Driving Pipeline Decommissioning Best Practice Through Experiential Learning

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Safety Moment: Cave Creek Disaster, New Zealand

What Happened?
- 28 April 1995
- Paparoa National Park, New Zealand
- Scenic viewing platform collapsed
- Platform fell approximately 40 m into chasm
- 14 people died

Why?
- Platform not designed or approved by a qualified engineer
- No one involved in its construction was a qualified engineer
- Nails were used to secure the platform instead of bolts because an appropriate drill had not been taken to the building site
- Steps to the platform, which were supposed to act as a counterweight, had not been properly attached
- No building consents were obtained
- Platform not listed on any inspection register
- Warning sign for the platform, suggesting a maximum limit of five people, had been ordered but was never installed at the site
Safety Moment: Cave Creek Disaster, New Zealand

- Lessons to be learned
  - Follow correct design and construction processes
  - Seek expert advice where required
  - Use the correct tools and materials for the job
  - Manage any changes to the design or job execution
  - Be aware of design limitations and communicate them
Introduction: Decommissioning Scope of Work

- UK Southern North Sea

- Three major gas fields
  - Gas and associated methanol lines

- Large infield infrastructure
  - 84 lines: 3 to 20 in.
  - 50m to 43 km

- Export pipelines
  - 5 lines: 16 to 36 in. with associated MeOH lines
  - 10.9 to 188 km
Challenges

- Pipelines still contained:
  - Hydrocarbon gas
  - Condensate
  - Water
  - Methanol
  - Sludge (causing blockages in some lines)
  - NORM contaminated debris
- Some lines never pigged since commissioning
- Other lines not pigged for decades
- Lines with stuck spheres
- Some lines badly corroded
Challenges

- Multiple stakeholders
- Platform limitations (NUIs, laydown areas, craneage, etc.)
- Aging infrastructure
- SIMOPS for P&A and decom
- No established industry standards
Objectives

▪ Remove line inventory

▪ Reduce hydrocarbon content to less than 30 mg/l

▪ Leave lines flooded with seawater

▪ Inject displaced fluid and solids down nominated disposal wells
Operations

- 3 distinct projects for the primary client: 1 for each field
- 5-year duration
- 89 pipelines: 1970 km
- 35 worksites: platforms and vessels
- Additional line (detail not included here)
  - Taking total length to more than 2000 km
- 7 scenarios
  - Satellite to satellite
  - Topsides to topsides
  - Topsides to subsea
  - Subsea to topsides
  - Topsides to shore
  - Topsides to shore to topsides
  - Onshore to onshore
Typical Equipment Rig Up: Satellite Platform to Hub Platform Operation
26” and 36” Gas Export Trunk Line Flushing 307km Loop

Onshore Gas Plant
Temporary crossover
Hose, Filtration & Booster Pump Spread

Offshore Hub
Seawater Supply & Pumping Spread

Offshore Hub
Filtration & Well Injection Spread
Operations: First Two Fields

- Typical cleaning train: gas lines

- MeOH lines
  - Typical three-line volume flush

- Export lines
  - Pigged offshore to onshore
  - Pigged back from onshore to offshore for disposal
  - Bidirectional pigs used over foam pigs
Operations

Worksites

- Accommodation work platform (AWP)
- P&A drill rig
- Normally manned platforms
- Normally unmanned satellites
- Work vessels
- Onshore gas terminal

Supply Vessel Based Flushing Spread c/w Flushing 2” HP Hose Deployed to Satellite

Onshore Receiving and Pumping Spread at Terminal
Operations

- Foam pigs used with chemicals on infield lines
- Bidirectional pigs and chemicals used on export lines
- Initial flushing of infield MeOH lines was three times the line volume
- Overflush reduced to a maximum of 20% based on received results
- Overflush on export MeOH lines at 5% in conjunction with gel slug
Operations: First Two Fields, Learnings

- Cleanliness achievable with flushing alone
- Cleaning efficiencies increased with a combined chemical/mechanical approach
  - Reduced overflush requirement
  - Reduced chemical requirement
  - Reduced volume for waste handling and disposal
  - Improved cleanliness results (typically)
  - Reduced operational time
  - Less impact on other ongoing decom operations (e.g., rig movements, well P&A, etc.)
  - Associated reduction in overall cost
Operations: Final Field Additional Challenges

- Dead legs

- Unpiggable tees

- Difficulties associated with subsea sampling of flush fluid
Operations: Final Field

- Combined pigging and chemical approach was still considered best
- Where “solid” pigs were not an option, a customized gel was designed
  - Trial performed on a platform-to-platform line
  - Trial results comparable to “solid” pig with overflush of 1.4 x line volume and 1.5 mg/l OIW
- Where sampling was impractical, agreed overflush of 1.6 x line volume was used
- This was based on previous experience and trial results

- Multiple techniques deployed
  - Solid pigs plus chemicals where architecture would allow
  - Gel and chemicals where architecture would not allow solid pigs
  - Sampling where possible
  - Calculation and agreed overflush where sampling not possible
  - Debris pickup gel included in 4-in. methanol export line
Results

- Total length of lines cleaned
  - 1970 km
  - 1,224 miles

- In 1,224 miles, you can
  - Drive from Land’s End to John o’Groats
  - Then drive back to Penrith
Results and Conclusions

- Average volume pumped per line: 1.132 x line volume
- Average OIW for field: 11.57 mg/l
  - Based on three consecutive reducing samples below 30 mg/l at 15- to 30-min intervals
- 240, 530 bbl (38,240 m³) of fluids and NORM-contaminated debris pumped into disposal wells
- Reduced waste handling, minimal fluids dumped overboard

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Results and Conclusions

- Where possible, use a combination of pigs and chemicals for optimal cleaning with minimal pumping
- Where pigging facilities are not available, gel or viscosified fluids are a viable alternative
- Where OIW sampling is not practical, a sensible overflush volume can be calculated
- Where possible, use disposal well to minimize waste handling—consider contingency
  - Spare disposal well and alternative disposal using treatment and overboarding
THANK YOU