Methodologies and practices for non-piggable lines

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COPEX 2010 – Brussels
March 25th, 2010

Presentation overview

(1) What are “non-piggable” lines ?

(2) TAL-inspection strategy for (non-) piggable lines

(3) Applied inspection-methodologies for non-piggable lines within TAL

(4) Practical experiences and lessons-learnt from inspecting non-piggable lines within TAL

(5) An outlook on inspection-technology (non-piggable lines)

(6) Summary

(1) What are “non-piggable” lines ?

Piggable lines can be inspected with a free-swimming in-line inspection tool without the need to either modify the tool or the pipeline

Aspects of piggability:

- **Inspectability**
- **Cleaning of pipe**
- **Emergency issues**
- **Leak-detection/localisation**

(1) What are “non-piggable” lines ?

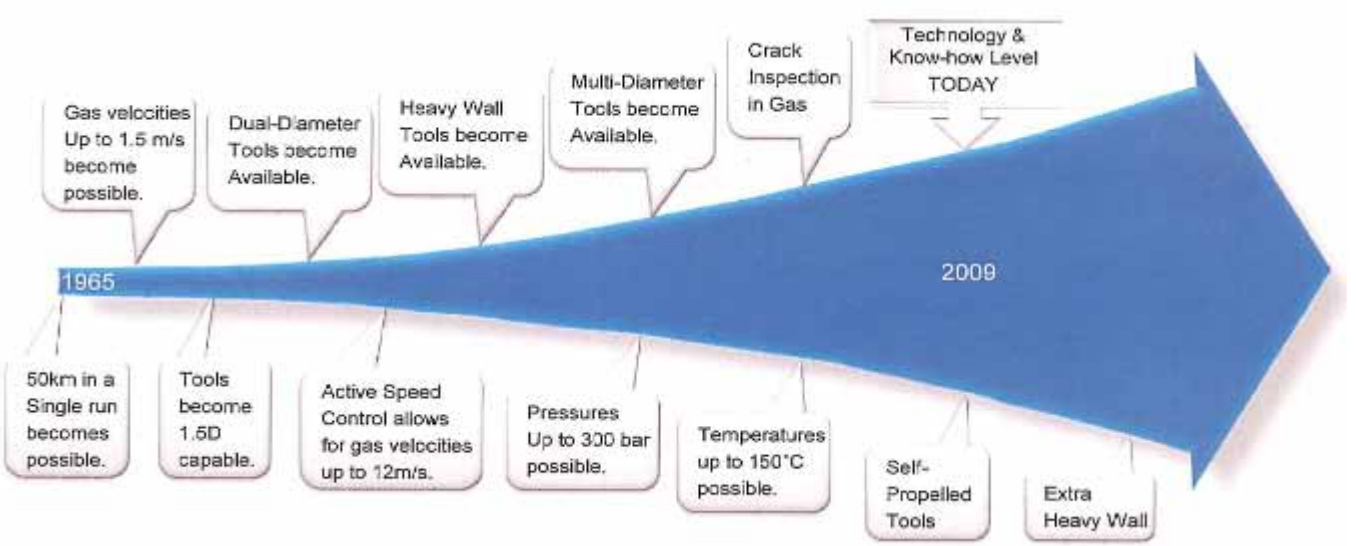
Non-piggable lines (not fulfilling a.m. definition) have certain restrictions for running a pig in line:

- **narrow bends (<1,5D) and diameter variations**
- **valve restriction and unbarred tees**
- **Pipe penetrations, measuring pockets**
- **no permanent launching/receiving facilities**
- **operational restrictions (medium, flow, temp., pressure,…)**

COPEX 2010-Methodologies/practices for non-piggable lines

Some aspects of non- piggable lines …

- **non-piggable lines mostly can be made piggable by modification of line installations and adaptations on inspection tools -> high financial efforts**
- **„non-piggable“ does not mean that no inline-pigging can be applied at all (various cable-operated or self-propelling pigging-tools for these lines available on the market)**
- **„non-piggable“ is a function of time and market**



(2) TAL-inspection strategy for (non-)piggable lines

- ü **All mainlines are or have to be made piggable and are regularly pigged (at least every 10 years)**
- ü **All non-piggable lines (station-piping and tankfarmlines) are covered in more year's inspection programs, set up to evaluate integrity status**
- ü **Inspection-programs are built up on risk-based approaches (potential/evaluated risk of piping)**
- ü **Inspection programs aligned and inspection results evaluated with external notified body (e.g.TUEV)**
- ü **Every single line and line-section has to be inspected and evaluated (no one left behind)**

