Thoughts on the 2018 PRMS

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Introduction

- The 2018 PRMS update is stated[1] to be part of an evolutionary progression that maintains the foundational principles contained in the 2007 PRMS, and to address many of the clarification points that have been collected over the years
- This is largely true
  - The fundamental principles are unchanged
  - Some ambiguities in the 2007 version have been clarified
  - But others remain, and some new ones have been introduced

[1] Key Changes from the Petroleum Resources Management System (PRMS 2007) to the PRMS 2018, available at https://www.spe.org/en/industry/reserves/

Today's Topics

- Production beyond the economic limit: is it Contingent Resources?
- Standalone Possible Reserves: what are they and are they Possible?

➢ At least we're no longer debating whether Proved Reserves have to be economic in their own right!

Production Beyond the Economic Limit: Is it Contingent Resources?

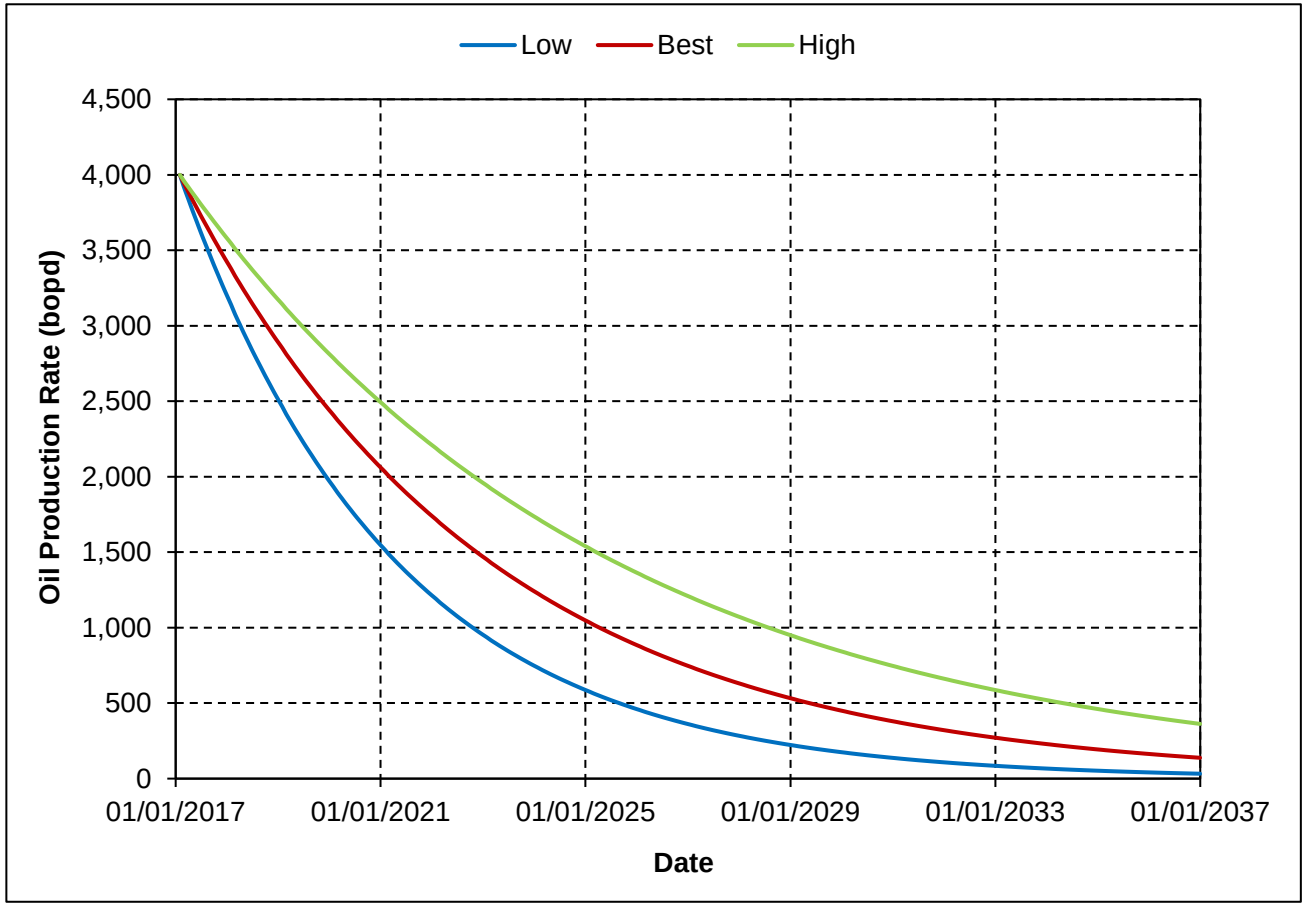
Background

- Pre-2018, various clients were reporting volumes forecast to be produced beyond the economic limit as Contingent Resources under (2007) PRMS
- Such volumes are technically recoverable, but not economic (under the current economic assumptions)
  - So do they fit within the definition of Contingent Resources?

    "those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations by application of development projects, but which are not currently considered to be commercially recoverable owing to one or more contingencies"
  - It looks like they do!
- However, a number of problems are immediately obvious
  - Where to truncate the profiles if there is no technical or licence limit?
  - 1C volumes being greater than 2C volumes and/or 2C volumes being greater than 3C volumes

