Description of document:	Several (BOEM) Bureau of Ocean Energy Management-funded Study Reports and Descriptions
Requested date:	Nov-Dec 2019
Release date:	28-June-2020
Posted date:	09-November-2020
Note:	This file contains a response to several FOIA requests BOEM aggregated into one FOIA case. See release letter.
Source of document:	BOEM FOIA Officer 45600 Woodland Road Sterling, Virginia 20166 Fax: (303) 462-9910 Email: boemfoia@boem.gov

United States Department of the Interior

BUREAU OF OCEAN ENERGY MANAGEMENT
WASHINGTON, DC 20240-0001

45600 Woodland Road, VAM-BOEM DIR
Sterling, VA 20166

Telephone (703) 787-1818
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June 28, 2019

Via electronic mail

RE: Freedom of Information Act (FOIA) Request No. BOEM-2019-00029

This letter is in reference to eight FOIA requests dated November 23 thru December 7, 2018 and received by the Bureau of Ocean Energy Management (BOEM) from December 6 thru Decemeber 12, 2018. These requests are aggregated and are assigned number BOEM-2019-00037. Please cite this number in any future communications with our office regarding your request.

Description of the Requested Records

In your resquests, you are seeking:

1. [A] copy of the Statement of Work, the interim reports, and the Final Reporting/ Closeout Report/Presentation/Study for the contract INM16PC00016 awarded to University of Rhode Island, regarding benefits of wind energy on recreation, tourism, etc.; [and]

2. [A] copy of the Statement of Work, and the Final Reporting/Closeout Report/ Presentation/Study for the contract INM11PC00012 awarded to International Associated of Oil and Gas Producers, to study Air Guns and Humpback Whales; [and]

3. [A] copy of the Statement of Work, the interim reports, and the Final Reporting/ Closeout Report/Presentation/Study for the contract INM16PC00014 awarded to AECOM, regarding benefits of renewable energy; [and]

4. [A] copy of the Statement of Work, the interim reports, and the Final Reporting/ Closeout Report/Presentation/Study for the contract INM09PC00003 awarded to FEKETE Associates, regarding Gas Hydrates (TR9A); [and]

5. [A] copy of the Statement of Work and the Final Reporting/Closeout Report Presentation/Study for the contract INM09PC000022 awarded to State of California, Sea Otter Hearing Study (NT-09-X10); [and]

6. [A] copy of the Statement of Work and the reporting documents (i.e. final and interim reports) produced between 2016 and 2018 under contract INM16PC00001, awarded to Calibre sstems, Inc. The topic of the contract was unexploded ordinance survey; [and]

7. [A] copy of the Statement of Work and the final reports produced under contact INM14PC00004, awarded to JASCO Applied Sciences. The topic of the contract was Acoustic Propagation and Marine Mammal Exposure Modeling of Geophysical Sources in the Gulf of Mexico; [and]

8. [A] copy of the Statement of Work and the final reports produced under contract INM12PC00006, awarded to Tidewater Atlantic Research. The topic of the contract was Analyzing the Potential Impacts to Cultural Resources at Significant Sand Extraction Areas.

The Bureau's Final Response

We are providing you with our final response:

- For Item 1, contract INM16PC00016, because of the public interest in this information, BOEM proactively disclosed the final report on our website at the following link:
  - https://espis.boem.gov/final%20reports/BOEM_2018-068.pdf
  - Additionally, BOEM located the attached 16 pages released to you in their entirety.
- For Item 2, records related to contract INM11PC00012, because of the public interest in this information, BOEM proactively disclosed the final report on our website at the following link:
  - https://espis.boem.gov/final%20reports/BOEM_2019-020.pdf
  - Additionally, BOEM located the attached five pages released to you in their entirety.
  - Further, a wealth of information regarding the Behavioural Response of Australian Humpback Whales to Seismic Surveys (BRAHHS) is located at http://www.brahss.org.au/index.html
- For Item 3, records related to contract INM16PC00014, because of the public interest in this information, BOEM proactively disclosed the final report on our website at the following link:
  - https://www.boem.gov/Final-Version-Offshore-Benefits-White-Paper/
  - Additionally, BOEM located the attached one page released to you in its entirety.
- For Item 4, records related to contract INM09PC00003, because of the public interest in this information, BOEM proactively disclosed the final report on our website at the following link:
  - https://www.boem.gov/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/Resource_Evaluation/Gas_Hydrates/Technical%20Recoverability.pdf

    - Additionally, BOEM located the attached 68 pages released to you in their entirety.
- For Item 5, records related to contract INM09PC000022, because of the public interest in this information, BOEM proactively disclosed the final report on our website at the following link:
    - https://www.boem.gov/ESPIS/5/5220.pdf
    - Additionally, BOEM located the attached 15 pages released to you with the following exceptions:
        - Portions of 14 pages are withheld in part pursuant to Exemption 5.
        - The remaining one page is released in its entirety.
- For Item 6, records related to contract INM16PC00001, because of the public interest in this information, BOEM proactively disclosed the final report on our website at the following link:
    - https://www.boem.gov/Munitions-and-Explosives-of-Concern-Survey-Methodology-and-In-field-Testing-for-Wind-Energy-Areas-on-the-Atlantic-Outer-Continental-Shelf/
    - Additionally, BOEM located the attached six pages released to you in their entirety.
- For Item 7, records related to contract INM14PC00004, because of the public interest in this information, BOEM proactively disclosed the final report on our website at the following link:
    - https://www.boem.gov/BOEM-EIS-2016-049-v2/ (Appendix D)
    - Additionally, BOEM located the attached four pages released to you in their entirety.
- For Item 8, records related to contract INM12PC00006, because of the public interest in this information, BOEM proactively disclosed the presentation on our website at the following link:
    - https://www.boem.gov/Applied-Physical-Sciences-Presentations-Robertson/
    - Additionally, BOEM located the attached eight pages released to you in their entirety.

This completes the Bureau's response to your request.

Information withheld Pursuant to Exemption 5

Exemption 5 allows an agency to withhold "inter-agency or intra-agency memorandums or letters which would not be available by law to a party... in litigation with the agency." 5 U.S.C. § 552(b)(5).Exemption 5 therefore incorporates the privileges that protect materials from discovery in litigation, including the deliberative process, attorney work-product, attorney-client, and commercial information privileges. We are withholding 14 pages in part under Exemption 5 because they qualify to be withheld under the following privilege:

Deliberative Process Privilege

The deliberative process privilege protects the decision-making process of government agencies and encourages the frank exchange of ideas on legal or policy matters by ensuring agencies are

not forced to operate in a fish bowl. A number of policy purposes have been attributed to the deliberative process privilege. Among the most important are to: (1) assure that subordinates will feel free to provide the decisionmaker with their uninhibited opinions and recommendations; (2) protect against premature disclosure of proposed policies; and (3) protect against confusing the issues and misleading the public.

The deliberative process privilege protects materials that are both predecisional and deliberative. The privilege covers records that reflect the give-and-take of the consultative process" and may include "recommendations, draft documents, proposals, suggestions, and other subjective documents which reflect the personal opinions of the writer rather than the policy of the agency.

The materials that have been withheld under the deliberative process privilege of Exemption 5 are both predecisional and deliberative. They do not contain or represent formal or informal agency policies or decisions. They are the result of frank and open discussions among employees of the Department of the Interior or our consultants. Their contents have been held confidential by all parties and public dissemination of this information would a chilling effect on the agency's deliberative processes.

I, Natasha Alcantara, BOEM FOIA Officer, am responsible for this partial denial. Mr. Gurney Small, Attorney-Advisor, Office of the Solicitor was consulted. We reasonably foresee that disclosure would harm an interest protected by one or more of the nine exemptions to the FOIA's general rule of disclosure.

Fee Category

We classified you as an "other-use" requester. As such, we may charge you for some of our search and duplication costs, but we will not charge you for our review costs; you are also entitled to up to 2 hours of search time and 100 pages of photocopies (or an equivalent volume) for free. *See* 43 C.F.R. § 2.39. You also agreed to pay up to $25.00 for processing each request. We do not bill requesters for FOIA processing fees when their fees are less than $50.00, because the cost of collection would be greater than the fee collected. *See* 43 C.F.R. § 2.37(g). Therefore, there is no billable fee for the processing of this request.

Appeal Rights and Mediation Services

You may appeal this response to the Department's FOIA/Privacy Act Appeals Officer. If you choose to appeal, the FOIA/Privacy Act Appeals Officer must receive your FOIA appeal no later than 90 workdays from the date of this letter. Appeals arriving or delivered after 5 p.m. Eastern Time, Monday through Friday, will be deemed received on the next workday.

Your appeal must be made in writing. You may submit your appeal and accompanying materials to the FOIA/Privacy Act Appeals Officer by mail, courier service, fax, or email. All communications concerning your appeal should be clearly marked with the words: "FREEDOM OF INFORMATION APPEAL." You must also include with your appeal copies of all correspondence between you and BOEM concerning your FOIA request, including your original FOIA request and BOEM's response. Failure to include with your appeal all correspondence

between you and BOEM will result in the Department's rejection of your appeal, unless the FOIA/Privacy Act Appeals Officer determines (in the FOIA/Privacy Act Appeals Officer's sole discretion) that good cause exists to accept the defective appeal.

Please include your name and daytime telephone number (or the name and telephone number of an appropriate contact), email address and fax number (if available) in case the FOIA/Privacy Act Appeals Officer needs additional information or clarification of your appeal.

Department of the Interior
Office of the Solicitor
1849 C Street, NW; MS: 6556 MIB
Washington, DC 20240
Attn: FOIA Appeals Office

Email: FOIA.Appeals@sol.doi.gov
Phone: (202) 208-5339
Fax: (202) 208-6677

For more information on FOIA Administrative Appeals, you may review the DOI's FOIA regulations, 43 C.F.R. Part 2, Subpart H.

The 2007 FOIA amendments created the Office of Government Information Services (OGIS) to offer mediation services to resolve disputes between FOIA requesters and Federal agencies as a non-exclusive alternative to litigation. Using OGIS services does not affect your right to pursue litigation. You may contact OGIS in any of the following ways:

Office of Government Information Services
National Archives and Records Administration
8601 Adelphi Road – OGIS
College Park, MD 20740-6001

Email:	ogis@nara.gov
Web:	https://ogis.archives.gov
Telephone:	(202) 741-5770
Fax:	(202) 741-5769
Toll-free:	(877) 684-6448

Conclusion

If you have any questions concerning your request, you may contact us by email at

boemfoia@boem.gov; by fax at (703) 787-1209; by phone at (703) 787-1818; or by postal mail at: FOIA Office; Bureau of Ocean Energy Management; Mail Stop: VAM-BOEM DIR; 45600 Woodland Road; Sterling, VA 20166.

Sincerely,

X_____

Natasha Alcantara
Freedom of Information Act Officer/Public Liaison
Bureau of Ocean Energy Management

Attachment: As Stated

SECTION C
DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

The project is titled "Analysis of the Effects of the Block Island Wind Farm (BIWF) on Rhode Island Recreation and Tourism Activities" as prepared by University of Rhode Island (URI).

The work to be performed under this contract is as a result of a proposal submitted in response to Broad Agency Announcement (BAA) M16PS00019 titled "Proposed Research Related to Technical Approaches for Environmental Review for Offshore Wind Energy Facilities".

URI shall furnish the necessary personnel, materials, services, and facilities, and shall otherwise do all the things necessary for or incidental to the performance of work set forth in its revised technical proposal dated August 31, 2016, submitted in response to BAA Topic 5: Benefits of Renewable Energy Projects.

Effects of the Block Island Wind Farm on Recreation and Tourism

BOEM contract M16pc00016

PI: Jen McCann

Co-PIs: David Bidwell, Amelia Moore, Hollie Smith, Tiffany Smythe

THE UNIVERSITY OF RHODE ISLAND GRADUATE SCHOOL OF OCEANOGRAPHY

CRC COASTAL RESOURCES CENTER

THE UNIVERSITY OF RHODE ISLAND DEPARTMENT OF MARINE AFFAIRS

Sea Grant Rhode Island

Research Team

- Jennifer McCann (PI), URI Coastal Resources Center
- David Bidwell & Amelia Moore, URI Marine Affairs
- Tiffany Smythe, U.S. Coast Guard Academy (formerly URI CRC)
- Hollie Smith, University of Oregon (formerly URI Communications)

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DEPARTMENT OF MARINE AFFAIRS

THINK BIG WE DO℠

Overview

- Offshore Wind and Tourism
- Block Island Wind Farm Case
- Study Methods
- Key Findings
- Indicators (just a taste)

Photo: David Bidwell

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DEPARTMENT OF MARINE AFFAIRS

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Offshore Wind Social Science @ URI

- Tourism Effects
- Attitudes of Tourists
- Attitudes of Coastal Residents
- Public Participation Processes
- Impacts on Recreational Fishing
- Preferences of Boaters
- Vacation Rentals Pricing

Photo: Sara Benson

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Offshore Wind and Tourism

Photo: David Bidwell

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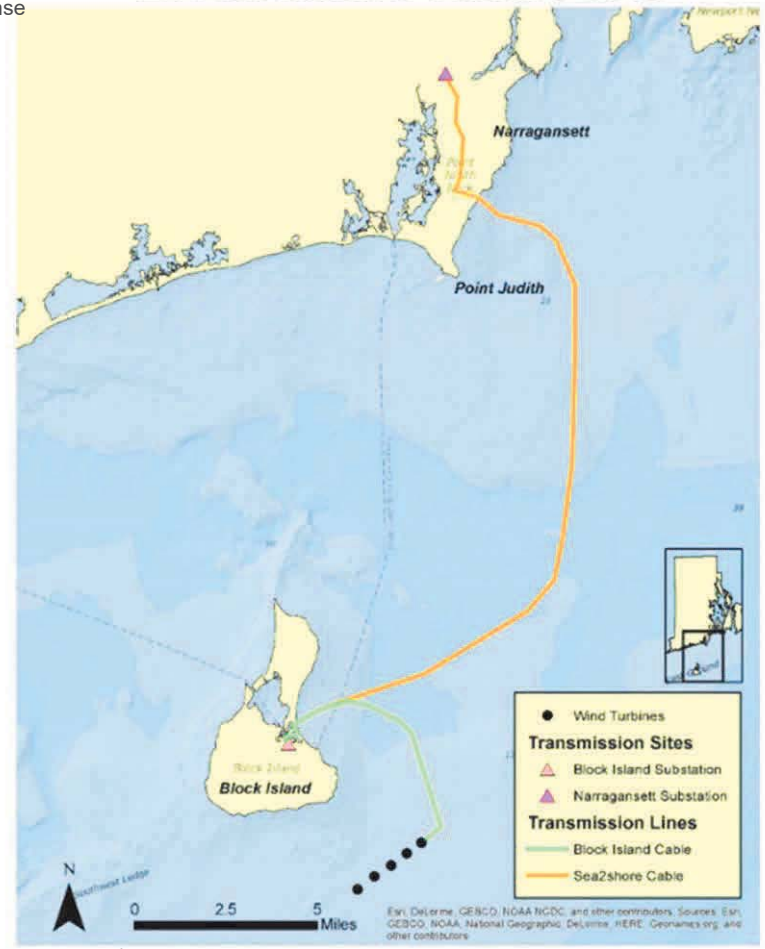
What do we mean by “tourism” impacts?

- What?
  - Water vs. Land
  - Passive vs. Active Recreation
  - Tangible vs. Intangible
- Who?
  - Overnight Visitors
  - Day Trippers
  - Seasonal Residents
  - Tourism/Recreation Community

Photo: Amelia Moore

Block Island Wind Farm



Map: Joseph Dwyer

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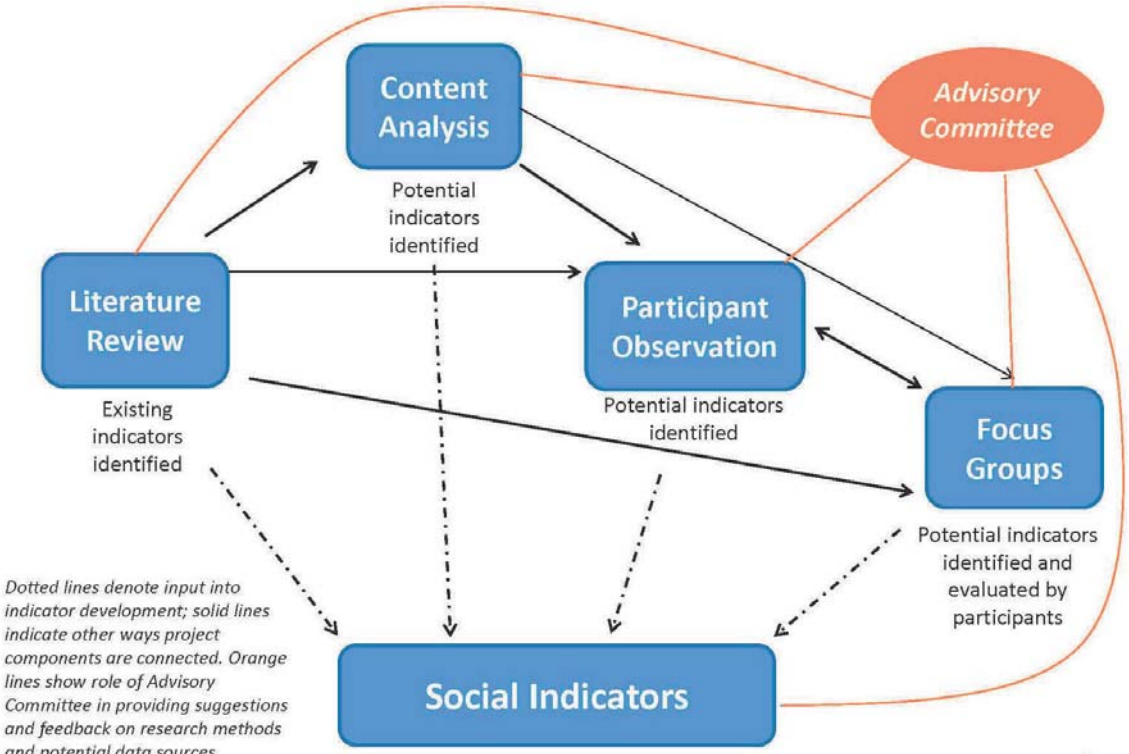
The Setting

Photo: John Supancic

Iterative, Integrative Nature of Research Design



Key Findings

1. Access Matters
   - Physical
   - Visual

2. Availability of Information
   - Opportunities missed
   - Misinformation

Photo: David Bidwell

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Key Findings

3. Lack of Baseline Data
   - Relevance
   - Scale and context

4. Process and Involvement
   - Not *tabula rasa*
   - Desire for ongoing engagement

Photo: Amelia Moore

Key Findings

5. Visual Descriptions
   - Important but varied
   - Neutral to positive

6. Wind Farm as Attractant
   - Visitors want to engage
   - Auxiliary attraction

Photo: Dina Elias

Key Findings

7. Marketing and Promotion
   - Opportunities realized
   - Opportunities missed

8. Weighing Costs and Benefits
   - Nuanced perspectives
   - Ongoing and unresolved

Photo: Amelia Moore

Indicators Development

- Reviewed literature and empirical data to develop Draft Indicators
- Reviewed Draft Indicators with stakeholders
- Revised Draft Indicators and Reviewed with Advisory Committee
- Refined and Finalized Indicators

Photo: No Fluke Charter Fishing and Tours

Acknowledgments

- This work was supported by BOEM contract M16pc00016
- Research Team: Jennifer McCann, Tiffany Smythe (USCGA), Amelia Moore, Hollie Smith (Oregon), and David Bidwell
- Support on final report: Dawn Kotowicz (URI CRC)
- Special thanks to CRC administrative staff and URI students Christine Gilbert, Claire Hodson, Sam Poli, Jamie Buck, and Sarah Matherson.

THE UNIVERSITY OF RHODE ISLAND
DEPARTMENT OF MARINE AFFAIRS

THINK BIG WE DO℠

SECTION C
DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

Behavior Response Study with Australian Humpback Whales and Seismic Air Guns

C.1 OBJECTIVE

This project aims to provide information that will reduce the uncertainty in evaluating impacts of seismic surveys on humpback whales. It will also assess the effectiveness of ramp-up as a mitigation measure, and the potential to improve design of ramp-up. The results will be in a form useful for designing management of seismic surveys and mitigation procedures.

To achieve this the Contractor will conduct experiments in which humpback whales migrating along Australian coasts are exposed a full commercial air gun array and to components of ramp-up, while they observe the reactions of the whales and measure a wide range of variables likely to affect the reactions. The whales are moving away from the breeding grounds and show behavior that is a combination of breeding, social interaction, and surface active behavior, as well as migration – all except feeding behavior. Their behavior is similar to that reported from other parts of the world. The seasonal presence of whales in the study areas is very predictable, having shown little variability for many years. The migration provides a daily turnover of whales ensures that no individual will be exposed twice. Measured whale reactions will include changes in physical behavior and vocalizations. Received sound levels (intensity and energy density or sound exposure) of the air guns at the whales will be determined from measurements at many positions in the study areas, using measured and modeled propagation loss. Digital recording tags such as DTAGs (Johnston and Tyack, 2003) will also be attached to whales for this purpose and for recording the dive profile. Longer term tags will be used to obtain the dive profile over periods of several days. Measurements will also include ambient noise and received levels of other stimuli such as vocalizing whales and vessels. Whales will be tracked visually and vocalizing whales acoustically while in the study areas.

The experiments are designed to provide results that would be generally applicable to humpback whales with similar behavior worldwide. This will be achieved by measuring a sufficient range in the values of the variables affecting the responses to allow the general dependence on these variables to be determined, thus separating the results from the specific conditions of measurement. To do this the Contractor will study two different humpback whale populations in different environments (with differing water depths and sound propagation) and use a range of air gun array sizes to vary the received level as a function of distance. Variation in other variables such as whale behavior, ambient noise and weather occurs naturally. By determining the values of these variables for any new site, the response can then be predicted.

There will be two experimental regimes and two study sites: one offshore and one inshore. One experimental regime, used only at the offshore site, will be the exposure of whales to a commercial seismic air gun array. The second regime will involve controlled exposure of whales to components of ramp-up, and will be used at both sites to compare responses to the same stimuli between sites. The inshore site allows more detailed and higher resolution observations by using land based observations and thus provides a larger amount of whale response information and a higher degree of experimental control than possible at the offshore site. Using these detailed observations, the Contractor can tease out detailed reactions to individual air gun

firings of ramp-up. It will also allow the Contractor to obtain the data needed to understand the function of behavior and vocalizations to relate whale reactions to life functions. It would not be possible, however, to use a full survey air gun array at the inshore site because of the difficulties of working so close to shore, including the difficulties of obtaining permits and ensure that reactions do not drive whales too close to the beach. Control observations will be made at both sites with the vessel towing the air gun array but without firing and also in the absence of the vessel.

C.2 SCOPE OF WORK

C.2.1 Overview

(a) To determine the response of humpback whales to a typical commercial seismic survey in terms of the variables affecting the response, such as the received sound level, relative movements of seismic array and whales and distance between them, behavioral state and social category of the whales, and environmental variables.

(b) To determine the response of humpback whales to soft start or ramp-up and its components, to assess the effectiveness of ramp-up as a mitigation measure in seismic surveys and the potential for improving the effectiveness.

(c) To relate these responses to the range of normal behavior and the response of the whales to other stimuli, such as passing ships, using the substantial body of knowledge that exists from previous research for the populations studied. Knowledge of the function of the behavior, the population dynamics and the biology of the whales will allow us to infer and model effects on life functions.

C.2.2 Hypotheses to be Tested

The hypotheses listed below will be tested, recognizing that the results may vary with: received air gun signal level and character; seismic array configuration; relative motion and range of the seismic array and whale; background noise level; social context of the whale or group of whales (e.g. single adult, mother and calf); and the behavior of the whale at the time of exposure (i.e. migrating, resting or socializing). The aim is to develop response relationships and response thresholds, in terms of the variables listed. Measures of behavioral change or reaction include: changes in course traveled by groups of whales through the study area; the consistency in course traveled (i.e. the changes in course); group speed; dive profile (including deep dive profiles, shallow dive profiles and surface intervals); surface-active behavior; sightability; and spatial relationships between individuals or other groups, especially mothers and calves. Measures of changes in vocalization include song structure, social sound type and characteristics and vocalization amplitude (source level).

Hypothesis to be tested:

1. Humpback whales show changes in behavior, including vocal behavior, when exposed to a commercial seismic air gun array.

2. The threshold of observed changes in behavior depend on
    a) received noise level
    b) distance of the whale from the array independently of received level
    c) whale social category (male, female, calf) and social context
    d) direction of air gun movement relative to the whale
    f) ambient noise level

3. The behavioral changes lie within the range of those observed in the absence of human activity.

4. Humpback whales show changes in behavior, including vocal behavior, when exposed to components/stages of ramp-up:
    a) a single air gun
    b) four air guns
    c) ramp-up from one to four air guns
    d) full ramp-up of a commercial air gun array

5. Humpback whales move away from the air guns when exposed to component/stages of ramp-up.

C.2.3 Summary of Methods and Approach

We will conduct experiments in which humpback whales migrating along Australian coasts are exposed a full commercial air gun array and to some components of ramp-up, while we observe the reactions of the whales and measure a wide range of variables likely to affect the reactions.

Exposure to components of ramp-up will be done at a near shore site on the east coast where a high resolution observations are possible with shore based observations. Exposure to a full seismic array will be done at an offshore site off the west coast. Aspects of the east coast experiments will be repeated off the west coast to come the reactions of the two populations. Observations will include vessel based observations of whale physical behavior, focal follows (following and observing a focal group), vocalizations, measurements of sound field throughout the site, tags such as DTAGs (for received sound field at, and the fine-scale 3D underwater movements of, the tagged whales), longer term tags (for broader scale movements), and biopsies (to determine gender for social context). The inshore site provides additional types of observations and higher resolution observations than are possible offshore, including theodolite tracking of most whales within a 10 km radius, theodolite focal follows of focal groups, and more accurate acoustic tracking of vocalizing whales. This provides greater detail, resolution and sample size than possible offshore, and allows reactions of multiple whales to be determined at several scales. The fine scale work will allow us to tease out the behavioral reactions in terms of the variables likely to affect the reactions such as received level, proximity of source, pattern of movement, social context of the whales). It will provide the context for interpretation of the commercial array trials. It will also provide the information needed to interpret reactions to ramp-up.

All experiments will include controls in which the air gun vessel is towing the air guns but they are not firing, and controls in which the vessel is absent. All focal group observations follow a

'before, during, after' design and so each group also acts as its own control. The sound field across the sites during experiments will be determined by multiple spaced measurements of received levels, propagation loss measurements and modeling. The observed behavioral changes at the sites will be compared with the extensive knowledge of normal behavior and its function, and reactions to other stimuli available from previous studies at these sites. These comparisons will be used to infer effects of air gun exposure on life functions. Varying the seismic array size and configuration will help avoid pseudo-replication to allow generalization of the results.

The results will be analyzed by developing generalized linear mixed models in which the contributions of the variables measured to the whale reactions can be determined.

C.2.4 Statement of the Scientific Significance of the Project

This project will build on previous studies of the effects seismic activity on whales and extend them in a number of areas. The logistic difficulties of studying whales limits the amount of observations that can be made and thus the sample size that can be obtained in experiments for reasonable cost.

Studying the effects of noise on behavior is further complicated by the need to separate observed behaviors associated with the noise stimulus from the range of behaviors that the whales exhibit normally. The experimental procedures to deal with these difficulties have developed in previous experiments over the last 25 years, and the results of these experiments have led to clearer understanding of the important issues that need to be addressed (see B.2 for details). Some experiments produced results that were somewhat uncertain because samples were too limited or the experimental design lacked some important feature such as adequate controls, but these results also showed us how to improve the experimental technique and obtain the sample size required. This project is the next step building on the ones that have gone before.

It will add to the previous work by combining the following:

- The proposed project will combine Behavioral Response Studies (BRS) (also known as Controlled Exposure Experiments) using a commercial seismic array and BRS using individual stages of the ramp-up procedure used in seismic surveys (single air gun, four air guns etc.) to determine whale reactions to a wide range of exposures. It will assess whether ramp-up is effective as a mitigation measure.
- Multiple scales of observation will provide significantly greater resolution and detail of behavioral data than most previous experiments.
- It will go beyond a simple dose response study where the dose related only to the received noise and test the contribution of a wide range of variables likely to affect reactions to air gun arrays. It will provide the range in the values of these variables needed to do this and to avoid pseudoreplication, the failure of the experimental design to provide sufficient variety in the samples taken to obtain a representative of the type of stimulus, the subject or other variables that affect the result.
- Variables will be measured over a range of values and multivariate statistical methods such as generalized linear mixed model will be used to tease out the contributions of the different variables, thus making the results generally applicable to humpback whales exhibiting similar behavior elsewhere. Statistical power analysis has been used to ensure that the planned sample

size is adequate to obtain statistically significant results and this analysis will be repeated for each subsequent experiment using data from the previous one.

• The reactions will be placed in the context of normal behavior and reactions to other stimuli that may be encountered by the whales using the unusually large amount of data on normal behavior and biology that exists for the populations studied. This will allow us to make progress in making inferences and developing models relating observations to effects to life functions.

SECTION C
DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

The project is titled “Benefits of Renewable Energy Projects” as prepared by AECOM Technical Services, Inc.

The work to be performed under this contract is as a result of a proposal submitted in response to Broad Agency Announcement (BAA) M16PS00019 titled “Proposed Research Related to Technical Approaches for Environmental Review for Offshore Wind Energy Facilities”.

AECOM Technical Services, Inc. shall furnish the necessary personnel, materials, services, and facilities, and shall otherwise do all the things necessary for or incidental to the performance of work set forth in its technical proposal, as revised, dated August 24, 2016, submitted in response to BAA Topic 5: Benefits of Renewable Energy Projects, incorporated herein by reference.

SECTION C

DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

For

Methane Hydrate Resource Assessment: Developing a Recovery Factor

C.1 INTRODUCTION

The Minerals Management Service (MMS) by virtue of the Outer Continental Shelf (OCS) Lands Act, the Submerged Lands Act, and pursuant to delegation of authority by the Secretary of the Interior has jurisdiction over leasing and development of OCS submerged lands for mineral development. In conjunction with this jurisdiction, the MMS is required to follow the overall minerals management goals as stated in the OCS Lands Act Amendments of 1978. The MMS responsibilities under the OCS Lands Act include the analysis of environmental and resource information on the OCS, including periodic assessments of the undiscovered oil and gas resource potential.

The MMS began a comprehensive resource assessment of natural gas hydrates on the OCS in 2003. Ultimately, the goal as stated was to produce an in-place, technically recoverable, and economically recoverable assessment of the volume of natural gas hydrate in the Gulf of Mexico, Atlantic, Alaskan, and Pacific basins. Initially, a series of workshops were convened that included presentations and recommendations from a number of accomplished scientists in the hydrate field. In 2004, the applicability of the scientific theory to quantitative stochastic modeling was investigated by statisticians and computer programmers. Additionally, a draft version of the proposed methodology was constructed and geoscientists with the MMS began to prepare input datasets from MMS proprietary seismic and borehole data.

In early 2005 the in-place assessment methodology had matured to the stage where computer programmers were able to begin construction of a model framework. At the same time, MMS inputs were nearing completion and the methodology underwent several revisions. During 2006 and the first quarter of 2007 the Gulf of Mexico dataset was run through the completed model several times. With each run, modifications were made to both the methodology and the correlative computer code. In February of 2008, OCS Report MMS 2008-004 was published as the release of both the initial in-place assessment of gas hydrate resources in the U.S. Gulf of Mexico (GOM) and the methodology that supports the assessment[1]. The MMS is currently working to develop similar in-place estimates for other OCS margins, as well as to reduce the in-place volumes to those volumes that are technically-recoverable. The technically-recoverable volumes are determined through a multi-step process that includes the critical step of assigning a fractional recovery factor to the in-place volume.

C.2 SCOPE OF WORK

The scope of work for this contract will include efforts related to the evaluation of certain reservoir parameters and how they impact the technical recovery of gas from a gas hydrate reservoir. Specifically, three "Types" of gas hydrate reservoirs will be investigated, including Type III (isolated hydrate-bearing zone), Type II (hydrate-bearing zone over mobile water), and Type I (hydrate-bearing zone over free gas). Mechanistic studies, reservoir simulation studies, and research and development work will be necessary to support all three models.

