Environmental Permit Application – Supporting Documentation Appendix G1- Qualitative Environmental Risk Assessment

Sawston Pilot Plant

Immaterial Limited

Unit 3, Cambridge South Business Park, Sawston, Cambridge, CB22 3FG

Prepared by:

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Revision Record

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Table of Contents

Tables in Text

1.0 Introduction

This Qualitative Environmental risk Assessment has been prepared in support of an application for a new bespoke Environmental Permit (EP) for an Installation to operate a Schedule 1 Part 2 Section 4.1 Part A(1) (a) activity 'Producing organic chemicals such as – (vii) organometallic compounds'.

The Operator will be Immaterial Limited, and the site is located at Unit 3, South Cambridge Business Park, Sawston, Cambridge, CB22 3FG (the site).

This Environmental Risk Assessment (ERA) provides a qualitative assessment of the risks to the environment and human health from accidents, odour, noise, and fugitive emissions that may be associated with the operations at the facility.

1.1 Methodology

The assessment has been completed in accordance with EA Technical Guidance 'Risk Assessments for your Environmental Permit' dated August 2022. The aim of the assessment is to identify any significant risks and to demonstrate that the risk of pollution or harm will be acceptable by taking the appropriate measures to manage these risks. The EA Guidance requires all receptors that are near the site and could reasonably be affected by the activities to be identified and considered as part of the assessment.

This ERA should be read in conjunction with the full set of technical documentation prepared in support of the permit application.

1.2 Site Activities to be Permitted

The permit application is for a bespoke Environmental Permit for an Installation to operate a Schedule 1 Part 2 Section 4.1 Part A(1) (a) activity 'Producing organic chemicals such as – (vii) organometallic compounds'.

Table 1: Scheduled Activities

Activity Reference	Activity Listed in Schedule 1 of the EP Regulations	Description of Specified Activity	Limits of Specified Activity
AR1	Section 4.1 A(1)(a)(vii) - Producing organic chemicals such as- organometallic compounds (for example lead alkyls, Grignard reagents and lithium alkyls);	Producing Organic Chemicals such as: densified metal-organic framework (MOF) materials	From receipt of raw materials to storage and despatch of finished product.

The activities proposed to be undertaken at the pilot plant will utilise pilot scale production equipment (reactors, blender, tray dryers) in order produce densified metal-organic framework (MOF) materials.

The plant will also be used to undertake and optimise scale up from laboratory scale testing and will also be used to gather Intellectual Property to enable the commercialisation of the proprietary process technologies and products.

The plant is intended to initially produce 6 and 12 tonnes of product per annum, with the potential for increased hours of operation increasing the production capacity up to around 20 tonnes per annum. The materials produced will be sold on for use by third parties for them to use in the development and testing of industrial scale end uses for the materials

The processes to be undertaken at site all involve the reaction of metal salts with organic materials and in some cases metal hydroxides in the presence of a solvent (either an organic solvent, water or other non-VOC solvents depending on the process), and other additives to generate densified metal-organic framework (MOF) product materials with subsequent recovery and purification processes. All processing will be on a batch basis with each stage of the process being able to operate independently.

A detailed process description, including details on the potential emissions to the environment are presented in the main technical supporting document submitted with as part of the application.

The Installation is still going through the design process and hence there are certain specific details of the site activities that are yet to be finalised. However, the design approach is intended to ensure that the final plant design and associated operational controls (e.g. the Environmental Management System) will be fully compliant with the requirements of Best Available Techniques (BAT) and appropriate Environment Agency guidance in advance of commencement of commissioning and operation of the processes.

1.3 Operation of the Installation and Management System

The Installation will be managed by technically competent personnel in accordance with an Environmental Management System (EMS) and associated operating procedures. This will ensure good practice on site and minimise environmental risk throughout the operation.

2.0 Identifying the Risks

Table 2-1 provides a summary of the potential environmental risks at the site; identifying those that can be screened out as not relevant (grey shaded) and the type of risk assessment carried out for those that are identified as relevant and the location of that assessment.

