REPORT

Application to Vary Environmental Permit EPR/WP3633BB

Caswell Production Facility

Supporting Information Document

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Approval for issue

Jennifer Stringer		080526

Prepared by:

RPS

Joanna Bruce

Consultant

20 Farringdon Street

T +44 1454 279650

E joanna.bruce@rps.tetratech.com

Prepared for:

Lumentum Technology UK Limited

Non-Technical Summary

This application is to vary environmental permit EPR/WP3633BB for Lumentum Technology UK Limited's site at Caswell Science and Technology Park, Caswell, Towcester ,Northants, NN12 8EQ.

The facility is situated at National Grid Reference SP 65100 51000. The site is approximately 4.5km to the north west of Towcester town It has a rural setting, surrounded by agricultural land and individual residential properties.

Operations at the site relate to the development and supply of advanced electronic materials technology and products (semiconductor materials and devices for microwave and optoelectronic systems) to external companies.

The variation seeks to permit a number of changes to the existing permitted activities. These include:

- Removal of the wet scrubber system and associated emission points.
- Removal of stacks that are no longer in use (Emission Points A01, A02, A06, A07, A08, A16, A18, A19, A20, A21,A22).
- Addition of a number of new emission points to air.
- Addition of nitrification tank within the effluent treatment plant (ETP) to provide additional control on emissions of ammonia from the site.
- A replacement towns water treatment plant to produce high quality water to meet manufacturing needs
- Removal of reference to selenium and selenium compounds that are longer used in production

No new processes will be introduced as a result of the variation. There is no change to the permit boundary associated with this variation, all changes are within existing buildings within the current permit boundary.

An air emissions screening assessment has been carried out to consider the impact of emissions to air, and concluded that emissions are insignificant. However, the EA highlighted uncertainty around using a proxy assessment level for Dinonyl Phthalate. Further detailed dispersion modelling was carried out, and confirmed that the effects of the facility are not considered to be significant.

The existing permit is issued to Oclaro Technology who are now part of Lumentum Technology UK Ltd. The variation will also update the permit to Lumentum Technology UK Limited.

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1 INTRODUCTION

1.1 Background

1.1.1 Oclaro Technology plc is currently permitted EPR/WP3633BB for the development and supply of advanced electronic materials technology and products (semiconductor materials and devices for microwave and optoelectronic systems) to external companies.

1.1.2 A number of modifications and refurbishment projects are being implemented at the site. There will be no change to the permit boundary associated with this variation. All changes are within existing buildings within the current permit boundary.

1.1.3 The variation seeks to remove reference to Hydrogen Selenide and Trichloroethylene, as these substances are no longer used on site and is therefore not required.

1.1.4 The Operator is also proposing to vary the permit to change the business name from Oclaro Technology Ltd to Lumentum Technology UK Ltd.

1.1.5 The variation application proposes to remove reference to Selenium and Selenium compounds (Section 4.2A(1)(d)) removed from the permit, as this is no longer used on site and is therefore not required.

1.2 Site Location

1.2.1 The facility is situated at Caswell, Towcester, Northamptonshire, UK, NN12 8EQ at National Grid Reference SP 65100 51000.

1.2.2 The site is approximately 4.5km to the north west of Towcester town centre and roughly 14km to the Southwest of Northampton City centre. The facility has a rural setting, surrounded by agricultural land and individual residential properties. The nearest properties are Caswell Farm, adjacent to the site's south eastern corner and a new build house approximately 50m south west of the site boundary. The village of Greens Norton is situated approximately 1.5km to the Southeast of the site.

1.2.3 The topography of the site slopes gently from north to south towards Caswell Brook.

1.3 The Applicant

1.3.1 The applicant and operator is currently Oclaro Technology Limited, however as per paragraph 1.1.4 above this application seeks to change the operator name to Lumentum Technology UK Limited.

1.3.2 Oclaro was acquired by Lumentum and legally became Lumentum Technology UK Ltd. The Companies House number remains the same (2298887).

1.4 Permitted Activities

Schedule 1 Activities

1.4.1 The installation currently operates the following activities listed in Table 1.1.1 of the permit.

- Section 4.2 A(1)(d) - Unless falling within another Section of this Schedule, any manufacturing activity, other than the application of a glaze or vitreous enamel, involving the use of any of the following elements or compound of those elements or the recovery of any compound of the following elements - antimony; arsenic; beryllium ; gallium; indium; lead; palladium; platinum; selenium; tellurium; thallium, where the

activity may result in the release into the air of any of those elements or compounds or the release into water of any substance listed in paragraph 13 of Part 2 of this Schedule.

- Section 5.4 A(i)(a)(i) Disposal of non-hazardous waste in a facility with a capacity of more than 50 tonnes per day .Biological treatment, not being treatment specified in any paragraph other than paragraph D8 of Annex IIA to Council Directive 75/442/EEC, which results in final compounds or mixtures which are discarded by means of any of the operations numbered D1 to D12 in that Annex (D8);
- Section 6.4B(A)(iv) - Unless falling within Part A(1) or A(2) of this Section or paragraph (c) of Part A(2) of Section 2.1, any process (other than for the repainting or re-spraying of or of parts of aircraft or road or railway vehicles) for applying to a substrate, or drying or curing after such application, printing ink or paint or any other coating material as, or in the course of, a manufacturing activity, where the process may result in the release into the air of particulate matter or of any volatile organic compound and is likely to involve the use in any period of 12 months of - 5 tonnes or more of organic solvents in respect of any activity not mentioned in subparagraph (iii).
- Section 7B - Surface cleaning using substances or preparations which because of their content of volatile organic compounds classified as carcinogens, mutagens or toxic to reproduction under Directive 67/548/EEC as last amended by Commission Directive 98/98/EC are assigned or need to carry one or more of the risk phrases R45, R46, R49, R60 or R61, or halogenated VOC's which are assigned or need to carry the risk phase R40.

