Emergent Technology Final Report

Submitted to
The Bureau of Safety and Environmental Enforcement (BSEE)

Submitted by
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Executive Summary

The Bureau of Safety and Environmental Enforcement (BSEE) is responsible for overseeing safe and clean operations on offshore the U.S. Outer Continental Shelf (OCS). In order to carry out this mission, BSEE establishes requirements for exploration and production activities and publishes these as regulations in the Code of Federal Regulations (30 CFR §250). BSEE continues to expand its role as a world leader in safety and environmental stewardship through innovative regulatory approaches and appropriate collaboration with industry. By doing this, BSEE fosters a culture of safety and compliance among Operators with an aim towards reducing the risk of accidents and hydrocarbon spills. For Fiscal Year 2015 (FY15) BSEE's Strategic Goal #1 was to regulate, enforce, and respond to OCS development using the full range of authorities, policies, tools to compel safety, emergency preparedness, and environmental sensitivity and responsible development and conversation of offshore oil and gas resources.

The OCS Lands Act of 2000 (43 U.S.C. 1331 et seq.as amended) authorizes and requires BSEE to provide for both an annual scheduled inspection and a periodic unscheduled (unannounced) inspection of all oil and gas (O&G) operations on the OCS. BSEE conducts drilling, well control and production inspections on drilling rigs and platforms. Within these inspections that are required pursuant to 30 CFR §250, are
On September 25, 2014, BSEE awarded ABSG Consulting Inc. (ABS Consulting) Task Order #E14PB00078 by BSEE. The contract's period of performance began on September 29, 2014 and ended on September 28, 2015. Through Technical Direction Letters (TDL) issued under this contract, the ABS Consulting team would provide technical support to provide an independent third party review to supplement the existing process within BSEE for reviewing submissions received from the oil and gas industry for the use of new technology.

On April 24, 2015, BSEE issued TDL #001 to provide a program risk assessment for new technology evaluations. Under this TDL, ABS Consulting would complete the following work.

1.) Develop a risk assessment framework and related processes/workflow for screening alternative compliance and departure submissions related to new technologies. This includes review of the existing practices and submittal requirements in place for the review of these operational submissions/permits.
2.) Develop and validate overall procedures and risk-based criteria for BSEE to use to evaluate and process DWOPs, Alternative Compliance and Departures involving the use of new technology associated with each of the following;
    - Subsea and other 'deepwater Blowout Preventers (BOPs)'
    - Shallow sea deep earth wells with high pressure and temperatures
    - HPHT evaluations that are not already covered above
    - Use of new technology in well control
    - New technology application in Arctic environments
    - High corrosive and other hostile environments

ABS Consulting established three teams to execute the project and produce the required deliverables. These teams were a Risk Assessment Team, Barrier Team, and a Process Guide Team. Each team developed various aspects of the deliverables, provided notable findings and contributed to the overall recommendations found within this report. This report contains the following deliverables:

Deliverables A and B: Risk Assessment Technical Note

- Provides workflow details associated with the risk assessments in connection with the barrier analysis.

Deliverables A and B: Barrier Analysis Technical Note

- Provides a clear understanding of barrier definitions and other relevant aspects of the barrier models that the Operator must submit to BSEE.

Deliverable C: Operator's New Technology Submission Guide

- Provides a systematic process for the Operator to prepare submissions to BSEE related to the use of new technology.

Deliverable C: BSEE SOP for New Technology Evaluation

- Provides a systematic process for BSEE to evaluate the Operator's submissions related to the use of new technology.

Deliverable D: Completed Risk Assessments - Five Case Studies

- Ultra Deepwater Drilling with a Subsea BOP
- Drilling a Well using a MODU with a Surface BOP
- Managed Pressure Drilling (MPD)
- HPHT and High Corrosive Environment
- Drilling from a Semi-Submersible in the Arctic

Recommendations are provided to assist BSEE with implementation and deployment of the information contained in these deliverables.

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1. Introduction

The Bureau for Safety and Environmental Enforcement (BSEE) seeks to expand its role as a world leader in safety and environmental stewardship. Through innovative regulatory approaches and appropriate collaboration with industry, BSEE fosters a culture of risk reduction and compliance among Operators that results in reducing the risk of accidents and spills and an enhanced ability to respond to those that do occur with prompt and appropriate regulatory action. BSEE seeks to continue serving as a model for other regulatory agencies and international peers. BSEE, along with other responsibilities has a requirement to review and assess oil and gas technologies that include complex and often unproven cutting-edge (new) technologies for unique operational conditions.

On April 24, 2015, BSEE issued TDL #001 under the Evaluation of Emergent Technology contract (E14PB00078) to provide a program risk assessment for new technology evaluations. The period of performance for this TDL was April 25, 2015 through September 28, 2015. Under this TDL, ABS Consulting would complete the following work

1.) Develop a risk assessment framework and related processes/workflow for screening alternative compliance and departure submissions related to new technologies. This includes review of the existing practices and submittal requirements in place for the review of these operational submissions/permits.
2.) Develop and validate overall procedures and risk-based criteria for BSEE to use to evaluate and process DWOPs, Alternative Compliance and Departures involving the use of new technology associated with each of the following;
    - Subsea and other 'deepwater Blowout Preventers (BOPs)'
    - Shallow sea deep earth wells with high pressure and temperatures
    - HPHT evaluations that are not already covered above
    - Use of new technology in well control
    - New technology application in Arctic environments
    - High corrosive and other hostile environments

The purpose of this project is to provide BSEE with risk-based procedures for evaluating and processing new technology submissions received by BSEE from Operators in the offshore oil & gas industry. Given the rapid advances in the use of new technology in the offshore oil and gas industry, senior leaders in BSEE, wanted to develop a systematic process to review and understand the risks associated with the use of new technology in exploration, development and production activities on the OCS.

This report contains the results of ABS Consulting's efforts over the duration of the project. Section 2 highlights the ABS Consulting teams involved in the project and provides an overview of the approach used by the team to develop a new technology assessment process, develop risk assessment methodologies and develop procedures to analyze the barriers associated with the new technologies. Section 3 contains recommendations for BSEE to consider when implementing and deploying these risk-based procedures. Several appendices provide work products and reference materials developed throughout the project including the specific deliverable for TDL #001.

2. ABS Consulting Approach

Upon receipt of TDL #001 on April 24, 2015 by BSEE, ABS Consulting prepared and delivered a response, which included a description of the required work and deliverables, a technical approach to completing the required work, along with a detailed discussion of each of the tasks. Following the review of the TDL response, BSEE issued the Notice to Proceed on May 1, 2015.

2.1 The ABS Consulting Team

ABS Consulting assembled four teams to conduct the work. These teams included 95 engineers and technical support staff from our offices in the United States, Norway, the United Kingdom, the Middle East, Singapore and Australia. The teams included:

- Project Management Team
- Barrier Analysis Team
- Risk Assessment Team
- Process Guide Development Team

Figure 1 shows the location of the ABS Consulting team members participating in this project.

