

OIL & GAS

Integrity Management of Offshore Assets

Opening session

Leif Collberg

05 May 2017

How regulations can solve the challenge of being performance based and prescriptive

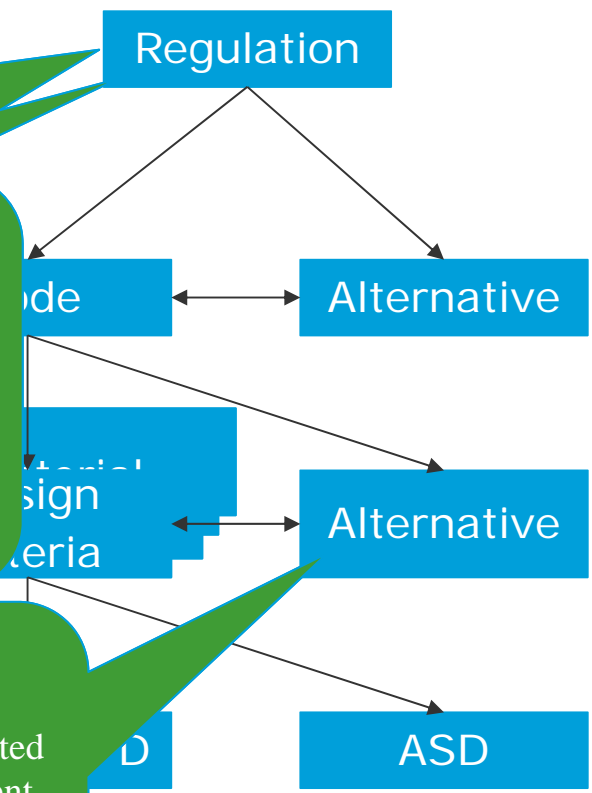
\$10 Loads, load effects and resistance

Loads that may affect installations or parts thereof, shall be quantified.

To \$10 Loads, load effects and resistance

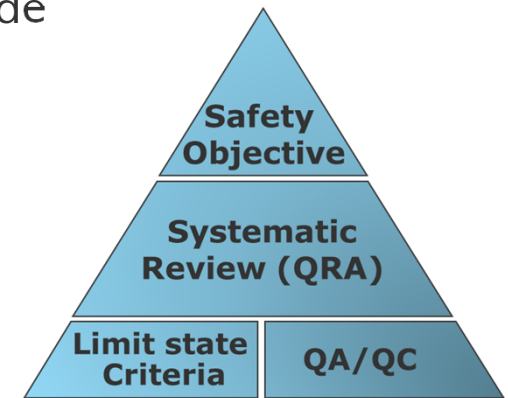
To satisfy the requirements to loads, load effects, resistance and combinations of loads on the pipeline system the following standards should be used: ISO 13623 section 6 and DNV OS-F101 section 3, 4 and 5 for rigid pipelines,

In case alternative methods and procedures to those specified in this Standard are used, it shall be demonstrated that the obtained safety level is equivalent to the one specified herein, see Sec.2 C500. Such Deviations shall be formally and rigorously justified and accepted by all relevant contracting parties.



