ATEX Compliance

Project No.:

EXPLOSION PROTECTION DOCUMENT

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0. INTRODUCTION

0.1 Background

Starrus Eco Holdings Limited (SEHL, which trades as Panda) operates a Waste Processing Facility at Rathdrinagh, Beauparc, Navan, Co Meath. The site operates under a Waste Licence issued by the EPA (Register No. W0145-05). Materials processed include construction and demolition waste, dry mixed recyclables, solid recovered fuel (mixed plastics and fibre) and bulky wastes. Processing of incinerator bottom ash (IBA) to remove ferrous and non-ferrous metals is also planned in Shed 3 at the facility.

Fresh IBA produced at Dublin Waste to Energy (Register No. W0232-02) has the potential to produce hydrogen gas in certain conditions which could give rise to a potentially explosive atmosphere. Accordingly, the facility is subject to the requirements of Part 8 of the Safety, Health, and Welfare at Work (General Applications) Regulations 2007 (SI No 299 of 2007) ("the Regulations"). The Regulations stipulate minimum requirements for protecting and improving the safety and health of employees, contractors, visitors, and members of the public potentially at risk from explosive atmospheres.

This Explosion Protection Document has been produced as required by Article 169 of the Regulations.

0.2 ATEX

Employers have a legal duty to protect their staff from the dangers of explosive atmospheres under the Safety, Health, and Welfare at Work (Explosive Atmospheres) Regulations S.I. No. 258 of 2003. These regulations transpose into Irish law the ATEX (Explosive Atmospheres) Directive, 1999/92/EC, which defines the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres. As the operations at our Rathdrinagh facility include areas where potentially explosive atmospheres can arise, Starrus Eco Holdings Limited is required to complete an Explosion Protection Document specifying the preventive and protection measures to be taken against explosion.

0.3 Requirement for an Explosion Protection Document

Under Article 4 of Directive 1999/92/EC, the employer must ensure that an Explosion Protection Document is drawn up and kept up to date.

This document must at least demonstrate:

- That the explosion risks have been determined and assessed,
- That adequate measure will be taken to attain the aims of the Directive,
- Those places which have been classified into zones,
- Those places where the minimum requirements set out in Annex II to the Directive will apply,
- That the workplace and work equipment, including warning devices, are designed, operated and maintained with due regard for safety, and

- That in accordance with Council Directive 89/655/EEC, arrangements have been made for the safe use of equipment.

The Explosion Protection Document must be drawn up prior to the commencement of work and be revised when the workplace, work equipment or organisation of the work undergoes significant changes, extensions, or conversions.

The Explosion Protection Document is intended to provide an overview of the results of the risk assessment and the consequent technical and organisational protective measure for a plant and its working environment.

The EU Guidance on implementing Directive 1999/92/EC states that:

- The document must be tailored to conditions in the firm concerned. It should as far as possible be well-structured and easy to read and the degree of detail should be such as to allow a general grasp of its content. The amount of documentation should therefore not be excessive. When necessary, the document should be produced in a form that allows additions, e.g. as a loose-leaf collection. This is particularly recommended for larger plants or where the plant engineering is frequently changed.

- Article 8 of Directive 1999/92/EC expressly allows existing explosion risk assessments, documents, or reports to be combined (e.g. the safety report under Directive 96/82/EC). An Explosion Protection Document may thus contain references to other documents without explicitly including them in full.

- When establishments have several plants containing hazardous places, it can be useful to divide the Explosion Protection Document into a general and a plant-specific part. The general part explains the structure of the documentation and measures applying to all plants, such as training. The plant specific part describes the hazards and protective measures in the individual plants.

- If operating conditions in a plant change frequently, e.g. as a result of batch processing of different products, the most dangerous conditions should be taken as the basis for assessment and documentation.

0.4 Layout of Explosion Protection Document

The Beauparc Protection Document contains the following sections:

- Description of the workplace and working areas
- Description of the process steps and / or activities
- Description of the substances used / safety parameters
- Results of the risk analysis
- Explosion protection measures taken
  - Technical
  - Organisational

- Implementation of the explosion protection measures
- Coordination of the explosion protection measures

1. DESCRIPTION OF THE WORKPLACE AND WORKING AREAS

1.1 Site Plan

Panda, Beauparc, Rathdrinagh, Navan, Co. Meath, Ireland. (Referenced as Rathdrinagh from here) is operated by Starrus Eco Holdings Ltd (SEHL).

The company's core businesses include waste processing and material recovery. This document is being prepared as part of our project to process incinerator bottom ash (IBA) at the facility in Rathdrinagh; the IBA will be processed in Shed 3.

This IBA is a product from Dublin Waste to Energy in Dublin Port. The IBA will be transported to Rathdrinagh by road using walking floor trailers or tipper trucks with loose covers that are owned or driven by or on behalf of SEHL. It will then be processed on site within 24 hours to remove metals. The residual ash will then be transported to Knockharley landfill the next day.

1.2 Layout Plan

The site layout plan shows the location of major buildings and plant items. A copy of the site layout plan is provided as Appendix 1.

The site layout drawing must be available onsite. The position of the emergency facilities, assembly point, first aid, fire extinguishers, chemical / oil storage areas should be shown.

1.3 Plan of Escape and Rescue Routes

The site emergency plan document (Appendix 2) highlights the actions to be implemented in the event of a fire, an explosion, a spillage, an unexpected hazardous or clinical waste or some of the above that would pose as a risk to human health and safety or to the environment.

The procedure to be followed for managing a fire alarm sounding is replicated below.

"The person discovering the fire should:

1) Immediately raise the alarm by giving verbal warning to those nearby or by operating the nearest break glass unit or using an air horn or using the internal radio system.