Table 2: Scope Of Risk Assessment

Risk Type	Relevant	Justification	Type of Risk Assessment	Location of Assessment
Air Emissions	Yes	Release of volatile organic compounds (VOC) from onsite production.	Air Emissions Risk Assessment (AERA)	Application Supporting Documentation Appendix E
Photochemical Ozone Creation Potential	Yes	Release of volatile organic compounds (VOC) from onsite production	Photochemical Ozone Creation Potential Assessment	See Section 4.1 of this document
Global Warming Potential	Yes	Release of VOCs, direct emissions of CO_2 from gas-fired boiler and indirect emissions of CO_2 from the use of electricity	Global Warming Potential Assessment	See Section 4.2 of this document
Soil and Groundwater Pollution Risk	Yes	Potential for loss of Relevant Hazardous Substances to Ground.	Soil and Groundwater Pollution Risk Assessment	Application Supporting Documentation Appendix B1 – Section 4
Groundwater (for groundwater activities only)	No	No direct discharge to groundwater is proposed	Not Required	N/A
Surface Water	No	There are no direct emissions to controlled waters from the Installation	Not Required	N/A

Risk Type	Relevant	Justification	Type of Risk Assessment	Location of Assessment
Sewer	No	There will be no discharge of effluents directly generated by the main process activities to sewer. There will however be the following discharges into the municipal sewer from the Installation • General site sewage from staff welfare facilities e.g. toilets / sinks etc. • Reject water from the site water deionisation unit. None of these discharges to sewer will contain potential environmental pollutants.	Not Required	N/A
Odour	Yes	No use of particularly odourous materials at the site. However acetic acid can be generated by the reaction process.	Qualitative Risk Assessment	See Section 4.3 of this document
Accidents	Yes	Potential for emissions from equipment failure etc.	Qualitative Risk Assessment	See Section 4.4 of this document
Noise & Vibration	Yes	Use of mechanical equipment	Noise Impact Assessment (NIA)	Application Supporting Documentation Appendix F
Fugitive Emissions	Yes	Dust, pests litter Emissions to air of VOCs	Qualitative Risk Assessment	See Section 4.5 of this document
Visible Emissions	No	No visible plume	Not Required	N/A
Bioaerosols	No	None emitted	Not Required	N/A

3.0 Site Setting and Receptors

The site address is: Unit 3, South Cambridge Business Park, Sawston, Cambridge, CB22 3FG.

The site is centred on grid reference TL 49004 50410 and is around 0.21 hectares in size. Immaterial is the leaseholder of the site.

A site location map is presented in Appendix A – Figure 1 of the application supporting documentation.

The site is located on the northern outskirts of Sawston, approximately 8 kilometres (km) southeast of Cambridge city centre. Surrounding land use is a mix of residential, agricultural, commercial and light industrial. A development plot is present to the northeast, light industrial and commercial properties are adjacent to the southeast and northwest and residential properties are present to the southwest.

Table 3 presents a summary of the surrounding land use, for the purpose of this report:

- A 2km radius from the site's proposed EP boundary has been adopted in reviewing potentially RAMSAR, SAC, SPA and SSSIs and sensitive receptors of ecological importance along with features such as Sites of Cultural and Natural Heritage; and
- A radius of 500m from the site's EP boundary has been adopted for all other potentially sensitive local receptors (for example, residential, commercial, industrial, agricultural, and surface water receptors).

Table 3: Surrounding Land Uses

Receptor / Feature	Description
Residential	A residential housing estate is located to the south and southwest of the site. The nearest residential property is on Broadmeadow (No.57) which is approximately 35m from the site boundary. There is also a single residential property – North Farm located approximately 275m to the northeast of the site.
Commercial and Industrial	The site is located on an industrial estate (Cambridge South Business Park) with other industrial / commercial units located immediately adjacent to the northwest and southeast perimeter of the site boundary and further industrial / commercial units to the southeast of the site (Dales Manor Business Park and South Cambridge Business Park) A vacant plot earmarked for development as further Industrial / commercial units is located immediately to the northeast of the site
Schools / Hospitals	There are no schools or hospitals located within 500m of the site. The nearest school is The Icknield Primary School located around 750m to the southeast of the site. There are no Hospitals within 2km of the site
Open Ground / Agricultural	There is open agricultural land located to the north and northeast of the site starting approximately 150m from the site
Recreational	The Cambridge City FC football stadium is located approximately 100m to the northwest of the site

Receptor / Feature	Description
Surface Water Features	Details are presented in Section 2.1.3 of the Site Condition Report presented in Appendix B1 of the Application Supporting Documentation
Geology, Hydrogeology and Hydrology	Details are presented in Section 2.1.1 – 2.1.3 of the Site Condition Report presented in Appendix B1 of the Application Supporting Documentation
Flood Risk	Details are presented in Section 2.1.4 of the Site Condition Report presented in Appendix B1 of the Application Supporting Documentation
Ecological Sites and Habitats	Details are presented in Section 1.1.6 of the Site Condition Report presented in Appendix B1 of the Application Supporting Documentation

4.0 Environmental Risk Assessment

4.1 Photochemical Ozone Creation Potential (POCP)

An assessment of the annual VOC emissions for the site for photochemical ozone creation potential (POCP) has been undertaken. This is summarised in Table 4.