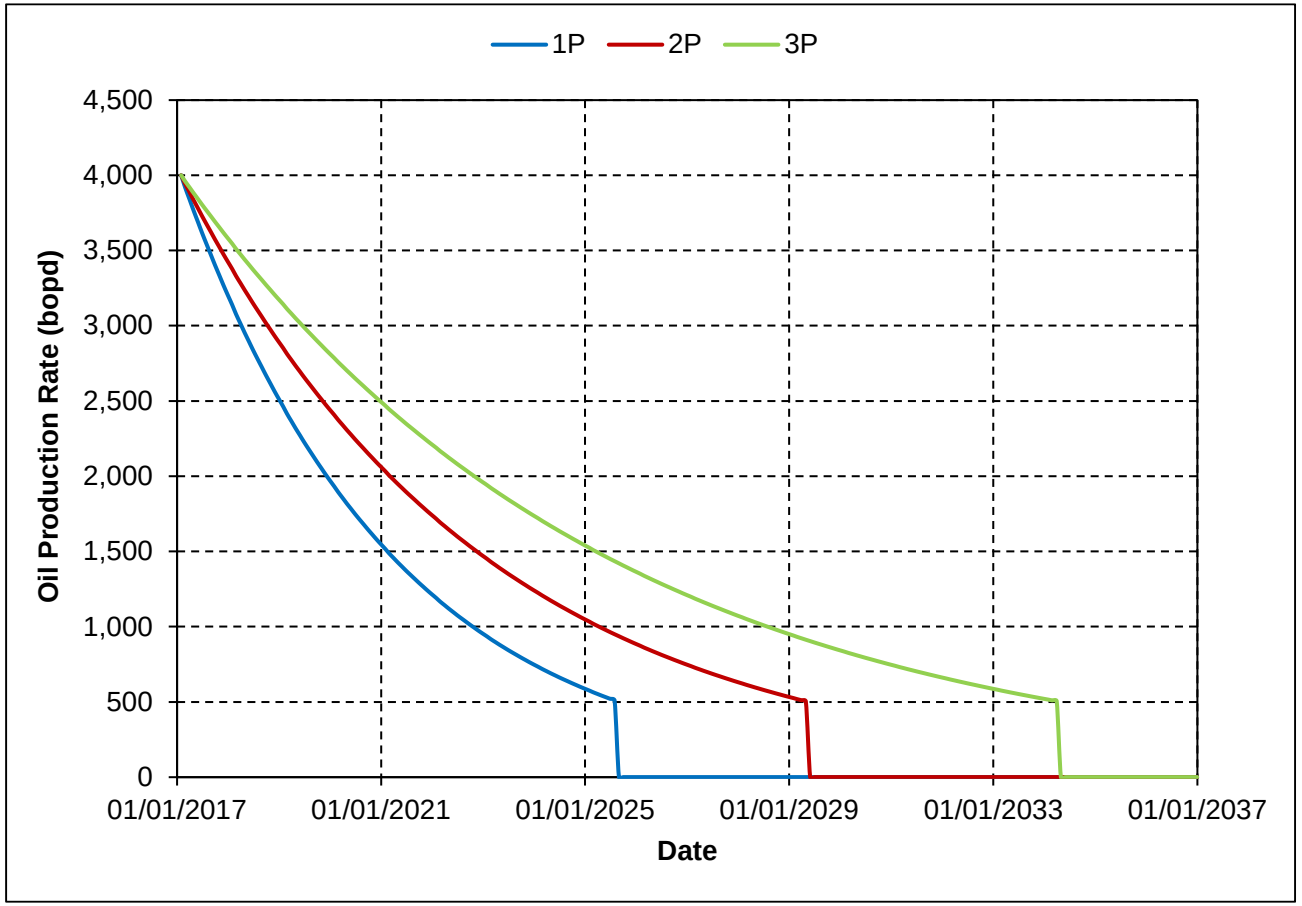
Example – Step 1

- Low, Best and High production forecasts have been made for a project up to the licence expiry date (end 2036)



Example – Step 2

- An economic limit test is performed for each case resulting in economic cut-off dates for the Reserves volumes



Example – Step 3

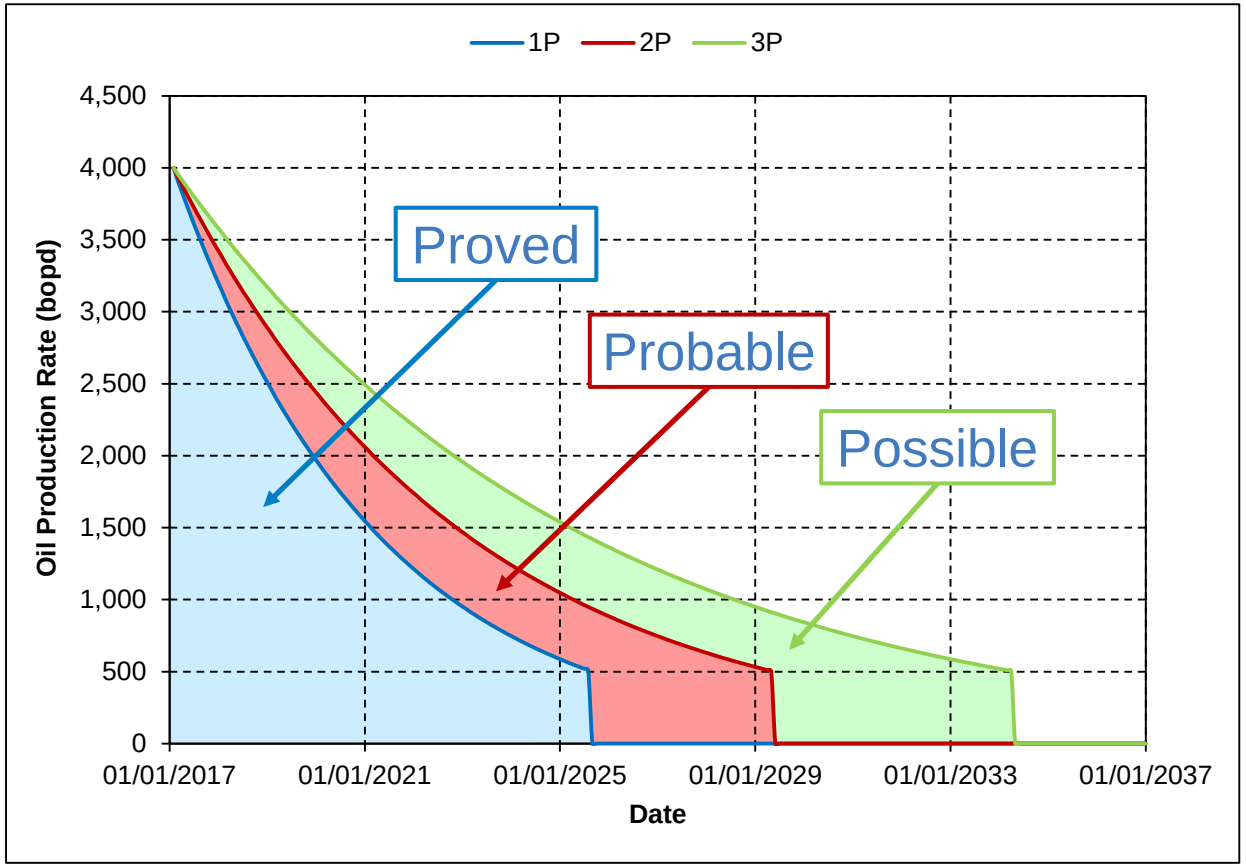
- Contingent Resources volumes are calculated by subtracting the 1P/2P/3P Reserves volumes from the Low/Best/High volumes technically recoverable up to licence expiry

MMBbl	Low/1P/1C	Best/2P/2C	High/3P/3C
Technical Volumes	6.04	8.40	11.08
Reserves	5.32	7.61	10.65
Contingent Resources	0.71	0.78	0.43

- In this case, 2C > 3C
  - Because the economic limit in the 3C case is close to the licence expiry date
- This is inconsistent with the definition of 1C, 2C, 3C as low, best and high estimates of the Contingent Resource

