



RYDER SCOTT COMPANY
PETROLEUM CONSULTANTS

Houston
Denver
Calgary



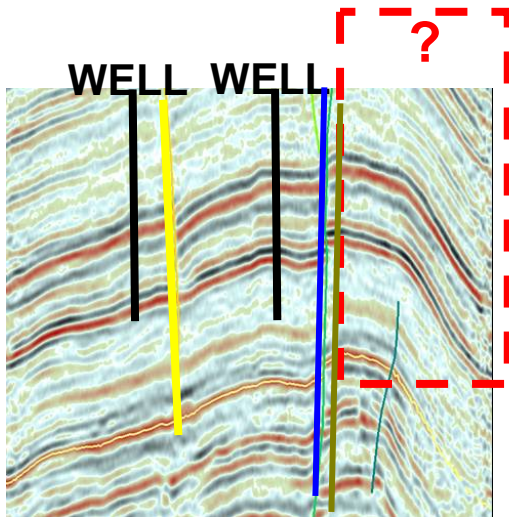
2010 Ryder Scott Reserves Conference
“Evaluation Challenges in a Changing World”

Reserves or Resources

“What Do You Have If You Don’t Have a Well Penetration”

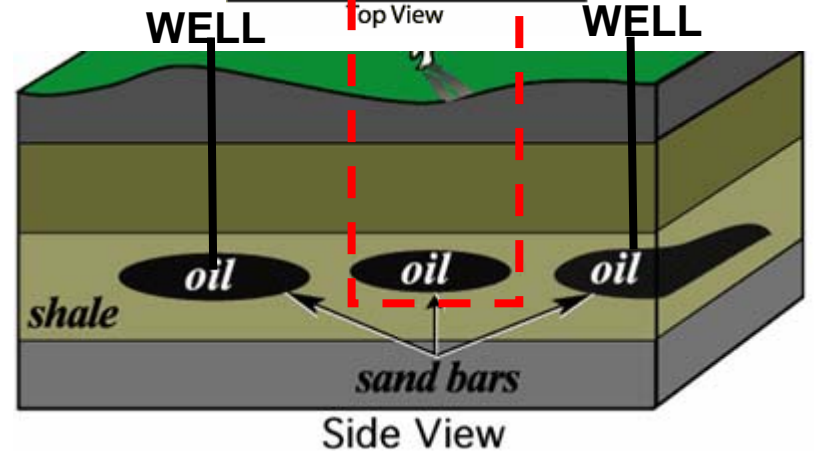
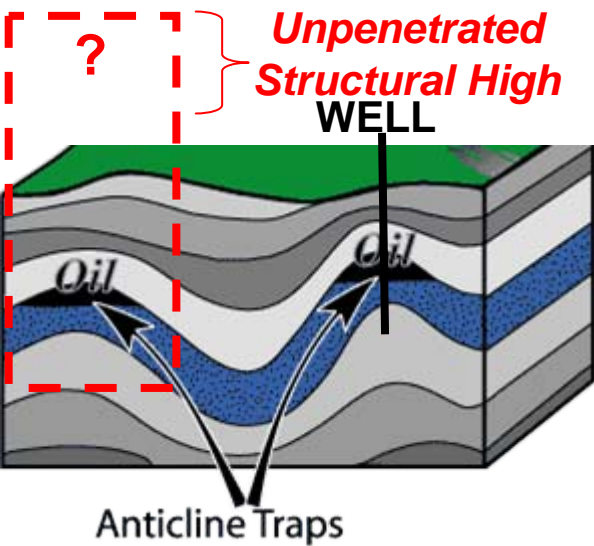
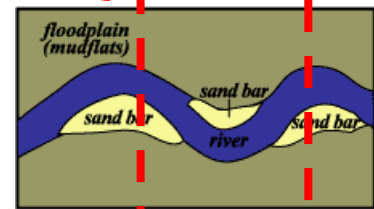
John Hodgins – President, Ryder Scott Company

What Do You Have If You Don't Have A Well Penetration?



*Unpenetrated
Fault Block*

*Unpenetrated
Stratigraphic Lobe*



Deciding On A Classification, Reserves or Prospective Resources



This presentation will review the criteria to consider when deciding on a classification for unpenetrated fault blocks. The same criteria may apply to other unpenetrated features.

