Composite energy

Field Development Plan

PEDL 133
Airth Pilot CBM Development

November 2006
Rev 1.6

Contents

This Field Development Plan has been prepared in accordance with DTI publication 'Guidance Notes for Coal Bed Methane and Mines Gas Field Development Plans' January 2006

1. Executive Summary

This Field Development Plan describes a proposed pilot scheme for the development of coal bed methane gas at Airth near Falkirk, Scotland within the boundary of DTi licence PEDL 133.

The licence holders are:

Composite Energy (Forth Valley) Limited - Operator	49%
BG International	51%

The pilot development scheme will consist of the following major components:

- Drilling and completion of 6 multilateral production wells
- Installation of a gas and water gathering system
- Installation of a water processing facility
- Installation of a water disposal facility
- Construction of a gas fired electrical power generation facility (up to 4 MVA)

A project plan for the scheme is provided in Appendix 1. [redacted]

The target coals in this development belong to the Limestone Coal formation. These coals exist as a number of isolated seams and will be exploited using horizontal drilling methods to maximise productivity and to minimise the total number of wells required. A map and schematics describing the geology of the PEDL 133 licence and the proposed development area at Airth are also provided in Appendix 1.

[redacted] A table of reserve ranges is provided in Table 2.2.

Production of gas during the pilot stage evaluation may be limited by the initial generation plant capacity. Well production capacity is expected to peak at [redacted]. A table of forecast production is provided in Table 3.1.

A Field Management Plan will be implemented with the following principal objectives:

- Cost effective and fit-for purpose well drilling and completions
- Environmentally sound water handling and disposal
- A production start up and ongoing monitoring programme which optimises learning through data gathering
- Consistent and predictable gas production
- Minimum venting and flaring, maximum exploitation of gas for commercial purposes

It is intended to initiate an additional pilot development on the PEDL 133 licence at Longannet during 2007. This will be the subject of a separate Field Development Plan to be submitted following the results of an appraisal well at the Longannet power station site. This well is scheduled to spud early 2007. It is planned to drill two further appraisal wells to assist in formulating a development plan for the licence as a whole. It is the Licence holders' intention to continue development activities organically in and around the Airth area on the basis of a successful pilot. If appropriate, a full scale development plan for the whole licence will be submitted on completion of the Airth area pilot project.

A copy of relevant planning consent documents are provided in Appendix 2. Additional well consents will be required and material changes to existing consents may also be required, subject to equipment selection and proposed means of deployment.

The Licence holders undertake to abandon all wells drilled and decommission all installed facilities on termination of production activities. Restoration of sites will be completed in accordance with all statutory regulations and Local Authority planning requirements.

2. Field Description

2.1 Geological Overview

2.1.1 Data Sources

The geological interpretation of licence PEDL 133 is based on all readily available data sources, primarily held or published by the British Geological Survey (BGS) and Coal Authority (CA). This includes, but is not restricted to:

- Selected mine abandonment plans held by the CA in Nottingham, with microfiche copies held at BGS offices in Edinburgh.
- National Coal Board documents, maps and geochemistry for proposed expansion of deep mining in Stirlingshire during the late 1940s, 1950s and early 1960s.
- All available current and historical geological maps for the licence area at ~1:50000 and ~1:10000 scales, including environmental geology maps for land use planning.
- All published economic memoirs (mining accounts) for the district published by the Geological Survey in the early 20th Century.
- All recent published geological memoirs for the district.
- Selected drilling records held at BGS offices in Edinburgh, and summarised in the online BGS Geoindex system.
- Data acquired by CBM appraisal and development drilling by Coalbed Methane Ltd and Composite Energy Ltd.

Historical seismic data exists for parts of PEDL 133, but has not been used directly for interpretation or field delineation due to insufficient resolution and line spacing. Attempts at delineation of the Airth Field by the previous licensee using Coal Board 2D seismic have been subsequently disproved by drilling.

2.1.2 Geological Setting

PEDL 133 lies within the northeast-southwest trending Midland Valley of Scotland, an area of low-lying ground approximately 80km wide. The parallel Highland Boundary and Southern Uplands Faults respectively separate the Midland Valley from the Lower Palaeozoic and older metamorphic terrain of the Grampian Highlands and the relatively unmetamorphosed Lower Palaeozoic ocean trench sequence of the Southern Uplands (Figure 2.1).

The graben structure of the present Midland Valley formed during the Carboniferous, when lithospheric tensional stretching caused periodic crustal sags and resulting cycles of shallow water marine incursions and fluvial-dominated delta sequences. During the Namurian, deltas and associated fluvial systems flowed into the area of PEDL 133 from the northwest and northeast and were channelled into a single major fluvial system prograding to the west-southwest.

