# Risktec Solutions

risk management and assessment for business

## Quantifying the HSE Risk of Underbalanced Drilling Operations –

## A Comparison with Conventional Drilling Operations

Presentation to Society of Petroleum Engineers – Underbalanced Drilling:
From Niche to Universal Adoption
Dubai, UAE, 4th – 6th February 2013

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# Agenda

- What is Quantitative Risk Assessment (QRA)?
- Why quantify risk?
- QRA UBD case study
- Limitations and uncertainties
- The way forward
- Final thoughts

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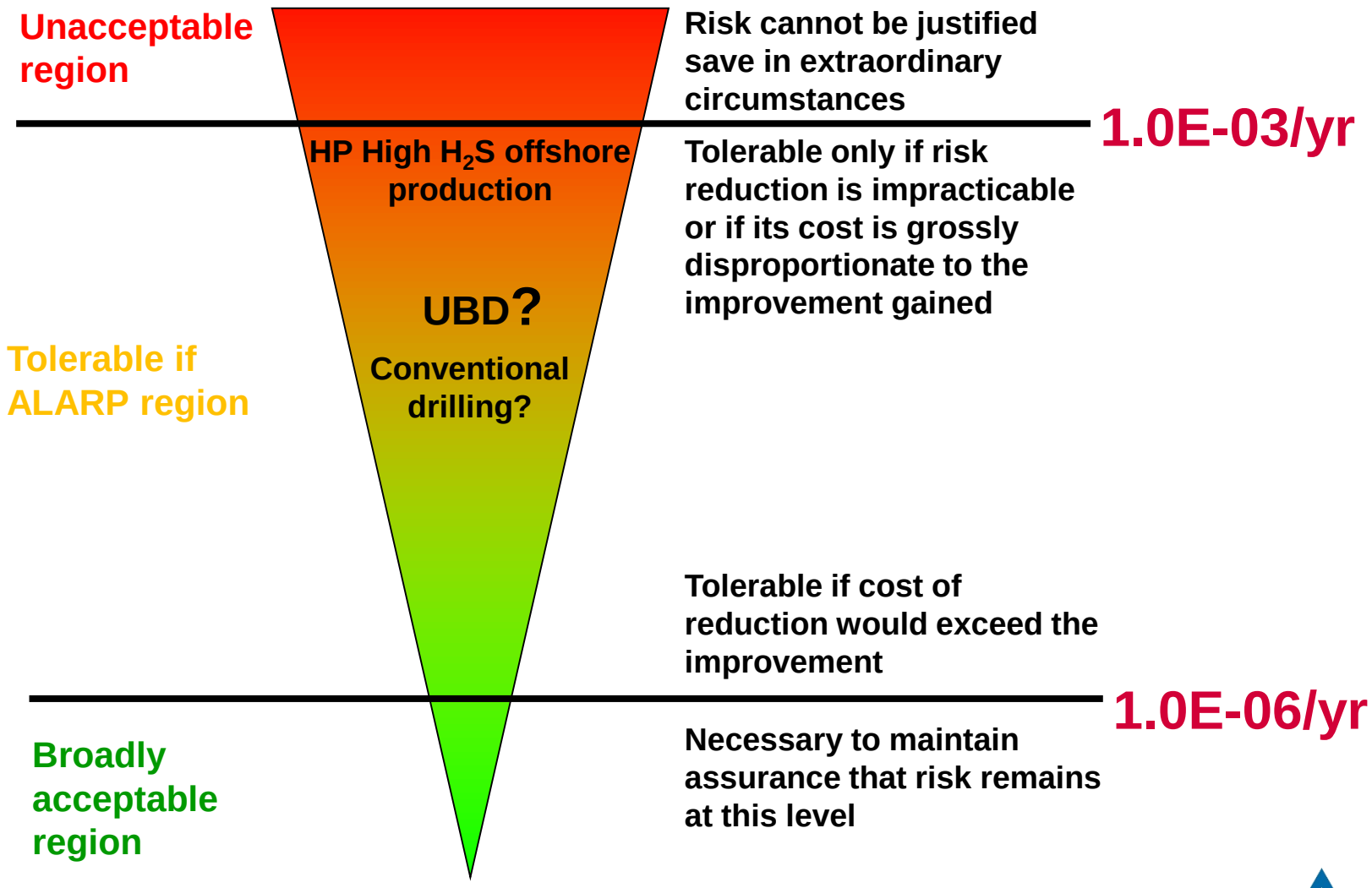
# What is QRA?