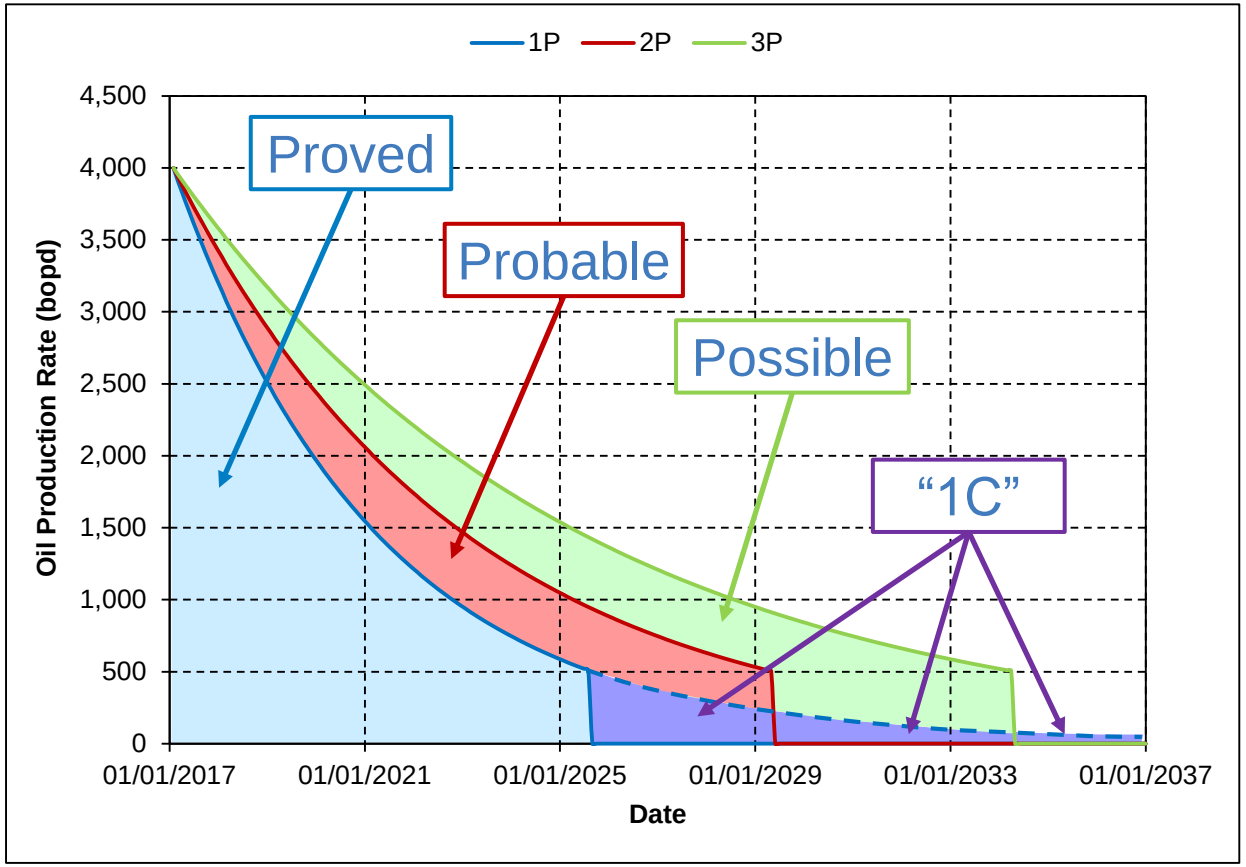
Example – Now look at it this way …

- Proved, Probable and Possible Reserves correspond to the shaded areas in the figure below



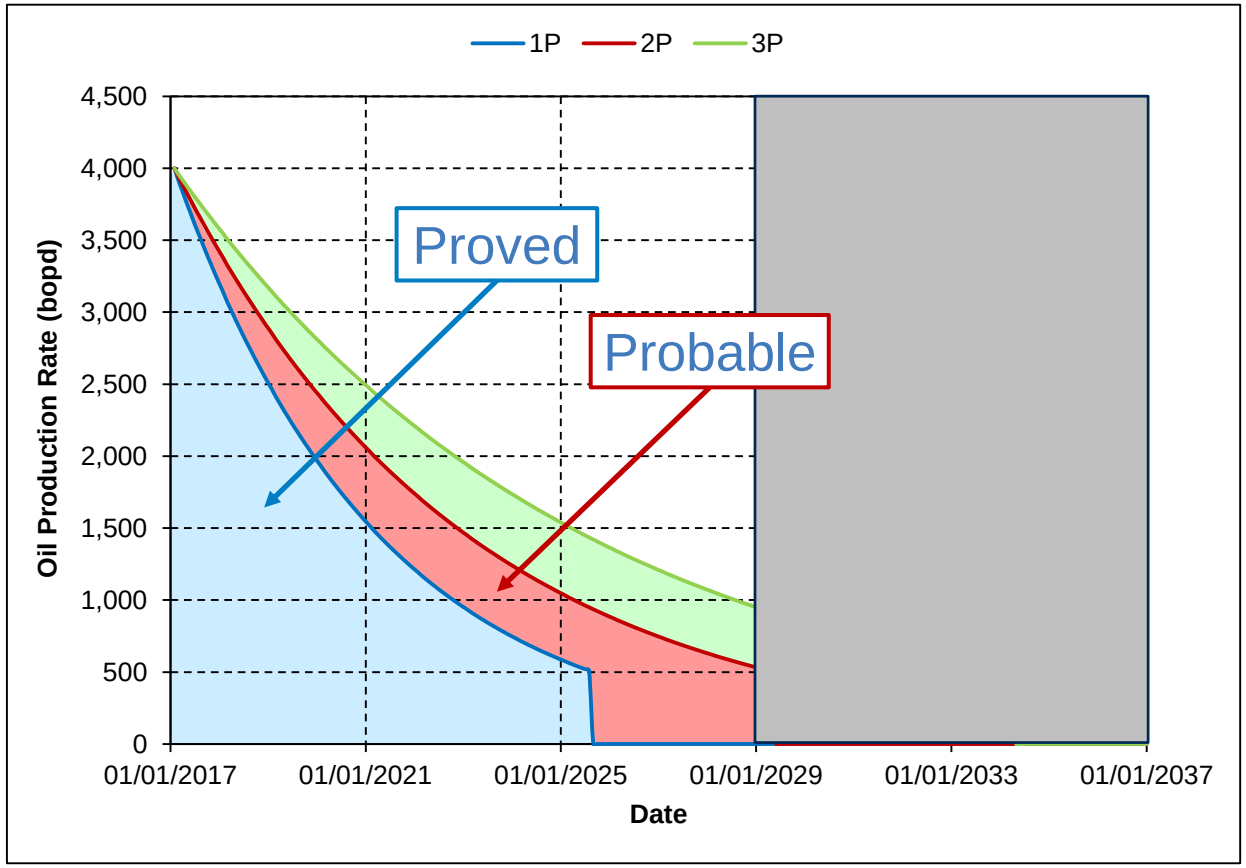
Example (Continued)

- If all volumes under the 1P profile after the 1P economic limit are considered as 1C Contingent Resources, there is overlap with the Probable and Possible Reserves



