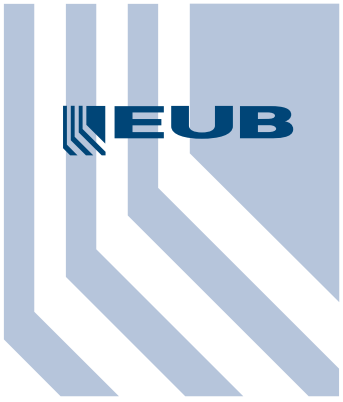


KeySpan Strachan Gas Plant 11-35-37-9W5M Flaring Incidents, January 23-25, 2001

EUB Staff Post-Incident Analysis and Recommendations

September 14, 2001

Alberta Energy and Utilities Board

ALBERTA ENERGY AND UTILITIES BOARD
KeySpan Strachan Gas Plant 11-35-37-9W5M
Flaring Incidents, January 23-25, 2001

September 14, 2001

Published by
Alberta Energy and Utilities Board
640 – 5 Avenue SW
Calgary, Alberta
T2P 3G4

Telephone: (403) 297-8311
Fax: (403) 297-7040

Web site: <www.eub.gov.ab.ca>

Contents

Executive Summary

The Alberta Energy and Utilities Board (EUB) investigated two flaring events that occurred at the KeySpan Strachan Gas Plant on January 23 and 25, 2001. The first event was caused by a power failure that required a plant shutdown and start-up and resulted in approximately 90 thousand cubic metres ($10\,m^3$) (3 million standard cubic feet [mmscf]) of gas being flared, with a hydrogen sulphide (H_2S) concentration averaging 17.3 per cent. The second event resulted from a sweetening process pump failure and resulted in approximately 1040 $10^3\,m^3$ (37 mmscf) gas being flared, with a maximum H_2S concentration of 0.01 per cent, until the plant restored its capability to process gas to sales specifications.

The EUB investigated the two flaring events with respect to the following matters:

- background and cause of the flaring incidents;
- addition of fuel gas to flared sour gas[1] or acid gas;[2]
- plant operating procedures during emergency flaring incidents;
- plume dispersion modelling of the January 23 event;
- results of the air monitoring recorded during the incidents;
- need for mobile monitoring during flaring incidents; and
- public notification requirements of industry during flaring incidents.

The results of the investigation are discussed in Section 3 of this report.

The EUB believes that KeySpan responded to the incidents in a timely and professional manner. However, for the January 23 event, KeySpan added sufficient fuel gas during the initial part of the event but cut fuel gas to the flare system while the acid gas meter was still showing a flow rate, resulting in a noncompliance. It cannot be determined whether the meter was measuring acid gas flow or water vapour. The fuel gas to flare was cut by KeySpan to save its power boilers, which are critical for winter operations. Written operating procedures have since been developed, submitted, and reviewed by the EUB. The intent of these procedures is to prevent a similar occurrence in the future.

The EUB expects that fuel gas to the flare system will be controlled so that the heating value of 12 megajoules per cubic metre (MJ/m^3) of flared gas is met and ambient air quality guidelines at ground level are not exceeded. KeySpan has now demonstrated that the control over the fuel gas will ensure that the minimum heating value to the flare is maintained. KeySpan now has also confirmed that controls are also in place to ensure that a minimum heating value of 12 MJ/m^3 is maintained when gas is flared.

KeySpan has completed dispersion modelling for the January 23 event using the CALPUFF dispersion model and incorporating hour-by-hour wind direction and speed,

[1] Sour gas is natural gas containing H_2S.
[2] Acid gas is sour gas with a high concentration of H_2S.

which predicted a concentration of 11 parts per billion (ppbv) east of the plant. This concurs with the two one-hour exceedances of 12 ppbv recorded on a stationary air monitoring trailer located 4 kilometres (km) northeast of the plant. During this event the model also which predicted that a concentration of 39 ppbv H_2S could have occurred in a very small area approximately 1 km northwest of the plant. These exceedances were likely due to not adding sufficient fuel gas for the entire period that gas was flared.

There was no contravention associated with the second event, which occurred on January 25. This gas was low in H_2S content and did not result in any ambient exceedances. KeySpan has since put in place written procedures to prevent a similar occurrence.

1 Purpose and Scope

This report on the KeySpan Strachan Gas Plant flaring incidents contains the EUB's principal observations and recommendations. It is part of the EUB's follow-up to ensure that

- pertinent information relating to the event is examined,
- the cause of the problem is identified and understood, and
- corrective action to prevent a similar recurrence is implemented.

