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Document Details

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Prepared by	John Cove – Landfill Energy Technical Support Manager
Reviewed by	Richard Phillips – Landfill Operations Manager North West
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Document Review History

Date	Description	Summary of Changes
November 2004	Original document issued as Section 5 of Operational Documents	Not Applicable
November 2012	Version 2.0	• Revised format to include updated operational procedures & reflect historical site development. • Revised in preparation for permit variation application to be submitted November 2012
January 2013	Version 3.0	• Inclusion of Environmental monitoring information.
October 2015	Version 4.0	• Revised format to include change in operational procedures following permit variation & historical site development.
April 2021	Version 5.0	• Revised format to include change in operational procedures. Addition of a second flare and seventh engine with the permit variation

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01-WIN-7R-GENERAL ARRANGEMENT-Rev2	GUP Layout (seven engines, two flares)
Whinney-Hill-GCS-0421	Whinney Hill GCS Drawing April 2021

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1 INTRODUCTION

1.1 SITE BACKGROUND

Whinney Hill landfill site is located at Altham, approximately 2km north of Accrington town centre at Ordnance Survey Grid Reference SD 758 304. The site consists of a very large multi-phased landfill operation that has evolved within an area of stone quarrying activity – making beneficial use of the void created from large scale mineral extraction. The site is of strategic importance in providing long term landfill capacity for Lancashire's wastes and provides an important regional facility for public and private sector users. Quarrying activity has been in operation since 1950 and landfilling of wastes from 1982. It is forecasted for waste inputs to decline from 2025 with the site continuing to tip beyond 2030.The area covered by this permit application consists of the current operational areas, cells 4 - 8, which are to be engineered to modern standards of containment, plus the total combustion emissions from the generation plant which utilises the gas from both phases 1 & 2.

Operation of the site is regulated by the following Environmental Permit BL9500IJ (As varied).

The site is classified as a non-hazardous landfill that will accept a range of household, commercial and industrial wastes.

1.2 OVERVIEW OF CURRENT LANDFILL GAS MANAGEMENT

The landfill gas management system extracts landfill gas via a series of valved header pipes (carrier mains), each with a series of valved connections to individual gas wells. Each individual 90mm or 63mm well connecting pipe has its own sample point and flow point, which in connection with the individual 2" control valve, enables extraction flow to be set to sustainable levels from each well. The individual header pipes are fitted with a sample point up-stream of the header pipe control valve. These are designated as 'Strategic Monitoring Points' or SMPs and as such, due to their importance are monitored & balanced for quality & flow on a weekly basis.

Horizontal gas wells are considered a key feature of efficient gas control during the operational phase of the landfill and have been progressively installed throughout the waste. The installation of horizontal wells will continue throughout the life of the remaining cells. The horizontals are constructed from Butt Fused 125mm or 160mm, SDR11 perforated & plain casing for durability. The horizontal well casing is installed in a stone filled trench at typically 30m – 35m centres, in staggered locations every 2 - 4 vertical lifts (typically 5m – 10m), as outlined in SPSD 008.

Side riser extraction wells are positioned by side walls allowing to capture both basal gas and gas reaching the edges. Side risers allow for both extraction of gas and consistent gravity fed condensate and leachate removal from the gas collection system. Allowing leachate to be removed without interruption from the gas

collection system is necessary to ensure effective gas control. Leachate which enters the drainage blanket is managed separately under the leachate management plan.

The landfill has in the order of 200 drilled gas wells in operation; from 125mm to 225mm diameter drilled landfill gas wells which are connected to the surface carrier main using, a gas wellhead as shown in SPSD 002, lengths of 63mm and 90mm pipe-work with individual and valved & saddled connections.

The vertical extraction wells installed at Whinney Hill landfill are constructed from medium or high-density polyethylene with a Standard Dimensional Ratio (SDR) of 11. This provides extra strength against the shear stresses experienced in a landfill environment. The individual lengths of well casing are butt fused, prior to installation. Steel gas wells with threaded sections have been installed at Whinney Hill however these are not commonplace.

The gas extraction wells have been drilled into the waste to varying depths depending on landfill conditions and standoff requirements from the basal and sidewall containment. The top section of the well is constructed from plain pipe with a minimum of three metres of bentonite providing the well seal. The remainder of the well casing is perforated to allow gas extraction. The annulus is filled with washed gravel up to 40mm in diameter, as outlined in SPSD 001. The specific design of each gas well is outlined in the individual CQA proposals taking into consideration the area conditions, flanks and expected settlement.

Air pumps are installed in many gas wells for leachate removal and are maintained and serviced routinely. Air pumps are actively assessed and moved between gas wells as required. Due to the requirement of air pumps at Whinney Hill, a common diameter of gas well is 160mm, with up to 225mm used for greater depths as these have well casings have greater shear strength and ensure air pumps can be installed within them for as long as possible.

All surface laid connection pipework is constructed of SDR 17.6 MDPE/HDPE pipe butt fused for maximum strength & durability & sized to ensure manageable friction losses with a maximum design velocity of at or less than 10m/s.

The surface laid carrier mains are laid to take advantage of on-site gradients to assist with dewatering of the saturated gas and at designed low points condensate is removed with both barometric and pumped ‘knock out pots’ to ensure efficient gas extraction, as shown in SPSD 004.

Gas flows from the site via the carrier mains to the gas control compound. The gas main is intercepted by a pumped knockout pot at the entrance to the compound. The gas extraction is expedited by two 75kW boosters which feeds six Jenbacher J320 1MWe (electrical) spark ignition gas engines a 3000 m3/h enclosed ground flare and a 2000m3/h enclosure ground flare which is an additional flare for this permit variation. The boosters have been sized to allow for one unit to operate as a standby. An additional seventh Jenbacher J320 1MWe has been added to the permit variation as a standby/contingency unit however there is no immediate timeframe for its installation. The additional second flare has however been delivered to site.

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1.3 GAS MANAGEMENT PHILOSOPHY

As one of the leading waste management companies in the UK, SUEZ is dedicated to ensuring that landfill gas is controlled safely and effectively at all its landfill sites. This is achieved through continuous temporary capping of the site whilst the final levels are not reached and the implementation of active gas management systems which collect, extract and treat landfill gas at sustainable levels to prevent pollution to the environment, harm to human health or detriment to the local community.

SUEZ is committed to maximising energy recovered from waste and to this end supports the landfill gas management hierarchy outlined in the Landfill Directive. This hierarchy places energy recovery from landfill gas at the top of the possible treatment options and SUEZ aims to implement landfill gas utilisation projects on all sites where it is deemed to be technically and financially viable.

Landfill gas management systems are designed to enable the extraction, collection, and treatment of the maximum potential volume of landfill gas generated from a site. SUEZ will endeavour to maintain that its gas management systems ensure safe and sustainable extraction of landfill gas is maintained at all times, with the aim of preventing uncontrolled gas emissions. Please refer to the procedures set out in Appendix A.

All landfill gas management infrastructure and landfill gas management practices comply with relevant health and safety legislation. SUEZ Recycling & Recovery UK is committed to supporting the development of new landfill gas management technologies and will continue to operate in accordance with relevant regulations and codes. SUEZ manages its activities through the use of a quality manual which includes an array of procedures. These procedures are reviewed and approved within SUEZ prior to inclusion in the quality process and are subject to periodic review. Improvements in gas management technique are copied across all SUEZ Landfill Energy sites and accordingly Gas Management Plans share these procedures.

1.4 MANAGEMENT STRUCTURE

1.4.1 SUEZ Landfill Energy

Landfill Energy are a specialist team within SUEZ, responsible for managing all landfill gas power generation schemes within SUEZ R&R UK Ltd, including both internal and third party generation schemes operating on SUEZ sites. The primary aim of the landfill gas schemes is to ensure environmental compliance, through power generation; landfill gas utilisation is at the top of the Environment Agencies hierarchy for treatment options for landfill gas within the UK. Management of the landfill gas extraction and control systems is the responsibility of CLPE and is overseen by the SUEZ Senior Site Manager.

When required, the Senior Site Manager will call upon the Energy Technical Support Manager to assist with technical issues relating to the gas management systems. Day to day operation of the gas control system and routine balancing is carried out by CLPE staff. The CLPE staff on site are managed by the CLPE Gas Manager who works in accordance with this Gas Management Plan. The contractual and technical relationship with CLPE is primarily conducted by the Regional Manager and Energy Technical Support Manager.

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From time to time, SUEZ and their sub-contractor CLPE may also engage third parties to undertake specialist tasks such as engine maintenance, emissions testing and data collection works.

Effective gas control requires cooperation between all parties engaged in the management of the site. This gas management plan provides a formal framework and robust procedures to ensure complete gas control.

In general, the salient site relationships are:

Senior Site Manager (COTC Holder):	Carries permit responsibility for the site. Manages all support services from landfill engineers, SUEZ and compliance staff.
Landfill Engineer:	Initiates design and construction of any improvements for leachate, gas and landfill containment systems.
EIR Manager and/or Advisor:	Provides an advice and support service to the Operations Manager relating to all compliance issues and corresponds with the Environment Agency. Safety issues are handled by the H&S team within SUEZ.
Energy technical Support Manager:	Manages operation and maintenance of all landfill gas control system through CLPE the landfill gas contractor.

An organogram of the SUEZ recycling and recovery UK structure is included as follows:

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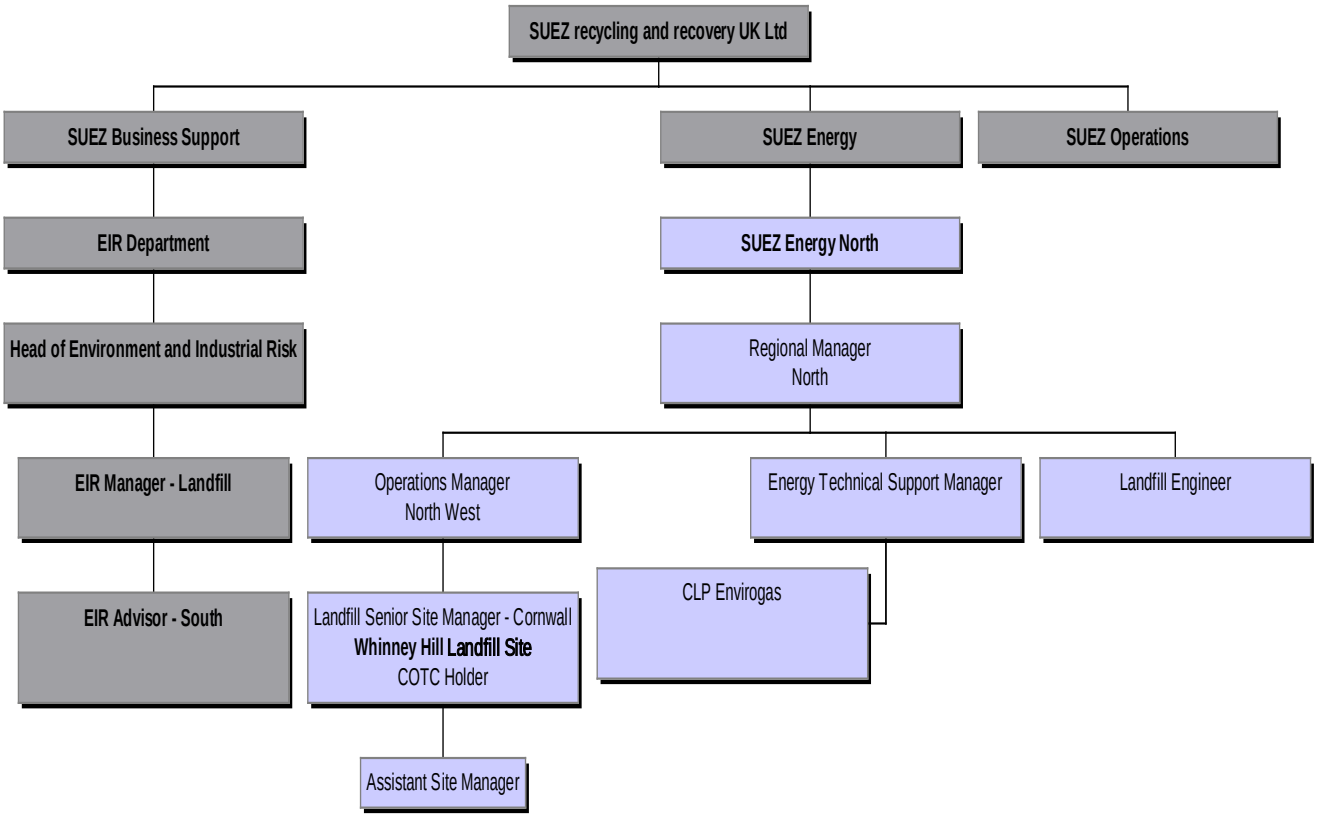

SUEZ site activities are coordinated by the Regional Operations Manager who manages both internal & external generation contractors, of which CLPE at Whinney Hill are one.

1.4.2 CLP Envirogas Ltd

The management and exploitation rights for landfill gas at Whinney Hill are contracted by SUEZ to CLPE.

CLPE have extensive experience in the design management and operation of landfill gas systems and in the UK including other SUEZ operated sites.

As a prudent and competent operator, CLPE have their own procedures for certain aspects of gas control. These procedures are subject to approval by SUEZ UK Ltd, to ensure that the Environmental permit requirements are complied with and that Health & Safety issues are properly addressed.

These procedures are included in Appendix B.

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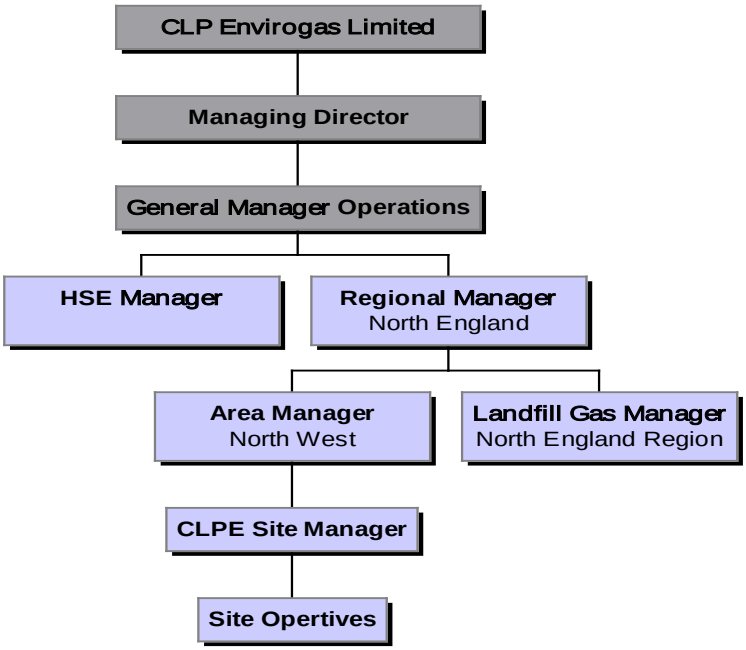
The CLPE Management structure at Whinney Hill is included as follows;



Care has been taken to ensure that CLPE and their sub-contractors are fully integrated into the site management team and with respect to odour management. This is done through site inductions and regular meetings with SUEZs Operations Team.

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2 OPERATIONS

In order to simplify the management of the gas system SUEZ and CLP ENVIROGAS have defined responsibilities. Tables 1 and 2 detail the various responsibilities designated to each of the companies.

Table 1: Responsibility for Inspection, Maintenance and Servicing

Operation	Activity	Responsibility	Subject to Approval by
Design	Gas extraction wells Dewatering system	CLPE	SUEZ
Construction	Gas extraction wells Gas extraction pipework Dewatering system	SUEZ	SUEZ
Installation	Gas engines Gas flares	CLPE	SUEZ
Quality assurance	Gas extraction wells Dewatering system	SUEZ	SUEZ
Operation	Gas engines Gas flares Gas extraction wells Dewatering system	CLPE	SUEZ
Inspection	Gas engines Gas flares Gas extraction wells Dewatering system	CLPE	SUEZ
Maintenance	Gas engines Gas flares Gas extraction wells Gas pipework Dewatering system	CLPE	SUEZ
Inspection & Maintenance of basal leachate wells	Leachate collection & Monitoring infrastructure	SUEZ	SUEZ
Leachate pumps	Gas wells only	CLPE	CLPE
Health & Safety Responsibilities	Gas Field Gas Engine Compound	CLPE / SUEZ Joint Responsibility CLPE	
Health and Safety	Annual H & S Audit	SUEZ	-

Table 2: Monitoring responsibilities

Monitoring	Responsibility
Perimeter Boreholes	SUEZ
Surface Emissions	SUEZ
Gas extraction Wells	CLP ENVIROGAS
Stack / Engine Emissions	CLP ENVIROGAS

3 SOURCE TERMS

3.1 WASTE INPUTS

The volume of waste within the phases of the landfill site amounts to approximately 8.3 million cubic metres with a surface area of approximately 32.1 hectares.

3.2 GAS MODELLING & RISK ASSESSMENT

An air dispersion model has been run with four scenarios the additional flare and contingency engine for the 2021 permit variation. These scenarios are as follows;

1. Scenario 1 – Six existing engines together with the 3,000m3/h capacity HT flare
2. Scenario 2 – Five existing engines, engine 7 and 3,000m3/h capacity HT flare
3. Scenario 3 – Five existing engines, engine 7, 2,000m3/h capacity HT flare
4. Scenario 4 – Both 3,000m3/h and 2,000m3/h capacity HT flares

Landfill gas production at Whinney Hill has been modelled on Gassim 2.5. This uses established gas production formulae, updated annually with actual waste import data and revised forecast data.

The data is calibrated to show the forecast increase of gas production and subsequent decline following closure and restoration of the site.

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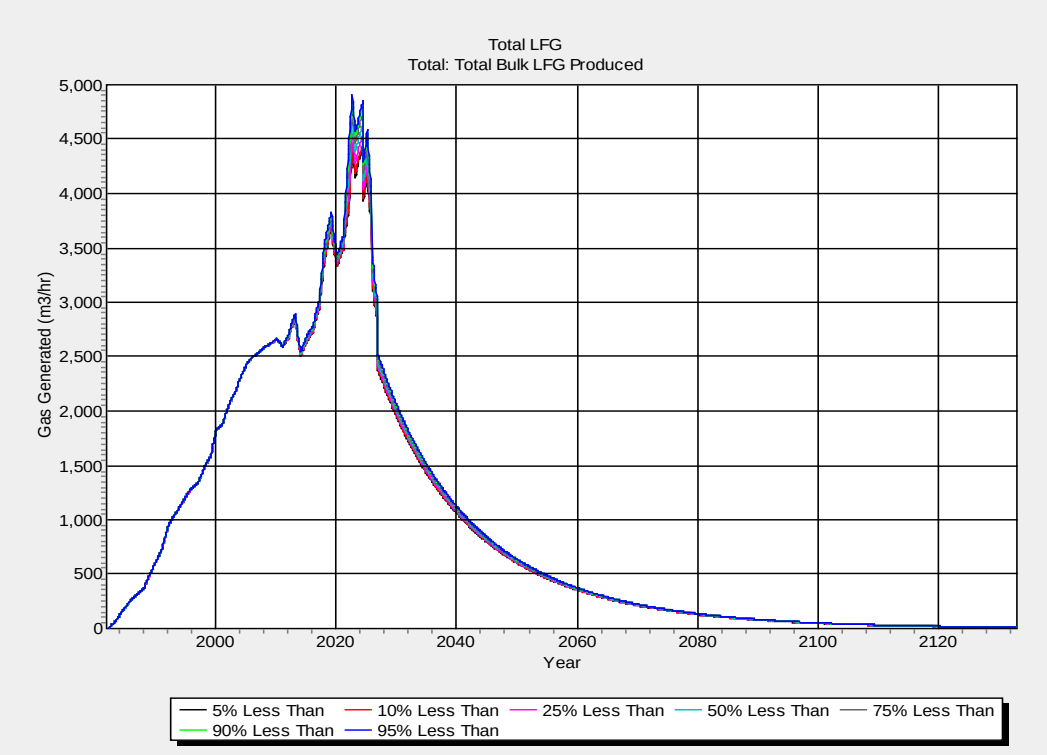
The model is used to ensure that emissions to air from sources of landfill gas are fully assessed and present no harm to human health, pollution of the environment or serious detriment to the amenity. It is also used to ensure the collection system is sized correctly.

The revised gas curve is provided below.



3.3 GAS EXTRACTION AND SYSTEM CAPACITY

The 50th percentile plot indicates gas production rate peaks at 4,700m3/h in 2022. The gas yield is forecast to decline sharply from 2026. The system is designed with sufficient capacity to accommodate the gas production from the site, whilst allowing for greater flexibility by utilising a second smaller flare.

4 GAS CONTROL MEASURES

4.1 DRAWINGS

The gas management system is one of containment, collection and treatment and is detailed in drawing Whinney Hill gas system as-built drawing Whinney-Hill-GCS-0421.pdf.

4.2 GAS FIELD OPERATION AND MAINTENANCE

SUEZ Energy utilises Monitor Pro to assess the landfill gas monitoring data. Monthly reports are formulated on the changes in gas well performance. On a monthly CLP ENVIROGAS adopts similar protocols using a web-based gas management platform to store, analyse and assess any changes required to the gas system and gas well performance.

4.2.1 Gas Field Balancing

Gas Field Balancing will be undertaken on site in accordance with CLPE's Field Balancing Procedure, 'Gas Monitoring and Flow Measurement Protocol, Maintenance and Inspection' and CLPE's site specific, 'Gasfield Operating Parameters' which are included in the Appendix B.

Balancing records will be kept and reported in line with the requirements of the Environmental Permit including the monitoring undertaken and any adjustments made. During normal operation the gas quality will be monitored on a daily basis at the inlet to the gas plant and weekly at manifold outlets and strategic monitoring points (SMPs) located across the GCS.

4.2.2 Gas Collection System Maintenance

The general maintenance arrangements for the site are provided in CLPE's Procedure Air Ingress & Remediation WERMS Methodology and Gas Monitoring and Flow Measurement Protocol, Maintenance and inspection which are included in the Appendix B.

In the event of the failure of a gas well, an assessment of the well data and its location within the site will be used to determine the need for remediation or replacement.

Whilst undertaking routine balancing, CLPE Gasfield Technicians are required to investigate and identify any defects observed.

The location and nature of any damage will be reported to the Landfill Site Manager. CLPE will take prompt and appropriate action in arranging repair of the damage. If possible, a temporary fix will be made prior to leaving site, pending permanent repair. A record will be kept in a site log of all remedial actions undertaken. The site log is stored in the CLPE's site office.

To remediate issues such as air leaks, it is prudent to use leak seeking equipment to identify methane leaks whilst the system is under negative pressure. The use of repressurisation whereby, extraction ceases temporarily in specific areas to allow landfill gas leaks to occur and point sources identified. Repressurisation surveys will be notified to the Environment Agency for approval.

Areas and/or infrastructure susceptible to leakage will require continuous improvement and preventative maintenance to ensure leaks are continually assessed and remediation.

An audit of the gas field will be undertaken periodically, usually annually in collaboration with CLPE to highlight possible defects on the gas collection system together with any remedial works necessary to maximise the efficiency of the installed gas collection system.

4.2.3 Prevention of Combustion

The potential for landfill combustion is minimised by careful operation in accordance with Procedure SPOP 020 Prevention or Control of Sub-Surface Landfill Combustion. This also provides the procedure to be followed in the event of combustion being detected.

4.2.4 Winterisation

To prepare the site for periods of inclement weather and specifically severe winters, a programme of winterisation has been put into place. This includes a number of measures that have been implemented in preparation for the freezing weather. These measures are detailed in Appendix B of this Gas Management Plan.

4.2.5 Gas Treatment

In line with efforts to improve gas systems on landfill sites, the design of gas extraction systems operated by CLP is subject to continual review.

The general arrangement of Whinney Hill Gas utilisation Plan is detailed in drawing 01-WIN-7R-GENERAL ARRANGEMENT-Rev2 and Whinney-Hill-GCS-0421.

The primary means of gas control at Whinney Hill landfill site is provided by the boosters & gas engines. In the event of failure of the gas engines the flare system is sized to accept the total flow from the landfill site.

5.1 GAS FLARES

A 3000m3/h high temperature ground flare is installed with automatic flame temperature control. This will burn with a combustion chamber temperature of 1000°C minimum when the methane concentration is above 25%. Minimum residence time is approximately 0.5 seconds. A second 2000m3/h flare is proposed under the 2021 permit variation which will allow for a wider range of flaring options. The additional, smaller flare provides a maximum flow rate of 5000m3/h whilst also allowing for a lower minimum flow rate of 400m3/h, down from 600m3/h on the existing 3000m3/h flare. The impact of the flare on emissions has been modelled within the ADMS model to ensure there is minimal impact to the local environment.

5.2 GAS ENGINES

CLPE have selected Jenbacher J320, which vary from 1048kW-1065kW generation range. These units have a proven track record globally with landfill gas utilisation, with high available efficiencies, low emissions and capable to operate with a low and variable gas qualities. Consequently, this unit is considered to meet the

BAT requirement. A 1MWe Jenbacher J320 contingency engine has been included within the permit variation to be operated as a standby engine, maximising generation in absence of an existing engine. The seventh engine operating as a standby has been included in the air dispersion modelling assessment as part of the 2021 permit variation.

5.3 MAINTENANCE

The reliability of gas control measures is dependent upon good maintenance procedures for the gas abstraction and utilisation plant.

Periodic maintenance of the installed Jenbacher 320 GSLL, generators is undertaken as follows:

Table 3: Jenbacher J320 Maintenance Frequency

Frequency of Check	Maintenance Checks
Weekly	Check ignition voltages re-gap spark plugs with reading>25kV Sample oil & send for condition monitoring.
As necessary	Change oil depending on weekly lab analysis results Change container air filters, as determined by pressure measurement Change gas filters, as determined by pressure measurement Overhaul charge air cooler, as determined by pressure measurement
1,000 hours	Carry out maintenance as specified in the Jenbacher manual(1)
2,000 hours	Check emissions & adjust mixture as necessary
4,000 hours	Grease alternator bearings Grease gas pump bearings Carry out borescope inspection of cylinder heads to determine condition and ash build-up
15,000 hours	Turbocharger change.
20,000 hours	Carry out top end overhaul and change crank shaft vibration dampers, includes fitting service exchange cylinder heads & de-coking combustion space

40,000 hours	Carry out bottom and overhaul, includes replacement of pistons, liners and large end shells, replace crankshaft main bearings
80,000 hours	Drive train replacement

The site earthing system, transformers and cabling are subject to inspection and testing by an electrical contractor on an annual basis.

5.4 INCIDENT RESPONSE

The correct operation of the flare and engines can be checked by their control screens and telemetry of gas parameters.

Both engines and flare systems are fitted with automatic call systems which dials over landline with a separate backup text message system relaying the fault status to the CLPE, on-call technician and other authorised persons.

Upon failure of the gas engines, the flare system automatically operates once gas suction has dropped to enable its operation to ensure that gas is incinerated and suction maintained to the landfill site.

In the event of an engine and/or flare failure, the on-call technician will respond to the automatic text message, investigate the fault, and initiate the appropriate remedial action.

Partial or total system failures which exceed 4 hours are regarded as an incident which should be notified to the Environment Agency. The Incident Notification Procedure is contained within the 'Site Emergency Plan' (CLP004), which is posted in the CLPE Site Office and included in Appendix B of this Gas Management Plan.

6 DEVELOPMENT OF GAS CONTROL SYSTEMS

The development of gas control infrastructure continues throughout the life of a landfill site in accordance with Procedure SPOP027, Landfill Gas Development Procedure. This includes

- Initial design and planning
- Coordination of operations, engineering and gas management.
- Standard design of gas systems
- Accommodation of engineering and restoration works

6.1 CONSTRUCTION QUALITY ASSURANCE (CQA)

All permanent elements of the gas control system will be constructed to an agreed design specification and assessed in accordance with recognised standards and methodologies. Construction Quality Assurance measures will be applied in accordance with Clause 7.1.2 of LFTGN03 Guidance on the Management of Landfill Gas and will be “pragmatic and commensurate with the potential consequences of failure of the plant and equipment concerned”.

