Health and Safety
Executive

HSE's AGEING & LIFE EXTENSION KEY PROGRAMME (KP4)

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KP4 website: www.hse.gov.uk/offshore/ageing.htm

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THE OFFSHORE INSTALLATIONS SAFETY CASE

- UKCS operates a Safety Case Regime
  - Literally "The Case for Safety"
- Offshore Installations (Safety Case) Regulations 2005
- The offshore installation Duty Holder must submit a Safety Case to HSE for acceptance
- Recommendation from Lord Cullen's inquiry into the Piper Alpha Disaster (6th July 1988)
  - 167 men died
  - 61 survivors
- Aim is to reduce risks from major accident hazards to the health and safety of offshore workforce
- Safety Case is a demonstration the duty holder has the ability and means to control major accident risks effectively

WHAT IS AGEING?

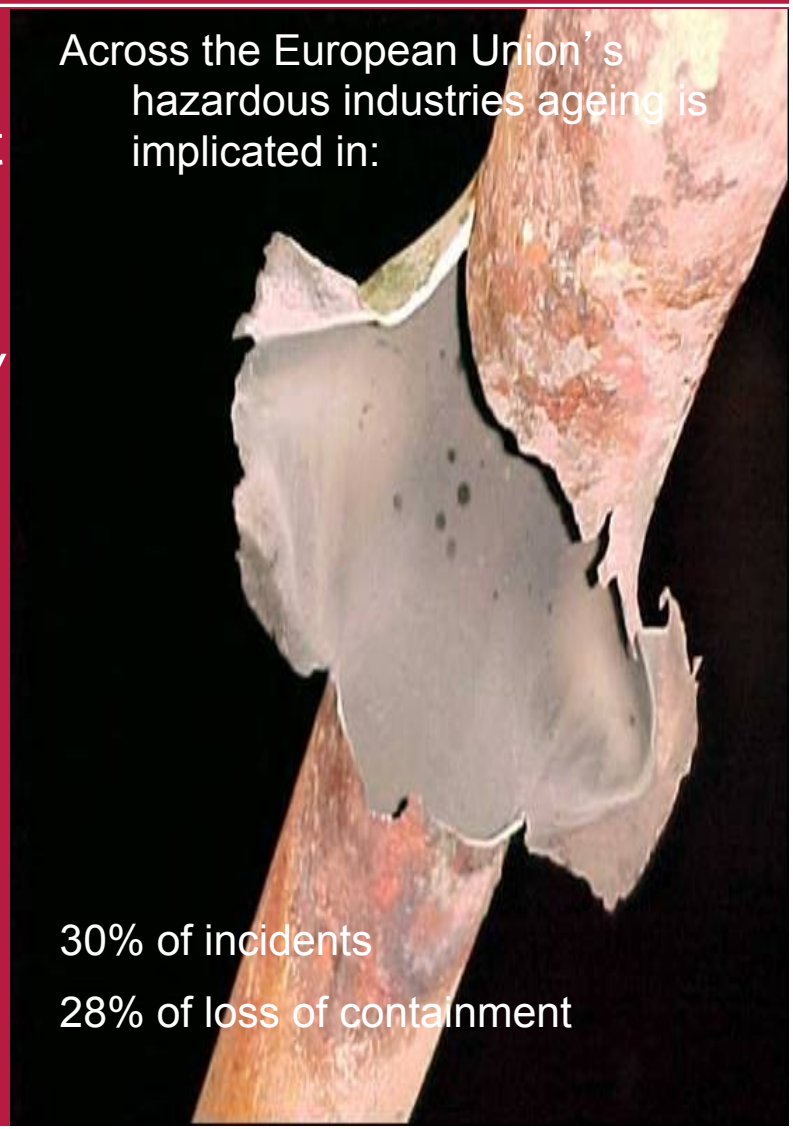
AGEING

It's about deterioration of work equipment which increases the likelihood of failure

"Ageing is not about how old your equipment is; it's about what you know about its condition, and how that's changing over time"

MANAGEMENT OF AGEING?