2 Background

2.1 January 23, 2001, Event

On January 23, 2001, at approximately 4:30 p.m., the KeySpan Strachan Gas Plant (see map in Appendix 1) experienced a power failure due to a third-party backhoe severing a power feed line while working at the adjacent Sunpine Forest Product's facility. Flaring was required to safely take the plant down and start back up once the electrical power was restored. KeySpan notified the EUB's Red Deer Field Centre of the incident at approximately 5:00 p.m. Once the power was restored, the plant was started back up, which required more flaring. The plant was back on line by 1:30 a.m., January 24. Alberta Environment received one call from a resident during the flaring incident. No public complaints were received by the EUB regarding the January 23 event.

2.2 January 25, 2001, Event

On January 25, 2001, at approximately 3:15 a.m., a high-pressure diethanolamine pump in the sweetening section of the plant shut down due to a seal failure. By the time the pump was blocked in and a standby pump was started by KeySpan, the elevated hydrogen sulphide (H_2S) levels in the gas stream leaving the sweetening section of the plant resulted in KeySpan directing the sales gas stream to flare. This flaring took place downstream of the molecular sieve water absorption towers. During the 12 minutes it took to switch pumps, the molecular sieve water absorption towers had adsorbed enough H_2S that they required regeneration. The regeneration process requires a substantial flow rate of sweet gas for an extended period of time. The H_2S content of the gas being flared was approximately 80 parts per million (ppm) at the start and gradually reduced to sales specification amounts of less than 16 ppm.

At 8:30 a.m. on January 25, KeySpan notified the EUB's Red Deer Field Centre of the flaring incident. The EUB travelled to the plant in response to the six public complaints that were received by the Field Centre. Upon arrival at the plant, it was noted that KeySpan was in the process of contacting area residents to inform them of the situation. As with the first flaring event on January 23, KeySpan did not consider the controlled flaring of gas a reason to activate its emergency response plan and only notified some local residents as a courtesy action.

During the flaring incident on January 25, KeySpan was in contact early in the morning with a local resident who had transported her three children to the Rocky Mountain House Hospital with symptoms she thought may have been caused by the flaring at the plant.

At 10:45 a.m. the EUB declared the event an internal government level-1 emergency. The EUB contacted Disaster Services, Alberta Environment, Workplace Health and Safety, and the David Thompson Health Region (DTHR). KeySpan agreed with the EUB's recommendation and called out a mobile air monitoring unit to survey the area for any possible fugitive emissions. No exceedances of Alberta Ambient Air Quality Guidelines (AAAQG) were detected by the mobile air monitor or the stationary air monitors. The gas plant sales gas was at sales specification by 12:10 p.m. on January 25. The flared gas stream was directed to sales and the flaring ceased. The resident who took her children to the hospital and KeySpan have continued to stay in contact with each other.

2.3 Health Issues

The EUB also had several follow-up conversations with the family of the children taken to hospital. The family expressed concern about H_2S, SO_2, and hydrocarbon emissions. The EUB explained that any health concerns and questions fall within the jurisdiction of the DTHR and as such should be directed to the DTHR Medical Officer. The EUB, however, did offer to organize and participate in any future joint meetings with the family, KeySpan, and other government agencies to ensure that all parties have a common understanding of the events and concerns.

All the other complainants were called back and informed about the causes of the flaring events.

2.4 Follow-up to the Flaring Events

The EUB representative requested and received preliminary plant process flowcharts, flared volumes, and H_2S compositions of the flared gas during the two flaring incidents on January 25, 2001.

On February 6, 2001, the EUB met with KeySpan to review the two flaring incidents and outline the action items and information required by the EUB to determine if KeySpan took the appropriate action during these events and if current regulations and expectations were met. Section 4 describes the improvements KeySpan has made to prevent future similar incidents.

3 Conclusions

The EUB reviewed the facts regarding the two flaring incidents and arrived at the following conclusions:

1) The cause of the first flaring incident on January 23 was third-party damage to the plant's main electrical power feed line, resulting in the plant having to shut down and flare gas. Gas also had to be flared during the ensuing start-up.

2) The plant's uninterruptible power system (UPS), the utility backup generator, and the MCC 1 backup generator operated satisfactorily during the power outage on January 23.

3) During the event on January 23, KeySpan cut fuel gas when flow through the acid gas meter was still being measured. While the flow may have been water vapour, the EUB expects that when there is a reasonable likelihood that H_2S could be flared, fuel gas will be added to the flare to maintain a minimum heating value of 12 megajoules per cubic metre (MJ/m^3).

