Dorado Contingent Resources

15 July 2019

CARNARVON PETROLEUM LTD

Highlights

- **Major resource in Dorado supported by independent technical expert**
- **Dorado-2 appraisal well success materially de-risked the Dorado development**
- **Final Investment Decision for development targeting the end of 2020**

Carnarvon Petroleum Limited ("Carnarvon" or the "Company") (ASX:CVN) engaged international energy expert ERC Equipoise Pty Ltd ("ERCE") to independently review the Dorado resource following the Dorado-2 appraisal well. ERCE has carried out this work using the June 2018 SPE/WPC/AAPG/SPEE Petroleum Resources Management System (PRMS) as the standard for classification and reporting. (https://secure.spee.org/sites/spee.org/files/prmgmtsystem_final_2018.pdf).

ERCE's work, summarised in the table below, confirms a major resource in the Dorado discovery containing oil, condensate, free and associated gas.

Gross Unrisked Contingent Resources	1C	2C	3C
Oil and condensate ("liquids") (million barrels)	86	162	285
Free and associated gas ("gas") (billion standard cubic feet)	367	748	1,358
Liquids and gas combined (million barrels of oil equivalent)	176	344	614
Carnarvon's previous volume estimate following Dorado-1 result (million barrels of oil equivalent) Refer to ASX announcement of 20 August 2018	128	283	566

Notes:

1) *"Gross Contingent Resources" are 100% of the volumes estimated to be recoverable from the discovery without any economic cut-off being applied.*
2) *Contingent Resources are 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 is not certain that the discovery will be developed or that the volumes reported as Contingent Resources will be recovered.*
3) *Totals shown are the deterministic addition of the probabilistic resources estimated for each reservoir. Assuming a degree of independency between reservoirs, deterministic addition will underestimate the low estimate and overestimate the high estimate.*
4) *Volumes reported here are "unrisked" in the sense that no adjustment has been made for the risk that the project may not be developed in the form envisaged or may not go ahead at all (i.e. no Chance of Development factor has been applied).*
5) *Chance of Development for the Contingent Resources shown here has been estimated to be 75%. This is based on further appraisal, development being at concept select phase and distance to existing gas infrastructure.*
6) *Contingent Resources have been sub-classified as "Development Unclarified" under the PRMS.*
7) *Natural gas volumes include inert gas (CO_2 and N_2) volumes of approximately 2% estimated from reservoir sampling.*
8) *Conversion from gas to barrels of oil equivalent is based on Gross Heating Value. The conversion is based on composition of gas in each reservoir and is 4.07 Bscf/MMboe, 3.85 Bscf/MMboe, 4.16 Bscf/MMboe, 4.45 Bscf/MMboe, and 3.87 Bscf/MMboe for the Upper Caley, Caley associated gas, Crespin, Baxter and Milne reservoirs, respectively.*

Dorado is located in WA-437-P in which Carnarvon holds a 20% interest.

Net Unrisked Contingent Resources	1C	2C	3C
Liquids (million barrels)	17	32	57
Gas (billion standard cubic feet)	73	150	272
Liquids and gas combined (million barrels of oil equivalent)	35	69	123
Carnarvon's previous estimate following Dorado-1 result (million barrels of oil equivalent) Refer to ASX announcement of 20 August 2018	26	57	113

See Notes below previous table

The work undertaken by ERCE is outlined in the attached report. This work included a review of the seismic data, reservoir engineering data, recovery factors, interpretation of porosity, hydrocarbon saturation and net reservoir thickness from the wireline logging program, analysis of potential hydrocarbon columns from the pressure data and a review of the fluid properties derived from the oil, gas and condensate samples.

ERCE has identified the remaining key contingencies that are required to be addressed prior to the recoverable volumes at Dorado being classified as Reserves. These include the drilling of the planned Dorado-3 appraisal well, selection of the field development concept and determination of commerciality.

Carnarvon Managing Director Adrian Cook said "we engaged ERCE to provide us with a robust assessment of the recoverable volumes from the Dorado structure and we are comfortable that the results of ERCE's review support the Company's views on the development potential for this project. As ERCE note in point 3 on the previous page, a deterministic methodology may underestimate the low case and over estimate the high case outcomes relative to a probabilistic method. Carnarvon would typically assess its volumes on this project at this time using the probabilistic methodology. However, the more conservative approach by ERCE for the low side case only strengthens Carnarvon's comfort in the commercial rigidity of this project.

The independently evaluated best case estimate of 162 million barrels (gross, 2C basis) for the Dorado liquids resource confirms we have discovered a very large field and a significant asset on the North West Shelf. The oil and gas-condensate found in the different reservoirs in Dorado are very similar in nature. Work to date indicates that the development facilities, production and the value of the saleable product for oil and condensate are likely to be similar."

