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Introduction

This paper is the first in a series written for Scottish Enterprise (SE) by the Industry Technology Facilitator (ITF) setting out some of the challenges facing the oil and gas industry where innovation in technology and processes is needed. Companies that create products or services that can meet these challenges have the opportunity to create or grow a business supplying to an industry that, in the UK alone, has an annual operational expenditure of around £7 billion and an annual capital expenditure of around £8.5 billion (1).

Asset integrity and reliability

One of the major challenges facing the oil and gas industry today is to ensure the safe operation of their ageing assets. There are more than 6,700 platforms in operation around the world. On average, 30% have been in operation for more than 20 years and many of these are operating beyond their original design. Asset integrity entails making sure an asset can perform its required function effectively and safely.

The ageing infrastructure of offshore and onshore installations presents the industry with a constant and growing challenge. Ageing is, in general, characterised by deterioration which, in the severe operational environment offshore, can be significant with serious consequences for installation integrity if not managed properly. The industry has some challenges ahead that need the support of research and technology. The challenge now is to ensure that the required technology and systems are developed within the required timescales.

The challenges facing the industry in this area can broadly be split into two categories:

- material-related issues
- inspection, repair and maintenance

Several integrity management systems and programmes are used by different operators to achieve this objective. However, many of the systems still lack the dynamic integrated approach needed to manage risks associated with the operations of these assets.

The prime areas of concern identified by the oil and gas industry as having technology/process limitation are as follows:

- monitoring and understanding the integrity of materials
- understanding corrosion under insulation
- extending the life of an asset
- asset integrity and obsolescence
- full life cycle design

Materials

Monitoring and understanding the integrity of materials

The deterioration of offshore and onshore installations can be a significant problem with potentially serious consequences for the integrity of an installation. This needs to be managed appropriately.
It is crucial to increase the maturity of asset management techniques based upon fundamental materials research in order to predict the lifetime of current and future materials used, and thus allow appropriate action to be taken in a timely manner. There are some challenges in this area that need the support of materials researchers and new technology.

The scope of this section covers pipelines, subsea and facilities.

The challenges

In particular the industry is seeking new ideas in the following areas:

- **Better understanding of the performance of materials in changing environments, including**
  - Fluid compatibility and its effect on material life, particularly for elastomers
  - Methods for continuous material service life monitoring and management

- **Detection and monitoring, including**
  - Online prediction and monitoring of the breakdown of coatings
  - Online detecting coating of disbondment prior to onset of corrosion
  - Online detection and management of stress corrosion cracking

- **Establish high level guidelines to provide a way to manage/mitigate the impacts of process changes on existing materials, including**
  - Understanding where well fluid changes will affect material performance in future

- **Establish common methodology for asset life extension, including**
  - Predictability of asset life – materials, operating conditions, and the ability to make adjustments from historical performance
  - Applying full lifecycle design (FLCD) principles in maximising remaining life of existing assets

**Understanding corrosion under insulation**

Corrosion Under Insulation (CUI) is a multi-billion dollar problem that destroys expensive industrial infrastructure. Continuous programmes of inspection and maintenance are required which result in costly plant and facility downtime.

The challenges

In particular the industry is seeking new ideas in the following areas:

- **Subsea CUI prediction and maintenance, including**
  - Providing an effective mechanism for prediction and maintenance of subsea CUI

- **Deep sea insulation repair system, including**
  - Providing an effective mechanism for repairing insulation and corrosion, particularly subsea

**Inspection, repair and maintenance**

**Extending the life of an asset**

Life extension assessment is a distinct activity which has only recently been formally recognised by the offshore industry, largely due to the recent introduction of regulatory requirements and the new ISO standards for offshore structures, ISO 19900 and ISO 19902. However, whilst the ISO 19900 series of standards provides a good basis for the assessment of life extension, the standards are still evolving.
The challenges
In particular the industry is seeking new ideas in the following areas:

• **Best engineering practice, including**
  - Replace, Repair, Re-use – the development of decision making criteria based on remaining asset life
  - Increased accuracy of fatigue and fatigue predictions (less conservative but more accurate models)
  - Developing a common understanding of best practice taking into account the many global standards

Asset integrity and obsolescence
Asset integrity entails making sure an asset can perform its required function effectively and safely. A key issue here is obsolescence. Older plant components might become obsolete, leading to replacement parts becoming unavailable, requiring the use of alternative replacement components and a thorough associated safety review.

The challenge
In particular the industry is seeking new ideas in the following areas:

• **Controlling obsolescence, including**
  - Managing software safety and integrity – legacy software is hard to assess and update
  - How to effectively manage component obsolescence
  - Providing upgrades to obsolete subsea control systems

Ensuring full life cycle design
The industry is under intense pressure. Compliance with increasingly stringent health, safety and environmental regulations is mandatory. New facilities must be brought online faster and more economically. Ageing infrastructure must be upgraded and modernised with minimal service interruptions.

To overcome these challenges, a significant change from past culture, processes, management and organisational concepts must be adopted and has to be carefully balanced.

The challenges
In particular the industry is seeking new ideas in the following areas:

• **Small kit prediction modelling for pipeline and facilities, including**
  - Risk Base Inspection (RBI) – Data set for small “Kit” for general industry use

• **Platform energy modelling, including**
  - How to effectively predict the energy usage requirement of new and existing offshore and onshore infrastructure.
Useful Links

The Industry Technology Facilitator (ITF)
http://www.itfenergy.com/

Scottish Enterprise – Business sectors – Energy
www.scottish-enterprise.com/your-sector/energy/energy-how-we-can-help.aspx

Scottish Enterprise – Fund your business – Scottish investment bank – Equity funding
www.scottish-enterprise.com/fund-your-business/scottish-investment-bank/sib-equity-funding

Scottish Enterprise – Fund your business – Innovation and R&D grants
www.scottish-enterprise.com/fund-your-business/innovation-and-rd-grants

Scottish Enterprise – Start your business – Proof of Concept Programme
www.scottish-enterprise.com/start-your-business/proof-of-concept-programme

Sources

1. The United Kingdom Offshore Oil and Gas Industry Association Limited (Oil & Gas UK), The 2012 Oil & Gas UK Activity Survey
   http://www.oilandgasuk.co.uk/cmsfiles/modules/publications/pdfs/EC028.pdf