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# Horse Hill Upper Portland Sandstone STOIP and Recoverable Volumes Review

## Independent Review Report

**UK Oil & Gas Investments PLC**

**Assignment Number:** L400228-S00

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The Directors

UK Oil & Gas Investments PLC (“UKOG”)

Suite 3B, Princes House,

38 Jermyn Street, London, SW1Y 6DN

6<sup>th</sup> February 2017

Dear Sirs,

Reference: Independent Review Report  
Horse Hill, Upper Portland Sandstone  
PEDL 137, Weald Basin, Southern England

In accordance with your instructions, Xodus Group Ltd. (“Xodus”) has reviewed the Upper Portland Sandstones of the Horse Hill discovery in PEDL137, United Kingdom.

We were requested to provide an independent evaluation of the hydrocarbon volumes expected in accordance with the 2007 Petroleum Resources Management System prepared by the Oil and Gas Reserves Committee of the Society of Petroleum Engineers (SPE) and reviewed and jointly sponsored by the World Petroleum Council (WPC), the American Association of Petroleum Geologists (AAPG) and the Society of Petroleum Evaluation Engineers (SPEE).

Volumes are expressed as gross Stock Tank Oil In Place volumes (“STOIIP”) and as gross and net recoverable Contingent Resources.

In conducting this review we have utilised information and interpretations supplied by UKOG, comprising operator information, geological, geophysical, petrophysical, well logs and other data along with various technical reports. We have reviewed the information provided and modified assumptions where we considered this to be appropriate. Site visits were not considered necessary for the purposes of this report.

Standard geological and engineering techniques accepted by the petroleum industry were used in our volume estimates. These techniques rely on geo-scientific interpretation and judgement; hence the resources included in this evaluation are estimates only and should not be construed to be exact quantities. It should be recognised that such estimates of STOIIP and recoverable resources volumes may increase or decrease in future if more data becomes available and/or there are changes to the technical interpretation. As far as Xodus is aware there are no special factors that would affect the operation of the assets and which would require additional information for their proper appraisal.



## 1 EXECUTIVE SUMMARY

UK Oil & Gas Investments PLC (“UKOG”) has a 31.2% interest in Licences PEDL137 and PEDL246<sup>1</sup>. There are two oil discoveries on the licences, one found by the Horse Hill-1 well (“HH-1”), drilled recently in 2014 and the other by the Collendean Farm-1 well (“CF-1”) drilled by Esso in 1964.

The HH-1 and CF-1 discoveries lie within an approximately 100-foot gross thick Jurassic Upper Portland sandstone reservoir within a 6km by 3km Late Cimmerian age tilted fault block structure and trap as defined by 2D seismic. The crest of the Upper Portland oil discovery lies at approximately 1760ft TVDSS and most likely extends over a mapped maximum areal closure of approximately 2000 acres. The Upper Portland reservoir is productive at the nearby Brockham Field, some 9km NNW, in which UKOG has an indirect interest by virtue of UKOG’s 2.79% shareholding in Angus Energy plc.

Xodus delivered a STOIP review report in May 2015 on behalf of UKOG. Since the delivery of this report, in March 2016, UKOG conducted a well test on the HH-1 Portland reservoir over a 103 ft perforated interval. The first test period was limited by pump capacity and gave a stable dry oil rate of 168 bopd over 9 hours. Further periods of flow resulted in a similar stable dry oil flow over a two-day period. When a larger stroke pump was installed a maximum rate in excess of 360 bopd and an average stable rate of 323 bopd over an 8.5 hour period was achieved, the rate still thought to be limited by pump capacity. A light, sweet 35-37 degrees API crude was produced. No water was produced with the oil.

These results have led to an update of the petrophysical interpretation impacting the STOIP volumes. No other geological or geophysical interpretations have been changed. The main difference with the previous petrophysical interpretation is a change in bound and unbound (free or mobile) water, with minor changes to  $R_w$  and permeability. The well test results have also allowed for an initial interpretation of possible dynamic reservoir behaviour.

Xodus has independently reviewed the new petrophysical interpretation of the Portland Sandstone and the underlying assumptions that have caused its revision. Xodus subsequently updated its independently derived the volume estimates through use of a stochastic simulation software tool, REP, similar to the approach used by UKOG.

Xodus concludes that the approach followed in the revised interpretation is sound and is based on an adequate interpretation of the available data.

