# Asset Integrity Management

*Significant Issues*

*IRF Perspective*

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# Presentation Overview

1. Process Safety
2. Life Extension of Aging Assets
3. Well Integrity
4. Marine/Platform or Rig Interfaces

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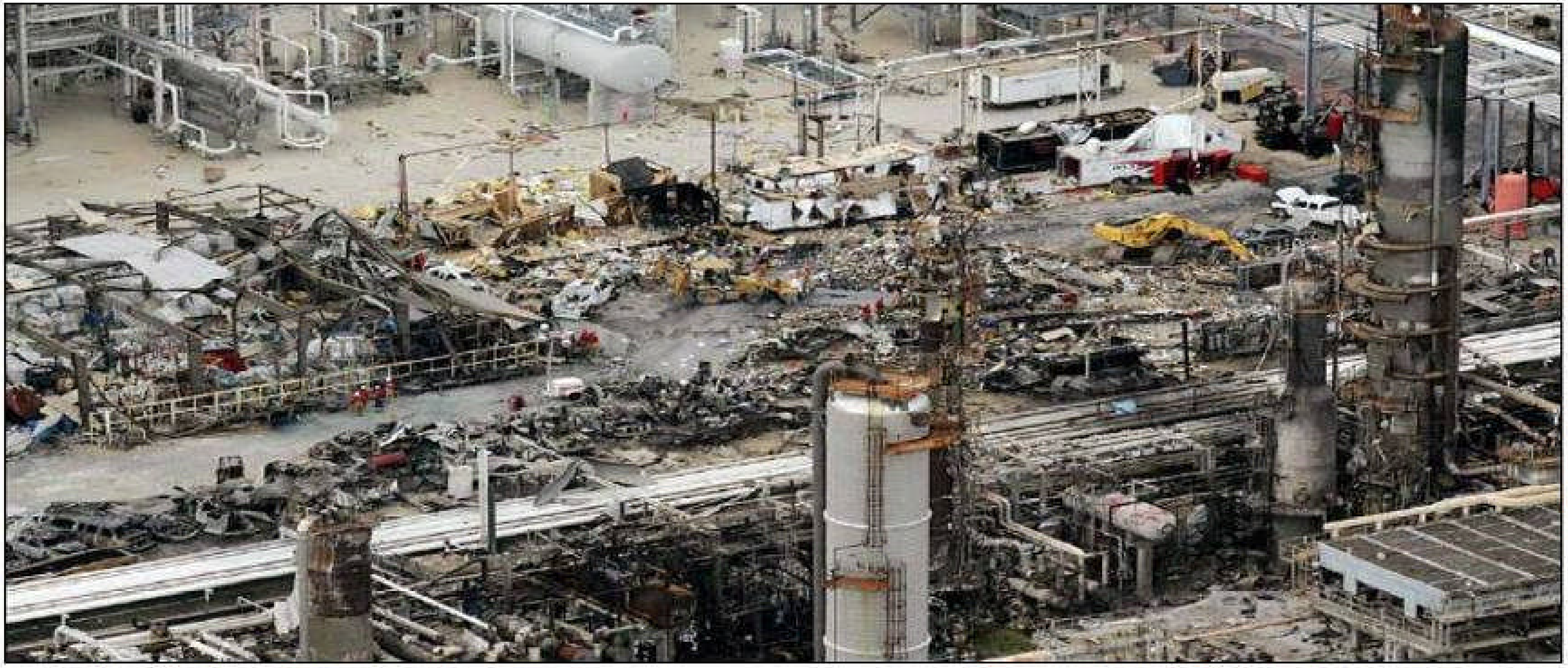
# Part 1 - Process Safety



BP Texas City Refinery Explosion and Fire
(15 killed, 180 injured)

