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Cawleys
local recycling global responsibility

Lithium-ion Operations
Fire Strategy
Luton | Covent Garden Close | July 2023

Lithium-ion Operations
Fire Strategy Plan
(Luton - Covent Garden Close)

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Lithium-ion Operations
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(Luton - Covent Garden Close)

1. Introduction

On its site located on Covent Garden Close, Luton, Cawley's Waste Management & Recycling run a Lithium Battery recycling operation. This strategy and associated procedures, specifically applies to the Lithium Battery recycling building, located at its site at Covent Garden Close, Luton. All other buildings and operations on site, are covered by separate strategies and procedures.

The lithium recycling operation is dedicated to; the recovery of the lithium battery materials and also giving an alternative second life recycling route. Cawleys have been dealing with lithium batteries for over 12 years and in the last 6 years have operated a dedicated workshop for the dismantling of batteries prior to export. We hold all applicable licences which include; Approved Battery Exporter (ABE), Approved Battery Treatment Operator (ABTO) and also multiple Transfrontier Shipment Notifications (TFS) as per requirements set out by the Environment Agency (EA).

The purpose of the operations is not purely in regard to shredding, but it is also in relation to the repurposing of the lithium batteries which equates to approx. 50% of tonnage handled.

We have a dedicated team who have previously pioneered the safe transportation, dismantling, discharging, shredding, and onward export logistics into Europe for waste batteries. In the event of a serious incident, we have control measures in place to ensure minimum business interruption and to ensure business continuity and that all operations can be business as usual within 24hrs of the incident arising, please review appendix 6 for further information.

Cawleys are leading the way and are one of a handful of companies that have a dedicated resource and facility to recycle lithium batteries. We have over 500 tonnes experience in dealing with lithium batteries both at our own site and whilst assisting with third-parties battery producers and emergency services.

Existing customers include waste battery producers from the following industries; Motorsport, Automotive Testing Companies, (MIRA, Millbrook Proving Ground UTAC) numerous OEM's battery manufacturers etc……

Alan Colledge the Technical Director of Lithium Battery Recycling Solutions is a 4th term Dangerous Goods Safety Advisor (DGSA) and has just under 30 years' experience in the waste industry. Having spent the previous 18 years specialising in Hazardous and dangerous Waste, heading up Cawleys Hazardous Division, Lithium Batteries from cars were introduced to Alan 10 years ago and since then he has pioneered the options and management of waste batteries for the company which has led to European partners and setting up one of the first UK dedicated workshops in 2017 to decommission waste EV batteries based in Luton. Alan has also established relationships for legitimate 2nd Life Reuse to divert waste batteries into power supplies. Since the launch of Lithium Battery Recycling Solutions in October 2021 Alan has moved the capabilities even further by setting up one of the first UK waste Battery plants to recover materials through mechanical separation. This is a big step for the UK allowing the batteries to become a mixed shredded material for onward recovery and refining and leading to starting a new value chain for Lithium batteries which is sorely missing domestically.

Cawley's, are committed to their statutory obligations to comply with the Regulatory Reform (Fire Safety) Order 2005 and will:

- Where necessary maintain and carry out structural improvements, maintain & update fire detection and warning systems, and carry out scheduled maintenance of all fire related equipment.

- Regularly review this strategy and procedure, the standards of the Lithium Building and it will, as far as is reasonably practicable, carry out all necessary remedial works.
- As part of its strategy and procedural reviews, Cawley's will keep up to date with any information pertinent to lithium batteries and also any legislative changes that may effect its operations.
- Maintain its commitment to training its staff and promoting the awareness of fire safety, in this way endeavouring to create a fire safe environment and ensuring safe and suitable premises for the well-being of staff, visitors, contractors and any other persons having access to the building and process.

1.1. Scope

This Fire Strategy applies to all staff, visitors, contractors, and any other persons visiting the building.

The aim of this document is to:

- Explain the structure of the organisation and how fire safety will be managed and communicated.
- Identify those staff with specific duties and responsibilities.
- Identify fire precautions and fire safety measures that are required to be complied with, to meet regulatory and best practice safety standards.
- To minimise business disruption.

1.2. Site plans / site setting

1.2.1. Drawing no. GPP/C/L/22/03 v1 details the layout of the buildings, any area where hazardous materials are stored, the main access routes for fire engines and any alternative access, access points around the perimeter to assist firefighting, hydrants and water supplies, the location of mobile and fixed plant and the quarantine area. (Appendix 1)

1.2.2. Drawing no. GPP-C-L-15-06 v7 details the site surface water drainage plan. (Appendix 2)

1.2.3. Drawing no. GPP-C-L-15-07 v2 details the foul drainage plan. (Appendix 3)

1.2.4. Drawing no. GPP-C-L-15-04 v2 outlines the site boundaries. (Appendix 4)

1.3. Building structures – Lithium Building

1.3.1. The Lithium Building is of brick-built construction, with a metal corrugated roof that has clear window lights within it make up. The internal design of the building is split in to 2 main areas:

- The workshop and shredding facility
- A meeting room, kitchenette, and small office.

1.4. Building Compartmentalisation

1.4.1. Separating the two areas is wall to wall compartmentation that consists of fire rated glass and FD30s rated fire doors. The Fire doors a provide a fire barrier between the 2 compartments, delaying the spread of fire and smoke.

2. Lithium-ion Operations – RAMS 09-24 (Appendix 5)

2.1. Feedstock Reception Handling

2.1.1. The organisation will only receive lithium batteries in accordance with our acceptance criteria aligned to this strategy. We do not accept any unsolicited waste consignments from third parties.

2.1.2. All batteries arriving on site will be transported in accordance with the Carriage of Dangerous Goods and use of Transportable Pressure Equipment Regulations 2009 (ADR 2023).

2.1.3. All batteries are assessed for electrical status and will be treated as 'live' until they have been through our discharge process.

2.1.4. All lithium batteries arriving on site will then be weighed in on the main weighbridge once weighed, the batteries will be transported to the Lithium Workshop.

2.1.5. Loads are then temperature checked on arrival before they are processed/stored.

2.1.6. If elevated temperatures are discovered on receipt, a dynamic risk assessment will be conducted by the high voltage engineers and specific actions will be undertaken as previously assessed and rehearsed. This could include for example, removing the battery/pack to the sterile/quarantine area or placing the affected pack/battery into the quenching tank situated outside the building or utilisation of the fire-fighting media such as the fire blanket/Lith-EX extinguishers. Potential specific scenarios are detailed in appendix 6.

2.1.7. In the event of discharge not being completed, batteries will remain connected, but discharge units will be isolated. A 60 min fire watch will be conducted prior to weekday end with no more than 500kilos being left at any one time.

2.1.8. All batteries are cleared from the lithium workshop prior every weekend.

2.2. Decommissioning of 'Live' Battery Packs in accordance with manufacturing guidelines/Safe System of Works (SSW)

2.2.1. Check battery visually and with thermal camera, voltage check from Orange Main Plug, check case voltage.

2.2.2. Decommission the outer shell using insulated tools, air tools and power tools.

2.2.3. Once the outer casing is removed check temperature and voltage across internal modules to find appropriate busbar connection positioned at halfway voltage point to be removed in order to reduce voltage to safer levels.

2.2.4. Remove remaining busbars to continue reducing pack voltage until all modules have been isolated.

2.2.5. Remove ancillary wiring and fixings around Modules.

2.2.6. Place Modules destined for second life reuse into insulated bags and into UN approved packaging in preparation for shipping to final destination. These modules are recorded in a shipping manifest and forwarded on accordingly.

2.2.7. Once packaged the modules are moved to the temperature-controlled ISO containers equipped with a fire detection (heat) system, surrounded by fire retardant concrete blocks and bespoke inlet valves to allow the ISO containers to be flooded with water by either the fire

services or trained and competent site staff using fire hoses and hydrant, in the unlikely event of an emergency.

2.2.8. Storage units are checked twice per day with temperature / thermal camera with the results recorded.

2.2.9. If elevated temperatures are recorded, the affected batteries / modules are removed from the ISO containers and placed in the quenching tank or covered by a fire blanket and then placed in the quarantine area.

2.2.10. No 'live' part decommissioned batteries are left in the building overnight. The high voltage engineers will not start to decommission any battery if the decommissioning cannot be completed fully that day.

2.3. Decommissioning of Battery Packs - Damaged/ Burnt Batteries.

2.3.1. Open case and check battery for elevated temperature, smoking/vapour release/noises.

2.3.2. In the event of signs of potential thermal runaway, a dynamic risk assessment will be conducted to either quarantine the affected pack/battery in the designated quarantine area outside the building covered with a fire blanket or placed into the quenching tank situated outside the building.

2.3.3. Check case for any voltage.

2.3.4. Move battery onto insulated table which is monitored by a thermal camera.

2.3.5. Damaged batteries may need additional cutting tools to safely remove outer casing.

2.3.6. Check voltage across all busbars visible. Conduct temperature checks.

2.3.7. Assess any batteries/components that may be live.

2.3.8. Assess and make plans to choose correct tooling and method before decommissioning starts. Consider Air tools, insulated tools, chisel, prybar. If no voltage present and safe to do so a large handling machine and skip can be used to shake battery components/ash away.

2.3.9. Burnt components to be placed into bags/drums awaiting shredding.

2.3.10. Larger Cases stored and palletised awaiting offtake.

2.4. Decommissioning of Battery Packs – Unpacked Modules/cells

2.4.1. Remove Batteries from packaging and check visually and for temperature.

2.4.2. Determine Batteries for 2nd Life or End of Life.

2.4.3. Discharge/Shred or repackage where appropriate.

2.5. Discharge Operations

2.5.1. Check Voltage on all Modules ready for discharge.

2.5.2. Connect/arrange modules with the same voltage, observing correct polarity, for Parallel or Series connections to not overload discharge unit voltage/amperage rating.

2.5.3. Make sure Discharge Unit is TURNED OFF.

2.5.4. Plug battery array into Discharge unit.

2.5.5. Turn on Discharge Unit and programme to discharge to 0.2 volts.

2.5.6. Record and refer to max AMP limit list per battery type if history present.

2.5.7. Regularly monitor batteries and state of discharged – no discharging is to be undertaken over-night, or when there are no Lithium Workshop operatives in the building.
2.5.8. Discharge Unit to only operate under vision of Thermal Camera system.
2.5.9. Discharge Unit alerts user after completion of battery discharge, battery to be installed with a short circuit jumper cable immediately, fixed between the positive and negative terminals to stop potential voltage creep (batteries now inert).
2.5.10. If battery is left for any sustained period after discharge, battery will need a voltage check first and if voltage present the battery must be discharged back down to 0.2 volts at which point jumper cable is fitted between positive and negative terminals.
2.5.11. All fully discharged batteries must be placed in quarantine for a minimum of 1 hour before shredding.
2.5.12. Check offtake FIBC bag is in place.
2.5.13. Check jumper short circuit wire is in place on batteries whilst on the height adjustable work platform – any batteries without a jumper cable to be returned to discharge.
2.5.14. Check battery is at zero volts using a digital multi meter – and batteries that show voltage must have jumper wire removed and taken back to discharge.
2.5.15. Check temperature of battery before placing onto feed conveyor – any batteries with elevated temperatures to be removed to quarantine area situated outside the building.
2.5.16. Turn on Shredder and allow self-start procedure to finish.
2.5.17. Turn on Conveyor.
2.5.18. Turn on LEV Extraction system.
2.5.19. Check Helios fire suppression system is fully operational.
2.5.20. Send Battery for shredding using the feed conveyor.
2.5.21. Monitor Process visually using CCTV system fitted in the hopper and with thermal cameras positioned within the shredding room.
2.5.22. Monitor offtake bag and stop process when full, as necessary.

3. Fire Strategy – Prevention

3.1. Arson

3.1.1. The site is manned daily Mon- Fri from 6:00am to 01:00am. Sat 6:00am to 12:00pm.
3.1.2. The site is securely fenced with lockable gates.
3.1.3. Recorded CCTV – cameras installed inside and outside the facility.
3.1.4. The main office building has an intruder alarm that is monitored by a watch station out of hours.

3.2. Plant and equipment

3.2.1. **Lithium workshop shredding system:** shredding system maintenance works will be carried out as and when required by a trained, authorised, and competent member of staff and as per the producer's instructions.
3.2.2. **Mobile plant:** mobile plant that is not being used is kept away from combustible waste. Mobile plant is serviced and maintained periodically by competent, authorised personnel in

accordance with the manufacturer's schedules/guidelines. Heavy plant is fitted with an automatic fire suppression system.

3.2.3. All plant and equipment are visually inspected at the beginning of each shift with the check recorded in R2C, and at the end of the working day by site operatives to ensure that there has been no build-up of dust on hot exhausts or engine parts. Any dust is cleaned off once the vehicle has cooled down.

3.2.4. All heavy mobile plant is fitted with automatic fire suppression systems.

3.3. Electrical Safety

3.3.1. Electrical equipment / installations on site are fully certified by a suitably qualified person.

3.3.2. Periodic electrical installation condition assessments are carried out every 3 years.

3.3.3. Portable appliances are tested on an annual basis.

3.3.4. Electrical faults are investigated and repaired by authorised and competent persons in line with manufacturers guidelines.

3.4. Smoking

3.4.1. Smoking is only permitted in the designated smoking areas across the site which are equipped with suitable metal receptacles for the disposal of discarded smoking materials.

3.5. Hot works

3.5.1. A hot works permit is used across the site by trained and authorised internal and external engineers supported by suitably trained staff members who act as fire wardens / fire watch throughout the works and for 3 hours after completion.

3.6. Use of industrial heaters

3.6.1. All workshops are fitted with oil-fired industrial heaters / coolers fitted in accordance with all applicable legislation – serviced and maintained in accordance with manufacturers guidelines by an authorised and competent third-party contractor.

3.7. Leaks and spillages of oils and fuels

3.7.1. Emergency spillage procedure in place (WI009-06). (Appendix 6)

3.7.2. Spill kits are kept on site in key locations e.g., outside Lithium Building.

3.7.3. Staff are briefed and trained on their function and can be used in the event of a spill or leak from any plant or equipment on site.

3.7.4. Spillage drills undertaken periodically.

3.8. Build-up of loose combustible materials

3.8.1. Daily end of shift clean-up regime in place for the Lithium Workshop.

3.9. Storage

3.9.1. Upon arrival at the Lithium workshop all batteries are checked for signs of elevated temperatures by the supervisor, and then stored in a temperature-controlled shipping container fitted with a fire alarm surrounded by a fire wall made of concrete legato blocks that hold an A1 fire-resistant classification in accordance with REI 240 (the shipping containers are located away from all combustible materials stored on site).

3.9.2. The containers are checked at regular intervals throughout the day with a handheld temperature gauge.

3.9.3. In the event that a battery is identified with an elevated temperature upon arrival at site it is removed from the UN approved packaging if safe to do so and placed in a water bath or covered with a fire-retardant blanket – if it is not safe to remove from the packaging the whole box is placed in quenching tank – once safe to do so emergency services are notified. (detailed in Appendix 6).

3.9.4. Maximum tonnage storage material and the storage location area:

Waste Type	m^2 / Height/Volume M3	Location
Lithium-ion Batteries	<20 tonnes	UN approved packaging within ISO Containers
Recovered Materials (shredded flake)	<30 tonnes	UN approved (FIBC's)

3.10. The Dangerous Substance and Explosive Atmosphere Regulations 2002 (DSEAR)

3.10.1. DEKRA were commissioned and have conducted an explosion safety assessment under the requirements of DSEAR [1] for Cawleys Lithium Battery Shredding Plant Operations. As part of the assessment in considered both dust and gaseous vapours.

3.10.2. The purpose of the study was to conduct an Explosion Risk Assessment and Hazardous Area Classification of the Lithium Battery Shredding Plant, and to assess compliance against the requirements of DSEAR [1]. (Appendix 7)

3.10.3. The main finding of the assessment is that there were gaps in the measures in place for the management of the risks of harm from fires and explosion. These gaps required additional actions to be taken and these actions have been summarised throughout the DSEAR Action Plan. (Appendix 8)

4. Fire Strategy – Detection/Suppression

4.1. Fire Alarm System

4.1.1. The Lithium building fire detection and alarm system has been properly designed, installed, and will be maintained in line with BS 5839: 2017. 'Fire Detection and Alarm Systems for Buildings' Testing & Maintenance.

4.2. Fire Suppression System.

4.2.1. A fire suppression system is fitted to the Lithium Workshop conveyor belt and shredder. The Lithium shredder is purpose built and has an automated 'Helios' fire suppression system fitted.

