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Asset integrity and corrosion management of late life assets

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Late life assets

Pittodrie Stadium

Stadium 974 Qatar

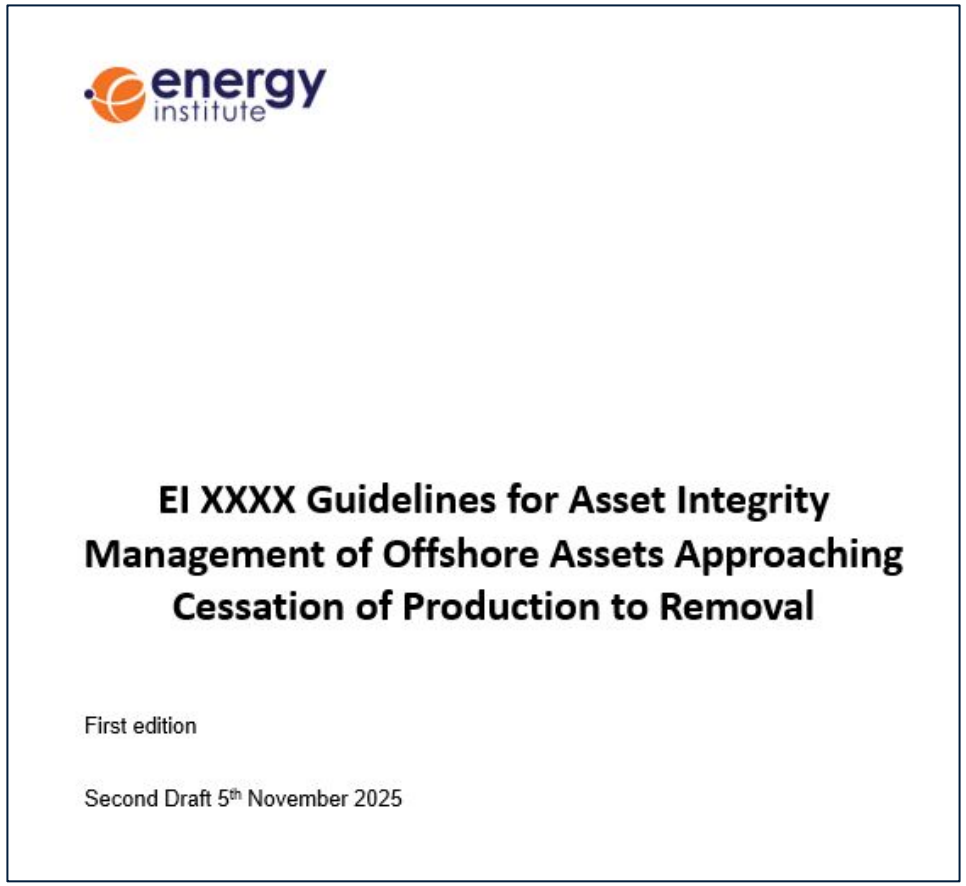
CoP and Late life

Late life assets are those approaching the cessation of production.

Most late life assets are also ageing assets

Successfully managing late life assets is ensuring that the changes through different life phases are being appropriately and economically managed.

Background



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Corrosion Controlled. Materials Assured.

Why Business as Usual Falls Short

Changing Priorities

As production winds down, the balance between maintaining maximum output and preparing for decommissioning shifts dramatically. Equipment priorities change.

People & Knowledge

Retaining skilled personnel becomes difficult amid uncertainty. The loss of experienced engineers represents an irreplaceable loss of institutional knowledge.