2) Contact your direct senior person who will escalate the information ASAP to the Fire Officer / Operations Manager or his/her deputy. At that stage, the Fire Officer will decide if the fire brigade should be summoned or not. If the fire brigade should be summoned, the Fire Officer might delegate the call to whoever is deemed competent to do so. This person will immediately contact the Emergency Services by dialling 112 or 999, requesting the fire brigade. He/she will provide the fire brigade with:

- *the address*
- *the location of the premises*
- *The phone number of the premises*
- *And any other relevant information to hand as regards the fire and state of evacuation.*

3) On hearing the warning of fire or the fire alarm, all the people in the concerned building should immediately leave by the nearest exit.

Where possible close (but do not lock) doors and windows on your way out.

The Fire Officer should immediately commence their designated duties.

The Fire Officer will retrieve the fire register and the emergency pack and proceed to the designated assembly point from where he will coordinate the emergency response plan."

There are also instructions for the other scenarios defined by the emergency plan.

2. DESCRIPTION OF THE PROCESS STEPS

2.1 Process Flow Description

IBA will be transported in the morning from Dublin Port to Shed 3 Rathdrinagh in six separate loads by walking floor trailers or tipper trucks with loose covers that are owned or driven by or on behalf of SEHL. Estimated arrival time will be communicated in advance by radio. Once on-site, these vehicles will be weighed at the weighbridge. After the shed supervisor and plant operator are again notified by radio, the trucks will be driven into Shed 3. The fresh IBA will be tipped in the processing shed in short term storage bays up to a maximum of 1000 tonnes, and processed IBA loaded on the empty truck for onward transfer to Knockharley landfill site to a dedicated IBA cell.

Mobile water misting systems will be used at the tipping location to minimize dust arising from the moving IBA and to ensure that moisture content of the IBA is between 17-20%. After all deliveries have been received, the Shed will be closed. and fresh IBA will be loaded to the processing line using 2-4 tonne bucket loads to trommel feed hopper (7-8 tonne capacity) onto a processing line (60 tonnes/hr processing capacity). The trommel removes oversize (>50mm) material (<5% of total amount), mainly ferrous metals and inert rubble, is passed under a magnet to split ferrous metal from inerts (no non-ferrous in this line). Inerts will drop off the end of the conveyor into a stock pile. Normal size (<50 mm) material from the trommel is fed to the next feed hopper (7-8 tonne capacity) up to a separate conveyor with a smaller magnet to eject ferrous material to a bunker area beneath conveyor. The conveyor passes on to an eddy current separator to remove aluminium/copper/zinc (non-ferrous). The eddy current is tuned for <50mm material, typical globules are 10 mm] which will fall into the bunker underneath. Residual ash will fall off the conveyor at the end of the line. Ferrous (8-12%) and non-ferrous (3-6%) fractions are weighed at the end of each day. If recovery is less than expected, the processed IBA can be rerun through the processing line. 0-4 mm material may 'jump' the splitter plate from the eddy current, so the basis for tuning the eddy-current separator is to get 1-2mm nonferrous taken. Typically, in-process inventory on the processing line is considered to be 10 tonnes.

The processed IBA will be moved to a stockpile in a separate bay on the other side of the shed, using a loading shovel [adjacent to incoming material separated by a bunker wall].

2.1.1 Instrumentation

17 Hydrogen sensors have been proposed in the project ventilation philosophy (Appendix 8 Figure 4.1). These will be listed in Appendix 4, which will identify the location of each device as well as whether it is located within a zoned area.

2.2 Description of Ventilation

The project ventilation philosophy (Appendix 8 Section 4) describes the design basis for proposed continuous ventilation arrangements in Shed 3 during IBA handling and processing. In all areas where there could be hydrogen, a flammable atmosphere must be avoided by the dilution of any releases with mechanical ventilation These assumptions will be transferred to a site zoning document providing an assessment of the ventilation for each area.

3. DESCRIPTION OF THE SUBSTANCES USED / SAFETY PARAMETERS

3.1 Safety Data Sheets

The Shed 3 IBA Processing Risk Assessment/Safe System of Work Plan (RA/SSOW) (Appendix 5) details the requirements for site awareness of chemical substances used on site. The latest SDS for IBA from Dublin Waste to Energy is also included in Appendix 5.

3.1.1 COSHH

The Appendix 5 document states that *"COSHH Assessments are undertaken for each chemical authorised and used along with a COSHH register*".

3.1.2 Known Flammable Substances

The project ventilation philosophy (Appendix 8) highlights hydrogen as the only flammable gas likely to be present in normal operation.

Relevant properties of hydrogen are listed in table 3.1 below.

There are no explosive dusts expected in the current process under normal conditions.

Table 3.1 Flammable Substances' Properties

No.	Flammable Material									Any other relevant information and remarks
	Name	Composition	Flashpoint (deg C)	Density (kg/m^3)	LEL Vol %	UEL Vol%	Relative Density of Gas or Vapour to Air	Auto Ignition Temperature (deg C)	Temperature Class [1]	
1	Hydrogen (assume 100% pure)	100% H_2	Not applicable (is a gas at ambient temperature)	0.084	4	75	0.00523	535	T1	

Notes:

1. **Temperature class** (also known as 'T-rating') defines the explosion hazard type for the Ex product. The class, from 1 to 6, indicates the highest temperature allowed without igniting anything in the area. Class defines risks of a zone in a given area. The classes are defined separately for gas and dust hazards by IEC standards 600079-10-1 (gas) and 600079-2 (dust). The temperature restrictions for gas apply to the whole product, inside and out. For dust, the classes only concern the hottest outer surface temperature. The international (IEC) classes are defined as follows:

Class	**Temperature (Celsius)**
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

3.2 IBA Maturation

Fresh IBA naturally undergoes a process termed maturation. One of the principal reactions involves the generation of hydrogen gas. This occurs in alkaline conditions where fresh aluminium is oxidised in the presence of water in the following reaction:

$$Al + 3\,H_2O + NaOH \longrightarrow NaAl(OH)_4 + 3/2\,H_2 \quad [1]$$

$$NaAl(OH)_4 \longrightarrow Al(OH)_3 + NaOH \quad [2]$$

[1] and [2] gives the overall reaction:

$$Al + 3\,H_2O \longrightarrow Al(OH)_3 + 3/2\,H_2$$

Important to note is that this is under NaOH rich, alkaline conditions since the bottom ashes always have a high pH.

