
Probabilistic Aggregation and Project Definition: A Missed Opportunity

E. Morales and W. John Lee

SPEE Annual Meeting
9-11 June 2013

Underlying Principles

- **SPE-PRMS is a project based system**
- A project can consist of **several fields**
- Probabilistic additions can take place **within a project**
- **Reasonable certainty** is required in proved reserves

So, what are the proved (or P90) reserves of a project?

The arithmetic addition of the P90 (proved) reserves of several fields within a project leads to proved reserves with a much higher level of confidence (depending on the degree of dependency amongst the fields it could be up to 99%). The probabilistic addition of the fields provides a “true” 90% level of confidence for the project’s proved reserves and reflects a more realistic project downside.

How to go about ...

- Start by defining and testing the “project” elements
 - Definitions/Statements (e.g., SPE-PRMS 2007, Chapter 2; SPE Guidelines Nov 2011, chapter 2, SEC January 2009 regulations and Q108.01 in October 26, 2009 SEC C&DI's)
- Apply consistent reserves assessment methodology (probabilistic) to all fields
- Aggregate fields probabilistically
- Do the project's proved reserves properly reflect requirements and regulations (e.g., reasonable certainty, LKH, non-penetrated blocks)?
- What is industry practice?

Example: Is an LNG plant and associated fields and facilities a “project”?

Key issues to consider:

- Type of investment decision covering fields, P/L's and LNG plant (one or several decisions)?
- Where is the point of sales (or transfer point) for the fields ?
- Are the fields operated by a single operator under a single joint operating agreement?
- What are the legal, environmental and social issues applying to the fields?
- What are government fiscal conditions (e.g., tax treatment) ?
- How is commerciality established (e.g., LNG plant alone, facilities and fields fully integrated and economically evaluated, supported by signed contracts to deliver LNG, or by the economics of each field without the rest of the infrastructure)?
- If the project is stopped is there any capital (\$) lost?
- Will the proved reserves (P90) require certification for all (aggregated) fields before signing LNG commitments (SPAs)?

Example: Is an LNG Plant and associated fields and facilities a “project”? (cont'd)

Key issues to consider:

- Are there sub-projects to come on stream at a later stage (e.g., phased field development)?
- How are decisions, operating philosophy, budgeting or optimization measures made (e.g., using integrated production forecasting with and without a planned incremental activity, to assess the benefit (for the project) of such an activity or not)?
- Does the project has a beginning and an end?
- Do individual fields have reserves without the system pipelines and LNG plant ?
- Are there binding sales and purchases agreements (SPAs) signed based on the forecast of the aggregated fields (i.e., LNG project)? Do commitments truly reflect a P90 confidence level?
- How did the fields, LNG plant and related facilities move through the maturation funnel prior to the investment decision being made?

Therefore ...

Considering these and other issues, an LNG plant and its associated producing fields and facilities with common ownership constitute a “project“

Proved reserves (probabilistically estimated) can be aggregated and reported probabilistically for the fields within this “project”, as allowed by SPE definitions and related regulatory requirements

However;

- A compelling case must exist including:
 - Making sure all “project” requirements are met (e.g., transfer point, fiscal issues, ring fencing, project definition, SEC project requirements as specified in Oct 26, 2009 guidance)
 - Systematic evaluation approach for each field within the project using consistent probabilistic approaches for each field
 - Compliance (e.g., LKH)
 - Clear assessment of dependencies between fields with proper independent expert opinion
 - Proper documentation and audit trail

Industry Practice

IT VARIES.....

Most companies estimate and externally report the proved reserves of LNG Projects (and other projects) by arithmetically adding the P90s (or proved reserves) of the individual fields within the project.

Is this a true reflection of the “Project” proved reserves with “reasonable certainty”? Does it truly reflect the “Project” P90 estimate ?. Are investors and shareholders capturing the real LNG marketing opportunities of the “Project” based on its proved reserves?