***Figure* 2.1** *Map of Scottish Midland Valley, showing location of PEDL 133 and major coalfields.*

There is a close spatial relationship between the location of major sedimentary basin areas and synclinal structures, and between intervening thinner block sequences and anticlinal structures. These structures may have been initiated not so much as conventional stress-related folds, but rather sags and drapes related to tensional stretching of basement (although the axes of the basins and blocks are normally offset to some degree and are enhanced and affected by subsequent stress-related folding). PEDL 133 is dominated by one such Carboniferous synclinal structure, known as the Clackmannan Syncline. The syncline is asymmetrical, with dips on the eastern limb up to 30°, but in the west dips rarely exceed 5-10°. The syncline closes to the south with very low northerly dips on the axis.

Three fracture orientations dominate major faulting on PEDL 133 which, in combination, divide the prospective CBM reservoir strata into numerous discrete blocks with a predominantly easterly trending elongation:

- **Easterly Faults** - these are by far the most numerous fractures, the largest of which is the Ochil Fault (10,000ft throw) which defines the northern boundary of the coalfield. Several of the easterly faults on PEDL 133 are intruded with quartz-dolerite dykes.
- **Northeasterly Faults** – these faults, of which the Carnock Fault has the largest throw (950ft), are possibly structural adjustments related to movements along the Campsie Fault which terminates at the western edge of PEDL 133.

- **Northwesterly Faults** - these are mostly small in length and throw, but include two major branches from the Ochil Fault having a throw of several thousand feet. Northwesterly faults become increasingly common in the southern part of PEDL 133 where they often terminate against easterly faults. In several places, mine abandonment plans show easterly faults curving round without a break to take up a northwesterly alignment.

The primary CBM reservoir target on PEDL 133 is the coal bearing sequence in the Limestone Coal Formation (Namurian) at the base of the Upper Carboniferous (Figure 2.2). Other coal-bearing strata exist within the syncline, primarily in the Middle and Lower Coal Measures (Westphalian), but are currently considered too shallow or too heavily worked to be viable CBM targets.