- Regulation
 - Safety
 - Performance based/ prescriptive

- Code



- Performance based/ prescriptive

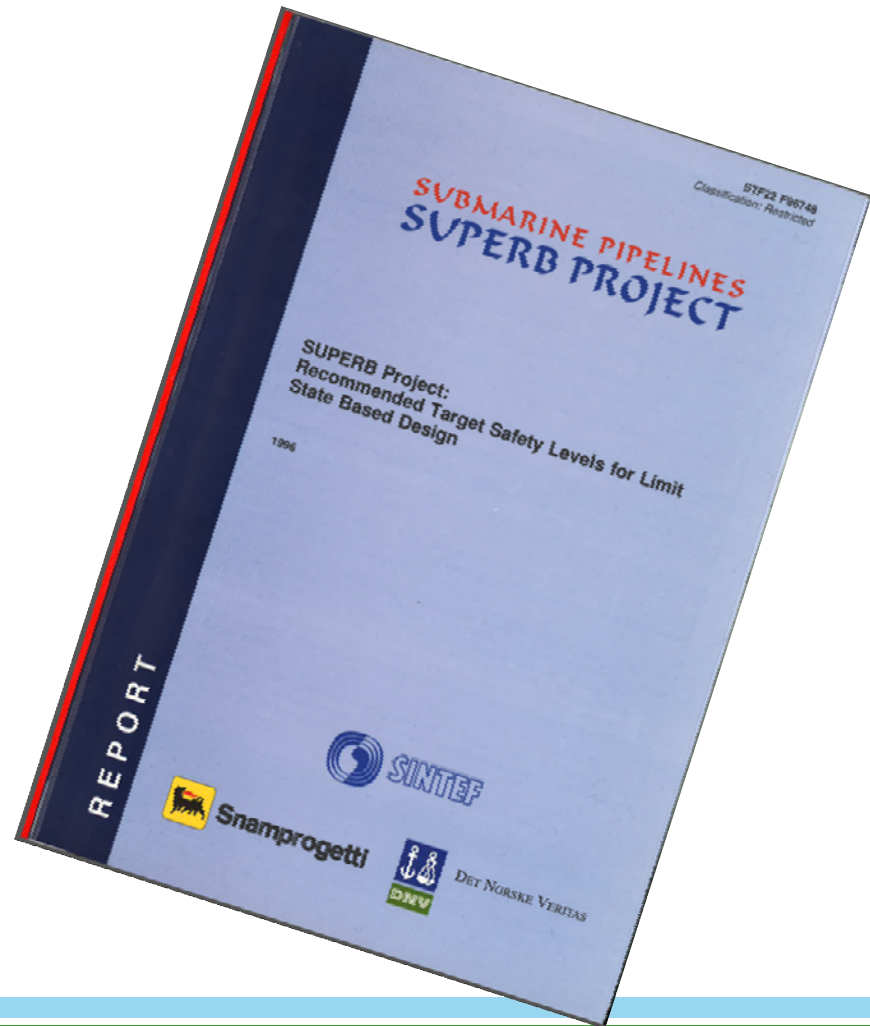
The Nominal Probability of Failure Where did it come from?

How stringent should the requirements be?

- One of the first formal design guidelines was probably given in the ASME standard B.31 (1925).
- This was based on some fundamental elements that still apply:
 - It requested the pipeline to be pressure tested. It expressed this pressure as a fraction of the Barlow hoop stress times the yield stress. This fraction was 0.9.
 - It required that the design pressure should be a fraction of the test pressure; 0.8. And the factor of 0.72 was born.
 - It required a lower fraction where the consequences were more severe. I.e. it had some inherent risk principles.

The Nominal Probability of Failure Where did it come from?

- The classical 0.72 design factor has shown to give an acceptable track record
- How can we determine design factors that will give similar track record as the classical 0.72 design factor for new failure modes and construction methods?
 - One could calculate the implicit failure probability of these criteria
- This was the basis for the work performed within the SUPERB project, a JIP in the first half of the 1990'ies.



The Nominal Probability of Failure Where did it come from?

- It resulted in the following recommended nominal target failure probabilities (DNV-OS-F101).

Limit State Category	Limit State	Safety Classes			
		Low	Medium	High	Very High ⁴⁾
SLS	All	10^{-2}	10^{-3}	10^{-3}	10^{-4}
ULS	Pressure Containment ¹⁾	10^{-4} to 10^{-5}	10^{-5} to 10^{-6}	10^{-6} to 10^{-7}	10^{-7} to 10^{-8}
ALS					
ULS	All other	10^{-3}	10^{-4}	10^{-5}	10^{-6}
FLS ²⁾					
ALS ³⁾					

1) The failure probability for the pressure containment (wall thickness design) is one to two order of magnitudes lower than the general ULS criterion given in the Table, in accordance with industry practice and reflected by the ISO requirements.

2) The failure probability will effectively be governed by the last year in operation or prior to inspection depending on the adopted inspection philosophy.

3) Nominal target failure probabilities can alternatively be one order of magnitude less (e.g. 10^{-4} per pipeline to 10^{-5} per km) for any running km if the consequences are local and caused by local factors.