Status of Existing Activities

1.4.2 For Section 4.2 A(1)(d), selenium and selenium compounds are no longer used and will be removed from the permit description. However, the activity classification remains appropriate as the site still uses named substances/compounds including gallium, arsenic, indium and platinum.

1.4.3 For Section 5.4A(i)(a)(i), the activity remains unchanged. The addition of a nitrification tank within the effluent treatment plant provides enhanced ammonia control but does not alter the activity classification.

1.4.4 Section 6.4 B(A)(iv) remains unchanged and an appropriate activity, as Lumentum are still applying optical coating during wafer processing.

1.4.5 Section 7 B remains unchanged and an appropriate activity, as Lumentum are still undertaking surface cleaning of wafers using solvents.

1.4.6 The following Directly Associated Activities are permitted. These remain unchanged as a result of this variation:

- Site boilers - combustion of mineral oils for hot water (>5 MW).
- Waste collection compound - collection and storage of process wastes.

1.4.7 The variation does not introduce any new processes that would trigger additional activities under Schedule 1 of the Environmental Permitting (England and Wales) Regulations.

1.4.8 All changes associated with the variation occur within existing buildings and within the current permit boundary.

1.5 Structure of Allocation Document

1.5.1 This section provides an overview of the proposals subject to this application. This is supplemented by further details in Sections 2 – 4 as follows:

- Section 2 summarises the management systems in place;
- Section 3 provides a description of the changes to the permitted activities on site;
- Section 4 addresses the environmental risk and effects; and
- Section 5 addresses the Best Available Technique

1.5.2 Supporting documents, assessments and application forms are provided within the appendices list as set out in the contents page.

2 MANAGEMENT OF ACTIVITIES

2.1 Environmental Management System Summary

2.1.1 Lumentum Technology UK Limited have an existing environmental management system (EMS) covering the activities on site. Following this variation the EMS will be reviewed and where necessary updated.

2.1.2 The EMS details the procedures for environmental management on site to minimise the environmental risk from the activities covered by the permit, albeit the environmental risk of this facility is considered low.

Operations and Maintenance

2.1.3 Existing management systems are in place and will be reviewed to ensure the facility is operated as designed.

2.1.4 Planned maintenance routines will be reviewed to ensure all key plant components which have the potential to affect the environmental performance of the facility remain in good working order.

Competence and Training

2.1.5 Staff will be sufficiently trained to ensure that they are technically competent to operate the plant according to the manufacturer's recommendations. This will not change as a result of the proposed variation.

Accident Management

2.1.6 The documented management system contains environmental incident and emergency response procedures. This will not change as a result of the proposed variation.

Site Security

2.1.7 The installed site security measures remain unchanged as a result of the variation.

Site Records

2.1.8 The operator will maintain records of any incident, accident, emergency or non-compliances. All monitoring including samples and analysis results will be recorded. Records of operational hours will be maintained to ensure the Facility operates within its revised operating hours

2.2 Energy Efficiency

2.2.1 The changes associated with this variation involve removal of some processes and introduction of new processes. Overall energy consumption is not expected to significantly change. The addition of Building 3A is expected to increase the annual energy consumption by approximately 2.3 GWh, increasing the overall energy consumption to approximately 16.4 GWh per annum.

2.2.2 A new energy meter will be installed to monitor the energy consumption and efficiency.

2.2.3 The EA have confirmed that as the facility is an existing MCP and the thermal input is less 5 MW_{th}, it is not required to comply with an MCPD permit until 01 January 2030.

2.2.4 The energy efficiency measures currently implemented will not change as a result of the variation.

2.3 Efficient Use of Raw Materials and Water

Efficient Use of Raw Materials

2.3.1 The variation seeks to remove reference to hydrogen selenide and trichloroethylene, as these substances are no longer used on site.

2.3.2 As a consequence of removing the wet scrubber sodium hypochlorite will no longer be used. Orthophosphoric acid will no longer be used in the scrubber, however it will remain in use within the manufacturing process, albeit only in small amounts

2.3.3 The expected usage of each raw material is expected to increase slightly as a result of the additional process equipment associated with the new local exhaust ventilation (LEV) systems in Building 3A. The increase in usage is shown in Table 2-1 below.

2.3.4 The storage all raw materials will not change as a result of the variation.

Water Use

2.3.5 A replacement water purification system will be installed to produce ultra pure quality water for the site. There will be no other changes to water use as a result of the variation.

2.4 Avoidance, Recovery and Disposal of Wastes

2.4.1 The dry abatement system will require periodic replacement of cartridges. The quantity per annum will be subject to operational performance. Online monitoring of the abatement will alert the suppliers of the need for a replacement to maintain the cartridges.

Table 2-1 Main Raw Materials Usage

Raw Material	Nature	Current Usage 2025 (tonnes/year)	Proposed Usage
Chlorobenzene	Organic Liquid	0.559	1.073
PRS2000	Organic Liquid	4.571	8.775
OPD 4262	Corrosive Aqueous Liquid	1.456	2.795
Nano EBR DC	Organic Liquid	1.252	2.404
1,3-dioxolane	Organic Liquid	0.28	0.538
Stripaid	Organic Liquid	2.328	4.469
Concentrated sodium hydroxide	Corrosive Aqueous Liquid	0.045	0.086
Hydrobromic Acid	Corrosive Aqueous Liquid	0.031	0.06
Hydrochloric Acid	Corrosive Aqueous Liquid	0.37	0.71
Hydrofluoric Acid	Corrosive Aqueous Liquid	1.265	2.429
Nitric Acid	Corrosive Aqueous Liquid	0.0975	0.187
Orthophosphoric Acid	Corrosive Aqueous Liquid	4.291	2.112

3 SITE OPERATIONS

3.1 Overview of Existing Installation

3.1.1 The Caswell Production Facility is involved with the development and supply of advanced electronic materials technology and products (semiconductor materials and devices for microwave and optoelectronic systems) to external companies. Research, development and small-scale manufacture is carried out at the Caswell site.