- It's about condition management
- Understanding the factors causing degradation
- Developing mitigation strategies
- Implementing strategies



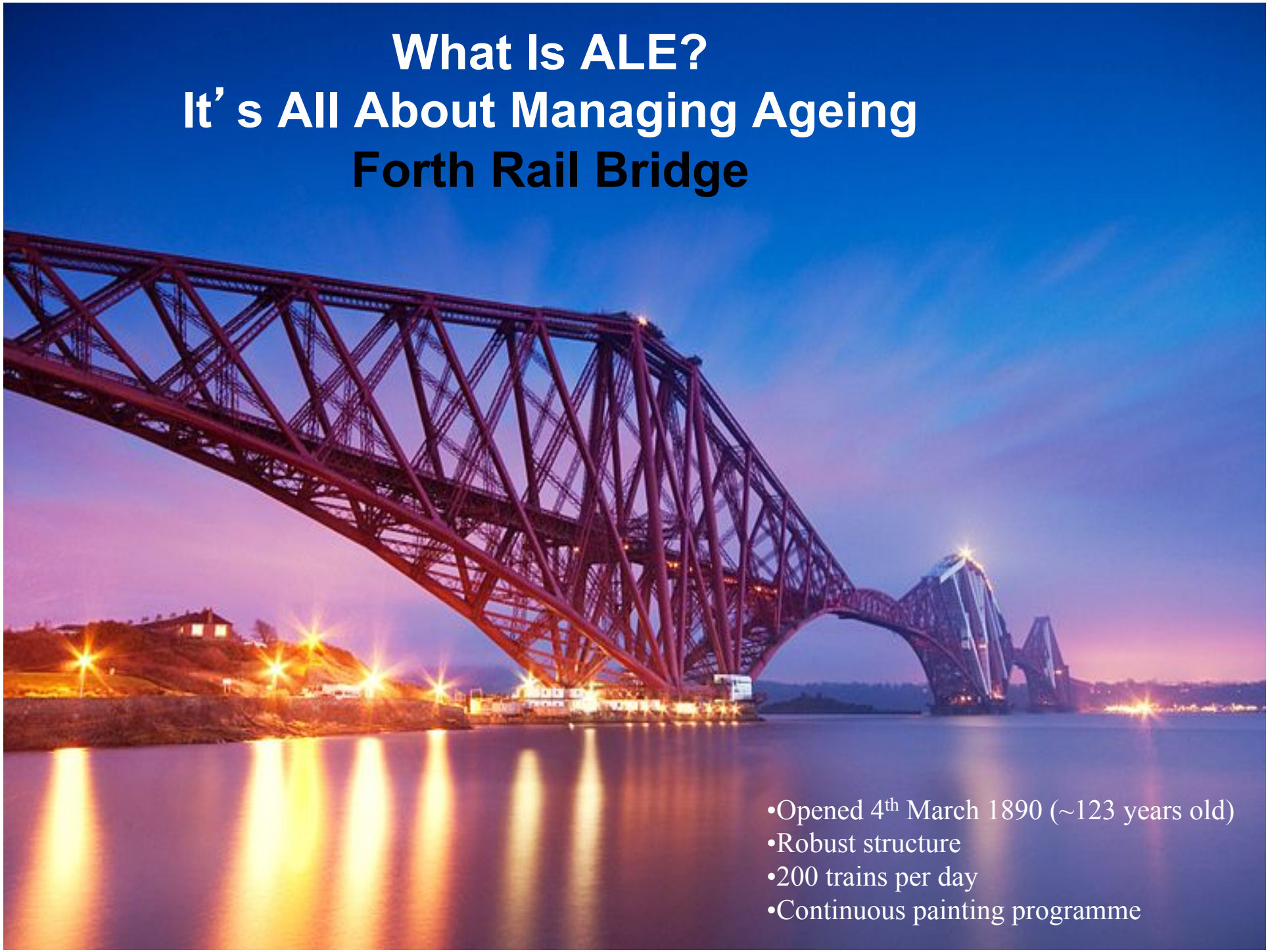
WHAT IS LIFE EXTENSION?