6.1.1 Installation of Gas Wells

The design of new gas wells is closely managed by SUEZ Energy to avoid damaging the basal liner. These operations are covered by procedures SPOP004; Drilling into Landfill Waste and LFEMA 5.1; In-Waste Gas Well Setting Out Procedure.

6.1.2 Installation of Gas Systems

Minor repair works on SUEZ sites may be undertaken by properly trained CLP staff. Installation projects will be installed with external gas contractors, ensuring their qualifications adhere to the EA guidance.

6.1.3 Standard Designs

All engineering work is undertaken in accordance with good engineering practice, utilising standard materials and components and to this end SUEZ recycling and recovery UK Ltd have adopted standard designs for critical gas control components. CLP ENVIROGAS operate under a similar principle and their designs provide the same standard of quality and reliability. Components used in the development and remediation of the gas control system will be in accordance with the following standard designs:

SPSD001	Schedule of Gas Well Design
SPSD002	Schedule of Gas Well Head Design
SPSD003	Schedule of Manifold Designs
SPSD004	Schedule of Dewatering Point Designs
SPSD008	Horizontal Gas Well Design

7 ENVIRONMENTAL MONITORING

The Monitoring Management Plan details the methods, frequency and standards required for environmental monitoring at the site. For gas control, fugitive emission sampling occurs by sampling and trending gas migration boreholes and surface emissions monitoring. Odour checks are also completed to ensure that fugitive emissions do not give rise to hazard or nuisance.

7.1 FUGITIVE EMISSIONS

In the event of gas migration exceeding trigger levels, CLP ENVIROGAS will assess and investigate the likely cause of the exceedance and initiate action to eliminate or control the migration. Such action will include adjustment of flow at specific gas wells, remediation of equipment such as fixing air leaks to allow for greater extraction, or proposal to augment or replace gas infrastructure.

Air-borne emissions detected by odour inspections or compliance monitoring (e.g. Surface Emissions Monitoring) will be addressed in the same manner.

CLP ENVIROGAS shall provide details to the SUEZ Energy Technical Support Manager of the nature and potential effect of any fugitive emissions and the action proposed to bring the emissions within permitted levels.

Notification of fugitive emissions and proposed actions will be supplied to the Environment Agency via the SUEZ EIR Adviser in accordance with the Environmental permit.

Alert levels are used to monitor perimeter boreholes which have likelihood of breaching. These alert levels can be used below the compliance trigger to generate an action before a breach occurs.

7.3 PROCEDURE FOR NON-ROUTINE EVENTS

Abnormal conditions may arise in the operation of the gas management system:

- Abnormal monitoring data
- Operational problems
- Failure of the gas control system
- Reported event

In the event of any release of gas or odour having a potential impact on the local air quality or human health, this will be investigated to identify the root cause. Prompt action will be taken as necessary to minimise any impact.

7.3.1 Failure Scenarios and Contingency Actions

Failure scenarios and contingency plans for unusual operational conditions, and failure of the gas extraction system are summarised below.

Table 4: Contingency Action Responses

Contingency Action	Response Time	Responsibility

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Full Loss of extraction due to engine failure Inform EA if full loss of extraction exceeds 4hrs or significant odour present	24 hours	CLPE should swap to a spare engine if possible and utilise the two flares if spare engines are not available.
Damage to landfill gas extraction infrastructure through accidental damage or vandalism	24 hours	CLPE to follow procedure MS003, and report to SUEZ site management CLPE to identify if parts are available on site to undertake repair. Order parts if required and make a temporary repair until parts arrive. Check adjacent gas infrastructure for signs of air ingress.
Sustained power outage resulting in loss of gas extraction on site. Inform EA if full loss of extraction exceeds 4hrs or significant odour present	24 hours	CLPE to inform SUEZ and bring a backup generator to site to allow flare to be powered and extraction. Inform SUEZ once power has been restored
Elevated levels of perimeter migration	48 hours with 24h retests	SUEZ monitoring personnel & CLPE staff. CLPE staff should follow procedures MSGF22 & MSGF04
Booster failure	4 hours after investigation	Use the standby booster
Unexpected release of gas (fugitive emissions to atmosphere) from a point source resulting in odour complaint.	4 hours after investigation	CLPE to investigate point source and report to SUEZ site management. CLPE to establish if emissions relate to their infrastructure of a capping defect. SUEZ site staff to carry out FID to identify the point source location and follow odour management plan. CLPE to organise repair on their infrastructure, SUEZ to organise repair if capping or leachate well seals are found to be the point source. SUEZ EIR manager to inform the EA of issues and confirm fugitive emissions have ceased once relevant repair has been completed.

Fire or Explosion	4 hours	Follow CLP Procedure for Fire & Explosion, Appendix B. A fire grab pack has been completed for Whinney Hill which is routinely updated and kept onsite.

7.4 ODOUR MANAGEMENT PLAN

Odours can arise at landfill sites from fresh or uncovered waste with landfill gas escaping or leachate vapours. An odour management plan is in use at Whinney Hill.

7.4.1 Community/Amenity

SUEZ will, where practicable, reinforce normal landfill gas control measures by:

- Increased attention to dressing and maintenance of capped areas
- Installation of shallow gas wells, installed by drill rig or excavator
- Close coordination between the SUEZ and CLP ENVIROGAS to ensure prompt response and investigation of odour reports.
- Use of FID / leak seeker to detect point source methane emissions surrounding infrastructure, or where odour is detected.
- Well desilting or installation of air pumps within gas wells if underperforming infrastructure is contributing to a rise in emissions.

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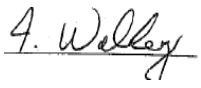
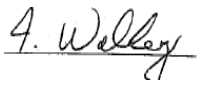
OPERATING PROCEDURE

Document Reference	SPOP 003	Issue	8
Title	GAS FIELD BALANCING AND GAS SYSTEM INSPECTION PROCEDURE	Date	25/01/2021

Approval & Amendment Record

Gas Field Balancing and Gas System Inspection

Issue	Date	Originator	Authorisation	
1	01/03/2006	T Otley	T. Otley	
2	18/07/2007	CJ Matthews	T. Otley	
3	15/02/2008	CJ Matthews	T. Otley	
4	23/01/2009	CJ Matthews	T. Otley	
5	23/04/2009	CJ Matthews	T. Otley	
6	19/09/2012	T J Williams	I Walker	
7	18/04/2016	T J Williams	I Walker	
8	05/01/2021	J M Cove		

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OPERATING PROCEDURE

Document Reference	SPOP 003	Issue	8
Title	GAS FIELD BALANCING AND GAS SYSTEM INSPECTION PROCEDURE	Date	25/01/2021

1 GENERAL

Gasfield operation aims to balance the rate of extraction of landfill gas with the rate of production of gas by the landfill site. The process involves the adjustment of suction at gas wells, the elimination of air from the landfill and the prevention of leaks out of the landfill or its infrastructure.

Gas balancing is a regular activity to adjust the extraction to the changing pattern of production in order to maximise the sustainable levels of gas extraction on site. It is also the primary opportunity to indentify and maintain the gasfield infrastructure.

This procedure establishes the necessary controls adopted by SUEZ Landfill Energy for routine gas field balancing and the identification, inspection and remediation of faults.

The following general controls apply to the implementation of this procedure:

- Monitoring shall only be carried out by suitably competent/qualified staff.
- All monitoring equipment shall be calibrated and serviced in accordance with the SUEZ Landfill Energy Calibration and Maintenance Procedure (SPOP001).
- All works on site will be carried out in accordance with the relevant site, company and national H&S legislation. The SUEZ Landfill Energy Lone Working Procedure (SPOP002) shall be adopted for works on unmanned or closed sites.
- Records shall be made on all visits and shall include the following general information:

  Name of Site

  Date and Time of Site monitoring visit

  Weather / Barometric Pressure

  Name of Monitoring Technician

  Equipment Utilised

- Any recent activities on the site such as recent shutdown of all or part of the site, significant change in flow etc. should also be noted

2 PROCEDURE

2.1 When completing a full gas extraction system balance the following areas and information should be recorded:

2.2 Gas Compound

2.2.1 Landfill gas extraction system balancing and monitoring must commence at the gas control compound where the following monitoring determinants must be recorded. It is important that pressure at suction side of the gas booster is recorded as this identifies the suction available to the gasfield.

2.2.2 Particular attention should be paid to the size and frequency of any variation in flow present on the manometer at the gas plant as this usually indicates a condensate blockage or failed knock out pot pump on the gasfield.

Landfill Gas Monitoring Determinants	***Units***
Methane (CH_4)	*% by vol*

Carbon Dioxide (CO_2)	*% by vol*
Oxygen (O_2)	*% by vol*
Suction / Delivery Pressure	*mbar*
Flow Rate (one side of booster only)	*m^3/hr*
Temperature	*^oC*
Valve Position	*% open*

2.2.3 A visual inspection of the gas plant should occur during the visit and notes made of any required works or maintenance.

2.2.4 The following operational criteria should also be recorded:

Landfill Gas Control System – Operational Recordings	**Units**
Blower Hrs (where available)	Hrs
Flare Operating Hours (where available)	Hrs
Flare Operating Temperature (where available)	^oC

2.3 Condensate Management (associated with the gas plant)

2.3.1 Any condensate management systems associated with the gas plant should be checked to ensure that they are working correctly. A visual inspection of the integrity of any condensate discharge pipes should be completed as failed knock out pot pumps will result in variation in suction and flow on the manometer. Pumps and floats should be checked to ensure that they are operating correctly. The following operational criteria should be recorded:

Condensate Management System – Operational Recordings	**Units**
Pump Running Hours (where available)	Hrs
Pump Strokes (where available)	Number
Record Delivery Air Pressure in Receiver (where available)	psi/barg

2.4 Gas Collection System

2.4.1 System monitoring should then move out onto the gas collection system. Systems will tend to be of three major designs:

- Well head system with valve control.
- Manifold based valve control with well head access
- Manifold based valve control with no well head access.

2.4.2 Systems which incorporate manifold control must be broadly balanced to distribute suction availability across the site. This requires careful setting of manifold valves particularly on manifolds closest to the gas utilisation plant. Once set, manifold valve adjustment should be an infrequent activity.

2.4.3 Individual gas wells should be monitored and balanced (at the well head or manifold port) to ensure that landfill gas is extracted at sustainable levels which are not going to increase the risk of generating localised aerobic conditions within the waste mass. Aerobic conditions can be diagnosed by two primary indicators:

CH_4 : CO_2 ratio. Gas production under anaerobic conditions generally results in a 60 : 40 CH_4 : CO_2 ratio. If the level of CH_4 declines then the well should

be progressively throttled back in order to maintain the CH_4 at a level set out in section 2.4.7 and at least 2% higher than CO_2.

Balance Gas / Free Nitrogen. Balance gas is predominantly the nitrogen in air detected after being drawn into the landfill site. A high balance gas reading together with a high O_2 reading indicates an air leak or leak pathway close to the well (for example, a loose Flexseal fitting or dipping cap or a failed bentonite / boot seal). However, high balance gas with low oxygen levels, result from aerobic activity (oxygen used up by bacteria) away / remote from the gas or leachate well being monitored. The level of aerobic activity can be assessed by subtracting 4 times the O_2 value from the balance. The remainder represents depleted air (free nitrogen), where its oxygen has been consumed by aerobic bacteria. Under normal operating conditions the levels of free nitrogen recorded in a well should be between 7.5% and 18%. With good operation and maintenance, the operator should maintain levels at the lower end of the scale.

For example, a gas reading showing 1.5% O_2 and 9% Balance would result in 9 – (4 x 1.5) = 3% free nitrogen (Well not aerobic).

For example, a gas reading showing 1.0% O_2 and 26% Balance would result in 26 – (4 x 1.0) = 22% free nitrogen (Well aerobic).

2.4.4 The oxygen reading can be used to gauge conditions within the system. If the O_2 reading is approximately one quarter of the balance reading, this indicates a leak close to the well head or on the gas system. Oxygen readings progressively lower than ¼ of the balance level indicate a leak path more remote which has resulted in air ingress into the site giving rise to aerobic conditions.

2.4.5 High oxygen levels can cause damage to the engines (plus a remote risk of an explosive gas mixture in the gas system) and must be carefully controlled. Only in exceptional circumstances, approved by the Area Manager shall gas wells be allowed to operate in excess of 5% O_2. On fields run primarily for power generation purposes gas wells shall be throttled back if O_2 exceeds 1%. For wells which are required to operate to minimise gas migration or odour emissions, the trigger level shall be relaxed to 3%. Any wells showing high O_2 levels at manifold sample point should be visually inspected during the balance. The operator should in all cases walk the length of the well pipe to the well, inspecting for defects. The gas quality should then be checked at the wellhead to establish the location of any defects and sources of air ingress. Obvious and simple defects should be remediated at the time, where possible and a repeat gas sample taken to confirm defect elimination. It is <u>not</u> acceptable to note high O_2 at the manifold, close the valve and move on recording the well condition as; air leak suspected. Elevated levels of O_2 that have no obvious visible cause should be recorded and subsequently escalated for further investigation with a work order.

2.4.6 Air ingress on a gas or leachate well, isolated from suction, can give rise to sub-surface combustion within the landfill. Aerobic activity produces heat which raises the temperature of the waste. A complex array of reactions then yields conditions necessary for combustion resulting in ignition of the more volatile gases with lower ignition temperatures. The first indicator is an increase in the levels of carbon monoxide (CO), which is only produced by incomplete combustion. The CO reading

can be affected by the presence of hydrogen and hydrogen sulphide and so cannot alone be taken as accurate or reliable indicator of combustion. Improved accuracy is given by hydrogen compensated analysers. However the precautionary principle is to treat a reading as correct until disproven. Wells showing levels of CO above 75 ppm shall be throttled back progressively to prevent combustion being established and / or spreading. (100ppm is the agreed / established indicator of landfill combustion with the Environment Agency). The operator should be familiarise themselves with procedure SPOP 021 – Control or Prevention of Sub-surface Landfill Combustion.

2.4.7 The table below details the operational criteria that should be adhered to when balancing gas collection systems, together with the monitoring requirements for each location:

Landfill gas monitoring determinants	Units and accuracies	Trigger Levels
Methane (CH_4)	% by volume (± 0.5%)	< 40% & >50%
Carbon dioxide (CO_2)	% by volume (± 0.5%)	No specific trigger level (see relationship with methane below)
Oxygen	% by volume (± 0.5%)	>3%
Gas Balance	% by volume (± 0.5%)	>20%
Free Nitrogen	% by volume (Calculated)	>18%
CO	ppm	> 75 ppm
Valve position	% open	No trigger levels set
Flow rate or suction	m^3/hr or mbar	No trigger levels set.

2.4.8 Prior to making any adjustments to a well's valve position, either at the wellhead or manifold, it is essential that a suction reading is taken with a correctly zeroed pressure transducer on the analyser to establish levels of applied suction or cross suction, if well closed on arrival. The amount of variation of suction if present should also be noted and if significant it should be a subject of further investigation (condensate blockage).

Where a control valve is closed on arrival, the pump should be started and stopped immediately to lock the pump before opening the control valve (a rapid double press of the fan button) to prevent drawing any condensate that maybe collected at the control into the analyser.

Adjustment of valves must take into account the previous history of the gas well to prevent cycling (evidenced by repeated opening & closing of a gas well.

2.4.9 Gas wells which are found to exceed trigger levels should be progressively closed unless site operating requirements, (usually gas migration or odour) dictate that suction should be maintained on the gas well. The operator must make a note when a decision is taken to override trigger levels. For such occasions the GA2000+ gas

has facility for input of gas well condition codes. If the operator uses an analyser with this facility then the codes in the following table must be used

1	Normal operation	Use where the readings fall inside the criteria in SPOP 003 Table section 2.4.7
2	Air leak found	If the O2 level indicates a leak and the operator takes immediate action. Ideally the well should be retested.
3	Air leak suspected	If the O2 level indicates a leak but the operator has insufficient time to make an immediate check.
4	Aerobic: check cover /capping	Used when free nitrogen rises above 20%. Requires a visit at a later date.
5	Controlling migration/odours	This code is used as an explanation for a valve being held open under adverse conditions.
6	'X' Suction	If the well shows suction when the valve is closed.
7	Maintenance /overhaul required	If extensive work is required e.g. renewing Canoflex pipes or seals, renewing bentonite seal, relaying pipes to falls. This code would entail a work request.
8	Line prone to flooding	Any line which requires daily dewatering. Once this is entered as a work request it need not be repeated.
9	Disconnected wells*	If this code is used, the gas readings taken must be a wellhead reading and not at the disconnected manifold.

2.4.10 Landfill gas field balancing should always be carried out utilising both gas quality and suction data. Gas fields cannot and should not be controlled by valve position alone due to the inherent variability in flow control provided by various valve types (70% of maximum flow at 30% valve open on a ball or butterfly valve).

2.4.11 Following adjustment, the gas well valve position at each point should be recorded together with suction to confirm the flow control facilitated by the valve To ensure the suction on departure is stored the following procedure is recommended.

- Remove the dust cover from the Tefen (note if unsecured or missing).
- Attach the gas analyser and allow the zeroed, pressure reading to settle and note the amount and frequency of variation.
- Sample the gas and decide on the appropriate action.
- If the decision is to change the suction applied to the well, press button **5** on the analyser, which frees the pressure reading.
- Adjust the valve to achieve the desired suction.
- Re-sample the gas for a short period thus ensuring that the reading stored is the suction set by the operator after valve adjustment.
- Replace the dust cover on completion of the process, to prevent grit or water ingress and subsequent failure and costly replacement of the sample point.

2.4.12 A visual inspection of the integrity of the gas wells or manifolds should be made at each visit.

2.4.13 Condensate management infrastructure associated with the gas collection system in the field should be visually checked on each site visit. Suction readings should be taken within individual gas mains and headers wherever monitoring ports are available. These reading should be used to identify any areas of significant suction loss or variation within the system.

Rapid variation in suction may indicate a partial blockage of the main or build up in the flow lines.

Large and irregular fluctuations in suction, either alone or together with rapid variations indicate major blockage or standing wave of condensate in the carrier main.

2.5 **Gas Field Performance Checks**

2.5.1 On completion of the field balance, the Site Supervisor or Operations Manager shall:

- Upload the data into Rungas if applicable, or spreadsheet
- Review the data using data filters to identify anomalous results.
- Use image maps if available to gain a spatial view of gasfield changes
- Plan actions / further investigations to address concerns arising from the balance by creating a work order.
- Produce a data print to be used in the next gas balance exercise.

2.5.2 Data review shall use criteria designed to highlight areas of under and over extraction, the onset of aerobic activity, localised air ingress, head loss and potential hotspot formation. Recommended values to use in the data filter fields are:

2.5.3 Performance Criteria:

- >55% Methane (CH_4)
- >18% Free Nitrogen (N_2)
- >3% Oxygen (O_2)
- >75ppm Carbon Monoxide (CO)
- <1 Valve depart (Position)
- Spread of (site specific) suction levels (Also check for high suction and positive pressure)

2.5.4 Following the performance review, the Area Operations Manager should request additional field adjustments / checks, or additional monitoring where necessary to enhance system performance or to identify potential areas of remediation.

2.5.5 Where CO concentrations exceed 100pm, the Area Operations Manager should request immediate isolation of gas wells within a 50m radius of where evidence of sub surface combustion is present or suspected (confirmation may include: elevated temperature at the wellhead, settlement cracks & “crater formation”, visible smoke &

or burning waste odour - “Hot Tar smell”). The elevated CO readings should then be automatically verified using either, Dreager tubes or Tedlar bag samples. Where no evidence of sub-surface combustion is present, but where readings exceed 75ppm, then the Area Operations Manager should request confirmation of the elevated, CO reading using either, Dreager tubes or Tedlar bag samples, prior to instructing immediate well isolations. False positive readings are possible when taken from wells in operational or recently landfilled waste, where the presence of hydrogen is likely / confirmed.

2.5.6 Following confirmation of CO readings in excess of 100ppm, the Area Operations Manager should inform the Site manager & provide the SHEQ Advisor with the details necessary to complete and forward a Schedule 5, to the relevant EA officer.

3 GAS FIELD MAINTENANCE

3.1 Defects uncovered on gas field infrastructure must be addressed as soon as is practicable. For minor adjustments or maintenance there is no need to record action taken, unless the operator perceives that there may be benefit to the asset history.

3.2 If the defect cannot be readily identified or fixed then the Site Supervisor discovering the defect must ensure that a work order is initiated on the SUEZ Landfill Energy System. If the action required is not clear then advice should be sought from the Operations Manager as to what work should be scheduled. Initially a work order may be an instruction to dip the well or take a closer look at the seal. It is not acceptable to leave gas infrastructure to perform outside normal operating parameters unless there is clear reason to do so.

3.3 Producing work orders builds the asset history and brings benefits in controlling operations. It also provides evidence to regulators and auditors that the site operator and manager are proactive in overcoming defects.

3.4 If the defect cannot be readily identified or fixed then the Site Supervisor discovering the defect must ensure that a work order is initiated on the SUEZ Landfill Energy System. If the action required is not clear then advice should be sought from the Operations Manager as to what work should be scheduled. Initially a work order may be an instruction to dip the well or take a closer look at the seal. It is not acceptable to leave gas infrastructure to perform outside normal operating parameters unless there is clear reason to do so.

4 PROCEDURE REVIEW

4.1 This procedure will be reviewed by the SUEZ Landfill Energy, Technical Support Manager as necessary to reflect current operational techniques.

Suez Landfill Energy

OPERATING PROCEDURE

Document Reference	SPOP 004	Issue	3
Title	Drilling Gas Wells in Landfill Waste	Date	17/03/2021

Approval & Amendment Record

Drilling Gas Wells in Landfill Waste Procedure

Issue	Date	Originator	Authorisation	
1	11/08/2009	Cliff Matthews	T Otley	
2	30/07/2010	Cliff Matthews	T Otley	
3	17/03/2021	John Cove		

Suez Landfill Energy

OPERATING PROCEDURE

Document Reference	**SPOP 004**	**Issue**	**3**
Title	**Drilling Gas Wells in Landfill Waste**	**Date**	**17/03/2021**

1. INTRODUCTION

1.1. This procedure governs drilling into landfill waste using a barrel or continuous flight auger for the purposes of installing landfill gas wells up to 250mm diameter well casing.

1.2. The primary hazards of drilling into landfill are:

1.2.1. release of toxic gases causing harm to operators
1.2.2. ignition of flammable gases
1.2.3. release of odorous gases causing nuisance to local communities
1.2.4. encountering hazardous waste substances
1.2.5. penetration of the liner

1.3. This procedure is based on the deliberations of the ESA Steering Group as presented in the draft Industry Code Of Practice ESA ICoP 4 (Drilling). The hazards encountered in drilling into landfill waste may be severe and therefore drilling work must always be preceded by a pre-site meeting to consider method statements, risk assessments and any special issues pertaining to the site.

2. HYDROGEN SULPHIDE

2.1. Hydrogen Sulphide is a significant hazard to drilling contractors. Prior to drilling the contractor must review site data provided by the site manager to assess the potential risks from hydrogen sulphide. Whilst on many sites the wearing of hydrogen sulphide alarms will be sufficient precaution, some sites contain areas in which hydrogen sulphide levels are sufficient to cause serious injury or death. The SUEZ Operations Manager must ensure that the drilling contractor is aware of and works to SUEZ Procedure SPSWP015 Working with Hydrogen Sulphide.

3. DSEAR – BOREHOLE CLASSIFICATION

3.1. For the purpose of ICoP 4, boreholes are divided into one of four types, which may be summarised as follows:

1 - Boreholes that produce negligible landfill gas

2 - Boreholes that may produce small amounts of landfill gas

3 - Boreholes that produce significant quantities of landfill gas

4 - Boreholes that have the potential to release large quantities of landfill gas

3.2. Unless risk assessments using recent site data and experience clearly demonstrate otherwise, each well drilled shall be treated as a Type 3 borehole for the purposes of planning and undertaking the drilling work. Type 3 Boreholes are defined in ESA Draft ICoP 4 as 'Boreholes that produce significant quantities of landfill gas'.

3.3. Control Measures to be applied in drilling this type of gas well are shown in the Table reproduced in section 4 – Control Measures for Drilling into landfill Waste. Those control measures which are marked as “Consider” shall be provided as follows:

3.3.1. Exhaust spark arrestor is needed.

3.3.2. Chalwyn valve not a necessity (covered by Point 30 in Table 4).

3.3.3. Portable methane monitor is satisfied by wearing Personal 4 Gas Alarms.

3.3.4. Portable fans must be provided and available on site and used if alarm activates.

3.3.5. Local exhaust ventilation not required on level 3.

3.3.6. Inert gas injection into borehole not required.

3.4. Percussive drilling not used.

3.5. If a larger-than-expected release of landfill gas occurs, then drilling should stop and the risk re-assessed.

3.6. Micro switches fitted to the drilling rig shall be suitable for operation in the appropriate zone, according to their position in proximity to the drilling head.

3.7. A fixed flammable gas detector, within its calibration period is required by this procedure. The drilling contractors safe operating procedure shall require flammable gas testing to commence prior to drilling and continue throughout the drilling operation. The drilling contractor shall have a safe drilling procedure which must detail the procedure to be adopted in the case of an alarm being given by the detector.

3.8. Footwear worn by drilling operatives and any visitors to the drilling area must be anti-static.

3.9. Operators shall be trained to NVQ level II in Land Drilling and have received training in hazards associated with landfill gas and in the use of flammable gas detectors.

4. ODOUR NUISANCE

4.1. The release of landfill gas through drilling works has the potential to cause an odour nuisance. The likelihood of complaints increases when the landfill is in close proximity to sensitive receptors and with elevated concentrations of hydrogen sulphide within the gas the risk of odour complaints, increases significantly. Mitigation of the potential risk should be agreed with the site and the Environment Agency prior to the commencement of the drilling works.

4.2. During the installation of gas wells on sensitive sites, daily odour assessments should be undertaken in line with SPWI 007 Odour Reports on Landfill Sites to asses the potential for odour nuisance.

4.3. Mitigation measures could include the use of perfume systems or the carefully controlled operation of temporary extraction with spheres of influence covering the location of the proposed well (careful operation required).

4.4. With odorous waste, all drill spoil should be removed for correct disposal immediately at the tipping face or to covered skip for off site disposal.

4.5. To prevent odour complaints on sensitive sites, all wells should be completed, capped and sealed by the end of each working day. The contractor should not start drilling a well if it is unlikely that it will not be completed within the working day.

4.6. In the event of breakdown or unexpected delay, a temporary bentonite seal can be used to seal an incomplete well. The 300mm temporary, fully hydrated bentonite seal should be installed above the auger(s), left in to provide a means of supporting the seal to prevent an uncontrolled gas escape.

4.7. Screw on top caps should be included in the specification of all wells and should be installed immediately upon completion.

4.8. Yellow, push-on caps are completely unacceptable as a means of sealing a completed borehole. The slightest positive pressure within the well, will lift off the cap resulting in uncontrolled migration and the potential for odour generation.

5. HAZARDOUS WASTE

5.1. Due to the uncertainty of waste types included on older, un-permitted landfills and the substances contained in permitted hazardous waste sites, there is the possibility of encountering hazardous waste materials, such as asbestos and radioactivity when installing new wells. On these sites where there is the potential risk of harm to human health a decontamination unit should be provided as part of the contract.

5.2. If it is understood that there is the potential for encountering hazardous waste materials in the area to be drilled, this information should be provided to the contractor at the tendering stage to enable all potential risks to be properly assessed. The contractors risk assessments & method statements received prior to the start of the work, should be checked for consideration and mitigation of the associated risks, prior to issuing of the permit to work.