   KeySpan must ensure that a sufficient volume of fuel gas is available to supply the flare system in emergency situations. During the January 23 event, fuel gas to the flare was manually shut off in an effort to keep the power boilers operational after the amine contactors had been blocked in and shutdown valves had been activated. KeySpan has since developed and submitted a written procedure to ensure that the minimum heating value will be met when gas is flared. A copy of this procedure is in Appendix 2.

4) KeySpan has not demonstrated that the control over the fuel gas will ensure that the minimum heating value to the flare is maintained. While the ratio of fuel gas to acid gas would appear to have been sufficient in the early stage of the January 23 incident before the fuel gas was turned off, KeySpan has also stated that the amount of fuel gas added was not based on ratio directly or feedback of another pertinent parameter. This means that the fuel gas valve is sized for the intended maximum flow rate only. *Guide 60: Upstream Petroleum Industry Flaring Guide* requires that sufficient fuel gas be added to the flare system to ensure that a minimum 12 MJ/m^3 heating value is maintained when any gas is flared.

5) The second flaring event, caused in part by the amine pump seal failure on January 25, may or may not have been associated with the power failure and subsequent plant shutdown of January 23. There had been no indications that the pump seal had problems prior to the incident.

6) It is evident that the volume of gas flared during the second incident on January 25 could have been reduced if proper operating procedures had been in place and followed in the 12-minute period it took to switch the amine pumps. When gas from the amine sweetening section needs to be flared due to high H_2S content, it should be flared from a point upstream of the dehydration molecular sieve towers to prevent their fouling. KeySpan has developed and submitted a written procedure to address this concern. A copy of this procedure is in Appendix 3.

7) The volume and rate of gas flared at the plant during the January 25 incident were due mainly to regenerate the mole sieve beds. This procedure was recommended by Van Waters & Rogers Limited, the supplier of the material, who discussed this procedure with the manufacturer.

8) During the flaring event on January 23, two one-hour average ambient H_2S concentrations, each of 12 parts per billion (ppbv), which are an exceedance of the AAAQG, were observed at a KeySpan monitoring station located 4 kilometres (km) northeast of the plant. These exceedances were likely due to the failure to add sufficient fuel gas to the flare system during the event.

9) The EUB requested that KeySpan conduct modelling of the January 23/24 flaring event. The dispersion modelling was conducted by an independent third party and the report was submitted to the EUB on May 14, 2001. The consulting company modelled this event using the CALPUFF dispersion model. Modelling was conducted using conservative, worst-case scenario data, which predicted a maximum ground-level concentration of 39 ppbv of H_2S to the northwest and later a concentration of 11 ppbv to the east of the gas plant due to this event. This correlates with the two exceedances recorded on the stationary air monitoring trailer located 4 km northeast of the plant. The current AAAQG is 10 ppbv. The EUB has reviewed the input parameters for this modelling work and is satisfied with the model and the inputs used.

10) In accordance with current Canadian Association of Petroleum Producers (CAPP) guidelines, which have been adopted by the EUB as minimum requirements, KeySpan's emergency response plan for this facility does not require resident notification during a level-1 emergency response. With respect to the January 23 and January 25 flaring incidents, KeySpan did not consider either to be a level-1 emergency response situation. It is noted that KeySpan made courtesy calls to nearby residents (18) during the January 25 flaring incident, informing them of the situation. KeySpan also issued a press release after the January 25 event and held a public meeting for area residents to discuss the incidents.

4 Action Taken

KeySpan was directed to develop written operating procedures for plant staff to follow in the event of similar events at the Strachan gas plant or other associated facilities. These procedures have been developed and reviewed with KeySpan's operating staff. Copies of the procedures were submitted to the EUB and have addressed the EUB's concerns.

KeySpan has provided the EUB with an internal written guideline on when mobile monitoring should be requested in the event of future incidents. The EUB has reviewed these guidelines and encourages this approach.

KeySpan has reviewed the Strachan plant's control of fuel gas to the flare system and has demonstrated that controls are in place to ensure that heating values of gas flared will meet the minimum 12 MJ/m^3 during all flaring events. This information was provided to the EUB.

KeySpan has developed a guideline to ensure that a hard copy of the alarm log will be saved when future major incidents occur. This guideline was provided to the EUB and it addressed the EUB's concerns.