The 1C liquids volume estimates provide the Joint Venture with a high degree of confidence to advance the field development concept evaluation work. A second appraisal well (Dorado-3) is scheduled in late 2019 to further assess reservoir connectivity and carry out flow testing before commencement of the Front End Engineering Design ("FEED"). A number of development concepts are currently being studied to develop the field. This includes the production of the oil and condensate and re-injection of the gas to enhance liquid recoveries before the gas is then subsequently produced.

The gas volume of 748 billion cubic feet is also a large resource, particularly when combined with the nearby Roc resource of 332 billion cubic feet (Gross 2C Contingent Resources disclosed in Carnarvon's ASX announcement dated 23 April 2018, unaudited by ERCE). Carnarvon sees a broad range of options for the development of the gas given that over one trillion cubic feet has been confirmed on a gross 2C basis. Gas assets of this scale are appealing in their ability to generate stable long-term cash flows.

The ERCE Contingent Resources estimates for Dorado are summarised in the tables above. Compared with the Company's previous estimates following the Dorado-1 result, the ERCE estimates (which are based on the additional results from the Dorado-2 well) are different due primarily to:

1. The determination of the oil water contact ("OWC") in the Caley formation in Dorado-2. The OWC was encountered as predicted and within the pre-drill range of outcomes albeit around 25 metres higher than Carnarvon's mid-case estimate. This had the consequence of reducing the estimate of recoverable oil from this reservoir;
2. There is an increase in the gas volumes due to two factors. Firstly, certain portions of the field outside the Caley reservoir have been reclassified from oil to condensate rich gas. ERCE undertook an independent review of the fluid types and have generally aligned with the operator's classifications at this stage, which are generally gas and condensate weighted. These classifications may be refined further following laboratory testing and additional well results. Secondly, in the Baxter and Milne reservoirs, the Dorado-2 well did not encounter a hydrocarbon-water contact thereby increasing the estimates of gas for these intervals.

In summary, the Dorado-2 well results have confirmed that all the reservoirs intersected in this well are in pressure communication with equivalent reservoirs in Dorado-1 approximately 2 kilometres away. This has enabled further refinement on possible hydrocarbon-water contacts particularly in the Caley oil reservoir, thus improving the definition of the range of volume estimates and increasing certainty for future development. While the mid case (2C) as calculated by ERCE is broadly similar to the pre-drill estimates of Carnarvon, the increase in confidence in the 1C Contingent Resources estimate is important for development funding purposes and consequently the result is an important and positive outcome for Carnarvon.

The above Contingent Resources do not include those from the Roc field which comprise an additional 332 bcf of gas and 20 million barrels of condensate (Gross 2C Contingent Resources, refer to Carnarvon's ASX announcement on 23 April 2018 for detailed information on this resource). Carnarvon is not aware of any new information or data that materially affects the Roc resource information and believes that all material assumptions and technical parameters underpinning the estimates in this announcement continue to apply and have not materially changed. ERCE have not undertaken an independent review of the Roc resources.

Nomenclature and Units

1C	Denotes low estimate of Contingent Resources.
2C	Denotes best estimate of Contingent Resources.
3C	Denotes high estimate of Contingent Resources.
Barrels	One barrel is equal to 159 litres
Standard cubic feet	Standard cubic feet measured at 14.7 pounds per square inch and 60 degrees Fahrenheit

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Annexure

Competent Person Statement Information

The resource estimates outlined in this report were compiled by the Company's Chief Operating Officer, Mr Philip Huizenga, who is a full-time employee of the Company. Mr Huizenga has over 25 years' experience in petroleum exploration and engineering. Mr Huizenga holds a Bachelor Degree in Engineering, a Masters Degree in Petroleum Engineering and is a member of the Society of Petroleum Engineers. Mr Huizenga is qualified in accordance with ASX Listing Rules and has consented to the form and context in which this statement appears.

Forward Looking Statements

This document may contain forward-looking information. Forward-looking information is generally identifiable by the terminology used, such as "expect", "believe", "estimate", "should", "anticipate" and "potential" or other similar wording. Forward-looking information in this document includes, but is not limited to, references to: well drilling programs and drilling plans, estimates of reserves and potentially recoverable resources, and information on future production and project start-ups. By their very nature, the forward-looking statements contained in this news release require Carnarvon and its management to make assumptions that may not materialize or that may not be accurate. The forward-looking information contained in this news release is subject to known and unknown risks and uncertainties and other factors, which could cause actual results, expectations, achievements or performance to differ materially, including without limitation: imprecision of reserve estimates and estimates of recoverable quantities of oil, changes in project schedules, operating and reservoir performance, the effects of weather and climate change, the results of exploration and development drilling and related activities, demand for oil and gas, commercial negotiations, other technical and economic factors or revisions and other factors, many of which are beyond the control of Carnarvon. Although Carnarvon believes that the expectations reflected in its forward-looking statements are reasonable, it can give no assurances that the expectations of any forward-looking statements will prove to be correct.

