

# TASMANIA EL 14/2009

## RISK ASSESSMENT & VOLUMETRICS

Larapintine Petroleum System (Ordovician-Devonian)					
RPS			GES		
Play Chance		Prospect Chance %			
RFs	%	RFs	Bellevue	Thunderbolt	
Reservoir	48	Trap	70	50	
Seal	100	Charge	80	80	
Source/Migration	25	Reservoir	60	60	
Play Chance	12	Seal	50	25	
		Prospect Chance	17	6	
Overall Chance			2.00	0.72	

Gondwana PS (Permian-Triassic) - GES		
Prospect Chance %		
RFs	Bellevue	Thunderbolt
Source	80	75
Reservoir	70	70
Trap	70	70
Timing/Mig.	60	60
Prospect Chance	24	22

Mean Prospective Resources MMB Oil			
	Permo-Triassic	Ordovician	Total
Bellevue	129	220	349
Thunderbolt	63	88	151
Total	192	308	500

# TASMANIA EL 14/2009 - RISK ASSESSMENT & VOLUMETRICS

## Summary

Because of the nature of risking, estimating chance of success (COS) is inherently imprecise and rather subjective, with methods relying on a number of chance factors that often are incomplete and based on indirect data.

The RPS model of dual play and prospect risk assessment (October 2008) yields a very pessimistic and restrictive view of the overall chance of success of individual prospects/leads in Empire Energy's EL 14/2009 permit onshore Tasmania (formerly SEL 13/98).

Bellevue, the largest prospect, has been assigned by RPS an overall chance of success of 2%. This value is misleading, as it includes double risking of certain geological factors. The value that best describes the chance of success (COS) is the prospect specific chance, estimated by RPS at 17%.

Our proposed risk assessment model yields more encouraging prospect probabilities, with a range of chance of success for the Bellevue prospect between 19% and 26%. These values could raise anew the interest of the financial and investing communities in the Tasmania project.

Prospective resource estimates for the Permian-Triassic exploration play in Bellevue and Thunderbolt prospects – completely ignored by RPS – are reviewed in this memorandum.

## The RPS Model

Table 1 (upper left panel) lists the geological factors and illustrate the methodology used by RPS in assessing probability of success for the Bellevue and Thunderbolt prospects.

The RPS model (middle left panel) comprises a two-step process for calculating overall chance of success: a Play Chance (the probability that at least one play in the basin contains recoverable resources); and, a Prospect Specific Chance (the probability that one prospects in the play contains recoverable hydrocarbons).

For Bellevue, the play chance of 12% is multiplied by the prospect chance of 17% to obtain the overall chance of success of 2%.

RPS uses three geological attributes (or Risk Factors RFs) to calculate the play chance, and four RFs for the prospect chance. Note that the serial multiplication of the seven factors listed in Table 1 produces the overall 2% COS value:  $0.48 \times 1.0 \times 0.25 \times 0.7 \times 0.8 \times 0.6 \times 0.5 = 0.02016$ .

Three geological factors [reservoir, seal, source/migration (charge)] in the model are common to both play and to prospect chance assessment. The occurrence of common or shared geological factors results in double risking of certain factors. Consequently, overall risk is much higher, since it is the product of seven factors, instead of four (the three above plus trap) that should be used in overall risk assessment (see further, Proposed Model).

The 2% valuation is practically meaningless, for these reasons:

- A 2% COS, which equates to an exceedingly large exploration risk of 1:50, means a 98% chance of dry hole on the first drilling attempt.
- The RPS model appears unlikely and highly questionable. Truly unfavourable, negative models are very likely to be based on supporting evidence of dry wells and other direct geological, geophysical, and geochemical data. This is not the case for Tasmania.
- Lack of data/information on plays/prospects should not necessarily result in overly negative assessment; rather, a more neutral approach would be preferable (see further).

From the above discussion, it is concluded that, under the RPS model, the prospect chance of 17% is the value that best represents the prospectivity and potential of the Bellevue prospect. It is this value, not 2%, that RPS should have reported in the Executive Summary of the CPR.