- A tool for determining the risk level associated with a facility or process.
- Can be defined as the formal and systematic approach to identifying hazards, potentially hazardous events, and estimating the likelihood of incidents and consequences to people, environment and assets developing from these events.
- Allows for the comparison of risk reduction options for a particular hazard on an equivalent basis, as well as allowing for the comparison of risks that are generated from separate and unique hazards.
- Output allows comparison of the assessed risk levels against regulator, company or industry risk acceptance criteria.

# Risk Tolerability Framework

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**32 people work for 32 years**

**If one dies during those 32 years due to an accident at work:**

**IRPA = 1 x $10^{-3}$**

***Intolerable!!***

**How many people do you work with?**

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# Quantitative versus qualitative

QRA may be appropriate when:

- High risk exposures
  - People
  - Strategic asset value
- Comparisons of options required
- Risk reduction not obvious
- Escalation possible
- Novel technology
- Demonstration needed

**Quantification may be mandated by legislation**

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# Conventional thinking…

- Removal of primary barrier (mud column)
- Hydrocarbons under pressure at surface
- Increased number of people on location (rig crew, service company personnel)
- Simultaneous drilling and production

= Increased risk

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# A different view…

- Improved kick detection
- Active management of pressure profile
- Faster response to influx where the closed system acts as a mode of *initial* well control prior to activating the BOP's

=

Reduced blowout frequency / reduced risk

**Can we quantify this?**

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# Case Study

- Study: Offshore UBD Project – QRA for Re-Injection of Native Crude Oil
- QRA Objectives: Quantify the HSE risk for 3 options : i) water injection through rig pumps (base case); ii) reinjection of native crude through auxiliary pumps on main deck; and iii) re-injection of native crude through rig pumps.  Simultaneous natural gas re-injection also considered for all 3 cases.
- General Assumptions: Based on generic leak frequency data, assumed RCD leak frequency 150% of leak frequency for conventional BOP.
- Limitations: Excluded UBD separators and atmospheric storage tanks.
- Result: UBD base case (water as drilling fluid) has the lowest overall contribution to risk, but  the risk associated with re-injection of crude oil is also demonstrated to be very low. Final selection of the drilling fluid should also take into account the technical issues for both options. If crude oil is used, recommended that re-injection is via an auxiliary pump skid mounted on the main deck of the drilling rig and not via the rig pumps. Gas injection is the major risk contributor.
- Recommendations: Using $N_2$ rather than natural gas would result in a significant risk reduction for both the UBD base case and crude oil re-injection options. Recommended that the technical and economic feasibility of this is investigated further.