6. LINER PENETRATION

6.1. All drilling works should be undertaken in conjunction with SPOP 005 Gas Well Setting out Procedure, to ensure the correct positioning of the proposed well locations on site and the accurate calculation and recorded issuing of definitive safe drill depths to prevent accidental penetration of the lining system.

6.2. A stand-off from the flat section of the basal liner should be a minimum of 3m or 10% of the total waste depth, which ever is less. Unless otherwise agreed with the Environment Agency.

6.3. The stand-off of safe drill depth over steep batters should be a minimum of 5m to allow for horizontal displacement of the augers or slight slippage of the borehole location through survey errors.

6.4. Penetration of the capping layer should be undertaken with a barrel auger only. This is to ensure and prove a clean hole, without ripping or snagging of the liner and to preserve the

removed disks of FML and geo-fabric for CQA purposes. These should be numbered and photographed and retained as part of the installation process.

7. REVIEW OF THIS PROCEDURE

7.1. This procedure will be reviewed annually by SUEZ Technical Support Manager.

Table 3: Control measures for drilling into landfill waste ESA Draft ICoP 4 Drilling into Landfill Waste					
Key: * = mandatory; 'consider' = rig operator's risk assessment should decide whether control is required					
Control measures		**Borehole type**			
		Type 1	Type 2	Type 3	Type 4
1	Drilling contractor to be advised on borehole type at tender stage	*	*	*	*
2	Site/Facility Manager to issue permit to drill, the frequency as agreed by the parties involved	*	*	*	*
3	Only NVQ-qualified and BDA-audited lead drillers and drillers to operate rig	*	*	*	*
4	Drill crew given list of names/telephone numbers of site manager (or deputy) and those required in the event of an emergency	*	*	*	*
5	Drill crew advised on borehole type immediately prior to commencement of drilling	*	*	*	*
6	Removal of temporary borehole seal[o] to be under the supervision of the lead driller	Not required	*	*	*
7	No smoking unless in designated areas; if permitted, at least 15 m from drill rig	*	*	*	*
8	No smoking materials (cigarettes, etc.), lighters and matches within 15 m of drill rig	*	*	*	*
9	Working area, as designated by the lead driller, to be marked out, e.g. with tape, barriers.	*	*	*	*
10	Entry of persons or equipment into working area to be authorised by lead driller	*	*	*	*
11	Warning notices (no entry, no smoking, no naked flames) to be visible from all directions and large enough to be read from the edge of the working area (see note 4 below this table).	*	*	*	*
12	Hazardous area warning signs to be visible from all directions and large enough to be read from the edge of the working area.	consider	*	*	*
13	No welding, grinding and other ignition sources without a permit-to-work issued by the site manager.	*	*	*	*

14	No flammable liquid or gases (apart from necessary lubricant/hydraulic oils and diesel)	*	*	*	*
15	Mobile phone to be available (outside the zoned area unless certified) in case of emergency	*	*	*	*
16	Fixed electrical equipment within a zone 1 (e.g. emergency stops, micro-switches on trip wires) to be suitably-certified (typically flameproof or supplied via an intrinsically safe galvanic isolator)	not required	not required	*	*
17	Fixed electrical equipment within a zone 2 (e.g. emergency stops, micro-switches on trip wires) to be suitably-certified or covered by a risk assessment – see section 6.5)	not required	consider	*	*
18	Ban on unauthorised electrical equipment e.g. personal stereo, etc. in the working area	consider	*	*	*
19	Daily check and record – correctly-certified fire extinguishing equipment on drill rig including fire blanket and appropriate fire extinguisher	*	*	*	*
20	Daily visual check of exposed electrical wiring, plus record by lead driller	*	*	*	*
21	Regular inspection of all potential sources of ignition which could arise through deterioration or damage, to include electrical systems[p].	*	*	*	*
22	Pre drilling check and record – rig emergency stop(s), rig safety interlocks, trip wires, etc.	*	*	*	*
23	Written drilling log by lead driller (depths, changes, alarms, etc.) to be completed	*	*	*	*
24	Anti static footwear for all personnel within working area	not required	*	*	*
25	No petrol-driven machinery within the working area	consider	*	*	*
26	No lone working of the drill rig	*	*	*	*
27	No light metal alloy (e.g. aluminium alloy) drill strings	not required	*	*	*
28	Exhaust spark arrestor on exhaust outlet (if within zoned area)	not required	consider	consider	*
29	Air intake “Chalwyn-type” valve on drill rig engine (if within zoned area)	not required	consider	consider	*

30	Continuous methane monitoring, with a flammable gas detector at a designated location on the drill rig. The device may be permanently fixed to the rig or temporarily attached during drilling. See Table 5.	consider	*	*	*
31	Portable methane monitor available on site. If required, this should be available from the Site/Facility Manager and may also be operated by the Site/Facility Manager.	consider	consider	consider	*
32	Drill crew trained on their own company's gas detection equipment	*	*	*	*
33	Pre drilling methane gas detector reading at site of proposed borehole prior to set-up of drilling rig	consider	*	*	*
34	On set-up, drill table should be situated up wind where local conditions allow	not required	*	*	*
35	Ban on non-essential vehicles in the zoned areas. For essential vehicles (e.g. for delivering stones for back-filling), access is preceded by a gas check. If a level of ≥20% LEL is detected more than 1m from the borehole, vehicles are not permitted.	consider	consider	*	*
36	Portable fans to enhance dilution of gas to be running during drilling (not to be situated in zone 2 unless suitable for hazardous area use)	not required	consider	consider	consider (see note 1)
37	Local exhaust ventilation (LEV) system fitted to borehole	not required	not required	consider	consider (see note 1)
38	Inert gas injection into borehole	not required	consider	consider	not required
39	Ban on rotary air flush drilling	not required	consider	*	*
40	Ban on percussive drilling without modifications being in place to minimise sparking	not required	consider	consider (see note 3)	*

Note 1: For Type 4 boreholes, one or the other of these two control measures should be used; the choice may be dictated by the site operator.
Note 2: For Type 4, the volume of nitrogen required for a large release would be excessive and impractical.
Note 3: The primary consideration is whether the percussion takes place within the zoned area and, if it does, the likelihood of a spark being generated.

Recycling and recovery UK

Landfill Energy

Operations Management System

In-waste Extraction Well Setting-out Procedure

01 July 2017

LFEMA 5.1 V1

Approval and Amendment Record

Ref no	Issue no	Date	Originator	Reviewer	Authoriser
LFEMA 5.1	1	01.07.17	George Peart	Chris Male Justin Hampton Leigh Broadhurst	Tim Otley

Contents

1.0 | Purpose

The purpose of this document is to establish controls for setting-out in-waste extraction wells and calculating drilling depths, with the main objective being to avoid any damage to the basal containment (liner) system, at SUEZ Landfill Energy landfill sites.

It should be read in conjunction with other SUEZ Landfill Energy procedures on drilling into landfill waste.

2.0 | Scope

This document applies to the retro-installation of in-waste extraction wells (including landfill gas and leachate monitoring / extraction wells) at all SUEZ Landfill Energy landfill sites. It also applies to any such wells proposed by a third party gas contractor operating on SUEZ landfill sites.

The procedure is designed to ensure that well depths are accurately calculated and that proposed well locations are accurately transposed from the design drawings to the landfill site.

A number of errors can occur during the design and construction of in-waste extraction wells, which can lead to incorrect drilling depths and the risk of penetration of the basal liner. Examples of these are:

- Incorrect drilling depths issued to the drilling team due to poor survey information for the ground level at the well location or incorrect basal data;
- Incorrect setting out by the surveying contractor resulting in the well position being at odds with the design drawings;
- Incorrect data issued to drilling contractors, e.g. the release of draft drilling depths, previously used for budget calculations;
- Confusion surrounding the drilling point reference number and the well number on the issued drill depths.

These possible errors should be considered when following this procedure.

3.0 | Definitions and Abbreviations

SUEZ National Survey Contractor - Specialist survey contractor appointed by SUEZ on a national basis for setting-out and survey work. The National Survey Contractor is the only survey contractor authorised to undertake setting-out of in-waste extraction wells. The Contractor is subsequently referred to as the ‘Surveying Contractor’ in this procedure.

CQA Consultant - Construction Quality Assurance (CQA) Consultant - 3rd party engineering & environmental consultant employed by SUEZ to provide design and CQA services for SUEZ Landfill Energy projects.

Drilling Contractor - Specialist in-waste drilling contractor appointed by SUEZ on a national or regional basis for in-waste drilling and well installation work. Note that an alternative specialist drilling contractor may be used but only if the national (or regional) drilling contractor does not have adequate resources to meet SUEZ's programme objectives.

Third Party Gas Contractor - Landfill gas contractor operating a gas extraction & utilisation scheme on a particular SUEZ landfill site, on behalf of SUEZ.

4.0 | Responsibilities

The following SUEZ Landfill Energy personnel are expected to be involved in the design and construction of in-waste extraction wells at landfill sites within their region:

Operations Manager (or Site Manager, where applicable);

Landfill Energy Technical Support Manager;

Survey Manager / CAD Manager;

Regional Engineer (Project Engineer or Engineering Manager);

Aftercare Technician;

Other personnel, as appropriate.

Operations Manager (or Site Manager, where applicable)

The Operations Manager will identify a requirement for new or replacement in-waste extraction wells at a particular site and provide information to allow design to proceed. [Note that this also includes any requirements of a Third Party Gas Contractor for in-waste extraction wells on the site]. The Operations Manager (or delegate) will also undertake checks, as part of the drilling depth authorisation process.

Any reference in this document to Operations Manager also applies to the Site Manager, where applicable.

Landfill Energy Technical Support Manager

The Landfill Energy Technical Support Manager will be responsible for elements of the project relating to extraction of landfill gas, including checking / determining proposed well locations and approximate depths.

Survey Manager

The Survey Manager will be responsible for checking / confirmation of the adequacy of the setting-out survey drawing provided by the Surveying Contractor, and for initial well depth checks / calculations. The Survey Manager may delegate these tasks to the CAD Manager.

Regional Engineer

The Regional Engineer will be SUEZ's Project Manager for the project, with duties including appointment / management of the CQA Consultant; appointment / management of the Drilling Contractor, design of leachate wells and checking proposed well depths.

Aftercare Technician

The nominated Aftercare Technician will assist the Project Manager with operations on site, including protection of setting-out points and providing access for the Drilling Contractor.

5.0 | Procedure

5.1 Initial Design

The Operations Manager will:

- Identify SUEZ requirements for new or replacement in-waste extraction wells at a particular site and provide information (to allow design to proceed) to the Landfill Energy Technical Support Manager, Survey Manager and Project Manager. Note that this also includes any requirements of a Third Party Gas Contractor for in-waste extraction wells on the site. In which case, the Operations Manager will brief the Third Party Gas Contractor on the requirements of this procedure and obtain the necessary design information.

The Landfill Energy Technical Support Manager will:

- Check / determine proposed well locations and approximate depths, with regard to gas extraction, ensuring that the new well locations consider the sphere of influence to optimise gas extraction and achieve compliance;
- Confirm the proposed well references for gas wells, following the site specific well referencing system;
- Supply design information to the Project Manager, including proposed well locations / layout drawing and approximate well depths.

The Project Manager will:

- Check / confirm that the proposed well references are as per the Environmental Permit and/ or site-specific referencing system;
- Check / determine proposed well locations and approximate depths, with regard to leachate extraction, taking account of the leachate compliance level and the presence / location of existing landfill features, such as target drilling pad, inter-cell bunds, sidewall liner, under cap recirculation systems etc;
- Consider whether increased environmental monitoring is required around the site in order to detect any potential adverse impacts from the drilling / installation work. This will be determined between the Project Manager, Landfill Energy Technical Support Manager, Operations Manager and Monitoring Team.
- Appoint the CQA Consultant to prepare a CQA Plan for the proposed works and provide the necessary information;
- Supply outline design information to the Drilling Contractor for costing and programming purposes;
- Request setting-out from, and supply proposed well references and locations to, the Survey Manager, who will arrange setting-out with the Surveying Contractor. Alternatively, the Project Manager will make arrangements directly with the Surveying Contractor and inform the Survey Manager.

At the request of the Project Manager, the Survey Manager, will check / transfer proposed well location points (with designated well references) onto the latest topographical survey drawing for the site.

Note that the SUEZ (or Third Party Gas Contractor) design locations should be shown on AutoCAD drawing layer name: ‘SUEZ extraction well design location + date’ with layer colour set as 'Dark Blue'.

5.2 Setting-out

The Surveying Contractor will set-out the well locations in accordance with the sub-procedure contained in Section 5.5 of this procedure, and also carryout checks whilst on site and prior the issuing the survey.

Either during, or soon after the setting out of the well locations, the Project Manager or his nominated representative will:

- Visually check the relative positions of the new locations in relation to other known points to make sure they are where they are expected to be and that they are in a safe and accessible location;
- Confirm that the correct well references have been transposed from the drawing to the set-out locations / pegs on the site.

The nominated Aftercare Technician will protect the set-out locations / pegs, as necessary, and inform any SUEZ staff and/or contractor working on the site of their presence.

5.3 Checks (setting-out and drilling depths)

5.3.1 Drawing Receipt

The Survey Manager will receive all setting-out survey drawings issued by the Surveying Contractor. Such drawings shall not be used until checked and confirmed as accurate by the Survey Manager.

5.3.2 Drawing Checks

Following receipt of the setting-out survey drawing (from the Surveying Contractor) the Survey Manager will check the drawing to confirm that it is dimensionally accurate and compliant with the setting-out / survey procedure. The Survey Manager will:

- Confirm that the set-out well locations have been overlaid onto the latest topographic survey (Reject the drawing and do not proceed if non-compliant).
- Check the surveyed ground level at each proposed well location against the interpolated level on the underlying topographic survey, together with the ground and/or cover levels of three existing features surveyed during the setting out process (e.g. nearby leachate wells / monitoring points). If any level (mAOD) varies by more than 250mm from the interpolated or corresponding level obtained from the update survey, then the Project Manager should be consulted for valid justification in order to proceed. (Reject the drawing and do not proceed if the information is considered non-compliant).
- Confirm presence, validity of and accuracy of the Surveying Contractor's survey control check table. The closure errors should be <50mm on all co-ordinates, of all stations (Reject the drawing and do not proceed if non-compliant).

The Survey Manager will notify the Project Manager of the outcome of the checks and (if compliant) supply a copy of the checked survey drawing to the Project Manager.

5.3.3 Depth to Landfill Base

Having checked the setting-out survey drawing, the Survey Manager will determine the depth to landfill base at each proposed well location. The Survey Manager will:

- Overlay the survey points onto the SUEZ basal survey drawing, where available;
- Input the well reference and coordinate information for each proposed well into the drilling depth calculation sheet, in numerical order;
-

- Input the surveyed ground level and associated landfill cell basal level (top of drainage stone or basal / sidewall liner) into the calculation sheet;
- Calculate the depth of waste (m below ground level);

- Input the relevant stand-off (i.e. distance from base of proposed well to top of drainage stone or basal / sidewall liner) and calculate safe drill depth (m below ground level);
- Issue the basal survey drawing and completed calculation sheet to the Project Manager, who will undertake further checks, as set-out below.

  For gas wells, the stand-off should be determined as follows:

  Over basal contours (>3 m from a steep slope / batter) - Stand-off is 3 m (If survey point is adjacent to a shallow inter-cell bund, use 3m stand-off but increase basal elevation to reflect mAOD of top of bund);

  Over basal contours (< 3m from a steep slope / batter) - Stand-off is 5 m;

  Over side slopes / batters - Stand-off is 5 m;

  Where no reliable basal information is available or other site specific concerns exist, the stand-off depth may be increased, as agreed with the Operations Manager and Landfill Energy Technical Support Manager.

For leachate extraction / monitoring wells the stand-off is determined by the Project Manager, having regard to the 'leachate compliance level' and the accuracy of the drawings and any other information held showing the elevation and construction of the basal liner system.

In the absence of accurate basal information, the Project Manager will consult with the Operations Manager regarding the available data and drilling depths.

5.3.4 Further Checks

Upon receipt of the setting-out survey drawing, as checked by the Survey Manager, and the calculated / checked drilling depths, the Project Manager will:

- Check the site name, document version and date;
- Check that the set-out well locations and well references match the proposed well locations and references;
- Check that the surveyed ground level for each well (as set-out) and the associated landfill cell basal level (top of drainage stone or basal / sidewall liner) have been correctly entered into the calculation sheet;

- Determine / check the applied stand-off;
- Check the accuracy or all formulas and the calculation of waste depths and drill depths.

In-waste extraction wells - Design calculation & check sheet (Form LFEMAF 5.1.1) is used for gas wells. All gas wells on a particular project may be included on a single form.

For leachate wells, In-waste extraction well (leachate) - Design calculation & check sheet (Form LFEMAF 5.1.1.1) is used; a separate sheet is used for each well, due to the requirement to provide additional information for leachate wells.

The Project Manager will check / complete, sign / date each form; then scan each form and send it to the Operations Manager, with supporting data, for final checking.

The Operations Manager (or delegate) will check and sign / date each form; then scan the form and send it to the Project Manager. This check is intended as a final numerical check and a 'sense check' by someone closely familiar with the site.

The Project Manager will then issue the checked / signed form(s) to the CQA Consultant and Drilling Contractor.

5.4 Construction Phase

5.4.1 Pre-start Meeting

The Project Manager or delegated representative will arrange / attend a pre-start meeting on site to include the Drilling Contractor and CQA Consultant.

A copy of the checked / signed drilling form(s) will be supplied to the Drilling Contractor's lead driller on-site, who will be asked to sign the form(s). If copying facilities are available on the site, the signed form will be copied / scanned and a copy will be retained by / forwarded to the Project Manager.

5.4.2 Check Survey

The Project Manager may require a check survey to be carried out by the Surveying Contractor during installation of in-waste extraction wells, e.g. when drilling close to the landfill basal liner and /or where significant settlement of the ground surface is anticipated following the initial setting-out.

In which case the Project Manager will make arrangements with the Surveying Contractor and inform the Survey Manager. On completion and following appropriate checks, the Surveying Contractor will issue the survey data directly to the Project Manager, copied to the Survey Manager. This is to allow rapid decisions to be made by the Project Manager, if necessary, during drilling operations. The data supplied would either:

i) support the initial set-out level (allowing for the possibly of a few mm settlement) or ii) show a significant difference, which would merit further investigation (and possible suspension of drilling operations, until the reason for the discrepancy is understood).

5.5 Sub-procedure for Surveying Contractor

5.5.1 Receiving Data for Setting Out

The Surveying Contractor will be given a minimum of 5 days notice by the Project Manager or Survey Manager for any setting out work, where reasonably practicable.

The Surveying Contractor will receive digital drawing data in an AutoCAD format. The Surveying Contractor will not accept text co-ordinates for setting out purposes. Locations must be shown on a CAD drawing, ideally shown on drawing layer named: 'SUEZ extraction well design location + date', with layer colour set as Dark Blue.

5.5.2 Setting-out Survey

The Surveying Contractor will set-out the proposed well positions on site (with correctly numbered peg or spray-marking, if located on a capping surface). A circle of spray paint will be formed around each peg, to show the peg's original position and provide evidence that the peg has not been moved / re-positioned after setting-out.

The ground and/or cover levels of three existing features will also be surveyed during the setting out process (e.g. three adjacent leachate wells / monitoring points) to provide additional data for checks on survey accuracy.

The set-out / surveyed positions will be entered in AutoCAD drawing layer name: 'SUEZ extraction well set-out location + date'', with layer colour set as Magenta. This layer should be 'switched on' when issued by the Surveying Contractor. The design locations will also be shown on the drawing under layer name: 'SUEZ extraction well design location + date', with layer colour set as Dark Blue. This layer should be 'switched off' for clarity when the drawings is issued by the Surveying Contractor.

The setting-out survey information will be plotted and overlaid onto the latest topographic survey for the site, to enable check of the relative positions and levels.

5.5.3 Review / Quality Assurance Procedure

The Surveying Contractor should identify the survey control stations used during the survey, together with the survey error. This information should be displayed on a Survey Control Table to be found in the legend of all survey drawings. The Survey Control Table should be reviewed by SUEZ's Survey Manager, upon

receipt of the setting out / survey data, prior to use, to ensure compliance with the survey tolerances set out in the National Survey contract, i.e. < +/- 50mm. (Reject the drawing & do not proceed if non-compliant).

This procedure should be incorporated into the Survey Contractor's own procedures and be reviewed with SUEZ's Survey Manager on a minimum of an annual basis and as necessary.

5.5.4 Survey Data Issue

The Survey Contractor will issue the setting-out survey drawing to the SUEZ Survey Manager (only), with the format as specified above, together with a table (Excel) showing the well reference and coordinates of each well location.

Note that any follow-on check survey may be issued directly to the Project Manager, on request (copied to the Survey Manager), as described in Section 5.4.2.

The Surveying Contractor should state on the issuing email that the work has been undertaken in accordance with the sub-procedure contained in 'SUEZ's In-waste extraction well setting-out procedure' and that all necessary checks have been completed to ensure the accuracy of the data provided.

6.0 | Related Documents

Related documents are as follows:

In-waste extraction well (gas) - Design calculation & check sheet (Form LFEMAF 5.1.1)

In-waste extraction well (leachate) - Design calculation & check sheet (Form LFEMAF 5.1.1.1)

Drilling Gas Wells in Landfill Waste Procedure, SITA Power, SPOP 004, Issue 2, dated 30/07/10;

In Waste Borehole [IWB] Setting-out and Drilling Procedure - SITA UK Ltd, Issue 001, dated 16/02/2006.

7.0 | Training Requirements

No specific training is considered necessary, as a result of issue of this procedure.

Suez Landfill Energy

OPERATING PROCEDURE

Document Reference	SPOP 020	Issue	2
Title	PREVENTION OR CONTROL OF SUB-SURFACE LANDFILL COMBUSTION	Date	25/01/2021

Approval & Amendment Record

Prevention Or Control Of Sub-Surface Landfill Combustion

Issue	Date	Originator	Authorisation	
1	18/07/2007	CJ Matthews	T. Otley	
2	08/03/2011	CJ Matthews	T. Otley	
3	25/01/2021	J Cove		

Suez Landfill Energy

OPERATING PROCEDURE

Document Reference	SPOP 020	Issue	2
Title	PREVENTION OR CONTROL OF SUB-SURFACE LANDFILL COMBUSTION	Date	25/01/2021

1. GENERAL

1.1. This procedure establishes the necessary management systems and practical techniques to prevent and control combustion within the body of a landfill site. The procedure is designed to ensure that all managers have an informed strategy and resources to deal with localised hot spots and combustion.

1.2. Training, information and support is provided within SUEZ Landfill Energy to ensure that SUEZ Landfill Energy managers are able to implement this procedure. SUEZ Landfill Energy area available to give training & support to other managers within SUEZ Recycling & Recovery UK.

1.3. On behalf of SUEZ Recycling & Recovery UK, SUEZ Landfill Energy were contributors to the Industry Code of Practice June 2008, Management and Prevention of Sub-surface fires. This procedure (SPOP020) has incorporated proven elements of the Industry Code of Practice.

2. PRINCIPLES

2.1. In addressing issues surrounding prevention and control of deep-seated landfill fires SUEZ Landfill Energy managers have recourse to specific training and information. In particular the EA have produced an R&D Technical Report: P1-490 Review and Investigation of Deep-Seated Fires within Landfill Sites

2.2. The most likely cause of combustion is ingress of air into the body of the landfill. This generally occurs at failed seals between the cap and infrastructure such as gas or leachate wells. Aerobic decomposition is exothermic and leads to hot spots in the waste mass. Subsequently combustion may occur, initially with inadequate oxygen supply leading to elevated CO. If unchecked, combustion can draw in further air and accelerate the combustion process.

2.3. Signs of sub-surface combustion includes localised subsidence, hot gas or leachate extraction pipework, melted leachate pump delivery pipework, damage to infrastructure (e.g. well heads melt) and smoke (from the vicinity of wells or fissures in the landfill surface).

2.4. The exact location, extent and depth of a fire may be difficult to ascertain but can be approximated as the remedial actions progress. Hot spots usually occur at or adjacent to the point of air ingress so if caught early, their extent is usually small, in the order of several metres. However deep-seated combustion can if unchecked become widespread. Early identification and remediation is critical for the elimination of sub-surface combustion.

2.5. In order to successfully remediate “hot spots” the aim is to reduce the temperature of the affected area by the introduction of water/leachate and to exclude air with improved capping and sealant.

2.6. Nitrogen may also be injected into the adjacent area to cool and suppress the fire by displacing available oxygen. This is very expensive and is usually only used to tackle deep-seated combustion once other options have proven ineffective.

2.7. In assessing the scale of the combustion, health and safety matters must be thoroughly considered. Monitoring or opening leachate or gas wells must be carefully

controlled. Excavation of nearby surfaces must be assessed against the risk of providing fresh supplies of air to feed the combustion.

2.8. In major fires, emissions may be a major concern. Dense smoke may contain carcinogens and toxic components.

3. PROCEDURE

3.1. The SUEZ Landfill Energy Operations Manager is responsible for ensuring that all power generation landfill sites have systems in place both to prevent the conditions for combustion arising and to enable a swift and effective response if combustion occurs. Such systems shall be in accordance with the following sections.

4. PERSONNEL

4.1. Each landfill site should designate personnel identifying the person(s) in order to deal with a combustion incident into provide Typically the team will comprise.:

4.2. Technical Support, Guidance and Training (***Technical Support Manager***)
4.3. Resources to overcome the combustion (Nominally the ***Landfill Manager***)

5. EQUIPMENT

5.1. The GA 5000 gas analyser provides two means of indication of unsatisfactory conditions arising

5.1.1. CO readings. These must be taken as indicative only as levels can be affected by the presence of hydrogen. Managers must follow the cautionary principle, accepting a high reading as correct until it is disproven.

5.1.2. A balance reading. Largely this is nitrogen. Nitrogen accompanied by oxygen indicates unconsumed air, generally from a source close to the well head or point being sampled., aerobic activity and combustion both consume oxygen leaving free nitrogen, roughly calculated by deducting 4 times the oxygen reading from the balance resulting in “free nitrogen” levels. Further details are available in Procedure SPOP 003 Gas Field Balancing Procedure

6. PREVENTION

6.1. “Hot Spot” formation can be prevented or eliminated at an early stage by monitoring and controlling Free Nitrogen levels. These provide early indication of aerobic activity.

6.2. Monitoring should also include regular CO monitoring of all gas wells using a Hydrogen Compensated GA 5000 gas analyser. Gas wells should be considered as being “at risk” if CO levels are higher than 100 ppm. The suction applied to such a well should be progressively reduced or closed , thereby reducing flow out of the well and associated air ingress at adjacent points.

6.3. Rising landfill gas quality and pressure within the affected area due to reduced or eliminated flow from adjacent wells will tend to suppress the combustion.

6.4. Subsequently, investigation may uncover the source of air ingress into the affected area. If possible such points of ingress should be sealed by use of bentonite around well heads or clay compaction in fissures, remediation of the MDPE pipe boot or

refitting/resealing of leachate wellhead lids etc

6.5. Under most circumstances, monitoring for CO and attention to sealing surfaces and joints will result in a reduction of CO levels and subsequent return to normal operations. However CO levels may continue to rise without any other visible signs. If so, then the GA5000 CO readings should be checked by sampling using Draeger tubes or by obtaining laboratory analysis of a bagged sample.

6.6. If confirmed by an alternative testing methods, high CO levels shall be taken as indicative of combustion and the issue shall become one of control.

7. CONTROL

7.1. Industry Code of Practice suggests that Dynamic Temperature Profiling may be used to identify the position of sub-surface combustion. This is not recommended or supported as a procedure on sites with engineered caps. Temperature Profiling is of use only where combustion is thought to be extensive and deep-seated.

