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The Application of Remote Real-Time Monitoring to Offshore Oil and Gas Operations

Some factors to consider in establishing a pilot programme for Blowout Preventer (BOP) Condition-Based Maintenance (CBM)

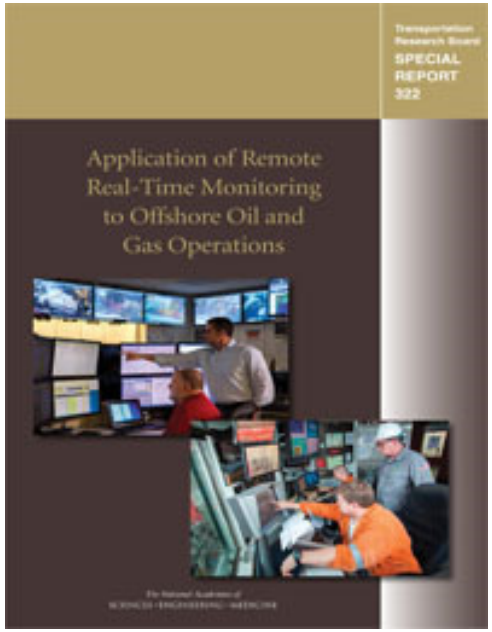
Dr. Andrew Jaffrey

Introduction

- Dr. Andrew Jaffrey CEng FIET
- Previously Director of Technology & Innovation at Cameron
- Conceived and led development of Cognition™ BOP monitoring and emergency management system introduced at OTC in 2014
- Represented Cameron at NAS committee meeting in 2015
- Made redundant from Cameron in March 2016
- Personal invitation from NAS Committee to participate in today's workshop
- Acting as an independent individual

Outline

- Today's Objectives
- Interested Parties
- Defining Pilot Objectives
- Logistics
- Detailed Considerations
- Thorny Issues
- Recommendations
- Conclusion



Objectives Today

- By necessity will ask many more questions than suggest answers
- Aiming to set the scene and lay the groundwork for the discussion of establishing a pilot BOP CBM programme for the industry
- Focus is on the issues that will need to be considered and the many opportunities this report opens to achieving important advances in understanding the health and behaviour of safety-critical subsea equipment
- Promote an open approach
  - The pilot offers an opportunity to investigate and compare potential solutions across a range of OEM equipment using a variety of analytical techniques
- Ultimately, the BSEE aspiration is to improve safety through CBM

Interested Parties

- Who are the stakeholders?
  - What are their roles and responsibilities?
- Regulators
- Standards agencies
- Operators
- Contractors
- OEMs
- Industry associations
- Software houses / solution providers
- Academia
- Independent advisers

Defining Objectives for the Pilot Programme

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- What is the pilot programme to achieve?
  - What are the measures of success?
  - How will these be verified?
  - What further initiatives will be informed by these results?
- What equipment is to be monitored?
- What data are to be captured?
- What values are to be derived from the captured data?
- What level of interpretation, analysis, prediction is to be targeted?
  - How much is this just monitoring versus condition assessment?
- Where is the boundary between real-time / condition monitoring and necessary system control feedback, e.g. ram position?

Logistics (1)

- Where is this to be done?
  - On a single installation?
    - Not ideal as it will limit the learning opportunities
  - On multiple installations?
    - Preferred as it will help highlight and address issues of scale
    - Needs to be across multiple companies (contractors / operators)
    - Needs to be across multiple OEM equipment
- What is the timetable?
  - To plan and instigate
  - To run (perhaps in phases)
  - To deliver outcomes
  - To report

Logistics (2)

- Organisation
  - How will pilot be run?
  - What oversight will be required
    - By whom and with what authority to intervene or adjust the programme?
  - Need to establish a central repository for data from all sources in order that multiple analyses can be performed by different parties using different tools and different philosophies; but all using the same dataset
    - Where will the database be housed?
    - Who will administer all the IT aspects?
    - What network infrastructure / architecture can be agreed?
    - Who will fund the supporting infrastructure?
    - What data formats will be used for commonality and access by all participants?

Detailed Considerations (1)

- What maturity of solution is to be tested?
  - Opportunity to use new and evolving tools as well as more established tools
- To what extent is this a proof of concept, and to what extent a demonstration of a particular system or solution?
- Commercial basis
  - Are participants to be asked to sponsor the trial by time, effort, software, equipment?
  - Are participants going to be compensated in any way?
  - Is the pilot going to be conducted using solutions chosen as a result of a competitive or review process?
  - Will this be a JIP with a formal structure and agreements?