Presentation Outline



- SEC Criteria
 - Key Elements
 - Pertinent Guidance
- SPE-PRMS Criteria
 - Key Elements
 - Pertinent Definitions for Review
- Interpretative Guidance
 - Basis for Assigning Reserves to Unpenetrated Fault Blocks
 - Across Minor, Non-Sealing Faults
 - Across Major, Potentially Sealing Faults
 - Exceptions to Mandatory Conditions
- Backup Slides
 - SEC and SPE-PRMS Pertinent Definitions & Guidance

Recap of SEC Criteria for Assigning Reserves Across Small or Non-Sealing Faults



Key Elements for SEC:

- 1. Discovery Status-Known Accumulation**
- 2. Economic Producibility-Reservoir Quality, Quantity**
- 3. Proximity-Directly Adjacent Portions of Reservoir Within the Same Accumulation**
- 4. Juxtaposition-Fault Displacement Less Than Formation Thickness**
- 5. Hydraulically Connected-Pressure Communication With the Known Proved Reservoir**

Section 117: Rules 4-10(a)(17) and 4-10(a)(18) Definitions -Possible Reserves; Probable Reserves

Question 117.02: *Can an issuer assign probable or possible reserves in an area in which it does not, or cannot, assign proved reserves?*

Answer: *Yes. However, disclosure of unproved reserves without associated proved reserves should be done only in exceptional cases ... Reserves should not be assigned without well penetration of the subject reservoir (rock volume) in the contiguous area that yields technical information sufficient to support the attributed reserve category.*

***Section 117: Rules 4-10(a)(17) and 4-10(a)(18)
Definitions -Possible Reserves; Probable Reserves***

Question 117.04: Can an issuer assign probable or possible reserves to an unpenetrated fault block?

Answer: No. Un-penetrated, **pressure-separated fault blocks** should not be considered to contain reserves of any category until penetrated by a well.

Key Elements for SEC:

1. Un-penetrated, **pressure-separated fault blocks** should not be considered to contain reserves of any category until penetrated by a well

We'll revisit this after we review the SPE-PRMS guidance.

Key Elements for SPE-PRMS:

(Essentially the same criteria as for the SEC)

1. Discovery Status-Known Accumulation
2. **Commercially Recoverable**-Reservoir Quality, Quantity
3. Proximity-Directly Adjacent Portions of Reservoir Within the Same Accumulation
4. Juxtaposition-Fault Displacement Less Than Formation Thickness
5. Connected-In Communication With The Known Proved Reservoir

Key Elements for SPE-PRMS:

- 1. Juxtaposition-Fault displacement by major, potentially sealing faults with caution and justification clearly documented**

We'll revisit this after we review the SPE-PRMS guidance.

SPE-PRMS Pertinent Guidance from Table 1: Recoverable Resources Classes



Reserves:

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 satisfy four criteria: they **must be discovered**, recoverable, commercial, and remaining based on the development project(s) applied.

Prospective Resources:

Those quantities of petroleum which are estimated, as of a given date, to be **potentially recoverable** from **undiscovered accumulations**.

Accumulation:

*An **individual body** of naturally occurring petroleum in a reservoir.*

Known Accumulation:

*An accumulation is an individual body of petroleum-in-place. **The key requirement to consider an accumulation as “known,”** and hence containing Reserves or Contingent Resources, is that it **must have been discovered, that is, penetrated by a well** that has established through testing, sampling, or logging the existence of a significant quantity of recoverable hydrocarbons.*

Penetration:

The intersection of a wellbore with a reservoir.

Discussion of the Considerations to Assign Reserves to Unpenetrated Fault Blocks



- Both the SEC and SPE-PRMS fundamentally treat probable and possible reserves as extensions of the established proved area and proved reserves.
- Both the SEC and SPE-PRMS state that probable (2P) and/or possible (3P) reserves may be assigned to areas of a reservoir adjacent to proved where data control or interpretations of available data are less certain and the interpreted reservoir continuity may not meet the reasonable certainty criteria necessary for the attribution of proved reserves.
- Both the SEC and SPE-PRMS go on to further note that in addition to being in direct proximity (adjacent), the evaluator must demonstrate that the adjacent areas are part of a common known/discovered reservoir. This demonstration is consistent with the premise that the probable (2P) and possible (3P) reserves are extensions of the established proved area.
- To demonstrate communication, the evaluator must make a compelling case that the unpenetrated area is in communication with the adjacent area with established reserves and hence is an extension of a common known/discovered reservoir.
- Both the SEC and SPE-PRMS state that the adjacent portions must be interpreted to be in communication with the known (proved) reservoir.