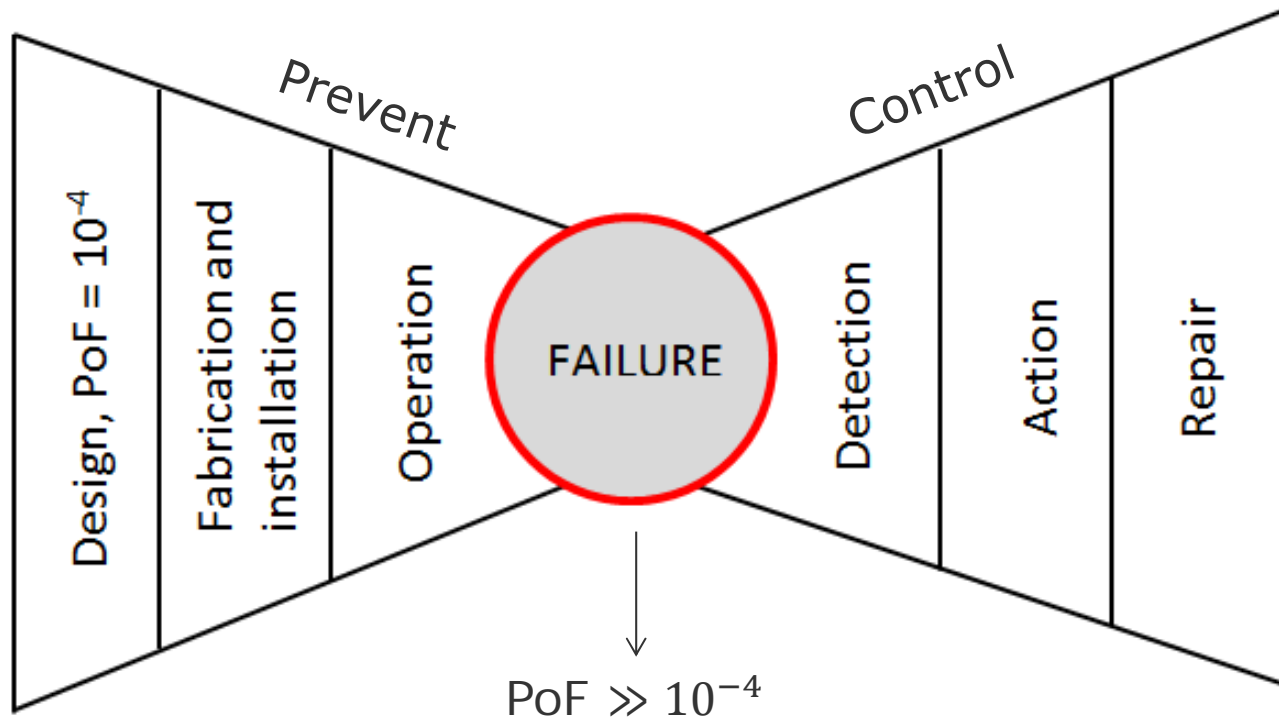
4) See Appendix F Table F-2.

5) The target shall be interpret as “probability that a failure occurs in the period of one year”.

Why do failures happen?