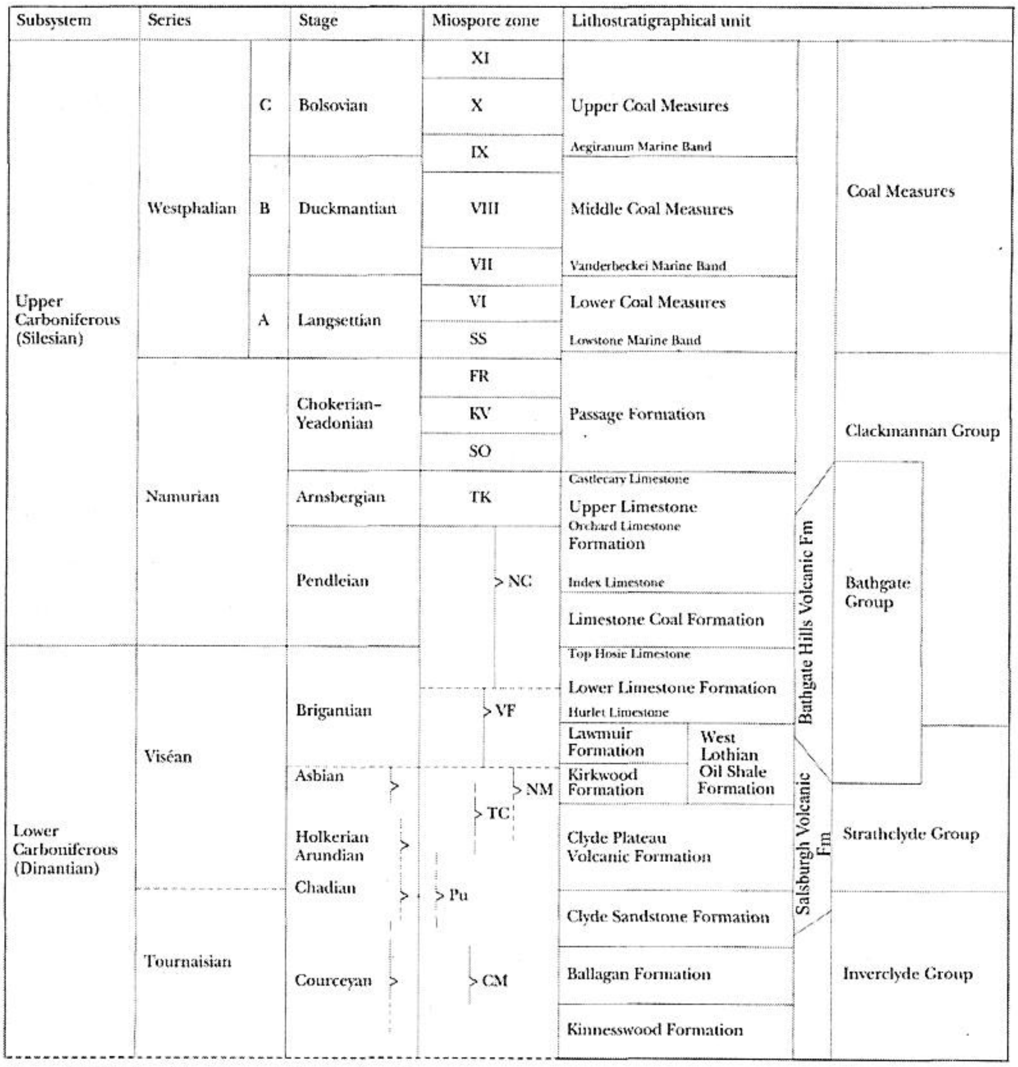

Figure 2.2 Classification of the Carboniferous at PEDL 133.

2.2 Geological Description of the Airth CBM Field

2.2.1 Structural Interpretation

The Airth field is defined by an uplifted fault block (horst) on the western limb of the Clackmannan Syncline. It is bounded by three major faults throwing more than 200ft on its northern, western and southern sides; its eastern flank is notionally defined by the axis of the syncline (see map and cross sections, Appendix 1, Enclosures 2-4), but there appears to be no conventional structural closure in this direction. As thus defined, the field has a lateral extent of 1750 acres.

The near-surface positions of the northern and southern bounding faults are known from shallow mine abandonment plans which also indicate a very low hade (c.50°) for both. The rockhead positions for these faults are indicated on the Geological Survey's 1:10000 map. The western boundary fault is uncharted by the Geological Survey but is inferred by correlation between Composite's Airth 6 well and data from coal exploration bores immediately to the west and northwest.

Within the field, strata dip due east at approximately 11° in western and central parts, with dips decreasing rapidly eastwards towards the axis of the syncline.

Minor faulting (<20ft throw) within the field is anticipated, based on mine abandonment plans from adjacent areas, and has been encountered in horizontal drilling. Little is known about the density and orientation of minor fractures within the field, or the extent to which they may compartmentalise the field's reservoirs.

Sedimentological variation in seam continuity is also known from adjacent mining data, and includes: localised erosion of coals by overlying channel sandstones; and seam splitting and coalescing. Whilst no erosive channels have been encountered in drilling at Airth to date, some evidence has been found for limited but extremely rapid coalescing of the Bannockburn Upper and Lower Coals within the field.

2.2.2 Reservoir Description

The field's primary reservoir comprises a c.200ft zone containing four closely-spaced coals in the central part of the Limestone Coal Formation (in upward sequence: the Knott Coal; the Bannockburn Lower Main Coal; the Bannockburn Upper Main Coal; and the Greenyards Coal [all coals between 3ft and 6ft thick]).

Additional thinner coals are present within the primary reservoir zone and also above it within the upper part of the Limestone Coal Formation (notably the Hartley Coal). A total cumulative coal thickness of 33ft was recorded in the cored and logged Airth 6 well in the middle and upper parts of the Formation. Similar sequences with varying coal thicknesses have been recorded in earlier wells drilled at Airth.

Three of the four seams within the primary reservoir zone are homogeneous, clean coals. However, the Bannockburn Upper Main Coal comprises three leaves in the Airth field, separated by two thin (<1ft) partings of mudstone which may act as barriers to vertical permeability within the composite seam.

All Limestone Coal Formation strata within and above the primary reservoir zone are derived from a lacustrine deltaic depositional environment, with the upward coarsening sequences (mudstone to sandstone) representing prograding delta lobes. Thinner, upward fining sequences represent river channels and alluvial or deltaic floodplains, and swamps are represented by plant-bearing mudstones, seatearths and coals. A lack of marine influence is considered responsible for the coals' low sulphur contents.

2.3 Petrophysics and Reservoir Properties

A graphical log of the primary reservoir zone at Airth 6 is presented in Enclosure 4. A density / gamma ray log was recorded across the entire zone of interest. Similar logs exist for all previous wells drilled at Airth. The Airth 6 well was cored through the entire reservoir section and the coal cores analysed by Ticora Geosciences Inc. The results of Ticora's gas content analyses for the main seams in the Limestone Coal formation are summarised in Figure 2.3 below.