Key Considerations for Assigning Reserves to Unpenetrated Fault Blocks



Key Consideration to Assign Reserves to Unpenetrated Fault Blocks:

1. Establish a compelling case that the unpenetrated fault block is in communication under current conditions with the adjacent fault block that contains established (proved) reserves and hence is an extension of a common known/discovered accumulation (common reservoir)

Mandatory Conditions for the Assignment of Reserves to Unpenetrated Fault Blocks:

1. Proximity: adjacent to fault block with established reserves
2. Juxtaposition: fault displacement less than formation thickness
3. Communication: non-sealing transmissible fault
4. Economic Producibility: similar reservoir quality to adjacent fault block with established reserves and sufficient volume to establish economic producibility
5. Analogs: to establish fault transmissibility, correlation to seismic amplitude or seismic inversion volume to establish hydrocarbon presence and potential reservoir thickness and/or reservoir quality and economic producibility

Mandatory Conditions for Assigning Reserves to Unpenetrated Fault Blocks



1. Proximity

- **Mandatory requirement, but must meet additional requirements noted below**
- Directly adjacent but separated from a fault segment with an existing well penetration and/or with reserves
 - Reserves may be proved, probable or possible but strongest case is to be adjacent to fault block with proved reserves

Mandatory Conditions for Assigning Reserves to Unpenetrated Fault Blocks



2. Juxtaposition

- **Mandatory requirement, but must meet additional requirements as noted regarding displacement and as noted below for communication and economic producibility**
- **Must demonstrate a common hydrocarbon column across both sides of the fault**
 - Fault displacement & transmissibility
- ❖ **Less than the formation thickness and fault is non-sealing (transmissible)**
 - Consideration for probable or possible reserves in unpenetrated fault block under SEC guidance, if can demonstrate fault is non-sealing (transmissible)

Mandatory Conditions for Assigning Reserves to Unpenetrated Fault Blocks



2. Juxtaposition Continued

- ❖ **Greater than the formation thickness or sealing faults where displacement is less than the formation thickness**
 - If the fault is major (greater than the formation thickness and has no juxtaposition to another adjacent reservoir with established reserves) or if the fault (displacement less than the formation thickness) cannot be demonstrated to be non-sealing, SEC guidance clearly states that no reserves of any category should be assigned as such areas contain potentially recoverable resources from an undiscovered accumulation and should be classified as prospective resources.

Mandatory Conditions for Assigning Reserves to Unpenetrated Fault Blocks



2. Juxtaposition Continued

- ❖ **Greater than the formation thickness or sealing faults where displacement is less than the formation thickness**
 - If the fault is major (greater than the formation thickness and has no juxtaposition to another adjacent reservoir with established reserves) or if the fault (displacement less than the formation thickness) cannot be demonstrated to be non-sealing, SPE-PRMS guidance states that caution should be exercised in assigning reserves to the unpenetrated fault block.
 - The key element to the SPE-PRMS guidance is the clear demonstration that there is communication between the unpenetrated fault block and a reservoir with established reserves in the adjacent fault block. This is necessary to demonstrate that there is a common hydrocarbon column across both sides of the fault and that the unpenetrated reservoir is part of the known accumulation.
 - A case would have to be made for communication and might give consideration to such circumstances as fluid flow up the fault plane, post migration fault movement to create the current observed separation between the reservoir on each side of the fault or a non-conventional reservoir where faults are not considered to segment the overall accumulation from a broader regional sense.

Mandatory Conditions for Assigning Reserves to Unpenetrated Fault Blocks



3. Communication

- **Mandatory requirement, but must meet additional requirements as noted regarding displacement and as noted below for economic producibility**
- **Must demonstrate a common hydrocarbon column across both sides of the fault**
 - Adjacent portions are in communication (SEC specifically states must demonstrate there is pressure communication, i.e. fault is non-sealing and transmissible) across the fault
- ❖ **Non-sealing (transmissible) faults**
 - Regardless of the magnitude of fault displacement, the evaluator must clearly demonstrate and support that the fault is non-sealing and transmissible to assign reserves to the unpenetrated fault segment under either SEC or SPE-PRMS guidance