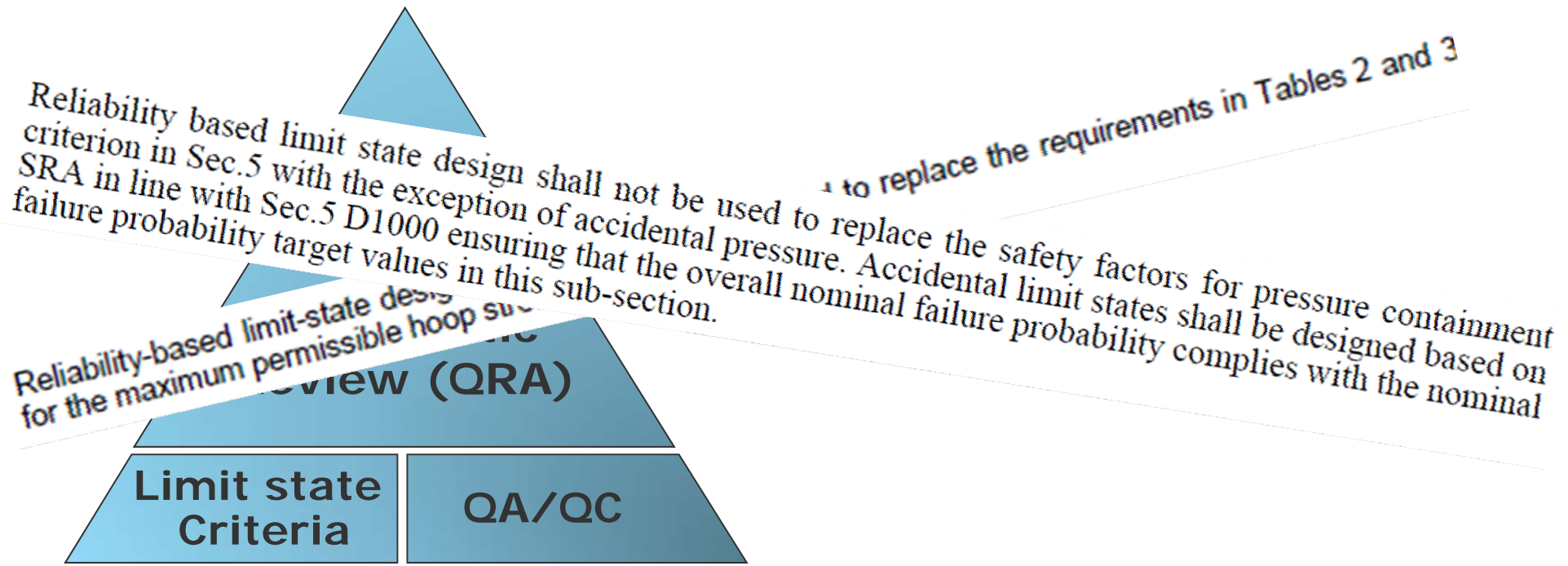
- One pipeline was severely damaged by an anchor
 - Anchors were not expected there in 215 m water....
- One pipeline broke when a trawl got stuck at a flange
 - The flange was specified to be protected by gravel in the design....
- One pipeline broke when a trawl got stuck at a flange
 - This was inside trawl free zone...
- One pipeline bursted after three years service
 - The pipeline was specified in the design to be been cleaned, inspected regularly and inhibited but was not....
- One pipeline was dragged 6m out of position and scratched the pipe by an anchor
 - No anchors were expected in 150 m water...
- One pipe experienced upheaval buckling in a depression
 - The survey for gravel determination was based on top of pipe...
-and so on....

Integrity assessment



Why do things go wrong?

- What property is the most important mitigation for most of the failures?



Regulations

- These should preferably be performance and prescriptive
- Performance based are good but needs some knobs/piles

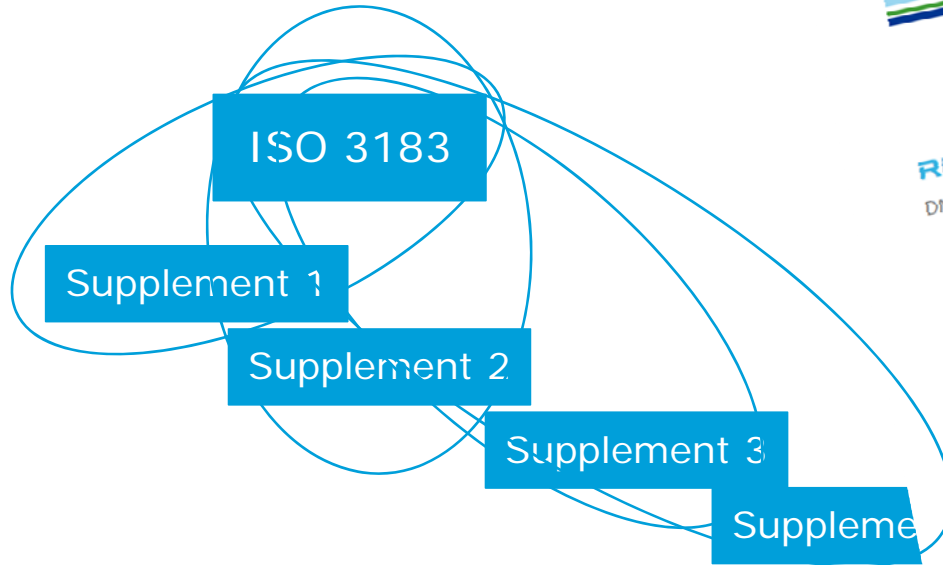
What is a standard or standardisation?

