Operating Techniques, BAT Assessment & Monitoring Plan

Oswestry STOR Facility

FOR: ARL 020 LTD

PROJECT NUMBER: ECCS 129 002

PREPARED BY: EC CONSULTANCY SERVICES LTD

Operating Techniques, BAT Assessment & Monitoring Plan

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ECCS 129 002 R 004 A

Project:	Oswestry STOR Facility
For:	ARL 020 Ltd
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1 INTRODUCTION

1.1 OVERVIEW

This report has been prepared on behalf of ARL 020 Ltd (hereby referred to as the 'Operator') in support of a bespoke permit installation application for a gas-fired Large Combustion Plant (LCP), to be located on land east of the A5, near Oswestry in Shropshire.

The proposed plant (hereby referred to as Oswestry STOR Facility) will consist of Twelve (No.12) x 2.5MWe reciprocating engines, with an aggregated capacity of 30.42MWe output (70.98MWth input). The proposed Oswestry STOR Facility is intended to participate in the National Grid's Short-Term Operating Reserve (STOR) programme, as well as Capacity Market Units and as an Energy Trading Generation site on the Energy Market.

STOR provides balance to the National Grid during unexpected periods of high demand for electricity or where there are constraints on electricity generation available in England and Wales. National grid can call upon a Facility such as the one proposed off Oswestry, to generate electricity on demand under contract.

This document has been prepared to provide supporting information in answer to questions within Parts A, B2 and B3 of the Environment Agency's application forms. The report will describe the proposed activities and processes in detail, along with the operational techniques to be used, in order to minimise and control emissions from the proposed Facility. The report includes justification for the chosen technology along with details of how the plant will meet Best Available Techniques (BAT).

Prior to the submission of this application, the applicant has sought pre-application advice from the Environment Agency. Relevant correspondence is provided within Appendix A to this report. The pre-application number allocated by the Environment Agency is EPR/PP3405BE/A001.

1.2 THE APPLICANT

The Operator for the proposed STOR Facility is a Special Purpose Vehicle (SPV) (ARL 020 Limited), a wholly owned subsidiary to the parent company Arlington Energy Ltd. Arlington Energy Ltd was established in 2017 as an investment company looking to invest and develop in low-carbon energy assets and clean power projects within the UK. The company has a number of power generation plant projects in conceptual design, planning and permitting stages of development. The intention is to support the electricity market by providing a number of Short-Term Operator Reserve (STOR) power generator plants across the country, that can be used at short notice to support gaps in demand and supply of electricity.

ARL 020 Limited (the Operator) will have direct day to day control over the running of the Oswestry STOR Facility, and will ensure compliance with any relevant permit conditions that relate to the operation of the proposed plant. They will have the power to employ and dismiss key staff who will manage the site and will have the power to make investment decisions. The Operator will ensure that emergency procedures are followed should a serious incident occur in relation to the STOR Facility. Details of the Company Directors is provided within Appendix B to this report.

1.3 SITE LOCATION AND ENVIRONMENTAL SETTING

The proposed STOR Facility is to be situated on land to the east of the A5 within the administrative boundary of Shropshire Council. The proposed site will occupy 0.5 hectares of land. The site is currently an undeveloped green field site with no allocated postcode (nearest postcode is SY11 2YU).

Agricultural fields and farmland surround the site to the north, east and southern boundaries, with the A5 running parallel, 70 west of the western boundary of the site. The proposed site was previously used for the grazing of cattle and consists of improved grassland with localised patches vegetation, a species-poor defunct hedge, and an existing access track with a wooden fence and dense scrub running parallel to the A5 west of the proposed site. A small watercourse (Common Brook) is situated just beyond the proposed sites south-eastern boundary and flows into a network of water features to the south-east.

The proposed site is situated in close proximity to existing infrastructure including pylons, overhead electrical lines and underground gas and water pipes. These existing utility features have restricted the choice of site location, thus the propose site boundary is considered the most suitable in order to circumvent existing infrastructure. A sewage treatment works is situated approximately 400m to the north-east of the proposed site. Access to the site will be off the southern bound carriageway of the A5, via the existing access point to the field in the south-western corner. The proposed sites location is illustrated in orange within in Figure 1.3.1 below.

The full site address is:

Oswestry STOR Facility

ARL 020 Ltd

Land East of A5

Oswestry

Ball

Shropshire

SY11 2YU

Site Grid Reference: **SJ 30828 30275**

Figure 1.3.1 Site Location

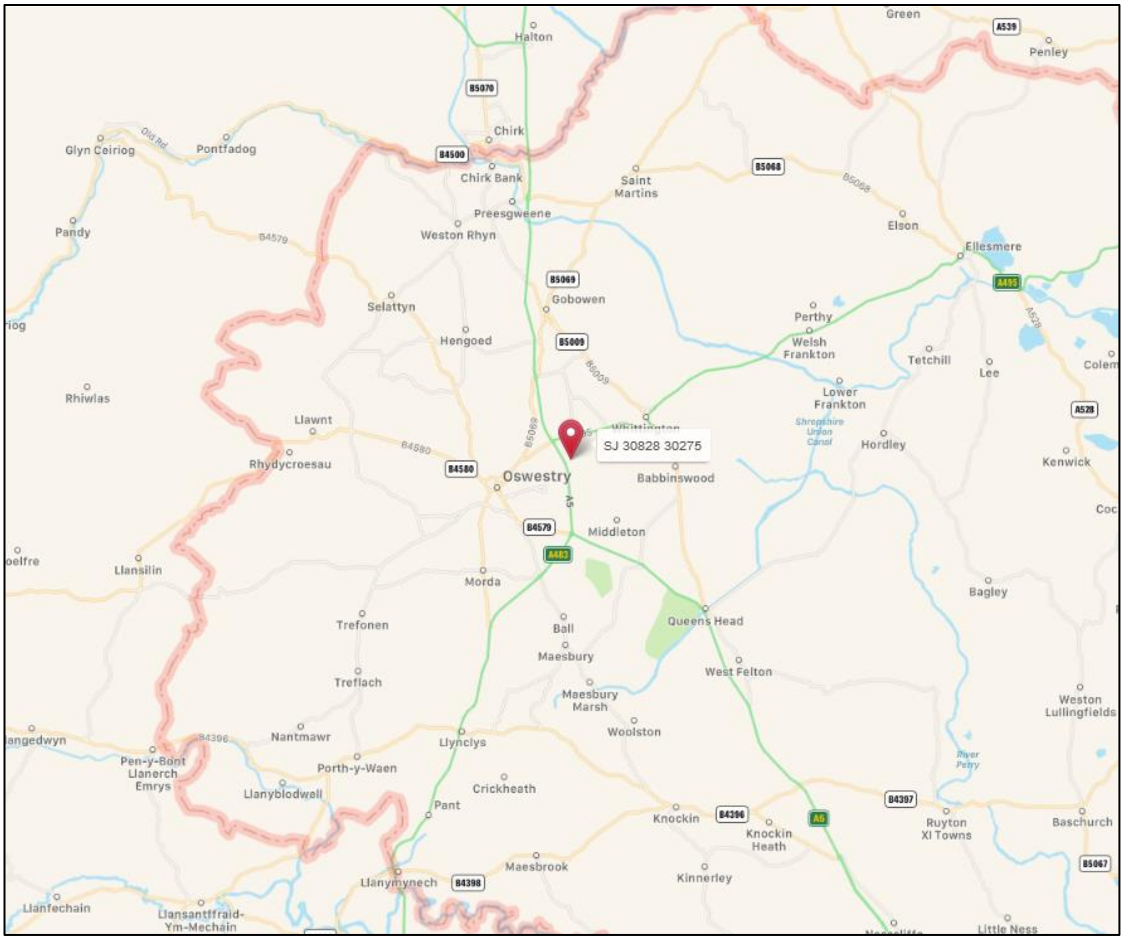

Image taken from Google maps © 2020
The site location is shown as a red marker

1.4 Regulatory Framework

In 2008 the Ambient Air Quality Directive (2008/50/EC) set legally binding limits for all member states for concentrations in outdoor air of major air pollutants that impact public health. This was followed in 2010 with implementation of the Industrial Emissions Directive (IED) which was subsequently transposed into domestic legislation in 2013. The IED combined and updated a number of older European Union (EU) Directives within its text, including both the Integrated Pollution Prevention and Control Directive (IPPCD) and Large Combustion Plant Directive (LCPD).

A Large Combustion Plant (LCP) is any combustion plant with a rated net thermal input which is greater or equal to 50MW. Chapter III of the IED applies to new and existing large LCPs. Multiple combustion units that discharge to atmosphere from a common stack (common windshield) are considered to be part of a single combustion plant with a combined thermal input. A common stack can contain multiple individual flues. For plants with multiple flues within a common windshield or supporting structure that form part of a larger, single combustion plant, the emissions from the multiple flues will need to be combined for assessment and overall throughput capacity purposes. Articles 28 and 29 explain exclusions to chapter III and aggregation rules respectively. The aggregation rule is as follows:

- An LCP has a total rated thermal input ≥50MW;
- Where waste gases from two or more separate combustion plant discharge through a common windshield, the combination formed by the plants are considered as a single large combustion plant; and
- The size of the LCP is calculated by adding the capacities of the plant discharging through the common windshield disregarding any units <15MWth.

Permit applications for new installations with a total thermal input of 20 MW thermal or more must also meet the requirements of Schedule 24 of the Environmental Permitting Regulations which implement the relevant requirements of the Energy Efficiency Directive (2012/27/EU) (EED).

More recently, the Environmental Permitting (England and Wales) (Amendment) Regulations 2018, as published in January 2018 (2018 No.110), transposed the requirements of the Medium Combustion Plant Directive (MCPD) EU/2015/2193 of 25 November 2015 into domestic legislation.

These Directives and amendments to domestic Legislation are designed to protect air quality whilst minimising impacts on energy security and costs to businesses.

1.5 PROPOSED ACTIVITIES

The Operator is applying for a Part A Installation Environmental Permit consisting of a single Schedule 1 listed activity, as detailed within Table 1.5.1 below.

Table 1.5.1 Proposed Activities

Proposed Activities	
Description of Activities	Limits of Activities
Section 1.1 A(1)(a) **Burning any fuel in an appliance with a rated thermal input of 50 megawatts or more**	Operation of Twelve (No.12) 2.5 MWe natural gas fired reciprocating engines with an aggregated thermal input of 70.98MWth operating for less than 2,500 hours per engine per year as a rolling average over a period of five years and with an operation in any individual year limited to a maximum of 2,500 hours.
DAA	Storage of raw materials
DAA	Site surface water drainage system

The engines will operate using the principle of lean burn combustion using Twelve (No.12) MTU 20V4000GS generating units. The units are to be housed in individual containers within a secure compound, along with transformers, electrical switchgear and other associated infrastructure.

The proposed power generation plant will comprise of Twelve (No.12) 2.5MWe engines consisting of twelve (No.12) individual stacks discharging to atmosphere at a height of 6.5m. Individually the plant does not form part of an LCP and so does not come under Chapter III IED requirements as the gross thermal input of each individual engine is less than 15MWth. However, collectively the engines will still aggregate to be part of the Section 1.1 A(1)(a) activity because they have a combined rated thermal input of 50MW or over. The installation is therefore a Chapter II installation and subject to the Medium Combustion Plant Directive (as each engine is over 1MWth capacity). Emissions from the engines will be required to comply with the Emission Limit Values (ELVs) specified within Schedule 25 of the Environmental Permitting (England and Wales) (Amendment) Regulations 2018.

1.6 ELECTRICITY MARKET AGREEMENTS

The Oswestry STOR Facility is intended to operate within the Capacity Market, Balancing Market and as an Energy Trading Generation Plant on the Energy Market. The services to be provided under contract include the following:

- ***Short Term Operating Reserve ("STOR") programme***: providing balance to the National Grid during unexpected periods of high demand for electricity or where there are constraints on electricity generation available in England and Wales. National Grid can call upon an electricity generator plants to generate electricity under contract on demand under this programme.
- ***Dynamic Frequency Response (DFR):*** DFR is a continuously provided service used to manage normal second-by-second changes on the system, (applicable to sites under operational hours constraints placed on it); and
- ***Firm Frequency Response (FFR):*** FFR or is provided within 30 seconds of an event, which can be sustained for 30 minutes.

1.7 PLANNING PERMISSION

Planning permission for the site was originally sought from Shropshire Council by Enso Energy Ltd. The site was granted conditional consent on 16 July 2019 (ref: 18/04510/FUL). Once planning permission was secured for the site, Enso Energy Ltd sold the asset onto a developer (ARL 020 Ltd).

A subsequent planning application to vary the original consented scheme was submitted to Shropshire Council on 18 October 2019, in order to bring the planning consent in line with current site design (planning reference No. 19/04640/VAR). Planning Permission was granted on 3 December 2019.

1.8 RELEVANT LEGISLATION AND GUIDANCE

The proposed activity is subject to a number of European, domestic, statutory and non-statutory legislation and guidance documents. Operators are required through the Environmental Permit application process, to demonstrate how they will comply with the relevant requirements of this legislation and guidance.