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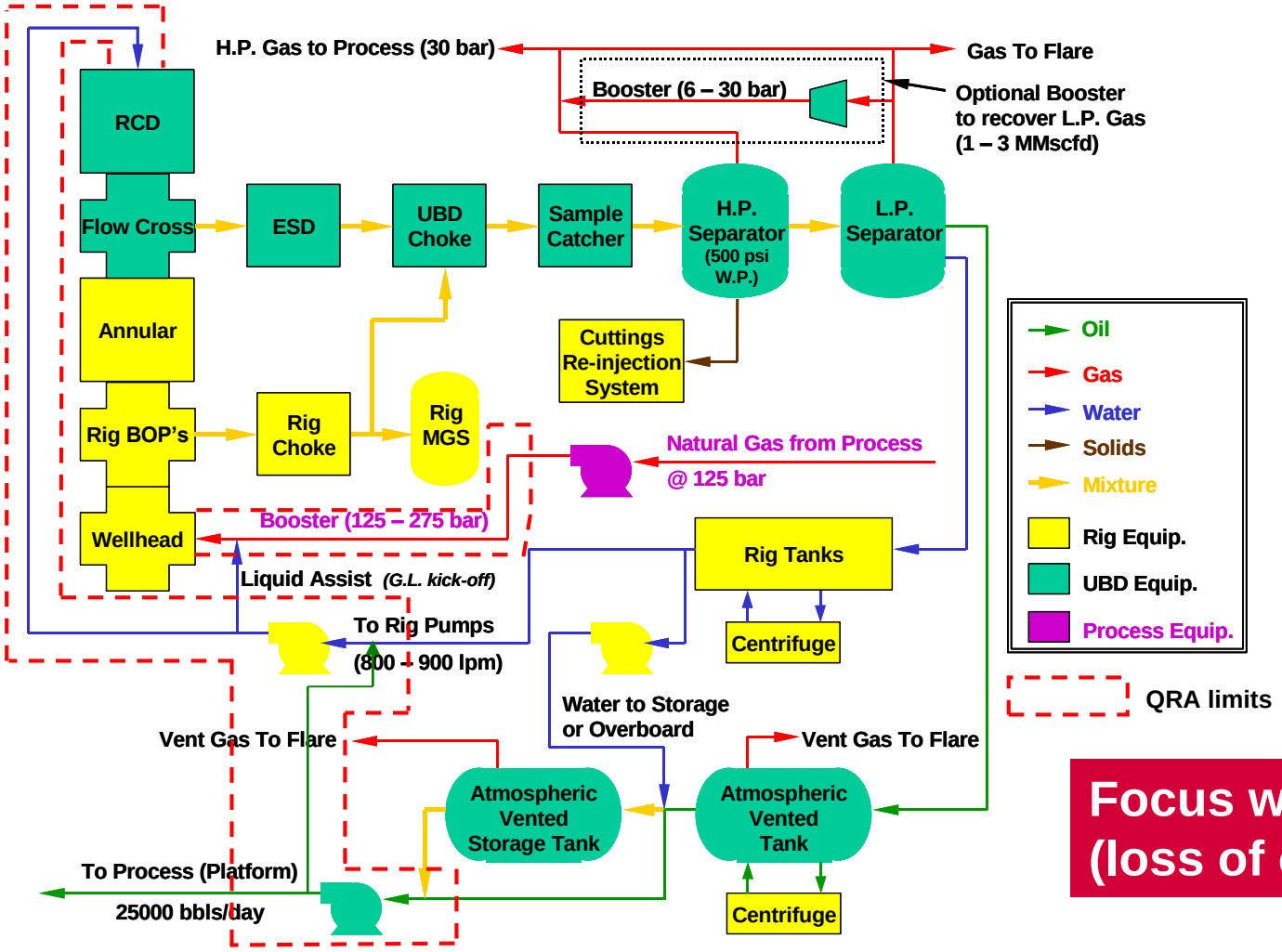
# Case Study – Process Schematic and QRA limits