External influences

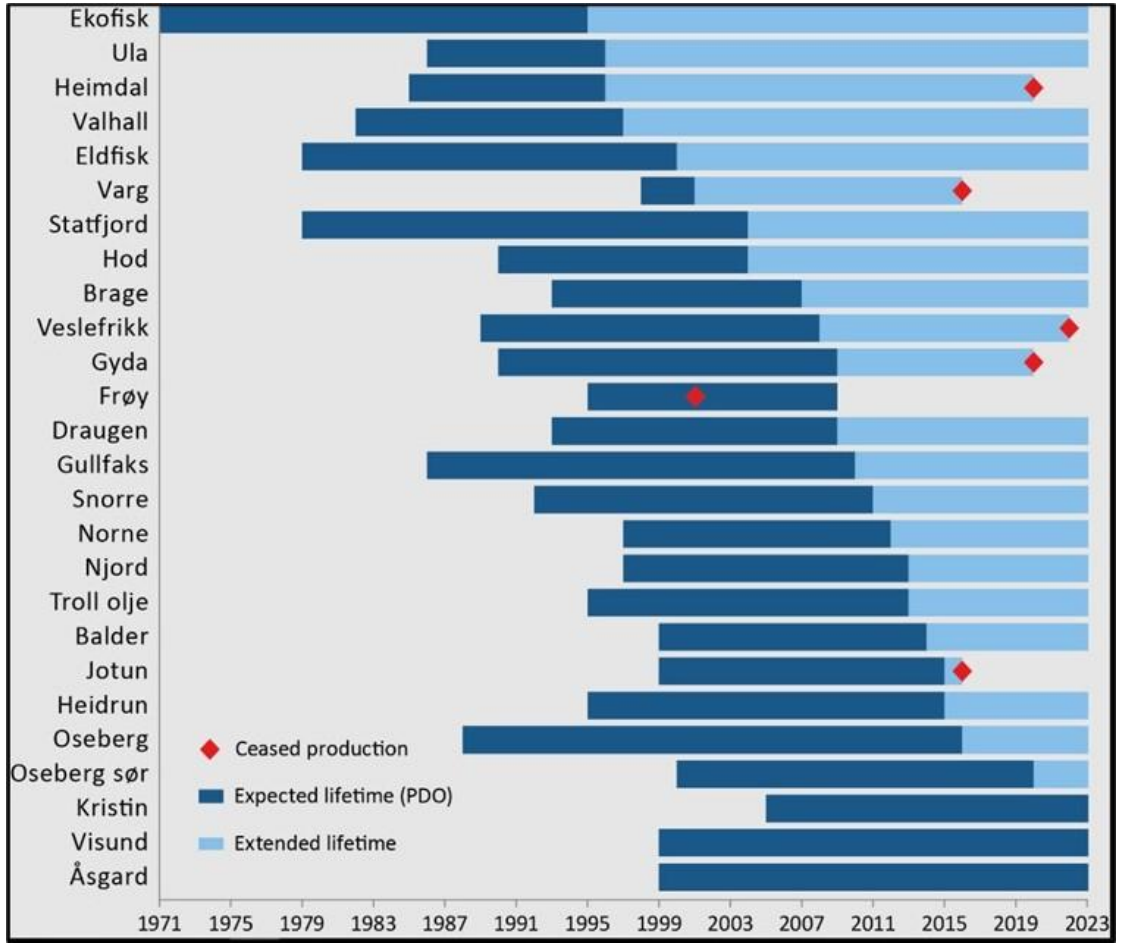
Shifting regulatory requirements and tax implications can fundamentally alter CoP timelines. Early planning enables operators to capitalize on opportunities and be flexible when needed.

Business as usual assumes stability. Production operations are designed around consistent operational objectives, established procedures, and stable workforce expectations. Late-life operations operate under fundamentally different conditions: shifting business drivers, uncertain timelines, and changing workforce dynamics.

