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DP operated floatels – Risk Management and Tecnology Development

ESRA Seminar kollisjonsrisiko

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Content

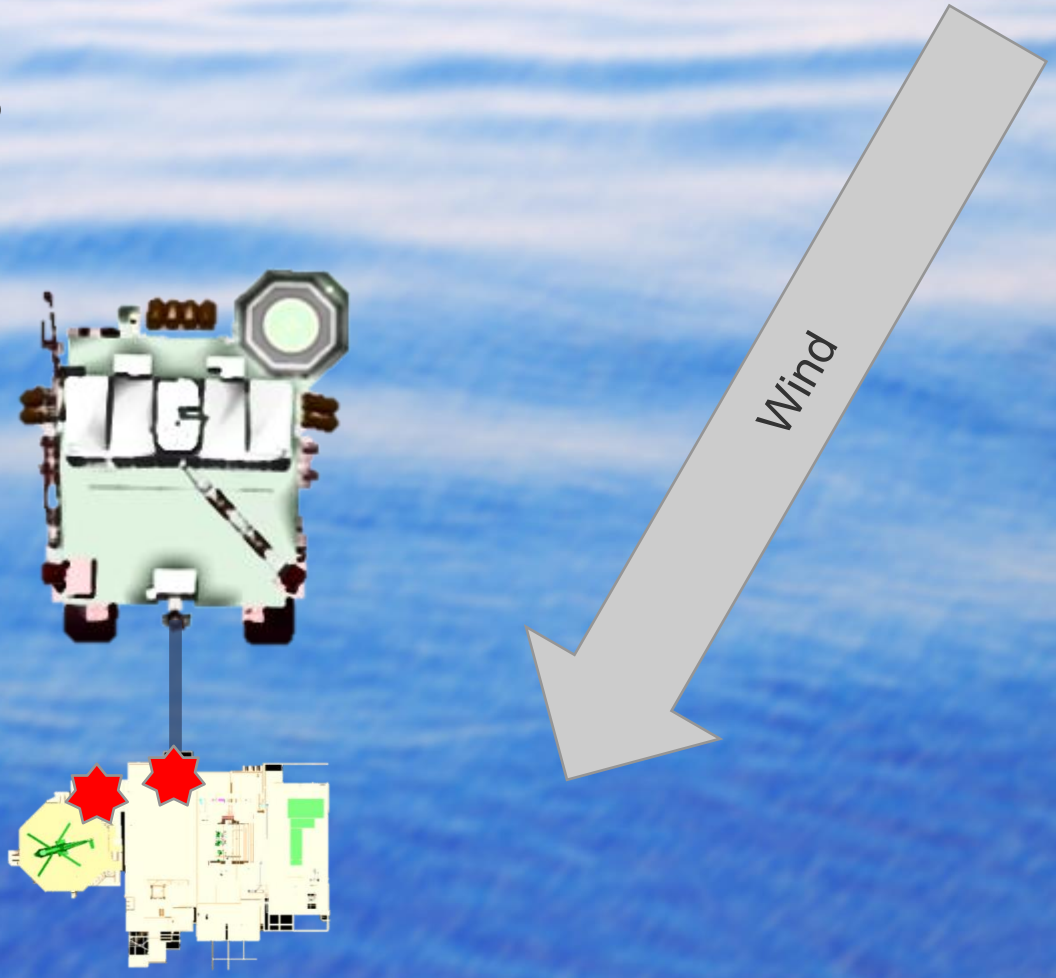
1. Introduction to the concept of DP operated flotels
2. Risk decription
3. Technology development
4. Risk reducing measures
5. Concluding remarks

1) Introduction to the concept of DP operated flotels

DP failure modes

«DRIFT-OFF»

- Loss of thrust due to blackout
- Motion and path of vessel determined by external environmental forces



