

Uncertainty: The Impact of Aggregation*

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Abstract

Both the PRMS and the new SEC rules limit Probabilistic aggregation of reserves to the “Project” level. Company proved reserves are then to be estimated by simple summation of the individual Project proved reserves. It is well established that such summation is mathematically illegitimate and that it produces proved reserves that are increasingly conservative. How conservative depends on how Projects are defined and the estimated ultimate recovery (EUR) distribution type and variance.

PRMS guidelines and SEC rules both allow a probabilistic definition of proved reserves as the 90% confidence (or having at least that proved amount) or P90 of the EUR distribution.

This article presents a number of examples illustrating the impact of probabilistic aggregation versus simple addition for a series of projects. We discuss the relevance and importance of how Projects are defined and the potential impact on proved undeveloped (PUD) reserves for conventional reservoirs and continuous accumulations (unconventional resources).

UNCERTAINTY: The Impact of Aggregation

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PRMS/ “New” SEC

Questions, Questions & More Questions



PUD Booking
(allowable
offsets)?

Principles-based?

Continuous (UCR) reservoirs?

What is a “Project”?

AGGREGATION??

UNCERTAINTY - The Impact of Aggregation

How does Aggregation affect Uncertainty?

Does it really matter how and at what level we aggregate reserves? Why or why not?

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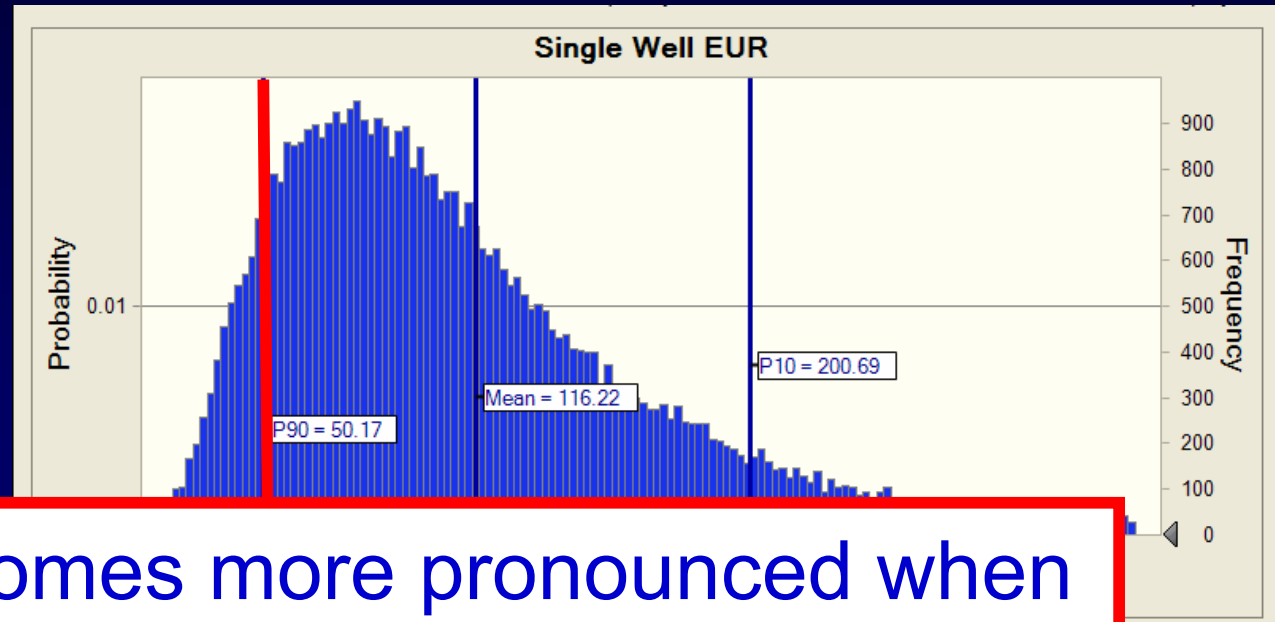
What impact does Aggregation have on Uncertainty?

The short answer – It reduces it!

Let's look at an example...