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# Hazards

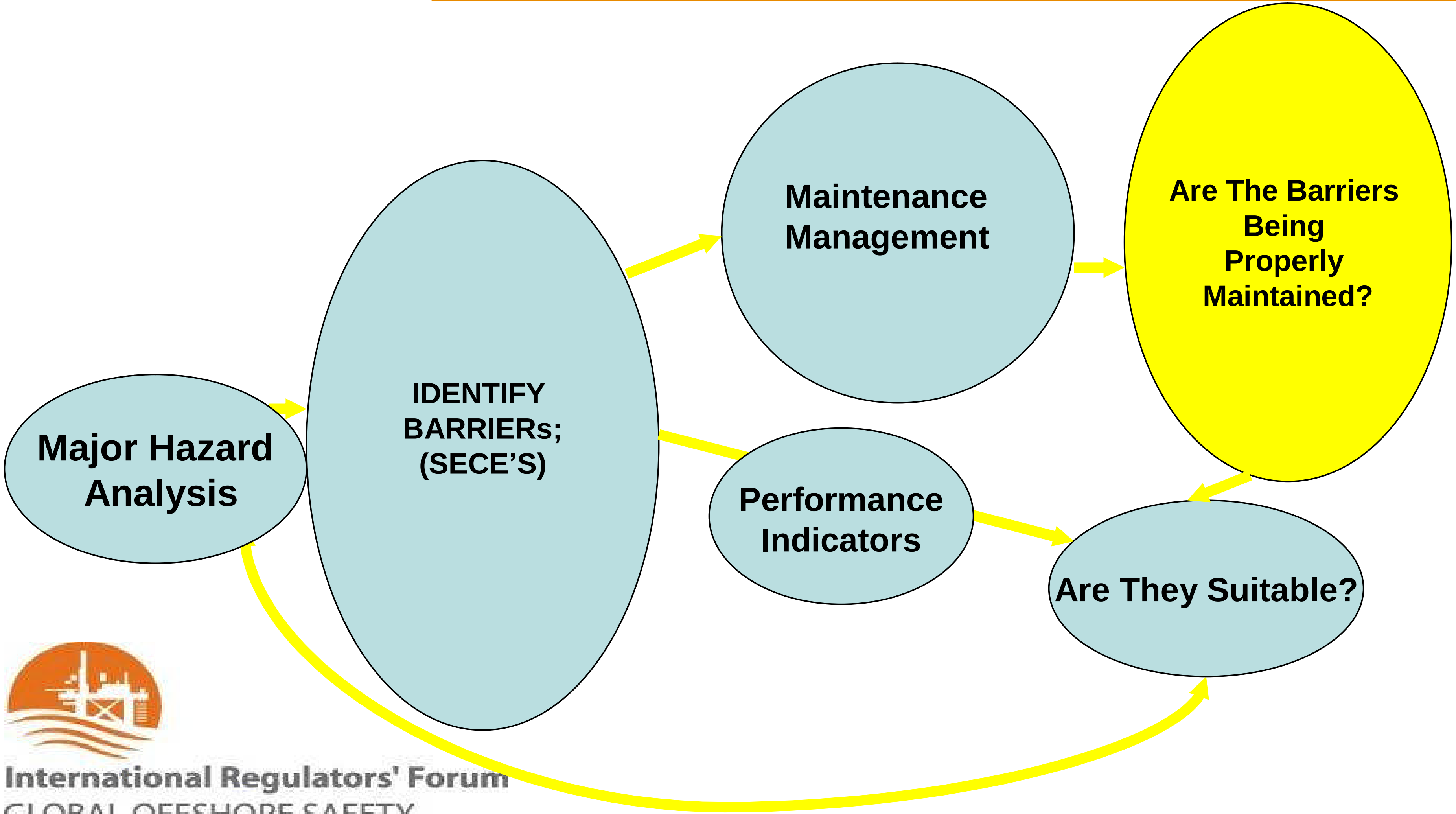
*Personal or Occupational Health and Safety Hazards*

- Can give rise to incidents or accidents that primarily affect one individual worker for each occurrence

*Process Safety Hazards*

- Can give rise to major accidents that can have catastrophic effects and can result in multiple injuries and fatalities, as well as substantial economic, property and environmental damage

# Process Safety Management
## Major Hazard Analysis/Maintenance Loop

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# Process Safety Management System


An effective process safety management system measures performance

***Key performance indicators must include appropriate indicators of process safety performance***

# Learning Points

Key areas requiring focus:

- Process Safety Culture / Process Safety Management System
- Competency assurance
- Definition / reporting of process safety performance indicators
- Maintenance strategy corresponds with risk of accidents / major accidents
  - Safety and Environmentally critical elements defined
  - Safety and environmental devices not bypassed during maintenance

# Learning Points

- Maintenance items properly classified and prioritized:
  - Appropriately resourced
  - Deferral process properly defined
  - Timely supply of materials
  - Project work not prioritized over maintenance work