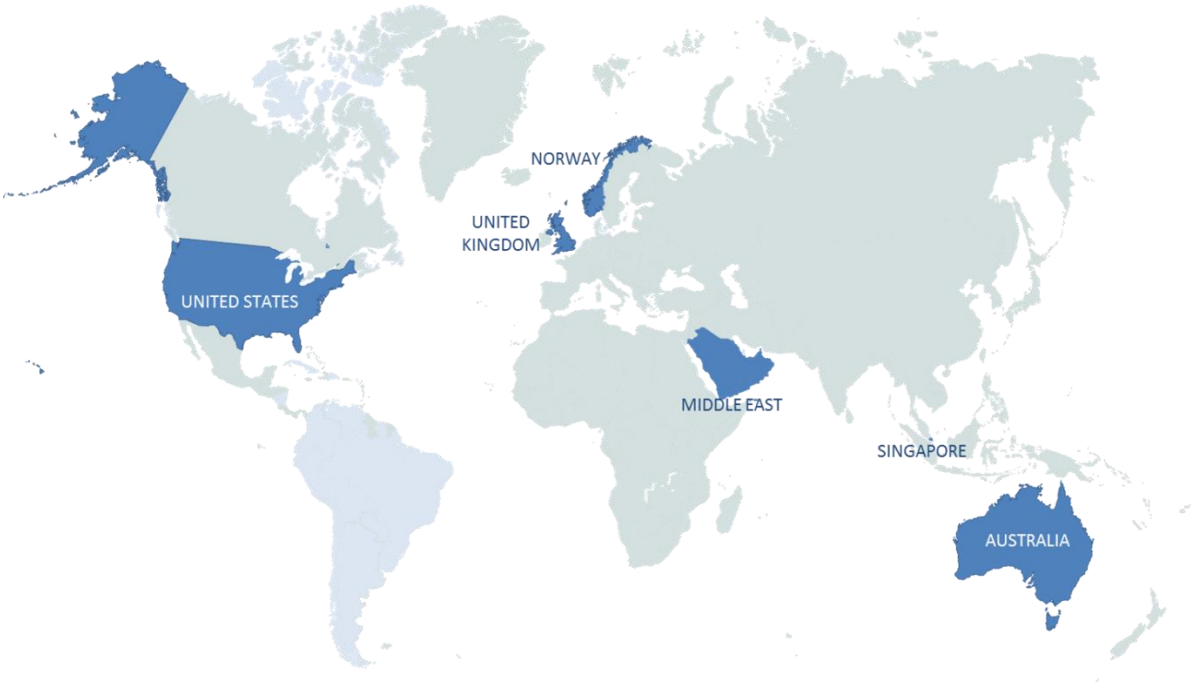

Figure 1: Location of ABS Consulting Team Members

2.2 The Approach to the Project

Figure 2 provides an illustration of the technical approach that ABS Consulting used to complete the required work.

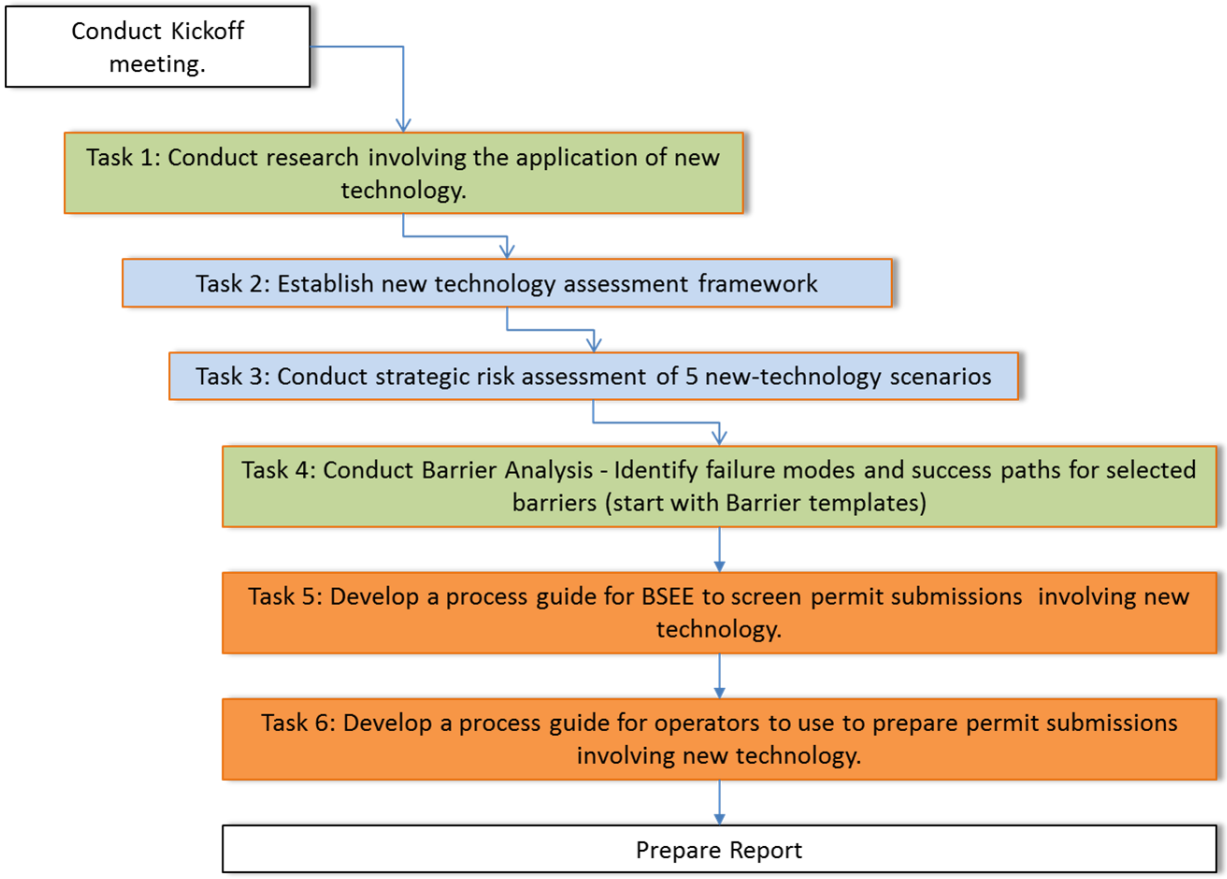

Figure 2: Approach to Completing the Project

ABS Consulting's approach began by researching the use of new technology in the offshore oil and gas industry throughout the world. The team developed four categories of new technology, which became part of a new technology assessment framework. The team also researched barrier modeling theory and concepts and developed a barrier model template for use in conducting barrier analysis. Five new technology scenarios were developed to serve as example 'projects' for the team to use to develop and ultimately complete example risk assessment and barrier analysis. With the new technology assessment framework in place, the process team began developing workflows for Operators to use to assess new technology applications and workflows for BSEE to use to evaluate Operator's submissions involving new technology. The team used the process workflows to develop example 'case studies' for each of the five scenarios, which included a completed new technology assessment, a completed risk assessment and a detailed barrier analysis, complete with barrier model and barrier element attribute checklists.