The gas production scenario considered is that the shed will always contain 1,000t of fresh IBA (i.e., the received IBA is remains in the shed for 24 hours unprocessed which is then dispatched and immediately replaced by a fresh delivery of IBA).

It is envisaged that most of the hydrogen generation will be in the short-term storage area in Shed 3.

Due to the density of hydrogen being less than air it will generally accumulate at the highest point if venting measures are not in place. In this case the hydrogen is likely to gather in the apex of the roof space of Shed 3

3.3 Hydrogen Gas

Hydrogen gas, with its molecular formula H_2, possesses a highly explosive nature that stems from its unique chemical properties. Being the lightest and most abundant element in the universe, hydrogen readily forms flammable mixtures with air. When ignited, hydrogen undergoes a rapid and exothermic reaction with oxygen, producing water vapor and releasing a significant amount of energy. While hydrogen is not inherently dangerous, its combustible nature makes it potentially hazardous if mishandled or if appropriate safety measures are not followed. Due to its explosive potential, hydrogen is widely used as a fuel in various applications, such as rocket propulsion and clean energy technologies, but precautions are essential to prevent accidental ignition and ensure safe utilization.

ATEX (Atmosphères Explosibles) is a set of European Union directives that outlines the standards for equipment and systems used in potentially explosive atmospheres.

In the context of hydrogen, which is highly flammable and has explosive properties, ATEX regulations become particularly relevant. Hydrogen falls under the category of a potentially explosive gas, and equipment used in areas where hydrogen is present needs to comply with ATEX directives. ATEX certification ensures that the design, manufacturing, and operation of equipment minimize the risk of ignition sources and mitigate the potential for explosions in environments where flammable gases, like hydrogen, may be present. Hydrogen-related installations, such as those involving hydrogen production, storage, or utilization, must adhere to ATEX standards to ensure the safety of the facilities and personnel. This includes the use of ATEX-certified equipment, proper zoning and classification of areas based on the likelihood of the presence of explosive atmospheres, and implementation of safety measures to prevent ignition sources.

Compliance with ATEX directives is crucial to creating a safe working environment in industries where hydrogen is handled, reducing the risk of explosions, and ensuring that equipment meets stringent safety standard.

3.4 Hydrogen Flammable Mass and Volume

An extract from EHSP Guidance on Hydrogen Safety Engineering – Guidance Document 01 May 2023 summarises the flammable and explosive ranges of hydrogen as follows:

Flammable mass and volume are needed to estimate the size of the cloud which takes part in explosion.

1. Flammable limits of hydrogen in air: 4%-75%, this represents the most conservative approach.

2. Explosive limits in air can be considered for: a) 8%-75%, according to NFPA 2020, Annex I.7, there is no sustainable ignition at hydrogen at concentrations lower than 8%, [15]. b) hydrogen mass contributing to fast deflagration is within 10%-75% concentration range

3.5 Hydrogen Ignition

An extract from European Industrial Gases Association publication entitled GASEOUS HYDROGEN INSTALLATIONS EIGA Doc 15/21 summarises the ignition of hydrogen as follows:

Ignition of hydrogen-air flammable mixtures occur with very low energy input, about one-tenth that of a gasoline-air mixture. An invisible spark and / or static charge can cause an ignition.

Minimum spark ignition energy in air	*0.000019 joule (19 µJ)*
Minimum spark ignition energy in oxygen	*0.000017 joule (17 µJ)*

Hydrogen can burn in two modes. One mode of burning is called deflagration, in which the flame travels through the mixture at subsonic speeds. Another mode of burning is called detonation, in which the flame and accompanying shock wave travels through the mixture at supersonic speed.

A deflagration occurs when an unconfined hydrogen-air mixture is ignited. An unconfined condition means outdoors in a well-ventilated area where there are no obstructions such as buildings or walls. Flame velocity can greatly increase with confinement. A detonation can be built up from an ordinary deflagration that has been ignited in a confined or partly confined mixture.

4. RESULTS OF RISK ANALYSIS

4.1 Facility Risk Assessment

The ATEX directive article 4 (assessment of explosion risks) requires that an EPD is drawn up and within the document a demonstration shall be made that the explosion risks have been determined and assessed and that the results of the risk analysis be described. The term risk is differentiated from hazard since it is inclusive of not just the potential to cause harm (hazard) but also consideration of likelihood. For both hazard and risk, such considerations can be qualitative, semi-quantitative or fully quantitative estimations.

As part of the preparation of this EPD, a preliminary HAZID study is in progress for IBA transport, storage, and processing on site. The procedure for this was as follows:

The HAZID records the various deviations from ‘normal’ operation. Here ‘normal’ operation is defined as operation when the expected value ranges of different process variables are achieved and maintained; all prescribed procedures are implemented during every stage of the operation and no unexpected changes are made during the operation. The following table lists the deviation categories and a few probable causes. Once a deviation has been chosen for the selected system, different causes resulting in the deviation are analysed.

Deviations change depending on the type of system. For process safety deviations, see Table 4.1., and for warehouse/ storage deviations, see Table 4.2.

Table 4.1 Process Safety Deviations

Deviation	Examples (caused by:)
Overpressure	Blocked lines, faulty valves, condenser blockages, external fire, dust explosion, etc.
Underpressure	Closed valves, blocked vents etc.
Overfilling	Instrument failure, procedures, human error, stock control, etc.
Overtemperature	Cooling water failure, thermal runaway reaction etc.
Under-temperature	Heating failure, weather changes etc.
Loss of Containment	Impacts from moving objects, corrosion / erosion, excessive vibration, structural fatigue etc.
Others	Start-up / shut-down issues, maintenance issues etc.

Table 4.2 Warehouse/ Storage Deviations

Deviation	Examples
Infrastructure	Caused by: Mechanical failure, Physical Impact, Corrosion etc.
Mechanical	Caused by: Fork Lift Truck (FLT), Heating System Failure, Overloading of Racking, Ramp Failure etc.