In relation to the activities proposed at Facility at Oswestry, the following pieces of legislation and guidance are considered relevant for this report:

- Industrial Emissions Directive 2010/75/EU;
- Medium Combustion Plant Directive (EU) 2015/2193;
- Waste Framework Directive 2008/98/EC;

- The Environmental Permitting (England and Wales) Regulations 2016;
- The Environmental Permitting (England and Wales) (Amendment) Regulations 2018;
- The Environmental Permitting (England and Wales) (Amendment) Regulations 2019;
- BREF, Best Available Techniques (BAT) Reference Document for Large Combustion Plants Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control) 2017;
- Guidance on Medium Combustion Plant and Specified Generators, Environment Agency (September 2019); and
- Department for Energy and Climate Change – Developing Best Available Techniques (BAT) for combustion plants operating in the balancing market (June 2016) (“the DECC Report”).

2 OPERATIONAL TECHNIQUES & BAT ASSESSMENT

2.1 PURPOSE OF INSTALLATION

In order to balance the supply and demand of electricity, the UK National Grid has contracts in place with generators and large energy users, to provide temporary, extra power, or a reduction in demand. These reserve services are needed if, for example, a power station fails, or if forecasted demand differs from actual demand. National Grid has several classes of reserve services, which in descending order of response time are: Balancing Mechanism (BM) Start-Up, Short-Term Operating Reserve, Demand Management and Fast Reserve.

At times of the day, National Grid needs access to additional power, in the form of either additional generation or, by a reduction in demand. These additional power sources, which are available to National Grid, are referred to as 'Reserve' and comprise synchronised and non-synchronised sources.

National Grid procures the non-synchronised requirement primarily by contracting for Short Term Operating Reserve (STOR), which is provided by a range of service providers, by means of standby generation and/or demand reduction.

The need for STOR varies depending on the time of year, the time of week and time of day, being a function of the system demand profile at that time. To reflect this, National Grid splits the year into a number of seasons, for both Working Days (including Saturdays) and Non-Working Days (Sundays and most Bank Holidays) and specifies the periods in each day that Short Term Operating Reserve is required. These periods are referred to as 'Availability Windows'.

Short-Term Operating Reserve is a contracted Balancing Service, whereby the service provider delivers a contracted level of power when instructed by National Grid, within pre-agreed parameters. The main, minimum capability requirements for the service are as follows:

- Minimum Contracted MW capability = 3MW.
- Contracted MW must be achievable no later than 7 minutes after instruction from National Grid.
- Contracted MW must be deliverable for no less than 2 hours.

The service can be provided by both Balancing Mechanism and non-Balancing Mechanism participants. Utilisation of the service from Balancing Mechanism participants, is via the Balancing Mechanism, whereas for non-BM service providers, a bespoke monitoring and dispatch system, 'STOR Dispatch', is installed (formerly known as SRD - Standing Reserve Dispatch).

2.2 PROCESS DESCRIPTION

The proposed Gen-sets are based on an MTU natural gas fuelled engines, mechanically connected to an 11kV alternator. The natural gas supply is taken from the local natural gas infrastructure transporter. The Gen-sets convert thermal power into mechanical power and then into electrical power. The Gen-sets specified for this site are Twelve (No.12) x MTU (Rolls Royce Company) 20V4000GS's, with a rating of 3168 kVA @ 0.8pf and the associated alternators generate three phase power at 11kV 50 Hz. The electrical power is transferred from the alternator terminals to the 11kV switchgear via cabling arranged in a triplex or trefoil formation.

All equipment and associated infrastructure to be installed at the Oswestry STOR Facility will be contained within a secure compound area (5286m^2 sized footprint), and will include:

- No.12 x MTU 20V4000GS 2 gas utilisation engines each discharging emissions to atmosphere via a 6.5m high stack (2.5MWe each);
- 1 x Switchgear cabin;
- 1 x Customer control / welfare cabin;
- Earthing resistors;
- Customer transformer;
- Gas governor;
- CCTV systems;
- 4m high lighting columns;
- DNO substation;
- Gated compound with 2.4m high palisade fencing.

The system will consist of the following termination points:

- Natural Gas connection onto the site;
- DNO 66kV switchyard and power transformer (outdoor compound);
- DNO 11kV Backup supply to the local network.

All cable runs and gas pipelines linking the proposed compound, to the point of connections on the national gas/electricity grid, will be located underground.

2.2.1 Fuel Input – Natural Gas

The Oswestry STOR Facility will have its own dedicated Natural Gas Connection. Natural Gas will be received at a dedicated on-site Gas Kiosk which will be fitted with standard issue gas regulator and slam-shut valves between the grid at the meter point of the National Grid supply. The gas pressure will be controlled by the gas regulator and the volume of gas measured by the fiscal meter which are also housed in the gas kiosk. When operational, gas will be transferred to the engines by a short section of above ground pipework.

The anticipated composition of the Natural Gas Fuel is described within Table 2.2.1 below.

Table 2.2.1 Composition of Fuel

Content or Characteristic	Value
Hydrogen Sulphide (H_2S) content	≤5 mg/m^3
Total Sulphur content (including H_2S)	≤50 mg/m^3
Hydrogen content	≤0.1% (molar)
Oxygen content	≤0.2% (molar)
Impurities	Shall not contain solid or liquid material which may interfere with the integrity or operation of pipes or any gas appliance (within the meaning of regulation 2(1) of the 1994 Regulations) which a consumer could reasonably be expected to operate

Hydrocarbon Dewpoint and Water Dewpoint	shall be at such levels that they do not interfere with the integrity or operation of pipes or any gas appliance (within the meaning of regulation 2(1) of the 1994 Regulations) which a consumer could reasonably be expected to operate
Wobbe Number (WN)	(i) ≤51.41 MJ/m3, and (ii) ≥47.20 MJ/m3
Incomplete Combustion Factor (ICF)	≤0.48
Sooting Index (SI)	≤0.60
Content or Characteristic	Value
Hydrogen Sulphide (H_2S) content	≤5 mg/m^3
Total Sulphur content (including H_2S)	≤50 mg/m^3
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Incomplete Combustion Factor (ICF)	≤0.48
Sooting Index (SI)	≤0.60

Source: © National Grid 2020

2.3 BAT Assessment Of Chosen Technology And Plant Configuration

A BAT assessment has been carried out for the proposed Oswestry STOR Facility, in order to consider the various combustion technologies available on the market that may offer the best solution for the Facility, as well as demonstrate that the proposed System, Procedures and Plant configuration satisfy relevant BAT standards.

2.3.1 Comparison of Combustion Technologies Available

The Facility will not be required to operate continuously, however the site must be responsive to sudden peak demands for electricity. The STOR Facility proposes to run for up to 2,500 hours per year. The Facility will be controlled remotely and will therefore operate under normal operations on an unmanned basis during its operational life. It will not be staffed year-round however will benefit from a schedule of regular maintenance checks and remote monitoring. In order for the technology to constitute BAT, the technology must consider quick start up times, Low emissions, High thermal efficiency (LHV%), Abatement Options as well as low maintenance.

