to insure that valves on reactors will be operational during a power failure emergency. The reactor valve switches located in the control room are powered by emergency power (24 volts DC).

VI. DEVELOPMENT OF A CHAIN TRANSFER AGENT

Production of resin grades at the highest operating pressures use a chain transfer agent (CTA) to lower the pressure. These resins have low molecular weights and the CTA enables the same grade of resin to be produced at lower polymerization pressure. This technology was developed to lower the production pressure of these grades of resin. Lowering of the production pressure allows more time to respond to an upset condition and provides more of a gap between the run pressure and the set point pressure of the reactor relief valves.

VII. HIGHER PRESSURE RATING OF EXPANSION REACTORS

The pressure rating of the reactors installed in the 1982 expansion is 25 pounds per square inch higher than the other reactors. This allows more time to respond to an upset condition and provides more gap between the run pressure and the set pressure of the reactor relief valves.

VIII. OTHER RELATED ITEMS

Other items or procedures that have been installed to reduce the likelihood of a discharge to the atmosphere from an uncontrolled pressure buildup or reduce the magnitude of the release are listed below.

VIII. Other Related Items (Continued)

1. The double rupture disc assemblies on the reactors have all been replaced with rupture disc/relief valve assemblies. This was done to reduce the amount of a release from a discharge that might occur on a reactor as the relief valve should reseat whereas the double rupture disc assemblies would continue to discharge as long as there is pressure in the reactor.

2. Often, during an emergency situation, other reactors in the same module are in operating modes that would allow them to accept material from another reactor in the same module. During an emergency situation, this can be used to reduce the possibility of discharges of vinyl chloride.

3. A severe weather radio is located in the Shift Supervisor's office in the control room and is monitored by the control room personnel. The Shift Supervisor, at his discretion, may have reactors that are in the polymerization portion of the cycle killed if he believes the weather is severe enough that a power failure may occur. Also it is plant practice not to charge reactors during severe thunderstorms.

QUESTION 4: FOR EACH VC DISCHARGE IDENTIFIED IN III.A.1. AS BEING CAUSED, IN WHOLE OR IN PART BY EQUIPMENT MALFUNCTION OR DEFECT, THE FOLLOWING INFORMATION:

a) DESCRIPTION IN DETAIL OF THE CAUSE OF THE MALFUNCTION OR DEFECT WHICH RESULTED IN THE VC DISCHARGE.

b) DESCRIPTION OF THE APPLICABLE INSPECTION AND MAINTENANCE PROCEDURES FOR THE EQUIPMENT THAT MALFUNCTIONED AND IDENTIFICATION OF THE FREQUENCY OF INSPECTION REQUIRED BY SUCH PROCEDURE. IF THE ACTUAL INSPECTION/ MAINTENANCE OF THE AFFECTED EQUIPMENT IS NOT CONSISTENT WITH THE REQUIRED PROCEDURE, DESCRIBE THE INCONSISTENCY AND EXPLAIN WHY.

Response:

The February 2, 1984 release was in part due to the unpredicted failure of the NO kill system tubing. From February 2, 1979 to July of 1984, when it was removed, the NO kill system was checked for integrity every six months.

VCM RELEASES WHICH OCCURRED FEBRUARY 10, 1979, APRIL 14, 1982 AND JANUARY 8, 1983 BECAUSE OF THE PREMATURE FAILURE OF A REACTOR RUPTURE DISC

Summary:

The premature failure of rupture discs which is defined as failure below the disc pressure rating is not new. Rupture disc technology has thus focused primarily on designs and manufacturing techniques to provide accurate burst pressures.

Conoco set up a program to study and prevent premature rupture disc failures in 1979 which Vista Polymers Inc. is still continuing. Application of the information which has been obtained in this program has greatly reduced the probability of a premature failure. However, it is now realized that complete elimination of premature failures is a difficult task because all of the causes are not known. The potential for large VCM releases has been reduced by replacing all of the double rupture disc assemblies with rupture disc and relief valve assemblies. A program has also been conducted to study the factors which may sometimes cause a relief valve to open when the rupture disc fails prematurely and which prevent the valve from quickly reseating. This study has resulted in some changes in the relief valve settings which are expected to both reduce the probability of a relief valve opening when a premature failure occurs and also to make the relief valves reseat more quickly. Thus the number and quantity of VCM releases due to premature rupture disc failures will be minimized.

Details on the results of the studies that have been conducted and the corrective steps that have been taken are provided in the answer to Question 2 below.

QUESTION 1: FOR EACH RELIEF VALVE OR MANUAL VENT VALVE DISCHARGE OF VINYL CHLORIDE ("VC") WHICH OCCURRED FOR THE PERIOD FROM JANUARY 1, 1979 TO JANUARY 1, 1985, A DESCRIPTION OF THE NATURE AND CAUSE OF THE DISCHARGE, INCLUDING PRIMARY AND/OR RELATED CAUSE(S).

Response:

Descriptions giving the nature and cause of the discharge, including primary and/or related cause(s) have been submitted to EPA. These are listed below.

February 10, 1979

1. This incident was reported in a letter to T. A. Gibbs, Chief Air Engineering Branch, on 2/19/79 which is attached as reference B-1, Appendix B.

2. More data was submitted 3/5/79 in a letter to T. A. Gibbs, Chief Air Engineering Branch. This letter included a copy of the plant emergency plan. This letter is attached as reference A-2, Appendix A.

3. Region IV EPA and PEDCo ENVIRONMENTAL Inc., an EPA Contractor, made a field inspection of the Aberdeen plant on August 21, 1979. The report on this inspection which was prepared by PEDCo Inc. included some details on this incident. PEDCo concluded that this release was nonpreventable. A letter from Curry L. Miller (Plant Manager) to Wayne Aronson, EPA Region IV dated October 15, 1980, provided some additional information and corrected some misleading and incorrect statements in the PEDCo report. A copy of this letter is attached as reference A-3, Appendix A.

April 14, 1982

1. This incident was reported in a letter to Jerry B. Banks, Mississippi Department of Natural Resources, dated April 23, 1982 which is attached as reference B-2, Appendix B.

2. A report on this incident was also made to the National Response Center on April 15, 1982.

January 8, 1983

1. This incident was reported in a letter to Jerry B. Banks, Mississippi Department of Natural Resources, dated January 17, 1983 which is attached as reference B-3, Appendix B.

2. A report on this incident was also made to the National Response Center on January 8, 1983.

QUESTION 2:

FOR EACH DISCHARGE DESCRIBED IN RESPONSE TO III.A.1., A DETAILED DESCRIPTION OF ALL RELEVANT CORRECTIVE STEPS TAKEN BEFORE AND DURING EACH DISCHARGE TO PREVENT AND/OR MINIMIZE THE RELEASE OF VC TO THE ATMOSPHERE, INCLUDING, BUT NOT LIMITED TO, SUCH STEPS AS REROUTING VC EMISSION VENTS TO A COLLECTION VESSEL OR INCINERATOR.

Response:

The relevant corrective steps taken before and during the February 10, 1979 and April 14, 1982 discharges are discussed in the incident reports which are references B-1, Appendix B, A-2, Appendix A, and B-2, Appendix B.

Relevant corrective steps taken before and during the January 8, 1983 discharge are discussed in the incident report which is attached as reference B-3, Appendix B. In addition to the corrective steps discussed in reference B-3, Appendix B, the reactor was vented to the recovery system which helped to reduce the reactor pressure so that the relief valve could reseat. At the time of the January 8, 1983 release, the D-744 reactor was being heated up to normal reaction temperature with steam on the jacket. When the release occurred, the steam was shut off and full cooling water turned on. This helped to stop the release by reducing the reactor temperature and pressure.

The information provided below and documented in the listed references is additional information relevant to corrective steps that were taken before and after the February 10, 1979, April 14, 1982 and January 8, 1983 incidents.