C.2.1 Type III and Type II reservoirs: Very little is known about the production potential of Type III and Type II gas hydrate reservoirs. As such, the scope of the work on these reservoirs will need to include an investigation of the influence of several reservoir parameters, and how they impact the production potential as seen in reservoir simulation studies. A recovery factor function that can be applied to the current MMS in-place gas hydrate estimates will be developed from these simulation studies.

C.2.2 Type I reservoirs: While some work has been published in the literature that addresses the production potential of Type I gas hydrate reservoirs [2], the applicability of these efforts to the MMS assessment model is not clear. Appropriate ranges of values for the various reservoir parameters applicable to the current structure of the MMS in-place model will be determined. Additional studies will be performed to define a recovery factor function that can be applied to the MMS estimates of in-place gas hydrate resources that reside in Type I reservoirs. The recovery factor function for Type I reservoirs will assume a similar model structure to those functions described for Type III and Type II reservoirs.

C.3 OBJECTIVE OF THIS STUDY

3.1 The scope of work for this contract includes two primary objectives that will be divided into separate tasks. The first objective is to gain a better understanding of the production potential of Type III and Type II gas hydrate reservoirs through simulation studies. The significance of various input parameters will be evaluated and a recovery factor function will be generated. The second objective is similar to the first, but the focus will be on Type I gas hydrate reservoirs. Here, many observations concerning the impact of reservoir parameters are available in the literature, and the focus of the proposed study will be to provide a recovery factor function to MMS that is similar to the one provided for Type III and II reservoirs.

3.2 The MMS has developed an in-place model for the estimation of gas hydrate resources on the federal OCS. Our ability to estimate that fraction of the gas hydrate that might be technically recoverable is somewhat limited by the paucity of gas hydrate reservoir engineering data in the public domain. For this reason, it is critical to develop simulation models, understand the impact of the various physical parameters, and render recovery factor functions that are directly applicable to the output of the MMS in-place assessment model.

C.4 SPECIFIC TASKS

The scope of work for this contract is divided into two tasks. The contractor will be responsible for ensuring the accuracy, timeliness and completion of all tasks assigned under this contract.

4.1 Task 1: The contractor will determine the reservoir characteristics that have a significant effect on the technical recoverability of Type III and Type II gas-hydrate reservoirs, and provide determination of an approximate function that relates the technically recoverable portion of a hydrate accumulation to its reservoir characteristics. Specifically:

- Develop a list of reservoir parameters that could affect gas production from a hydrate accumulation, and determine a reasonable range for each of these properties.
- Conduct mechanistic simulation studies to better understand how each of these reservoir characteristics may affect hydrate recovery.
- Determine performance indicators that are important in evaluating whether a hydrate accumulation is technically unrecoverable; conduct simulation studies to help determine these performance indicators.
- Develop a surface function between the calculated performance indicators and the reservoir characteristics.
- Conduct Monte-Carlo simulation to determine the most important reservoir characteristics that affect the performance indicators.
- Provide a recovery factor function that is applicable to existing MMS in-place gas hydrate assessment model.

4.2 Task 2: The contractor will use this contract to leverage existing numerical simulation studies of the production potential of Type I gas hydrate reservoirs in an effort to identify the reservoir characteristics that have a significant effect on the technical recoverability of gas hydrate reservoirs. Subsequently, determine an approximate function that relates the technically recoverable portion of a hydrate accumulation to its reservoir characteristics. Specifically:

- Evaluate the list of reservoir parameters that could affect gas production from a hydrate accumulation, and determine a reasonable range for each of these properties.
- Conduct mechanistic simulation studies to better understand how each of these reservoir characteristics may affect hydrate recovery, assuming constant pressure production.
- Determine performance indicators that are important in evaluating whether a hydrate accumulation is technically unrecoverable; if needed, conduct simulation studies to help determine these performance indicators.
- Develop a surface function between the calculated performance indicators and the reservoir characteristics.
- Conduct Monte-Carlo simulation to determine the most important reservoir characteristics that affect the performance indicators.

- Provide a recovery factor function that is applicable to existing MMS in-place gas hydrate assessment model.

C.5 GENERATE AND DELIVER PROJECT REPORT

5.1 Task 1: The contractor's project team will generate a draft final report and a final report for the MMS (in hardcopy and in electronic form) summarizing the work carried out and findings/results as part of the above tasks and the report shall be reviewed and submitted in accordance with Section F paragraphs F.4 and F.5.

Deliverables will include:

- A summary report that contains a definition of all reservoir parameters, the range of values applied to each, and the source of the information; simulation study results and documentation of simulation workflow; description of recovery factor functions and recommendations for their use.
- Recovery factor function for Type III reservoirs.
- Recovery factor function for Type II reservoirs.
- Consultant support for the incorporation of recovery factor functions into the MMS technically-recoverable model methodology.

5.2 Task 2:

Deliverables will include:

- A summary report that contains a definition of all reservoir parameters, the range of values applied to each, and the source of the information; simulation study results and documentation of simulation workflow; description of recovery factor functions and recommendations for their use.
- Recovery factor function for Type I reservoirs.
- Consultant support for the incorporation of recovery factor functions into the MMS technically-recoverable model methodology.

General quality measures, as set forth below, will be applied to each work product received from the contractor under this statement of work:

- *Accuracy* - Work Products shall be accurate in presentation, technical content, and adherence to accepted elements of style.

- *Clarity* - Work Products shall be clear and concise. Any/All diagrams shall be easy to understand and be relevant to the supporting narrative.

- *Format* - Work Products shall be submitted in hard copy (where applicable) and in media mutually agreed upon prior to submission. Hard copy formats shall follow any specified Directives or Manuals.

- *Timeliness* - Work Products shall be submitted on or before any scheduled date determined by the Government and the contractor.

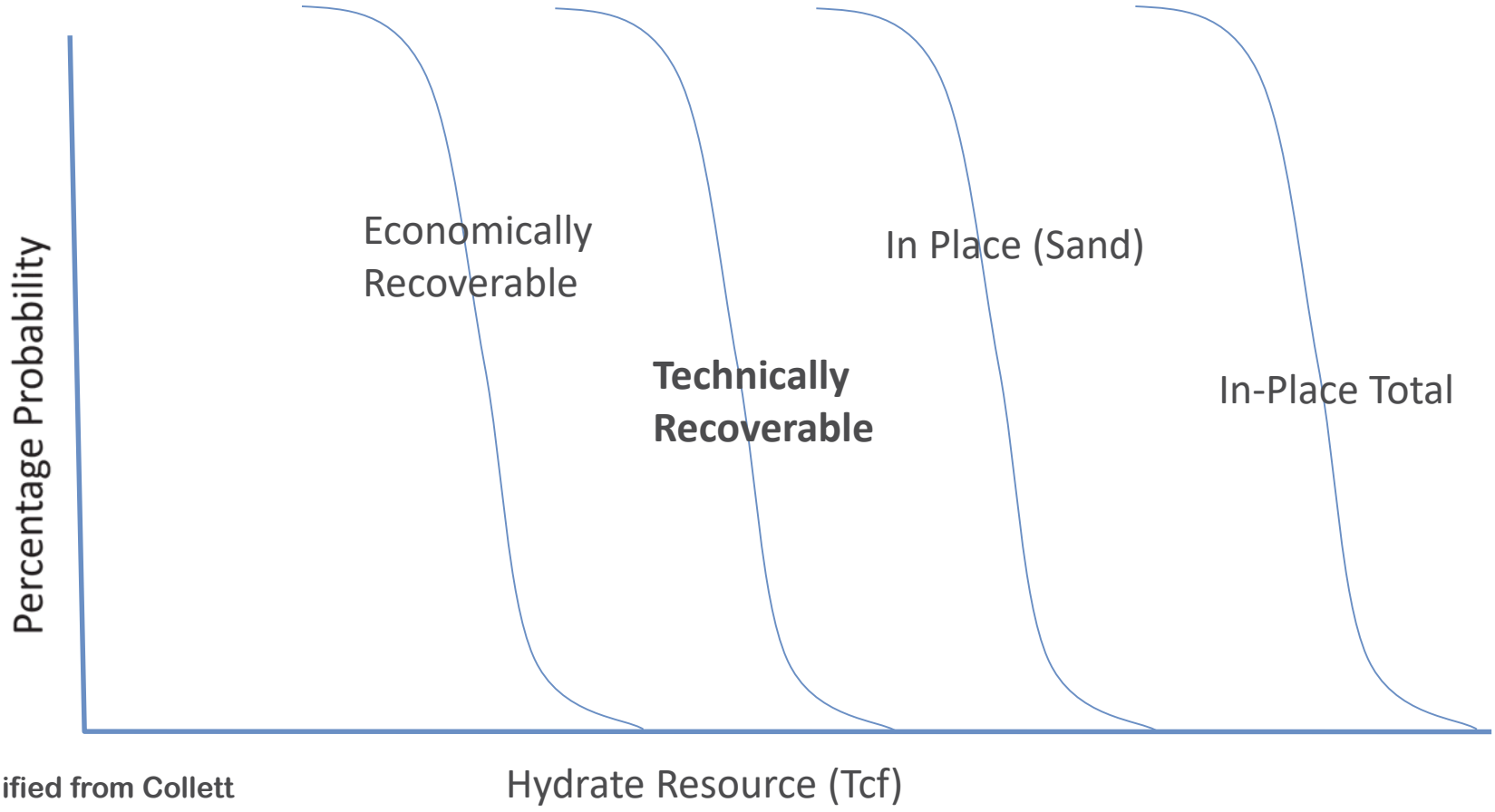
Estimating Technical Recoverability of Hydrate Accumulations

Type II and Type III Reservoirs

Fekete Associates Inc.

July 2009

Background



Modified from Collett

Objectives

- Clarify
  - What constitutes technical recoverability
- Determine
  - Reservoir characteristics with significant impact on technical recoverability
  - Approximate functions that use reservoir characteristics to predict technical recoverability (to be applied on cell by cell basis)

Methodology

- Suggest criteria for technical recoverability
- Develop a list of reservoir parameters, and their ranges
- Conduct sensitivity studies to better understand effect of each parameter
- Conduct simulations and relate recovery with reservoir parameters (i.e. response function)
- Conduct Monte-Carlo simulation and determine range of technical recoverability
- Determine the degree of importance of individual parameters (Tornado chart)
- Revisit/iterate
- Explore limitations and degree of error

Assumptions

- Production by depressurization
- Sandy accumulations
- Homogeneous properties
- No geomechanical effects

Fineprint:
Each of the above could have a significant bearing on the applicability of assumptions.
For example, in the presence of significant heterogeneity (in the form of disconnected
Sand bodies), more than one well may be required to access the hydrates within the study area.

Criteria for Technical Recoverability

- Initial consideration
  - Minimum recovery factor (of say 20% in 50 years)
  - Minimum gas production rate (of say 1 or 10 MMSCF/day)
  - Maximum water gas ratio (of say 100 or 1000 STB/MMSCF)

- Instead: determine performance indicators
  - Recovery in 50 years
  - Cumulative gas production in 50 years

- Determine cut-off criteria
  - p/T conditions
  - Others (not investigated)
    - Minimum GIP per cell? Minimum Accumulation size?
    - Presence of cap rock?
    - Unconsolidated sand (sloughing, other geomechanical problems)?
    - Large connected aquifer?

Range of Reservoir Parameters

Reservoir Characteristics	Variable Name	Low estimate	Medium Estimate	High Estimate
Water depth, m*	WD	750	1200 (1500)	2000 (3000)
Reservoir mid-point depth below sea floor, m*	RD	100	250 (300)	400 (600)
Porosity, %	Phi	30	35	40
Initial Permeability within hydrate layer, mD*	Ki	0.05	0.5	5
Hydrate Saturation, %	SH	40	60	85
Sand thickness, m	H	3	6	20
Dip angle, degrees	Angle	0	5	10
Ratio of hydrate column to total	R_HC	0.5	0.7	0.9
Extent of aquifer (in addition to the water in the base model)**	Aquifer	No	No	5 times of reservoir size
Permeability within the underlying free water, mD	Kabs	100	500	1000
Gas relative permeability	krg0	0.1	0.5	1.0

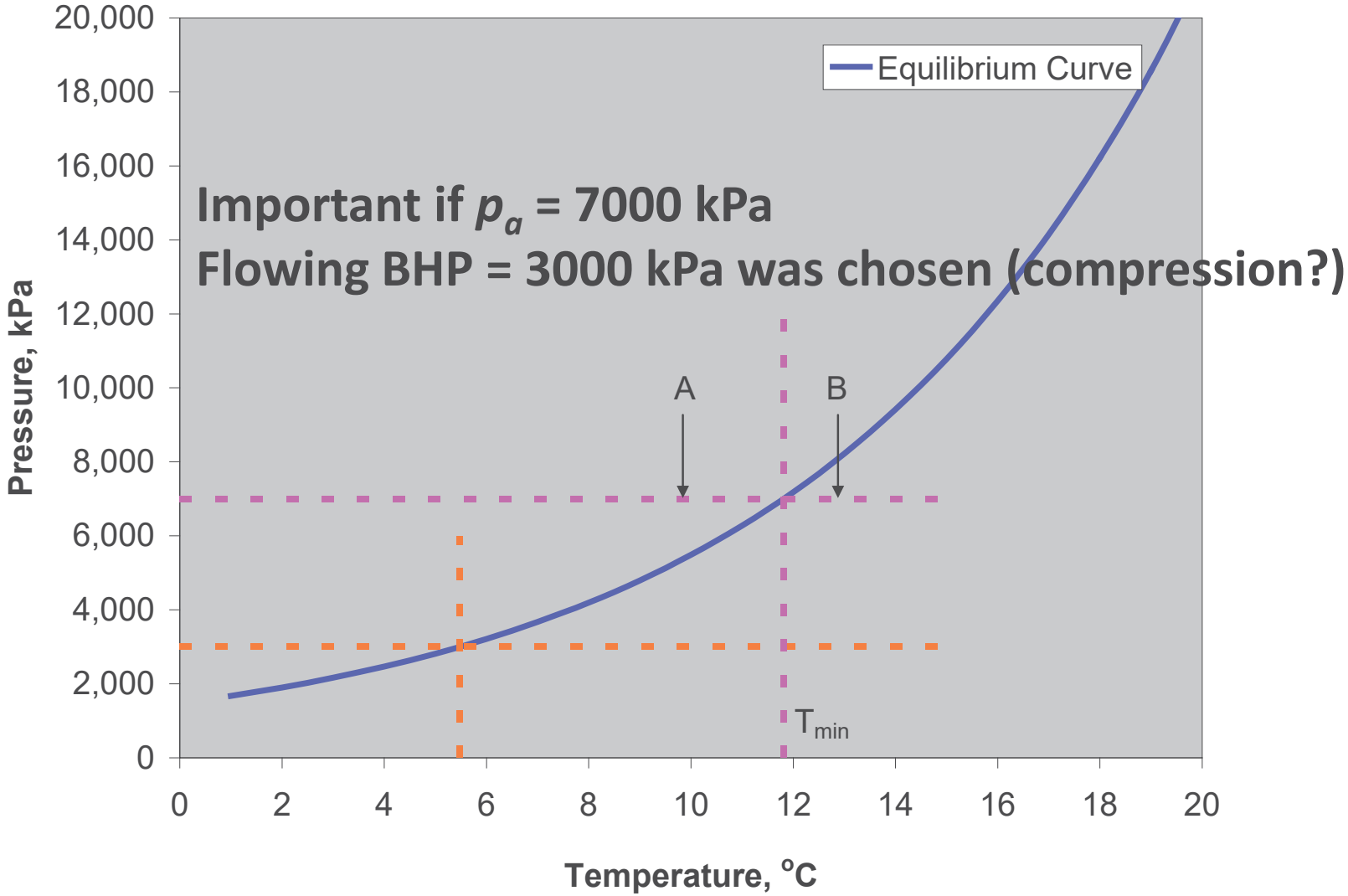
*See Appendix I for some details

** Reservoirs with active aquifer are excluded

Parameters Not Varied

- Constant bottomhole production at 3000 kPa (see next slide)
- Constant equilibrium relation (see Appendix I)
- Geothermal gradient of 24.55 C/km (e-mail communication, March 4, 2009)
- Vertical well (See Type III section)
- Study area of ~760 m by ~760 m (1/4 cell or 160 acres well spacing)
- Numerical parameters (shale thickness, grid size) (See Appendix I and Type III Section)
- Details of simulation with STARS (See Pooladi-Darvish et al. 2008, Uddin and Coombe, 2007, Wilder et al. 2008)

p/T cut-off criterion



Hydrates whose temperature < T_{min} will not decompose In addition: Hydrate

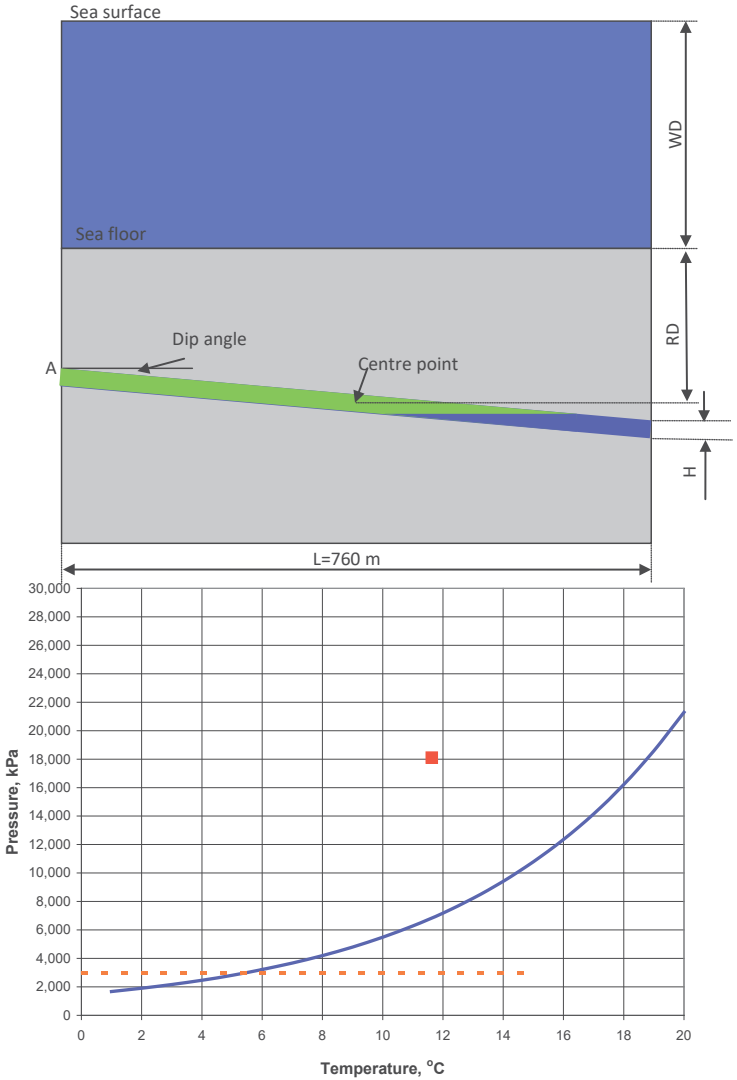
For details see Progress Report #1 (21/2/2009) Need to be present

Study of Type II Reservoirs

- Base Case Properties
- Base Case Results
- Range of Results (sensitivity study)
- Range and probability of recovery and cumulative gas produced

Base Case

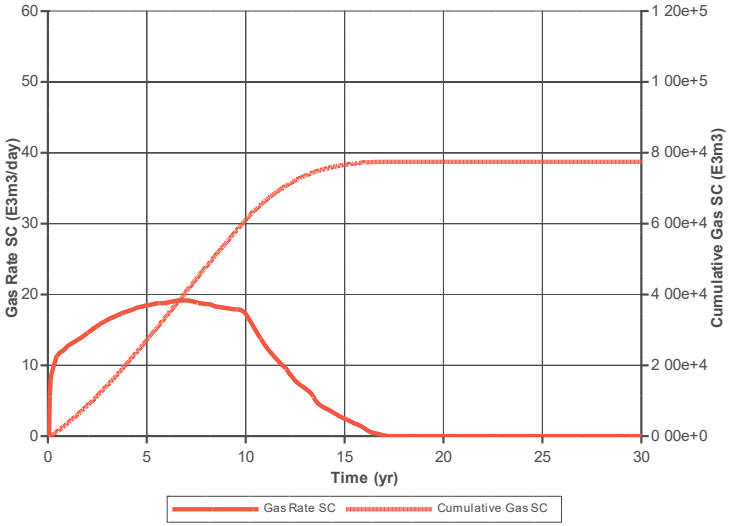
Reservoir Characteristics	Base value
Water depth, m	1500
Reservoir mid-point depth below sea floor, m	300
Equilibrium Curve	In-place study (mean)
Porosity, %	35
Hydrate Saturation, %	60
Sand thickness, m	6
Dip angle, degrees	5
Ratio of hydrate/sand thickness	0.7
Extent of the aquifer	No
Permeability within the underlying free water, mD	500
Permeability (S_{Hi}), mD	0.5
Production pressure, kPa	3000
Reservoir size	760 m × 760 m
Initial Pressure, MPa	18100
Initial Temperature, C	11.63

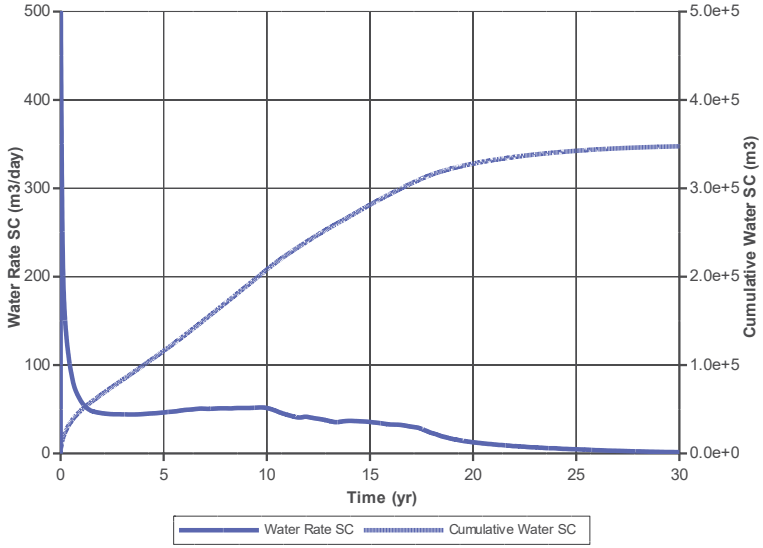


At 7000 kPa, no decomposition

Base Case – Results

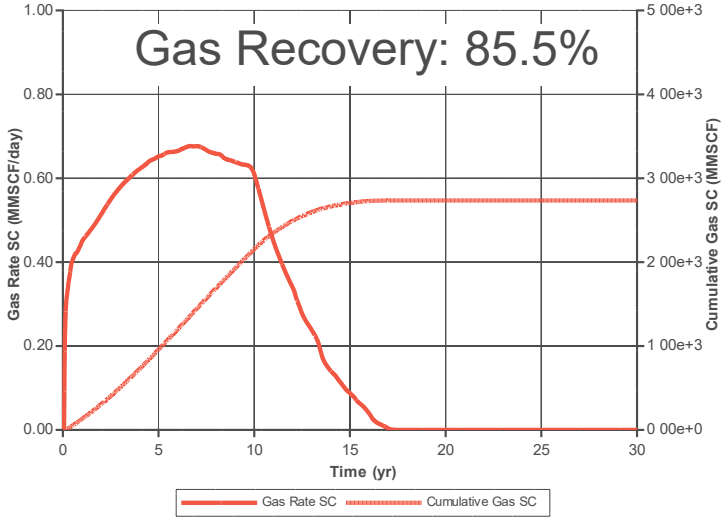
SI unit



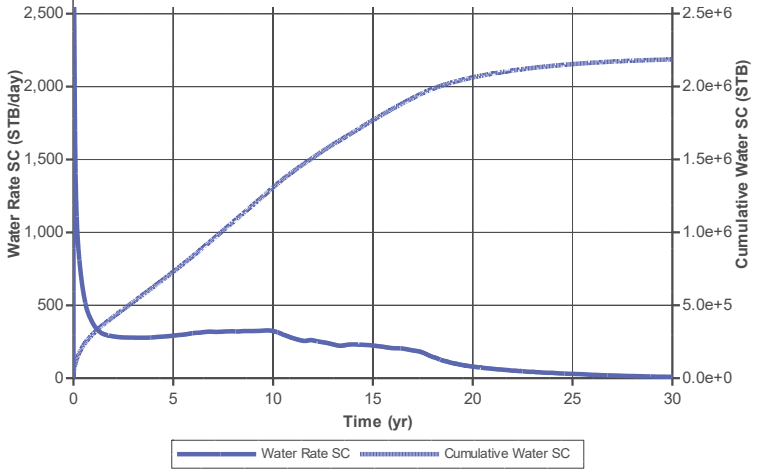


Field unit

Gas Recovery: 85.5%



W/G: 4.5 m3/E3m3 (800 stb/MMscf)



Gas Recovery = (Cumulative gas production)/(Initial gas in hydrate)*100

Base Case – Results

Hydrate Saturation

Initial

15 years

5 years

10 years

This is a half model (760m x 380 m). Half of well productivity is modeled. Previous reported result is double of this model, means for a drainage area of 760 m x 760 m

Base Case – Results

Temperature

Initial

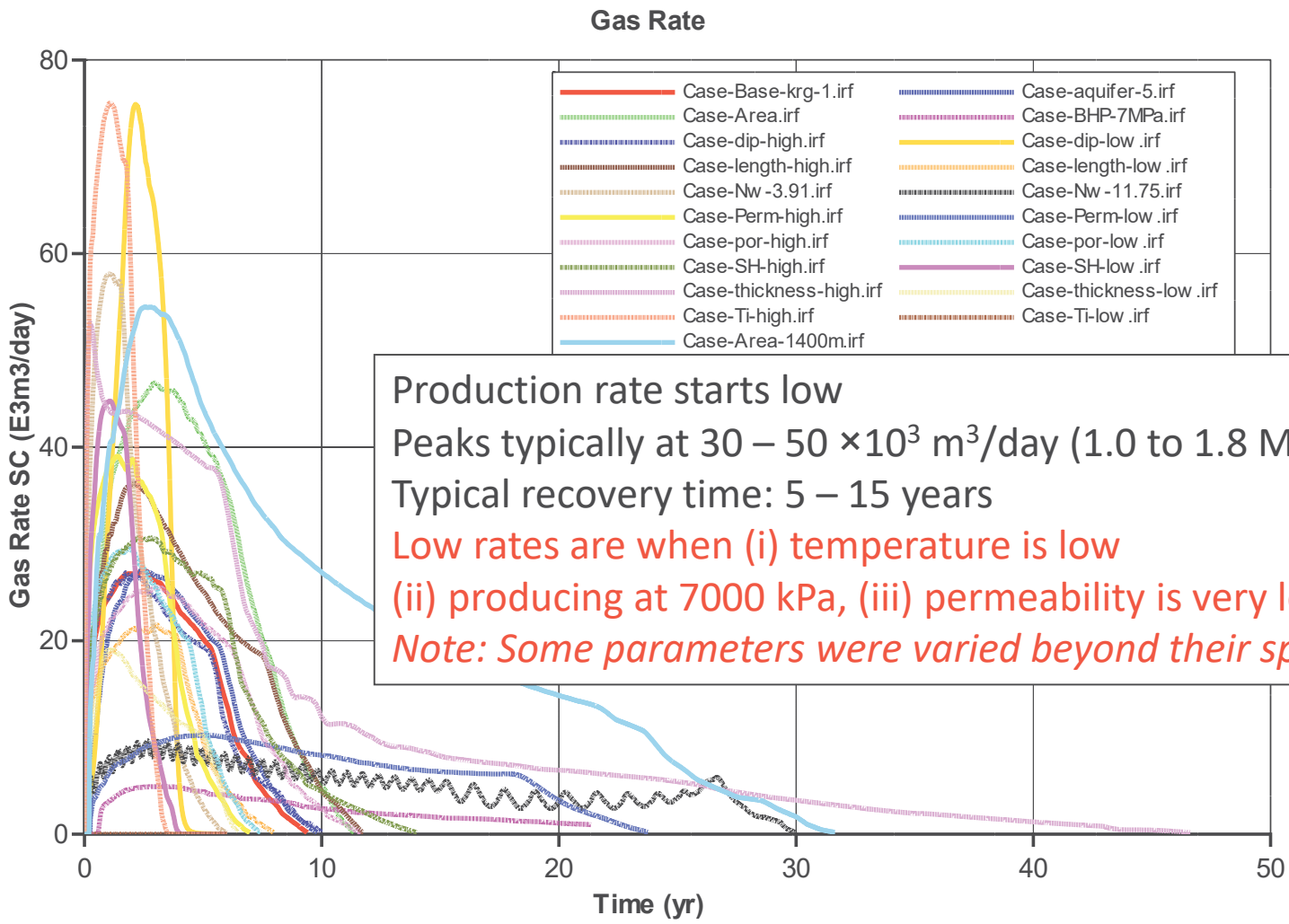
20 years

Reservoir warms up slowly after all hydrate has dissociated

5 years

10 years

Range of Results (Gas Rate)



Production rate starts low

Peaks typically at 30 – 50 $\times 10^3$ m^3/day (1.0 to 1.8 MMscf/day)