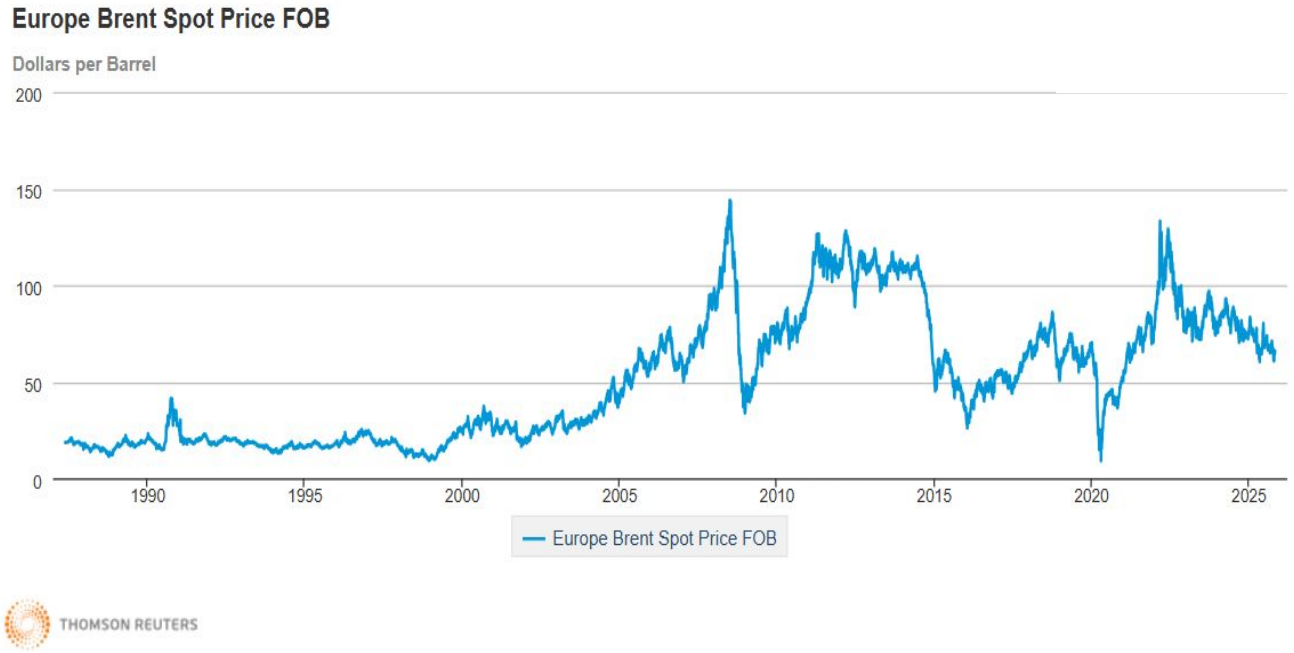
Applying production-phase procedures directly to late-life operations creates misalignment between strategy and execution.

Factors impacting CoP

- **Asset Condition**
  - High integrity and repair costs vs. return on investment (ROI).
  - Poor condition can accelerate CoP; good condition allows flexibility.
- **Life Extension Opportunities**
  - Poor performance or rapid decline may accelerate CoP.
  - Potential for new drilling, interventions (e.g., gas lift), or third-party tie-ins.
- **Single Point Failures (SPFs)**
  - Risk of failure in critical equipment (e.g., pumps, compressors, export pipelines) that is uneconomical to repair.



External drivers on CoP



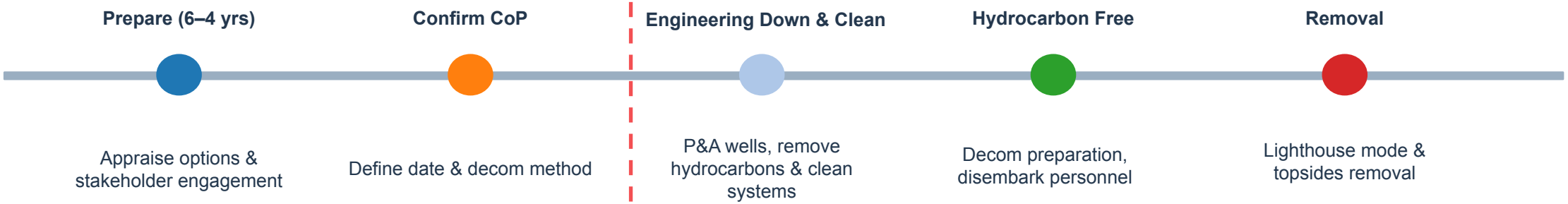
- **Oil & Gas Price**
  - Price volatility directly impacts the marginal profitability of late-life assets.
  - Commercial & Operator Changes
- **Mergers, acquisitions, or asset sale to a different operator**
  - Impact of shared infrastructure (e.g., pipelines) or new commercial tie-in opportunities.
- **Fiscal & Regulatory Environment**
  - **Fiscal:** High tax burdens or instability can make an asset non-viable.
  - **Regulatory:** Changing rules, denied license extensions, or new environmental limits.

