Navigating the Changing World of Reserves and Resources in the Context of the PRMS

20 - 21 AUGUST 2024 | BRISBANE, AUSTRALIA

Prospective Resources and Contingent Resources

Greg Horton

Greg Horton Petroleum Engineer

Collaborators Barbara Pribyl, Paul Lyford, Greg Horton, Doug Peacock

The presentation material is the view of the collaborators in general, but not necessarily in detail, and not necessarily the view of their employer or SPE. The material is provided to promote discussion amongst the workshop attendees on better understanding of PRMS.

Note: The presentation addresses the AG22 errata and points out areas PRMS 2018 can be improved

Topics

- Issues
- Examples that raise the issues
- Pc, Pg, Pd – PRMS Framework
- Principles of Prospective Resources per PRMS
- Issues 1 & 2 answered by AG22 errata
- Issue 3 – Pg and Pd?
  - Pg
  - Pd
  - PRs via Untruncated vs Truncated Distributions
- Issue 4 – PRMS 1.2.0.4?
- Issue 5 – Are PRs and CRs TRRs?
- Answers
- Conclusions
- Questions

Issues (some of…!)

(1) What is presented for the Low, Best and High estimates of recoverable resources for a project per PRMS 2018?

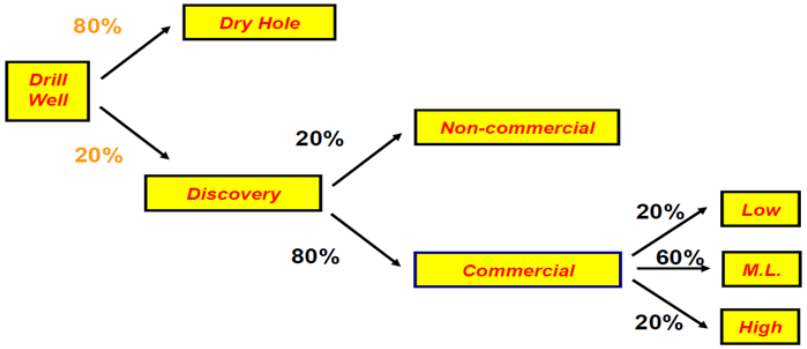
(2) Is it the same for each class?

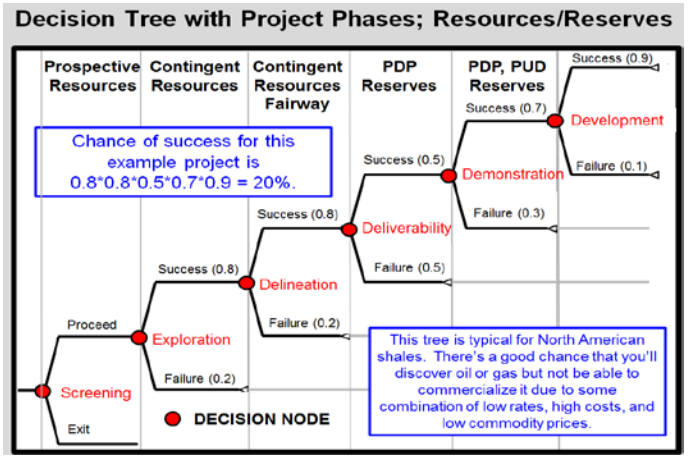
(3) What about the corresponding Pg (Chance of Geologic Discovery) and (Chance of Development) Pd?

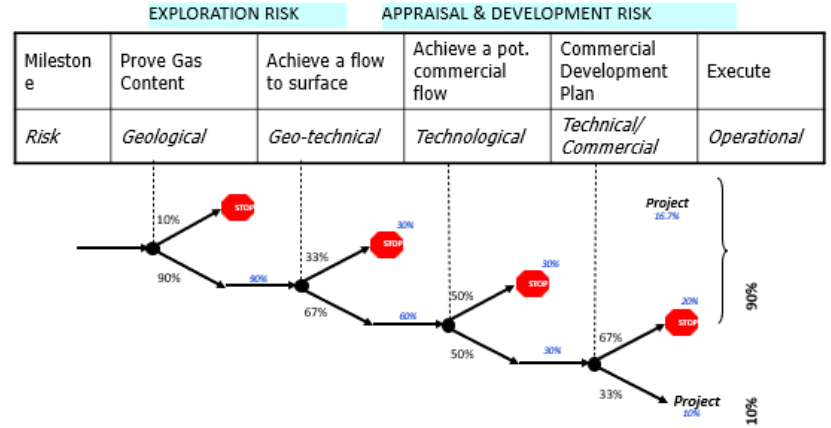
(4) What about the truncations to be done per 1.2.0.4?

(5) Are Prospective Resources (PRs) and Contingent Resources (CRs) Technically Recoverable Resources (TRRs)?