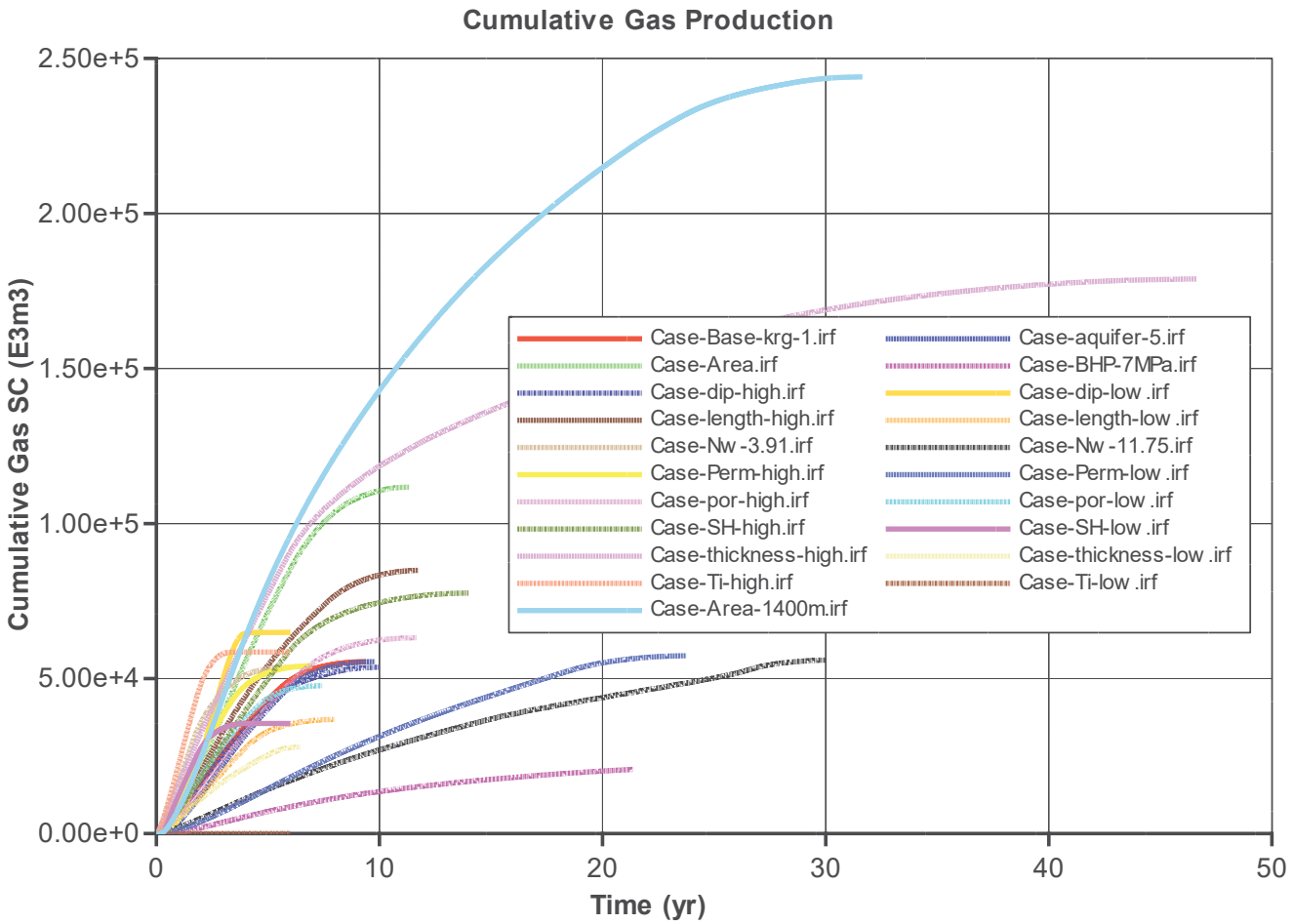
Typical recovery time: 5 – 15 years

Low rates are when (i) temperature is low

(ii) producing at 7000 kPa, (iii) permeability is very low (0.001 m

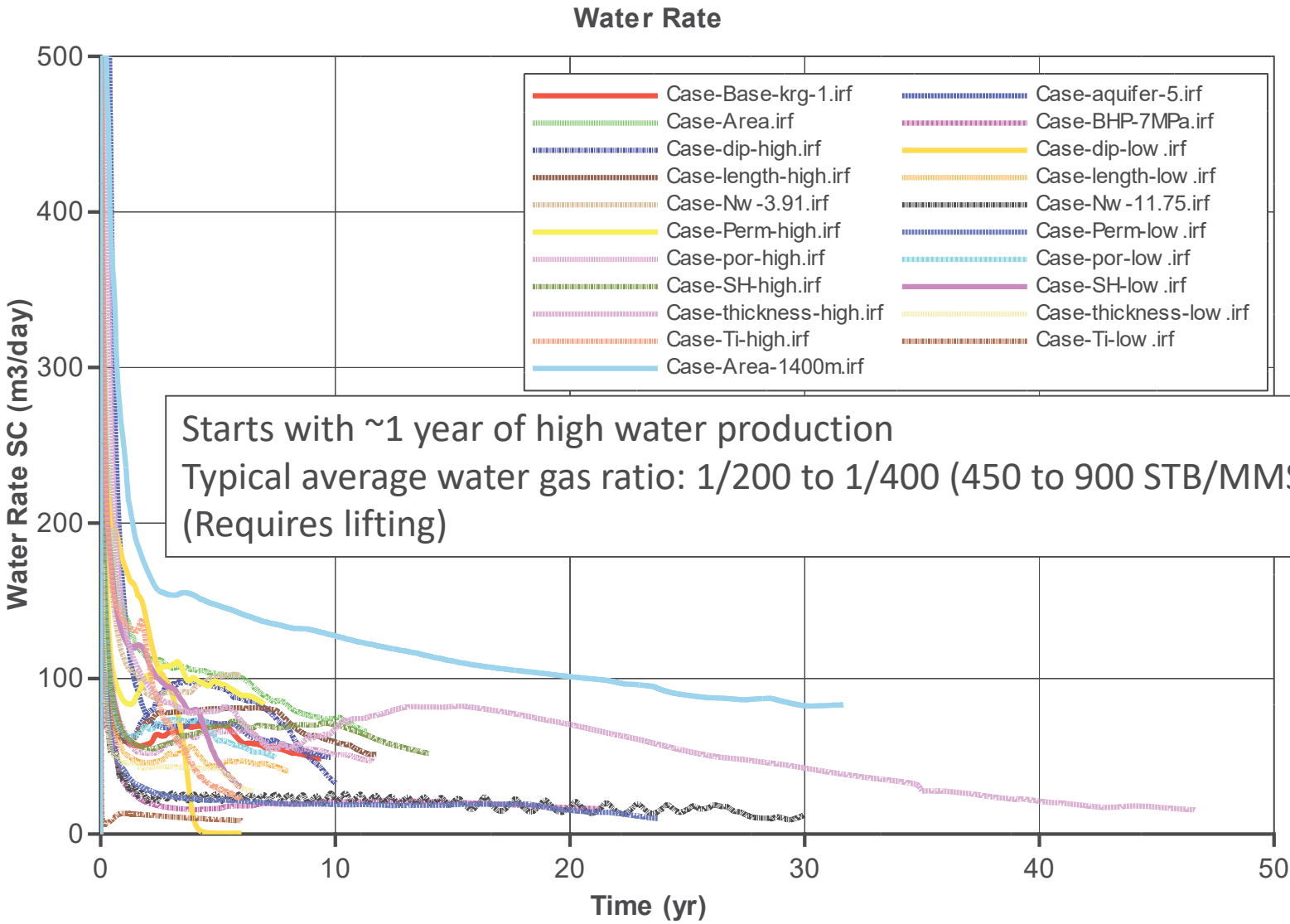
Note: Some parameters were varied beyond their specified range

Range of Results (Cum Gas)



Typical cum Production: 60 – 80 $\times 10^6$ m^3 (2 to 2.8 Bcf)

Range of Results (Water Rate)



Starts with ~1 year of high water production

Typical average water gas ratio: 1/200 to 1/400 (450 to 900 STB/MMSCF)

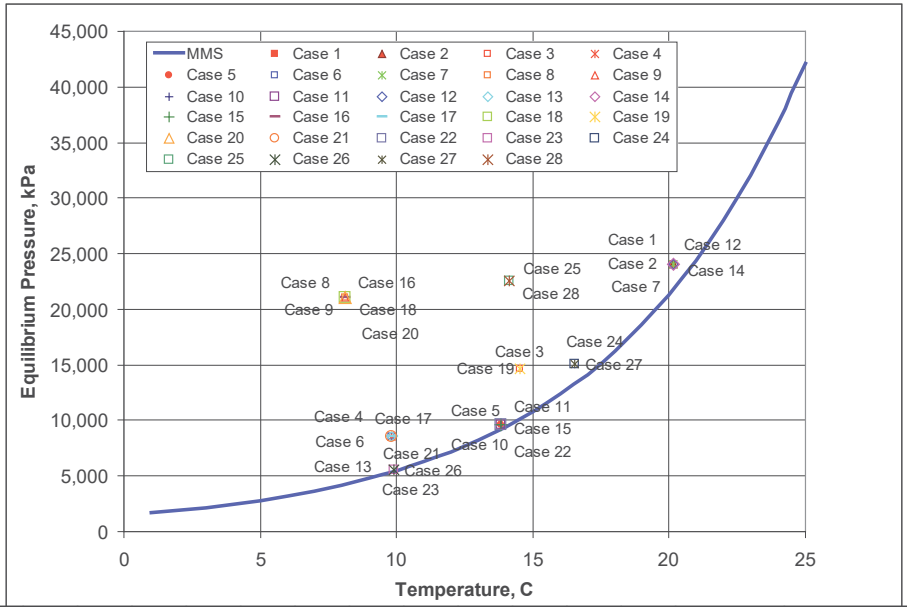
(Requires lifting)

Methodology

1. Conduct 2-level experimental design (10 – 20 cases)
2. Conduct simulations
3. Determine surface function (e.g. recovery vs. parameters)
4. Determine distribution of recovery
5. From Tornado chart, determine the more important parameters
6. Conduct 3-level experimental design (10's of cases)
7. Return to step 2

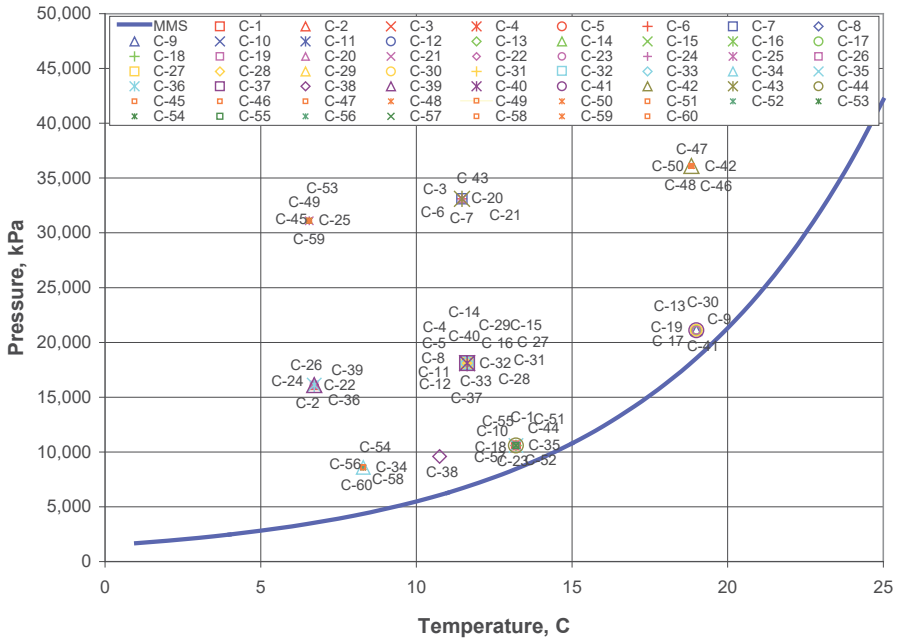
Cases Studied

Two Level



	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	Resp_1	Resp_2
Exp #	WD	RD	Phi	Ki	SH	H	Angle	R_HC	Aquife	kabs	krg0	BHP	Recovery,%	Cum Gas, E3m3
1	2000	400	30	0.05	40	3	10	0.5	1	100	1	7000	70.91	13,177
2	2000	400	40	0.05	40	20	10	0.5	1	1000	0.1	3000	78.97	130,440
3	1200	250	35	0.5	60	6	5	0.7	0	500	0.5	3000	87.25	79,085
4	750	100	40	5	40	20	10	0.5	0	100	0.1	7000	0.00	0
5	750	200	40	5	85	3	0	0.9	1	100	1	7000	35.18	33,146
6	750	100	30	0.05	85	3	10	0.5	1	1000	1	7000	0.00	0
7	2000	400	40	5	40	3	4	0 9	0	1000	1	3000	89.50	39,878
8	2000	100	30	5	85	3	10	0 9	0	100	0.1	3000	44.94	31,875
9	2000	100	40	0.05	85	20	10	0 9	0	100	1	7000	0.00	0
10	750	200	40	0.05	40	3	0	0 9	0	1000	0.1	7000	61.63	27,323
11	750	200	30	5	85	20	10	0 5	0	1000	1	3000	74.46	194,829
12	2000	400	30	0.05	85	20	0	0 9	1	100	0.1	3000	82.18	389,456
13	750	100	30	5	40	20	0	0 9	1	1000	1	3000	83.14	184,195
14	2000	400	30	5	85	3	0	0 5	0	1000	0.1	7000	62.93	24,854
15	750	200	40	0.05	85	20	0	0 5	0	100	1	3000	90.62	316,148
16	2000	100	30	0.05	40	20	0	0 9	0	1000	1	7000	0.00	0
17	750	100	30	0.05	40	3	0	0 5	0	100	0.1	3000	69.70	12,849
18	2000	100	40	5	40	3	0	0 5	1	100	1	3000	67.55	16,718
19	1200	250	35	0.5	60	6	5	0.7	0	500	0.5	3000	87.25	79,085
20	2000	100	40	5	85	20	0	0 5	1	1000	0.1	7000	0.00	0
21	750	100	40	0.05	85	3	10	0 9	1	1000	0.1	3000	73.95	69,566
22	750	185	30	5	40	20	4	0 9	1	100	0.1	7000	12.89	28,252

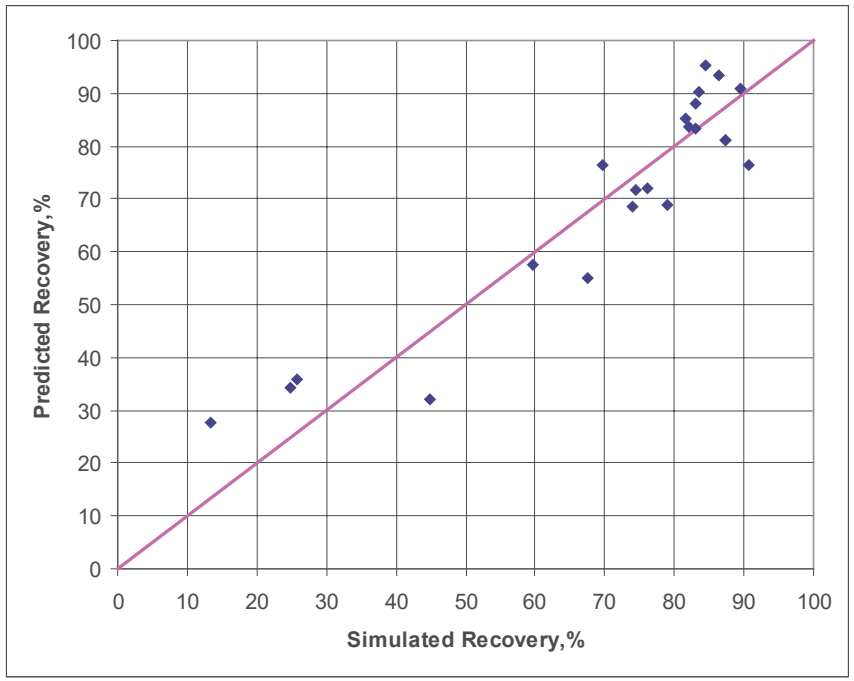
Three Level



60 Cases

Recovery

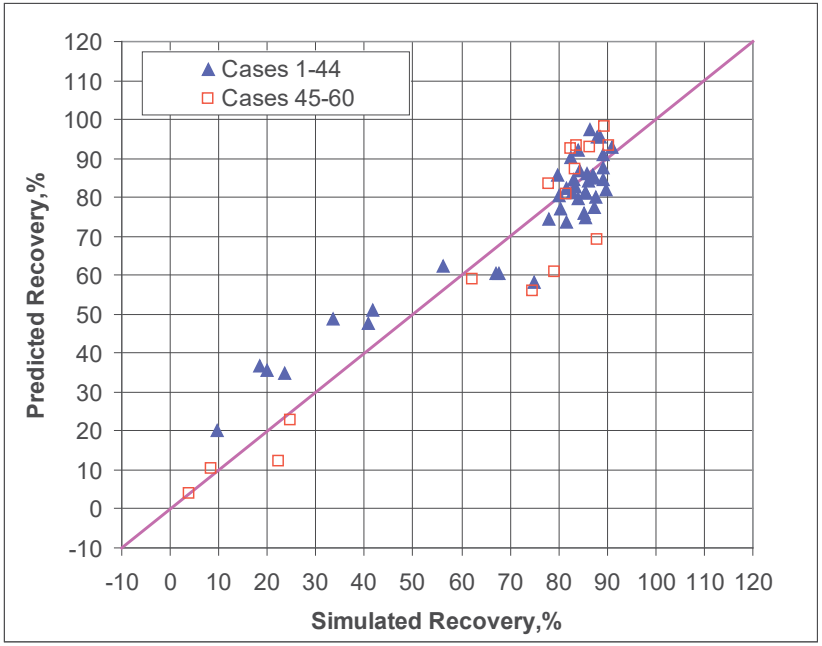
Two Level



Recovery% = b0 + b1*WD + b2*RD + b3*Phi + b4*Ki + b5*SH + b6*H + b7*Angle + b8*R_HC + b9*Aquifer + b10*kabs + b11*krg0

b0	102.50
b1	-0.02018
b2	0.130
b3	-0.805
b4	-1.214
b5	-0.05467
b6	-0.795
b7	-1.305
b8	5.962
b9	6.829
b10	0.00696
b11	12.26

Three Level

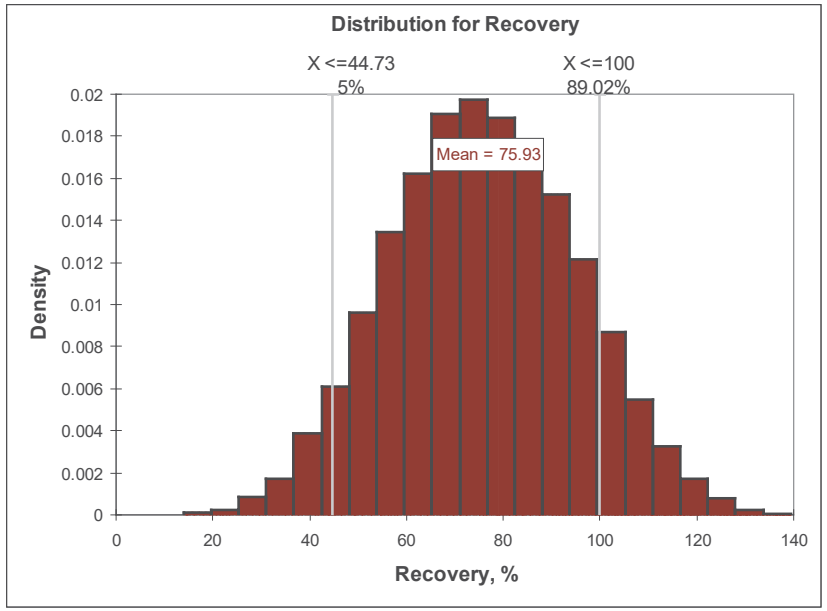


Recovery (%)= b0 + b1*RD + b2*RD*RD + b3*WD*H + b4*SH*Angle + b5*RD*H + b6*RD*Angle + b7*RD*SH + b8*H*SH + b9*WD*SH + b10*WD*RD + b11*H*Angle + b12*WD*WD + b13*WD

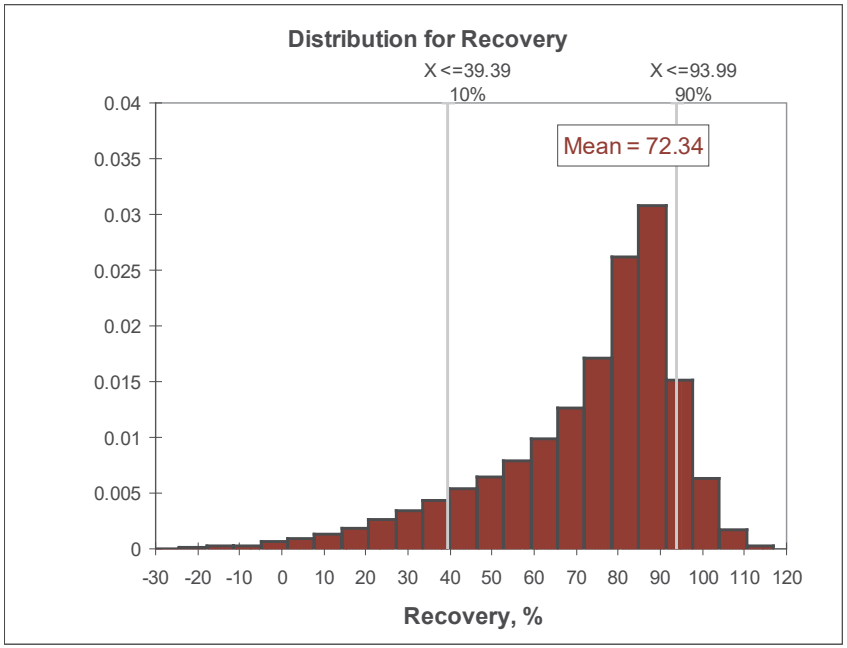
b0	7.141111E+01
b1	1.825620E-01
b2	-3.694706E-04
b3	-3.852847E-04
b4	-2.676772E-02
b5	3.840768E-03
b6	4.349370E-03
b7	1.374189E-03
b8	-1.805354E-02
b9	-1.216576E-04
b10	1.910550E-05
b11	-6.973584E-02
b12	7.337392E-06
b13	-2.940365E-02

Recovery

Two Level



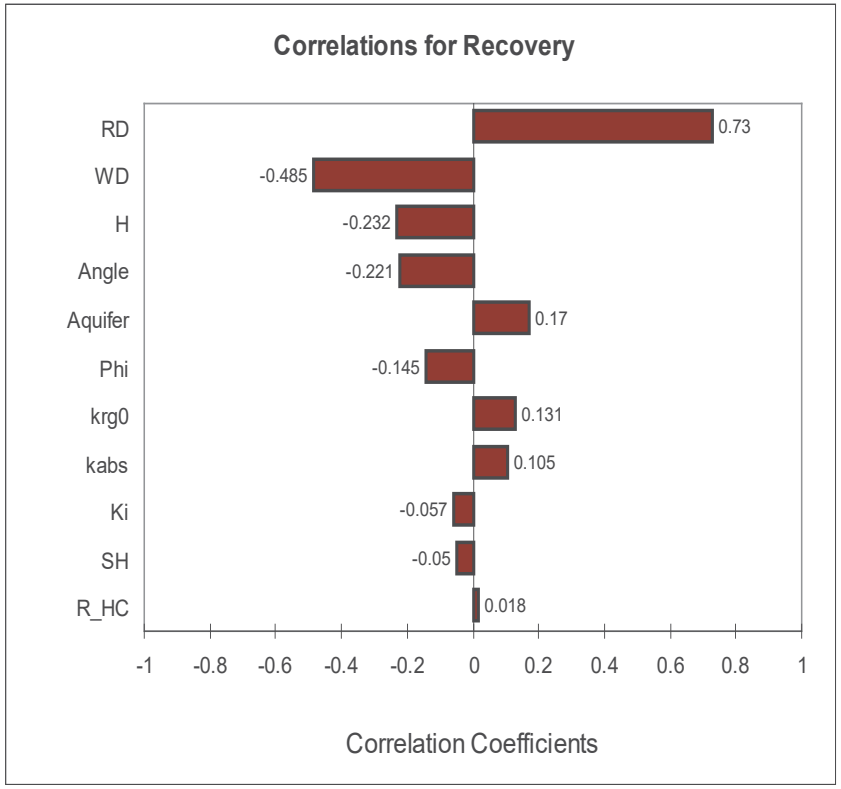
Three Level



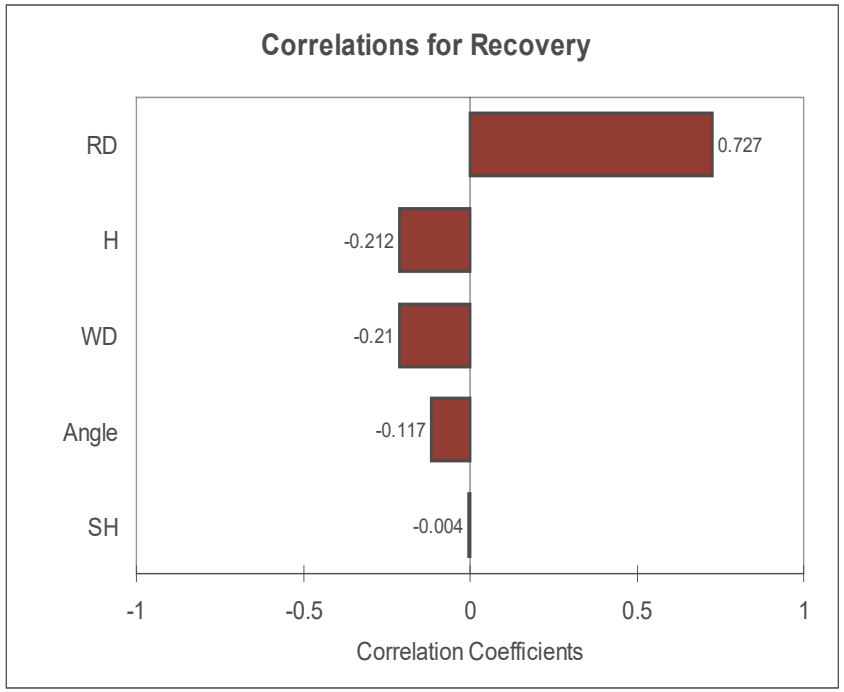
2- and 3-level results are consistent
Mean Recovery: 72%
Error: ±20% (?)

Recovery

Two Level:
RD, WD, H, Angle, Aquifer

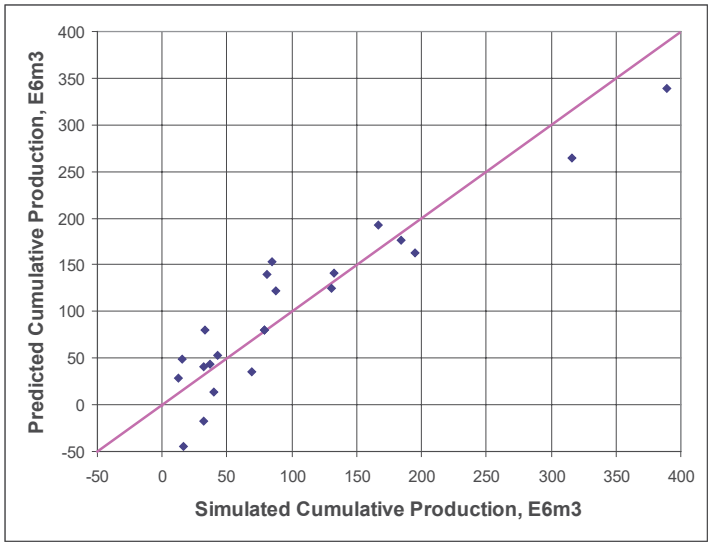


Three Level:
RD, H, WD, Angle



Cumulative Gas Produced

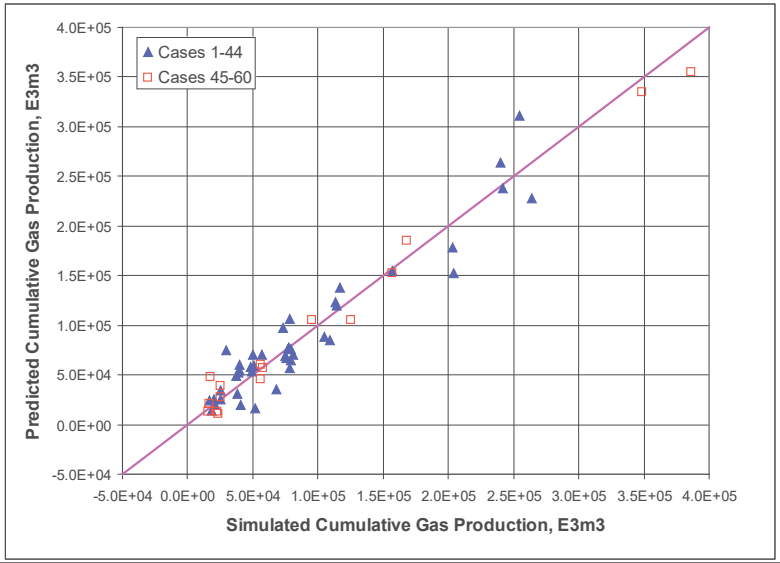
Two Level



CumGas = b0 + b1*WD + b2*RD + b3*Phi + b4*Ki + b5*SH + b6*H + b7*Angle + b8*R_HC + b9*Aquifer + b10*kabs + b11*krg0

b0	-30552.8
b1	-40.41
b2	325.61
b3	-2274.3
b4	-6975.6
b5	1501.6
b6	8417.1
b7	-6170.3
b8	83086.2
b9	18965.6
b10	-31.83
b11	17594.2

Three Level

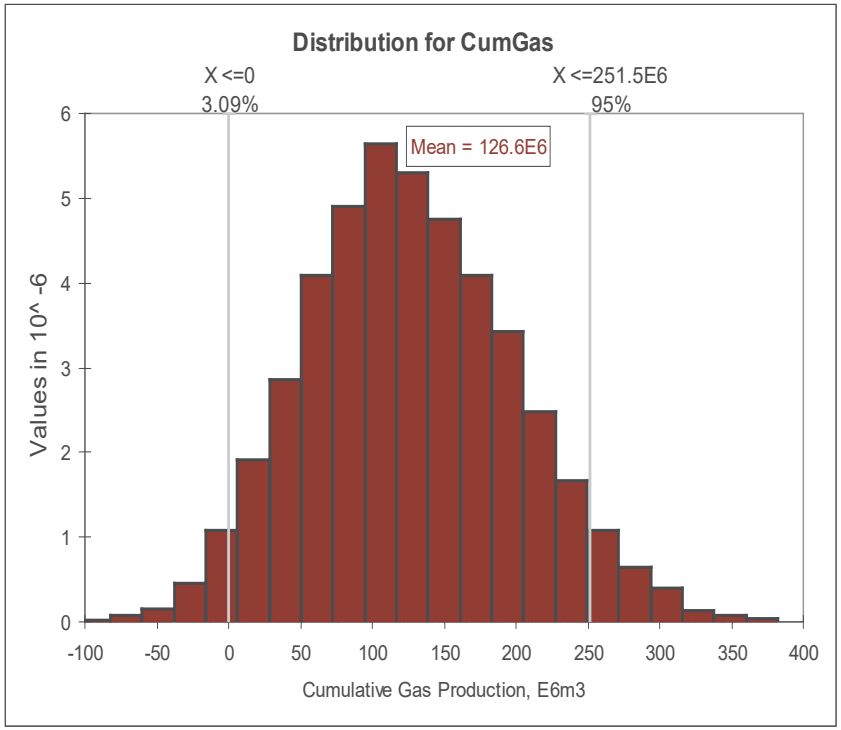


CumGas (E3m3) = b0 + b1*RD*H + b2*H*SH + b3*WD*H + b4*RD*RD + b5*RD*SH + b6*H*Angle + b7*WD*Angle + b8*SH*Angle + b9*WD*SH + b10*WD*WD

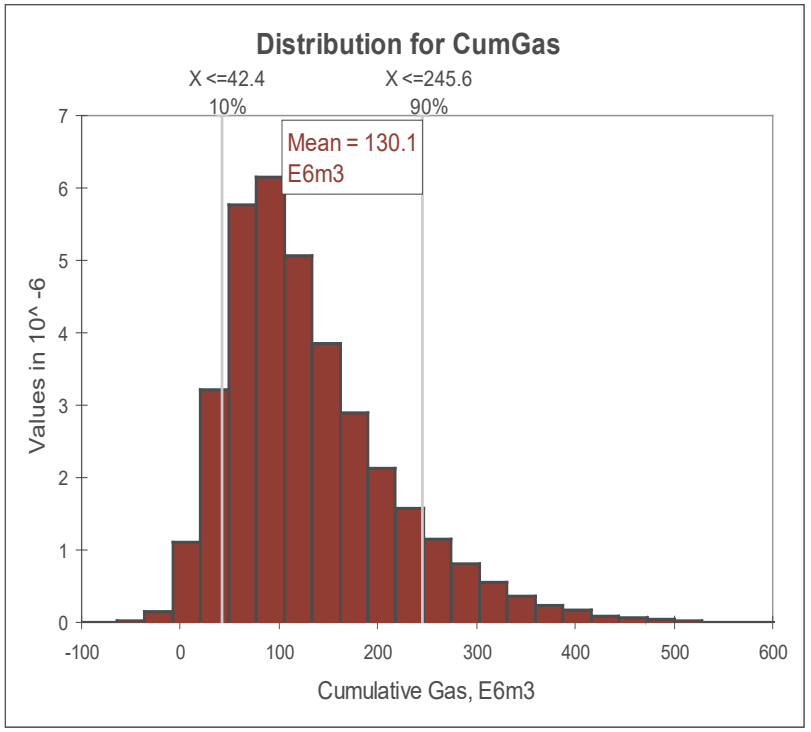
b0	5.5448E+03
b1	2.7223E+01
b2	9.5902E+01
b3	-2.3881E+00
b4	-5.6748E-01
b5	5.4240E+00
b6	-2.7004E+02
b7	3.4381E+00
b8	-7.7876E+01
b9	-4.9043E-01
b10	5.8042E-03