Late Life Strategies

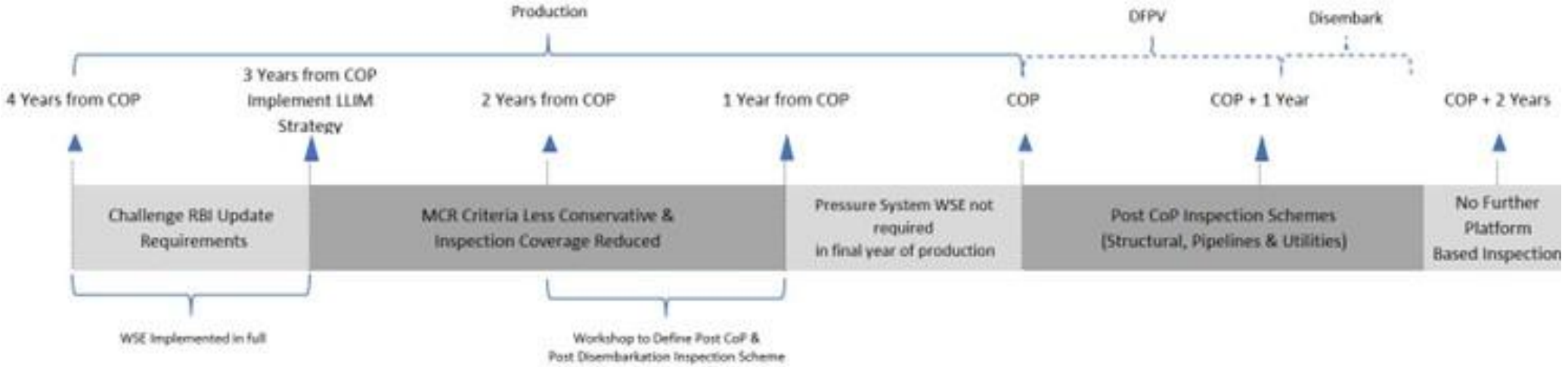
- Business as usual
- Normal Operations with Ad Hoc Adjustments
  - Operational framework remains unchanged, but individual teams begin making informed judgements about the necessity of certain tasks.
  - Activities such as inspections, maintenance, and fabric maintenance may be selectively deferred, rescheduled, or cancelled based on perceived criticality and remaining service life.
- Formal "Management of Change" (MoC)-Driven Approach
  - Under this model, CoP is treated explicitly as a material change, initiating the company's formal MoC process. All scope adjustments, including inspection deferrals and reductions in maintenance activities, are formally reviewed and documented through structured MoC protocols.
- Integrated Approach
  - Organisations managing multiple late-life assets commonly adopt an integrated approach. Under this structure, Operations, Plug & Abandonment (P&A), and Decommissioning teams all fall under a pre-defined approach and planning structure. Common planning tools (such as "Decommissioning Passports" or asset integrity handover workshops) ensure aligned strategies across teams and assets.