*There is a need for long term investment strategies and decision making by senior management for maintenance of asset integrity.*

# Part 2 - Life Extension of Aging Installations

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# Elements of Aging that Affect Safety of Installations

- Fatigue
- Corrosion
- Geotechnical and Geological Hazards
- Accidental Damage
- Extreme Weather
- Modifications and Change of Use
- Marine Growth

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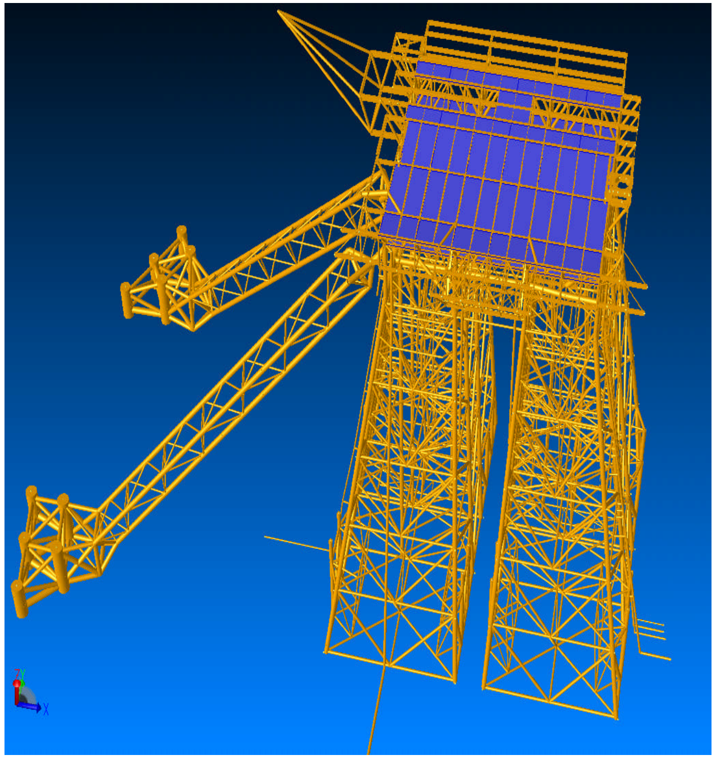
***If not effectively managed, will significantly increase the risk of major accidents***

# Fatigue



- Cracking of welded structural components can have serious implications
- Cracking can occur much earlier or later than anticipated

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# Corrosion

- General hazard that must be monitored
- Need to assess
  - Effectiveness of sacrificial anodes
  - Coatings
  - Corrosion allowances
  - Corrosion under insulation

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# Geological and Geotechnical Hazards

**Installation Foundation Hazards:**

- Pile degradation / failure

**Geological hazards:**

- Subsidence and slope instability
- Earthquakes

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# Accidental Damage

- Ship Collision
- Dropped Objects
- Accumulated Damage; includes
  - Minor damage not repaired
  - Missed damage

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# Extreme Weather

- Design to appropriate loading criterion
- Damage occurs primarily to:
  - Members and joints in steel sub-structure
  - Structural supports for risers
  - Topside structural supports
  - Equipment on lower deck

# Modifications and Change of Use

- Addition of new facilities
  - consideration of topside weight
- Change in purpose

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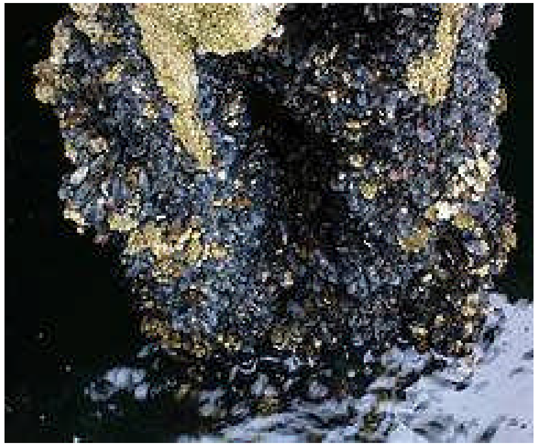
# Marine Growth



