



**IGas Energy PLC**

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**Licence Relinquishment Report**

**PEDL 092-1**

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**1 HEADER**

Licence Number:	PEDL 092-1
Licence Round and History:	Originally awarded in the 9 <sup>TH</sup> Round of Onshore Licencing to PERMAGAS LTD and ALTWOOD PETROLEUM LTD (APL) from 29 <sup>th</sup> November 2000. ISLAND GAS LIMITED entered the licence replacing STRATAGAS on 11 <sup>th</sup> February 2005. 09 <sup>th</sup> December 2005 NEXEN EXPLORATION UK LTD entered the licence. ISLAND GAS LTD inherited operatorship from previous licence partner NEXEN in 2011.
Licence Type:	Traditional
Ordnance Survey Squares:	SE62 and SE72 (North Yorkshire)
Operator:	IGas Exploration Ltd – 80% Equity (Operator) Island Gas Ltd – 20% Equity
Partners:	None
Wells:	L46/06-MF1 (Mill Farm-1)

**2 SYNOPSIS**

Licence Status: End of Second Term

PEDL 092-1 currently comprises 200 km<sup>2</sup> in two adjacent Ordnance Survey squares in North Yorkshire (SE62 and SE72). The current licence is the remnant of a larger area awarded to Permagas and Altwood Petroleum in September 2000. The licence was acquired from the original licensees by Stratagas in 2001 and most recently by Nexen. Operatorship of PEDL 092-1 was inherited in 2011 by Island Gas, who had previously been a partner in the licence with Nexen.

The initial term working obligations were to acquire 200km of public domain 2D seismic within the first year of the licence (120km of which would be on the area currently held by Island Gas). This obligation was met. On successfully meeting these obligations, the licenced area could be retained initially for 6 years except for the two Ordnance Survey blocks (SE62 and SE72) currently held by Island Gas which were required to be surrendered after three years unless an application to drill a CBM well on either block was received (the well would need to be drilled within the initial term of 6 years). This well (Mill Farm 1 (L46/06-MF1)) was drilled by Nexen in 2007 and the licence had therefore entered into its second term. On the 04<sup>th</sup> September 2006 by Deed of Variation the initial term was extended to seven years and the second term reduced to four years.

Following review of PEDL 092-1 and the end of the second term of licence (September 2011) Island Gas Ltd now wishes to relinquish the licence with immediate effect.

### 3 EXPLORATION ACTIVITIES

The working obligation was: "to acquire 10km of existing 2D seismic on SE62, 100km of existing 2D seismic on SE72 and 80km of existing 2D seismic on SE73 within 1 year of the commencement date of the licence". This was purchased by Stratagas in compliance with the obligation and prior to transfer of licence ownership to Island Gas/Nexen. No new additional seismic was required as part of the award. No additional seismic has been shot. Mill Farm-1 well was drilled by Nexen in 2007. No further exploration activities have been conducted.

Within PEDL 092-1 the most important geological era is deemed the Carboniferous – strata of this age contain: the potential CBM reservoirs; the source, traps and seals of conventional reservoirs; and also potentially prospective shale gas horizons.

PEDL 092-1 squarely overlies a broad shelf area (The Humber Shelf or Market Weighton Block) and sits between deep Dinantian/Namurian basinal areas to the north (Cleveland Basin), the southwest (Gainsborough Trough), the southeast (Humber Basin), and the west (Bowland Basin).

PEDL 092-1 lies on the northwestern flank of a vast Upper Carboniferous (Westphalian A-C) coal basin which extends westwards from considerable depths beneath the North Sea to outcrop east of the Pennines in the UK and in Belgium and Germany. At outcrop onshore UK, this coal basin forms the historically important coalfields of Nottinghamshire, Derbyshire and South Yorkshire. The East Midlands – Humberside part of the coal basin is a concealed resource – within the licence area it is overlain by Permian and Triassic strata which dip gently eastwards into the offshore area. The base of this Mesozoic sequence is a surface of major unconformity with the underlying Upper Carboniferous and this also dips gently towards the east and east-northeast.

The stratigraphy to the top of the Lower Carboniferous, established by coal and hydrocarbon exploration drilling around PEDL 092-1, is illustrated in the column (**Figure 1**). Despite more than 130 boreholes and colliery shafts in and around PEDL 092-1, variations within the complete Westphalian succession are relatively poorly known. Fewer than 20 boreholes penetrate all the way to the base of the Coal Measures. It is estimated that the entire Westphalian sequence attains just less than 900 m thickness on PEDL 092-1, very much thinner than it is to the south in the vicinity of the Gainsborough Trough.