- Typical design life for production assets ~25 years
- When assets exceed design life = Life Extension
- Then refer to Cessation of Production (CoP)
- About half of the UKCS production platforms are in the life extension phase
- Some platforms now anticipate 50-70 years
- Plus 5-10 years until complete removal from the sea bed

WHAT IS KP4/ALEP?

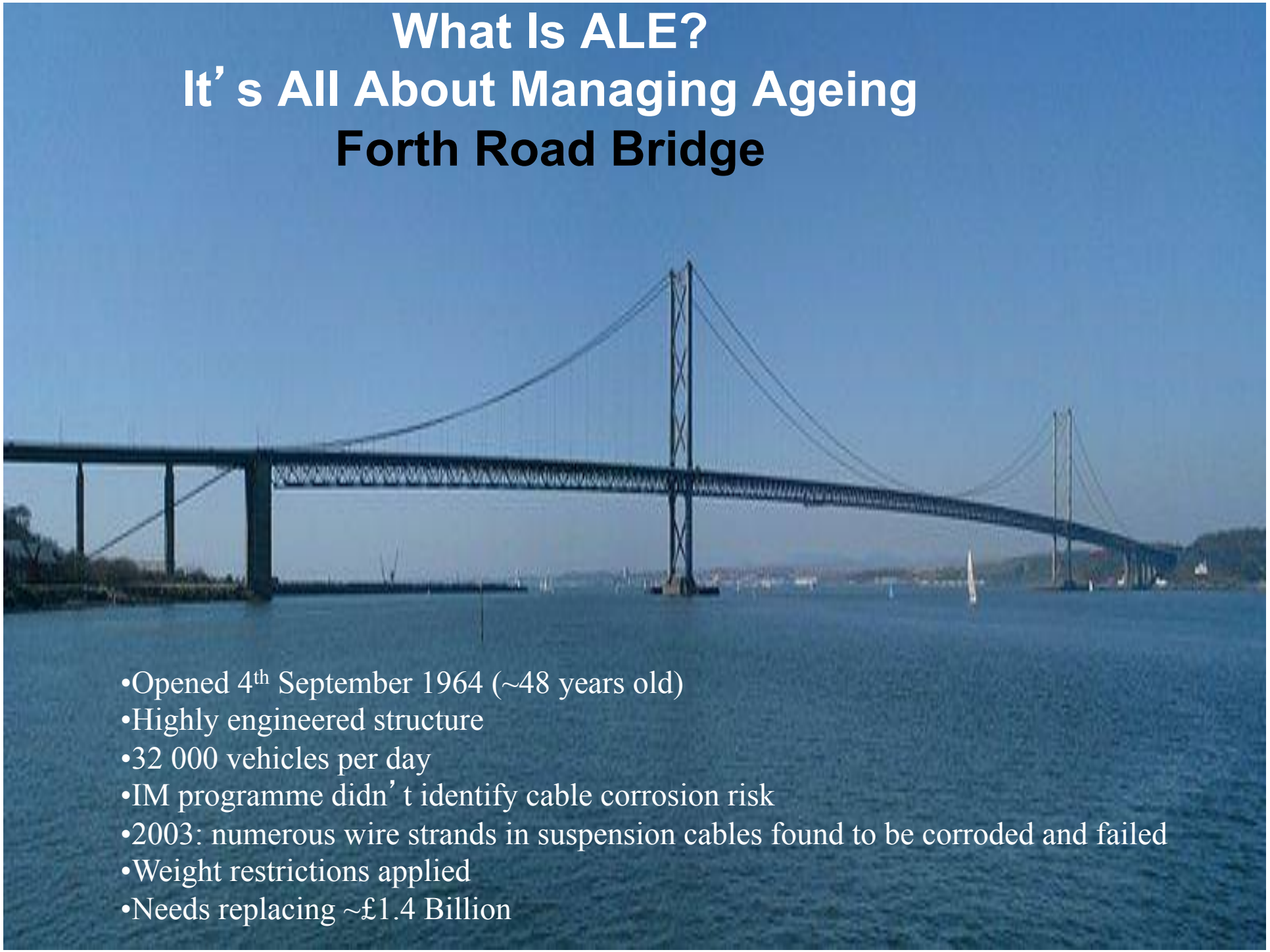
- Raising awareness of consequences of ALE
- Understanding & forecasting degradation mechanisms & rates of SCEs
- SCE obsolescence management
- Continuous health & safety improvement
- Reducing Hydrocarbon Releases
- HSE working with the Offshore Industry for a common goal
- Sharing ALE knowledge for the benefit of all