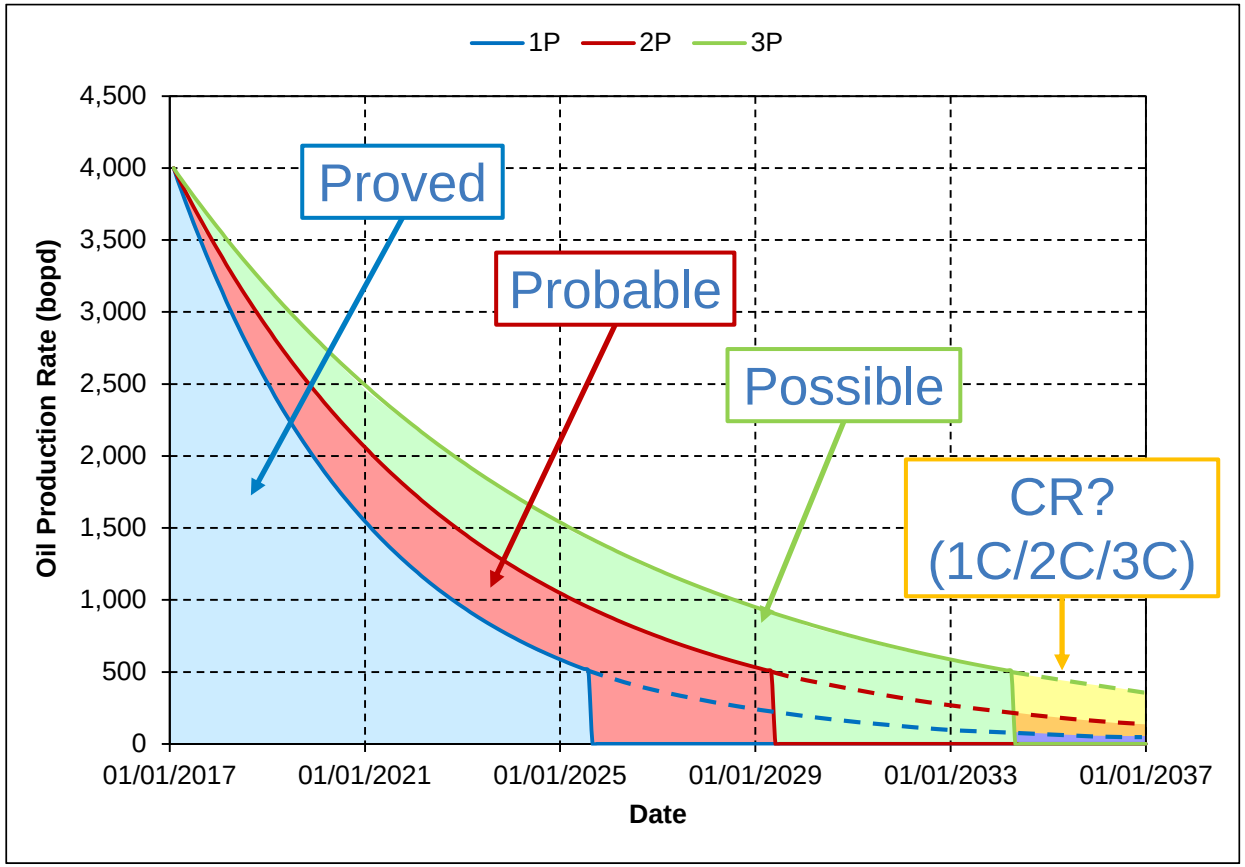
Example (Continued)

- This argument is very convincing if the 2P and 3P cases are economic until licence expiry (now assumed to be 2029), assuming extensions are uncertain
- If the 1P limit becomes later due to better economic assumptions, volumes move from Probable to Proved, not from CR to Proved!



Example (Continued)

- Perhaps only volumes after the 3P economic limit can be considered as Contingent Resources?
- However, this is not very satisfactory as the “2P+2C” does not “add up”



The Answer?

- 2018 PRMS has “clarified” that a project cannot have both Reserves and CR associated with it:

> 2.2.0.4 Moreover, a single project is uniquely assigned to a sub-class along with its uncertainty range. For example, a project cannot have quantities classified in both Contingent Resources and Reserves, for instance as 1C, 2P, and 3P. This is referred to as “split classification.”

- So what is the “project” associated with the volumes beyond the economic limit?
  - Cost reduction: acceptable
  - Negotiate better contract terms: may be acceptable if realistic
  - Increased prices: may be acceptable if realistic (probably only for gas)
- If a specific cost-reduction project has been identified, then it would be appropriate to report the extra volumes associated with that project, but only up to the new economic limits corresponding to the reduced costs

Clarification?

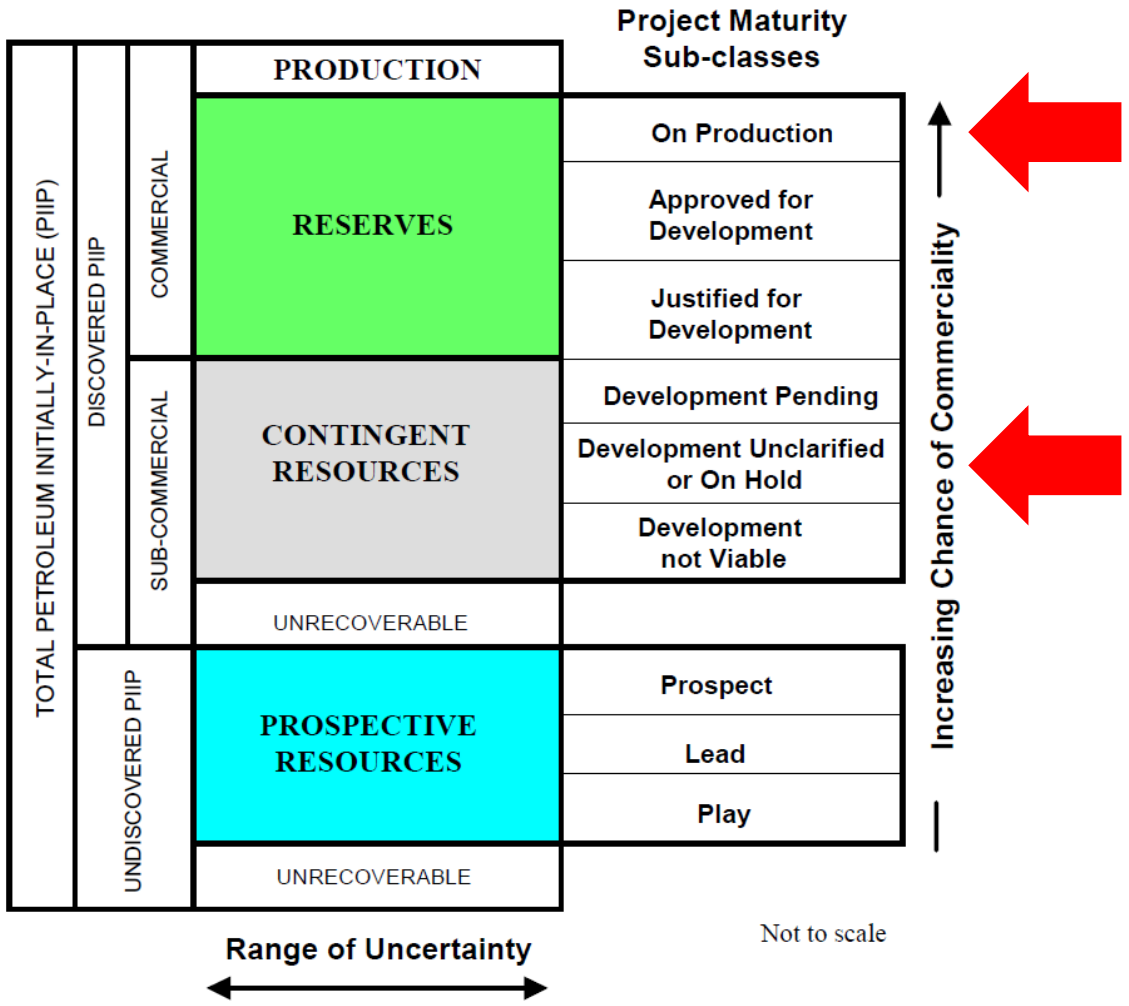


Figure 2-1: Sub-classes based on Project Maturity.
(From 2007 PRMS)

- How could a single project be at more than one place on the vertical axis at any one time?

