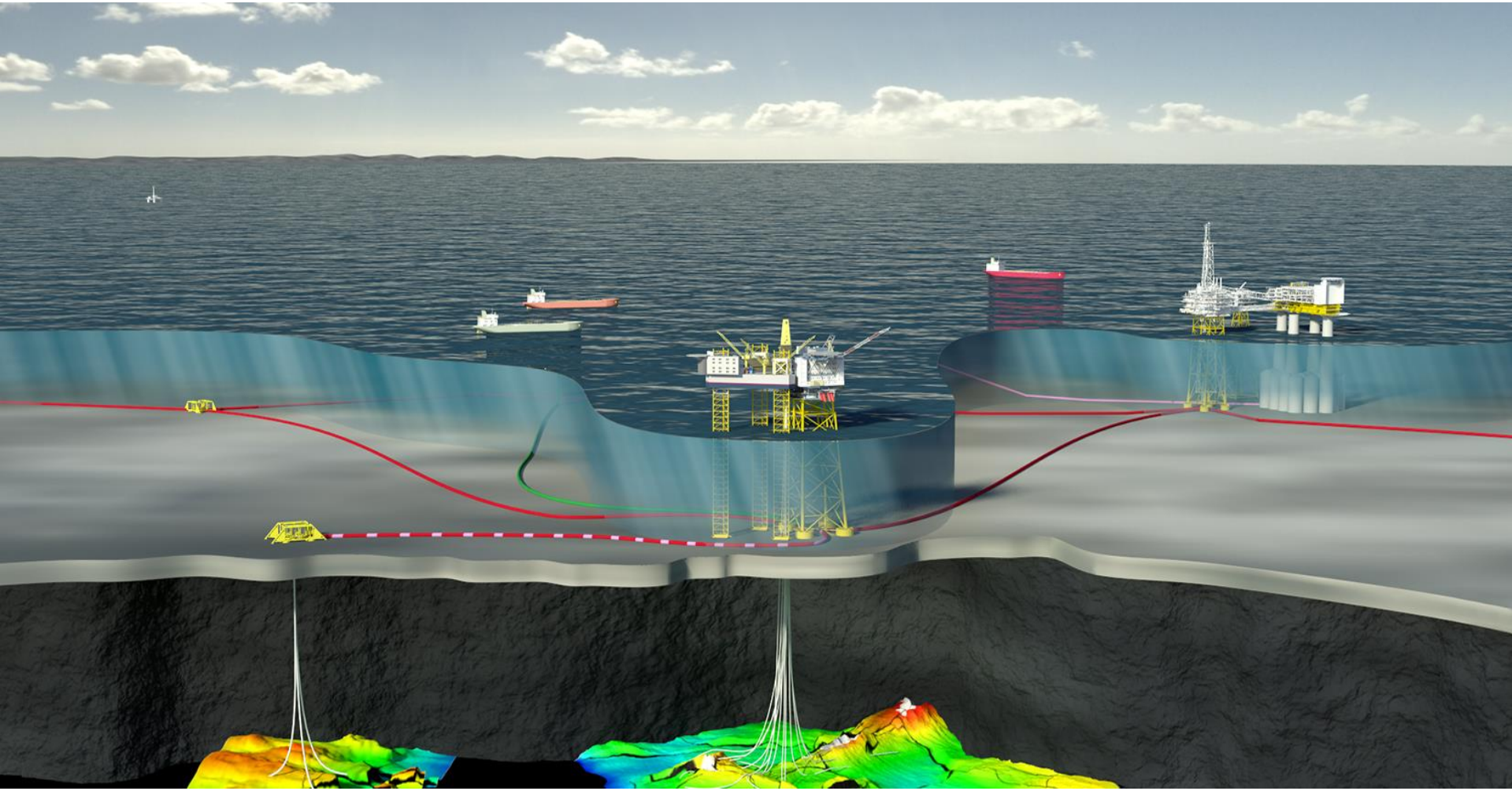
Example from offshore industry

Use of ALARP evaluations for installation of SSIV

Gina Krog field development