13 July 2019

Carnarvon Petroleum Pty Ltd

Level 2, 76 Kings Park Road

West Perth WA 6872

Australia

Attention: Mr Philip Huizenga

Dear Sir,

Re: Independent Technical Review of Carnarvon Petroleum's Dorado Discovery

In response to your request, ERC Equipoise Pte Ltd ("ERCE") has carried out an Independent Technical Review ("ITR") of Carnarvon Petroleum Pty Ltd ("Carnarvon") interests in the Dorado Discovery, located in the WA-437-P license, offshore Western Australia.

ERCE reports in this letter all Contingent Resources estimated to be recoverable from the Dorado Discovery as at 30 June 2019.

ERCE has made every effort to ensure that the interpretations, conclusions and recommendations presented in this report are accurate and reliable in accordance with good industry practice. ERCE does not, however, guarantee the correctness of any such interpretations and shall not be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation or recommendation made by any of its officers, agents or employees.

This report is produced solely for the benefit of and on the instructions of ERCE's client named in the contract, and not for the benefit of any third party. Any third party to whom the client discloses or makes available this report shall not be entitled to rely on it or any part of it.

Carnarvon agrees to ensure that any publication or use of this report which makes reference to ERCE shall be published or quoted in its entirety and the client shall not publish or use extracts of this report or any edited or amended version of this report, without the prior written consent of ERCE.

In the case that any part of this report is delivered in digital format, ERCE does not accept any responsibility for edits carried out by the client or any third party or otherwise after such material has been sent by ERCE to the client.

ERCE has carried out this work compliant with the reporting requirements of the Australian Stock Exchange ("ASX"). These requirements are based on the SPE/WPC/AAPG/SPEE/SEG/SPWLA/EAGE Petroleum Resources Management System, as revised in June 2018 ("PRMS"). The full text of the PRMS can be downloaded from:

https://secure.spee.org/sites/spee.org/files/prmgmtsystem_final_2018.pdf

In applying these standards, nothing came to the attention of ERCE that would suggest that information provided by Carnarvon was not complete and accurate. ERCE reserves the right to review all calculations referred to or included in this report and to revise the estimates in light of erroneous data supplied or information existing but not made available which becomes known subsequent to the preparation of this report.

The accuracy of any resources estimates is a function of the quality and quantity of available data and of engineering interpretation and judgment. There are numerous uncertainties inherent in estimating resources. While the resources estimates presented herein are considered reasonable, the estimates should be accepted with the understanding that new data arising subsequent to the date of the estimate may justify revision, either upward or downward.

Introduction

Permit WA-437-P is located approximately 160 km offshore of Port Headland, NW Australia. The permit covers an area of 4,840 km^2 and water depths across the block range from 60 m to 140 m. Carnarvon entered the permit in 2009 and currently holds a 20% non-operated interest. The permit is operated by Santos, which holds the remaining 80% interest.

The current five-year phase of WA-437-P commenced in 4 November 2014. There are no remaining commitments or relinquishments in the current phase. Four wells are currently drilled on the permit, Roc-1, Roc-2, Dorado-1 and Dorado-2. A summary of the permit is shown below in Table 1.

Table 1: WA-437-P Permit Summary

Country	Permit	Discoveries	Carnarvon Working Interest (%)	License		Current Area (km2)	Outstanding Commitments
				Start of Current Phase	End of Current Phase		
Australia	WA-437-P	Dorado / Roc	20.00	04/11/2014	03/08/2019	4,840	None

Well Dorado-1 was drilled by Quadrant Energy in May 2018 and reached a total depth of 4,554 mTVDSS. The well encountered hydrocarbon bearing reservoirs in the Caley, Baxter, Crespin and Milne Formations; top reservoir was intersected at a depth of 4,000 m. A total of 43 valid

XPT / MDT points were acquired along with 26 PVT / bulk samples. No core was taken, and no DSTs were performed. The well was subsequently plugged and abandoned.

