

OIL & GAS

# Managing New Technology Risks – DNV GL Technology Qualification (TQ) Process

## AIChE - Houston

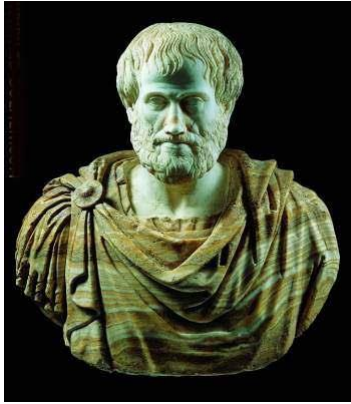
**Amar Ahluwalia**

03 August 2018

## Meeting Agenda

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1. Overview of DNV GL RP A-203 Technology Qualification Process
2. Benefits of Technology Qualification (TQ) Certificate
3. Other DNV GL service offerings
4. Discussion/Feedback



“It is likely that something unlikely will occur”

(Aristotles)

*However*



“Chance favors the prepared mind”

(Louis Pasteur)

## What is Technology Qualification (TQ)

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- Qualification is the process of ***providing the evidence*** that the technology will ***function within specific limits*** with an ***acceptable level of confidence***
- Systematic risk-based approach that supports technology developers and operators to manage risks/uncertainties when bringing new technology to market.

## Proven Technology

C: Case is based on proven technologies

C: Concept covered by standards

C: Design complies with standards

C: Produced according to specs

Business Idea

Concept Development

Pre-Eng'ng FEED

Design

Construction

Operation: capture value

C: Business attractive if technology works

C: Concept is technically feasible

C: Design is fit for intended use

C: Recipient ready to use new technology

C: Basic principles validated

C: Tech. uncertainties can be handled by normal design process

C: Produced according to specs

## New Technology

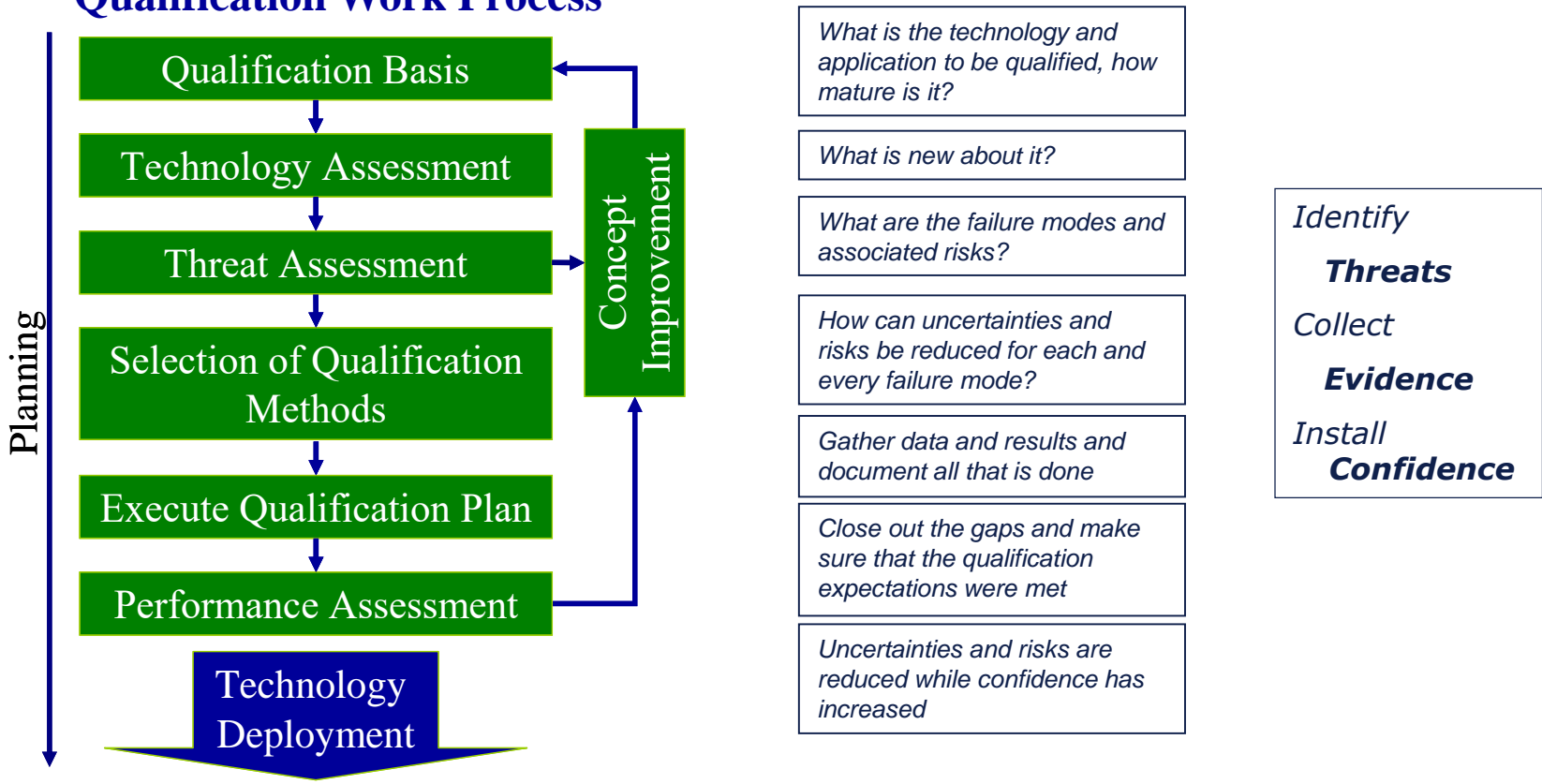
# Key Aspects of Technology Qualification