What Is ALE?
It's All About Managing Ageing
Forth Rail Bridge



- Opened 4th March 1890 (~123 years old)
- Robust structure
- 200 trains per day
- Continuous painting programme

What Is ALE?
It's All About Managing Ageing
Forth Road Bridge



- Opened 4th September 1964 (~48 years old)
- Highly engineered structure
- 32 000 vehicles per day
- IM programme didn't identify cable corrosion risk
- 2003: numerous wire strands in suspension cables found to be corroded and failed
- Weight restrictions applied
- Needs replacing ~£1.4 Billion

ORGANISATION AND HUMAN FACTORS

HSE

ALE MANAGEMENT WORKS WELL WHEN:

- Senior management are fully engaged and supportive
- Duty Holders have ALE focal points/ Life of Field Managers
- There is good inter-departmental communication
- There are KPI dashboards
- There are Independent ALE audits
- There is succession planning
- High AIM workloads are prioritised according to risk
- ALE policies are embedded into existing AIM policies and procedures

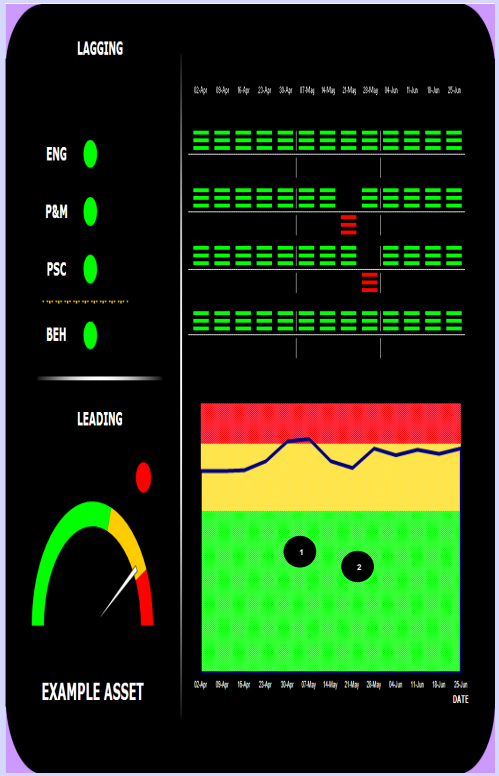
Asset 'X' Example Dashboard

Lagging Indicators

No barrier breaches during June 2012

Leading Indicators

Corporate Tolerance Levels exceeded are:
• Approved Temporary repairs reduced from 18 to 14 repairs
•8 are on Hydrocarbon / Process Systems **[CTL=6]**
• Deviations and ORAs increased from 7 to 8 **[CTL=6]**



Enduring issue (>2 Months)

•MAHE system inhibits
•Static at 2 inhibits

Key Events from graph

•Maintenance backlog increased from zero to 6 tasks (48 Hrs)
•Temporary repairs reduced from 18 to 14 repairs. Permanent repairs carried out.

HYDROCARBON LEAKS:
INFLUENCE OF PEOPLE AND PLATFORM AGE

Studies by Prof Jan Erik Vinnem (Preventor) for PSA Norway found:

- 60% of leaks due to human interventions:
  - Significant issues were:
    - – Failure to check pre-work isolations, and
    - – Failure to check isolations & integrity after re-instatement
- "It is not possible to demonstrate a correlation between leak frequency and the age of an installation"
    - – other factors are more important
- "Technical degradation caused ~21% of HC leaks

