Threat interaction – a case of confusing terminology

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As we continue this exploration of pipeline risk assessment, let’s tackle some terminology obstacles. Pipeline risk assessment is a challenging topic on its own, so added confusion from terminology is most unwelcome.

In some recent regulatory initiatives, a criticism has risen regarding some pipeline operators’ failure to properly account for ‘threat interaction’ in their formal risk assessments. To most, ‘threat interaction’ means the coincident occurrence(s) of multiple integrity threats and their combined impact on failure potential. While this may seem straightforward, confusion surrounding the word ‘threat’ has resulted in the observed weaknesses in some risk assessments. This confusion can be traced to certain guidance documents. One of the most important pipeline industry integrity management guidance documents identifies nine primary threat conditions. In that document, the nine threats are placed into three separate categories:

- **Time-dependent threats** (threats which tend to grow over time)
  - Internal corrosion
  - External corrosion
  - Stress-corrosion cracking

- **Time-stable threats** (defined as threats which do not grow over time unless acted upon by another condition or failure mechanism)
  - Manufacture
  - Fabrication/construction
  - Equipment

- **Time-independent threats** (random events, not influenced by time)
  - Human error
  - Third-party damage
  - Earth movement, outside force, or weather

At first glance, these may all appear to represent failure mechanisms; however, these nine threats actually contain two different areas of threat: failure mechanisms and weakness locations. Some are not failure mechanisms at all but potential weak points or locations of ‘increased vulnerability’.

**Features categorised as manufacturing or construction anomalies, such as wrinkle bends and hook cracks in low-frequency electric resistance welded (ERW) seams, should be treated as locations of potentially lower resistance. They may be more susceptible – less resistant – to unmitigated exposures of external forces or fatigue.**

**Locations of identified metal loss or laminations will generally have reduced resistance to further corrosion.**

Similarly, **features categorised as ‘equipment threats’ – such as gaskets, pump seals, and pressure-control equipment – should also be treated as locations of differing resistance characteristics. Their presence does not constitute a new exposure; the attack is normally the same as on the nearby pipe.**

However, they may have reduced resistance to certain failure mechanisms (unmitigated exposures) such as external forces or fatigue. These features often warrant a separate evaluation of PoF from nearby pipe, fittings, and other appurtenances. This is consistent with a practice of proper segmentation.

By coupling all failure mechanisms with all potential weaknesses on a segment, full recognition of any and all interactions is ensured. There is no need for special categories of threat or special treatment of interactions. As all are already fully included in the fundamental design of the risk assessment.

**Risk assessments are valuable**

Remember that direct numerical estimates of risk – a measure of some consequence over time and space, such as ‘losses per km-year’ – are the most meaningful measures of risk we can create.

**Future column topics**

- The troubles with weightings
- Damage vs failure – an important distinction
- Measuring damage potential – what is attacking? How effective are defences?
- Consequences of failure – ID the scenarios
- ‘The perfect storm’ chain of events
- What if I don’t have much data?
- How do I handle non-pipe assets?
- Myth busting – I don’t have enough data
- Getting info from SMEs – facilitation