2.1 Development of New Technology Assessment Framework

As the exploration, development and production of offshore oil and gas moves into deeper, harsher and colder environments, the offshore industry is introducing emergent technologies to address the operational needs in these environments. Regulations in Title 30 CFR 250.200 define *New* or *unusual* technology as equipment or procedures that:

1. Have not been used previously or extensively in a BSEE OCS Region;
2. Have not been used previously under the anticipated operating conditions; or
3. Have operating characteristics that are outside the performance parameters established by this part.

ABS Consulting's first step was to developing a New Technology Assessment Framework. The teams researched the type of new technology received by BSEE in various permits and submissions, including Deepwater Operating Plan, Applications for Permit to Drill, alternative compliance and departure request to gain an understanding of the types of new technology emerging in the offshore oil and gas industry. The research included:

1. Literature review of relevant codes, standards and regulations initiated based on the focus areas related to new technology.
2. Sample submissions provided by BSEE related to new technologies in order to:
    a. Understand what was considered as new technology in the submittal
    b. Identify typical supporting information / documents provided to BSEE
    c. Any risk assessments carried out to support the proposed new technology

The teams also met with BSEE representatives at Headquarters and the Gulf of Mexico, California and Alaska regional offices to discuss the new technology related challenges and current criteria used by BSEE to review these permit and other submissions. From this, research the team developed a new technology assessment process to identify novel and conventional aspects of technology and assess the degree of novelty for each. This process included four categories to identify new technology:

1. Known Technology, Known Conditions
2. Known Technology, Different or Unknown Conditions
3. New Technology, Known Conditions
4. New Technology, Different or Unknown Conditions

Using these categories, the Team developed a *New Technology Assessment Framework* in order to identify the types of analysis that needed to assess the risks associated with the new technology. The framework helps determine if the submission involves new technology, new operating conditions, or both, and categorizes the new technology for further evaluation. **Figure 3** illustrates the new technology assessment framework, which consists of four categories. Category 1 involves known technology used in known conditions. As such, Operators do not have to conduct additional analysis. Categories 2 and 3, involve changes to the area/conditions in which the technology used or to the technology itself. Analysis of new technology in these two categories would need to focus on the changes in the technology or the condition. Category 4 involves changes to both the area/conditions and technology and requires more in-depth analysis.

Operators considering the use of new technology in categories two, three and four, should conduct a hazard identification study to identify major accident hazards and identify the barrier functions affected (See Steps 2.1, 3.1 and 4.1 in **Figure 3**). Next, the Operator should identify the relevant barrier critical systems (See 2.2.1, 3.2.1 and 4.2.1 in **Figure 3**) and conduct any additional risk assessment as identified during initial hazard identification focusing on the changes to either the technology and/or the condition. (See Steps 2.2.2, 3.2.2 and 4.2.2 in **Figure 3**). Finally, a barrier analysis identifies barrier critical systems by developing a barrier model and identifying barrier element attributes and their success criteria (See Steps 2.3.1, 3.3.1, and 4.3.1 in **Figure 3**).

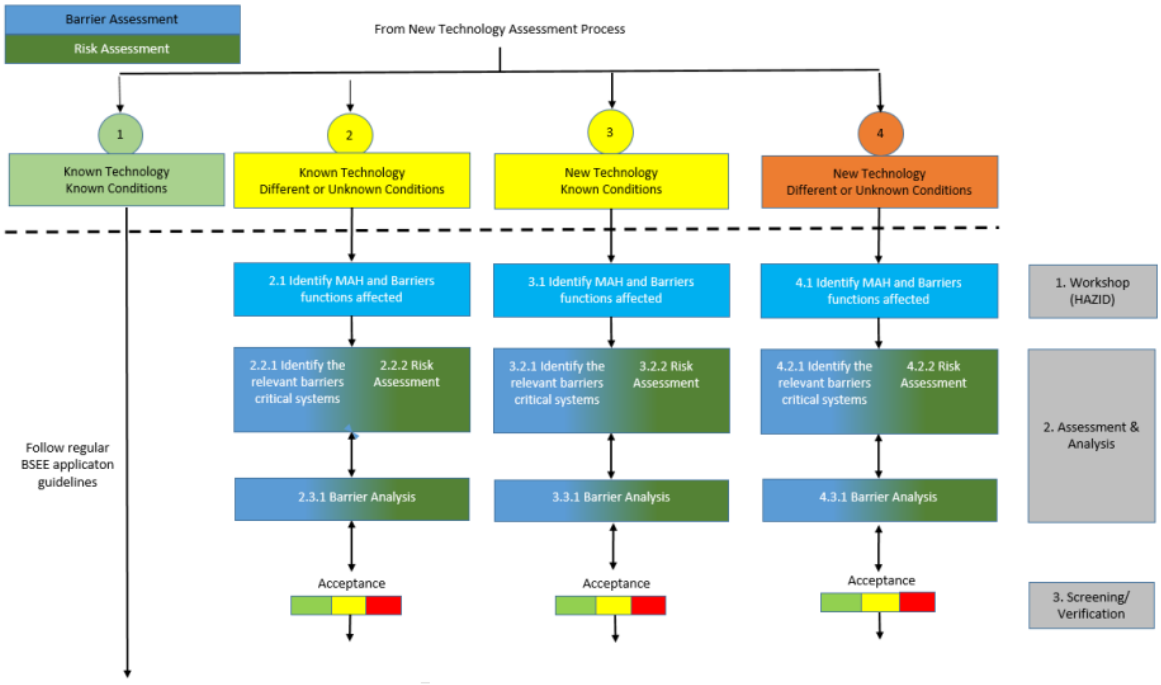

Figure 3: New Technology Assessment Framework

Research continued to review other important steps within the new technology assessment process including:

- Triggering new technology review process based on a given change in technology or condition in which it is being applied
- Level of indenture for system decomposition related to new technologies required to analyze the critical aspects influenced by the novelty

With the framework in place, the Risk Assessment team developed example scenarios involving the use of new technology and those of most interest to BSEE. These scenarios will validate the risk assessment framework, conduct risk assessment, analyze associated barriers and simulate real-life submissions from an Operator.