A follow up appraisal Well Dorado-2 was drilled in May 2019 by Santos Energy to a total depth of 4,524 mTVDSS. Petrophysical and pressure data showed all four formations were encountered with a hydrocarbon water contact encountered within the Caley and a water-bearing Crespin interval. A total of 51 valid XPT / MDT points were acquired along with 25 PVT / bulk samples. 233 m of core was taken, and no DSTs were performed.

It is ERCE's understanding that a third appraisal well is planned in late 2019. The well will be designed to further evaluate reservoir connectivity within the field and will carry out a number of flow tests.

Data Provided

Carnarvon provided ERCE with a dataset which comprised:

- Well data, including composite logs and end of well reports
- Open-hole well logs and digital interpreted petrophysical logs with associated reports
- Sample and PVT analysis data of reservoir fluids
- Reservoir pressure measurements
- TWT and depth grids for the main horizons
- Seismic data of various vintages and angle stacks/inversion products
- Seismic velocity models
- Static and dynamic reservoir models
- Technical Committee Meeting/Operating Committee Meeting slides
- Field Development Plans
- Development concept planning slides
- Legal and commercial documentation

ERCE has relied upon Carnarvon for the completeness of all the data provided.

Work Completed

The dataset provided by Carnarvon enabled ERCE to complete a comprehensive review for the Dorado Discovery of the:

- Hydrocarbons initially in place, where applicable
- Contingent Resources at 1C, 2C and 3C levels of confidence

The effective date of this evaluation is 30 June 2019.

ERCE has carried out this review using data and information made available by Carnarvon, a joint venture partner of the licence. These data comprise details of Carnarvon's licence interests, seismic data, basic exploration and engineering data (including well logs, core and PVT data), technical reports, interpreted data (including reservoir simulation studies), and development plans.

Our approach has been to commence our investigations with the most recent technical reports and interpreted data. From these we have been able to identify those items of basic data which require re-assessment. We have carried out a review of seismic data and reservoir engineering data and prepared independent estimates of hydrocarbons initially in place. We have reviewed the recovery factor assumptions used by Carnarvon and carried out sensitivity analyses using the same. We have derived independent estimates of Contingent Resources for oil and gas volumes.

In estimating petroleum in place and recoverable, we have used standard techniques of petroleum engineering. These techniques combine geophysical and geological knowledge with detailed information concerning porosity and permeability distributions, fluid characteristics and reservoir pressure. There is uncertainty in the measurement and interpretation of basic data. We have estimated the degree of this uncertainty to calculate the range of petroleum initially in place and recoverable volumes.

In the case of the discovered resources (Contingent Resources) presented in this report, there is no certainty that it will be commercially viable to produce any portion of the resources.

No site visit was undertaken in the generation of this report.

Summary of Results

Contingent Resources associated with the WA-437-P Permit for the Dorado Discovery are presented in Table 2. Both gross and net attributable to Carnarvon unrisked Contingent Resources are presented in the Table.

Table 2: Unrisked Contingent Resources to Carnarvon for the Dorado Discovery at 30 June 2019

	Light Oil & Condensate (MMstb)			Free & Associated Natural Gas (Bscf)			Barrels of Oil Equivalent (MMboe)		
	1C	2C	3C	1C	2C	3C	1C	2C	3C
Gross	86	162	285	367	748	1,358	176	344	614
Net Attributable to Carnarvon	17	32	57	73	150	272	35	69	123

Notes:

1) "Gross Contingent Resources" are 100% of the volumes estimated to be recoverable from the discovery without any economic cut-off being applied.
2) Contingent Resources are 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 is not certain that the discovery will be developed or that the volumes reported as Contingent Resources will be recovered.
3) Net Contingent Resources attributable to Carnarvon represent the fraction of Gross Contingent Resources allocated to Carnarvon, based on Carnarvon's 20% interest in WA-437-P.
4) Totals shown are the deterministic addition of the probabilistic resources estimated for each reservoir. Assuming a degree of independency between reservoirs, deterministic addition will underestimate the low estimate and overestimate the high estimate.

5) The Contingent Resources reported here are “unrisked” in the sense that no adjustment has been made for the risk that the project may not be developed in the form envisaged or may not go ahead at all (i.e. no Chance of Development factor has been applied).
6) Chance of Development for the Contingent Resources shown here has been estimated to be 75%. This is based on further appraisal, development being at concept select phase and distance to existing gas infrastructure.
7) Contingent Resources have been sub-classified as “Development Unclarified” under the PRMS.
8) Natural gas volumes include inert gas (CO_2 and N_2) volumes of approximately 2% estimated from reservoir sampling.
9) Conversion from gas to barrels of oil equivalent is based on Gross Heating Value. The conversion is based on composition of gas in each reservoir and is 4.07 Bscf/MMboe, 3.85 Bscf/MMboe, 4.16 Bscf/MMboe, 4.45 Bscf/MMboe, and 3.87 Bscf/MMboe for the Upper Caley, Caley associated gas, Crespin, Baxter and Milne reservoirs, respectively.