- Vinnem, Hestad, Kvaløy & Skogdalen. (2010) Analysis of root causes of major hazard precursors (hydrocarbon leaks) in the Norwegian offshore petroleum industry, *Reliability Engineering and System Safety*, 95/11, 2010, pp 1142-1153
- – Kongsvik, Johnsen & Sklet. (2011) Safety climate and hydrocarbon leaks: An empirical contribution to the leading– lagging indicator discussion, *Loss Prevention in the Process Industries*, 24/4, 2011, pp 405-411

PROCESS SAFETY

ALE MANAGEMENT WORKS WELL WHEN:

- Operating & Maintenance systems identify the Process Safety issues
- There are tools to identify SCEs acting collectively as barriers to prevent loss of containment
- SCEs and Safety Integrity Levels are mapped
- Effective HAZOPs and HAZIDs
- Offshore red-line mark-ups are contemporaneous
- Hardware and software obsolescence is managed

New ESDV hydraulic bottles

FIRE & EXPLOSION

ALE MANAGEMENT WORKS WELL WHEN:

- HAZOPS/HAZIDS/QRAs are aligned to the 5 yearly Thorough Review Summary
- Performance trending of SCEs
  - Go/no-go checks are insufficient
- Relationships between SCE failure and Major Accident Hazard risks are identified
- Effective Root Cause Analyses