4.2.2. To minimise fire risk from fine particles, the Lithium shredding process within the workshop has an active air extraction system which is fitted with a carbon filter. Air is positively extracted from the workshop through the carbon filter and vented via a small exhaust stack (Local Exhaust Vent [LEV]) as shown on drawing reference GPP/C/L/22/03 version 1.

4.2.3. The LEV system within the Lithium Building, is an 'ATEXON® VR18Z Spark Detection and Extinguishing System' and has been installed and designed to reduce the risk of ignition sources such as embers from reaching protected equipment.

4.2.4. Fire Fighting Equipment is provided and correctly positioned and maintained in accordance with BS 5306: Part 8, 2012 'Fire Extinguishing Installations and Equipment on Premises'

4.2.5. In the event of signs of battery thermal runaway, a dynamic risk assessment will be conducted to either quarantine or place the pack/battery into a quenching tank that is located directly outside the Lithium Building.

4.2.6. The tank is supplied by a mains water supply to ensure that is always readily available for use. The quenching tank is inspected on a regular basis to ensure that water levels are adequate and that no foreign objects have contaminated it.

4.2.7. There are fire hydrants at the gateway from both access points, plus an additional fire hydrant located in Arundel Road.

4.2.8. The sizing of the water mains pipe servicing the fire hydrants are as follows: Covent Garden close 75mm, Wingate Road 150mm, Arundel Road 100mm.

5. Fire Strategy – Emergency Response Procedures

5.1. Evacuation on discovering a fire.

5.1.1. Sound the Fire Alarm by operating the nearest break glass call point.

5.1.2. Activate the Conveyor and LEV E-Stops.

5.1.3. Activate the Helios Quench System.

5.1.4. If safe to do so attempt to tackle the fire using the correct type of fire extinguisher. N.B Only Trained persons to tackle any fire.

- Fire involving Lithium – LithEX extinguisher.
- Electrical – Co2 Extinguisher
- Any other combustible solid – Foam
- Fire Blanket

5.1.5. Evacuate the building and go to the Assembly Point.

5.1.6. If you are 'hosting' a visitor or a contractor, you are responsible to ensure that they are escorted to the Fire Assembly Point. If this is not possible report their presence and location to the Fire Warden.

5.1.7. Do not return to the building unless authorised to do so by the Fire Warden or in the case of a fire, the OIC (Officer in Charge) of the attending Fire Service.

5.1.8. Silencing of the fire alarm system should never be taken as an indication that it is safe to re-enter the building.

5.1.9. Re-entry of the building is strictly prohibited until the fire brigade officer in charge declares it is safe to do so.

5.2. Fire Loss/Business Interruption

5.2.1. In the very unlikely event of a fire that makes the Lithium Workshop unusable, batteries would be taken directly to supply chain partners based in the UK and Europe who either have the ability to safely discharge and package batteries for onwards compliant disposal in the EU or discharge and shred to a Lithium flake under a tolling arrangement with Lithium Recycling Services.

5.3. Notifications

5.3.1. All significant incidents shall be notified to the Environment Agency as soon as reasonably practicable on 0800 80 70 60 (must be within 24 Hours).

5.4. Clearing and decontamination after a fire

5.4.1. The main pollutant identified, should a fire occur, would be air pollution.
In the event of a fire in the Lithium Workshop, the clean-up procedure would be subcontracted to a third-party external provider.

Lithium-ion Operations Fire Strategy Plan

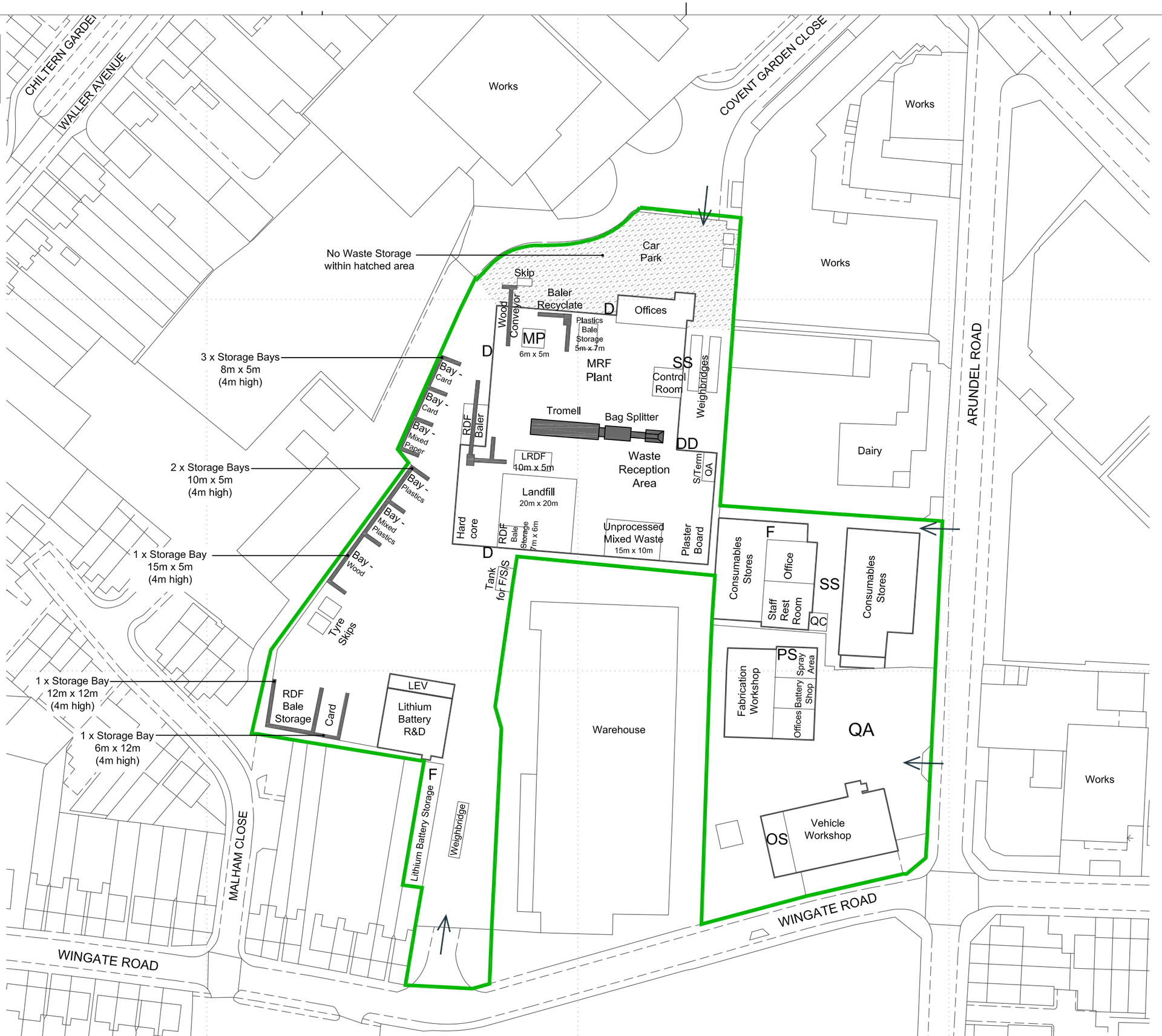
(Luton - Covent Garden Close)

Reviewed by:	Matt Smith MIFSM, CFRAR
Reviewed by:	Nigel Ingram Operations Director
Reviewed by:	Alan College Technical Director DGSA WAMITAB holder, CPC holder
FPP reviewed by:	Amanda Clark Compliance Manger DipNEBOSH ENVDIP

The Lithium-ion Operations Fire Strategy will be reviewed annually or in the event of significant changes to the premises or personnel, changes to work activities or equipment, or changes to legislation.

APPENDICES

- Appendix 1 – GPP-C-L-22-03 Luton Site Layout Plan.
- Appendix 2 – GPP-C-L-15-06 Luton Surface Water Drainage Plan.
- Appendix 3 – GPP-C-L-15-07 Luton Foul Drainage Plan.
- Appendix 4 – GPP-C-L-15-04 v2 outlines the site boundaries.
- Appendix 5 – Lithium-ion Operations – RAMS 09-24
- Appendix 6 – Emergency spillage procedure in place (WI009-06).
- Appendix 7 – DEKRA DSEAR Survey.
- Appendix 8 – DSEAR Survey Action Plan.
- Appendix 9 – Declaration of Conformity.
- Appendix 10 – EU Certificate of Conformities (Explosion isolation flap valves VIGILEX).
- Appendix 11 – EU Certificate of Conformities (VIGILEX Vent Panel).
- Appendix 11A –VIGILEX Vent Panel Diagram.
- Appendix 11B – Explosion Panel Detail.
- Appendix 12 – Lithium Building Site Plan
- Appendix 13 – Incident Management Plan



KEY

S/Term QA	Short Term Quarantine Area
QC	Quarantine Container - Gas Bottles
Tank for F/S/S	Proposed Site for Tank for Fire Suppression System
QA	Quarantine Area in the event of a Fire
SS	Smoking Shelters
D	MRF Door
	Access Points
F	Fuel Storage
OS	Oil Storage
MP	Mixed Paper Bales
LRDF	Loose RDF
PS	Paint Store

No areas of made ground.
Total site surfaced with concrete.

Rev	Description	Initial	Date
1	Amendment to bay uses, QA, fabrication workshop, Lithium battery relocated. Text updated.	KD	18/07/22

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ICon Environmental Innovation Centre, Eastern Way, Daventry, Northamptonshire, NN11 0QB
Registered in England No. 6019666

TITLE:	Luton Waste Facility Covent Garden Close, Luton Permit - Site Layout Plan
CLIENT:	CAWLEYS

DRAWN BY:	KD	CHECKED BY:	CS
DRAWING NO.:	GPP/C/L/22/03	REV NO.:	1
SCALE:	1:1000 at A3	DATE:	11 July 2022
SCALE BAR:	0 5 10 20 30 50		

ORIGINAL A3 SIZE SHEET

Works
Works
Works
Works
Works
Works
Works
Dairy
Warehouse

COVENT GARDEN CLOSE
ARUNDEL ROAD
MALHAM CLOSE
ALLER AVENUE
E ROAD

FH
FH
FH

Underground
Storage Tank
1,000 Litre Capacity

1,000 Litres
Interceptor

IN
OUT
100,000 Ltrs = 100m³

Rev	Description	Initial	Date
7	Underground pipe connection added, key updated.	KD	14/06/16
6	Permit boundary amended to the north.	KD	26/04/16
5	Additional text to key.	KD	20/04/16
4	Additional drain, surface water & surface water sewer added to Arundel Road. 3 x Fire Hydrants added.	KD	23/03/16
3	Slight amendments and additional text added.	KD	17/03/16
2	Slight amendment to direction of flow, following a discussion with Alan Colledge.	KD	11/06/15

KEY

- Manhole
- Soakaway
- Drain Cover
- Interceptor
- Fire Water Containment & Silt Interceptor (IN / OUT)
- Grit Chamber
- Surface Water
- Surface Water Sewer
- Underground Pipe Connection
- Direction of Flow
- Storm Outlet
- FH — Fire Hydrants
- OUT — Shut Off Valve

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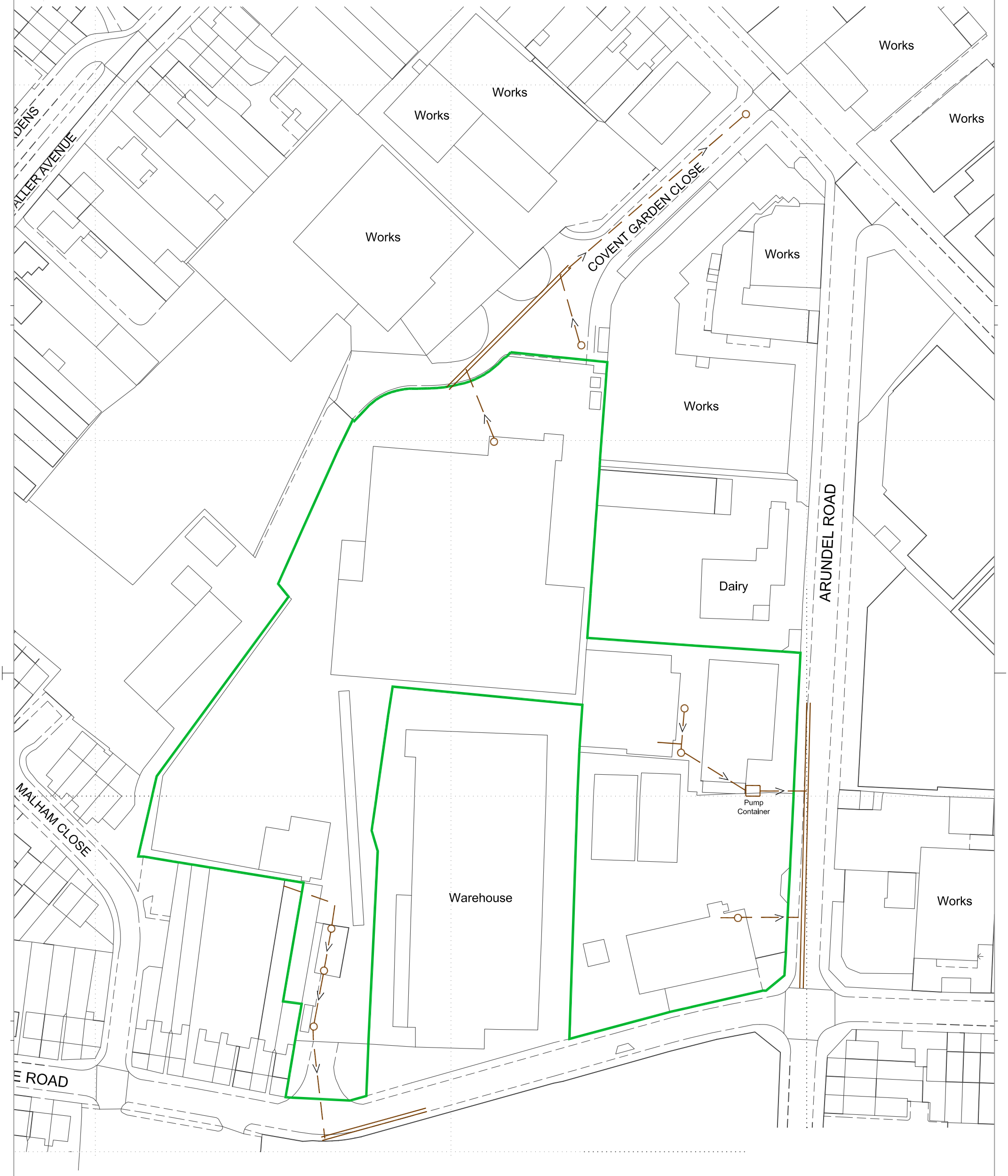
TITLE:	**Luton Waste Facility, Covent Garden Close, Luton Surface Water Drainage Plan**
CLIENT:	Cawleys

DRAWN BY:	KD	CHECKED BY:	GP
DRAWING NO.:	**GPP/C/L/15/06**	REV NO.:	7
SCALE:	1:1000 at A3	DATE:	09 June 2015
SCALE BAR:	0 5 10 20 30 50		

ORIGINAL A3 SIZE SHEET



KEY

- Manhole
- Foul Sewer
- Foul Water
- Direction of Flow

Rev	Description	Initial	Date
2	Permit boundary amended to the north.	KD	26/04/16

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Registered in England No. 6019666

TITLE:	**Luton Waste Facility, Covent Garden Close, Luton Foul Drainage Plan**
CLIENT:	Cawleys

DRAWN BY:	KD	CHECKED BY:	GP
DRAWING NO.:	**GPP/C/L/15/07**	REV NO.:	2
SCALE:	1:1000 at A3	DATE:	09 June 2015
SCALE BAR:	0 5 10 20 30 50		

ORIGINAL A3 SIZE SHEET

N

CHILTERN

WALLER AVENUE

Works

COVENT GARDEN CLOSE

Works

Works

ARUNDEL ROAD

Dairy

No Waste Storage within hatched area

Car Park

Skip

Baler Recyclate

D

Offices

Wood Conveyor

Plastics Bale Storage 5m x 7m

MP 6m x 5m

D

3 x Storage Bays 8m x 5m (4m high)

Bay - Card

Bay - Plastics

Bay - Mixed Paper

MRF Plant

SS

Control Room

Weighbridges

RDF Baler

Tromell

Bag Splitter

DD

2 x Storage Bays 10m x 5m (4m high)

LRDF 10m x 5m

Waste Reception Area

S/Term QA

Bay - Grade C Wood

Bay - Grade B Wood

Landfill 20m x 20m

Hard core

RDF Bale Storage 7m x 6m

Unprocessed Mixed Waste 15m x 10m

D

Tank for F/S/S

F

Consumables Stores

Office

SS

Staff Rest Room

QC

WEEE Storage

Tyre Skips

1 x Storage Bay 12m x 12m (4m high)

MALHAM CLOSE

Lithium Battery R&D

Sterile Area

Warehouse

Fabrication Workshop

Spray Area

Battery Shop

Offices

QA

F

Lithium Battery Storage

Weighbridge

OS

Vehicle Workshop

Works

WINGATE ROAD

KEY

S/Term QA	Short Term Quarantine Area
QC	Quarantine Container - Gas Bottles
Tank for F/S/S	Proposed Site for Tank for Fire Suppression System
QA	Quarantine Area in the event of a Fire
SS	Smoking Shelters
D	MRF Doors
→	Access Points
F	Fuel Storage
OS	Oil Storage
PS	Paint Store
MP	Mixed Paper Bales
Sterile Area	Sterile Area

No areas of made ground.
Total site surfaced with concrete.