ADDITIONAL DETAILS ON CORRECTIVE STEPS TAKEN BEFORE THE FEBRUARY 10, 1979 RELEASE

Stainless steel rupture discs were originally installed on the reactors. These discs were replaced with nickel discs because of concern that the stainless discs might be subject to chloride stress corrosion cracking and because of information which indicated that nickel would be less subject to polymer buildup. A release at Conoco's Oklahoma City PVC plant in August 1978 which was attributed at that time to chloride stress corrosion cracking reinforced this decision.

The Aberdeen polymerization reactors were equipped with 6" BS&B S-90 nickel discs in late 1976. These discs were a new design at that time and were chosen after an evaluation of the reverse buckling discs that were available from the major manufacturers. Only reverse buckling discs were considered in this evaluation since the older design tension loaded discs are not recommended for cyclic applications such as those experienced in the Aberdeen Plant PVC Process where the pressure on each batch ranges from a high vacuum to over 100 psig. All of the other reverse buckling discs available at that time including the BS&B RB-90 disc reversed against knife blades which cut the disc. The S-90 disc, however, is prescored so that the disc will open without cutting when it reverses The S-90 disc thus does not require any knifeblades. Eliminating knife blades eliminated problems such as:

1. The knifeblades becoming dull and not providing a clean cut when the disc reverses.

2. The knifeblades plugging with polymer.

3. Disc reversal against the knifeblades without being cut open can occur. This may only happen occasionally but is a serious problem because the disc will then not burst until a pressure much higher than the design burst pressure is reached in the vessel. The disc thus no longer performs the intended function of protecting against vessel overpressure.

Another advantage of the S-90 disc for PVC reactors is that the pressure cycles do not fatigue the disc. Metallurgical studies of S-90 discs that have been removed from the reactors have confirmed that there is no evidence of metal fatigue. Further discussion of reverse buckling discs was provided in the reply to an EPA Region VI section 114 letter by the Oklahoma City PVC plant dated September 15, 1981.

BS&B did not manufacture 8" S-90 discs in 1976. The 8" reactor rupture discs were converted to S-90's in the second quarter of 1980 when they first became available from BS&B.

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Training of the mechanics in proper handling and installation procedures of the rupture discs was conducted by maintenance supervisors. A record of training on 1/31/77 is attached as reference B-4, Appendix B. Under normal plant procedures other training sessions would have been held but training records have not been located.

ADDITIONAL DETAILS ON CORRECTIVE STEPS TAKEN AFTER THE FEBRUARY 10, 1979 RELEASE

Conoco initiated a study of the causes of premature rupture disc failures and methods of preventing such failures in 1979. This study included extensive discussions with BS&B and other rupture disc vendors, Conoco specialists and DuPont specialists. BS&B has also cooperated with this study by running burst tests on rupture discs and rupture disc/relief valve combinations. This study has led to a realization that improved handling and proper installation of the rupture discs will reduce the probability of premature failures. The first step taken to reduce premature failures was thus to provide the best available training for the plant mechanics.

Plant mechanics and supervisors were trained by BS&B representatives in the proper procedures for the inspection, installation and testing of rupture discs. Training sessions were held 3/13/80, 4/20/82, 4/28/82, 5/24/82, 5/25/82, 6/21/83 and 7/18/84. Additional training for plant mechanics was provided by the plant maintenance supervisors on 3/15/82, 1/17/83 1/19/83 and 7/16/84. Records of these training sessions are attached as references B-5 through B-14, Appendix B. Records of the 5/24 and 5/25/82 sessions are not included since they have not been located. However, plant personnel are sure that the sessions were held. Mechanics who are qualified to do rupture disc installations and testing are listed in memos which are updated as changes occur. Memo's which were issued March 7, 1983, August 22, 1983 and December 15, 1983 are attached as references B-15, B-16, and B-17, Appendix B respectively.

Rupture discs that were available from vendors other than BS&B were evaluated during the vendor discussions. The conclusion reached was that the BS&B S-90 discs were the best choice. Later discussions with DuPont confirmed this choice. DuPont based their conclusions on extensive tests which they conducted on rupture discs manufactured by BS&B and other vendors. During the first series of tests in 1977 the BS&B discs all burst within the proper range but the burst pressures of the other manufacturers discs were rather erratic. DuPont concluded that the BS&B discs exhibited remarkable burst accuracy. The burst pressures of the other manufacturers discs were greatly improved during a second series of tests in 1978 but they were still no better than BS&B.

Another step that was taken to improve rupture disc handling and installation procedures was to purchase new BS&B SRB-7RS holders and to mount all reactor rupture discs in them. This change was completed in the second quarter of 1979. The SRB-7RS holders were also purchased for the other S-90 discs in the plant and the installation was completed by late 1981. Use of the SRB-7RS holder permits rupture discs to be mounted in the holder in the shop where they can be carefully pretorqued to the proper value. Improper torque on the disc has been identified as one of the factors

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which can lead to premature failures. The mounted reactor discs are then tested in the shop to 90% of the rated burst pressure. This test confirms that the disc has not sustained any damage during shipment or mounting. BS&B believes and Conoco and Vista concur that proper mounting of rupture discs in the SRB-7RS holders is one of the most important steps in reducing premature failures. The SRB-7RS holder includes a bite ring to provide a tight metal to metal seal and hold the disc firmly in place to insure accurate burst pressures. This bite ring is four to five thousandths of an inch high when the holder is new.The rupture disc/relief practice manual which is attached as reference B-27, Appendix B contains a section on inspection of the bite ring. The manual states that a feeler gauge is to be used to measure the bite ring height and that the holder needs to be reconditioned when the bite ring is worn down to two thousandths of an inch. Since the manual was prepared, BS&B representatives in their annual training sessions at the plant have given new procedures for checking the bite ring. They now recommend that the holder be visually inspected to assure the bite ring is intact with no indentations or flat spots and then for the inspector to run his fingernail around the bite ring. If the bite ring is high enough to hold the fingernail all the way around, the holder is suitable for reuse. The holder is replaced and sent out for reconditioning if a flaw is found in the bite ring. Current practice at the plant is to visually inspect and use the fingernail test to determine if the bite rings are satisfactory rather than to use a feeler gauge. A letter from BS&B which includes a discussion of the bite ring is attached as reference B-19, Appendix B.

The performance of relief valves mounted over rupture discs was initially assumed to be the same as the relief valves alone. The opening of relief valves at pressures below the relief valve set point when rupture discs failed prematurely showed that this was not the case. Conoco, therefore, proposed a series of tests of rupture disc/relief valve systems to BS&B. BS&B agreed to conduct these tests and Consolidated Valve agreed to provide the relief valves for the tests. These tests were conducted in January 1980 and demonstrated that the relief valve would open even when the rupture disc burst at a pressure as low as 70% of the relief valve set pressure. Opening of the relief valve is attributed to the shock wave created when the rupture disc bursts. Two letters written by M. H. Lewis dated January 18, 1980 and February 5, 1980 which provide further details on these tests are attached as references B-20 and B-21, Appendix B.

A metallurgical examination was conducted of several intact rupture discs which were removed from the Oklahoma City reactors. A memorandum dated April 22, 1980, from J. Kirk Carnahan is attached as reference B-22, Appendix B. Some of these discs were burst by BS&B on the test bench. One of the discs burst at 135 psig which is well below the design pressure of 200 psig. The conclusion was that this low burst pressure was not caused by metallurgical factors.

The double disc assemblies on the reactors were replaced with rupture disc/relief valve assemblies. This change was made to reduce the amount of VCM released if a premature rupture disc failure occurs. All of the double rupture disc assemblies had been replaced by September 1981 and the EPA was notified in a letter dated September 29, 1981 which is attached as reference B-23, Appendix B.

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The rupture disc which failed April 14, 1982 was installed April 4, 1982 in a BS&B SRB-7RS holder and pressure tested in the shop by a maintenance supervisor. This supervisor had been trained by BS&B in proper installation procedures. The disc was then installed on the reactor by a qualified mechanic. Since all known precautions had been observed, this release illustrates the unpreventable nature of premature rupture disc failing and the difficulties that are faced in trying to completely eliminate premature rupture disc failures.