3.1.2 The company purchases indium phosphide and gallium arsenide wafers, which are processed in a series of stages into microelectronic devices.

3.1.3 Manufacturing processes vary with the particular product but device manufacture involves three main stages:

- Electronic material preparation;
- Device processing; and
- Development of prototype assemblies.

3.1.4 Products may leave the site after each of these manufacturing stages.

3.1.5 Device processing involves a series of micro-machining processes. Depending on the end product, wafers may have to undergo some of these several times.

3.1.6 The main process steps are:

- Deposition of thin film semiconductor materials;
- Cleaning of the wafers and stripping of photoresist;
- Photolithography to delineate patterns on the wafers;
- Depositing insulators, barrier layers or connecting metal which will form the basis of micro-electronic circuits.
- Etching of selected areas of the wafer by aqueous chemicals “wet etching” or by plasma activated gases “dry etching”;
- Implanting other elements into the surface of the wafers;
- Reduction of wafer thickness by grinding and polishing;
- Testing and inspection; and
- Separation of wafers into individual dice (or chips).

3.1.7 The permitted activities are carried out across a number of buildings on the site. A site plan showing the layout of the permitted activities and permit boundary is provided as Drawing 2.

3.2 Changes to Permitted Activities

3.2.1 A number of modifications and refurbishment projects are being implemented at the site. These improvements are being made to increase the overall manufacturing capacity but also to address risks associated with critical tools that represent a single point of failure and the replacement of ageing critical tooling. The changes to the permitted activities are described with reference to the building in which they are located. Figure 3.1 below summarises key manufacturing equipment changes. Building references are shown in the site layout plan in Appendix B (Drawing 2).

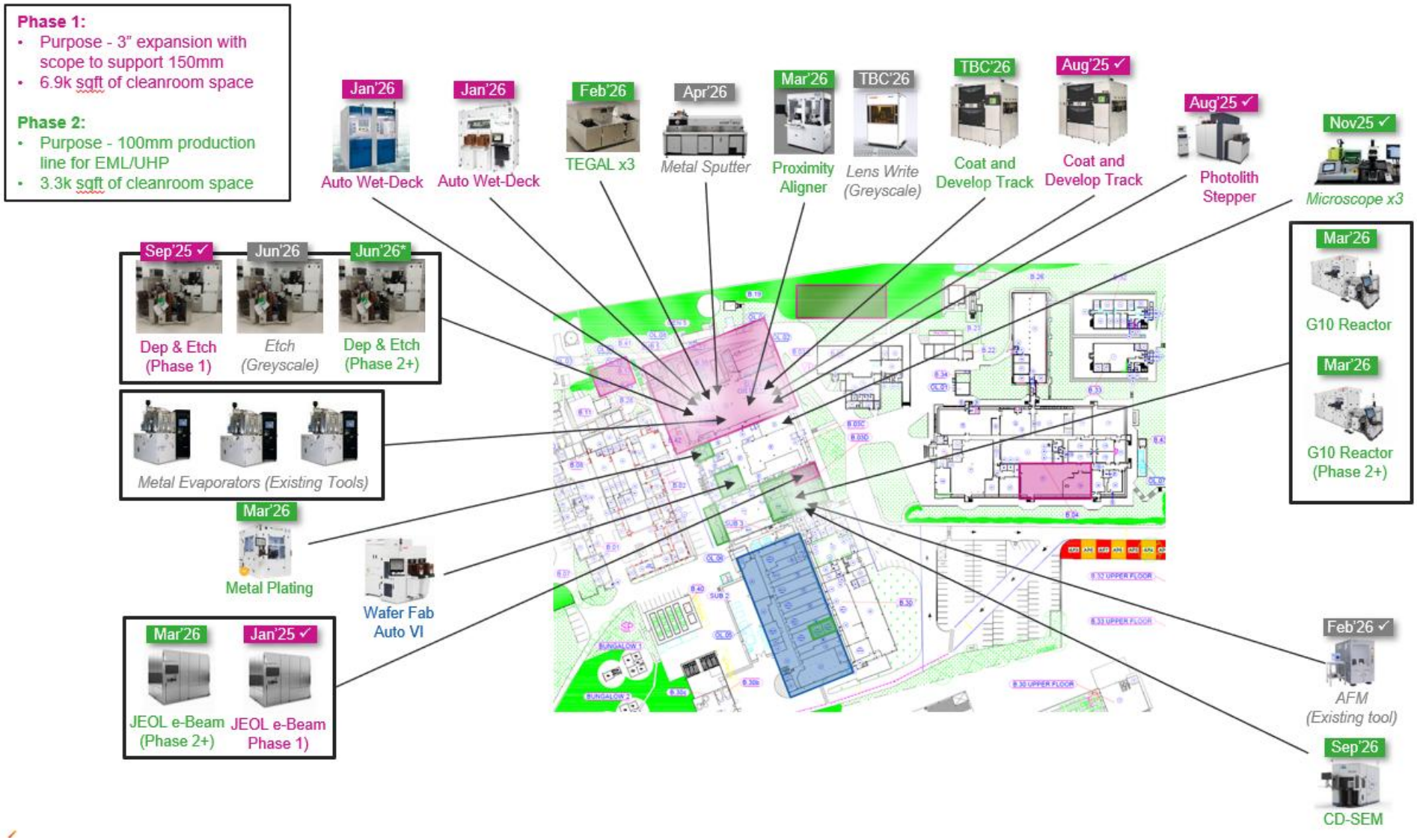

Figure 3-1: Illustrative Summary of Manufacturing Equipment Changes

3.2.2 There will be no change to the permit boundary associated with this variation, all changes are within existing buildings within the current permit boundary .