Examples that raise the issues







Pc, Pg, Pd – PRMS Framework

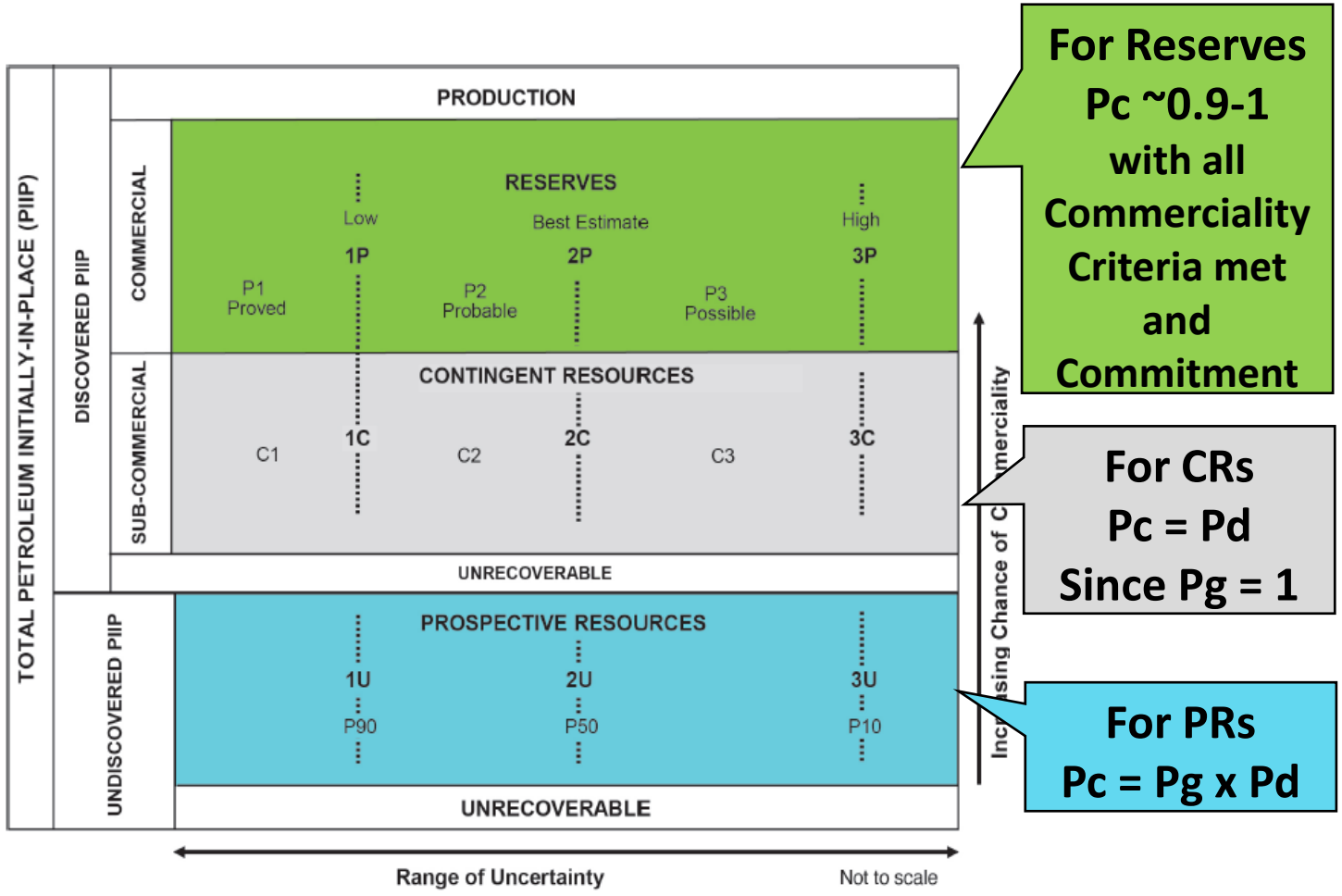


Figure 1.1—Resources classification framework

For Reserves
Pc ~0.9-1
with all Commerciality Criteria met and Commitment

For CRs
Pc = Pd
Since Pg = 1

For PRs
Pc = Pg x Pd

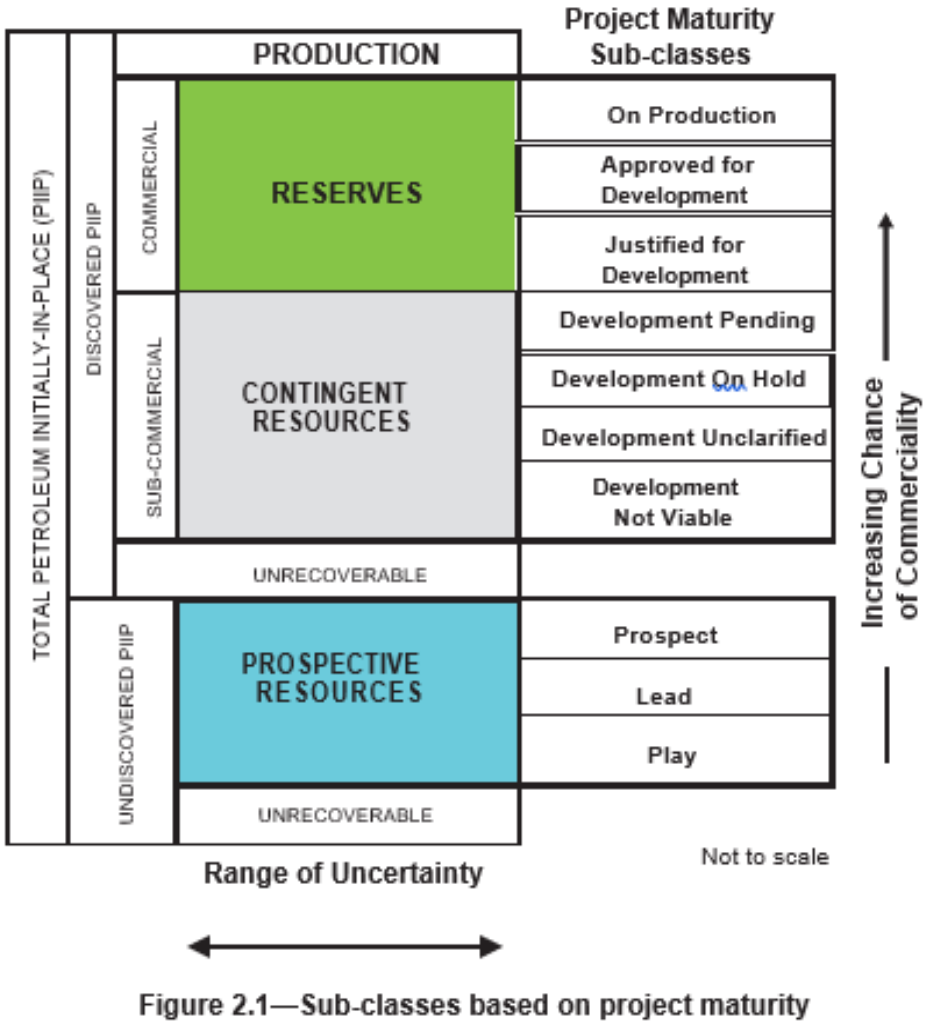
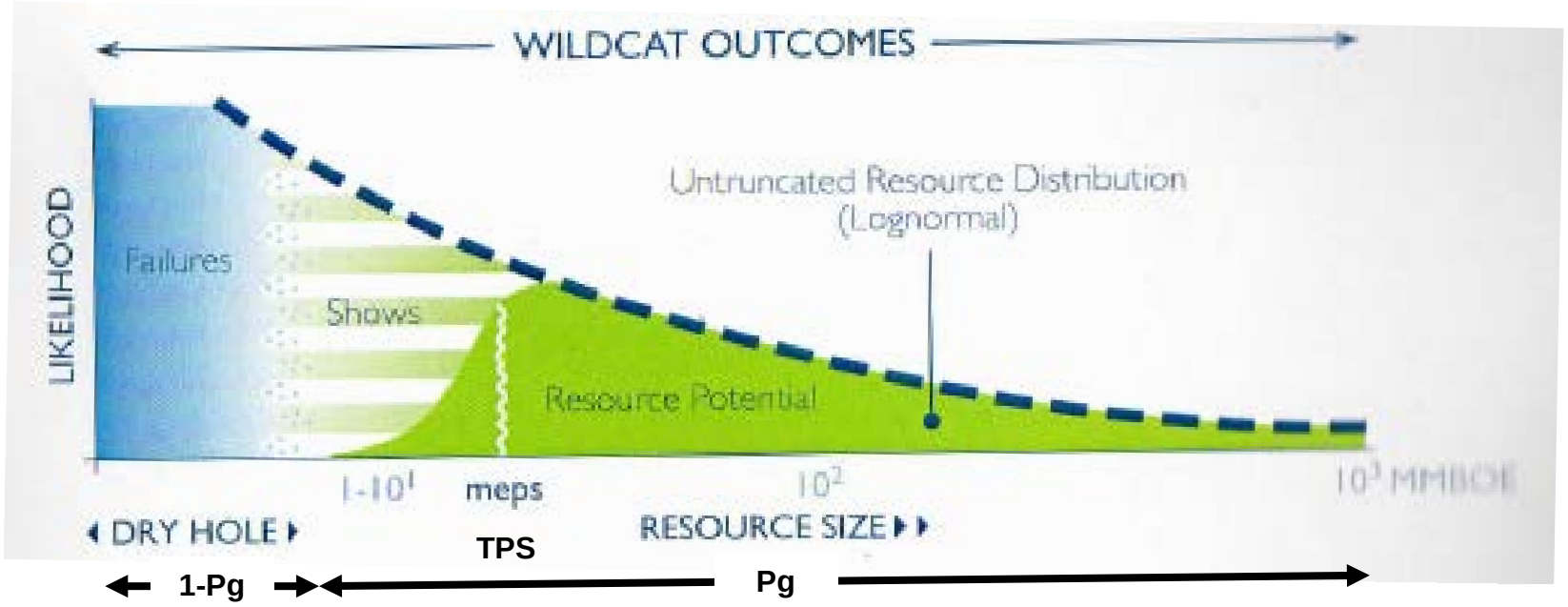