Conclusions

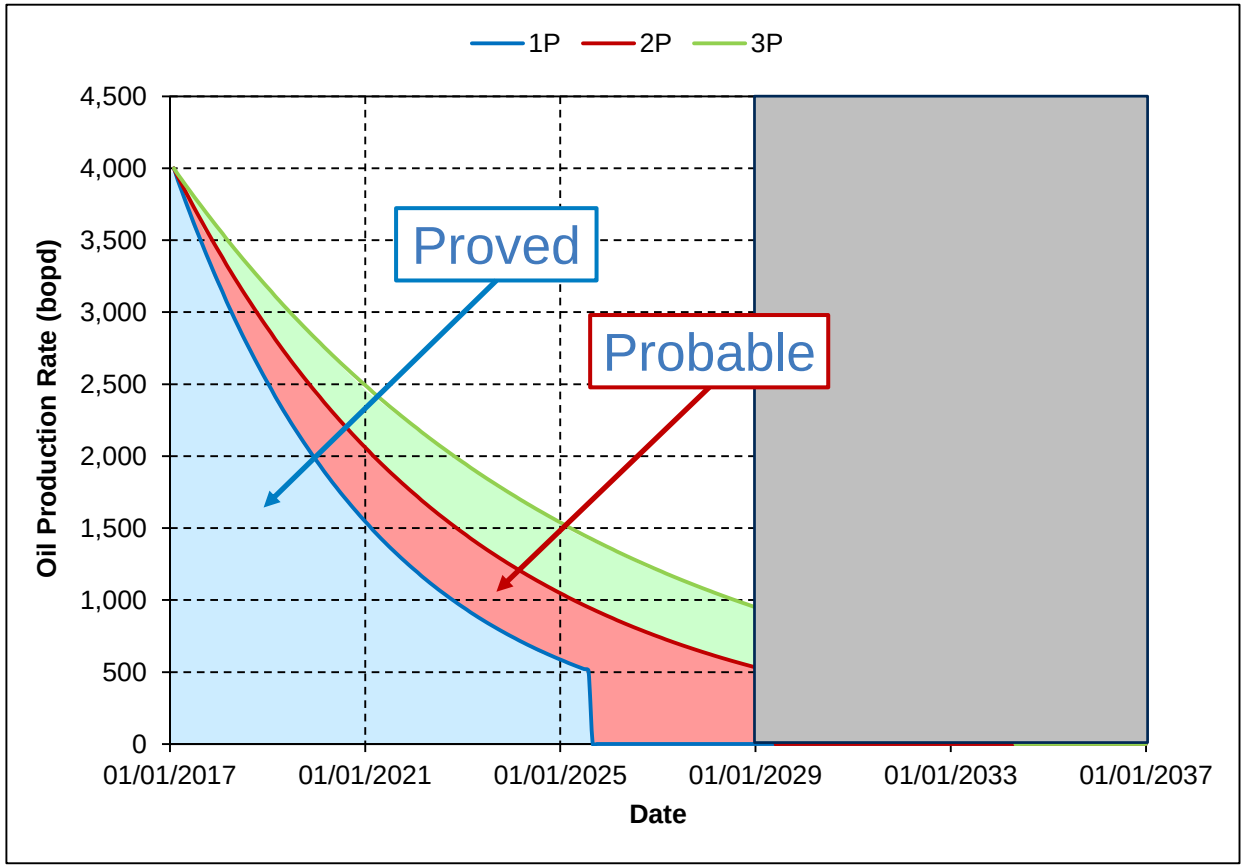
- Volumes beyond the economic limit are not Contingent Resources unless a specific project to recover them has been identified (e.g. cost reductions)
  - Even though they are technically recoverable …
  - … they are in fact “Unrecoverable” (but part of the Technically Recoverable Resources (TRR))
- Contingent Resources associated with an identified project should be evaluated according to the parameters of that project (i.e. up to the new economic limit)
  - Even though Contingent Resources don’t have to be economic

➢ **Resource assessments should be realistic**

- However, there are still some questions …

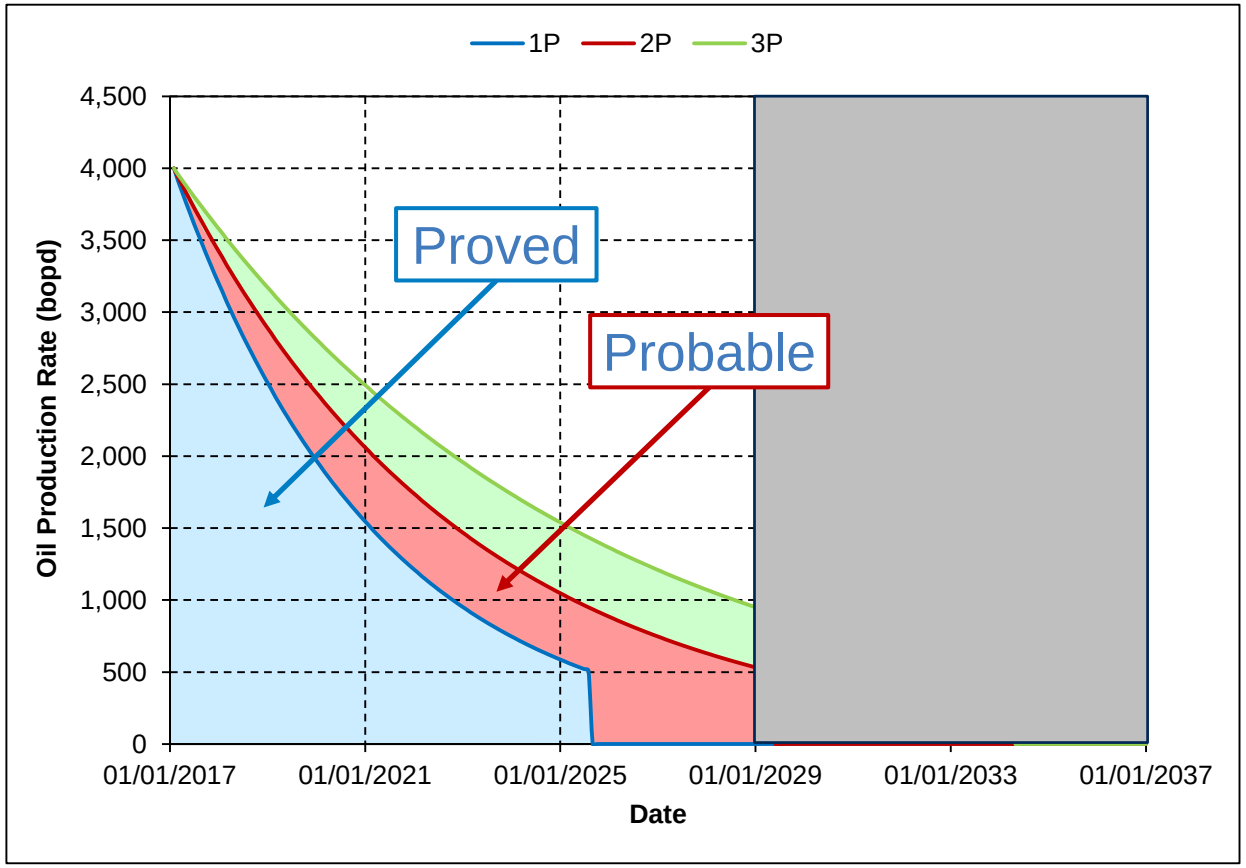
Questions – 1

- In this case, if there is a potential cost reduction project
  - It will have benefit only in the “Low” case
  - But this is the “High” (3C) outcome of the project
  - So 1C=2C=0, 3C>0?
  - However, if the project is approved, the 3C would then be added to the 1P, which is potentially confusing
  - Is it the right approach?
- More guidance is needed!