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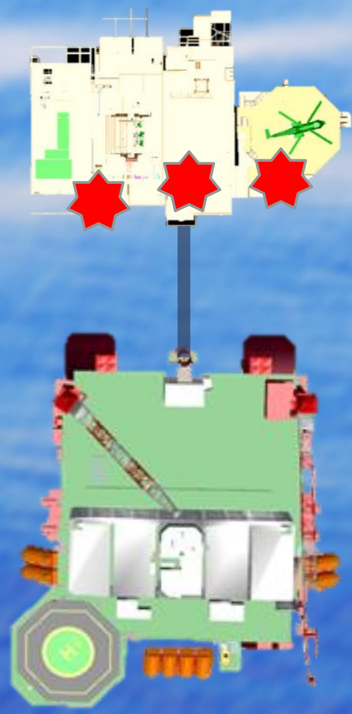
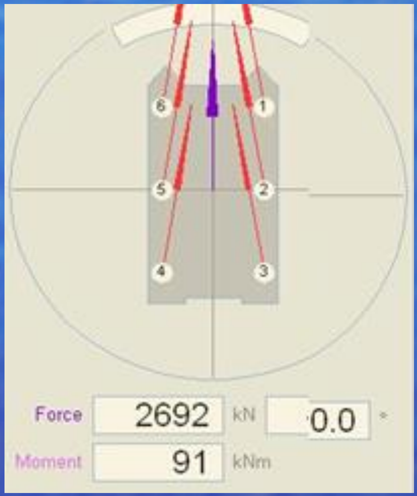
DP failure modes

«DRIVE-OFF»

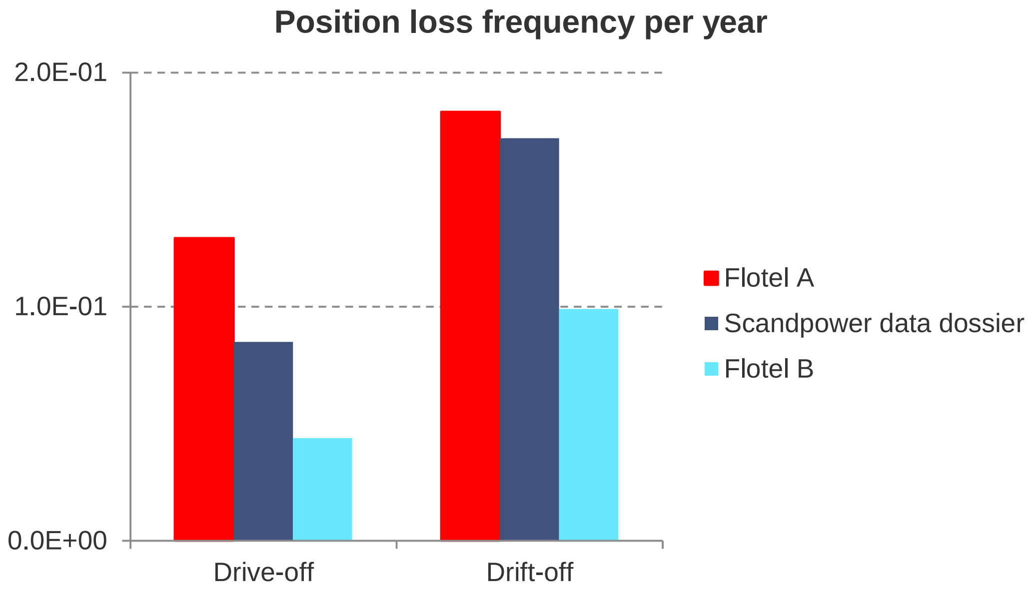
- A situation where the vessel is driven off position





2) Risk decription

DP operations adjacent to installations – The challenge



Floater with a large mass + large available thrust + DP positioning + adjacent to an installation

- <u>All</u> DP-systems have an inherent risk for loss of position – drive-off or drift-off
- TAM is not specified for winter season on the NCS
- Given a drive-off scenario, successful intervention from the DP-operator is the **only** barrier

Floatel Superior @Njord A (2012)

PSAs challenge to the industry January 2011

- Ptil: [Risiko for kollisjoner med besøkende fartøyer]

Ptil forventer at det skal være et rimelig samsvar mellom utførte kollisjonsanalyser og faktiske opplevde kollisjoner på innretningene på norsk sokkel. Gode kollisjonsanalyser vil ikke øke sikkerheten dersom de kun blir en akademisk øvelse.

