Prescriptive and risk based SIL allocation methods used together

Handling of potential inconsistencies between NOG GL 070 and LOPA

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Working together for a safer world

Outline

- Key questions to the industry as a whole
- Experience with combining Guideline 070 with LOPA
- Have we established a ”best practice”?
- Effects of choices

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Key questions

- Why do we want to combine the Norwegian Oil and Gas Association's Guideline 070 with risk analysis for establishing required saferty integrity levels?
- How do we select which functions will be given a SIL rating based on the guideline, and which functions will be subject to a semi-quantitative risk assessment?
- Using risk based approaches requires stronger risk owner engagement in the SIL allocation process. What can the consulting firm not do by itself?
- How do we assess the consequences of an undesirable events?
- Why is it important to select consistent risk acceptance criteria when using LOPA for SIL allocation?

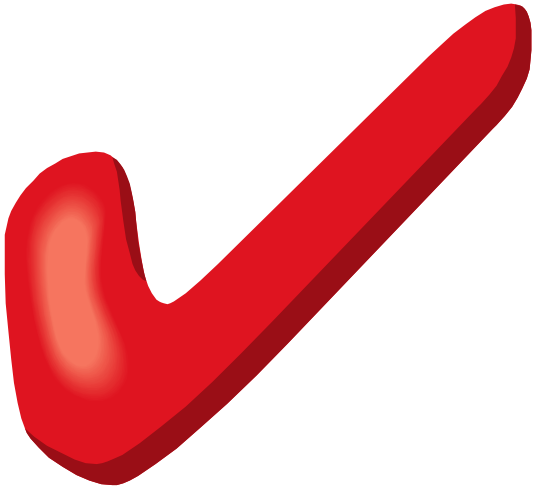
Experience with combining the Norwegian Oil and Gas Association's Guideline 070 and LOPA in Lloyd's Register Consulting

Experience base

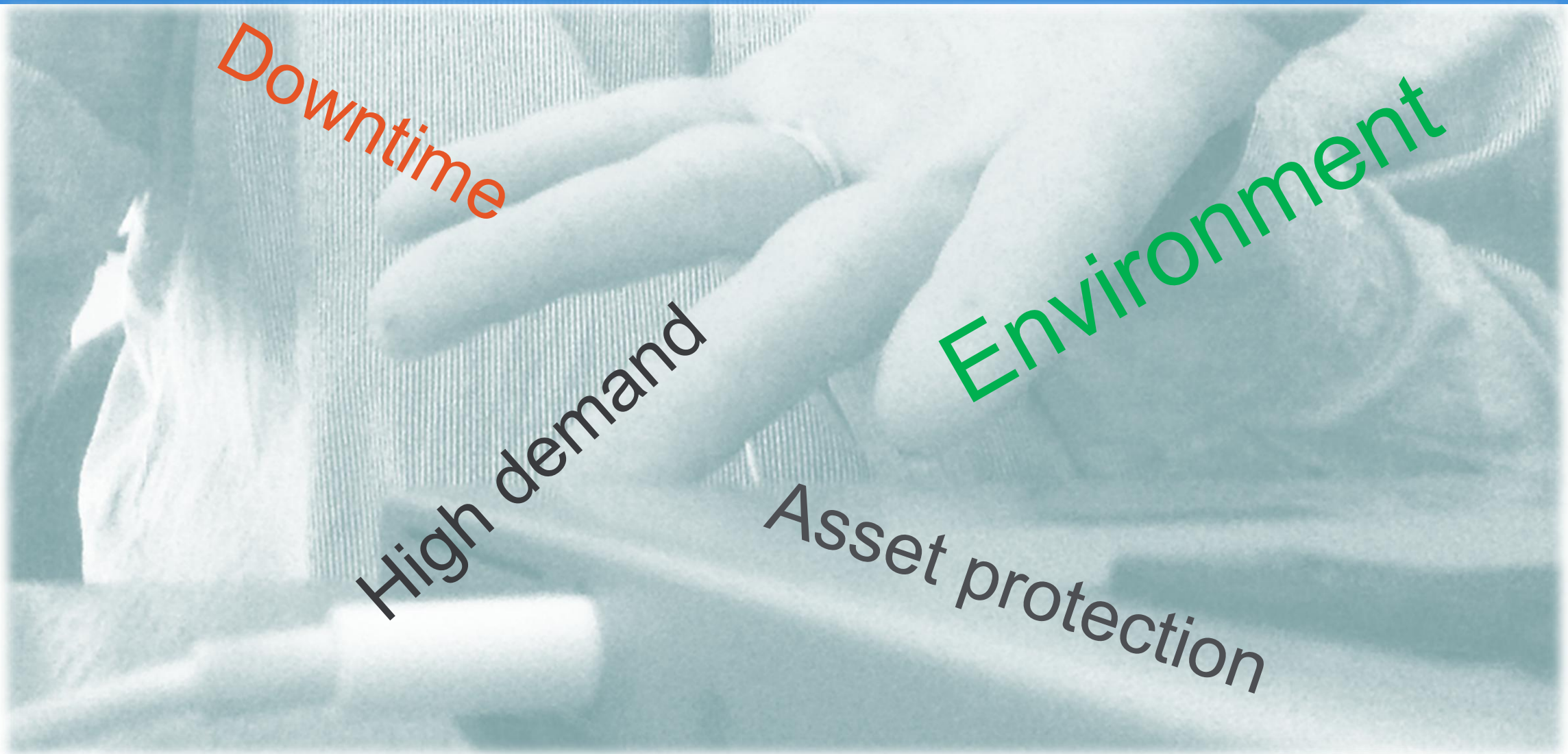
- More than 3 different operators on the Norwegian Continental Shelf
- Fixed and floating installations
- Large and small projects
- Engineering contractors from different regions in the world