Coal geochemistry data is also available from National Coal Board exploration on the western limb of the Clackmannan Syncline during the 1950s. For the proposed deep colliery at Airth (sinking works abandoned in 1961) the NCB predicted the following geochemical properties of the target seams based on adjacent drilling and mining data (Table 2.1).

Coal Seam	Ash (air dried) %	Sulphur (air dried) %	Volatile Matter (dry ash free) %	Coal Survey Rank Code
Upper Hirst	9.4	0.40	35	701/301
Hartley	6.7	0.63	33	501
Greenyards	8.0	0.75	31	501
Bannockburn Upper Main	5.5	0.65	27	301
Bannockburn Lower Main	3.6	0.75	26	301
Knott	7.8	1.3	25	300a

Table 2.1 *Coal Geochemistry at Airth*

***Figure* 2.2** *Gas Content in the Limestone Coal Formation – source Airth #6.*

2.4 Gas in Place and Reserves

Composite have undertaken a conventional volumetric analysis of the Gas in Place (GIP) at Airth by [redacted] Recoverable reserves have been estimated by applying a recovery factor to determine the expected percentage recovery of the total GIP. In addition, a completion efficiency is used to allow for coals which have not been accessed because they have not been completed. Accessibility due to faulting and/or surface constraints is considered in the variation of drainage area. It has been assumed that all of the coals in the Limestone coal formation are included because some, if not all, of the original vertical wells at Airth will be produced as part of the development scheme.

A high degree of uncertainty remains in all of the parameters used in these GIP and reserve estimates, reflected in the large range estimated ([redacted] A mid case has been presented for the purpose of providing production projections but these will be refined once early pilot production data is secured.

The key parameters used in the volumetric calculation are Coal thickness, **h** (ft), Coal Density, **D** (ton/acre-ft), Gas Yield, **Y** (scf/ton), Completion Efficiency, **CE** (%), Recovery Factor, **RF** (%) and Drainage Area, **A** (acres). Each is considered in turn below.

[redacted]

Coal thickness Coal vertical thickness is assumed to be consistent across the basin and a mid-case value of 30 ft based on the Airth area wells located at the centre of the Clackmannan syncline. Low Case 15 ft, Mid Case 30 ft, High Case 40 ft.

Coal density Coal density is reasonably well known from borehole sampling but may vary with depth across the basin. A mid case value of 1900 t/acre-ft has been used and varied by +/-15% for the low and high cases. Low Case 1615 t/acre-ft, Mid Case 1900 t/acre-ft, High Case 2185 t/acre-ft.

Gas yield [redacted] These values are consistent with more recent values recorded at Airth #6.

Completion efficiency (which includes access efficiency) The completion efficiency used is based on vertical well US well analogues where the seams are interspersed with non-pay formations. It has been assumed that attempts will be made to access all coals within the Limestone Coal formation in some of the wells drilled at Airth. These are likely to be wells completed later in the sequence when drilling experience is more mature. The proposed horizontal well scheme should achieve much better completion efficiencies primarily because the bit is expected to remain in a continuous coal seam for extended periods exposing more coal and by accessing potentially faulted blocks which might otherwise be undrained. The completion efficiency has been weighted on the high case for this reason. [redacted]

Recovery factor Recovery factors have been based on US analogues. [redacted]

Drainage area The drainage area has been estimated from the structure maps provided in Appendix 1. The actual drainage area could extend further to the east as no obvious fault or other boundary is currently mapped. Equally the area drained may also be constrained by well coverage, surface geographical limitations and/or the effects of small scale faulting within the target seams. The mapped area for the Airth scheme shows a mid-case drainage area of [redacted]

bcf	Low Case	Mid Case	High Case
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Table 2.2 Deterministic GIP and Reserve Estimates at Airth

Key assumptions

- Low case assumes only four main seams accessible
- Mid case assumes some attempt to access all coals in the Limestone Coal sequence
- High Case assumes all coals accessed

2.5 Well Performance

A number of well completion types will be tested and evaluated during the pilot development. The performance expected from the various horizontal well types is described in section 3.2. Existing vertical wells will also be pumped where possible.

2.6 Reservoir Modelling

Reservoir simulation modelling of the Airth area will be conducted using commercially available coal bed methane reservoir simulation software. New production data will be recorded from the horizontal well completions and modelling work will be conducted to enable predictions of performance for the Airth area to be made. History matching of existing production data in the Airth area recorded by Coal Bed Methane Ltd, the previous licence holder, may also be attempted.