Vurderte risikoanalyser har i liten grad behandlet kollisjoner med besøkende fartøyer i detalj. Flere feilmodi er ikke identifisert eller analysert. Analysene er lite brukt som grunnlag til å redusere risikoen. Her ser vi behov for forbedringer.

DP risk assesment – An example

An example on evaluation of drive off scenarios in a quantitative risk analysis:

A: Drive off frequency based on historical data (DP2&DP3): 0.1 pr year on DP

B: Improvement factor due to latest generation equipment and robust sensor setup: 10

C: Probability for operator not intervening successfully: 0.1

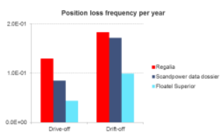
D: Probability for drive off towards nearby installation: 0.25

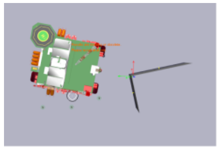
E: Probability for high energy collission (> 14 MJ): 0.1

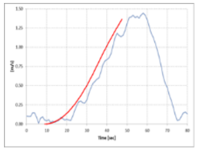
- Probability for high energy collission due to drive off:
  - $P = A \times 1/B \times C \times D \times E = 2.5\ 10^{-5}$
  - This corresponds to a return period of 40 000 years
- **Conclusion**: Below ALS cut of level– No need to assess possible consequences

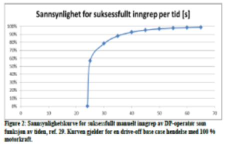
Task Force : Elements to be adressed in a QRA

Suggested elements to be adressed in a QRA

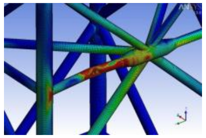


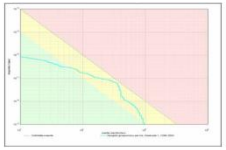


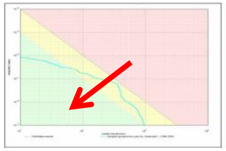




$$E = \frac{1}{2}\frac{M}{1000}kV^2 \text{ [MJ]}$$





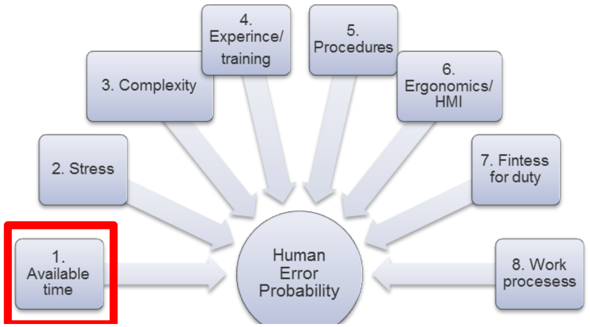


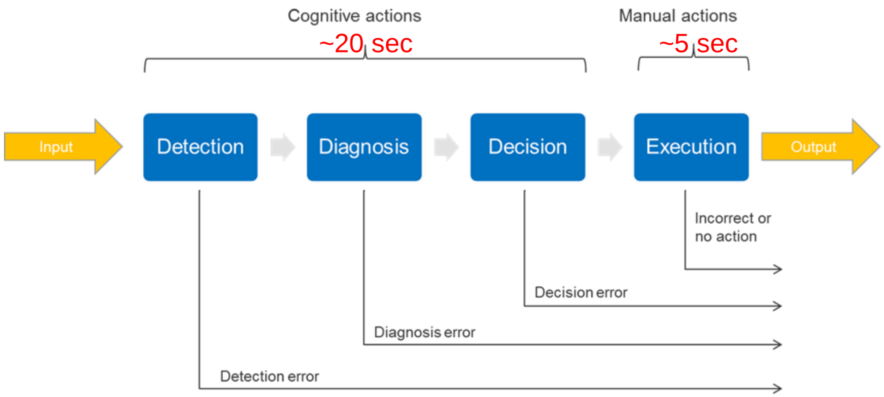
1 Drive-off/Drift-offFrequencies	2 Positioningmatrix	3 Flotel respons curves	4 Intervention by DPO	5 Impactscenarios Collisionenergies	6 Structuralcapacity	7 Risk = f (**P**, **C**) RAC	8 Uncertanties Risk reductionmeasures ALARP