Deviation	Examples
Electrical	Caused by: Charging, Wiring, Heater Failure, Cooling Failure, Utilities etc.
Natural Events	e.g. High/Low Temperature, Erosion, Lightning, Flooding, Snow Loading, High wind, Geology etc.
Handling	Caused by: Movement of Pallets, Dropped Objects, FLT Movements, Dust Explosion, Stock Rotation, Labelling, Human Factors, Fork Piercing, Speeding etc.
Loss of Containment	e.g. Aerosols and Storage Under Pressure, Corrosion/Embrittlement of Packaging etc.
Other	e.g. Security, Maintenance, External Fire, Incompatible Materials, Adverse or Unexpected Chemical Reactions, Cranes, Pest Control, Domino Initiators etc.

The HAZID also records the immediate cause for the selected deviation and the corresponding initiating event. For example, if the deviation is ‘overpressure’, a possible cause could be a vessel rupture following an attempt to offload to a vessel with a blocked vent. This could occur due to operator error, maintenance error etc.

An integral part of the risk assessment process is the allocation of values to represent the risks to people and/or to the environment because of each event. This was done on the HAZID tables for each event identified as a potential major accident.

Two values are assigned to rank the risk (R); severity (S) and likelihood (L). Severity is used to assess the potential consequences to people and the environment, and the likelihood rank qualitatively estimates the frequency of the event and is predominantly based on the experience of the HAZID participants.

Severity and likelihood values are assessed twice under the following headings:

Raw Risk: The initial ‘raw’ risk assumes that the hazard in question occurs, allowing worst-case values to be assigned to the likelihood and severity. In raw risk, all mitigative measures are ignored, e.g. vessels are stock (i.e. no pressure relief, high-level alarms etc.) and no account is taken for the ability to shut down.

Residual Risk: After the prevention, control, detection, and mitigation measures that were discounted in the raw risk have been documented; the risk values are then reassigned. By taking these measures into account the group can assign a ‘residual’ risk.

This two-stage method is particularly useful in that:

- the effectiveness of risk reduction measures is immediately evident.
- the criticality of a particular system can be ascertained and discussed; and
- if any residual risk values are too high, improvement plans can be put in place.

To ensure the study was carried out in a detailed and efficient manner, the plant was split into smaller systems of study, and the attendees covered a range of expertise with a knowledge of health and safety, production, engineering, and maintenance.

Detailed results of the 2024 Shed 3 IBA storage HAZID can be found in the HAZID Tables (Appendix 7)

4.2 Task-based Risk Assessment

Beauparc have a standard methodology of risk assessments/ safe systems of work (RA/SSOW) for individual tasks and scenarios across their sites, which have been applied to the Shed 3 IBA processing activities (Appendix 5). The individual risk assessments provide a list of the hazards (described as "Risks" in the document) which could potentially be encountered, the persons exposed to those risks and the various control measures which have been identified. The risk assessment also describes the relevant PPE required for the scenario and any information / training which is required for the activity of concern.

4.3 Hazardous Area Classification

4.3.1 Hazardous Area Classification Procedure

The potential hazard associated with this project is that of hydrogen which can be within the explosive range. The appropriate standard for area classification for areas where flammable liquids or vapours may be present is **I.S. EN IEC 60079-10:2021**

The methodology requires:

- Identification of the hazardous properties of the materials, e.g. flash point, Lower Explosive Limit (LEL), temperature classification, etc.
- Identification of the sources of release.
- Determination of the grade of release.
- Assessment of ventilation present.
- Classification into Zones 0, 1, 2 or non-hazardous (safe).

The definition of zoning follows from Directive 1999/92/EC where:

- Zone 0 is a place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.
- Zone 1 is a place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.
- Zone 2 is a place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

- Non-hazardous area (NH):

This is classified as an area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation, and use of apparatus

4.3.2 Classification Team

The classification team that completed the zoning for Rathdrinagh comprised:

- Donal Monahan (Beauparc)
- Emmet Nicholson (DPS)

4.3.3 Classification Considerations

Table D.1 – Zones for grade of release and effectiveness of ventilation

Grade of release	Effectiveness of Ventilation						
	High Dilution			Medium Dilution			Low Dilution
	Availability of ventilation						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
Continuous	Non-hazardous (Zone 0 NE)[a]	Zone 2 (Zone 0 NE)[a]	Zone 1 (Zone 0 NE)[a]	Zone 0	Zone 0 + Zone 2	Zone 0 + Zone 1	Zone 0
Primary	Non-hazardous (Zone 1 NE)[a]	Zone 2 (Zone 1 NE)[a]	Zone 2 (Zone 1 NE)[a]	Zone 1	Zone 1 + Zone 2	Zone 1 + Zone 2	Zone 1 or zone 0[c]
Secondary[b]	Non-hazardous (Zone 2 NE)[a]	Non-hazardous (Zone 2 NE)[a]	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 and even Zone 0[c]

[a] Zone 0 NE, 1 NE or 2 NE indicates a theoretical zone which would be of negligible extent under normal conditions.

[b] The zone 2 area created by a secondary grade of release may exceed that attributable to a primary or continuous grade of release; in this case, the greater distance should be taken.

[c] Will be zone 0 if the ventilation is so weak and the release is such that in practice an explosive gas atmosphere exists virtually continuously (i.e. approaching a 'no ventilation' condition).

'+' signifies 'surrounded by'.

Availability of ventilation in naturally ventilated enclosed spaces shall never be considered as good.

from IEC standard 60079-10-1

During design development, it has been found that natural ventilation cannot be credited, so hydrogen could accumulate at the apex of the roof of shed 3. If this was to remain un-vented, then a Zone 1 or 2 area would be created due to the accumulation of hydrogen, in a building where existing equipment has not been designed for operation in hazardous areas.

For this reason, continuous ventilation with backup electrical power supply has been included as the basis of safety with the target of always maintaining hydrogen concentration well below 25% of LEL. (Appendix 8).

