To: R. Bryan, Westlake, LA

From: R. W. Churns - Houston
P.F. Fetizanan "
Date: March 19, 1985

Interoffice Communication

Subject: MISCELLANEOUS CAPITAL ITEMS FOR REDUCING INCINERATOR BYPASSES - EPA CONSENT DECREE-LCVCM

VISTA

Evaluations of miscellaneous capital items to reduce incinerator bypasses by increasing the reliability of the incinerator have been completed. The estimated capital and incremental operating costs of each option are summarized in Table I. These options are discussed in more detail in the report. Preliminary designs required to develop the capital costs are included in the appendix. Evaluation of ways to reduce HCl column venting is being addressed separately.

As discussed, we plan to meet at the plant on Friday, March 22 to review this package and other consent decree related items.

RW Churns

R. W. Churns

P. F. Fetizanan

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Attachments

cc: RAC, RB, SCR, VMF, JRH, PEM, MLA, MCM, PLF, CRH, MWC - LCVCM
MGH, RTF - LCCP
CRD, JCL, WLM - Houston
File

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MISCELLANEOUS CAPITAL ITEMS FOR

REDUCING INCINERATOR BYPASSES

EPA CONSENT DECREE

LCVCM PLANT

March 19, 1985

Review Issue

Work By

RW Churns

R. W. Churns
Senior Staff Engineer
Process Engineering Division

P. F. Fetizanan
Senior Process Engineer
Process Engineering Division

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CONSENT DECREE COMPLIANCE
LAKE CHARLES VCM PLANT

General Discussion

The proposed consent decree requires Conoco/Vista to submit a plan to EPA outlining measures taken and to be taken at the VCM Plant to minimize incinerator bypasses, relief valve discharges, and HCl column vents. This document shows the results of an evaluation of methods to reduce incinerator bypasses by increasing the reliability of the incinerator system. A previous evaluation considered making incinerator bypasses non-hazardous by treating and removing VCM from the material bypassed around the incinerator. Relief valve discharges and HCl column vents are being addressed separately

An incinerator bypass occurs whenever high pressure in the vent header opens a valve dumping the vent system through C500 to the atmosphere. This may be as a result of high vent rates or an incinerator shutdown. Incinerator shutdowns are caused by loss of burner flame, equipment failure, loss of power, or by one of a number of dangerous instrument readings. Burner flame loss occurs when the burner mixture is deficient in oxygen, deficient in fuel, or when insufficient mixing prevents proper burning. From June 1, 1983, through December 31, 1984, the incinerator was bypassed a total of 84 times. The following table summarizes the causes of these bypasses.

Cause	Occurrences
High Pressure and/or Flow	36
Instrument Failure	23
Equipment Failure	18
Utility Outage	4
Miscellaneous	3
Total	84

Results and Conclusions

Procedural changes and equipment modifications were evaluated as methods to correct each of the above causes of incinerator bypass. These modifications and changes are to either correct or minimize the cause of the problem or to increase the capacity or reliability of the incinerator. A procedural change that may protect against many of these causes is to run both incinerators or at least run one steam driven and one electric driven air blower in parallel as much as possible. This can handle most of the high pressure and flow cases and may also protect against a failure in either of the operating incinerators. In addition to changes in procedure, instrument changes are required to allow the incinerators to respond to feed changes quickly and without adverse effect.

Some of the past incinerator bypasses have been caused by equipment failure, particularly failure of the tank farm vent

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blowers and the incinerator burners. The addition of the tank farm vent eductor and the replacement of the present burners with new ones of improved design for higher reliability and better mixing may avoid some of the shutdowns from these causes.

Changes to incinerator instrumentation as mentioned above and other changes to incinerator and main plant instrumentation such as changes to control and alarm settings and the addition of restriction orifices in vent lines may avoid shutdowns from high vent flow.

