Effects of Water Depth Workshop

BSEE
Bureau of Safety and Environmental Enforcement

Topic 3 – Well Drilling & Completion Design and Barriers

Jim Raney

Disclaimer – Individual Opinions

Topic 3 – Well Drilling & Completion Design and Barriers

The opinions contained in this presentation are my own and do not necessarily represent the opinions or position of Anadarko Petroleum or any other company.

Session Objectives

Topic 3 – Well Drilling & Completion Design and Barriers

- Demonstrate Alignment among Operators, Service Providers, and Regulators
- Addressing Today's Issues – Conversation with Regulators regarding the design of wells for life cycle integrity
- Moving Forward – Setting the stage for future dialog between Operators and Regulators, to work together to ensure safe and efficient operations

Workshop Preparations

Topic 3 – Well Drilling & Completion Design and Barriers

- Develop a White Paper to Discuss:
  - A) Current Technologies – Implementation Challenges
  - B) Trends or Notable Technologies (near & long-term)
  - C) Coordination & Communication to help Align Industry and Regulators
  - D) Human Factors in Safety

Develop Findings on the Above Topics

- Coordination & Communication to help Align Industry & Regulators (16 Findings)
- Human Factors in Safety (4 Findings)
- Well Design – Technical Challenges (6 Findings)
- Operational Challenges Barrier Systems (5 Findings)
- Completion Design (3 Findings)

Bureau of Safety and Environmental Enforcement

2-Day Workshop Process

Topic 3 – Well Drilling & Completion Design and Barriers

- Present Key Findings
- Presentations and Discussions
  - The Structure – The Deepwater Well
  - Safety, Risk and Regulations
  - Loads – Jim Raney, Anadarko
  - Strengths – Mike Payne, BP
  - Barriers (API RP/Std 96) – Rick Graff, Chevron
  - Cement as a Barrier – Craig Gardner, Chevron
  - Connections as a Barrier – Bob Sivley, Hunting
  - New Technology – John Kozicz, Transocean

Workshop Products

Topic 3 – Well Drilling & Completion Design and Barriers

- Findings
- Conclusions
- Recommendations (path forward)
- Captured in the Final White Paper