Table 1: New Technology Case Studies and Associated Barriers

Scenario Title	Barrier Involved
1: Ultra-Deepwater Drilling	Subsea BOP
2: Deepwater Drilling with Surface BOP from a Floating Facility	Surface BOP and Subsea Disconnect system
3: Managed Pressure Drilling	MPD System
4: Production Operation in HPHT & Sour Environment	Surface Controlled Subsurface Safety Valve [SCSSV]
5: Drilling from a Semi-sub in the Arctic	Capping Stack

Subject Matter Experts (SMEs) from BSEE's regions worked with the ABS Consulting team to review the scenarios to ensure they contain relevant details that BSEE would typically review in a new technology submission. ABS Consulting team members also attended the API Summer Standards Conference sessions pertaining to HPHT, Well Control Equipment, BSEE Cementing / Casing liner, Subsea Production and Cementing to gain additional information on the applications of new technology directly from industry subject matter experts. As development of the scenarios continued, the team identified technical and safety challenges related to the scenarios including:

- Main challenges / concerns – threats, consequences on bowtie, barrier modeling and success / failure path attributes
- Main systems / equipment involved – possible barriers on the bowtie
- Relevant codes, standards, regulations and BSEE SOPs that can be used to determine attributes and related success criteria

2.2 Development of Risk Assessment Methodology

As noted in **Figure 3**, Operators considering the use of new technology should conduct a risk assessment to identify hazards associated with the application of new technology. To facilitate this risk assessment, the risk assessment team employed set of risk assessment methodologies. The team included members with several years of experience in the O&G, nuclear and process industry, conducting risk assessments across various industries. This team's efforts involved researching and evaluating appropriate risk methodologies based on the desired outputs. From this research, they initiated the development of a guidance document comprised of various risk assessment methods, documenting their relative strengths and weaknesses in relation to the offshore and general applications.

With the research complete the team turned their efforts towards designing the risk assessment process with major steps including research, data analysis, workshop design, subject matter expert (SME) elicitation techniques, and workshop material preparation. This also included defining risk acceptance criteria and risk lexicon to facilitate consistent communication. After development of the risk assessment framework the risk team began to develop an approach to conduct the risk assessments for each of the five selected scenarios.

As part of their scope, the Risk Assessment Team determined the applicability, scope, methodology, criteria and process as well as evaluated and selected the appropriate methodology to model the five

case studies to validate the emergent technology risk assessment framework. Risk assessment involved conducting hazard identification workshop, performance of any additional risk assessment study as identified by the risk assessment, major accident hazards and associated barrier critical system/element identification.

Through the lessons learned from the approach and methodology, the Risk Assessment team created a technical note that documents the best practices to conduct a risk assessment for new or emergent technologies. The technical note is included as **Appendix A. New Technology Risk Assessment Methodologies,** to this report. The technical note provides details associated with the risk assessments, which should accompany a new technology submission.

2.3 Development of Barrier Analysis Methodology

In order to establish a common understanding of barriers, it is important to determine the purpose of the barriers and their functions. The Barrier Team began development of a barrier analysis methodology by researching barrier concepts. This involved reviewing barrier management philosophies used in the United Kingdom by HSE (Safety Critical Elements (SCEs)) and in Norway by PSA, as well as philosophies used in other industries such as nuclear, process and aviation. The Barrier Team reviewed the barrier approached proposed by Argonne National Laboratories (ANL) and discussed the success path approach with ANL representatives. The team also met with BSEE representatives to discuss barrier management philosophies and how its application to evaluating new technologies. The team reviewed different modeling techniques using success logic and failure logic and evaluated the pros and cons of each. **Appendix B. Barrier Theory and Modeling Methods** contain a paper documenting the team's research into barrier theory and modeling methods. Following the review, discussions with ANL and BSEE representatives, the team concluded that success path approach was the best way forward for the barrier models and focused on physical barriers with other operational and organization factors considered as supporting elements for physical barrier integrity.

To facilitate barrier analysis, the team developed the first draft of a generic template for barrier models, including key considerations to account for when building the models. To explain the barrier analysis concept and application of the barrier model template, the team drafted the technical note *Barrier Analysis for New Technologies in OCS* for BSEE review (See **Appendix C. Barrier Analysis Technical Note**). The Barrier Team also developed materials to train Operators and BSEE with barrier analysis concepts (see **Appendix D. Barrier Model Introductory Training Slides**).

With the Barrier Model Template completed, the team conducted a series of barrier modeling workshops to develop models for the barriers associated with the five scenarios developed earlier in the project (See **Table 1**). This included researching and developing a barrier model for each scenario representing the barrier functions, barrier critical systems and barrier elements. **Table 2** lists the barrier modeling workshops that the team conducted.

Table 2: Barrier Modeling Workshops

Workshop / Date	Industry Participants	BSEE Participants
Subsea BOP / August 26, 2015	Frank Gallander (Chevron / Former API S53 Chair)	Mike Pittman, Suzanne Chang, Mike Worden, Jarvis Outlaw and Jarvis Abbott
Managed Pressure Drilling / August 18, 2015	Dennis Moore (MarathonOil), Mike Mitchell (ConocoPhillips), Shadi Morieras (SafeKick)	Mike Worden
Arctic Capping Stack / August 31, 2015	Scott Vickers (Bayside Technical Solutions), David Barnett (IPT Global)	Mike Pittman, Jarvis Abbott, Kyle Monkelien, Kathy Crumrine and Jarvis Outlaw
HPHT SCSSV / September 9, 2015	None	Russell Hoshman and Mike Connor

Following the workshops, the team updated the barrier model template using feedback from the workshop SMEs. Revisions made to the technical note also reflected the second draft of the barrier model template; the lessons learnt and best practices for barrier analysis. The barrier analysis training slides are based on the first draft of the barrier model template and will have to be updated before using them to conduct training.

2.4 Development of Process Guides

The Process Team developed guidance to assist Operators with conducting the new technology assessment, risk assessment and barrier analysis discussed in the previous sections. The team also developed guidance to assist BSEE with the review of submissions related to new technology received from Operators. Team members include consultant with experience in developing standard operating procedures, process design, and development of job aids. The team was also familiar with BSEE's regulations and the various permits and submissions received from the oil and gas industry.

2.4.3 BSEE Overview of Current Plans, Permits and Submissions by Operators

As required by the regulations in Title 30 CFR §250, Operator are required to submit plans, permits and other submissions to BSEE for certain exploration, development or production activities. Work began with research into current regulations and guidance for permits, plans and other submissions. The team met with representatives from the Office of Offshore Regulatory Programs (OORP) to identify the relevant permits and submission types to be included in the project. OORP representatives provided copies of existing process flow diagrams to assist the team with their research. Team members conducted a thorough review of the process flow diagrams and standard operating procedures, focusing on Deepwater Operating Plans (DWOPs), Applications for Permit to Drill (APD), Applications for Permit to Modify (APM), Sustained Casing Pressure, Enhanced Recovery, Platform Verification, Pipeline applications and Structure applications. The team identified how BSEE evaluates each permit type; the key steps in the review/approval process and the specific criteria utilized and documented the following information:

- The process that BSEE uses to review these plans/permits

- The steps in their approval process
- The criteria uses as the basis for their approval
- Who within BSEE is involved in processing the plan/permit
- The type of guidance that BSEE issues to assist Operators with submitting these
- The extent to which new technology is evaluated

A summary of their research is contained in **Appendix E. Summaries of Applicable Permit Types.**

Through their research, the team concluded that the current regulations and policy do not include information on how new technology is assessed and evaluated. Building on the information developed by the Risk and Barrier teams discussed above, the team began development of guidance for Operators to use to develop plans, permits and other submissions to BSEE, as well as development of guidance for BSEE to use to evaluate these submissions. **Figure 4** illustrates the relationship of these permits, plans and submissions to new technology evaluations.