7.2. SUEZ Landfill Energy procedure is to identify the area of combustion through samples taken at well heads.

7.3. If combustion is suspected then all gas wells within 50 metres of the affected point should be immediately closed and subsequently monitored for CO. Wells exhibiting elevated CO concentrations (in excess of 100 ppm) must be closed along with all additional neighbouring wells up to 50 metres distant.

7.4. CO readings from GA5000 gas analysers are indicative only and are affected by other materials, in particular hydrogen which is both a product of decomposition and a product of inorganic reactions that may precede ignition. Therefore CO monitoring should be wholly undertaken or verified by the use of Draeger tubes and laboratory analysis of bagged samples.

7.5. On generating sites the SUEZ Landfill Energy Technical Support Manger shall provide overall direction and control but it is the SUEZ Landfill Energy Site Manager's responsibility to organise and implement dousing of the affected areas.

7.6. At the earliest opportunity, the affected area or wellhead must be investigated and remediated to prevent air ingress. If the combustion has developed and become visible at the surface, (usually during a period of reduced extraction) then the area should be excavated immediately to expose the annulus of the well and the waste interface up to 1 metre from the well centre. Excavation should only commence when the ability to douse the affected area has been confirmed. To prevent liquid bypassing the combustion, the well should be plugged with non-porous inert materials. If the site is capped with LLDPE and the gas or leachate well has a pipe boot installed, this should be removed to enable both the inside of the casing and the annulus to be dowsed for a prolonged period of time until the surface expression of the combustion has been eliminated. The well casing or area should then be temporarily capped with cohesive soils to prevent air ingress.

7.7. If the casing remains intact in the affected area this should be securely capped but remain visible to enable further dousing if necessary.

7.8. Gas wells, which appear to be within 2-5 metres of the seat of combustion, should be

used as dousing points, beyond this distance it is unlikely that liquid would reach the affected area. Gas well piping may be disconnected and modified to accept pumped supplies of water, condensate or leachate in significant quantities. If the gas well has melted partially or totally, then hoses should directed towards and/or into the cavity.

7.9. The surrounding area and infrastructure should be inspected for signs of cracking, breaks in seals etc. Temporary repair to surface defects must be made without undue delay to stop further ingress of air. In effecting such repair, excavation must be avoided or minimised if unavoidable. Permanent repair can be made once the risk of combustion is eliminated.

7.10. Dousing should be continued until visible signs of combustion are eliminated. The most important aspect of the process is to ensure sufficient volumes of liquid are pumped to cool the waste mass at the seat of the sub-surface combustion. Estimates of the volumes of liquid pumped may be inferred from local flowmeters or standard pump capacities (pump curves etc). This information should be recorded if available and supplied with the incident report to the Site Manager to enable review of the HRA.

7.11. There are significant challenges in applying liquid to the base of a deep-seated fire. In those instances in which the combustion proves difficult to control, then Temperature Profiling of existing wells can give a good indication of the depth of the combustion. Temperature readings should be taken at metre intervals down the gas well. Drilling additional wells to provide temperature profiling is not recommended or supported by SUE Landfill Energy.

7.12. It is important that when a fire is detected that a trained member of SUEZ staff maintains a watch on the area so long as there is a surface expression of the sub-surface combustion. The person watching the area must ensure that additional support is called in should the emissions from the area indicate a worsening condition. The fire watcher may withdraw when all surface expression is eliminated by dousing and covering of affected areas.

8. ADDITIONAL METHODS

8.1. Dousing a fire with liquid may fail if the liquid pumped in bypasses the fire, falling to the base by the most direct route. In such cases alternative solutions may be considered and implemented on the discretion of the Site Manager

8.2. Installation of shallow pin wells for liquid injection at 5-10 metre spacing may prove successful if pumping around affected wells does not show an improvement in CO and free nitrogen readings.

8.3. Foam may be pumped under pressure into the well or cavity. Foam has a greater tendency than water to penetrate the fill

8.4. Liquid nitrogen can be delivered in tankers to the site and injected via the tanker's evaporator into the site. To give greatest chance of success, the surrounding area must be inspected and any leakage paths, such as fissures, cracks and seals around wells must be repaired to prevent nitrogen wastage through the surface.

8.5. Excavation of shallow fires must be exercised with great caution due to the possibility of supplying a source of oxygen to the fire. The waste is excavated and doused with

water (not leachate) or soils. Such an exercise should only be undertaken following a site-specific risk assessment. All materials required to overcome the fire must be present prior to excavation commencing.

9. MONITORING

9.1. Once the SUEZ Landfill Energy Manager assesses that combustion has been addressed, the operation shall progress into the monitoring phase.

9.2. All wells surrounding the affected areas shall be monitored daily for CO levels for 5 days to minimise the possibility that combustion is dormant but may flare up again.. Monitoring at wells showing normal CO levels (below 30 ppm) may be discontinued after this time.

9.3. Wells with persistent high CO levels will be monitored daily until CO levels have reduced below 30 ppm.

9.4. Monitoring at the last well to show elevated CO levels shall continue daily for five days after levels fall below 30ppm.

10. RETURN TO SERVICE

10.1. Close attention shall be paid to wells in the affected zone when returning these to service. Wells shall be opened gradually over a number of days. The well considered most at risk shall be monitored daily for CO levels for 7 days. Samples must be representative and taken at the well head or at the manifold with gas valve cracked open for the period of monitoring.

10.2. It must also be borne in mind that combustion may have damaged the capping layer and that therefore the potential for future air ingress will be higher until the containment is repaired.

11. REMEDIAL

11.1. Landfill, Technical and Gasfield Managers should meet to assess the scale of damage caused by combustion. Such damage may be limited to surface cracking (through drying out) or may possibly include damage to capping materials.

11.2. A remediation plan must be produced (bearing in mind the risk of excavation) to repair damage to infrastructure and/or capping. The remediation plan must detail the CQA requirements for the work involved.

11.3. Final remediation of the cap / infrastructure should only be undertaken once it has been confirmed that combustion has been eliminated.

12. INCIDENT REVIEW

12.1. The occurrence must be reviewed to assess from gasfield data, witness statements and subsequent investigation what the likely cause of the fire was. The report should identify possible causes and make recommendations to prevent a reoccurrence.

13. ICOP Review

13.1. Revision of this procedure included a specific review of ICOP Management and Prevention of Sub-Surface Fires. The following elements in particular were considered.

13.2. (ICOP Clause 4) Indicators of Sub-Surface Fires. SUEZ follow an approach of regularly reviewing free nitrogen and CO levels after every gas balance (see SPOP003 Gas Field Balancing and Gas System Inspection Procedure). In this analysis trends as well as absolute readings are checked.

13.3. (ICOP Clause 4) Indicators of Sub-Surface Fire. CO levels are an important part of SUEZ monitoring for potential combustion. Gas analysers must be fitted with an H_2S filter to prevent false CO readings.

13.4. (ICOP Clause 4.3) Temperature. Leachate temperature monitoring is not a routine part of SUEZ approach to landfill combustion as our general experience is that leachate occupies the base of the cell and combustion occurs in higher levels.

13.5. (ICOP Clause 4.3). Thermal imaging as a procedure is only applicable to sites in which combustion appears to be extensive.

13.6. (ICOP Clause 4.5) Nitrogen/Oxygen ratios are not used in SUEZ approach to monitoring or prevention of landfill combustion. More useful parameters are free nitrogen and CO values and trends.

13.7. (ICOP Clause 4.7) Hydrogen readings are not a reliable indicator of combustion and are susceptible to errors in sampling. Aerobic waste is naturally high is hydrogen. Therefore this is not considered to be an important indicator in SUEZ approach to monitoring or prevention of landfill combustion. More useful parameters are free nitrogen and CO values and trends.

13.8. (ICOP 5.1.1) Fire Watch requirements are covered in clause 7.11 of this procedure.

13.9. (ICOP 6.2.1) Dynamic Temperature Profiling is of use only where combustion is thought to be extensive and deep-seated. It is not a standard SUEZ procedure.

13.10. (ICOP 6.2.2) Temperature Profiling of existing wells may be a useful technique in certain circumstances, see Clause 7.10 of this procedure.

13.11. (ICOP 6.2.3) Static Temperature Profiling does not bring additional benefits to that of Temperature Profiling as per ICOP 6.2.2 and the use of free nitrogen and CO readings.

13.12. (ICOP 6.3) Thermal imaging has not proven to be useful on SUEZ sites where the emphasis is on early detection and control of combustion.

13.13. (ICOP 8.2) Shallow pin wells should not be installed in the initial stages as experience shows that flooding around affected gas wells is generally successful for combustion detected at an early stage.

13.14. (ICOP 8.2) The use of detergents on a large scale is not supported by SUEZ.

13.15. (ICOP 8.2) Drilling deep wells to control sub-surface combustion is not supported by

SUEZ.

13.16. (ICOP 8.5) Foam injection is not supported by SUEZ.

13.17. (ICOP 8.6) Excavation is only supported by SUEZ in accordance with clause 8.5 of this procedure.

14. REVIEW PROCEDURE

14.1. This procedure will be reviewed annually and after every incident which requires the use of this procedure.

Landfill Energy

OPERATING PROCEDURE

Document Reference	SPOP 024	Issue	2
Title	Instructions to Contractors Construction & Environmental	Date	13/03/2021

Approval & Amendment Record

Instructions to Contractors
Construction & Environmental

Issue	Date	Originator	Authorisation
1	17/06/2008	C J Matthews	T. Otley
2	13/03/2021	J Cove	

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1 GENERAL

1.1 This procedure must be read in conjunction with SPOP023 Procedure for Engineering & Construction Contracts.

1.2 This procedure supplies the standard instructions for contractors engaged in engineering and construction.

1.3 The procedure allows for specific additions or amendments to cover the requirements of a particular contract.

1.4 The contractor shall undertake any environmental monitoring required by legislation to ensure that emissions of noise or pollutants is kept within allowable limits.

2. PROCEDURE

2.1. Water Encountered in Work

2.1.1. The Contractor shall notify the Employer if any water is encountered during excavation activities. No water shall be discharged to surface ditches. Excessive amounts of water (enough to significantly hamper normal construction operations) encountered during excavation activities is to be handled as directed by the Engineer or Resident Engineer.

2.2. Water Control

2.2.1. The Contractor shall provide methods to control surface water to prevent damage to the project, the Site, or adjoining properties. The Contractor shall control fill, grading and ditching to direct surface drainage away from excavations, pits, tunnels and other construction areas; and to direct drainage to proper runoff.

2.2.2. The Contractor shall provide, operate and maintain hydraulic equipment of adequate capacity to control surface erosion.

2.2.3. The Contractor shall dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site or to adjoining areas.

2.3. Dust Control

2.3.1. The Contractor shall provide positive methods and apply dust control water to minimise raising dust from construction operation, and provide positive means to prevent airborne dust from dispersing into the atmosphere. Chemical dust suppressant shall not be used. Dust suppressants shall be approved by the Engineer prior to use.

2.4. Debris Control

2.4.1. All areas under the Contractors control shall be maintained free of extraneous debris.

2.4.2. All waste material excavated or generated during the works shall be disposed of by the contractor at the Working face of the landfill. Any requirement to dispose of waste at the working face shall be agreed in advance with the Site Operations Manager.

2.5. Pollution Control

2.5.1. The Contractor shall provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations.

2.5.2. The Contractor shall provide equipment and personnel to perform emergency measures required to contain any spillage's and to remove contaminated soils or liquids; and shall excavate and dispose of any soil contaminated by the construction operations off-site and replace with suitable compacted fill and topsoil as directed by the Engineer or the Employer.

2.5.3. The Contractor shall take special measures to prevent harmful substances from entering public waters; and shall prevent disposal of wastes, effluents, chemicals, sediments, or other such substances adjacent to streams, or in sanitary or storm sewers.

2.5.4. The Contractor shall provide systems for control of atmospheric pollutants; and shall:

2.5.4.1. prevent toxic concentrations of chemicals
2.5.4.2. prevent harmful dispersal of pollutants into the atmosphere.
2.5.4.3. prevent noxious or odorous releases to atmosphere.
2.5.4.4. minimise the area of exposed waste at any time and should an odour arise, provide suitable masking agents as to fully mask or render acceptable the odour created.

2.6. Noise Control

2.6.1. Unless otherwise approved by the Engineer, the Contractor shall comply with noise level requirements for the site and as directed, if necessary, with the planning Authority and/or Environment Agency.

2.6.2. Reversing alarms used on vehicles and equipment shall be of the bell tone type or the directional type capable of adjusting their noise level automatically to 5dB(A) above the ambient noise level.

2.6.3. The Contractor shall at all times use every reasonable means to ensure that the level of noise resulting from the Works is kept to the minimum amount possible. All

compressors, breakers, drills and other machines are to be fitted with efficient silencers, mufflers or other approved devices and the Contractor is at all times to comply with the recommendations contained in the Department of the Environment Advisory Leaflet No.72 and BS 5228.

2.6.4. Should a nuisance arise the Contractor shall:

2.6.4.1. Forthwith comply with any notice or order served upon him by any competent authority.

2.6.4.2. Indemnify the Employer from and against any liability whatsoever arising on account of noise or other disturbance crested whilst on or in carrying out the Works. In the event of any complaint concerning noise, the Contractor shall provide and maintain an accurately calibrated instrument to measure noise levels for the use of the Employer.

2.7. Construction Aids

2.7.1. The Contractor shall provide any and all construction aids, equipment and materials required to facilitate execution of the Work, including adjacent properties and public facilities which may be affected by execution of the Work.

2.7.2. **Preparation** The Contractor shall consult with the Engineer and/or Resident Engineer. and review site conditions and factors which affect construction procedures and construction aids, including adjacent properties and public facilities which may be effected by the execution of the work.

2.7.3. General Installation of facilities shall be of a neat and reasonable uniform appearance, structurally adequate for required purposes.

2.7.4. The Contractor shall maintain barriers during the entire construction period.

2.7.5. The Contractor shall relocate barriers as required by progress of construction.

2.7.6. All work shall be undertaken in accordance with the current Planning Permission, Site Licence, and the site Working Plan (all available on site).

2.8. Excavation

2.8.1. All excavations shall be undertaken safely in accordance with SPOP012 Trenching and Excavation Procedure.

2.8.2. No excavation or drilled hole greater than 1 metre deep shall be left unattended or left open overnight unless securely covered in a manner acceptable to the Engineer. Precautions shall be taken to protect open boreholes from the introduction of storm water.

2.8.3. During the excavation of the restoration materials in any part of the site, the Contractor will observe any vertical soil structures and separate materials as these are removed accordingly. Excavations shall be backfilled in layers to match the original vertical structure.

2.8.4. No excavations must be made into the engineered MDPE cap or clay liner without prior approval from the Engineer.

2.9. Tree and Plant Protection

2.9.1. The Contractor shall preserve and protect existing trees and plants at the site which are designated to remain, and those adjacent to the site.

2.9.2. The Contractor shall protect root zones of trees and plants and shall perform the following in areas of protected trees and plants:

2.9.2.1. Not allow vehicular traffic or parking
2.9.2.2. Not store materials or products
2.9.2.3. Prevent dumping of refuse or chemically injurious materials or liquids.
2.9.2.4. Prevent puddling or continuous running water.

2.9.3. The Contractor shall replace, or suitably repair, trees and plants which have been designated to remain and which are damaged or destroyed due to construction operations.

2.10. Clearing Site

2.10.1. The Contractor shall completely remove temporary barriers, materials, equipment and services:

2.10.1.1. when construction needs can be met by use of permanent construction;
2.10.1.2. at completion of Project.
2.10.1.3. The Contractor shall clean and repair damage caused by installation or by use of Temporary Facilities.

2.10.2. Waste Disposal The contractor will be expected to leave the Site in a clean and tidy condition. All waste material excavated or generated during the works shall be properly disposed of. The contractor should make provision for off site disposal as specified in the Bill of Quantities.

2.11. Existing Gas Systems

2.11.1. The Contractor must restrict disruption of existing systems to a minimum. Works which involve disconnection of any existing system requires prior approval by The Engineer of the contractor's method statement and programme.

2.12. Gas Wells

2.12.1. Location and drilling of gas wells will be in accordance with Landfill Energy procedure SPOP 004 Installation of Gas Wells.

2.12.2. In the event of a significant obstruction being encountered in drilling a well, the contractor shall inform the Engineer prior to the onset of additional drilling charges. The Engineer will decide if the well should be continued or aborted. If aborted the Engineer will identify a suitable new well location.

2.12.3. All new wells are classified as Type 3 under the draft ESA ICOP 4 Drilling into Landfill Waste, Section 6.2 Type of borehole – 'Boreholes that produce significant quantities of landfill gas'.

2.12.4. All mandatory control measures outlined in ESA ICOP 4 Table 3, section 6.4 – 'Control measures' shall be employed as part of normal drilling operations on all new wells.

2.12.5. The SUEZ engineer is to be the nominated DSEAR contact specified in ICOP 4.

2.12.6. Following installation of gas wells the installed pipework must be capped with an appropriate design of cap. Sealing of wells using plastic bags or other similar technique is unacceptable. The Contractor must check the integrity of the installed caps, minimum, on a daily basis.

2.12.7. Wells which will be installed in capped areas must be undertaken strictly in accordance with the specification and procedures agreed with the engineer (and prior agreement from the Environment Agency.)

3 RECORDS

3.1 Copies of any environmental monitoring records shall be supplied to the Engineer for the Contract within two weeks of completion of the contract.

4. REVIEW OF PROCEDURE

4.1 The National Operations Manager shall review this procedure annually.

5. RESPONSIBLE PERSONS

5.1 It is the responsibility of the Landfill Energy General Manager, National Operations Manager, Technical Manager and Operations Managers to ensure that this procedure is followed in full.

Landfill Energy
OPERATING PROCEDURE

Document Reference	SPOP 025	Issue	2
Title	Instructions to Contractors Construction Quality Assurance	Date	21/04/2021

Approval & Amendment Record

Instructions to Contractors
Construction Quality Assurance

Issue	Date	Originator	Authorisation
1	17/06/2008	C J Matthews	T. Otley
2	21/04/2021	J Cove	

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1. GENERAL

1.1 This procedure must be read in conjunction with SPOP023 Procedure for Engineering & Construction Contracts.

1.2 This procedure supplies the standard Construction Quality Assurance instructions for contractors engaged in engineering and construction.

1.3 The procedure allows for specific additions or amendments to cover the requirements of a particular contract.

2. Construction Quality Assurance (CQA) Procedure

2.1. Programme of Works

2.1.1. Within two weeks of receiving and accepting a contract, the Contractor shall supply the Engineer with a detailed programme and CQA Plan covering the Contract Works and showing how it is intended to complete the works by the agreed completion date.

2.1.2. The plan should detail the proposed techniques and records to be collated during the installation works.

2.1.3. This programme shall be approved by the Engineer prior to the commencement of the works.

2.2. Design & Supply

2.2.1. Gas wells shall be constructed in accordance with SPSD 003 : Schedule of Gas Well Head Design.

2.2.2. Seals between gas wells and plastic capping shall be installed in accordance with SPSD 001 : Gas Well Boot Detail

2.2.3. The works shall be designed and installed to a high standard to ensure continuity of satisfactory operation. All plant and apparatus supplied under this Contract shall be of a make, type, material, design and construction approved by the Engineer and, unless specified to the contrary, shall comply with the most recent applicable British Standard or other equivalent approved National or International Standards.

2.3. Construction

2.4. **MDPE Pipe Fusion** Gas mains shall be constructed from MDPE of a specification in accordance with Landfill Energy standard design.

2.4.1. All pipe fusion shall be in accordance with the requirements detailed in the CQA Section of the specification

2.4.2. All fusion jointing (utilising both 'Butt Fusion' and 'Electrofusion' methods) should be carried out in accordance with the Water Industry Specification – WIS 4-32-08 'Specification for Site Fusion Jointing of PE80 and PE100 Pipe and Fittings (August 1994: Issue 2). The contractor should provide a method statement that details the quality system they propose to employ to ensure consistently good quality fusion. This should be sufficiently detailed in order to comply with the requirements of Clause 5 (Quality Assurance) of WIS 4-32-08. Adequate records in accordance with the standard should be made available to the engineer if requested during the works and form part of the Quality Assurance Report on completion of the works.

2.4.3. The following Conditions are considered onerous for Landfill Gas Collection Systems and the following relaxation in WIS 4-32-08 are allowed.

- *Clause 2.1.7 External and Internal Bead Remover*

De-Beading is not required if using a fully automated Butt Fusion machine.

- *Clause 5.10 Training*

In line 6 add 'or similar approved training' after NVQ.

2.5. **Identification** All manifolds shall be marked with the well numbers using an appropriate form of marking to provide durability.

2.6. As Built Drawings – Gas Collection System

2.6.1. The Engineer will provide the contractor with the current established site survey control. The contractor will be required to utilise this control for any survey work carried out at the site.

2.6.2. The engineer will provide the contractor with a site plan (to the site survey control) and the gas system should be superimposed on this plan. All components of the installed gas collection system should be clearly identified and labelled on the plan.

2.6.3. The drawings shall be provided in accordance with the SUEZ standard Autocad format and must use the following line type format

- LINETYPE: Continuous
- COLOUR: In accordance with the legend
- LAYER: Monitoring

2.6.4. Schematic sections should be provided for each pipe run which indicate the fall of the pipe and ground level.

2.7. As Built Records – Gas Well Drilling Logs

2.7.1. Drilling logs should be provided for all gas wells installed at the site. These logs should be completed in accordance with British Standard BS5930. In particular they must contain information on depth (at which horizons are encountered, drill depth, dipped depth of borehole, a record of all water strikes and the approximate degree of saturation of each horizon).

2.7.2. The logs should provide information relating to the Gas Well installation within the borehole. In particular the log must contain information relating to the design of the well (plain and slotted components in meters) and the installation within the annulus (gravel pack and bentonite seal in meters).

2.8. **Construction Quality Assurance Report**

2.8.1. All CQA information required to fulfil this specification should be detailed into a Construction Quality Assurance Report. The format and requirements of this report are contained in Landfill Energy form SPF046 Construction Quality Assurance (CQA) Report

3 RECORDS

3.1 Construction Quality Assurance Reports must be submitted to the Engineer for the Contract. Once the record is approved as meeting the requirements of this procedure, the records will be passed to the System Administrator to be lodged in the site file.

4. REVIEW OF PROCEDURE

4.1 The National Operations Manager shall review this procedure annually.

5. RESPONSIBLE PERSONS

5.1 It is the responsibility of the Landfill Energy General Manager, National Operations Manager, Technical Manager and Operations Managers to ensure that this procedure is followed in full.

LANDFILL ENERGY
OPERATING PROCEDURE

Document Reference	SPOP 028	Issue	3
Title	Gas Utilisation and Flaring Systems	Date	12/01/2021

Approval & Amendment Record

Gas Utilisation and Flaring Systems

Issue	Date	Originator	Authorisation
1	14/10/2009	C Matthews	T. Otley
2	May 2016	I Walker	
4	12/01/2021	J Cove	

1. INTRODUCTION

1.1. This procedure provides recommendations for the standard SUEZ R & R approach to the installation of gas boosters, gas flares and utilisation systems.

1.2. The purpose is to continually improve the reliability, performance and efficiency of gas utilisation equipment.

1.3. Local conditions and considerations arising from the gas risk assessment may lead to variations from the standard configuration. A full set of layout drawings, general arrangements, electrical & control drawings and manuals held at site with a copy at the LFE Office head office will define the site specific arrangement.

1.4. Gas booster and flare systems installed prior to this procedure (or subsequent revisions) shall only be modified to comply with this procedure if:

1.4.1. benefits (environmental, H&S or revenue) justify the cost involved

1.4.2. and the modifications do not jeopardize the operability of the system.

2. Electrical Equipment

2.1. The gas plant and flare system must be constructed, maintained and operated in accordance with the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR), refer to SPF038 Area Classification for Landfill Gas Extraction

2.2. SUEZ R & R adhere to the procedures provided in ESA Codes of Practice and with respect to landfill gas systems the following Codes Of Practice are directly relevant:

2.2.1. ESA ICoP 1 Edition1: November 2006 DSEAR Implementation For The Waste Management Industry Industry

2.2.2. ESA ICoP 2, edition 2, 1 July 2006 Area Classification For Landfill Gas Extraction, Utilisation And Combustion Industry Code Of Practice

2.3. Equipment used on landfill gas utilisation plants must comply with the ATEX Product Directive (ATEX 94/9/EC Directive2).

2.4. System design should consider the potential for mains failure and the consequent effect on gas control. If necessary provision to attach a mobile generator should be made. Sites must make arrangements for a rapid response provision of a suitably sized diesel fuelled generator.

3. Gas Inlet Train

3.1. Inlet pipe

The gas plant may be isolated from the landfill extraction system by a valve, typically this will be a DN200 PN16 wafer pattern manual gearbox operated butterfly gas isolation valve with CI body, 316SSdisc, 410 SS stem and nitrile seal.

The inlet line should be fitted with

Tefen gas sampling port

-20ºC to +60ºC temperature gauge

0 to -250mbar vacuum gauge

3.2. Knock-Out Pot

The knock-out pot removes collects condensate arriving with the landfill gas. The standard design for this is shown in SPSD004 Schedule of dewatering pot designs: DWP4 Pumped Steel Condensate De-Watering Leg. Typical construction is Carbon Steel hot dip galvanised to BS EN ISO 1460.

3.3. Demister

This is often provided as a component of the flare system and removes fine droplets of water from the gas stream. Carbon steel, hot dip galvanised demister fitted with a knitted polypropylene demister element, supported by top and bottom grids with a minimum filter thickness of 200mm. The demister shall be fitted with:

An entry port allowing easy access for filter removal.

Differential pressure connections either side of the demister element and be fitted with either two 0 to -250mbar vacuum gauges or a single differential pressure gauge.

High condensate level switch

Drain connection with 1” stainless steel ball valve. Where drain connections are fitted with piping these should include swept bends to enable rodding.

Test connection with ¼” stainless steel ball valve.

Condensate shall be piped to a suitable location for disposal, either back into the waste mass or into the site leachate extraction system to comply with relevant permit conditions or as agreed with the site manager but the system must incorporate a liquid seal of at least 1.6m to prevent line suction compromising the liquid seal.

3.4. Gas Filter

A gas filter prevents solid materials reaching the control valves and engines. Normally a Donkin Fig. 121 gas filters is used. The filter is typically a 50 micron element, though this may be varied to meet engine manufacturers specification. The discharge line from the filter shall be fitted with a 0 to -250mbar vacuum gauge.

3.5. Insulation

Exposed pipework between the inlet to the gas plant and the discharge to engines or flare must be reviewed carefully. Insulation and trace heating of the lines should be considered.

3.6. Inspection and Maintenance

The gas inlet train must be checked regularly to monitor the differential pressure across the demister, gas filter and flame arrestor. Suction levels which vary significantly may indicate partial blockage at the knock-out pot or on the gas main from the gas field.

Filters, demister and flame arrestor elements should be removed and cleaned as required, in accordance with manufacturers recommendations. Safe working procedures are detailed in

SPSWP005 Demister filter replacement

SPSWP006 Donkin Filter replacement

4. Gas Booster

4.1. Flow measurement

An orifice plate shall be fitted on the line between the gas booster and engines/flare unit. This shall be fitted with an oversize manometer to avoid loss of liquid during surges.

The orifice plate connections may be fitted with a differential pressure cell to provide digital display and output for a flow transmitter.

Plant flow measurement may be augmented by turbine meters fitted on the inlets to gas engines. If manual oiling system is provided then this must be included in the maintenance schedule.

4.2. Gas Booster Specification

Preferred manufacturer is Fans & Blowers GX Gas Booster providing a minimum of 250mbar pressure lift at its rated output. These boosters are certified to ATEX fan category 3G

The gas booster should be fitted with anti-vibration mountings and if noise issues require be installed within an acoustic enclosure.

