PRESENTATION OUTLINE

- The problem of UK’s ageing offshore installations
- Where we have targeted our regulatory research activity
- What have been the results
- Where now?
- Discussion
Definitions - how old is old?

- UKCS, first gas platforms were in 1968, first oil platforms were in 1974 – and most still in place!

- Department of Energy / HSE Guidance Notes identify a 20-year minimum period

- Design Life (ISO 2394 & ISO 19902)
  - The assumed period for which a structure is to be used for its intended purpose with anticipated maintenance but without substantial repair from ageing processes being necessary

- Life Extension
  - Continued operation of an installation beyond the design life assumed at the time of design or revised following a reassessment with reference to a new baseline to reflect changes through prior service
Indications of ageing?
Corrosion?
Fatigue cracking?

Number of failures vs. Time to detection of fatigue damage after installation (Years)

- Number of failures:
  - 0 failures: 13 years
  - 1 failure: 1 year
  - 2 failures: 7 years
  - 3 failures: 2 years
  - 4 failures: 6 years
  - 5 failures: 8 years
  - 6 failures: 4 years
  - 7 failures: 9 years
  - 8 failures: 11 years
  - 9 failures: 12 years
  - 10 failures: 10 years
  - 11 failures: 14 years
  - 12 failures: 16 years
  - 13 failures: 18 years
  - 14 failures: 15 years
  - 15 failures: 17 years
  - 16 failures: 19 years
  - 17 failures: 20 years
  - 18 failures: 21 years
  - 19 failures: 22 years
  - 20 failures: 23 years
Maintenance?
Impact?
Beyond design loading?

Gulf of Mexico, Hurricane damage
2007 SUPPLY - RELIANT ON OLDER FIELDS

Proportion of production from field

Age of installation

 Buzzard
 Britannia
 Elgin
 Foinaven

 Morecambe S
 Rough

 Oil
 Dry gas
 Associated gas

 Forties
 Beryl
 Brent
 Magnus
 Ninian
 Claymore
 Viking
 Leman Per.
 Leman Shell
 West Sole
Research

- In UK, we’ve undertaken a range of research and other activities to identify how such inevitable ageing can be managed:
  (a) Problems associated with identifying ageing deterioration
    - Structural integrity analysis techniques (RR642)
    - Predicting fatigue crack growth (RR643)
Research

(b) Problems associated with ageing on specific safety critical aspects
   - Passive fire Protection - Information Sheet 12/2007
   - RR509 “Plant ageing: management of equipment containing hazardous fluids or pressure” 2006
   - PS/06/24 “Guidance on fire and explosion hazards associated with ageing offshore oil and gas platforms” HSL (internal)

(c) How to manage the ageing processes offshore
   - RR684 “Structural integrity management framework for fixed jacket structures” 2009
   - “Structural integrity management of mobiles” due for publication late 2009
   - “A framework for monitoring the management of ageing effects on safety critical elements” – The Energy Institute – due for publication 2009
Research done - so what?

- Managing ageing is complex!
- Yet simple - “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”
- Research has provided good practise strategies
Key documentation

- Offshore Information Sheet 4/2009 “Guidance on management of ageing and thorough reviews of ageing installations”. Provides a summary, and strategy of taking this forward, in particular:
  - Guidance on how to decide when to reappraise the fire and explosion risk assessment (FERA)
  - How to ensure the installation Structural Integrity Management (SIM) plan incorporates deterioration and degradation
  - Ageing KPIs to facilitate management oversight

- Offshore Information Sheet 5/2007 “Ageing semi-submersible installations” (in conjunction with PSA)
How to manage ageing platforms

Factors for consideration

- Ageing/deterioration
- Change in hazard profile of platform
- Modifications
- Improvements in knowledge and/or good practise

Management techniques

- Through review of safety case
- Appropriate changes to key risk control systems and SCEs
- Inspection strategy
- Revise fire and explosion assessment?
- Extended life assessment?
Management of ageing platforms

- Deterioration
  - Fatigue (welded connections, piles, supports)
  - Corrosion
  - Accidental damage (ship impact, dropped objects – cumulative effects)
  - Environmental overload – metocean
  - Geological & geotechnical (subsidence, scour, pile failure)
Management of ageing platforms

● Changes in hazard profile
  – e.g. Reservoir conditions
    • Pressure drop -> enhanced oil/gas recovery
    • Gas/oil/water ratios change -> more slug flow/vibration?
    • H₂S levels rise -> enhanced corrosivity

● Modifications
  – New accommodation units, changes to process equipment, conversion to hub operation etc can all lead to:
    • Changes in structural loading
    • Changes in fire and explosion profile
Management of ageing platforms

● Advances in knowledge and technology
  – Better understanding: e.g. improved explosion modelling may predict different overpressures
  – New technologies: e.g. in structural integrity assessment, fire protection systems etc
  – Obsolescence: e.g. replacement parts no longer available, or software systems no longer supported
  – More stringent standards
  – Learning from past events

● All factors for consideration when managing ageing installations
TYPICAL ‘BATH TUB’ CURVE

Early life failures

Steady failure rate

Wear-out phase

Time
PERFORMANCE INTO LIFE EXTENSION

(a) No loss of performance with time
(b) Fabrication problems corrected by remedial repairs/strengthening
(c) Loss of performance but acceptable into life extension phase
(d) Loss of performance acceptable at design life but not into life extension
MAIN ISSUES FOR LIFE EXTENSION

Loss of key data from evaluation should be managed to include assessment of the original design level processes and the need to link inspection requirements to these processes (e.g. fatigue, corrosion).

Data Update

Data → Evaluation → Inspection Strategy → Inspection Programme

A more detailed inspection may be required if a period of life extension is to be justified.
Ageing: Where now for HSE?

• Probably a key programme for OSD over next few years – proposals now being developed

• Continuing development of solutions, via research if necessary
  • e.g. review of damage in ageing mobile and fixed offshore structures, to identify probable causes and to make recommendations for improved structural integrity management.
FURTHER INFORMATION

- Acknowledgements to Alex Stacey and Stephen Connolly of HSE
- Technical papers: OMAE 2008 workshop (including paper 57418)

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Discussion

- Do other ICRARD members have similar concerns about ageing?
- What research have you done or intend to do?
- Are any of the UK approaches useful?
- Do you have different approaches?
- What more can ICRARD do to share knowledge about ageing issues?
International Dimension

- **Norway:**
  - PSA requires consent to extend life
  - DnV standard (OSS-101) to include ‘ageing semi-subs, jack-ups’

- **ISO:**
  - ISO 19900: ‘assessments’ required for all structures at end of design life
  - ISO 19902 (fixed structures), Section 25: detailed requirements for assessment (end of design life is a trigger)
  - ISO 19904 (semi-subs) & ISO 19905 (jack-ups): no formal section on assessment

- **USA:**
  - API RP2A Section 17 – triggers do not include ‘life extension’
  - MMS: Current studies on ageing underway