Building 3A

3.2.3 New tooling, new cleanroom space and associated infrastructure is being created. The new equipment associated with Building 3A is as follows:

- Automated wet etching equipment
- Dielectric deposition and dielectric etch units
- Etch and oxygen ashing equipment
- Photolithography pattern exposure unit
- Photolithography resist coat and development units
- Metal plating tool
- New heating ventilation and air condition (HVAC) systems
- New ultra pure water system
- New process cooling water system
- Specialist gas distribution system (Ar, He, H_2, N_2, O_2, Cl_2, SiH_4, NH_3, NF_3, N_2O, SF_6, HBr, CHF_3, CF_4, C_4F8, SF_6) with associated hazardous gas monitoring
- New UPS system to back up existing generators

3.2.4 A new local exhaust ventilation (LEV) system has been installed as follows:

- Solvent/general local exhaust ventilation- 3 stacks co-located, duty standby/standby
- Acid/alkali local exhaust ventilation- 3 stacks co-located, duty standby/standby
- Silane local exhaust ventilation – 2 stacks on 50% duty or duty stand by.

3.2.5 Air from tooling and gas cabinets that serve the tooling will be extracted via one of the new LEV systems. The LEV systems will be installed as safety systems in the event of a system failure or leak. Under normal operation air within the building will be clean.

3.2.6 A silane cabinet is to be installed adjacent and to the west of Building 3A. Two vents will exhaust air from the silane cabinets from stacks attached to the exterior of building 3A.

3.2.7 Further details on the emission points are provided in Section 4.1.

Building 3C and 3D

3.2.8 The existing permitted activities within Building 3C produce both a dilute and a concentrated acid waste stream. The dilute acid is plumbed into an existing system for collection and transfer of the dilute waste to onsite neutralisation tank. It is then sent to the existing offsite effluent treatment plant. Management of the dilute acid waste stream will not change as a result of the variation.

3.2.9 The concentrated waste stream is currently collected within barrels and when full the barrels are transported to the existing storage area. Changes will be made to allow the concentrated acid to be pumped directly to new centralised storage tanks, reducing the risk of accidents leading to spillage of this waste.

3.2.10 The new storage tanks for concentrated acid waste will be located to the south of Building 3A and Building 3C. There will be two acid tanks with a capacity of 12,000 L (total capacity 24,000L), and will be fully bunded to contain 110% of the tank content in compliance with CIRIA guidance[1] and industry standard.

3.2.11 Building 3C will include a metal plating bench that has acid (sulphuric acid) and solvent extraction systems. There will be additional outlet systems and emission points as a result. These additional emissions points are included in Table 4-2.

3.2.12 Within Building 3D (and 3C) currently there are 8 No. Metal Organic Chemical Vapour Deposition (MOCVD) reactors and associated dry scrubbers. This variation introduces a further two reactors in Building 3D with 4 associated emission points (2 per reactor). Similar to the emissions from Building 3A, under normal operation air extracted from the building via the various LEV systems is expected to be clean air. Only during an incident/leak would a release occur.

3.2.13 Dry scrubbers servicing the new reactors are being installed on the south facade of Building 3D (see Section 3.3 for further details) to replace existing wet scrubbers. The existing wet scrubbers will be removed. They all have LEV systems associated with them for safety purposes.

Building 30

3.2.14 Many activities previously carried out within building 30 have ceased or are in the process of being removed. The majority of the existing local exhaust ventilation systems and associated stacks are proposed to be removed from Building 30 in this variation. Remaining operations within Building 30 will be limited to metal deposition, wafer grinding, and wafer cleaning. A small number of solvent and acid cleaning stations will also remain in use.

3.2.15 Those release points remaining are detailed in Section 4.1.

3.2.16 Building 30 has been partially cleared with a view to use as cleanroom space and production tooling in the future. However, these changes are not fully designed and therefore do not form part of this variation.

Building 4

3.2.17 The MOCVD reactors previously operated within Building 4 have been removed. Associated emission points previously A01 and A02 will therefore be removed from the permit.

Water Purification Plant

3.2.18 A replacement and larger water purification system plant will be installed to produce ultra-pure quality water for the site.

3.2.19 The water treatment plant combines ion exchange (cationic and anionic) and reverse osmosis (RO) treatments. Periodic regeneration of the ion exchange units will be carried out using sulphuric acid and sodium hydroxide. Waste from ion exchange regeneration is

[1] CIRIA C736F

sent to the neutralisation tank for pH adjustment before being discharged to the existing effluent treatment plant.

3.2.20 The RO stage produces a reject stream. This reject water is also sent to the existing effluent treatment plant. The maximum flowrate discharged from the water purification plant is expected to increase by 0.03 l/s.

3.3 Process Controls and Abatement

Scrubbers

3.3.1 The wet scrubber system and associated emission points will be removed in this variation. The sodium hypochlorite used in the wet scrubber will therefore no longer be required as this abatement plant is being removed.

3.3.2 Dry scrubbers will be installed on all new process safety gas release points. The dry scrubber units have a cartridges which contain the active media, absorber granulate, which have been selected for the sources of releases,

3.3.3 Dry abatement system requires periodic replacement of cartridges. The quantity of cartridges per annum will be subject to operational performance. Online monitoring in the abatement will alert the suppliers of the need for a replacement.

Effluent Treatment Plant

3.3.4 A nitrification tank has been installed within the effluent treatment plant (ETP) to provide additional control on emissions of ammonia from the site. This unit has been operational since early 2025. This additional treatment stage is included after the existing humus tank.