What can Guideline 070 give us?

- Time savings
- Conservative safety results
- Covers ”conventional” functions – ref ISO 10418
- Covers global SIFs



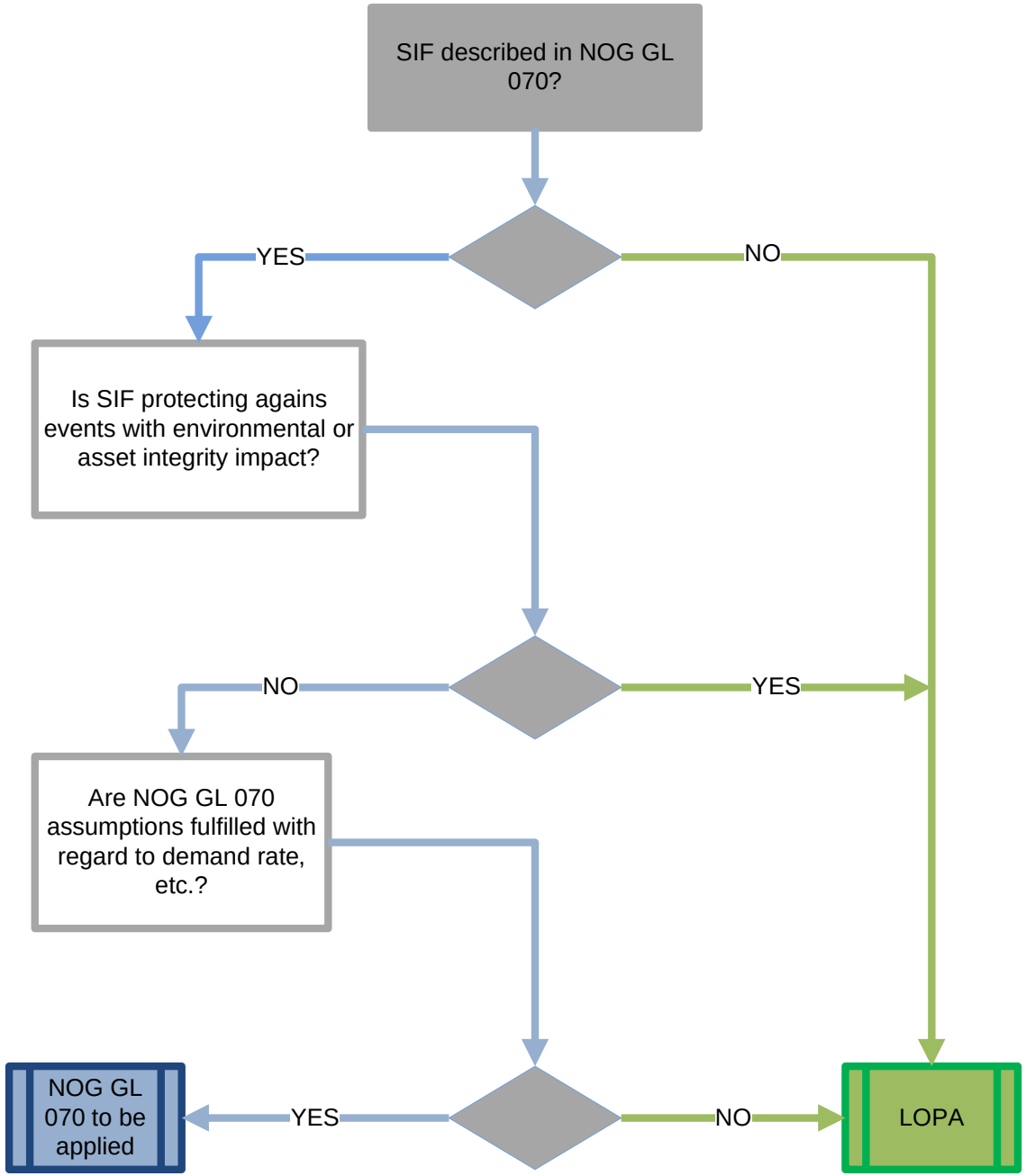
What can Guideline 070 not give us?