Figure 2.1—Sub-classes based on project maturity

Principles of Prospective Resources per PRMS

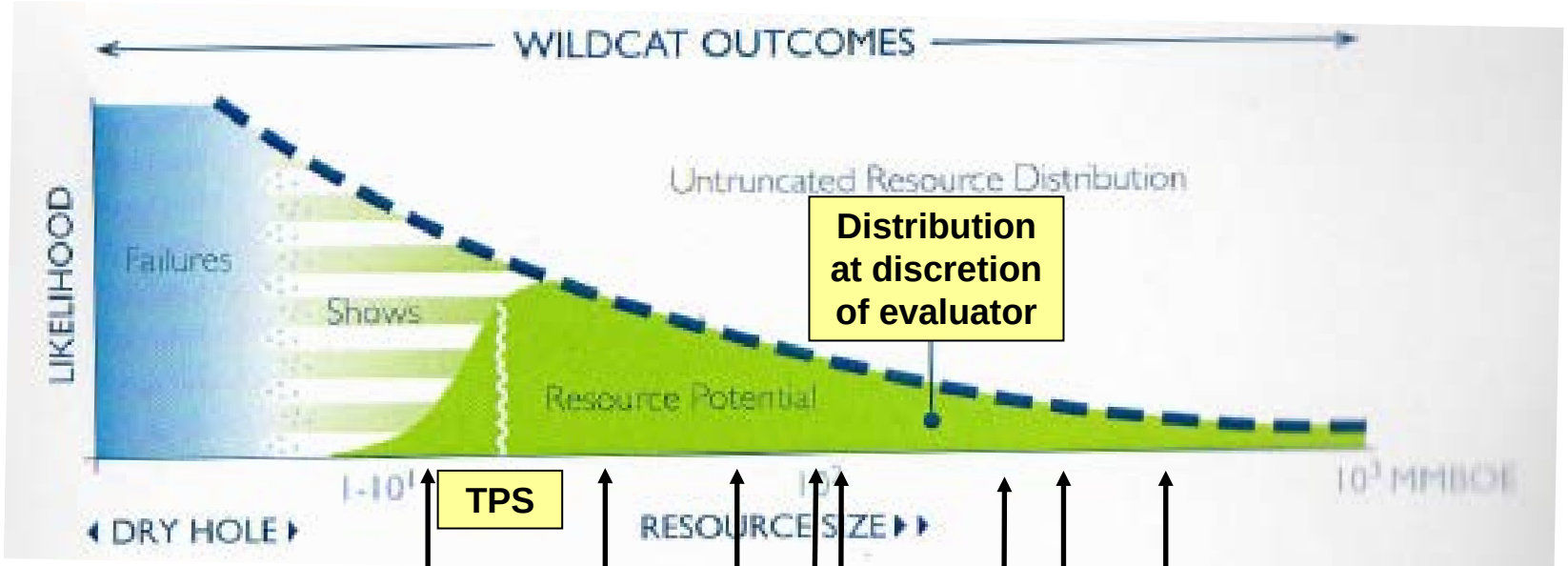
Principles of Prospective Resources per PRMS (1/3)



Potential Wildcat Outcomes

- Schematic representation of range of potential outcomes for an exploration wildcat
- Typically, technical and commercial failures lie to the left of the Threshold Project Size (TPS) – new term alternative to MEPS (or MEFS).
- Entity or evaluator to decide
  - Basis of TPS
  - “full” or “truncation” methodology

Principles of Prospective Resources per PRMS (2/3 – TPS ~$1U_{Full}$)