Detailed Considerations (2)

- Training
  - What training will be needed for front-line personnel?
  - What about service, support and project personnel?
  - Where, when, how and by whom will training be given?
- Offshore impact
  - Will raw or processed data be made available to offshore users?
    - This will depend, in part, on the objectives of the pilot
- Will indicators or recommendations be acted upon when raised?
  - If not, how to later prove those recommendations were correct?
  - Recover and dismantle components later for analysis?
  - Condition could change between indication and inspection

Detailed Considerations (3)

- Equipment changes
  - What modifications will be allowed by operators, contractors, OEMs or regulators to fit the sensors needed to execute a meaningful pilot?
  - Who will bear the cost of such changes?
  - Where will the new sensors come from?
- What standards (if any), e.g. API, ABS or DNV, can or must be applied to the programme?
- Will dispensations or exemptions be needed to support the pilot?
- Preconditions and interdependencies, e.g.
  - For CBM to be effective, there needs to be an Asset Management system in place to support the assessment process

Detailed Considerations (4)

- What can we learn from other industries?
  - We do not need to re-invent the wheel for all things
  - What tools and techniques can be transferred or adapted from aerospace, defence, process, power, water…
- Apply to new build and / or retrofit?
  - Must address retrofit – new build is too small a target
  - Retrofit raises extra challenges and costs
  - Cannot rely on factory-fresh baseline signature data
  - Need more pragmatic approach to assessing condition

Thorny Issues

- Ownership of data
  - Both raw and processed
- Liability over failure to predict events
- Liability in predicting events which do not occur
- Proprietary nature of some of the data, e.g. original baseline data for equipment signatures
- Visibility of data
  - Required by all parties involved in the programme
- Data integrity
  - Ensure data have not been manipulated, e.g. by recording a failure as mechanical instead of electrical (by accident or design)
- Cybersecurity

Challenges

- The technical elements of a successful BOP CBM pilot programme will be interesting and challenging
- The non-technical elements such as commercial, legal and confidentiality could prove to be more difficult
  - What can be leveraged from the agreements used in the BOP Reliability JIP run by IOGP and IADC?
  - The reluctance to share data has been resolved – how?

Safety is not a Competition

- International Air Transport Association (IATA)
  - *"No matter how hard airlines may compete within an industry sector or how differently they may see the world when it comes to commercial issues, **airlines do not compete on safety**. Every improvement is a gain for the industry. That has allowed aviation to develop a tradition of transparently sharing information, experiences, and best practices to make flying ever safer"*

- This reflects the consistent theme of the presentations and discussions throughout the Centre for Offshore Safety Forum (Houston, 20th & 21st Sept 2016) on the vital need to share data within the oil and gas industry

Make a positive from a negative?

- In this downturn, can use be made of the large number of rigs idle in places like the Cromarty Firth in Scotland?
  - Use as test beds?
  - Trial and prove modifications?
  - Streamline installation requirements?
  - Reduce risks and increase confidence before going to an operating rig?

Recommendations (1)

- Consider the following
  - Variety of types and makes of equipment
    - Ram BOP, annular BOP and as many elements of their control systems as are meaningful
    - Absolute minimum are items on safety-critical paths
  - Variety of approaches to investigate the pros and cons of different solution philosophies and methodologies
    - Statistical / modelling / machine learning / Bayesian networks etc.
    - Compare the results against each other and the actual equipment
    - All approaches using the same dataset
    - This is a huge learning opportunity

Recommendations (2)

- Cybersecurity
  - Separate monitoring data and control systems
    - Monitoring must not compromise operational integrity
  - Consider intermediate read-only historians on VPNs
- Data volumes
  - Use reporting on exception as part of strategy to manage data when it is appropriate to do so
- The opportunity is to advance the state of the art and to greatly increase the range of information captured and processed
  - Restricting the exercise to, for example, cycle count data, will be to miss an opportunity to move BOP monitoring into the 21st Century
  - This will require new sensors and not just rely on the limited data presently available, as they are inadequate for comprehensive insights into the health of systems

These thoughts are only part of the bigger topic

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- This is an important subject where progress can and must be made
  - Partly through the application of existing technologies
  - Partly through new developments, e.g. sensors, data interfaces, algorithms and predictive techniques
  - From a willingness by all concerned to participate and collaborate fully and constructively in the many factors that will need to be addressed

Conclusion

- A successful programme outcome is eminently achievable and should pave the way for a substantial advance in monitoring, managing and maintaining subsea BOP

Dr. **Andrew Jaffrey** CEng FIET

www.TechDevEng.com

aj@techdeveng.com

+44 (0)7824-636022