3.3.5 Treated water from the nitrification stage is recycled back to the settling stage.

3.3.6 There will be no change to the capacity of the ETP albeit a slight increase in the volumes of water released as a consequence of the proposed changes is expected. The variation seeks to include the additional treatment stage which is not currently regularised under the permit.

3.3.7 A simple block diagram indicating the ETP process stages is show in Figure 3-2 below :

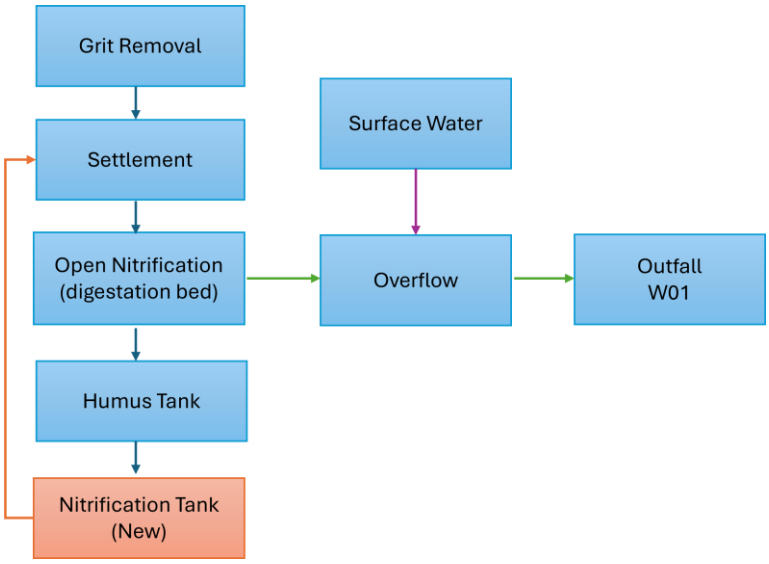

Figure 3-2: Flow diagram illustrating effluent treatment plant process

4 EMISSIONS AND MONITORING

4.1 Point Source Emissions to Air

4.1.1 The emission points in Table 4-1 below are being removed with this permit variation.

Table 4-1: Emission Points to be Removed from Permit

Emission Point Reference	Location	Plan Reference	Nature of Emission
A01	Building 3D	03D/038	Wet Scrubber (removed)
A02	Building 3D	03D/039	Wet Scrubber (removed)
A06	Building 4	04/044	Old Epi Reactors (removed)
A07	Building 4	04/045	Old Epi Reactors (removed)
A08	Building 30	30/002	Solvent Wet Bench
A16	Building 30	30/031	Solvent Extract
A18	Building 30	30/036	General/Solvent extract
A19	Building 30	30/052	Solvent Extract - Photolith
A20	Building 30	30/006	Acid wet bench
A21	Building 30	30/007	Acid Wet bench
A22	Building 30	30/017	Acid Wet benches

4.1.2 See Table 4-2 for the new emission points are proposed to be added to the permit as part of this variation.

4.1.3 The site has 93 emission points to air. Under normal operations, most emission points are associated with LEV systems used for safety purposes, fume cupboards and/or emergency systems for use by the fire brigade and comprise only air. The dry scrubber system is designed to fully remove contaminants and therefore emissions to air from these points will be free from the substances being abated (see section 5.2 for further detail).

4.1.4 Emissions to air will include Volatile Organic Compounds (VOCs) from eleven stacks. There are numerous other emission points from the site, however these are associated with local exhaust ventilation systems used for safety purposes, fume cupboards and/or emergency systems for use by the fire brigade. These emission points release clean air other than an emergency and/or are not in use during normal operations and therefore are not considered within this assessment.

4.1.5 A screening assessment of emissions to air has been completed and concluded that impacts from emissions to air are not significant. Details of the screening assessment are provided in Appendix E.

4.2 Point Source Emissions to Surface Water (Other than Sewers)

4.2.1 There will be no changes to the nature of the point source emissions to surface water as a result of the variation. The discharge will remain as a combined release of RO reject wastewater and surface waters.

4.2.2 However, a slight increase in discharge volume to the nearby Caswell Stream is expected because a replacement water-treatment plant will be installed and its reject water routed to the existing effluent treatment plant prior to discharge. See Section 3 for further details.

4.2.3 An assessment of the impacts to water from discharges to surface water is provided in Appendix D.

4.3 Point Source Emissions to Sewers, Effluent Treatment Plants or Other Transfers off Site

4.3.1 There are no point source emissions to sewer, off-site effluent treatment plants or other transfers off site associated with the permitted activities and this will not change as a consequence of the proposed changes.

4.4 Point Source Emissions to Land

4.4.1 There are currently no point source emissions to land and this will not change as a result of the variation.

4.5 Fugitive Emissions

4.5.1 There are not expected to be changes to fugitive emissions as a result of the variation. The new acid tank will be fully bunded to contain 110% of the tank content in compliance with CIRIA guidance[2] and industry standard, and therefore the risk of accidental release remains low. There are no significant dust-generating activities or dusty materials used or stored within the facility.

4.5.2 An assessment of fugitive emissions is provided in the Environmental Risk Assessment in Appendix C.

4.6 Odour

4.6.1 The facility is permitted to use solvents with the potential for odour emissions, there will be no changes to the types of solvent permitted to be used at the facility. Existing management practices for handling of these materials will remain in place. The site does not have a history of odour complaints

4.6.2 The potential for odour will therefore remain unchanged. Odour risk associated with the proposed changes has been considered in the Environmental Risk Assessment provided in Appendix C and was concluded to be low.

4.7 Noise and Vibration

4.7.1 The existing facility does not have significant noise sources and there is no history of noise complaints from the operational activities.

[2] CIRIA C736F

4.7.2 The noise generating operations at the facility operate continuously, however noise emissions are limited as most equipment is located in a building reducing the noise. The main external plant is the ETP and storage tanks.