TPS

$1U_{Full}$ | $2U_{Full}$ | $3U_{Full}$ | With $Pd_{(Full)}$

PRs Full Distribution

Mean U_{Full}

And Pg

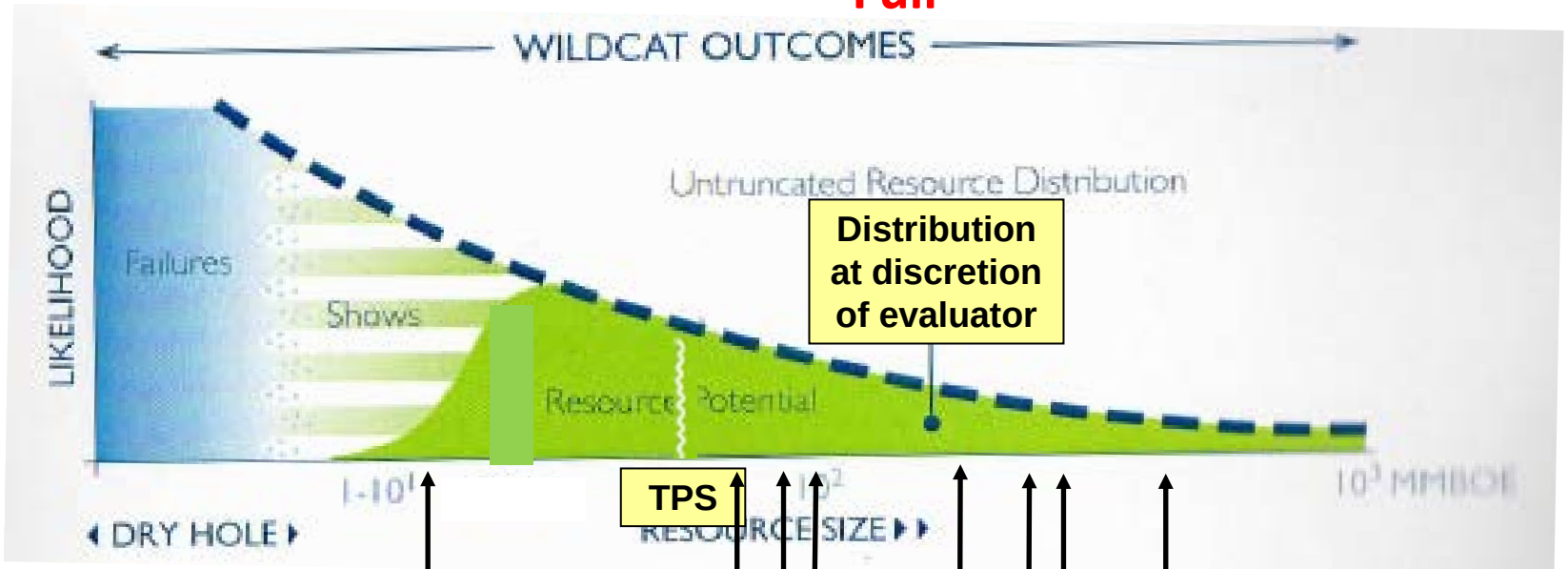
$1U_{Trun}$ | $2U_{Trun}$ | $3U_{Trun}$ | With $Pd_{(Trun)}$

PRs Truncated Distribution

Mean U_{Trun}

And (same?) Pg

Principles of Prospective Resources per PRMS (3/3 – TPS >> $1U_{Full}$)



Distribution at discretion of evaluator

TPS

$1U_{Full}$ | $2U_{Full}$ | $3U_{Full}$ | With $Pd_{(Full)}$

Mean U_{Full} | And Pg

PRs Full Distribution

$1U_{Trun}$ | $2U_{Trun}$ | $3U_{Trun}$ | With $Pd_{(Trun)}$

Mean U_{Trun} | And (same?) Pg

PRs Truncated Distribution

Issues 1 & 2 answered by AG22 errata

Issues 1 & 2 answered by AG22 errata (1/2)

Chapter Two

Issue: Sec. 2.6 Chance of Commerciality (p. 14) – **concerning whether a "success case" or a "full distribution" case could be used for resource estimates.**

The current passage reads:

An alternative approach for estimating Prospective Resources is to include only the commercially successful portion of the full distribution (i.e., the "success case" portion rather than the "full distribution"). In this case, the range would exclude outcomes that are below the economic threshold for a commercially viable project; therefore, the probability of achieving this "success case" portion of the range with a discovery well is lower, which must be incorporated into the chance of development (P_d) when using the "success case" as the Prospective Resource range (i.e., "full distribution" P_d > "success case" P_d).

=> AG22 (and AG11) state that either the "full distribution" or "success case" (ie truncated) may be used… BUT errata says …

Issues 1 & 2 answered by AG22 errata (2/2)

Chapter Two

Issue: Sec. 2.6 Chance of Commerciality (p. 14) – concerning whether a "success case" or a "full distribution" case could be used for resource estimates.

Solution: The revised passage reads:

An alternative approach for estimating Prospective Resources is to include only the commercially successful portion of the full distribution (i.e., the "success case" portion rather than the "full distribution"). In this case, the range would exclude outcomes that are below the economic threshold for a commercially viable project. When weighing alternative investment decisions for Prospective Resources, the success case may facilitate comparison. However, disclosing success-case quantities for Prospective Resources **would fail to align with the disclosure of the full distribution quantities for Contingent Resources and Reserves**. To ensure consistency, **the full distribution approach should be used for the disclosure of all Resources and Reserves quantities**.

=> AG22 errata has advised only the "full distribution" should be used for PRs AND that CRs and Reserves must be the "full distribution"

Answers so far

(1) What is presented for the Low, Best and High estimates of recoverable resources for a project per PRMS 2018?

Ans: "full distribution"

(2) Is it the same for each class?

Ans: Yes

(3) What about the corresponding Pg and Pd?

(4) What about the truncation to be done per 1.2.0.4?

(5) Are PRs and CRs Technically Recoverable Resources (TRRs)?

Issue 3 – Pg and Pd?

Issue 3 – Pg and Pd? (1/7)

Pc = Pg x Pd

TERM	PRMS Section	DEFINITION
Chance of Commerciality, Pc	2.1.3	The estimated probability that the project will achieve commercial maturity to be developed. For Prospective Resources, this is the product of the chance of geologic discovery and the chance of development. For Contingent Resources and Reserves, it is equal to the chance of development.
Chance of Development, Pd	2.1.3	The estimated probability that a known accumulation, once discovered, will be commercially developed.
Chance of Geologic Discovery, Pg	2.1.3	The estimated probability that exploration activities will confirm the existence of a significant accumulation of potentially recoverable petroleum.

Issue 3 – Pg and Pd? (2/7)

Pg

- Only an issue for PRs (since Pg = 1 for CRs and Reserves)
- Typically, Pg would be the same for “full distribution” or “truncated distribution”