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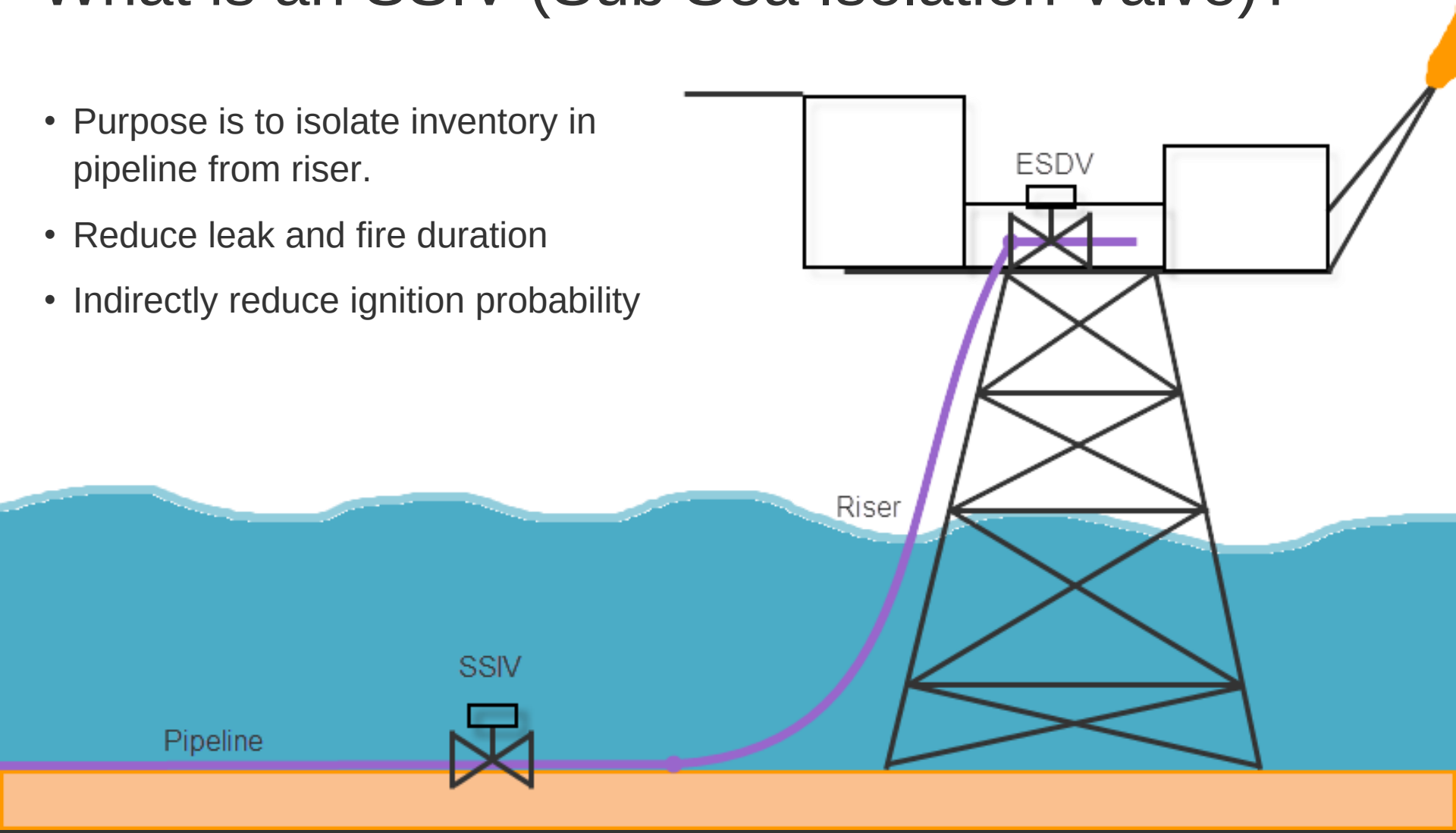
What is an SSIV (Sub Sea Isolation Valve)?