Mandatory Conditions for Assigning Reserves to Unpenetrated Fault Blocks



3. Communication Continued

❖ Major or potentially sealing faults

- Major and/or sealing faults which cannot be demonstrated to be transmissible or in (pressure) communication with an adjacent known reservoir with established reserves result in a separation of the common hydrocarbon column with unpenetrated fault block and should not be considered to have reserves of any category by the evaluator for SEC bookings
- For conventional reservoirs, consideration may be given under SPE-PRMS guidance to the timing on fault movement relative to hydrocarbon emplacement. If a case can be made that there is communication up the fault plane or there was a common reservoir with communication across the fault in the geological past, then consideration may be given to the assignment of reserves to the unpenetrated fault block.

Mandatory Conditions for Assigning Reserves to Unpenetrated Fault Blocks



3. Communication Continued

❖ Major or potentially sealing faults

- Guidance considered by RSC previously indicated consideration may be given to booking reserves across major, potentially sealing faults in unconventional reservoirs such as coal seams and shale gas on an exception basis. Under these circumstances, crossing a fault may not decrease the likelihood of the presence of hydrocarbons as they were formed in-place rather than emplaced via migration. The nature of these type reservoirs may not allow a clear demonstration of reservoir communication beyond the lateral distances indicated by the drainage spacing area of a well.

Mandatory Conditions for Assigning Reserves to Unpenetrated Fault Blocks



4. Economic Producibility

- **Mandatory requirement, but must meet additional requirements as noted regarding displacement and as noted above for communication**
 - Similar (in the aggregate and no more favorable in the fault segment with an existing well penetration) reservoir quality to adjacent penetrated fault segment and
 - Sufficient reserve volume to establish economic producibility

Mandatory Conditions for Assigning Reserves to Unpenetrated Fault Blocks



5. Analogs

- **Mandatory requirement to demonstrate fault transmissibility and to support economic producibility in the unpenetrated fault block**
 - Guidance from both SEC and SPE-PRMS indicate that 2P and 3P or in this case Pb and Ps reserves must be based on reasonable alternative technical and commercial interpretations within the reservoir that are clearly documented, including comparison to results in successful similar projects
 - SEC guidance indicates that unproved reserves without associated proved reserves (in the same fault block) should be done only in exceptional cases

Probable and Possible Reserves:

Caution should be exercised in assigning Reserves to **adjacent reservoirs isolated by major, potentially sealing, faults until this reservoir is penetrated and evaluated as commercially productive. **Justification for assigning Reserves in such cases should be clearly documented.****

Reserves should not be assigned to areas that are clearly separated from a known accumulation by non-productive reservoir (i.e., absence of reservoir, structurally low reservoir, or negative test results); such areas may contain Prospective Resources.

- Author's Comment-Intervening separation by non-productive reservoir precludes the mandatory condition for a common hydrocarbon column with communication between reservoir segments. Assigning reserves in these situations would be deemed an exception to the mandatory conditions as previously noted.

SPE-PRMS Resources Classification System: Criteria for Classification of Reserves and Prospective Resources