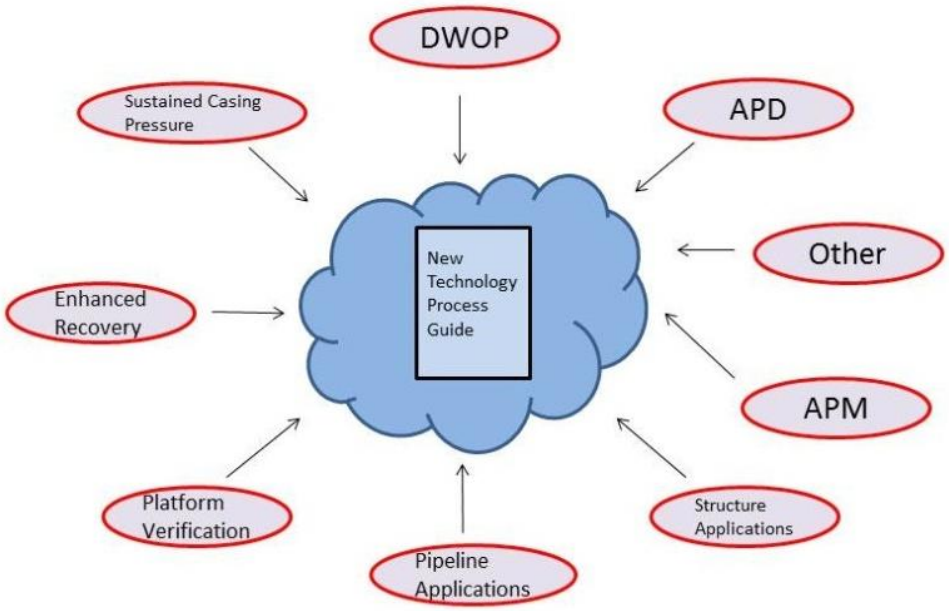

Figure 4: Relationship of BSEE Plan, Permits and Submissions to New Technology Evaluations

2.4.1 Operator Process Guide

Using the research, the Process Team develop an initial process workflow to illustrate how new technology assessments, risk assessments and barrier analysis could be conducted by Operators for new technology submissions. The team then developed a similar process workflow for how BSEE would review these submissions once received from Operators. The team discussed these workflows with OOPR representatives to ensure alignment and make any adjustments in the process steps.

After these reviews of the various permit submission types, the Process Guide team then began to develop, two distinct process guides based on the knowledge acquired during the initial research of the various permit application and submission types to BSEE. The team analyzed the processes and

knowledge that Operators and BSEE engineers would need for each step in the process workflows. This analysis formed the basic outline for the *Operator's New Technology Submission Guide*. (See **Appendix F. Operator's New Technology Submission Guide**)

The *Operator's New Technology Submission Guidance* provide Operators of OCS oil, gas, and sulfur exploration, development and production facilities with a systematic process for preparing submissions to BSEE related to the use of new technology. The Operator's guide includes four major processes:

1.) **New Technology Assessment Section:** This section outlines the process an Operator uses to determine if the technology proposed for offshore exploration, development and production needs to go through a new technology submission process.
2.) **Risk Assessment Section:** This section outlines a risk assessment framework and related processes/workflow for the Operator to consider when evaluating all new technology submissions related to new technologies.
3.) **Barrier Analysis Section:** This section outlines a barrier analysis framework and related processes/workflow for the Operator to consider when identifying proposed new barriers and identification of the potential effects on other barriers and critical systems. This includes the introduction of the Barrier Model Template, which assists Operators to analyze the barrier critical system/ new technology and determine the barrier element life cycle phase attributes with associated success criteria.
4.) **How to Submit New Technology Results to BSEE:** This section outlines the process to review and validate the submission. A checklist provides Operators with a quick list of the recommended analysis that BSEE needs to expedite the review process and to verify the information is complete.

2.4.2 BSEE Process Guide

Using the Operator's process guide as a framework, the team developed policy guidance that BSEE engineers could use to review new technology submissions received from Operators. The process team identified the procedures and knowledge needed to evaluate these submissions accepted or rejected the Operator's proposed use of new technology. This analysis formed the basis for the *BSEE SOP for New Technology Evaluation*, found in **Appendix G. BSEE SOP for New Technology Evaluation**. This guide contains four primary sections:

1.) **New Technology Assessment Section:** This section outlines procedures for BSEE engineers to verify the category of new technology proposed by Operators.
2.) **Risk Assessment Section:** This section provides an overview of risk assessments, the identification of major accident hazards and critical barrier system functions. It also includes procedures for BSEE engineers to use to verify the Operators risk assessment results.
3.) **Barrier Analysis Section:** This section contains an overview of the barrier analysis including the introduction of the Barrier Model Template and key features of the model. It also include procedures for BSEE engineers to use to evaluate the Operator barrier analysis, including the linkages of barrier element life cycles phase attributes to associated success criteria.

4.) **How to Review New Technology Submissions Section**: This section includes procedures for BSEE engineers to review new technology submissions received from Operators. It includes a checklist to facilitate the review process.

2.5 Development Case Studies

To validate the new technology evaluation process developed during this project, the team developed five case studies containing different applications of new technology. Team members, assigned to one or more of the five scenarios, worked through the processes outlined in the *Operator's New Technology Submission Guide* to produce fully developed examples of completed new technology assessments, risk assessments and barrier analysis. Each case study also contains completed barrier attribute checklists that documents the success criteria for each barrier affected by a major accident hazard. **Table 3** contains a list of the case studies and the category of new technology represented by the scenario.

Table 3: New Technology Case Study Examples

Case Study	Scenario	Barrier Involved	New Technology Category
1	Ultra-Deepwater Drilling	Subsea BOP	Category 2 - Known Technology, Different or Unknown Conditions
2	Deepwater Drilling with Surface BOP from a Floating Facility	Surface BOP and Subsea Disconnect system	Category 3 - New Technology, Known Conditions
3	Managed Pressure Drilling	RCD + PRV + C&K	Category 3 - New Technology, Known Conditions
4	Production Operation in HPHT & Sour Environment	Subsurface Safety Valve [SSSV]	Category 2 - Known Technology, Different or Unknown Conditions
5	Drilling from a Semi-sub in the Arctic	Barrier - capping stack	Category 4 - New Technology, Different or Unknown Conditions

Appendix H. New Technology Risk Assessment Scenarios contains the fully developed Case Studies. These completed case studies are also included in the *Operator's New Technology Submission Guide and the BSEE SOP for New Technology Evaluation* when published to serve as examples for Operators and BSEE engineers to use in completing the new technology evaluation.

3. Recommendations

Recommendation 1: Adopt and Deploy New Technology Process Guides

BSEE should adopt and deploy the internal process guide, *BSEE Standard Operating Procedure (SOP) for New Technology Evaluation*, as well as the industry process guide, *Operator's New Technology Submission Guide*, in order to improve the assessment and evaluation of new technology applications.