The incinerator will shutdown after a three second power outage. If the power outage lasts less than three seconds but the air blowers shutdown, the incinerator will still shutdown. The installation of an automatic tie-breaker at the LCCP Stauffco electrical substation in combination with running one steam driven and one electric driven air blower may avoid shutdowns from steam and/or electrical failures.

Table I summarizes the capital costs and incremental operating costs for each of the options evaluated. Preliminary designs supporting the cost estimates are shown in the appendix. A number of ways to combine the options is possible. Five of these combinations are examined in Table I comparing the total capital costs, additional operating costs, and estimated effectiveness in reducing incinerator bypasses. The case combinations are:

Case I - Maximum capital to include instrumentation to solve high vent rates, instrument failure, equipment failure, utility outage, and parallel operation using one blower

Case II - Same as Case I without parallel operation

Case III - Same as Case II without burner replacement

Case IV - Parallel operation with one blower, no burner replacement, no instrumentation revisions for high vents

Case V - Same as Case IV but parallel operation uses two air blowers

High Pressure and/or High Flow

Vent feed to the incinerator is automatically closed and diverted to a vent stack on high pressure in the flame arrestor. High flows and pressures are a result of impurities (unreactibles) in the ethylene or chlorine feedstocks, equipment venting, and vents from rail car or ship loading. Procedural measures to reduce the vent flow rate are to start the standby incinerator or reduce the reactor feed rates. Restriction orifices can be placed in manual vent lines to reduce vent rates and prevent overloading the incinerators.

When the incinerator feed rate increases it is necessary, in most cases, to increase the air flow rate. Air feed rate is presently controlled by the incinerator steam production. This occurs after the flow increase and can result in loss of flame because of a lack of air. Additionally, the increased flow can be non-combustible, which with the accompanying increased air flow can make the incinerator feed too lean to burn. The following instrumentation changes were evaluated as means of increasing the incinerators speed in responding to flow changes.

Excess Oxygen Control of Combustion Air

The combustion air flow rate is presently directly controlled by steam make and adjusted by the oxygen analyzer. The response time for this is approximately one minute. It is possible that the flame could be extinguished from lack of oxygen in this time. Several incinerator manufacturers, including John Zink and Trane Thermal use the oxygen analyzer for direct control of air flow. They believe that the analyzer response is faster than the steam flow response. The additional capital and operating cost of making this change will be low because all of the instrumentation is existing.

Feed-forward Air Control on Vent Flow

In this scheme, the vent flow or pressure is used to feed forward to the air blower controller. The wet and dry vent header flow rates are added and the signal fed to the air controller of either incinerator. New controllers may be required to make this possible.

The system's response to sudden vent surges would be improved by anticipating the need for combustion air, thus preventing some flameouts. However, in rare cases where the slug of vent coming in is basically inert (nitrogen, HCl, or carbon dioxide) a feed-forward control scheme may cause rather than prevent a flameout. Automatic adjustment of the supplementary fuel (natural gas) as described in the "flame temperature control" option may prevent flameouts from fuel deficiencies. The capital cost of these revisions will be approximately $23,000 with a small increase in operating cost.

Flame Temperature Control

A more stable flame is possible by sensing the temperature and controlling the air or fuel requirements. Honeywell's radiamatic pyrometers, used by Trane and others in the industry, can be used as the sensing element for this application. One drawback of the system is its inability to determine whether low flame temperatures are due to lack of fuel or lack of air. A combination of excess oxygen and feed-forward air control and flame temperature fuel control may be a more workable system. The capital cost of this option is $21,000 with a small increase in operating cost.

Restriction Orifices

Restriction orifices may be installed in specific lines to prevent high incinerator flows during manual venting of certain pieces of equipment. A number of potential restriction orifice locations have been identified by the plant and are included in this evaluation. These restriction orifices will cost about $9,000 with no additional operating cost.