The POCP for the Installation will vary significantly based upon a number of factors including:

- The product being produced;
- The solvent required for the product being produced;
- The number of process stages operating;
- The duration of each process stage;
- The target plant throughput; and
- The number of operational hours;

It is not therefore possible at this stage to advise exactly what the actual likely power usage at the site will be, and this will be reviewed as the process design progresses, and again on commissioning and initial operations.

It is also noted that the use of VOC solvent in use at the installation will be either ethanol or methanol depending on the product being processed, and for some products the solvent used in the reaction will not be a VOC. Simultaneous use of both VOC solvents (ethanol and methanol) will not occur. Table 4 presents the maximum credible emission of each VOC solvent species to define the maximum credible POCP for the site.

Table 4 presents an indicative estimate of POCP based on the plant operating 5 days per week and for 8 hours per day, and with up to 50% of the process plant operating at any one time. The annual mass emission of the named VOC's has assumed continual emission at the proposed mass emission limits as defined in Table 11 of the main technical supporting document to the Application.

Table 4: Photochemical Ozone Creation Potential (POCP) Assessment

Substance	Annual Mass (Tonnes)	POCP for Chemical	Annual POCP - Site
Methanol or	1.13	14	45.37 or
Ethanol	0.82	39.9	11.44
Maximum POCP			45.37 (assuming use of methanol only throughout the year)
POCP values taken from: Horizontal Guidance Note Environmental Assessment and Appraisal of BAT - H1 Annex F – Air Emissions: Appendix A - Photochemical Ozone Creation Potential dated July 2023.			

Commented [LB1]: ESHA - include in glossary

4.2 Global Warming Potential Assessment

4.2.1 Direct Emissions

The onsite natural gas fired hot water boiler will emit carbon dioxide.

The VOC's emitted to atmosphere are not considered to represent direct impact greenhouse gases and as such are excluded from the calculation.

The chiller / refrigeration system used to provide chilled water to the site users will contain refrigerant gas. However, these will be within a sealed system and are not expected to be routinely released to air and as such are excluded from the calculation.

4.2.2 Indirect Emissions

The process generates indirect emissions from the use of electricity to heat and power the site.

4.2.3 Calculation of Global Warming Potential

Table 5 presents a calculation of the maximum theoretical energy usage assuming all plant is operating continuously 24 hours per day 7 days per week. – this is not considered to represent a likely operating scenario, but has been provided to give an indication of the theoretical upper envelope of energy use at the site

Table 5: Global Warming Potential – Maximum Possible Emissions

Energy Source	Estimated kWh per Year	Conversion Factor (1)	CO_2 Equivalent kg
Electricity	2,330,160	0.22535	525,102
Gas	1,489,200	0.20264	301,771
Total			**826,873**

Notes: 1) CO_2 conversion factors taken from UK Government GHG Conversion Factors for GHG Reporting 2024 Greenhouse gas reporting: conversion factors 2024 - GOV.UK :

- 0.20264 kg CO_2e / kWh natural gas,
- 0.20705 kg CO2e / kWh grid electricity generated; plus
- 0.01830 kg CO2e / kWh grid electricity transmission and distribution losses

Table 6 presents a calculation of the more likely theoretical energy usage at the site in the initial phase of operation assuming that the plant operates 5 days per week and for 8 hours per day with up to 50% of the process plant operating at any one time, and the gas boiler only operating at 50% load.

Table 6: Global Warming Potential – Estimated Likely Annual Emissions

Energy Source	Estimated kWh per Year	Conversion Factor (1)	CO_2 Equivalent kg
Electricity	388,360	0.22535	87,517
Gas	248,200	0.20264	50,295
Total			**137,812**

4.3 Odour

In consideration of the anticipated volumes of raw materials and products / wastes present on site, as well as their low / negligible associated odour potential, these are not anticipated to be a significant source of odours.