As shown in the stratigraphic column (**Figure 1**), the most numerous and thickest coals occur in the Westphalian B and topmost Westphalian A sequence. The most consistently thick seams (> 1 m net) include the Barnsley Coal, the Flockton Coal, the Parkgate Coal and the Beeston Coal (all contain multiple leaves). Several other seams thicken locally to more than 1 m but their distributions are not reliably charted. Within the East Midlands region as a whole, net coal thicknesses, determined largely from oil and gas exploration wells, range from 9.7 m to 29 m; part of the variation almost certainly due to different interpretations of the gamma ray and density wireline logs and the density cut-off used for coal lithology.

Even fewer boreholes penetrate the entire Namurian sequence (none on PEDL 092-1 itself) and, since few cores were taken, there is little palaeontological dating control that can be applied. Around PEDL 092-1, the Namurian section appears to be around 510 m thick, about

average for that overlying the Lower Carboniferous carbonate shelf areas. The Namurian is often referred to as the Millstone Grit and, although thick and continuous coarse channels sands are present throughout, they are mainly concentrated in the upper half of the sequence. The lower part of the sequence is dominated by mudstones and siltstones; the Bowland Shale Fm equivalent from the succession to the west, but much thinner here on the Humber Shelf (c.8-31 m) than in the Bowland Basin and Gainsborough Trough (> 200 m) to the west and southwest.

The shelf limestones and associated rocks of Dinantian age underlying the district are probably several hundred metres thick on evidence from boreholes well to the south of PEDL 092-1. Those boreholes are located over a Dinantian basinal area and as such will not be representative of the depositional lithofacies present on PEDL 092-1. Only a handful of boreholes have penetrated the topmost Dinantian within 5-10km distance of PEDL 092-1 and nothing significant can be concluded about its character other than it is dominated by limestones with some shale bands. From the deeper wells to the south, it would appear that the argillaceous content decreases away from the basin/trough centres, and so a predominantly carbonate (limestone) Dinantian sequence should be anticipated on PEDL 092-1.

The surface geological map is largely devoid of faulting – most of the faulting and folding took place immediately prior to deposition during the Mesozoic so most structural features are completely concealed by younger cover. Many of the major faults affecting the Westphalian appear to be reactivated Lower Carboniferous growth faults with associated rollover folds. Although public domain 2D seismic does exist for the licence area, no structure mapping has been carried out by Island Gas or the previous licensee, Nexen.

There are no charted abandoned mine working, but 15-20% of the PEDL 092-1 licence is affected by deep mining licences (**Figure 2**)