The DECC Developing Best Available Techniques for Combustion Plants Operating in the balancing market (2016) considers four BAT candidate technologies suitable for power generation plants such as that proposed at Oswestry. These are:

Combined Cycle Gas Turbines (CCGT)

CCGT technology uses a primary gas turbine coupled to a secondary steam turbine. Air is compressed through a rotating compressor, then mixed with fuel and combusted before being expanded through a gas turbine, converting the thermal energy into rotation of the turbine blades. Some of the mechanical energy powers the compressor, with the majority turning a generator which converts the mechanical energy to electricity. The hot turbine exhaust gasses then pass through a boiler to generate steam. The steam is fed to a steam turbine which powers a second generator, producing further electricity.

Open Cycle Gas Turbines (OCGT)

OCGT consist of a compressor, combustion chamber and gas turbine. They differ from CCGT's in that they operate without the secondary component to recovery heat. Air is fed into the compressor, pressurised and then passed to the combustion chamber where fuel is added and combusted. The hot exhaust turns the turbine blades and energy is converted into electricity. OCGTs can provide STOR and peaking services but not fast reserve services as during start-up thermal stresses need to be managed through a slow heating up process.

Gas Engines

A gas engine consists of a bank of fixed cylinders inside which, pistons move, injecting air and fuel, compressing the mixture, igniting the mixture and then expanding the hot gas produced, converting the thermal energy into rotation of a crank shaft. The engine load is adjusted by controlling the amount of gas and air injected into the cylinder, which is controlled by an automated system. A generator connected to the crank shaft of the engine converts the mechanical energy into electricity for export to the grid.

Diesel Engines

Diesel engines work in a similar fashion to gas engines with the key difference being that diesel is injected into the cylinder after compression of the air has taken place, and automatically ignites as a result of the high temperature of the compressed air. Engines are generally rated for continuous power output but can exceed this by stated amounts for shorter periods of time in modes named Standby (1he maximum) and Prime (12 hr maximum). These higher outputs come at the cost of higher emissions and greater equipment costs.

A comparison of these technology types is presented in Table 2.3.1 below. All start up, efficiency and emissions data contained within the table is obtained from the DECC Report.

Table 2.3.1 Comparison of Combustion Technologies

BAT Consideration	Technology Description			
Process Description	Combined Cycle Gas Turbine (CCGT)	Open Cycle Gas Turbine	Gas Engine	Diesel Engine
Start-up Time	1->3.5 hours	15 - 30 minutes	1 - 10 minutes	>10 minutes
Thermal Efficiency (LHV%)	42.1 – 60.7	19.0 – 41.5	35.0 – 45.0	35.0 – 37.0
Abatement Options	Dry Low NOx Burners, Wet Low Emission Systems	Dry Low NOx Burners, Wet Low Emission Systems	Lean Burn, Enhanced Lean Burn	Exhaust Gas Recirculation, Water Injection, Engine Optimisation

BAT Consideration	Technology Description			
Emissions with Abatement (mg/Nm3) at 15% O_2	Dry Low NOx Abatement NOx <19 - 34 PM <5 SO_2 10 CO 1.5 - 1.9	Dry Low NOx Abatement NOx 33 - 63 PM <5 SO_2 10 CO 4 - 5	Enhanced Lan Burn Abatement NOx <95 PM <5 SO_2 10 CO 370	Water Injection Abatement NOx <1156 - 1807 PM 20 - 100 SO_2 85 - 2540 CO 25 - 185

Source: DECC Report, June 2016

Given the requirements of the proposed Oswestry STOR Facility and taking into account all of the aspects required for the effective energy generation by technology suitable for Balancing Services, Gas engines have been determined as BAT for the site. They have fast start-up times, low emissions, and the highest thermal efficiency within the reciprocating engine category.

2.3.2 Fuel Type

The Operator has chosen natural gas as the most suitable fuel for the facility as it is available directly from the mains gas supply from the National Grid and considered the most reliable and least polluting fuel available for use at the site. By allowing fuel to arrive at the site via pipeline this will keep vehicle movements to and from the site to a minimum and will provide the Operator with the flexibility needed to operate under Balancing Service conditions and remove the need for storing fuel on site. In addition, delivery of fuel via pipeline will minimise the risks of potential leaks or spillages during transport and delivery of fuels to site via road and will minimise the overall carbon footprint of fuel delivery to site.

By using natural gas, there will be negligible emissions of sulphur and particulates, and by operating in a lean burn mode, the quantities of NOx emitted will also comply with the Medium Combustion Plant Directive emission limits for new gas fuelled engines.

2.3.3 Justification for 2,500 Hours Operation

The site will have primary abatement designed into the technology, through implementation of optimised combustion and enhanced lean burn. Furthermore, the engines will run at an efficiency of at least 40% and will comply with the <95mg/Nm^3 NOX emission limit.

An Air Quality Assessment (provided within Appendix D of the Environmental Risk Assessment Report - *ECCS 129 002 R 002 A ERA Final*) modelled impacts of NO_2 process contributions emitted from the proposed Facility based on the generating units operating for up to 2,500 hours per annum. The assessment concluded that all emissions (where they have not been screened out as insignificant), are considered to be 'not significant' as the predicted environmental contribution (PEC) is less than the Air Quality Standards (AQS) and that AQSs would still be met based on this operating window.

It is acknowledged that the 2016 DECC report requirements for a Facility of this size and nature operating in the Balancing Market, indicate a restriction of 1,500 hours per annum, however this aspect was discussed in detail during pre-application dialogue and the Environment Agency advised that a higher operating window may be permitted, provided the Operator can demonstrate emissions remained insignificant and where the efficiency of the gas engines are particularly low NOx intensity compared with other technologies or higher energy efficiency than those already permitted for <1500 hours previously a higher operating window would be considered. The efficiency of the engines selected for this project (MTU (Rolls Royce Company) 20V4000GS's) provide /LHV thermal efficiency comparable to Gas Turbines, even when operating at reduced loads. Further details of the engine specification are provided within Appendix D.

2.3.4 Primary Emissions Control

The primary emission of concern associated with combustion using gas engines is NOx. It is considered that Selective Catalytic Reduction (SCR) or Non-Selective Catalytic Reduction are not suitable for use here, due to the intermittent nature of the proposed operations. Both technologies require engines, downstream catalysts and reaction chambers to reach a steady operating temperature and flow rate of gas to operate effectively. Steady state of operation is usually reached after 15-30minutes of operation. Thus, given the proposed operating window and intermittent demand under contract to supply electricity to the National Grid, significant periods of the plants Operation would be operated unabated even if secondary abatement was installed. In addition, the injection of urea or ammonia into the exhaust would inevitably result in ammonia slip in the exhaust gasses and have the potential to generate emissions of ammonia to atmosphere, which would likely become a more significant issue than emissions of NOx.