However as acetic acid can be generated by the reaction process and has the potential to be vented to atmosphere via the channelled air emission systems, this is considered a potential source of odour.

Potential maximum theoretical emissions of acetic acid and the potential for offsite air quality impacts have been assessed in the Air Emissions Risk Assessment (Application Supporting Documentation Appendix E). The AERA has identified that the emissions generated will not lead to any significant air quality impacts but has not specifically reviewed the risk of offsite odour impacts occurring, the results are summarised in Table 7.

Table 7: AERA Results for Acetic Acid

Pollutant	Averaging Period	PC (µg/m^3)
Acetic Acid	1-Hour Mean	22.1

It should be noted that these results are based upon the assumed coincident operation of all process units with maximum coincident emissions, reflecting a precautionary approach. It is also noted that the H1 screening tool that was utilised for the AERA is known to provide precautionary results.

In reality, it is expected that reactors 1 and 2 will not operate coincidentally, and peak emissions from each of the remaining process stages are also unlikely to actually have coincidental peak emissions. As a result of this, emissions are anticipated to be lower than those assessed within the AERA, and hence the short-term peak offsite concentrations of acetic acid are also expected to be lower than that presented in Table 7 above.

The original H4 guidance issued in 2002 included an Odour Threshold Value (OTV) for acetic acid of 0.043 mg/m³. This OTV represents the anticipated concentration of acetic acid at which the odour becomes perceptible to a human assessor. In reference to Table 7 above, the maximum predicted short-term (hourly average) concentration of Acetic Acid is 22.1µg/m^3, which is well below the OTV outlined within the 2002 H4 guidance. As such, potential emissions of acetic acid from the process are not anticipated to be perceptible to nearby sensitive receptors. Therefore, it is considered unlikely that there would be any adverse impacts upon amenity as a result of potential emissions of acetic acid.

4.4 Accident Risk Assessment

A qualitative assessment of fugitive emissions risk is provided in Table 8.

4.5 Fugitive Emissions

A qualitative assessment of fugitive emissions risk is provided in Table 9.

Table 8: Accident Risk Assessment

Hazard	Receptor	Pathway	Risk Management	Probability of Exposure	Consequence	What is the Overall Risk
Loss of containment onsite Spillage and Leakage of raw materials and other potential pollutants	Underlying soils and groundwater	Direct loss to ground	The Soil and Groundwater Pollution Risk Assessment presented in Section 4 of the Site Condition Report (Application Supporting Documentation Appendix B1) presents a full appraisal of potential impacts and the pollution prevention and control measures in place.	Low for all materials stored within the building Medium in the event of spillage whilst loading or loading IBC's into the storage unit, or onto road vehicles outside the building,	Spillage to building floor Contamination of soil and groundwater underlying the site.	Low for all materials stored within the building Medium in the event of spillage whilst loading or loading IBC's into the storage unit, or onto road vehicles outside the building, Note that Immaterial will be reviewing additional options to minimise the risk of loss of material to ground associated with the storage and handling of bulk flammable materials in IBC's outside the building.
Fire / explosion	Air – smoke and products of combustion Local receptors Adjacent commercial units Soil and Groundwater for contaminated firewater	Air Direct flow to ground (contaminated firewater)	The process has been designed to minimise the risk of fire or explosion occurring and all key processes where VOC's are present are inerted with nitrogen. The detailed design of the plant is still ongoing, and this will include the design of the fire prevention, fire identification and monitoring and fire response systems. Consideration will also be given to the type of fire suppression that would be used to fight a fire at the site and whether firewater would be used, or alternative firefighting methods e.g. powder, inert gas, CO_2, etc. Only once this has been completed will the site have sufficient detail to advise on likely firewater volumes and the containment provisions required The site EMS will include the development of incident and fire response procedures, and appropriate training will be provided to site staff. All flammable materials will be stored in the dedicated IBC store outside the building and only moved into the building when in use, so as to minimise the risk of a significant fire within the building.	Low – on the assumption that suitable control measures will be in place.	Human health impacts(air) Soil / groundwater contamination (contaminated firewater)	Low Firewater risk to be re-assessed once the plant design has been completed.