Workshop Approach

Topic 3 – Well Drilling & Completion Design and Barriers

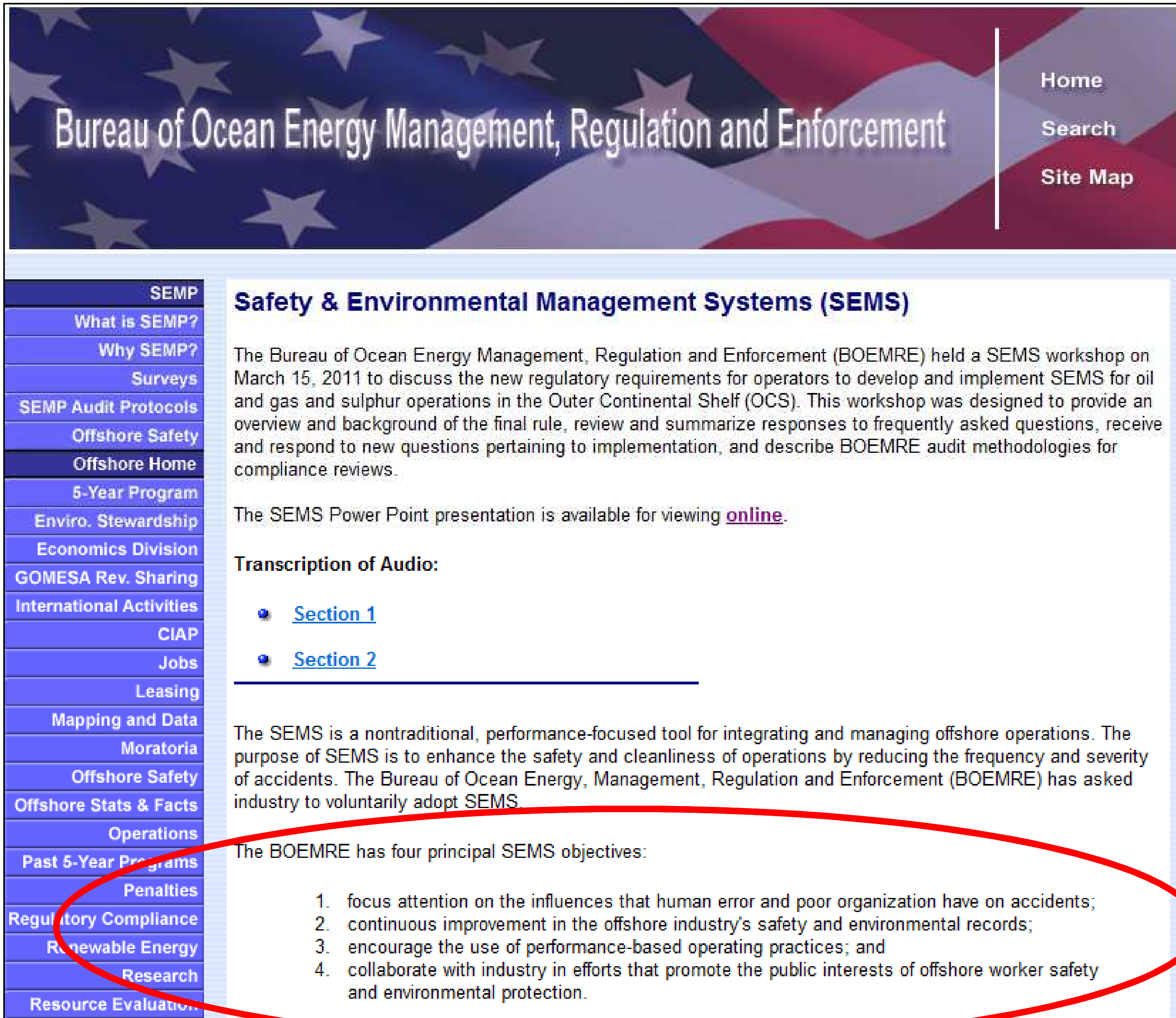
- Conversational – Seeking Rational Direction that Enhances Safety while Meeting Regulations and Honoring Industry Standards
- Not Confrontational – Seeking Alignment on Key Design and Regulatory Issues – Discuss Real Issues and Opportunities
- Starting Point – Many Conversations to Come

Safety, Risk and Regulations

PSM	Workplace Safety Rule API RP 75 – SEMS I, II
Employee Participation	Employee Participation (SEMS II)
Process Safety Information	Safety and Environmental Information
Process Hazard Analysis	Hazards Analysis
Operating Procedures	Operating Procedures
Training	Training
Pre-Startup Safety Review	Pre-Startup Review
Mechanical Integrity	Mechanical Integrity
Work Permits	Safe Work Practices
Management of Change	Management of Change
Incident Investigation	Investigations of Incidents
Emergency Response Plan	Emergency Response and Control
Compliance Audits	Auditing, Use of independent 3rd Pty auditors
Trade Secrets	
Contractors	Records and documentation
	A Stop Work provision (SEMS II)
	Definition of authority (SEMS II)
	Reporting of unsafe conditions (SEMS II)
	Additional requirements for JSAs (SEMS II)

BSEE Bureau of Safety and Environmental Enforcement

Argonne National Laboratory



Bureau of Ocean Energy Management, Regulation and Enforcement

Home

Search

Site Map

SEMP

What is SEMP?

Why SEMP?

Surveys

SEMP Audit Protocols

Offshore Safety

Offshore Home

5-Year Program

Enviro. Stewardship

Economics Division

GOMESA Rev. Sharing

International Activities

CIAP

Jobs

Leasing

Mapping and Data

Moratoria

Offshore Safety

Offshore Stats & Facts

Operations

Past 5-Year Programs

Penalties

Regulatory Compliance

Renewable Energy

Research

Resource Evaluation

Safety & Environmental Management Systems (SEMS)

The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) held a SEMS workshop on March 15, 2011 to discuss the new regulatory requirements for operators to develop and implement SEMS for oil and gas and sulphur operations in the Outer Continental Shelf (OCS). This workshop was designed to provide an overview and background of the final rule, review and summarize responses to frequently asked questions, receive and respond to new questions pertaining to implementation, and describe BOEMRE audit methodologies for compliance reviews.