Furthermore, the DECC (2016) report assessed literature research as well as feedback from operators and concluded that secondary abatement measures for NOx and SO_2 abatement, such as SCR and FGD, were not economically or technically feasible for plant operating in the balancing market.

The configuration of the engines, the application of enhanced lean burn technology and the utilisation of natural gas as a fuel (which is characterised by low emissions of Sulphur dioxide (SO_2)), will ensure sufficient primary abatement measures are in place to maximise combustion efficiency and minimise the production of NOx and SO_2, and will ensure that the engines are capable of achieving 95 mg/m^3 (15% O_2) of NOx.

It is therefore concluded that the use of secondary abatement techniques is not considered BAT for the proposed Oswestry STOR Facility.

2.3.5 Cooling System

There are several appropriate cooling technology options suitable for large power generation plants. The BREF document for LCPs considers the most appropriate cooling technology for LCPs includes:

- Once through cooling (wet cooling);
- Natural draught tower cooled recirculating systems (wet cooling);
- Mechanical draught tower cooling recirculating systems (wet cooling); and
- Air cooled condensers (dry cooling).

The use of a wet cooling system often results in higher plant efficiencies and electrical output. Given that the proposed STOR Facility will comprise a number of small combustion plants, the use of cooling towers, air condensers or once through cooling systems are not considered appropriate or viable.

As such, the cooling system proposed for Oswestry STOR Facility will comprise a small-scale sealed cooling system consisting of the use of individual radiators mounted on the roof of each engine. The cooling system will use coolant within the radiators (following a similar design to a standard car engine radiator). Each engine will have its own cooling system. The cooling system requires no handling of coolant between services (services will take place every 2 years), nor does it require a continuous water supply.

2.4 MANAGEMENT & CONTROL

2.4.1 Environmental Management System (EMS)

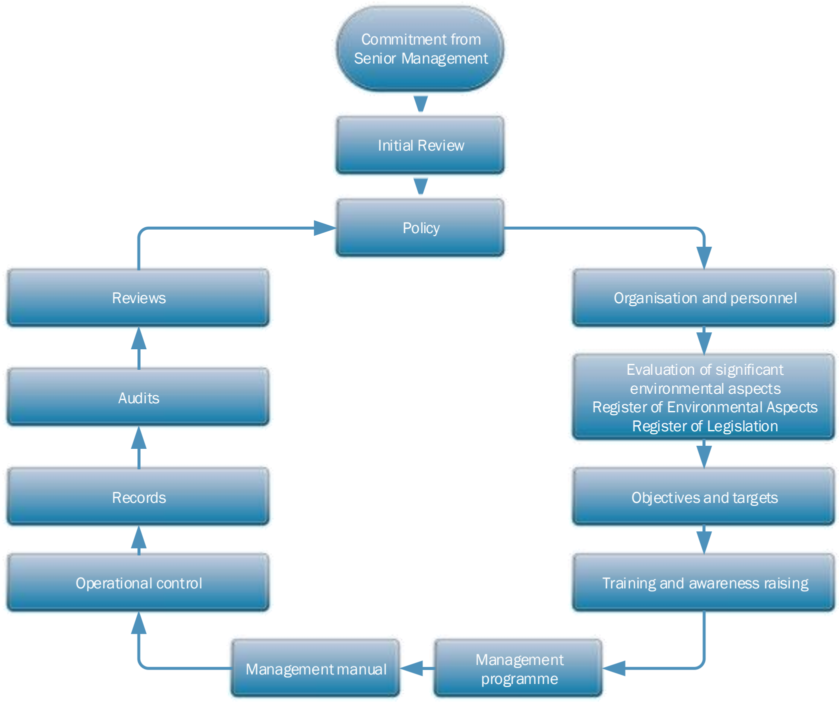
The EU Reference (BREF) Document for Large Combustion Plants published 2017 defines BAT standards required for management systems in place for large combustion plant. Operations undertaken at the proposed Oswestry STOR Facility will take place in accordance with the Operators' own Environmental Management System (EMS). The EMS will be structured in accordance with the BAT requirements laid out in the BREF document. A summary of the EMS structure is also provided within Figure 2.4.1 below, with further details of the EMS contents and Emergency Protocols provided within Appendix C and E respectively.

An Environmental Policy Statement and Health & Safety Statement will be produced by the Parent Company Arlington Energy Ltd and will apply to all subsidiary company's which sit beneath it (including ARL 020 Ltd). It is Arlington Energy Ltds intention to work towards ISO14001 accreditation within 5 years of the site becoming fully operational.

The EMS provides a framework through which its environmental performance can be monitored, controlled and improved upon. The EMS sets out supporting information on plant technology and the appropriate level of information to provide:

- a mechanism for defining environmental responsibilities for all staff, helping them to understand the environmental impact of their activities and individual actions;
- ensures that all operations have procedures that minimise their impacts and strive towards high standards of environmental protection by preventing or minimising emissions;
- records environmental performance against set targets;
- can be audited; and
- will help the company identify opportunities to reduce waste and improve raw material consumption and energy efficiency.

Figure 2.4.1 EMS Structure



2.4.2 Staff Training

All staff employed by the Operator will benefit from a training programme to improve their professional and technical knowledge. The assessment of training needs will be reviewed on an annual basis. The training programme will seek to maintain staff awareness of the site Permit and EMS. New employees will be given full induction training by managerial staff or other appropriately qualified persons. Records will be kept of all staff qualifications and training in relation to operation of the processes at the site, emergency protocols and the content and requirements of the environmental permit and its management plans.

Where works are contracted out (i.e. scheduled maintenance works), the successful contractor will have undergone an assessment during the procurement process to determine technical competency and to satisfy training standards required by the company.

2.4.3 Site Maintenance

Maintenance is a key component of operational control, particularly for ensuring emissions are minimised below required limits, and energy efficiency is maximised. Maintenance activities are typically planned or reactive (i.e. in response to breakdowns or performance deterioration resulting from a fault). Routine maintenance and planned downtime reduces the risk of unexpected abnormal conditions or reactive maintenance issues arising.

The Oswestry STOR Facility will not have any planned operational shutdowns throughout the year and therefore the plant will look to provide power on demand all year round.

All planned preventative maintenance will be carried out in accordance with predefined procedures and schedule by qualified technicians. Maintenance will be managed using a computerised maintenance management system (CMMS). The standard maintenance regime for the MTU engines is summarised within Table 2.4.3 below.

Table 2.4.3 MTU Engine Maintenance Regime

Interval	Activity	Downtime
Every 4 days	Routine Maintenance inspections as described within section 4.2 below	N/a
2,000 hrs	Planned Service	8 hours / engine
30,000 hrs	Minor Overhaul	5 days / engine
60,000 hrs	Major Overhaul	5 days / engine

2.4.4 Site Automated Control System

A Supervisory Control and Data Acquisition (SCADA) software system will be deployed, and the combustion units will be operated automatically with supervision from the Operator's control centre via an on-line system. The SCADA software will operate continuously gathering and analysing real time data. A TREND system with modem facility will be installed at site that will enable remote access to the control panels for the Operator's Engineers.