- “on the shelf” design
 - Same dimensions
 - Same material

- The same standard
 - The same bases for development of pipelines

Standardisation

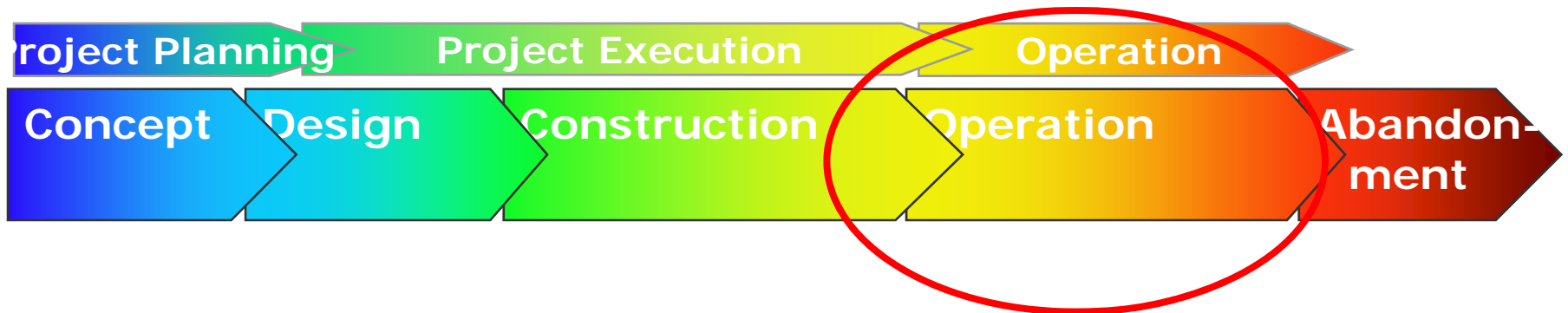
- Is a minimum standard, standardized



OIL & GAS
**Operation and Integrity
Management**

Leif Collberg

05 May 2017



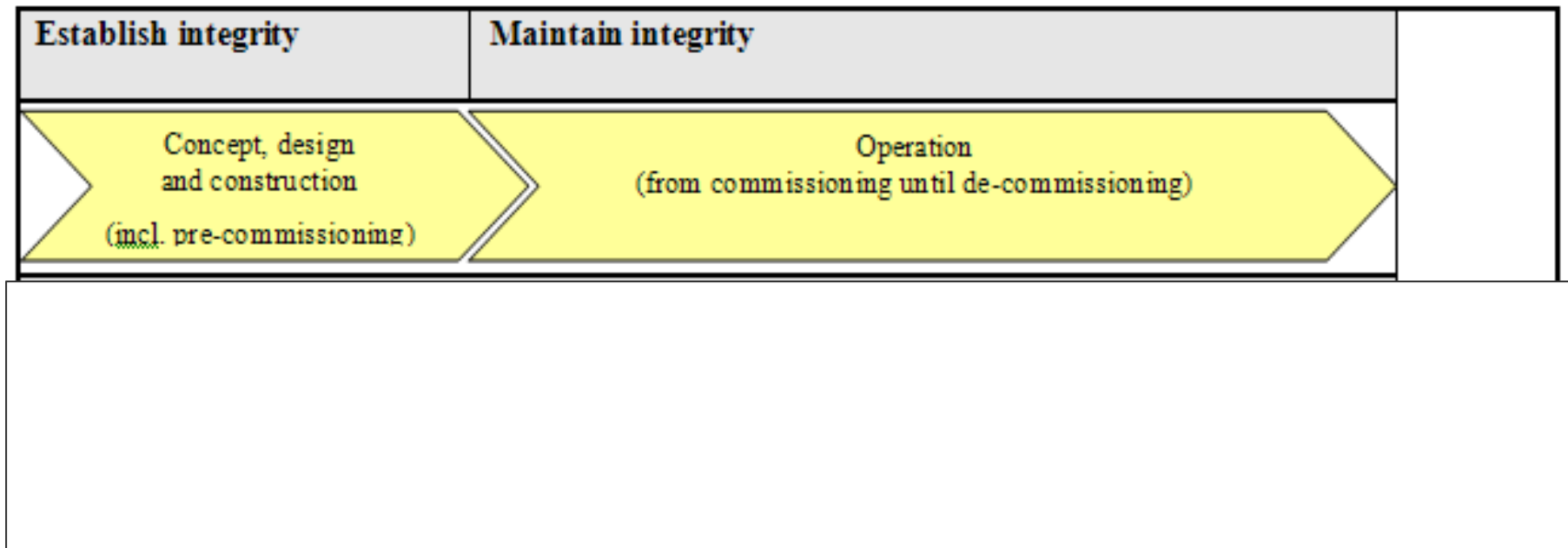
Pipeline Integrity...