KeySpan has identified to the EUB and committed to contact those residents within the emergency planning zone who would like to be contacted by KeySpan prior to or during major flaring events.

KeySpan has agreed to provide a timetable confirming that similar procedures are in place to ensure sufficient heating values at all other KeySpan sour facilities in the province. This will be forwarded to the Red Deer Field Centre by September 21, 2001.

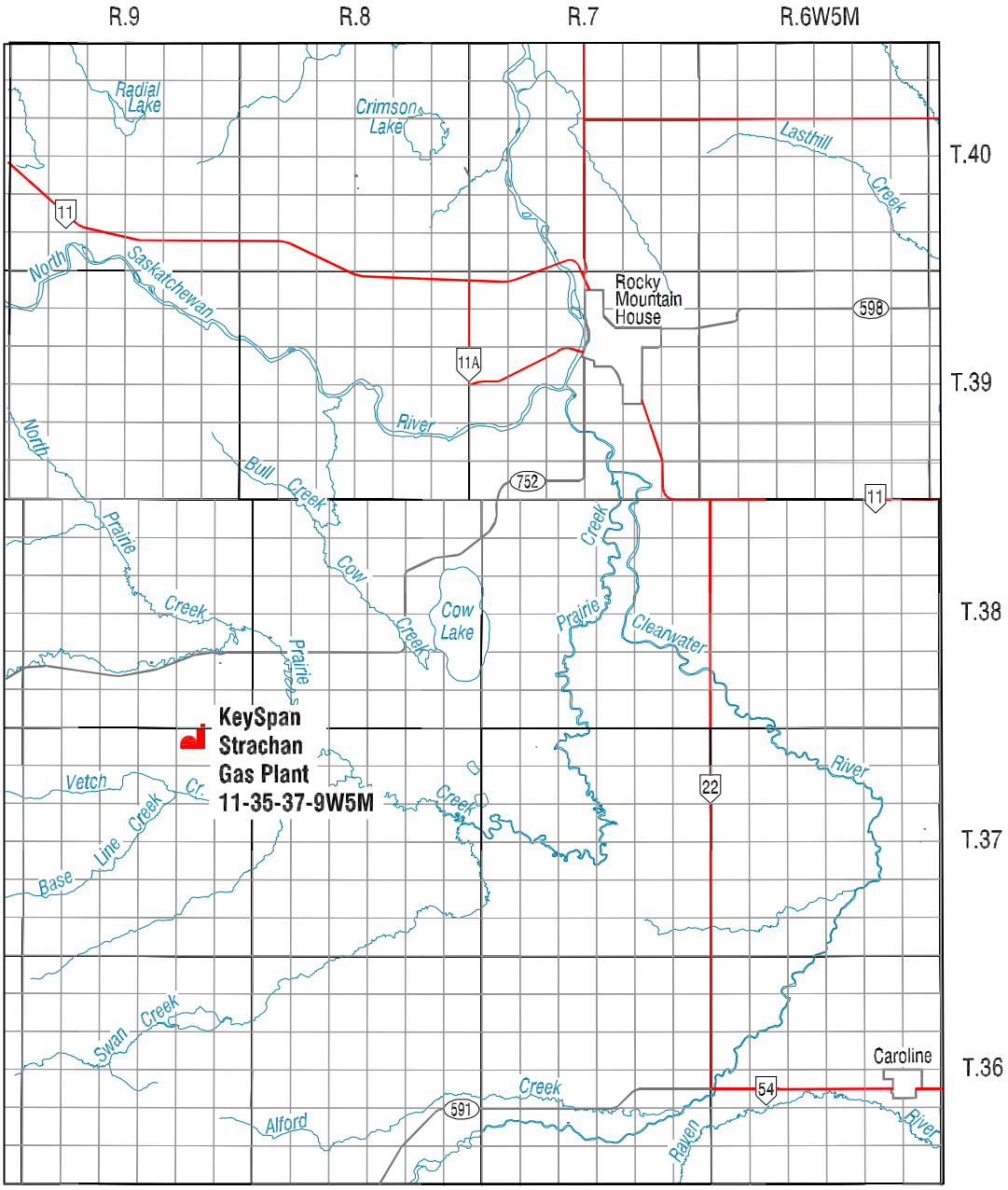
5 EUB Enforcement

The EUB regards the failure to add sufficient fuel gas to the acid gas flare as a major level-2 noncompliance event. As indicated in the report, KeySpan has put in place procedures to address the noncompliance and prevent a similar recurrence. A second major noncompliance in the same inspection category on a provincial basis within a twelve-month period will result in the EUB escalating KeySpan to a major level-3 noncompliance. Level-3 enforcement will result in full or partial suspension of the noncompliant facility. Enforcement will be in accordance with *Informational Letter (IL) 99-4: EUB Enforcement Process, Generic Enforcement Ladder, and Field Surveillance Enforcement Ladder*.