Hazard	Receptor	Pathway	Risk Management	Probability of Exposure	Consequence	What is the Overall Risk
Vandalism/Security Leading to loss of containment	Local Residents and businesses (air emissions) Soil and Groundwater (Loss of containment – liquids)	Air Direct loss to ground	The main site building will be secured at all times, the majority of the site activites and storage are within the building. The need for security systems at the site e.g. CCTV will be reviewed prior to commencement of operations. IBC's of flammable liquids will be stored outside the building within a dedicated bunded storage unit, this will be secured at all times when not being accessed by site staff. The site management team will be responsible for implementing risk management measures in accordance with appropriate procedures outlined in the EMS.	Low	Theft. Spillage of materials Harm to human health. Pollution risks are similar to those assessed in the soil and groundwater pollution risk assessment,	Low.
Flooding Leading to loss of pollutants into flood water	Soil, Groundwater, nearby watercourses Local residents and nearby commercial premises	Flood waters flow into site and then away over land.	The Flood Map for Planning reveals that the site lies within Flood Zone 1: designated as low probability of flooding from rivers and the sea. As the site is <1 hectare in size, and in a Zone 1 flood risk area, a flood risk assessment (FRA) would not typically be required. The Long-Term Flood Risk Assessment indicates that the site is at 'low risk' of flooding from surface water. Low risk means that this area has a chance of flooding of between 0.1% and 1% each year. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding. All materials will be stored within appropriate storage areas on site and on appropriate racking or in bespoke storage units.	Low	Contaminated flood waters impacting land, groundwater and possibly watercourses	Low
Failure of site surfacing / site secondary containment	Soil and Groundwater	Direct loss to ground	The Soil and Groundwater Pollution Risk Assessment presented in Section 4 of the Site Condition Report (Application Supporting Documentation Appendix B1) presents a for a full appraisal of potential impacts and the pollution prevention and control measures in place. All primary containment systems will be inspected on arrival to ensure integrity and then subject to regular visual checks to ensure they remain in good order with no leaks / losses. All secondary containment systems will be subject to regular visual checks and scheduled inspection to ensure they remain fit for purpose. Site hardstanding will also be visually checked regularly and subject to periodic inspection to ensure it remains in good order. Any defect identified will be prioritised for repair.	Low	Loss of potential pollutants to soil / groundwater	Low
Failure of air emissions abatement systems	Increased emissions of Ethanol / methanol to air Possible impacts on local residents and nearby commercial premises	Air	All equipment is subject to pre-planned preventative maintenance checks and maintained in accordance with manufacturer's recommendations. Should any problems, malfunctions or breakdowns occur, which affects the ability to safely function, the manufacturing will stop until the problems are rectified. Monitoring systems are in place to ensure that all relevant parameters are recorded and that any operating faults can be detected. When detected, action would be taken to make the process safe and minimise environmental impacts	Low	Increased emissions of Ethanol / methanol to air	Low
Failure of site services: heating, power, water supply	Air emissions Possible impacts on local residents and nearby commercial premises	Air	All equipment is subject to pre-planned preventative maintenance checks and maintained in accordance with manufacturer's recommendations. Should any problems, malfunctions or breakdowns occur, which affects the ability to safely function, the manufacturing will stop until the problems are rectified. Processes would be placed into a safe state with negligible environmental emissions	Low	None	Not significant