Example Timeline

Example Project timeline

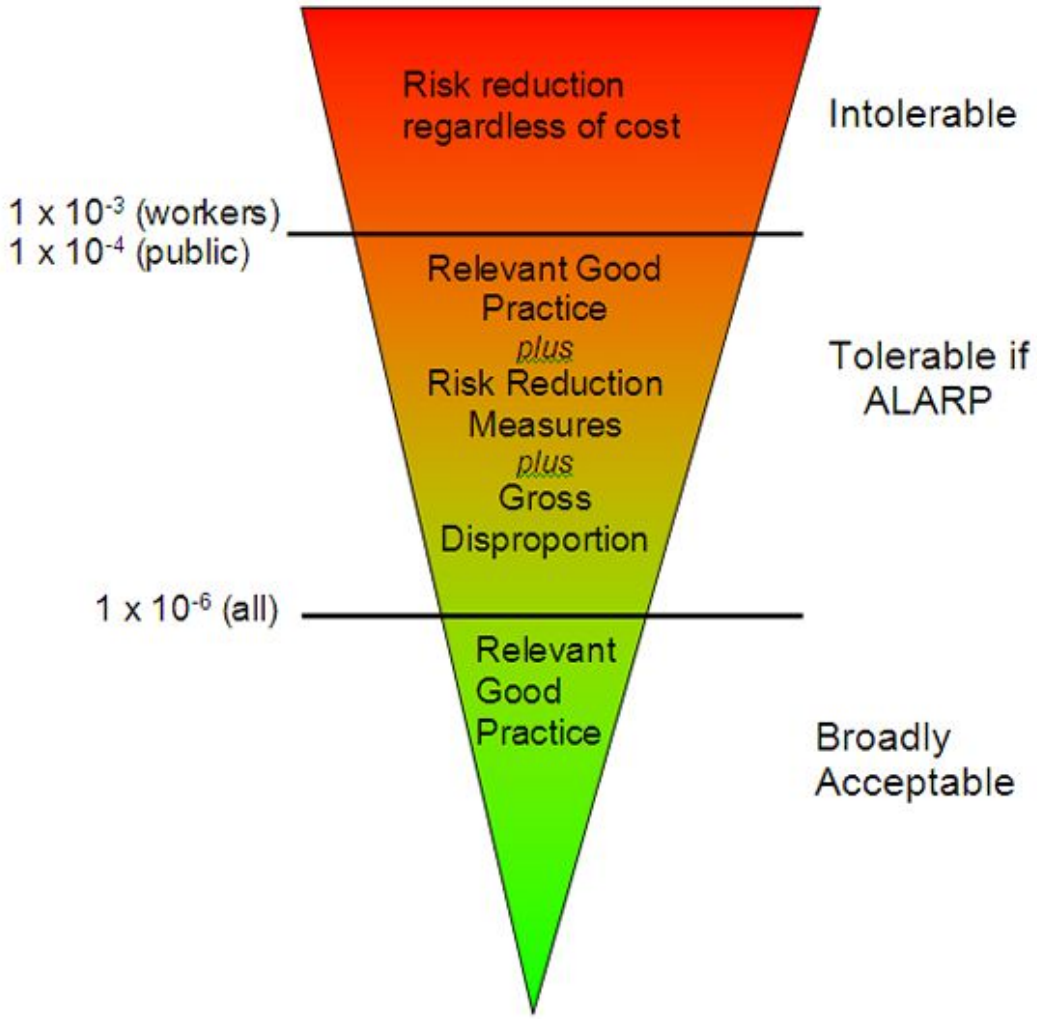


Example Integrity timeline



ALARP

- All strategies must ensure the risk to personnel remains As Low As Reasonable Practical (ALARP) throughout
- Generally, reductions in safety are not acceptable
- Duty Holders must maintain necessary competencies,
  - This can be staff or consultants/contractors



Late life integrity framework

Once CoP is declared, the late life strategy is select and the MoC procedure is implemented, the integrity documents should be updated

The inspection planning is normally based on a hierarchy of documents:

Safety Case

- Identifying Major Accident Hazards and the approach to controlling the associated risk.