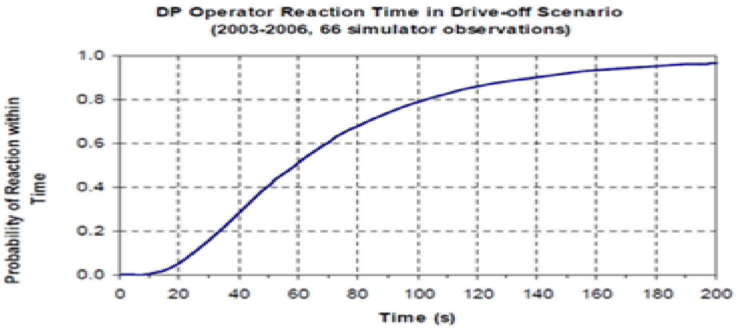
1. Assess position loss (i.e. drive-off and drift-off) frequencies
2. Establish vessel positions at the installation and regularity related thereto
3. Establish speed of impact in case of drive-off and drift-off
4. Assess probability of successful operator intervention in case of drive-off and drift-off
5. Define collision scenarios and compute collision energies related to drive-off and drift-off
6. Establish installation's capacity against collision
7. Perform quantitative risk analysis
8. Identify sensitivities and mitigating actions according to ALARP

DP operator as safety barrier?

- Probability of human error = ?
- Human reliability analysis
  - SPAR-H (Standard Plant Analysis Risk - Human Reliability Analysis) - suitable for control room tasks
  - Fundamental problem: Monitoring for extraordinarily rare deviations – task poorly suited for humans. Low probability for intervention to avoid collision at drive-off.
  - Time available before collision has largest influence on the probability for adequate intervention