Cumulative Gas Produced

Two Level



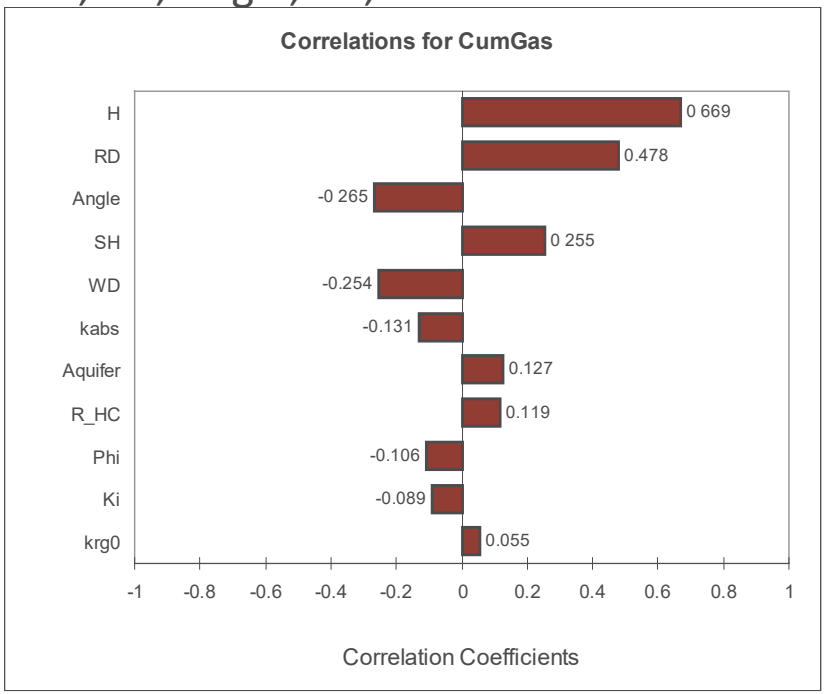
Three Level



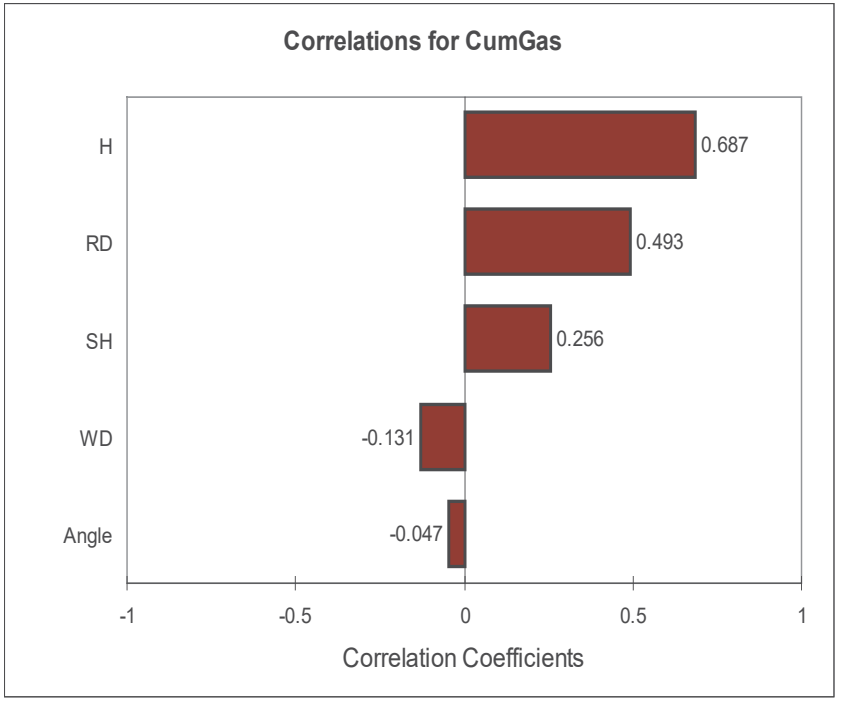
Mean cum Production: 127×10^6 m^3 (4.5 Bcf)
Compare with 2 to 2.8 Bcf

Cumulative Gas Produced

Two Level:
H, RD, Angle, SH, WD



Three Level:
H, RD, SH, WD

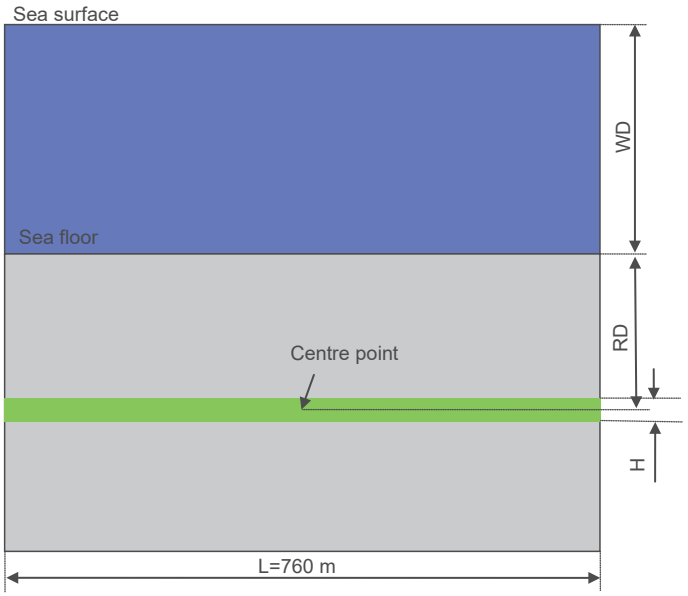


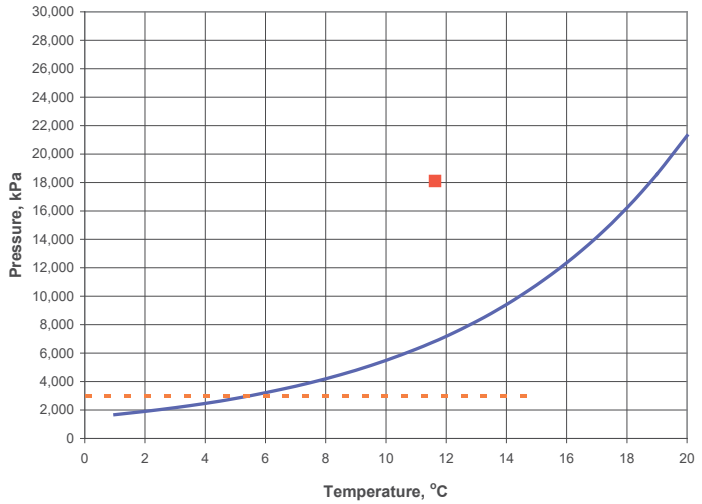
Study of Type III Reservoirs

- Base Case Properties
- Base Case Results
- Range and probability of recovery and cumulative gas produced

Base Case

Reservoir Characteristics	Base value
Water depth, m	1500
Reservoir mid-point depth below sea floor, m	300
Equilibrium Curve	In-place study (mean)
Porosity, %	35
Hydrate Saturation, %	60
Sand thickness, m	6
Dip angle, degrees	0
Ratio of hydrate/sand thickness	(N/A)
Extent of the aquifer	(N/A)
Permeability within the underlying free water, mD	500
Permeability (S_{Hi}), mD	0.5
Production pressure, kPa	3000
Reservoir size	760 m × 760 m
Initial Pressure, MPa	18100
Initial Temperature, C	11.63

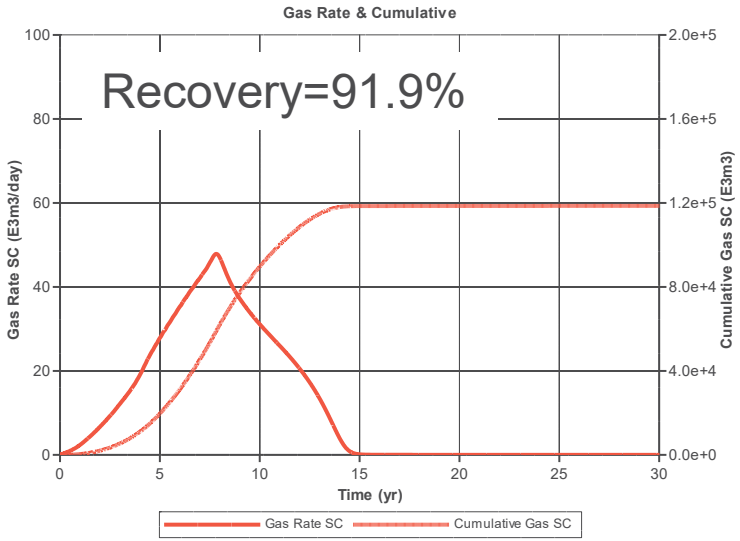


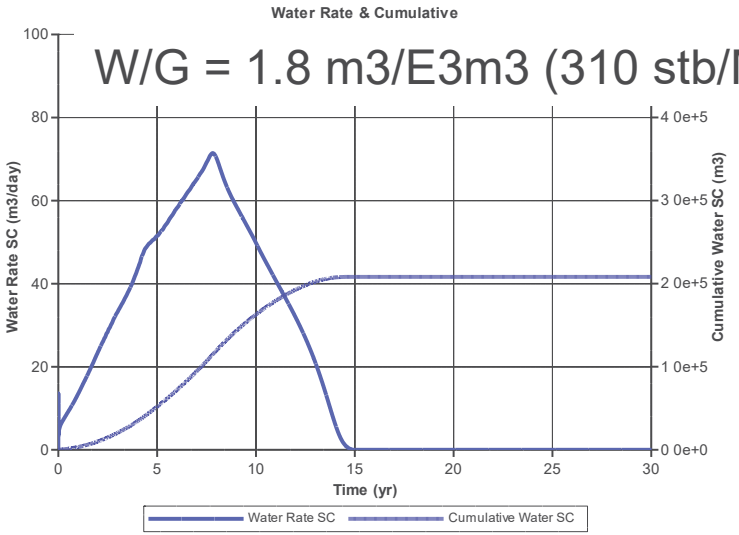


Base Case

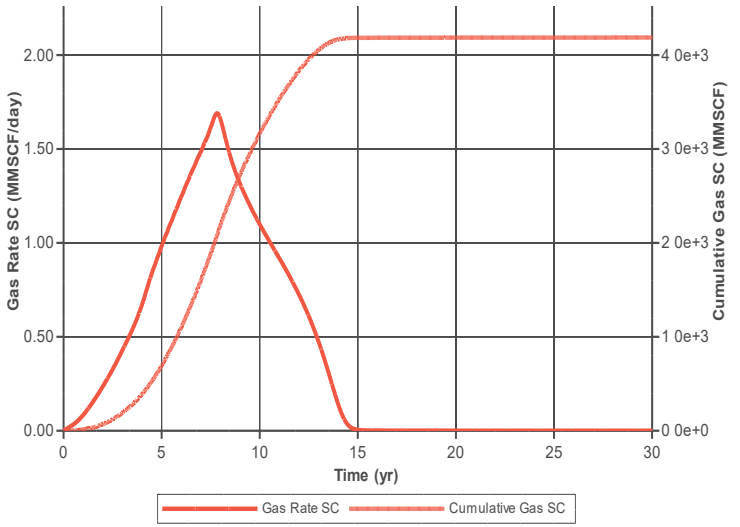
Base Case – Results

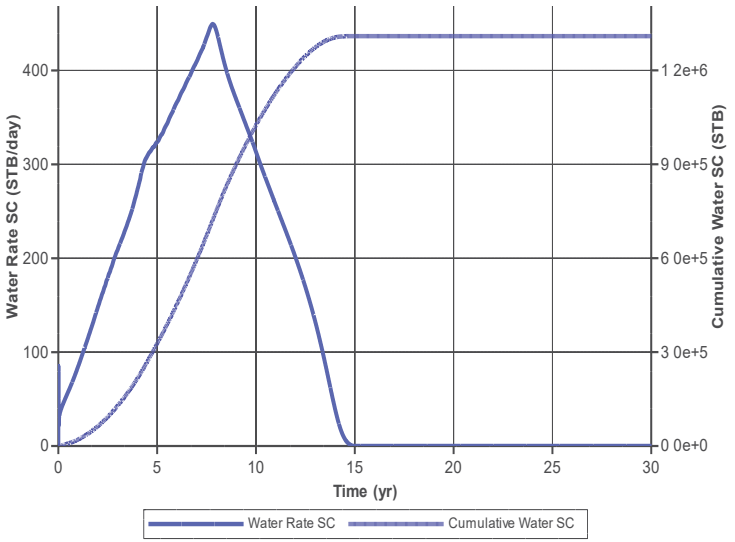
SI unit





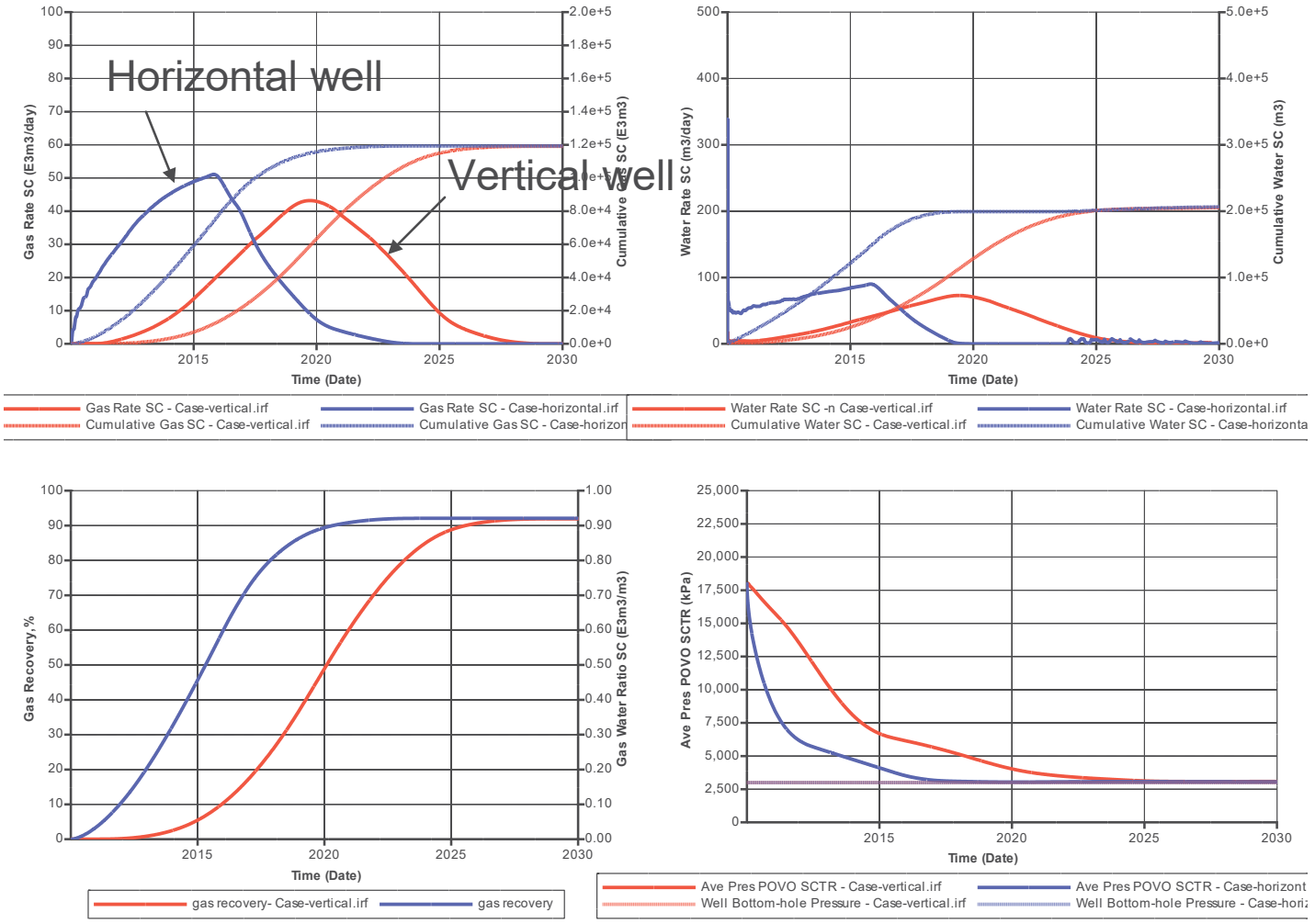
Field unit





Production rate is low for a few years

Application of Horizontal Wells



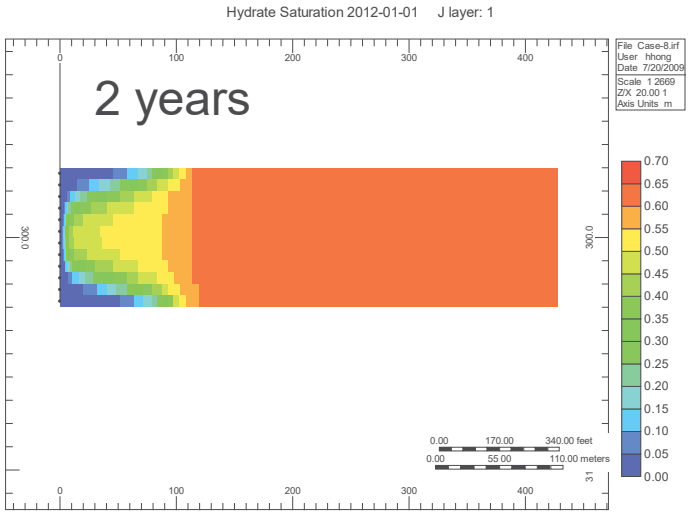
Horizontal completion can accelerate recovery

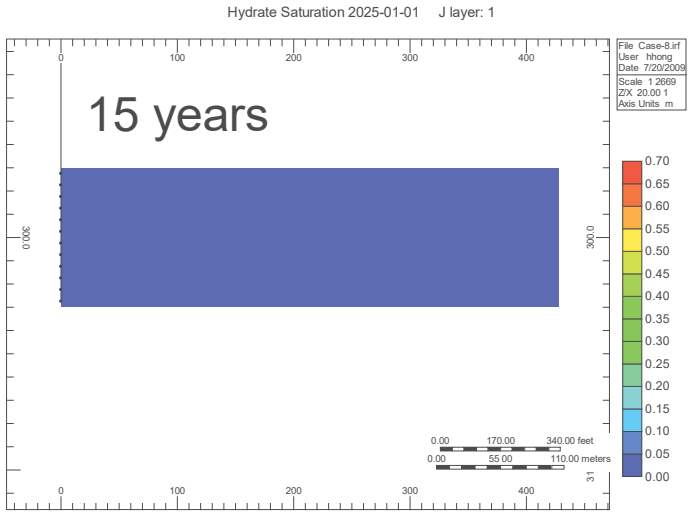
The 50 year recovery does not depend on completion type

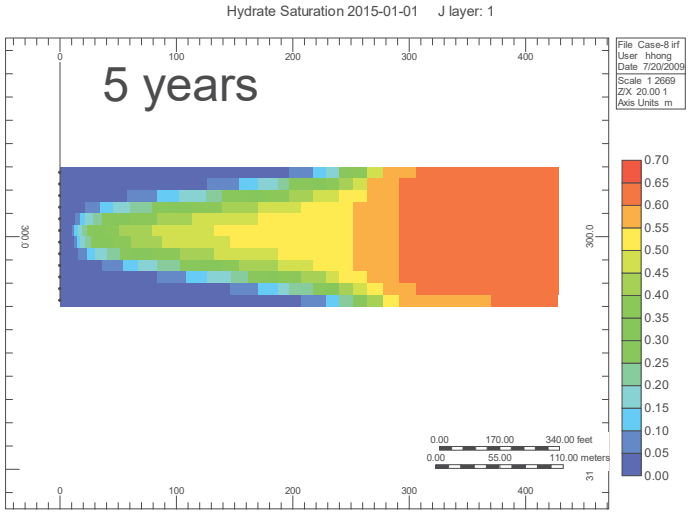
Vertical completion was chosen (Skin = -2)

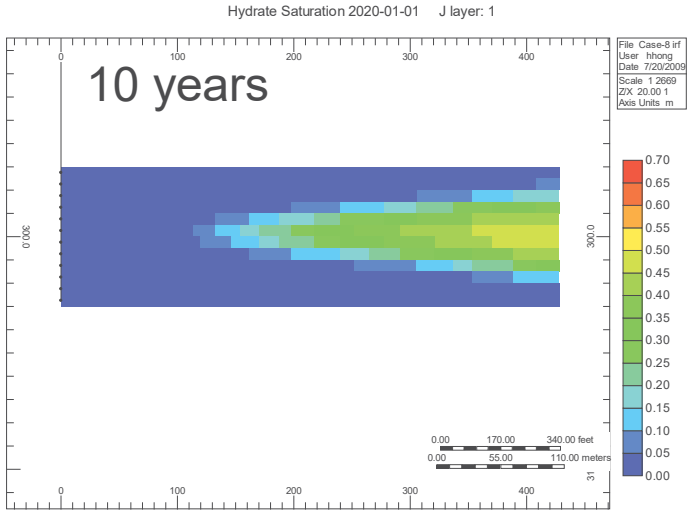
Base Case – Results

Hydrate Saturation



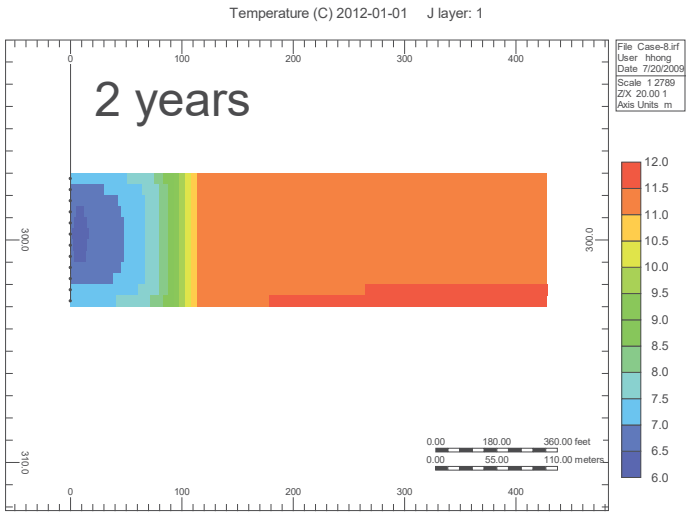


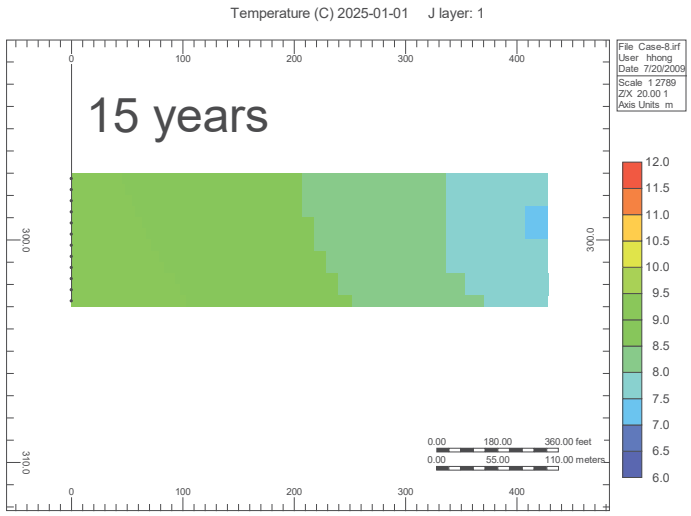


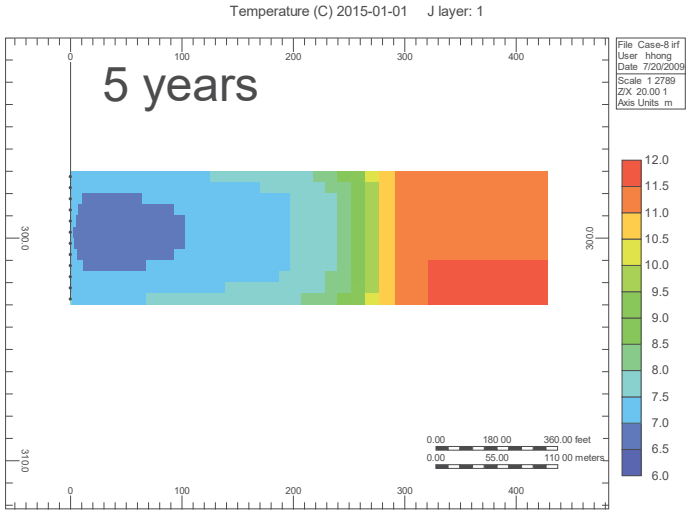


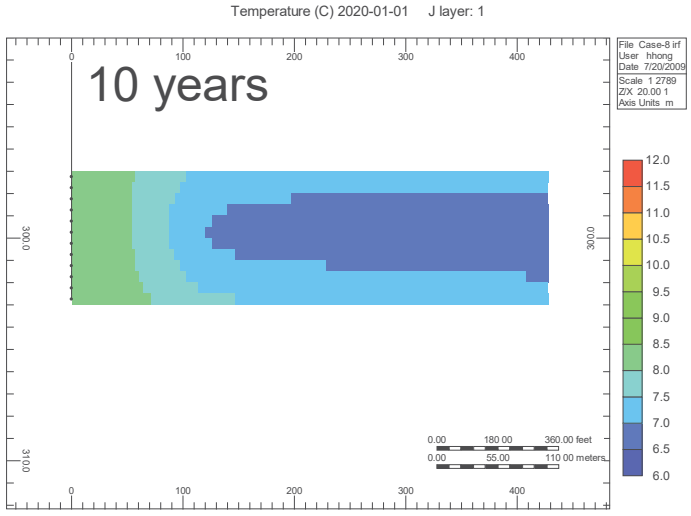
Base Case – Results

Temperature

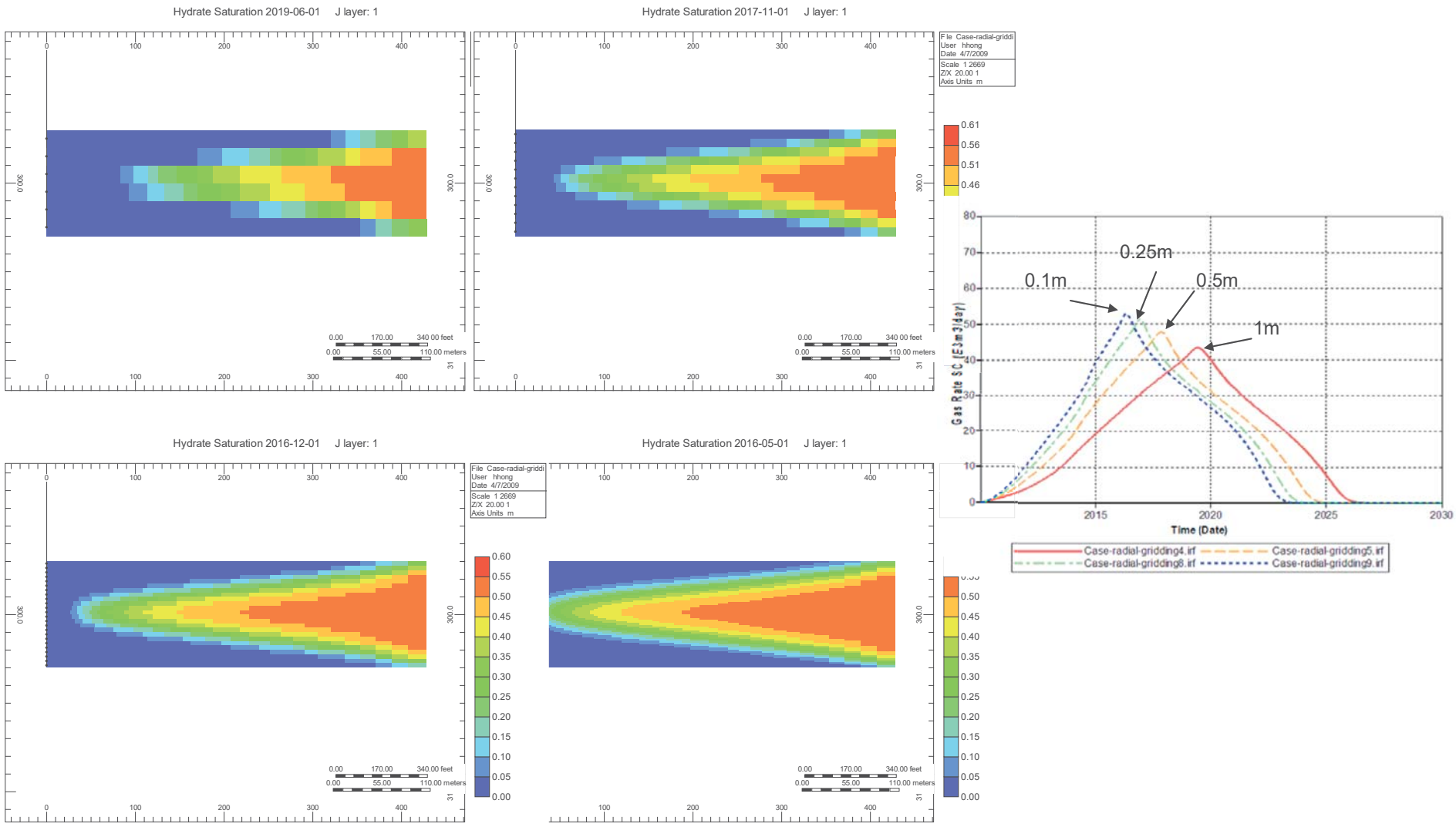




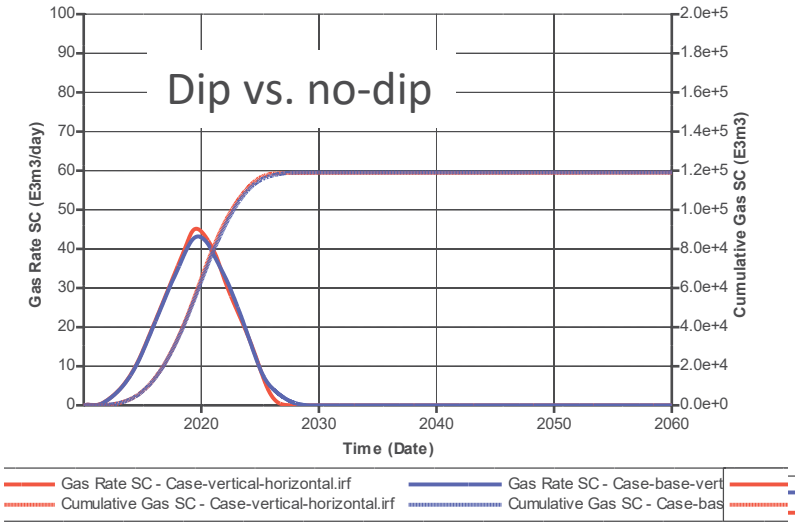


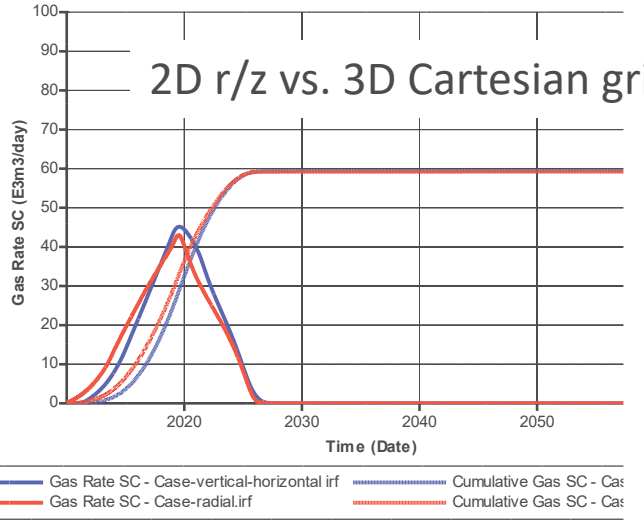


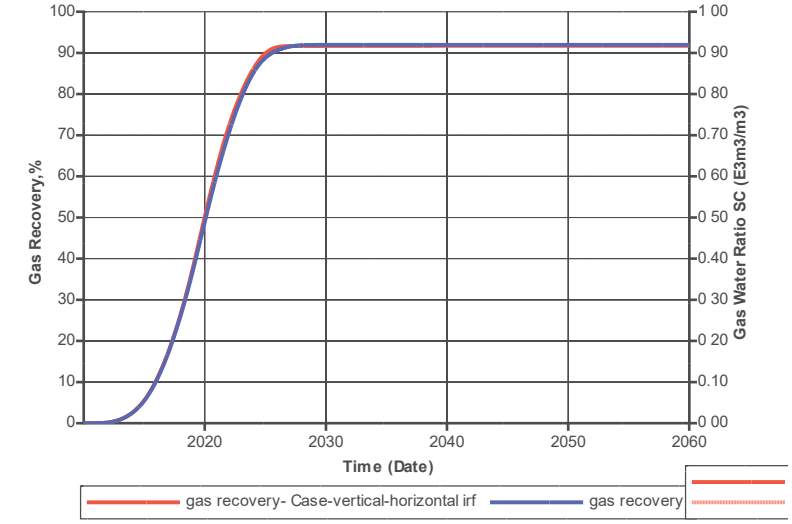
Base Case (Effect of Gridding)