Direct Chlorination Reactor (R101) High Pressure Shutdown

One of the sources of high vent flow is from the direct chlorination reactor. This occurs when the chlorine gas feed from PPG contains abnormally large amounts of air. When this happens unreacted ethylene is vented along with the air. This vent potentially contains enough fuel to exceed the capacity of the existing air blowers. Measures to reduce this possibility include lowering the direct chlorination reactor high pressure shutdown point so that the maximum pressure and thus the maximum vent rate are reduced. The capital and operating costs of this step are small because the instrumentation is existing.

Miscellaneous

Other instrumentation changes were considered but rejected before process designs and cost estimates were made. One system involves determination of the vent gas fuel content upstream of the incinerator. BTU analyzers or Thermox CARI (Combustion Air Requirement Index) analyzers are available for this purpose. These options were rejected because of material of construction and response time problems.

The possibility of controlling the rate of increase of the total vent flow to the incinerator and allowing the vent header pressure to increase was also considered. The limited surge capacity of the vent system makes this impractical.

The existing burner management system has two flame scanners on the main flame and one on the pilot. The pilot is extinguished when the main flame is lit. Both main flame scanners must fail to determine the presence of flame to initiate an incinerator shutdown. It is possible to add an independant air supply to the existing pilot and keep it operating all of the time. Its flame scanner would be included with the other two so that all three flame scanners would have to fail to detect flame to shutdown the incinerator. The pilot would have a cleaner flame which would be easier for the flame scanner to detect. However, the prolonged loss of the main burner could possibly result in the formation of an explosive mixture in the firebox.

<u>Instrument Failure</u>

Incinerator bypasses occur when failure of one of the shutdown instruments initiates a shutdown or when failure of another instrument causes a shutdown instrument to initiate a shutdown. The burner management system contains interlocks which automatically shutdown the incinerator under one or more of the following conditions:

1. High firebox temperature - both temperature switches
2. Low steam drum level - both level switches
3. High HCl Absorber gas temperature - both temperature switches
4. Low primary combustion air flow rate - both flow switches
5. Low standby air flow rate - one flow switch
6. Loss of flame - both flame scanners
7. Flame scanner failure - both flame scanners
8. High temperature in flame arrestor
9. Low level in flame arrestor
10. Manual shutdown from main control panel
11. Manual shutdown from burner management panel
12. Power outage exceeding three seconds

As noted, each shutdown instrument has a separate redundant instrument which must also fail or indicate a dangerous level to initiate an incinerator shutdown. Additionally, each shutdown instrument has one or more instruments to indicate dangerous situations and one or more alarms to sound on dangerous situations before a shutdown is initiated. There have been several instrument failures leading to incinerator shutdowns and bypasses. It is, however, believed that incinerator reliability will not be improved by adding additional incinerator shutdown instrumentation.

Flame Arrestor Instrument Revisions

A flame arrestor level control malfunction caused one past incinerator shutdown. Level control and alarm setpoint changes, instructions to operators in the use of the fresh water makeup valve bypass, and installation of position alarms on emergency water addition valves LCV-958 and LCV-958B have been proposed.

Cold Weather Instrument Insulation

One incinerator shutdown was caused by an instrument freeze up during unusually cold weather. Insulation of all instruments and leads affected by cold weather is complete.

<u>Equipment Limitations and Failures</u>

This section considers the failure or limitations of specific pieces of equipment in incinerator service.

Air Blower

Evaluations show that a single air blower can supply enough air to support combustion of most plant vents (except the direct chlorination reactor with air in the chlorine feed). On rare occasions the vent flow exceeds the range of the vent flow indicator making the actual flow difficult to determine and having an air requirement exceeding the blower capacity. If the incinerator operators have adequate notice of an increase in vent flows they can manually startup a second air blower. This takes at least one minute. Two methods are available to ensure adequate air. One is to operate two air blowers at all times. This may increase the incinerator power consumption but with proper instrumentation may allow a large increase in incinerator feed fuel content instantaneously. If one of the two operating blowers is the steam turbine-driven blower, this operating mode may ensure that air flow is not lost on either steam or power failure.