Performance standards

- Stating the required performance of all SECEs

Integrity Management Framework

- Integrity strategies
  - Disciple specific definition of how integrity is assured
- Corrosion Risk Assessment Study (CRAS)
  - Determines what corrosion mechanisms are expected to be active in different systems
- Risk Based inspection (RBI)
  - The RBI takes the results of the CRAS and for each system
  - Defines techniques, extent and intervals of inspection
  - After an inspection has been undertaken then the RBI should be updated to reflect the results of the inspection
- Corrosion Management Plans (CMP)
  - Defines the approaches to managing corrosion and environmental cracking, such as chemical treatments, coatings, cathodic protection, process control

CoP ± X years	Operations Activities	Decommissioning Related Activities
-5	Commence CoP / decom review Identify key stages Thorough Review Summary submission Develop a management strategy	Engage with personnel, contractors, and heavy lift vessel contractors Develop the Operations to Decommissioning transition plan
-4	Review & revise RBI / RBA Review & revise FFS data Review inspection data, identify all inspections Engineering assessments to determine if inspections can be delayed > CoP WSE applies	Develop a critical post CoP systems list Review & revise budgets, plan any extra inspections required to ensure decommissioning can proceed post CoP
-3	All Integrity inspection activities and anomaly management as per the revised RBI and anomaly management procedures Stop updating RBI's & Intervals after inspection	Planning for P&A, Hydrocarbon free
-2	Defect acceptance criteria are less conservative Inspection reduced, Critical review of temporary repairs Consider early inspection to reduce inspection effort in the last year	
-1	Minimise all inspections and FM	Start system cleaning and shutdown preparation
CoP	Cease HC production Complete EDC Remove HC related performance standards no longer applicable	
CoP + 1	Post CoP inspections to ensure safe for decom & HLV personnel	Complete Decommissioning passport/handover to removal contractor
There is no one-size approach, whilst the operator should have significant control over the operations and hydrocarbon removal phases. The availability of heavy lift vessels may constrain the decommissioning, P&A activities drill rigs, the earlier the operator addresses these the better. ALARP principle always applies All relevant Regulations apply Specific Regulations to be aware of: SCR2015 Reg 23(1), PUWER Reg 7, PUWER Reg 6		

Systems approach

- Each system should be reviewed and the requirements for late life identified
- NORSOK Z-DP-002 is a good source of system list if the current CMMS hierarchy isn't suitable
- The review should involve all stakeholders:
  - Asset management (budget holders)
  - Integrity
  - Operations
  - Decommission
  - Well P&A

	System	Declaration CoP		P&A		Hydrocarbon Warm stack	Comments
Production Support Utilities system							
38	Glycol / methanol regeneration		x				
33	Oil storage				x		Last offload, may include slops tanks after cleaning
39	Loading					x	still need for diesel and pot water, until very end
40	Cooling medium		x				
41	Heating medium		x				
42	Chemical injection		x				Depending on reasons for chemical injection possible to reduce from declaration. Equipment with hazardous contents to be to be maintained until EDC complete.
45	Fuel gas					x	
46	Methanol injection		x				
Seawater and Fresh Water Handling							
47	Chlorination					x	
50	Sea water				x		Will be specific to platform requirements/uses
52	Ballast water					x	Floating structures wont typically have significant life beyond P&A. However, systems to be maintained throughout.
53	Fresh water					x	Alternative arrangements may be required during cold stack
55	Steam		x				
Drainage							
56	**Open drain**					x	Bunding may be required for some systems in warm stack
57	**Closed drain**				x		
44	**Oily water**				x		
Platform Utilities							
61	Jet fuel					x	The use of temporary equipment may a simpler solution for some systems
62	Diesel oil					x	
63	Compressed air					x	
64	Inert gas				x		
65	Hydraulic power		x				
66	Sewage treatment					x	
69	Lubrication oil					x	
Main Safety Systems							

Deluge and hazardous zones

- The Zone approach influences the CRAS and RBI insofar that it affects the Consequences of Failure (CoF) and Risk of Failure (RoF)
- If the Zone classification of an area / module is reduced, it can decrease the CoF and RoF calculations
- Most areas will have multiple systems, all of which must me made hydrocarbon free to allow re-classification
- Re-zoning involves considerable work to justify the changes, is likely to affect the Safety Case and will require Regulatory approvals. Typically, this is not done until the platform is declared hydrocarbon free.
- Realistically re-zoning does not affect inspections of process equipment but is more significant with regards to safety systems.
- There is only value in re-zoning if there is a very significant justification, typically if a complete train or module is mothballed or made redundant, then the safety systems can be reduced.
- It may be prudent to use temporary deluge systems in some instances; these will require little to no inspection and can be installed relatively quickly