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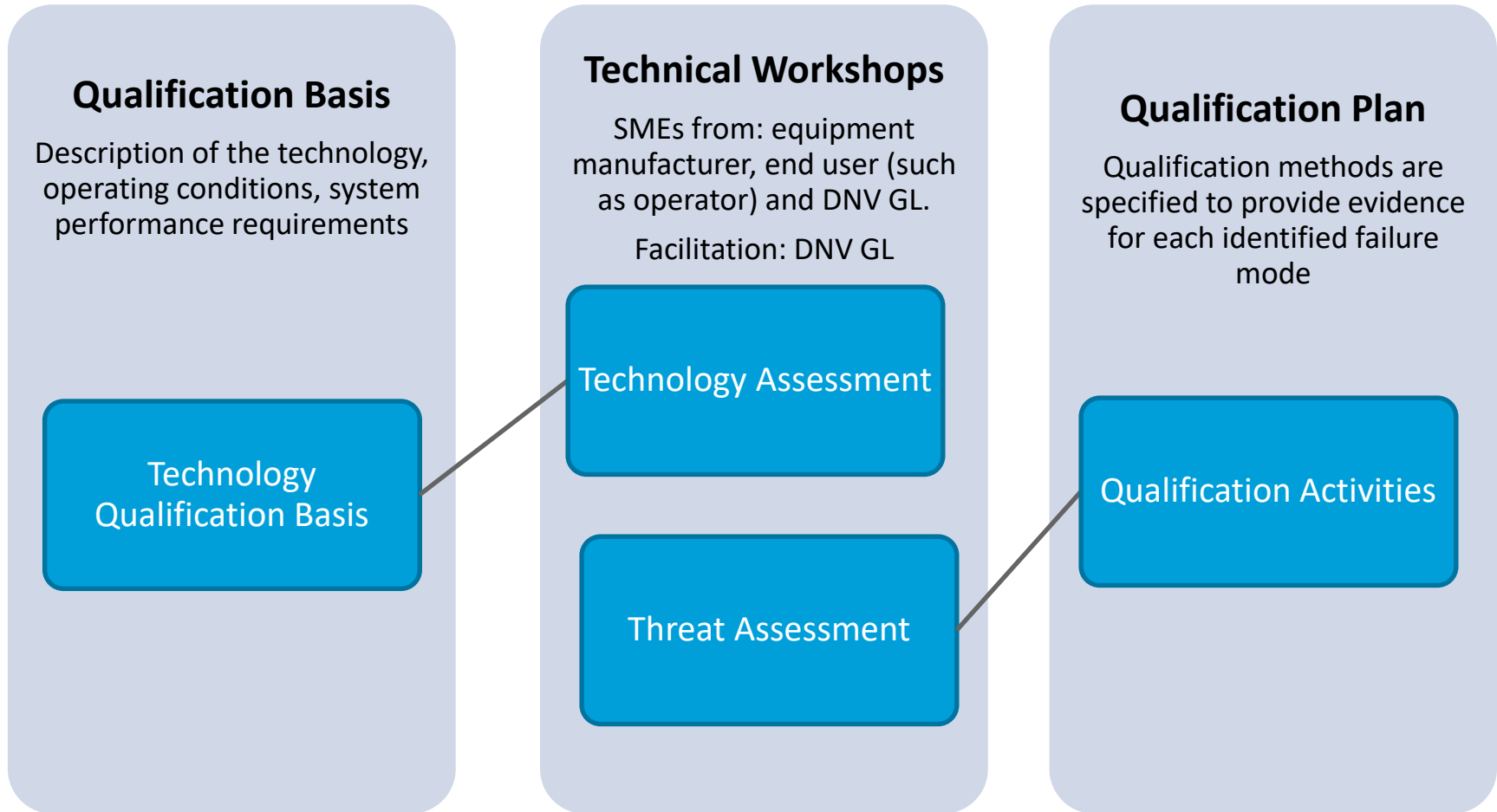
- Technology Qualification establishes:
  - What needs to be tested
  - How it should be tested (for example on a pilot well)?
  - In which scale tests or analyses should be performed (small scale, pilot test, onshore/offshore)?
  - What are the testing conditions, acceptance criteria?
  - What are documentation needs?
  