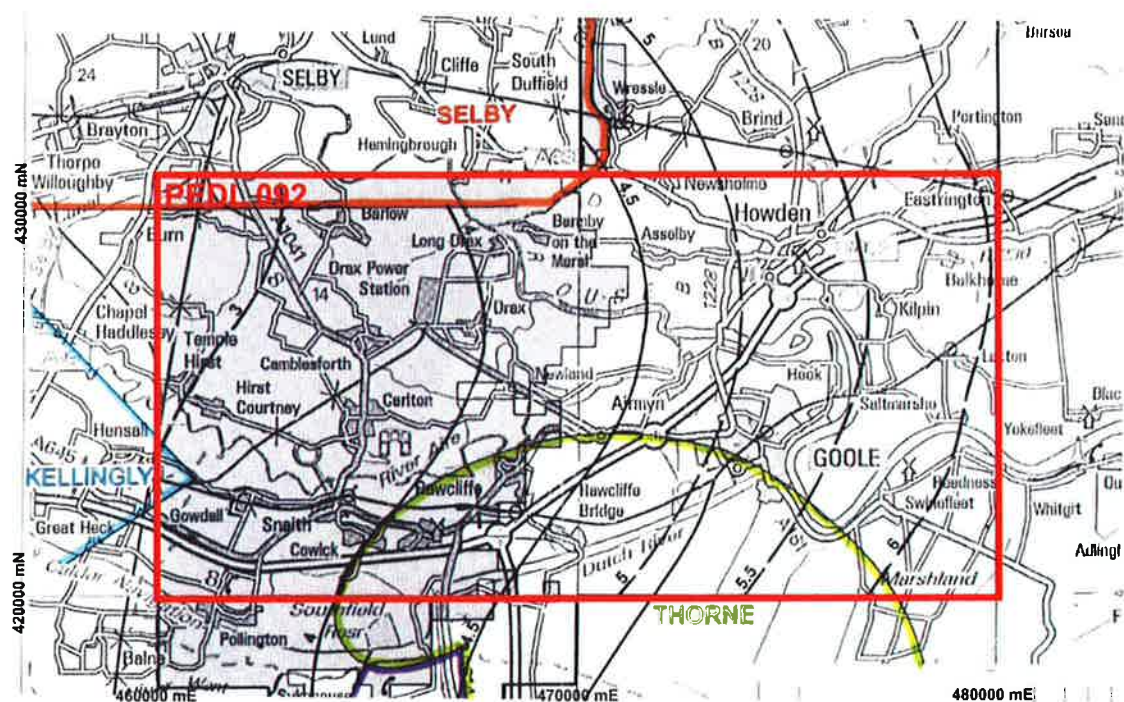


Figure 2: Map showing areas of known underground coal extraction on and around PEDL 092-1 (areas shaded grey). Adapted from Wardell Armstrong (2002). Active mining licences extending into PEDL 092-1 are also outlined from the abandoned Thorne Colliery (green) and the Selby Complex (brown).

#### 4 PROSPECTIVITY ANALYSIS

CBM prospectivity is hampered by an absence of modern (USBM) gas content and gas saturation measurements from below the top Carboniferous degassed zone. Using Coal Board data for net thickness and non-standard gas content data, a best estimate GIP resource of 230 bcf has been calculated, translating to an estimated 63 bcf recoverable resource translating to c.0.42 bcf/km<sup>2</sup>. These figures assume that all seams > 0.3 m can be completed by efficient well designs and completion styles. If only seams > 1 m are included (perhaps by limiting wells to horizontal designs) the recoverable resource will be considerably lower. Low reported gas contents and removal of resource by mining and deep mine licensing are largely responsible for the low resource volumes. Low measured permeability would certainly impact on production efficiency but no more so than most coal basins in the UK and continental Europe. Finally, the scattered distribution of seams

throughout the long Westphalian sequence also has a negative impact on the efficiency of recovering the limited resource.

A previous attempt at establishing CBM production on PEDL 092-1 (Nexen's Mill Farm 1) failed due to inappropriate well design (vertical) for European compressively stressed coal basins, and completion of a reservoir within a likely zone of degassing.

Based on the currently available data, the CBM prospectivity of PEDL 092-1 is marginal to low.

Prospectivity for shale gas in the Namurian on PEDL 092-1 is considered extremely low for the following reasons:

- Presence of likely high TOC Bowland Shale is confirmed but the expected gross shale interval is thin (14 metres) and not consistently developed in quiescent and anoxic deep water facies.
- Other, thicker Namurian shales do exist on PEDL 092-1 but do not display high gamma signatures associated with sufficiently high TOC shales. Facies analysis by the Geological Survey indicates that these are predominantly non-marine or shallow marine in origin.
- The basal Namurian shales are marginally mature for shale gas. They are approaching the peak oil generation window which, whilst also capable of generating early gas, is likely to significantly reduce in situ poroperm character by the presence of liquid hydrocarbons.

In view of the disappointing initial assessments of gross thickness, facies and maturity, it is felt that no justification can be made for further (intrusive) investigation of other shale parameters through coring or logging.

Potential for conventional hydrocarbon prospectivity to be present on PEDL 092-1 is strengthened by strong shows and small gas and light oil discoveries in close proximity to the licence (**Figure 3**). Whilst poor reservoir quality in Namurian and Westphalian clastic reservoirs and absence of thick source rocks ended the most recent phase of exploration in the late 1980's, suggestions of the existence of an Upper Carboniferous tight gas play in neighbouring acreage and the advent of new drilling and stimulation technology makes the entire area attractive for a new phase of exploration. No attempt has been made to identify suitable structural closures or stratigraphic traps, although a previous operator has indicated that two faulted dip closures may be present in the eastern half of the licence.

## 5 RESOURCE SUMMARY

Utilising the available data an attempt has been made to calculate GIP resource for PEDL 092-1 using optimistic, pessimistic and best estimate criteria:

Parameter	Low Case	Mid Case	High Case
<b>Reservoir Area (acres)</b>	37,066 (Assumes much of the entire licence is prospective other than those areas covered by extant deep mining licences)	37,066 (Assumes much of the entire licence is prospective other than those areas covered by extant deep mining licences)	37,066 (Assumes much of the entire licence is prospective other than those areas covered by extant deep mining licences)
<b>Reservoir thickness (ft)</b>	10.0 (minimum net thickness observed in boreholes, seams > 3 ft thick, with 20% eliminated in degassed zone)	18.0 (average net thickness from boreholes, seams > 3 ft thick with 10% eliminated in degassed zone)	45.0 (maximum net thickness observed in boreholes, seams > 1 ft, no coAL eliminated in degassed zone)
<b>Gas Content (scf/ton)</b>	28 (Mill Farm 1, Wheatworth Coal)	192 (average methane + ethane content from Coal Board measurements)	275 (max storage capacity measured in Mill Farm 1, Wheatworth Coal)
<b>Density (g/cc)</b>	1.29	1.32	1.35
<b>Gas in Place Volume (bcf)</b>	18	230	842