Geological mapping of the greater licence area is also being conducted and planning for larger scale development activity will be undertaken based upon the same modelling approach and learning from the Airth pilot work.

3. Development and Management Plan

3.1 Proposed Development Plan

The primary objective of the proposed pilot development at Airth area is to demonstrate the commerciality of coal bed methane and production within the PEDL 133 licence. Drainage from a large but confined geological area with multiple off take points is considered to be the most effective way of achieving this.

The key elements of the proposed development are :

[redacted]
- a gas gathering pipe network
- a water processing and disposal facility
- a gas-to-wire generating facility

The proposed surface location and horizontal orientation of the development wells is illustrated in Enclosure 1. Well orientation is selected in order to achieve three objectives, namely to permit gravity drainage within the well completion, to achieve effective drainage across the development area and to ensure optimal placement to take advantage of directional permeability trends, if these exist.

Development wells will consist of two basic completion designs, commonly referred to as an 'Up-dip' or a 'Down dip' configuration.

The 'Up-dip' well design utilises a single surface borehole. The reservoir section is drilled at high angle (up to 75deg) and cased off. The target seams are then accessed using a mill and whip stock assembly and a horizontal borehole of 6" diameter is drilled in-seam for up to 1000m at a relatively shallow up-dip angle (approximately 4 degrees). This process is repeated for each of the target seams to create a multi-lateral arrangement from a single mother bore. The well is then completed open hole with an ESP or PCP pump installed in the well sump below the lowermost lateral. This well design has been used extensively in the US and is likely to be the most common design employed. The well design is illustrated in Appendix 4.

The 'Down-dip' well design utilises two surface boreholes. The first is a simple vertical well cased off across the reservoir section – this becomes the target well. Casing windows are milled in the seams of interest. A second well is then drilled from an offset location up-dip of the target well. Multiple horizontal in-seam sections are drilled at a shallow down-dip angle to intersect the prepared windows in the target wellbore. Electromagnetic ranging technology is used to achieve the well intersection. Individual lateral sections may be abandoned at the up-dip end as they are completed. The down-dip or target well is then completed with an ESP or PCP pump in the vertical sump below the lowermost lateral. This well design has already been successfully drilled on PEDL133 (Airth #5z). It has been used extensively in Australia and multiple offset wells may be drilled to a single target location. This well design is also illustrated in Appendix 4.

To complement the horizontal type completions above it may be possible to re-complete existing vertical boreholes or even to drill and complete additional vertical wells if this is deemed appropriate. [redacted]. Finally, the possibility exists to drill multi-lateral extensions within a single seam to provide a more extensive drainage pattern. This has been tried in the US with some success. The Licence holders will consider the advantages and practicality of this technique before considering its deployment at Airth.

3.2 Production Profiles

The production performance of the various completion types is uncertain. Some historical production data for vertical stimulated wells at Airth does exists and this data has been used to project a typical well production profile for forecasting purposes. A typical well production profile is provided in Figure 3.1. Based on US analogues it has been assumed that the horizontal well will initially produce around four times that of a vertical well equivalent. [redacted]. All of these assumptions have great uncertainty attached to them and the performance of individual wells will be dependent on the status of other wells in the development and the drainage status of the pilot area overall.

Figure 3.1 *Typical Airth Horizontal Well Production Profile*

Low initial well gas production (<100 mscfd) will simply be vented. Higher levels of gas will either be used to directly drive well pumps or will be flared using a low pressure hidden flame facility (described later). Gas flaring will only be continued in order to establish a firm production trend for each of the wells. Production would be subsequently curtailed pending the commissioning of a dedicated gas-to-wire generating facility. Peak gas flaring will be limited by available flaring equipment capacity to 3,000 mscfd. The maximum anticipated flared volume prior to the commissioning of the electrical generation facility is approximately

60 mmscf. Fuel gas is not expected to exceed 100 mscfd prior to power generation. The power plant is expected to consume up to 1,500 mscfd.

Water production is expected to be constrained only by reservoir deliverability. Water processing facilities and disposal capacity to the Forth are not expected to restrict production. Initial peak water for each well and the nature of the expected decline remains an uncertainty. The profiles used are conservative to ensure that reservoir deliverability is the only constraint.

The various gas production profiles are provided in Table 3.1 below and more detailed information is provided in Appendix 3. Production is shown out to 2026 though the cessation of production is anticipated to be dictated by an economic cut-off at an average well production of less [redacted] The pilot nature of this development, however, means that failure to reach the anticipated levels of production or to sustain the modest decline rate assumed could result in premature abandonment of the scheme.