Rev	Description	Initial	Date
7	Measurements added.	KD	14/06/16
6	Permit boundary amended to the north.	KD	26/04/16
5	Additional labeling to site layout & key up dated.	KD	20/04/16
4	Additional amendments to layout and labels.	KD	23/03/16
3	Additional labelling of buildings/layout	KD	15/03/16
2	Additional labelling of buildings/layout	KD	13/10/15

GPP GP PLANNING LTD ENVIRONMENTAL CONSULTANTS

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TITLE:	**Luton Waste Facility Covent Garden Close, Luton Permit - Site Layout Plan**		
CLIENT:	Cawleys		
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DRAWN BY:	KD	CHECKED BY:	GP
DRAWING NO.:	**GPP/C/L/15/03**	REV NO.:	7
SCALE:	1:1000 at A3	DATE:	30 September 2015
SCALE BAR:	0 5 10 20 30 50		

ORIGINAL A3 SIZE SHEET

Risk Assessment / Method Statement

(Vehicle Operations) RAMS 09-24

Section 1 | Details of Activity / Task / Process

Site:	All Sites including Customer Sites	Revised By:	Amanda Clark (SHEQ Manager), Nigel Ingram (Director of Operations) Alan College (Technical Director) Joe Chester (Lithium Workshop Supervisor), Gerry Robinson (Lithium Worksop Technician)
Department:	Lithium Battery Recycling Solutions	Issue No.:	4
Activities:	Operation of Lithium-Ion Battery Dismantling Area	Date Revised:	April 2023
		Next Rev. Due:	August 2023

Section 2 | Risk Assessment

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
Movement of batteries into the Lithium Workshop – from delivery vehicles or from	Struck by moving machinery (FLT/HGV). Struck by falling object. Overturning FLT.	Lithium workshop operatives or other person in working area.	3 x 5=15 High	Trained, licenced, and authorised FLT /mobile plant / HGV operatives only.	2 x 5=5 Medium	FLT refreshers undertaken as required.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
the storage containers	Manual Handling. Slip/trip/fall.			FLT maintained in accordance with manufacturers requirements by authorised and competent persons Site speed limit always observed. Never exceed the SWL of the FLT. Suitable safety footwear worn. Good housekeeping.		FLT LOLER'98 thorough examination. Pre-use checks completed and recorded. Manual handling training undertaken as part of mandatory training. Adjustable table to be sourced and trialled. Daily site inspections completed and documented by site manager	April 23 March 23
Packing / unpacking batteries (metal / wood cases).	Manual Handling. Slip/trip/fall. Struck by falling object.	Lithium workshop operatives or other person in working area.	3 x 5=15 High	To be completed by trained, authorised and competent persons only. Fixed gib hoist / crane to be used for moving heavy items.	2 x 5=5 Medium	Manual handling training undertaken as part of mandatory training. Ancillary lifting equipment LOLER'98 thorough examination.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
				Adjustable working platform for battery dismantling. Good housekeeping. Appropriate PPE always worn		Storing hand tools on top of the FIBC should be prevented.	
Positioning batteries on adjustable work platform for dismantling or repacking of modules for onward transport.	Struck by falling object. Slip/trip/fall Manual handling Contact with electricity	Lithium workshop operatives or other person in working area.	3 x 5=15 High	Fixed gib hoist / crane to be used for moving heavy items. Adjustable working platform to be used as and when required. High voltage battery dismantling training undertaken WAMITAB approved. Appropriate PPE always worn. Good housekeeping. Shepherds crook in place. First aiders in place	2 x 5=5 Medium	Manual handling training undertaken as part of mandatory training. Ancillary lifting equipment LOLER'98 thorough examination. Periodic refresher training completed as and when required.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
Preparation of EV Batteries for processing.	Contact with electricity; Manual Handling; Fire; Electrical flash over.	Lithium workshop operatives or other persons within the local vicinity	3 x 5=15 High	Trained/ competent and authorised technicians. High voltage battery dismantling training undertaken (WAMITAB approved. Method statement + SOP in place, for the safe discharging of batteries (below). Insulated and height adjustable working platform. Insulated tools and gloves always worn. Flash overprotective clothing always worn.	2 x 5=5 Medium	Fire safety management programme of maintenance and testing in place. Periodic refresher training completed as and when required.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
				Firefighting equipment available – L2 powder extinguishers, Bridgehill fire blankets. Shepherds Crook available. First Aider on site always. Thermal imaging system and integrated fire alarm system installed in building. . Fire blankets available. Fire wardens available on site. Quenching tank on site.			

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
Storage of batteries pre-processing.	Fire Thermal runaway Gas release Security Theft	Lithium workshop operatives or other person in working area.	3 x 5=15 High	Batteries to be packed in accordance with the ADR 2023 regulations. Units that have not been discharged to be stored in a 40ft temperature-controlled ISO container fitted with a fire alarm system surrounded by concrete fire-retardant blocks. All batteries discharged prior to Shredding. Re-use batteries to be stored in appropriate ADR packaging in a 40ft temperature-controlled ISO container fitted with a fire alarm system contained in a concrete fire-retardant concrete block wall.	2 x 5=5 Medium	Fire safety management programme of maintenance and testing in place. Periodic refresher training completed as and when required. Aircon servicing programme in place as per manufacturers guidelines. ISO containers always locked. Temperatures checked and recorded daily. Fire alarm servicing program in place as per manufacturers / statutory requirements.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
				Shredded battery Lithium flake to be stored in 205l clipped top containers or 1000ltr FIBC bags (no significant risk of fire as the battery cells have been destroyed). All battery decommissioning and shredding to be completed within daily shift. Method statement to be always followed (see below)			
Loading packages for onward shipping / processing	Struck by moving machinery (FLT / mobile plant / HGV Struck by falling object. Manual handling	Lithium workshop operatives or other person in working area.	3 x 5=15 High	Packages to be placed on pallets and secured with banding prior to moving. Use of FLT to lift and position pallets in place on vehicle.	2 x 5=5 Medium	FLT LOLER'98 thorough examination. Pre-use checks completed for FLT prior to use(R2C). Drum truck PUWER'98 statutory inspection.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
				Load secured with ratchet straps by driver (carrier). Traffic route to be managed throughout loading process.		Manual handling training undertaken by Lithium Workshop operatives.	
Handling Lithium Battery Flake	Contact with hazardous chemicals) Lithium Hexafluorophosphate LiPF6, Hydrofluoric Acid, Hydrogen fluoride	Lithium workshop operatives	3 x 5=15 High	Only shred batteries when LEV (filtration system) and Helios fire suppression system fully operational. FFP3 masks to be worn in Shredding Hall during operation or when changing over FIBC bags. Chemical proof Nitrile gloves or gauntlets to be used when handling lithium flake or equipment that is in contact with.	2 x 5=5 Medium	Contaminated PPE to be bagged and placed in clip top drums for hazardous waste disposal. Heath surveillance program in place – lung function, dermatitis, HAV. Face mask fit test undertaken.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
Cleaning after fire suppression system trigger	Contact with hazardous chemicals Lithium Hexafluorophosphate LiPF6, Hydrofluoric Acid, Hydrogen fluoride	Lithium workshop operatives	3 x 5=15 High	FFP3 masks to be worn. Chemical proof Nitrile gloves or gauntlets to be used when handling lithium flake or equipment that is in contact. Wet vacs to be used to remove contaminated water and emptied into drums/IBCs for Hazardous waste removal.	2 x 5=5 Medium	Litmus tests to periodically test for pH and signs of acidity. Contaminated PPE to be bagged and placed in clip top drums for hazardous waste disposal. Heath surveillance program in place – lung function, dermatitis, HAV. Face mask fit test to be undertaken.	April 23 March 23

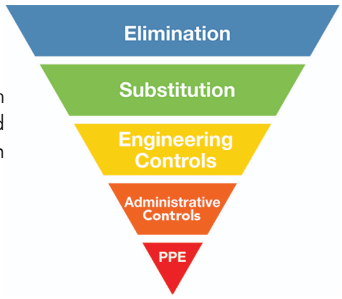
Likelihood of Occurrence \ Severity of Harm		Nil/Negligible (scratch, bruise) 1	Minor (First Aid) 2	Moderate (Lost time, medical treatment) 3	Major (Broken bone, Serious injury, disease) 4	Extreme (Fatality, permanent incapacity) 5
Very Unlikely (practically impossible)	1	1	2	3	4	5
Unlikely (rare but could occur)	2	2	4	6	8	10
Possible (occurred before but not common)	3	3	6	9	12	15
Likely (known to occur from time to time)	4	4	8	12	16	20
Very Likely (common, occurs frequently)	5	5	10	15	20	25

A 5x5 risk grid should be used to evaluate the risk.

Risk Rating = Likelihood x Severity

Multiplying relevant likelihood of occurrence by severity of harm gave a risk factor priority risk from identified hazards and activities as low/medium/high rating which was then checked in the table below to decide the level of actions required.

15-25 High / unacceptable - immediate actions required
6-12 Medium – efforts should be made to reduce the risk
1-5 Low / acceptable – no action required – to be monitored



PERSONAL PROTECTIVE EQUIPMENT (PPE) *(tick as appropriate)*

☒ ☒ ☒ ☒ ☐ ☐ ☐ ☒ ☐ ☒

Section 3 | Method Statements – Standard Operating Procedure

1. Only trained, competent and authorised personnel are to undertake the task of battery dismantling.
2. High voltage battery dismantling training undertaken (WAMITAB approved)
3. High risk activities such as dismantling / connecting batteries (>80V) to the discharge unit shall only be undertaken by two members of staff. A single technician may process low voltage batteries (<80V).
4. Only use the tools provided in the work area. Any requirement for additional tools must be approved by the SHEQ Manager.
5. Wear the protective clothing as supplied and use as you have been trained to at all times. Any damage to clothing must be reported at the earliest opportunity. Due to some of the voltages / amperages in complete EV units it is possible for arc-flash over to occur. Arc Flash proof PPE to be utilised when working at voltages above 80V.
6. Observe good manual handling principles.
7. Pack batteries in accordance with ABE export requirements detailed in the manual.
8. In the event of a fire, raise the alarm and ensure the fire brigade are called and if trained and safe to do so, attempt to extinguish the fire. Note: use appropriate fire extinguishers.
9. Always ensure that when the lithium workshop is not occupied, all roller shutter doors and the office door are securely locked.
10. In the event of an electrocution incident, use the bespoke hook to move the person away from the source of energy and call for first aid / the emergency services.

Decommissioning of Battery Packs - Non-Damaged/Non-Burnt Batteries.

1. Open UN approved case used for transportation and check battery for elevated temperature, smoking/vapour release/noises.
2. In the event of signs of potential thermal runaway, a dynamic risk assessment will be conducted to either quarantine or place the affected pack/battery into a quenching tank situated outside the building or covered by a fire blanket and then removed from the building and placed in quarantine area. Emergency Services to be called as required.
3. Check case for any voltage.
4. Move battery onto insulated table which is monitored by a thermal camera
5. Check battery visually and with Temperature camera, voltage check from Orange Main Plug, check case voltage again recording results.
6. Decommission outer shell using insulated tools, air tools and power tools.
7. Once outer casing is removed check temperature and voltage across internal modules to find appropriate halfway voltage point to reduce voltage to safe levels quickly.
8. Remove busbars carefully to separate voltage from modules.
9. Remove Wiring and fixings around Modules.
10. Remove fixings for modules and remove safely.
11. Place Modules destined for reuse into insulated bags and into UN approved packaging awaiting offtake – once packaged these are moved to the temperature-controlled ISO containers equipped with a fire alarm and surrounded by fire retardant concrete blocks. Storage units to be checked twice per day with temperature / thermal camera with the results recorded. If elevated temperatures are recorded, the affected batteries / modules are removed from the ISO containers and placed in the quenching tank or covered by a fire blanket and then placed in the quarantine area. Emergency services to be called as required.
12. Place Modules for End-of-Life Shredding onto insulated trolley to await discharge/shredding procedures

Damaged/ Burnt Batteries.

1. Open case and check battery for elevated temperature, smoking/vapour release/noises.
2. In the event of signs of potential thermal runaway, a dynamic risk assessment will be conducted to either quarantine the affected pack/battery in the designated quarantine area outside the building covered with a fire blanket or placed into the quenching tank situated outside the building. Emergency Services to be called as required.
3. Check case for any voltage.
4. Move battery onto insulated table which is monitored by a thermal camera.
5. Damaged batteries may need additional cutting tools to safely remove outer casing.
6. Check voltage across all busbars visible. Conduct temperature checks.

7. Assess any batteries/components that may be live.
8. Assess and make plans to choose correct tooling and method before decommissioning starts. Consider Air tools, insulated tools, chisel, prybar. If no voltage present and safe to do so a large handling machine and skip can be used to shake battery components/ash away.
9. Burnt components to be placed into bags/drums awaiting shredding.
10. Larger Cases stored and palletised awaiting offtake.

For Unpacked modules/cells.

1. Remove Batteries from packaging and check visually and for temperature.
2. Determine Batteries for 2nd Life or End of Life.
3. Discharge/Shred or repackage where appropriate.

Discharge Operations.

1. Check Voltage on all Modules ready for discharge.
2. Connect/arrange modules with the same voltage, observing correct polarity, for Parallel or Series connections to not overload discharge unit voltage/amperage rating.
3. Make sure Discharge Unit is TURNED OFF.
4. Plug battery array into Discharge unit.
5. Turn on Discharge Unit and programme to discharge to 0.2 volts.
6. Record and refer to max AMP limit list per battery type if history present.
7. Regularly monitor batteries and state of discharged – no discharging is to be undertaken overnight, or when there are no Lithium Workshop operatives in the building.
8. Discharge Unit to only operate under vision of Thermal Camera system.
9. Discharge Unit alerts user after completion of battery discharge, battery to be installed with a short circuit jumper cable immediately, fixed between the positive and negative terminals to stop potential voltage creep (batteries now inert).
10. If battery is left for any sustained period after discharge, battery will need a voltage check first and if voltage present the battery must be discharged back down to 0.2 volts at which point jumper cable is fitted between positive and negative terminals.
11. All fully discharged batteries must be placed in quarantine for a minimum of 1 hour before shredding.

This instruction applies to the operation of the battery discharge and shredding unit.

General Control measures

1. Only trained and authorised personnel to operate the battery shredding system.

2. Always carry out the pre-operational checks as specified by the manufacturer and record these, any defects identified must be rectified by a competent and authorised engineer prior to use.
3. Only fully discharged batteries can be processed by this unit (clearly short circuited with jumper wire).
4. Always operate the equipment in accordance with the manufacturer's guidelines.
5. All repairs to be carried out in accordance with the manufacturer's guidelines by an authorised and competent person – all repairs must be recorded.
6. Feed Conveyor belt to be used to move all fully discharged battery modules to the shredder hopper. Larger batteries bigger than the feed conveyor should be reduced in size first by safe dismantling – feed conveyor is covered by CCTV monitoring input feed.
7. If a blockage occurs, follow the blockage clearance procedure detailed below.
8. In the event of a fire, follow the fire alarm and emergency evacuation procedure.
9. In the event of a liquid spillage (VOC and odour suppression system liquid), use the spill kit.
10. Following shredding, always isolate and lock off the power supply to the unit.
11. Do not store hand tools on top of the FIBC.

Shredding Operations.