- The function of submarine pipeline systems is to *efficiently* and safely transport a variety of fluids
- ... the submarine pipeline system's ability to operate safely and withstand the loads imposed during the pipeline lifecycle. If a system loses this ability, a failure has occurred.

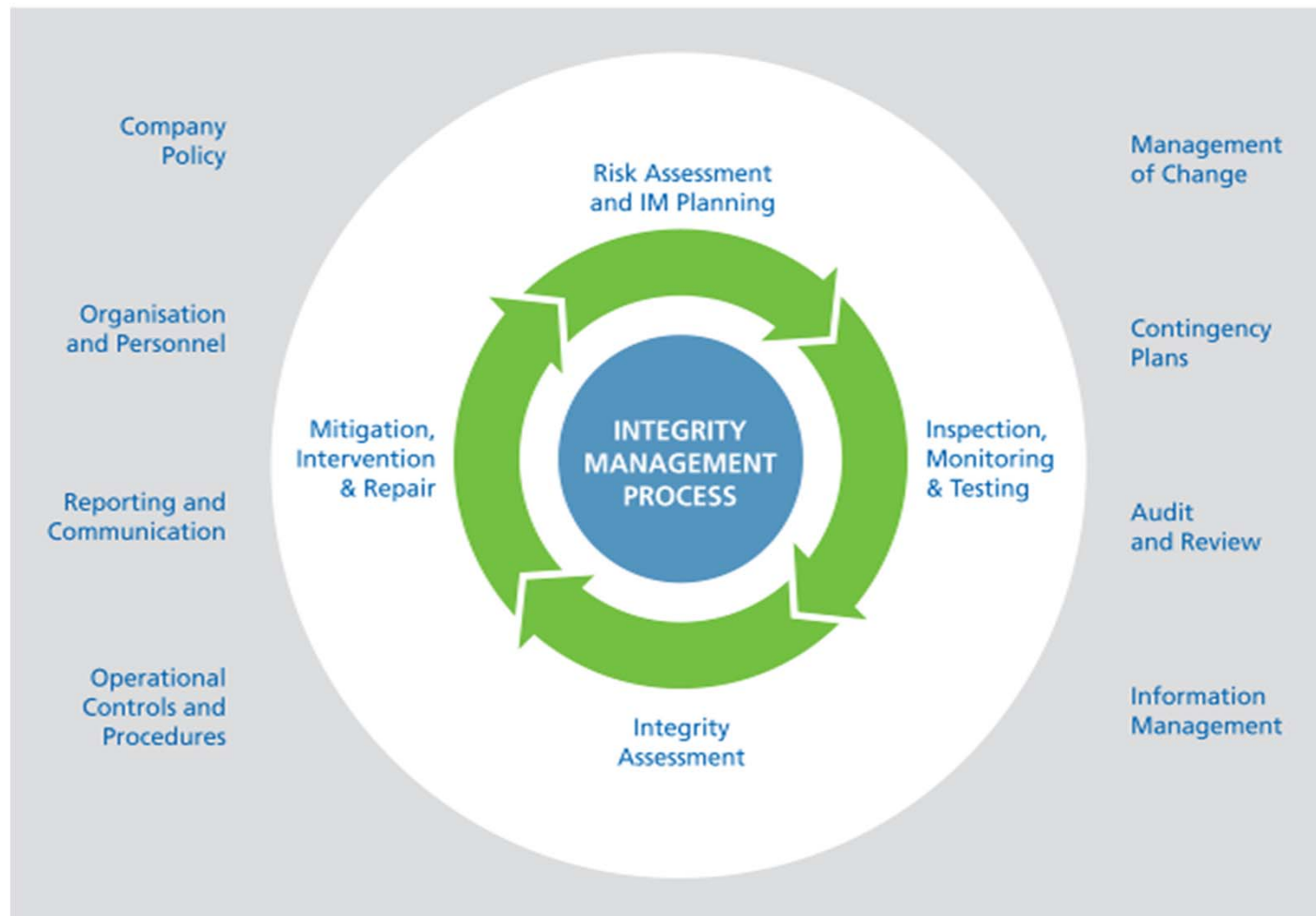
Pipeline integrity (II)