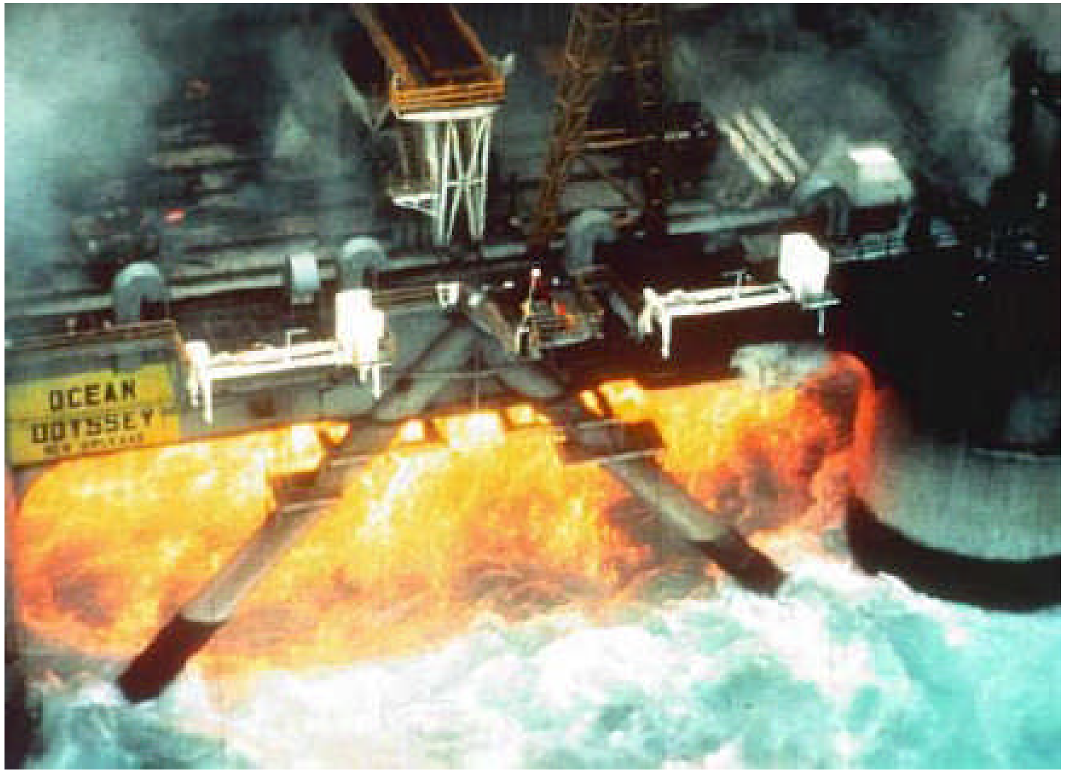
- Increases wave loading on a structure
- Impedes ability of FPSO to depart in emergency situation

# Learning Points

An approach to life extension may include these steps:

1. Define current anticipated operating life
2. Define extended operating life (based on field life and other factors)
3. Undertake a comprehensive safety review to confirm continued integrity
   - Assessment of records
   - Testing and inspection data
   - Check against modern codes and standards
   - Redundancy analysis
4. Identify shortfalls / implement improvements
5. Define ongoing inspection / maintenance strategy