ERCE has identified the remaining key contingencies that are required to be addressed prior to the recoverable volumes at Dorado being classified as Reserves. These include the drilling of the planned Dorado-3 appraisal well, selection of the field development concept and determination of commerciality.

Professional Qualifications

ERCE is an independent consultancy specialising in petroleum reservoir evaluation. Except for the provision of professional services on a fee basis, ERCE has no commercial arrangement with any other person or company involved in the interests that are the subject of this report.

The work has been supervised by Mr Stewart Easton, General Manager of ERCE’s Asia Pacific office, a Professional Geologist registered as a Fellow of the Geological Society and a member of the Society of Petroleum Engineers with over 23 years of experience in the oil and gas industry.

Yours faithfully

ERC Equipoise Limited

Stewart Easton

General Manager, Asia Pacific

Appendix 1: SPE PRMS

SPE/WPC/AAPG/SPEE Petroleum Reserves and Resources Classification System and Definitions

The Petroleum Resources Management System

Preamble

Petroleum Resources are the estimated quantities of hydrocarbons naturally occurring on or within the Earth's crust. Resource assessments estimate total quantities in known and yet-to-be-discovered accumulations; Resources evaluations are focused on those quantities that can potentially be recovered and marketed by commercial projects. A petroleum Resources managements system provides a consistent approach to estimating petroleum quantities, evaluating development projects and presenting results within a comprehensive classification framework.

International efforts to standardise the definitions of petroleum Resources and how they are estimated began in the 1930s. Early guidance focused on Proved Reserves. Building on work initiated by the Society of Petroleum Evaluation Engineers (SPEE), SPE published definitions for all Reserves categories in 1987. In the same year, the World Petroleum Council (WPC, then known as the World Petroleum Congress), working independently, published Reserves definitions that were strikingly similar. In 1997, the two organizations jointly released a single set of definitions for Reserves that could be used worldwide. In 2000, the American Association of Petroleum Geologists (AAPG), SPE, and WPC jointly developed a classification system for all petroleum Resources. This was followed by additional supporting documents: supplemental application evaluation guidelines (2001) and a glossary of terms utilised in Resources definitions (2005). SPE also published standards for estimating and auditing Reserves information (revised 2007).

These definitions and the related classification system are now in common use internationally within the petroleum industry. They provide a measure of comparability and reduce the subjective nature of Resources estimation. However, the technologies employed in petroleum exploration, development, production, and processing continue to evolve and improve. The SPE Oil and Gas Reserves Committee works closely with other organizations to maintain the definitions and issues periodic revisions to keep current with evolving technologies and changing commercial opportunities.

The SPE-PRMS consolidates, builds on, and replaces guidance previously contained in the 1997 Petroleum Reserves Definitions, the 2000 Petroleum Resources Classification and Definitions publications, and the 2001 "Guidelines for the Evaluation of Petroleum Reserves

and Resources"; the latter document remains a valuable source of more detailed background information.

These definitions and guidelines are designed to provide a common reference for the international petroleum industry, including national reporting and regulatory disclosure agencies, and to support petroleum project and portfolio management requirements. They are intended to improve clarity in global communications regarding petroleum Resources. It is expected that the SPE-PRMS will be supplemented with industry education programs and application guides addressing their implementation in a wide spectrum of technical and/or commercial settings.

It is understood that these definitions and guidelines allow flexibility for users and agencies to tailor application for their particular needs; however, any modifications to the guidance contained herein should be clearly identified. The definitions and guidelines contained in this document must not be construed as modifying the interpretation or application of any existing regulatory reporting requirements.

The full text of the SPE/WPC/AAPG/SPEE Petroleum Resources Management System document, hereinafter referred to as the SPE-PRMS, can be viewed at http://www.spe.org/specma/binary/files6859916Petroleum_Resources_Management_System_2007.pdf

Overview and Summary of Definitions

The estimation of petroleum resource quantities involves the interpretation of volumes and values that have an inherent degree of uncertainty. These quantities are associated with development projects at various stages of design and implementation. Use of a consistent classification system enhances comparisons between projects, groups of projects, and total Company portfolios according to forecast production profiles and recoveries. Such a system must consider both technical and commercial factors that impact the project's economic feasibility, its productive life, and its related cash flows.