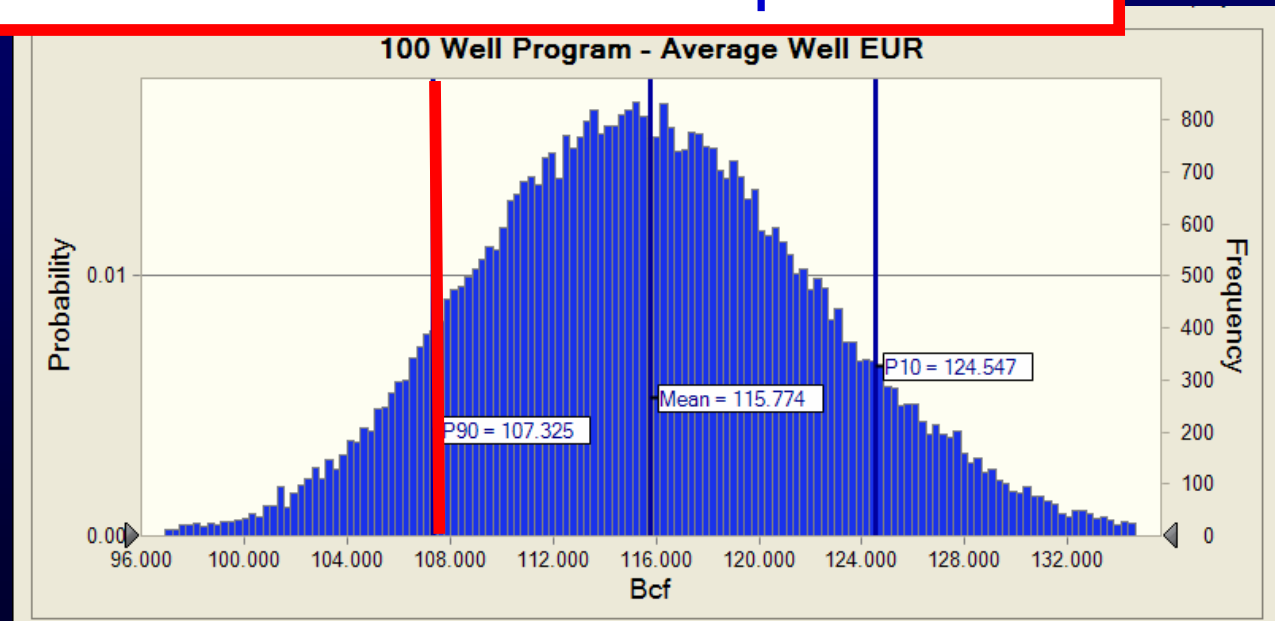
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Single Well P90 = 50 mbo
 $P10/P90 = 4$



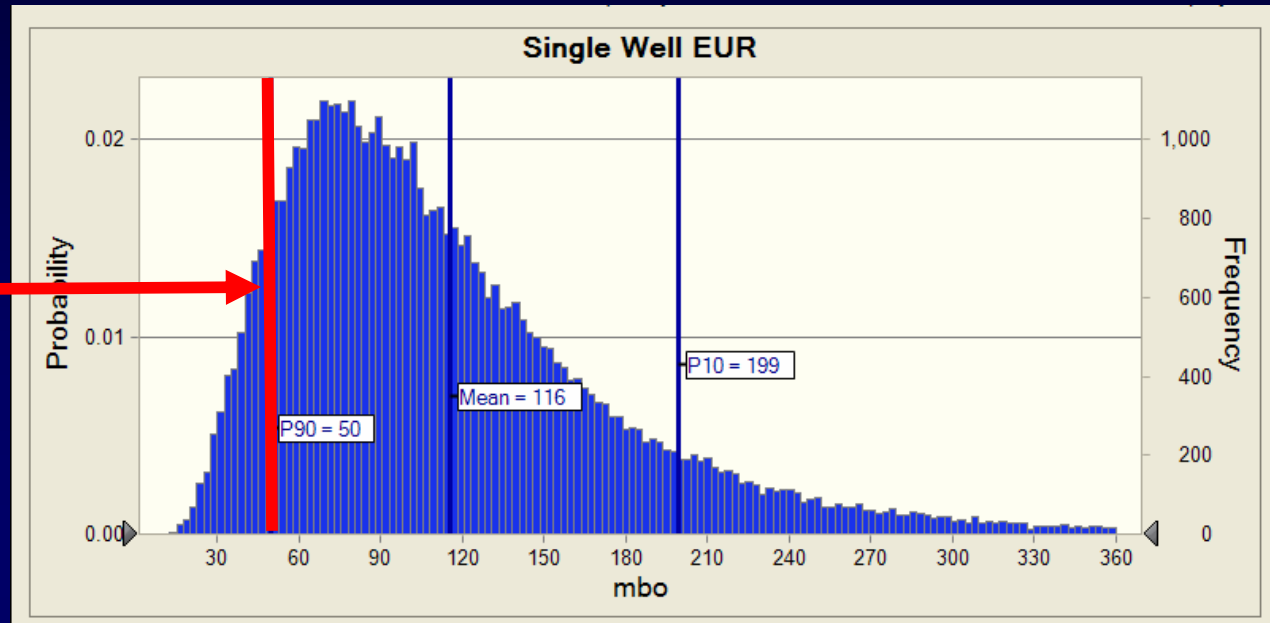
The impact becomes more pronounced when using the same x-axis scale on both plots!

