

RESEARCH & DEVELOPMENT PROGRAM SUBCOMMITTEE FINDINGS AND RECOMMENDATIONS

Subcommittee Roster

- **Dr. Douglas J. Foster, Chair**
- **Mr. D. Stephen Pye**
- **Dr. Quenton R. Dokken**
- **Mr. James D. Litton**

General Comments

The R&D Program Subcommittee of the UDAC notes that the *2014 Annual Plan* has continued to take into account safety and environment in several aspects of the proposed program. This program is nearly complete and therefore the *2014 Annual Plan* represents a slight modification of the *2013 Annual Plan*. Acknowledging that it is late in the program, we still wish to stress the importance of the emphasis on safety into the future. Also, we feel it is important to highlight gaps in the current research program.

The Program Subcommittee is largely in agreement with the suggestions for research topics contained in the *2014 Annual Plan*. In the UDAC report on the *2012 and 2013 Annual Plans*, there was acknowledgement that there has been an overall redirection of research topics towards safety and accident prevention. The *2013 Annual Plan* reflects this redirection of research as well. In last year's recommendation, the Program Subcommittee stressed there should be more emphasis on the importance of human factors relating to safety and environmental issues. To date, there is one approved project, (RPSEA 11121-5101-01), analyzing the human factors related to safety. This positive effort by RPSEA is acknowledged and should be encouraged in the complementary research programs within the National Energy Technology Laboratory (NETL) and Los Alamos National Laboratory (LANL).

Traditionally, the research program has focused on technical issues, and the expert advice helping guide the program has come from physical scientists and engineers. We encourage input from experts on human behavior in hazardous operating conditions. The National Commission Report to the Presidential found:

- " ... *As a result of our investigation, we conclude:*
- *The explosive loss of the Macondo well could have been prevented;*
 - *The immediate causes of the Macondo well blowout can be traced to a series of identifiable mistakes made by BP, Halliburton, and Transocean that reveal such systematic failures in risk management that they place in doubt the safety culture of the entire industry."*

That is, the Macondo incident was primarily the result of human failure, requiring more emphasis on this factor by the research program.

A first action could be to establish an expert in the occupational behavioral sciences and have this person survey what is already known. Gaps could be identified and resources could be redirected to fill these gaps. This should be accomplished by the RPSEA 11121-5101-01 project, but there is no follow on work in the 2014 plan. This research effort could also include advanced decision support and backup systems.

Although it may be late in the research program, some future consideration should be given to issues related to the containment of hydrocarbons throughout the entire lifecycle of an oil or gas field. The flow of hydrocarbons should be exclusively confined to the reservoir, production tubing, and surface facilities. Not only should hydrocarbon flow be controlled, but also any injected fluids or gas. There is funded research on the metallurgy of pipes and on cements; however, there appears to be little attention paid to other potential avenues of leakage, such as long term borehole stability and fracturing through the overburden formations. Also, there is funded research in reservoir characterization, but little to no attention paid to characterizing the overburden for potential paths of leakage and areas of abnormal pressure. In the *2014 Annual Plan* there is a solicitation for reservoir and overburden characterization and we encourage this effort. Technology is lacking for adequate monitoring of hydrocarbon production and this is particularly true in UDW environments. There is project solicitation on advanced pore pressure prediction but very little on long term containment monitoring.

We feel it is important to include a general comment not exclusive to UDW but applicable to other marine operations. Information is limited regarding methods to prevent and respond to catastrophic events, and mitigate the negative impacts of spills in remote, harsh and sensitive environments. Environmental protection and personnel health and safety working in harsh, unique and sensitive marine habitats requires additional focus. Characterization of the risks to unique and sensitive marine habitats associated with drilling, completion and production activities demands more research.

The R&D Program subcommittee offers the following findings and recommendations. We are not requesting a change of direction of the program, but wish to point out significant areas of research for UDW that should warrant further attention.

Findings and Recommendations

Finding 1

The *2014 Annual Plan* does not adequately address human factors related to accident prevention. The following recommendations would enhance the program:

Recommendation 1

Increase the emphasis in areas of human interaction. Models can be found in training or simulator programs utilized by nuclear and aviation industries. Effective implementation will require that the *2014 Annual Plan* be modified to give this area higher priority.

Possible areas of focus might include:

- Prepare a survey of studies on human behavior in hazardous operating environments, (while this may be included in RPSEA 11121-5101-01, we encourage the follow on of this project);
- Continued work on instruments and data analysis (expert systems) to improve decision making capability, and;
- Expand work on hazards and risk analysis from a human perspective. Training methods such as those used in nuclear submarine and nuclear materials handling in the USN and DOE National labs might be adaptable for UDW operations.

Finding 2

The *2014 Annual Plan* lacks content regarding expert (case based) systems that alert operating personnel to potential hazards before they occur, which provide recommendations to mitigate potential risk. There appears to be a gap in developing a systematic way to integrate and analyze diverse measurements related to the overall safety of deepwater operations.

Recommendation 2

Determine the present scope of expert (case based) systems, and then identify benefits and limitations as well as other applications (such as cementing, completions, wellbore design, etc.) that would reduce the risk when operating in deepwater. The development of synthesis and analysis systems that integrate different types of data can be useful for insuring safe operations.

Finding 3

The safe and environmentally responsible operation of oil and gas production throughout the entire life of a field requires the containment of hydrocarbons to the reservoir, production casing and surface facilities. Barriers in both the wellbore vicinity and the subsurface should be identified, and facilities should be designed accordingly. Also, adequate monitoring systems need to be developed so that out of zone flow can be detected early and mitigated. There are elements of containment (pipe metallurgy and cements) but no comprehensive program in the *2013 Annual Plan* for addressing this issue.

Recommendation 3

Possible areas of focus might include:

- Mitigate leakage in and around the boreholes from reservoir fluids and gas as well as any injected liquids and materials;
- Long term borehole stability;
- Establish plugging and abandoning technology for long term containment of hydrocarbons, and;

- Long term monitoring systems (i.e. down hole and well head pressure sensors, time lapse seismic surveying, sea bed monitoring, etc.);
- Expand the NETL complementary research program to include larger range of issues of borehole integrity.

Finding 4

The 2014 Annual Plan stresses the need for better reservoir characterization in the research program, but little attention is given overburden characterization. Possible abnormal pressure zones and leak paths can negatively affect the drilling and production activities. There is no effort to monitor the overburden changes throughout the complete lifecycle of a producing field.

Recommendation 4

Expand the research on reservoir characterization to include overburden characterization as well. Technology and methods for geological and geomechanical characterization of the subsurface from sea bed to the reservoir should be emphasized. Develop systems to monitor overburden variations over time.

Finding 5

In funded projects aimed at reducing risks in the UDW, there lacks a comprehensive understanding of how the individual components fit together. The risk and the consequences are addressed in the individual components of drilling and engineering design, but not of the overall system.

Recommendation 5

The Engineering and Operational Practices (EOP) should be developed for overall logistics of UDW operations. The EOP should be designed to capture all risk elements, their interdependencies, and the associated consequences. We recommend that EOP be included in relevant projects funded by the research program.