• Design availability of ventilation for Beauparc can be considered Good: Present virtually continuously with generator backup.

• Providing a ventilation Velocity Uw across the stockpile, to achieve "High dilution" is not practical. However, the Buoyant velocity of Hydrogen (1.2 to 9m/s) make it in effect "self-ventilating" once an exhaust route is available. Very low quantities of hydrogen are releasing into a vast ventilated space and a case can be made for high dilution.

• That would then give an ATEX classification of Non-hazardous (Zone 0 NE) (Negligible Extent) and with the mitigation measures, justify the use of non-Hazardous equipment in the area.

• Action levels on detection are 10 times below 25% LEL, this factor is in effect also included.

4.4 Hazardous Area Classification Drawings

There are no Hazardous Area Classifications Drawings for this building.

4.4.1 Equipment

The equipment to be used for hydrogen detection and forced ventilation in the roof space of the shed will be suitably rated for the ATEX zoning classification..

4.4.2 Results of Area Classification

The results of the area study exercise and any subsequent alterations to it need to be placed on record.

4.4.3 Summary of Hazardous Areas Classification

The hazardous area classification for Rathdrinagh is summarised below:

Zone 0

There are no Zone 0 areas.

Zone 1

There are no Zone 1 areas.

Zone 2

The roof space measured 0.5m vertically from the ridge will be classified as Zone 2.

Non-hazardous

All areas below the 0.5m vertical distance from the ridge are zoned non-hazardous.

4.5 Ignition Sources

In those parts of the site identified by the hazardous area classification as zoned areas it is necessary to avoid sources of ignition. I.S. EN 1127-1 identifies thirteen possible mechanisms of ignition, as follows:

- Hot surfaces
- Flames and hot gases (including hot particles)
- Mechanically generated impact, friction, and abrasion
- Electrical equipment and components
- Stray electric currents, cathodic corrosion protection.
- Static electricity
- Lightning
- Radio frequency electromagnetic waves from 104 Hz to 3× 1011 Hz.
- Electromagnetic waves from 3×1011 Hz to 3×1015 Hz.
- Ionizing radiation
- Ultrasonic Waves
- Adiabatic compression and shock waves.

- Exothermic reactions, including self-ignition of dusts.

These 13 mechanisms for ignition are reviewed individually in the following sections of the EPD.

4.5.1 Hot surfaces

The only substance with the potential to generate a flammable atmosphere is hydrogen. The autoignition temperature of H_2 is 535°C (Section 3.1.2). Monitoring is present in Shed 3 for the concentrations of hydrogen. It is not expected that any equipment would reach this temperature in normal operation.

Equipment in hazardous areas at Rathdrinagh is rated for the appropriate zone. Instrument and motor lists are provided in Appendices 4 and 9.

4.5.2 Flames and hot gases (including hot particles)

There are no credible sources of flames or hot gases in the designated hazardous areas at the Rathdrinagh site in normal operation. If maintenance work requires the use of flames or hot gases within the designated hazardous areas the work will be subject to a 'Hot work permit'. The hot work permit should ensure that the work area where flames or hot gases are to be used will be free from flammable materials. It should also ensure that potential sources of hazard have been inhibited for the duration of the hot work. The atmosphere should be tested during the work and the hot work must be made safe if a threat from a potentially explosive atmosphere is perceived.

Under these circumstances, the occurrence of flames or hot gases in the hazardous area should not coincide with the presence of a potentially explosive atmosphere.

4.5.3 Mechanically generated impact, friction, and abrasion

When introduced in 2003, the ATEX directives placed specific requirements on duty holders to consider both mechanical and electrical ignition risks from equipment located within a hazardous area. For the Rathdrinagh Shed 3, all mechanical equipment selected and purchased for future installation into the designated hazardous areas will be selected in accordance with ATEX 114 (2014/34/EU).

Equipment which pre-dates 2003 has a requirement for the duty holder to ensure that it is fit for purpose by performing a risk assessment which is suitable and sufficient. This is typically achieved by conducting a Mechanical Equipment Ignition Risk Assessment based on the guidance of I.S. EN ISO 80079-36:2016 for non-electrical equipment in potentially explosive atmospheres.

4.5.4 Electrical equipment and components

All items of Electrical equipment permanently installed or temporarily used in Hazardous Areas must be selected in accordance with ATEX 114 (also referred to as 2014/34/EU) to ensure that they are suitable for use in that hazardous area.

Hazardous area electrically powered apparatus requirements have been explained to the EPS employees to prevent unsuitable apparatus or other potential sources of ignition being taken into hazardous areas. These controls apply to portable personal apparatus, e.g., mobile phones, uncertified pagers, matches, lighters, etc. which must be excluded from hazardous areas. Controls are also applied to work equipment such as drills, grinders, welding equipment etc., which can only be taken into a hazardous area under a hot work permit (see section 4.5.2 of this Explosion Protection Document).

A list of the instrument equipment items at Shed 3 Rathdrinagh will be provided in the Instrument List (Appendix 4). This list details the device tag number, location, relevant hazardous zone, device model, Motor Control Center, PLC Signals, Power, Field Connections, and Convertor location. This needs to be reviewed and updated against the HAC study (Appendix 12).

4.5.5 Stray electric currents, cathodic corrosion protection

Stray electric currents are prevented or protected from becoming a source of ignition by the correct selection, installation, inspection, and maintenance of electrically powered apparatus (see the section above).

Stray currents are also prevented from becoming a potential source of ignition by good equipotential bonding. Equipotential bonding is considered in the Static electricity section below.

According to the RA/SSOW (Appendix 5), '*Where possible electrical works must only be carried out on isolated equipment. Only trained and competent electricians are authorised to carry out electrical works on site.*'

No cathodic corrosion protection is used on site.

4.5.6 Static electricity

All metal or conductive vessels and pipes have equipotential bonding to one another and to earth such that the resistance to earth for any fixed metallic item is intended to be less than 10Ω and is certainly below 10,000Ω. The same approach applies to metallic or conductive instruments, gearboxes, motor cases etc. Main equipment items and equipment requiring earthing are done according to the I.S.10101:2020 standard.