(2) TAL-inspection strategy for (non-)piggable lines

- **Inspection, if possible, should be combined with rehabilitation measures (e.g. internal coating)**
- **Inspection method selected according to local restrictions/requirements, using well-proven and state-of-the-art inspection technologies**
- **Definition of so called asset-limits (50% WT) for re-inspection and integrity-limits for pipe-exchange**
- **Regular cathodic protection measurements and localised inhibition activities along lines and in stations**
- **Check of new inspection techniques in trials**
- **Inspection data kept in a living integrity database (PDS)**

(3) Applied inspection-methodologies for non-piggable lines within TAL

Non-piggable lines in TAL-assets are:

- **Station-piping (including related installations)**
- **Tankfarmline-piping (including manifolds)**

Inspection programs for these lines were set up based on the following inspection methods:

- **Internal inspections**
- **External inspections**
- **Pressure testing**
- **Pigging of line-sections**
- **Trials with new inspection systems**

Internal inspections (1)

Method applied for tankfarm-lines (in I and G) in combination with rehabilitation measures (internal coating)

- **Cut-sections 70-220 m length (depending on design/restrictions)**
- **Cleaning, gas-freeing and sandblasting (old coating removal) before inspection**

Internal inspections (2)

- Internal visual inspections, mainly concentrating in 5-7 o'clock position
- Measured internal corrosions up to 50% of WT (after 40 years of operation (0,1-0,2mm/a)

- Corrosions in local deep points, at girth-welds, in 6 o'clock position
- Manual measurements of internal corrosions with gauging tool

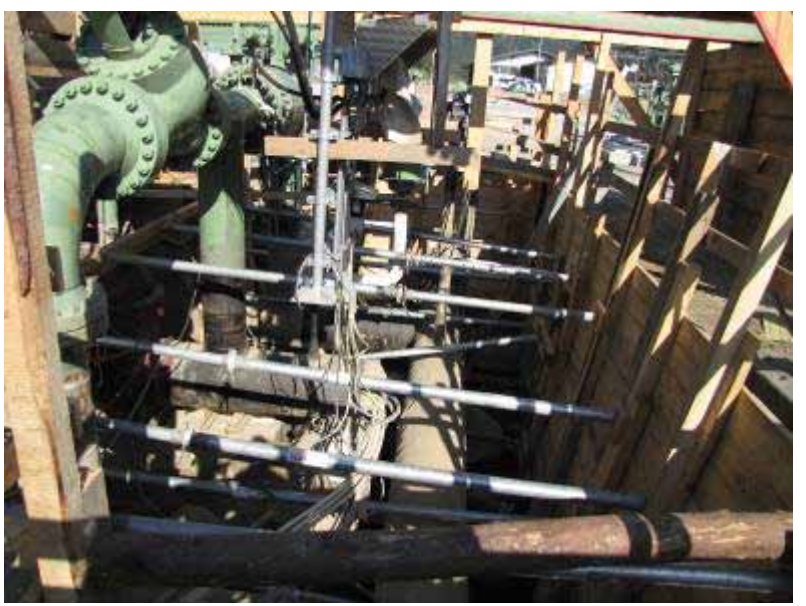
Internal inspections (3)

- Fine grinding and internal coating application
- Check of layer thickness and conductivity
- Spot checks for external corrosion by manual UT-measurements

- Documentation of features in drawings, inspection reports and photos; data in PDS