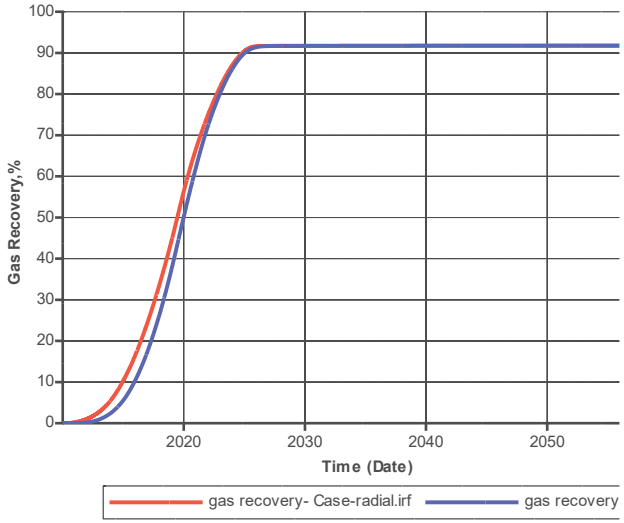


Resolving the Gridding Problem









2-D radial/vertical gridding was used in a non-dipping reservoirs

Methodology (similar to that for Type II)

1. Conduct 2-level experimental design (10 – 20 cases)
2. Conduct simulations
3. Determine surface function (e.g. recovery vs. parameters)
4. Determine distribution of recovery
5. From Tornado chart, determine the more important parameters
6. Conduct 3-level experimental design (10's of cases)
7. Return to step 2

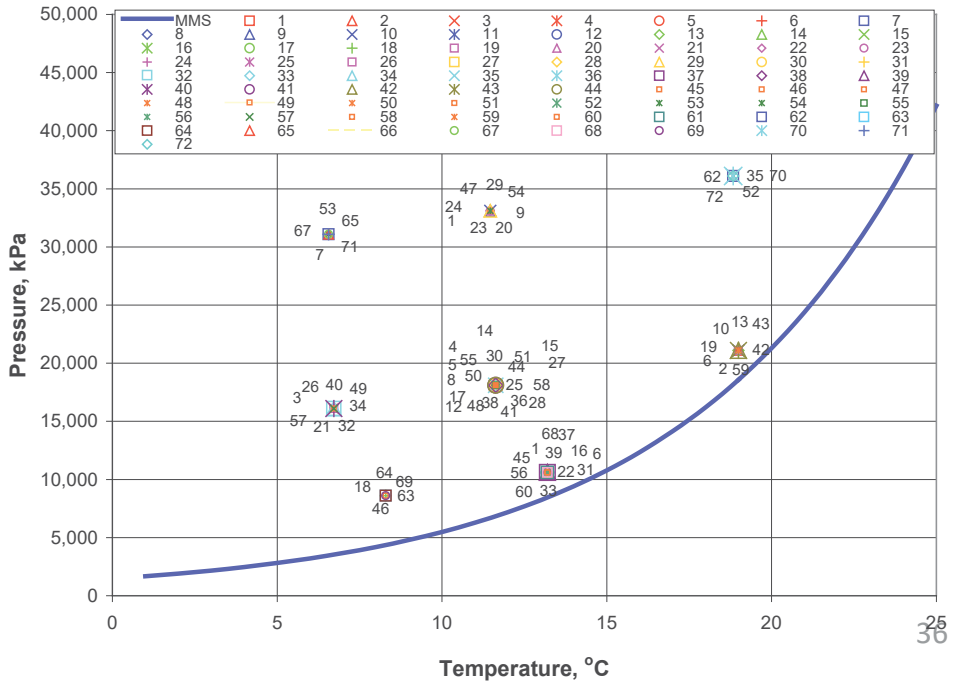
Cases Studied

Two Level

Case #	WD	RD	H	SH	Phi	Ki	Kabs	Krg0	Recovery,%	CumGas,E3m3
1	3000	100	20	85	30	5	100	0.1	0.15	0
2	1500	300	6	60	35	0.5	500	0.5	91.91	118588
3	750	100	3	85	40	5	100	1	73.87	76847
4	3000	600	20	40	40	5	100	1	90.79	299750
5	3000	100	3	40	40	5	1000	0.1	34.73	17162
6	750	100	20	85	40	0.05	1000	1	23.16	160645
7	750	100	3	40	30	0.05	100	0.1	12.00	4408
8	750	300	20	85	30	5	1000	0.1	88.73	461960
9	750	300	3	40	30	5	1000	1	91.26	33536
10	3000	600	3	85	40	0.05	1000	0.1	91.02	95796
11	3000	600	3	85	30	0.05	100	1	94.97	74957
12	3000	100	20	40	30	0.05	1000	1	0	0
13	1500	300	6	60	35	0.5	500	0.5	91.91	118588
14	750	300	20	40	40	0.05	100	0.1	27.70	90497

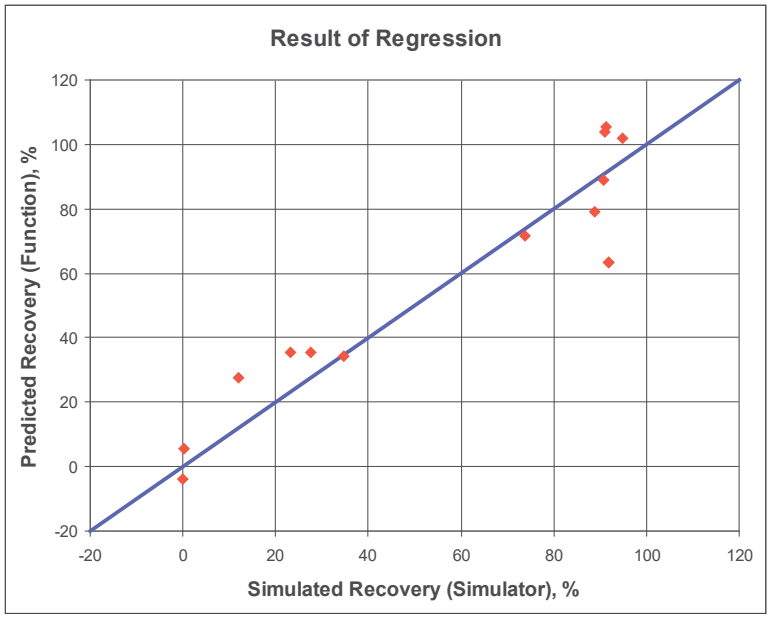
Three Level

72 Cases



Recovery

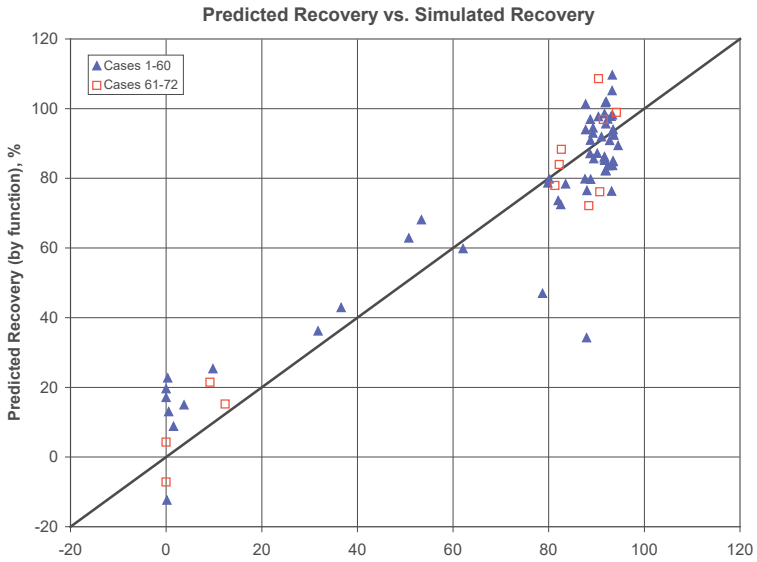
Two Level



Recovery(%) = b0 + b1*WD + b2*RD + b3*H + b4*SH + b5*Phi + b6*Ki + b7*Kabs + b8*Krg0

b0	11.33
b1	-0.01270
b2	0.164
b3	-1.520
b4	0.222
b5	0.08404
b6	4.484
b7	0.01337
b8	11.90

Three Level

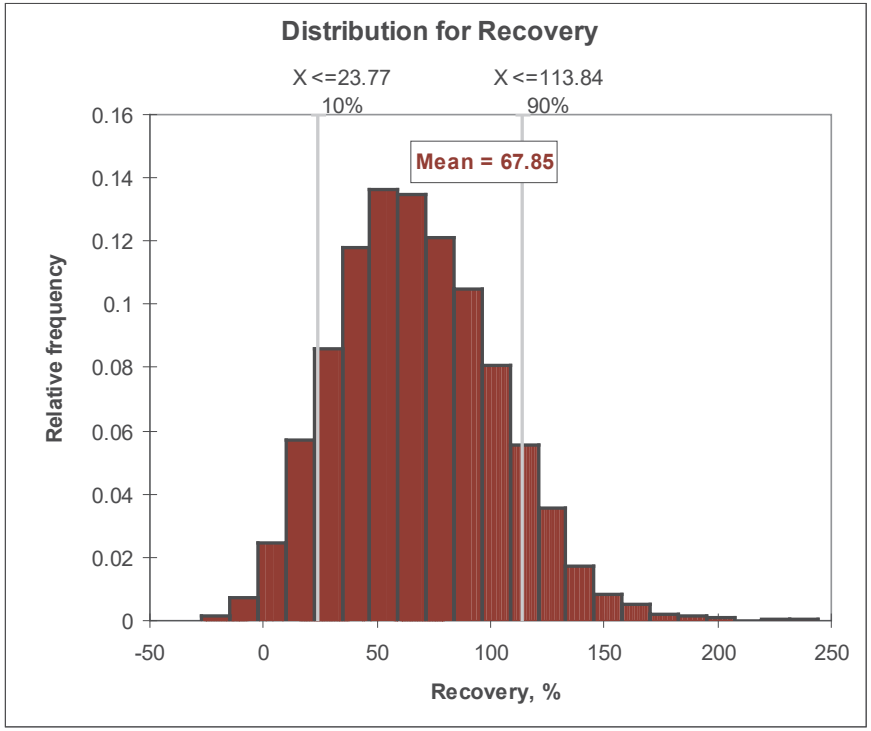


Recovery(%) = b0 + b1*RD + b2*RD*RD + b3*RD*Ki + b4*WD*Ki + b5*WD + b6*WD*WD + b7*H*SH + b8*SH*SH + b9*RD*H + b10*SH*krg0 + b11*Ki*krg0 + b12*RD*Kabs + b13*Kabs + b14*WD*SH + b15*krg0

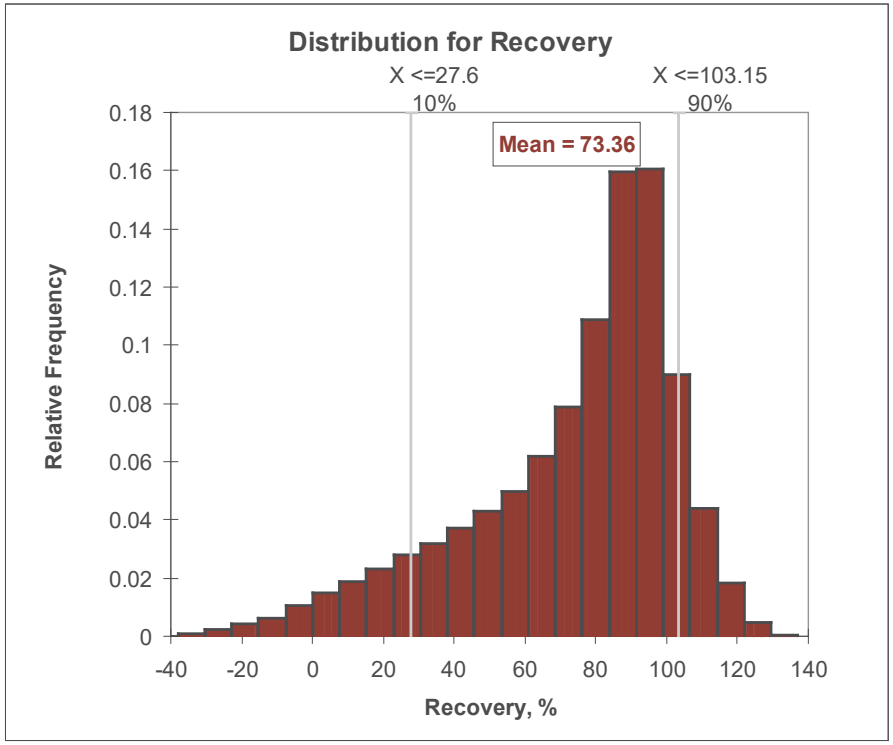
b0	-1.8226E+01
b1	5.6244E-01
b2	-5.6620E-04
b3	-9.1575E-03
b4	1.4910E-03
b5	-2.8741E-02
b6	8.4598E-06
b7	-3.2494E-02
b8	7.3074E-03
b9	3.4011E-03
b10	-5.3920E-01
b11	3.3845E+00
b12	-7.6880E-05
b13	3.1250E-02
b14	-2.2135E-04
b15	3.4926E+01

Recovery

Two Level



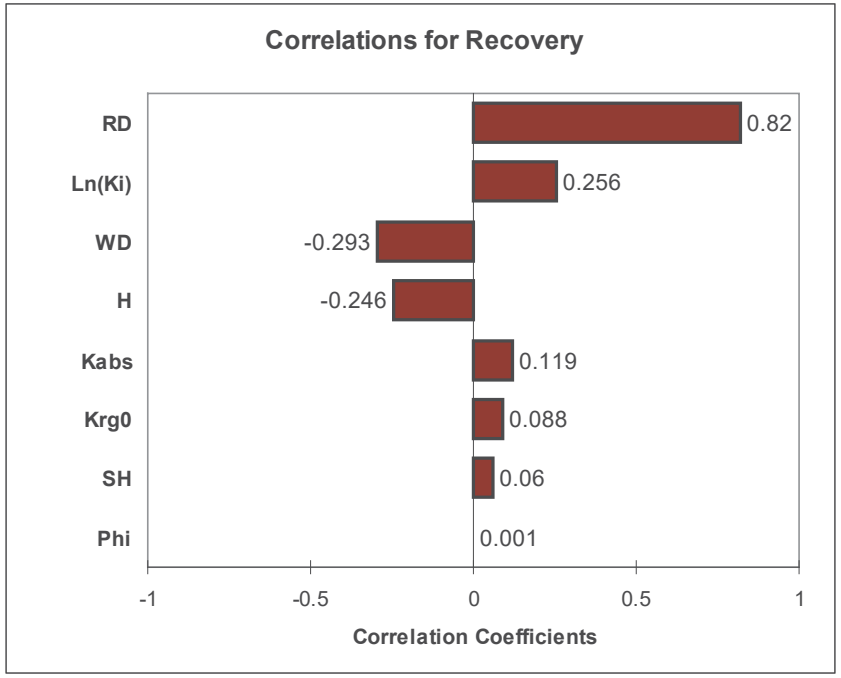
Three Level



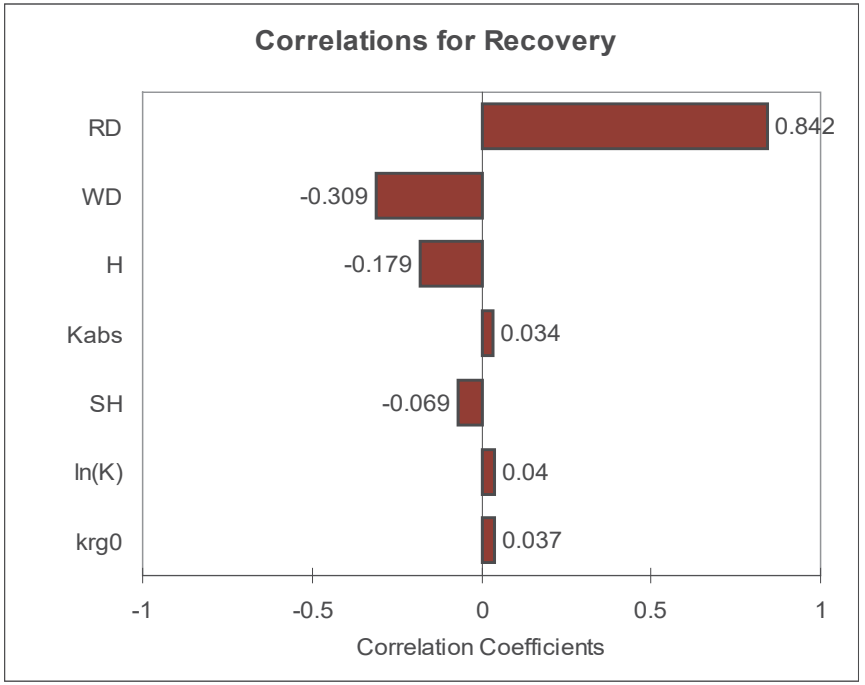
2- and 3-level results are consistent
Mean Recovery: 70%
Error: ±20% (?)

Recovery

Two Level:
RD, ln (ki), WD, H, Kabs

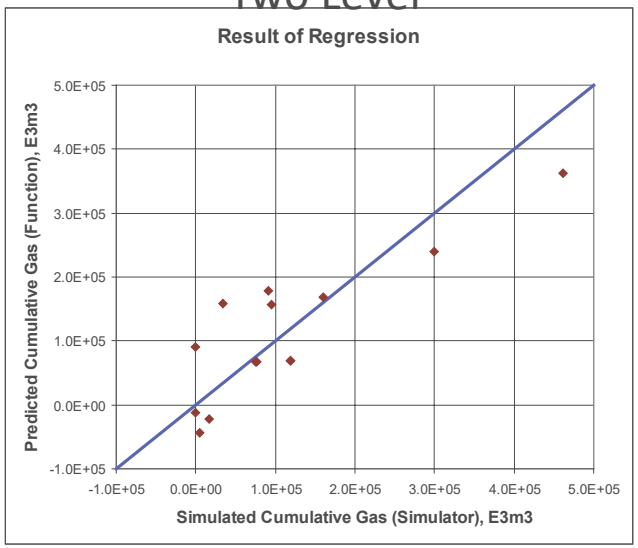


Three Level:
RD, WD, H, Kabs, SH



Cumulative Gas Produced

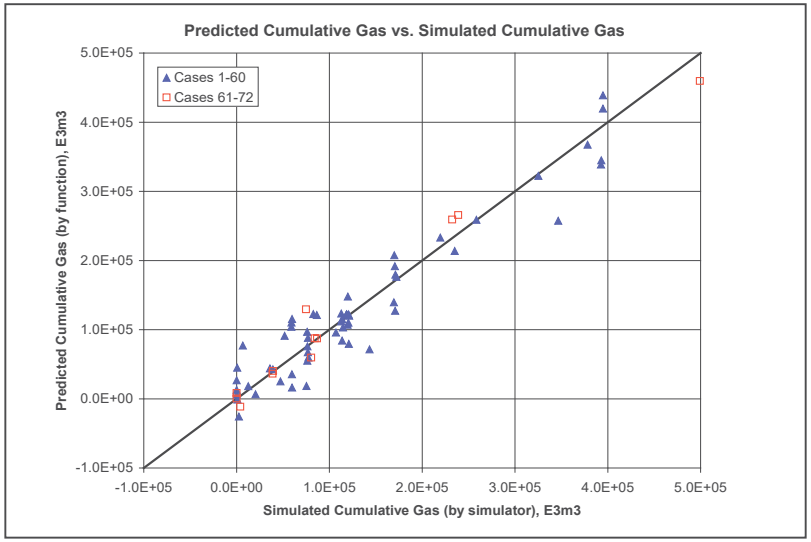
Two Level



CumGas (E3m3) = b0 + b1*WD + b2*RD + b3*H + b4*SH + b5*Phi + b6*Ki + b7*Kabs + b8*Krg0

b0	-130735
b1	-56.72
b2	436.09
b3	7615.5
b4	1048.1
b5	583.47
b6	17259.4
b7	63.42
b8	-30729.3

Three Level

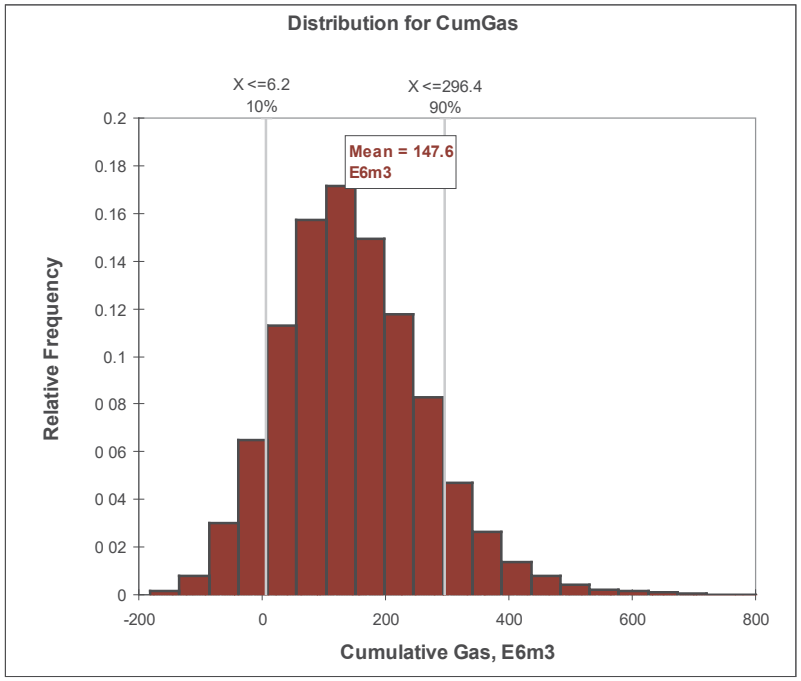


CumGas (E3M3) = b0 + b1*RD*H + b2*WD*SH + b3*Kabs*krg0 + b4*RD*RD + b5*RD*SH + b6*WD*H + b7*WD*WD + b8*H*SH + b9*RD + b10*SH*Kabs + b11*Kabs*Kabs + b12*krg0*krg0 + b13*RD*Kabs + b14*H*krg0 + b15*WD*Ki

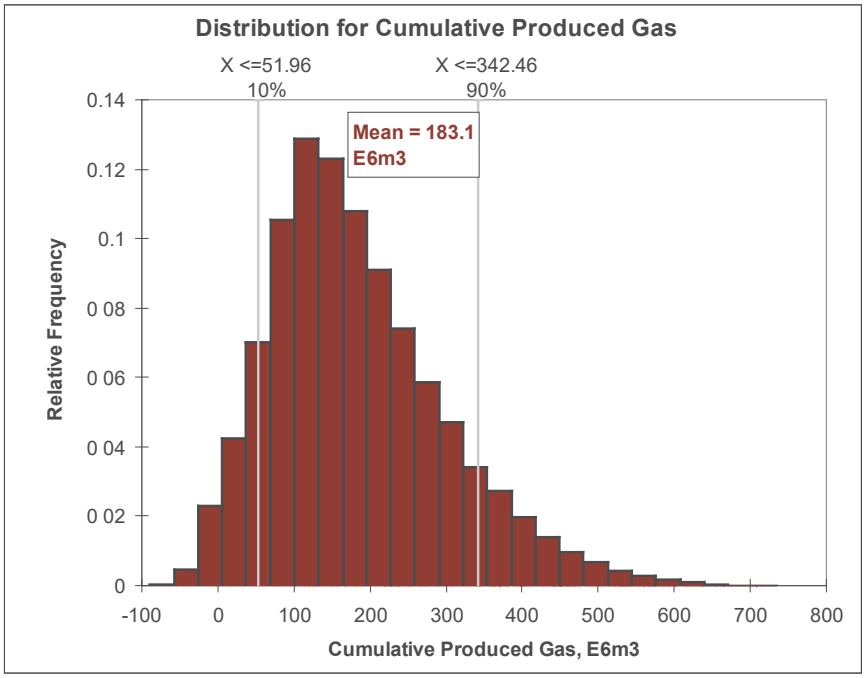
b1	3.91570E+01
b2	-7.99350E-01
b3	6.45185E+01
b4	-1.08607E+00
b5	6.42244E+00
b6	-2.42481E+00
b7	1.31738E-02
b8	3.92537E+01
b9	3.91154E+02
b10	1.80134E+00
b11	-8.46499E-02
b12	-3.89247E+04
b13	-1.14153E-01
b14	3.03614E+03
b15	1.63984E+00

Cumulative Gas Produced

Two Level



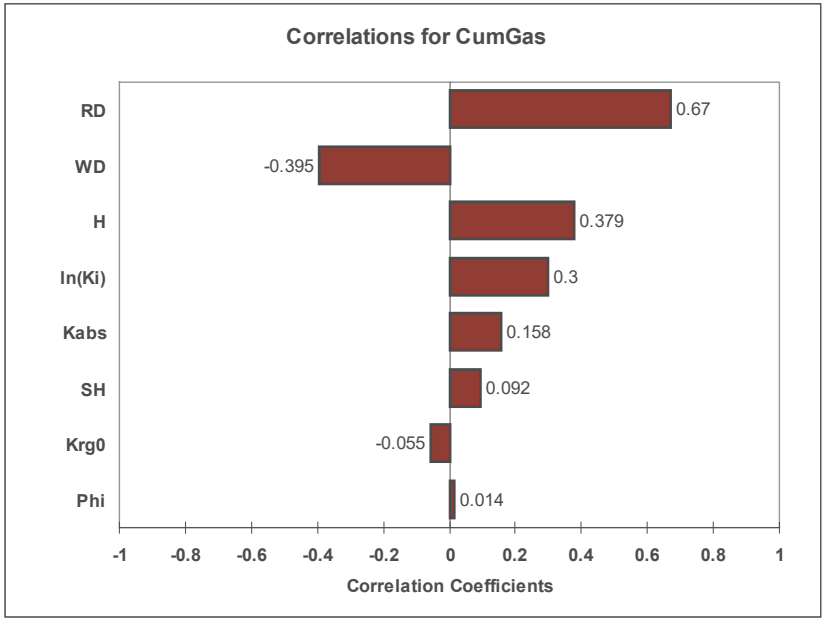
Three Level



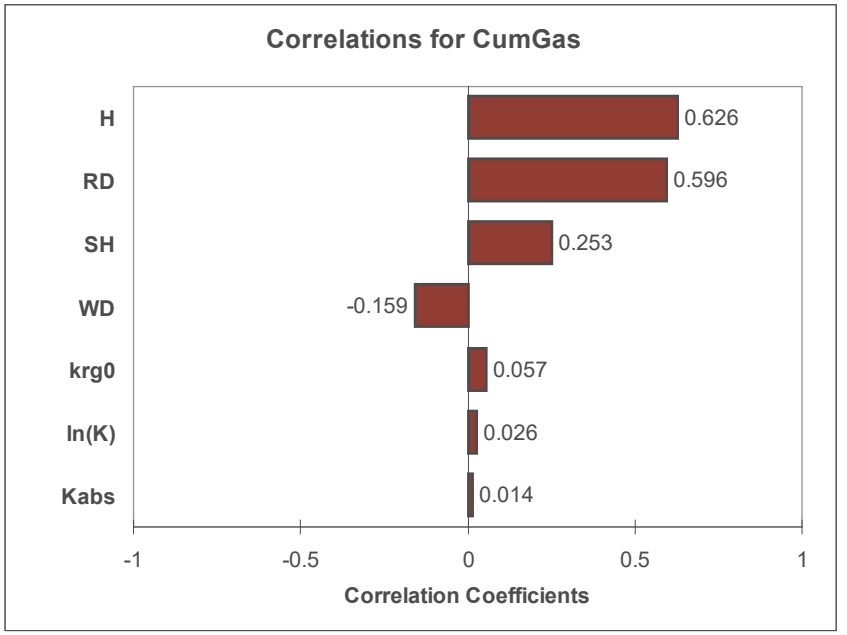
Mean cum Production: 150 - 180×10^6 m^3 (5.3 – 6.3 Bcf)

Cumulative Gas Produced

Two Level:
RD, WD, H, Ki, Kabs



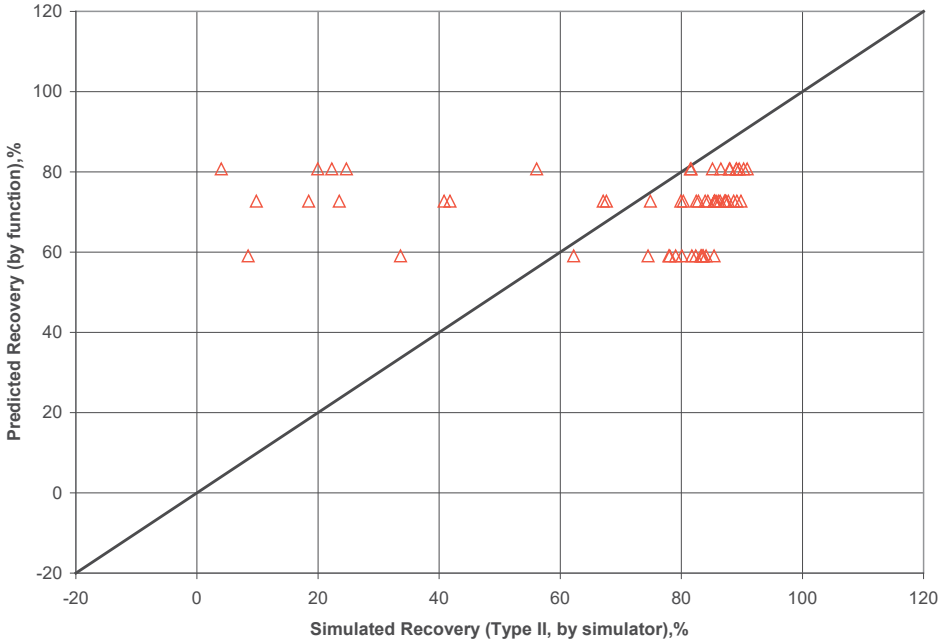
Three Level:
H, RD, SH, WD, Krg0



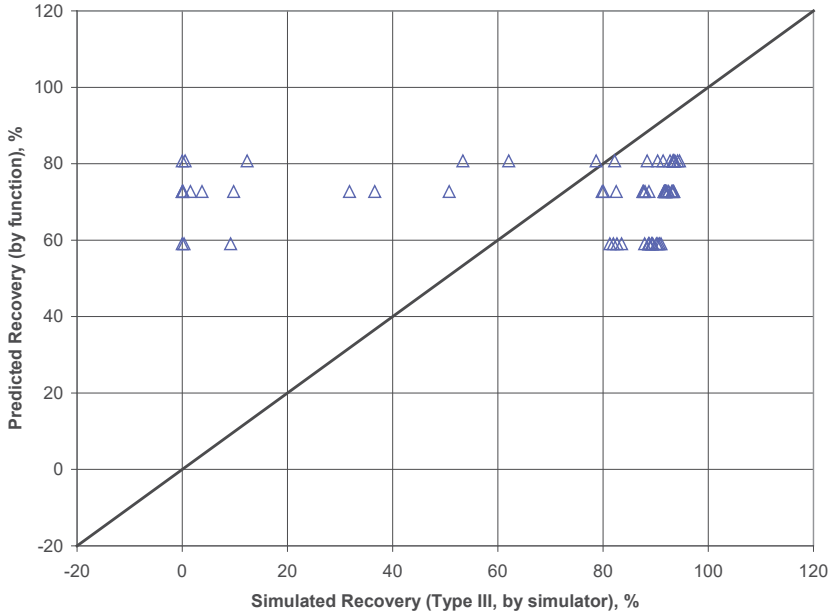
Exploring Some Questions

- How is use of a simple function?
- What are the causes for low recovery?
- Can Type II and III correlations be combined

What about Using A Simple Function?