**Focus was on quantifying the process (loss of containment) risk for each option**

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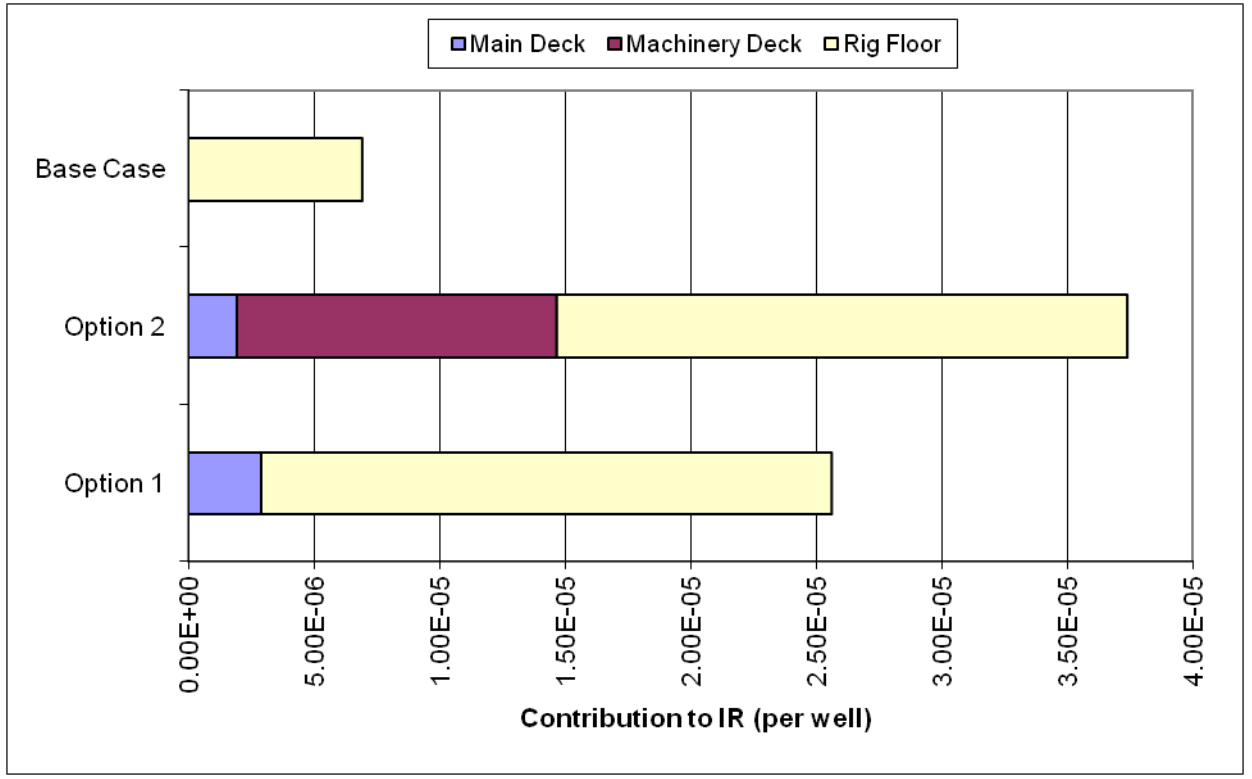
# Case Study

## Comparison of Risk Levels for UBD Options

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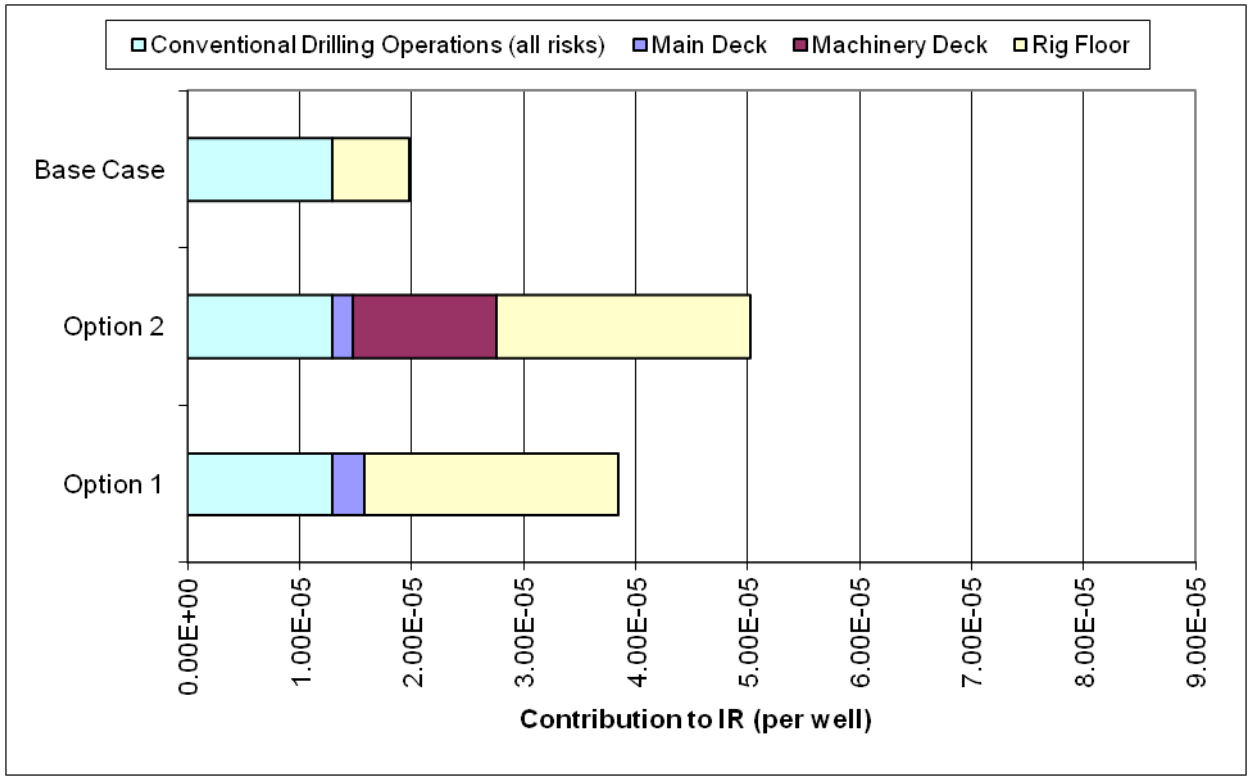
# Case Study