- Purpose is to isolate inventory in pipeline from riser.
- Reduce leak and fire duration
- Indirectly reduce ignition probability



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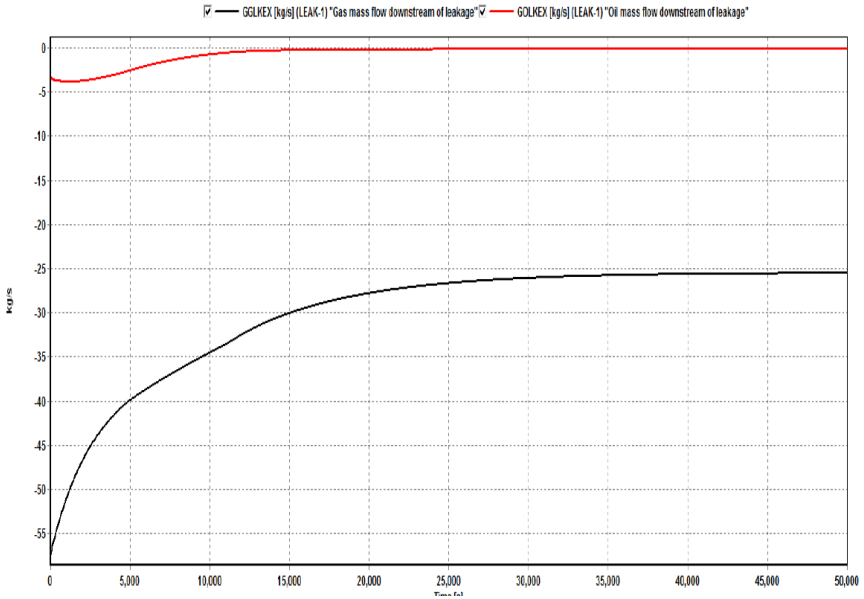
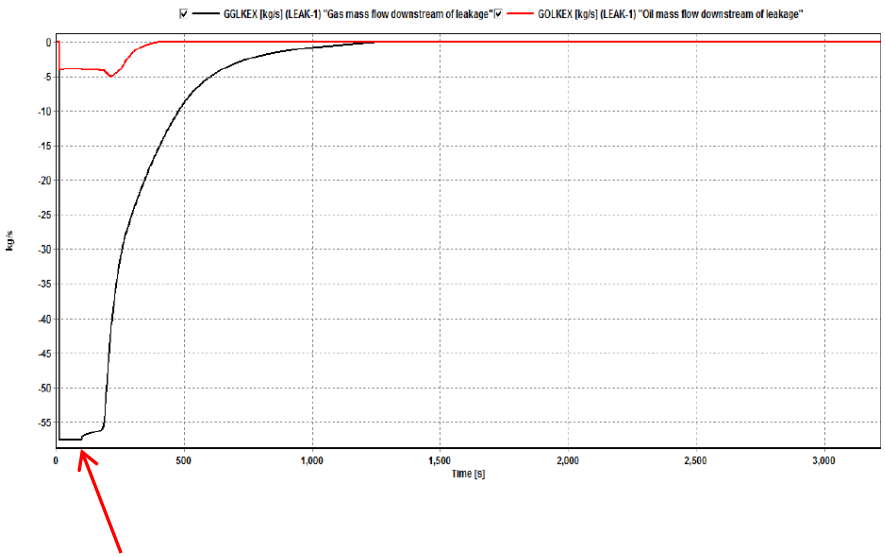
Effect of SSIV