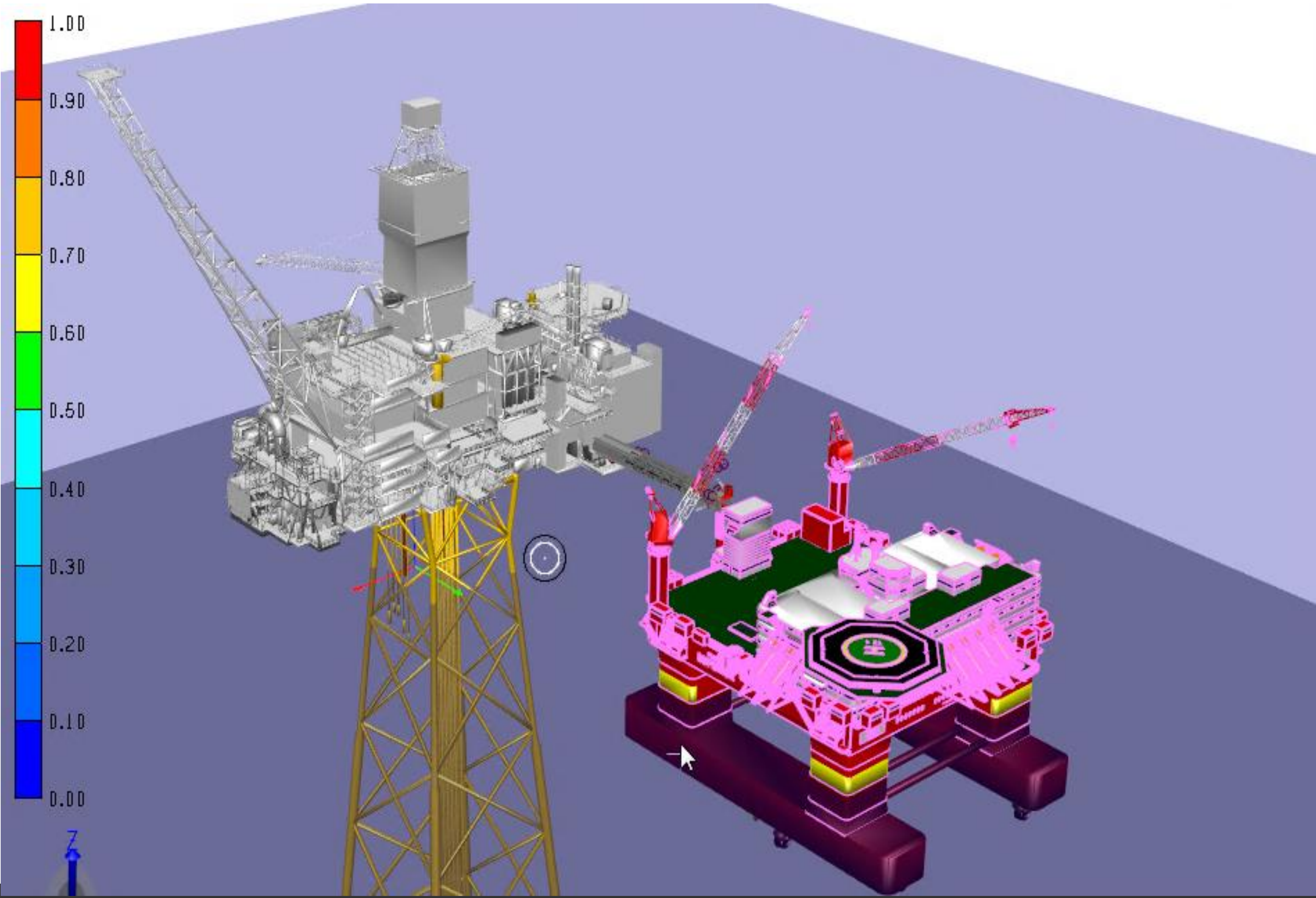




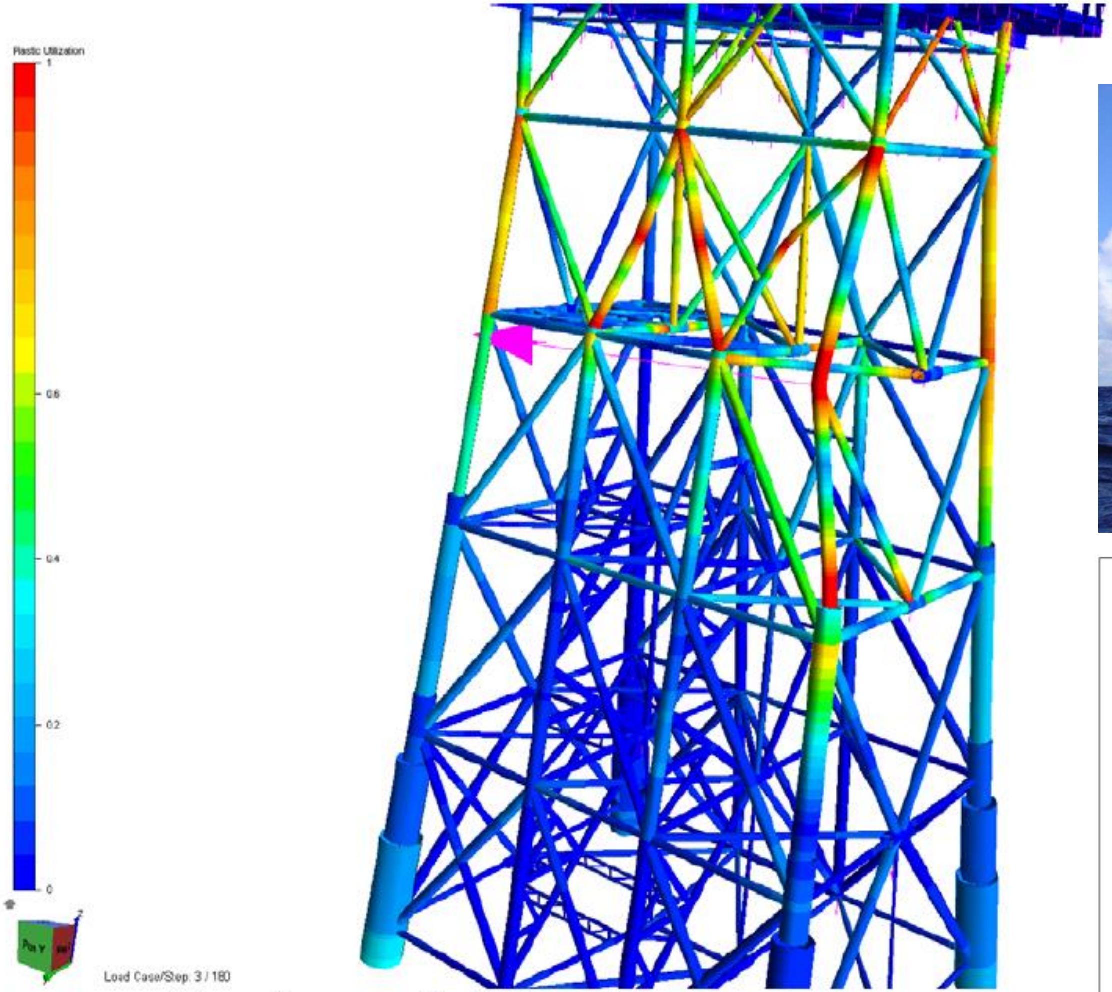


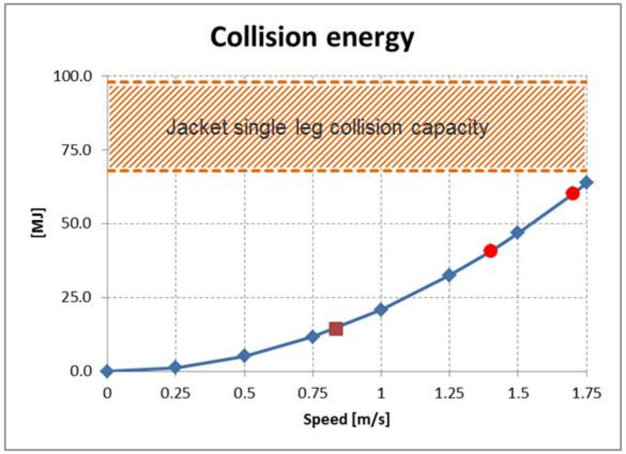
H. Chen, T. Moan (2004), Probabilistic modeling and evaluation ofcollision between shuttle tanker and FPSO in tandem offloading, Reliability Engineering andd System Safety 84, pp.169-186

Time is the critical factor, but the risk may be reduced by increased training, better procedures and better HMI