Questions – 2

- If the cost reduction project is approved, won't it just move some Probable Reserves to Proved?
  - Why doesn't the "overlap" argument apply here?
  - Is this "convincing" argument flawed?



Standalone Possible Reserves: What are they and are they Possible?

Standalone Possible Reserves – Definition

- New to PRMS in 2018 …
- … but not actually defined
- Assumed to mean
  - Possible Reserves attributed to a specific development project at a given date, without any Proved or Probable Reserves being attributed to that project at that date.
- However, to qualify for Reserves, a project must be economic at the 2P level
  - So standalone Possible Reserves are not possible!

Standalone Possible Reserves – Guidance

- Only one mention in the 2018 PRMS (paragraph 2.2.2.8 C)

  "Possible Reserves that are located outside of the 2P area (not upside quantities to the 2P scenario) may exist only when the commercial and technical maturity criteria[1] have been met (that incorporate the Possible development scope). Standalone Possible Reserves must reference a commercial 2P project (e.g., a lease adjacent to the commercial project that may be owned by a separate entity), otherwise stand-alone Possible is not permitted."

  – So standalone Possible Reserves are possible!

  – Albeit in limited circumstances

[1] "Commercial and technical maturity criteria" are presumably the criteria for "Commerciality" set out in paragraph 2.1.2.1

Standalone Possible Reserves – Example

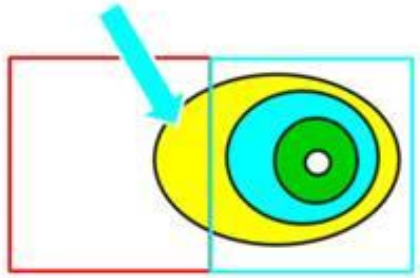
- This slide has been shown at certain SPE events

"Possible Reserves" Issues

Are stand-alone Possible Reserves allowed?

No, unless they are upside to commercial 2P project …

… which may be on an adjacent lease

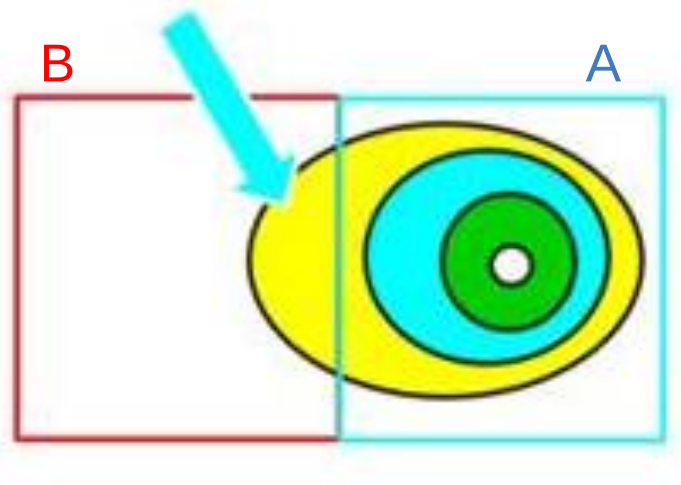


There may be special circumstances where Possible Reserves may be assigned to that part of an accumulation for which an Entity has the rights when 2P Reserves have been assigned to adjacent parts of the same accumulation for which the Entity does not have rights

- It is assumed that unitization is neither required nor being considered

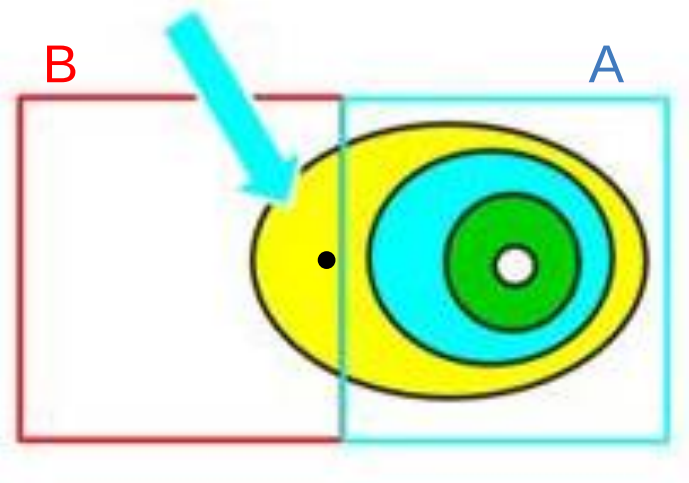
Example (Continued)

- It seems the holder of the Lease B (“Company B”) can book (stand-alone) Possible Reserves provided
  - There is a “commercial 2P project” on Lease A
  - The “commercial and technical maturity criteria have been met (that incorporate the Possible development scope)” for Company B’s project
- The latter would be mostly met if
  - Company B has a firm intention to develop the relevant part of Lease B within a reasonable timeframe
  - There are no particular barriers to that development
- However, the economic criteria that Company B’s project must meet are unclear



Example – Economics

- Suppose Company B plans a single-well development*
- Logically, Company B will have evaluated the economics of the well allowing for the risk of a dry hole
  - Probably on an EMV basis
  - $EMV = P_s \times NPV_s - (1 - P_s) \times NPV_f$
- EMV>0 appears to be a rational economic test for qualifying stand-alone Possible Reserves
  - At the company's internal hurdle rate/economic metrics
- Note this is not an exploration well
  - It targets a known accumulation
  - It does have an appraisal aspect but is fundamentally intended as a development well



The multi-well case will be discussed later in this presentation

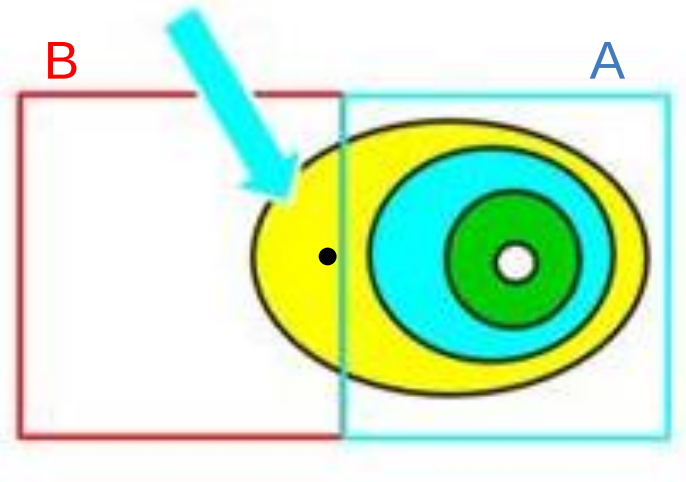
A Dangerous Exception?