# Part 3 - Well Integrity

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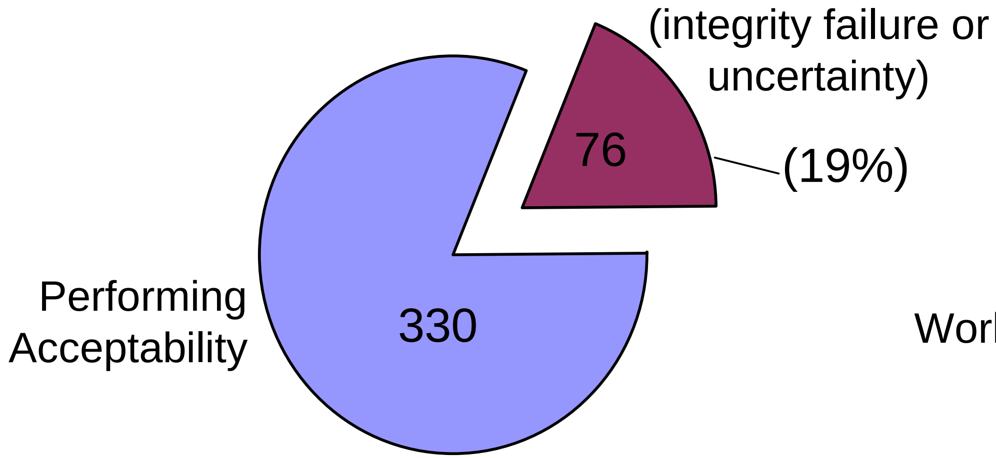
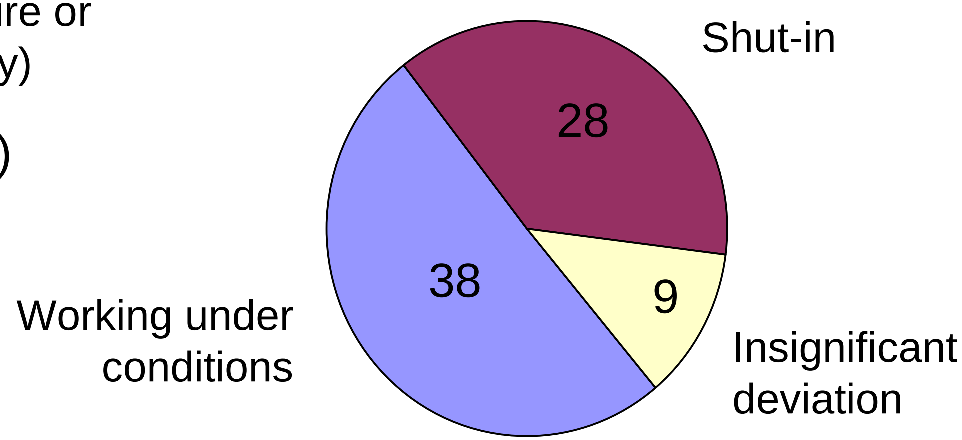
# Well Integrity
# Norwegian Study, 2006




406 Wells Surveyed
300 Platform, 106 Sub-sea




76 Wells With Integrity Failure or Uncertainty

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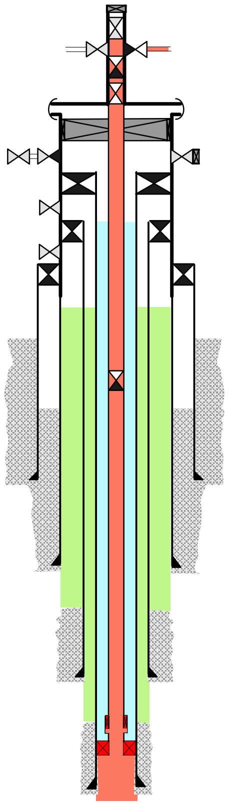
# Response to Leaks

Best practices….



- Well data kept complete and current
- All leaks investigated and risked
- Implement necessary mitigation measures
- For annular leaks, integrity of next casing string checked
- Well data (including risk level) updated when leak detected
- Update of operational procedures

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# Well Integrity

## Well Risk Categorization

| Level | Description | Risk Assessment |
|---|---|---|
| 1 | No downhole leak | Acceptable |
| 2 | Marginally degraded well<br>Increase in risk | Acceptable; only if risk factors can be controlled |
| 3 | Severely degraded well<br>Unacceptable risk | Not acceptable |

***Operations personnel must have a clear indication of well barrier status at all times***

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# Learning Points

Increased focus required on well integrity issues, including:

- Competency assurance
- Acceptable tolerances and safety factors in design
- Safety in use of leading edge technology
- Maintaining compliance with planned drilling and work-over programs
- General adherence to 2 barrier philosophy
- Verification and condition monitoring
- Adequate maintenance
- Quality and management of well integrity data