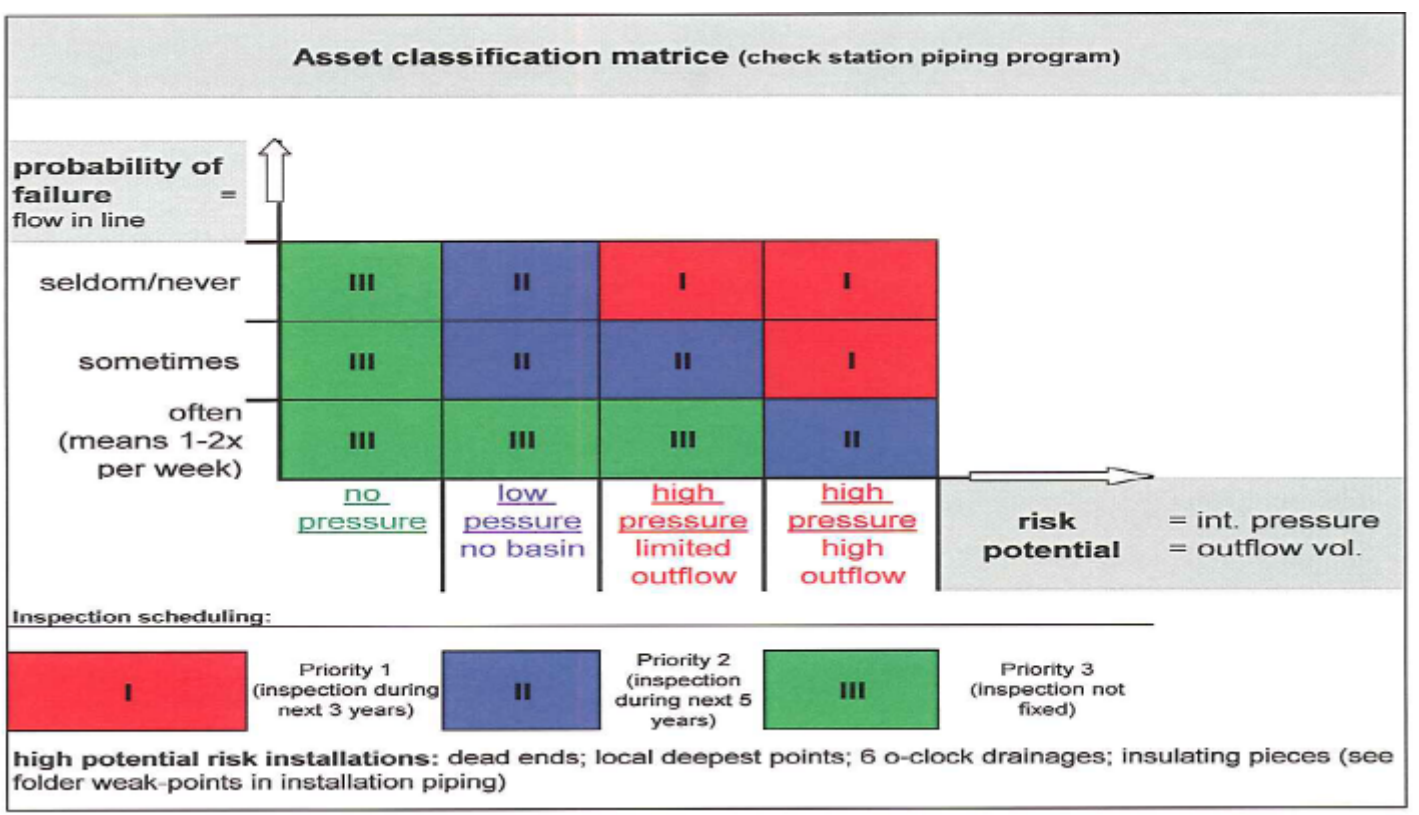
External inspections (1)

- **Method applied for line-station-piping (where pressure-testing is not required)**
- **Special focus on low-throughput-lines, local deep-points, drainage-piping, dead ends, insulating joints, fittings,…**



External inspections (2)

- **Station-piping classified according to risk-evaluation and integrated in a more year's station-piping- inspection program**



External inspections (3)

- Digging up by excavator or sucking trucks
- Cleaning of surface and sandblasting
- Coating renewal on all inspected station piping/installation
- Inspection data-capture in a specific station-piping-database

Inspection methods:

ü Visual inspection for external corrosion

External inspections (4)

External inspection methods for station-piping applied (mainly done in 5-7hrs. position):

- ü **Mechanised pipe-scanning by Slofec-scanner (Eddy-current)**

External inspections (5)

- **Mechanised UT-scanning (also for installation with higher WT e.g. Bends, Tees); good surface preparation needed**

External inspections (6)

- **Manual UT-measurements for verification of local spots and check of fittings**

External inspections (7)

- ü **Crack-Testing on welds of fittings with magnetic particle test**

- ü **Inspection program on valves by manual UT-measures and crack-tests**

External inspections (8)

- ü **Inspection program on insulating joints by manual UT-testing (on anodic corrosion)**

- ü **Guided waves inspection on pipe-penetrations and pipe-supports**

Pressure testing (1)

- Pressure tests generally asked by German TUEV to proof Integrity status of station piping
- Additionally external inspections on neuralgic piping required (dead ends, fittings, tees, service pipes, valves,…)
- Definition of pressure test sections in stations according to ANSI-rating of piping (ANSI 150, 300, 400, 600)
- Pressure-testing of slop-systems in stations with water or (as recently applied) with tracer-gas (N2/H2)