1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Z

Collission vs jacket



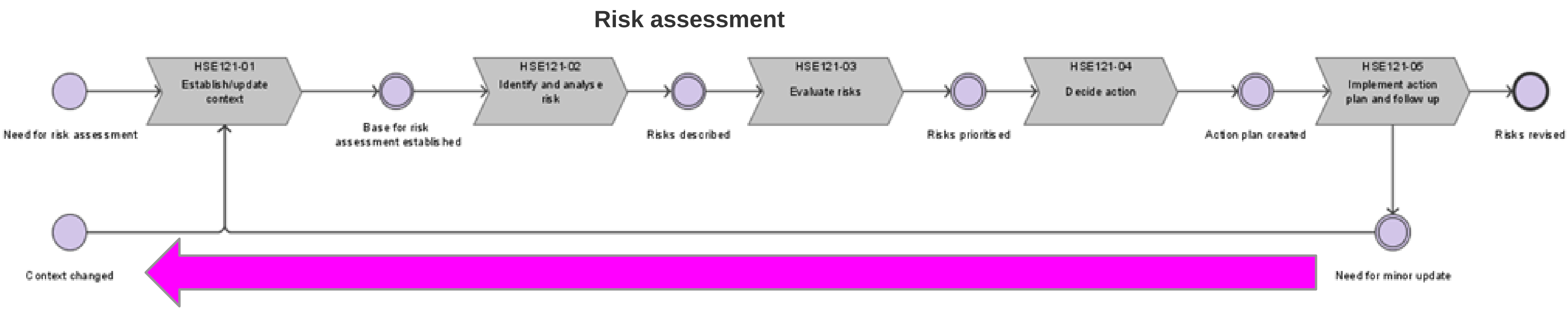


Major accidents as a consequence of collission
A scenario to be taken seriously

Mumbai High: 27. July 2005:
A Multi Purpose Support Vessel collided with and penetrated a gas export riser that immediately ignited. After two hours little remained of the host installation. 11 people confirmed dead and 11 missing.