The SEMS Power Point presentation is available for viewing online.

Transcription of Audio:

- Section 1
- Section 2

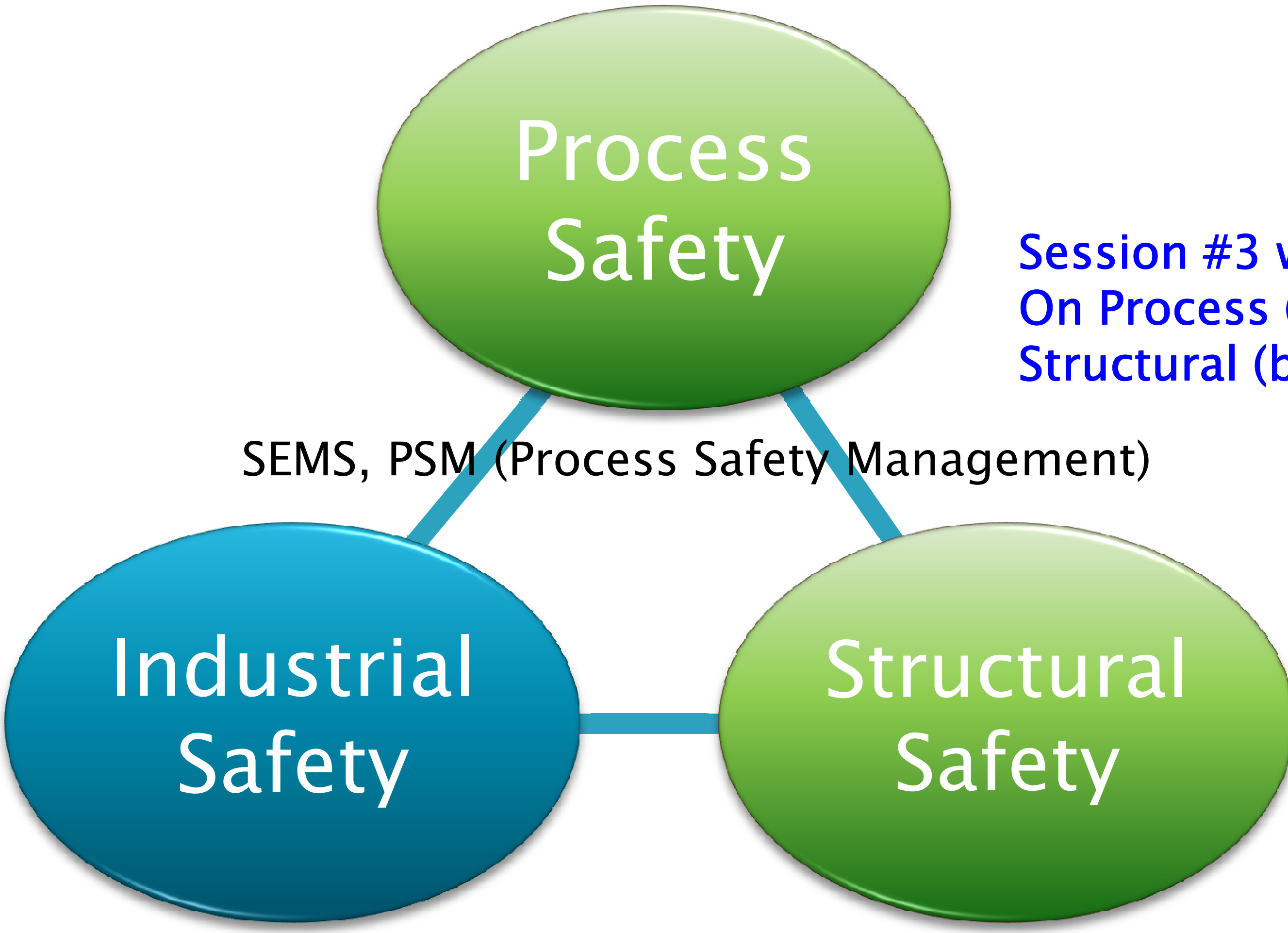
The SEMS is a nontraditional, performance-focused tool for integrating and managing offshore operations. The purpose of SEMS is to enhance the safety and cleanliness of operations by reducing the frequency and severity of accidents. The Bureau of Ocean Energy, Management, Regulation and Enforcement (BOEMRE) has asked industry to voluntarily adopt SEMS.