100 Well "Portfolio"
Avg Well P90 = 107 mbo
 $P10/P90 = 1.2$

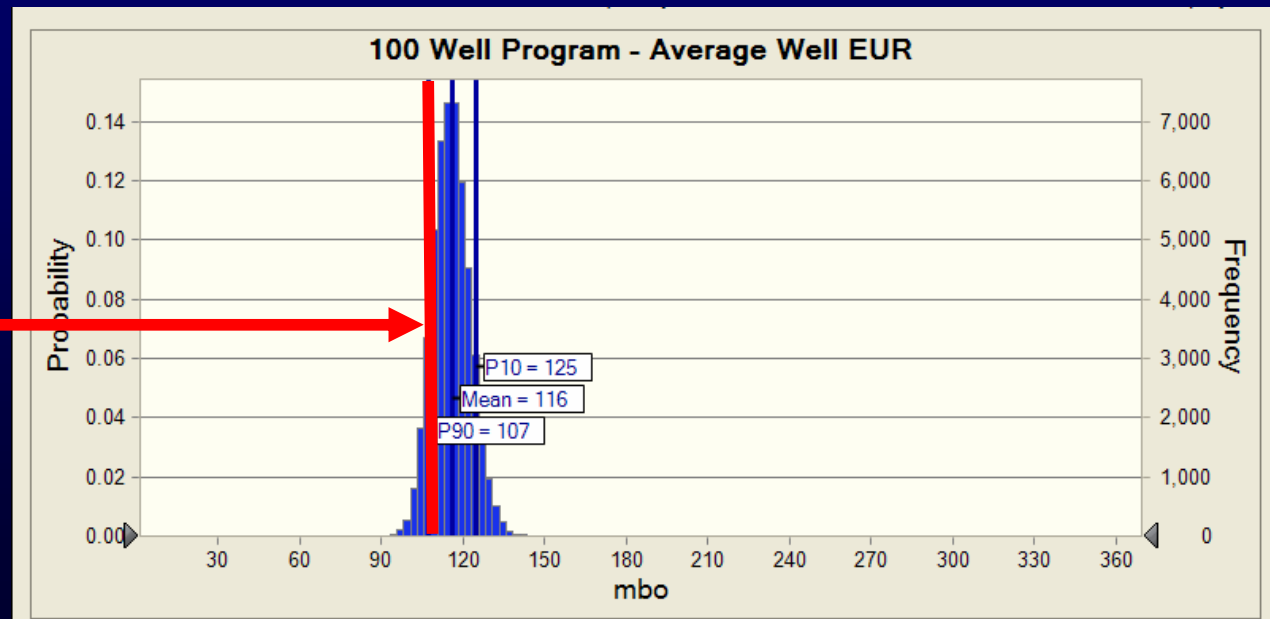


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Single Well P90 = 50 mbo
 $P_{10}/P_{90} = 4$