4.7.3 The proposed changes will not introduce any significant new noise sources.

4.7.4 The Environmental Risk Assessment provided in Appendix C has considered the potential risk of noise associated with the proposed changes. Overall, the risk of noise emitting from the facility is proposed to be similar or lower as the currently permitted facility.

4.8 Monitoring and Reporting

4.8.1 Monitoring of Emissions to Water/ Sewer

4.8.1 There will be no changes to the monitoring of point source emissions to water/sewer.

Monitoring of Emissions to Air

4.8.2 The emission points are designated A03 – A93 as shown in Table 4-2 below alongside details on the pollutants emitted, emission limits, emissions monitoring and proposed monitoring methods. Note emissions points that are being removed in this variation (e.g. A01 and A02) are not included in Table 4-2.

Table 4-2: Air Emission Points

Emission Point Reference	New or Existing	Location of Emission Point on Site Plan	Building	Parameter	Emission Limit	Monitoring Frequency
A03	Existing	03C/021	Building 3A	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A04	Existing	03C/020	Building 3A	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A05	Existing	03C/019	Building 3A	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A13	Existing	30/021	Building 30	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A13A	Existing	30/021	Building 30	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A14	Existing	30/027	Building 30	-	-	-
A15	Existing	30/029	Building 30	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
				Chlorobenzene (C_7H_7Cl)	2mg/Nm^3	
A17	Existing	30/032	Building 30	-	-	-
A23	Existing	A23	Building 02	-	-	-
A24	New	3A/001	Building 3A	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A25	New	3A/002	Building 3A	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A26	New	3A/003	Building 3A	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A27	New	3A/004	Building 3A	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A28	New	3A/005	Building 3A	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A29	New	3A/006	Building 3A	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly

Emission Point Reference	New or Existing	Location of Emission Point on Site Plan	Building	Parameter	Emission Limit	Monitoring Frequency
A30	New	45/001	Outside of Building 3A	-	-	-
A31	New	45/002	Outside of Building 3A	-	-	-
A32	New	3C/018	Building 3C	-	-	-
A33	New	3C/022	Building 3C	-	-	-
A34	New	3C/023	Building 3C	-	-	-
A35	New	3C/024	Building 3C	-	-	-
A36	New	3C/025	Building 3C	-	-	-
A37	New	3C/028	Building 3C	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A38	New	3C/029	Building 3C	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A39	New	3C/EF2	Building 3C	-	-	-
A40	New	3C/EF1	Building 3C	-	-	-
A41	New	3C/EF3	Building 3C	-	-	-
A42	New	3C/026	Building 3C	-	-	-
A43	New	3C/027	Building 3C	-	-	-
A44	Existing	3D/025	Building 3D	-	-	-
A45	Existing	3D/026	Building 3D	-	-	-
A46	Existing	3D/027	Building 3D	-	-	-
A47	Existing	3D/028	Building 3D	-	-	-
A48	Existing	3D/029	Building 3D	-	-	-
A49	Existing	3D/030	Building 3D	-	-	-
A50	Existing	3D/031	Building 3D	-	-	-
A51	Existing	3D/032	Building 3D	-	-	-
A52	Existing	3D/033	Building 3D	-	-	-
A53	Existing	3D/040	Building 3D	-	-	-

Emission Point Reference	New or Existing	Location of Emission Point on Site Plan	Building	Parameter	Emission Limit	Monitoring Frequency
A54	Existing	3D/041	Building 3D	-	-	-
A55	Existing	3D/042	Building 3D	-	-	-
A56	New	3D/059	Building 3D	-	-	-
A57	New	3D/060	Building 3D	-	-	-
A58	New	3D/056	Building 3D	-	-	-
A59	New	3D/50	Building 3D	-	-	-
A60	New	3D/51	Building 3D	-	-	-
A61	New	3D/52	Building 3D	-	-	-
A62	New	3D/53	Building 3D	-	-	-
A63	New	3D/54	Building 3D	-	-	-
A64	New	3D/55	Building 3D	-	-	-
A65	New	3D/56	Building 3D	-	-	-
A66	New	3D/57	Building 3D	-	-	-
A67	New	3D/58	Building 3D	-	-	-
A68	Existing	30/053	Building 30	-	-	-
A69	Existing	30/004	Building 30	-	-	-
A70	Existing	30/004	Building 30	-	-	-
A71	Existing	30/018	Building 30	-	-	-
A72	Existing	30/003	Building 30	-	-	-
A73	Existing	30/020	Building 30	-	-	-
A74	Existing	30/035	Building 30	-	-	-
A75	Existing	30/065	Building 30	-	-	-
A76	Existing	30/048	Building 30	-	-	-
A77	Existing	30/001	Building 30	-	-	-
A78	Existing	30/001	Building 30	-	-	-
A79	Existing	30/068	Building 30	Dinonyl phthalate ($C_{26}H_{42}O_4$)	5 mg/m^3	Quarterly

Emission Point Reference	New or Existing	Location of Emission Point on Site Plan	Building	Parameter	Emission Limit	Monitoring Frequency
				Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	
A80	Existing	30/049	Building 30	-	-	=
A81	Existing	30/002	Building 30	Acetone (C_3H_6O) 2-propanol (C_3H_8O)	20 mg/Nm^3 (TVOC)[1]	Quarterly
A82	Existing	30/078	Building 30	-	-	-
A83	Existing	06/066	Building 4	-	-	-
A84	Existing	04/067	Building 4	-	-	-
A85	Existing	04/068	Building 4	-	-	-
A86	Existing	04/069	Building 4	-	-	-
A87	Existing	04/071	Building 4	-	-	-
A88	Existing	04/072	Building 4	-	-	-
A89	Existing	04/074	Building 4	-	-	-
A90	Existing	04/076	Building 4	-	-	-
A91	Existing	04/090	Building 4	-	-	-
A92	Existing	04/091	Building 4	-	-	-
A93	Existing	04/092	Building 4	-	-	-
A94	New	04/077	Building 4	-	-	-
A95	New	04/089	Building 4	-	-	-

1. TVOC is expressed in mg C/Nm^3

5 BEST AVAILABLE TECHNIQUES

5.1.1 This section addresses the BAT requirements as set out in the Environment Agency (EA) guidance for Common Waste Gas Management and Treatment Systems in the Chemical Sector[3].