- Long term integrity management of Temporary Refuges
- Reliability of obsolete gas detection systems is managed effectively
- Audits of Operational Risk Management systems
- Long term planning

STRUCTURES

ALE MANAGEMENT WORKS WELL WHEN:

- Structural analyses are up to date and identify ALE risks
- Failure and deterioration models address both Ageing and Life Extension
- Barriers to failure are suitable for ALE
- Failure trends are analysed and extrapolated
- MoDU jack-up fatigue assessments are up to date and identify ALE risks
- The risks associated with un-inspectable components are resolved
- Air gaps for the 10,000 year wave are re-assessed

MECHANICAL

HSE

ALE MANAGEMENT WORKS WELL WHEN:

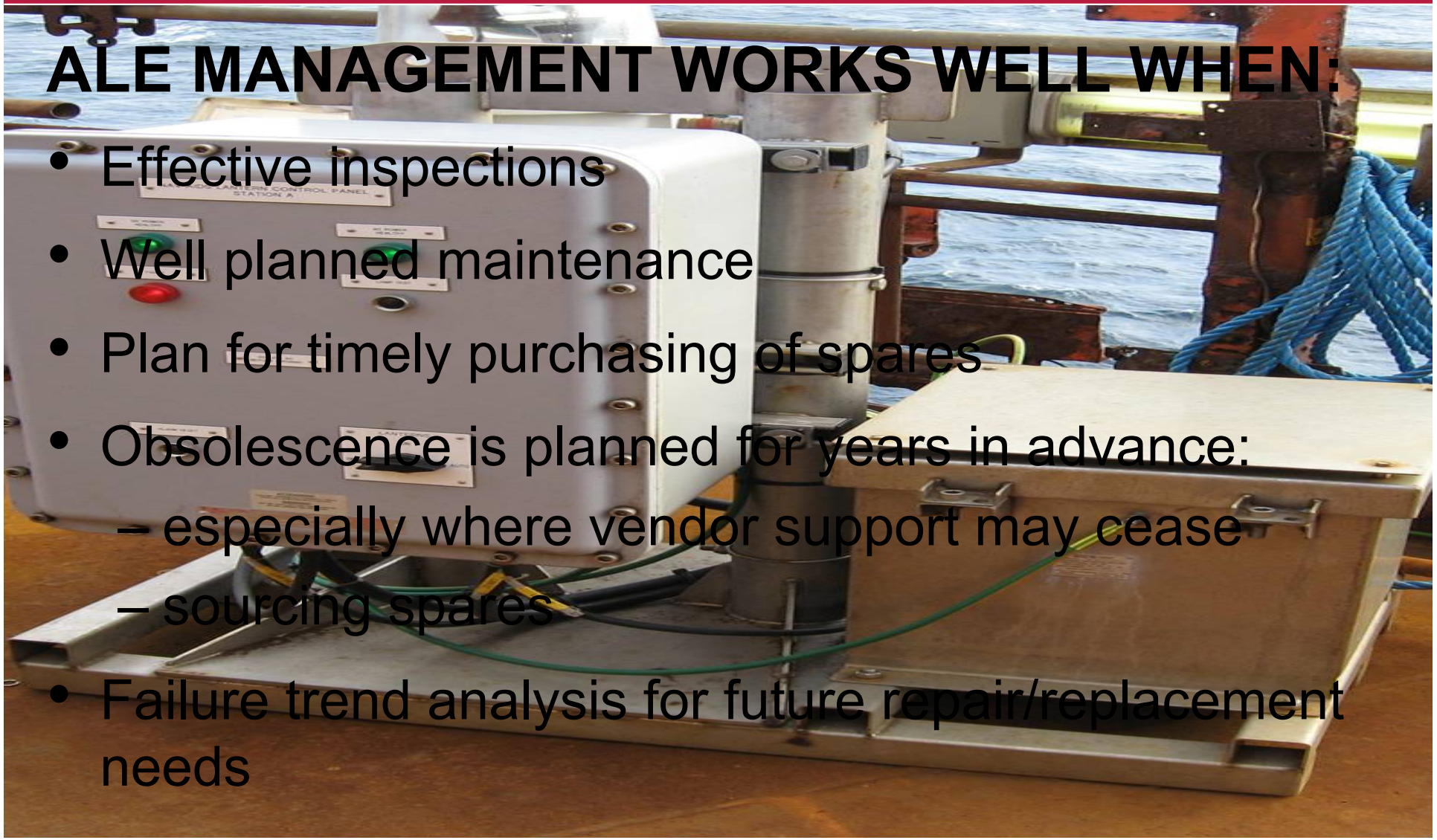
- ALE management is integrated into AIM programmes
- DHs take control of integrity and maintenance management
- Temporary repairs are replaced with permanent solutions
- ALE gap analyses are undertaken
- Effective anomaly management tools
- ALE is included in HAZOPS
- ALE effects and consequences are understood
- Inspection of static parts of rotating equipment
- Long term maintenance strategies