- Involvement:
  - On behalf of technology developer,
  - On behalf of end user
  - On behalf of independent party such as regulator

# Overview of DNV GL RP A-203 Technology Qualification Process

## Qualification Work Process



# Technology Qualification Phase I





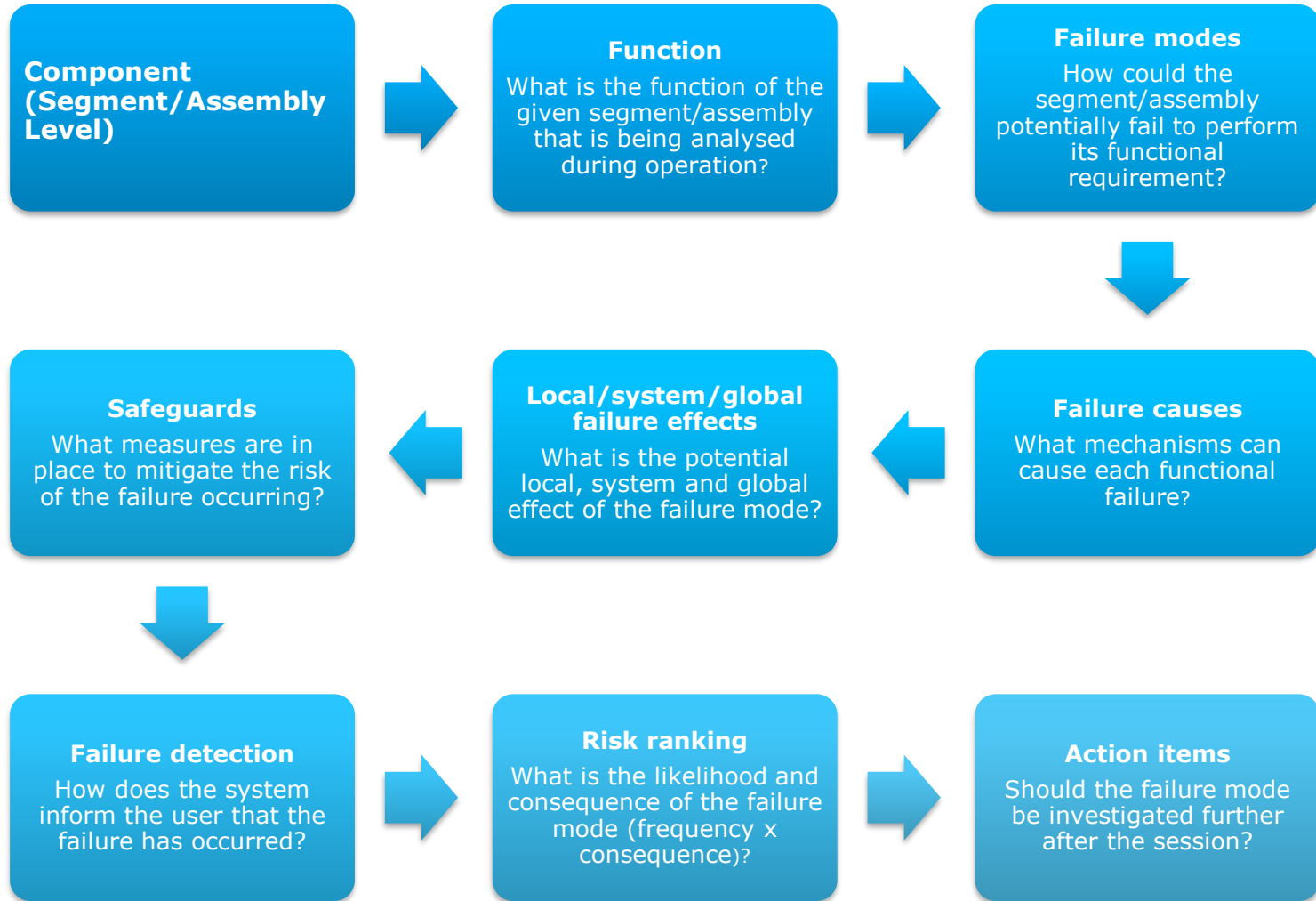
# Technology Assessment

Application	Technology Maturity		
	1 - Proven	2 - Limited field history	3 - New or Unproven
1 - Known	1	2	3
2 - Limited	2	3	4
3 - New	3	4	4