Petroleum is defined as a naturally occurring mixture consisting of hydrocarbons in the gaseous, liquid, or solid phase. Petroleum may also contain non-hydrocarbons, common examples of which are carbon dioxide, nitrogen, hydrogen sulphide and sulphur. In rare cases, non-hydrocarbon content could be greater than 50%.

The term "Resources" as used herein is intended to encompass all quantities of petroleum naturally occurring on or within the Earth's crust, discovered and undiscovered (recoverable and unrecoverable), plus those quantities already produced. Further, it includes all types of petroleum whether currently considered conventional" or "unconventional."

Figure 1-1 is a graphical representation of the SPE/WPC/AAPG/SPEE Resources classification system. The system defines the major recoverable Resources classes:

Production, Reserves, Contingent Resources, and Prospective Resources, as well as Unrecoverable petroleum.

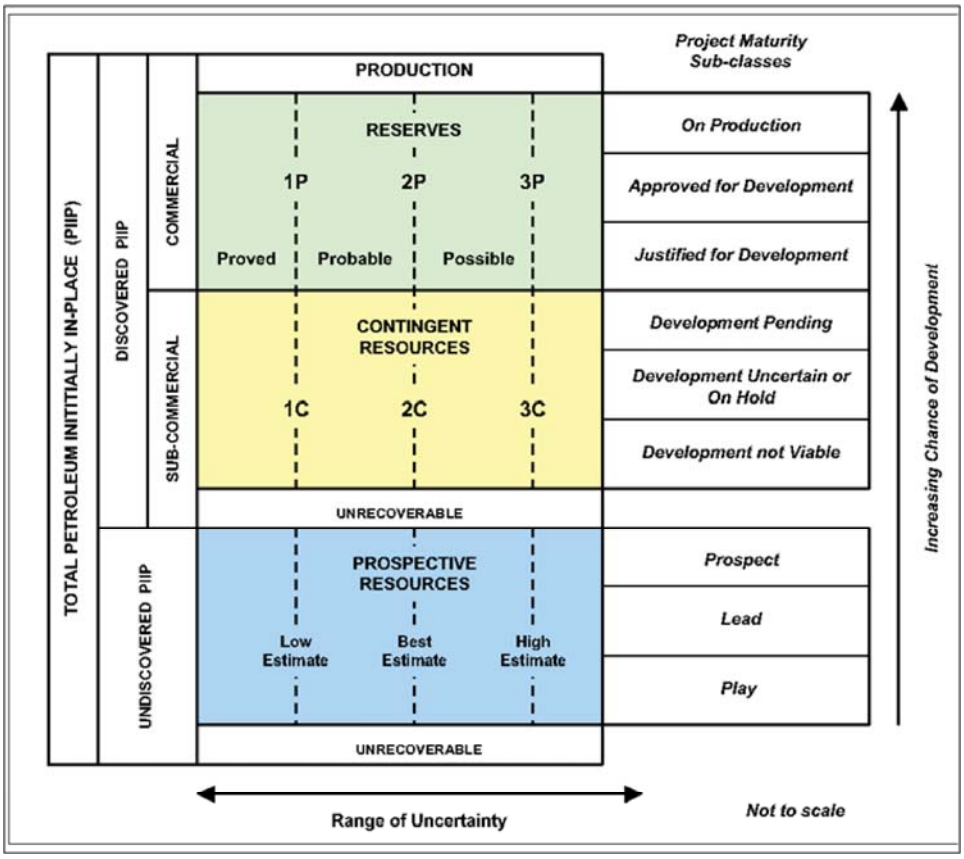

Figure 1-1: SPE/AAPG/WPC/SPEE Resources Classification System

The “Range of Uncertainty” reflects a range of estimated quantities potentially recoverable from an accumulation by a project, while the vertical axis represents the “Chance of Development”, that is, the chance that the project that will be developed and reach commercial producing status.

The following definitions apply to the major subdivisions within the Resources classification:

TOTAL PETROLEUM INITIALLY-IN-PLACE

Total Petroleum Initially in Place is that quantity of petroleum that is estimated to exist originally in naturally occurring accumulations.

It includes that quantity of petroleum that is estimated, as of a given date, to be contained in known accumulations prior to production plus those estimated quantities in accumulations yet to be discovered (equivalent to “total Resources”).

DISCOVERED PETROLEUM INITIALLY-IN-PLACE

Discovered Petroleum Initially in Place is that quantity of petroleum that is estimated, as of a given date, to be contained in known accumulations prior to production.

PRODUCTION

Production is the cumulative quantity of petroleum that has been recovered at a given date.

Multiple development projects may be applied to each known accumulation, and each project will recover an estimated portion of the initially-in-place quantities. The projects shall be subdivided into Commercial and Sub-Commercial, with the estimated recoverable quantities being classified as Reserves and Contingent Resources respectively, as defined below.

