Introduction to Pipeline and Standards

IN ACCORDANCE TO FDP PROGRAM

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References for this presentation

SP-1211 is the primary source (Revision 6.0; Jan2020). If otherwise, the reference shall be provided.

α symbol represents SHALL[PS]: mandatory requirement with Process Safety.

β symbol represents SHALL: mandatory requirement without [PS].

γ symbol represents "should": a recommendation

If neither α, β or γ is mentioned, then the procedure is merely permitted.

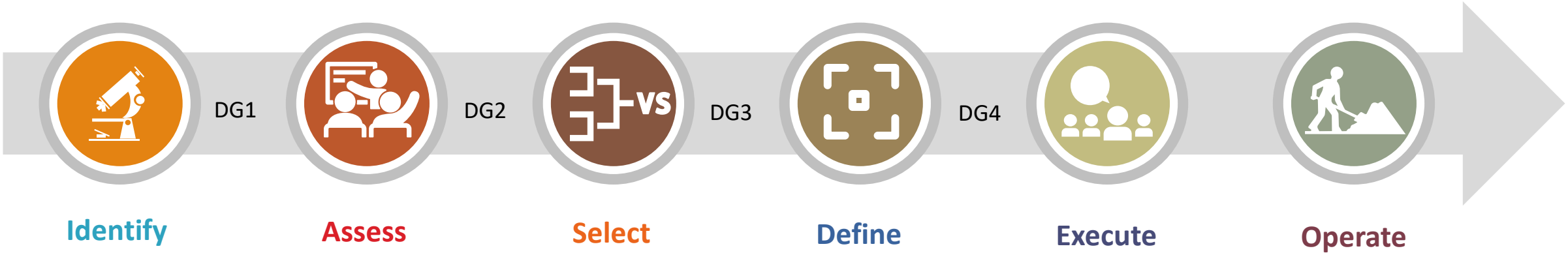
$\therefore$ symbol indicates that the subject shall be clarified in the coming slides; otherwise, there will be no further clarification.

Principles of Pipeline Design

Definition of pipeline: a pipeline is defined as a system of pipes for the transportation of fluids in the liquid or gaseous phase, or a combination of both phases, between (but excluding) wellhead facilities, manifold stations, production plants, pressure boosting stations, processing plants or storage facilities. **S_1.1**

Pipelines are the most efficient way to transport oil and gas comparing to other methods like trucks.

Opportunity Realization Process (ORP)[CP-223]

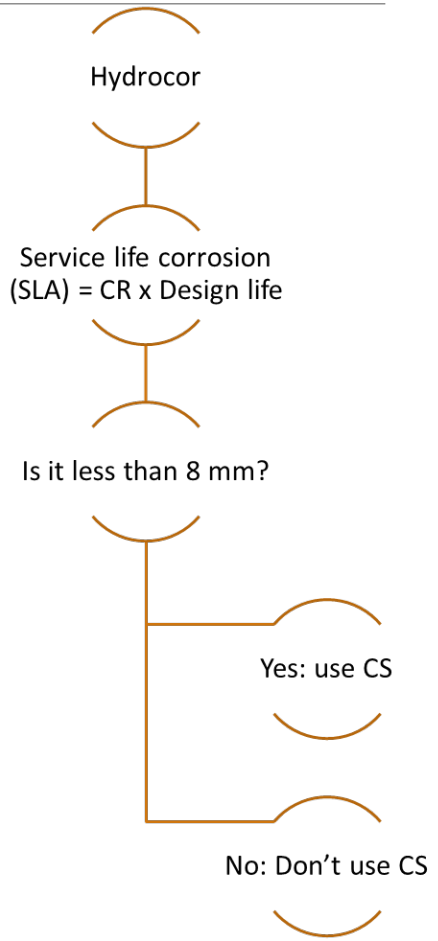


Material Selection

[Pipeline engineering course]

- Follows SP-2337 which is Amendments/Supplements to ISO 21457.
- All procedures in ISO 21457 are [β] procedures.
- Short-listing the acceptable materials and choosing the ones with lowest life-cost.
- Selection of metallic materials for the pipeline:

1. Carbon steel ∴
2. Stainless steel ∴
3. Duplex
4. Super duplex
5. Ni-alloys



Carbon Steel

Metallurgy And Metallic Materials Summary

- Carbon steel is a steel with $0.05\% \preceq C \preceq 2.1\%$ by weight.
- Properties:

1. The most common material used today.
2. Known of is excellent mechanical properties high availability.
3. Economically suitable.
4. Has poor corrosion resistance properties.
5. Usually requires corrosion control techniques.