1. Conduct operational checks on Shredder Unit to make sure it is operating correctly – shredder may only be used if all sections are fully operational, Shredder, conveyors, LEV, and Helios fire suppression system – if any one part is not working shredding must not take place until an authorised and competent engineer has made repairs.
2. Before Shredding make sure suitable Fire, Extinguishers and Fire blankets are present and checked in date where applicable.
3. Check offtake FIBC bag is in place.
4. Check jumper short circuit wire is in place on batteries whilst on the height adjustable work platform – any batteries without a jumper cable to be returned to discharge.
5. Check battery is at zero volts using a digital multi meter – and batteries that show voltage must have jumper wire removed and taken back to discharge.
6. Check temperature of battery before placing onto feed conveyor – any batteries with elevated temperatures to be removed to quarantine area situated outside the building.
7. Turn on Shredder and allow self-start procedure to finish.
8. Turn on Conveyor.
9. Turn on LEV Extraction system.
10. Check Helios fire suppression system is fully operational.
11. Send Battery for shredding using the feed conveyor.

12. Monitor Process visually using CCTV system fitted in the hopper and with thermal cameras positioned within the shredding room.
13. Monitor offtake bag and stop process when full, as necessary.

In the event of Helios fire system activation.

1. In the event of fire being detected (via either the thermal camera covering the shredding process, or the flame detection sensors fitted to the roof of the hopper and the primary discharge conveyor) the Helios system will self-activate and extinguish the fire, in the event the fire re-starts the Helios system will self-deploy – this process repeats until the fire is extinguished. The Helios system activates within 0.5 seconds from detection with each deployment lasting 2 to 3 seconds – deployment time can be changed by a competent and authorised engineer if required.
2. The Helios system is also fitted with a manual activation button that can be used by the Lithium workshop operatives at any time in the event of failed automatic deployment.
3. The Helios system records all instances of activation, which are fully investigated by the Lithium workshop operatives – CCTV footage is reviewed as part of this process to aid understanding of triggers.

In the event of a fire outside of the Helios fire suppression system coverage.

1. L2 fire extinguishers and fire blankets to be used, if safe to do so the battery can be removed from the building and placed in the quenching tank or in the quarantine area.
2. Emergency services to be called as required.
3. Follow local Emergency Procedures.

Blockage clearance procedure.

1. Only competent and authorised lithium workshop operatives are permitted to deal with blockages.
2. Blockages may only be cleared when two members of staff are present.
3. It is anticipated that a blockage could occur in the feed hopper if the in-feed material is loaded too quickly – to reduce this occurrence, the infeed conveyor is fitted with a variable speed potentiometer.
4. In the event of a blockage in the hopper, stop the shredder and conveyor system leaving the LEV and Helios fire suppression system fully operational. Isolate the appropriate power supply and lock-off using personal padlocks.
5. Each person involved in the clearing the blockage must lock-off the power supply using their personal padlock and if required, a padlock hasp must be used to ensure all locks can be applied.
6. Open the inspection hatch and check the blockage situation.
7. Use a metal insulated pry bar to agitate the material, close the inspection hatch, remove all padlocks from the isolation point and turn the power ON.
8. Run the machine to check that the blockage is cleared.

9. In the event of the blockage not being cleared repeat points 4 to 8 until blockage clears.
10. When blockage cleared, restart the shredding process.

Periodic System Checks

1. Fire Suppression Unit – to be performance tested on a monthly basis for satisfactory water deployment to upper shredder and lower conveyor areas. Manual Trigger buttons to be tested also. It will be noted that during normal operations the system may trigger automatically when dealing with thermal events. These events can replace the need to test separately and recorded.
2. Shredder Unit – to be inspected monthly for general state of health and teeth condition. Shredder teeth to always remain sharp and affective to prevent friction heat build-up.
3. Conveyor System – To be inspected before operation for damage and obstruction. Additionally, during operation periodic thermal camera checks are to be done to check heat build-up on moving parts and flake freshly processed from shredder discharge to FIBC discharge spout.
4. Dust Extraction Unit – Filter replacements to be completed by competent operatives under permit to work. All hot works to be accompanied by a Hot Permit to Work issued by competently trained staff.

Approved by Name: Amanda Clark, Nigel Ingram, Alan Colledge, Joe Chester, Gerry Robinson

Date: April 2023

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WI009-06 Emergency Spillage Cleaning Procedure

1. Emergency Procedure

Prevention of environmental pollution must be given priority during any emergency event but with full regard to the health and safety of all persons.

2. Immediate actions

- Raise the alarm where human safety is at risk;
- If necessary, contact emergency services;
- Extinguish all naked flames;
- Obtain help from other members of staff nearby;
- In all cases wear and use appropriate Personal Protective Equipment;
- Do not enter tanks or confined spaces unless trained in correct procedures and not before all procedures have been satisfied.

3. Emergency Equipment

Each site must have sufficient spillage containment and clearage equipment suitable for the quantity of material being stored. This must include at least one oil spillage kit and one chemical spillage kit. There should also be designated brushes and shovels to remove contaminated equipment. If specialised personal protective equipment is identified on the SDS sheet this must also be available.

4. Secondary actions

Follow appropriate procedures for type of accident as described in the following tables:

Accident Type	Anticipated Consequences	Action to be taken (listed in order of priority)
Overflow or failure of: • Vacuum pump • Tank • Storage tank • Diesel tank Failure of tanker pipe work or controls Chemical spillage Spillages during loading, unloading or transport operations	Potentially polluting liquids flow over ground into; clean drain inlet/ ditch/stream/pond/ surrounding land	• If possible quickly stem the source of the spill • Assess route of discharge and identify easiest method and location to prevent further discharge • Identify areas of risk to people and environment • Cordon off area if necessary • If possible block off drains and gullies, using combination of absorbent, sand or earth where practical • Contact Line Manager (this may be whilst any of the above is being carried out) • If the load is hazardous for carriage, consult Emergency Instructions in Writing for further information • If necessary, contact Environment Agency 0800 80 70 60 • If possible, stop further additions to tank • For small spillages absorb product using on board spillage kit • For larger spillages use vacuum tanker to clean up spillage and dispose of safely

Accident Type	Anticipated Consequences	Action to be taken (listed in order of priority)
Failure of pumping system resulting in tank overflow Failure of automatic load control/ball valve Rupture of pipe Contaminated surface water from firefighting or other emergency activity		▸ Reduce tank contents to a safe level ▸ Make temporary repairs if necessary ▸ Clean up yard/land/ditch/contaminated areas ▸ Dispose of contaminated materials safely ▸ Assess cause and take action to prevent reoccurrence ▸ Record incident, measures taken and to be taken

5. Testing of the emergency spillage clean-up procedure

Periodic testing of this procedure to be undertaken by the SHEQ department in conjunction with the relevant department. Details of the test shall be recorded on F002-02 Accident & Incident Investigation Report and next test due date shall be monitored through REG-005 Thorough Examination Register.

Associated Documents

- COSHH-RA – COSHH Risk Assessment
- PR016 – COSHH Procedure
- REG-028 – COSHH Register
- F002-02 Accident & Incident Investigation Report and
- REG-005 – Thorough Examination Register

DEKRA
www.dekra-uk.co.uk

DSEAR Assessment for Lithium Battery Shredder

Client	F & R Cawley Ltd. Maidenhall, Bedfordshire.
Contact	Amanda Clark SHEQ Manager
Report issue date	20 March 2023
Report number	R3016012936R1ak




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1. PROJECT DETAILS

Project Number	3016012936
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1.1 Revision History

Table 1: Report revision history

Version №	Date	Reason for Revision	Author	Reviewer
R1	20/03/2023	First report with Recommendations	AK	SG

2. EXECUTIVE SUMMARY

DEKRA conducted an explosion safety assessment under the requirements of DSEAR [1] for Cawleys Lithium Battery Shredding Plant located in Maidenhall, Bedfordshire.

The purposes of the study were to conduct an Explosion Risk Assessment and Hazardous Area Classification of the Lithium Battery Shredding Plant, and to assess compliance against the requirements of DSEAR [1].

The main finding of the assessment is that there are gaps in the measures in place for the management of the risks of harm from fires and explosion. These gaps will require additional actions to be taken and these actions have been summarised as recommendations throughout this DSEAR assessment.

The Basis of Safety for the Lithium Battery Shredding Plant is based on:

- The Avoidance of Explosive Dust Atmosphere inside the battery shredder via the application of dust extraction system.
- The Avoidance of Ignition Sources at the dust collection unit through the use of ATEX-certified work equipment.
- The Application of Organisational Measures (battery discharging and testing, compliance with manufacturer's instruction, operator training, etc) for fire prevention inside the shredder.
- The Application of Technical Measures for fire detection and control via fire-resisting materials of construction, spark detection and extinguishment system.

For the Basis of Safety to hold, the recommendations summarised in Section 8 on page 29 should be implemented / actioned so far as is reasonably.

3. ACRONYMS

ATEX: ATmosphères EXplosives

BoS: Basis of Safety

CCTV: Closed Circuit Television

DSEAR: Dangerous Substances and Explosive Atmospheres Regulation

FIBC: Flexible Intermediate Bulk Container

HAC: Hazardous Area Classification

HEDB: High Energy Density Battery

LEV: Local Exhaust Ventilation

MEC: Minimum Explosive Concentration

MIE: Minimum Ignition Energy

NFPA: National Fire Protection Association

PBD: Propagating Brush Discharge

PtW: Permit to Work

SDS: Safety Data Sheet

STEL: Short Term Exposure Limit

WEL: Workplace Exposure Limit

4. DEFINITIONS

ATEX-certified: Equipment certified to the requirements of EU Directive 2014/34/EU and suitable for the hazardous area.

Equipment: machines, apparatus, fixed or mobile devices, control components and instrumentation which are capable of causing an explosion through their own potential sources of ignition.

Explosion: a release of energy that causes a rapid pressure rise.

Flash fire: the term for a slow deflagration of a premixed, truly unconfined, unobstructed fuel-air cloud producing negligible overpressure. Thermal effects are the main hazard.

Fire: a slow combustion where the fuel and air are not premixed. Thermal effects are the main hazard.

Grade of release:

> **Continuous Grade of Release:** release which is continuous or is expected to occur frequently or for long periods.
>
> **Primary Grade of Release:** release which can be expected to occur periodically or occasionally during normal operation.
>
> **Secondary Grade of Release:** release which is not expected to occur in normal operation and, if it does occur, is likely to do so only infrequently and for short periods.

Hot Work: welding, cutting, grinding, brazing, drilling and similar activities which results in sparks, fire, molten slag, or hot surfaces.

Zone 20: an area in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.

Zone 21: a place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.

Zone 22: an area in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

5. INTRODUCTION

F&R Cawley Ltd (Cawleys) have designed and installed a Lithium Battery Shredding Plant at their Recycling Facility in Maidenhall, Bedfordshire. The shredding plant is used for shredding Lithium ion high energy density batteries (HEDB). A significant hazard of the process is dust explosion due to ignition of an explosive dust cloud of the product from the shredding operation.

Cawleys has requested DEKRA Organisational & Process Safety (DEKRA) to conduct an explosion safety assessment as required by the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) [1].

The project scope is outlined in the DEKRA quotation 3016012936. In summary, the scope of the project is to conduct an Explosion Risk Assessment and Hazardous Area Classification of the Lithium Battery Shredder.

This report does not include assessment of chemical reaction hazards if found on site, although anecdotal comments may be made if appropriate. Also, a fire risk assessment required by the Regulatory Reform (Fire Safety) Order 2005 [9] is outside the scope of this assessment. It is important that such risk assessment is carried out if not done already.

Ade Kalejaiye of DEKRA visited Cawleys Recycling Facility on 16 February 2023 to undertake the assessment. Alan Colledge (Technical Director - Lithium), for Cawleys was present during the assessment and provided valuable information for the exercise.

If a 'Unit Operation' is identified as not being an issue as far as this assessment is concerned, it must be understood that this is only valid as long as the process and circumstance of operation are the same as when the assessment was carried out. If there is any alternation to the Unit Operation in the future e.g., flammable materials are introduced where initially, there were none, then the assessment should be carried out again.

Throughout this report, recommendations are given to either improve safety or fulfil a legal requirement. These recommendations are prioritised using the following principles:

- **Priority H** - High **(H)** recommendations address high-risk issues. This is because the combination of likelihood and severity of the fire/explosion is currently too high. These should be addressed first particularly where the action is easy to implement and / or of low cost.
- **Priority M -** Medium **(M)** recommendations address issues presenting a lower but still moderate risk to personnel. Moreover, recommendation(s) which fulfil a legal duty but are not necessarily addressing a high-risk problem are also marked as M. These items should be addressed in the short term, particularly where the action is easy to implement and / or of low cost.
- **Priority L** - Low **(L)** recommendations address issues presenting low risk issues. Other smaller suggestion to improve safety also fall under this category.

The recommendations given in this report are intended to be a means of ensuring safety for personnel in accordance with the intent of DSEAR. These have all been compiled in Section 8 on page 29. If, however, there is an equally effective way of attaining the same aim, then the two are deemed interchangeable.

It is a legal requirement to review the risk assessment so as to keep it up to date and particularly if significant changes occur in the future. Therefore, the recommendation below is made.

R1. **General -** DSEAR (Regulation 5) requires this assessment to be reviewed at regular intervals. Based on the risks and changes foreseen, it is recommended to review this assessment whenever changes are made but even without changes at no later than 4 years from the date of this report. This should be captured in the site's action tracker or equivalent system. **(M)**

The brief overview of the assessment methodology used in this report is discussed in Appendix B. In summary, it follows the hierarchical 'Three Rules of DSEAR' approach:

1. Do not have a flammable atmosphere, but if you can't and you do…
2. Do not ignite it, but if you can't and you do…
3. Do not hurt anyone.

5.1 Site Overview

Cawleys Recycling Facility in Maidenhall is a multi-purpose waste handling and recycling facility located in a densely populated industrial estate. The Lithium Battery Shredding Plant is located in a warehouse-style building at the southwest corner of the facility (see illustration in Figure 1).

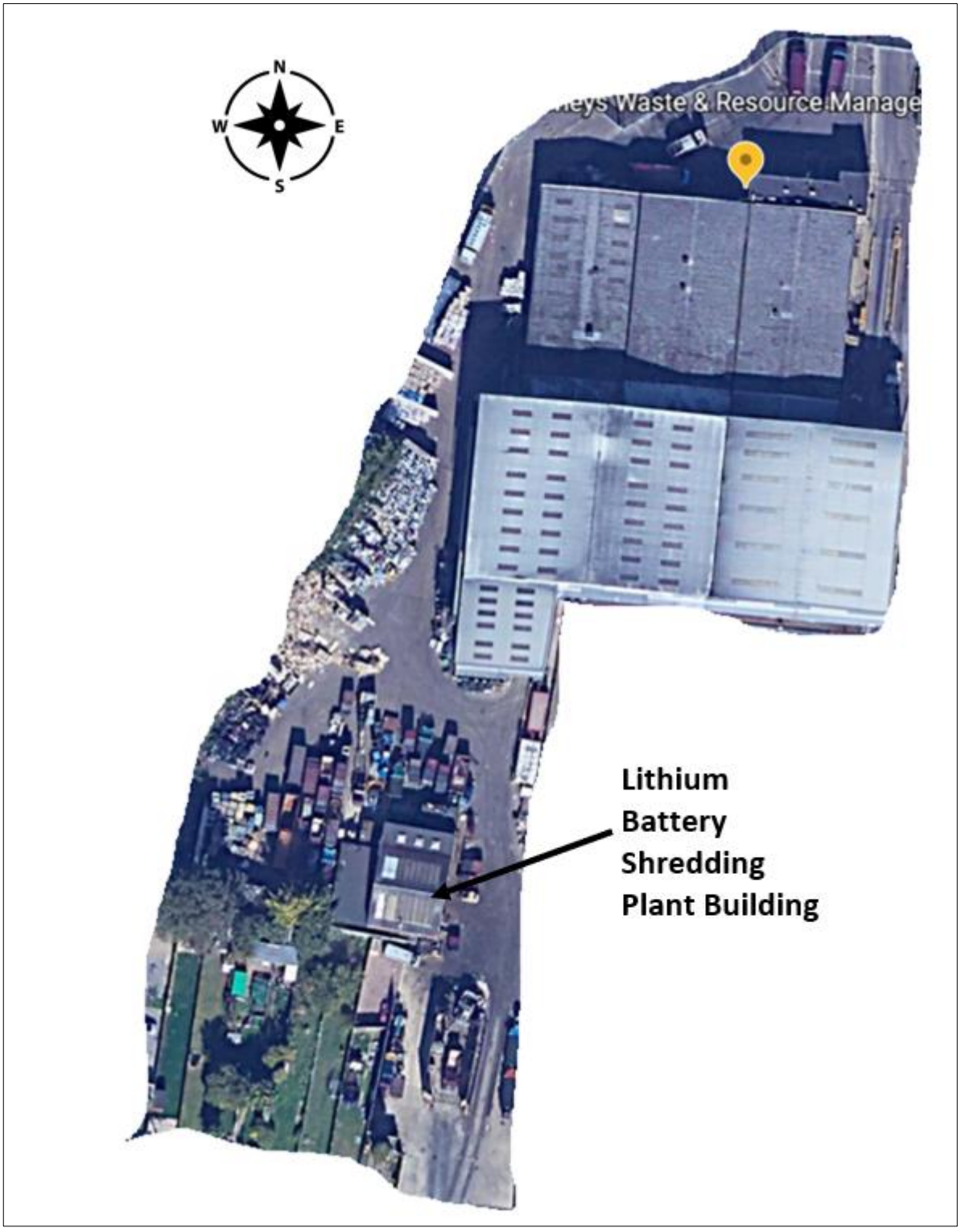

Figure 1: Recycling Facility Layout

6. LITHIUM BATTERY SHREDDING PLANT - HOUSEKEEPING

Good housekeeping is vital in preventing dust explosions in the workplace. Dust layers are extremely dangerous and are known as a major source of secondary dust explosions. Also, layers of dust on items of equipment act as insulators which can cause an item of equipment to overheat which leads to smouldering of the dust layer in contact with the surface of the equipment. Smouldering dust layers are potential ignition sources of explosive dust atmospheres.