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. Reserves are further subdivided in accordance with the level of certainty associated with the estimates and may be sub-classified based on project maturity and/or characterised by their development and production status. To be included in the Reserves class, a project must be sufficiently defined to establish its commercial viability. There must be a reasonable expectation that all required internal and external approvals will be forthcoming, and there is evidence of firm intention to proceed with development within a reasonable time frame. A reasonable time frame for the initiation of development depends on the specific circumstances and varies according to the scope of the project. While five years is recommended as a benchmark, a longer time frame could be applied where, for example, development of economic projects are deferred at the option of the producer for, among other things, market-related reasons, or to meet contractual or strategic objectives.

In all cases, the justification for classification as Reserves should be clearly documented. To be included in the Reserves class, there must be a high confidence in the commercial producibility of the reservoir as supported by actual production or formation tests. In certain cases, Reserves may be assigned on the basis of well logs and/or core analysis that indicate that the subject reservoir is hydrocarbon-bearing and is analogous to reservoirs in the same area that are producing or have demonstrated the ability to produce on formation tests.

Proved Reserves

Proved Reserves are those quantities of petroleum, which by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be commercially recoverable,

from a given date forward, from known reservoirs and under defined economic conditions, operating methods, and government regulations.

If deterministic methods are used, the term reasonable certainty is intended to express a high degree of confidence that the quantities will be recovered. If probabilistic methods are used, there should be at least a 90% probability that the quantities actually recovered will equal or exceed the estimate. The area of the reservoir considered as Proved includes:

the area delineated by drilling and defined by fluid contacts, if any, and

adjacent undrilled portions of the reservoir that can reasonably be judged as continuous with it and commercially productive on the basis of available geoscience and engineering data.

In the absence of data on fluid contacts, Proved quantities in a reservoir are limited by the lowest known hydrocarbon (LKH) as seen in a well penetration unless otherwise indicated by definitive geoscience, engineering, or performance data. Such definitive information may include pressure gradient analysis and seismic indicators. Seismic data alone may not be sufficient to define fluid contacts for Proved Reserves (see “2001 Supplemental Guidelines,” Chapter 8). Reserves in undeveloped locations may be classified as Proved provided that the locations are in undrilled areas of the reservoir that can be judged with reasonable certainty to be commercially productive and interpretations of available geoscience and engineering data indicate with reasonable certainty that the objective formation is laterally continuous with drilled Proved locations.

For Proved Reserves, the recovery efficiency applied to these reservoirs should be defined based on a range of possibilities supported by analogs and sound engineering judgment considering the characteristics of the Proved area and the applied development program.

Probable Reserves

Probable Reserves are those additional Reserves which analysis of geoscience and engineering data indicate are less likely to be recovered than Proved Reserves but more certain to be recovered than Possible Reserves.

It is equally likely that actual remaining quantities recovered will be greater than or less than the sum of the estimated Proved plus Probable Reserves (2P). In this context, when probabilistic methods are used, there should be at least a 50% probability that the actual quantities recovered will equal or exceed the 2P estimate.

Probable Reserves may be assigned to areas of a reservoir adjacent to Proved where data control or interpretations of available data are less certain. The interpreted reservoir continuity may not meet the reasonable certainty criteria. Probable estimates also include incremental recoveries associated with project recovery efficiencies beyond that assumed for Proved.

Possible Reserves

Possible Reserves are those additional Reserves which analysis of geoscience and engineering data indicate are less likely to be recoverable than Probable Reserves

The total quantities ultimately recovered from the project have a low probability to exceed the sum of Proved plus Probable plus Possible (3P), which is equivalent to the high estimate scenario. When probabilistic methods are used, there should be at least a 10% probability that the actual quantities recovered will equal or exceed the 3P estimate.

Possible Reserves may be assigned to areas of a reservoir adjacent to Probable where data control and interpretations of available data are progressively less certain. Frequently, this may be in areas where geoscience and engineering data are unable to clearly define the area and vertical reservoir limits of commercial production from the reservoir by a defined project.

Possible estimates also include incremental quantities associated with project recovery efficiencies beyond that assumed for Probable.

Probable and Possible Reserves

(See above for separate criteria for Probable Reserves and Possible Reserves.)

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.

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.

In conventional accumulations, where drilling has defined a highest known oil (HKO) elevation and there exists the potential for an associated gas cap, Proved oil Reserves should only be assigned in the structurally higher portions of the reservoir if there is reasonable certainty that such portions are initially above bubble point pressure based on documented engineering

analyses. Reservoir portions that do not meet this certainty may be assigned as Probable and Possible oil and/or gas based on reservoir fluid properties and pressure gradient interpretations.