## Incremental Risk for UBD Options

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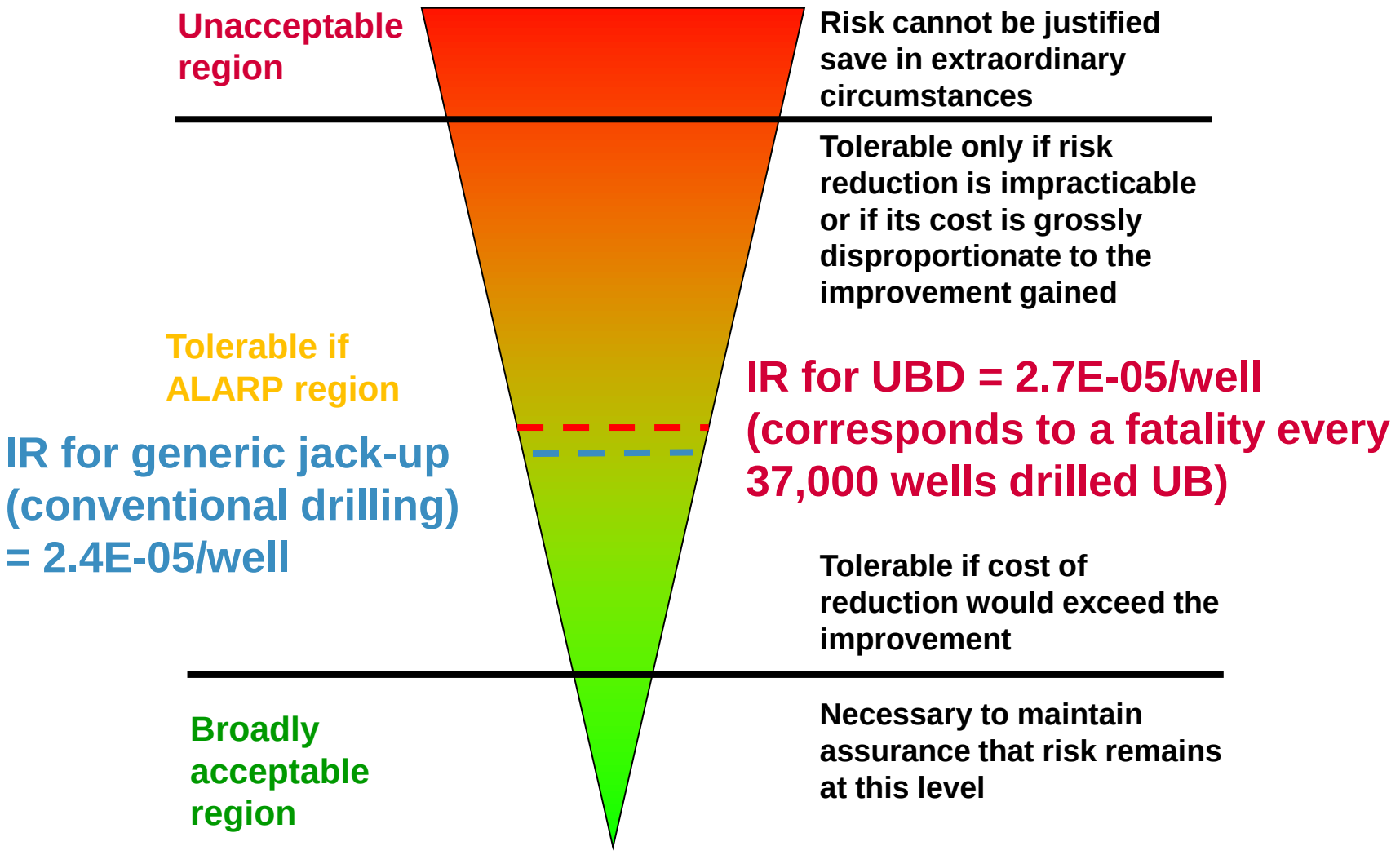
# Case Study