ADDITIONAL DETAILS ON CORRECTIVE STEPS TAKEN AFTER THE APRIL 14, 1982 RELEASE

New procedures were established by C. R. Miller (Plant Superintendent) for the installation and testing of rupture discs in a memorandum dated April 26, 1982. A list of qualified mechanics and test observers was included with the procedures. A copy of this memorandum is attached as reference B-24, Appendix B. A copy of the operating instructions to the shift supervisors and operators to check all rupture discs before charging reactors which was dated April 28, 1982 is also attached as reference B-25, Appendix B.

A Rupture Disc/Relief Valve Practices manual was issued on May 6, 1982. This manual was revised and reissued on September 26, 1983. A copy of the revised manual is attached as reference B-27, Appendix B. This manual sets up detailed procedures for ordering, new rupture disc lot inspection and testing, rupture disc installation in holders, bench pressure testing, installation in the plant and removal after service. The procedure which has been set up to destructively test all discs removed from reactors is also described.

Since the Rupture Disc/Relief Valve Practices manual was issued, several of the items covered have been changed. On page 3 of the manual, item II.B.6. states that the maintenance department must notify the receiving department in writing that the lot of discs have either passed or failed the burst test. This notification is now done verbally. On page 7, item IV.A.3. states rupture discs on the reactors must be changed out at least every six months. Current practice is to change out the reactor rupture discs on an annual basis. This change is discussed in the answer to Question 5. On page 7, item IV.A.4. states that when a reactor is taken out of service for condenser drilling the condenser rupture disc guard(s) must be installed over the rupture disc nozzle(s). Current practice is to either remove the rupture disc and holder from the condenser when a condenser is drilled or to protect it with a guard. On page 10, item VII.B. covers in-place relief valve testing. Since changing the blowdown ring settings on the relief valves which is discussed on page 24, the stated procedure is no longer applicable. The plant is currently developing a method for in-place testing of relief valves with the new blowdown ring setting.

The procedure for the inspection and testing of new lots of rupture discs is described in detail in the rupture disc manual (reference B-27). The procedure calls for the discs to be inspected for flaws such as deep scratches or dents and then one disc from the lot is burst on the bench. Flawed discs are returned to the manufacturer. If the disc that is burst does not meet specifications, then the entire lot is rejected and returned to the manufacturer. One lot has been rejected at this time. This lot had five discs with deep scratches. One of these discs was burst on the bench.

The rated burst pressure for the lot was 189 psig but the selected disc burst prematurely at 164 psig. The other four discs with deep scratches were then tested successfully at BS&B up to 90% of the rated pressure. The decision was then made to use this lot of discs to evaluate the effect of various types of damage to the discs on disc burst pressure. These tests were run at BS&B in August 1982. The conclusion from these tests was that damage to the top of dome is much more serious than damage at the outer radius. Scratches and small nicks did not seem to have any effect on burst pressure. Details on the tests are contained in a letter from Cindy Ziobro dated September 27, 1982 which is attached as reference B-28, Appendix B. BS&B suggested in a letter dated September 9, 1982 that a scratch depth over 50% of the disc thickness should be one of the criteria for disc rejection. This letter is attached as reference B-29, Appendix B. Because of the difficulty which the plant has experienced in measuring scratch depth, the plant rejects any disc that has a scratch or indentation that can be felt on the other side of the disc.

To reduce the possibility of leaks, the reactors are hydrotested to 90% of the pressure rating of the lowest rated disc each time that one of the major flanges on the reactor has been unbolted for any reason. There has been some concern that a rupture disc might be damaged during this hydrotest if the reactor became liquid full or if the test pressure were allowed to rise too rapidly. A revised procedure was thus established for pressure checking reactors after opening to reduce the possibility of damaging a disc during the hydrotest. This procedure included witnessing of all hydrotests by a process engineer or operations supervisor. A copy of this procedure dated August 2, 1982, is attached as reference B-30, Appendix B. The procedure was also documented in a memo dated November 15, 1982, which is attached as reference B-31, Appendix B. This memo set up a pressure check logbook.

ADDITIONAL DETAILS ON CORRECTIVE STEPS TAKEN AFTER THE JANUARY 8, 1983 RELEASE

Standard rupture disc ordering criteria were established in a letter dated August 3, 1983, which is attached as reference B-32, Appendix B. These criteria were written after extensive discussions within Conoco and with BS&B to ensure that uniform high quality rupture discs would be purchased and installed on the PVC reactors. Most of the items specified are not new. The most significant new items are a requirement that the discs be ASME code stamped and that they be tested to 90% the rated burst pressure before shipping.

The long blowdown of the D-744 relief valve on January 8, 1983 after relieving at 19% below its set pressure because of the premature rupture disc failure raised serious questions about the reason why the valve did not reseat quickly. The plant discussed this problem extensively with Farris who manufactured the valve and found that there were several possible reasons why this could happen. The most likely reason being that the relief valve blowdown ring was set too close to the valve disc holder. This is called a high blowdown ring setting but it represents a low number of notches on the blowdown ring. The position of the blowdown ring is set by counting the number of notches away from the disc holder. The plant then decided to run a series of tests in one of the reactors using air.

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These tests were run in May 1984 and a Farris representative participated. The tests evaluated the effect of the blowdown ring setting on the reseating pressure of the valve. The amount of relief valve opening when a rupture disc beneath the valve was burst below the valve set pressure was also investigated. From the results of these tests, it was concluded that the possibility of a VCM release would be reduced if the blowdown rings were set further away from the disc holder. This change was completed in October 1984 when all of the blowdown rings were set at 30 notches which is almost double the normal 18 notches. This change was documented in a plant memorandum dated October 29, 1984 which is attached as reference B-33, Appendix B.

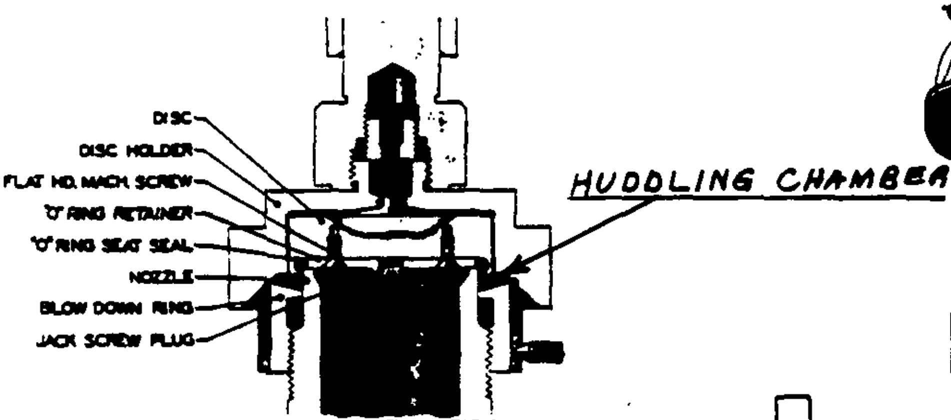
A discussion of how the blowdown ring affects safety relief valve operation will help to show why this change in blowdown ring setting will reduce the likelihood of VCM relief valve emissions. A diagram of the Farris 2600 safety relief valve which is used on most of the plant reactors is reproduced from the Farris catalog on the following page. An understanding of how the blowdown ring controls the relief valve reseating pressure at blowdown can be obtained by referring to the diagram. As the pressure increases in the protected vessel, the force against the disc begins to overcome the spring pressure. The disc then lifts slightly which allows some leakage past the valve O-ring seal into the huddling chamber. Leakage out of the huddling chamber (simmer) is controlled by the clearance between the blowdown ring and the disc holder. A setting of the blowdown ring close to the disc holder will thus reduce the clearance and the leakage rate out of the huddling chamber. When the leakage rate into the huddling chamber becomes greater than the leakage rate out then pressure will buildup in the huddling chamber. Pressure in the huddling chamber will lift the disc holder. The force on the disc holder added to the force on the disc overcomes the closing force of the spring and causes the valve to open quickly in the characteristic pop action. After the valve opens, it is kept open by the kinetic energy of the flowing gas as it changes direction in the huddling chamber. A gas flow of 25% or more of valve capacity is generally required to keep the valve open. When the relieving pressure drops below the valve set pressure, the spring force is able to overcome this kinetic energy and close the valve. However, if the blowdown ring is set close to the disc holder, pressure will again build in the huddling chamber as the disc holder approaches the blowdown ring and the force against the disc holder will prevent the valve from closing. Increasing the blowdown ring setting to a higher number of notches will increase the clearance between the blowdown ring and the disc holder and thus reduce the huddling chamber pressure and the force on the disc holder. This allows the spring to close the valve at a higher pressure. By positioning the blowdown ring further away from the disc holder, it should also be more difficult for the shock wave from a premature rupture disc failure to pop open the valve. This was confirmed by the plant tests. Thus a consideration of both the way the reactor safety relief valves are designed to operate and the results of the tests that were conducted leads to the conclusion that the new blowdown ring settings should reduce the possibility of VCM releases. Training in the changes that were to be made in the blowdown ring settings was provided to the plant engineers on July 13, 1984 which is documented in reference B-34, Appendix B.