The site conducts earth bonding testing, with a periodic inspection report carried out every 5 years. This document requires the electrician to test equipment and associated pipework within zoned areas and to record any defects found prior to resolution.

The most up to date testing was performed in xxxx (compliant with the sites' own requirements) and the record sheets show evidence of fault finding and fault correction. The testing included main earth termination points.

4.5.7 Lightning

No lightning protection is used on site. This was determined using a risk assessment completed according to I.S. EN 62305-1:2011 (Appendix 14).

4.5.8 Radio frequency electromagnetic waves from 104 Hz to 3× 1011 Hz

No specific consideration has been made to risks from Radio Frequency Ignition Risks on-site.

Such work involves reviewing guidance such as I.S. CLC TR 50427 – 2005 and performing the relevant assessments which can then be placed within this EPD or cross referenced. The I.S. CLC TR 50427 – 2005 guide, which describes how to perform this involves an initial assessment in Section 10.2.2 of the guide and identifies if a hazard exists. Should the conclusion of the screening process indicate a hazard, then a full assessment is performed (Section 10.4 of the standard).

4.5.9 Electromagnetic waves from 3×1011 Hz to 3×1015 Hz

I.S. EN 1127-1:2019 details how "radiation in this spectral range can – especially when focused – become a source of ignition through absorption by explosive atmospheres or solid surfaces". Examples used are "sunlight which can trigger an ignition if objects cause convergence of the radiation (e.g., bottles acting as lenses, concentrating reflectors)". This specific example is not credible for the Rathdrinagh site within building units or where potentially explosive atmospheres are contained by e.g., gas holders etc.

The standard then goes onto suggest that; "under certain conditions, the radiation of intense light sources (continuous or flashing) is so intensively absorbed by dust particles that these particles become sources of ignition for explosive atmospheres or for dust deposits". As no flammable dusts are stored in these conditions on site, this is no issue.

Finally, the standard states that; With laser radiation (e.g., in communications, distance measuring devices, surveying work, visual-range meters), even at great distances, the energy or power density of even an unfocussed beam can be so great that ignition is possible. Here, too, the process of heating up occurs mainly when the laser beam strikes a solid body surface or when it is absorbed by dust particles in the atmosphere or on dirty transparent parts. No lasers are used on site for any purpose, so this is not credible. If any lasers are to be used, this will be under a Permit to Work.

4.5.10 Ionizing radiation

Sometimes, ultraviolet radiation is used on sites for disinfection of process water sprays. It is unknown if such a unit is used on the Rathdrinagh site for cleaning water purposes and as to whether it could credibly be used to such an extent in Shed 3 to be considered an ignition source.

4.5.11 Ultrasonic Waves

Ultrasonic devices are sometimes used on process plants for level measurement. There are no liquid storage tanks in Shed 3, so this is not considered to be a credible ignition source.

4.5.12 Adiabatic compression and shock waves

There is no credible source of adiabatic compression or shockwaves of any kind either inside the plant or close enough to the plant to be a hazard. This is not a credible source of ignition.

4.5.13 Exothermic reactions, including self-ignition of dusts.

I.S. EN 1127 details how *"exothermic reactions can act as an ignition source when the rate of heat generation exceeds the rate of heat loss to the surroundings and how temperature is dependent, among other parameters, on the volume/surface ratio of the reacting system, the ambient temperature, and the residence time. These high temperatures can lead to ignition of explosive atmospheres and the initiation of smouldering and/or burning"*.

The thermite reaction between iron oxide (rust) and more reactive metals, e.g. aluminium, is a well-known exothermic reaction. FM Global Property Loss Prevention Data Sheet 7-85 recommends '*Limit thermite ignition sources by ensuring metal equipment surfaces remain free and clean of any metal oxides or scale (e.g., rust on iron or steel surfaces). When present, include potential thermite sources as part of the housekeeping inspections*.'

4.6 Hazards due to Malfunction

Malfunction of equipment / instrumentation is included (at a high level) in the HAZID study. This identifies the risk associated with malfunctions and safeguards in place to prevent and mitigate risks.

The hydrogen sensors, extract fans and supporting power supply for Shed 3 link back to an alarm system. These monitors identify hydrogen gas levels, by giving indication and warning of flammable hazards due to sensor malfunction, such as blockage, or fan/ventilation failure.

Check sheets are also completed weekly for notes / comments on odours / gases around the site.

4.7 Start-up / Shutdown

Since the IBA processing operation only occurs during the day, the IBA processing line is shut down at night. It is currently intended to switch off the exhaust fans at night to save electricity. Every day, prior to introduction of fresh IBA to Shed 3, it is important to ensure that all the exhaust fans are running as well as running the processing line without material. After all the fresh IBA has been processed at the end of the day, it is also important to run the line to ensure that there is no residual unprocessed IBA in the building. It is also important to confirm that there are no active alarms on hydrogen sensors, fans or (emergency) power supply. As site carries out safe procedures covered by Risk Assessment / Safe System of Work (RA/SSOW) (Appendix 5), and requires a work permit for any abnormal operations, this should be sufficient to identify any risks of flammable atmospheres which may have been generated by the shutdown and start-up conditions.

4.8 Cleaning

Standard cleaning operations are carried out daily after IBA processing covered by Risk Assessment / Safe System of Work (Appendix 5) to ensure safe operation of the mechanical equipment and to avoid accumulation of unprocessed fresh IBA.

Non-standard cleaning operations are carried out using a work permit to identify additional hazards, including flammable atmospheres which may be apparent.

4.9 Process / Product Changes

It is envisaged that Shed 3 will be dedicated for IBA processing, and there are no regular product changes.

For significant changes to the process, the Management of Change (MOC) procedure will be carried out. MOC procedures should consider whether a process or plant change impacts or creates a zoned area, by increasing flammable substances, ignition sources or confinement, and whether additional protection measures are required.