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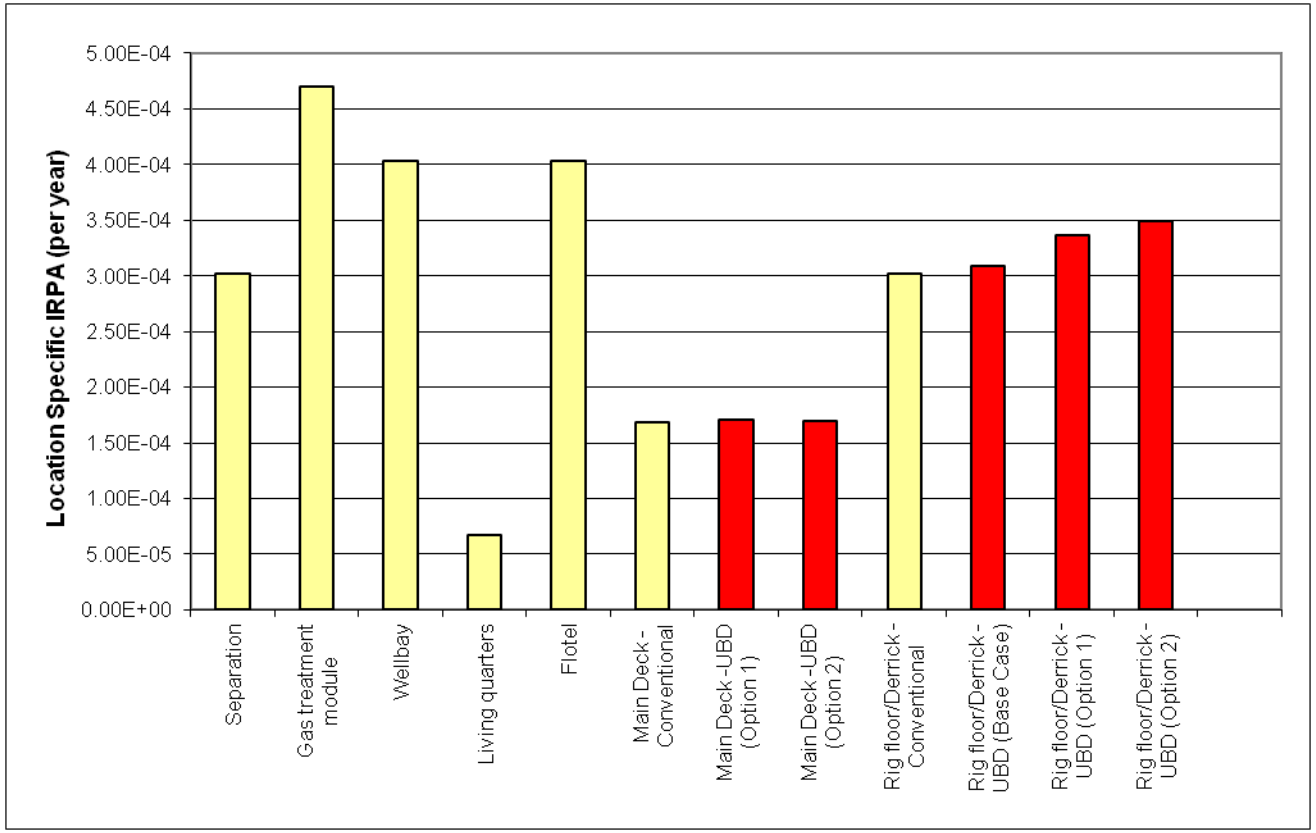
# Case Study