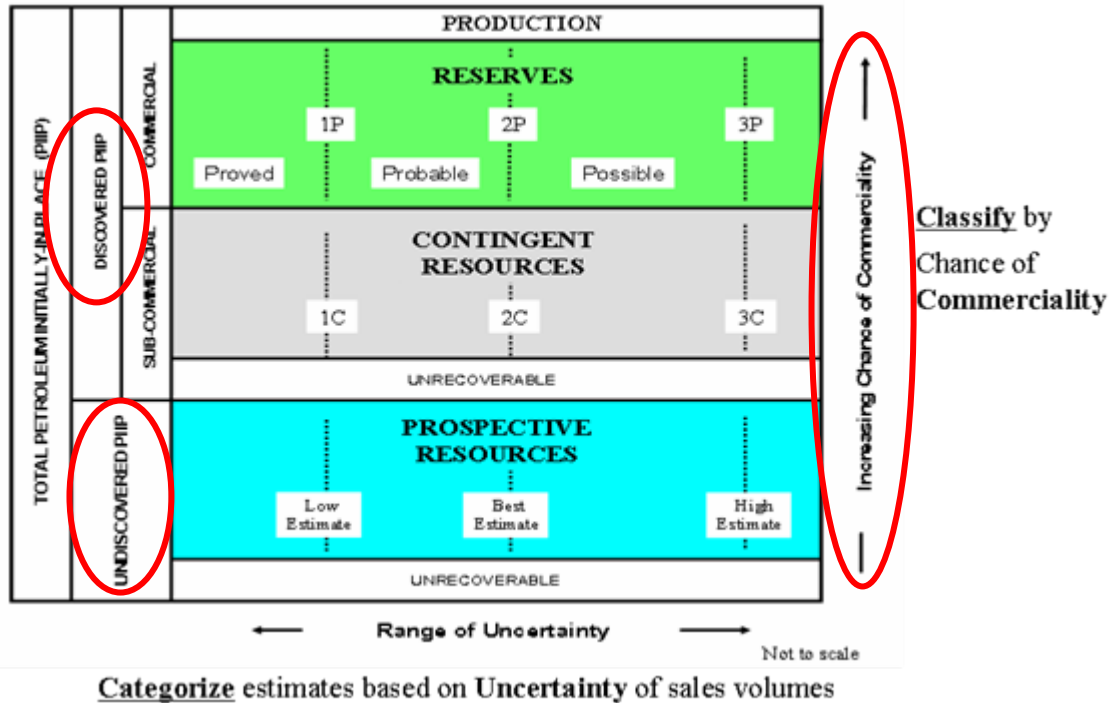


Key Elements:

1. Chance/Risk of Discovery
2. Chance/Risk of Development

SPE-PRMS Appendix A:

Chance-Used to describe the probability of a discrete event occurring.



SPE-PRMS Resources Classification System: Criteria for Classification of Reserves and Prospective Resources



Key Elements:

1. Chance/Risk of Discovery
2. Chance/Risk of Development

Based on SPE-PRMS Section 2.1.3

- Technical Risk-The chance that the potential accumulation will result in the discovery of petroleum, referred to as the “chance of discovery.”
- Commercial Risk-Once discovered, the chance that the accumulation will be commercially developed, referred to as the “chance of development.”

Reserves:

Have no appreciable commercial risk or technical risk (100% chance of discovery).

Contingent Resources:

Have only commercial risk and no technical risk (100% chance of discovery).

Prospective Resources:

Can have both commercial risk (chance of development) and technical risk (chance of discovery).

(3). Range of Uncertainty in Recoverable Volumes

- The range of uncertainty in the recoverable volumes would be handled through the categorization process: P1, P2, P3 or C1, C2, C3.

SPE-PRMS Resources Classification System: Criteria for Classification of Reserves and Prospective Resources



Key Elements:

1. Chance/Risk of Discovery
2. Chance/Risk of Development



Questions: If the evaluator can make a compelling case there is no appreciable technical risk for the chance of discovery or commercial risk for the chance of development, why wouldn't these volumes be classified as reserves, even if such volumes were for an unpenetrated fault block ?

Can a compelling case be based on statistical data that verify a 100% chance of discovery and subsequent development of commercial volumes?

What if the statistical data is based on a long standing track record from a significant sample population?

SPE-PRMS Resources Classification System: Criteria for Classification of Reserves and Prospective Resources



Can an evaluator “justify” a case for a reserves classification based on the foregoing application of statistical analysis?

1. Does the data unequivocally support the lack of appreciable technical or commercial risk?
2. If so, then the classification of reserves may be justified. The author is of the opinion that such cases will be rare and require substantial data to develop a compelling case.

SPE-PRMS Table 3: Reserves Category Definitions

Probable and Possible Reserves:

Caution should be exercised in assigning Reserves to *adjacent reservoirs isolated by major, potentially sealing, faults* until this reservoir is penetrated and evaluated as commercially productive. Justification for assigning Reserves in such cases should be clearly documented.

Probable and Possible Reserves:

Although not explicitly addressed in the SPE-PRMS, there may be a compelling case for an exception to assigning reserves across a major, potentially sealing fault if the evaluator can support the argument there was communication and a common hydrocarbon column across the fault in geological time rather than being limited to current conditions.

Recap of SEC Criteria for Assigning Reserves Across Major or Potentially Sealing Faults



Key Elements for SEC:

1. Un-penetrated, **pressure-separated fault blocks** should not be considered to contain reserves of any category until penetrated by a well

We'll revisit this after we review the SPE-PRMS guidance.