4) Technology development

Risk management process



- DOP (drive-off preventor)
- Passive barrier feasibility study
- Operator reliability verification study

Technology development

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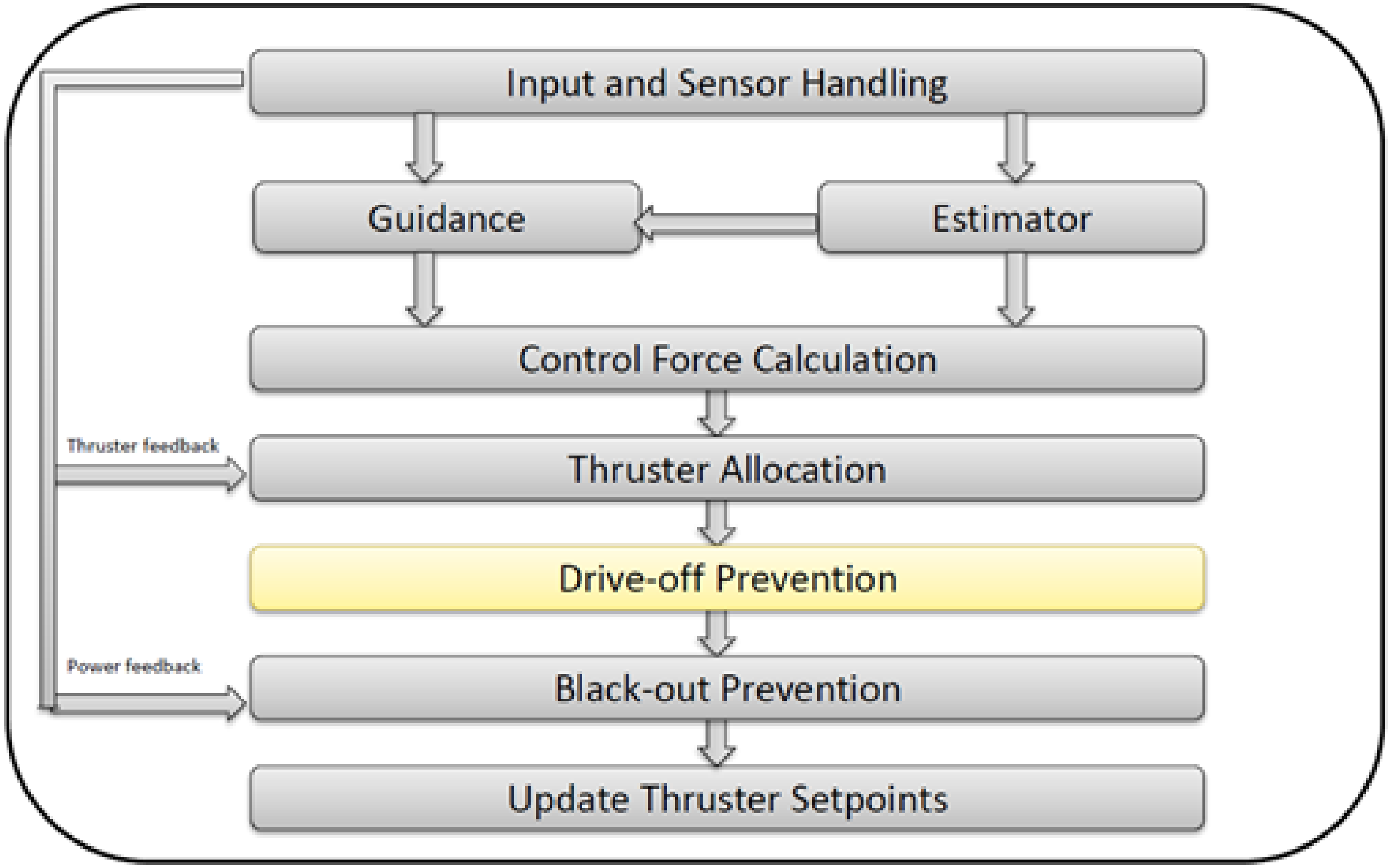
DP Software



Input and Sensor Handling
Guidance
Estimator
Control Force Calculation
Thruster feedback
Thruster Allocation
Drive-off Prevention
Power feedback
Black-out Prevention
Update Thruster Setpoints