The discharge must be fitted with a tefen gas sampling port, a 0 to 400 mbar pressure gauge and a 0^{o}C to 120^{o}C temperature gauge.

The system typically must be protected with an outlet pressure switch to enable shutdown if the fan operating pressure drops below a set level. Sites should plan for regular bearing and seals replacement at appropriate time intervals to avoid unplanned outages.

4.3. Fan Curves

The fan curve for the particular fan installed must be held at site as an aid to operation and troubleshooting.

4.4. Standby systems

A risk assessment is required prior to final specification to establish the standby requirements for the gas booster system. This must consider the potential harm from gas booster failure and the time required to re-establish suction to the gas field following booster failure. Acceptable solutions are:

Standby booster installed and ed enabling rapid changeover in the case of main booster failure.

Spare inlet and discharge connections to enable rapid hook-up of a portable or spare booster to provide gas control whilst the main unit is under repair.

An external plug socket to facilitate connection of a mobile generator and enable flaring in the event of a power cut.

A spare booster and/or motor held on site to enable booster or motor replacement in the case of failure.

Main spares held on site with trained personnel available to undertake overhaul and refit within an acceptable period of time.

Spare booster set held by supplier or at a central location.

Isolation valve fitted either side of the booster to facilitate working on the booster in-situ, thereby minimising downtime for routine maintenance or breakdown.

4.5. Inspection and Maintenance

4.5.1. Equipment shall be maintained in accordance with manufacturers recommendations.

4.5.2. The manuals and operating instructions for the component equipment shall be combined in a single file.

4.5.3. Following a review of manufacturers instructions and local conditions (gas quality, condensate loading, trace components, particulates etc) the maintenance requirements shall be transferred into a single routine maintenance schedule.

5. Air Compressor

5.1. Compressed air is required to operate pumps and control valves. The air compressor may be designed to service the control and condensate pumping needs of the booster station and may if circumstances require include sufficient capacity for the knock-out pots on the landfill site. Sufficient capacity must be allowed to ensure that the compressor does not run continually.

5.2. The air compressor must be included in the maintenance schedule for the gas booster and flare system. Portable air compressors are readily available should breakdown occur but system design and the operating manual should accommodate introduction of a portable unit (supply, air connection point etc).

6. Gas Analyser

6.1. Type of equipment

Typical equipment is obtained from Hitech or Geotechnical Instruments and provides continual measurement of CH_4, CO_2, and O_2. These systems fulfil the requirement for continual gas monitoring at landfill sites. Continuous developments mean that other providers may be considered from time to time subject to reliability testing.

The piping for such systems is critical as water ingress can cause expensive damage to analyser cells. Condensate traps, filters, trace heating and/or insulation is recommended to eliminate the possibility of condensation. Consideration may be given to the use of an active carbon filter to remove harmful levels of hydrogen sulphide which can adversely affect the internal components of analysers.

6.2. Remote monitoring

Control is enhanced by incorporation of gas analyser output along with signals from pressure transmitters, flowmeters and engine output signals to provide a datastream to internet based software. Such systems enable remote checking of operating conditions and aid in the early detection of faults. Such systems entail significant cost and are generally implemented at unmanned sites prone to operating variation.

6.3. Calibration & Maintenance

The site operator must be trained in simple fault finding and calibration of the analyser. MCERTS compliance can only be achieved if recalibration is undertaken by suitably qualified and certified personnel. Calibration of equipment is recorded in SPF019 Calibration Certificates Registration Form.

7. Gas Flare system

7.1. General features and specification

7.2. The design of the flare system must consider the mode of operation. The control systems and operating logic of flares differ according to the operating requirement.

7.2.1. generation systems in which the flare is a generally a standby, used in the event of engine failure with transfer to flare occurring manually or by automatic systems.

7.2.2. Excess gas systems in which gas supply exceeds the capacity of the engines. In such instances the flare is operated continually with a pressure controller and motorised control valve directing a varying quantity of spill gas to the flare.

7.2.3. Systems in which the flare is designed to shutdown following flame failure. This configuration is generally not used for generation facilities.

7.3. In general the flare must be in accordance with the guidance provided by LFTGN05 Guidance for Monitoring enclosed landfill gas flares. In particular as described in section 3.1 Operational Design of Flares, the flare must be enclosed with a minimum residence time of 0.3 seconds and achieve a combustion temperature of 1000^{o}C

7.3.1. Flares must be capable of destruction of the landfill gas thereby limiting emissions to the levels required in LFTGN05 Guidance for monitoring enclosed landfill gas flares - Table A Summary of emissions testing requirements for enclosed landfill gas flares

7.3.2. The flare shall be capable of achieving these requirements across a turn-down range of 5:1 with gas quality varying from 35% to 55% CH_4.

7.4. Pilot System

The pilot gas train comprises equipment which will allow isolation of the line for maintenance, temperature sensor, flame arrestor plus a solenoid valve.

7.5. Flame arrestor.

The main gas line and pilot line must contain a flame arrestor to guard against flash-back of the flame during shutdown and or deterioration in gas quality. The flame arrestor shall be ATEX certified in accordance with DSEAR regulations.

An optional feature of flare systems is the inclusion of a flashback event recording system.

7.6. Thermocouples

The flare control system generally relies upon thermocouples in its safety control systems. It is preferable that flare systems should be fitted with spare thermocouples to minimise the possibility of flare shutdown caused by thermocouple failure.

7.7. Inspection and Maintenance

7.8. Flare maintenance should be undertaken generally at quarterly intervals by the flare manufacturer or engineer trained in flare system maintenance. Site staff should however regularly check the operation of the flare, in particular:

Monitoring flare temperatures when operational.

Checking differential pressure gauges on demister pots, Donkin filters and flame arrestors. Flame arrestor blockage may be a common cause of flare failure.

Checking the operation of vent louvers, particularly on automatic systems.

Observation of flame colour and any signs of malfunction at individual burners.

7.9. It should be borne in mind that although flares are designed to minimise heat loss through the body and are fitted with numerous safety devices, there is always the potential for a defect of some kind. Personnel should not touch the flare body without gloves and should not spend too much time in the vicinity of air inlet louvers as there is always the risk of flashback through these louvers.

8. Selection of Gas Utilisation system

8.1. SUEZ R & R in line with industry practice primarily adopt generation using spark ignition engines as the standard form of gas utilisation.

8.2. Alternative utilisation systems are adopted in cases in which

8.2.1. the cost of connection to the local or national electricity grid is uneconomic

8.2.2. environmental restrictions prevent the use of engines

8.2.3. there is a local outlet for the use of gas for process heat.

8.3. Gas Engines

8.3.1. SUEZ R & R sites standardise on the following engines:

Caterpillar CAT SR4B – 16 cylinder 1150KW

Jenbacher 320 – 20 cylinder 1060KW

Jenbacher 312 – 12 cylinder 630KW

Jenbacher 208 – 8 cylinder 330KW

Perkins 315 L – 8 cylinder 300KW

8.3.2. Further details of these engines are provided in SPF057 Gas Engine Specifications. If site conditions require, other engines may be installed to match site needs.

8.4. SUEZ R & R assign maintenance of gas engines to 3rd party operating & maintenance (O&M) contractors. Contracts assigned are long term, typically created at the time of purchase and extend through the full service lifetime of the engine (50,000 hours).

8.4.1. Detail records of service history is maintained by the service contractor. These records are maintained at site with a copy at the O&M Contractors Head Office.

8.4.2. Overhaul planning is based on running hours, condition and periodic inspections.

8.4.3. Running hours is used to schedule the major overhauls required.

8.4.4. Condition monitoring (oil quality and/or exhaust emission analysis) for oil change and minor service.

8.4.5. Periodic inspections, or analysis of operating parameters may result in preventative maintenance being undertaken.

8.4.6. Overhauls are planned and the specific timing will be adjusted to accommodate other aspects of site planning.

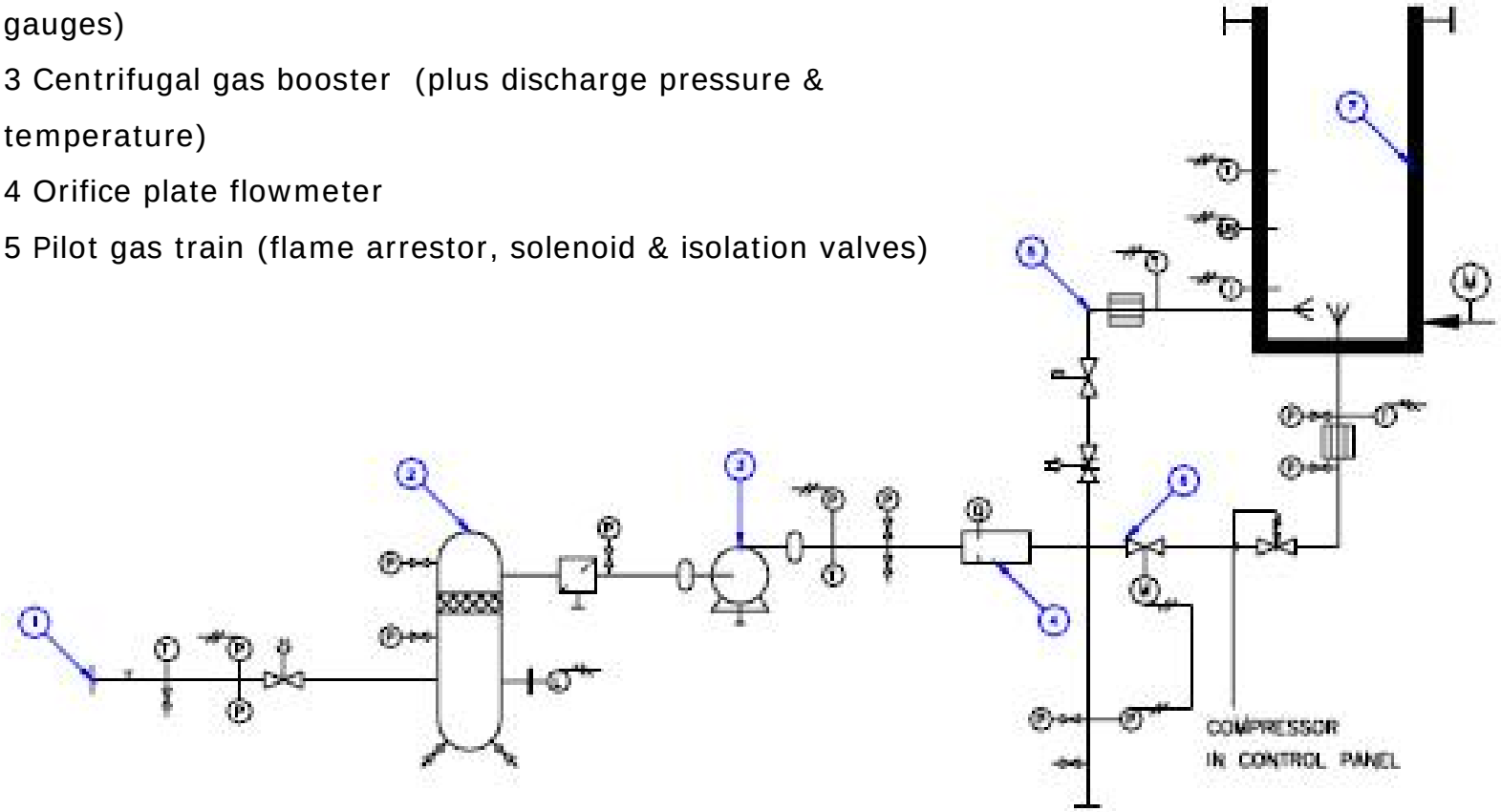
1 Inlet system (isolation, sample, temperature, pressure)

2 Demister + downstream Donkin filter (plus differential gauges)

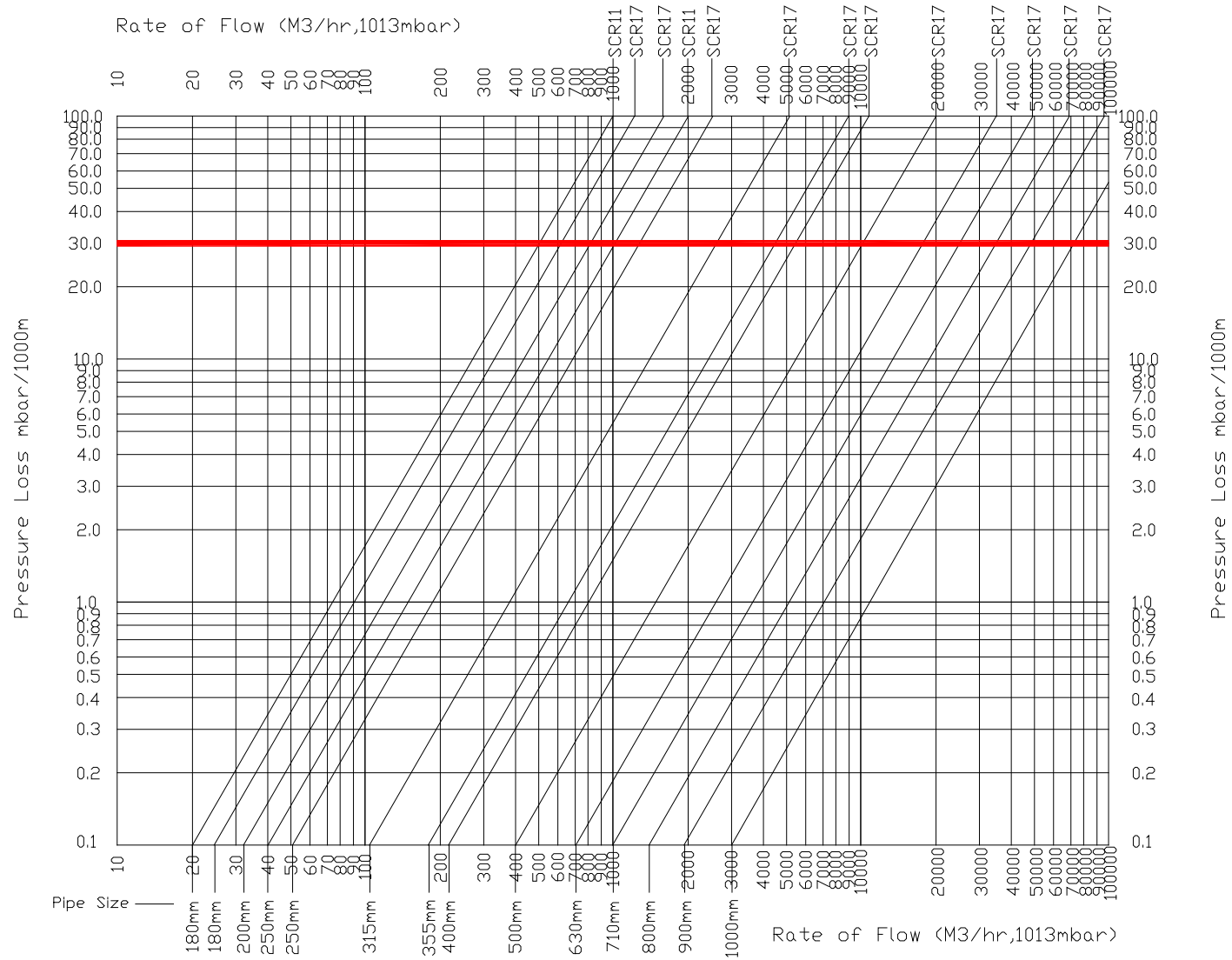
3 Centrifugal gas booster (plus discharge pressure & temperature)

4 Orifice plate flowmeter

5 Pilot gas train (flame arrestor, solenoid & isolation valves)



Flow Diagram for Polyethylene Pipes



Limit pressure loss to 30mbar/1,000m run of pipe.
Limit flow velocity to 10 metres per second.

Landfill Energy

SAFE WORKING PROCEDURE

WORKING WITH HYDROGEN SULPHIDE ON LANDFILL SITES

1 MAIN HAZARDS

Hydrogen Sulphide (H_2S) is a Toxic Gas,
see SPCOS004 Hydrogen Sulphide

2 PERSONNEL RESPONSIBILITY

The Site Manager is responsible for ensuring compliance with this Safe Working Procedure
Including the following:
Commissioning gas analysis
Obtaining support and advice regarding toxic trace gases
Identifying areas and level of risk
Ensuring that all site personnel are informed and briefed
Provision of suitable monitoring equipment, personal alarms
Risk Assessment for all activities in which there is exposure to Hydrogen Sulphide
Provide adequate supervision of activities covered by risk assessments
Delegation of the supervision of elements of this procedure to site supervisors.

Where the landfill is a Generating Site the SUEZ Operations Manager is responsible for:
Provision of expert advice on trace gas analysis and assessment.
Support regarding management of gas control systems to minimise Occupational Risk
Training and briefing site staff as requested by the Site Manager

3 CONTROL MEASURES

Draft Risk Assessment (to be produced as Model Risk Assessment) RA20152ClM provides Guidance on the formulation of specific risk assessments and method statements.
Technical Support provided to site by SUEZ and/or Processing H&S Manager
COSHH sheet SPCOS004 Hydrogen Sulphide to be held on site and to be readily available.
Briefing and instruction of all site personnel (including engineering staff and contractors) regarding hazards presented by H_2S
Training in use of personal H_2S alarm
Procedures and training to cover evacuation following detection of H_2S
Breathing apparatus training to cover major works
Rescue procedure to be used in conjunction with breathing apparatus
Sampling and monitoring : Trace Gas Analysis, Draeger tube testing, Gas analysers
Detail planning and preparation of all work.
Planning work involving gas release to include consideration of wind direction.
Incidental risks considered (other toxic gases) in planning
Evacuation or protection of workers downwind
Workers at risk to be accompanied.
Application of suction to systems (where possible) during work
Sealing of systems
Provision of personal H2S Alarms
Provision of gas filters for escape purposes
Technical advice re: filters
Use of ventilation fans for work which significantly breaches containment
Breathing apparatus training
Provision of breathing apparatus (permanent or on-loan) for major works.

4 PRELIMINARY ASSESSMENT

4.1 The trigger for a site (or part of a site) to be covered by this procedure is the detection of Hydrogen Sulphide in bulk gas streams or leachate vapour spaces at such a level that release would cause harm to human health. This “high risk” level is set at 700 mg/m^3

4.2 Sites which have levels of H_2S below this “high risk” level may present considerable risk to employees, contractors, visitors and the community. It is recommended that this procedure is followed in undertaking any work which compromises the integrity of H_2S loaded gas containing systems

4.3 If any sample exceeds the “high risk” level then relevant site activities are governed by this procedure. A drawing must be produced to show potential sources of hazard (leachate wells, leachate monitoring points, gas systems under pressure etc). Parts of the site may be excluded if a local sample of gas shows lower H_2S than the “high risk” threshold. If the Site Manager opts to have part of the site excluded the drawing must clearly show the areas in which hydrogen sulphide is a potential hazard. The drawing must be displayed in all site offices. Where available (typically Generating Sites) a Monthly updated Surfer Image map should be kept in the Site Office.

4.4 Technical advice must be obtained regarding the presence of other toxic trace gases. Precautions taken against Hydrogen Sulphide may not provide any defence against other toxic materials. Where additional hazards exist a site specific procedure may be necessary. Consideration should also be given to the potential for oxygen depletion.

5 TRAINING AND INFORMATION

5.1 On sites in which hydrogen sulphide is found above the threshold, training must be introduced and reinforced to explain the hazards presented and the precautions necessary.

5.2 The COSHH Data sheet SPCOS004 Hydrogen Sulphide must be held on site and be used in any training undertaken.

5.3 Training will include the use of personal alarms and the action to be taken when the alarm activates. This will normally be evacuation to a known point of safety.

5.4 Training will include the use and care of filter masks. The training must emphasise that masks are a means to enable escape from a hazardous area and not a means of working in a hazardous atmosphere. This training must include testing that the filter masks seal tightly to the face (Face Fit Testing).

5.5 Training is recommended for at least on person, per site in the use of breathing apparatus for use in emergency evacuation only, whether or not breathing apparatus is held at site. Breathing apparatus may be hired for specific jobs and the presence of a

trained person on site will ensure that such provision is made available when required for major works.

6 CONTROL OF GAS

6.1 Control of gas containing high levels of H_2S is dependent upon two factors. Primary is the integrity of sealing systems for site infrastructure and secondary to this suction applied by the gas control system (if present). The main factor in the safety of personnel is therefore containment and capture of gas.

6.2 All systems which are shown on the plan as containing potentially high levels of Hydrogen Sulphide must be regularly inspected for integrity of seals. Leachate wells are prone top leakage around the base and so the seal at the surface (bentonite seal or engineered boot detail) must be included in the inspection.

6.3 The most problematic areas generally lie within operation areas of the site where sealing systems are difficult to maintain as waste levels rise and leachate wells and monitoring points are extended. Nonetheless great care must be taken in installing and preserving this infrastructure throughout the active period.

6.4 The odorous nature of H_2S makes leak detection a simple matter, at low concentrations <5 ppm, but if a more analytical approach is required Flame Ionisation Detectors (FID) can identify leaks of flammable materials at very low levels and can provide corroboration of system integrity.

6.5 If the site infrastructure is well sealed then the gas control system, correctly engineered and managed will prevent major point sources of hydrogen sulphide escape.

6.6 Work on landfill site infrastructure must consider the effect on the gas control system. Intrusive work requiring seals to be broken (dipping, sampling, well extension etc) generally requires the gas system to be turned off and this should be mitigated in the associated method statement or safe system of work. Undertaking repairs to bentonite seals or capping boot arrangements benefits from a temporary increase in local gas extraction rates. When a site is a Generating Site no work should be undertaken without full consultation with the SP Area Manager.

7 PLANNING

7.1 All works in the designated high risk areas of the site which involve the possibility of causing or increasing local gas escape must be undertaken in accordance with a formal risk assessment and method statement.
7.2 All works undertaken in the designated high risk areas of the site which involve the possibility of causing or increasing local gas escape must be planned and the effects mitigated. Such planning will minimise the duration of work by for example ensuring that all tools and materials are in place prior to work commencing.
7.3 Incidental risks must be considered, in particular the presence of any other components in the gas which might have a harmful effect.
7.4 The method statement produced at the planning stage must state the equipment to be used in the planned activity.
7.5 Filter masks must be provided for any work which involves the possibility of significant release of gas for example, total replacement of bentonite seal, leachate well extension, leachate pump removal
7.6 Additional risk assessments must be undertaken to cover others hazards (lifting/handling, DSEAR implications). This Safe Working Procedure covers only the precautions against the toxic effects of Hydrogen Sulphide and not for example its potential as a flammable hazard.
7.7 The effect on other workers and activities must be fully considered, in particular those personnel who may be downwind of work being done on leachate or gas systems.
7.8 The wind direction must be considered in planning of any work involving the potential release of Hydrogen Sulphide. Method statements may state that personnel should stand upwind of the source of hydrogen sulphide when undertaking work. However the effects of the wind cannot be cited as a Control Measure if the source of Hydrogen Sulphide presents significant risk. If the work requires forced ventilation then the plan must stipulate the provision of a suitable fan.
7.9 The manager of the gas control system must be involved at the planning stage to ensure that suction is applied where possible or if necessary that gas control systems are closed to prevent air ingress into the gas system.
7.10 Planning of work which may have an effect on the integrity of gas seals must ensure that such work is not undertaken by a lone worker. The need for an observer / rescuer in the event of unplanned / unexpected exposure (possibly with breathing apparatus) must be considered.

8 EQUIPMENT

8.1 All personnel entering designated areas must wear a personal H_2S alarm.

8.2 Filter masks must be suitable for the level of H2S present on site, normally a Class 1 Type B filter (inorganic gases & vapours) using a standard half mask. Filter masks are available for multiple gas hazard but the weight of combined filter may require the use of a full face mask.

8.3 Gas detection may be provided by:

8.3.1 Geotechnical Gas GA5000. The H2S maximum can vary, some analysers are built to read up to 10,000ppm.

8.3.2 Draeger tubes or Rae tubes, using bellows or pump device to draw a sample into the tube.

8.3.3 Suitably specified single (or multiple) sensor detector fitted with sensors able to give readings at the levels encountered on site.

8.3.4 Gas samples analysis undertaken off-site from a sample taken in a Tedlar bag from the relevant gas or leachate well. Off-site testing is generally involves significant delay.

8.4 Suitably sized ventilation fans must be available if required to disperse gas escapes. The fan should be fitted with a suitable length of flexible duct to enable the air to be supplied to the area of operation while relocating the ignition source to outside the DSEAR zone.

8.5 The purchase of Breathing Apparatus is not recommended as a routine necessity. Certain tasks may require the provision for an emergency plan where there is the possibility of personnel being overcome by the level of H2S at source. Breathing Apparatus must be hired in advance of such work (unpacked & located in the area of the work prior to commencement). The plan must state a named person trained in the use of breathing apparatus to observe and if necessary act should the situation demand.

9 SITE REVIEW

9.1 The designation of the whole site or parts of the site as high risk area(s) in which high concentrations of Hydrogen Sulphide maybe encountered must be reviewed annually upon receipt of the trace gas analysis.

9.2 Areas designated as having high concentrations of H_2S must only have this status removed if a representative sample shows levels below the threshold for this procedure.

9.3 Site review must include review of this procedure. Any requests for amendment, based on site experience must be directed to the National Operations Manager, SUEZ.

10 PROCEDURE REVIEW

10.1 This procedure will be reviewed annually by the National Operations Manager, SUEZ

Approval & Amendment Record

Safe Working Procedures – Working with Hydrogen Sulphide on Landfill Sites

Issue	Date	Originator	Authorisation
1	23/01/2009	CJ Matthews	T. Otley
2	21/01/2021	J Cove	

CLP Envirogas

GAS WELL MONITORING AND BALANCING PROTOCOL
Revision 1

1.0 INTRODUCTION
This in-house statement advises on the method used to measure landfill gas concentrations/levels and other relevant supporting information such as gas flow, pressure and environmental data from gas extraction wells.

2.0 REFERENCES
Environment Agency LFTGN 03 'Guidance on the management of landfill gas'

3.0 OBJECTIVES
To describe the measures required for safe and accurate monitoring and recording of landfill gas data from monitoring points on the gas extraction system on both operational and non-operational landfill sites.

4. MONITORING

4.1 Gas Analysers
CLP use Geotechnical Instruments GA2000 plus or GA5000.

The instrument includes the following main features that CLP make use of:

- Methane and Carbon Dioxide measurement by Infra-Red Absorption
- Oxygen
- Hydrogen sulphide
- Hydrogen compensated Carbon Monoxide (Plus version only)
- Measurement of gas flow from borehole (optional)
- Measurement of borehole pressure
- Measurement of barometric pressure

All gas analysers used by CLP meet the criteria as laid out in LFTGN 03, in addition to any requirements of the individual site EP/SEPA Permit or Waste Management Licence.
Data and measurements saved on the instrument during monitoring are downloaded to a PC and loaded onto spreadsheets for analysis and trending for each monitoring point.

The analysers are maintained in good working order by taking advantage of the manufacture's lifetime guarantee. This requires collecting the instruments every six months from the site and carrying out a full diagnostic check/service & calibration. The instruments are stamped, dated and calibration screen updated for QA purposes by the manufacturer, with the date of the next service due.

The analysers are also field calibrated regularly on-site check that the measuring sensors / cells remain accurate. This is done using certified calibration gas and in relevant barometric conditions to the readings about to be taken. Other information such as ambient temperature and recent weather conditions are also be recorded.

4.2 Landfill Gas Monitoring

Each individual well is monitored for methane, carbon dioxide oxygen and pressure in millibar (mb) other gases may also be monitored in accordance with the individual site permit/ licence. Flow measurements are taken at the same time as monitoring for gases to improve balancing and to assess the viability of wells and manifolds. Gas wells are monitored in accordance with the site permit as a minimum frequency.