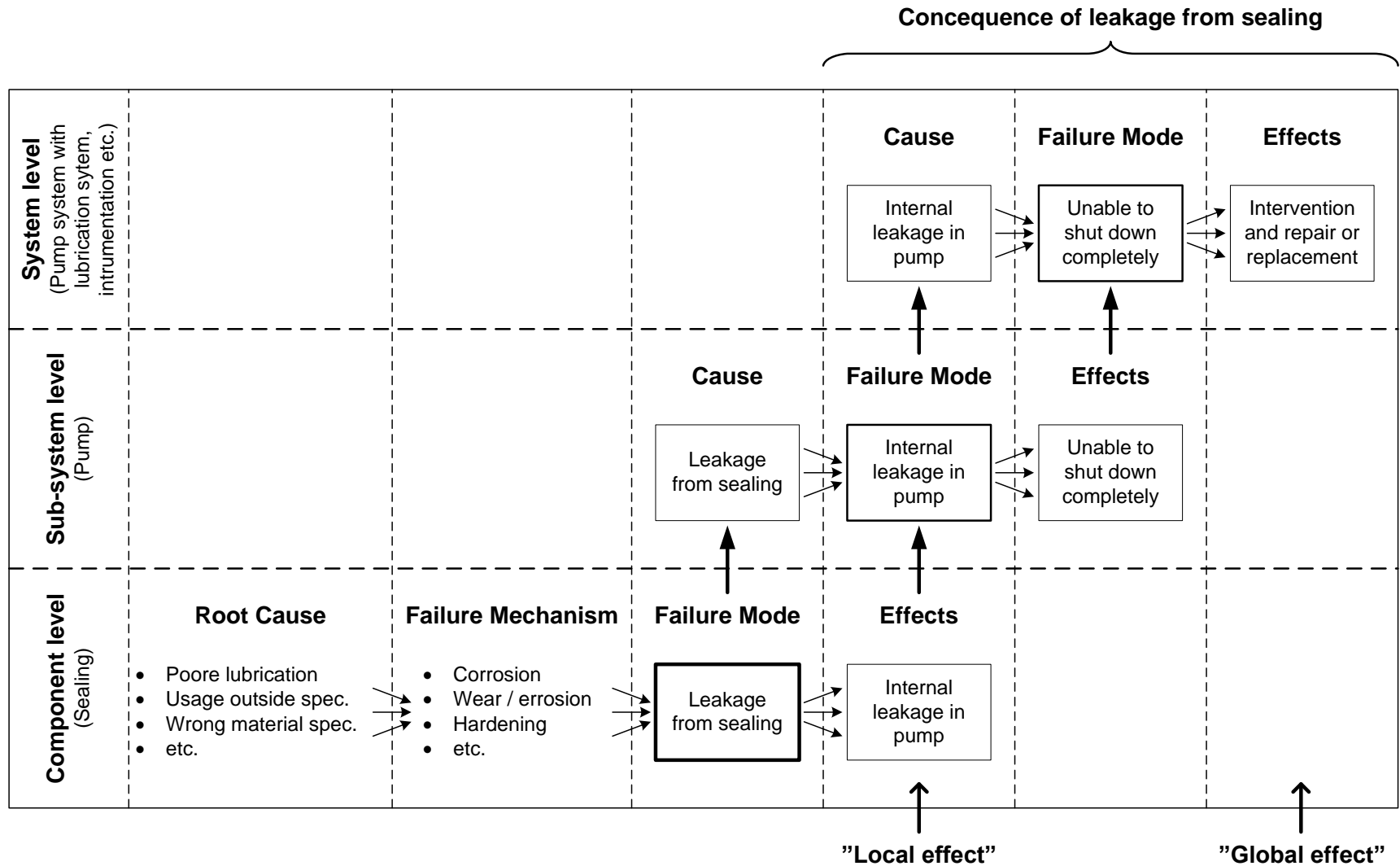
Technology Assessment Novelty Scale :

1. No new technical uncertainties
2. New technical uncertainties
3. New technical challenges
4. Demanding new technical challenges

# Threat Assessment \_ FMECA Methodology



# Failure mode/mechanism hierarchy



# Threat Assessment\_Risk Matrix

Consequence Likelihood	Impact				Increasing Likelihood				
	Safety & Health	Reputation	Environment	Assets	1 - Rare	2 - Remote	3 - Unlikely	4 - Seldom	5 - Occasional
	Acute Injuries & Community Health	Damage to industry reputation	Physical and Biological	Facility Damage, Business Interruption, Loss of Product	Rare or unheard of	Has occurred once or twice within industry	Reasonable to expect that the event will not occur at this facility.	Has occurred several times in the industry. Exceptional condition may allow consequences to occur within the facility lifetime.	Has occurred once or more at this facility. Condition may allow consequences to occur at the facility during its lifetime.
1 - Incidental	Workforce: <b>Minor</b> first-aid injury to a single person in the workforce. Treatment is minimal or not necessary. <b>AND Public: No impact.</b>	Slight impact; customer awareness but resolution within Schlumberger	Impact such as <b>localized or short term</b> effects on habitat, species, and environmental media.	Minimal damage, negligible downtime or asset loss. Costs < \$30,000.	L	L	L	L	M
2 - Minor	Workforce: One or more injuries, <b>not severe</b> . Full recovery with medical treatment. <b>OR Public: One or more first-aid injury.</b> Treatment is minimal or not necessary.	Limited impact; resolution involves active participation by technical personnel	Impact such as <b>localized, long term</b> degradation of sensitive habitat or <b>widespread short term</b> impacts to habitat, species or environmental media.	Some asset loss, damage and/or downtime. Costs \$30,000 to \$ 150,000.	L	L	L	M	M
3 - Moderate	Workforce: One or more <b>severe</b> injuries. Full recovery with extensive medical treatment. <b>OR Public: One or more injuries, not severe.</b> Full recovery with medical treatment.	Considerable impact; negative awareness and active involvement by asset and high level technical personnel	Impact such as <b>localized but irreversible</b> habitat loss or <b>widespread, long-term</b> effects on habitat, species or environmental media.	Serious asset loss, damage to facility and/or downtime. Costs of \$ 150,000 to \$ 2 Million.	L	L	M	M	H
4 - Major	Workforce: <b>Fatalities</b> (1-4) <b>OR Public: One or more severe</b> injuries. Full recovery with extensive medical treatment.	Extensive negative attention with specific customer; high level Schlumberger and customer awareness and involvement	Impact such as <b>significant widespread and persistent changes</b> in habitat, species or environmental media. (e.g. widespread habitat degradation)	Major asset loss, damage to facility and/or downtime. Costs of \$ 2 Million to \$ 20 Million.	L	M	M	H	H
5 - Severe	Workforce: <b>Multiple fatalities</b> (5-50) <b>OR Public: Multiple fatalities</b> (1-10)	Extensive negative attention in the industry	Impact such as <b>persistent reduction</b> in ecosystem function on a landscape scale or <b>significant disruption</b> of a sensitive species.	Severe asset loss or damage to facility. Significant downtime with appreciable economic impact. Costs > \$ 20 Million.	M	M	H	H	H