- What if a “normal” project is uneconomic in the Low and Best cases, but so economic in the High case that the EMV* of the project is very attractive
  - $EMV = 0.3 \times NPV(Low) + 0.4 \times NPV(Best) + 0.3 \times NPV(High)$
- It may be rational to go ahead with such a project, but it isn’t justified to book stand-alone Possible Reserves under these circumstances because
  - There is no “commercial 2P project” to “reference”
  - Companies will in fact go ahead with such projects only if the risk capital is limited, usually to one or two wells

** The EMV formula here uses Swanson’s rule to estimate the mean NPV of the project on the assumption it will go ahead; it differs from the formula on the previous slide, which refers to a project which has a risk of producing no hydrocarbons*

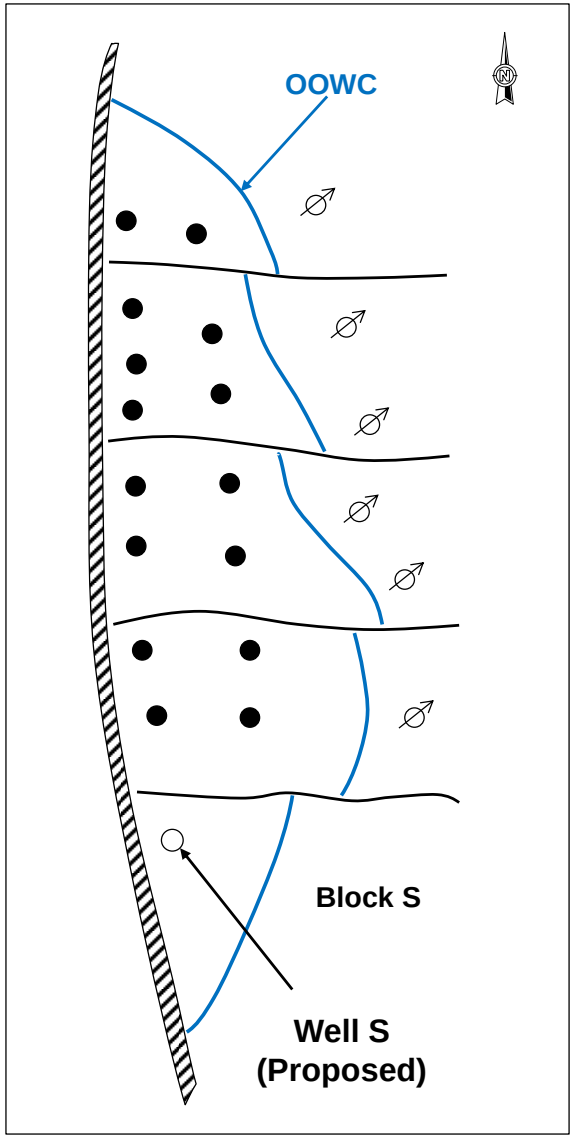
Annoying Technicalities

- What if the development project for the Lease A appears commercially attractive and has no known contingencies but the holder of the lease has not yet committed to the project and has not booked any Reserves for it?
- Then there is no “commercial 2P project” to reference so Company B cannot book standalone Possible Reserves!
  - This is ridiculous if the projects are independent (no shared infrastructure, etc)
- More clarification is needed!
- Note also the non-compliant wording
  - Projects may be described as “commercial”, but not as “2P” (or “not 2P”)
  - A project with 2P Reserves is by definition commercial



Digression – Field Z, Another Example

- Mature North Sea oil field nearing end of life
- Recently acquired by start-up Company X
- All penetrated fault blocks have same OOWC
- Block S is downthrown but above OOWC
  - Fault throw < reservoir thickness
- Well S estimated to have 40% chance of success
  - Risk of Block S being water-bearing
  - Risk that OOWC has already risen
- But Well S is attractive on an EMV basis, Company X is committed to it and the well is about to spud
- Well S is a project that could have standalone Possible Reserves

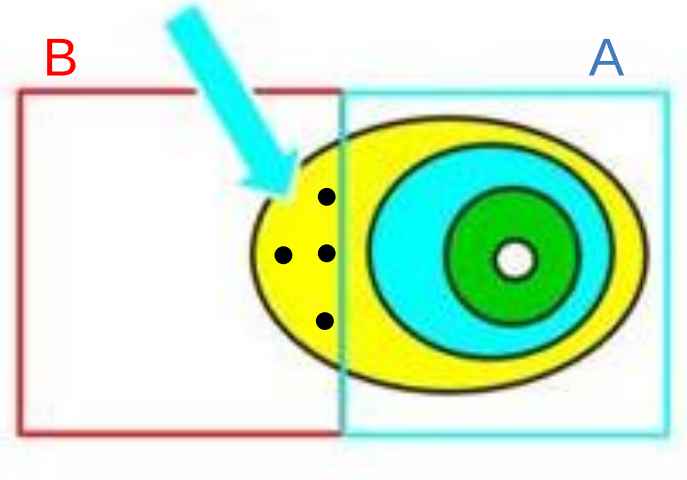


Digression – Field D, Another Example

- Satellite oil field tied back to a nearby platform (owned by another company)
- Developed with a single sub-sea well (Well D)
- Was producing at 10,000 bopd but now shut in because of an integrity problem
- A work-over is planned
  - Cost is US$15 MM
  - Chance of success is 40%
  - Work-over project is attractive on an EMV basis
- The Operator is committed and the work-over rig is on its way to the field
- The work-over of Well D is a project that should have standalone Possible Reserves
  - But where is the reference “commercial 2P project”? In the past?

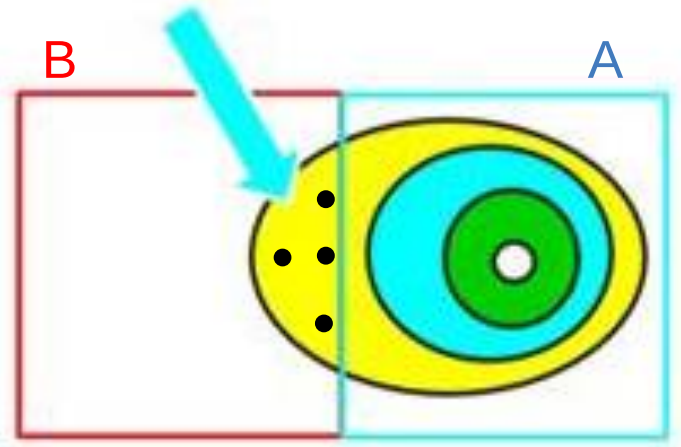
Back to Leases A and B

- Now suppose Company B plans to develop Lease B with four wells and
  - All necessary approvals are in place for this development plan
  - Each well has positive economics on an EMV basis
  - There are no known contingencies that would prevent the development
- So all of the commercial and technical maturity criteria have apparently been met
- Can Company B to book standalone Possible Reserves for all four wells?
  - Will Company B drill all four wells if the first well is a dry hole?



Four-Well Case – the Answer?

- The area in Lease B may be “possible” because it is below the LKO
  - The first well may prove the OWC is shallower than the highest point in the lease, so no further wells would be drilled
- Wells 2-4 are thus contingent on the results of Well 1, aren’t they?
  - But this line of reasoning could be applied to all wells in probable and possible areas below the LKO, for any project
  - Any well outside a proved area (except the first one) would then be contingent!
  - It seems unlikely this is what is the PRMS intends
- Thus, it may be legitimate for Company B to book standalone Possible Reserves for all four wells
  - On the understanding that some of these wells may be cancelled if initial drilling results are disappointing



Standalone Possible Reserves – Conclusions

- Standalone Possible Reserves are allowed under the PRMS in certain specific circumstances, provided that
  - "All the commercial and technical maturity criteria have been met"
- What economic criteria they should satisfy is unclear
  - I suggest the criterion should be that EMV > 0 at the appropriate discount rate
- Stand-alone Possible Reserves can exist in several different circumstances, not just on "adjacent leases"