Can we utilize a statistical analysis approach as previously described to assign SEC reserves across major, potentially sealing faults?

Section 131: Rules 4-10(a)(31)

Definitions –Undeveloped Oil and Gas Reserves

Question 131.02: *Does the standard, "reasonable certainty of economic producibility," in the definition of "undeveloped oil and gas reserves" mean that a registrant cannot assign probable or possible undeveloped reserves beyond areas containing proved undeveloped reserves?*

Answer: No. *Reliable technology can be used* to establish (1) that probable reserves in undeveloped locations are as likely as not and (2) that possible reserves in undeveloped locations are possible but not likely.

SEC Pertinent Guidance from Regulation 210.4-10(a) Definitions



(25) Reliable Technology.

Reliable technology is a grouping of one or more technologies (including computational methods) that has been field tested and has been demonstrated to provide reasonably certain results with consistency and repeatability in the formation being evaluated or in an analogous formation.

- Author's Comment-Applying a statistical method (computation method as referenced) to support the assignment of SEC reserves across a major, potentially sealing fault, would be deemed as a major exception and should be utilized with extreme caution. Consideration should be given to requesting a pre-booking opinion directly for the SEC staff if the proposed reserve volumes are material.

Disclaimer and Request for Your Comments?



The comments expressed in this presentation are informed opinions of the author and should not be construed to represent the position of the Society of Petroleum Engineers or the Society of Petroleum Engineers Oil and Gas Reserves Committee. Comments regarding U.S. SEC reserves reporting regulations may not be identical to advice to be obtained from the SEC. As with any set of reserve definitions, the applicability of the guidance should be considered on a case by case basis.





2010 Ryder Scott Reserves Conference “Evaluation Challenges in a Changing World”

Reserves or Resources

“What Do You Have If You Don’t Have a Well Penetration”

John Hodgin – President, Ryder Scott Company

SEC Pertinent Guidance from Regulation 210.4-10(a) Definitions



(17) Possible reserves.

- (v) Possible reserves may be assigned where geoscience and engineering data identify **directly adjacent portions of a reservoir within the same accumulation** that may be separated from **proved areas by faults with displacement less than formation thickness or other geological discontinuities** and that have not been penetrated by a wellbore, and the **registrant believes that such adjacent portions are in communication with the known (proved) reservoir**. Possible reserves may be assigned to areas that are structurally higher or lower than the proved area **if these areas are in communication with the proved reservoir.**
- (iv) The **proved plus probable** and **proved plus probable plus possible** reserves estimates **must be based on reasonable alternative technical and commercial interpretations within the reservoir or subject project that are clearly documented, including comparisons to results in successful similar projects.**

SEC Pertinent Guidance from Regulation 210.4-10(a) Definitions



(26) 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**. ...*

Note to paragraph (a)(26): Reserves should not be assigned to adjacent reservoirs isolated by major, potentially sealing, faults until those reservoirs are penetrated and evaluated as economically producible. ... Such areas may contain prospective resources (i.e., potentially recoverable resources from undiscovered accumulations).

SPE-PRMS Pertinent Guidance from Table 3: Reserves Category Definitions



Probable and Possible Reserves:

Probable and Possible Reserves:

In conventional accumulations, Probable and/or Possible Reserves may be assigned where geoscience and engineering data identify **directly adjacent portions of a reservoir within the same accumulation that may be separated from Proved areas by minor faulting or other geological discontinuities** and have not been penetrated by a wellbore but are **interpreted to be in communication with the known (Proved) reservoir**. Probable or Possible Reserves may be assigned to areas that are structurally higher than the Proved area. Possible (and in some cases, Probable) Reserves may be assigned to areas that are structurally lower than the adjacent Proved or 2P area.

Caution should be exercised in assigning Reserves to **adjacent reservoirs isolated by major, potentially sealing, faults** until this reservoir is penetrated and evaluated as commercially productive. **Justification for assigning Reserves in such cases should be clearly documented**. Reserves should not be assigned to areas that are clearly separated from a known accumulation by non-productive reservoir (i.e., absence of reservoir, structurally low reservoir, or negative test results); such areas may contain Prospective Resources.

The **2P** and **3P** estimates may be based on reasonable alternative technical and commercial interpretations within the reservoir and/or subject project that are **clearly documented, including comparisons to results in successful similar projects**.