5. EQUIPMENT INSPECTION

Beauparc maintenance procedures ensure particular attention is paid to the regular checking and maintenance of the facility, especially any equipment/plant items that can act as ignition sources, e.g. bearings or belts. There is a preventative maintenance system in place, which is linked to the site quality management system.

There is a range of health and safety checklists that are completed on a daily, weekly, or monthly basis by site personnel or the site H&S staff.

In addition, there is a phone app that enables any member of staff to report issues as they are identified.

5.1 Electrical Equipment Inspection

A list of instruments at Rathdrinagh Shed 3 is provided in Appendix 4. Inspections of these equipment items are scheduled to take place at routine intervals. Periodic inspections are carried out under the Periodic Inspection Report for all electrical assets over a 3-year period. Intervals between inspections and maintenance are decided based on manufacturers guidance.

There are also lists of motors used on the exhaust fans for Rathdrinagh. These documents provide the zoned area where motors are located (see Appendix 9).

The inspections of electrically powered equipment in hazardous areas may be carried out by a third-party contract company.

Inspectors of electrically powered equipment in hazardous areas must be ‘CompEx’ trained or have an equivalent level experience and understanding of Ex protected electrically powered equipment.

Inspection records are kept within the plant file in the operations department records.

Non-compliance of any item is identified at the time of inspection. The non-compliant equipment will be risk assessed. Depending on the category of non-compliance it will either be immediately isolated (for ignition capable non compliances) or permitted to remain in service (for minor non compliances, e.g., illegible label or circuit tag missing) until the non-compliance is rectified.

In all cases of non-compliance, remedial work will be scheduled to return the item to compliance within an appropriate period.

A standard for zoned area electrical inspection procedures typically used across industry is IEC EN 60079-17.

5.2 Mechanical Equipment Inspection

Equipment lists are shown in Appendix 4 and 9, and the List of Equipment for Area Classification (LEAC) (Appendix 13) shows all equipment within zoned areas.

Inspection and repairs are carried out periodically as decided through appropriate methods such as manufacturers recommendations.

Mechanical Equipment Ignition Risk Assessment (MEIRA) should be carried out for this equipment.

6. Organisational Measures

6.1 Operating Instructions

The company maintains a full catalogue of operating procedures or risk assessed method statements that are either global throughout the business or specific to facilities or activities.

6.2 Competency Management

Training, SOPs, and PPE in place for working with dangerous substances in line with the RA/SSOW (Appendix 5).

Competency requirements are defined in the RA/SSOW for drivers and machinery operators.

6.3 Emergency /Incident Response

An Emergency Response Plan (ERP) (Appendix 2) already exists for the Rathdrinagh site. The specific actions and procedure to be undertaken in the event of an explosion should be detailed in the ERP with similar initial response to that already stated for fire in terms of notifications and evacuation. The plan will be updated to state that Shed 3 and vehicles containing fresh IBA are the only areas where explosion risk exists due to the presence of hydrogen.

The site Emergency Plan is currently in its 4th revision, dated 21/11/2023. The emergency plan review schedule is for testing at intervals not exceeding 12 months and more frequently if required (i.e. if the result of a test highlights deficiencies in the emergency plan).

6.3.1 Means of Escape

A plan of the premises is available in a visible location to people entering and exiting the building.

The plan indicates the location escape routes, firefighting equipment, gas, electricity, the control panel for any fire detection or alarm system, installations such as fuel and oil tanks, and other areas of high fire risk by reference to the point at which the plan is displayed.

A floor plan is displayed in a prominent position in each area indicating the escape routes by reference to the point at which the plan is displayed.

A copy of the Plan is included in the Emergency Pack for the Officer in charge of the Emergency Services.

All plans are displayed on durable material, are easily legible and of a suitable scale.

It is the responsibility of the Fire Officer to ensure that this plan is up to date, displayed in the appropriate location and revisions communicated to the appropriate staff. Since these documents are generic, site wide and applicable to all plants and processes they are not individually referenced within the EPD, although form a part of compliance.

6.3.2 Accident and Incident Reporting

The RA/SSOW (Appendix 5) indicates to '*always report all Hazards, Incidents & Threats (HITs)*'.

6.4 Training Provision

Staff induction training informs employees of the company's approach to safety and to the safety procedures and requirements throughout the company and at each company facility. Training programmes are designed to inform employees of the need to work safely and have the necessary knowledge and skills to do so.

The training is supported by a continuing effort on the part of the Company's SHEQ team and Supervisors to provide information and guidance to employees with a view to eliminating any unsafe working practices, which might develop.

6.5 Mobile Work Equipment

The RA/SSOW (Appendix 5) describes hazards and safeguards associated with operation, maintenance, and cleaning of the trommel used for removing oversized material.

6.6 Personal Protective Equipment

The RA/SSOW (Appendix 5) states the personal protective equipment (PPE) and respiratory protective equipment (RPE) to be used while working in Shed 3. Personal gas monitors and occupational air and gas monitoring are also required for the front end loader (FEL) trommel operator.

6.7 Permit-to-Work

Additionally, a written authorisation is required for special work, such as welding, grinding, or maintenance of electrical equipment in areas that have been identified as subject to an explosion or fire hazard, i.e. a hot work permit, working at height within the classified zone in Shed 3 as described in the RA/SSOW (Appendix 5).

6.8 Marking of Hazardous Places

Directive 1999/92/EC stipulates that the points of entry to places where hazardous explosive atmospheres may occur in such quantities as to endanger the health and safety of workers must where necessary be marked by the employer with the following warning sign:

Figure 6.8.1 Warning sign for places where explosive atmospheres may occur.

Distinctive features: Triangular shape: Black letters on a yellow background with black edging

The yellow part is to take up at least 50 % of the area of the sign.

ATEX signs have not yet been installed. The company intends to install signs in the locations identified below.

ATEX Signs Locations

Identification Number	Location of Ex Signs
1 & 2	On entry to Shed 3
3 to 6	Internal
6 to 19	

Anybody taking out a permit to work in a hazardous area is required to be made aware of the hazardous area in which they are about to work.