Does Guideline 070 suggest how to proceed?

Whereas IEC 61508 describes a fully risk based approach for determining SIL (Safety Integrity Level) requirements, this document provides minimum SIL requirements for the most common instrumented safety functions on a petroleum production installation (ref. chapter 7). Deviations from these requirements may however be identified (ref. section 7.7), and in such case the overall methodology and documentation should be in accordance with IEC 61508.

(Why) do we want to combine the Norwegian Oil and Gas Association’s Guideline 070 with risk analysis for establishing required saferty integrity levels?


SIF described in NOG GL 070?
YES
NO
Is SIF protecting agains events with environmental or asset integrity impact?
NO
YES
Are NOG GL 070 assumptions fulfilled with regard to demand rate, etc.?
NOG GL 070 to be applied
YES
NO
LOPA

Do we get consistent results when combining GL 070 and LOPA?

Safety

Becomes reference for ”important SIL”

Guideline 070

Different from LOPA results?

Financials

Often leads to ”high” SIL!

Consequence?

What is the acceptable frequency?

Environment

Engineers are typically clueless!

Consequence?

What is acceptable frequency?

Acceptable mitigated event frequencies – controlling factor!

- Typically a LOPA can reproduce ”expected” SILs from GL 070
- Requires meaningful numbers to be entered!
- E.g. overpressure in inlet separator
  - Safety, environment or asset protection dominating?
  - What are the acceptance criteria?
- In example we only consider safety – to compare with GL 070!

Overpressure in inlet separator

Initating event	f	IPL1 – Alarm	IPL2 – PSV	IPL3 – F&G	Event probabilty modifier	Ignition prob.	Mitigated event frequency
Blocked outlet	0.1	0.1	0.01	0.01	1	0.1	10^{-7}
Start-up malop.	24	1	0.01	0.01	0.1	0.1	2.4×10^{-5}
Choke collapse	24	1	0.01	0.01	0.01	0.1	2.4×10^{-6}

Acceptance criteria: 10^{-6} events per per year [overpressure leading to gas release with fire/explosion, multiple fatalities]
Redisdual risk: 3.77×10^{-2}

Conclusion: SIL 2 (rounding to integrity level above)

Consequence assessment and choice of categories for severity assessment

Ownership of risk

Operator

- Exposed to risk
- Knowledge of consequences of all categories
- Varying degree of method competence

Engineering

- Moderate exposure to risk (financial)
- Knowledge of consequences to safety and assets
- Varying degree of method competence

Consulting firm

- Very limited exposure to risk
- Knowledge of consequences to safety
- Strong method competence

Effect of poorly chosen consequence categories

- Typical effect: loss of production for a short time is protected with higher integrity than multiple fatalities

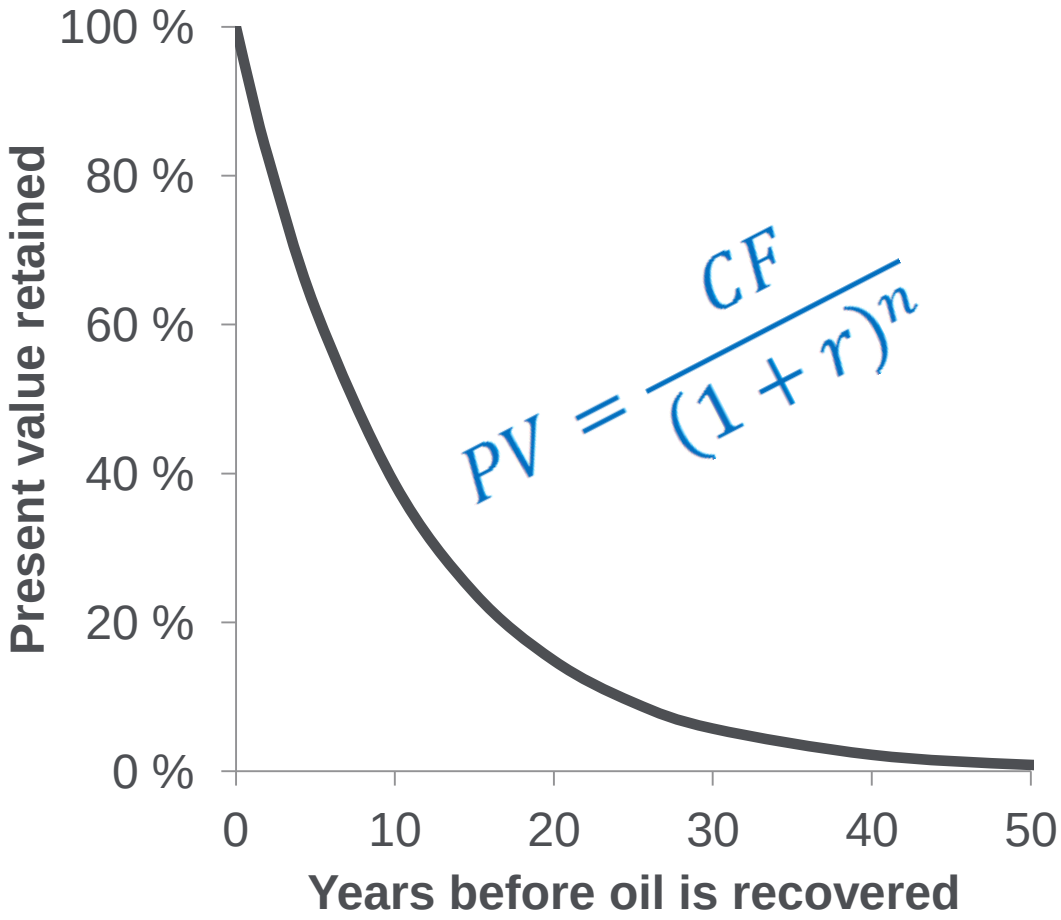
- Environmental concerns are either exaggerated or neglected
  - Engineers cannot assess ecological conseqeunces in workshops
  - Need acceptance criteria engineers can relate to