The BOEMRE has four principal SEMS objectives:

1. focus attention on the influences that human error and poor organization have on accidents;
2. continuous improvement in the offshore industry's safety and environmental records;
3. encourage the use of performance-based operating practices; and
4. collaborate with industry in efforts that promote the public interests of offshore worker safety and environmental protection.

Three Areas of Safety and Risk Focus

Topic 3 – Well Drilling & Completion Design and Barriers



Session #3 will focus
On Process (activity) &
Structural (barriers)

Personal Safety – Slips, trips, falls…

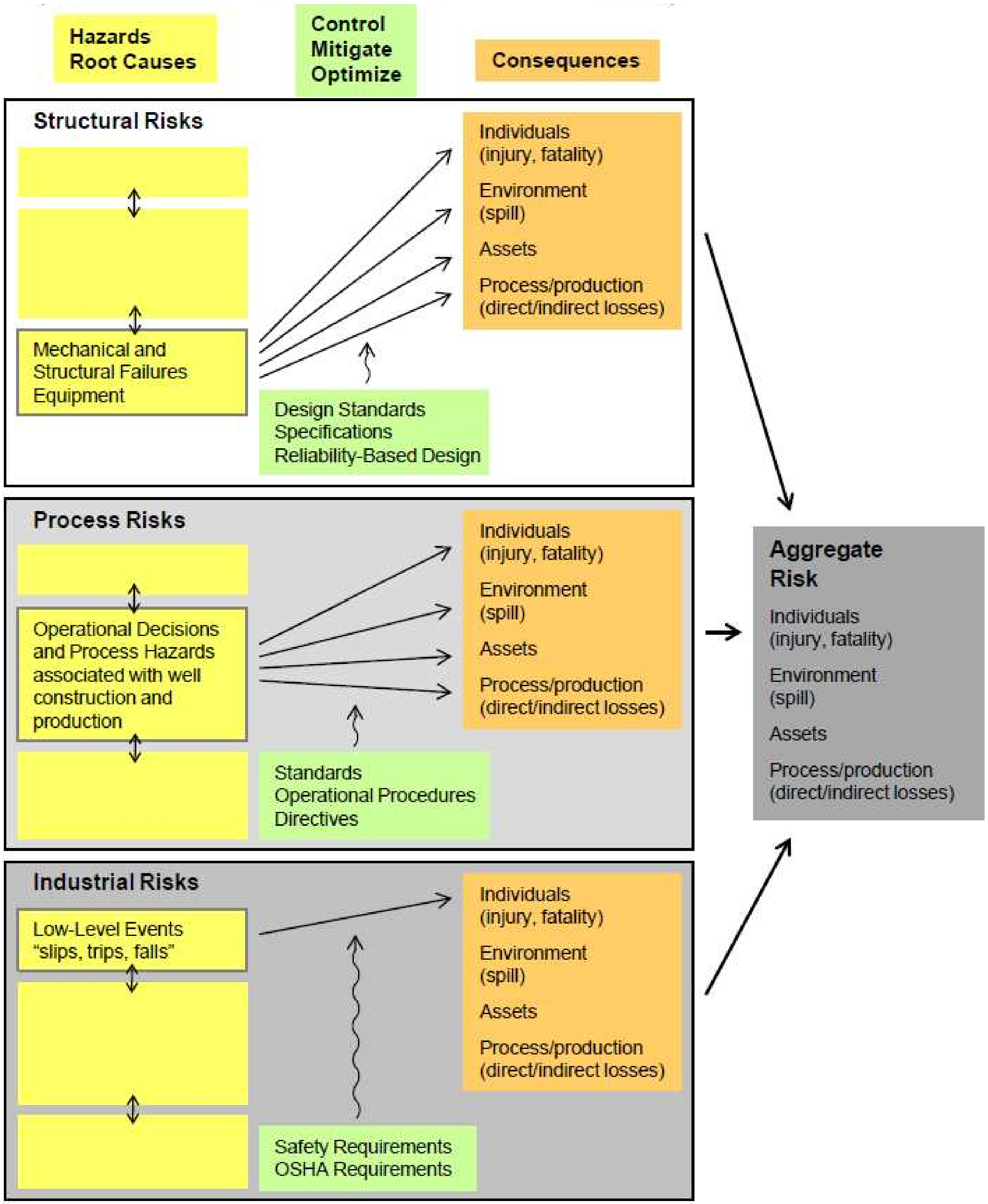
Mechanical Integrity

Types of Risk

Structural

Process

Industrial



BSEE Bureau of Safety and Environmental Enforcement

Argonne NATIONAL LABORATORY

Key Findings

Key Findings – Question 1 (Design)

Topic 3 – Well Drilling & Completion Design and Barriers

1. **Worst Case Discharge Design Load** – The Worst Case Discharge design load, as currently required by the BOEMRE, is overly conservative. The mandated design case has resulted in well designs that add operational risk, limit design options, and that exceed operational requirements. Alternatives to this design criterion should be considered by the BOEMRE. The collapse load increase is significant and the value of resisting theoretical collapse should be compared with unintended consequences.

5. **Annular Pressure Build-up Mitigation** – Well designers want to retain the ability to choose APB mitigations that address credible risks during well construction and operation. Because of the extreme low probability associated with the Worst Case Discharge load case, it is recommended that WCD not be used to dictate APB mitigations.

Key Findings – Question 2 (Barriers)

Topic 3 – Well Drilling & Completion Design and Barriers

1. **In-situ Verification of Barrier Integrity** – Regulations should change to require only one pressure test of a dual barrier system. Additional work should be undertaken to establish standards that improve the reliability of “negative” pressure tests.