Monitoring points are positioned at key points of the gas collection system, such as manifolds and spur junctions. These are monitored twice a week and form the basis and initial focus when carrying out ad-hoc monitoring, balancing and when fault finding the gas field.

4.3 Landfill Gas Monitoring Method

4.3.1 Preliminaries

Prior to sampling:

- the analyser will be checked for instrument drift
- If drift is noticed the instrument shall be site calibrated with certified calibration gas held on each site. Otherwise calibrate the instrument weekly.
- Ensure that the analyser is charged and in good working order**.**
- The hydrophobic filters must be checked and be clean dry and in good condition.
- Check the condition of the inline H_2S filter
- If everything is in order the site data must be updated. Select 'Update site Data' from the Menu. '1'. this must be done every time the analyser is used.

4.3.2 Monitoring

In order to ensure accurate monitoring when taking a sample, it is important to check the sample point condition.

- The sample point must be cleared of any obstructions or liquid and cleaned prior to connecting the analyser. This can be done by opening and closing the valve quickly to minimise air ingress, which could otherwise provide a false reading on a well which is turned off.
- If the flow control valve is closed, a pressure reading should be taken and followed by opening the flow control valve to take a sample of the gas quality. If the flow control valve has been closed, this valve must be opened to give a maximum of -5mb pressure at the well to allow flow from the gas well.
- The gas will stabilise after a few minutes and a sample can be taken which will be indicative of the gas content in the well.
- A sample can then be taken and recorded as indicated below.

Gas Quality Monitoring;

- Select the well ID on the analyser and allow to finish the purge cycle
- Attach the sample inlet tube to the sample point on the well head or manifold.
- Open the valve on the sample point.
- Allow the pressure reading to stabilise.
- Turn the pump on and leave to run until the gas values stabilise. The counter is set to 90 seconds but if necessary, restart the pump until the reading is stable. This may take multiple restarts.
- Once the gas reading has stabilised, they are saved on the analyser.
- Enter the valve position, comments, engine load as required during the save process for each point.
- The sample valve can then be turned off and the sample tube removed,
- The pump should be left to run until the CH_4, and CO_2 readings returns to zero and O_2 returns to ambient levels (normally 20.9%).

Whilst monitoring is being carried out the operator must ensure that the instrument remains in true working order. If in doubt the instrument should be rechecked against calibration gas and if required replace suspect sample points. Water should not be allowed to enter into the instrument and filters should be frequently checked to ensure the gas flow is not restricted.

4.3.3 Taking a Flow Measurement;

Monitoring points which are not within chambers include a flow monitoring port positioned downstream of the gas sampling point so that flow readings can be taken using an anemometer attached to the GA2000 / GA5000 at the same time as a gas sample is being taken.

The pipe internal diameter is needed to get a reading for flow measurements. These are entered in the software for each monitoring point before uploading the well ID's to the GA2000 / GA5000. If the internal pipe diameter hasn't been set before uploading to the instrument it will request one when the reading is saved.

Sequence of events;

- Whilst monitoring for gases insert the anemometer into the monitoring point so it sits 1/3 distance into the pipe. At this position the flow is considered to be at its optimum.
- The arrow on the vane head should point in the direction of flow.
- Flow values will appear on the analyser.
- When saving, the analyser will prompt for the flow reading to be saved first.
- Save the reading and continue to save the gas reading as detailed.

5.0 BALANCING

The strategy for gas management and control is through using parameters given to the site for gas quality whilst using gas flows as the basis for balancing the gas field. By recording gas flow for each monitoring point it is possible to see how much gas can be extracted from a specific point or area whilst maintaining it in an anaerobic state with good gas quality through the life of the landfill, and whilst maintaining control over migration.

The basic tenets for balancing the gas field is through the monitoring and recording of CH4, CO2, O2, Balance gas, relative pressure and Flow from each monitoring point. The data is reviewed off the gas field within a database where wells within parameter can be selected for increasing by up to 4m3/h LFG flow and wells out of parameter can be selected for decreasing or be turned off. During this selection process, historic readings for each well are presented for each well selected for adjustment, ensuring the best decision of the well is achieved. A gas balance plan is printed and taken back onto the gas field where these actions are completed.

The exception to the above method, is where a well shows high oxygen content (5% or greater). In this case, immediate investigations must be carried out to determine the cause of the high oxygen. If above ground causes cannot be found and immediately repaired, the

well should be left, when possible, with a minimal suction of no more than 1mbar. If it is not possible to leave the suction applied for any reason, the well should be isolated. Further investigation should then take place and any issues found, rectified as a matter of urgency.

By measuring flows and planning adjustments to well flow, it is possible to determine whether adjustments will lead to a positive or negative effect on the well field but will mean that wells are brought within compliant parameters using a structured, controlled and measurable methodology.

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METHOD STATEMENT/ SAFE SYSTEM OF WORK

ID Number	MS.003	Author	M Greenough	Date	29/10/2017
Review Dates & Name	D A Greenough 23 /11/17				

Work Description		
SMP Checks	LOCATION	Compound/Gas Field

Site All Sites

Area Compound/Gasfield Extraction System

Scope of Work

To measure the composition and quantity of gas at the gas utilisation plant and strategic monitoring points.

Plant Resources GA2000/GA5000 with anemometer
Polaris ATV

Manpower One **(MINIMUM)**

Interaction with site operations and activities Interactions with site operations may occur on the site access roads and when monitoring certain SMP points. Site operator's rules and safe routes must be followed at all times. In addition the site monitoring plan should be consulted to ensure which areas are safely available and those indicated as quarantined not entered. Notwithstanding this an ongoing POWRA must be carried out to ensure access to areas available remains safe.

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Safe System of Work

Site set up:
The only equipment needed is to be carried by hand to the each working area, it may be necessary to drive between working areas using a Polaris ATV. Before proceeding to carry out the task, ensure that the ground conditions are safe and that access is adequate. If access is not practical, it should be made so. The measurements can be taken from various points and the monitoring points can be extended using hose.

Work organisation:

All equipment and plant are subject to pre- work inspections to ensure that it is serviceable and all guards are in place. Electrical equipment is checked for broken casings and damage to leads or connections. Statutory and periodic examinations are carried out as they become due. Ground conditions and access should be checked to ensure it is adequate and safe. The site monitoring plan should be consulted to ensure all areas are safely available and those indicated a quarantined not entered

The Area manager will visit the site regularly to evaluate any safety concerns and check the quality of workmanship.

Personal Protection Equipment:
All personnel are issued with standard equipment and will wear the appropriate equipment for the work being carried out.

The minimum safety equipment required comprises of: Safety boots with midsole protection, overalls, work gloves, eye protection, hard hat, strong water proof gloves, four gas alarm and hi-vis vest.

Accident Procedure:
Standard procedures exist in the event of an accident. Depending on the level of injury, a detailed record will be maintained at head office. Minor injuries will be treated by a first aider using the site first aid kit if possible on site followed medical attention if required. More serious accidents will be attended by the Emergency Services. In any event all parties requiring notification will receive it.

All accidents and High Potential Near Misses (HPNM) will be investigated and assessed for the reoccurrence along with the degree of competence adopted.

Risk Assessments:

Risk Assessment Ref; - 03 Gas well/SMP & Borehole monitoring

“On site assessment” POWRA - Ensuring so far as is reasonably practicable the ground conditions are safe and suitable for the works being carried out.

Work Sequence;

The task will be carried out following the methodology described below

1. The analyser is to be calibrated if required
2. The analyser is to be taken to the area(s) of work by hand or with the ATV if necessary by following the safe route pre- agreed with the gas manager
3. The analyser is to be turned on and the correct monitoring ID selected
4. The inlet hose should be connected to the sample point. If the sample point is a Tefen style valve, this should be the red connector clicked into place. If the sample point is a ball valve type, the hose should be placed over the hose tail on the valve and the valve then opened. The valve should only be opened AFTER the hose is connected
5. The relative pressure is to be recorded and the pump started
6. Once the time has elapsed, the gas readings are to be stored
7. Once the gas reading has been taken the anemometer should be set to the correct length for the pipe being checked
8. The flow sample point valve should have the plug removed (if fitted) and be opened. If the flow point just has a plug but no valve, a valve should be fitted
9. The anemometer should be inserted quickly to ensure minimal oxygen ingress
10. Once the flow reading has settled and it should be saved and the anemometer removed, the valve should now be closed quickly and the plug refitted
11. Repeat steps 2 to 10 for any remaining points to be monitored

CLP Envirogas

METHOD STATEMENT/ SAFE SYSTEM OF WORK

ID Number	MSGF04	Author	M Greenough	Date	29/10/2017
Review Dates & Name	D A Greenough 12/12/17				

Work Description		
Gas Well Monitoring	LOCATION	Compound/Gas Field

Site All Sites

Area Gasfield Extraction System

Scope of Work

To measure the composition and quantity of gas at gas wells around the site

Plant Resources GA2000/GA5000 with anemometer
Polaris ATV

Manpower One **(MINIMUM)**

Interaction with site operations and activities Interactions with site operations may occur on the site access roads and when monitoring certain points. Site operator's rules and safe routes must be followed at all times. In addition the site monitoring plan should be consulted to ensure which areas are safely available and those indicated as quarantined not entered. Notwithstanding this an ongoing POWRA must be carried out to ensure access to areas available remains safe.

CLP Envirogas

Safe System of Work

Site set up:
The only equipment needed is to be carried by hand to the each working area, it may be necessary to drive between working areas using a Polaris ATV. Before proceeding to carry out the task, ensure that the ground conditions are safe and that access is adequate. If access is not practical, it should be made so. The measurements can be taken from various points and the monitoring points can be extended using hose.

Work organisation:

All equipment and plant are subject to pre- work inspections to ensure that it is serviceable and all guards are in place. Electrical equipment is checked for broken casings and damage to leads or connections. Statutory and periodic examinations are carried out as they become due. Ground conditions and access should be checked to ensure it is adequate and safe.

The Area manager will visit the site regularly to evaluate any safety concerns and check the quality of workmanship.

Personal Protection Equipment:
All personnel are issued with standard equipment and will wear the appropriate equipment for the work being carried out.

The minimum safety equipment required comprises of: Safety boots with midsole protection, overalls, work gloves, eye protection, hard hat, strong water proof gloves, four gas alarm and hi-vis vest.

Accident Procedure:
Standard procedures exist in the event of an accident. Depending on the level of injury, a detailed record will be maintained at head office. Minor injuries will be treated by a first aider using the site first aid kit if possible on site followed medical attention if required. More serious accidents will be attended by the Emergency Services. In any event all parties requiring notification will receive it.

All accidents and High Potential Near Misses (HPNM) will be investigated and assessed for the reoccurrence along with the degree of competence adopted.

Risk Assessments:

Risk Assessment Ref; - RAGF04

“On site assessment” POWRA - Ensuring so far as is reasonably practicable the ground conditions are safe and suitable for the works being carried out.

Work Sequence;

The task will be carried out following the methodology described below

1. The analyser is to be calibrated if required
2. The analyser is to be taken to the area(s) of work by hand or with the ATV if necessary by following the safe route pre-agreed with the gas manager
3. The analyser is to be turned on and the correct monitoring ID selected
4. The inlet hose should be connected to the sample point. If the sample point is a Tefen style valve, this should be the red connector clicked into place. If the sample point is a ball valve type, the hose should be placed over the hose tail on the valve and the valve then opened. The valve should only be opened AFTER the hose is connected
5. The relative pressure is to be recorded and the pump started
6. Once the time has elapsed, the gas readings are to be stored
7. Once the gas reading has been taken the anemometer should be set to the correct length for the pipe being checked
8. The flow sample point valve should have the plug removed (if fitted) and be opened. If the flow point just has a plug but no valve, a valve should be fitted
9. The anemometer should be inserted quickly to ensure minimal oxygen ingress
10. Once the flow reading has settled and it should be saved and the anemometer removed, the valve should now be closed quickly and the plug refitted
11. Repeat steps 2 to 10 for any remaining points to be monitored

WERMS

Well E R M System

This guide is a working statement of how a bentonite plug can be introduced into the gravel pack of a poorly performing gaswell so it can be sealed and recovered for a relatively modest outlay. The work is in development and some of the photographs are illustrative only.

1. Equipment:

1. 3 Tonne Dumper
2. Tow hitch on dumper to include ball and pin types.
3. Grout Pump – catalogue number – 042005 from Aplant.
4. Water Bowser.
5. Bentonite POWDER – Must be powder,
6. Flexseal couplers 160mm for headwork's
7. 63mm & 32mm EF Couplers
8. Adaptors between pump hose and 32mm injection lance

Tow hitch with ball

Grout Pump

All together

1. Stent & Wellhead Construction:

Re.; fig 1

The stent and well head are supplied separately and have to be built to suit the well characteristics;

1. Determine the depth of sealing required on each well through camera survey, drill logs and/ or other methods.
2. EF the required length of 63mm mdpe to the stent - remember to leave extra to allow it to protrude through headwork's. 300mm should be enough.
3. Secure the 63mm mdpe to the well head with the compression fitting on the well head
4. Extend the 32mm pipe welded to the head works to within 300- 500mm above the stent and secure with tie wraps to the 63mm pipe.
5. Mark each assembly with the well ID

The 32mm pipe will allow the bentonite to be injected just above the stent and fill the well from the bottom, ensuring that pressure is felt through the entire column of bentonite an, giving bentonite the best chance of being forced into the gravel pack.

2. Preparation;

1. Scrub inside of well to remove any lime scale type scum from walls of well using the chimney sweep and rods.
2. Spray inside of well and stent with water to allow it to slide in easier (fairy liquid helps) If another lubricant is used, ensure it is silicon based as mineral oils will damage the bag stopper. Spray the bag with silicon lubricant to make it easier to extract.
3. Attach a rope or wire tether to the bag stopper for recovering the bag after use
4. Attach air line.
5. Thread both lines through the stent until the bag is touching the bottom of the stent. Prevent the air line and tether from falling through the stent into the well as the assembly is lifted into position. The bag can be pulled into the tube slightly or the tether held until the bag has been inflated.

3. Stent Insertion;

1. Cut the well to the required height taking into account the extra height added by the well head.
2. Fit the EF or flexseal coupling to the well.
3. Fully insert the Stent assembly into the well through the coupling. The stent is extremely tight in the well casing and cannot be pulled out of the well by hand.
4. Secure or fuse the headwork's coupler
5. Inflate the bag stopper to max 3 bar using compressed air. A portable mini compressor/ tyre inflator is useful. Schrader valve required.

Inserting the stent

Bag inflation and EF Joint

4. Bentonite mixing & pumping:

1. Mix grout/bentonite – Using roughly 80ltrs water to 1 bag of powdered bentonite.
2. Add water first then turn mixer on and add the bentonite powder slowly to the mixer. The mix doesn't want to be too thick as it will not flow into gravel pack or too runny that it goes straight through and back into the well below the bag.
3. Connect the grout pump hose to the 32mm pipe welded on the headwork's using a length of 32mm mdpe, adaptors and compression fittings . Order an adapter when hiring the grout mixer.
   Adaptor - Bauer QR fitting on the hose to 2" bspm or f. This can be reduced to 32mm using a reducer and compression adaptor.
4. Pump bentonite slurry into well.
5. A rough calculation can be made as to the volume required to fill the well casing itself using the formula - $\pi r^2 h$ - then allow some to allow for filling the surrounding gravel pack.
6. 80ltrs is $0.125m^3$
7. Remove a plug so you can see when the casing is full, then replace and continue pumping till the required amount of bentonite has been pumped in.

Sloppy Mix lance

Reduction from the grout pump QR hose to 32m inj.

Injection lance attachment

Bung removed to observe bentonite filling well casing

5. Bag Stopper Removal:

1. Leave bag stopper in for approx 24hrs to allow bentonite to ‘set’
2. Release pressure from bag and remove bag through 63mm
3. Connect flow line to gas well and recommission.

This came up the gap down the side of the well.

6. External Seals

Using a steel stake make vertical holes in the ground around the well casing to at least 2m depth Holes will probably need to be approx 150mm apart all way round well.

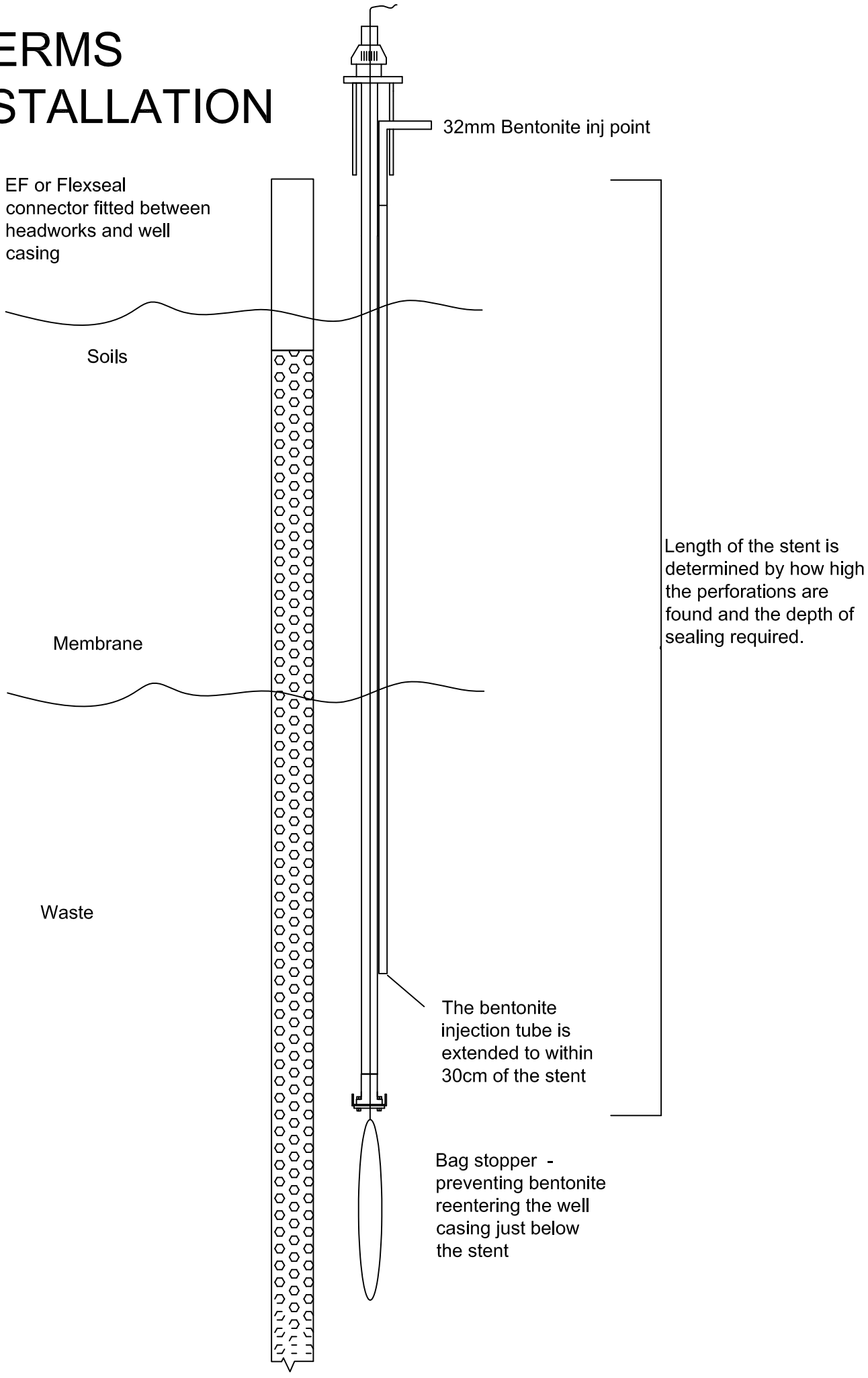
Use the injection lance – *(32mm pipe)* - fitted on the grout pump hose

insert into holes and pump slurry into holes.

Slurry should be mixed the same as with internal seal method

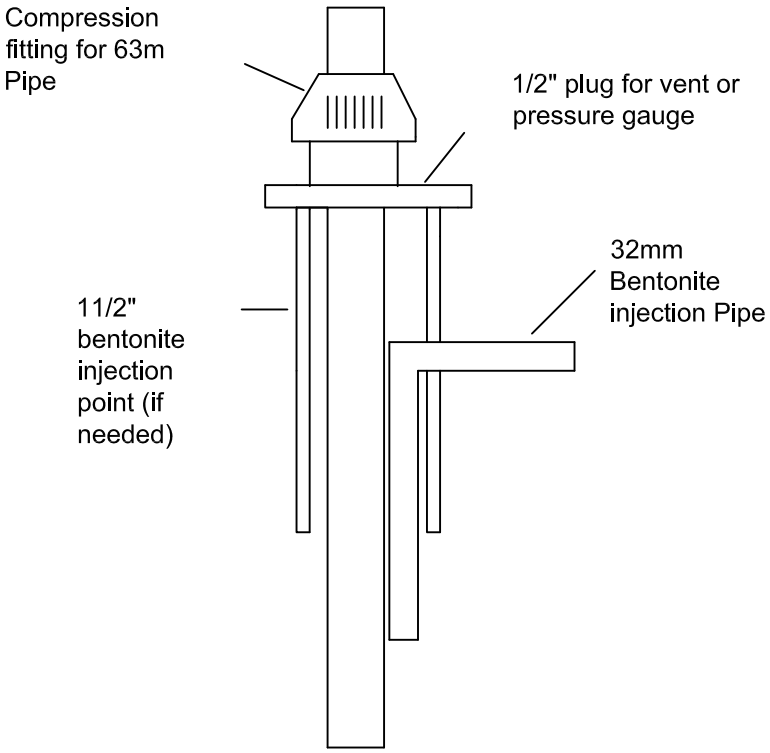
Easy in existing bentonite seals

WERMS INSTALLATION

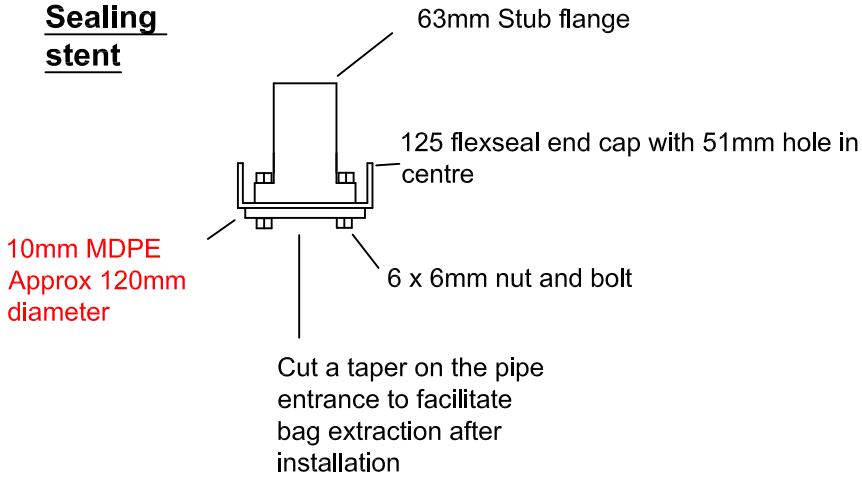


Head Works & Stent Detail

Head works



Sealing stent



The gas collection system is monitored to record the gas quality, pressure and flow rate and are reported on Monthly.

The gas collection system is inspected for signs of vandalism, wear and tear and problems caused by seasonal temperature variation and operational damage at the same time as any monitoring. Obvious problems such as low and high vacuum or oxygen are investigated immediately.

Monitoring methodology

Before taking gas measurements, the gas monitoring instrument will be switched on and the methane and carbon dioxide readings allowed to zero whilst drawing clean air.

All landfill gas monitoring wells will be monitored by connecting the gas measuring instrument directly to the sampling tap of the well to be monitored. Once connected to the well, gas will be drawn through the instrument and the readings monitored until stable readings are obtained. Once stable readings have been obtained, the values will be recorded. Where a GA2000 is being used, the results are logged electronically on the instrument for future reference and downloading. Once the measurement has been taken and recorded, the sampling tap on the well will be closed. The instrument will be allowed to purge, and methane and carbon dioxide readings allowed to zero, before connecting to the next borehole to be monitored.

Table 1: Monitoring Frequencies for Landfill Gas within the Engineered Containment

Determinands	Monitoring Frequencies	Units	Accuracies
Methane (CH_4)	Monthly	%v/v	Up to 5% CH_4 ± 0.5%; 5 to 15 % CH_4 ± 1.0%; More than 15% CH_4 ± 3.0%
Carbon Dioxide (CO_2)	Monthly	%v/v	Up to 5% CO_2 ± 0.5%; 5 to 15 % CO_2 ± 1.0%; More than 15% CO_2 ± 3.0%
Oxygen (O_2)	Monthly	%v/v	± 1%
Atmospheric Pressure	Monthly	mBar	± 1 mBar
Relative pressure	Monthly	mBar	± 0.1 mBar
Meteorological Data	Monthly	N / A	N / A

Maintenance and inspection

The landfill gas extraction system is inspected during each monitoring round to ensure the optimum performance. This includes visual inspection of manifolds and all other aboveground infrastructure. Any anomalies identified are investigated and rectified using the BATNEEC principle (i.e. best available techniques not entailing excessive costs).

Detection of hot spots

In the event that monitoring results obtained show a concentration of CO above 100ppm, monitoring frequency will increase and bag samples are to be taken in accordance with the hot spot management protocols.

CLP Envirogas

METHOD STATEMENT/ SAFE SYSTEM OF WORK

ID Number	MSGF02	Author	M Greenough	Date	29/10/2017
Review Dates & Name	D A Greenough 23 /11/17				

Work Description		
Daily Gas Check	LOCATION	Compound

Site All Sites

Area Compound/Gasfield Extraction System

Scope of Work

To measure the composition and quantity of gas at the gas utilisation plant.

This may include more than one point to measure where multiple lines come together at the compound.

Plant Resources GA2000/GA5000 with anemometer

Manpower One **(MINIMUM)**

Interaction with site operations and activities The work area is not in an active area so interference with or from the site operations will be minimal and will be restricted to access purposes only. The work area does not have any buried services of any kind.

CLP Envirogas

Safe System of Work

Site set up:
The only equipment needed is to be carried by hand to the working area. Before proceeding to carry out the task, ensure that the ground conditions are safe and that access is adequate. If access is not practical, it should be made so. The measurements can be taken from various points and the monitoring points can be extended using hose.

Work organisation:

All equipment and plant are subject to pre work inspections to ensure that it is serviceable and all guards are in place. Electrical equipment is checked for broken casings and damage to leads or connections. Statutory and periodic examinations are carried out as they become due. Ground conditions and access should be checked to ensure it is adequate and safe.

The Area manager will visit the site regularly to evaluate any safety concerns and check the quality of workmanship.

Personal Protection Equipment:
All personnel are issued with standard equipment and will wear the appropriate equipment for the work being carried out.

The minimum safety equipment required comprises of: Safety boots with midsole protection, overalls, work gloves, eye protection, hard hat, strong water proof gloves, four gas alarm and hi-vis vest.

Accident Procedure:
Standard procedures exist in the event of an accident. Depending on the level of injury, a detailed record will be maintained at head office. Minor injuries will be treated by a first aider using the site first aid kit if possible on site followed medical attention if required. More serious accidents will be attended by the Emergency Services. In any event all parties requiring notification will receive it.

All accidents and High Potential Near Misses (HPNM) will be investigated and assessed for the reoccurrence along with the degree of competence adopted.

Risk Assessments:

Risk Assessment Ref; - RAGF02

"On site assessment" POWRA - Ensuring so far as is reasonably practicable the ground conditions are safe and suitable for the works being carried out.