## **Proposed Model**

The ***petroleum prospect chance of success*** is the key factor in all exploration ventures. It is commonly the main factor on which most companies base their oil prospect exploration decisions. Naturally, knowledge of the prospect geological framework (petroleum system, basin-wide play distribution, and associated chance factors) is a prerequisite when the prospect probability of discovering hydrocarbon resources is addressed.

Concepts and models of petroleum prospect probability evaluation are not universally uniform, and there are significant differences in approach to valuation and in the number and nature of geological chance factors used.

The proposed model (Table 1, upper right panel) is based on Chevron's model published in 1997 (Otis & Schneidermann). The probability of geologic success is the product of individual probabilities of occurrence for four basic factors (or risk factors, RFs): source, reservoir, trap and play dynamics (timing and migration).

In Chevron's model, elements of risk are described as unfavourable (0.05-0.30), questionable (0.30-0.50), neutral (0.50), encouraging (0.50-0.70), and favourable (0.70-1.00). Factors which have an equal probability of positive or negative outcomes are assigned a probability of occurrence of 0.5 (50%). This applies in the case of lack of data and information on one or more elements for that specific factor. For any risk factor, the weakest element determines the risk.

Therefore, a neutral assessment of 0.5 (50% probability) for all four factors yields a 6.25% COS, which compares with most petroleum evaluators' perception of about a 5% COS on a wildcat well.

In the Chevron's approach, a model supported by indirect analogical data (as is the case for Tasmania) may be described as encouraging, allowing the geologist to assign relatively low risk probabilities in the range of 0.5 to 0.7.

## **Bellevue Prospect – Risk Factor Analysis**

Probability value assigned to the different parameters, and conclusions thereon, are provisional. The final assessment of COS and risk factors for all the prospects/leads, will

be made at the completion of ongoing evaluation of geochemical data and information in Tasmania.

The Bellevue prospect is a large domal structure with Larapintine petroleum system targets (Ordovician-Devonian).

Factor probabilities are estimated as follows:

<b>Factors</b>	<b>Neutral case %</b>	<b>Low case %</b>	<b>Best case %</b>
Source	50	60	65
Reservoir	50	72	76
Trap	50	80	88
Timing & Migration	50	55	60
<b>Overall chance</b>	<b>6.25%</b>	<b>19%</b>	<b>26%</b>

It is therefore concluded the probability of success for the Bellevue prospect ranges from 19% to 26%, with a corresponding risk of 1:38 to 1:52 (moderately high). The neutral case has a 6.25% COS.

The value of 26% is taken to indicate the most probable prospect chance of discovering hydrocarbons in the Ordovician-Devonian play for the Bellevue prospect. This value is shown in Table 1, upper right panel.

Similarly, the prospect chance for Thunderbolt is estimated at 16% under our model, as opposed to 6% under the RPS model.

### **Volumetrics: Permian-Triassic Play**

RPS have completely neglected to carry out estimates of prospective resources for the Permian-Triassic (Gondwana) play system in the Bellevue and Thunderbolt prospects.

Table 2 summarises our evaluation of prospective resources for the Permian-Triassic play in both prospects. The Three-Point Method resource determination, a simple model that multiplies several and variable input parameters, has been used to derive resource estimates for the 5%, 50% and 95% case, respectively. No Monte Carlo simulation has been applied.

Recoverable mean prospective resources in the Bellevue and Thunderbolt prospects, for both Permo-Triassic and Ordovician-Devonian plays, are summarised in Table 1, lower right panel.

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London  
11 April 2012

## **Selected References**

**CCOP, 2000**, Guidelines for Risk Assessment of Petroleum Prospects; *Coordinating Committee for Coastal and Offshore Geoscience Programme in East and Southeast Asia*, Bangkok, Thailand, 35 p.

**Otis, R. & Schneidermann N., 1997**. A process for evaluating exploration prospects: *AAPG Bulletin*, 81/7, p. 1087-1109.

**Rose, P.R, 1992**. Chance of success and its use in petroleum exploration; in *R. Steinmetz, ed, The business of petroleum exploration: AAPG Treatise of Petroleum Geology*, p. 71-86.

**Salleh, S.H., E. Rosales & I. Flores-de la Mota, 2007**. Influence of different probability based models on oil prospect exploration decision making: a case from southern Mexico; *Revista Mexicana de Ciencias Geologicas*, 24/3, p. 306-317.