Some companies properly disclose a “true” P90 for the project proved reserves by probabilistically estimating the “project” proved reserves (i.e., 1P), e.g.:

1) Since 2001 BHP has externally disclosed (in their 20-F) probabilistic addition of fields in the proved reserves associated with the Northwest Shelf LNG Project (Australia). Comment letters on this issue were exchanged between BHP and the SEC in 2002 and 2007.

2) Woodside externally discloses probabilistic addition of fields within the Northwest Shelf LNG project in their annual reports (meeting ASX requirements).

Probabilistic addition within a project has been certified (as compliant) by consulting firms

Some countries add (and report) their reserves probabilistically to better represent and understand their portfolios, potential security of supply, downsides and ability to meet commitments based on proved reserves

ISSUES

- Fields must have a consistent and common approach (probabilistic)
- SEC regulations refer to probabilistic aggregation within a project in main text (page 2172) of the January 2009 Modernization of Oil and Gas Reporting (Final Rule) but not in page 2194, Subpart 229.1202 (Item 1202) (3) of this document. An oversight?
- BHP and the SEC exchanged Comment Letters in 2003 and 2007 regarding this issue. Text used by BHP in their 20-F allegedly was provided by the SEC to BHP in 2002.
- Requires more work than arithmetic aggregation and a good understanding of probabilistic issues
- Must follow standards and be compliant with applicable regulations
- Arithmetic aggregation is clearly understood, probabilistic not quite
- Can be applied to other projects with proper care, attention and compliance

A Paper on this subject will be published and presented by E. Morales and J. Lee at the ATCE 2013 in New Orleans (Sept 30-Oct 2, 2013)

What about other types of “projects”?

- Offshore development of several fields with common ownership and one central processing facility and sales point?
- Gas projects with one contractual (GSA) commitment sourced by several fields sharing facilities and having a common sales point?

Further work and clarification in this area would benefit the industry

Ensuring proper transparency and compliance with standards (SPE) and regulatory requirements is key

Probabilistic Aggregation and Project Definition: A Missed Opportunity

End

BACKUP SLIDES

Probabilistic Aggregation and Project Definition: A Missed Opportunity

E. Morales and W. John Lee

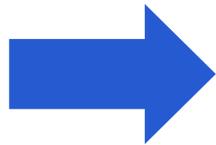
SPEE Annual Meeting
9-11 June 2013

Probabilistic addition- When can we do it?

- SPE-PRMS wording:

“The aggregation methods utilized depend on the business purpose. It is recommended that for reporting purposes, **assessment results should not incorporate statistical aggregation beyond the field, property, or project level**”.

“In statistical aggregation, except in the rare situation when all the reservoirs being aggregated are totally dependent, the P90 (high degree of certainty) quantities from the (*probabilistic*) aggregate are always greater than the arithmetic sum of the reservoir level P90 quantities”



Probabilistic additions can take place **within a project**

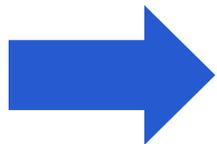
Probabilistic Addition- When can it be done?

- SEC wording (page 2172)

“Regardless of whether the reserves were determined using deterministic or probabilistic methods, the reported reserves should be simple arithmetic sums of all estimates at the well, reservoir, property, field, **or project level** within each reserves category”.

“*Reasonable certainty.* If deterministic methods are used, reasonable certainty means a high degree of confidence that the quantities will be recovered. If probabilistic methods are used, **there should be at least a 90% probability** that the quantities actually recovered will equal or exceed the estimate”.

Author’s note: Arithmetic addition of several P90 reserves estimates , within a reservoir, property, field, or project, will result in a higher (than P90) degree of confidence. Depending on the degree of dependencies of the added elements , this arithmetic addition may be as high as P99 ,which would not reflect the required Reasonable Certainty for the Proved reserves of the reservoir, property, field, or project.



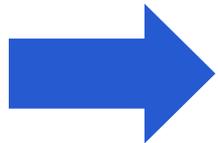
Probabilistic additions can take place within a project but what about text on page 2194?