2600 Series

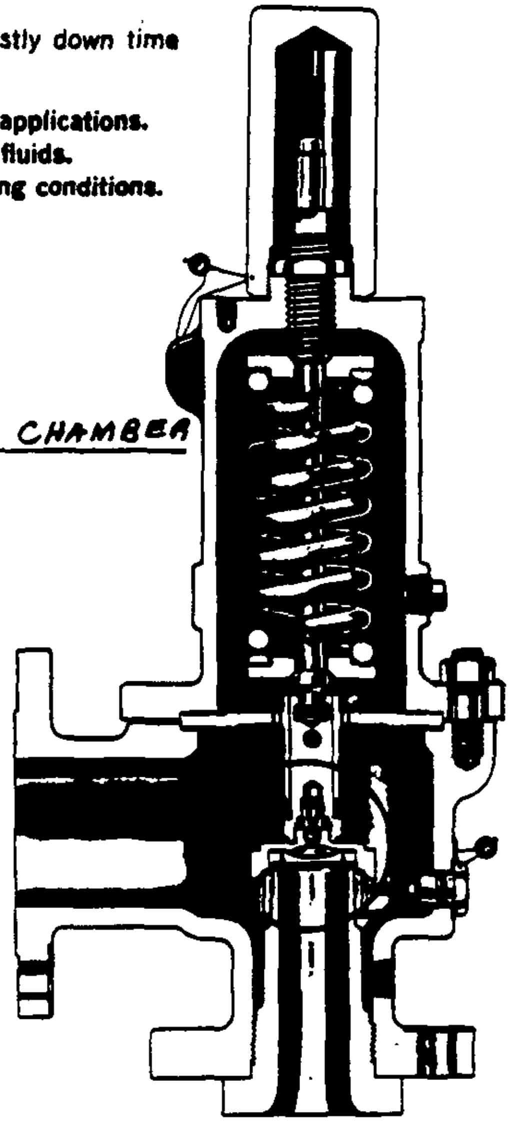
Farris "O" Ring Seat Pressure Seal for Conventional or BalanSeal

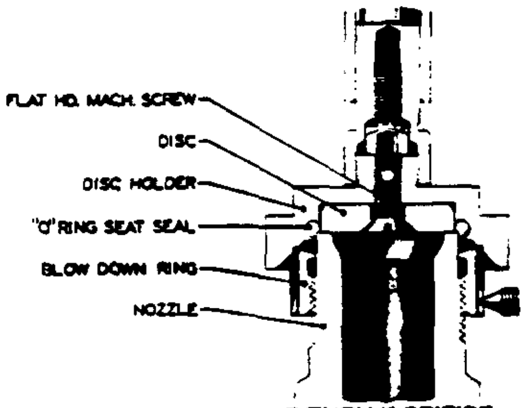
Minimizes leakage and costly product loss as well as costly down time and maintenance on troublesome applications such as:

- Operation too close to set pressure.
- Light, hard to hold fluids.
- Entrained foreign particles and solids.
- Vibratory applications.
- Corrosive fluids.
- Nozzle icing conditions.
- Discharge piping strains.



L THRU T ORIFICE





D THRU K ORIFICE

Recognizing the need for a resilient seat in a safety-relief valve for extreme tightness, Teledyne Farris Engineering first made available an "O" Ring seat seal in early 1950. Although limited in pressure, the "O" Ring design received phenomenal acceptance since it made possible complete tightness at pressures much closer to the valve set pressure than was ever possible with the standard metal to metal seats after service.

The present "O" Ring Seat Pressure Seal design is an improvement which allows the use of the "O" Ring Seat Seal to higher pressures and, equally important, the spring load is solely carried by the metal to metal portion of the seat with the "O" Ring becoming a pressure seal within its recessed chamber and the outer edge of the nozzle, assuring the ultimate in tightness.

The "O" Ring Seat Pressure Seal is available in our 2600 Series line of flanged safety-relief valves – conventional or BalanSeal construction – for pressures up to a maximum of 1500 PSIG.

Referring to the selection tables on pages 2.12 thru 2.39, substitute a "C" for the fourth digit "A" in the type number for the conventional valve and a "D" for the fourth digit "B" in the type number for the BalanSeal construction when an "O" Ring Seat Seal is required:

26FA10 becomes 26FC10 (Conventional)
26FB10 becomes 26FD10 (BalanSeal)

The pressure limit of the Conventional or BalanSeal valves covered in the selection tables is the same for the "O" Ring design in all type numbers and orifices with the 150 lb., 300 lb. and 600 lb. inlet flanges. On the "O" Ring design in all type numbers and orifices, 1500 lbs. is the limit for the "O" Ring design, not the conventional valve limit shown in the selection tables & charts. Refer to "O" Ring Material Selection Chart on page 2.11 for Temperature and Pressure ratings of the various elastomeric "O" Ring materials available.

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CONFIDENTIAL

VCM RELEASES WHICH OCCURRED JANUARY 19, 1980 AND JANUARY 13, 1983 DUE TO HYDROSTATICALLY OVERFILLED REACTOR CONDITIONS

Summary:

On January 19, 1980 and January 13, 1983, the plant experienced emergency relief valve discharges on PVC reactors due to hydrostatically overfilled conditions. Response to relevant questions is provided on both discharges in this section since the incidents are closely interrelated. The corrective action taken since these discharges include changes in procedures, operator training, installation of additional instrumentation and additional reactor charge interlocks. These actions are believed to be adequate as no further releases have occured.

QUESTION 1: FOR EACH RELIEF VALVE OR MANUAL VENT VALVE DISCHARGE OF VINYL CHLORIDE ("VC") WHICH OCCURRED FOR THE PERIOD FROM JANUARY 1, 1979 TO JANUARY 1, 1985, A DESCRIPTION OF THE NATURE AND CAUSE OF THE DISCHARGE, INCLUDING PRIMARY AND/OR RELATED CAUSES(S).

Response:

Descriptions giving the nature and cause of the discharges have been submitted and are listed below:

1. The initial discharge report for the January 19, 1980 release was submitted to EPA Region IV in a letter dated January 24, 1980 which is attached as reference C-1, Appendix C.

2. On March 4, 1980 a copy of the reactor strip chart for the January 19, 1980 release was sent to Mr. Wayne Aronson, EPA Region IV, per his phone request which is attached as reference C-2, Appendix C.

3. The initial discharge report for the January 13, 1983 release was submitted to the Mississippi Bureau of Pollution Control in a letter dated January 21, 1983 and is attached as reference C-3, Appendix C.

Subsequent to the initial discharge report submitted to EPA on January 24, 1980 concerning the January 19, 1980 release, it was determined that the agitator amperage indicator on D-400 reactor, the reactor on which the release occurred, was not functioning properly at the time of the release. A more detailed description of the January 19, 1980 release and the effect of the agitator amperage indicator not working properly follows.