Further Thoughts

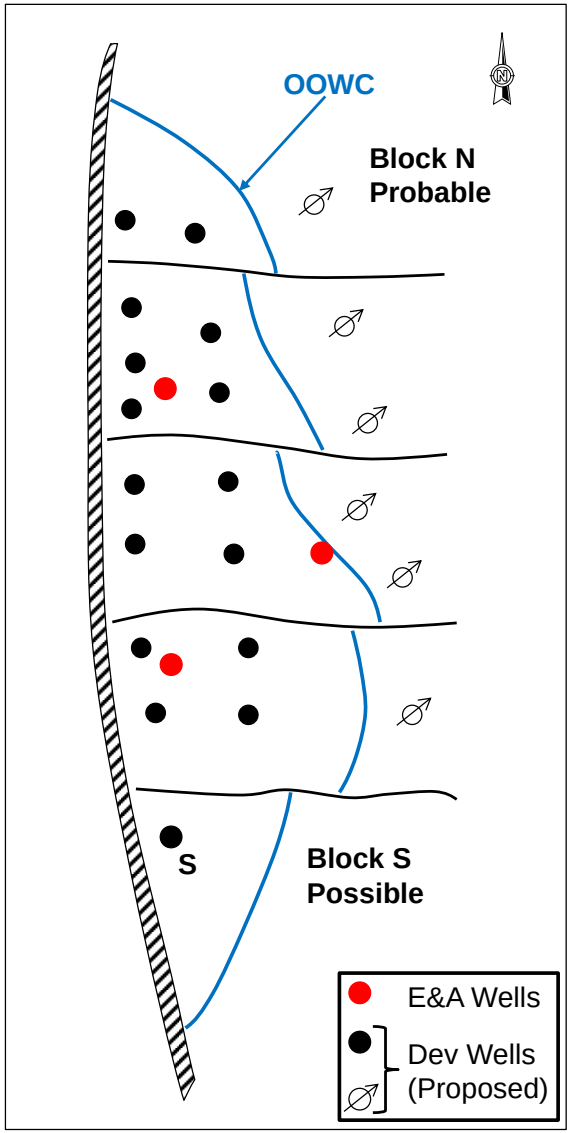
- Some of the considerations discussed apply to any Possible Reserves “located outside of the 2P area”
- Recall paragraph 2.2.2.8 C of the 2018 PRMS:

  “Possible Reserves that are located outside of the 2P area (not upside quantities to the 2P scenario) may exist only when the commercial and technical maturity criteria have been met (that incorporate the Possible development scope). Standalone Possible Reserves …”

Field Z Again – But at Time of FID

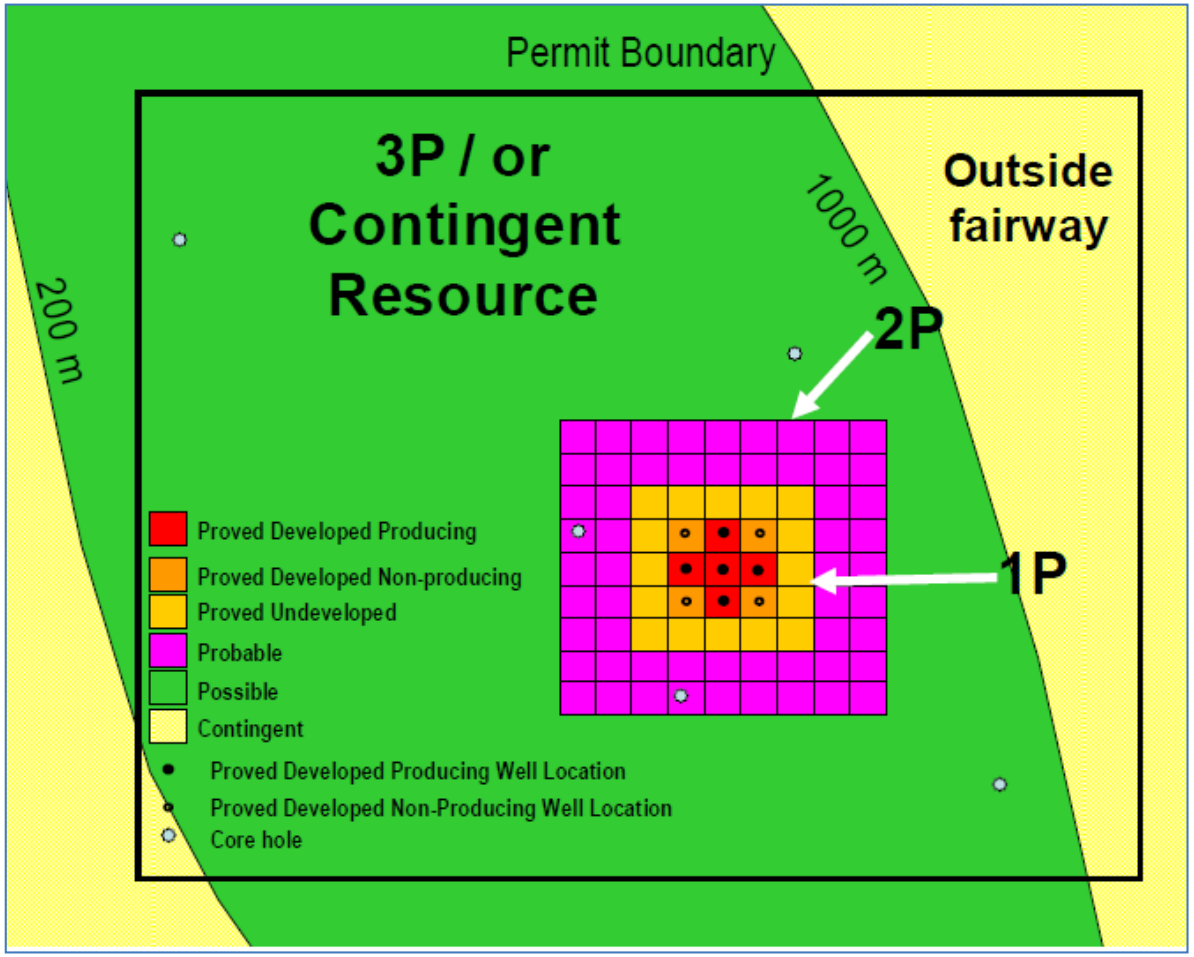
- FDP includes a well in Block S
- Only Possible Reserves can be assigned to this well
- 2P case has positive economics*
- Do the economics of Well S have to be tested?
  - If so, on what basis?
- What if the FDP included 4 wells in Block S?
  - Can Possible Reserves be assigned to all 4 wells?
  - Are three of them Contingent on results of the first?
  - How are these three described in the FDP?
  - Are these three really approved, to be cancelled if not required, or will additional approvals be needed?

*Should the cost of a dry hole in Block S be included in the 2P case economics?



Unconventional Example

- What if there are a really large number of “Possible” locations?



Source: PRMS Application Guidelines (2011)

Variable Project Scope (New in 2018)

- “2.1.3.4 Contingent and Prospective Resources can have different project scopes (e.g., well count, development spacing, and facility size) as development uncertainties and project definition mature”

- “2.1.3.7.4 The project development scenarios may vary in the number and type of wells, facilities, and infrastructure in Contingent Resources, but to recognize Reserves, there must exist the reasonable expectation to develop the project for the best estimate case”

Final Conclusion on PRMS 2018

- **There are still plenty of areas where further clarifications are needed!**

Thank you for your attention!