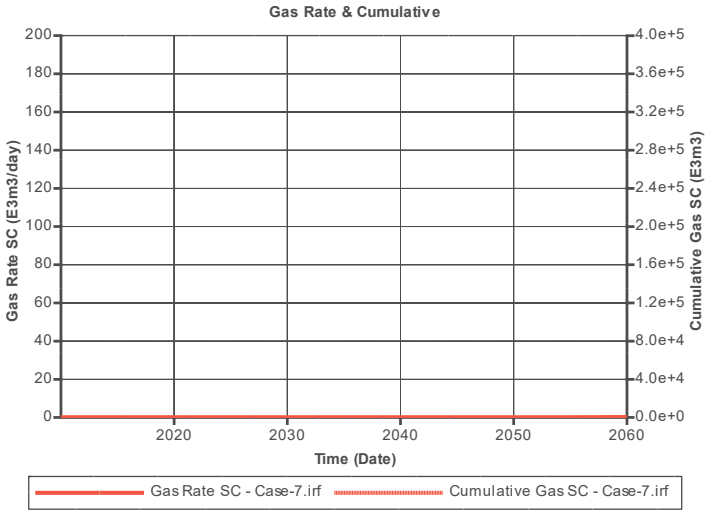
Type II

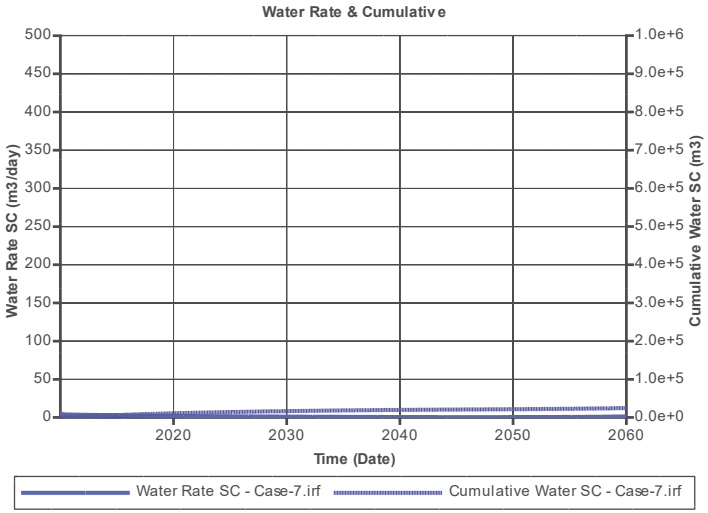


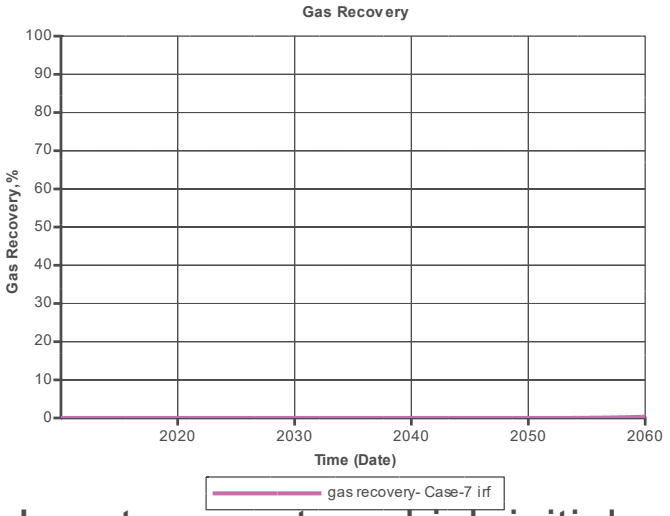
Type III

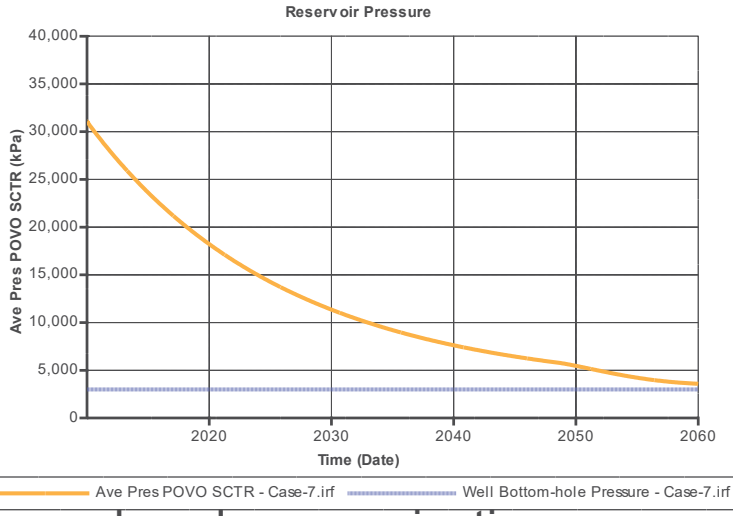
Can not predict the low recovery cases.

Low Recovery: Case-7 (Type-III)





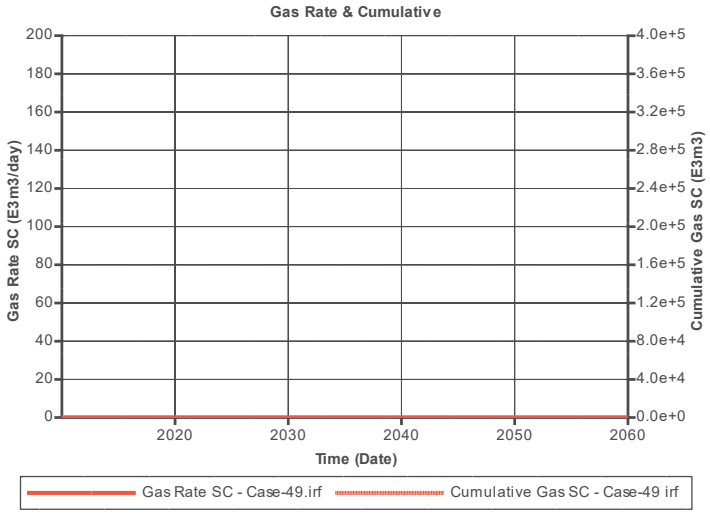


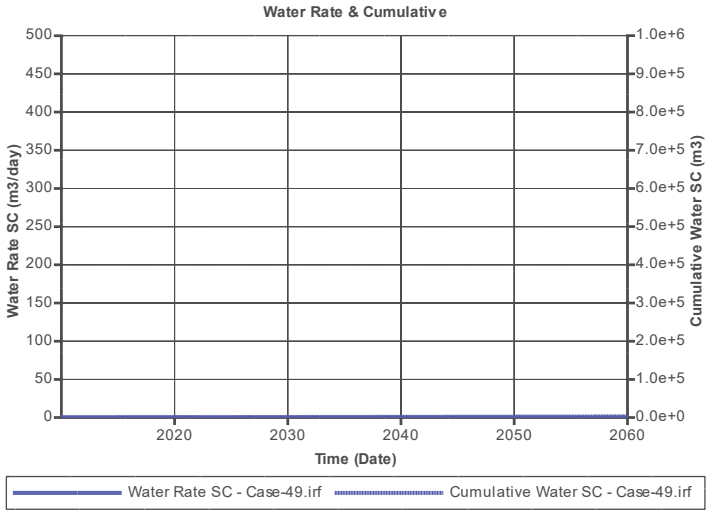


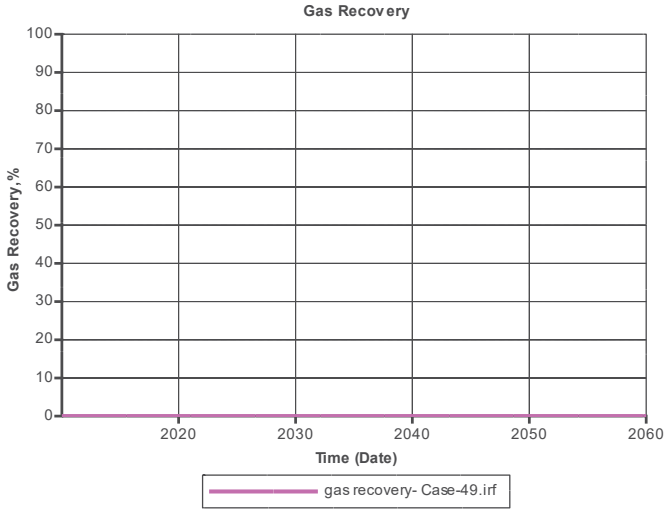
Low temperature, high initial pressure, slow depressurization.

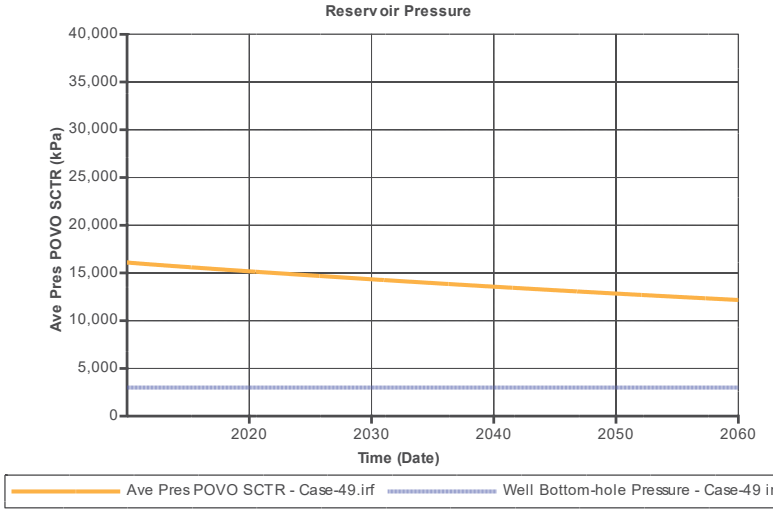
Case-53 has similar behavior

Low Recovery: Case-49 (Type-III)





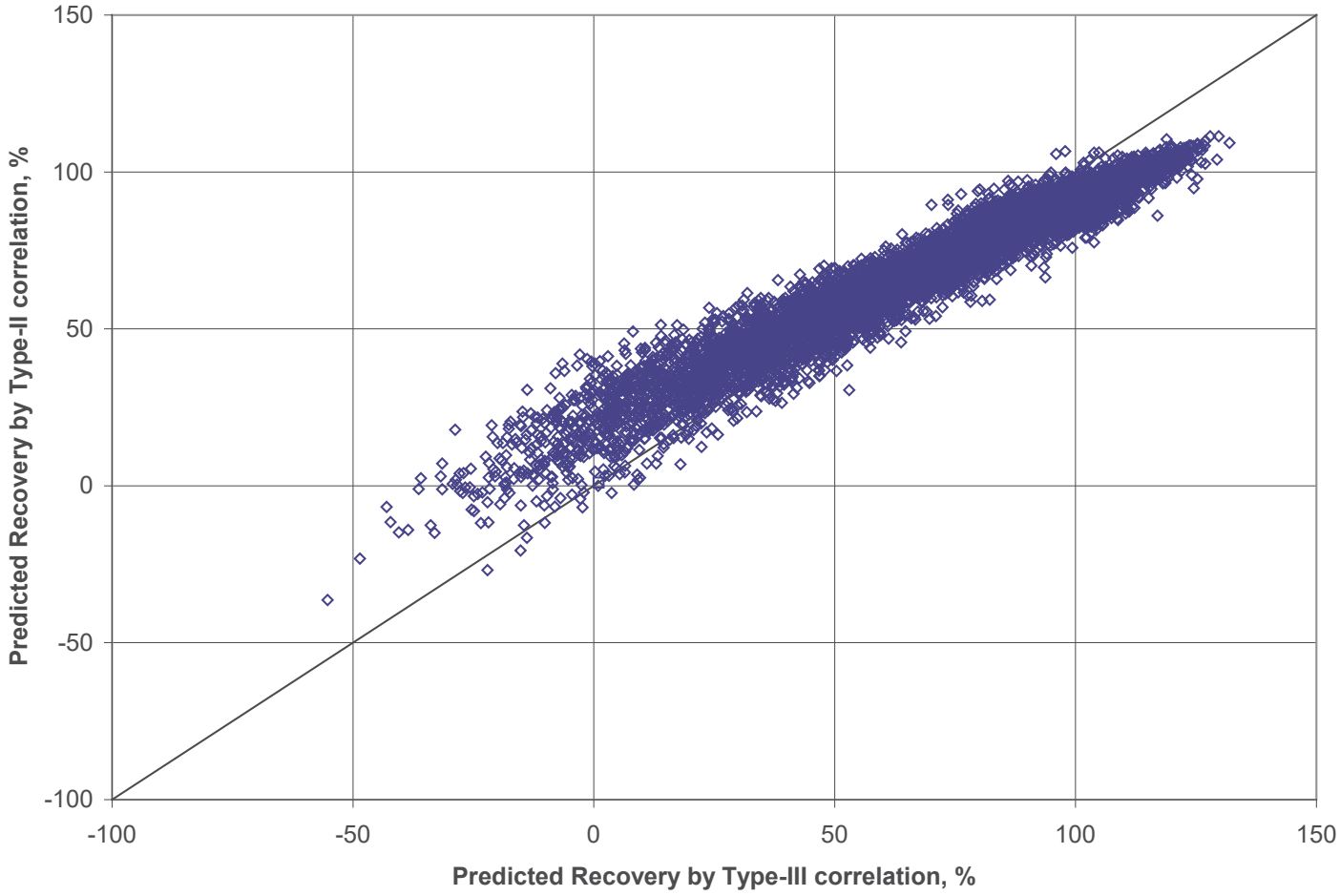




Low temperature, low initial permeability

Case-32 has similar behavior

Exchanging Type II and III Relations



The parameters between the two functions are not consistent

The idea of making the two functions consistent was not pursued

Summary of Results

- Simple relations have been developed to relate hydrate recovery and cumulative gas production to a number of reservoir parameters
- Initial Pressure and Temperature Play the dominant factor

Limitations of the Study

- Initial Pressure and Temperature Play the dominant factor
  - Importance of other factors may not be well captured – Idea of separating the effect of pi/Ti
  - Variations in the Equilibrium curve are expected to be important especially for low recovery cases
  - Permeability values lower than 0.1/0.01 mD could affect performance, especially for cold hydrates (highly saturated sands)
- Active aquifers are excluded

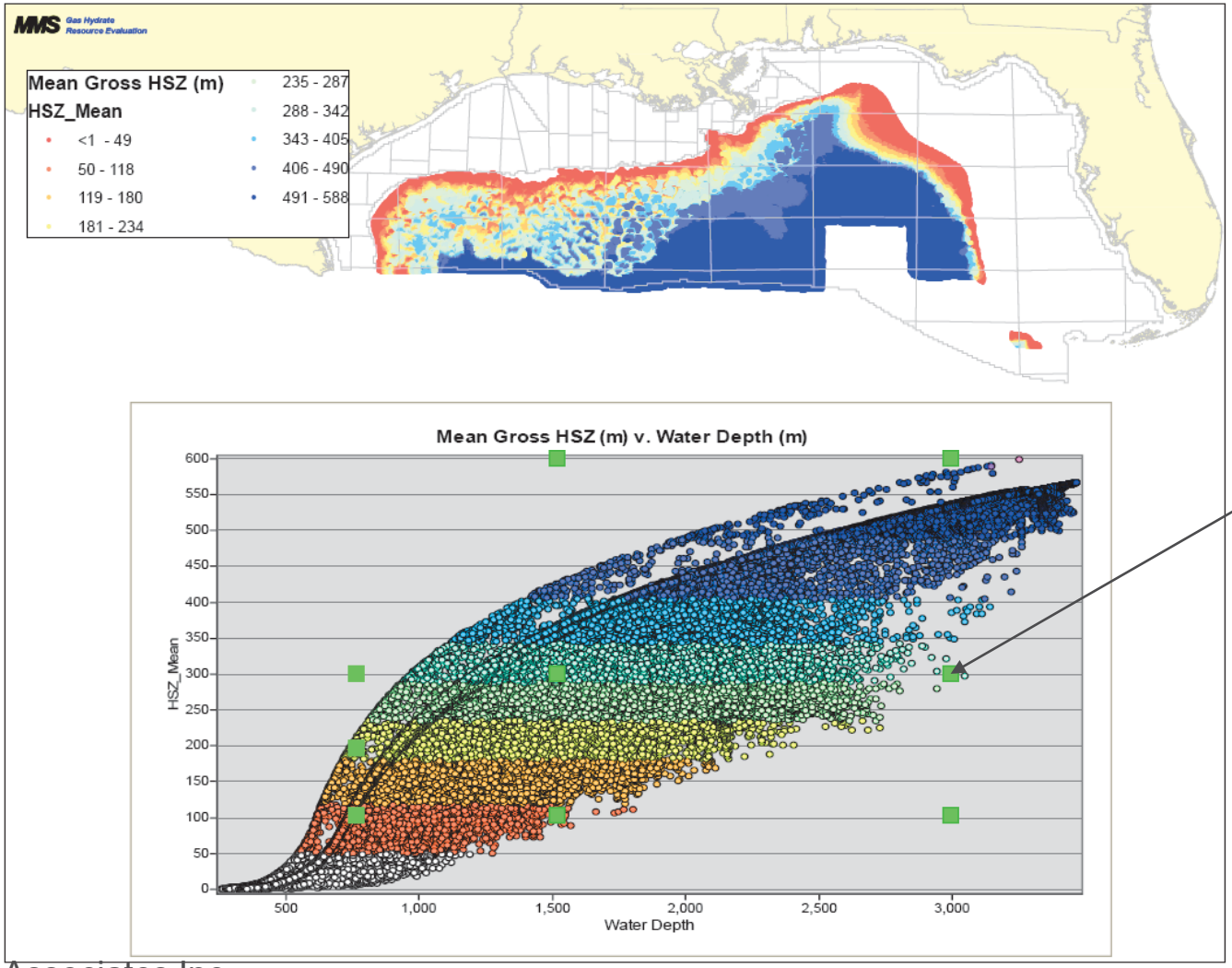
- Will 70% recovery be reached?
  - geological controls not considered here

- May want to cross-check one case against a different simulator (our group or others)

Thank You

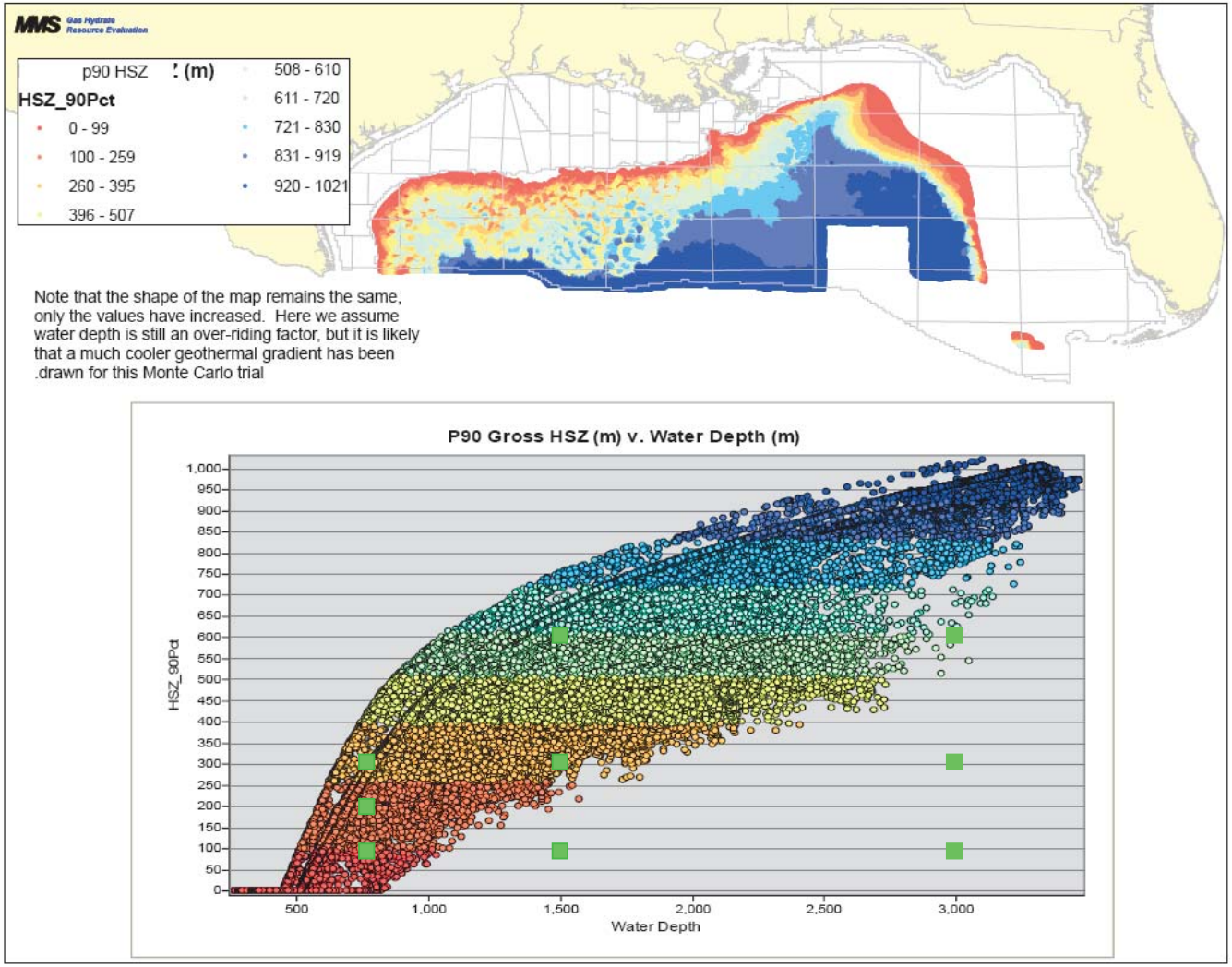
Appendix I: Range of Reservoir Parameters

Water Depth and Reservoir mid-point below seafloor



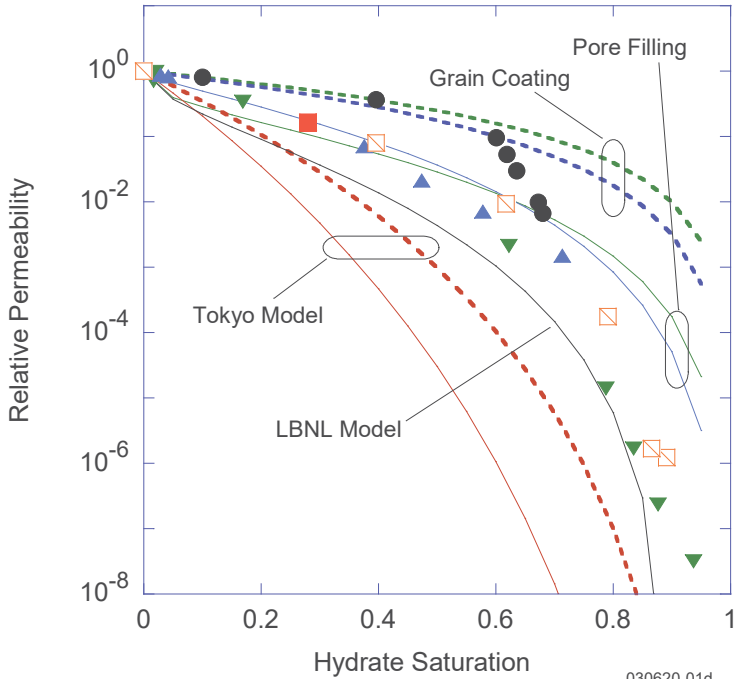
These points indicate the locations used in the study

P90 HSZ



Range of Reservoir Parameters

- Permeability within the hydrate zone
  - Mt. Elbert (S_{Hi} = 0.65): $K(S_{Hi})$ = 0.1 – 0.2 mD
  - Mallik: $K(S_{Hi})$ = 0.001 to 1 mD
- Our Choice: 0.05, 0.5, 5 mD

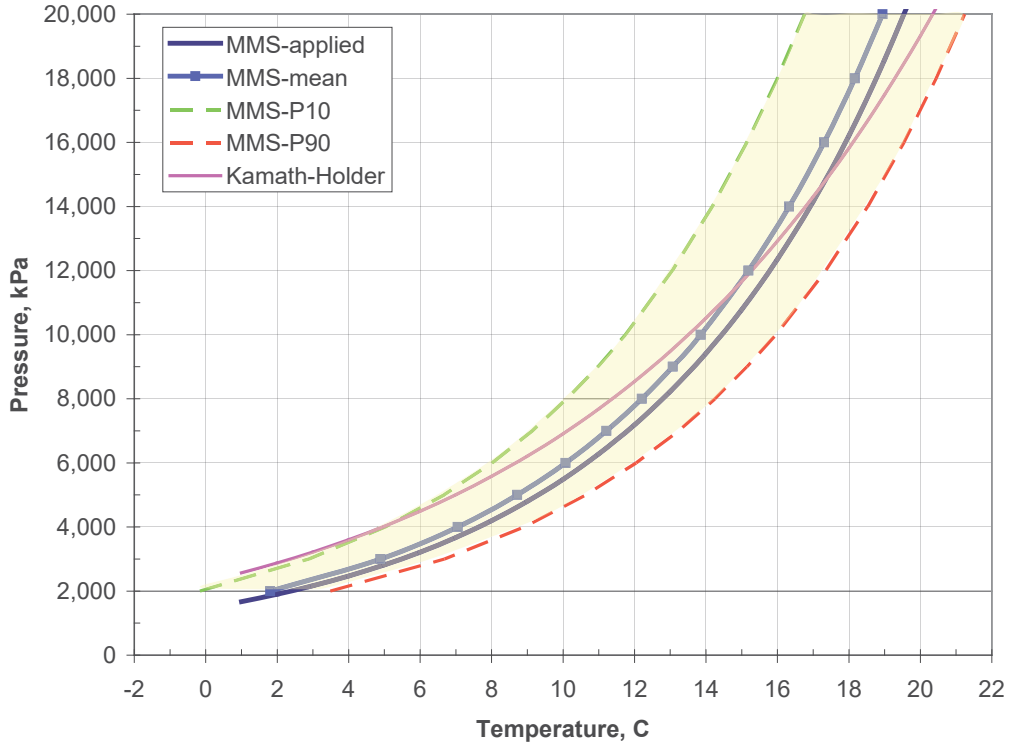


Kleinberg 2005

Our Choice: 10^{-4} to 10^{-2}
(Assuming K = 500 mD, corresponding to Sandy sections of AC 818#1)

For distribution of input parameters see Type II and Type III Progress Reports

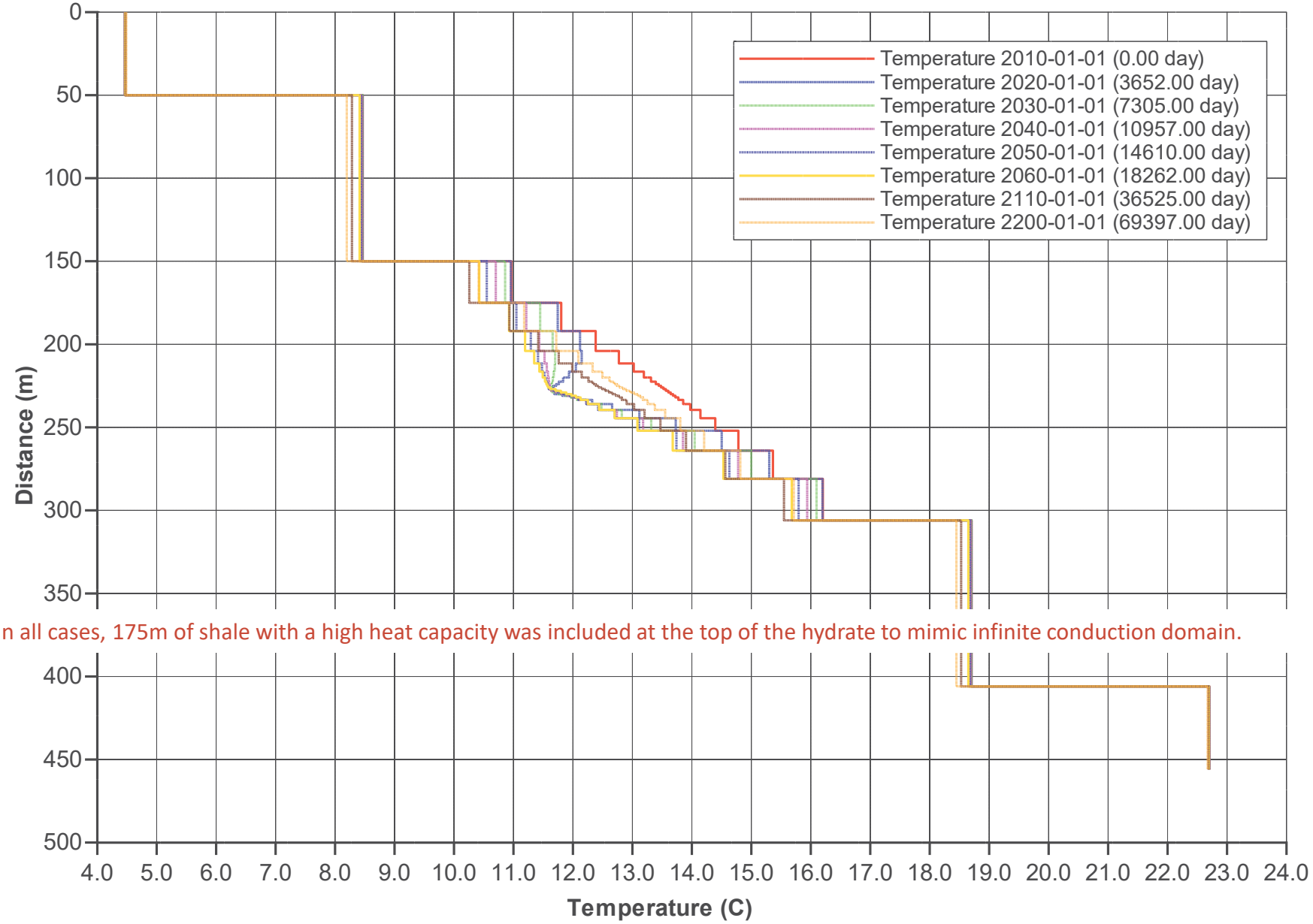
Reservoir Parameters (Equilibrium Curve)



Source: MMS 2008-04, pages 57 - 59

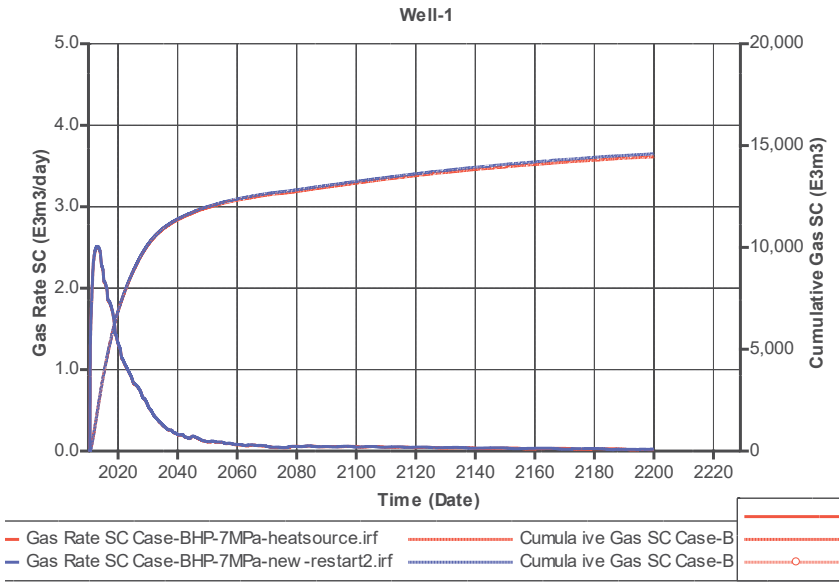
- A constant equilibrium curve was used in this study

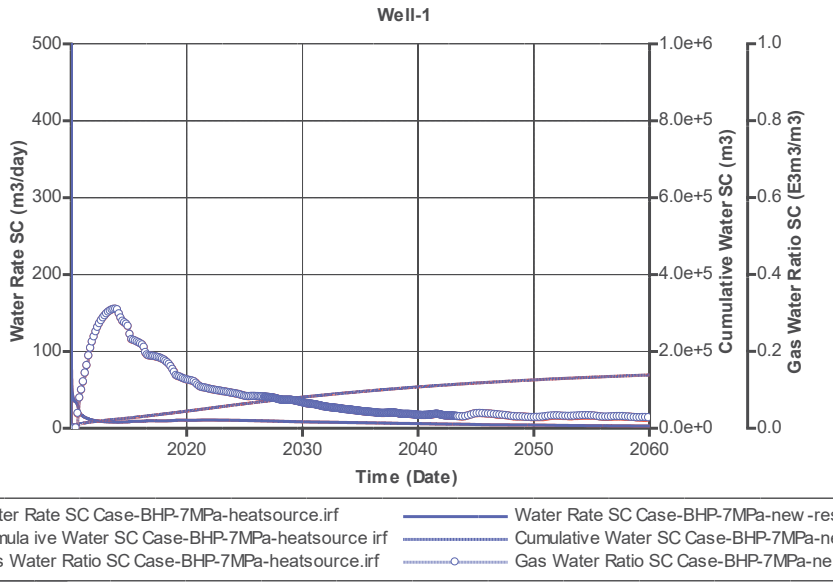
Reservoir Parameters (Shale Thickness)

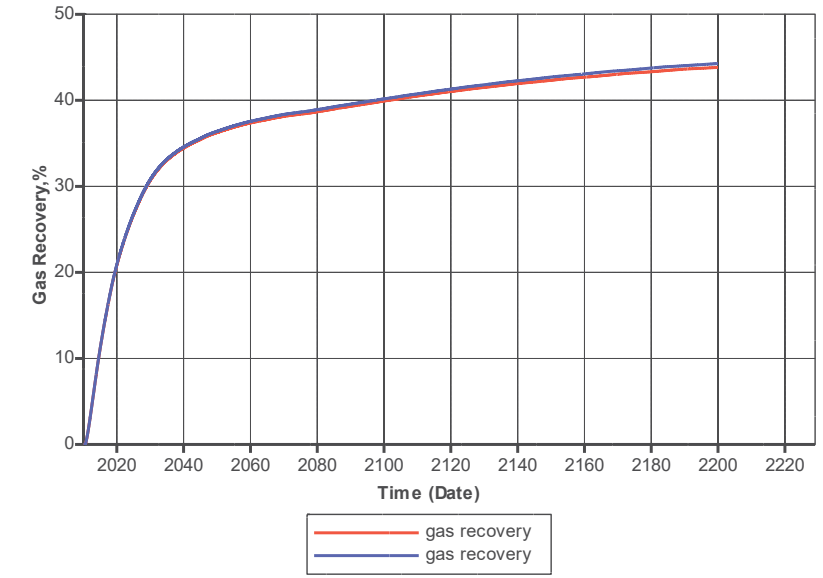


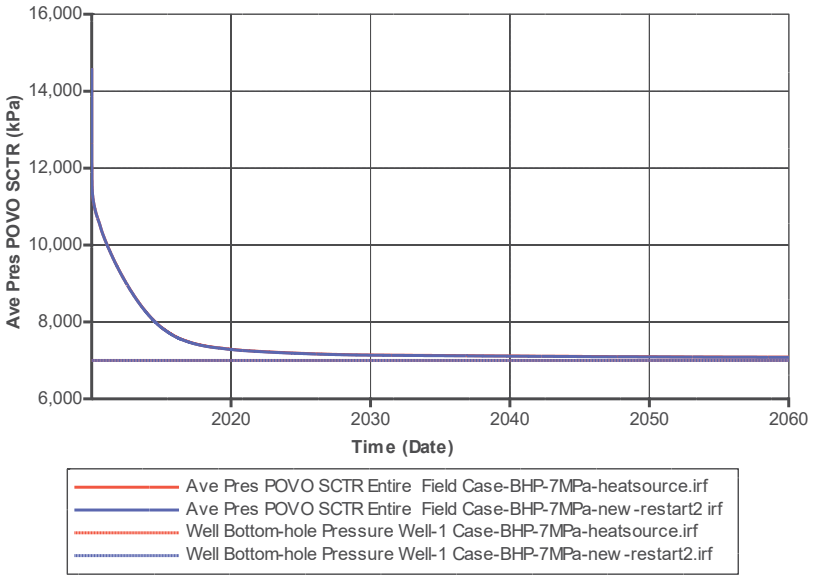
In all cases, 175m of shale with a high heat capacity was included at the top of the hydrate to mimic infinite conduction domain.