7. Coordination of the Explosion Protection Measures

The Explosion Protection Document will be stored in a marked file within the Slane site manager's office.

All project engineers who will be making changes will be trained in ATEX and made aware of the Explosion Protection Document and the necessity to review it when making a change and assess if the change affects the Explosion Protection Document.

If it does the project engineer will inform the engineering manager/safety officer and safety engineer that the Explosion Protection Document will have to be updated to represent the change. The project engineer will update the Explosion Protection Document, and this will be reviewed and approved by the engineering manager/safety officer and safety engineer. For clarity the project engineer could be an employee of the company availing of external expertise to manage particular risks such as ATEX or an external advisor specifically engaged to provide specialist advice directly.

The RA/SSOW (Appendix 5) defines induction requirements for employees, visitors, and contractors.

7.1 Implementation of the Explosion Protection Measures

The persons responsible for maintenance of equipment and explosion protection measures on the site are:

The persons responsible for maintaining and updating the Explosion Protection Document are:

(Note: probably need to appoint a competent advisor – e.g. SLR)

8. Explosion Protection Document Review

The EPD thus will be a live document that can be revised e.g. from Rev A to Rev B, and so on.

8.1 Review / Update Periodicity

This EPD, and relevant supporting documents, should be reviewed at a period of no less than 3 years, or when significant changes to the plant, process or substances used occurs.

8.2 Recommendations

Based on the zonings laid out in this report the following recommendations are suggested:

- Review procedures to ensure that they address ATEX compliance.
- Provide ATEX awareness training and instruction for all employees.
- Carry out refresher training at an agreed frequency. EPD to be issued to staff and training to take place.
- Update the Site Safety Booklet for visitors and contractors to include information on explosion protection and ATEX requirements.
- Signage should be displayed at suitable points near zones.
- Out of hours notifications of hydrogen levels and emergency power activation should be communicated to an on-call person.
- The Safety Statement should be updated to include explosion prevention and protection. This should be brought to the attention of employees and others who may be affected. (The hot work risk assessment will be updated based on the zoning for ATEX).
- Nominate an ATEX coordinator for the site.

  The ATEX Coordinator should satisfy the following requirements:

  - Must have explosion protection expertise.
  - Knowledge of the national regulations transposing Directives 89/391/EEC and 1999/92/EC (Health & safety and ATEX).
  - Knowledge of the firm's organisational structure.
  - Leadership qualities to ensure that the necessary instructions are put into effect.

The duties of the coordinator comprise site inspections and coordination meetings, as well as planning, supervision and, if necessary, re-planning of work in response to difficulties arising.

- The various staff, the contractor(s) and all others working on the site should provide the coordinator in good time with the following information:
  - Work to be undertaken;
  - Planned start of work;
  - Anticipated end of work;
  - Place of work;
  - Workers assigned;
  - Planned method of work plus measures and procedures for implementing the explosion protection document;
  - Name of the person(s) in charge.
- No modification to equipment or operating procedures should be made without discussion with the ATEX Coordinator.

- Full review of ATEX compliance by external independent consultant prior to processing IBA and within 7 days of commencing processing and storage, and thereafter on monthly basis or other interval determined by the ATEX coordinator.
- The complete system for compliance with the ATEX requirements will be incorporated into the company's compliance system for Safety Health Environment and Quality (SHEQ).
- Limit thermite ignition sources by ensuring metal equipment surfaces remain free and clean of any metal oxides or scale (e.g., rust on iron or steel surfaces). When present, include potential thermite sources as part of the housekeeping inspections.
- The specific actions and procedure to be undertaken in the event of an explosion should be detailed in the ERP with similar initial response to that already stated for fire in terms of notifications and evacuation. The plan should be updated to state that Shed 3 and vehicles containing fresh IBA are the only areas where explosion risk exists due to the presence of hydrogen.

9. REFERENCES

9.1 Relevant Standards

I.S. EN 1127-1: 2019 Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology

I.S. 10101:2020, National Rules for Electrical Installations

I.S. EN 60079-10-1:2021, Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres

I.S. EN 60079-10-2:2015, Explosive atmospheres – Part 10-2: Classification of areas – Combustible dust atmospheres.

I.S. EN 60079-14: 2014, Explosive atmospheres – Part 14: Electrical installations design, selection, and erection

I.S. EN 60079-17:2014, Explosive atmospheres – Part 17: Electrical installations inspection and maintenance

I.S. EN 60079-19:2019, Explosive atmospheres – Part 19: Equipment repair, overhaul and reclamation

I.S. EN 60079–25:2022, Explosive atmospheres – Part 25: Intrinsically safe electrical systems

IEC TS 60079-32-1:2018, Electrostatic hazards, guidance

I.S. EN 80079–36: 2016 Explosive atmospheres – Part 36: Non-electrical equipment for explosive atmospheres – Basic method and requirements

9.2 Relevant Guidelines

I.S. CLC TR 50427:2005, Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation - Guide

FM Global Property Loss Prevention Data Sheet 7-85: July 2002, Combustible and Reactive Metals

10. APPENDIX 1 SITE LAYOUT

11. APPENDIX 2 SITE EMERGENCY PLAN DOCUMENT

12. APPENDIX 3 – PROCESS FLOW DIAGRAMS

13. APPENDIX 4 AS-BUILT INSTRUMENT LIST

14. APPENDIX 5 HSQE PLAN

15. APPENDIX 6 MATERIAL SAFETY DATA SHEETS

1.1 WRc Test Report

1.2 Detritus Report WRc Test Report

16. Appendix 7 Risk Assessments

17. Appendix 8 Hazardous Area Zoning Document

18. APPENDIX 9 MCC MOTOR LISTS

19. Appendix 10 Operating Instructions (SOP)

20. APPENDIX 11 SOP TEMPLATE

21. APPENDIX 12 HAZARDOUS AREA CLASSIFICATION DOCUMENT

22. Appendix 13 List of Equipment for Area Classification (LEAC) Document

23. APPENDIX 14 LIGHTNING PROTECTION DOCUMENT