Types:

1. Low carbon steel: $\preceq 0.3$ carbon.
2. Medium carbon steel: $0.3\% \prec C \preceq 0.6\%$.
3. High carbon steel: $0.6\% \prec C \preceq 1.0\%$.

Stainless Steel Metallurgy And Metallic Materials Summary

Stainless Steel is defined as a ferrous alloy containing a minimum of 11 % of Cr.

Properties:

- Known of its superior resistance against corrosion.
- Known of its good mechanical properties.
- Divided into five families according to their crystallographic structure.

Material Selection Cont.

- For non-metallic materials, GRE (Glass Reinforced Epoxy) is commonly used.
- Glass reinforced epoxy (GRE) belongs to a group of fiber-reinforced plastics. It is a composite material consisting of an epoxy resin, used as the base polymer matrix, reinforced with glass fibers.
- GRE Material Selection Principles: **[S_1.6_SP-2092-1]**

1. Obtain all essential data to propose the material. [$\boldsymbol{\beta}$]
2. Ensure if the GRP material proposed is within the experience envelop and have successfully been used in deferent conditions.
3. All GRE pipelines must be buried. [$\boldsymbol{\alpha}$]
4. GRE pipelines can't be connected to any vibrating or rotating parts. [$\boldsymbol{\alpha}$]
5. GRE pipelines shall not be connected to frequently maintained/serviced areas. [$\boldsymbol{\beta}$]

Material Selection Cont.

- Another commonly non-metallic material is Polyethylene liners in carbon steel CS-PE. It's usually used in the flowline rather than pipeline due to its superior corrosion resistance.
- It follows SP-2094

Overview On Pipeline Integrity Management

- Risks related to pipeline integrity in the operational phase **shall** be regularly assessed through a variety of pro-active operational methods (e.g. pigging and sampling) and inspection methods (e.g. Intelligent pigging, corrosion measurement, visual monitoring) as detailed in SP-1210 'Pipeline Integrity Management'. **[S_3.3]**
- Process Definition: "Integrity of PDO pipelines is assure[d] through a continuous and iterative process enabled and supported by the governance framework for Asset Management[…]". **[S_2.1_SP-1210]**
- Process Deliverables: ensuring that pipeline systems are maintained and operated so that they are safe, reliable, cost effective, and present a risk due to loss of containment that is As Low As Reasonably Practicable (ALARP). **[S_2.2_SP-1210]**

Risk Control [S_3.5]

To minimize the risk and control it:

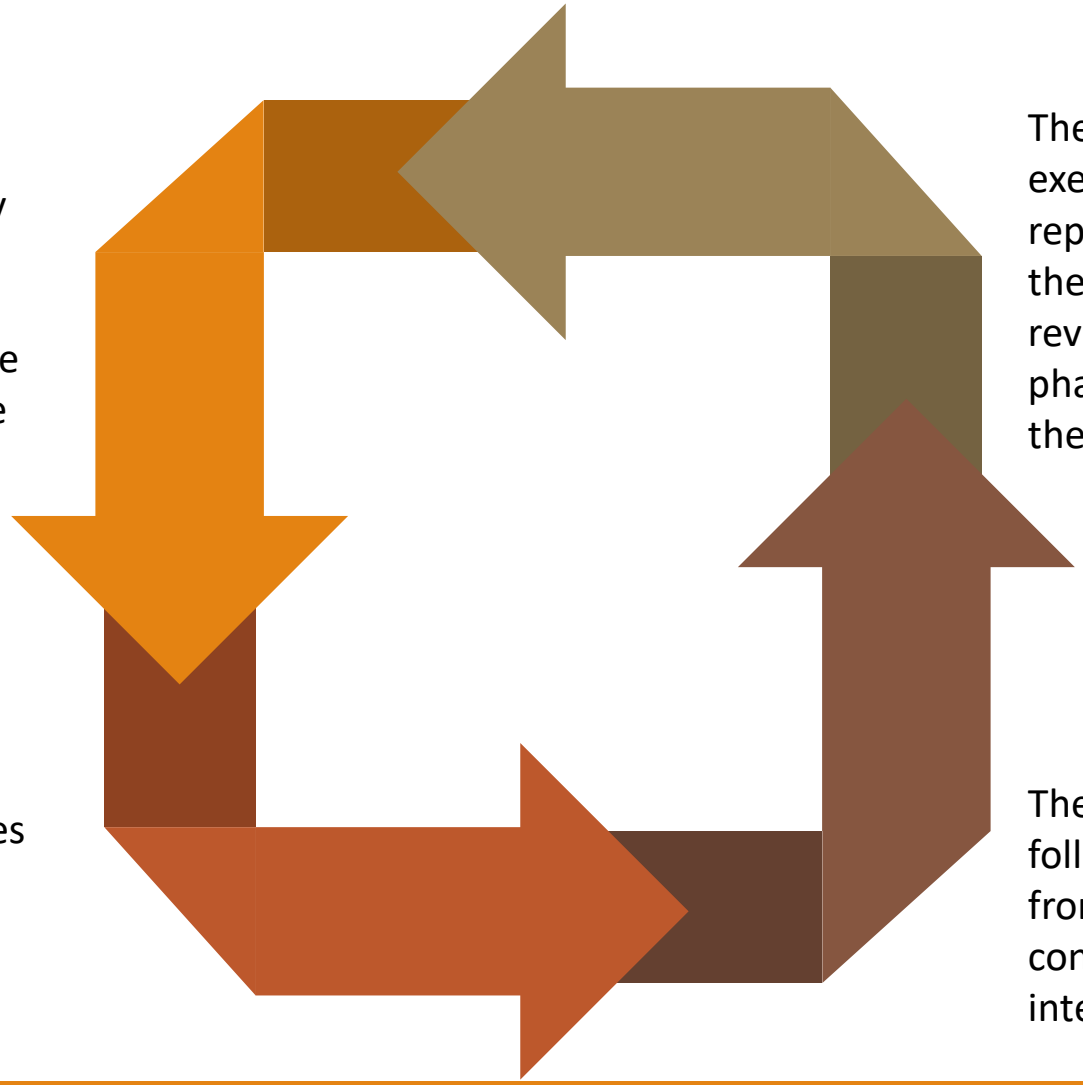
1. Lower design factor: increase thickness of the wall.
2. Better material selection: avoid mixing incompatible martials and easily corrosive materials.
3. Rerouting if possible: avoid unstable geographical paths.
4. Additional protection: fence, camera monitoring, galvanic protection, pipeline casing etc.
5. Controlled method of operation: protect from over-pressurization using pressure safeguarding system.
6. Maintenance and inspection: pipeline pigging (or intelligent pigging), inspection, wax cleaning etc.

In case of failure, the Emergency Response System is initiated as detailed on SP-1210. **[S_3.6]**

Integrity Management Process [SP-1210]

Plan

The planning phase shall specify inspection, monitoring and maintenance activities as necessary to ensure that pipelines are able to accommodate all foreseeable operational demands on them while ensuring that risks presented to the environment, the people, and the property are managed to ALARP.



Act

The Act phase of the cycle assures execution of any mitigation, repair, or replacement required to eliminate the anomalies identified by the reviews conducted in the ‘Check’ phase, to reduce the risk of failure of the pipeline system.

Do

The Do phase of the process ensures detailed scheduling, execution and documentation of the activities defined from ‘Plan’ phase.

Check

The Check phase of the process follows up and analyses the results from the ‘Do’ phase to establish a continuously updated pipeline’s integrity status.

History of Standards[source]

- Piper Alpha Disaster (Jul 6, 1988 – Jul 7, 1988)
- 167 men deied
- Property damage: £1.7 billion, or $2.29 billion
- The changes ensured:
  - adequate maintenance of pipeline integrity;
  - a major accident prevention document (MAPD) is in place.

- MAPD is a guidance document demonstrating that the operator has considered all potential risks to the pipeline and has implemented a safety management system to control these risks. Changes were also made to the offshore pipeline industry, with the Submarine Pipelines Act (1975) being updated in 1998, preventing commercial exploitation at the expense of safety.