100 Well "Portfolio"
Avg Well P90 = 107 mbo
 $P_{10}/P_{90} = 1.2$



PRMS/New SEC

Aggregation: Better But Still Mathematically Conservative

A Tale of Three Companies

Common Data: P90 (1P) = 50,000 mbo/zone, P10/P90 = 4

Small Company*

Comparable to Cabot, Edge or Southwestern

Mid-Size Company*

Comparable to EOG, Murphy or Newfield

Large Company*

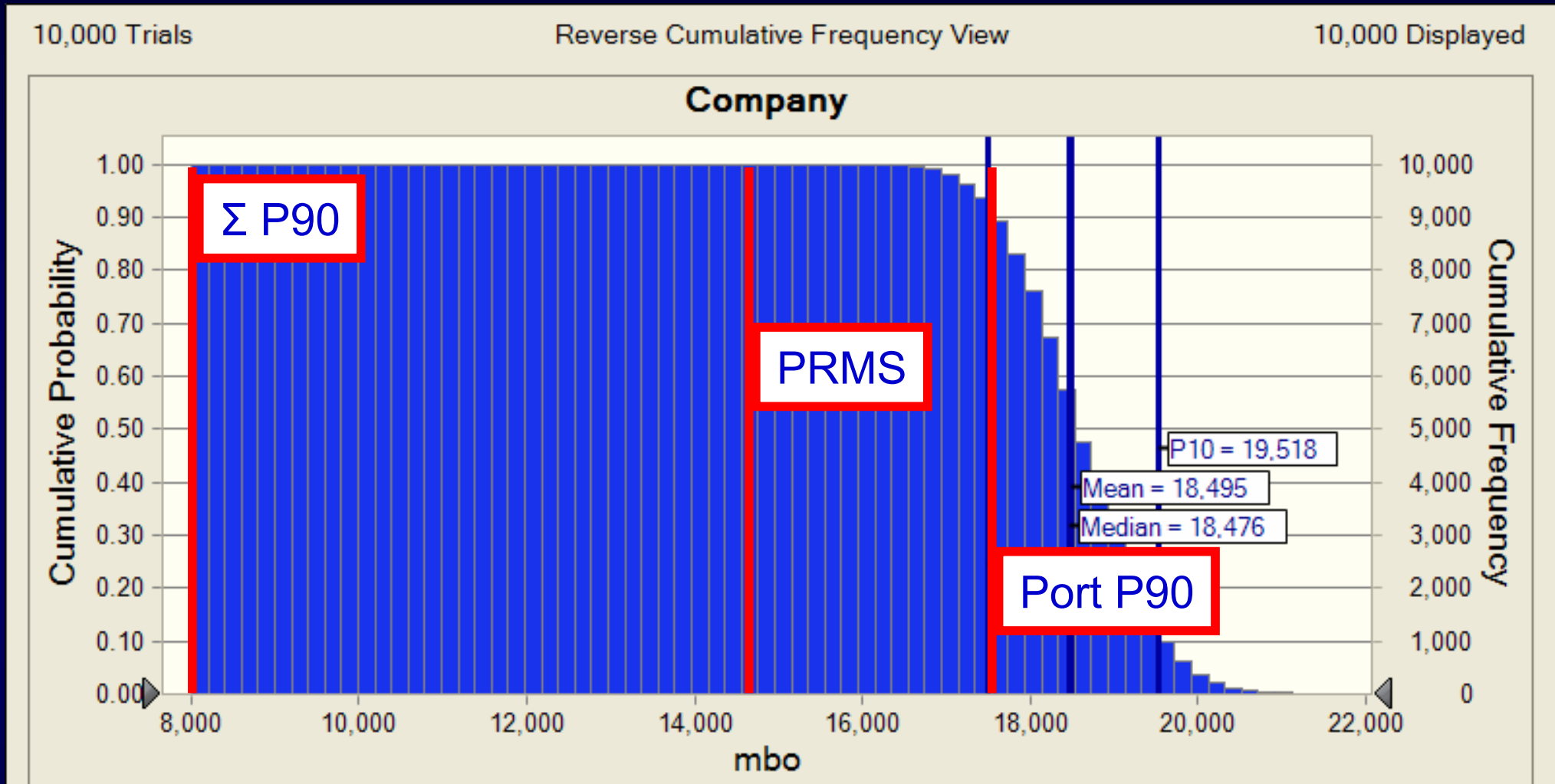
Comparable to Hess or Marathon

* Oil reserves ONLY, not oil equivalent

Aggregation – 3 Company Comparison

	<u>Small Company</u>	<u>Mid-Size Company</u>	<u>Large Company</u>
Zones/Well	1	2	2
Wells/Property	5	5	10
Properties/Field	2	3	4
Fields/Trend	2	3	4
Trends/Basin	2	2	2
Basins/Region	2	3	4
Regions/Company	2	3	4
Total Zones	160	1,620	10,240