To implement the process guide BSEE should meet with its Regional Offices to discuss and receive input on the New Technology Process Guides. This will provide the opportunity for the regional offices to provide input to the guides.

BSEE should also host workshops for offshore oil and gas industries to provide an overview of the contents of the *Operator's New Technology Submission Guide*, and seek input from Operators on the contents.

Recommendation 2: Training on Internal and External Process Guides

Once finalized, BSEE should conduct training on how to use the new technology process guides. This would involve designing a training curriculum, developing course materials and scheduling training sessions. This training would ensure that BSEE reviewers are familiar with the contents of the guides and with the procedures for reviewing new technology submissions received from Operators.

Likewise, BSEE should design, develop and conduct training workshops for oil and gas Operators on how to use the *Operator's New Technology Submission Guide*. This training should also particularly focus on the barrier analysis contained in the guide.

Recommendation 3: Develop criteria for Third Party Review and Other Additional Requirements based on Operational Risks

BSEE should develop criteria for determine the different types of reviews that may be required for new technology submissions. This includes the need for third party assessments. To establish these criteria, BSEE should conduct a broad operational risk assessment in order to develop risk profiles for OCS operations. This operational risk assessment would provide provides a common understanding of risks spanning BSEE's mission including putting risks of new Emergent Technology in context within BSEE's current risk portfolio.

Recommendation 4: Develop and Implement a Standardized Document Naming and Identification Convention

Throughout the duration of this project, it became clear that BSEE should develop and implement a standardized naming and identification convention for its internal guidance documents and the guidance it provides to Operators. This includes standards method to enhance identification, use, and version control of its policy and guidance documents.

Recommendation 5: Develop Performance Measures to monitor the effectiveness of New Technology Permit Process

After the implementation of the new technology evaluation process guides, BSEE should develop appropriate performance measures to monitor the effectiveness of the new technology submission and review process at reducing risks associated with exploration, development and production operations on the OCS. BSEE should also develop a plans and procedures to collected and analyze the data needed to populate the performance measures. These performance measures will provide BSEE with valuable insight and enable it to implement the lesson learned to improve the evaluation of new technology applications.

Recommendation 6: Consider Regulatory Changes to Incorporate the Use of the New Technology Review Process

BSEE should establish new regulations to codify the procedures contained in new technology guides developed under this project. In particular, BSEE should develop new regulations that require a complete risk assessment and barrier analysis for new technology applications.

Recommendation 7: Establish a New Technology Database

BSEE should develop a database to track different types of new technology submissions and the associated barrier analysis conducted as part of the submission. This database would include the new technologies, its application (system), the platform where new technology is being considered, and the success criteria for the barrier attributes associated with this new technology. The database would eventually show the new technology approval/disapproval for the application (system) requested. This database would facilitate the evaluation of new technology submissions. This database could also incorporate current platforms that BSEE uses in its permit application process such as submissions through its online *eWell system.*

Recommendation 8: Conduct a Pilot Program using the New Technology Process Guides

To demonstrate the effective use of the two New Technology Process Guides, BSEE should conduct a pilot program with its TAS and District Operations Support Offices. Under this pilot, BSEE could use the new technology submission guidance developed under this project to review real submissions by Operators involving new technology. This pilot will also involve Operators so that they become familiar with the recommended procedures contained in the guides.

Recommendation 9: Work with the Appropriate Standards Organizations

BSEE should work with international and domestic standards organizations to incorporate the assessment methodologies contained in the Operator's New Technology Guide into the relevant standards and recommended practices.

Recommendation 10: Revise existing permitting guidance to reference the New Technology Submission

BSEE should revise the regulations and guidance that governs the existing permits, plans and submissions when these submissions involve new technology. These revisions would refer Operators and BSEE engineers to the new technology submission guidance developed during this project.

Appendix A. New Technology Risk Assessment Methodologies

Appendix B. Barrier Theory and Modeling Methods

Appendix C. Barrier Analysis Technical Note

Appendix D. Barrier Model Introductory Training Slides

Appendix E. Summaries of Applicable Permit Types

The summaries below include notable regulatory requirements within the CFR, applicable NTLs and API standards, required content and forms for submitting a particular permit or plan submission to BSEE.

Deep Water Operations Plan (DWOP)

A DWOP, as defined in 30 CFR §250.286, is a plan that provides sufficient information for BSEE to review a Deepwater development project, and any other project that uses non-conventional production or completion technology, from a total system approach. The DWOP does not replace, but supplements other submittals required by the regulations such as BOEM Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents. BSEE will use the information in your DWOP to determine whether the project will be developed in an acceptable manner, particularly with respect to operational safety and environmental protection issues involved with non-conventional production or completion technology.

The BSEE Field Office of Technical Assessment Section (TAS) is the primary office responsible for reviewing, evaluating and approving Conceptual Plans (CDWOP) and Deepwater Operations plans (DWOP). Other BSEE offices having involvement and input into the DWOP review process could be; The Pipeline Section and the Office of Structural and Technical Support (OSTS) among others as required. BSEE describes five variations of the DWOP they are;

a) Conceptual Deepwater Operations Plan (CDWOP or Conceptual Plan) where Operators must describe the concept of their proposed project particularly describing ay new technology or drilling methods to be used (greater detail in question 2 below),
b) Deepwater Operations Plan (DWOP) where Operators provide a very specific description of their project as prescribed by 30 CFR §250.286,
c) Combined CDWOP/DWOP where Operators can combine the CDWOP and the DWOP if the Operator has conducted similar operations and meets other certain requirements.

The DWOP process consists of two parts: a CDWOP and the DWOP. There are a number of Code of Federal Regulations (CFRs) that are directly related to the development of a CDWOP and the DWOP. In 30 CFR §250, it outlines in detail the requirements for the development of both plans. BSEE publishes Notices to Lessees (NTLs), Letters to Lessees or Operators (LTLs) and Information to Lessees (ITLs). These formal documents are used to provide industry with clarification and BSEE interpretations to regulations or OCS Standards, provide guidance on specific lease stipulations or regional requirements, and transmit BSEE administrative information such as telephone numbers, change in personnel and office addresses. In addition, there are API Standards are directly relate to the development of and must be address in the DWOP submission. It is the Operator's responsibility to identify and include all appropriate API standards and recommended practices when developing a DWOP submission.

Application for Permit to Drill (APD)

An Application Permit to Drill (APD), as defined in 30 CFR §250.410, is part of a multi-document submittal process that , if successful, will provide approval from a BSEE District Manager to allow an Operator to drill, sidetrack, bypass or deepen a well. APDs are also used to submit to BSEE proposed

changes to wells in operations and gain BSEE approval for those changes. The APD (Form BSEE-0123) and Supplemental APD Information Sheet (Form BSEE-0123S) are accompanied by other supporting documents that must also meet the requirements of 30 CFR §250. These documents include the BOEM Exploration Plans (EP), the Development and Production Plans (DPP), the Development Operations Coordination Documents (DOCD) and required attachments which include: Drilling prognosis and summary of drilling, cementing, and mud processes; Engineering Calculations; Proposed Wellbore Schematic; Proposed Well Location Plot; Directional Program; Pore pressure (PP), Mud Weight (MW), and Fracture Gradient (FG) Plot, and; BOP & Diverter Schematics with Operating Procedures. Optional attachments include: Departure List; an ABS/DNV Certificate, and; U.S. Coast Guard Certificate.