At the time of the site visit, there was no discernible dust layers inside the battery shredding plant and it was stated that cleaning of the work area is carried out at the end of the work day. On that basis, it is assumed that dust layers are controlled, and the level of housekeeping was considered to be good.

7. LITHIUM BATTERY SHREDDING PLANT

7.1 Overview of Process

The Lithium Battery Shredding Plant is a warehouse-style building with a roller shutter door located at the east wall of the building and personnel entrance / exit doors located in various areas across the building. Most of the building is open plan but with dividing brick block walls separating offices and the Lithium Battery Shredder from the open plan area.

The primary uses of the open plan area are:

- Storage of batteries waiting to be shredded.
- Storage of 1-ton flexible intermediate bulk containers (FIBC) of battery flakes pending transfer to outdoor storage area.
- Battery discharger and discharging station.
- Battery shredder control panel and video display, and battery loading gravity (roller) conveyor.

The main process steps associated with the battery shredding plant are:

- Battery packs received at the facility are manually dis-assembled into individual batteries.

- The individual batteries are connected to a proprietary battery discharger which ensures that the battery is deep discharged to 0%. The discharger is connected to the power grid and transmits the energy removed from the battery to the grid.

- The discharged battery is kept in a holding area inside the building pending the time they can be loaded into the shredder. A red wire is connected between the positive and the negative terminal of each battery to prevent a build-up of potential difference across the battery terminals.

- The discharged batteries are loaded on to the gravity conveyor, the red wires are removed, and the operator performs a final voltage test to confirm that each battery is fully discharged before starting the battery shredder.

- The battery shredder crushes the batteries to produce flakes of about 10mm particle size which are stored in a 1-ton FIBC. It is understood that the standard practice is to keep the FIBC at less than ¾ of its safe working load so as to limit material losses to the dust extraction unit.

<u>Lithium Battery Shredder</u>

The lithium battery shredder is an assembled equipment comprising of an in-feed belt conveyor, a charging hopper for the shredder element, product (enclosed) belt conveyor [Photograph 1], and a 1-ton FIBC filling station [Photograph 2].

The hopper, product (enclosed) conveyor and FIBC station are fitted with dedicated local extract ventilation (LEV) ducting which is connected to a dust extraction unit that maintains a negative pressure around the shredder unit. It is understood that the battery shredder cannot be started if the dust extraction unit is not working.

There is live closed-circuit television (CCTV) monitoring of the shredder element installed inside the hopper, this allows the operator to have a real time view of the shredding operation inside the hopper.

A spark detection and fire extinguishing (water deluge) system is provided at the inlet side of the shredder element (top of the hopper) and at the outlet side of the shredder element (hopper discharge). It is understood that the drive system for the shredder element has reverse rotation features for managing process upsets.

Whenever a spark or ember is detected inside the hopper, a short (intermittent) burst of water mist is automatically activated to extinguish the fire and an audio alarm is generated at the same time to alert the operator. The spark detection and extinguishing system automatically stops the intermittent burst of water mist when the fire has been extinguished, hence, a manual reset is not required every time the system is activated. This ensures uninterrupted operation of the shredder. It is understood the conveyors are stopped until the fire is extinguished.

The material of construction of the shredder is carbon steel except for the belts on the conveyors. The marking plate on the battery shredder indicated that it was fabricated in August 2020.

Dust Extraction System

Nuisance dust extracted from the battery shredder is passed through a dust collection unit located outside of the building [Photograph 3]. The unit is a two-compartment design that allows automatic cleaning of the filters in one compartment while the filters in the other compartment are in use. The air mover is a centrifugal fan installed at ground level adjacent to the pressurised water reservoir for the spark detection and extinguishing system.

Cleaning of the filters is via a mechanical (pneumatic) shaker. Dust and lithium ion battery flakes collected inside the dust collector hopper are discharged – at timed interval - into an FIBC station at the bottom of the hopper. It is understood that the mechanical shaker is provided to aid the removal of dust and battery flakes from inside the hopper during discharge into the FIBC.

It was stated that the dust collector hopper has an open top for explosion venting. It is unlikely that it will be a permanently open top. There are normally open explosion vents but there is usually a lightweight shield without any fasteners or similar cover arrangements for the vent. Therefore, the following recommendation is made.

R2. **Dust Extraction Unit -** Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector. **(M)**

Spark detection and extinguishing system like that installed on the battery shredder is provided at the inlet ducting to the dust extraction unit [Photograph 3].

The dust extraction unit is fabricated from galvanised steel, and it was stated that the unit was installed in 2022.

The ATEX marking plate on the unit provides the certification “Ex II 2D c T80^{o}C”. In the absence of technical documentation for the dust extraction unit, the following recommendation is made.

R3. **Dust Extraction Unit –** Confirm the full details of the ATEX certification from the manufacturer. **(L)**

Photograph 1: Shredder hopper, enclosed product (belt) conveyor and LEV ducting.

Photograph 2: FIBC Filling Station comprising of product conveyor discharge spout, FIBC support frame and FIBC LEV ducting.

Photograph 3: Dust Extraction Unit including spark detection system (red colour, top left) on inlet piping.

7.2 Hazardous Area Classification (HAC)

7.2.1 Flammable Atmospheres

At the time of the visit, there was no information on the explosion characteristics of the flakes produced from the battery shredding process.

Safety Data Sheet (SDS) [2] provided for the battery pack indicates that typical ingredients for the cathode is an oxide of lithium and one or more metals such as Cobalt, Nickel, Manganese, etc. It is understood that the electrolyte is a paste comprising of a Lithium salt and an organic carbonate (e.g., ethylene or propylene carbonate) as the electrolyte solvent.

The anode is stated to be usually carbon powder or graphite which could be up to 20% weight of the battery. Carbon powder is a carbonaceous dust, and it is classed as dust group IIIB (non-conductive dust) according to NFPA 499 [3]. The shredding process is expected to release the carbon powder or pulverise the graphite such that they can pose a dust fire or explosion hazard.

A key step in any dust hazard analysis is a detailed knowledge of explosive characteristics of the powder and/or particulate solid being handled. Such detailed information is often not included in an SDS and would require testing to determine the explosive characteristics. Testing should always be carried out on the finest and driest sample likely to be found in the process. In this case it is likely to be the material entering the FIBC at the base of the dust collector. Testing should also be performed from material collected just prior to the shredder blades being changed as this is usually when the finest particles will be produced. Therefore, the following recommendation is made.

R4. **General –** Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA. **(H)**

However, for the purposes of this assessment it is assumed that dust produced from the shredding process is capable of dust explosion in the form of a dust cloud and dust fire in the form of a dust layer.

7.2.2 Hazardous Area Classification

The following summarises the sources and grades of release for the purposes of HAC:

Identified Primary Grades of release:

1. Dust collector hopper and dirty side of filter media – this is based on short self-cleaning intervals of the filters which could produce explosive dust cloud periodically during normal operation.

Identified Secondary Grades of Release:

2. Clean-side of the dust filter, inside of fan casing and outlet ducting – due to a filter element failure.
3. Exhaust fan outlet – due to a filter element failure.
4. Hopper discharge spout – due to potential for a short duration dust cloud when the hopper is discharging into the FIBC and when a full FIBC is being replaced.

5. Dust extraction inlet ducting – due to a blunt shredding blade.

Non-Hazardous Area

It is understood that the dust extraction system is designed to control health hazards of dust. Such units will be adequately sized to have sufficient volumetric air throughput to ensure the dust concentration in the workplace is below the workplace exposure limit (WEL) and hence, the dust / air entering the dust collector will be below the minimum explosive concentration (MEC). For example, carbon black has a short term exposure limit (STEL) of 0.007 g/m^3 [4] and its MEC is > 50 g/m^3 [3], the MEC is almost a thousand times the STEL. Based on this design parameter, the following sections of the plant are classed as non-hazardous.

1. Internals of the shredder hopper.
2. The enclosed product conveyor.
3. Internals of the product FIBC.

Filter changing task would generate dust cloud, but a hazardous zone is not required because such a task would be done according to the specialist contractor safe systems of work. However, the following recommendation is made.

R5. **Dust Extraction Unit** - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources. **(L)**

7.2.3 HAC Table

The table below shows the HAC schedule for the Lithium battery shredding plant in accordance with the BS EN IEC 60079-10-2 [5].

Table 2: HAC Schedule for Lithium Battery Shredding Plant

	Source of release			Hazardous Area Classification			Comments
No.	Description	Location	Grade of release (C, P, S)	Zone Type (20/21/22)	Zone extent (m)		
					Horizontal	Vertical	
1.	Dust Collector Hopper & dirty side of filter	Dust Extraction System	P	21	Internal volume of the hopper including dirty side of filter.		
2.	Clean side of filter, inside of fan casing and outlet ducting	Dust Extraction System	S	22	Internal volume of clean side of filter including outlet ducting and inside of fan casing.		
3.	Exhaust Fan Outlet	Dust Extraction Unit	S	22	1m radius around fan exhaust outlet.		
4.	Dust Collector Hopper Discharge Spout	Dust Extraction Unit	S	22	1m radius around the hooper spout.		
5.	Dust extraction inlet ducting	Dust Extraction Unit	S	22	Internal volume of inlet ducting		

7.3 Ignition Assessment

The following ignition categories are listed in BS EN 1127-1 [6], but those in bold are the relevant ignition sources applicable to the explosive dust atmospheres identified for the Lithium battery shredder plant.

1. **Hot surfaces.**
2. **Flames and hot gases (including hot particles).**
3. **Mechanically generated sparks.**
4. Unsuitable or malfunctioning electrical equipment.
5. Stray electrical currents, cathodic corrosion protection.
6. **Static electricity.**
7. Lightning.
8. Radio frequency (RF) electromagnetic waves.
9. Visible light electromagnetic waves.
10. Ionising radiation.
11. Ultrasonics.
12. Adiabatic compression and shock waves.
13. Exothermic reactions, including self-ignition of dusts.

The ignition sources assessment is governed by the following two considerations:

1) The probability that the ignition source is present. This depends on the severity of the hazardous area.
    a. For a Zone 22, the only ignition sources considered are those which are present in normal operation.
    b. For Zone 21, ignition sources in normal and expected abnormal situations are considered.
    c. For Zone 20, ignition sources in normal, expected abnormal and rare abnormal situations are considered.
2) The probability that the identified ignition source is effective enough to ignite the explosive dust. The answer to this query depends on two sub-aspects, these are:
    i. The strength of the ignition source can deliver, which is either indicated by the temperature produced or an amount of energy dissipated. This will be judged on a case-by-case basis for each identified ignition source.
    ii. The ignition sensitivity of the explosive dust.

The following sub-sections assesses the relevant ignition sources in this process.

7.3.1 Hot Surfaces

The only location where a hot surface could exist is at the electric motor for the dust extraction fan, but the electric motor is not within an explosive dust atmosphere. Therefore, normal equipment protection is sufficient for the electric motor.

7.3.2 Mechanical Sparks

An obvious source of mechanical sparks will be from dust extraction fan blades if the blades come in contact with the fan casing. This can only occur due to a misalignment of the fan shaft if the casing is not properly supported, or it is installed on shifting ground or it is not installed on level ground. Such issues would have been identified during commissioning and it is not considered further. Regular inspection and maintenance is required to identify issues with the fan if any occur over the life of the unit.

Mechanical sparks may be encountered during maintenance / repair work at or near the dust extraction unit. Examples of sources of mechanical sparks that may be encountered during maintenance / repair work include the use of hand tools such as portable grinder, drills, etc.

Protection against mechanical sparks from such tools will be by control of the use of such tools in areas where explosive dust atmosphere may be present. BS EN 1127-1 [6] allows the use of steel tools (e.g., screwdrivers, spanners, etc.) which can only cause single sparks when they are used in Zones 21 and 22 only.

Tools such as portable grinders, which generate showers of sparks are only permitted if no explosive dust atmosphere is present in the workplace. That is, the use of such tools must be under a permit to work, which ensures that the work area has been adequately made dust-free.

7.3.3 Flames and Hot Gases (including hot particles)

Hot particles could occur due to fires from crushing of a battery that is not fully discharged. The hot particles can be carried to the dust collector. But there are spark detection and extinguishing system provided in the shredder hopper, product conveyor and at the inlet ducting before the dust collector.

Flames or hot particle could occur from hot work associated with repairs / maintenance. Hot work entails welding, cutting, grinding, brazing, drilling and similar activities which results in sparks, fire, molten slag, or hot surfaces. Hot work is automatically assumed to be strong enough to ignite explosive dust atmospheres and initiate smouldering of dust layers.

The principal prevention is to separate out the fuel (flammables / combustibles) and the hot work. Hot work should be managed by a permit to work (PtW) system. The following guidance should be followed as a minimum (not exhaustive):

- Where possible, hot work is not carried out where an explosive dust atmosphere may be present, e.g., it is carried out in workshops under appropriate controls.
- Where hot work has to be carried out inside the dust collector, all combustibles / flammables are removed, and the dust collector is thoroughly de-dusted to ensure there is no potential for explosive dust atmosphere.
- The work is contained, e.g., through the usage of fire blankets and shields.
- A fire watch present during the work independent from the person using the equipment.

- There is provision for an emergency response plan (e.g., fire extinguishers), and this should consider the unique hazards posed by the hot work activity for which existing firefighting provisions may be insufficient.
- There is adequate detection and monitoring prior to and during the hot work.
- A fire watch is present after the work is completed to observe for any developing fires and smoulders and to monitor the temperature of surfaces affected by the work. This is to ensure surface temperatures are sufficiently low before reintroducing a flammable material into the booth.
- Persons issuing hot work permits are competent to do so, familiar with the area in question and suitably trained.

The PtW system was not examined at the time of the site visit. Therefore, the following recommendation is made.

R6. **Dust Extraction Unit –** Ensure there is a permit to work system in place for managing hot work activities. **(L)**

7.3.4 Static Electricity

Static Electricity and use of FIBCs

Static charges can be generated whenever the dust collector is emptied into the FIBC, the charge can accumulate on the deposited material as well as on the fabric from which a FIBC is constructed or any parts of it. An ignition could occur if the accumulated charge is released in the form of an incendiary discharge in the presence of an explosive dust atmosphere. Spark, brush, cone, and propagating brush discharges are all possible when FIBCs are used.

The requirements and specifications which FIBCs should meet depend on the nature and sensitivity of the explosive dust atmosphere present during filling and emptying. The final goal for the construction of FIBC is to exclude incendive discharges from the FIBC fabric during their intended use.

Since discharges of different incendivity (i.e., different types of discharges, such as spark, brush, or propagating brush discharges) may be generated, the necessity of their exclusion and thus the requirements for construction of the FIBC depends on the intended use of the FIBC. For this reason, different types of FIBC have been developed, which are defined as Type A, B, C or D.