The second is to automatically start a second blower when the main blower approaches its maximum capacity. This is done with a pressure switch on the air signal to the operating blower's inlet louver. The main blower is then base loaded and the second blower is controlled on air demand. This system will be designed so that the steam turbine-driven blower will be either the main blower or the standby blower and the standby blower will start in the event of either a steam failure or power failure.

Burner Replacement

When the mixture of vents and air to the burner is deficient in oxygen, deficient in fuel, or inadequate mixing prevents complete combustion, the burner flame will go out or form smoke. In these cases the flame scanners may fail to detect a flame and shut down the incinerator. Calculations show that in most instances there is both sufficient air and sufficient fuel to promote complete burning. If some of the flameouts are then caused by inadequate mixing, replacement of the existing burners with a burner of improved design for better mixing may prevent some flameouts. The installation of a Trane Thermal LV Vortex burner on one of the incinerators will cost about $300,000.

Burner Acid Cone Revision

A increase in the gap of the acid tip has been recommended for the next unit ordered. This change will reduce the vent header operating pressure thus increasing the system surge capacity.

Tank Farm Vent Eductor

Vents from the EDC Tank Farm are collected and sent to the incinerator using one of the Tank Farm Vent Blowers, BL412 A or B. If the operating blower fails, the tank vents discharge to the atmosphere. This is considered an incinerator bypass. The historic reliability of these blowers shows a need for a backupp system. A nitrogen powered eductor system is recommended based on evaluations of other alternates. The tank farm vent is automatically routed to the eductor system on high pressure in the existing vent knockout drum. This can be caused by power failure or blower malfunction. The pressure in the knockout drum is controlled by regulating the nitrogen motive fluid to the eductor. This system will cost $72,000 to install and will have a small operating cost.

Utility Outages

Incinerator bypasses have occurred when electrical power is lost. These power losses can be for the entire Vista Lake Charles Chemical Complex, the VCM Plant or only the Incinerator Area. Although incinerator inlet flow rates are lower if the VCM Plant and the Ethylene Plant are operating, only power to run the incinerator is required to prevent an incinerator bypass on power failure. Additionally, a steam failure may cause an incinerator failure from low air flow if only the steam turbine driven air blower is operating.

Potential remedies to minimize incinerator bypasses from loss of electrical power are to install an automatic tie-breaker system to switch to a live GSU feeder if the other GSU feeder is lost, to generate electrical power for the incinerator using incinerator steam, or to install steam turbines on one of each pair of incinerator drivers. It may also be necessary to provide automatic switching of nitrogen into the instrument air header in the above instances. The incinerator shutdown system will initiate a shutdown after a three second loss of instrument power. Low air flow on loss of the operating air blower will also cause an incinerator shutdown and bypass. The loss of other electrical users may not cause an immediate shutdown.

Automatic Tiebreaker

An automatic tie-breaker may be installed across the GSU number 1 and number 2 feeders in the main LCCP sub-station (the Stauffco sub-station), across the VCM number 1 and number 2 feeders in the VCM Plant sub-station, or across the incinerator feeds (VCM Plant "F" and "G" sub-stations).

Each of the tie-breaker three options will switch power to the undisturbed power line within two seconds of losing power to one of the two incoming electrical feeders. The incinerator control system will shutdown the incinerator on a power failure lasting longer than three seconds. The pumps in the VCM Plant and incinerator area are designed for automatic restart within six seconds of losing power. If power is restored with a two second delay, all electric motors would slow down. When the power was restored these motors would try to restart but would overload the circuits in doing this. The motors would then have to be restarted manually. If the air blower continued to operate and assuming that some failure other than power failure did not shut the incinerator down, it would continue to operate during the two second power outage. If the critical pumps were restarted immediately, the incinerator would not have to be bypassed.