The EUB will audit future flaring events at the Strachan plant to ensure that the commitments made by KeySpan are adhered to.

Appendix 1

Area Map



KeySpan Strachan Gas Plant
11-35-37-9W5M

Appendix 2

Guideline for Loss of Electrical Power Supply

KEYSPAN ENERGY CANADA – STRACHAN GAS PLANT

GUIDELINE FOR LOSS OF ELECTRICAL POWER SUPPLY

The following guideline is provided as a means to give our operations staff some operating consistency for H2S contamination of the Dehydrators. The guideline is generic in nature and such cannot account for all the conditions that may be encountered by our operations staff. Operators must use their best judgement in assessing the situation, applying these guidelines and taking the necessary corrective actions to achieve the best results.

Chief Operator

The following actions should be taken when a power outage occurs.

1. Assess the situation by observing the condition of the power boilers to see whether they are still running. If the Power Boilers are off proceed to step 2. If they are still on proceed to step 3.

2. If the Power Boilers are down try to re-light them, if they are not relit immediately to maintain 300# header pressure. Close the contactor block valve and flare gas off the contactor via Short Horn to Flare.

3. If the Power Boilers are still online, continue to monitor and maintain steam header pressures.

4. Monitor D-131 H2S analyzer. Since there will be no cooling fans running until the emergency generator is online, you may have to flare the gas off the contactors via the Short Horn to flare valve.

5. After 15 minutes if main power has not been restored, begin to take the plant down by reducing inlet flows while still maintaining plant utilities such as air, feedwater, and steam header pressures.

6. As time permits, notify Supervisors of the situation so that they can notify the appropriate agencies, pipeline operators and residents.

7. Keep flaring to a minimum, and eliminate flaring in the shortest time possible.

8. Reduce Inlet gas with the highest concentration of H2S last

9. Try to keep the Solar inlet compressors online as long as possible. This will help to maintain steam header pressure if the boilers have tripped. (They will eventually trip on high compressor temperature).

10. Take the North Inlet Compresser (C-1000) offline if it did not already trip.

11. Maintain amine circulation and monitor amine system.

12. Keep reducing Inlet gas flows until a medium is reached.

13. At any point if main power is restored and seems to be stable, begin to bring plant back online.

Operator #1

The following actions should be taken when a power outage occurs.

1. Assess the situation by observing the condition of the Power Boilers. If they have tripped re-light immediately.

2. Immediately start the Car Emergency Generator, and let it warm up.

3. While the Generator is warming up the following items can be completed.

   -Check to see if the Kohler Generator is running, if it is not running start it.
   -Start the gas driven bearing H2O pump. (Critical)
   -Start the gas driven condensate return pump.
   -Start the gas driven treated H2O make up pump.
   -Check that the steam driven air compressor is online.
   -Put the Old air dryer online. Turn the power off and block in the new air dryer.
   -Turn off the steam driven Fire Water Pump and start the gas driven Fire Water Pump (to preserve steam) and run @ low speed to provide circulation and cooling.
   -Take off end plates on incinerator burner face and open top & bottom manual louvers on the front of the furnace.

4. If air header pressure can not be maintained block in air to non-critical equipment such as:
   -Air supply to CS-200
   -C-131A Sales compressor if it is shut down.
   -Air to Offsites & Prill Tower Area
   -Air to "A" or "B" Sulphur plant switching valves, whichever Sulphur plant is offline.

5. If main power has not been restored at this time, follow the procedure for putting load on emergency generator.

6. Restart "C" Power Boiler.

If After 30 minutes and Main power has not been restored.

1. The #1 operator should watch the sulphur plant and keep it online as long as possible with the diminishing Acid gas flow. When the sulphur plant is down to minimum flow, block in the Acid gas, trip the blower, and flare the remaining Acid gas.

   NOTE: It is very important to note that acid gas is NEVER to be flared in a raw state. Sweet gas for dilution is mixed on a 1:1 ratio with the acid gas before flaring. This dilution will reduce the H_2S concentration in half.

2. Monitor utilities and boilers, and assist the Chief operator as required.

Operator #2

The following actions should be taken when a power outage occurs.