Pipeline integrity is

- **Established** during the concept, design and construction phases.
- **Transferred** from the development phase to the operations phase. This interface involves transfer of vital data and information about the system.
- **Maintained** in the operations phase



The Integrity Management (IM) System

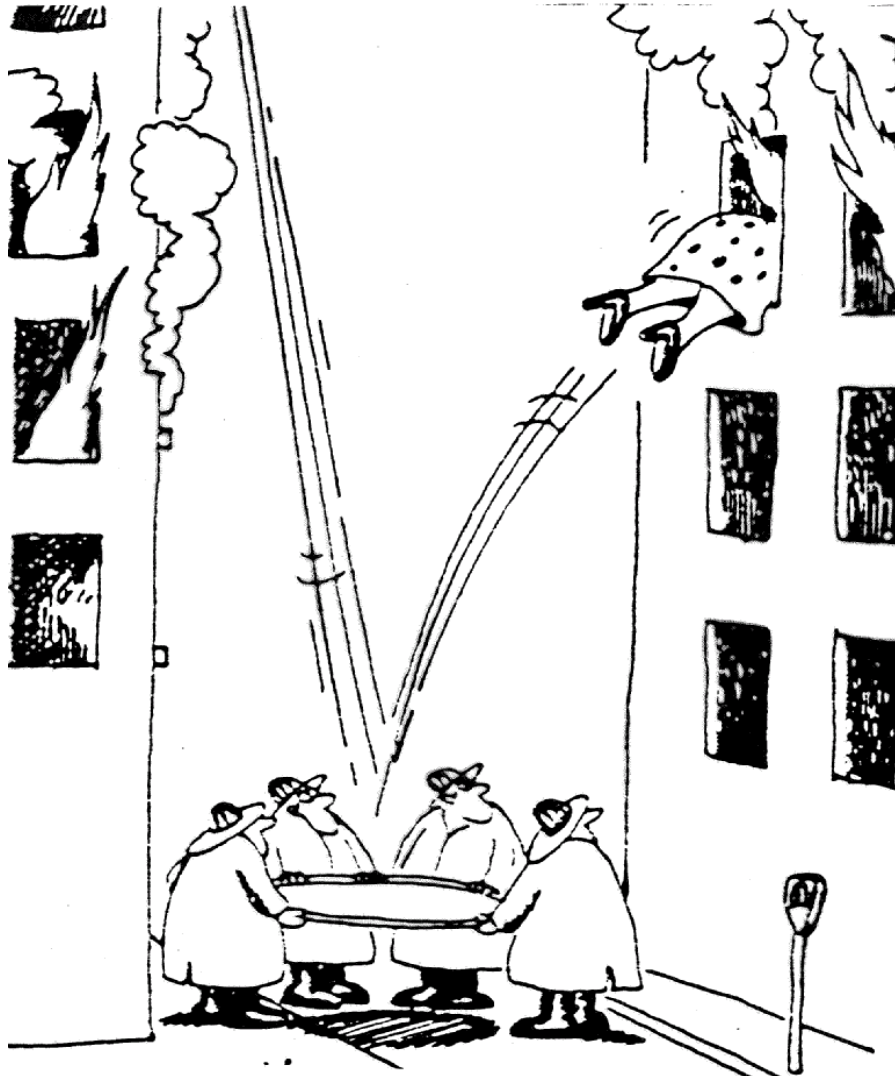


Risk assessment and integrity management (IM) planning

- Risk based pipeline integrity management takes into
 - identification of threats and failure modes
 - estimation of probabilities of failure (PoF)
 - estimation of consequences of failure (CoF)
 - estimation of risk level (CoF × PoF).
- Risk assessments are used to focus on the right issue to prioritize and schedule activities.
- Provides long term plans / high level plans



