Case Study: Response and Cleanup of a Gas Well Blowout

Devin Allibone, Canadian Natural Brent Albrecht, Marquis Alliance

Outline

- Incident details
- Initial response
- Equipment required on-site and on standby
- Mitigation measures to control release of products on site
- Well control and eventual abandonment
- Areas requiring assessment to determine the presence of impacts once all infrastructure had been removed
- What impacts were identified and how they remediated
- Why not utilize the SST for the produced water impacted areas?

Incident Details

- Early hours of Feb 24th, 2010 a kick was noticed and the well shut in.
- Well site was evacuated soon after the shut in occurred.
- The gas ignited at 6:44 am ultimately leading to the destruction of most surface equipment on lease.
- The well was capped on March 8^{th,} 13 days after the incident began.

Incident Detail Cont'd

- No injuries were noted during the entire incident.
- No H₂S exceedence was detected on stationary/mobile air monitoring units during the entire event.
- All spills from leaking equipment, broken storage containers and the well, were contained immediately.

Initial Response Efforts

- Canadian Natural personnel mobilized to the command centre and the field location within hours. This allowed for a large presence of company responders to help control the well and associated items.
- Safety BOSS, Local Fire department and Air monitors were dispatched, as soon as possible.
- A security perimeter was established to keep all nonessential personnel from accessing the area.
- All applicable equipment, including contingency equipment was mobilized immediately.
- The impact zone was contained to the wellsite.

Initial Response Efforts

- ERCB, AENV, local fire departments, RCMP, the Town of Hythe, SRD, OH&S and all other pertinent regulatory bodies were notified within hours.
- Disposal facilities in the area were put on notice that a large amount of well fluids may have to be disposed of.
- Hazardous waste management companies were put on standby in the event that a large amount material needed to be hauled out. This would prevent spills and help keep the area around the site safe to work in.
- Several mobile air monitoring units were brought to the site to ensure there were no H₂S or SO₂ concerns.

No exceedances were noted during the entire incident.



Equipment required on-site and on standby

- Fire control equipment.
- Vacuum Trucks contain any spill materials. Also used for fluid containment.
- Spill trailer This was precautionary as there were no spills noted.
- Stationary and Mobile air monitoring units.
- Multiple pieces of tinned heavy equipment.





Wind speed and direction monitoring equipment

Air monitoring equipment powered by its own system

0

3-D topographical mapping software

Aug. 1

A vast array of communications equipment

FRCB

in Redail

Notebook computers that contain all relevant data on all Alberta's energy facilities, and full high-speed Internet access

Constant of





Mitigation measures to control release of products on site

- Poly liners were brought to site as a possible containment aide.
- Drainage area was constructed to contain any well fluids in an area that would be safe to access frequently.
- Off site pits were excavated to contain any fresh water that may be produced.
- Pumps were brought to the location and hoses inserted into drainage area to allow for continuous removal, if required.



Mitigation measures to control release of products on site

- Spill trailer was mobilized to the site in the event it would be needed.
- All hazardous waste was removed as soon as it was safe to do so.
- Large three sided shale bin was used to contain any non-DOW wastes before they were hauled to a Class II landfill.
- Tree Hugger moment, all metal that could be saved was sent to a recycling facility. This meant picking through the "garbage"!



Well control and eventual abandonment

- Excavated area around well centre down to competent surface casing.
- Installed a casing extension and a new casing bowl.
- Snuffed the flame to install the new BOP and re-ignited the flame.
- Snuffed the flame to divert the flow to a well test package.
- Gas flow rate and pressure were monitored to determine the optimum well kill program.







Well control and eventual abandonment

- Annulus killed utilizing a volumetric (lubricate) kill procedure with 1700 kg/m3 water based kill mud. The weighting agent was Barite. The Barite was suspended with Bentonite Gel and caustic soda to activate the gel.
- Drill pipe was killed using a bullhead kill procedure with water, 2400 kg/m3 water based kill mud, followed by 1950 kg/m3 Class 'G' cement.



Well control and eventual abandonment – Contingency Plans

- Hole collapse or depletion could have controlled the well. Although hole collapse did not occur, depletion did aid in the final well kill operation.
- The well was capped and controlled with minimal difficulty since the gas rate is easily managed with the kill method.
- Well is capped, but it cannot be controlled because of high gas rate at which point the well is flared until partial depletion occurs.
- Cap the well, but it cannot be controlled because of high rate. A pipeline is run to allow the well to be produced until it can be controlled or the relief well is completed.
- Relief well drilled to TD and used to circulate kill fluid to control the well.



Initial Equipment Layout



Expansion of Lease







Initial Assessment Locations

1. Well Centre

- Area of most activity due to well kill operations and the event itself.
- 2. Shale Pit Area
 - Initial well shale storage area and onsite drainage area to manage fluids flowing from the well.

3. Flare Tank Area

- Potential area of concern based on drilling fluid used to drill the well.
- 4. Invert Tank Area
 - Obvious area of potential impact!

Assessment Locations Continued

- 5. East Expansion Area
 - Potential area of concern based on the equipment working in and around the area. Area was used to house most of the fire control equipment.
- 6. West Expansion Area
 - Potential area of concern based on the equipment working in and around the area. Area was used to house most of the well kill equipment.
- 7. Staging Area
 - Potential area of concern based on the equipment working in and around the area.
- 8. Access Road
 - All equipment dragged off site was brought down the access road.

Assessment Methodology

- Target sampling was completed in areas with known or suspected impacts (well centre, shale pit etc.)
- Areas where impacts were not known or were suspected, samples were collected using a grid pattern (east/west expansion areas, staging areas etc.)
- Field screening and a EM31 survey were used to guide which samples were submitted for laboratory analysis.

Example - Staging Area Sampling



Initial Sampling Summary



Results Summary

- Some initial salinity exceedances (SCARG).
- Hydrocarbon and barite exceedances were noted.
- No groundwater impacts noted at anytime.

Investigation after initial findings

- Areas of impact were investigated further.
 16 samples from 200 sample points had exceedances.
- Site was prepped for hauling

 Obviously impacted material was excavated and stored for eventual facility disposal.

Site Cleanup



Remediation Successes

- All impacted material was hauled to an approved Class II landfill.
 - Site assessed, remediated and closure achieved within 3.5 months of initial incident (including break-up).
- Tier I and SCARG End points were achieved.

- This site was left in a state ready for reclamation.

Remediation Successes



Why not SST?



Why not SST?



Why not SST?

- Total Barite ranged from 10,000 20,000 mg/kg by ICP Fusion
 - Barite One initial borehole, during conf. sampling 2 walls failed (this material was hauled for disposal).
- F2 and F3 exceedances

 Hydrocarbon - One initial borehole, during conf. sampling 4 walls failed (this material was hauled for disposal).

Questions?