Work Sequence;

The task will be carried out following the methodology described below

1. The analyser is to be calibrated if required
2. The analyser is to be taken to the area(s) of work
3. The analyser is to be turned on and the correct monitoring ID selected
4. The inlet hose should be connected to the sample point. If the sample point is a Tefen style valve, this should be the red connector clicked into place. If the sample point is a ball valve type, the hose should be placed over the hose tail on the valve and the valve then opened. The valve should only be opened AFTER the hose is connected
5. The relative pressure is to be recorded and the pump started
6. Once the time has elapsed, the gas readings are to be stored
7. Once the gas reading has been taken the anemometer should be set to the correct length for the pipe being checked
8. The flow sample point valve should have the plug removed (if fitted) and be opened. If the flow point just has a plug but no valve, a valve should be fitted
9. The anemometer should be inserted quickly to ensure minimal oxygen ingress
10. Once the flow reading has settled and it should be saved and the anemometer removed, the valve should now be closed quickly and the plug refitted
11. Repeat steps 2 to 10 for any remaining points to be monitored

CLP Envirogas

METHOD STATEMENT/ SAFE SYSTEM OF WORK

ID Number	MSGF28	Author	M Greenough	Date	29/09/2017
Review Dates & Name	D A Greenough 19-01-18				

Work Description		
General Repairs	LOCATION	Gas Field

Site All Sites

Area Gasfield Extraction System

Pre work requirements

A Permit to Work if it is suitable to the task must be drawn up to include all required precautions and isolations. This will designate works to be done and the working area and the site operator/site operations managers as appropriate to be informed prior to any commencement of any works. Any additional work not stated on the original PTW or if the task location changes will require a new PTW to be issued and complied with.

Scope of Work

To carry out general repairs on the gas system, such as

- Replace sample points
- Move sections of pipe work
- Replace end caps on gas wells

Plant Resources

Hand Tools
Excavator
Dumper
Polaris ATV

Manpower

One **(Minimum)**

Interaction with site operations and activities

Interactions with site operations may occur on the site access roads and when accessing some areas. Site operator's rules and agreed safe routes must be followed at all times. Working on the tip face is hazardous and communication with the site operator must take place.

CLP Envirogas

Safe System of Work

Site set up:

Ensure a route is planned beforehand and that specific areas are targeted. Take all equipment to the work area before proceeding. Before proceeding to carry out the task, ensure that the ground conditions are safe and that access is adequate. If access is not practical, it should be made so.

Work organisation:

All equipment and plant are subject to pre- work inspections to ensure that it is serviceable and all guards are in place. Electrical equipment is checked for broken casings and damage to leads or connections. Statutory and periodic examinations are carried out as they become due. Ground conditions and access should be checked to ensure it is adequate and safe.
The Area manager will visit the site regularly to evaluate any safety concerns and check the quality of workmanship.

Personal Protection Equipment:
All personnel are issued with standard equipment and will wear the appropriate equipment for the work being carried out.

The safety equipment required comprises of: Safety boots with midsole protection, overalls, work gloves, eye protection, hard hat, strong water proof gloves, four gas alarm and hi-vis vest

Accident Procedure:
Standard procedures exist in the event of an accident. Depending on the level of injury, a detailed record will be maintained at head office. Minor injuries will be treated by a first aider using the site first aid kit if possible on site followed medical attention if required. More serious accidents will be attended by the Emergency Services. In any event all parties requiring notification will receive it.

All accidents and High Potential Near Misses (HPNM) will be investigated and assessed for the reoccurrence along with the degree of competence adopted.

Risk Assessments:

Risk Assessment Ref; - RAGF28

“On site assessment” POWRA - Ensuring so far as is reasonably practicable the ground conditions are safe and suitable for the works being carried out.

Work sequence

1. Take all equipment to the working area
2. Assess the task to be carried out
3. Follow the correct procedure and method statement for the task at hand
4. If the task does is not covered by an existing method statement or risk assessment – STOP
5. Liase with your manager or supervisor and complete a POWRA and if necessary create a new method statement for your task. Most general repairs should be covered under the documents in place, but sites and situations can vary

CLP Envirogas

METHOD STATEMENT/ SAFE SYSTEM OF WORK

ID Number	MSGF16	Author	M Greenough	Date	29/10/2017
Review Dates & Name	D A Greenough 17-01-18				

Work Description		
Exchange of pneumatic pumps from wells or knock out pots sumps	LOCATION	Gas Field

Site All Sites

Area Gas field Extraction System

Pre work requirements

A Permit to Work suitable to the task must be drawn up to include all required precautions and isolations. This will designate works to be done and the working area and the site operator/site operations managers as appropriate to be informed prior to any commencement of any works. Any additional work not stated on the original PTW or if the task location changes will require a new PTW to be issued and complied with..

Scope of Work

Exchange of pneumatic pumps from wells or knock out pots sumps

Plant Resources

Hand Tools
Excavator
Polaris

Manpower Two **(Minimum)**

Interaction with site operations and activities

Interactions with site operations may occur on the site access roads and when accessing some areas. Site operator's rules and safe routes must be followed at all times.

CLP Envirogas

Safe System of Work

Site set up:

Take all equipment to work area before proceeding to carry out the task, ensure that the ground conditions are safe and that access is adequate. If access is not practical, it should be made so.

Work organisation:

All equipment and plant are subject to pre work inspections to ensure that it is serviceable and all guards are in place. Electrical equipment is checked for broken casings and damage to leads or connections. Statutory and periodic examinations are carried out as they become due. Ground conditions and access should be checked to ensure it is adequate and safe.

The Area manager will visit the site regularly to evaluate any safety concerns and check the quality of workmanship.

Personal Protection Equipment:
All personnel are issued with standard equipment and will wear the appropriate equipment for the work being carried out.

The minimum safety equipment required comprises of: Safety boots with midsole protection, overalls, work gloves, eye protection, hard hat, strong water proof gloves, four gas alarm, hi-vis waterproof coat and over trousers.

Accident Procedure:
Standard procedures exist in the event of an accident. Depending on the level of injury, a detailed record will be maintained at head office. Minor injuries will be treated by a first aider using the site first aid kit if possible on site followed medical attention if required. More serious accidents will be attended by the Emergency Services. In any event all parties requiring notification will receive it.

All accidents and High Potential Near Misses (HPNM) will be investigated and assessed for the reoccurrence along with the degree of competence adopted

Risk Assessments:

Risk Assessment Ref; - RAGF16

“On site assessment” POWRA - Ensuring so far as is reasonably practicable the ground conditions are safe and suitable for the works being carried out. A permit for such work should be in place

CLP Envirogas

Removal from Gas Well Work sequence

1. Isolate the gas well/KOP from the gas system
2. Isolate the pump from the air and leachate/condensate systems by turning off the valves
3. Relieve the air pressure using the bleed valve on the bottom of the regulator
4. Disconnect the air line from the regulator outlet
5. Disconnect the leachate/condensate line
6. Loosen the head works, standing perpendicular to the direction of the wind in relation to the well. It may be necessary to used forced ventilation
7. Observing correct manual handling techniques or using plant machinery, lift the head works free slowly. Be careful to avoid leachate dripping onto you
8. Pull the pump free of the well, it may be quite deep and heavy, assess the load and if necessary use plant machinery to assist. Take care to avoid contact with leachate, particularly from the discharge line
9. Lay the pump and pipe work on the ground
10. Note which pipe is the air exhaust and which is the inlet and mark them accordingly
11. Disconnect the 32mm discharge line taking care as the pipe will be almost certainly be full of leachate
12. Remove the old pump ready to be serviced

Installing new pump to gas well

1. Connect the 32mm discharge to the new pump
2. Connect the air inlet and exhaust lines to the new pump
3. Lift the pump carefully and lower into the well, again it may be necessary to use plant machinery to assist
4. Slowly lower the pump to depth making sure to keep fingers free from the headworks
5. Re-tighten the well head
6. Reconnect the leachate/condensate discharge line
7. Reconnect the air inlet line to the regulator outlet
8. After ensuring that they are securely connected, turn the air and discharge lines back on
9. Turn the gas well back on if necessary

Exchange of pump from KOP Sump

1. Ensure that opening the sump will not have an effect on the gas system and that it is not a gaseous environment using a gas analyser. If there is gas present then follow the procedure for exchanging a pump in a gas well. Knock out pot sumps should not have any gas present and if so they should be further investigate to find out why
2. Isolate the pump from the air and leachate/condensate systems by turning off the valves

CLP Envirogas

3. Relieve the air pressure using the bleed valve on the bottom of the regulator
4. Disconnect the air line from the regulator outlet
5. Disconnect the leachate/condensate line
6. Loosen the head works if necessary, most sumps used by CLP have loose fitting lids to ensure that they can vent
7. Observing correct manual handling techniques or using plant machinery, lift the head works free slowly. Be careful to avoid leachate dripping onto you
8. Pull the pump free of the well, it may be heavy, assess the load and if necessary use plant machinery to assist. Take care to avoid contact with leachate, particularly from the discharge line
9. Lay the pump and pipe work on the ground
10. Note which pipe is the air exhaust and which is the inlet and mark them accordingly
11. Disconnect the 32mm discharge line taking care as the pipe will be almost certainly be full of leachate
12. Remove the old pump ready to be serviced
13. Connect the 32mm discharge to the new pump
14. Connect the air inlet and exhaust lines to the new pump
15. Lift the pump carefully and lower into the sump, again it may be necessary to use plant machinery to assist
16. Slowly lower the pump to depth making sure to keep fingers free from the headworks
17. Re-fit/re-tighten the well head
18. Reconnect the leachate/condensate discharge line
19. Reconnect the air inlet line to the regulator outlet
20. After ensuring that they are securely connected, turn the air and discharge lines back on
21. Turn the gas well back on if necessary

CLP Envirogas

METHOD STATEMENT/ SAFE SYSTEM OF WORK

ID Number	MSGF19	Author	M Greenough	Date	29/10/2017
Review Dates & Name	D A Greenough 18-01-18				

Work Description		
Inspect Knock Out Pot	LOCATION	Gas Field

Site All Sites

Area Gasfield Extraction System

Scope of Work

To check the knock out pot is clear and that the pump is functioning

Plant Resources Hand Tools

Manpower One **(Minimum)**

Interaction with site operations and activities

Interactions with site operations may occur on the site access roads and when accessing some areas. Site operator's rules and agreed safe routes must be followed at all times.

CLP Envirogas

Safe System of Work

Site set up:

Before proceeding to carry out the task, ensure that the ground conditions are safe and that access is adequate. If access is not practical, it should be made so.

Work organisation:

All equipment and plant are subject to pre- work inspections to ensure that it is serviceable and all guards are in place. Electrical equipment is checked for broken casings and damage to leads or connections. Statutory and periodic examinations are carried out as they become due. Ground conditions and access should be checked to ensure it is adequate and safe.

The Area manager will visit the site regularly to evaluate any safety concerns and check the quality of workmanship.

Personal Protection Equipment:
All personnel are issued with standard equipment and will wear the appropriate equipment for the work being carried out.

The minimum safety equipment required comprises of: Safety boots with midsole protection, overalls, work gloves, eye protection, hard hat, strong water proof gloves, four gas alarm and hi-vis vest.

Accident Procedure:
Standard procedures exist in the event of an accident. Depending on the level of injury, a detailed record will be maintained at head office. Minor injuries will be treated by a first aider using the site first aid kit if possible on site followed medical attention if required. More serious accidents will be attended by the Emergency Services. In any event all parties requiring notification will receive it.

All accidents and High Potential Near Misses (HPNM) will be investigated and assessed for the reoccurrence along with the degree of competence adopted.

Risk Assessments:

Risk Assessment Ref; - RAGF19

“On site assessment” POWRA - Ensuring so far as is reasonably practicable the ground conditions are safe and suitable for the works being carried out.

Work sequence

1. Once at the knock out pot, use the gas analyser or manometer to check the pressure at either side of the knock out pot
2. If the pressure is equal or there is very little pressure loss, the pot is functioning as intended. Unless there is a ring main in operation where the pot could have suction applied from both sides. If this is the case, valves must be isolated and the checks redone to check for blockages
3. If the pressures difference is great, the knock out pot is likely to be blocked and warrants further investigation.
4. If the KOP drains into a lance, remove the cap from the lance and check the level of the liquid in it with a dip tape or dip stick.
    - If the lance is blocked, remove it and clean or replace it
    - When replacing the lance pay attention to what the lance is installed into, if it is a gas well follow the appropriate procedures to ensure exposure to gas is limited
5. If the KOP drains into a pumped sump check the liquid level in the sump, if the liquid level is high the pump has failed, if it is not, it is likely the lance in the sump that has failed, in which case repeat step 4
6. If the pump is pneumatic, replace it as per the approved procedure
7. If the pump is electric, only suitably qualified persons are to replace it

CLP Envirogas

METHOD STATEMENT/ SAFE SYSTEM OF WORK

ID Number	MSGF21	Author	M Greenough	Date	29/10/2017
Review Dates & Name	D A Greenough 18-01-18				

Work Description		
Dipping of Gas Wells	LOCATION	Gas Field

Site All Sites

Area Gasfield Extraction System

Pre work requirements

A Permit to Work suitable to the task must be drawn up to include all required precautions and isolations. This will designate works to be done and the working area and the site operator/site operations managers as appropriate to be informed prior to any commencement of any works. Any additional work not stated on the original PTW or if the task location changes will require a new PTW to be issued and complied with.

Scope of Work

To dip gas wells and other points on site to check liquid levels

Plant Resources Hand Tools

Manpower Two **(Minimum)**

Interaction with site operations and activities Interactions with site operations may occur on the site access roads and when accessing some areas. Site operator's rules and agreed safe routes must be followed at all times.

CLP Envirogas

Safe System of Work

Site set up:

Before proceeding to carry out the task, ensure that the ground conditions are safe and that access is adequate. If access is not practical, it should be made so.

Work organisation:

All equipment and plant are subject to pre- work inspections to ensure that it is serviceable and all guards are in place. Electrical equipment is checked for broken casings and damage to leads or connections. Statutory and periodic examinations are carried out as they become due. Ground conditions and access should be checked to ensure it is adequate and safe.

The Area manager will visit the site regularly to evaluate any safety concerns and check the quality of workmanship.

Personal Protection Equipment:
All personnel are issued with standard equipment and will wear the appropriate equipment for the work being carried out.

The minimum safety equipment required comprises of: Safety boots with midsole protection, overalls, work gloves, eye protection, hard hat, strong water proof gloves, a charged four gas alarm, hi-vis waterproof coat and over trousers.

Accident Procedure:
Standard procedures exist in the event of an accident. Depending on the level of injury, a detailed record will be maintained at head office. Minor injuries will be treated by a first aider using the site first aid kit if possible on site followed medical attention if required. More serious accidents will be attended by the Emergency Services. In any event all parties requiring notification will receive it.

All accidents and High Potential Near Misses (HPNM) will be investigated and assessed for the reoccurrence along with the degree of competence adopted.

Risk Assessments:

Risk Assessment Ref; - RAGF21

“On site assessment” POWRA - Ensuring so far as is reasonably practicable the ground conditions are safe and suitable for the works being carried out. A permit should be in place for this work.

Work sequence

1. Firstly, assess if it is safe to dip the well, is the well too high to lift the head from comfortably? Is there a pump fitted which would complicate the job? Can everything be isolated as required? Is the well in a hollow which would create a confined space when the head is removed?
2. Isolate the gas well
3. Stand perpendicular to the wind in relation to the well
4. Loosen the well head and lift it out carefully, observing proper manual handling techniques
5. Remaining perpendicular to the wind, lower dip tape into the well until it hits liquid and is noted with an audible beep, retract the tape and lower it again to make sure it is in liquid. Note the level
6. Continue to lower the tape until it hits the bottom – when the tape goes slack – note the level
7. Refit the wellhead and measure the well head height above ground level and record it

CLP Envirogas

METHOD STATEMENT/ SAFE SYSTEM OF WORK

ID Number	MSGF22	Author	M Greenough	Date	29/10/2017
Review Dates & Name	D A Greenough 19-01-18				

Work Description		
Fault Finding on Gas Field	LOCATION	Gas Field

Site All Sites

Area Gasfield Extraction System

Pre work requirements

If appropriate a Permit to Work suitable to the task must be drawn up to include all required precautions and isolations. This will designate works to be done and the working area and the site operator/site operations managers as appropriate to be informed prior to any commencement of any works. Any additional work not stated on the original PTW or if the task location changes will require a new PTW to be issued and complied with.

Scope of Work

To identify faults on the gas collection system

Plant Resources Hand Tools

Manpower One **(Minimum)**

Interaction with site operations and activities Interactions with site operations may occur on the site access roads and when accessing some areas. Site operator's rules and agreed safe routes must be followed at all times.

CLP Envirogas

Safe System of Work

Site set up:

Before proceeding to carry out the task, ensure that the ground conditions are safe and that access is adequate. If access is not practical, it should be made so.

Work organisation:

All equipment and plant are subject to pre- work inspections to ensure that it is serviceable and all guards are in place. Electrical equipment is checked for broken casings and damage to leads or connections. Statutory and periodic examinations are carried out as they become due. Ground conditions and access should be checked to ensure it is adequate and safe.

The Area manager will visit the site regularly to evaluate any safety concerns and check the quality of workmanship.

Personal Protection Equipment:
All personnel are issued with standard equipment and will wear the appropriate equipment for the work being carried out.

The minimum safety equipment required comprises of: Safety boots with midsole protection, overalls, work gloves, eye protection, hard hat, strong water proof gloves, four gas alarm hi-vis vest

Accident Procedure:
Standard procedures exist in the event of an accident. Depending on the level of injury, a detailed record will be maintained at head office. Minor injuries will be treated by a first aider using the site first aid kit if possible on site followed medical attention if required. More serious accidents will be attended by the Emergency Services. In any event all parties requiring notification will receive it.

All accidents and High Potential Near Misses (HPNM) will be investigated and assessed for the reoccurrence along with the degree of competence adopted.

Risk Assessments:

Risk Assessment Ref; - RAGF22

“On site assessment” POWRA - Ensuring so far as is reasonably practicable the ground conditions are safe and suitable for the works being carried out.

Work sequence

1. Following the Gas field monitoring procedures, gather data and compare it to historic data. This will enable you to determine which area of site the fault is in
2. Once the area of the site has been identified, monitor every point in the area until you have narrowed down the source of the problem
3. If necessary, isolate the source from the system, this will enable you to check that you have identified it correctly – before you do, listen to the source of the issue to see if you can hear where the leak or issue is
4. Visually inspect the source, usually issues will be obvious but some may take some careful analysis
5. Repair the issue following the correct procedure for the task

CLP Envirogas

Procedure for Explosion and Fire

Whinney Hill Landfill Site

Fire - Generation Plant
Actions to Take on Discovering a Fire

1. Sound the fire alarm by operating the nearest Break Glass Fire Alarm Contact Point (if fitted) or by shouting **'FIRE – FIRE- FIRE'.**
2. Immediately stop the generators and gas blower by using the large red emergency stop button and vacate the area by the nearest available route and proceed to the assembly point.
3. Isolate the gas supply to the site from the nearest point outside the compound **ONLY** if it is safe to do so.
4. **ONLY** attack the fire if it is safe to do so with the appliances provided. **DO NOT** take personal risks. Ensure that there is a safe exit before attempting to extinguish a fire.
5. Use the fire extinguisher to aid your escape from the containers.
6. Operate the sites main electrical supply trip if circumstances require.

On Hearing the Alarm

7. Immediately vacate the area by the nearest available route and go to the assembly point. Do not stop to collect personal possessions. Walk quickly but do not run, close doors behind you.
8. Attend the **Fire Assembly Point** and report to the **'Designated site person'.**

Do not re-enter the site until told to do so.

Fire / Explosion - Landfill / Gasfield

Actions to Take on Discovering a Fire

Immediately stop work and vacate the landfill / gasfield and go to the site office and report your findings to the **'Designated site person'** giving clear details of and the location of the fire or explosion.
Any further actions i.e. stopping the generators and isolating the main gas line(s) valve(s) will be determined by the size and location of the fire as detailed in 6.7.

Escape and Warning Facilities
Evacuation Assembly Point

1. All persons from this site will assemble **OUTSIDE THE COMPOUND** reporting to the **'Designated Site Person'**
2. The **'Designated Site Person'** will ensure, where possible, that;
   a) All personnel are accounted for.
   b) Machines and processes are stopped and gas supply is isolated.
   c) Telephone the emergency services;

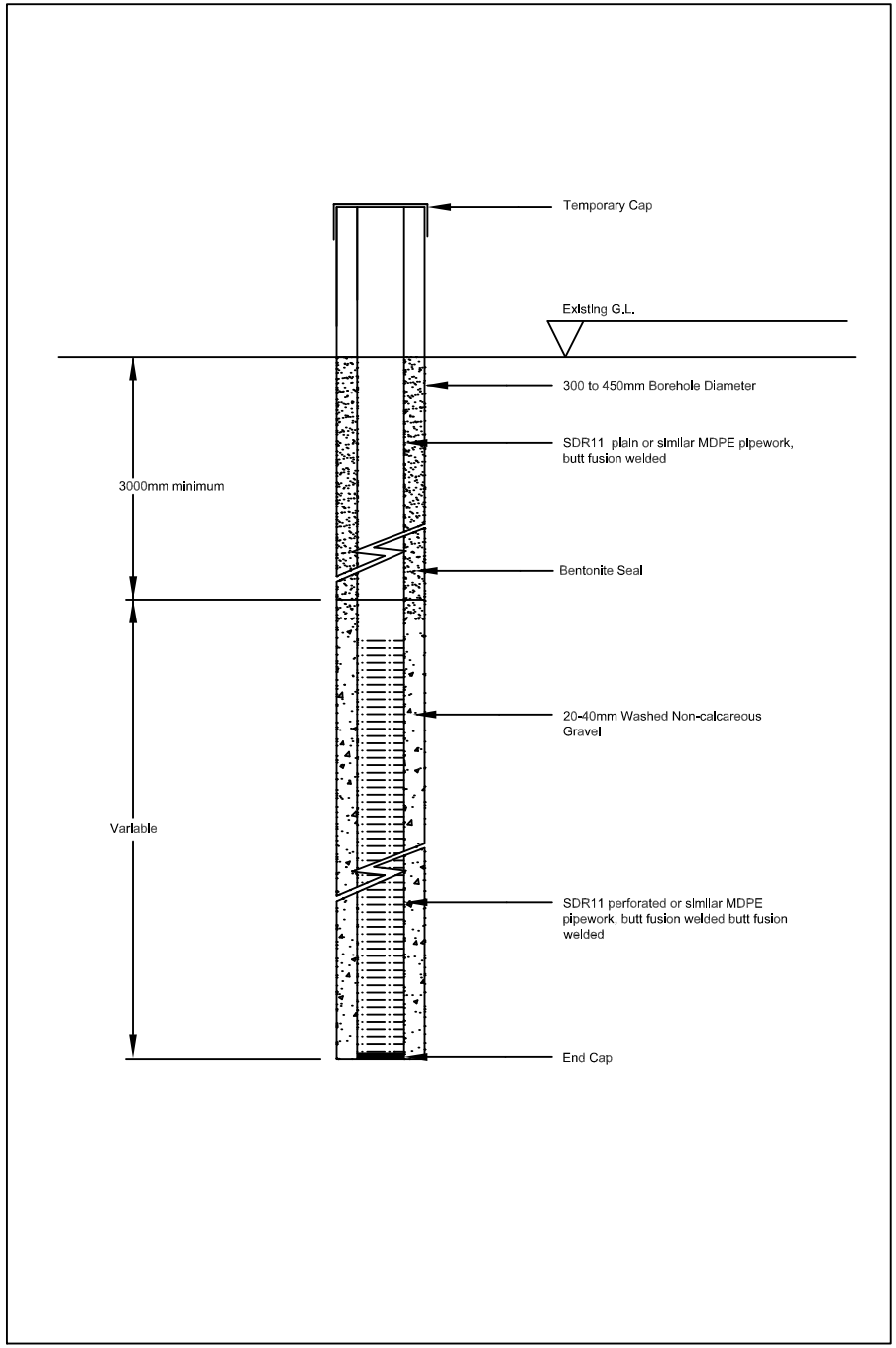
Give the site address and telephone number.

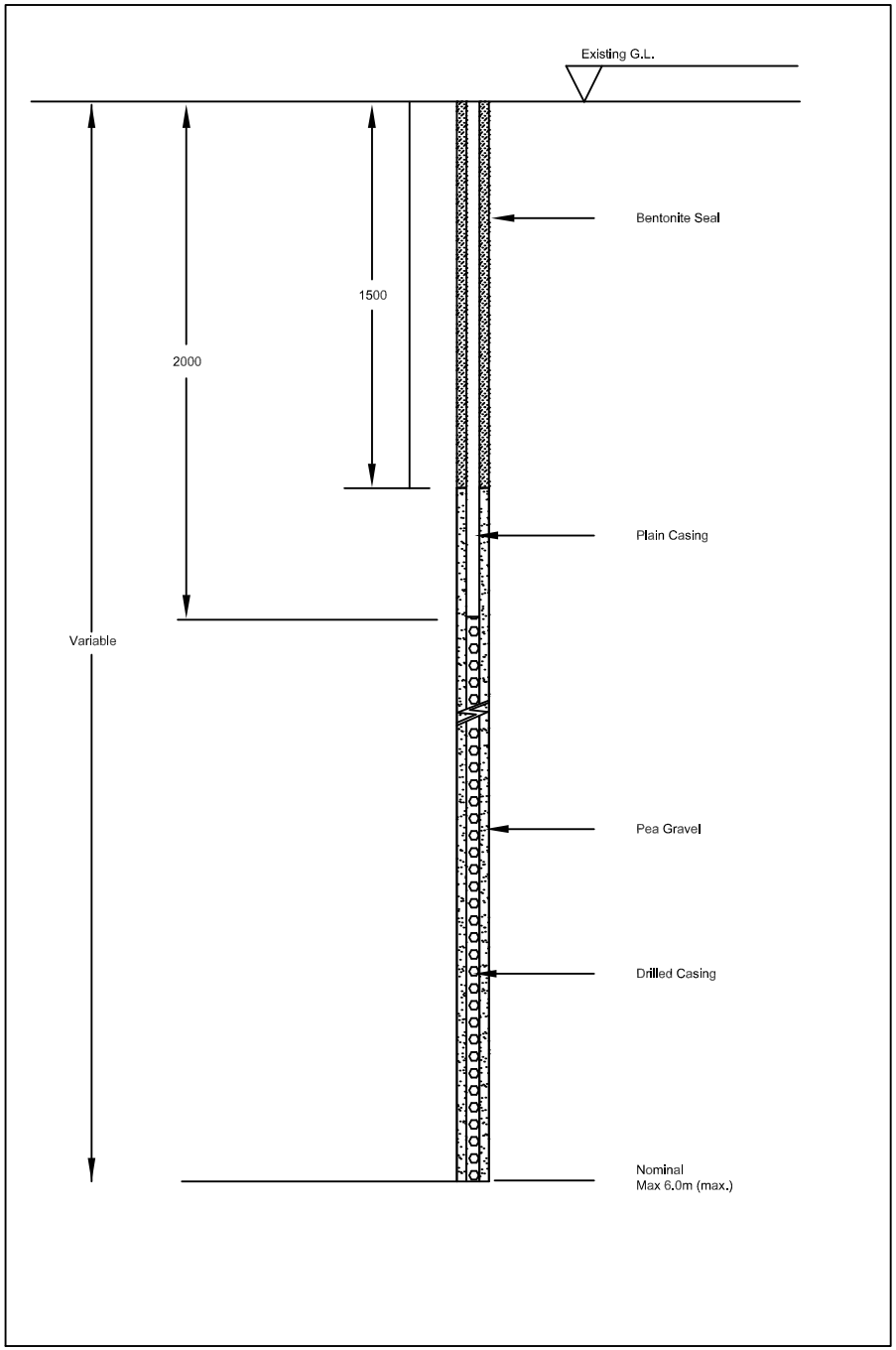
State **'WE HAVE A FIRE'.**

Receive confirmation that the details have been received correctly.