5.1.2 This section will demonstrate that the proposed changes to process configuration, abatement system and emissions profile from the installation is to BAT standards. The scope of this assessment considered BAT for the following:

- Abatement of Emissions to Air
- BAT Emissions Levels for Emissions to Air
- Abatement of Emissions to Water

5.2 Abatement of Emissions to Air

5.2.1 The site has 93 emission points to air. Under normal operations, most emission points are associated with LEV systems used for safety purposes, fume cupboards and/or emergency systems for use by the fire brigade and comprise only air and with only 17 emission points which have low levels of VOCs present.

VOC Emissions Abatement

5.2.2 The nature of the process emissions that emit VOCs results in only low levels of VOC releases and with the exception of emission point A79, emissions are below BAT AELs. Further discussion on the selection of BAT AELs is provided in Section 5.3.

5.2.3 No specific abatement of VOC emissions is operated. The impact from VOC emissions is controlled via dispersion.

5.2.4 The impact of VOC emissions from release points A03, A04, A05, A13, A13A, A14, A15, A24, A25, A26, A27, A28, A29, A37, A38, A79 at the selected BAT AELs has been considered within the H1 screening assessment in Appendix E. The assessment concluded that impacts screen as insignificant.

5.2.5 However, the EA highlighted uncertainty around using a proxy assessment level for Dinonyl Phthalate. Further detailed dispersion modelling was carried out from the two emission points A79, which releases Dinonyl Phthalate, and A15, which releases Chlorobenzene. The modelling confirmed that the effects of the facility are not considered to be significant. The Air Quality Assessment is provided in Appendix F.

5.2.6 On this basis, and with the exception of A79, the use of additional abatement is not considered BAT for the VOC emission points.

5.2.7 Emission point A79, is an existing emission point which is not changing as a consequence of this variation. This emission point releases a mixture of VOCs including dinonyl phthalate, acetone and 2-propanol. Emissions monitoring is carried out for total VOCs, and no speciation of VOCs has been carried out. The H1 screening and air dispersion modelling has been carried out assuming each individual VOC is released at a concentration equivalent to the total VOC measurement which is conservative. Based on this conservative assumption,

[3] PS_UK_BATC_WGC_Formal_draft.pdf

current emissions of dinonyl phthalate from this emission point cannot comply with the BAT AEL of 5 mg/m^3. Monitoring data for this emission point indicates a five year maximum release concentration of 48.55 mg/m^3 using the conservative assumption. As this is an existing emission point that is not being modified under this variation, Lumentum proposes to undertake further consideration of emissions from this release point. This will initially include carrying out monitoring to determine the actual concentration of dibutyl phthalate to establish whether the relevant BAT AEL can be met. Where this can be met a report supporting this will be submitted to the Environment Agency. Should the BAT AEL not be met, consideration of additional measures will be carried out to reduce releases di-nonyl phthalate. The outcome of this assessment will be shared with the Environment Agency to agree a programme of improvements to achieve compliance with the relevant BAT AEL for dinonyl phthalate.

Other Emissions Abatement

5.2.8 Of the emission points that normally release only air during standard operation, emission points A03, A27, A28, A29, A42, A56, A59 and A64 have the potential to release substances requiring abatement under abnormal operating conditions. Abatement is provided primarily for health and safety reasons.

5.2.9 The pollutants controlled by the abatement systems under abnormal operations for each of these emission points is summarised in Table 5-1 below.

Table 5-1: Abatement Control

Emission Point Reference	Location of Emission Point on Site Plan	Abatement Type	Abatement Pollutant Control
A03	03C/021	CS Clean FABLine (serving dry-etch tools PECVD dieseltric deposition process)	AsH_3, PH_3, F_2, HF, Cl_2, HBr, $SiCl_4$, $SiBr_4$, $AlBr_3$, $AlCl_3$, $AsBr_3$, $AsCl_3$, SiF_4, $GaBr_3$, $GaCl_3$, H_2S, HCl, $InBr_3$, $InCl_3$, PBr_3, PCl_3, PCl_5.*
A27	3A/004		
A28	3A/005		
A29	3A/006		
A42	3C/026	CS Clean PRIMELine (serving the MOCVD process)	AsH_3, PH_3, Si_2H_6, Cl_2, TMIn, DMZn, DEZn, TMGa, TEGa, TMAl, Cp_2Mg, H_2, N_2, O_2*
A56	3D/059		
A59	3D/050		
A64	3D/064		

**Note the substances referenced above are listed in Appendix G, Table 5-4.*

5.2.11 Control of releases from abnormal operations has previously been controlled using a wet scrubber system. Air extracted from the process area was treated using a sodium hypochlorite solution as the scrubbing liquor. This solution is effective for controlling pnictogen hydrides (arsine (AsH_3) and phosphine (PH_3)) converting them to the soluble chloride form. The scrubbing liquor was maintained in large

excess to ensure that these gases were fully converted to their chloride form achieving 100% removal of the hydride. Hydride sensors were installed in the exhaust stack after the scrubber to verify performance. If any hydride was detected, then the system would automatically shut down, and the emission would remain below the detection limit.

5.2.12 This variation application proposes to replace the wet scrubber with multiple dry bed scrubber units of two different types. CS Clean PRIMELine scrubbers will serve the MOCVD reactors, and CS Clean FABLine scrubbers will serve the dry-etch and PECVD dielectric deposition processes. The emission points these scrubbers systems relate to are displayed in Table 5-1.