The SCADA will be programmed with a set control philosophy, which will standardise plant configuration, including start up sequences. All twelve (No.12) engines will have a standard start up sequence of banks of 4 (each with a staggered start-up of 60 second intervals). It is anticipated that demand will require only a few engines to operate at any one time. The SCADA will automatically select the engines with the least run time hours first, thus ensuring an even use of engines throughout the operational lifetime of the plant. On average it will take approximately seven (No.7) minutes for each engine to complete start up.

Alarms and faults will be communicated to the Operator via an on-line system. Critical alarms will be relayed to personnel who will investigate and follow the Emergency Protocol for Critical Alarms as detailed within Appendix F. Should an engineer be required to attend site we can mobilise to site within 4 hours.

2.4.5 Energy Efficiency

The primary objective of the facility is to generate energy from Twelve (No.12) natural gas fired 2.5MWe MTU reciprocating engines. Selection of this type of engine is based on an achievable electrical efficiency of 42.8% at 100% of rated load. As detailed above, this is considered the most efficient technology available for the proposed installation, compared with other technologies capable of meeting the requirements of the National Grid's Reserve Services.

Each engine can modulate and maintain a set-point between 2.5 MWe (100%) and 1.2 MWe (50%) load. At lower load the efficiency of the engine will reduce slightly from its optimal levels but still remain high. In practice, the electrical output of the plant will vary depending on the requirements of National Grid - some engines may stay dormant whilst others are producing electricity and engines can be run at variable loads if required to suit local demand. The generators will be required to operate for a maximum of 2,500 hours per annum. The following table details the performance level at 100%, 75% and 50% load.

Table 2.4.5a Electrical Energy Efficiency Performance

Load	100%	75%	50%	Unit
Gas Input	5915	4495	3126	kW
Electrical Output	2535	1901	1268	kW
Electrical Efficiency	42.9	42.3	40.6	%

Table 2.4.5b below summarises predicted energy consumption per annum for the Oswestry STOR Facility.

Table 2.4.5b Energy Consumption and Export Data

Energy Generation	Delivered, MWh (per annum)[1]	Primary MWh (per annum)[1]	% of Total (using primary data)[1]
Predicted electricity export and generation[2]	29.44	30.42	96.77
Site Use	**Delivered, MWh (per annum)[1]**	**Primary MWh (per annum)[1]**	**% of Total (using primary data)[1]**
Installation consumption from site generation (parasitic load)[3]	30.42	0.981	3.22

Note 1. Electricity generation and export figures assume that there will be No.12 engines online, on average, for up to 2,500 hours per annum.
Note 2. Definition: Total primary electricity that will be generated by the installation. Predicted from Supplier's Engine Specification.
Note 3. Electricity used to operate the installation, as provided directly from the installation (parasitic load) or supplied directly from the National Grid. Parasitic load is expected to be approximately 1.5% of gross generation. Predicted from Supplier's Engine Specification.

Monitoring and planned preventative maintenance will be used to ensure that the plant will run at optimum performance thereby maximising the energy efficiency.

As detailed within section 2.3 above, the use of individual gas engines is considered to be the most efficient solution (in terms of cost and performance) for peaking electricity supplies. Utilising smaller spark ignition engines, capable of fast start up and shut down, improves the overall efficiency of the plant as individual engines can be run at optimum loading (and therefore higher efficiency), whilst other engines are left dormant.

A detailed Cost Benefit Assessment (CBA) has been prepared to support this application (*ECCS 129 002 R 003 CBA C Final*). The assessment has concluded there is currently no viable opportunity to recover waste heat from the engines due to the nature of their operation. The typically short operating period of the installation does not suit operations which employ technologies such as combined heat and power. In addition, the Operator proposes to only operate for a maximum of 2,500 hours thereby further limiting the recovery of energy given its limited availability.

2.4.6 Raw Material Consumption

There will be a minimum use of raw materials aside from fuel input (natural gas) and lubrication oil for the engines.

As natural gas will be delivered to site via pipeline there is no requirement for additional storage on site. The Operator will give due consideration to the environmental impact of all new purchases of raw materials for the site. Treatment techniques and raw materials used on site will be regularly reviewed to ensure that their operations continue to reflect best practice and to regularly review new developments in raw materials and those with an improved environmental profile.

All raw materials will be stored in suitable above ground tanks or containers that satisfy CIRICA C736 guidance (where appropriate) and will benefit from the following pollution prevention techniques:

- Impermeable bunds with a capacity of 110% of the largest volume;
- Fill points provided with secondary containment (as appropriate);
- Be subject to regular visual inspection;
- Spill kits – materials suitable for absorbing and containing minor spillages will be readily available on site; and
- Any spills or leaks will be handled in accordance with the company's Emergency Protocols for Spillages (see Appendix F).

Details of the type amounts and specific provisions for each raw material to be stored within the secure compound are provided in Table 2.4.6 below.

Table 2.4.6 Raw Materials

Product / Substance	Principal Environmental Characteristics	Predicted annual consumption	Quantity stored on-site	Pollution prevention measures
Natural Gas	H220: Extremely Flammable Gas H280: Gas under pressure, may explode if heated; May displace oxygen and cause rapid suffocation if inhaled	39,864 MWh/yr	N/a	Delivered to site via pipeline Gas leak maintenance and monitoring regime in place Site compound is to be a non-smoking area
Mains Water	No impact	2,000ltrs/yr	N/a	Delivered to site via connection with mains water supply
Transformer Oil	R40: Carcinogenic R10: Flammable Harmful to aquatic life Slight to moderate irritant Affects central nervous system Harmful or fatal if swallowed Produces vapours	450ltrs/yr	10,000ltr	Bunded to 110% capacity of tanks. Oil storage located inside containerised unit. The oil is transferred via a day tank within the generator containers and then through the engine. Storage area serviced with sealed drainage.
Engine Lubrication Oil	R40: Carcinogenic R10: Flammable Harmful to aquatic life Slight to moderate irritant Affects central nervous system Harmful or fatal if swallowed Produces vapours	1,600ltr (each Gen-set)	1,600ltr (each Gen-set)	Bunded to 110% capacity of tanks. Oil storage located inside containerised unit. The oil is transferred via a day tank within the generator containers and then through the engine. Storage area serviced with sealed drainage.

The Operator will:

- take appropriate measures to ensure that raw materials are used efficiently;
- maintain records of raw materials consumed on site;
- review and record at least every 4 years whether there are suitable alternative materials that could reduce environmental impact or opportunities to improve the efficiency of raw material; and
- take any further appropriate measures identified by a review.