Pressure testing (2)

Comprehensive preparation work to be done:

- Bordering assets at valves or by blind flanges, blanking plates
- Valve tightness checks (back pressure)
- Removal of thermal safety valves
- Enwraping of flanges;
  splash guards,
  secondary containments
- Sealing removal at pumps
- Oil sucking and water
  filling and removal

Pressure testing (3)

- Ø Definition of check-pressure for each section: e.g. 100/75 bar for main-piping and service lines; 30 bar for slop-lines
- Ø Definition of pressure medium: Water; crude-oil (under certain circumstances)

- Ø Definition of pressurising procedure; e.g. number and interval of pressure increases, holding times (e.g. some hrs.)

Pressure testing (4)

- Exact documentation of pressure losses; recalculation of thermal influences

- Visual checks on deformation of piping and untightness
- Confirmation of successful pressure test by TUEV

Pigging of tankline-sections

- Some trials done at TAL in tanklines in all 3 countries with UT- /MFL-tools
- High efforts for pipe-modifications and re-circulation of media
- High operational restrictions due to shut-downs of tanklines
- Results in larger diameters (24“,36“) not really satisfying due to echo-losses in bends, some misleading indications to be re-checked by diggings

Trials with new inspection-systems:

Ø Pigging with self-propelling tool

Cleaning, atmospheric conditions

MFL-tool

Results: problems in bends and ovalities; pig got stuck

Ø NoPig-inspection

Current generator

Sensor array, Data storage

Capacities: 1000m, 36”, 2m cover, 10mmWT

20%ml, size 50x50mm

Results: no reliable data due to influence of neighbour-piping; rough failure estimation

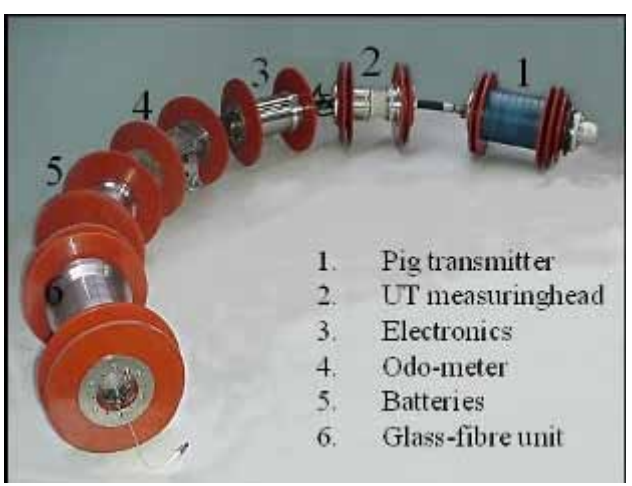
(4) Practical experiences and lessons-learnt from inspecting non-piggable lines within TAL

- **Critical line sections: Low-throughput-lines and drainage-piping systems are risky pipe sections to be re-inspected in intervals (especially affected by corrosion: insulation flanges/joints, small scale 6-o'clock drainages, dead-ends, seldom used by-pass-sections, cracks at fittings,…)**
- **Repeated measurements on defects: Direct assessments for re-evaluation on potential risk-sections are necessary**
- **Corrosion monitoring sensors could give hints on corrosion development**
- **Evidence of external corrosion, coating renewal and re-habilitation to be regarded when selecting inspection method**

(5) An outlook on inspection-technology (non-piggable lines)

- Pigging companies to develop new tools for non-piggable lines operating under various restrictions (narrow, bends, dual-diameter, …) using temporary traps

Pigging-tools: self-propelling pigs (driven by crawler); thethered pigging tools (connected by cables, fibre optics,…); pigging tools pulled by winches or pushed by medium



(5) An outlook on inspection-technology (non-piggable lines)

- **Direct assessment: guide waves technology, electromagnetic induced UT-method (EMUS); LIMA-testing; external pipe-scanning-tools with UT-sensors, MFL- and Eddy current technology**

- **Other methods: NoPig-technology, endoscopic tools, …**

(6) Summary

- Inspection-mix for non-piggable lines: Large variety of inspection methods for non-piggable lines- specific selection to be done based on local restrictions
- Internal and external inspection methods based on UT-/ET-technologies as alternatives to pressure testing
- New Inspection technologies: Big efforts of pigging companies to develop new systems for non-piggable-lines
- New inspection methods for direct assessment on the market to be further checked/approved in reliability
- Permanent piggability is an issue for longer line-sections outside fences only

Thank you for your attention !