- Type A FIBCs are made from fabric or plastic sheet without any measures against the build-up of static electricity.
- Type B FIBCs are made from fabric or plastic sheet designed to prevent the occurrence of propagating brush discharges.
- Type C FIBCs are made from fabric interwoven with connected conductive threads or filaments and designed to prevent the occurrence of incendiary sparks, brush discharges and propagating brush discharges. Type C FIBCs are fitted with dedicated earthing connections and must be connected to earth during filling and emptying operations.
- Type D FIBCs are made from static dissipative fabric with discontinuous conductive threads designed to prevent the occurrence of incendiary sparks, brush discharges

and propagating brush discharges, without the need for a connection from the FIBC to earth.

The four different types of FIBC should be used according to the minimum ignition energy (MIE) of the powder and/or particulate solid as shown in Table 3 below. Other types of FIBC or FIBC of unknown type should only be used in the presence of flammable atmospheres after detailed evaluation by an expert.

Table 3: Use of the different types of FIBC [7]

Material in FIBC	Surroundings	
MIE of material	**Non-flammable atmosphere**	**Dust Zones 21 & 22**
MIE > 1000 mJ	A, B, C, D	B, C, D
3 mJ < MIE ≤ 1000 mJ	B, C, D	B, C, D
MIE ≤ 3 mJ	C, D	C, D

The ability to use an FIBC safely in hazardous explosive dust atmospheres may change if an inner liner is installed in the FIBC. Combinations of FIBC and inner liner that can be used safely in hazardous atmospheres are shown in Table 4.

Table 4: Use of the different types of FIBC [7]

FIBC	Inner Liner		
	Type L1	**Type L2**	**Type L3**
Type B	Not permissible	Permissible	Permissible
Type C	Permissible	Permissible	Not permissible
Type D	Not permissible	Permissible	Not permissible

The three types of inner liners are based on surface resistivity as follows.

- Type L1 inner liners are made from materials with surface resistivity on at least one surface of less than 10 mega-ohms (MΩ) and, where necessary, a breakdown voltage through the material of less than 4 kV.
- Type L2 inner liners are made from materials with surface resistivity on at least one surface of between 1 giga-ohms (GΩ) and 1 tera-ohms (TΩ), and a breakdown voltage through the material of less than 4 kV.
- Type L3 inner liners are made from materials with surface resistivity of greater than 1TΩ and a breakdown voltage through the material of less than 4 kV.

At the time of the site visit, information on an FIBC label indicates that it is 'multi-trip[1]', with a safe working load of 1000 kg and a safety factor of 6. There was no information on the FIBC

[1] FIBCs are classed as either single trip or multi-trip.

type or the inner liner type (if any). This certainly means the FIBCs are not Type C or D as such FIBCs are clearly labelled as such. Therefore, the following recommendation is made.

R7. **General –** Based on the MIE provided by the test in recommendation R4, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4. **(M).**

Spark Discharges

Spark discharges occur from charged isolated conductors i.e., when charge is allowed to accumulate. This can occur for example on unearthed metal and other conductive or static dissipative items of equipment. Spark discharges can ignite explosive dust atmospheres (dependent upon MIE) and should be avoided by effective earthing and bonding of conductors.

A key source of isolated conductors in the explosive dust atmosphere identified in the HAC schedule (Table 2) is damaged earth cable connections in cartridge filters sleeves or clamps, and bag filter supports. During filter cleaning, the self-cleaning (shaker) mechanism may jostle the filter (now an isolated conductor) closer to the grounded dust collector hopper thereby leading to a spark discharge in the presence of an explosive dust atmosphere.

It is nearly impossible to guarantee that all small parts of a dust collector are bonded and earthed by cable connections. Hence, the primary protection measures for such a scenario is by the design and construction of the dust collector unit along with explosion protection. It is understood that explosion venting is provided at the top of the dust collector hopper. ATEX certification indicates that the ignition protection (construction safety) concept for the dust collector unit minimises the likelihood that an ignition source will arise from the unit provided that the equipment is inspected and maintained.

Another source of isolated conductors is charged hand tools that are stored on an FIBC during maintenance work around the dust collector. Whilst not likely to be high energy sparks, if the MIE of the powder is suitably low (not verified as yet), spark discharges even from low capacitance hand tools could be incendive for the dust atmosphere at the discharge of the dust collector hopper or inside the FIBC.

R8. **Dust Extraction Unit -** Until MIE data is available and a better risk judgement can be made, the practice of storing hand tools on top of the FIBC should be prevented as part of the risk assessment process under the permit to work for the maintenance task. **(L)**

Brush Discharges

Brush discharges occur from insulating materials e.g., plastic items or insulating powders. The maximum spark equivalent energy associated with brush discharges is 3 to 4 mJ [**Error! Reference source not found.**7]. Brush discharges can arise from the charging effect that occurs when dust is captured on the surface of a filter medium or from the charge powder itself or from the surface of the FIBC if insulating.

PD CLC/TR 60079-32-1: 2018 [7] states that current knowledge does not provide any indication that brush discharges can cause incendive ignition of combustible dusts independent of their MIE. Therefore, this ignition source can be disregarded.

Propagating Brush Discharges (PBD)

The principal precondition for a PBD is a high electrical charging regime on a thin (less than 10 mm) insulating material. They are more likely to occur if the insulator is in contact with an earthed conductor although this is not a prerequisite for a PBD. They do not occur in all metal plant.

Pneumatic conveying of dusts and particulate solids generates static charges on the materials being conveyed. PBD can occur inside the multi-compartment dust collector if there is a deflection plate used to direct the incoming gas-solid stream to the online filter compartment, and the surface of this deflection plate is coated with an insulating material.

The protection measure for this scenario is avoidance of the use of insulating deflection plates and provision for explosion protection. It is understood that explosion venting is provided at the top of the dust collector hopper. ATEX certification also indicates that the ignition protection (constructional safety) concept for the dust collector unit (based on its Type non-electrical 'c' certification) along with recommended maintenance minimises the likelihood that an ignition source will arise from the unit.

R9. **Dust Extraction Unit** – Verify with the equipment manufacturer if an insulating deflector plate is used inside the dust collector. **(L)**

Cone Discharge

Cone discharges occur from a heap of highly charged non-conductive powder after entering hoppers or silos. These are possible in FIBCs. Whilst unlikely to be incendive to the dust cloud in question, this cannot be completely discounted until MIE data is available.

7.4 Discussion

Discussion at the site visit indicates that there is experience of fires inside the shredder hopper. It was stated that this is due to release of energy from batteries that have not been deep discharged to 0%. The site identified that such an event occurs when batteries received from suppliers are damaged and one or more cells inside a battery are isolated from the charge/discharge circuit. For such batteries, the discharger and test equipment at the site will not identify such faults. The energy released from the charged cell(s) is incendive to combustible particles from the shredding process. Hence, the site installed the spark detection and extinguishing system at the hopper inlet and outlet, and at the inlet to the dust collection unit. It is understood that there is a maintenance service plan for the spark detection and extinguishing system. However, the following recommendation is made.

R10. **General –** Ensure that the tasks associated with the maintenance service plan for the spark detection and extinguishing system includes a performance test of the system. **(L)**

BS EN IEC 62485-6:2021 [8] indicates that lithium-ion batteries do not contain lithium metal. Therefore, the use of water as a fire extinguishing agent does not pose reactive and hydrogen generation hazards associated with the interaction between water and lithium metal.

Concerns were raised about the potential for smouldering fires under a pile of battery flakes inside the product FIBC because it was thought that the battery flakes may still be hot from the frictional heating by the shredder element. However, thermal imaging conducted during the site visit at the discharge of the hopper, along the product conveyor and across the content inside the FIBC indicated no hot spots and showed that the flakes are at ambient temperature. This indicated that the shredder mechanism uses very low force of attrition and would not lead to frictional heating. However, the following recommendation is made.

R11. **Battery Shredder –** Ensure there is a system in place for regular inspection and replacement of the shredder blades if this has not been specified by the shredder manufacturer. **(L)**

R12. **Battery Shredder -** Consider carrying out periodic thermal imaging of the shredded product from the shredder discharge through to the FIBC discharge spout. **(L)**

Dust explosion inside the dust collector is a known hazard to the site. Hence, the site has made provision for explosion protection and installed the dust collector outdoors. It is apparent that there are gaps in the explosion protection design basis and sufficient information of the dust extraction unit. These gaps have been captured by relevant recommendations.

7.5 Basis of Safety

The Basis of Safety for the Lithium battery shredding plant is based on:

- The Avoidance of Explosive Dust Atmosphere inside the battery shredder, enclosed conveyor and product FIBC via the application of dust containment and extraction system.
- The Avoidance of Ignition Sources at the dust collection unit through the use of ATEX-certified work equipment, spark detection and appropriate maintenance of the equipment and earthing and bonding. Explosion venting and isolation is present as a secondary basis of safety.
- The Avoidance of Ignition Sources during FIBC filling by ensuring correct choice of FIBC and liner, and appropriate measures to ensure the FIBC is used correctly.
- The Application of Organisational Measures (battery discharging and testing, compliance with manufacturer's instruction, operator training, etc.) for fire prevention inside the shredder.
- The Application of Technical Measures for fire detection and control via fire-resisting materials of construction, spark detection and extinguishment system.

For the Basis of Safety to hold, the recommendations summarised below should be implemented / actioned as far as is reasonably practicable.

7.6 Recommendations

R2. **Dust Extraction Unit -** Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector. **(M)**

R3. **Dust Extraction Unit –** Confirm the full details of the ATEX certification from the manufacturer. **(L)**

R4. **General –** Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA. **(H)**

R5. **Dust Extraction Unit** - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources. **(L)**

R6. **Dust Extraction Unit –** Ensure there is a permit to work system in place for managing hot work activities. **(L)**

R7. **General –** Based on the MIE provided by the test in recommendation R4, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4. **(M).**

R8. **Dust Extraction Unit -** Until MIE data is available and a better risk judgement can be made, the practice of storing hand tools on top of the FIBC should be prevented as part of the risk assessment process under the permit to work for the maintenance task. **(L)**

R9. **Dust Extraction Unit** – Verify with the equipment manufacturer if an insulating deflector plate is used inside the dust collector. **(L)**

R10. **General –** Ensure that the tasks associated with the maintenance service plan for the spark detection and extinguishing system includes a performance test of the system. **(L)**

R11. **Battery Shredder –** Ensure there is a system in place for regular inspection and replacement of the shredder blades if this has not been specified by the shredder manufacturer. **(L)**

R12. **Battery Shredder -** Consider carrying out periodic thermal imaging of the shredded product from the shredder discharge through to the FIBC discharge spout. **(L)**

8. CONCLUSION AND RECOMMENDATION SUMMARY

A DSEAR assessment has been undertaken for F&R Cawley Ltd for the activities undertaken at the Lithium Battery Shredding Plant in Maidenhall, Bedfordshire.

The main finding of the assessment is that there are gaps in the measures in place for the management of the risks of harm from fires and explosion. These gaps will require additional actions to be taken and these actions have been summarised as recommendations throughout this DSEAR assessment.

The Basis of Safety for the Lithium Battery Shredding Plant is based on:

- The Avoidance of Explosive Dust Atmosphere inside the battery shredder via the application of dust extraction system.
- The Avoidance of Ignition Sources at the dust collection unit through the use of ATEX-certified work equipment.
- The Application of Organisational Measures (battery discharging and testing, compliance with manufacturer's instruction, operator training, etc) for fire prevention inside the shredder.
- The Application of Technical Measures for fire detection and control via fire-resisting materials of construction, spark detection and extinguishment system.

For the Basis of Safety to hold, the recommendations summarised below should be implemented / actioned so far as is reasonably practicable.

9. FLAMMABILITY DATA

The following table gives the flammability data for typical ingredients in the HEDBs handled on site. The information was sourced from NFPA 499 [3].

Table 5: Flammability data for powders

Classification of Data	Ignition Sensitivity			Explosion Severity		Electrostatic Properties		Thermal Decomposition	Burning Behaviour	Limits	
Test Parameter	Layer Ignition Temp. (LIT)	Cloud Ignition Temp. (CIT)	Minimum Ignition Energy (MIE)	20 litre Sphere		Resistivity (Low RH)	Charge Relaxation Time (Low RH)	Onset Temp.	BZ Number	Minimum Explosible Conc. (MEC)	Limiting Oxygen Conc. (LOC)
Units	°C	°C	mJ	P_{max} barg	K_{st} bar m/s	Ohm m	hours	°C	-	g/m^3	% $^{v}/_{v}$
Carbon Powder										> 50	

Key:

- Blank fields mean no data are available from the information sources used.

10. REFERENCES

1. "*Dangerous Substances and Explosive Atmospheres Regulations 2002*", S.I.2002 No.2776 (DSEAR 2002).
2. *"High Energy Density Battery – Safety Data Sheet*", Assembly 0754A12-002, Rev. A1, Issue Date: 01/04/2018, UEC Electronics.
3. NFPA 499:2021, "*Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas"*, NFPA.
4. *"EH40/2005 Workplace Exposure Limits"*, 4th Edition, HSE.
5. BS EN IEC 60079-10-2:2015, "*Explosive atmospheres. Classification of areas. Explosive dust atmospheres*", BSI
6. BS EN 1127-1:2019, "*Explosive atmospheres. Explosion prevention and protection. Basic concepts and methodology*", BSI.
7. *PD* CLC/TR 60079-32-1:2018, "*Explosive atmospheres. Electrostatic hazards, guidance. British Standards Institution*", BSI.
8. BS EN IEC 62485-6:2021, *"Safety requirements for secondary batteries and battery installations. Safe operation of lithium-ion batteries in traction applications"*, BSI.
9. "*Regulatory Reform (Fire Safety) Order 2005*", S.I. 2005 No. 1541

APPENDIX A DSEAR 2002

The following is a summary of the regulations of DSEAR:

- **Regulations 1 to 4** deal with preliminary issues, i.e., the date of entry into force of the Regulations, scope and definitions.
- **Regulation 5** requires employers and the self-employed to assess risks to employees and others whose safety may be affected by the use or presence of dangerous substances at work.
- **Regulation 6** sets out how the risk to safety from dangerous substances should be eliminated or reduced.
- **Regulation 7** contains specific requirements to be applied where an explosive atmosphere may be present (in addition to the requirements in regulation 6).
- **Regulation 8** requires the provision of arrangements to deal with accidents, incidents and emergencies.
- **Regulation 9** requires the provision of information, training and instruction on dangerous substances.
- **Regulation 10** requires the identification of pipes and containers where these contain dangerous substances.
- **Regulation 11** addresses the need to coordinate explosion protection measures where employers share the same workplace.

A.1 When does DSEAR Apply?

DSEAR applies whenever:

- There is work being carried out by an employer (or self-employed person), and
- A *dangerous substance* is present (or is liable to be present) at the workplace, and
- The dangerous substance could be a risk to the safety of people as a result of fires, explosions or similar energetic events or through corrosion to metal.

Fires and explosions create harmful physical effects such as thermal radiation, overpressure effects and oxygen depletion. These effects can also be caused by other energetic events such as runaway exothermic reactions involving chemicals or decomposition of unstable substances such as peroxides. These events are also covered by DSEAR.

Gases under pressure can also cause explosions creating harmful effects. Substances that are corrosive to metal may cause damage to metal/metal containing structures which could result in reduced structural integrity.

A.2 Definition of Dangerous Substances?

Dangerous substances include:

- A substance or mixture which meets the criteria for classification as hazardous within any physical hazard class laid down in the CLP Regulation whether or not the substance is classified under that regulation.
- Any kind of dust that when spread in air to form a cloud (ie form an explosive atmosphere), can explode.

- Any other substances, or mixtures of substances, which because of their physical properties and the way in which they are present in the workplace create a risk to safety from fires and explosions, but which may not be covered by CLP Regulation. For example high flashpoint liquids present in the workplace at elevated temperatures.

A.3 Main Requirements of DSEAR

In summary, DSEAR places duties on employers (and the self-employed, who are considered employers for the purposes of the Regulations) to assess and eliminate or reduce risks from dangerous substances. Specific requirements are discussed below.

A.3.1 Assessing Risks

Before work is carried out, employers must assess the risks that may be caused by dangerous substances. The purpose is to help employers to decide what they need to do to eliminate or reduce the risks from dangerous substances. If there is no risk to safety, or the risk is trivial, no further action is needed. If there are risks then employers must consider what else needs to be done to comply fully with the requirements of DSEAR.

As part of the risk assessment, employers must classify areas where hazardous explosive atmospheres may occur into zones. The classification given to a particular zone, and its size and location, depends on the likelihood of an explosive atmosphere occurring and its persistence if it does.

DSEAR defines a place where an explosive atmosphere may occur in quantities that require special precautions to protect the health and safety of workers as **hazardous**. A place where an explosive atmosphere is not expected to occur in quantities that require such special precautions is deemed to be **non-hazardous**. For these purposes "**special precautions**" means precautions to control potential ignition sources within a hazardous area, particularly in relation to the construction, installation and use of equipment.