Impact on drive-on collision frequency

- Probability of «failure-on-demand»
  - Base case = 10^{-1}
  - Lower limit = 10^{-2}

- Drive-off collision frequency scales with PFD

- Risk analysis utilizes PFD = 10^{-1}

5) Risk reducing measures

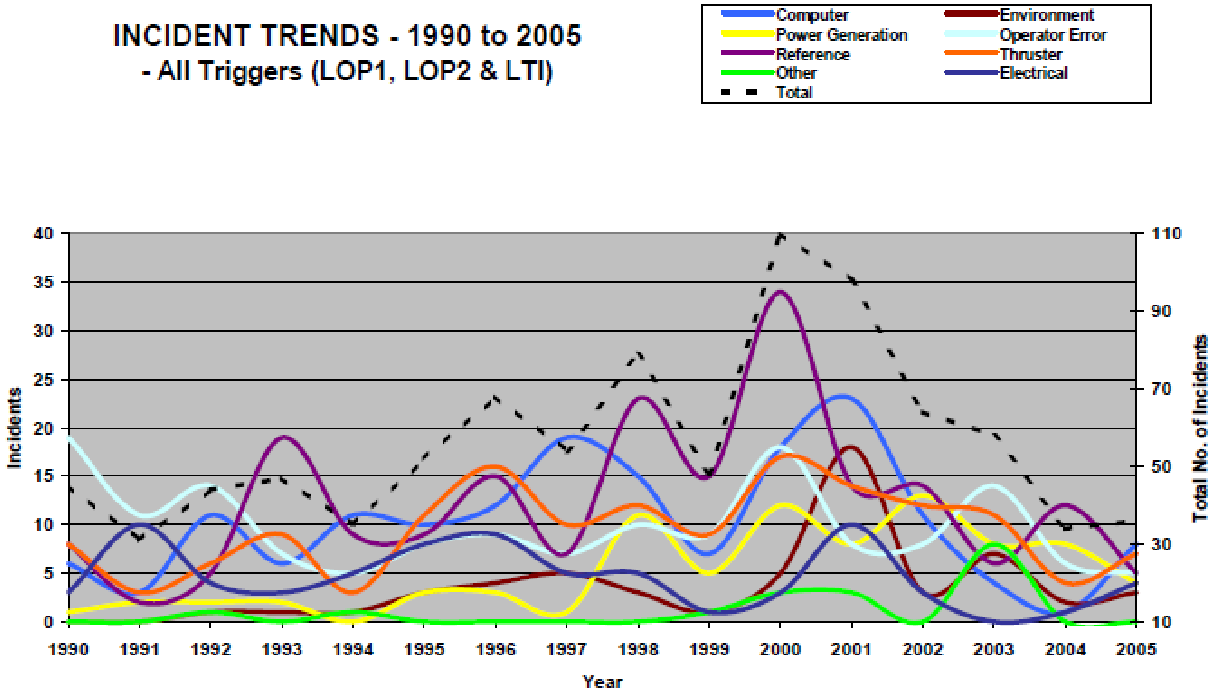
Some examples

Mitigating action	Risk reducing effect
Operational restrictions	Reduces probability for loss of position collisions
Alternative bridge balcony platform	Reduces probability for drift off collisions
Water filling of ballast compartment in collission zone	Avoid loss of stability as possible consequence
Restriction in allowable positions for DP vessel	Avoid expose of sensitive structure or equipment to collission
Automatic drive off arrest (DOP – «Drive off preventor»)	Avoid critical drive off to develop
Utilize Poosmor ATA (thruster assisted mooring)	Physical passive barrier (reduces loss of position frequency)

6) Concluding remarks

Position loss risk

- Position loss risk is intrinsic to all DP systems
  - Drive-off
  - Drift-off



Remarks

- DP technology is a source of opportunity
  - When used right it provides us with a flexible platform from which we can do our operations
- The risk is not negligible even if the following are in place:
  - Latest generation of DP technology
  - Redundancy (i.e. DP2 or DP3)
  - Competent personnel
- Incidents happens
- Risk awareness

There's never been a better time for good ideas

THANK YOU

QUESTIONS ?

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