# Qualification Activities Example for High/Medium Risk Items

Component	Failure Modes	Actions/Safeguards
<b>Component #1</b>		<ul style="list-style-type: none"> <li>• Independent verification</li> <li>• FEA Analysis</li> <li>• Historic reference review</li> </ul>
<b>Component #2</b>		<ul style="list-style-type: none"> <li>• Isolated full-scale nozzle test using LNG</li> </ul>
<b>Component #3</b>		<ul style="list-style-type: none"> <li>• Design alternatives to eliminate the actuated plugs</li> </ul>
<b>Component #4</b>		<ul style="list-style-type: none"> <li>• Usage of bearings under similar applications</li> <li>• Rotor stress/deflection calculations</li> <li>• Mechanical run tests.</li> <li>• SIL certification for over-speed protection</li> <li>• Modal analysis of the turbine wheel</li> <li>• Performance test of scaled VPT unit.</li> </ul>

# Technology Qualification Phase II

## Qualification Plan Execution

Carry out the Technology Qualification Plan in order to substantiate the performance margins for the failure modes of concern

Qualification Activities

## Performance Assessment

Review available qualification documentation against the technology qualification basis and the acceptance criteria in the Technology qualification plan

Review Qualification Results, establish qualification Management Table

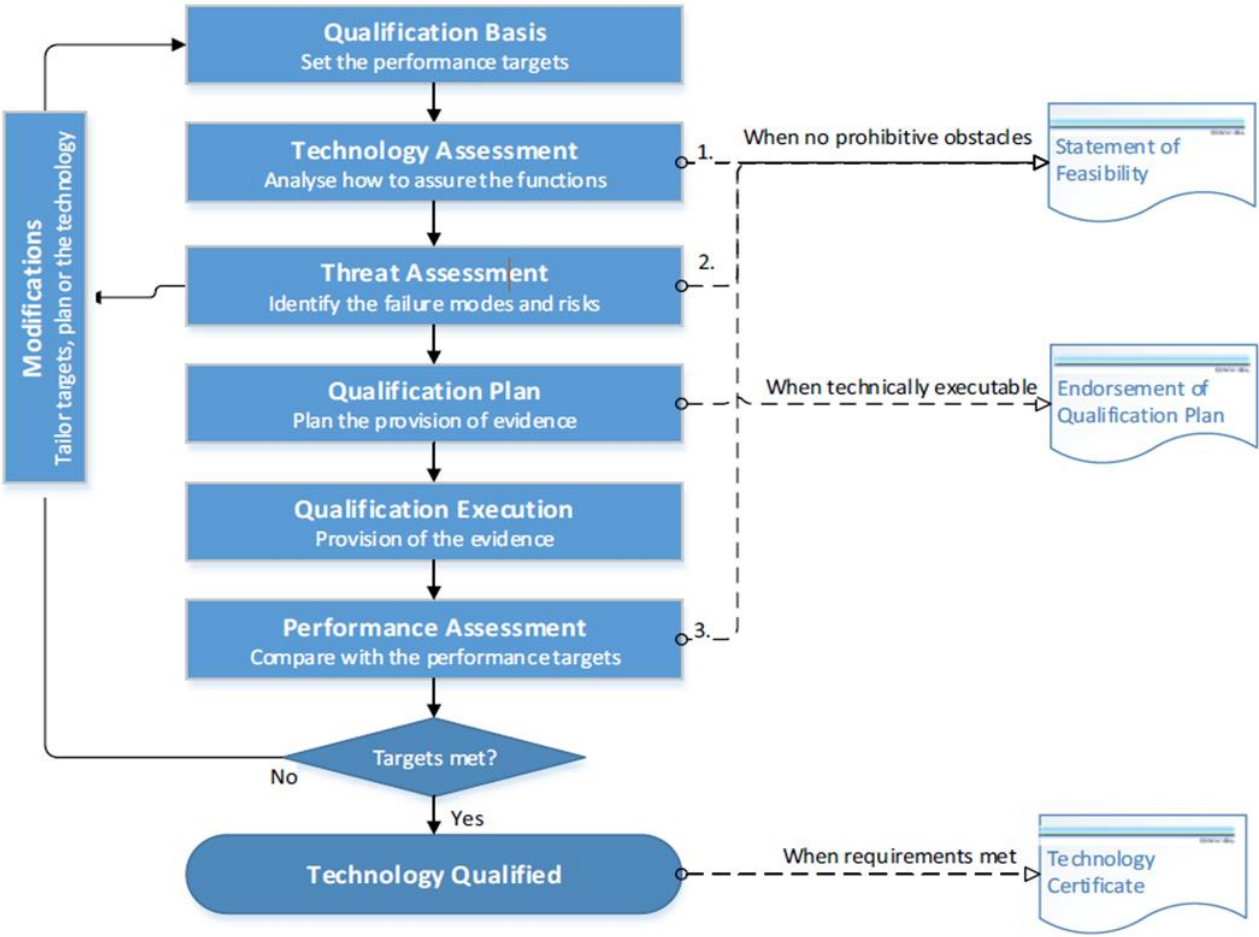
Collect Qualification Evidence

## Technology Qualification Certificate

Conclude the technology has been qualified and is ready to deployment

Issue TQ certificate

# DNV GL TQ Process (DNV RP A-203) Deliverables



## Benefits of DNV GL TQ Certificate

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- DNV GL TQ Process: systematic risk-based process of providing evidence that a technology will function within specific limits with an acceptable level of confidence;