Table 9: Fugitive Emissions Risk Assessment

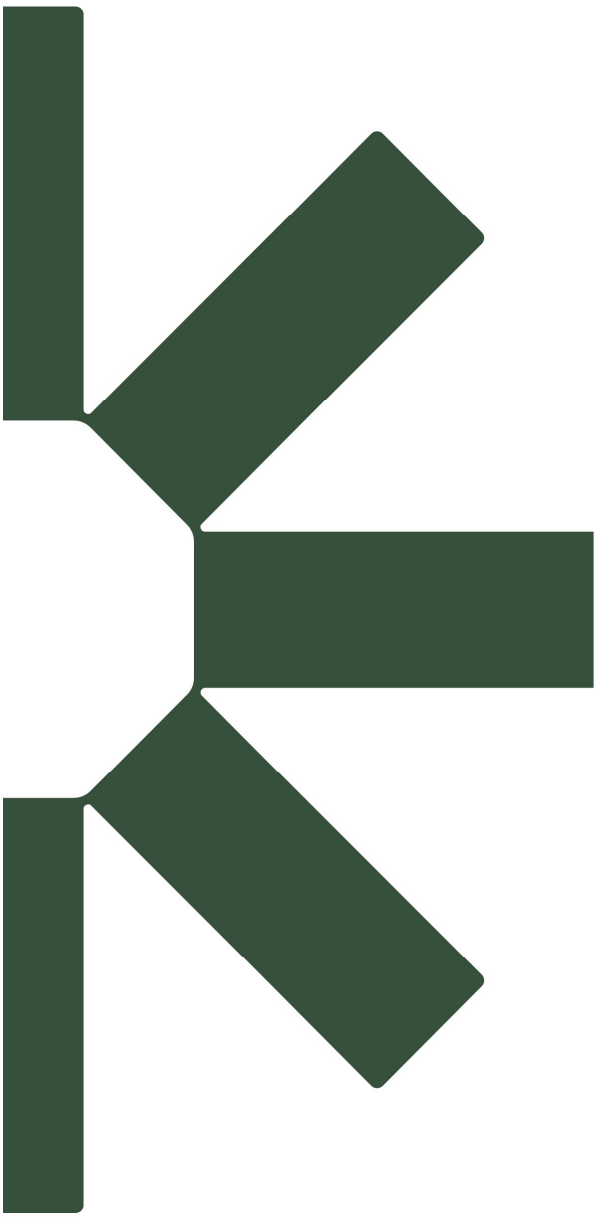
Hazard	Receptor	Pathway	Risk Management	Probability of Exposure	Consequence	Overall Risk
To Air:						
Dust Dust from storage and handling of powdered raw materials	Local residents and nearby commercial units	Air	All powdered materials will be delivered to site in sealed bags / sacks / drums etc. Packaging will be inspected on deliver and if damaged, the delivery will either be rejected, or the damaged bags placed into a new intact bag (double bagged). Offloading will be undertaken within the building and they will be transferred to the appropriate storage location and racking. Transfer of powdered materials into the process is undertaken within a downflow booth, where materials are unloaded from bags into sealed containers for transfer to the reactor loading system. The downflow booth is installed with multiple dust filters including HEPA filters, the air purged from this system is recirculated into the building. Any spillage of dust within the building will be cleaned up as part of routine housekeeping. The likelihood for any dust to exit the building is extremely low.	Low	Minor emission of dust	Not significant
Fugitive VOC Emissions	Local residents and nearby commercial units	Air	No significant diffuse VOC emission sources are anticipated. The plant has been designed to minimise the potential for diffuse VOC emissions. The process has been designed to capture all VOC into channelled emission control system where possible, and VOC handling systems have been designed to minimise the potential for leakage. Plant VOC usage is relatively limited when compared against full scale industrial sites due to the scale of processing activities proposed at the site. Immaterial will develop and agree a method for calculation of diffuse VOC emissions with the EA and review methods to further minimise diffuse VOC emissions.	Low	Negligible VOC (ethanol / methanol) emissions	Not significant.

5.0 Conclusion

The qualitative ERA and other supporting risk assessments have demonstrated that the proposed activities at the site will not pose any significant risk to the local environment.

The assessment has assumed that all required appropriate management and operating systems as well as all pollution prevention and control measures will be in place prior to the commencement of commissioning of the plant, and that these will be suitable and sufficient to minimise pollution risk. This includes the following aspects which have been identified as requiring further consideration as part of the remaining design process and preparation of site operational controls:

1) Development of the overall site management systems including the Environmental Management System (EMS) which should include:
    a. Development of specific operating manuals and operating procedures;
    b. Development of emergency / incident response procedures;
    c. Development of inspection and maintenance routines and scheduling;
    d. Development of data monitoring and reporting plans; and
    e. Staff training.
2) Development of the site fire management systems including:
    a. Identification of relevant fire event scenarios;
    b. Development and installation of:
        i. Suitable fire prevention measures;
        ii. Fire identification and alarm systems;
        iii. Fire response systems and a firefighting strategy;
        iv. Specification of firefighting materials that can be used at the site;
        v. Identification of potential firewater requirements and containment requirements for potentially contaminated firewater
    c. Liaison with the local fire service.
3) Review of options to minimise environmental pollution risk associated with the storage of flammable solvents and waste solvent outside the main building i.e.
    a. Review whether the flammables storage unit needs to be outside the building;
    b. Identify and implement measures to reduce the risk of a loss of material to ground during loading and offloading of solvent IBC's outside the main building – ideally these activities should be undertaken over an impermeable surfacing with appropriate secondary containment measures to contain any losses.
4) Development of appropriate systems to quantify, manage and minimise diffuse VOC emissions.



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