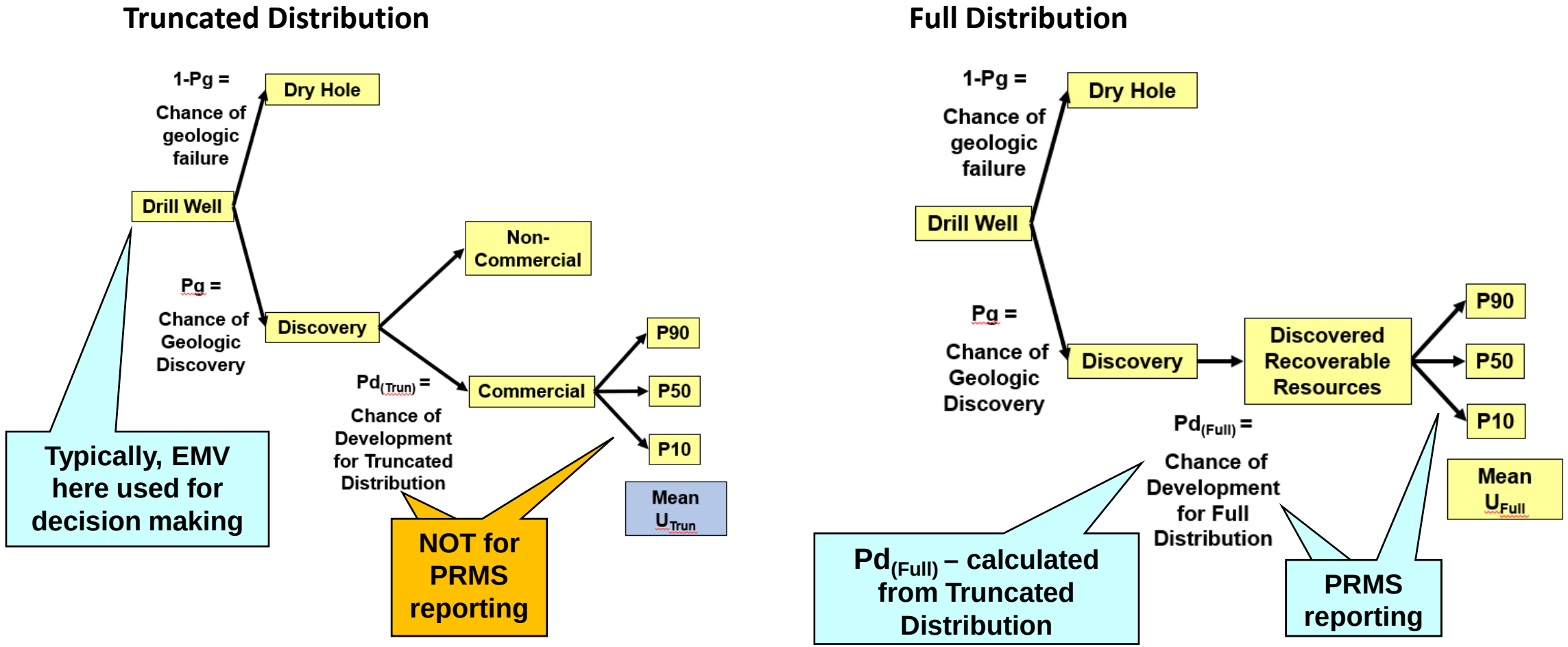
- BUT; what if drill down structure to assist getting on the “success case” portion of the full distribution?
- The well would be more “risky”? So Pg would be less?

Discuss later …?

Issue 3 – Pg and Pd? (3/7)

Pd

- Full distribution => $Pd_{(Full)}$



Issue 3 – Pg and Pd? (4/7)

Pd (ctd)

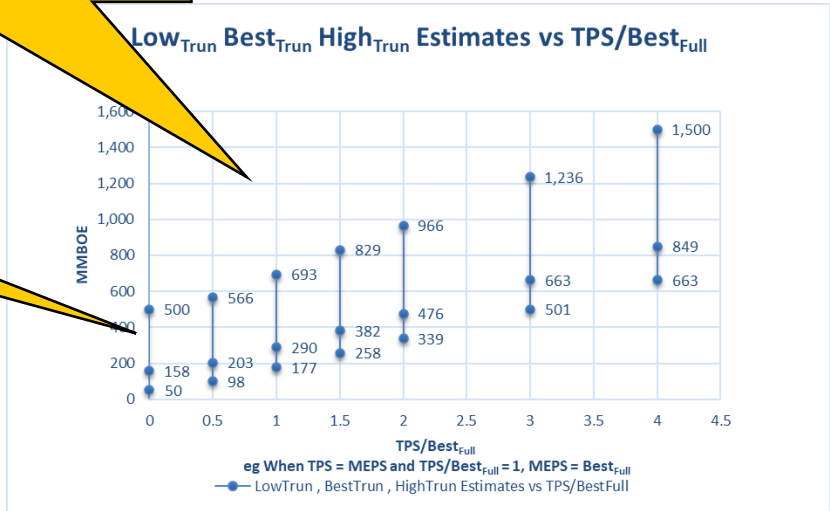
- Full Distribution recommended for PRs

  - Consistency with CRs and Reserves

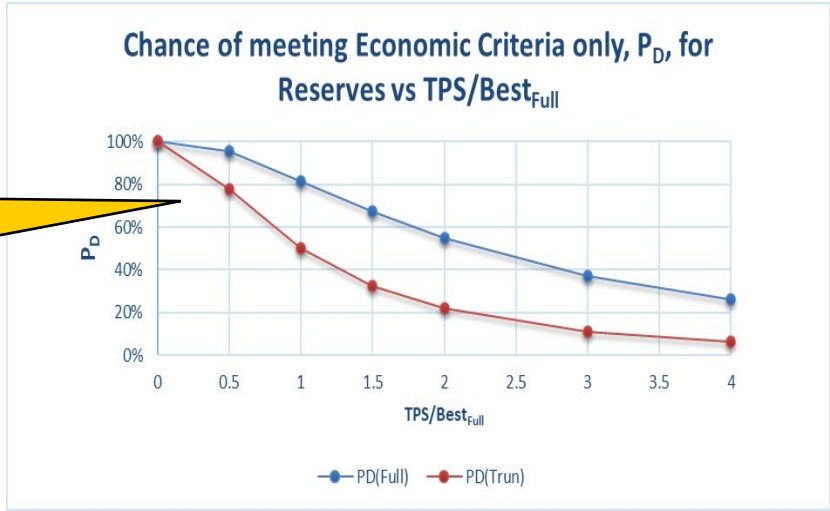
  - As a prospect gets “worse”, PRs being the Truncated Distribution “look better” -> hence potential for misleading

(2) Significantly increasing Truncated Distributions as Threshold Project Size increases

(1) Full Distribution



(3) Significantly reduced chance as Threshold Project Size increases



Issue 3 – Pg and Pd? (5/7)

Pd (ctd)

- Truncated Distribution still useful:

  - Decision-making process
  - Estimating directly Pd associated with the "full distribution", and,
  - Also applies to CRs when appraisal or TUD process being considered

    …

Key issue:

How is $Pd_{(Full)}$ estimated?