- For Equipment Manufacturer (Technology Owner):
  - ✓ Incorporate regulatory requirement or other compliance requirement early on in the design phase and reduce the rework risk;
  - ✓ Opportunity to improve system design at early stage;
  - ✓ Leverage industry experience as we have completed many TQ projects for various companies;
  - ✓ Marketing competitive advantage: DNV-RP-A203 widely accepted and recognized in the industry for Technology Qualification;



## Benefits of DNV GL TQ Certificate (Cont'd)

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- For Equipment End User:
  - ✓ Minimize the uncertainty/risk associated with deploying the new technology;
  - ✓ Reduce development cycle time by using “qualified technology”;
  - ✓ Common criteria when selecting different vendors;
  - ✓ Enhance confidence on the operation where there is no proven experience in the application

## When would you do Technology Qualification projects?

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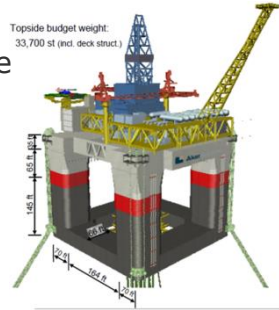
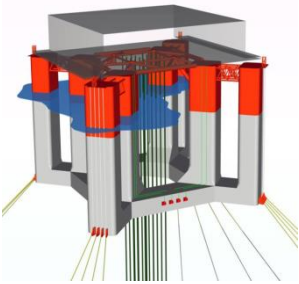
- Lack of confidence on the technology, not sure how it will behave as expected
- Not knowing what they do not know, need an expert source of knowledge
- Need to comply with internal company requirements for new technology use
- Market Competitive Advantage
- Operator / End Customer Requirement
- Technology Selection for increased reliability

**What do you think would be areas/technology in downstream that are applicable to the Technology Qualification project criteria?**

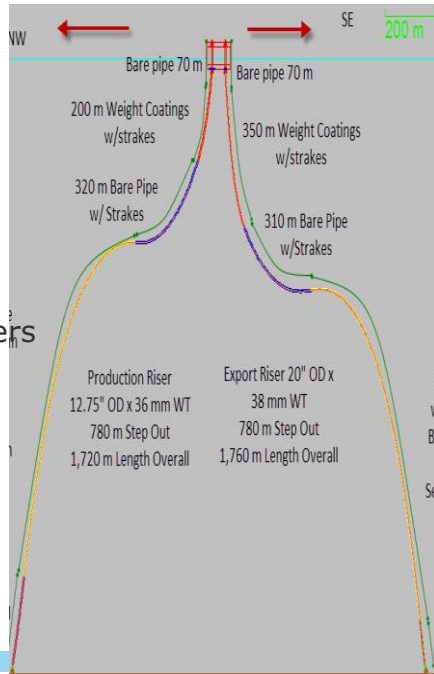
# Examples of technologies we are qualifying