	Gross Gas mscf	Fuel Mscf	Flare / Vent mscf	Net Gas mscf
2006			2000	
2007			55500	
2008			60000	
2009			60000	
2010			60000	
2011			60000	
2012			60000	
2013			60000	
2014			60000	
2015			60000	
2016			60000	
2017			60000	
2018			60000	
2019			60000	
2020			60000	
2021			60000	
2022			60000	
2023			60000	
2024			60000	
2025			60000	
2026			60000	
2027			*60000*	
Total			**1197500**	

Table 3.1 Airth Annual Gas Production

3.3 Drilling and Production Facilities

Composite Energy is owner and operator of its own Drilling Unit, a Drillmec G55, through its wholly owned subsidiary company, Geometric Drilling Ltd. This rig is fully equipped to drill the proposed wells in the programme but with a 55 tonne lift capacity may be constrained in terms of the maximum horizontal well lateral length achievable. An additional drilling unit, a Drillmec HH102, with twice the capacity of the G55 is currently under construction and will be delivered Q1 2007. This unit will also be manned and operated by Geometric Drilling Ltd. Both units will be dedicated to PEDL133 development activities and will ensure completion of the proposed drilling and workover activities at Airth described in this plan.

All new wells to be drilled as part of the Airth area development will include the following key design features:

Hole Size	Casing	Depth
Excavated	20" Surface Conductor	20ft
12-1/4"	9-5/8" Intermediate casing	400ft
8-1/2"	7" Reservoir Casing	TD (up to 5,000ft md)
6"	Open hole	Laterals, up to 8,000 ft md

A 13-3/8" contingent casing string will be deployed in the event of surface drilling problems – the most likely cause being open cast of shallow mine workings

Lateral boreholes will be drilled 6" diameter and left open hole. Installation of a contingent 3" slotted liner will be considered in the event of production problems associated with hole collapse.

ESP or PSP type pumps will be installed on 2-7/8" tubing into the well bore sump below the lowermost lateral. A Claxton design wellhead incorporating an electrical penetration for ESPs will be deployed. Sucker rods with wear guides will be used for the PCPs. A mixture of gas engine hydraulic and direct electric surface PCP drives will be deployed to evaluate the best type of arrangement anticipated for wider scale deployment within the licence. Similarly it is intended to test deploy an ESP system once basic production performance data from a well with a PCP pump has been obtained. Schematics of the various well completion designs to be employed in the Airth development are provided in Appendix 4.

It is anticipated that the smaller G55 rig will be deployed on surface well preparation with the larger HH102 rig being deployed for all the more demanding directional drilling work. This approach provides for optimal deployment of the available rig capacity. Both the G55 and HH102 drilling units are capable of conducting all anticipated well workover and intervention operations. Some operations may also be completed using a simple crane arrangement. However, it is recognised that a dedicated workover unit specifically designed for this type of activity might improve efficiency and optimise the deployment of available hardware.

3.4 Process Facilities

During the pilot development phase, a variety of process facilities and equipment are to be trialled at Airth in order to optimise the production and treatment of gas and associated water in order to determine the longer term viability of commercial production. Composite Energy is working with a local process engineering design house who have extensive experience in the petrochemical industry relating to the design of hydrocarbon treatment facilities. Water processing facilities design is being worked on in conjunction with one of the leading design houses in mine water treatment; the waters produced at Airth have much in common with mine waters being successfully treated at a number of locations throughout the UK.

Initially much of the pilot development will be based upon utilisation of temporary equipment; all such equipment will be certified to required codes and standards and will undergo a programme of routine maintenance and inspection. Temporary power generation, air compression and other diesel powered machinery will be deployed at each well site as required. Once confidence in the well performance has been established and production profiles for both water and gas are better understood, specific equipment will be designed, procured and installed. Currently the requirements for the long term treatment of water are better understood (due to mine water experience) than those for gas treatment. Gas processing requirements will ultimately depend upon the final market for the gas; gas sales specification varies depending upon how it is to be transported and used. The initial Airth development is targeting the use of gas for an Embedded Power Generation project and for use in wellhead drive engines. Suitable vents and flares are to be utilised in the initial production testing phase.

A brief summary of equipment, including capabilities and operational envelopes follows.

3.4.1 Vents and Flares

Vents and flares, designed and built in accordance with the Pressure Systems Safety Regulations 2000 are to be located at each of the well pad sites in order to accommodate expected rates and flowing pressures. Vents will restrict flow (via restriction orifice which will be used also to meter the vented gas) to 100 mscfd. Flares will have a design capacity of 1,000 mscfd and gas will be metered using thermal mass flowmeters.