# Part 4 - Vessel / Platform / Rig Interactions

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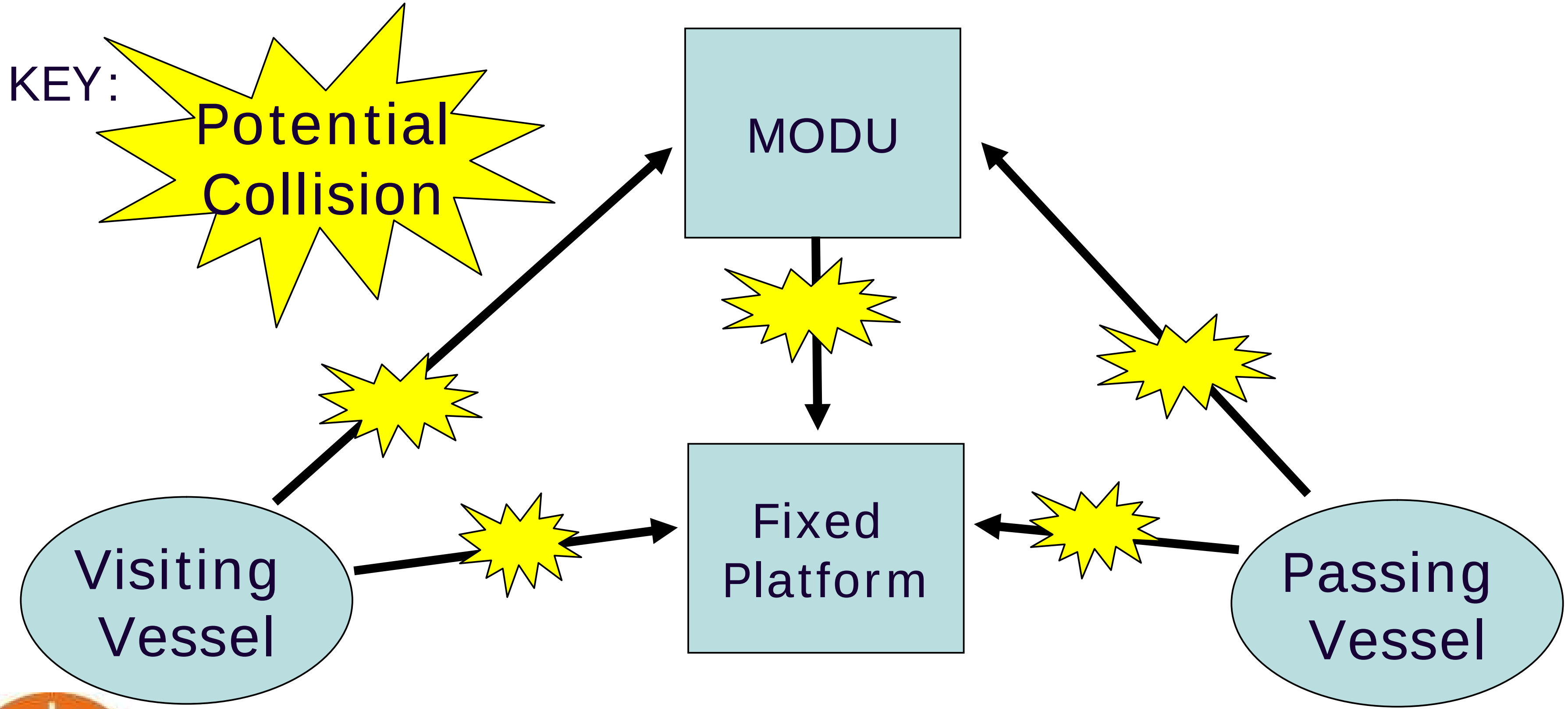
# Types of units and possible interactions

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# Some Recent Examples: Platform / Visiting Boat Collision

- India / July 2005
- Bombay High North platform offshore Mumbai
- Drill rig NCY was also on location
- Platform was struck by a work boat
- Large release / fire
- 22 fatalities
- Major asset loss

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# Platform / Passing Vessel Collision


- UK–NS. August 2007
- A passing vessel struck the unmanned Viking Echo gas platform
- The ship sank
- Platform damage estimated at $20m
- Sig. loss of revenue
- No loss of life
- Vessel captain jailed for 12 months for being drunk and for entering the 500m zone

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# JU Rig / Platform Collision


- Mexico / October 2007
- Usumacinta JU Rig working over a PEMEX platform.
- Details are to be confirmed, however, it is understood that:
- Heavy weather
- The rig moved and struck the platform
- Gas release / $H_2S$
- Evacuation / 23 fatalities?

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# Learning Points

- Vessel / Platform / Rig collisions may be rare but they can happen
- Consideration should be given to:
  - Collision avoidance
  - The positioning of risers and their potential for damage.
  - The need for fenders / riser guards
  - ESDV positioning
- The risks associated with collisions and riser damage need to be managed

# My Job is Done!

And now over to the Panel ………….

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