All reactors were equipped with agitator amperage indicators at the time of the release. These amperage indicators show different amperages for different levels of liquid in the reactors. Although the differences in amperage cannot be used to accurately measure the level inside the reactor, it is a good indication of the presence or absence of material in the reactor. When a reactor contains material, amperage will be higher than when it is empty and it should return to approximately the same amperage after the reactor is empty again. However, the amperage indicator for reactor D-400 was not functioning correctly at the time of the release.

The reactor batch previous to the one on which the release occurred took a little longer than usual to dump. This was a sign to the panel operator that there could be a small amount of plugging in the dump lines, so he proceeded cautiously with the pre-charge procedures. Upon finishing reactor rinsing after dumping the slurry, the panel operator radioed to the outside operator and asked him to check the bullseye on the line to the sewer.

The bullseye is used to check flow from the reactor to determine if it is empty or if there is pluggage in the dump manifold. If the reactor is empty and there is no pluggage, there will be a large flow indicated at the bullseye when the reactor is rinsed and this flow will almost stop when the reactor drains empty. The outside operator said that "nothing was coming out of the reactor except the usual small amount of water from reactor flushes". Two reactor flushes normally add about 0.8 gallons per minute to the reactor. The outside operator saw an amount of water flowing through the bullseye and it looked to be like the normal reactor flush water which would indicate that the reactor was empty. If there had been more or less water flowing, the outside operator would have suspected pluggage problems. The amount of water flowing through the bullseye appeared normal. The panel operator then checked the agitator amperage indicator and it was showing a little less than 100 amps. Since this was the normal amperage for this reactor at the time, the panel opertor thought the reactor was empty.

The panel operator then proceeded to evacuate the reactor for the next charge. Another indicator of liquid in the reactor is usually inability to obtain a vacuum quickly. However, evacuation proceeded normally so there was no warning of a problem.

When the required vacuum was reached in the reactor, the outside operator, who reads the mercury manometer on the reactor, informed the panel operator to proceed with the charge. The first step in the charge sequence is to "break vacuum". This procedure opens up one vinyl chloride charge valve, allowing a small amount of vinyl chloride in the charge manifold to enter the reactor and pressurize the reactor to about 30 pounds per square inch gauge. The outside operator can then check the reactor for leaks and ensure rupture discs are intact. When the VCM charge valve was opened to break vacuum, both the outside operator and the chief lead operator, who was near the reactor, noticed unusual vibration. The chief lead operator is normally the most experienced person on the shift besides the shift supervisor. The chief lead operator suspected something was wrong and went to the control room to check the amperage indicator. The amperage indicator showed less than 100 amps. Because this was normal for this reactor and because of the other checks done previously, the chief lead operator thought everything was normal. The charge then proceeded as normal until the reactor charge was about 87% complete. The panel operator noticed that the pressure in the reactor was 110 psig and increasing rapidly. He immediately shut off the VCM and water charge pumps. Before the panel operator could put the reactor on the recovery system, the pressure in the reactor reached 182 psig as indicated by the reactor strip chart. At this time, there was a momentary release through the relief valve.

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Description - continued

After the release, a new amperage meter was ordered and installed on reactor D-400 agitator. On January 22, 1980 all reactor batch sheets were modified to include a space for reactor agitator pre-charge amperage. The operator must record this amperage before each batch is charged. The problem with the D-400 amperage indicator is not fully understood. However, to reduce the possibility of obtaining misleading information from these indicators, reactor empty pre-charge amperages have been established. If the panel operator does not get a reading equal to the established empty amperage, the reactor is not to be charged until the problem is resolved.

QUESTION 2: FOR EACH DISCHARGE DESCRIBED IN RESPONSE TO III.A.1. A DETAILED DESCRIPTION OF ALL RELEVANT CORRECTIVE STEPS TAKEN BEFORE AND DURING EACH DISCHARGE TO PREVENT AND/OR MINIMIZE THE RELEASE OF VC TO THE ATMOSPHERE INCLUDING, BUT NOT LIMITED TO, SUCH STEPS AS REROUTING VCM EMISSION VENTS TO A COLLECTION VESSEL OR INCINERATOR.

Response:

The correspondence mentioned in Question 1 above contains information on relevant preventative steps taken before and after the January 20, 1980 and the January 13, 1983 releases to minimize the release of VC to the atmosphere. The following additional information is submitted.

PREVENTIVE MEASURES

I. Introduction

The causes of hydrostatically overpressuring a reactor have been studied and preventive measures have been taken. Both of the incidents which have resulted in releases due to hydrostatically overfilling a reactor and other causes or incidents which have not resulted in releases but were potential causes for a release have been analyzed. The following information shows proper preventive measures have been taken to reduce the possibility of hydrostatically overpressuring a reactor.

II. Possible Hydrostatic Overpressure Conditions

A. Reactor Not Completely Drained

If a reactor is not completely drained, a discharge can occur because of hydrostatically overpressuring the reactor during the charge of the next batch. This condition resulted in releases on January 19, 1980 and January 13, 1983. Listed below are the preventive measures taken to reduce the possibility of a similar occurrence.

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1. Prior to January 19, 1980

Prior to January 19, 1980, the following procedures and instrumentation were available to reduce the possibility of a vinyl chloride release due to charging a reactor that was not completely drained.

a. The reactors were equipped with agitator amperage indicators. A no-load agitator amperage is an indication that the reactor is empty. The operators had been trained to check this parameter before charging. Although documentation of this specific training has not been located, the fact that checks were performed immediately prior to the January 19, 1980 release show that the operators had been taught and understood the significance of the no-load amperage

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b. The reactor sewer line was equipped with a bullseye for watching flow from the reactor to the sewer. A flow larger than the normal 0.8 gallons per minute flow would be an indication that the piping is partially plugged. A flow lower than normal or no flow would indicate that piping is likely plugged.

2. Between January 19, 1980 and January 13, 1983

a. Reactor emptying procedures were issued on January 21, 1980. These are attached as references C-4 and C-5, Appendix C. These procedures specify checking the reactor amperage before charge, posting no-load amperage for each reactor and rinsing through the reactor with flow that is not hindered by pluggage in the lines. Specific training on these procedures was given to the operators in January, 1980. Plant records showing that formal training was given are attached as referances C-6 and C-7, Appendix C.

b. The reactor batch sheets were revised on January 22, 1980 to include the pre-charge agitator amperage. The no-load agitator amperage was established for each reactor. Operators were instructed not to charge reactors unless there is a no-load amperage showing for the reactor agitator.

c. The amperage indicator that read incorrect no-load amperage on reactor D-400 was replaced.

d. Reactor agitator amperage recorders were installed for all reactors. This recording of amperage helps operators see trends in the agitator amperage and spot possible problems.

e. Remote controlled cameras were installed to enable the panel operator to also inspect the bullseye to check that the reactor is empty according to the procedure.

f. Reactor emptying procedures were again reemphasized to vinyl employees on January 31, 1981. Plant records are attached as references C-8 and C-9, Appendix C. The importance of following procedures to make sure reactors are empty was stressed.

3. Since January 13, 1983

a. An interlock was added to the reactors that will not allow automatic reactor charge if the agitator amperage is above a certain setting or below a certain setting. This interlock reduces the possibility of charging the reactor with high amperage that would indicate liquid in the reactor or charging the reactor with the agitator off.

b. Robert E. (Bob) Morgan was the panel operator whose failure to follow established procedures caused the January 13, 1983 relief valve discharge. The specific errors that were made are as follows:

1) The low agitator amperage panel alarm was ignored during rinse of the reactor.

2) The proper procedure for checking for an empty reactor was not followed. According to the reactor emptying procedures issued January 21, 1980, the operator should have checked for water being able to flow through the reactor. The operator checked the manifold below the reactor for pluggage. This procedure did not check for pluggage in the reactor or in the sewer piping.