Aggregation – Small Company Impact



Σ P90 – Simple addition of zone P90 values

PRMS – Probabilistic aggregation through the Field level only

Port P90 – Probabilistic aggregation through the Company level

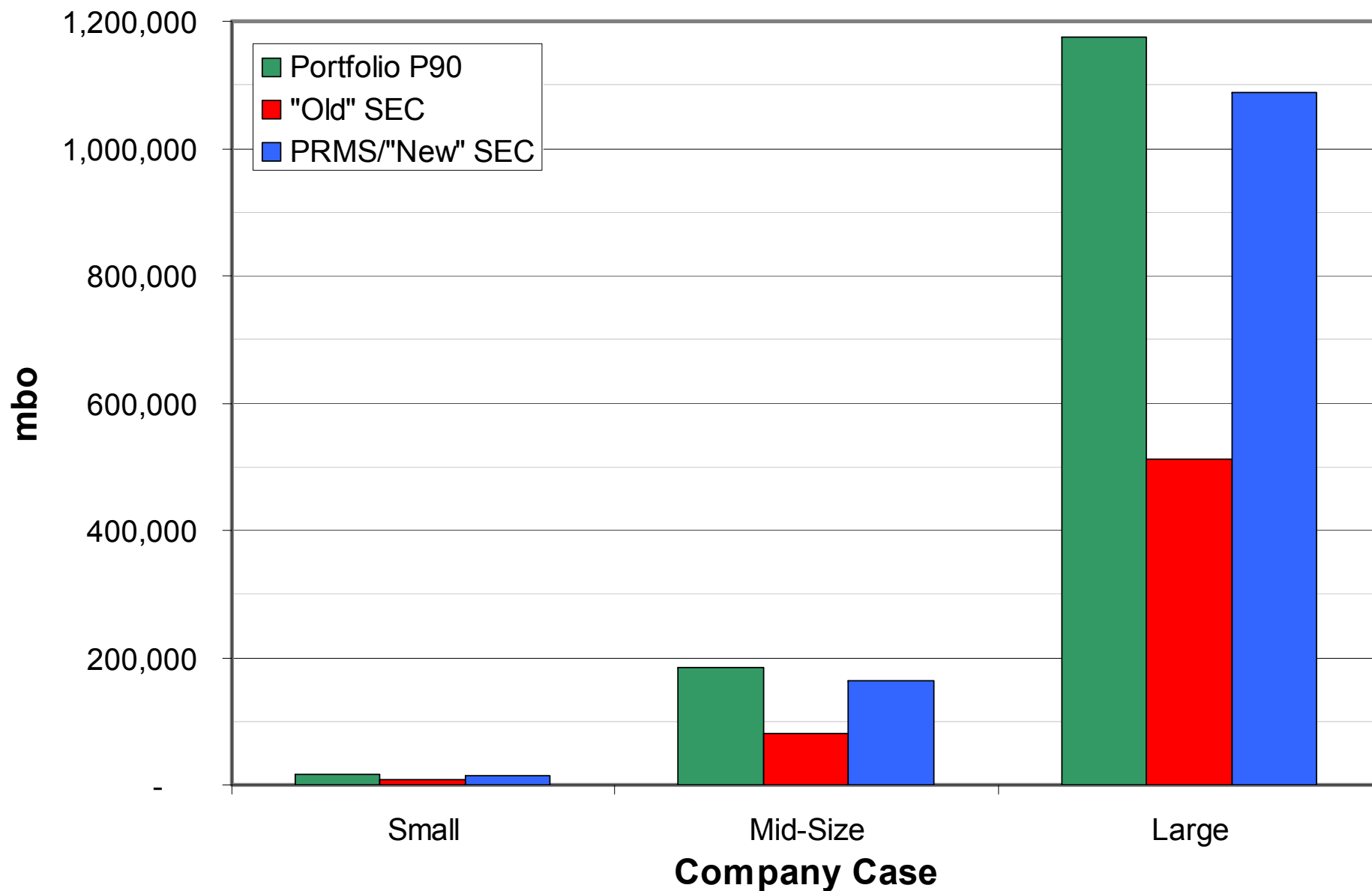
Aggregation – 3 Company Comparison

“What difference does Aggregation make?”

<u>Company</u>	<u>"Old" SEC (Σ P90) mbo</u>	<u>Portf P90 mbo</u>	<u>PRMS/ "New" SEC mbo</u>	<u>"Lost" Reserves mbo / %</u>
Small	8,000	17,501	14,422	3,079 / 18
Mid-Size	81,000	184,100	162,700	21,400 / 12
Large	512,000	1,176,100	1,088,250	87,850 / 7

“Lost” Reserves – The difference between the Portfolio P90 (full probabilistic aggregation) and PRMS/ “New” SEC (aggregation through the Field level only).

Aggregation – 3 Company Comparison



UNCERTAINTY - The Impact of Aggregation

How does Aggregation affect Uncertainty?

Does it really matter how and at what level we aggregate reserves? Why or why not?

“I’m a staff geoscientist and have no influence over how we aggregate reserves. What role do I have with all of this?”