## Comparison of UBD Operations against example offshore risks

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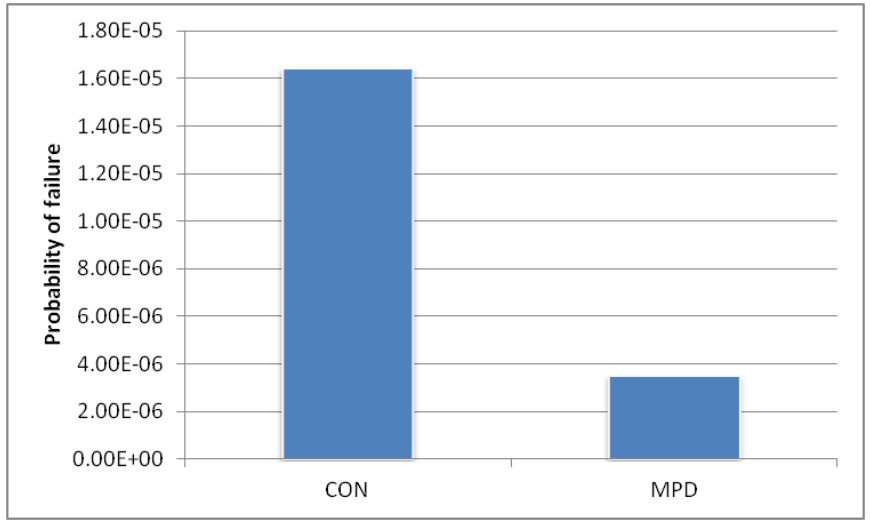
# But with better data…

- Probabilistic analysis demonstrates probability of blowout significantly less for MPD (SPE/IADC 156893)
- Statistical analysis demonstrates that frequency of blowout reduced by 90% by use of RCD (SPE 115483)




Adapted from SPE/IADC 156893

**Better UBD incident data = more accurate QRA studies**

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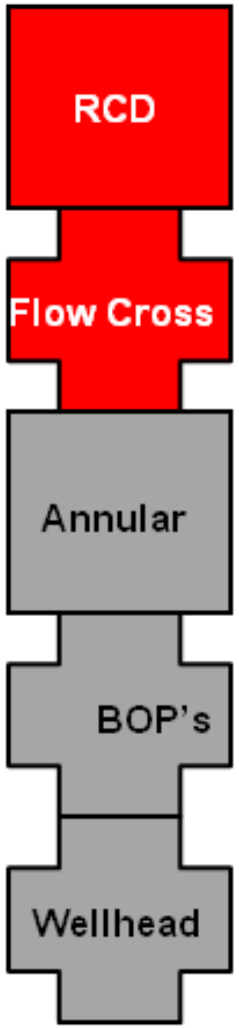
# RCD failure data




Statistical and probabilistic analysis (SPE/IADC 156893, SPE 115483, SPE/IADC 91242)

Comprehensive industry failure databases (OGP, HSE, SINTEF)

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# The way forward…

- Develop comprehensive UBD/MPD equipment failure database
- UBD/MPD blowout/well release frequency analysis based on historical incidents
- Further statistical/probabilistic analysis of RCD, including Failure Mode & Effects Analysis
- Wider adoption of QRA techniques to compare risk of UBD/MPD and conventional drilling operations

# Final thoughts

Are we asking the right question?

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# Thank you for your attention

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