3) The panel operator recorded incorrect information on the reactor batch sheet. Instead of checking the amperage on the reactor before recording the amperage, the panel operator recorded what the pre-charge amperage should have been. A copy of the batch sheet and the amperage recording are attached as references C-10 and C-11, Appendix C. On the amperage strip chart, the reading on the right is the dumping of the previous batch. Note that the amperage starts at 54-59 amps (5.4 x 10, etc.) and drops as the batch is dumped to about 32 amps. Then the amperage drops to zero indicating that the agitator is off. When the agitator is again turned on, the reading was 53-58 amps. The panel operator turned on the agitator during evacuation before the charge started, but failed to look at the indicator or the recorder.

As a result of these errors, Bob Morgan, was given a two-day disciplinary suspension. Documentation of this suspension is attached as reference C-12, Appendix C.

It should also be noted that Bob Morgan had been trained in the proper emptying procedures. Bob Morgan signed his name on the training sheet for training given January 27, 1980 which is attached as reference C-7, Appendix C.

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It should also be noted that recording of incorrect information on batch sheets receives appropriate attention. One such incident involving recording erroneous amperage is attached as reference C-13, Appendix C. A written warning to panel operator J. D. Sims was given in a letter dated July 13, 1981.

c. On January 25, 1983, the empty reactor checkout procedures were again reemphasized to all vinyl operators. A copy of this memo is attached as reference C-14, Appendix C.

B. Catalyst Injection Water Overpressure

Since the catalyst injection water could hydrostatically overfill a reactor, measures have been taken to reduce the possibility of a relief valve discharge for this reason. These measures are listed below:

1. Training has been given to operators stressing the importance of only adding the proper amount of catalyst water to the reactor. Operators have also been instructed they must be in the immediate area when catalyst flush water is being added to the reactor. This procedure cannot take place unattended. If for some reason the operator must leave the area, the flow of flush water must be stopped.

   Formal and documented training of this fact has been given on at least seven different occasions. Training records are attached as references C-15 through C-21. More training was no doubt given, but these are the only documented specific training sessions for which records are still available. However, in extensive training given to outside vinyl operators in 1982, this fact was stressed as noted on Question 2 of the attached operator quiz as referenced C-22, Appendix C.

   The note at the top of the July 8, 1982 training session shows the type of attention given by management to environmental programs. The note from the plant manager, John Friend, asks the vinyl superintendent, Pete Markey, if this training has already been given. The reply by Pete Markey is that the shift supervisors are going through the training again to emphasize its importance.

2. When the catalyst injection bombs are pressurized, a light is illuminated in the control room so that the panel operator can tell that there is water entering the reactor. If the catalyst injection bomb remains pressurized due to water flowing into the reactor for a specific length of time, an alarm will sound in the control room. The panel operator can then communicate with the vinyl outside operator to stop the flow of water into the reactor.

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C. Excessive Flush Water Rates

There are two small constant water flushes that enter the reactor. The agitator lip seal flush water and the spray nozzle flush. These combined flows amount to about 0.8 gallons per minute. Because of the small volume of these streams and the large capacity of the reactor vapor space, it is unlikely that these flushes would overpressure a reactor. To reduce the possibility of these flushes causing problems, the following measures are taken:

1) If the reactor must contain liquid or slurry for any long period of time, the flow rates to these flushes are reduced to a minimum.

2) Under normal circumstances, the flush water is checked every batch to make sure they are at the proper settings. There is a flow meter available at each flush to facilitate monitoring.

D. Reactor Overcharge

If the reactor was overfilled due to excessive charge ingredients, a relief valve discharge could occur. In order to reduce the possibility of this occurrence, the following measures are taken:

1) Since the product quality is highly dependent on following a specific formula for each product, careful attention is given to the addition of material to the reactor. The addition of major volume ingredients is controlled by a programmable controller which starts and stops pumps and opens and closes valves. Dual flow meters exist for the water and the vinyl chloride monomer so that if one meter were to malfuntion, another meter would be available for use. These flow meters have readouts in the control room. During charge, the panel operator constantly monitors the progress of the charge since addition of the proper type and quantity of ingredients is critical to the product quality and to the prevention of overfilling.

2) There is an interlock which will not allow the charge of a larger reactor volume in a smaller reactor. The larger reactor formula cannot be entered in the charge mode for a smaller reactor.

3) There is also an interlock that limits the total charge quantity to each reactor. The programmable controller will prevent charge to a specific reactor if it exceeds a preset volume.

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VCM RELEASES FROM THE OLD MODULE BLOWDOWN TANK
SAFETY RELIEF VALVE ON APRIL 3, 1980 AND APRIL 7, 1980

Summary:

These releases occurred because the old module blowdown tank was rated for only 66 psig whereas some of the systems feeding the blowdown tank operate normally at 70 to 80 psig. In this situation, any malfunction in the emission recovery system which removed vapors from the blowdown tank or an excessive VCM feed rate could quickly lead to overpressuring the tank. This tank has now been replaced with two new vessels with design pressures of 150 psig so that this type of problem can no longer occur.

Details on the corrective steps which were taken to prevent any more VCM releases from this source are included in the answer to Question 2.

QUESTION 1:

FOR EACH RELIEF VALVE OR MANUAL VENT VALVE DISCHARGE OF VINYL CHLORIDE ("VC") WHICH OCCURRED FOR THE PERIOD FROM JANUARY 1, 1979 TO JANUARY 1, 1985, A DESCRIPTION OF THE NATURE AND CAUSE OF THE DISCHARGE, INCLUDING PRIMARY AND/OR RELATED CAUSE(S).

Response:

Descriptions of these incidents are provided in the documents which are referenced below:

April 3, 1980

1. This incident was reported in a letter to Rebecca Hanmer, Region IV EPA dated April 8, 1980 which is attached as reference D-1, Appendix D.

April 7, 1980

1. This incident was reported to Rebecca Hanmer, Region IV, EPA in a letter dated April 16, 1980 which is attached as reference D-2, Appendix D.

QUESTION 2:

FOR EACH DISCHARGE DESCRIBED IN RESPONSE TO III.A.1., A DETAILED DESCRIPTION OF ALL RELEVANT CORRECTIVE STEPS TAKEN BEFORE AND DURING EACH DISCHARGE TO PREVENT AND/OR MINIMIZE THE RELEASE OF VC TO THE ATMOSPHERE, INCLUDING, BUT NOT LIMITED TO, SUCH STEPS AS REROUTING VC EMISSION VENTS TO A COLLECTION VESSEL OR INCINERATOR.

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Response:

The relevant corrective steps taken before and during the April 3, 1980 and April 7, 1980 releases are discussed in the references provided under Question 1.

The information provided below and documented in the listed references is additional information relevant to corrective steps that were taken before and after these incidents.

ADDITIONAL DETAILS ON CORRECTIVE STEPS THAT WERE TAKEN BEFORE THE APRIL 3, 1980 RELEASE

Operating procedures were written and issued to provide the operators with guidelines to prevent operating problems. A copy of the operating procedure dated April 27, 1979 is attached as reference D-3, Appendix D.

ADDITIONAL DETAILS ON CORRECTIVE STEPS THAT WERE TAKEN AFTER THE APRIL 3, 1980 RELEASE

The shift operators were trained in the blowdown tank operating procedures. A record of the training of one of the shifts dated 4/6/80 is attached as reference D-4, Appendix D. Normal plant practice would have called for the operators on the other shifts to have also been trained. However, records of this training have not been located.

ADDITIONAL DETAILS ON CORRECTIVE STEPS THAT WERE TAKEN AFTER THE APRIL 7, 1980 RELEASE

A new batch waste water stripping system was installed and put into operation in July 1981. Notification of the startup of this stripper was given to Rebecca Hanmer, EPA Region IV, in a letter dated June 1, 1981 which is attached as reference D-5, Appendix D. This stripping system replaces the old blowdown drum which was taken out of service. Since the new stripper has a design pressure of 150 psig it is not subject to the type of problem which caused these releases.