No SSIV

Leak stabilizes at 25kg/s after 12 hours



SSIV closing within 2 minutes

Leak stopped after 20 minutes

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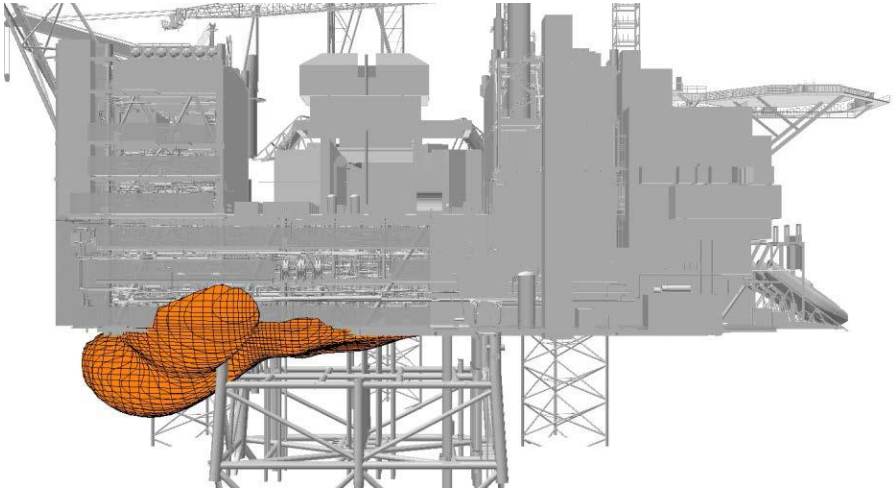
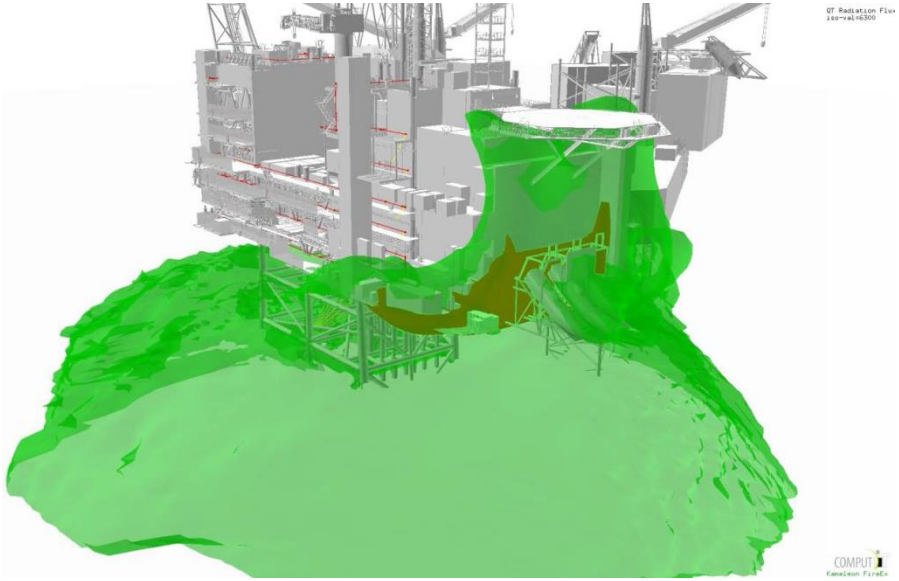
Setting the scene – Riser leak scenario