Answer:

By equating the "risked means" and solving for $Pd_{(Full)}$

$$Pd_{(Full)} \times Mean_{(Full)} = Pd_{(Trun)} \times Mean_{(Trun)}$$

$$Pd_{(Full)} = \frac{Pd_{(Trun)} \times Mean_{(Trun)}}{Mean_{(Full)}}$$

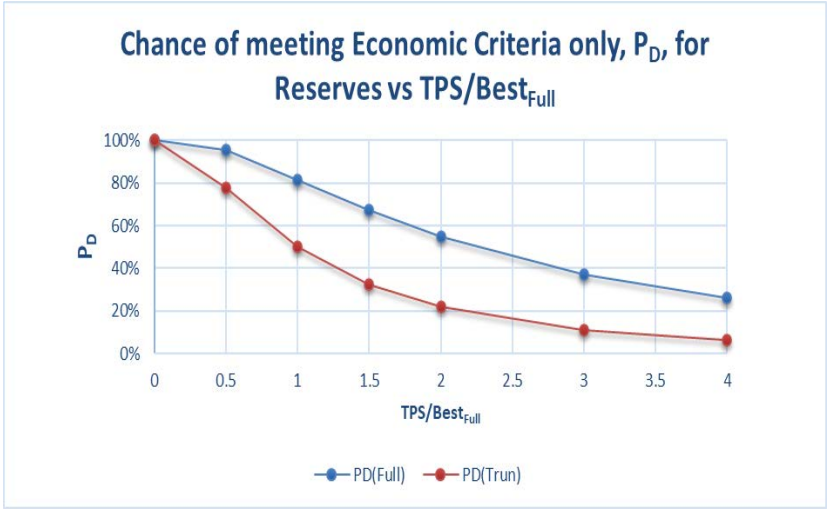
Issue 3 – Pg and Pd? (6/7)

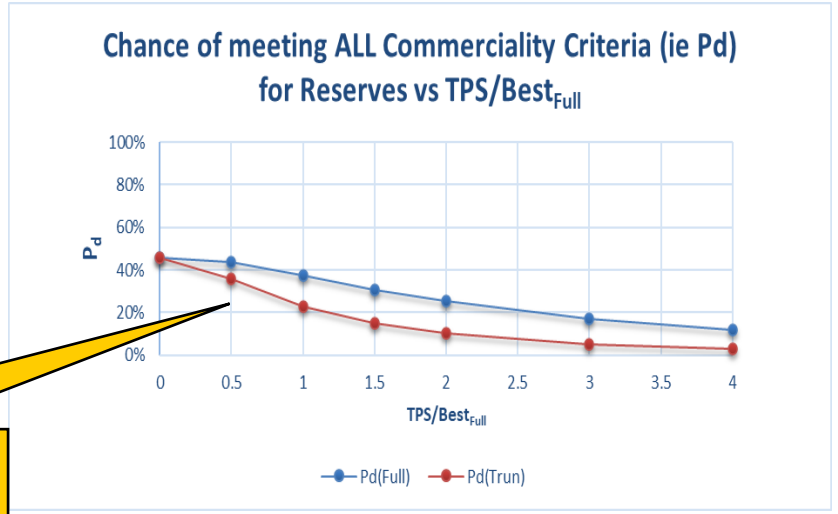
Pd (ctd)

- In this example, Pd is assumed to only reflect "chance of achieving the threshold project size", TPS

  - Other Commerciality Criteria risks are ignored here (in real life they must not be ignored) – see Estimating Pd topic

  - Pd will be lower when all risks included





Pd significantly reduced chance when **all Commerciality Criteria considered**

Issue 3 – Pg and Pd? (7/7)

PRs via Full Distribution (ie Untruncated) vs Truncated Distributions

- Simple Decision Tree
- Determine "full distribution" (ie "Untruncated") –> $1U_{(Full)}$, $2U_{(Full)}$, $3U_{(Full)}$ for PRMS reporting, and $Mean_{(Full)}$ permitted by ASX for PRs
- Determine TPS
- Determine "success case" (ie Truncated") -> $Pd_{(Trun)}$, $Mean_{(Trun)}$ -> $Pd_{(Full)}$ for PRMS paired with the 1U, 2U, 3U for Full Distribution
- Must adjust Pd's for risks associated with other Commerciality Criteria and Commitment (out of scope – refer estimating Pd topic)

Answers so far

(1) What is presented for the Low, Best and High estimates of recoverable resources for a project per PRMS 2018?

Ans: "full distribution"

(2) Is it the same for each class?

Ans: Yes

(3) What about the corresponding Pg and Pd?

Ans: Pg not affected. Use $Pd_{(Full)}$ - Use equality of "risked means" to move between "full" and "success case" distributions and Pd's. Can be applied to Pd for PRs and CRs. Must adjust for other Commerciality Criteria and Commitment risk.

(4) What about the truncation to be done per 1.2.0.4?

(5) Are PRs and CRs Technically Recoverable Resources (TRRs)?

Issue 4 – PRMS 1.2.0.4

Issue 4 – PRMS 1.2.0.4 (1/5)

Truncation of cashflows:

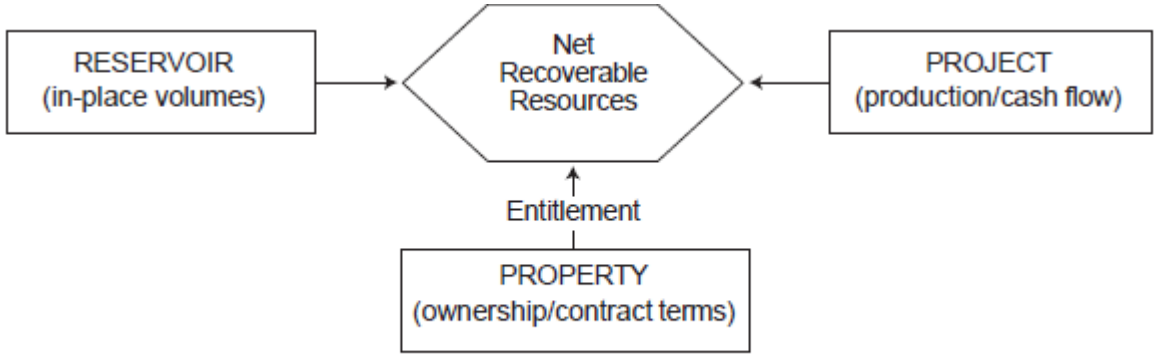


Figure 1.2—Resources evaluation

1.2.0.4 extract …

reservoir's development generates a unique production and cash-flow schedule at each level of certainty. The integration of these schedules taken to the project's earliest truncation caused by technical, economic, or the contractual limit defines the estimated recoverable resources and associated future net cash flow projections for each project. The ratio of EUR to total PIIP quantities defines the project's recovery efficiency. Each project should have an associated recoverable resources range (low, best, and high estimate).