2.4.7 Avoidance, Recovery and Disposal of Wastes

There will be very minimal quantities of waste produced by the Oswestry STOR Facility, comprising predominantly of waste oil and occasional wastes from maintenance activities.

Waste oil will be removed from site and will be recovered at an appropriately permitted facility. As a waste producer, the Operator will receive consignee returns every quarter from their consignee dealing with any hazardous wastes. If returns are not automatically provided, the Operator will write to the consignee requesting copies.

The Operator recognises the need to implement the principles of the Waste Hierarchy wherever possible. Environmental Targets set within the EMS will include auditing of wastes generated in order to identify opportunities for improvement.

2.4.8 Accident Prevention and Emergency Protocols

An assessment of potential accidents and measures to reduce the risk of them occurring has been undertaken and is included within the Environmental Risk Assessment (ERA) prepared in support of this permit application, document reference *ECCS 129 001 R 002 A ERA Final*. The site-specific ERA identifies the potential hazards posed by the facility under both normal and abnormal operating conditions. An assessment of each hazard identified has been evaluated and the potential risk and prevention measures described.

Operational procedures which identify the actions to be taken to minimise the potential causes of accidents, and the consequences in the event of an accident occurring will be implemented through the EMS. The Emergency Protocols which form part of the EMS are provided within Appendix F. These have been developed to put measures in place to prevent and manage accidents, incidents and non-conformances and include the following key emergency or abnormal scenarios:

- Lines of Reporting;
- Incident Reporting;
- Critical Level Alarms;
- Gas Leak;
- Power Outage;
- Fire and Emergency (Daytime Hours);
- Fire and Emergency (Out of Hours); and
- Minor and Major Spillages.

2.4.9 Site Security

Access to the Oswestry STOR Facility will be restricted with access controlled via a single pedestrian and vehicle secure gate. The site will be surrounded by security fencing to prevent the public access.

Site security has been included as a control measure within the Environmental Risk Assessment (*ECCS 129 001 R 002 A ERA Final*) provided in support of this permit application.

2.4.10 Decommissioning and Closure

The Operator will prepare a site closure plan in line with Environment Agency Guidance in the event of cessation of operations on site. The Site Closure Plan will confirm how the site will be decommissioned to return it to a satisfactory state upon the cessation of activities. Records will be maintained of the location of facilities and infrastructure, as well as the services and sub-surface structures installed during the operating phases of the facility.

De-commissioning will be in compliance with procedures outlined in the Site Closure Plan. During the de-commissioning process, operational records will be reviewed and assessed against the Site Condition Report documented in this Permit application. If areas of deterioration during the operation of the site are identified these areas will be remediated as appropriate and the site will be returned to a satisfactory state as defined at the Permit application staged.

3 EMISSIONS FROM SITE

3.1 POINT SOURCE EMISSIONS TO ATMOSPHERE

Table 3.1.1 below indicates the anticipated emissions parameters for each of the emission points. Emissions will be from a total of twelve (No.12) individual stacks, all discharging to atmosphere via 6.5m high stacks. The location of each point source emission to atmosphere is illustrated on the site layout plan (21331A-0205 P1 - Permit Plan).

Table 3.1.1 Point Source Emissions to Atmosphere

Emission Point Reference and Location	Source of Emission	Stack Height (m)	Emissions
A1 - 330788, 330261	Single engine exhaust stack	6.5	Oxides of nitrogen (NO and NO_2 expressed as NO_2) Carbon monoxide (CO) and Sulphur Dioxide (SO_2)
A2 - 330792, 330263	Single engine exhaust stack	6.5	
A3 - 330796, 330266	Single engine exhaust stack	6.5	
A4 - 330772, 330270	Single engine exhaust stack	6.5	
A5 - 330776, 330273	Single engine exhaust stack	6.5	
A6 - 330781, 330275	Single engine exhaust stack	6.5	
A7 - 330785, 330277	Single engine exhaust stack	6.5	
A8 - 330790, 330279	Single engine exhaust stack	6.5	
A9 - 330794, 330282	Single engine exhaust stack	6.5	
A10 - 330798, 330284	Single engine exhaust stack	6.5	
A11 - 330803, 330286	Single engine exhaust stack	6.5	
A12 - 330807, 330288	Single engine exhaust stack	6.5	

Details of emission limits and proposed monitoring regime for the site are provided within Section 4 below.

3.2 FUGITIVE EMISSIONS TO ATMOSPHERE

The likelihood of fugitive releases to atmosphere from the proposed Oswestry STOR Facility is considered to be insignificant. Natural Gas fuel is delivered to site via pipeline, with effective maintenance regimes in place to detect leaks. Gasses may be released during routine or reactive maintenance activities, however the risk from these activities will be negligible.

3.3 POINT SOURCE EMISSIONS TO SEWER

The site is not situated within an area serviced by the local sewage undertaker therefore there will be no discharges to sewer. As a result, any foul water produced from on-site welfare facilities will discharge into an underground cesspit, which will be maintained and emptied regularly.

3.4 Point Source Emissions to Land and Groundwaters

There will be no point source emissions to land or groundwaters from the proposed Oswestry STOR Facility.

3.5 Point Source Emissions to Surface Waters

Drainage for the proposed Facility has been designed in accordance with SUDS Manual. There will thus be no point source emissions to surface waters from the proposed Oswestry STOR Facility.

The proposed access track to the site will be formed in permeable material 300mm thick minimum and will replace the current sections of compacted soil track. The runoff will therefore be reduced, and infiltration provided into the natural underlying soil and adjacent vegetation.

Site foundations will be formed on permeable material through which the base will bear onto the underlying soil. This will allow clean surface water to be stored in the top layer of granular material and then infiltrate into the underlying soil. There will be a gentle gradient across the site to ensure the water will be managed by the permeable gravel to avoid pooling or areas of standing water. (up to 1 in 20 has been found to perform sufficiently). There will be some impermeable areas across the site (bases of the engine units).

All hazardous substances including transformer oil and lubrication oil used for the engines will be serviced with dedicated bunds that will be designed to C736 standards. Any rainfall captured within the transformer oil secondary containment bund, will be drained manually after inspection into a shallow catch pit type soakaway within the permeable gravel. In the event there is evidence the rainwater has been contaminated within oil, the oily water will be removed via vacuum tanker and taken off site to a suitable facility for onwards treatment.

The gravel areas have been designed to store all the rainfall landing on the area in a 6 hour, 1 in 100-year event with climate change allowance, for the lifetime of the development.

4 SITE MONITORING PLAN

4.1 EMISSIONS TO AIR MONITORING

As stated within Section 3 above, there will be a total of twelve (No.12) point source emissions to atmosphere from the Oswestry STOR Facility. The proposed emission limits are summarised within Table 4.1.1 below.

