One Operator’s Hydrocarbon Leaks
Prior to 2007 the belief was that the cause of leaks was equipment related. A HCLR program was implemented in 2004.

In 2007 we re-analysed and came to a different conclusion.
Hydrocarbon Leak Root Cause Analysis (%)

Initial Analysis
- Operational Discipline: 30%
- Hardware: 50%
- Act of God: 20%
- No Root Cause identified: 0%

Revisited Analysis
- Operational Discipline: 58%
- Hardware: 40%
- Act of God: 2%
- No Root Cause identified: 0%
The Hydrocarbon Leak Reduction program was re-launched in 2007 with an additional focus on Operating Discipline.
**Cause of Hydrocarbon Leaks**

**Major & Significant Leaks**

**Summary of Root Cause of Failure**

- **Operating Practices** – People not doing the jobs as per intent or instruction
- **Design** – poor design (Thermowell failure)
- **Competency** – SBT incorrectly made-up
- **Procedures/Standard/Practices** – deficient procedures & bad practices
Hydrocarbon Leak Reduction Plan

• All hydrocarbon leaks examined to establish root causes and lesson learned (improved quality of incident investigation).
• Specific training and competency assurance of personnel.
• Pro active leak prevention area inspection programmes.
• Elimination of potential leak points.
• Enhanced flange management procedures.
HCLR plan continued

• Increased use of vibration surveys.
• Create and implement a robust small bore fitting procedure and inspection programme.
• Improved control of equipment being returned to service.
• Enhanced flexible hose management procedure and inspection.
• Enhanced pipework and vessel inspection programmes.
• Provision of dedicated painting and insulation resources both onshore and offshore.
HCLR continued

Vulnerability and Awareness Program

• More than 90% of workforce including senior management have attended Spadeadam.

Process Safety

• Comprehensive process safety review carried out across the three assets.
• Process safety fundamental training for onshore and offshore personnel.
• ‘SAFE TO GO’ initiated.
Hydrocarbon Leak The Big Questions

Are we slipping or have we leveled out? What do we have to do to get to zero?

Maersk Oil Minor, Significant & Major HSE Reported Leaks

2002 - 2010
Hydrocarbon Leaks
Case Studies
1st Incident - PSV Tubing Gas Release

25th Feb 2010 – Gas leak during normal production operations on HPGC 3rd Stage PSV. HSE classification - Significant

Fabricated bend not to the correct angle and the tube end would have been pulled to one side in order to get other end seated

Visible tube distortion

Crack not visible at the time leak was discovered offshore
2nd Incident – PSV Tubing Gas Release

28th June 2010 - Gas leak detected during normal production operations on HPGC 2nd Stage PSV. HSE classification - Significant

A crack approx. 1 cm long is clearly visible. Tubing material stressed during installation and/or subjected to high levels of vibration.

Tube End A
Tube End B

Tubing deformed, has either been ‘forced’ into the connection at End-A
3rd Incident – PSV Tubing Gas Release

29th Sept 2010 - Gas leak detected during normal production operations on HPGC 2nd Stage PSV. HSE classification - Significant

Maintenance request raised to replace 2 missing studs 3 days before failure.

Fracture occurred at the thread root immediately adjacent to the PSV fitting.

Point of failure
PSV Tubing Gas Releases – Root Cause

28 Feb 2010
Poor workmanship - Tube distortion resulted in cracking
Vibration reported to have been present
Attempt to nip up connection would have resulted in a catastrophic failure

28 June 2010
Poor workmanship - Tube distortion resulted in cracking
Vibration reported to have been present
The fatigue cracking occurred under low nominal stress, high cycle loading conditions
Tubing failed due to the initiation and propagation of fatigue cracking

29 Sept 2010
Poor workmanship - fitting not adequately supported after maintenance
Vibration reported to have been present
The fatigue cracking occurred under low nominal stress, high cycle loading conditions
Fitting failed due to the initiation and propagation of fatigue cracking

Poor workmanship aided by high vibration resulted in failures
What we are doing?

- Approx. 31% of HC releases are due to Small Bore Tubing failures;
- Approx. 84% of HC releases are due to a combination of piping, valve and SBT/ instruments related failures.

**PSV Tubing Failures**
- Assessing the reliability of fittings on PSV’s;
- Assessing the suitability of using pilot operated valve;
- Initiating new PMRs to specifically capture pilot operated PSV;
- Comprehensive survey by vibration specialists.

**SBT/Valve/Piping Failures**
- Reviewing instrument tubing in high vibration areas;
- Coaching/ training of personnel in making-up of fittings, flanges and also in awareness of risks and consequences;
- Restricting vendor intervention with SBT’s during other maintenance activities;
- Standardising fitting types, tubing installation and flange make-up;
- Competency assessment programme;
- Valve RBI and remedial maintenance;
- Review of procedures;
- Dedicated team to follow-up on recommendations and actions after incident investigation;
- Continuous Improvement – Learning Organisation.
Condensate Spill to Deck

2nd Jan 2010 - During flushing activities of LP Comp 2nd stage scrubber outlet LCV to remove blockages, residual condensate and gas released. HSE Classification - Significant

What Happened?
• LCV being flushed prior to inspection of valve trim for blockage.
• Isolations applied under “own isolations certificate” – not in accordance with permit, procedures or expected standards.
• ESDV used to provide isolation from flare header – not in accordance with isolation standards.
• During draining, CRO reported several level transmitter “spikes” and forced a 15% level on LT (LALL healthy), without discussion – not in accordance expected operating standards.

What causes good, careful and conscientious people to take these actions?