What is a “Project” - Definitions/Statements (SPE-PRMS)

Project (SPE-PRMS): “ Represents the link between the petroleum accumulation and **the decision making process, including budget allocation**. A project may, for example, constitute the development of a single reservoir or field, or an incremental development in a producing field, **or the integrated development of a group of several fields and associated facilities with a common ownership**. In general, an individual project will represent a specific maturity level at which a decision is made on whether or not to proceed (i.e., spend money), and there should be an associated range of estimated recoverable resources for that project ” .

“RESERVES are those quantities of petroleum anticipated to be **commercially recoverable by application of development projects to known accumulations** from a given date forward under defined conditions. Reserves must further satisfy four criteria: they must be discovered, recoverable, commercial, and remaining (as of the evaluation date) **based on the development project(s) applied”**.

“While each organization may define specific investment criteria, **a project is generally considered to be “economic” if its “best estimate” case has a positive net present value under the organization’s standard discount rate, or if at least has a positive undiscounted cash flow”**.



A Project can consist of several fields

Chapter 2 of the November 2011 Applications Document provides further and good guidance on Project issues

Note: “Project” is mentioned some 340 times in the 2007 SPE-Petroleum Resource Management System and constitutes the core of the SPE-PRMS

What is a “Project” - Definitions/Statements (SEC)

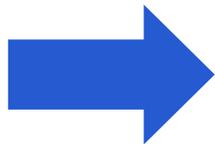
“ *Development project.*: A development project is the **means by which petroleum resources are brought to the status of economically producible**. As examples, the development of a single reservoir or field, an incremental development in a producing field, **or the integrated development of a group of several fields and associated facilities with a common ownership** may constitute a development project ”.

“ We initially adopted our oil and gas disclosure requirements in 1978 and 1982. Since that time, there have been significant changes in the oil and gas industry and markets, including technological advances, **and changes in the types of projects in which oil and gas companies invest their capital**”.

“:*Reserves.*: Reserves are estimated remaining quantities of oil and gas and related substances anticipated to be economically producible, as of a given date, **by application of development projects to known accumulations**”.

However, page 2194 of the Federal Register (14/1/2009) quotes: “.... When probabilistic methods are used, reserves should not be aggregated probabilistically beyond the field or property level; instead they should be aggregated by simply arithmetic summation” (note that project is missing). This seems misaligned with statement on page 2172, where reserves at project level are referred to.

Note: “Project” is mentioned 46 times in the Federal Register, Modernization of Oil and Gas Reporting. Final rule of January 14, 2009



A Project can consist of several fields

What is a “Project” - Definitions/Statements (SEC)

Question 108.01

Question: For an issuer that intends to develop a large field involving the drilling of numerous wells in multiple stages, what constitutes a **development project**?

Answer: A development project is typically a single engineering activity with a **distinct beginning and end**, which, **when completed, results in the production, processing or transportation of crude oil or natural gas**. A project typically **has a definite cost estimate, time schedule and investment decision; is approved for funding by management; may include all classifications of reserves; and will be fully operational after the completion of the initial construction or development**. The scope and scale of a project are such that, **if a project were terminated before completion, for whatever reason, a significant portion of the previously invested capital would be lost**.

If an investment decision has been made to develop only a portion of the primary, secondary or tertiary reserves, the remainder of the reserves would not be considered to be proved reserves until such time as management has made an investment decision to develop those additional reserves, the requisite level of certainty has been demonstrated from the initial portion of the development or by other means, and the additional development is within five years of being initiated. [Oct. 26, 2009]

Available Literature

- Several SPE papers have been written on probabilistic addition of reserves within a Project:
 - Carter & Morales – SPE 50113 (1998)
 - Van Elk, Vijayan & Gupta- SPE 64454 (2000)
 - Delfiner & Barrier- SPE 90129 (2004)
 - Van Elk, Gupta & Wann- SPE 116395 (2008)
 - Morales & Lee- ATCE 2013 paper