**6 MAPS AND FIGURES**

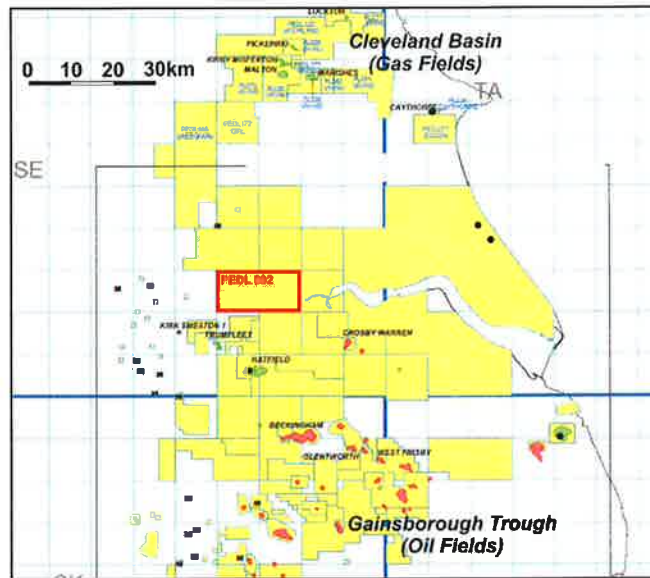


Figure 3: Location of PEDL 092-1 in relation to existing oil and gas fields.

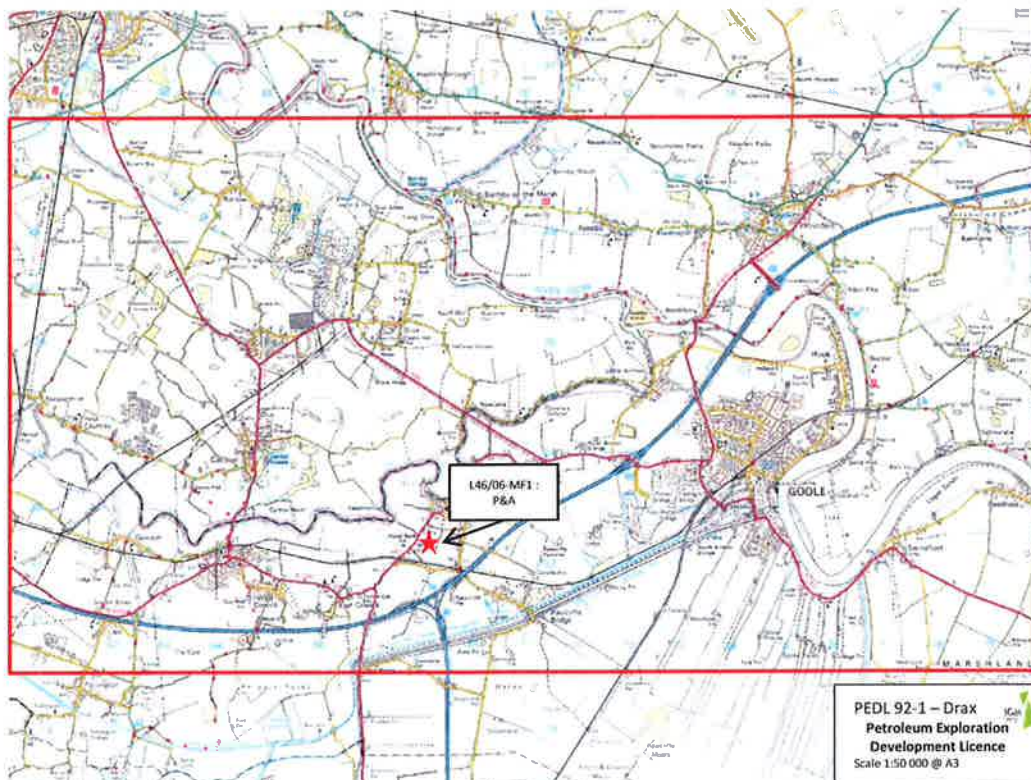


Figure 4: Location of Mill Farm-1 L46/06-MF1

## **7 CLEARANCE**

IGas Exploration Ltd and Island Gas limited confirms that DECC is free to publish the information contained within this report.