The gross PEDL 137 Upper Portland volume ranges estimated by Xodus are as per the Table 1.1 below.

<b>STOIP (MMbbl)</b>	<b>Low</b>	<b>Best</b>	<b>High</b>	<b>Mean</b>
Upper Portland Gross 100%	21.5	32.2	47.4	33.5

Table 1.1 – STOIP volumes in Horse Hill Portland Reservoir

These volumes represent a significant increase (~50% for  $P_{50}$ ) over the volumes calculated in the previous assessment of May 2015.

<sup>1</sup> Although the HH-1 and CF-1 wells denote discoveries in deeper horizons that possibly extend into PEDL246 and therefore both licences are often referred in conjunction, the Horse Hill Portland reservoir lies entirely in PEDL137.



Given the results of the well test and subsequent analysis of the well test data, Xodus was able to estimate well performance. Xodus developed a range of possible production profiles and a range of recoverable resources volumes on the assumption that the field can be drained by 2, 3, or 4 production wells for primary recovery (in the 1C, 2C and 3C case respectively).

For a shallow but permeable reservoir, such as the Portland, should a water re-injection scheme be undertaken to provide pressure support and improve sweep-efficiency in the field's early productive life, it is reasonable to expect a material increment in overall oil recovery. The successful implementation of such a scheme is estimated to lead to the recovery of an additional 8-14% of STOIIIP, which based on current estimates of STOIIIP, as shown in Table 1.1 and in Table 4.3, could be equivalent to a further 1.7 - 6.6 MMstb of gross recoverable oil. The Portland itself is a potential source of water for re-injection. Since such a plan would be sanctioned only after further testing of the Portland, Xodus have therefore not included any incremental volumes for water injection in the ultimate recoverable volume estimates at this time.

The next activities on the Horse Hill Portland reservoir include carrying out an extended well test on HH-1 in 2017, which UKOG is presently preparing. Further subsurface interpretation will follow. The estimated recoverable volumes in the Portland reservoir are classified as Contingent Resources as the submission a field development plan to the authorities will only be made once the results of the planned extended well tests are known in 2017 (Table 1.2).

<b>Contingent Resources</b>	<b>Gross</b>			<b>Net to UKOG</b>		
	<b>1C</b>	<b>2C</b>	<b>3C</b>	<b>1C</b>	<b>2C</b>	<b>3C</b>
Oil (MMstb)	0.592	1.498	3.629	0.185	0.467	1.132

**Table 1.2 – Contingent Resources in PEDL137 Portland Sandstones**

### **Conclusions**

Xodus has reviewed the available information on the Horse Hill discovery and concludes that generally UKOG and its partners have performed a reasonable and robust interpretation of the available data. Where deemed necessary, Xodus has amended the UKOG proposed volumes. Xodus believes that the figures in this report accurately reflect the potential on the prospect, given the current status of knowledge.

### **Professional Qualifications**

Xodus is an independent, international energy consultancy. Established in 2005, the company has 300+ subsurface and surface focused personnel spread across offices in Aberdeen, Dubai, Edinburgh, Glasgow, The Hague, Houston, London, Orkney, Oslo, Perth and Southampton.

The wells and subsurface division specialise in petroleum reservoir engineering, geology and geophysics and petroleum economics. All of these services are supplied under an accredited ISO9001 quality assurance system.

Except for the provision of professional services on a fee basis, Xodus has no commercial arrangement with any person or company involved in the interest that is the subject of this report.

Jonathan (Jon) Fuller is the Global Head of Advisory for Xodus and was responsible for supervising this evaluation. A Reservoir Engineer, with a strong commercial experience he has 22 years of international experience in both International Oil Companies, large Service Companies and Consultancy organisations. The last 10 years he has been the technical and project management lead on reserve / resource evaluations in M&A, competent person reports and expert opinion linked bank and institutional investment (both debt and equity).



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Jon has an M.Eng (Hons) in Engineering Science from Oxford University, a Master's Degree in Petroleum Engineering from Heriot-Watt, and an MBA from INSEAD. He is a member of the Society of Petroleum Engineers (SPE), and the Association of International Petroleum Negotiators (AIPN).

Yours faithfully,

Jonathan Fuller  
Director Advisory, London, Xodus Group Ltd  
For and on behalf of Xodus Group Ltd.