Identifying hazardous or non-hazardous areas should be carried out in a systematic way. Risk assessment should be used to determine if hazardous areas exist and to then assign zones to those areas. The assessment should consider such matters as:

a) The hazardous properties of the dangerous substances involved;

b) The amount of dangerous substances involved;

c) The work processes, and their interactions, including any cleaning, repair or maintenance activities that will be carried out;

d) The temperatures and pressures at which the dangerous substances will be handled;

e) The containment system and controls provided to prevent liquids, gases, vapours or dusts escaping into the general atmosphere of the workplace;

f) Any explosive atmosphere formed within an enclosed plant or storage vessel; and,

g) Any measures provided to ensure that any explosive atmosphere does not persist for an extended time, e.g. ventilation.

Before a workplace containing zoned areas comes into operation for the first time, the employer must ensure that the overall explosion safety measures are confirmed (verified) as being safe. This must be done by a person or organisation competent to consider the particular risks in the workplace, and the adequacy of the explosion control and other measures put in place.

If an employer has five or more employees, the employer must record the significant findings of the risk assessment.

A.3.2 Preventing or Controlling Risks

Employers must put control measures in place to eliminate risks from dangerous substances, or reduce them as far as is reasonably practicable. Where it is not possible to eliminate the risk completely employers must take measures to control risks and reduce the severity (mitigate) the effects of any harmful event.

The best solution is to eliminate the risk completely by replacing the dangerous substance with another substance, or using a different work process. This is called substitution in the Regulations.

In practice this may be difficult to achieve, but it may be possible to reduce the risk by using a less dangerous substance. For example, replacing a low flashpoint liquid with a high flashpoint one. In other situations it may not be possible to replace the dangerous substance at all. For example, it would not be practical to replace petrol with another substance at a filling station.

A.3.3 Control Measures

Where the risk cannot be eliminated, DSEAR requires control measures to be applied in the following priority order:

- Reduce the quantity of dangerous substances to a minimum.
- Avoid or minimise releases of dangerous substances.
- Control releases of dangerous substances at source.
- Prevent the formation of a dangerous atmosphere.
- Collect, contain and remove any releases to a safe place (for example, through ventilation).
- Avoid ignition sources. Areas classified into zones must be protected from sources of ignition. Equipment and protective systems intended to be used in zoned areas should be selected to meet the requirements of the *Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996*. Equipment already in use before July 2003 can continue to be used indefinitely provided a risk assessment shows it is safe to do so.
- Avoid adverse processing conditions (for example, exceeding the limits of temperature or control settings) that could lead to danger.
- Keep incompatible substances apart.

These control measures should be consistent with the risk assessment and appropriate to the nature of the activity or operation.

A.3.4 Mitigation

In addition to control measures DSEAR requires employers to put mitigation measures in place. These measures should be consistent with the risk assessment and appropriate to the nature of the activity or operation and include:

- Reducing the number of employees exposed to the risk.

- Providing plant that is explosion resistant.
- Providing plant that is corrosion resistant.
- Providing explosion suppression or explosion relief equipment.
- Taking measures to control or minimise the spread of fires or explosions.
- Providing suitable personal protective equipment.

A.3.5 Preparing Emergency Plans and Procedures

Arrangements must be made to deal with emergencies. These plans and procedures should cover safety drills and suitable communication and warning systems and should be in proportion to the risks. If an emergency occurs, workers tasked with carrying out repairs or other necessary work must be provided with the appropriate equipment to allow them to carry out this work safely.

The information in the emergency plans and procedures must be made available to the emergency services to allow them to develop their own plans if necessary.

A.3.6 Providing Information, Instruction and Training for Employees

Employees must be provided with relevant information, instructions and training. This includes:

- The dangerous substances present in the workplace and the risks they present including access to any relevant safety data sheets and information on any other legislation that applies to the dangerous substance.
- The findings of the risk assessment and the control measures put in place as a result (including their purpose and how to follow and use them).
- Emergency procedures.

Information, instruction and training need only be provided to other people (non-employees) where it is required to ensure their safety. It should be in proportion to the level and type of risk.

The contents of pipes, containers, etc must be identifiable to alert employees and others to the presence of dangerous substances. If the contents have already been identified in order to meet the requirements of other law, this does not need to be done again under DSEAR.

APPENDIX B HAZARD AND RISK ASSESSMENT METHODOLOGY

This section gives a brief overview of the methodology used to assess the fire and explosion hazards and risks (where possible).

1. Firstly, the flammability properties, quantities involved, circumstances or work and the process is assessed to determine whether a flammable atmosphere is or could be present under credible abnormal situations. If not, the unit operation can be concluded to being non-hazardous and the assessment can be regarded as being completed. The supporting justification is documented so there is a record that it has been formally assessed.
2. If there is a potential flammable atmosphere present, then the next sub-section discusses how it can be prevented from forming, or how it can be reduced in size or duration – this is the Hazardous Area Classification (HAC) part of the assessment.
3. Once hazardous areas have been identified, the ignition sources present and capable of igniting the hazardous areas are assessed. The objective here is to identify the relevant ignition sources and assess whether they are adequately controlled when examined a built facility. Where appropriate, guidance would be given on how ignition sources can be adequately controlled.
4. Once the ignition sources have been assessed, the fire and explosion hazard scenarios are identified. Where possible and required, the hazard likelihood and consequence(s) are assessed, and this allows a view to be formed about the risk of the process unit. By this stage, a Basis of Safety (strategy for keeping personnel safe from the hazards of fires and explosions) can be identified or proposed.
5. Following all of this, or throughout the above steps: recommendations are made. The recommendations are then accumulated in Section 8, page 29, as a ‘check off’ list

The following subsections give a more detail about the methodology employed to assess the fire and explosion hazards.

B.1 Plant Overview and Process Description

This section provides an overview of the relevant information about the process and plant to enable the assessment to be carried out. The process description should give consideration:

- Material(s), quantities or flow rates involved.
- Relevant process conditions e.g., temperature, pressure, or any parameter that can affect the explosion hazards and risks.
- Major plant items and statement or indication on sizes and materials of construction.
- Any procedural aspects of the process which have ramifications on the fire/explosion hazard e.g. sampling, or line breaking etc.
- Facility siting.
- Risk control systems such as safeguards, citation to existing protection against any aspect of explosion safety may be given.

B.2 Hazardous Area Classification (HAC)

A relevant standard e.g., BS EN IEC 60079-10-2 [5] for dusts is first identified and then used as the method to identify the sources and grades of release and assign the hazardous area(s) taking into account the various factors which influence the overall zones.

In order to determine whether a *hazardous* flammable atmosphere (*hazardous area* for short) is present, the properties of the material(s), quantities involved, circumstances or work and the process is assessed to check whether ignition of the flammable atmosphere could cause harm to personnel.

If ignition of the flammable atmosphere could harm personnel, then a formal hazardous area may need to be assigned and ignition sources rigorously controlled. If not, then assigning a formal hazardous area is unnecessary e.g., spray cleaning using a low flash point, high boiling point liquid from a small (less than 1 litres) bottle would release very little flammable vapours that even if ignition occurred, serious harm to personnel would not occur. As such special precautions such a ATEX certified equipment is not required.

The conclusions of the HAC are typically given in a tabulated form, from which plan and elevated drawings can be derived. NB: HAC plan and elevation drawings are not part of the standard delivery of an explosion safety assessment.

B.3 Ignition Sources

Next, ignition source(s) present in the identified hazardous areas that is/are capable of igniting the flammable atmosphere are assessed. If none are present, or they can be adequately controlled, then safety can be based on *Avoidance of Ignition Sources*. Possible sources of ignition that should be considered for a process are listed in full in BS EN 1127 [6]:

1. Hot surfaces
2. Flames and hot gases (including hot particles)
3. Mechanically generated sparks
4. Unsuitable or malfunctioning electrical apparatus
5. Stray electrical currents, cathodic corrosion protection
6. Static electricity
7. Lightning
8. Radio Frequency (RF) electromagnetic waves
9. Visible light electromagnetic waves
10. Ionising radiation
11. Ultrasonics
12. Adiabatic compression and shock waves
13. Exothermic reactions, including self-ignition of dusts

The ignition sources assessment is directed by the following two considerations:

1. The likelihood of the ignition source being present. This is guided by the following principles (as detailed in BS EN 1127 [6]):
    i. For Zone 22 areas, ignition sources during normal operation shall be considered.
    ii. For Zone 21 areas, ignition sources during normal operation and expected malfunctions shall be considered.
    iii. For Zone 20 areas, ignition sources during normal operation, expected malfunctions and rare malfunctions shall be considered.

2. The likelihood of the identified ignition source being effective enough to ignite the material(s) of concern. The answer to this query depends on two sub-aspects:
    i. The strength that the ignition source can deliver, which is typically either indicated by a temperature or an energy dissipated. This will be judged on a case-by-case basis for each identified ignition source.
    ii. The ignition sensitivity of the flammable material(s).

If an effective ignition source has been identified, control measures to either being stop its occurrence or neutralise its effectiveness is explored.

B.4 Discussion on Hazards and Risks

This section identifies the fire and explosion hazards of the process. If possible, a view about the associated risks is also given. Once the hazard scenarios have been identified, their likelihood is assessed by taking into consideration the conclusions from the HAC i.e., likelihood of flammable atmosphere, and the ignition assessment.

The scale of the anticipated effects and extent of harm (i.e., consequences of the event), and occupancy patterns of personnel in the affected area are also considered when appropriate. The above factors are combined with any other relevant conditional modifiers and safeguards to give a view about the risk.

Where a view has been expressed about the acceptability of a risk, this is normally a qualitative judgement based on what would typically be expected by industry norms for that process or operation. It is assumed this would correspond to a tolerability criterion acceptable under the law.

- Where a risk has been deemed to be acceptable, it means it exceeds or is at least aligned with good engineering practice, industry norms or demonstrably of no significant concern. As such, the process can run although minor improvement may still be recommended.
- Where a risk has been deemed to be ALARP (as low as reasonably practicable), this will invariably entail a cost-benefit analysis showing the cost to achieve further risk reduction to bring the risk into the tolerable region is grossly disproportionate to the benefit achieved.
- Where a risk has been deemed to be unacceptable or intolerable, this process would ideally cease from operation until the major improvement have been made.

B.5 Basis of Safety

A summary of the Basis (or Bases) of Safety is given in this section taking into consideration the hierarchy of risk management under the law.

B.6 Recommendations

This section lists the recommendations for the process being assessed. The objective is to identify all necessary recommendations to make the risk(s) acceptable or ALARP. At time, there could be in an information gap that needs to be addressed first, and that too is often captured in the recommendations list.

No.	Recommendations	Priority
1	DSEAR (Regulation 5) requires the DSEAR assessment to be reviewed at regular intervals. Based on the risks and changes foreseen, it is recommended to review this assessment whenever changes are made but even without changes at no later than 4 years from the date of this report. This should be captured in the site's action tracker or equivalent system.	Medium
2	Dust Extraction Unit - Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector.	Medium
3	Dust Extraction Unit – Confirm the full details of the ATEX certification from the manufacturer.	Low
4	General – Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA.	High
5	Dust Extraction Unit - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources.	Low
6	Dust Extraction Unit – Ensure there is a permit to work system in place for managing hot work activities.	Low
7	Based on the MIE provided by the test in recommendation R4, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4.	Medium
8	Dust Extraction Unit - Until MIE data is available and a better risk judgement can be made, the practice of storing hand tools on top of the FIBC should be prevented as part of the risk assessment process.	Low
9	Dust Extraction Unit – Verify with the equipment manufacturer if an insulating deflector plate is used inside the dust collector.	Low
10	General – Ensure that the tasks associated with the maintenance service plan for the spark detection and extinguishing system includes a performance test of the system.	Low
11	Battery Shredder – Ensure there is a system in place for regular inspection and replacement of the shredder blades if this has not been specified by the shredder manufacturer.	Low

12	Battery Shredder - Consider carrying out periodic thermal imaging of the shredded product from the shredder discharge through to the FIBC discharge spout.	Low

Responsible Person(s)	Actions Taken	Target Date	Date Closed
Amanda Clark	To include the DSEAR assessment survey on the Reg - 005 Thorough Examination register.	01-Apr-23	01/04/2023
Nigel Ingram	NI - To contact portable conveyors to obtain the technical file for the dust collector. To chase again 09.05.23 update 23.05.23 - technical file received and	30-May-23	23/05/2023
Nigel Ingram	NI - To contact portable conveyors and obtain the ATEX certification from the manufacturer. To chase again 09.05.23 update 23.05.23 - documents received.	30-May-23	23/05/2023
Alan Colledge / DEKRA	Sample sent 26th April 2023 - results due back week commencing 5th July 2023.	30-May-23	
SHEQ	PTW is established and would be implemented for this task.	01-Apr-23	01/04/2023
SHEQ	PTW is established and would be implemented for this task.	01-Apr-23	01/04/2023
Alan Colledge / DEKRA	Sample sent 26th April 2023 - results due back week commencing 5th July 2023.	30-May-23	
SHEQ	RAMS 09-24 has been reviewed to stipulate that hand tools are not to be stored on top of the FIBC.	01-Apr-23	01/04/2023
Nigel Ingram	NI - to contact portable conveyors to verify if the insulating detector palte is used inside the dust collector.To chase again 09.05.23 update from manufacturer 23.05.23 - 'We do not use an insulating deflector plate as we have inlet sections to	30-May-23	23/05/2023
Alan Colledge	Alan Colledge - To review SOP/RAM and to test and record system on a monthly basis to commence May 23.	30-Apr-23	01-May-23
Nigel Ingram/Alan Colledge	RAMS 09-24 have been reviewed to include inspections of the shredder blades.	30-Apr-23	9th May 2023

Alan Colledge	Alan Colledge - To review SOP/RAM and to test and record system on a monthly basis to commence May 23.	30-Apr-23	01-May-23

Status
Closed
Closed
Closed
In progress
Closed
Closed
In progress
Closed
Closed
Closed
Closed

Closed

EC DECLARATION OF INCORPORATION OF COMPLETED MACHINERY

We: Air Plants Dust Extraction Ltd:

Declare that the completed machinery described by and limited to the APDEL contract number (listed below) has been manufactured in conformity with the Supply of Machinery (safety) Regulations 2008, in so far that the equipment supplied is intended to form a completed system. The system is itself is declared as fully compliant with the provisions of the said regulations and therefore compliant with Directive 2006/42/EC.

Technical documentation has been complied in accordance with annex VII (Part 7) and will be made available to national authorities in response to a reasoned request either as a hard copy or in electronic format.

We further declare that when incorporated into the complete system the equipment supplied conforms with the following directives:

Low Voltage Directive 2014/35/EU

Pressure Equipment Directive 2014/68/EU

EMC Directive 2014/30/EU

ATEX Directive 2014/34/EU

APDEL Contract No.:	11190
Functional Description:	Dust Extraction System
Authorised Representative:	Mick Johnson
Signature of Authorised Representative:	*M Johnson*

EU Certificate of conformity

Explosion isolation flap valves VIGILEX

CUSTOMER

Customer :	**MACCLANCY AND SONS LTD**
Purchase order number :	**059330-140 Qty : 1/3**
Customer reference S/N:	**CS2020102301**
Item code STIF P/N:	**57VPA0401B51TB00_3020**

PRODUCT SPECIFICATIONS

Marking ATEX :	**Ex II D**		
Type DN:	**VIGIFLAP Ø 400 STD**	**Date of manufacturing :**	**50/2020**
Body material :	**MILD_STEEL_RAL3020**	**Serial number :**	**059330-140-1**
Assembly :	**Checking lock mechanism**	**Customer S/N :**	
Flap gasket :	**EPDM**		
Lock flap sensor :	**YES**		
Capacitive sensor (option) :	**NO**		

DUST PARAMETERS

All dust kind :	**Kst max :**	**≤ 250 bar.m/s**
	Vessel, Pred max :	**≤ 0.5 bar**
	Body pressure resistance :	**≤ 2.0 bar**
	Pmax :	**≤ 10 bar**
	TMI (MIT) :	**≥ 400° C / 752° F**
	EMI (MIE) :	**≥ 10 mJ**
	IEMS (MESG) :	**≥ 1.7mm**

PRODUCTION QUALITY INSURANCEON

Notified body:	**INERIS**
Address:	**Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte**
N° of notified body:	**0080**
N° of quality certificate:	**INERIS 08ATEXQ406**

production quality Insurance certificate according to instruction of appendix IV and VII of the ATEX directive

ATEX CERTIFICATION

Notified body:	**INERIS**
Address:	**Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte**
N° of notified body:	**0080**
N° of quality EC certificate:	**INERIS 19ATEX0016X_00**
Technical file:	**BE1257003 - 01/20**
Harmonized norm:	**EN16447 : 2014**
European ATEX directive:	**94/9/EC (up to 19 April 2016) - 2014/34/EU (from 20 April 2016)**

We certify that safety device covered by this data has been manufactured, inspected, tested and packaged in accordance with the purchase order requirements.
All guaranty documents of this conformity certificate are on file available for examination.