The APD form follow the requirements of 30 CFR §250.410 through 30 CFR §250.418 and requires the Operator to provide numerous information, including, the permit type, geological/geophysical information, accuracy to the regulations, specific information about the BOP stack, Plans information, the anchor pattern radius, a detailed check that all questions accurately answered, the EPA discharge permit number is provided, rig certificates are up to date, validation that the rig is using anchors, water depth, the rig rating, safe welding areas provided/approved, casings tested IAW regulation, and a detailed check that follows all required regulations.

The Well APD eWell As Is Review Process is documented on a BSEE flow diagram that shows there are 10 main BSEE divisions that participate in APD review: Industry Lease Operators, Pay.Gov for FEE payment, District Office, District Support Section, Environmental Enforcement Branch, Production Development, BOEM (Geological, Geophysical Analysis Section, BOWM Regional analysis Unit, OSRP Branch, OIMS Multimedia/Internet Production.

Application for Permit to Modify (APM)

Pursuant to 30 CFR §250.465, Operators must submit an Application for Permit to Modify (APM) if they are considering the following: Intend to revise drilling plans, change major drilling equipment or plug-back; Determine a well's final surface location, water depth, and rotary Kelly bushing elevation, and; Move a drilling unit from a wellbore before completing a well. In addition, within 30 CFR §250.1712, an APM is to be filed, "before [an Operator] permanently plugs a well or zone." Operators wishing to submit APM's for activities in the Outer Continental Shelf (OCS) must follow six timeframe criteria noted in 30 CFR §250.1704(g); 1) Before [the Operator] temporarily abandon's or permanently plugs a well or zone; 2) Within 30 days after [the Operator] plugs a well; 3) Before [the Operator] installs a subsea protective device; 4) Within 30 days after [the Operator] completes a protective device trawl test; 5) Before [the Operator] removes any casing stub, mud line equipment or subsea devices, and; 6) Within 30 days after [the Operator] completes site clearance verification activities.

APM's are to be submitted and paid for through two separate mechanisms, the application submission website (eWell) and the application fee and service charge payment website (Pay.gov). BSEE maintains a list of forms that are approved for use by the Office of Management and Budget (OMB). In particular *Form BSEE–0124*, pertains to APM. The submission of an Operator's APM, preferably electronic through eWell and paid electronically through Pay.gov, must be accompanied by payment of the service fee listed in 30 CFR §250.125, which was revised in 2013 to be $125. As noted in 30 CFR §250.126, "if an application is submitted through eWell, [the Operator] must use the interactive payment feature in that system, which directs [the Operator] through to Pay.gov."

There are no statutory or regulatory/formal deadlines/procedures on the permitting approval process, rather the Operator may take as long as needed to correct information or gather missing information and resubmit an application. The permit approval and review process has always involved a back and forth exchange of documents and information between the Operator and BSEE/Gulf of Mexico Region (GOMR) office. That said, the informal process includes the following; District Workover Engineers, District Operations Support Engineers and Structural Engineers. In addition, a Well Ops Engineer conducts an initial review to determine if additional reviews are needed or if the APM can go directly to final review. Aside from these individuals, there are two primary individuals within BSEE (specified within CFR) that are involved in the submitting and processing the Plan/Permit when Operators submit an APM. Those are the Regional Supervisors and the District Managers.

Structural Installation Applications

The Platform Approval Program (PAP), under the Office of Structural & Technical Support (OSTS), is the BSEE basic approval process for platforms on the OCS. The requirements of the Platform Approval Program are described in 30 CFR §250.904 through 30 CFR §250.908. Completing the requirements will satisfy BSEE criteria for approval of fixed platforms of a proven design that will be placed in the shallow water areas (≤400 ft.) of the Gulf of Mexico OCS. Other notable section in the CFR that provides Operators with guidance include, 30 CFR §250.901, "Industry standards that platforms must meet," and 30 CFR §250.906, "What Operators must do to obtain approval for the proposed platform site."

The requirements of the Platform Approval Program must be met by all platforms on the OCS. Additionally, if an Operator wants approval for a floating platform; a platform of unique design; or a platform being installed in deepwater (> 400 ft.) or a frontier area, they must also meet the requirements of the Platform Verification Program (PVP). PVP requires additional plans be submitted to the Regional Supervisor for approval.

Operators must submit an application and obtain the approval of the Regional Supervisor before performing any of the following activities: Installing a platform; Making a Major modification to any platform; Making a Major repair of damage to any platform; Converting an existing platform at the current location for a new purpose; Converting an existing mobile offshore drilling unit (MODU) for a new purpose. The application must include the following: an Application Cover Letter; Location Plat; Front, Side, and Plan View; Complete Set of Structural Drawings; Summary of Environmental Data; Summary of the Engineering Design; Project-Specific Studies used in the Platform Design or Installation; Description of the Loads imposed on the Facility; Summary of Safety Factors Utilized; A Copy of the In-Service Inspection Plan; Certification Statement, and; Payment.

Pipeline Permits

An application is required when a pipeline owner has plans to significantly change a previously approved pipeline. This permit application request may be used for route-modification, hot-taps, or changes in product type, cathodes, couplings, and/or safety components. Modification applications need only address those items in the original application that are affected by the proposed alteration. However, a pipeline modification application that will include a hot tap requires additional information from the Operator, which is not included in other pipeline permit applications.

Regulatory authority for BSEE to require pipeline permits comes from 30 CFR §250.1007. This section of the code asks that pipeline owners submit a new permit or modification application to the Regional Supervisor. A modification application will only need to include the items that are affected in the original application, including, but not limited to: Plats drawn to scale with X-Y coordinates of key points; Schematic drawing; Description of cathodic protection system; Description of external pipeline coating system; MAOP and calculations; Type of protection to be afforded crossing pipelines, subsea valves, taps, and manifold assemblies, and; Shallow hazards survey report. The document is then assigned to and reviewed by an Engineer in the Pipeline Section of BSEE, who determines the technical adequacy of the permit application.

If the pipeline permit application involves new methodology/design or a hazardous procedure, a separate review process is done of the new methodology. If the new procedure is not acceptable to BSEE's standards, the company is required to explain inadequacies or provide further information on the new technology or process. If the plan is accepted, Operators are notified with a listing of any special conditions, notifications, or reporting requirements for new methodology/plan.

Platform Verification Program (PVP)

The Platform Verification Program (PVP) is the BSEE approval process for ensuring that floating platforms; platforms of a new or unique design; platforms in seismic areas; or platforms located in deepwater or frontier areas meet stringent requirements for design and construction. The program is applied during construction of new platforms and major modifications of, or repairs to, existing platforms. The following five conditions are subject to the Platform Verification Program; Platforms installed in water depths exceeding 400 feet (122 meters); Platforms having natural periods in excess of 3 seconds; Platforms installed in areas of unstable bottom conditions; Platforms having configurations and designs which have not previously been used or proven for use in the area; or Platforms installed in seismically active areas.