CONTINGENT RESOURCES

Contingent Resources are 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 due to one or more contingencies.

Contingent Resources may include, for example, projects for which there are currently no viable markets, or where commercial recovery is dependent on technology under development, or where evaluation of the accumulation is insufficient to clearly assess commerciality. Contingent Resources are further categorised in accordance with the level of certainty associated with the estimates and may be sub-classified based on project maturity and/or characterised by their economic status.

UNDISCOVERED PETROLEUM INITIALLY-IN-PLACE

Undiscovered Petroleum Initially in Place is that quantity of petroleum that is estimated, as of a given date, to be contained within accumulations yet to be discovered.

PROSPECTIVE RESOURCES

Prospective Resources are those quantities of petroleum which are estimated, as of a given date, to be potentially recoverable from undiscovered accumulations.

Potential accumulations are evaluated according to their chance of discovery and, assuming a discovery, the estimated quantities that would be recoverable under defined development projects. It is recognised that the development programs will be of significantly less detail and depend more heavily on analog developments in the earlier phases of exploration.

Prospect

A project associated with a potential accumulation that is sufficiently well defined to represent a viable drilling target.

Project activities are focused on assessing the chance of discovery and, assuming discovery, the range of potential recoverable quantities under a commercial development program.

Lead

A project associated with a potential accumulation that is currently poorly defined and requires more data acquisition and/or evaluation in order to be classified as a prospect.

Project activities are focused on acquiring additional data and/or undertaking further evaluation designed to confirm whether or not the lead can be matured into a prospect. Such

evaluation includes the assessment of the chance of discovery and, assuming discovery, the range of potential recovery under feasible development scenarios.

Play

A project associated with a prospective trend of potential prospects, but which requires more data acquisition and/or evaluation in order to define specific leads or prospects.

Project activities are focused on acquiring additional data and/or undertaking further evaluation designed to define specific leads or prospects for more detailed analysis of their chance of discovery and, assuming discovery, the range of potential recovery under hypothetical development scenarios.

The range of uncertainty of the recoverable and/or potentially recoverable volumes may be represented by either deterministic scenarios or by a probability distribution. When the range of uncertainty is represented by a probability distribution, a low, best, and high estimate shall be provided such that:

• There should be at least a 90% probability (P90) that the quantities actually recovered will equal or exceed the low estimate.

• There should be at least a 50% probability (P50) that the quantities actually recovered will equal or exceed the best estimate.

• There should be at least a 10% probability (P10) that the quantities actually recovered will equal or exceed the high estimate.

When using the deterministic scenario method, typically there should also be low, best, and high estimates, where such estimates are based on qualitative assessments of relative uncertainty using consistent interpretation guidelines. Under the deterministic incremental (risk-based) approach, quantities at each level of uncertainty are estimated discretely and separately.

These same approaches to describing uncertainty may be applied to Reserves, Contingent Resources, and Prospective Resources. While there may be significant risk that sub-commercial and undiscovered accumulations will not achieve commercial production, it useful to consider the range of potentially recoverable quantities independently of such a risk or consideration of the resource class to which the quantities will be assigned.

Evaluators may assess recoverable quantities and categorise results by uncertainty using the deterministic incremental (risk-based) approach, the deterministic scenario (cumulative) approach, or probabilistic methods (see “2001 Supplemental Guidelines,” Chapter 2.5). In many cases, a combination of approaches is used.

Use of consistent terminology (Figure 1.1) promotes clarity in communication of evaluation results. For Reserves, the general cumulative terms low/best/high estimates are denoted as

1P/2P/3P, respectively. The associated incremental quantities are termed Proved, Probable and Possible. Reserves are a subset of, and must be viewed within context of, the complete Resources classification system. While the categorization criteria are proposed specifically for Reserves, in most cases, they can be equally applied to Contingent and Prospective Resources conditional upon their satisfying the criteria for discovery and/or development.

For Contingent Resources, the general cumulative terms low/best/high estimates are denoted as 1C/2C/3C respectively. For Prospective Resources, the general cumulative terms low/best/high estimates still apply. No specific terms are defined for incremental quantities within Contingent and Prospective Resources.

Without new technical information, there should be no change in the distribution of technically recoverable volumes and their categorization boundaries when conditions are satisfied sufficiently to reclassify a project from Contingent Resources to Reserves. All evaluations require application of a consistent set of forecast conditions, including assumed future costs and prices, for both classifications of projects and categorization of estimated quantities recovered by each project.