3.4.2 Water Treatment

A prototype water treatment plant is to be established at one well site, with the capability of treating [redacted] of water containing up to 250 mg/l of Fe^{2+} ion, which is the main constituent of the water requiring removal. The discharge consent is for water containing less than 25 mg/l, which will be achieved by precipitation of the iron through pH control and aeration of the water. Water from other well sites will be either piped through flowlines or temporarily transported via bowser. Water will be degassed using dedicated "Poor Boy" type degassers. Treated water will be discharged into the Forth River through an existing dedicated outfall. Performance of the water handling and disposal facility is still uncertain and experience during initial trials will influence the nature and scale of the facility required to process production from up [redacted] wells in future.

3.4.3 Gas Gathering and the Embedded Generation Project

Up to 4 MVA of embedded generation is to be established at the Airth #3 well site and connected to the Scottish Power network at Carron. For this, gas will be gathered via existing and new gas flowlines, run from individual well sites to the Airth #3 location. Gas will be dewatered using a simple demister pot and pressure regulated with dedicated flowline manually set regulators. Orifice metering or thermal mass flowmeters will be used on individual flowlines.

Typical small scale generation plant will be deployed, consisting of containerised, gas engine driven alternators of between 1 and 2 MVA, depending upon the provider. These will produce 415V, 3 phase, 50Hz power distributed to the other well sites via underground cables, and will replace temporary generation at those sites. Step-up transformers (415-11kV) will connect to Scottish Power equipment for connection to the grid. There will be no back-feed capability from the SP grid.

3.4.4 Control Systems

Other than the embedded generation, which will have a dedicated, remotely monitored, plc-based control system, all equipment will require "operator in attendance" starting and will include basic, automated safety shutdown system. As dedicated equipment is procured and as the various well sites are inter-connected with flowlines and power cables, a telemetry system will be installed to enable remote monitoring with some control from a central location. A distributed control system (DCS) is envisaged.

3.5 Field Management Plan

Management of the pilot development at Airth will be primarily focused upon demonstrating commerciality of a larger scale development of the PEDL 133.

The following principal objectives will be pursued during this development:

- Cost effective and fit-for purpose well drilling and completions
- Environmentally sound water handling and disposal
- A production start up and ongoing monitoring programme which optimises learning through data gathering
- Consistent and predictable gas production
- Minimum venting and flaring, maximum exploitation of gas for commercial purposes

Initially well drilling and completion costs are expected to be relatively high as new techniques are deployed or modified – this is seen as part of the normal 'learning curve' process. Similarly it is expected that workovers for pump change-outs will be more frequent in the first 12 months of the development as knowledge regarding the performance and reliability of the various pump types is acquired. However, the intention is to take a 'continuous improvement' approach in this area to ensure future development wells can be drilled cost effectively and completed with tried and tested completion and pump technologies. Drilling and completion costs will be critically reviewed at the end of each well operation.

Water production will be metered at each well site and then gathered together for processing at a single location. Processing will involve either mechanical agitation to aerate the water and encourage iron oxidation/drop out, or will be treated chemically to reduce pH to achieve the same end. A combination of both methods is likely to be deployed. Treated water will then be disposed of directly to the Firth of Forth under a SEPA licence with total volumes and regular quality analysis being recorded. Composite Energy is currently in the process of applying for an extension of an existing water disposal licence with SEPA. During the development options for the disposal of water will reviewed to consider the following:

- Expansion of the existing Composite operated outfall facility
- Use of existing outfall capacity (e.g sewage or other industrial outfalls)
- Subsurface re-injection

Each of the above will be considered in the light of expanding development activities beyond the current 6 well pilot at Airth.

At production start up it is anticipated that up to 3 wells will be available for production with three 'paired' vertical wells available for data monitoring. It is intended to bring the horizontal wells on production individually and to stagger the addition of new wells by at least one month. Data monitoring using downhole and surface pressure gauges, as well as echometer surveys, will be conducted to monitor individual wells performance and to assess the interference impact of multi-well production.

Initially well gas production will be recorded using a simple orifice type metering and a vent. Once individual well production exceeds 100 mscfd a flare system with a 1,000 mscfd capacity will be deployed. This system will be equipped with mass flow metering for more accurate recording of gas production. Fuel gas used by gas engined PCP pumps will be estimated based on the simple calculation of engine load.