The site isolation valve is located behind the gas booster outside the compound.

Isolation valves inside the compound





Notes

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Rev	subject	date

suez

Danver Resource Recovery Park, Lower Eccleshill Road, Darwen, BB3 0RP
Tel:(01254)819700, Fax:(01254)819749, Email:-RichardJones@ukx.co.uk

Site: Suez Recycling & Recovery UK Ltd

Title: Schedule of Gas Well Design

Scale: NTS

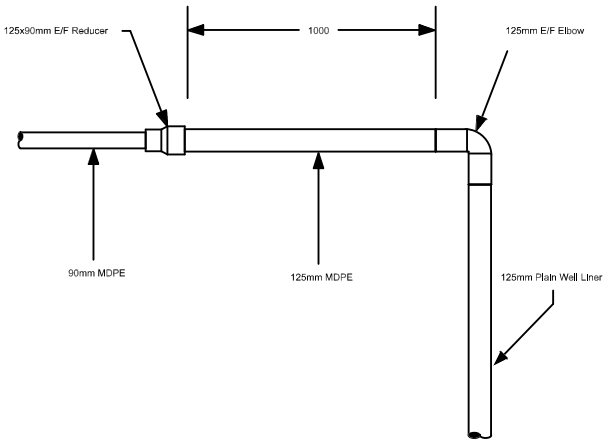
Date: December 2020

Drawing Ref: SPSD001

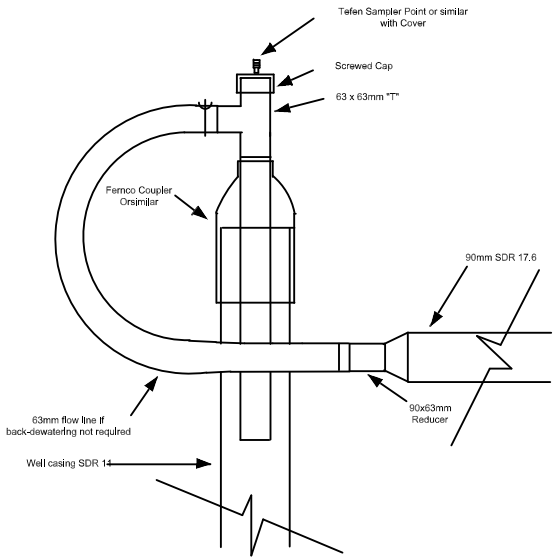
Drawn by: JC

Checked by:

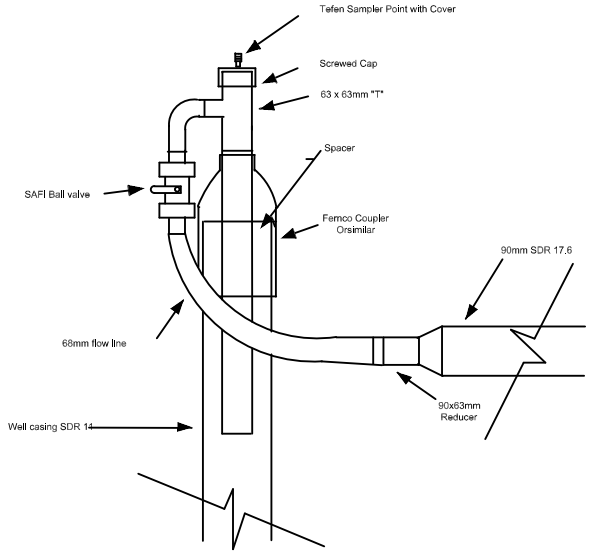
90° Well Head Connection.



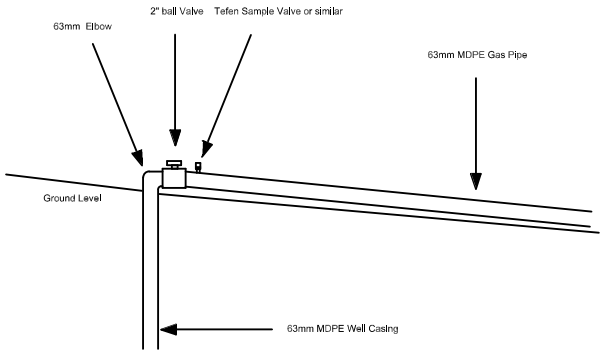
Non-Valved Well Head (with sampling facility).



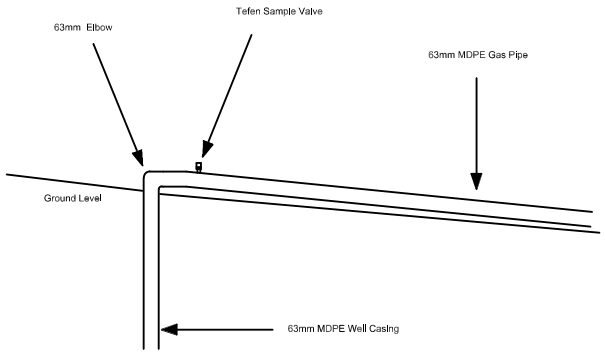
Valved Well Head (with sampling facility).



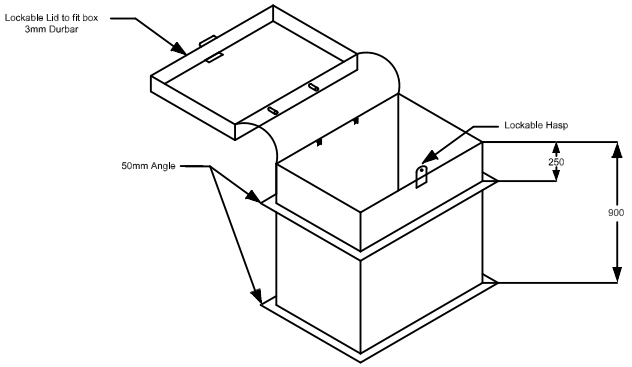
Gas Extraction Probe Well Head (Valve Control)



Gas Extraction Probe Well Head (Without Valve Control)



Gas Well Cover.



Notes

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Rev/Mod	Subject	Date

suez

Suez Recycling & Recovery UK Ltd

Schedule of Gas Well Heads

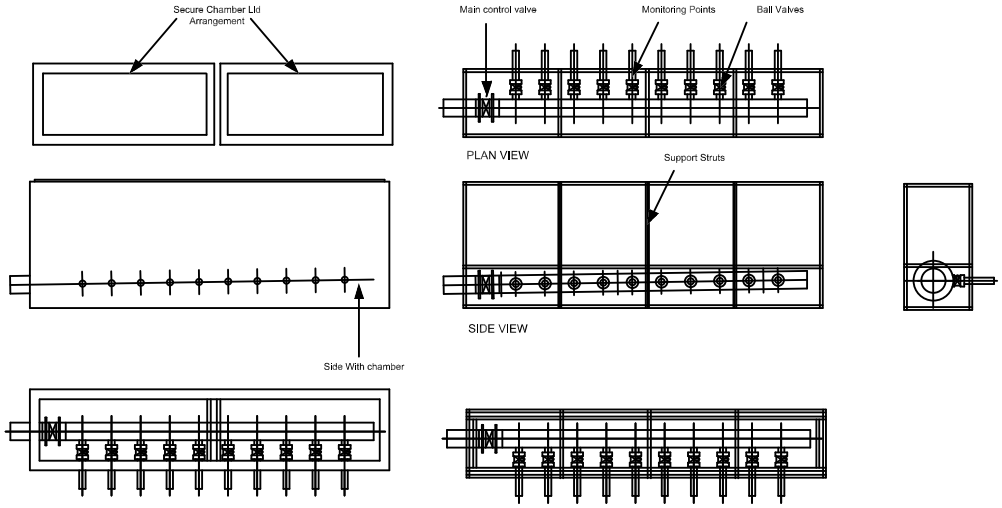
NTS

December 2020

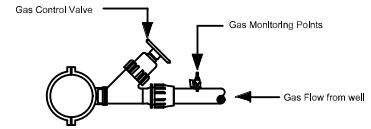
SPSD002

JC

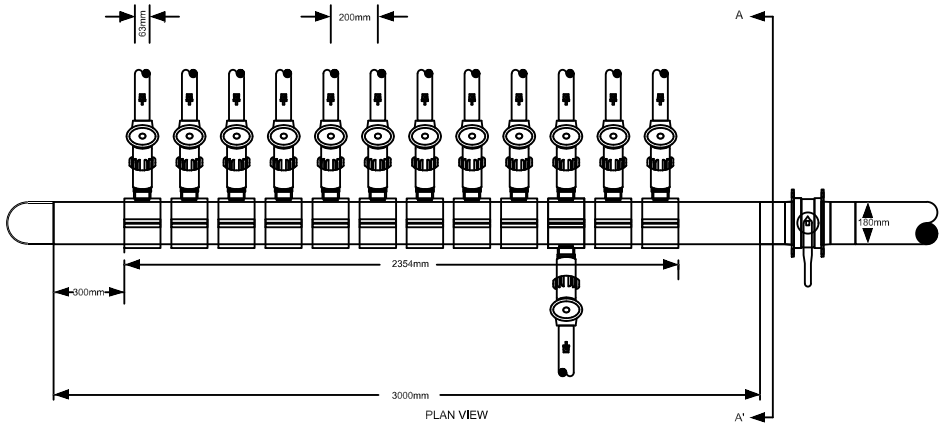
Intergrated Manifold and Chamber.



Surface Laid Manifold with Gate Valve Control.

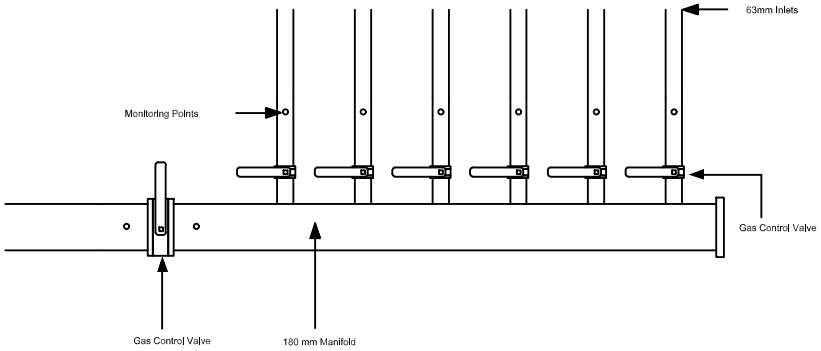


SECTION A - A

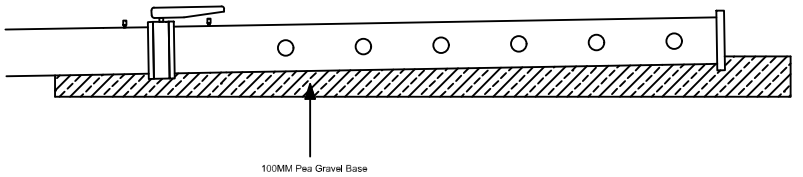


PLAN VIEW

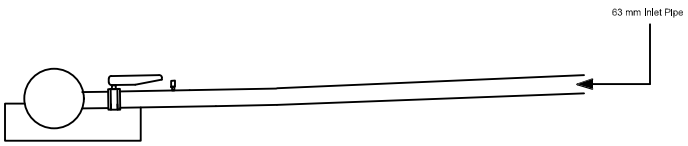
Surface Laid Manifold with Butterfly Valve Control.



PLAN VIEW



FRONT VIEW



SIDE VIEW

Notes

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Revision	Subject	Date

SUEZ

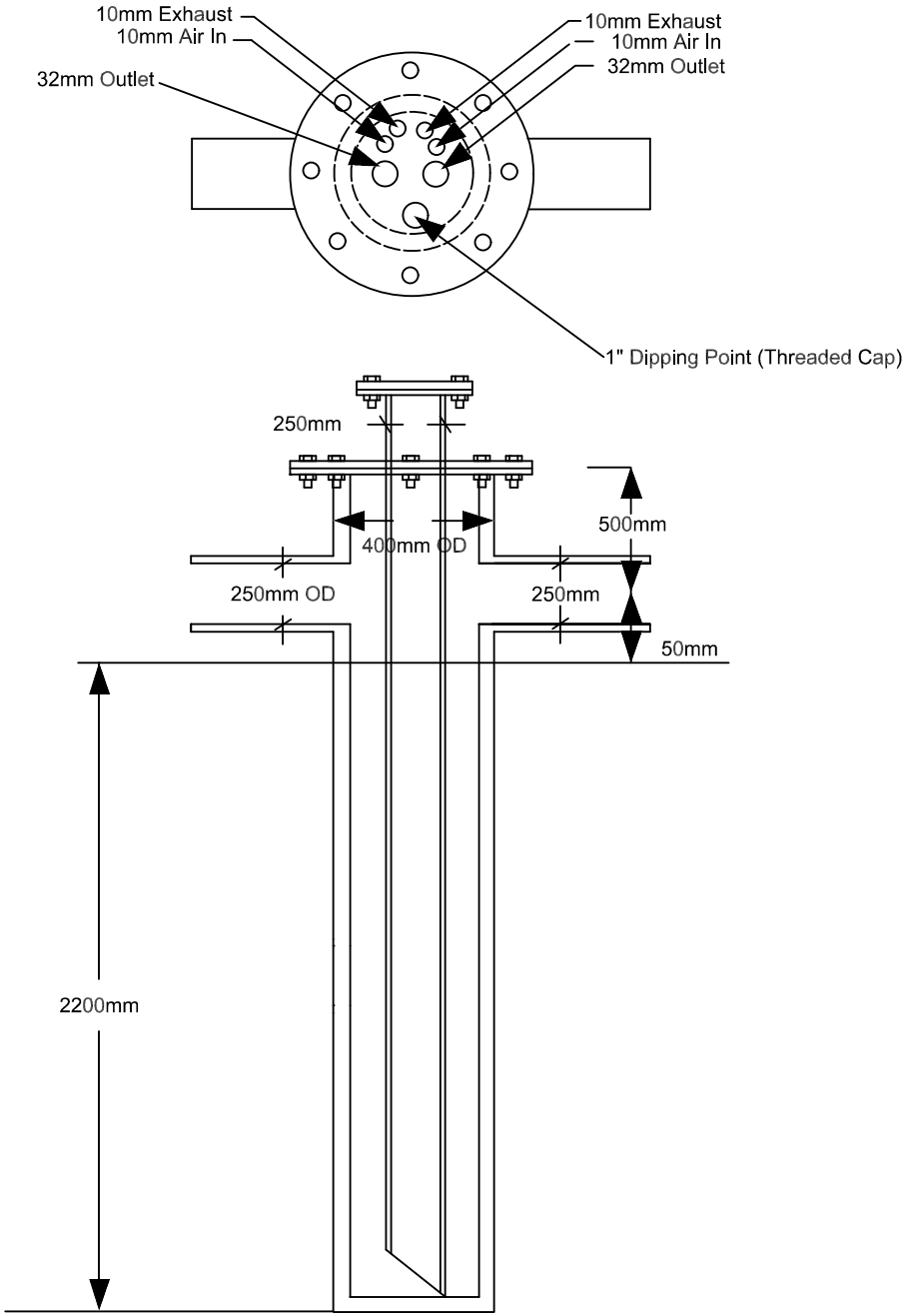
Title: SUEZ Standard Library Details

Title: Schedule of Manifold Designs

Scale: NTS

Date: December 2020

Drawing Ref.	Drawn By
SPSD003	MLS



DWP3 - Vacuumless Pumped Condensate De-Watering Leg. (Air Pump)

Revision	Subject	Date

SUEZ

Title: SUEZ Standard Library Details

Title: Schedule of De-Watering Pot Designs

Scale: NTS

Date: December 2020

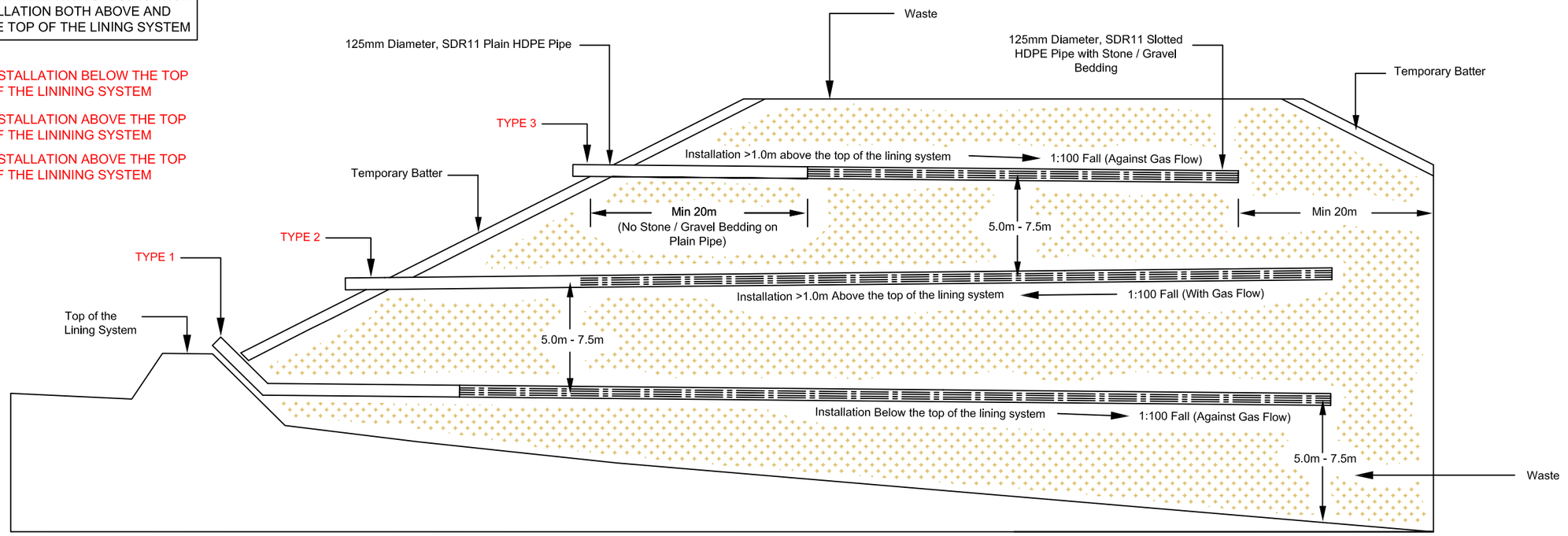
Drawing Ref.	Drawn By
SPSD 004	JC

SECTION THROUGH A HORIZONTAL GAS EXTRACTION WELL WITH SPECIFICATION FOR INSTALLATION BOTH ABOVE AND BELOW THE TOP OF THE LINING SYSTEM

TYPE 1 - INSTALLATION BELOW THE TOP OF THE LININING SYSTEM

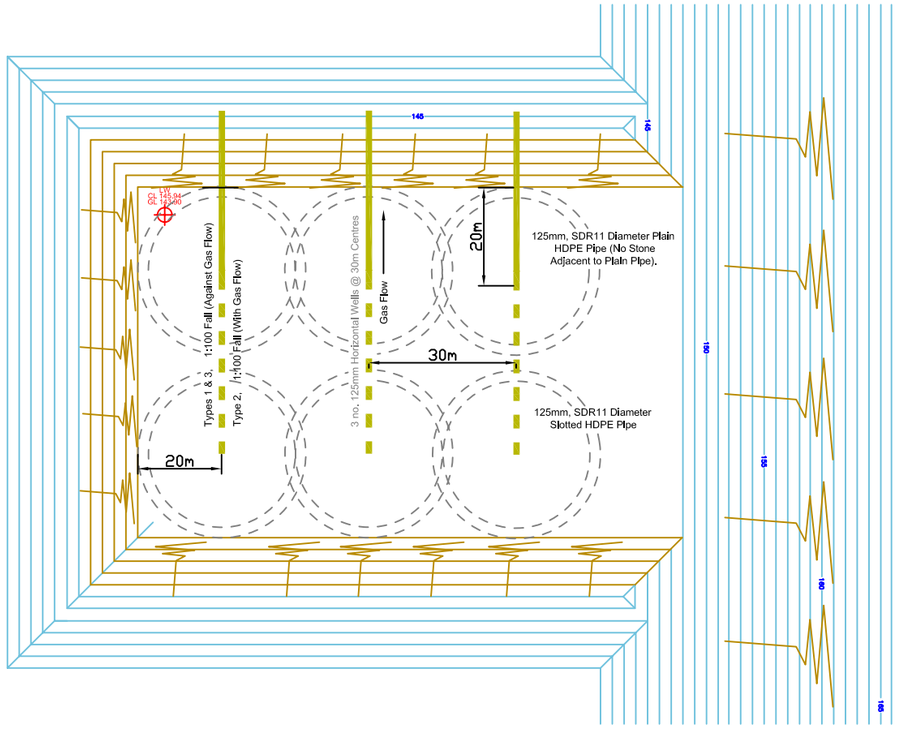
TYPE 2 - INSTALLATION ABOVE THE TOP OF THE LININING SYSTEM

TYPE 3 - INSTALLATION ABOVE THE TOP OF THE LININING SYSTEM

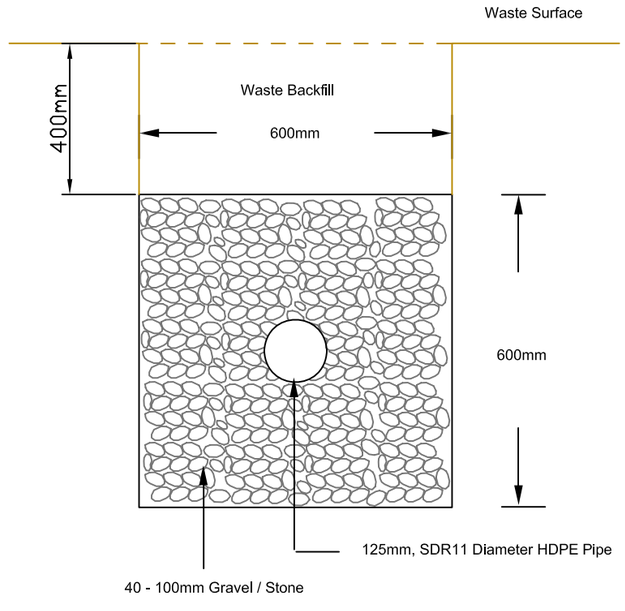


Basal Lining System - Phase Separation Bund / Sidewall Liner

PLAN VIEW OF A HORIZONTAL GAS EXTRACTION WELL



SECTION THROUGH A HORIZONTAL GAS WELL



Notes

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Revision	Subject	Date
C	Revision of specification.	23/11/15
B	Revision of specification.	20/11/15
A	Revision of specification.	21/01/15

SUEZ

Darwen Resource Recovery Park, Lower Eccleshill Road, Darwen, BB3 0RP
Tel:(01254)819700, Fax:(01254)819749, Email:richard.bisset@silta.co.uk

Site: SUEZ Landfill Energy Standard Library Details

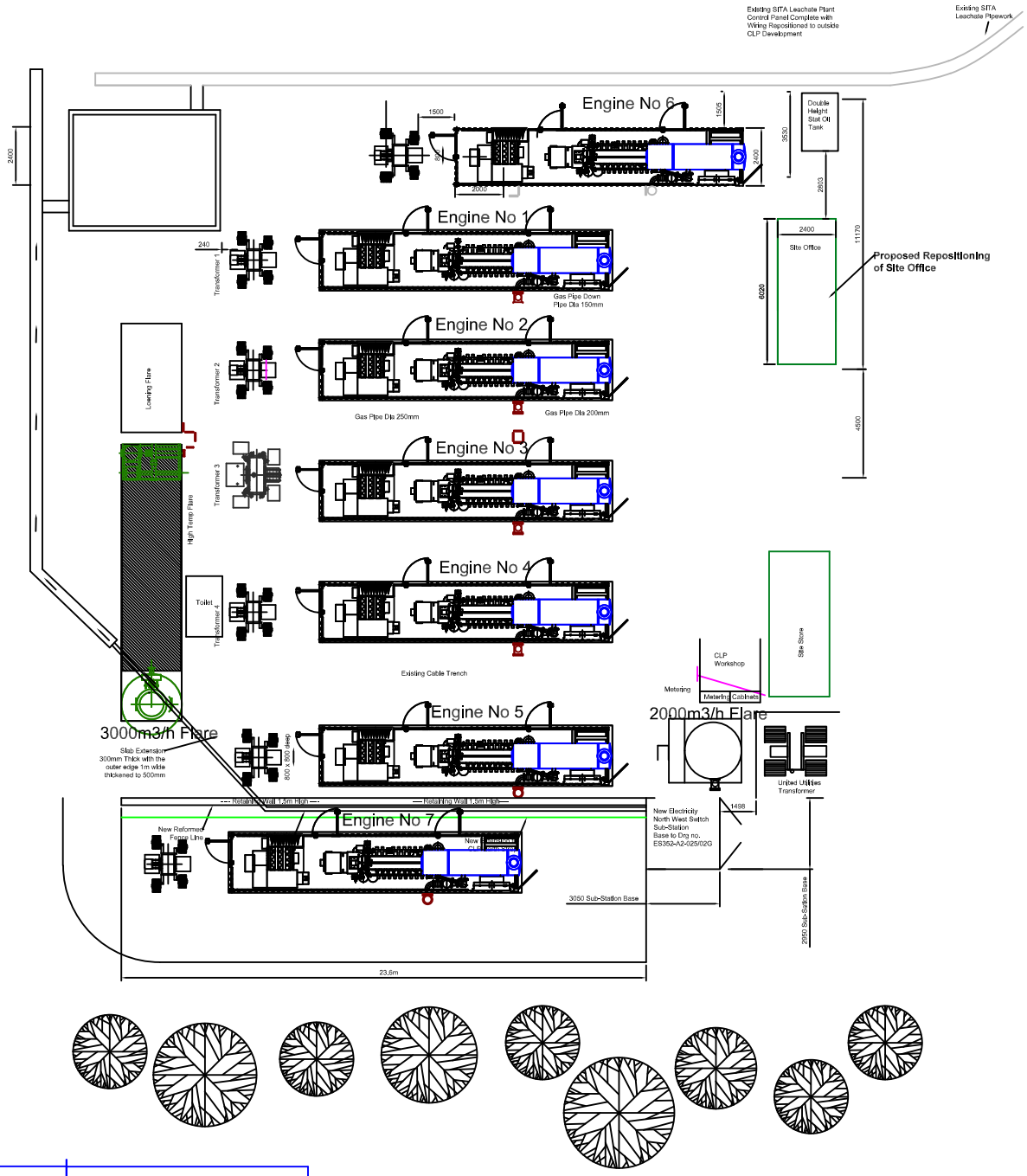
Title: Horizontal Gas Well Design

Scale: NTS

Date: NOVEMBER 2009

Drawing Ref.: SPSD 008

Drawn By: TJW



RevNo	Description	Date	Signature

CLP Envirogas Ltd.
Unit 14-15 Queensbrook
Bolton Technology Exchange
Spa Road
Bolton
BL1 4AY

Tel: 01204 544540
Fax: 01204 535310

CLP Envirogas

Drawn by - John Greenhalgh	Date - 21st December 2020	Drawing Title - GENERAL ARRANGEMENT	Project - WHINNEY HILL LANDFILL SITE
Checked by -	Scale - 1/200		Drawing Number - 01-WHI-7R-GENERAL ARRANGEMENT-Rev1

Notes

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Survey Update Area

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Dunsen Resource Recovery Park, Lower Eccleshill Road, Darwen, BB3 0RP
Tel:(01254)819700, Fax:(01254)819749, Email:richard.oliver@sita.co.uk

Site	Whinney Hill Landfill Site
Title	GCS 04 2021
Scale	1:1500 @ A3
Date	April 2021
Drawing Ref	Whinney-Hill-GCS--0421
Drawn by	JC
Checked by	

Rev	subject	date