At face value it appears that the earliest limit must be done for all recoverable resources … not so … it depends …refer to some FAQs …

Issue 4 – PRMS 1.2.0.4 (2/5)

FAQ 4.3. Question: Economic limit consideration in Resources. Should Contingent Resources (or Prospective Resources) be subjected to an economic limit test?

Answer: [Oct. 2022] Resources include quantities from projects that do not meet all Reserves criteria and economics may be one of the criteria not met. Thus, the economic limit may or may not be taken into account for the Contingent Resources assessment. If evaluators include Contingent Resources quantities based on economics within contract terms because they want to clearly define the quantities to be reported as potential Reserves based on project scope envisioned, then they should apply economic producibility with an economic limit test determination. If the objective is to recognize the project's potential recovery, the evaluation process may use a technical limit instead.

Contingent and Prospective Resources have different project maturity sub-class levels and, for projects approaching Commerciality (Contingent Resources Development Pending), evaluators should increase focus on achieving economic criteria. Contingent Resources projects are already discovered and may be approaching Commerciality determination, while Prospective Resources are not at such level of maturity.

Entities that are maturing a project in the Contingent Resources Development Pending sub-class and intend to move the project into the Reserves class will have economics included in the entity's assessment of project commercial viability.

In preparing to decide to drill Prospective Resources projects in the Prospect sub-class, a risk assessment with economics is typically evaluated to support investment decision. Please note that economics are only one element of commerciality.

Entities may assign less-mature projects with no economic evaluation (or which are non-commercial) to Contingent and Prospective Resources sub-classes that reflect their remaining contingencies. Evaluators should clarify their assumptions and state whether or not they have applied an economic limit test.

Issue 4 – PRMS 1.2.0.4 (3/5)

FAQ 4.4. Question: Contract renewals in Contingent Resources. Does §3.0.0.2 imply that evaluators do not need to address all defined conditions for Contingent Resources, and that they do not need to limit these resources to an economic limit test or contract limits?

Answer: [Oct. 2022] The PRMS allows contingencies to exist in non-Reserves classes and these contingencies can be related to unknown and known elements. Whether or not to recognize technical, economic, or contractual limits depends on the situation.

Contingent Resources quantities based on a project's incremental recovery planned to be implemented but which has not been approved should respect the technical, economic, and contract limits, whichever occurs first. Separate projects to recover additional resources after the first project's limitation occurs (technical, economic, or contractual) may also be able to be recognized.

When Contingent Resources are based on renegotiating a contract extension, the assessment likelihood of the outcome and its chance of commercialization are taken into account for Contingent Resources [see §3.3.3.2 below].

The use of the economic limit test in evaluating projects is common with Development Pending projects, and its application in lesser mature sub-classes would depend on the specific situation. There are methods available that do not contain the detail of an economic limit test that may be used in these cases.

§3.3.3.2 *Reserves cannot be claimed for those quantities that will be produced beyond the expiration date of the current agreement unless there is reasonable expectation that an extension, a renewal, or a new contract will be granted. Such reasonable expectation may be based on the status of renewal negotiations and historical treatment of similar agreements by the license-issuing jurisdiction. Otherwise, forecast production beyond the contract term must be classified as Contingent Resources with an associated reduced chance of commercialization. Moreover, it may not be reasonable to assume that the fiscal terms in a negotiated extension will be similar to existing terms.* [There may be governmental or regulatory conditions of the reporting basis that require Reserves and Resources provided that is different than the entity's entitlement share. Such requirements must therefore be reflected.]

Issue 4 – PRMS 1.2.0.4 (4/5)

FAQ 4.5. Question: Economic application to Contingent Resources. Should Contingent Resources be limited to the economic portion of the cashflow forecast? Does this limitation apply to different sub-classes?

Answer: [Oct. 2022] Contingent Resources quantities are not limited to those with economic cashflow, as there is a Contingent Resources sub-class "Development Not Viable" which is often related to a project's economic viability and may not yield a positive cash flow under reasonable forecast conditions.

Projects in the more mature Development Pending sub-class of contingent resources are typically truncated by the economic limit.

Issue 4 – PRMS 1.2.0.4 (5/5)

FAQ 4.6. Question: Economic application to Contingent Resources. If a project with Contingent Resources has no single period (e.g., one year) of positive cashflow, should quantities recorded be zero?

Answer: [Oct. 2022] No, a positive cash flow is not a requirement to recognize Contingent Resources. See §2.1.3.7.1 B for reference to "Economically Not Viable Contingent Resources" and the inability of such projects in this sub-class to yield a positive cash flow under reasonable forecast conditions. For non-economic projects, the economic viability will be a project contingency before it can be considered for Reserves classification.

However, if unreasonable commercial criteria (i.e., economic or any other) are required to enable the project to become commercial, then it should be deemed Unrecoverable rather than Development Not Viable (refer to the PRMS Glossary: Unrecoverable Resources).

Answers so far

(1) What is presented for the Low, Best and High estimates of recoverable resources for a project per PRMS 2018?

Ans: "full distribution"

(2) Is it the same for each class?

Ans: Yes

(3) What about the corresponding Pg and Pd?

Ans: Pg typically not affected. Use $Pd_{(Full)}$ - Use equality of "risked means" to move between "full" and "success case" distributions and Pd's. Can be applied to Pd for PRs and CRs. Must adjust Pd's for other Commerciality Criteria and Commitment risk.

(4) What about the truncation to be done per 1.2.0.4?

Ans: Refer FAQs: It depends! Reserves "must", CRs Dev Pending, "should", CRs On hold, Unclarified and Not viable, "may", PRs yes if presenting results of cash flow analysis, otherwise "may". Also, clear if CRs can only become commercial with unreasonable improvements in commercial conditions or technology -> Unrecoverable.

(5) Are PRs and CRs Technically Recoverable Resources (TRRs)?

(5) Are Prospective Resources (PRs) and Contingent Resources (CRs) Technically Recoverable Resources (TRRs)?

Issue 5 – Are PRs and CRs TRRs? (1/2)

TRRs definition:

> **B.** **Technically Recoverable Resources (TRR)** are those quantities of petroleum producible using currently available technology and industry practices, regardless of commercial considerations. TRR may be used for specific Projects or for groups of Projects, or, can be an undifferentiated estimate within an area (often basin-wide) of recovery potential.
>
> 1.1.0.9 Whenever these terms are used, the conditions associated with their usage must be clearly noted and documented.

- TRRs for a specific project (or case of a project", before any truncations (other than applying a "technical limit") are based on the Technical Forecast, and this must be Gross or 100% by definition.

Technical Forecast	2.1.2	The forecast of produced resources quantities that is defined by applying only technical limitations (i.e., well-flow-loading conditions, well life, production facility life, flow-limit constraints, facility uptime, and the facility's operating design parameters). Technical limitations do not take into account the application of either an economic or license cutoff. (See also Technically Recoverable Resources).