## Platform Concepts – Interface with Offshore Class

- Aker Dry Tree

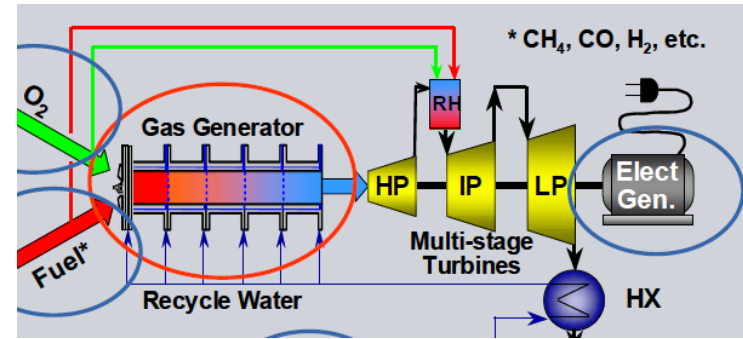


- HOE Dry Tree

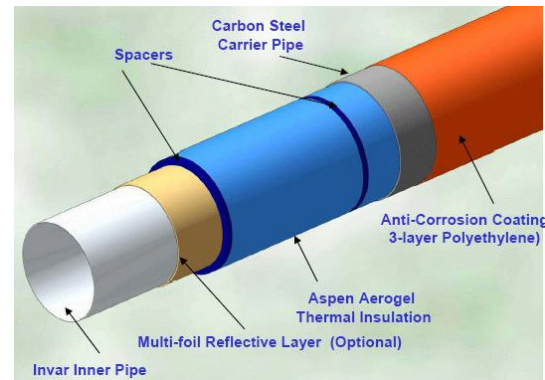


- Compliant Vertical Risers
- Composite Risers
- Flexible Risers

## Oxy-Fuel Generator



- Pipe-in-pipe solutions
- Enhanced collapse properties



- Bi-directional piggable wye



# DNV GL TQ Project Reference

Customer	Technology Qualification Project Name	Project Completion
PGS	Subsea Fiber Optics monitoring system 1.0	2010
Fluor Corporation	Subsea LNG cryogenic Pipeline	2010
Chevron	CIMV TQ	2010
Chevron	Tahiti 2 water Injection Pumps	2010
Chevron	JSM TQ support	2010
Enbridge Offshore Facilities	QCS' Dual Director Wye™	2011
Chevron	Direct Electric Heating System	2011
FloaTEC, LLC	Extendable Draft Semi-Submersible Grouted Connector	2011
Roxar	Roxar's Subsea Multiphase Flow Meter	2012
Chevron	Blind Faith Artificial Lift	2012
Parker Hannifin Corporation	Phastite Pipe Fitting	2013
Voith Composites GmbH & Co. KG	Carbon Fiber Reinforced Polymer (CFRP) Drill Pipe	2013
Trendsetter Engineering Inc. (TEI)	10K and 15K Capping Stack	2014
BP	Bonded Composite Pipe for Subsea Spools	2014
Shell	Low Salinity Water Flood System	2014
Chevron	Lianzi TQ support ( Subsea sampling system, DEH, MPFM)	2015
Techlam	TLP Tendon Connector	2015
Aker Solutions	5" - 15k/10K Vertical Christmas Tree on Tubing Head Spool (VXT on THS)	2015
ConocoPhillips Company Inc. (COP)	Flashing Liquid Expander Technology Qualification	2015
Chevron	Intelligent well completions	2015
Chevron	Lufkin PRC Regen well manager sysetm	2015
Cameron	CDX system TRL Assessment	2016
PGS	Subsea Fiber Optics monitoring system 2.0	2016
SOFEC	Internal Turret System	2017
MWCC	20K Capping Stack	Ongoing
View into the Blue	Underwater camera	Ongoing
Schlumberger	Managed Pressured Drilling System	Ongoing
Steelhead	Compositie accumulator	Ongoing
Transocean/Shell	BOP control system (ZED)	Ongoing
Halliburton	3' subsea tree EH control system	Ongoing

## Public Service Announcement!

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- DNV GL RP- A203 is a publicly available document.

<https://rules.dnvgl.com/docs/pdf/DNV/codes/docs/2011-07/RP-A203.pdf>

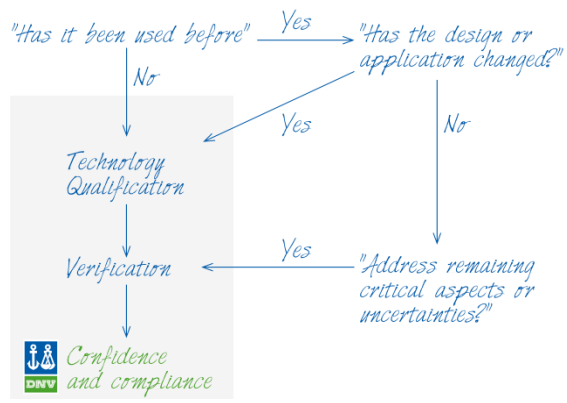
# Our services span through the asset life



## TECHNOLOGY QUALIFICATION

## VERIFICATION/ CERTIFICATION

## INTEGRITY MANAGEMENT



## INDEPENDENT ANALYSIS





# Certification Services & Differentiation of Services

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- Type Examination Certification
  - “Certification” to Recognized Industry Standards (i.e. API/ ISO/ EN/ AUS/NZ)
- Product Certification
  - “Certification” to DNV GL SE-0045/ ST-0035