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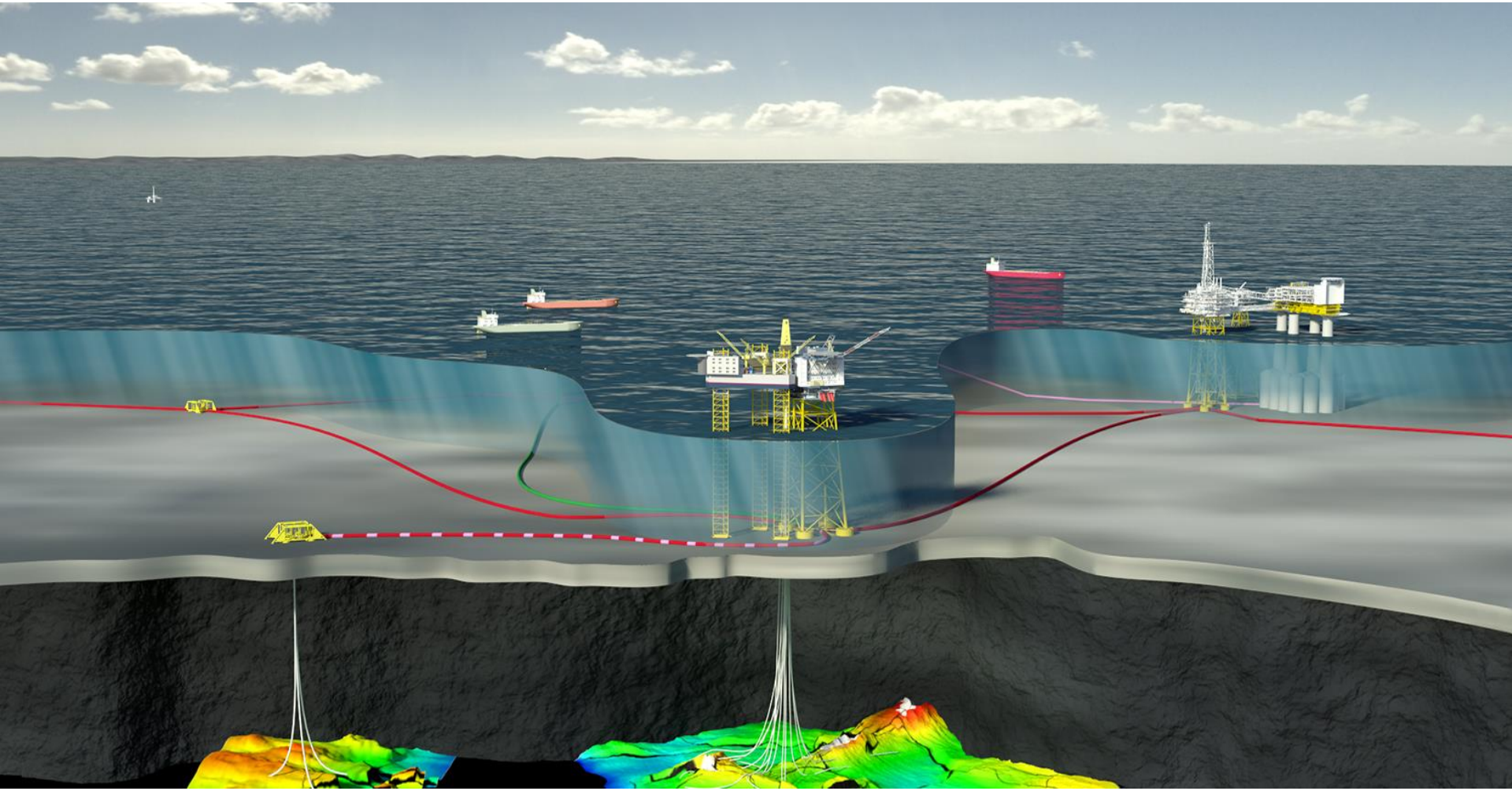
Gina Krog – Where to install SSIV?



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Simplified ALARP methodology

RISK REDUCING MEASURE, TITLE AND REFERENCES			
EVENT / IMPACT, DESCRIPTION			
In case of any leak in the Sleipner pipeline above splash zone, the duration until the leak rate is below 0,1kg/s will exceed 120 min. The fire frequency is 2,66E-05, and the time to escalation to another riser will be in the order of 6 to 8 minutes.			
Impact category for potential event (if measure is not implemented)	8	A - Corresponding cost (see table) (MILL USD)	88 970
RISK REDUCING MEASURE, DETAILS			
Description of risk reducing measures:			
It is suggested to install a SSIV about 250m from the ESDV. The SSIV will most likely stop fires from all large leakages from escalating to other risers, as well as all medium leakages below the splash zone.			
B - Cost estimate (MILL USD)			8,0
C - Payback period (default = 10 år):			30
EVALUATION OF EFFECT OF MEASURE **NB: Choose one of the effects, frequency (probability) reducing or impact reducing, depending on the most important effect of the measure**			
FREQUENCY REDUCING		**IMPACT REDUCING**	
D1 - Reduction in frequency (%)	0,55 %	D2 - Reduction in impact (MILL USD - see table):	