Once significant gas flows are achieved more permanent metering will be installed both at the wellhead and at the gas gathering and power generation site. All gas will be utilised for the generation of electrical power though some may be deemed 'fuel' for the purposes of accounting for utility power consumption. Estimates of this quantity will be made once the power generation plant type is selected and deployed. Flaring and venting at this stage will be minimal and will be restricted to unplanned production trip events and perhaps well testing or well clean up operations. Estimates of flaring and venting have been included in the production summary in Appendix 3.

Well pumps are expected to achieve an overall uptime in excess of 90%. Gas driven PCP pumps will require frequent engine oil changes but temporary loss of pumping is not considered to have a significant impact on depletion in a multi well scheme. Good well maintenance planning will minimise the impact of planned downtime.

Electrical power generation plant is predicted to have an uptime in excess of 95% based on extensive experience with this type of plant. A planned maintenance arrangement will be in place which will include a rapid response call-out facility in the event of an unplanned shut down. Remote monitoring of machine performance is possible with most systems ensuring minimum response time and thereby minimum downtime.

The key to achieving consistent and reliable gas flows is to ensure:

1. Minimum unplanned shutdowns of wells and plant
2. Optimum uptime through good planned maintenance
3. Available well gas deliverability always exceeds consumption capacity

3.6 Planning Consents

Local Authority Consents are required to undertake both drilling and production type operations. At Airth all activities of this kind are controlled and monitored by Falkirk District Council. Existing consents for drilling sites and for production operations, including the installation of power generation facilities are provided in Appendix 2. New well drilling consents for three additional wells will be provided as and when they are secured. At the time of writing two such consents are already in the Planning consent process.

Water disposal is executed under an existing SEPA licence using road transport and an existing Composite operated outfall to the Firth of Forth. A copy of the SEPA discharge licence is provided in Appendix 2. Discussions are ongoing with SEPA for a change to this licence to accommodate the larger volumes expected from the pilot. The water treatment plant and transport pipeline to the outfall point will be ultimately sized to accommodate up to 25 producing wells and this 'planning for success' approach has been adopted in discussions with SEPA.

Since April 2006 water abstraction also requires to be licenced by SEPA. Composite Energy is one of the first companies in Scotland to apply for such a licence through the new scheme. SEPA have entered into discussions to ensure that the licence granted is suited to a multiple borehole abstraction process.

3.7 Future Development of PEDL 133

A successful pilot development at Airth will permit the rapid expansion of further development activity. Composite already has plans to conduct a further pilot development in the Longannet area north of the Firth of Forth – this will be the subject of a separate pilot development application.

Geologically the coals of interest will have been mapped across the PEDL 133 licence within the next 12 months. This work will include detailed mine and borehole studies which will identify geological constraints in certain parts of the licence. Appraisal activity (3 new wells within PEDL133 during Q1 2007) will help to identify any additional macro geological or petrophysical constraints.

Generating capacity at Airth will be limited to 4 MVA initially though it may be possible to extend this if required and it is likely that other markets for gas will be considered including direct sales to local customers and/or export directly to the national gas grid. The main constraints on future expansion of the scheme will be:

- Available rig capacity
- Sufficiently rapid access to new well pad locations (Local Planning)
- Access time to secure access to UK grid infrastructure

Experience to date indicates that suitable additional drilling hardware could be available within 12 months of a commitment to additional development activity. However, there is a concern that Local Authority planning process may not be able to keep up with the required or desired pace of development.

The lead times to gain access to UK gas grid infrastructure can be significant. UK gas specifications are very rigid and there are only a very limited number of non-North Sea gas sources accessing the grid. Up to 2 years lead time is anticipated to gain access. Careful consideration of compression requirements and the distribution of access points will be required. Currently the Licence owners envisage a 'cluster' approach with multiple access points, production gathering stations and water disposal outfalls. Optimisation of such large scale development will hinge upon learning outcomes from the Airth Pilot Development.

3.8 Project Funding

[redacted] Further development at Airth will initially involve the addition of more wells and capital equipment (either compression and/or generation facilities) the precise nature of which will be determined by the future gas sales philosophy for the licence. Additional investment would be conducted under a supplement to this plan or as part of a larger scale development plan for the licence as a whole.

4. Appendices

Appendix 1 - Enclosures

1. Airth area structural plan
2. Airth area structural x-section N-S
3. Airth area structural x-section E-W
4. Airth #6 Limestone Coal Primary reservoir
5. Airth development Project Plan

Appendix 2 - Planning Consent Documents

Appendix 3 - Production Profiles

Appendix 4 - Well Completion Schematics