Reservoir Parameters (Shale Thickness)









Investigation of Reasons for Low Recovery of Hydrate Reservoir

Fekete Associates Inc.

Cases with Recovery < 50%

Type-II

Exp #	WD	RD	H	SH	Angle	Recovery,%	CumGas, E3m3	Pi, kPa	Ti, C
2	1500	100	3	60	5	40.80	18439	16100	6.72
22	1500	100	6	40	5	33.62	20316	16100	6.72
24	1500	100	6	85	5	19.94	25599	16100	6.72
25	3000	100	6	60	5	18.46	16732	31100	6.56
26	1500	100	6	60	10	23.50	21297	16100	6.72
36	1500	100	20	60	5	9.79	29583	16100	6.72
39	1500	100	6	60	0	41.77	37889	16100	6.72
45	3000	100	20	40	10	8.46	17060	31100	6.56
53	3000	100	20	85	0	4.02	17229	31100	6.56
56	750	100	20	85	10	22.26	95316	8600	8.29
59	3000	100	3	85	10	24.67	15888	31100	6.56

Type-III

Exp #	WD	RD	H	SH	Ki	Kabs	krg0	Recovery_%	CumGas_E3M3	Pi, kPa	Ti, C
3	1500	100	20	60	0.5	100	0.5	0.17	731	16100	6.72
7	3000	100	6	40	0.5	500	0.5	0.34	0	31100	6.56
21	1500	100	6	60	5	500	1	36.59	47175	16100	6.72
26	1500	100	3	60	0.5	1000	0.5	31.78	20486	16100	6.72
32	1500	100	6	60	0.05	500	0.1	0.00	0	16100	6.72
34	1500	100	3	60	0.5	100	0.5	3.74	2430	16100	6.72
40	1500	100	6	60	5	500	0.1	9.77	12597	16100	6.72
49	1500	100	6	60	0.05	500	1	0.00	0	16100	6.72
53	3000	100	6	85	0.5	500	0.5	0.53	981	31100	6.56
57	1500	100	20	60	0.5	1000	0.5	1.55	6676	16100	6.72
63	750	100	3	40	0.05	100	0.1	9.18	3932	8600	8.29
64	750	100	20	85	5	100	1	12.34	74865	8600	8.29
65	3000	100	20	85	0.05	1000	0.1	0.00	0	31100	6.56
71	3000	100	20	40	0.05	100	1	0.00	0	31100	6.56

Reason for Low Recovery

- Primary reason for the low recoveries is that those reservoirs sit at low temperature and high pressure environment. (Shallow RD, Deep WD)
  - Exception is at low hydrate saturation,thin sand and possible of high initial permeability(Type II and III each has one case)

Type II

Exp #	*WD*	*RD*	*H*	*SH*	*Angle*	*Recovery,%*	*CumGas, E3m3*	Pi, kPa	Ti, C
49	3000	100	3	40	0	74.51	22526	31100	6.56

Type III

Exp #	*WD*	*RD*	*H*	*SH*	*Ki*	*Kabs*	*krg0*	*Recovery_%*	*CumGas_E3M3*	*Pi, kPa*	Ti, C
67	3000	100	3	40	5	1000	1	90.69	39220	31100	6.56

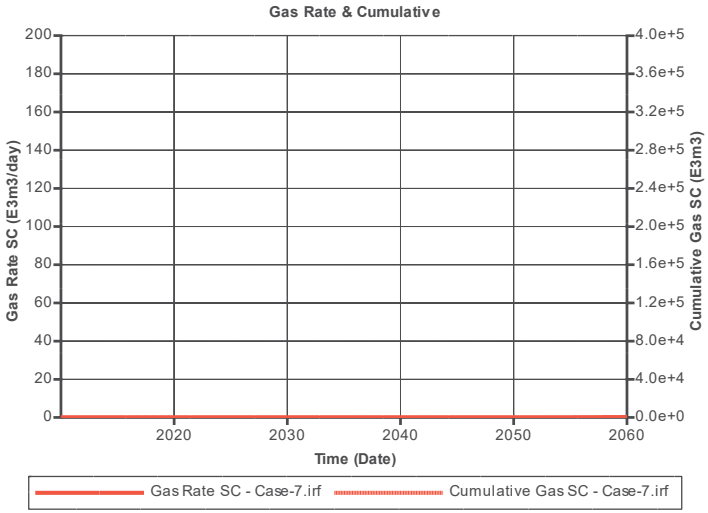
Reason for Low Recovery

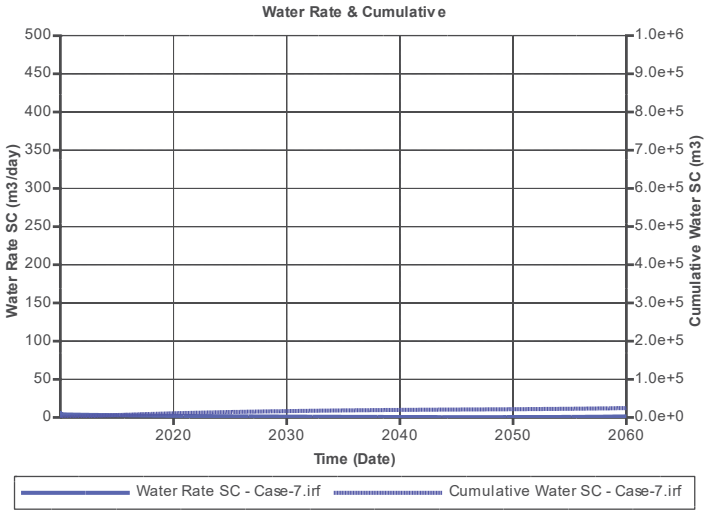
- Within listed cases, those with low hydrate saturation, thin sand, high permeability and moderate reservoir pressure can achieve the recovery between 30-50%
- Within listed Type II cases, 3 cases with sand thickness of 20 m have recovery of less than 10%, indicates that in addition to the cold and high pressure environment, thicker sand resulted in lower recovery. But the cumulative gas production of those 3 cases are not necessarily very low.

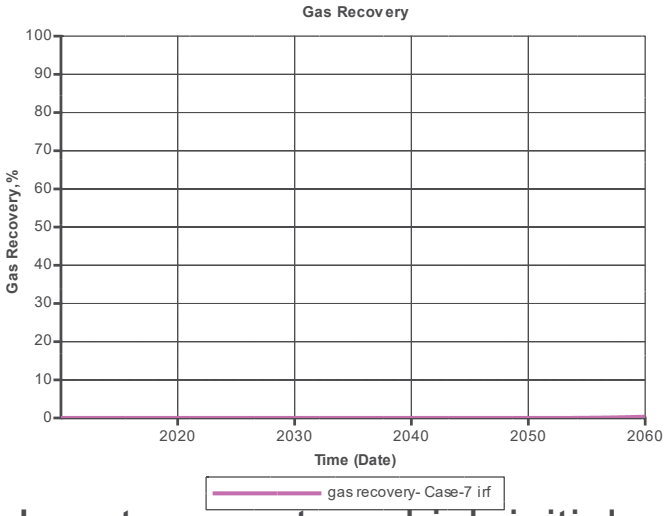
Reason for Low Recovery

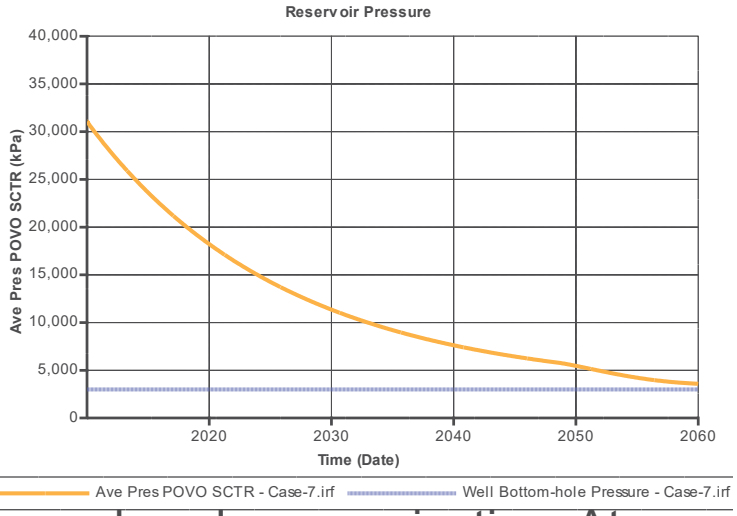
- Within listed Type III cases, low initial permeability, thick sand are secondary reasons for the recovery less than 10% in additional to the cold and high pressure environment

Case-7 (Type-III)





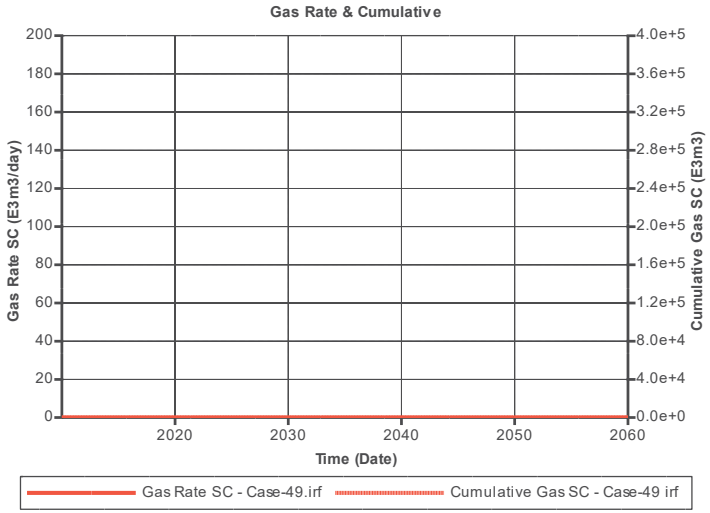


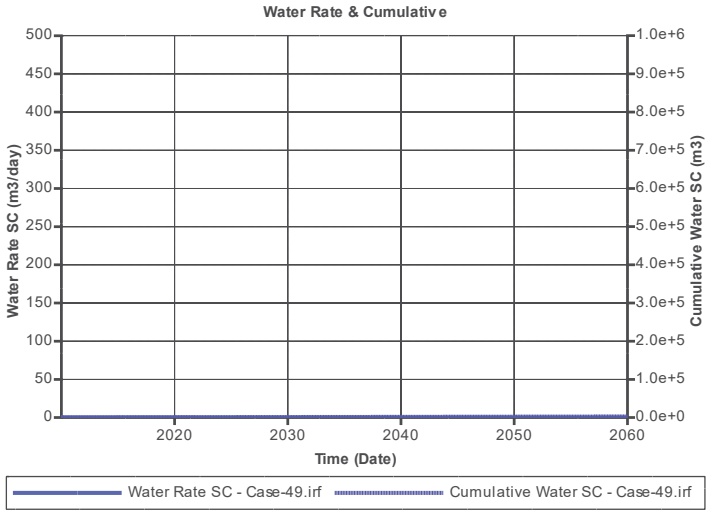


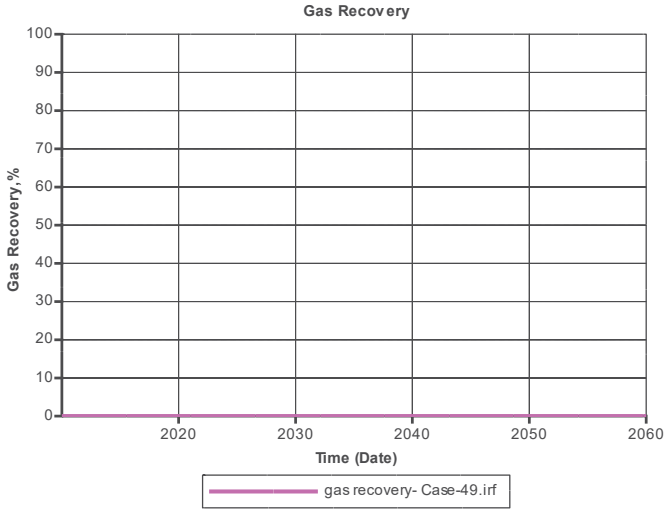
Low temperature, high initial pressure, slow depressurization. At reservoir temperature of 6.56 C, the hydrate can dissociate only when the pressure drops below 3500 kPa.

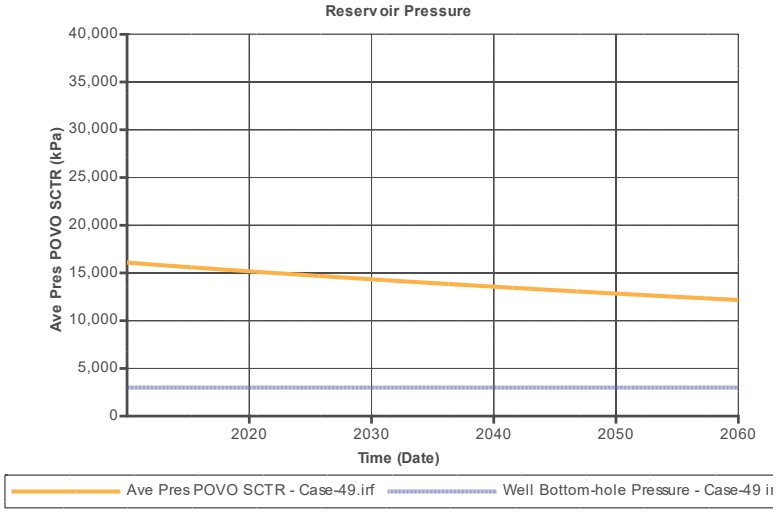
Case-53 has similar behaviour

Case-49 (Type-III)





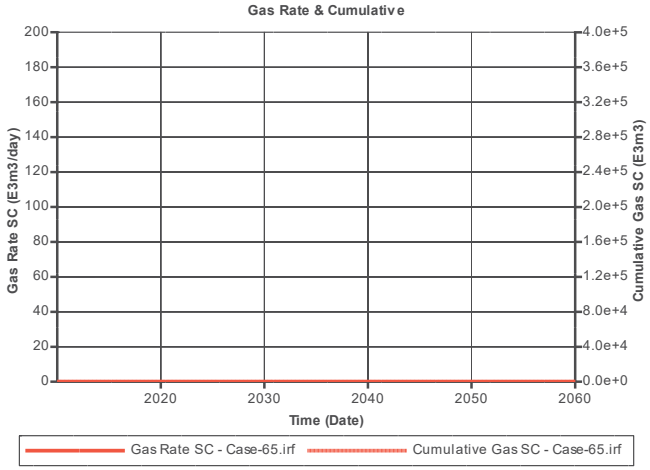


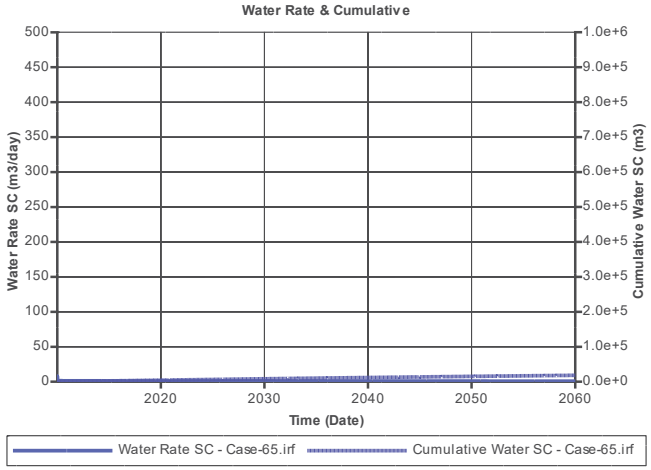


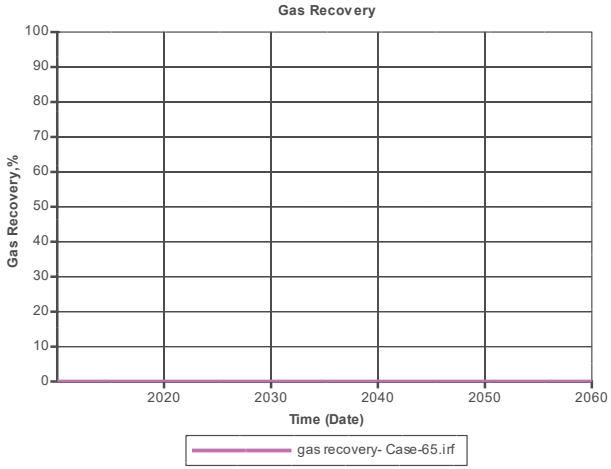
Low temperature, low initial permeability

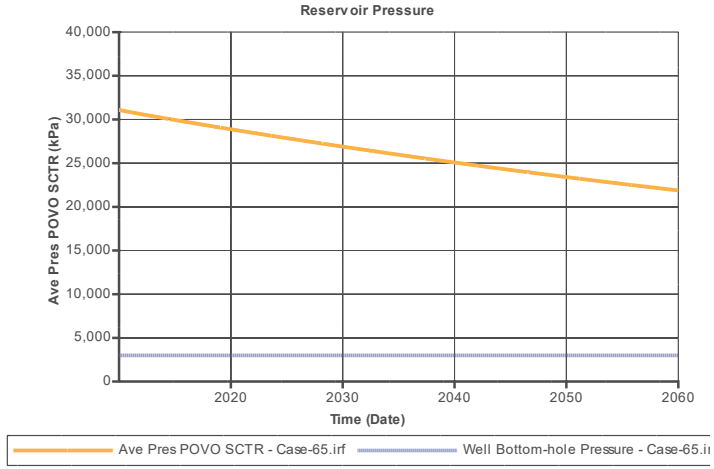
Case-32 has similar behaviour

Case-65 (Type-III)









Low temperature, high pressure, low initial permeability

Case-71 has similar behaviour

SECTION C
DESCRIPTION/SPECIFICATIONS/WORK STATEMENT
for
"An Opportunistic Study of Hearing in Sea Otters (Enhydra lutris): Measurement of Auditory Detection Thresholds for Tonal and Industry Sounds"

C.1 Introduction

The Contractor shall furnish the necessary personnel, materials, services, and facilities, and shall otherwise do all things necessary for incidental to the performance of the work set forth in the Contractor's proposal entitled "An Opportunistic Study of Hearing in Sea Otters (Enhydra lutris): Measurement of Auditory Detection Thresholds for Tonal and Industry Sounds." The Contractor's March 17, 2009 proposal is incorporated by reference under this award to add an additional sea otter. This proposal was a revision to the Contractor's proposal submitted on November 6, 2008.

C.2 Objective

MMS received an unsolicited proposal from Institute of Marine Sciences, Long Marine Laboratory, University of California at Santa Cruz on October 30, 2008. The objective of this proposal is to capitalize on a unique opportunity to obtain in air and underwater hearing thresholds for sea otters (Enhydra lutris) to tonal and industry sounds. Such information is presently unavailable and will fill a critical data gap for environmental assessment of industry activities in coastal Alaskan habitats.

This anticipated 24 months study seeks to capitalize on the immediate availability of unique expertise and unique resources to describe and evaluate, for the first time, the auditory sense of sea otters. The effort leverages existing funding from the Office of Naval Resources and the National Marine Fisheries Service which supports the assessment of hearing and the impacts of anthropogenic noise in several species of marine carnivores, including northern elephant seals, harbor seals, and California sea lions. This research effort will expand the prior research to include sea otters and has been facilitated with seed money provided by the Packard Endowment to the Institute of Marine Sciences at US Santa Cruz, which has provided the start-up costs for this research. The support requested from MMS will fund the direct measurement of auditory hearing thresholds in trained sea otters using behavioral methods. This effort, to be conducted over 24 months, will provide quantitative in air and underwater audiograms which will describe frequency-specific hearing sensitivity in sea otters, so that their acoustic susceptibility to noise in different frequency bands can be easily evaluated. Additionally, this study will provide auditory detection thresholds for four types of industry noise sources: seismic airgun pluses, pile driving impulses, small engine boat noise, and helicopter over flight.

Trip Report
Post-Storm Season Assessment of Surrogate Mobility and Field Methodology Examination
Bureau of Ocean Energy Management (BOEM)
Unexploded Ordnance (UXO) Survey Methodology Investigation
10 - 14 April 2017

1. Introduction

(b) (5)

Summary of Comments on 2017-04_BOEM_PostStorm_FieldReport_JM.pdf

Page: 1

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Page: 8

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SECTION C
DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

Unexploded Ordnance Survey Methodology Investigation for Clearing Renewable Energy Sites on the Atlantic Outer Continental Shelf

C.1 BACKGROUND

The 1953 Outer Continental Shelf Lands Act (OCSLA) and its subsequent amendments require the Secretary of Interior to balance the nation's energy needs with the protection of the human, marine, and coastal environments, while ensuring that the concerns of coastal states and *competing users* are taken into account. The Bureau of Ocean Energy Management (BOEM), a bureau within the U.S. Department of the Interior (DOI), has jurisdiction over all mineral resources on the Federal Outer Continental Shelf (OCS), and is charged with conducting OCS lease sales as well as monitoring and mitigating unwelcome impacts that might be associated with resource development.

In 2005, the Energy Policy Act (EPAct) amended Section 388 of the OCSLA, giving the Secretary discretionary authority to issue leases, easements, or rights-of-way for renewable energy projects on the OCS. Under this new authority, the BOEM may issue leases on the OCS for potential renewable energy projects including, but not limited to, wind energy, wave energy, ocean current energy, solar energy, and hydrogen production. The BOEM recognizes that new and future uses of the OCS, including renewable energy development, should be managed in a deliberate and responsible manner, keeping both the nation's energy needs and concerns for the marine environment in mind.

To comply with National Environmental Policy Act (NEPA) and other relevant laws, BOEM's renewable energy regulations require a lessee to identify man-made hazards, such as unexploded ordnance (UXO) and/or munitions and explosives of concern (MEC). Areas of the seabed that will be disturbed during installation should be cleared of UXO and MEC prior to installation actives for both human safety and environmental protection. There are few guidelines that provide detailed guidance on methodologies capable of identifying surficial, partially buried, and fully buried UXO and MEC likely to be encountered on the Atlantic OCS.

C.2 PURPOSE

In-situ UXO and MEC identification methodologies are not well established components of offshore renewable energy development in the United States. The purpose of this investigation is to provide guidance to renewable energy developers and BOEM on identification and site clearance methodologies specific to UXO and MEC as required in a Construction and Operations Plan (COP).

The anticipated size and type of UXO and MEC has a large impact on equipment choice and survey methodologies, therefore, understanding the anticipated UXO and MEC that could be encountered is another key element of this study.

BOEM will incorporate relevant report findings into guidance documentation and suggest potential applicants and developers use the findings when developing survey plans.

The goal of the study is to investigate, verify, and recommend methodologies to identify UXO and MEC specific to conditions found in renewable energy lease and planning areas along the Atlantic OCS. The study will also work to identify regional expectations of type, size, and likelihood of presence for UXO and MEC along the Atlantic OCS.

This study includes the following objectives:

1) Determine regional expectations for UXO and MEC that could be found along the Atlantic OCS.
2) Investigate and recommend offshore UXO and MEC identification methodologies for the Atlantic OCS wind areas and compatibility with expected UXO and MEC.
3) Verify recommended methodologies with an offshore field effort that identifies surficial, buried, and partially buried objects of anticipated size and signature.

The analysis methodology should incorporate domestic and international knowledge from private industry, academic experts, and government agencies like the Department of Defense (DoD), United States Geologic Survey (USGS), and NOAA. It may be beneficial to work with organizations that have experience in offshore renewable energy development in Europe to incorporate lessons learned.

C.3 SCOPE OF WORK

C.3.1 Task 1 – Anticipated UXO and MEC

UXO and MEC methodologies depend greatly on the size and signature of the expected objects. Therefore, the first step in recommending a methodology is to understand the objects that are being identified.

The Contractor shall investigate historical and current activities that result in UXO and MEC deposition near wind energy areas on the Atlantic OCS and include it in the report. The report will also include a summary of expected UXO/MEC and discuss the likelihood of an encounter in the wind energy areas. The investigation should focus on sources relatively close to wind energy areas and discuss the general sizes and signatures of the anticipated materials.

C.3.2 Task 2 – Methodology Development

Methodologies should be analyzed and developed based on the size and signature of the anticipated UXO and MEC. The Contractor shall determine the most appropriate equipment and survey design capable of identifying the expected surficial, partially buried, and buried UXO and MEC. In the event UXO and MEC have strong regional differences, it may be appropriate to recommend regionally appropriate methodologies and equipment choices.
The Contractor shall present relative information regarding the estimate of ship time required for

a given area of coverage.

C.3.3 Task 3 – In-Field Testing and Methodology Verification

The Contractor shall verify the methodology recommendations with in-field testing by either finding or placing objects with similar sizes and signatures of expected UXO and MEC on the seabed, partially buried in the seabed, and buried to a depth of between 1.5 to 2 meters. The contractor will then follow their developed methodology and verify the ability to identify representative objects. It may be advantageous to only field verify the smallest and most difficult objects to identify based on the assumption that larger targets would be readily detectable.

A burial depth of 1.5 to 2 meters is based on average cable route burial depths associated with wind planning areas and leases offshore the Atlantic coast.

This task includes data processing, data analysis, and documentation of study results. The final report should include a detailed account of the infield events, data processing steps, analysis procedure, and results.

C.4 PROJECT MANAGEMENT PLAN

The Contractor shall operate under the negotiated PMP. This plan shall include a Project Manager (PM) with sufficient authority to serve as the Contract Administrator, the point of contact with the BOEM, and provide leadership to the study Team. The PM will ultimately be responsible for all deliverables, budget control, quality assurance for all products, compliance and adherence with schedule of the study, and that all personnel work synergistically and cooperatively for the common goal of the study.

The Project Management Plan (PMP) is to achieve the goals and task objectives of this study. The PMP shall include key aspects about the execution of this project, and encompass all tasks from initial planning through and including the BOEM's final acceptance of all deliverables. The Contractor shall deliver all required deliverables in accordance with Sections C, E, and F.

C.5 MEETINGS, REPORTS, AND OTHER DELIVERABLES

The following deliverables shall be submitted and meetings held in accordance with the schedules specified below. The Contractor is responsible for editing and proofreading all material prior to delivery to the BOEM in order to submit products of the highest technical and editorial standard. The Contractor shall establish an effective quality control program to assure that the end product meets professional requirements and submit a Quality Control Plan to the BOEM.

C.5.1 Post-Award Meeting and Summary

The Contractor shall hold a Kick-off Meeting with BOEM in Sterling, VA, as soon as possible following award, not to exceed two (2) weeks. At least one (1) week prior to holding the Kick-

off Meeting, the Contractor shall submit a Quality Control Plan to the BOEM CO and COR. At the Kick-off Meeting, the Project Management Plan shall be reviewed and remaining technical or managerial issues shall be resolved. Within two (2) weeks following the meeting, the Contractor shall prepare and distribute to the parties listed in Section F.5 a summary detailing the discussions and any mutually agreed to decisions. Any agreed to changes that might affect the award are subject to approval in writing by the BOEM CO and COR.

C.5.2 Monthly Progress Updates

The Contractor shall submit monthly progress updates via email. The letters must include, at a minimum: a summary of all work performed during the month; an explanation of overall progress made against the work schedule; a summary of any significant technical, budgetary, or problems encountered during the report period, including an assessment of their probable effects on meeting contract provisions.

C.5.3 Draft Final Report

Upon completion of all requirements outlined in Tasks 1-3 (Sections C.3), the Contractor shall prepare a draft report as specified in Section F.5 and submit to the BOEM within twelve (12) months from the contract award date. Using knowledge gained through the literature review, and other data collection and research efforts, the Contractor shall produce a final analysis that, at a minimum:

a) Details all methodologies, techniques, equipment, evaluations, and analyses employed or generated in the fulfillment of the contract requirements;
b) Describes the analytical and the information/data used in the effort;
c) Describes the relevant history of UXO and MEC deposition near federally identified WEAs on the Atlantic OCS;
d) Describe they various types, sizes, and data signatures of UXO and MEC anticipated to be present near federally identified WEAs on the Atlantic OCS;
e) Discuss and recommend methodologies in detail and the rationale behind the recommendations;
f) Present and discuss the in-field data and results verifying the recommended methodology;
g) Uses tables, figures, graphics, and maps to clearly illustrate descriptions and discussions.