ALTERNATIV A: RISK BASED APPROACH	
f - Frequency of event if measure is not implemented (frequency per year)	1,86E-05
E Corresponding saved cost due to risk reduction (mill USD)	0,271678753
COST/BENEFIT	
RESULT (this is an automatically generated result based on input)	**Reject**
RESULT (PROPOSED CONCLUSION):	

- Background for proposal and corresponding accident cost
- Proposal for, and effect of risk reducing measure
- Proposed result from simplified ALARP calculation

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Sensitivity studies performed by Safetec

- Fire frequency for ignited riser events: 3,92E-05 (1/year)
- Extra equipment needed for SSIV is evaluated to have no effect on ignition frequency, SSIV will have a negligible effect on leak frequency.
- Leak duration is mainly reduced from >120min to:

Size category	Sleipner pipeline	Sub Sea field pipeline
Small	>120 min	47 min
Medium	13 min	4 min
Full rupture	1 min	30 sec

- Time to escalation is calculated, and escalation will occur within roughly **6** minutes in a jet-fire scenario, and roughly **8** minutes in a pool-fire scenario.

- Without SSIV, frequency of impaired Muster Area (or Evacuation) is 1,862E-05
- SSIV on Sleipner pipeline will reduce this frequency to 1,851E-05 (**0,55%**)
- SSIV on subsea import pipeline will reduce this frequency to 1,616E-05 (**13,21%**)

Results from simplified ALARP evaluation

SSIV Gas export to Sleipner (GK side)

Impact category for potential event (if measure is not implemented)	8	A - Corresponding cost (see table) (MILL USD)	88 970
B - Cost estimate (MILL USD)			8,0
D1 - Reduction in frequency (%)	0,55 %	D2 - Reduction in impact (MILL USD - see table):	
E Corresponding saved cost due to risk reduction (mill USD)			0,271678753
RESULT (this is an automatically generated result based on input)			**Reject measure**

SSIV Sub Sea field flowline to GK

Impact category for potential event (if measure is not implemented)	8	A - Corresponding cost (see table) (MILL USD)	88 970
B - Cost estimate (MILL USD)			8,0
D1 - Reduction in frequency (%)	13,21 %	D2 - Reduction in impact (MILL USD - see table):	
E Corresponding saved cost due to risk reduction (mill USD)			5,470162072
RESULT (this is an automatically generated result based on input)			**Reject measure**

As Low As Reasonably Practicable

Significant uncertainties:

- Quantifiable uncertainties:
  - Accident cost
  - Equipment cost
  - Accident frequency
  - Effect of risk reducing measure
  - Escalation probability
- Qualitative uncertainties:
  - Risk related to installation of SSIV
  - Cost of testing
  - Maintenance cost
  - Perceived risk

As Low As Reasonably Practicable

What is corresponding accident cost?

Stormy weather: BP's stock hits new low

By Paul Tharp June 26, 2010 | 4:00am

Meanwhile, investors saw their holdings in BP shrink another 6 percent yesterday, as shares slid to $27.02, or nearly 54 percent this year.

http://nypost.com/2010/06/26/stormy-weather-bps-stock-hits-new-low/

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As Low As Reasonably Practicable

What is the cost of equipment?

Kostnad for tre livbåter fra 40 mill. til 1,5 mrd

Se det elleville regnestykket her.