Raphaël CERIZIER 08/12/2020
ATEX manager

STIF
SOCIETE DE TOLERIE INDUSTRIELLE FRANÇAISE
S.A.S. au Capital de 800 000 €
Z.A. de la Lande - 49170 ST GEORGES SUR LOIRE
Tél. : 33 (0)2.41.72.16.80
SIRET 328 876 503 00025-RC Angers 84 B 12

Z.A. de la lande - 49170 Saint-Georges-sur-Loire - France
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Email : sales@stifnet.com - Site internet : www.stifnet.com
SAS au capital de 800 000 € - R.C.S. Angers B 328 876 503 - 84B12 APE 2511Z - N° TVA FR 35 328 876 503

EU Certificate of conformity

Explosion isolation flap valves VIGILEX

CUSTOMER

Customer :	**MACCLANCY AND SONS LTD**
Purchase order number :	**059330-140 Qty : 1/3**
Customer reference S/N:	**CS2020102301**
Item code STIF P/N:	**57VPA0401B51TB00_3020**

PRODUCT SPECIFICATIONS

Marking ATEX :	**Ex II D**		
Type DN:	**VIGIFLAP Ø 400 STD**	**Date of manufacturing :**	**50/2020**
Body material :	**MILD_STEEL_RAL3020**	**Serial number :**	**059330-140-2**
Assembly :	**Checking lock mechanism**	**Customer S/N :**	
Flap gasket :	**EPDM**		
Lock flap sensor :	**YES**		
Capacitive sensor (option) :	**NO**		

DUST PARAMETERS

All dust kind :	**Kst max :**	**≤ 250 bar.m/s**
	Vessel, Pred max :	**≤ 0.5 bar**
	Body pressure resistance :	**≤ 2.0 bar**
	Pmax :	**≤ 10 bar**
	TMI (MIT) :	**≥ 400° C / 752° F**
	EMI (MIE) :	**≥ 10 mJ**
	IEMS (MESG) :	**≥ 1.7mm**

PRODUCTION QUALITY INSURANCEON

Notified body:	**INERIS**
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N° of notified body:	**0080**
N° of quality certificate:	**INERIS 08ATEXQ406**

production quality Insurance certificate according to instruction of appendix IV and VII of the ATEX directive

ATEX CERTIFICATION

Notified body:	**INERIS**
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Technical file:	**BE1257003 - 01/20**
Harmonized norm:	**EN16447 : 2014**
European ATEX directive:	**94/9/EC (up to 19 April 2016) - 2014/34/EU (from 20 April 2016)**

We certify that safety device covered by this data has been manufactured, inspected, tested and packaged in accordance with the purchase order requirements.
All guaranty documents of this conformity certificate are on file available for examination.

Raphaël CERIZIER 08/12/2020
ATEX manager

STIF
SOCIETE DE TOLERIE INDUSTRIELLE FRANÇAISE
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SAS au capital de 800 000 € - R.C.S. Angers B 328 876 503 - 84B12 APE 2511Z - N° TVA FR 35 328 876 503

EU Certificate of conformity

Explosion isolation flap valves VIGILEX

CUSTOMER

Customer :	**MACCLANCY AND SONS LTD**
Purchase order number :	**059330-140 Qty : 1/3**
Customer reference S/N:	**CS2020102301**
Item code STIF P/N:	**57VPA0401B51TB00_3020**

PRODUCT SPECIFICATIONS

Marking ATEX :	**Ex II D**		
Type DN:	**VIGIFLAP Ø 400 STD**	**Date of manufacturing :**	**50/2020**
Body material :	**MILD_STEEL_RAL3020**	**Serial number :**	**059330-140-3**
Assembly :	**Checking lock mechanism**	**Customer S/N :**	
Flap gasket :	**EPDM**		
Lock flap sensor :	**YES**		
Capacitive sensor (option) :	**NO**		

DUST PARAMETERS

All dust kind :	**Kst max :**	**≤ 250 bar.m/s**
	Vessel, Pred max :	**≤ 0.5 bar**
	Body pressure resistance :	**≤ 2.0 bar**
	Pmax :	**≤ 10 bar**
	TMI (MIT) :	**≥ 400° C / 752° F**
	EMI (MIE) :	**≥ 10 mJ**
	IEMS (MESG) :	**≥ 1.7mm**

PRODUCTION QUALITY INSURANCEON

Notified body:	**INERIS**
Address:	**Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte**
N° of notified body:	**0080**
N° of quality certificate:	**INERIS 08ATEXQ406**

production quality Insurance certificate according to instruction of appendix IV and VII of the ATEX directive

ATEX CERTIFICATION

Notified body:	**INERIS**
Address:	**Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte**
N° of notified body:	**0080**
N° of quality EC certificate:	**INERIS 19ATEX0016X_00**
Technical file:	**BE1257003 - 01/20**
Harmonized norm:	**EN16447 : 2014**
European ATEX directive:	**94/9/EC (up to 19 April 2016) - 2014/34/EU (from 20 April 2016)**

We certify that safety device covered by this data has been manufactured, inspected, tested and packaged in accordance with the purchase order requirements.
All guaranty documents of this conformity certificate are on file available for examination.

Raphaël CERIZIER 08/12/2020
ATEX manager

STIF
SOCIETE DE TOLERIE INDUSTRIELLE FRANÇAISE
S.A.S. au Capital de 800 000 €
Z.A. de la Lande - 49170 ST GEORGES SUR LOIRE
Tél. : 33 (0)2.41.72.16.80
SIRET 328 876 503 00025-RC Angers 84 B 12

Z.A. de la lande - 49170 Saint-Georges-sur-Loire - France
Siège social, achats et usine : tél.: +33 2 41 72 16 80 - Fax +33 2 41 72 16 85
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Email : sales@stifnet.com - Site internet : www.stifnet.com
SAS au capital de 800 000 € - R.C.S. Angers B 328 876 503 - 84B12 APE 2511Z - N° TVA FR 35 328 876 503

EU Certificate of Conformity
VIGILEX Vent Panel

CUSTOMER

Customer :	**MACCLANCY AND SONS LTD**
Purchase order number :	**083212-010** **Qty : 100**
Customer reference S/N :	**2022080302/A**
Item code STIF P/N:	**57VLBE30052092**

PRODUCT SPECIFICATIONS

Product type :	**VIGILEX VL**	**Serial number :**	**083212-010-1 / 395668**
Nominal size :	**524x924**	**Date of manufacturing :**	**45/2022**
Material :	**1.4307 / EPDM**	**Manufactured quantity :**	**108**
		Serial customer S/N :	
ATEX marking :	**Ex II GD**		

BURST TEST RESULTS

Test made according EN 14797:2006

Pstat : **100mbar ±15% @22° C / Min : 85mbar - Max : 115mbar**

Vacuum : **50mbar**

Quantity tested : **8**

Test résult :	**(1) 105mbar**	**(5) 112mbar**	**(9)**	**mbar**	**(13)**	**mbar**	**(17)**	**mbar**
	(2) 109mbar	**(6) 104mbar**	**(10)**	**mbar**	**(14)**	**mbar**	**(18)**	**mbar**
	(3) 113mbar	**(7) 113mbar**	**(11)**	**mbar**	**(15)**	**mbar**	**(19)**	**mbar**
	(4) 110mbar	**(8) 105mbar**	**(12)**	**mbar**	**(16)**	**mbar**	**(20)**	**mbar**

Tests realized in an ambient temperature included between 15° C and 25° C.

BUILDING MATERIALS

Component	Material	Material's certificate
- Vent panel :	**1.4307 (304L)**	**Material batch : 220702**
- Gasket :	**EPDM (black)**	

PRODUCTION QUALITY INSURANCE INFORMATION

Notified body :	**INERIS**
Address :	**Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte**
N° of notified body :	**0080**
N° of quality certificate :	**INERIS 08ATEXQ406**

Production quality Insurance certificate according to instruction of appendix IV and VII of the ATEX directive

ATEX CERTIFICATION INFORMATION

Notified body :	**INERIS**
Address :	**Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte**
N° of notified body :	**0080**
N° of quality EU certificate :	**INERIS 15ATEX0001X - 02**
Technical file :	**BE1257001- B**
Harmonized norm :	**EN14491 : 2012 / EN14994 :2007 / EN14797 : 2006**
European ATEX directive:	**2014/34/UE**

We certify that safety device covered by this data has been manufactured, inspected, tested and packaged in accordance with the purchase order requirements.
All guaranty documents of this conformity certificate are on file available for examination.

Jean-Marc FAURIE Date :07/11/2022
Products engineer

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EMERGENCY RESPONSE INFORMATION

Lithium Workshop

Cawleys — local recycling global responsibility

FIRE SERVICES	HOSPITAL - A&E	POLICE STATION	ENVIRONMENT AGENCY	FIRE ASSEMBLY POINT	LOCATION OF COMBUSTIBLES	LOCATION OF FIRE EXTINGUISHERS	FIRST AID KIT & ACCIDENT BOOK	WATER	ELECTRICITY	GAS	FUEL / DIESEL
Luton Fire Brigade, Studley Rd, Luton LU3 1BB **T: 01234 845 000**	The L&D Hospital, Lewsey Rd, Luton LU4 0DZ **T: 01582 491 166**	Luton Police Station, Buxton Rd, Luton, LU1 1SD **T: 01582 401 212**	Incident hotline/ Report an incident (Freephone, 24-hour service) **T: 0800 80 70 60**	By the site's perimeter fence (rear gate)		Various locations as marked on the plans below	As marked on the plan below (accident book in Lithium Workshop Office)	Bin Shed / Canteen (LHS Gents Toilet) Affinity Water **T: 0345 357 2407**	As marked on the plan below. UK Power Networks **T: 0800 31 63 105**	N/A	Dieses in double bunded tank adjacent to the Lithium Workshop

EMERGENCY SITE CONTACTS

Alan Colledge:	07970 213692
Nigel Ingram:	07392 870 906
Amanda Clark:	07827 772 557

LEGEND

- Diesel Tank
- Battery Discharge Unit
- Suppression Syst. Tank
- LEV Extraction Unit
- AdBlue Pump
- Air compressor
- Pedestrian walkway
- Emergency spill kit
- First aid kit
- Electric board
- Electric Car Charging Point
- Conveyor Belt Controls & Emergency Stop
- Fire exit route
- Fire Alarm Bell
- Fire call point
- Fire extinguisher
- Emergency Light
- Fire Blanket
- Fire Action Control Panel
- Fire assembly point
- Barrier

IN CASE OF AN EMERGENCY CALL 999

Specific Unlikely Scenarios across touchpoints

All eventualities of the Lithium Recycling process have been documented through our Risk Assessment and Method statements. In order to enhance these the following narrative describes the likely procedures should a fire or thermal runaway develop at the various stages where the live batteries are handled and processed at the following touch points.

Off Loading/loading and general moving of Lithium Batteries

- *Risk Scenario*

In the unlikely event that a battery is abused either through dropping, forklift piercing and then develops into thermal runaway leading to a fire.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.
Should the battery cell/module/pack show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) then the battery cell/module/pack is to be moved by forklift and placed into the onsite quenching tank where safe to do so.
If the battery is on fire with naked flame then this is to be attended by using Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer. Where safe to do so the battery can then be moved away from the workshop into the Sterile zone at the front of the building using a forklift truck and into the onsite quenching tank where safe to do so.

Decommissioning and dismantling of Lithium Batteries

- *Risk Scenario*

In the unlikely event that a live battery is abused through the action of dismantling such as short circuit across battery terminals, dropping a module half out of the pack casing and then develops into thermal runaway leading to a fire.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.
Should the battery cell/module/pack show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) then the battery cell/module/pack is to be moved by forklift (or by hand in the case of cells and modules supported by dynamic risk assessment) and placed into the onsite quenching tank where safe to do so.
If the battery is on fire with naked flame then this is to be attended by using Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer. The dismantling table can also be removed from the workshop area using a forklift truck as an option and left in the Sterile zone at the front of the building. Once flames are extinguished the battery cell/module/pack can be moved by forklift from the workshop/sterile zone and placed into the onsite quenching tank where safe to do so.

Head Office: 1 Covent Garden Close, Luton, Beds, LU4 8QB
Tel: 0845 260 2000 Fax: 01582 847 453 Web: www.cawleys.co.uk
Registered Name: F & R Cawley Ltd Registered No. 4170234 England
Registered Office: 1 Covent Garden Close, Luton, Beds, LU4 8QB
VAT Registration No. 772 8757 77 Waste Carriers Registration No. CB/WE5935WC

Discharging of Lithium Batteries

- *Risk Scenario*

In the unlikely event that a live battery is abused through the action of discharging such as short circuit across battery terminals, dropping a module while manually moving it and reverse polarity error on connection which then develops into thermal runaway leading to a fire.

- *Immediate Action*

The emergency electrical stop button is to be pressed to isolate the electrical supply from the batteries.
Raise the alarm, call emergency services where appropriate.
Should the battery cell/module/pack show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) then the battery cell/module/pack is to be cut from any wiring and moved by forklift (or by hand in the case of cells and modules supported by dynamic risk assessment) and placed into the on site quenching tank where safe to do so. The discharge trolley is mobile on wheels and if the option is safe, can be pushed through the adjacent roller shutter door and left in the Sterile zone at the front of the building or directly to the quenching tank.
If the battery is on fire with naked flame then this is to be attended by using Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer. The discharging trolley can be removed from the workshop area manually using a forklift truck as an option and left in the Sterile zone at the front of the building. Once flames are extinguished the battery cell/module/pack can be moved by forklift from the workshop/sterile zone and placed into the on site quenching tank where safe to do so.

Loading of Lithium batteries onto shredder conveyor

- *Risk Scenario*

In the unlikely event that a fully discharged and short circuited battery cell or module is abused through the manual movement onto the gravity table and conveyor belt of the shredder such as dropping a module while manually moving it which then develops into thermal runaway leading to a fire.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.

Should the battery cell/module show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) then the battery cell/module is to be moved by forklift (or by hand in the case of cells and modules supported by dynamic risk assessment) and placed into the on site quenching tank where safe to do so.
If the battery is on fire with naked flame then this is to be attended by using Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer. At this position (on or near the feed conveyor) several options are available.

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Battery on Conveyor - If the battery cell/module is on the conveyor already then this can continue to be loaded into the shredder hopper and utilise the fire suppression system built in as it may be difficult to handle a partially flame damaged battery module whilst elevated.
Battery on Gravity table - The whole gravity table which is on wheels can be removed using a fork lift truck and left in the Sterile zone at the front of the building.
In either cases once flames are extinguished the battery cell/module/pack can be moved by forklift from the workshop/sterile zone and placed into the on site quenching tank where safe to do so.

Storage of Lithium Batteries (doors open)

- *Risk Scenario*

In the unlikely event that a battery is abused during storage in the designated ISO containers either through dropping, forklift piercing and then develops into thermal runaway leading to a fire. Assumes personnel operating in the area with the container doors open.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.
Should the battery cell/module/pack show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) and is accessible then the battery cell/module/pack is to be moved out of the container by forklift and placed into the on site quenching tank where safe to do so. Other batteries stored on the same pallet need not be separated at this point and all can go in the quench tank.
If the battery is on fire with naked flame then this is to be attended by using the containers built in sprinkler system, monitor lance linked to the front hydrant or by Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer where safe to do so. Only once all flames are extinguished the battery can be moved away from the storage containers into the Sterile zone at the front of the building using a forklift truck and placed into the on site quenching tank where safe to do so.
In the event of a large scale fire, evacuation procedures should be followed awaiting the emergency services and letting the inbuilt sprinkler system .

Storage of Lithium Batteries (doors closed)

- *Risk Scenario*

In the unlikely event that a battery fire is discovered in the designated ISO containers when the doors are shut.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.
Do not open the container doors. Evacuation procedures should be followed awaiting the emergency services and letting the inbuilt sprinkler system to flood the container with water. If safe to do so a monitor lance can be connected to the hydrant at the front entrance and be pointed at the container to aid in preventing the thermal transfer of heat.