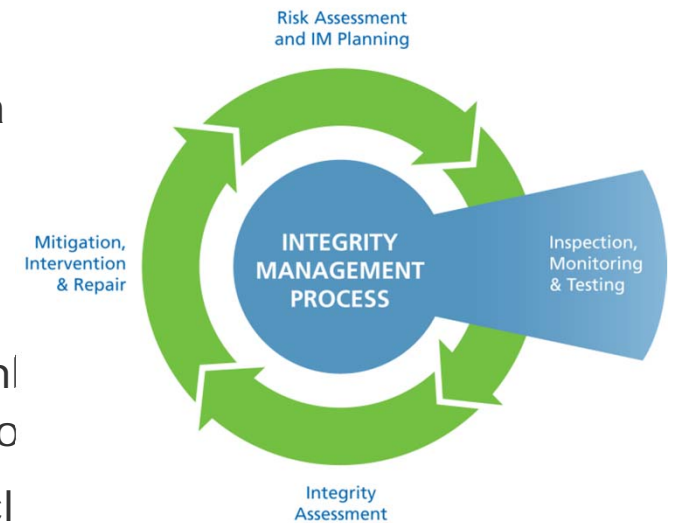
Improving



- Good planning and quality control is very important when improving integrity

Inspection, monitoring and testing

- Inspection and Monitoring
 - are activities carried out to collect parameter data and information that give indications to the condition / state of the equipment
- Testing
 - are activities carried out to test if the system or inl the required structural integrity or are working pro
- The “Inspection, Monitoring and Testing” activity incl
 - Detailed planning
 - Execution
 - Evaluation
 - Reporting and documentation
- Potentially unacceptable mechanical damage or other abnormalities detected shall be reported as input to the Risk Assessment and Integrity Management Planning activity (where overall plans for more detailed integrity assessments / re-qualifications shall be developed)



Integrity Assessment Activities

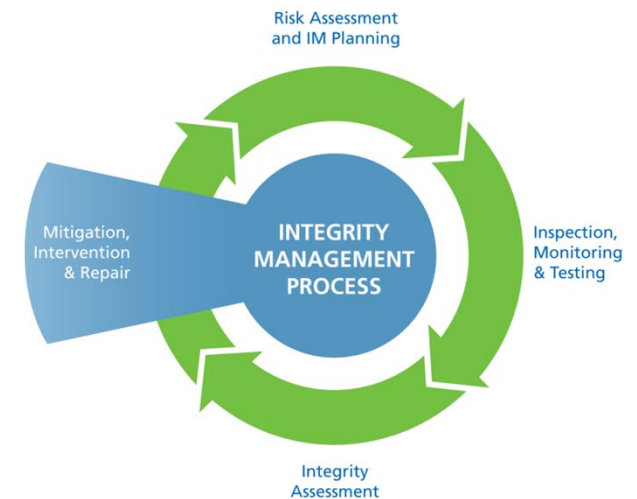
Within the Integrity Management Process cycle, the “Integrity Assessment” step comprises:

- Planning
- Data management
- Evaluation of integrity
- Evaluation/identification of corrective actions
- Report



Mitigation, intervention and repair

- *Mitigating* actions are preventive maintenance actions, mainly related to internal conditions of the pipeline.
- Pipeline *intervention* actions are mainly rectifying actions related to the external pipeline constraints.
- Pipeline *repair* are mainly rectifying actions to maintain compliance with requirements related to structural integrity and / or pressure containment of the pipeline.



These actions shall not impair the safety level of the pipeline system below the specified safety level, as defined by the design process.