OLJE OG ENERGI 09.10.2014 08:31 Av Glenn Stangeland

http://www.sysla.no/2014/10/09/oljeenergi/kostnad-for-tre-livbater-fra-40-mill-til-15-mrd/

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As Low As Reasonably Practicable

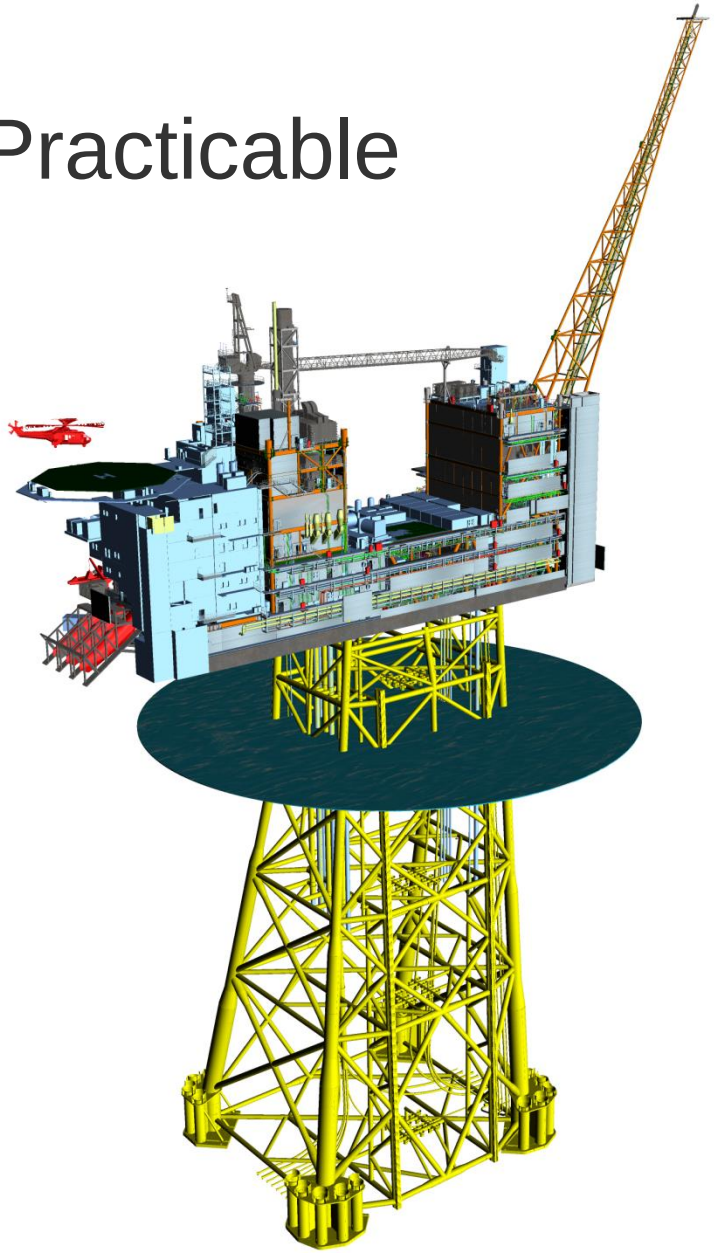
Validity of risk evaluation?

- Accident frequency
  - Frequency for loss of main safety function
- Effect of risk reducing measure
  - Measured for main safety function with largest reduction
- Probability for escalation

As Low As Reasonably Practicable

Qualitative uncertainties

- Risk related to installation of SSIV
  - Does all the risk parameters decrease?
- Cost of testing
- Maintenance cost
- Perceived risk



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Key learnings

- Risk analyses are nothing more than input to decisions
- No risk evaluations are better than your input data.
- No tools can outmanoeuvre the effect of common sense
- Remember to test your uncertainties

There's never been a better time for good ideas

Use of ALARP evaluations for installation of SSIV

Kjetil Skarestad
Sr. Engineer Technical Safety
Gina Krog Field Developmen Project

www.statoil.com

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