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VCM RELEASES WHICH OCCURRED SEPT. 16, 1981 AND NOV. 5, 1981 FROM THE VCM CHARGE FILTER IN REACTOR MODULE NO. 1

Summary:

These two releases occurred from the thermal relief valve on the north fresh VCM charge filter in reactor module No. 1. The filterpak was overpressured in both cases but the cause for the overpressuring was different. These thermal relief valves have now been tied into the batch water strippers. Since no further releases have occurred this change is believed to have solved the problem.

QUESTION 1:

FOR EACH RELIEF VALVE OR MANUAL VENT VALVE DISCHARGE OF VINYL CHLORIDE ("VC") WHICH OCCURRED FOR THE PERIOD FROM JANUARY 1, 1979 TO JANUARY 1, 1985, A DESCRIPTION OF THE NATURE AND CAUSE OF THE DISCHARGE, INCLUDING PRIMARY AND/OR RELATED CAUSE(S).

Response:

Descriptions of each of these incidents have previously been provided to the Region IV EPA in the documents which are referenced below:

September 16, 1981

1. This incident was reported in a letter to Charles R. Jeter, Region IV EPA, in a letter dated September 23, 1981, which is attached as reference E-1, Appendix E.

2. This incident was also reported to the National Response Center on September 16, 1981.

November 5, 1981

1. This incident was reported in a letter to Charles R. Jeter, Region IV EPA, dated November 13, 1981, which is attached as reference E-2, Appendix E.

2. A report was also made on this incident to the National Response Center on November 5, 1981.

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QUESTION 2:

FOR EACH DISCHARGE DESCRIBED IN RESPONSE TO III.A.1., A DETAILED DESCRIPTION OF ALL RELEVANT CORRECTIVE STEPS TAKEN BEFORE AND DURING EACH DISCHARGE TO PREVENT AND/OR MINIMIZE THE RELEASE OF VC TO THE ATMOSPHERE, INCLUDING, BUT NOT LIMITED TO, SUCH STEPS AS REROUTING VC EMISSION VENTS TO A COLLECTION VESSEL OR INCINERATOR.

Response:

The relevant corrective steps which were taken before and during each discharge to prevent and/or minimize the discharge are discussed in the references provided under Question 1.

The information provided below and documented in the appropriate references is additional information relevant to corrective actions taken before, between, and after the September 16, 1981 and November 5, 1981 incidents to prevent VCM releases caused by overpressuring of the VCM filter pak.

FILTER PAK VAPOR EQUALIZATION LINE

Prior to September 16, 1981, this filter was vented to the fresh VCM receiver with a vapor equalization line. The line was designed to be open at all times that the filter was in service so that the filter could not be overpressured. The rupture disc and relief valve were provided only as a safety device to guard against the remote possibility that the equalization line could become plugged or otherwise closed off. The September 16, 1981 incident occurred when this equalization line became plugged with PVC polymer.

Subsequent to the September 16, 1981 release, the standard operating procedure was changed to include a daily check of the filter pak pressures. This item was added to the reactor "A" checklist on September 23, 1981. Equalization of the pressure between the VCM filter pak and the VCM receiver after the charge is complete indicates that the equalization line must be open. This pressure check procedure was discontinued after the relief valve discharge was piped to a containment system.

It should be noted that the equalization line was open when the November 5, 1981 release occurred. It is believed that the November 5 release occurred when the VCM charge pump ran blocked in for a short period of time. The equalization line was too small to relieve all the pressure in the system.

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FILTER PAK RELIEF VALVE CONTAINMENT

A plan was developed after the September 16, 1981 release to tie the discharge of the filter pak relief valve in to the new batch water stripper which normally operate at a pressure below 10 psig. The materials necessary to make this tie-in were ordered on October 15th. Because of the time required to procure the necessary relief valves and other material required to make this tie-in, the installation had not been done when the November 5, 1981 discharge occurred.

On November 6, 1981 a temporary tie-in was made from the filter pak relief valve discharge to the recovered VCM receiver. This tie-in ensured that any future overpressuring of the filter would not result in an atmospheric VCM release from the relief valve.

The permanent blowdown system described above to contain the filter pak relief valve discharges was completed as soon as practicable after the valves and other material were received. It should be noted that this tie-in required a unit shutdown. Also because of problems that can occur during freezing weather, the plant operating philosophy is to not take planned unit shutdowns during the cold weather months. This system was operational in February of 1982. This should provide a good solution to the problem since the batch water stripper normally operates at a pressure below 10 psig. The tie-in line should also not be subject to plugging since it does not normally have a high VCM concentration. This installation is believed to have solved the problem which led to these discharges.

QUESTION 4:

FOR EACH VC DISCHARGE IDENTIFIED IN III.A.1. AS BEING CAUSED, IN WHOLE OR IN PART BY EQUIPMENT MALFUNCTION OR DEFECT, THE FOLLOWING INFORMATION:

a) DESCRIPTION IN DETAIL OF THE CAUSE OF THE MALFUNCTION OR DEFECT WHICH RESULTED IN THE VCM DISCHARGE.

b) DESCRIPTION OF THE APPLICABLE INSPECTION AND MAINTENANCE PROCEDURES FOR THE EQUIPMENT THAT MALFUNCTIONED AND IDENTIFICATION OF THE FREQUENCY OF INSPECTION REQUIRED BY SUCH PROCEDURE. IF THE ACTUAL INSPECTION/MAINTENANCE OF THE AFFECTED EQUIPMENT IS NOT CONSISTENT WITH THE REQUIRED PROCEDURE, DESCRIBE THE INCONSISTENCY AND EXPLAIN WHY.

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Response:

9/16/81 Release

There is no indication that any equipment malfunction or defect contributed to this release.

11/5/81 Release

The direct cause of this release was the overpressuring of the filter pak during VCM charge which resulted in bursting the rupture disc and lifting of the relief valve which discharged to the atmosphere. Mechanical malfunctions lead to the overpressuring of the filter pak.

Overpressuring of the filter pak is believed to have been the result of a sequence of events which was not foreseeable when the system was installed. The VCM charge was controlled by a MODICON programmable controller which was programmed to start the charge pump when the pump discharge valve was opened. In this case, the charging operation proceeded normally until charge was complete and the signal was given to close the pump discharge valve and shutdown the pump. It appears that the problem started when the pump discharge valve did not close properly. A signal would normally be provided to the programmable controller at that point indicating that the valve was closed. In this case, a closed signal from the valve was apparently not received by the programmable controller.

The programmable controller then restarted the pump since its information indicated that the valve was open. Since the other valves in the charge line were still closed, the pump started up dead headed and overpressured the filter. Overpressuring of the filter was only momentary since as soon as the pump started up the operator shut it down. Thus the conclusion is that the problem was caused by a malfunction of the valve or of the switch that indicates that the valve is closed. Immediately after the incident, additional interlocks were programmed into the controller to prevent the VCM pump from starting up if any of the valves in the pump discharge line are closed.

VCM RELEASE WHICH OCCURRED OCTOBER 16, 1981 FROM THE TANK FARM SURGE DRUM

Summary:

On October 16, 1981, the relief valve on the tank farm surge drum, T-201, discharged. The discharge occurred due to the unloading compressors being run in a "blocked-in" condition from operator error. The compressors then relieved into the surge drum, T-201, which became overpressured. The corrective action taken as a result of this discharge includes operator training, revised operating procedures and installation of appropriate instrumentation. These actions are considered to be adequate because no further releases have occurred.

QUESTION 1: FOR EACH RELIEF VALVE OR MANUAL VENT VALVE DISCHARGE OF VINYL CHLORIDE ("VC") WHICH OCCURRED FOR THE PERIOD FROM JANUARY 1, 1979 TO JANUARY 1, 1985, A DESCRIPTION OF THE NATURE AND CAUSE OF THE DISCHARGE, INCLUDING PRIMARY AND/OR RELATD CAUSES(S).