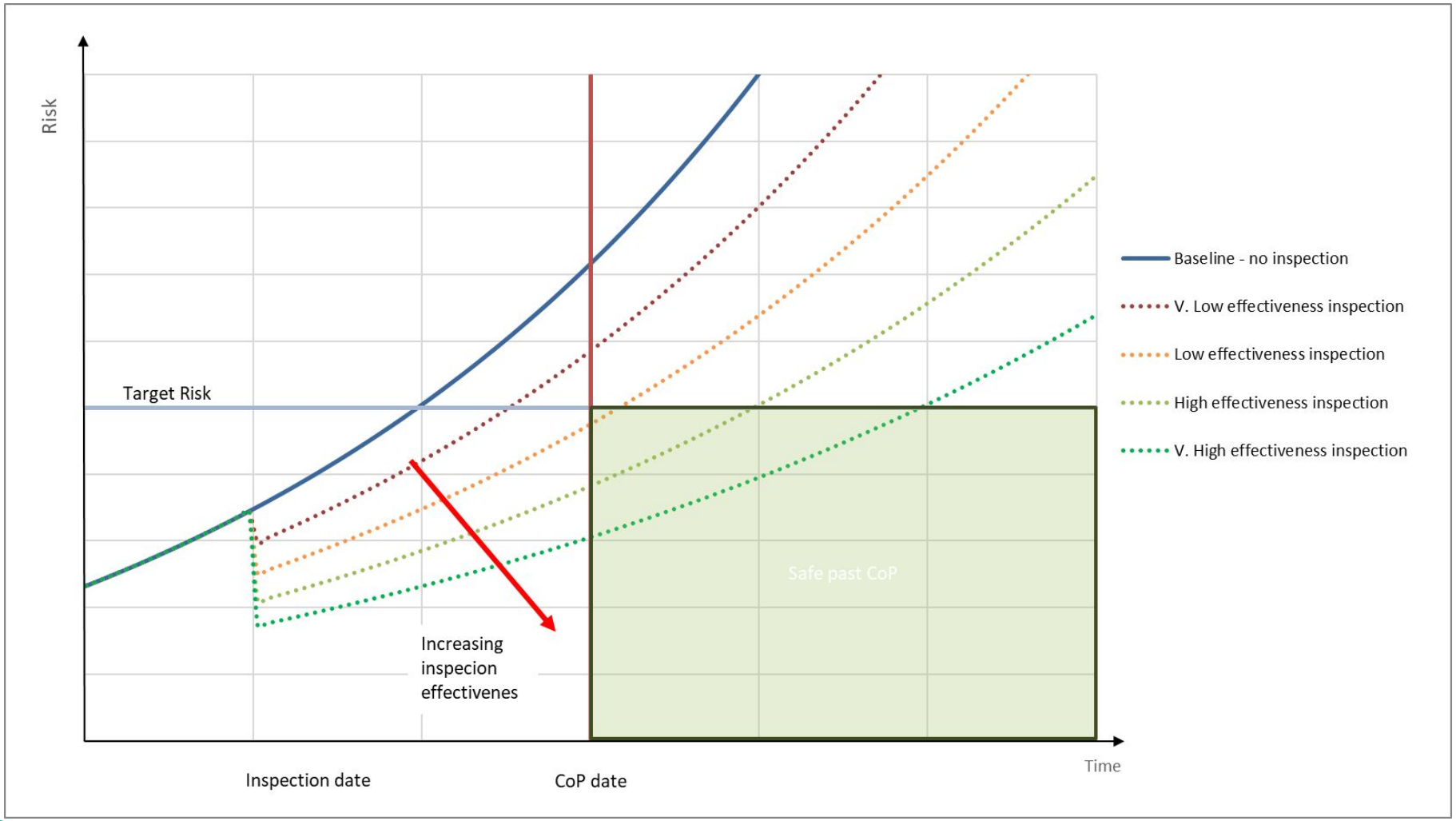
Inspection effectiveness

- Inspection effectiveness refers to how well an inspection method detects deterioration mechanisms
- It can be used to adjust the Probability of Failure (PoF) in Risk-Based Inspection.
- Examples of reduction in efficiency in late life may include:
  - Reduction in volume of inspection
    - Extent of UT
    - Only at bottom of pipe, or know problem areas
  - Substitution of Techniques
    - Nonintrusive inspection of vessels (HOIS guidelines)
    - UT instead of RAD
    - Visual weld inspection instead of Penetration
    - Use of drones for close visual inspection
    - Fix on fail methods
- Guidance on effectiveness can be found in API 581 and similar codes

LEVEL	Meaning	Impact on Probability io Failure
A	High probability of detecting damage	PoF decreases significantly
B	Reasonable detection capability	Moderate decrease in PoF
C	Basic inspection with limited detection	Small decrease in PoF
D	Minimal detection capability	PoF nearly unchanged
E	No meaningful inspection	PoF remains high

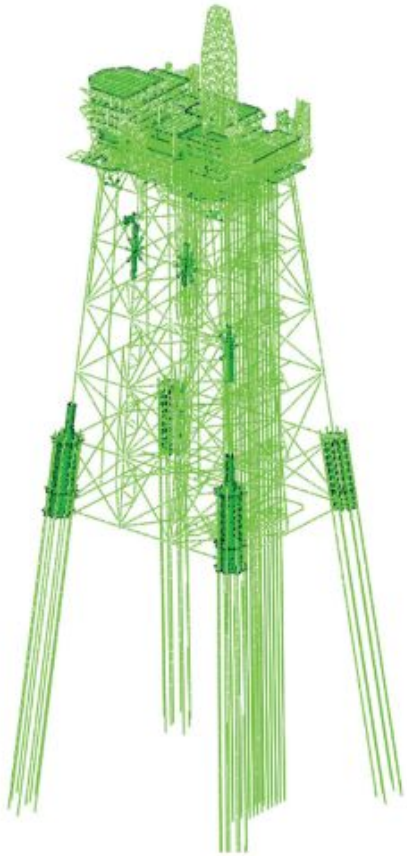
RBI Inspection frequency	Inspection date (years before COP)	Inspection Effectiveness Reduction
5	5	One level
4		No change
3		No change
2		No change
4	4	Two levels
3		One level
2		No change
3	3	Two levels
2		One level
2	2	Two levels

Inspection techniques



Structures

- Generally, structures will be required to have sufficient integrity until the removal is complete
- Therefore, some integrity management will be ongoing
- For jackets it may not be practicable to install full subsea repairs in last years of life
- Partial repairs may be acceptable or more advanced assessments
- Operation controls can be used to mitigate risk such as setting adverse weather limits to down-man the platform



Structures – defined life repairs

Scaffold boards covering degraded deck plate

Scaffold supporting degraded structures

Preparation for decom

- Preparation for removal does not fall under the integrity team
- However, specific equipment may be required until removal is complete
  - Cranes
  - Utilities, power and water
  - Access structures
  - Caissons
  - Lift points
- Often more efficient to perform activities with core crew than a separate team
- RBI and planning should account for continued monitoring of required systems post CoP

Next steps

- What significant operational transitions are on your horizon?
  - Early engagement will position your organisation to make strategic choices rather than reactive responses.
  - What elements of the proactive approach can you implement immediately in your organisation?
- Are you engaging in the necessary collaboration?
  - Successful late-life management requires alignment across operations, decommissioning, finance, and leadership.
  - Do you have the information needed to implement systematic late-life strategies?
- Look out for the Energy Institute's upcoming guidance, available through the website

Questions?

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