The utilisation of natural gas as a fuel is characterised by low emissions of Sulphur dioxide (SO_2), and particulate matter. CO_2 generation is minimised by controlling combustion conditions, whilst the engine provides complete destruction to an efficiency of >99% of an VOCs within the gas. No limits are therefore expected to be conditioned within the permit for Carbon Monoxide or Sulphur Dioxide.

Table 4.1.1 Emissions to Atmosphere – Emission Limits and Monitoring Requirements

Emission Point Reference and Location	Source of Emission	Parameter	Emission Limit Value	Reference Period	Proposed Monitoring Frequency	Sampling Point
A1 – A12	Release from Engine exhaust stacks	Oxides of nitrogen (NO and NO_2 expressed as NO_2)	95mg/Nm^3[1]	Periodic	Annually	BS EN 14792
		Carbon Monoxide (CO)	No limit set	Periodic	Annually	BS EN 15058
		Oxygen	No limit set	Periodic	Annually	BS EN 14789
		Water Vapour	No limit set	Periodic	Annually	BS EN 14790
		Sulphur Dioxide (SO_2)	No limit set	Periodic	Annually	By calculation method as agreed in writing within the Environment Agency

Note 1: Normalised conditions at 273K, 101.3kPa, 15% O2, dry gas

Point source emissions to air will be subject to a programme of monitoring as detailed in the above table.

Monitoring points will be installed to meet the requirements of Environment Agency Guidance Note M5 and MCERTS Standards. Monitoring methods have been selected as appropriate for each parameter and will meet the requirements of Environment Agency Guidance Note M2.

4.2 Process Monitoring

All containers, tanks and secondary containment bunds will be regularly inspected to ensure they remain integrally sound. When maintenance is required on any secondary containment, the primary container will be isolated and emptied in order to allow for inspection and / or maintenance works to take place.

The Operator will have a computer-based system in place to monitor all key aspects of operating the Oswestry STOR Facility to optimise efficiency and identify system failures. All of the key components of the plant (each individual engine) will have their own dedicated control panels that will send signals to the Main Control Panel, which in turn will control and monitor the overall operation of the Facility. Key aspects monitored will include gas quality, gas consumption, combustion conditions, energy generation and engine conditions (including gas flowrate, gas pressure, coolant temperatures and oil temperature and pressure).

A Supervisory Control and Data Acquisition (SCADA) software system will operate continuously gathering and analysing real time data. Data will download continuously thus allowing the operator to generate monitoring data reports for all key elements of operating the generating plant.

Routine maintenance will be carried out be an approved maintenance contractor under a Service Level Agreement (SLA). Under the O&M (operation and maintenance) SLA, the contractor will undertake the following routine monitoring:

Site Monitoring via the SCADA system

- The site will be monitored remotely via the SCADA monitoring and control system;
- Alarm signals can be reset either remotely or in person via the control panel itself.

Emergency Call Out Service - 4-hour response to site

- Should an engineer be required to attend site maintenance crew can mobilise to site within 4 hours;
- The site can be remotely shut down into a safe condition if required while the engineer attends.

A Site technician will attend site twice a week to perform the following duties:

- Generator weekly and biweekly checks;
- Generator housing maintenance:
    - Clean the air intakes of any leaves and other debris so air flow isn’t restricted;
    - Check the cooling system for leaks;
    - Check for oil leaks or loss of integrity to secondary containment;
    - Test for gas leaks;
    - Check generator preheating system;
- General site services:
    - Check the overall site for signs of vandalism of intruders;
    - Regular turning of the gravel infill areas to reduce algae build up;
    - Regular jet washing where required;
    - Apply weed killer to the gravelled areas where required;
    - Removal of any rubbish or debris from the site;

- Regular inspection of the perimeter fencing;
- Check and oil all external locks;
- Test the emergency stop systems;
- Test fire alarm systems;
- Test intruder alarm systems;
- Clean and test the CCTV cameras;
- Check and replace consumable items (First aid kit, welfare items);
- Complete the site logbook;
- Induct any external service personnel with an onsite safety talk;
- Attend to the perimeter;
- Inspect external equipment to signs of rust and repair where required; and
- Check the under and over ground earth nest electrode for signs of vandalism.

All of the above parameters are recorded and maintained for inspection by the Environment Agency upon request.

5 RECORDS AND REPORTING

5.1 GENERAL OVERVIEW

As part of the sites Management Systems, audits will be carried out on an annual basis to check that all activities are being undertaken in line with the requirements of the Environmental Permit, Management Procedures and associated legislation.

Frequency of reporting monitoring data to the Environment Agency will be in accordance with conditions specified within the permit. Reports submitted will use the appropriate reporting forms as required by the regulatory.

As a minimum, the Operator will ensure the following information is recorded:

- Any changes to the as built design throughout the life of the site;
- Hours of operation;
- Abnormal Events or Emergencies;
- Complaints and actions taken;
- Plant/equipment failure;
- Periods of Maintenance or Downtime;
- Any Incidents/accidents on site and actions taken;
- Security failures;
- Emissions monitoring;
- Environment Agency Compliance Assessment Reports (CARs); and
- Reportable incidents in accordance with the Permit.

Environment Agency Guidance requires operators to keep the period of start-up (SU) and shutdown (SD) to a minimum. Site Operational Procedures (SOPs) will define SU and SD thresholds as either a fixed percentage of rated output or as discrete criteria. Records will be maintained to monitor the frequency of start-up and shut-down.

All records will be held in the site office and will be made available on request. Any records held electronically will be backed up on a regular basis. Electronic back up records will be held in the company's head office.

5.2 Reporting

Reporting requirements for the site are anticipated to include the parameters specified within Table 5.2.1 below as a minimum.

Table 5.2.1 Anticipated Reporting Requirements

Parameter	Emission or Monitoring Point	Reporting Period
Emissions to Air Data	A1-A12	Annually Reporting Deadline: 1 January
Process Monitoring	Installation	Every 6 months Engine Performance Parameters (time of day and duration (i.e. Beginning and end) of operational periods of each individual engine) Reporting Deadline: 1 January, 1 July
Process Monitoring	Installation	Annually Total operating hours per annum
Power Generated	Installation	Annually Reporting Deadline: 31 January
Performance parameters	Installation	Annually Performance parameters including annual water and energy consumption, oil changes and total operating hours Reporting Deadline: 31 January
Pollution Inventory Form	Installation	Every 12 months (following completion of calendar year) Reporting Deadline: 28 February

APPENDICES

APPENDIX A – EA CORRESPONDENCE

APPENDIX B – COMPANY DIRECTORS

APPENDIX C – EMS DOCUMENTATION

APPENDIX D – ENGINE SPECIFICATION

APPENDIX E – RAW MATERIALS MSDS

APPENDIX F – EMERGENCY PROTOCOLS