Response:

A description of the nature and cause of the discharge was sent to Region IV of the EPA in a letter dated October 26, 1981 which is attached as reference F-1, Appendix F.

QUESTION 2: FOR EACH DISCHARGE DESCRIBED IN RESPONSE TO III.A.1. A DETAILED DESCRIPTION OF ALL RELEVANT CORRECTIVE STEPS TAKEN BEFORE AND DURING EACH DISCHARGE TO PREVENT AND/OR MINIMIZE THE RELEASE OF VC TO THE ATMOSPHERE INCLUDING, BUT NOT LIMITED TO, SUCH STEPS AS REROUTING VCM EMISSION VENTS TO A COLLECTION VESSEL OR INCINERATOR.

Response:

Relevant corrective action taken to reduce the possibility of this type incident recurring is discussed below:

1. Operators were reinstructed on the proper valves to have open and closed at the tank farm during the unloading operation. The operators were also instructed in the proper use of a checklist to be followed at each unloading. The checklist shows the proper valve arrangement that the operators must have in order to not run the compressors in a blocked-in situation. The training record and the checklist are attached to the letter from P. E. Markey dated November 17, 1981, which documents corrective action taken. This letter is attached as reference F-2, Appendix F.

2. A two-day disciplinary lay-off for "inattention to operations" was given to the yard operator who improperly lined up the valving at the tank farm. The letter of suspension is attached to the corrective action step letter from P. E. Markey dated November 17, 1981. (reference F-2, Appendix F)

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QUESTION 2: Continued

3. Since the cause of the release was the compressors running in a "blocked-in" condition which caused the compressor relief valves to relieve to the surge vessel, T-201, a pressure switch was installed in T-201. When the pressure in T-201 reaches 100 psig, the pressure switch will shut down the compressors. This pressure is well below the T-201 relief valve set pressure of 150 psig. This action was completed and tested by November 13, 1981 as documented by the attached letter from P. E. Markey dated November 17, 1981.(Reference F-2, Appendix F)

4. As an additional measure, high temperature shutdown switches were installed on each compressor. If a compressor runs in a "blocked-in" condition, the temperature of the gas and the compressor will increase greatly. These temperature switches with associated instrumentation were installed in late 1981. The sensors were attached to the compressor with an epoxy compound. Due to vibration, this proved to be an unsatisfactory long term solution as the sensors came loose after a period of time. The compressors were then machined with a special slot for the sensors. This work was completed in late 1983.

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VCM RELEASE FROM THE RECOVERED VCM CONDENSER RELIEF VALVE, REACTOR MODULE NO. 2 ON JANUARY 11, 1982

Summary:

This release was caused by overpressuring of the recovered VCM condenser during an attempt to thaw it out with steam. Operating practices were changed to reduce the possibility of reoccurance.

QUESTION 1: FOR EACH RELIEF VALVE OR MANUAL VENT VALVE DISCHARGE OF VINYL CHLORIDE ("VC") WHICH OCCURRED FOR THE PERIOD FROM JANUARY 1, 1979 TO JANUARY 1, 1985, A DESCRIPTION OF THE NATURE AND CAUSE OF THE DISCHARGE, INCLUDING PRIMARY AND/OR RELATED CAUSE(S).

Response:

EPA Region IV has previously been provided with a full description of the January 11, 1982 incident. This information has been provided on the following dates in the documents noted below.

1. The incident was reported to the National Response Center on January 12, 1982.

2. A report on the discharge was filed with the Region IV EPA in a letter to Charles R. Jeter dated January 14, 1982 which is attached as reference G-1, Appendix G.

QUESTION 2: FOR EACH DISCHARGE DESCRIBED [IN RESPONSE TO III.A.1.] A DETAILED DESCRIPTION OF ALL RELEVANT CORRECTIVE STEPS TAKEN BEFORE AND DURING EACH DISCHARGE TO PREVENT AND/OR MINIMIZE THE RELEASE OF VCM TO THE ATMOSPHERE INCLUDING, BUT NOT LIMITED TO, SUCH STEPS AS REROUTING VC EMISSION VENTS TO A COLLECTION VESSEL OR INCINERATOR.

Response:

The documents noted in response to Question 1 above describe measures taken before or during the incident to prevent or minimize the release of VCM to the atmosphere. No further information is available. The measures taken at that time to prevent future incidents of this type are believed to be effective since no further incidents of this type have occurred.

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VCM RELEASE FROM THE RECOVERED VCM CONDENSER RELIEF VALVES REACTOR MODULE NO. 2 ON JUNE 10, 1982

Summary:

This release was caused by a plugged liquid VCM discharge line. Instrumentation has now been installed which will alert the operator to a high pressure in the VCM recovery system before a VCM release from these relief valves can occur. This instrumentation is believed to be the best means to prevent a repetition of this incident.

QUESTION 1: FOR EACH RELIEF VALVE OR MANUAL VENT VALVE DISCHARGE OF VINYL CHLORIDE ("VCM") WHICH OCCURRED FOR THE PERIOD FROM JANUARY 1, 1979 TO JANUARY 1, 1985, A DESCRIPTION OF THE NATURE AND CAUSE OF THE DISCHARGE, INCLUDING PRIMARY AND/OR RELATED CAUSE(S).

Response:

The Mississippi Department of Natural Resources has previously been provided with a full description of the June 10, 1982 incident. This information has been provided on the following dates in the documents noted below.

1. The incident was reported to the National Response Center on June 10, 1982.

2. A report on the discharge was filed with the Mississippi Department of Natural Resources in a letter to Jerry B. Banks, Bureau of Pollution Control, dated June 18, 1982 which is attached as reference H-1, Appendix H.

QUESTION 2: FOR EACH DISCHARGE DESCRIBED [IN RESPONSE TO III.A.1.] A DETAILED DESCRIPTION OF ALL RELEVANT CORRECTIVE STEPS TAKEN BEFORE AND DURING EACH DISCHARGE TO PREVENT AND/OR MINIMIZE THE RELEASE OF VCM TO THE ATMOSPHERE INCLUDING, BUT NOT LIMITED TO, SUCH STEPS AS REROUTING VC EMISSION VENTS TO A COLLECTION VESSEL OR INCINERATOR.

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CONFIDENTIAL

Question 2: (Continued)

Response:

The documents noted in response to Question 1 above describe measures taken before or during the incident to prevent or minimize the release of VCM to the atmosphere.

The information provided below is additional information relevant to corrective actions taken before and after the June 10, 1982 incident to prevent any VCM release caused by a plugged recovered VCM line.

VCM POLYMERIZATION INHIBITOR

The polymerization of VCM in the recovered VCM system is minimized by adding a Hydroquinone-water solution to the VCM compressor sealwater. This system was in place before the June 10, 1982 incident. Experience has shown that this inhibitor is effective in reducing the polymerization rate and that plugged VCM lines are much less frequent than they were before Hydroquinone injection was practiced. The practice of hydroquinone injection continues to date.

INSTRUMENTATION TO DETECT HIGH PRESSURE IN THE VCM RECOVERY SYSTEM

Prior to the June 10, 1982 incident, the pressure instrumentation in the recovered VCM system for both reactor modules consisted of local pressure gauges. The purpose of these gauges is to permit troubleshooting of the recovery unit when problems develop. Polymer buildup in the liquid VCM line between the condenser and receiver can be detected by reading the pressures at the two ends of the line at a time when the VCM flow is high. A greater than normal difference between these pressures is an indication that buildup is probably occurring. These pressure checks were added to the "A" operators checklist after the June 10, 1982 incident to provide advance warning of a developing problem. Plans were also developed at the same time to install a pressure recorder and pressure alarm on the discharge of the VCM compressors. These instruments were operational in December 1983. The new instruments allow the panel operator to monitor the condenser pressure and provide a record of any pressure increase. Cleaning of the line will be scheduled before the blockage is complete whether the increased pressure drop was detected by the pressure gauge readings or the new pressure recorder. However, since June 1982, increased pressure drop in this part of the system has not occurred.