The Contractor shall be familiar with the BOEM's regulatory responsibilities so that the recommended best practices are consistent with federal regulations. Any final recommendations shall be fully justified by the analysis. A draft report that requires many changes, corrections, edits, or additions will be deemed unacceptable. If the report is unacceptable, it will be returned to the Contractor for correction and re-submittal, still as a draft report.

C.5.4 Final Report

Within 30 calendar days of the BOEM receiving an acceptable Draft Report and Technical Summary, the BOEM will review the documents for accuracy and scientific validity and will provide the Contractor with written comments based on the review. The Contractor shall correct all omissions or deficiencies resulting from nonconformance with the contract requirements. The

Contractor shall also make additions, revisions, or corrections relating to data interpretation, judgments, or recommendations that have been mutually agreed upon with BOEM.

If the Contractor does not agree with the BOEM's comments and recommendations, discussions shall be held with the COR to resolve the disagreements. Once all disagreements have been resolved, the Contractor shall submit a written response to the COR as to how the Contractor will address the findings in the final material submitted. This response shall be submitted within thirty (30) calendar days from the date BOEM's written comments were received. The BOEM will then have fourteen (14) calendar days to either approve or disapprove the response.

C.5.5 Final Presentation

The contractor shall give a presentation of study results at a government office in Sterling, VA., two weeks after the date of the BOEM receiving the final report. The fee should include travel cost for two personnel. The presentation shall include an overview of the study effort, results, and salient points identified during the study.

C.5.6 Scientific Integrity

Scientific integrity is vital to Department of the Interior (DOI) activities under which scientific research, data, summaries, syntheses, interpretations, presentations, and/or publications are developed and used. Failure to uphold the highest degree of scientific integrity will result not only in potentially flawed scientific results, interpretations, and applications but will damage DOI's reputation and ability to uphold the public's trust. All work performed must comply with the DOI Scientific Integrity Policy posted to http://www.doi.gov, or its equivalent as provided by their organization or applicable law.

SECTION D
PACKAGING AND MARKING

D.1 All deliverables submitted under the contract shall be prepared and packaged in a cost-effective manner equivalent to standard commercial quality. Elaborate art work, expensive paper and bindings are neither necessary nor desired.

D.2 Unless otherwise directed by the Contracting Officer (CO), if not hand delivered or electronically delivered by the Contractor, all reports shall be delivered by First Class mail or regulated package carrier. The cost of delivery by more expensive means will be denied unless approval is obtained in advance from the CO.

D.3 All paper deliverables shall meet at least the minimum requirements for post-consumer recycled content, set forth in EPA's Comprehensive Procurement Guidelines

SECTION C
DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

Acoustic Propagation and Marine Mammal Exposure Modeling of Geophysical Sources in the Gulf of Mexico

C.1 BACKGROUND

The Bureau of Ocean Energy Management (BOEM) manages the exploration and development of the nation's offshore resources. It seeks to appropriately balance economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies. The Division of Environmental Assessment prepares program-level National Environmental Policy Act (NEPA) and Outer Continental Shelf (OCS) Lands Act reports; provides oversight, policy guidance, and direction for NEPA and other environmental laws and regulations affecting OCS activities; and participates in international conventions and treaty activities. The Bureau must comply with numerous environmental statutes, regulations, and executive orders (such as the Endangered Species Act [ESA] and Marine Mammal Protection Act [MMPA]) to carry out its mission.

The BOEM is seeking contractor's support for acoustic source and propagation and marine mammal exposure modeling of geophysical activities in the Gulf of Mexico (GOM). This modeling will be included in the preparation of a NEPA analysis and petition for MMPA rulemaking for Geological and Geophysical (G&G) activities in the GOM. The geophysical activities to be modeled are primarily associated with GOM Outer Continental Shelf (OCS) subsurface imaging for oil and gas exploration. The BOEM is currently authorizing all G&G permits in the GOM under an Environmental Assessment (EA) and requires additional NEPA coverage for geophysical authorizations. Given the scope of the proposed surveys and their potential cumulative impacts, BOEM has determined that a Programmatic Environmental Impact Statement (PEIS) is required under NEPA.

Geographic scope for this modeling includes the entire Exclusive Economic Zone (EEZ) in the GOM (both federal and state waters). Impacts associated with the proposed project may affect resources throughout the project area, including but not limited to animals that migrate through and adjacent to the project area.

C.2 PURPOSE

The PEIS is in preparation. The purpose of this project is to complete the sound source, acoustic propagation, and marine mammal exposure modeling necessary to complete the impact analysis in the PEIS, and for inclusion in a petition for rulemaking under section 101(a)(5) of the MMPA and the Endangered Species Act (ESA) section 7 consultation on GOM G&G activities.

C.3 OBJECTIVES

The objective of this project is to:

a. Complete acoustic source and propagation modeling; and
b. Complete marine mammal acoustic exposure modeling.

The modeling results shall include an estimate of the number of individual animals of each species expected to be present in the GOM that may be exposed above given received levels, as specified by BOEM and the National Marine Fisheries Service (NMFS), for each of the ten modeled years. These results shall include an ability to record, and an analysis of the estimation of the duration and characteristics of those exposures (e.g., minutes, hours, days, months, frequency, repeating interactions, etc.), which would likely require the use of an animal exposure or dosimeter history in the modeling for each modeled individuals.

In addition to providing the above results for representative single-source and single-duration scenarios provided, the models must have the flexibility to model multi-source and longer duration scenarios (e.g., of at least three months and up to a year for some situations), to report results in Sound Pressure Level (SPL) or Sound Exposure Level (SEL) metrics (binned by frequency band if needed), and to consider ambient noise information is provided. The Contractor shall build in flexibility to run some creative scenarios that would be subsequently designed to help better understand how aggregate sources (in different configurations), different survey lengths, different mitigations, and other factors may affect marine mammal exposures to given levels of sound.

C.3 SCOPE OF WORK

C.3.1 Task 1 - Draft Modeling Scenario Case

Two months after the award of the contract, the Contractor shall provide a working draft set of data for one draft modeling scenario case, in a BOEM-approved location. This case shall nominally consist of one survey type (such as a 3-D survey) in a BOEM-specified configuration, which was conducted for up to three months. The resulting exposure histories for all marine mammal species present at that location, shall include sound pressure level and energy levels. Additionally, this data shall be analyzed using the current standard methodologies with thresholds which will be specified by BOEM. This analysis shall serve as a baseline assessment of the exposures and resulting impacts to the modeled species. A series of up to six (6), post-modeling, analyses must then be conducted on this data in order to characterize the statistical nature of the data and to explore the variation of the results from the baseline results for up to six different impact criteria or calculation methodologies. The results of this experimentation shall ultimately be incorporated into the Task 2 analyses to complete the impact assessments for the programmatic EIS.

C.3.2 Task 2 - Final Modeling Scenario

No later than seven (7) months after the award of the Contract, the Contractor shall provide the Final Modeling Results and Synthesis Report. The modeling must include:

C.3.2.1 Acoustic Source and Propagation Modeling

The Contractor shall provide the underwater acoustic source and propagation modeling necessary to assess the potential impacts for all geophysical surveys projected to occur in the GOM that will be addressed in the PEIS and in the petition for MMPA rulemaking. Specifically, this modeling shall address:

- Ten year period covered under the proposed action for the PEIS (nominally 2015-2024);
- Year-round geophysical activities/operations;
- The entire area affected by the operation of the indicated sources in the entire U.S. portion of the Gulf of Mexico, including both state and federal waters;
- Up to six (6) acoustic sources (some scenarios will also have multiple sources) which may include but are not limited to airguns/airgun arrays, multibeam sonar, sidescan sonar, subbottom profiler, bathymetric echosounder, chirp and boomer sources; and
- At least seven (7) survey methodologies which may include but are not limited to: conventional 2D, 3D, and 4D (coiled and rectangular); wide azimuth, rich azimuth, and full azimuth (WAZ, RAZ, FAZ), with sequential and simultaneous source deployment; ocean bottom surveys (OBS); vertical seismic profiling (VSP); bathymetric ocean bottom surveys; and shallow penetration (high resolution) surveys.

These models and the supporting databases must be representative of the best available science and practices, and they shall be capable of producing results which are consistent with NMFS' current acoustic guidelines as well as any revisions to those guidelines (see http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm).

At minimum, the modeling must identify the extent of the various isopleths (and/or other threshold boundaries). The Contractor must be ready to extend these simulations out to the 120 dB SPL isopleth. The Contractor shall specifically detail and justify their plans and approach to complete the required acoustic modeling, including spatial and temporal variability in use of acoustic sources that will be covered by this analysis, deployment of sources in various configurations (e.g., multi-source), as well as all assumptions used in the analyses. The proposed methodology must be appropriate for the GOM environment as well as the specified sources. After the award of contract, BOEM shall provide descriptions of the geophysical activities to be modeled, as well as any additional data requirement for inclusion in the modeling (which may include to current ambient noise data).

C.3.2.2 Marine Mammal Exposure Modeling

The Contractor shall provide a marine mammal exposure estimate that incorporates the acoustic source and propagation modeling and the current standard as well as the latest draft NMFS acoustic thresholds in the calculation methodologies. The Contractor shall provide up to four permutations of their basic modeling effort in order to address several alternatives and mitigation measures. These permutations may include, but not be limited to:

- Variations on the number, length of time or distribution of survey operations;
- Inclusion of mitigation measures (e.g., time or area closures, shutdowns at certain distances, or other possible operational restrictions such as source separation requirements);
- Multi-source scenario modeling;
- Modeling of short and long duration scenarios (such as up to a year); and
- Inclusion of ambient noise data

C.4 CONTRACTOR METHODOLOGY/ SOLUTION

The Contractor must present an approach which will facilitate an interactive and iterative discussion with both BOEM and NMFS to ensure that the modeling will achieve the objectives outlined above. The preliminary exposure estimates shall be subject to BOEM and NMFS review, as well as by designated cooperating agencies (i.e. the Bureau of Safety and Environmental Enforcement), followed by contractor revisions, and final BOEM approval of the marine mammal exposure estimates.

Historically in seismic compliance documentation and analyses, modeling results and impact assessments have focused predominantly on acoustic thresholds and quantifying the exposures above those levels, with less focus on what those exposures might mean to individuals.

The Government under this effort is requiring the modeling results to be robust and of sufficient quality to allow the exploration of a number of possible approaches and/or metrics to derive 'impacts' from the model-produced 'exposure' record (the number of individuals exposed versus the number of exposures). For example, if the primary modeling outlined in the objectives above were accomplished using a standardized time-period for single-source surveys intended to be scaled to the actual time and circumstances of future surveys, the modeler could augment these results with results of a separate more simple model intended to allow comparisons to longer duration or multiple-source surveys that could then feed into a correction factor, as appropriate, to the basic results. Therefore, the Contractor’s solution must conduct this type of interactive and iterative analysis up to four permutations.

SECTION C
DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

ANALYZING THE POTENTIAL IMPACTS TO CULTURAL RESOURCES AT SIGNIFICANT SAND EXTRACTION AREAS

C.1 INTRODUCTION

The United States Department of the Interior (DOI), Bureau of Ocean Energy Management (BOEM) is required under Section 106 of the National Historic Preservation Act (NHPA) to consider the effects of its permitted actions on significant historic properties. BOEM requires that, prior to issuing leases or permits for bottom disturbing activities related to the extraction of sand, gravel, and other mineral resources from the Outer Continental Shelf (OCS), the applicant of the proposed action must identify potential submerged cultural resources within the Area of Potential Effect (APE).

Through its Marine Minerals Program, BOEM has designated Significant OCS Sand Resource Extraction Zones, based on sediment thickness, in selected areas of the Gulf of Mexico (GOM). These zones, along with similarly designated zones in Louisiana state waters, may be leased and utilized as sand sources for coastal restoration and protection projects. Three of the Significant OCS Sand Resource Extraction Zones currently scheduled or under consideration for upcoming sand use projects include: Sabine Bank (Figure 1), which includes portions of the High Island, West Cameron, Sabine Pass (Texas) and Sabine Pass (Louisiana) lease block areas; Ship Shoal (Figure 2), which includes portions of the Ship Shoal and South Pelto lease block areas; and St. Bernard Shoals (Figure 3), which includes portions of the Main Pass and Chandeleur lease block areas.

Additionally, in 2010 the State of Louisiana authorized sand dredging activities in State waters to protect fragile wetlands from the impacts of the *Deepwater Horizon* oil spill. These sediments were deposited on State-owned submerged bottomlands in an effort to prevent oil from entering these sensitive areas. Dredging of the sand sources occurred in high-energy, shallow-water environments near Hewes Point, Chandeleur Islands where shipwrecks have been reported in historical accounts. Pre-dredging remote-sensing surveys of the borrow and deposition areas identified multiple potential historic shipwreck locations; however, dredging-related impacts to these locations have not yet been determined.

Concurrently with the above actions, the State received an Emergency Sand Agreement (lease) from BOEM to use OCS sand from the St. Bernard Shoals extraction zone. During the emergency response, and in an effort to comply with Section 106 of the NHPA, the borrow areas, sand conveyance pipeline corridors, and rehandling areas on the OCS were all subjected to high-resolution remote-sensing survey, again resulting in the identification of several potential historic shipwreck locations. Prior to any sediment extraction operations, however, access to OCS sand was ultimately denied when the Federal On-Scene Coordinator did not concur with proposed offshore dredging efforts.

This study aims to utilize both existing and newly acquired data sets in order to inform BOEM of the potential impacts to shipwreck sites in a given APE for sand and gravel extraction. Moreover, results will provide comparative data about the use of sand resources from relatively lower energy OCS environments and those located in more dynamic shallow water environments such as Hewes Point, Chandeleur Islands; an area which was historically prone to a high occurrence of ship groundings. Data recovered from shipwreck sites will be used to fulfill the Section 106 process by determining if each site is eligible for inclusion on the National Register of Historic Places as well as provide information to the general public about Louisiana's maritime heritage and archaeological resources.

C. 2 AUTHORITY

Services under this contract shall be provided in compliance with the BOEM responsibilities under the National Historic Preservation Act of 1966 (PL 89-665) as amended; Executive Orders 11593 and 13007; the Archaeological and Historic Preservation Act of 1974 (PL 93-291); Title 36 of the Code of Federal Regulations (CFR) Parts 60-66, 79, 800, as appropriate; the *Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation* (Federal Register 48:190:44716-44742); applicable Louisiana state historic preservation regulations and guidelines that are in effect on the date of award of this contract; the BOEM *Handbook for Archaeological Resource Protection* (620.1-H); and other laws, rules, regulations, and guidelines as applicable and appropriate.

C.3 STUDY OBJECTIVES

In an effort to understand what impacts might occur to shipwrecks as a result of BOEM's sand leasing activities, this study will provide BOEM with information on the location, preservation, and extents of debris fields associated with potential shipwrecks within selected sand borrow areas. Information obtained from this study will assist BOEM with complying with its Section 106 responsibilities under the NHPA by providing data about archaeological sites encountered in Significant OCS Sand Resource Extraction Zones. This study will also help determine best management strategies that should be employed for sites, including information about appropriate mitigation measures to protect such sites during future sand leasing activities. Geophysical and geotechnical data regarding the character and quality of sand resources will also be acquired and applied to better understand the morphologic evolution and sediment dynamics of dredge pits in the vicinity of existing cultural resources, as well as to assess the effectiveness of dredging setback buffers (within or proximal to a dredge pit). The results of this study will have broad-scale implications for BOEM's Marine Minerals Program and the impacts of OCS dredging for extracting valuable sand sources on submerged cultural resources. Public outreach tools that highlight BOEM's Marine Minerals and Archaeology Programs along with the purpose, scope, and results of this study area are also a primary objective.

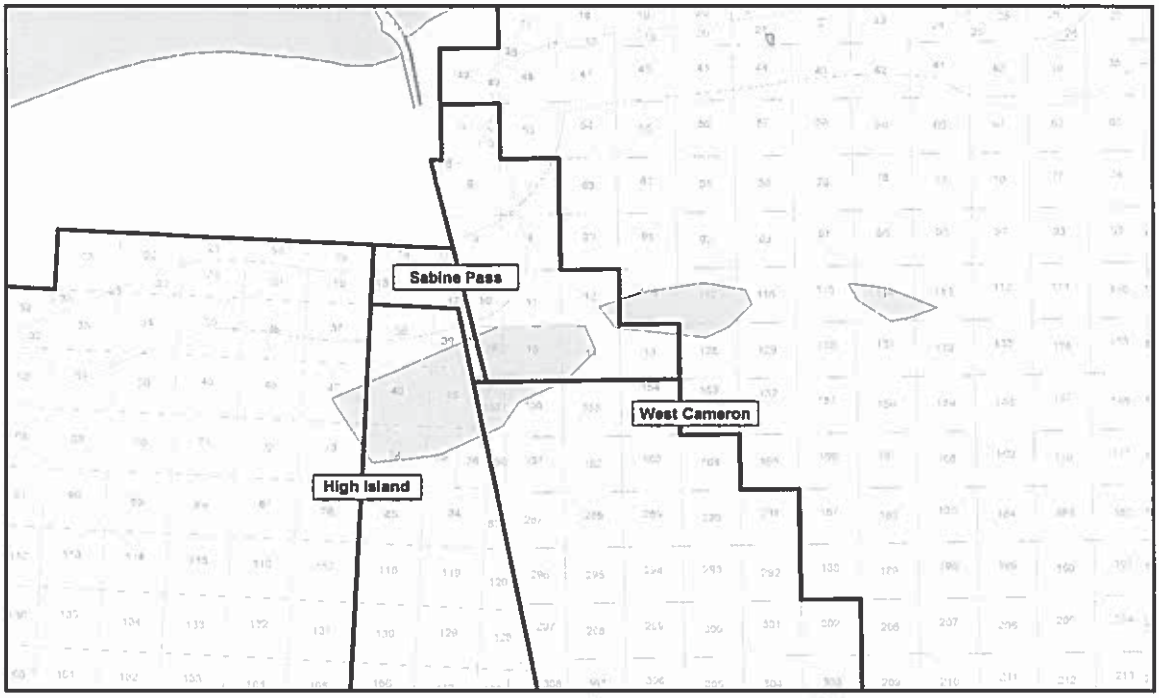

Figure 1. Significant OCS Sand Resource Extraction Zone; Sabine Bank

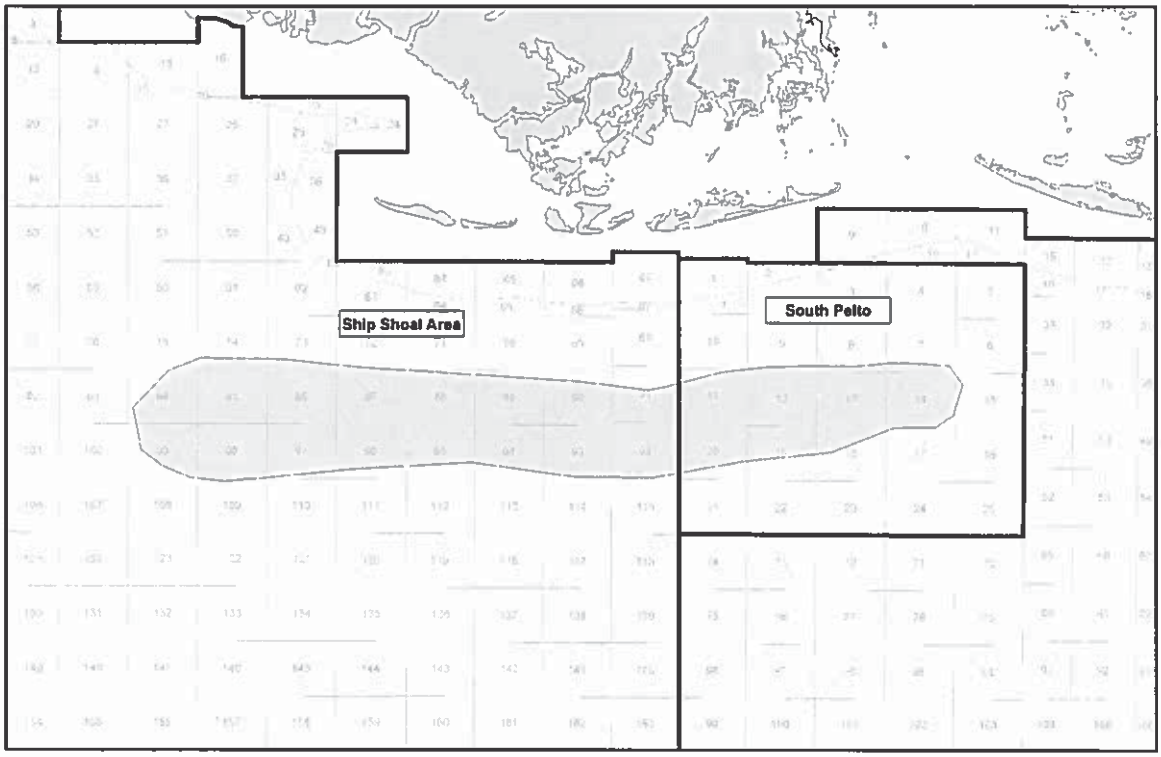

Figure 2. Significant OCS Sand Resource Extraction Zone; Ship Shoal

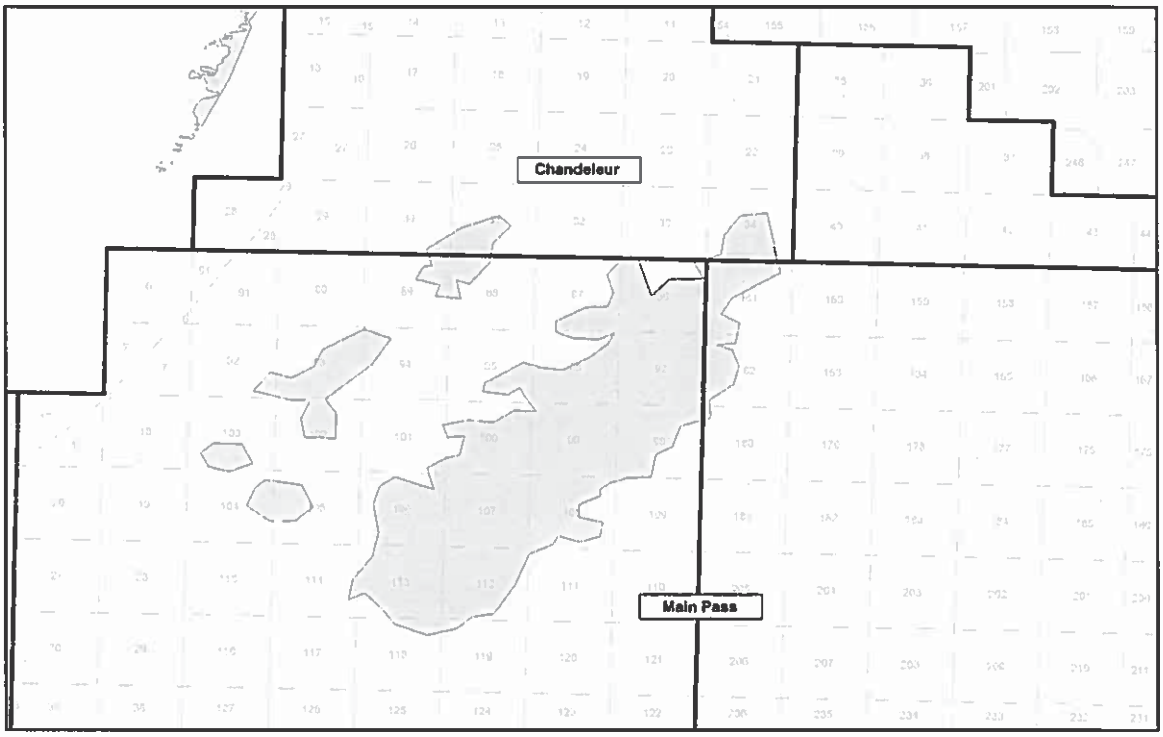

Figure 3. Significant OCS Sand Resource Extraction Zone; St. Bernard Shoals

C.4 SCOPE OF WORK

C.4.1 *Task 1: Conduct Remote-Sensing Sampling Surveys*

The Contractor, in consultation with BOEM archaeologists, will design and conduct high-resolution remote sensing surveys within portions of the Ship Shoal, Sabine Bank, and St. Bernard Shoals Significant OCS Sand Resource Extraction Zones (see Figures 1–3), in order to identify potential shipwreck sites that may be impacted by future sediment removal operations. Portions of each of these zones have been previously surveyed either by the oil and gas industry or for proposed sand and gravel extraction projects. Depending on the location and resource need these previous surveys were conducted at either a 30-meter (m), 50-m, 120-m, or 300-m transect spacing. Copies of the relevant survey reports will be provided to the Contractor.

Survey designs for Task 1 should include a combination of site-specific surveys of potential archaeological resources, refinement of previously collected data sets, and data collection in previously un-surveyed areas. Remote sensing survey instrumentation will include but is not limited to a marine magnetometer, side-scan sonar, sector-scan sonar, and sub-bottom profiler. A maximum transect spacing of 30 m is expected, and precise survey boundaries will be determined, in consultation with BOEM, after contract award. For site specific surveys at potential shipwreck locations, the survey area will extend at least 300 meters from the center point of each site in order to determine the horizontal extent of any associated debris fields. BOEM may provide a Mesotech sector scanning sonar to collect additional sonar imagery from each site.

The combined remote-sensing data acquisition and analysis for Task 1 should comprise a minimum of twenty-five percent of the overall contract effort.

C.4.2 *Task 2: Diver Investigation of Potential Shipwreck Locations*

The Contractor shall analyze the data collected in Task 1 and, in coordination with BOEM, identify up to 10 potential shipwreck sites for diver investigations. The Contractor will then conduct a Phase II archaeological field investigation at each of the selected sites. The fieldwork should be scheduled in a way that provides ample time to collect sufficient data at each of the selected sites, and allows for weather delays and equipment malfunctions. Testing will be performed by marine archaeologists applying a variety of techniques including remote sensing, diving, limited sediment removal and artifact recovery, mapping of site remains, and collection of underwater imagery such as high-resolution digital photographic/video documentation.

Test units may be excavated when necessary as a means to identify intact areas of the site. If necessary, diagnostic artifacts may be collected on a limited basis, and any artifacts collected during the investigation are to undergo conservation and curation in accordance with State of Louisiana protocols. Arrangements for conservation and curation facilities and materials must be made prior to any artifact collection. Other lab analyses such as wood analysis may also be conducted at each site as appropriate. Should the site lie in or near an area where dredging activities have already taken place, an evaluation should be made to quantify any impacts that have occurred to the site.

In addition, site specific investigations will be conducted on at least one potentially significant shipwreck site that was identified during State-mandated emergency-response remote sensing surveys conducted prior to dredging in the Hewes Point, Chandeleur Islands area. These investigations will require coordination with the state of Louisiana but are expected to use the same remote-sensing and diving investigation methods used for sites on the OCS.

Finally, cores and other geotechnical data sets will be acquired and analyzed to characterize sand resources in the vicinity of potential shipwreck sites. Instrumentation should be deployed within each study area to measure short term, near field parameters that can be scaled using longer-term oceanographic and meteorological data sets to refine the understanding of sediment dynamics and dredge pit stability within each OCS and State sand extraction zone.

C.4.3 *Task 3: Historical and Archival Research*

The Contractor shall conduct primary and secondary source archival research for each shipwreck or archaeological site discovered. Significant effort should be made to locate and copy extant photographic images, drawings, paintings, and/or builder's plans of each vessel, if available. Where possible, oral history interviews of surviving passengers and/or crew may be conducted. Research must be directed toward placing each vessel in its historic context and should draw on both primary and secondary sources. Historical data and imagery acquired under this contract must be analyzed in such a way as to identify each site to the extent possible, and establish the vessel's type and date of construction, nationality, ownership (past and present), use history, mission and cargo (if any) at time of loss, and factors contributing toward its loss.

C.4.4 *Task 4: Analysis and Data Interpretation*

The Contractor shall produce a Final Report that presents the assessments of the body of data collected in the archaeological, historical, geological, and physical processes investigations, including descriptions of methods and analyses, interpretations of the analyzed information, and results and discussions of the findings.

In addition to detailing the results of the historical, documentary, and field investigations in the report, the Contractor should address observations on the state of preservation of each site in relation to its depth and analyze the horizontal extent of debris associated with each site for the purpose of developing adequate no-impact zones. Any observed impacts from dredging activity should also be discussed and analyzed. National Register nomination forms for each vessel that the Contractor deems potentially eligible based on criteria established in 36 CFR 60.4, and in consultation with the COR and BOEM Historic Preservation Officer, must be completed and submitted as a separate document for each site along with the Final Report. Sediment and physical processes data should be analyzed and interpreted to produce predictive conceptual models regarding the forces driving sediment dynamics and dredge pit evolution. This report should also provide recommendations for responsible management and protection of any known or potential shipwreck sites within Significant OCS Sand Resource Extraction Zones.

C.4.5 *Task 5: Public Outreach*

To run concurrently with all other tasks, the Contractor shall produce materials that may be used for public outreach purposes and may include but not be limited to the following: web sites, posters, teacher packets, and other informational sources detailing the project's history, scope of work, results, impacts of these types of operations on historic resources, BOEM's role in OCS marine archaeology and marine minerals utilization, and discoveries made that showcase Louisiana and the Gulf of Mexico's rich maritime heritage.

C.5 PROJECT MANAGEMENT

The Contractor shall operate under the negotiated Project Management Plan (PMP). This plan shall include a Project Manager (PM) with sufficient authority to serve as the point of contact with BOEM, and provide leadership to the study team. The PM will ultimately be responsible for all deliveries, budget control, quality assurance for all products, compliance and adherence with schedule of the study, and that all personnel work synergistically and cooperatively for the common goal of the study.

C.6 DATA MANAGEMENT

The Contractor shall be responsible for proper archiving, quality control, and dissemination of any data collected in this study.

C.6.1 Data Administration

The Contractor shall implement a data administration system to ensure continuous evidence of data possession and control with signatures, dates, times, and location of the data being noted. The Contractor shall ensure the proper formatting and reporting of all data and the distribution of data, as required, with the Principal Investigator.

C.6.2 Data Control

Scientific data resulting from photographs shall be processed by the Contractor. The Contractor shall utilize a data inventory control system to monitor study progress, identify gaps in the information acquired, and suggest additional processing requirements. The inventory control procedures shall enable the Contractor to document data availability, data reduction, and data analysis at each reporting period.

C.6.3 Data Utilization

The Contractor shall implement a data management program to ensure that all data are processed, validated, and made available as needed to study participants, and these data must be retrievable, as necessary or desirable, for any future analysis.

The Contractor shall not provide copies of the data, documentation, nor any subsequent revisions prepared during the review process, nor data contained within, nor any portions thereof, to any outside parties prior to final acceptance by BOEM of the Final Report. If a need arises to do so, the Project Manager must obtain the written approval of the CO.

C.6.4 Archiving

The Contractor shall provide a method for the safe storage and easy retrieval of all acquired data and photographs of documents. The Contractor shall ensure that no loss of information occurs in any processing step taking place prior to archiving. The Project Manager (PM) shall inventory the data and verify the presence of any and all necessary documentation prior to archiving. Original data shall be copied as early as possible and original copies shall never be mailed until at least one (1) verified copy has been made. The Contractor shall retain a copy of the information collection logs and all acquired data and materials that were delivered to the BOEM for a period of one (1) year from the contract completion date. Digital image files shall be copied and stored separately from originals.

C.6.5 BOEM Data Archiving Submission

The Contractor shall be responsible for the submission of contract data to BOEM in digital and paper copies according to the schedule in Section F.

C.7 GOVERNMENT FURNISHED PROPERTY, MATERIALS, FACILITIES OR INFORMATION

C.7.1 Government Furnished Property

At its discretion, the Government may provide the use of a Mesotech sector-scanning sonar.

C.7.2 Government Furnished Information

The Government will provide necessary archaeological and hazard survey reports collected in association with BOEM permitted activities on the OCS to the Contractor.

C.8 PROFESSIONAL QUALIFICATIONS STANDARDS

The Contractor must adhere to the professional qualifications standards set forth in the *Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation* (Federal Register 48:190:44716-44742). It is the responsibility of the Contractor to ensure that the designated Principal Investigator (PI) and Key Personnel are in compliance with this requirement.