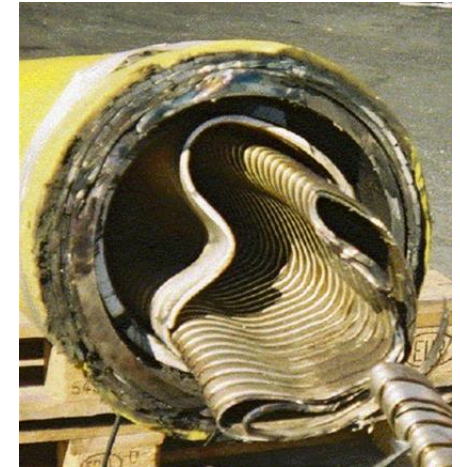
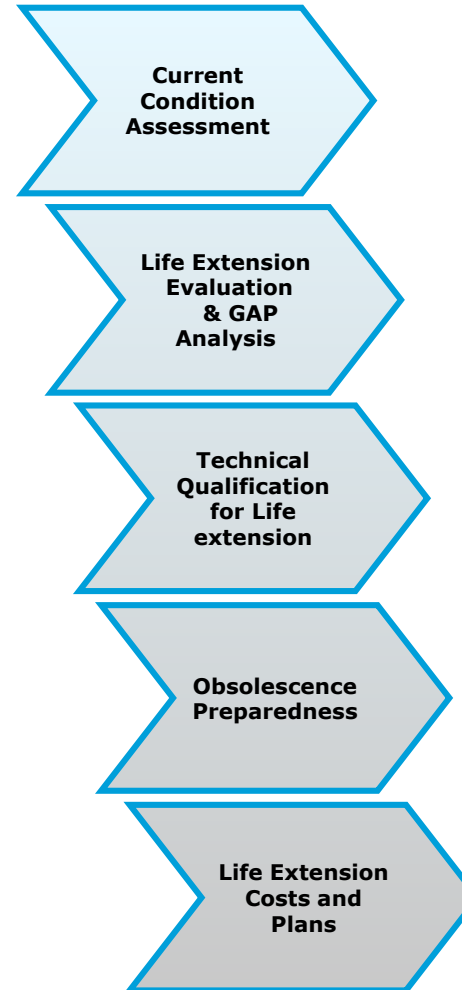
## Certification Notes

- ***Certification is a conformity assessment requiring both design and manufacturing verification activities to be performed.***
  - ***Certification is typically performed on a scope of work dictated by the DNV GL or the publically available scheme.***
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- Compared to Verification?
    - ***Verification is typically performed on a scope of work dictated by the client.***

# Late-Life Assessment

## ■ Late-life Assessment services

- Verify that structure, systems and components is in compliance with today's standards and legislation
- Ensure technical, operational and organisational integrity
- Assess sufficient integrity to continue safe operations throughout lifetime
- Late-life costs and planning
- *Goal: Comply with NORSOK U-009 Life Extension for Subsea Production Systems*



## Risk Management Advisory Services

Risk Management Advisory offers a portfolio of capabilities that cover a full range of services in the area of risk assessments and mitigation techniques. Our services can be categorized as:

<b>SAFETY RISK MANAGEMENT</b>	Comprises services which help our customers manage their activities' risk to humans. These services focus on risk prevention and mitigation, as well as investigating why things go wrong. These services are also inputs to asset, environmental and enterprise risk.
<b>ASSET RISK MANAGEMENT</b>	Comprises services taking care of our customers' activities' risk to their own assets. The services concentrate on risk prevention, looking at the systems and plans as well as the activities and the physical assets themselves.
<b>ENVIRONMENTAL RISK MANAGEMENT</b>	Comprises services regarding risk to the external environment. The services focus on risk prevention and mitigation and include detailed environmental analysis of an area's vulnerability.
<b>ENTERPRISE RISK MANAGEMENT</b>	Comprises services taking care of our customers' business, albeit always with a technical perspective. The services concentrate on risk identification, control and prevention, looking at the systems and plans as well as the overall activities in their projects or organization.

## Service Areas

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- Quantitative Risk Assessment (QRA)
- Fire and Explosion Analysis (CFD or Phast)
- Smoke and Gas Dispersion Analysis (CFD or Phast)
- Turbine Exhaust Assessment
- Emergency Systems Survivability Assessment
- Emergency Escape, Evacuation and Rescue Analysis
- Dropped Objects Analysis
- Structural Integrity Analysis
- Fire & Gas Mapping Study
- Process Hazard Analysis (PHA) – HAZOP / HAZID
- FMECA / FMEA
- Reliability, Availability and Maintainability (RAM) Analysis
- Functional Safety (SIL / LOPA)
- Fault Tree Analysis
- Noise and Vibration Study
- Bowtie Analysis / Barrier Management
- Incident Investigation
- Safety Critical Elements Identification / Assessment and Performance Standards
- Human Factors Analysis
- ALARP Study
- Readiness Reviews
- Safety Culture Diagnostic and Implementation of Improvement Measures
- Safety Case Development
- Development of Safe Work Practices, Operating Procedures, Emergency Response Plans, Close-out Process
- Compliance support with permits, licenses and consents
- Management System Related Gap Analysis
- Illumination Study

## Some Value Adding Services / Differentiators

- **Advanced 3D visuals or short animations** of a release event, which offer a powerful method of risk communication.



- **Visualization of QRA** risk results in Google Earth
- **Streamlined PHA** significantly reduces costs for facilities with requirements to conduct periodical PHA reviews (e.g. once every five years or annually).
- **PHA with Analytics** helps companies prioritize the implementation of safeguards and recommendations within their facilities through improved analysis of their PHA data.
- **BSCAT for Incident Investigation** Barrier-based Systematic Cause Analysis Technique (BSCAT) approach more clearly identifies safeguards and controls that failed or were degraded in operation, and also makes more transparent why a recommendation might be generated.

We build trust and confidence

## Discussion and Feedback

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# Thank You !

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