Floating platforms are subject to the Platform Verification Program based on various criteria.
The application must include: Design verification plan; Fabrication verification plan; Installation verification plan; A complete schedule of all phases of design, fabrication, and installation for the Regional Supervisor's approval. One must include a project management timeline, Gantt Chart, that depicts when interim and final reports required will be submitted to the Regional Supervisor for each phase.

On the timeline, one must break-out the specific scopes of work that inherently standalone (e.g., deck, mooring systems, tendon systems, riser systems, turret systems).Include the nomination of a Certified Verification Agent (CVA) as a part of each verification plan required. In addition, Operators must obtain approval for modifications to approved plans and for major deviations from approved installation procedures from the Regional Supervisor. The Platform Verification Program requires Operators to submit paper copies of the information, documents, with fee, for proposed projects. Applications may be submitted electronically "When the Region/District is equipped to accept it." BSEE does not provide steps for the approval process but does list the exact plan descriptions that are required.

Enhanced Recovery and Pressure Maintenance Requests

Pursuant to the Code of Federal Regulations (CFR), most notably 30 CFR §250.1165, an Enhanced Recovery, or Enhanced Oil Recovery (EOR), and Pressure Maintenance Report is required by Operators. Furthermore, within 30 CFR §250.105, the term Enhanced Recovery Operations is defined as, "pressure maintenance operations, secondary and tertiary recovery, cycling and similar recovery operations that alter the natural forces in a reservoir to increase the ultimate recovery of oil or gas." The Directional Well Survey (DWS)/ Historical Well Data Cleanup (HWDC) aspects of these requests have moved to BSEE Technical Data Management Section (TDMS) and BSEE has removed RSV Determination/Response from this request/plan as well (not frequent enough to warrant inclusion, no shallow-water royalty relief, only deep-water royalty relief for which we already have workflows). In regards to timing for submission of the report, there appears to be no particular time frame for Operators, rather the language within 30 CFR §250.1165 states, "[Operators must promptly initiate enhanced oil and gas recover operations for all reservoirs…" While 'promptly' is used, there is no particular deadline or amount of days specified that the Operator has to submit these reports.

In the BSEE guidance portion of the CFR, 30 CFR §250.1167, it asks for 2 copies of Form BSEE-0126, a Well Potential Test (WPT) Report, along with maps, seismic data, logs, engineering data and other general information. These are outlined within a chart in this section of the CFR which in addition to the WPT Report and required data and information, emphasizes approvals for Gas Cap Production, Downhole Commingling and Production within 500 feet of a unit or lease line. When an Operator fills out a WPT Report, it is to include well test data and test production date at 24 hour rates. Furthermore, in the BOEM guidance portion of the CFR, 30 CFR §550.1167, it asks for 2 copies of Form BOEM-0127, a Sensitive Reservoir Information (SRI) Report, along with maps, seismic data, logs, engineering data and other general information. These are also outlined within a char in this section of the CFR which in addition to the SRI Report and required data and information, emphasizes approvals to be included for Reservoir Reclassification. When an Operator fills out the SRI Report, it is to include volumetric data, fluid analysis data, and production data.

The responsible persons involved in the review process, pursuant to 30 CFR §250.1165, are further detailed in this section whereby Operators, "must submit a proposed plan [for enhanced recovery operations] to the BSEE Regional Supervisor to receive approval for pressure maintenance, secondary or tertiary recovery, cycling and similar recovery operations." In addition, Operators, "must report to the Office of Natural Resources Revenue," certain information related to oil, gas, or other substances injected, produced or produced for a second time under 30 CFR §1210.102. BSEE's Development & Unitization Section (DUS) would also be heavily involved in the approval process.

Sustained Casing Pressure Plans (SCP)

In regards to Sustained Casing Pressure (SCP) plans, pursuant to 30 CFR §250.519, Operators are to monitor [their] wells for casing pressure and record the pressures [they] observe (including zero pressure present) as follows: Fixed platform wells –at least one pressure data point recorded per month for each casing; Hybrid wells and subsea wells –at least one pressure data point recorded per day for each riser and/or the production casing., and; Wells operating under a casing pressure departure – Manned fixed platforms and unmanned fixed platforms, at least one pressure data point recorded for each casing. "Self-Approval" or "Self-Permit" is granted if the Operator conducts regular pressure management pursuant to regulations, but when there are discrepancies, that is when BSEE requires certain reports/plans within certain time frames and parameters.

The steps in the approval process by BSEE are outlined within 30 CFR §250.529 and 30 CFR §250.530. Although there is no official flowchart, these sections state that casing pressure management requests and terms; "are approved by the Regional Supervisor, Field Operations, for a term to be determined by the Regional Supervisor on a case-by-case basis. The Regional Supervisor may impose additional restrictions or requirements to allow continued operation of the well." In addition, if denied, "Then the operating company must submit plans for corrective action to the respective District Manager within 30 days of receiving the denial. The District Manager will establish a specific time period in which this corrective action will be taken. The Operator must notify the respective District Manager within 30 days after completion of the corrected action." Pursuant to 30 CFR §250.526, "within 14 days after an Operator performs a diagnostic test, the Operator must submit a notification of corrective action or a casing pressure request to the appropriate District Manager and copy the Regional Supervisor- Field Operations…" Casing pressure and diagnostic tests, pursuant to 30 CFR §250.524, must be maintained at the Field Office nearest the well for a minimum of 2 years.

The most notable sections within the CFR that provides regulatory guidance is 30 CFR §250.519. In addition to that, for SCP, or any Casing Pressure Management, the criteria for approval of a plan by BSEE are based on requirements outlined within 30 CFR §250.519 which states that, "Once you install your wellhead, you must meet the casing pressure management requirements of API RP 90 (as incorporated by reference in 30 CFR §250.198)…. If there is a conflict between API RP 90 and the casing pressure requirements of this subpart, you must follow the requirements of this subpart." According to BSEE Notice to Lessee's (NTL) No. 2009-P07, carried over from when BSEE was the Minerals Management Service (MMS), this NTL details in a section called "Monitoring, Evaluating, and Reporting Casing Pressure," that pursuant to 30 CFR §250.517, "[Operators] are to monitor [their] wells for casing pressure and record the pressures [they] observe (including zero pressure present).

Appendix F. Operator's New Technology Submission Guide

Appendix G. BSEE SOP for New Technology Evaluation

Appendix H. New Technology Risk Assessment Scenarios

Case Study 1: Ultra-Deepwater Drilling

Case Study 2: Deepwater Drilling with Surface BOP from a Floating Facility

Case Study 3: Managed Pressure Drilling (MPD)

Case Study 4: Production Operation in HPHT & Sour Environment

Case Study 5: Drilling from a Semi-sub in the Arctic