CORROSION

ALE MANAGEMENT WORKS WELL WHEN:

- There is good cross industry knowledge sharing (EI docs)
- Well designed Corrosion Management Strategies, addressing A
  - Corrosion Threats Assessments
  - Risk Based Inspection programmes
  - Written Schemes of Examination
- Equipment lists are up to date
- Long term planning
- Fabric maintenance
- Audits on effectiveness of CMSs
- Inspection data is audited
- Experienced Offshore Inspection Engineer
- There are high reliability chemical injection systems

ELECTRICAL, CONTROL & INSTRUMENTATION



ALE MANAGEMENT WORKS WELL WHEN:

- Effective inspections
- Well planned maintenance
- Plan for timely purchasing of spares
- Obsolescence is planned for years in advance:
  - especially where vendor support may cease
  - sourcing spares
- Failure trend analysis for future repair/replacement needs

MARINE

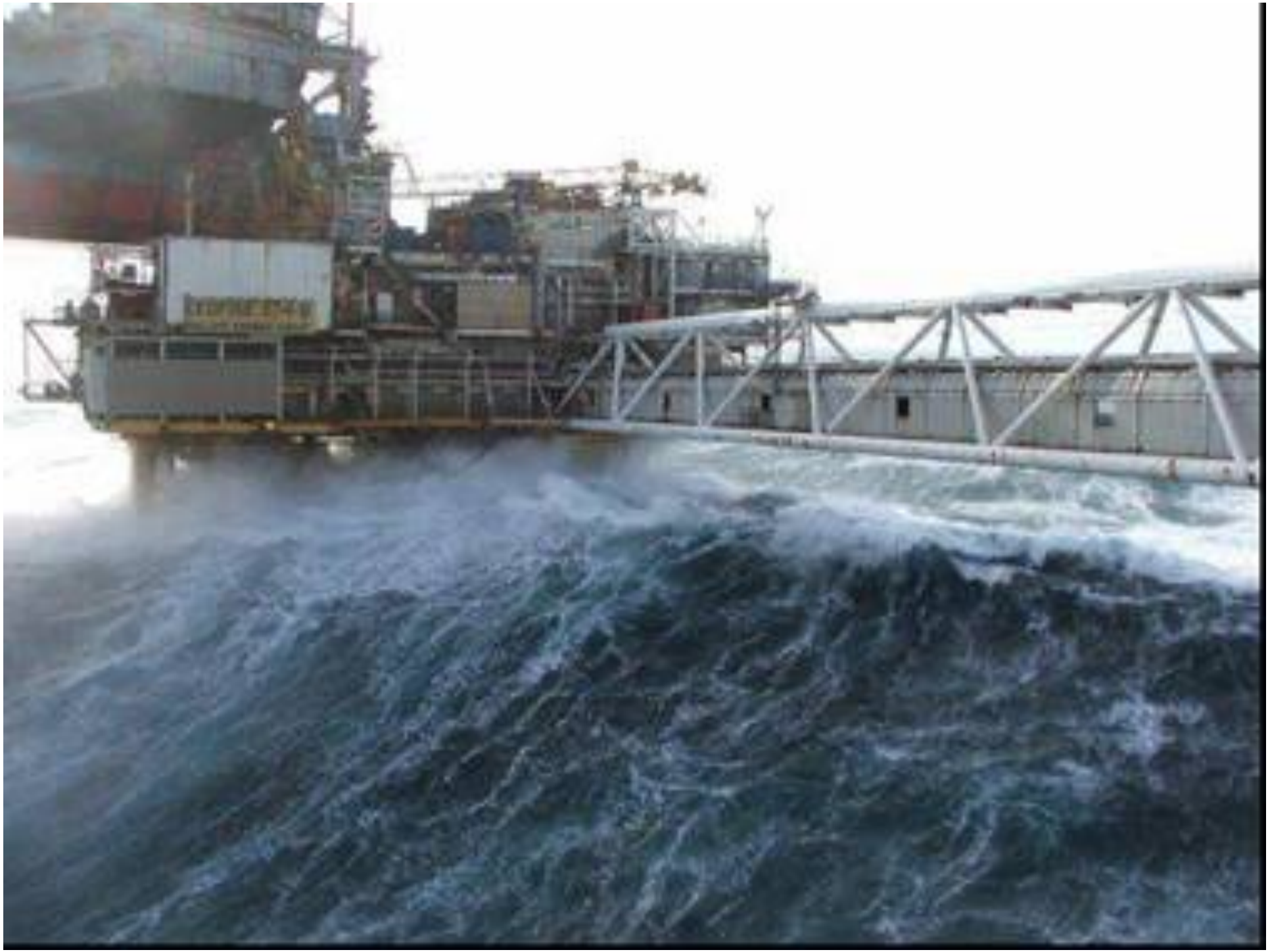
ALE MANAGEMENT WORKS WELL WHEN:

- Effective policies for structural & marine integrity
- ALE KPIs and dashboards
- Up to date structural modelling
- Real time condition monitoring
- Five year Class Society inspections are undertaken
- Long term planning for equipment replacement
- Quantitative rejection criteria for SCEs
- Long term data trend analyses to plan for future maintenance
- Effective inspection programmes for secondary marine systems

PIPELINES

ALE MANAGEMENT WORKS WELL WHEN:

- There are effective risk-based PIMS
- ALE is included in AIM policies
- There is specific consideration of the effects and consequences of ALE elements into specific pipeline AIM policies and procedures
- Pipeline AIM is re-validated to ensure integrity to CofP
- ALE issues of flexible risers are considered
- Audits are undertaken in accordance with the KPIs
- Cleaning and IP frequencies match KPIs
- IP frequencies are regularly reviewed to match degradation threats