2. **Reliability of Mechanical Barriers** – The reliability of a mechanical barrier can be established by various factors including quality in design, manufacture, installation and testing.

3. **Reliability of Cement Barriers** – The reliability of an annular cement barrier is in part a function of annular clearance and centralization. These attributes are particularly important in close tolerance casing programs.

5. **Casing and Cementing Equipment Reliability** – There is a need to identify and reduce common equipment failure modes; to increase the reliability of individual casing/cementing equipment components; and to improve the integration of these components into highly reliable barrier systems.

Findings – C) Coordination/Communication

Topic 3 – Well Drilling & Completion Design and Barriers

- Aligning the Efforts of Industry & Regulators
  - Alignment Mechanisms
  - Improved Relationships
  - Gaps/Issues – Regulations, Standards, & Collaboration

Findings – D) Human Factors in Safety

Topic 3 – Well Drilling & Completion Design and Barriers

- Training and Competency
- Risk Management
- Management of Change
- Identification & Management of Critical Equipment

Effects of Water Depth Workshop

BSEE
Bureau of Safety and Environmental Enforcement

Back-up slides

Findings

White Paper

Findings

Three Questions

Topic 3 – Well Drilling & Completion Design and Barriers

1. *What Challenges Exist in Casing and Equipment Design for Deepwater Wells?*

2. *What are the Operational Challenges with Implementing Reliable Barrier Systems?*

3. *What Challenges Exist in Deepwater Completion Designs?*

Findings – Question 1 (Design)

Topic 3 – Well Drilling & Completion Design and Barriers

1. **Worst Case Discharge Design Load** – The Worst Case Discharge design load, as currently required by the BOEMRE, is overly conservative. The mandated design case has resulted in well designs that add operational risk, limit design options, and that exceed operational requirements. Alternatives to this design criterion should be considered by the BOEMRE. The collapse load increase is significant and the value of resisting theoretical collapse should be compared with unintended consequences.