1. Assist operator #1 by starting the gas drivers before mentioned in the # 1 Operator list, block in air, and help start the emergency generator.
2. Block in Sales gas compressor and shut off Turbine Seal air.
3. The Steam header off of the waste heat boiler should be vented once the Solar compressors are shutdown. This is to protect the steam header from building up with condensate and to prevent freezing. (make sure the non-return bypass is open).
4. Drain all water from Inlet Separators & T-133 scrubber.
5. Switch liquids from Deepcut to Old Plant mode.
6. Ensure plant fuel gas is being provided via fuel gas buy-back line.
7. Restart electrical equipment supplied by MCC #1 when Cat Generator is online.

Operator #3

The following actions should be taken when a power outage occurs.

1. Block in air to CS-200 Amine Analyzer
2. Assist Operator #1 and #2
3. Restart the required Amine cooler fans, regenerator overhead fans, and amine reflux pumps, once the Cat Generator is online.
4. Switch Stabilizer and Stripper into Old Plant mode.
5. Once the Refridge system loses its load, shut down the propane compressors and block in the chiller LCV loop.

Prill Area Operator

The following actions should be taken when a power outage occurs.

1. After tower trips, block in P-701 (Sulphur transfer pump) and P-702 (Pod room pump), to keep the seals from leaking.

2. Assist operations staff in plant.

Appendix 3

Loss of DEA Circulation Guideline

KEYSPAN ENERGY CANADA – STRACHAN GAS PLANT

Loss of DEA Circulation Guideline

The following guideline is provided as a means to give our operations staff some operating consistency when a loss of DEA circulation is experienced. The guideline is generic in nature and such cannot account for all the conditions that may be encountered by our operations staff. Operators must use their best judgement in assessing the situation, applying these guidelines and taking the necessary corrective actions to achieve the best results.

Scenario #1 Amine Flow restored within 5-7 minutes

1. Immediately close Contactor block valve if D-131 H2S analyzer begins to climb (Approx. 3 minutes) and flare through the short horn to flare.
2. Contact area operator to check out situation and restore Amine circulation.
3. Open recycle valve on C 1000 or close D-101 inlet control valve if compressor is down, which will cut 2600 10^3 M^3 of gas. This would leave a flare volume of 2100 10^3M^3 .
4. When amine flow is re-established, you have to flow gas through the contactors to sweeten them up. This usually takes about 10 – 15 minutes. You will have to check the gas off each contactor with a manual draeger to make sure they are sweet, This should be between 3 – 5 ppm.
5. When the gas off the contactors tests sweet, you can start to open the contactor block valve and feed the gas into the plant while closing the short horn to flare. While doing this monitor the H2S analyzer at D 131. If it starts to rise to 10 ppm close the Dehydrator block valve and flare through the long horn to flare. If the H2S analyzer at D-131 does not rise any more you can close the long horn to flare and open the dehydrator block valve. Continue to open the contactor block valve and close the short horn to flare to put the gas through the plant and out to sales.
6. At this point if the H2S analyzers look good at D 131 and Nova (sales), you can bring the gas flows through the plant back to normal.
7. Record flaring and notify Supervisor so residents and proper agencies can be contacted.

Scenario #2 Amine Restored in 10 to 20 Minutes

1. Repeat steps 1-3 from Scenario #1.

2. Shut down Sulphur Plant and flare acid gas. With no amine flow for this period of time there will not be enough acid gas to keep Sulphur Plant on line.

3. Shut down D3 Booster Compressor and open surges on the Solar Compressors to cut most of the sour gas. Control pressure on solar suction with the inlet gas valve and back up the Strachan field some. This way we would have to flare very little acid gas.

NOTE: You may need to switch Buffer gas supply for Solar Compressors due to loss of pressure on discharge side of the plant.

4. Pinch inlet gas valves on D-154, D-157, and D-151, this will cut most of the gas flow to the plant and will back up all the fields for a short time until Amine circulation is restored. Notify pipeline Operators and request they advise third party producers of the situation. Monitor pipeline pressures at this time to keep them below 9000 kpa.

5. When Amine flow is re-established repeat steps 4 - 7 of scenario #1.

6. Bring sour gas back in as soon as Contactors are sweet so we can re-lite the Sulphur Plant as soon as possible to reduce the amount of Acid gas flared.

7. Re-lite sulphur Plant so we can stop flaring Acid Gas & Dilution gas

Completed and Prepared by "B Shift"