## Larapintine Petroleum System (Ordovician-Devonian)

RPS				
Play Chance		Prospect Chance %		
RFs	%	RFs	Bellevue	Thunderbolt
Reservoir	48	Trap	70	50
Seal	100	Charge	80	80
Source/Migration	25	Reservoir	60	60
		Seal	50	25
Play Chance	12	Prospect Chance	17	6
Overall Chance			2.00	0.72

GES		
Prospect Chance %		
RFs	Bellevue	Thunderbolt
Source	65	65
Reservoir	76	76
Trap	88	65
Timing/Mig.	60	50
Prospect Chance	26	16

RPS Model
Two-step process: 1) Play Chance and 2) Prospect Chance.
Play Chance - multiplication of three RFs (Risk Factors): $0.48 \times 1.0 \times 0.25 = 12\%$ or Risk= 1:8.
Prospect Chance - multiplication of four RFs: $0.7 \times 0.8 \times 0.6 \times 0.5 = 17\%$ or Risk= 1:6.
Overall Risk = product of play chance and prospect chance: $0.12 \times 0.17 = 2\%$ .
Note that three RFs (reservoir, seal, source/migration (charge)) are common to both play & prospect chance assessment.
The occurrence of common or shared geological factors results in double risking of certain factors.
As a result, the overall risk is much higher, as it is the serial multiplication of 7 RFs: $0.48 \times 1.0 \times 0.25 \times 0.7 \times 0.8 \times 0.6 \times 0.5 = 0.02$ or 2%.

GES Model
Based on Chevron's Model (1997).
Probability of geologic success is the product of individual probabilities of occurrence of four basic factors.
Elements of risk are described as unfavourable (0.05-0.30); questionable (0.30-0.50); neutral (0.50); encouraging (0.50-0.70); and favourable (0.70-1.00).
Factors with equal probability of positive or negative outcomes are assigned a 50% (0.50) probability of occurrence.

Gondwana PS (Permian-Triassic) - GES		
Prospect Chance %		
RFs	Bellevue	Thunderbolt
Source	80	75
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Mean Prospective Resources MMB Oil			
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TABLE 1 - TASMANIA : GEOLOGICAL RISKING & VOLUMETRICS

# GONDWANA PETROLEUM SYSTEM (PERMIAN-TRIASSIC)

## Three Point Method Resource Determination

<b>BELLEVUE PROSPECT</b>	5%	50%	95%	Mean
Conversion Factor (bbl/acre-ft)	7758	7758	7758	7758
Area (Acres)	6000	8000	10000	8000
Number of Pay zones	1.00	1.00	1.00	1.00
Gross pay (Feet)	55.00	80.00	110.00	80.93
Net to Gross	1.00	1.00	1.00	1.00
Geometric Factor	0.50	0.65	0.80	0.65
Oil Volume Ratio	1.00	1.00	1.00	1.00
Porosity	0.15	0.25	0.30	0.24
HC Saturation	0.65	0.80	0.90	0.79
1/FVF	0.83	0.80	0.95	0.83
Recovery Factor	0.20	0.25	0.30	0.25
	Low	Median	High	
	<b>20.72</b>	<b>129.09</b>	<b>525.34</b>	<b>129.47</b>

<b>THUNDERBOLT PROSPECT</b>	5%	50%	95%	Mean
Conversion Factor (bbl/acre-ft)	7758	7758	7758	7758
Area (Acres)	2000	3000	5000	3185
Number of Pay zones	1.00	1.00	1.00	1.00
Gross pay (Feet)	60.00	100.00	130.00	98.15
Net to Gross	1.00	1.00	1.00	1.00
Geometric Factor	0.50	0.65	0.80	0.65
Oil Volume Ratio	1.00	1.00	1.00	1.00
Porosity	0.15	0.25	0.30	0.24
HC Saturation	0.65	0.80	0.90	0.79
1/FVF	0.83	0.80	0.95	0.83
Recovery Factor	0.20	0.25	0.30	0.25
	Low	Median	High	
	<b>7.53</b>	<b>60.51</b>	<b>310.43</b>	<b>62.52</b>

TABLE 2 - TASMANIA EL 14/2009 : PROSPECTIVE RESOURCE ESTIMATE