The tiebreaker at the Stauffco station is the preferred option if it is feasible and the cost is in the same range as the others. The Stauffco tiebreaker may permit quick Ethylene and VCM Plant restarts as well as incinerator restarts. A VCM Plant tiebreaker will permit a quick VCM Plant restart but is expected to have the highest cost because the existing VCM Plant feeder switches must be replaced with circuit breakers so that an automatic tie-breaker can be installed. The incinerator tiebreaker may protect against transformer and bus faults in the VCM Plant or incinerator sub-stations but will not permit quick VCM Plant restarts and will result in higher incinerator flow rates than the other tie-breakers. The LCCP (Stauffco sub-station) and incinerator automatic tie-breakers will each cost about $60,000. A VCM Plant automatic tie-breaker will cost more than this. All three options will have a negligible operating cost while the LCCP and VCM Plant tie-breakers will reduce costs by preventing plant shutdowns.

Incinerator Power Generation

The second option for preventing an incinerator shutdown and bypass on loss of electrical power is to generate electrical power for incinerator use. Then, except for generator start-up, the incinerator is independant of GSU power. An auxilliary power generator could not be started up on loss of GSU power before the incinerator had shut down on loss of instrument power or air flow. Therefore, any incinerator electrical power generation must be operated continuously.

Diesel-driven and steam turbine-driven generators were both considered. The diesel-driven generator was ruled out because it is believed that its capital cost and operating cost will be higher and its reliability may be lower than those for a steam turbine-driven generator.

The generator option that was evaluated was to install a steam turbine-driven generator to generate power to operate the instruments for both incinerators and to operate the pumps and blower for one incinerator. Fortunately the incinerator produces enough steam to generate the required power in a condensing turbine-driven generator. The incinerator with generated power must be operated as much as possible. Automatic switching of nitrogen into the incinerator instrument air header may also be required.

A steam turbine-driven electrical power generator will have an installed cost of about $890,000. It will consume steam with an annual value of about $560,000 while reducing purchased electricity requirements by $381,000 per year. It is expected that this generator will be less reliable than GSU power.

Steam Turbine Drivers

The next option is to install and operate steam turbine drivers on one pump in each service. The steam turbine drive must be operated as much as possible. If a power failure occurs while an electric-driven (spare) pump is operating, the steam driven pump must be started as soon as possible or the incinerator may shut down. The system will be designed so that the non-operating pump (either the steam-driven pump or the electric-driven pump) will start automatically on low pump discharge pressure.

In addition to steam turbine drivers for pumps and automatic switching of nitrogen into the instrument air system some form of emergency power is required for instruments and lights. An inverter and battery storage is specified for this purpose.

The steam turbines and the associated piping, instrumentation, and auxilliary equipment will have an installed cost of about $1,320,000. If the turbine exhaust steam can be used in the VCM Plant or LCCP, the reduced steam value is $53,000 per year. This is more than offset by the reduction of $136,000 per year in electrical consumption. If 250 psig steam is valuable but 150 psig and 50 psig steam must be vented then the reduced steam value is $1,560,000 per year.

Parallel Operation

Parallel incinerator operation has been used in the past when large vents are expected from the plant. Operation in this manner enables the system to better respond to sudden increases in vent flow thus minimizing shutdowns due to flameouts and other equipment limitations.

A major result of parallel operation is the reduced life of the carbon steel tubes in the present standby incinerator. As a standby unit, receiving process vents less than 15 percent of the time, the tubes are expected to last more than twelve years. As a parallel unit operating 85 percent of the time, the tubes may only last about 2.5 years. Replacing the tubes every 2 1/2 years has an annual maintenance cost of $43,000.

Incremental utility costs for parallel operation are small compared to single incinerator operation if both units can be run with one air blower. This can be accomplished by installing separate control valves in each combustion air line. In this system either the steam driven blower or one of the motor driven blowers is the main air blower as dictated by the economics of the steam balance. Some electrical savings may result from not running the present standby air blower (15 HP). Natural gas rates would be the same as the present 4,000 SCFH used to maintain 600 degrees F in the standby incinerator. In the past, incremental natural gas has not been required to split vents into the two incinerators.