- BUT any commercial evaluation is done on the Production Forecast NOT the Technical Forecast…

PRMS 2018 and AG22 often make this mistake!

Issue 5 – Are PRs and CRs TRRs? (2/2)

Production Forecast:

Production Forecast	2.1.3.7	A forecasted schedule of production over time. For Reserves, the production forecast reflects a specific development scenario under a specific recovery process, a certain number and type of wells and particular facilities and infrastructure. When forecasting Contingent or Prospective Resources, more than one project scope (e.g., wells and facilities) is frequently carried to determine the range of the potential project and its uncertainty together with the associated resources defining the low, best, and high production forecasts. The uncertainty in resources estimates associated with a production forecast is usually quantified by using at least three scenarios or cases of low, best, and high, which lead to the resources classifications of, respectively, 1P, 2P, 3P and 1C, 2C, 3C or 1U,2U and 3U.

- Start as “100%” and be converted to entitlement share and have appropriate cutoffs.
- Reflects anticipated sales quantities, such as a “plateau period” before natural decline to the appropriate limit. (Note: the “technical limit” is based on “100%”).
- So, PRs and CRs ***may be*** TRRs but only if:
  - The Production Forecast is the same as the Technical Forecast
  - No cut-offs for economic or contract limit have been applied
  - The entity has 100% ownership and there is no “government take”
  - The TRRs do not require unreasonable improvements in commercial conditions or technology to become commercial
- Notably CRs should be referred to as “Sub-commercial” and not as TRRs

PRMS 2018 and AG22 often make this mistake!

Answers

(1) What is presented for the Low, Best and High estimates of recoverable resources for a project per PRMS 2018?

Ans: "full distribution" PRMS update should include this point.

(2) Is it the same for each class?

Ans: Yes

(3) What about the corresponding Pg and Pd? *Ans: Pg typically not affected. Use $Pd_{(Full)}$ - Use equality of "risked means" to move between "full" and "success case" distributions and Pd's. Can be applied to Pd for PRs and CRs. Must adjust Pd's for other Commerciality Criteria and Commitment risk. PRMS update should include these points.*

(4) What about the truncation to be done per 1.2.0.4?

Ans: Refer FAQs: It depends! Reserves "must", CRs Dev Pending, "should", CRs On hold, Unclarified and Not viable, "may", PRs yes if presenting results of cash flow analysis, otherwise "may". Also, clear if CRs can only become commercial with unreasonable improvements in commercial conditions or technology -> Unrecoverable. PRMS update should include these points.

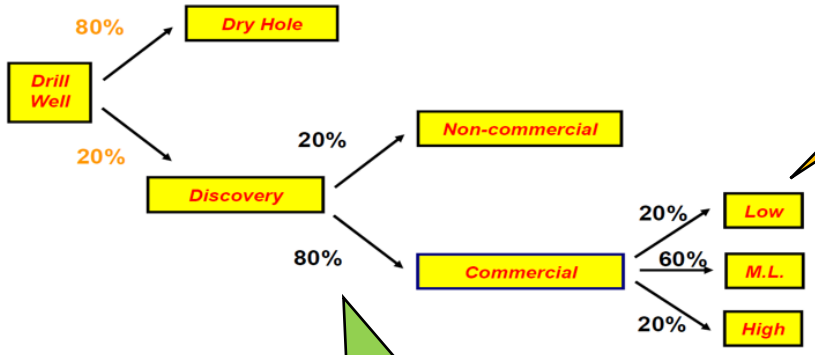
(5) Are PRs and CRs Technically Recoverable Resources (TRRs)?

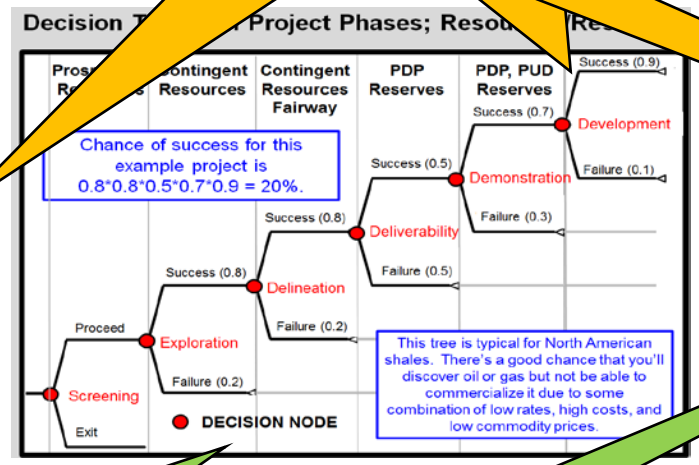
Ans: Maybe, but typically not. Fundamentally all recoverable resources per PRMS are based on the Production Forecast(s) NOT the Technical Forecast(s) which are the basis for TRRs.

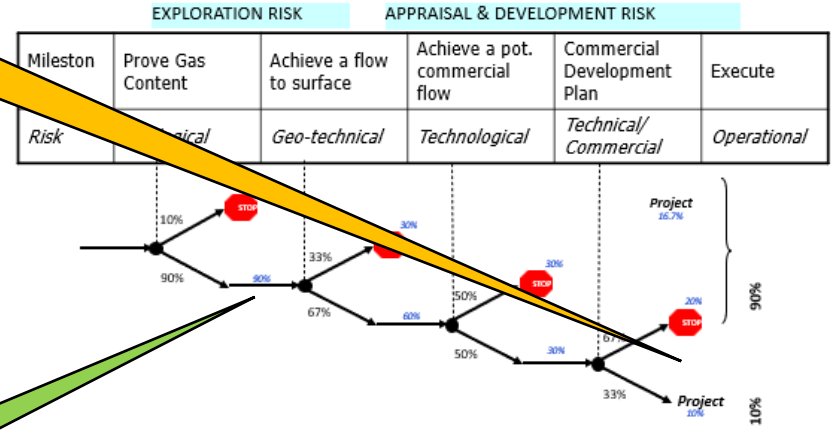
PRMS update should include these points.

Conclusions

The "success case" is NOT for PRMS reporting (until Reserves)







PRMS reporting is the "full distribution" of recoverable resources as if the project was implemented at the EFFECTIVE DATE based on the information available at that EFFECTIVE DATE

- Some estimates for PRs and CRs claimed to be per PRMS may be the "truncated distribution" not the "full distribution"
- The associated Pd's may not be paired correctly
- Beware different "limits" applied
- CRs may be based on the Technical Forecasts when the basis should be the Production Forecasts

Questions?