Financial risk – assessing consequences

- Asset replacement and repairs are limited in cost
- Production downtime worth millions per day
- If grouped in one category – fixed asset cost is rarely dominating

Value of downtime is lost?

- For a long field-life, cost of capital eats up the value in terms of present worth
- With 10% discount factor, a cash flow deferred by 20 years retains only 15%
- For short field life, complete loss of present value is too conservative
- For short field life, asset repair CAPEX may be dominating



Including time value of money?

- Impractical and difficult in workshop
- Consequence in terms of ”practical” descriptions better
- To be adapted to the actual field, project and the operator’s chosen risk profile
- Can only be done by operator!
- Consulting firm can help suggest categories in cooperation with operator!

Suggested practice

- Add both direct asset cost and production value as separate acceptance criteria
- Consider degree of ”undesiredness” up against safety criteria to avoid ”valuing money over people”
- Note that too conservative acceptance criteria on financial risk will typically yield high SIL requirements on water systems!

Cat.	Safety	Fixed Assets	Production downtime
A	Multiple fatalities	Not used	Not used
B	Single fatality	> 100 mill.	> 1 year
C	Lost time incident	20 – 100 mill.	2 months – 1 year
D	First aid injury (minor)	2 – 20 mill	14 days – 2 months
E	Injury not requiring first aid	< 2 mill.	< 14 days

Example only – categories not from actual project – numbers are not meant to be used in real risk assessments

Can somebody please think about the animals?

- Environmental consequences are difficult to assess
- Engineers do typically not have this type of competence
- Consequences often expressed as ”severe damage to environment with more than 10 years of recovery time”

Even more difficult than time-value of money!

Acceptance criteria for environment – oil releases

- Accidents that affect environment are typically due to loss of containment
- It is possible to estimate the amount of hydrocarbons lost
- Oil more problematic than gas
- What about climate gases?

Photo: Wikimedia commons (Exxon Valdez)

Acceptance criteria for the environment – gas releases

- Local ecosystem effects much smaller than oil
- Tend to be completely disregarded as ”not harmful to environment”
- Methane is a potent greenhouse gas – 20 times the effect of CO_2
- Methane accounted for ~9% of human contributed greenhouse gas emssions in the United States in 2011 (Source: epa.gov)

Category	Oil release	Gas release
A	> 500.000 bbl	Not used
B	100.000 – 500.000 bbl	> 12500 tons HC gas
C	20.000 – 100.000 bbl	2500 – 12500 tons HC gas
D	1000 – 20.000 bbl	250 – 2500 tons HC gas
E	< 1000 bbl	< 250 tons HC gas

Suggested type of categorization for environmental impact.
Numbers that engineers can relate to. Note: not intended for actual use.

Inconsistencies

- Unnecessary high ”financial SILs” give extra maintenance cost and work – typically on ”safe” systems
- Erodes trust in safety mangement
- Portrays company as ”money before poeple” – likely in dissonance with visions and stated goals

What can the consulting firm not do?

Who do we assess consequences of undesirable events?

Why is it important to select consistent acceptance criteria?

Summary

How

- Based on pre-defined criteria
- Data dossier must be established as ”firm basis”

Risk

- Operator owns risk
- Consulting firm cannot set RAC

Pitfall

- Inconsistent RAC erodes trust in safety management
- May lead to lack of attention to follow-up in operations

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