2. **Long String versus Liner and Tieback** – A long string is a viable alternative to liner and tieback designs. The long string provides advantages in many deepwater well applications. Both designs have merit and should continue to be available to well designers.

3. **Production Liner – Well Control Design Options** – For well control scenarios, it is important to retain the design option to allow for production liner collapse. Liner collapse can be an effective way to mitigate flow from the reservoir under extreme well control conditions.

BSEE Bureau of Safety and Environmental Enforcement

Argonne NATIONAL LABORATORY

Findings – Question 1 (Design)

Topic 3 – Well Drilling & Completion Design and Barriers

4. **BOP and Wellhead Equipment for Deeper Water, Higher Reservoir Pressures** – There are technical, regulatory and operational challenges associated with the use of existing BOP systems in high-pressure applications. Without consideration for seawater hydrostatic back-up, current subsea BOP systems are not able to shut-in on wells with pressures exceeding 15 K psi at the BOP (note: backup pressures, which can be significant in deepwater, are not considered for the BOPs, though they are for casing design – see Question 1, Finding 6). Because of the extreme low probability of WCD occurrence, the load case associated with cap and flow well control operations should be permitted for high pressure exploration wells. Operational risk should be considered for management of cap and flow under severe weather conditions such as winter storms and hurricanes.

5. **Annular Pressure Build-up Mitigation** – Well designers want to retain the ability to choose APB mitigations that address credible risks during well construction and operation. Because of the extreme low probability associated with the Worst Case Discharge load case, it is recommended that WCD not be used to dictate APB mitigations.

6. **Working Pressure Ratings of Subsea BOP Equipment** – The prediction of the benefit derived from hydrostatic pressure back-up is straightforward for simple geometries such as tubulars. The benefit to more complex geometries, such as subsea BOP equipment, is not as easily predicted. Industry should continue to work to estimate the working pressure benefit that can reliably be provided to subsea BOP systems as a result of environmental pressure effects.

Findings – Question 2 (Barriers)

Topic 3 – Well Drilling & Completion Design and Barriers

1. **In-situ Verification of Barrier Integrity** – Regulations should change to require only one pressure test of a dual barrier system. Additional work should be undertaken to establish standards that improve the reliability of "negative" pressure tests.

2. **Reliability of Mechanical Barriers** – The reliability of a mechanical barrier can be established by various factors including quality in design, manufacture, installation and testing.

3. **Reliability of Cement Barriers** – The reliability of an annular cement barrier is in part a function of annular clearance and centralization. These attributes are particularly important in close tolerance casing programs.

4. **Mechanical Lock-Down of Hanger and Hanger Seal Assemblies** – The requirement to lock down seal assemblies should apply only to those seals with the potential for exposure to hydrocarbons.

5. **Casing and Cementing Equipment Reliability** – There is a need to identify and reduce common equipment failure modes; to increase the reliability of individual casing/cementing equipment components; and to improve the integration of these components into highly reliable barrier systems.

Findings – Question 3 (Completions)

Topic 3 – Well Drilling & Completion Design and Barriers

1. **Stimulation of Deep Tight Formations** – The commercial development of deep tight formations will require special production stimulation techniques that may exceed current capabilities.

2. **Well Intervention Systems** – Intervention operations on deeper and higher-pressure wells may exceed the capacity of available equipment. Additional development will of intervention systems will be required.

3. **Low Cost Reservoir Access** – While low cost reservoir access techniques have been successfully used in recent years, the development of specialized equipment, systems and deployment vessels will be required to make full use of this approach to access deepwater Gulf of Mexico reserves.

Findings – C) Coordination & Communication

Topic 3 – Well Drilling & Completion Design and Barriers

- Aligning the Efforts of Industry and Regulators
  - Alignment Mechanisms
  - Improved Relationships
  - Gaps/Issues – Regulations, Standards, & Collaboration

Findings – D) Human Factors in Safety

Topic 3 – Well Drilling & Completion Design and Barriers

- Training and Competency
- Risk Management
- Management of Change
- Identification & Management of Critical Elements