NIMROD DISASTER REVIEW
THE IMPORTANCE OF THE SAFETY CASE

Haddon-Cave Review: loss of the RAF Nimrod MR2, Afghanistan 2006

- Immediate causation: leak during air-to-air refuelling – overfilling #1 fuel tank – ignition from exposed element of a hot air duct.
- Contributory factors:
  - Age of non-structural components
  - Unsuitable maintenance regime policy
  - Lack of fire detection and suppression system
  - Safety Case failed to identify the potential threat: ie co-location of fuel and hot air system
  - Safety Case process considered to be a "paper exercise" – worthless as a safety tool
  - Failure to identify implications of successive changes to the fuel system and associated procedures
  - Acceptance that fuel leaks were inevitable
  - No trending of leak frequencies
  - Overheat detection system in the wrong place
  - Did not learn lessons from previous incidents

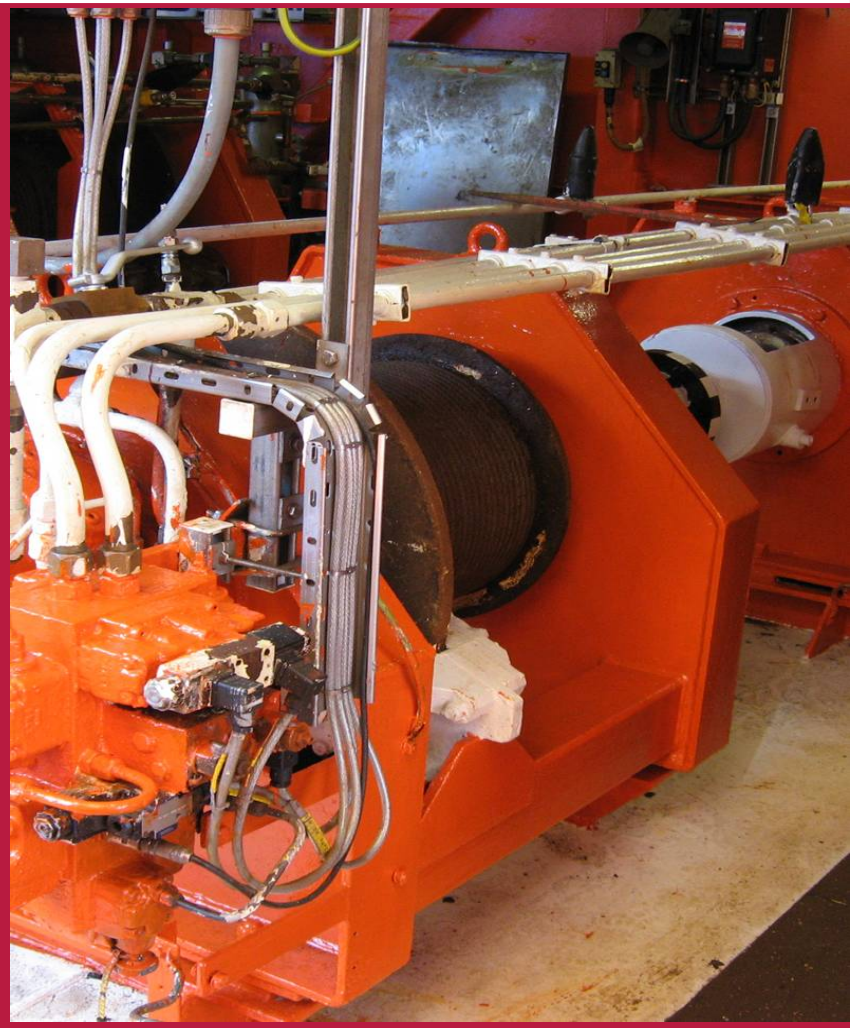
NIMROD DISASTER REVIEW
THE IMPORTANCE OF THE SAFETY CASE

HSE

- Management structure RAF Kinloss:
  - Engineering personnel come under non-specialist leadership - believed to have had a negative effect
- Training courses did not provide skills to maintain 40 year old aircraft
- Stretched engineering resource; loss of skilled personnel - dilution of engineering skills
- Lack of corporate memory

CONCLUSIONS

- HSE has seen evidence the offshore industry is investing considerable time and money improving ALE management
- Forward planning / anticipating the challenges will reap rewards:
  - improved long term H&S performance
  - extended production
- Need to continue effort to cessation of production



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