5.2.13 The dry bed scrubbers are designed to provide abatement that would previously have been abated in the wet scrubbers serving the MOCVD reactors and the PECVD systems previously abated using gas reaction columns. Under normal operating conditions, air extracted via the LEV systems is expected to be clean and not require treatment. The dry bed systems provide a defined and predictable abatement performance and allow clearer reporting and tracking of any abnormal emissions.

5.2.14 Different dry scrubber systems have been selected for the MOCVD reactors and the PECVD systems which are tailored to the nature of the gases released. The dry systems provide effective removal of pnictogen hydrides, but also of a wider suite of pollutants (as shown in Table 5-1 above).

5.2.15 Both types of dry bed absorber units will be subject to a manufacturer service agreement with regular inspections to ensure they are maintained appropriately. The routine service will include monitoring of the effectiveness of the units and timely media replacement. Following any abnormal event a service engineer visit will be arranged at the earliest opportunity to check he performance of the dry scrubber.

5.2.16 This section considers the performance of these abatement plant in controlling emissions. The scope of this assessment includes consideration of the following:

- Air emissions performance
- Raw material consumption and waste generation
- Accident potential

5.2.17 There are no emissions to land or water associated with either abatement technique and the performance of these two abatement options in relation to noise and odour are similar. On this basis these impacts have not been considered within this BAT Assessment.

Air Emissions Performance

5.2.18 The dry bed scrubbers are expected to perform as effectively as the previous wet scrubber system with both systems capable of 100% removal of metal halides, and in several respects provide improved abatement capability.

5.2.19 The former wet scrubber served only the MOVCD process, and provided effective (100%) removal of arsine (AsH_3), phosphine (PH_3) and disilane ($Si2H_6$). The PECVD systems abated using gas reaction columns which treated silane (SiH_4). However, former abatement systems capability was limited to these specific substances, and it did not effectively remove other gases, for example the gas reaction columns did not abate ammonia.

5.2.20 The proposed dry media systems are equally capable of 100% removal of the pnictogen hydrides but also removes the wider range of gases as set out in in Table 5-1.

5.2.21 Overall, the dry scrubber provides improved abatement of emissions to air and permits tailored control of the different species potentially present during abnormal conditions from the two different types of sources (MOCVD and PECVD).

Raw Material Consumption and Waste Generation

5.2.22 The wet scrubber uses sodium hypochlorite and orthophosphoric acid as the scrubbing medium. These materials are stored onsite and dosed directly into the scrubber. To achieve a high removal efficiency (100%) the scrubber medium are dosed in excess. An aqueous waste stream is generated comprising spent scrubber liquor. This liquor is periodically removed off site for disposal.

5.2.23 The dry scrubber media is contained in a cartridge which is periodically replaced by the scrubber supplier maintenance engineer. The maintenance engineer will remove the used cartridges from site for disposal.

5.2.24 Overall, the raw material consumption and waste generation associated with the dry scrubber system is expected to be lower.

Accident Potential

5.2.25 The storage and use of sodium hypochlorite and orthophosphoric acid and management of spent liquors pose a potential risk from leaks and spillages. Site management and handling of these materials is designed to minimise the risk, but should a leak or spill occur there is the potential for this to be released into the local surface water.

5.2.26 The dry scrubber media is contained in cartridges. The filter media is solid and therefore unlikely to be discharged into the environment should a cartridge break for example. There is no storage of residues on site associated with the dry scrubber systems.

BAT Summary for Emissions Abatement

5.2.27 The dry bed scrubbers provide at least the same level of control for key gases previously treated by the wet scrubber and gas reaction columns, and in several respects offer improved abatement capability. Unlike the former wet scrubber and gas reaction column, which was effective only for a limited range of hydrides, the dry scrubber can capture a wider range of gases as identified in Table 5-1, giving a more robust performance during abnormal events and still achieving 100% removal of those pollutants removed by the wet scrubber.

5.2.28 All abatement options utilise raw materials and generate wastes, however given the wet scrubber medium and gas reaction column were dosed in excess, usage for the dry scrubber systems is expected to be lower. In addition, there is no storage of waste associated with the dry scrubber system. Storage of raw materials associated with the dry scrubbers present a lower environmental risk than the liquid reagents required for the wet scrubber and gas reaction columns. As a consequence, the accident potential for the dry scrubber is lower.

5.2.29 Based on the above, the dry scrubber is considered to provide effective and improved control of emissions to air and better overall environmental performance than the wet scrubber and gas reaction columns and represents BAT.

5.3 Emissions Limits

5.3.1 As stated in paragraph 5.2.1, there are 93 emission points from the site, however the majority of these are associated with LEV systems used for safety purposes, fume cupboards and/or emergency systems for use by the fire brigade. These emission points release clean air other than an emergency and/or are not in use during normal operations and therefore BAT AELs will not apply.

5.3.2 Emissions to air will include VOCs from eleven stacks outlined in Table 5-2 below.

Table 5-2: BAT AEL Assessment

Emission Point Reference	New or Existing	Location of Emission Point on Site Plan	Building	Substance	BAT AEL
A03	Existing	03C/021	Building 3A	Acetone 2-propanol	20 mg/Nm^3 (TVOC)
A04	Existing	03C/020	Building 3A	Acetone 2-propanol	20 mg/Nm^3 (TVOC)
A05	Existing	03C/019	Building 3A	Acetone 2-propanol	20 mg/Nm^3 (TVOC)
A13	Existing	30/021	Building 30	Acetone 2-propanol	20 mg/Nm^3 (TVOC)
A15	Existing	30/029	Building 30	Acetone 2-propanol	20 mg/Nm^3 (TVOC)
				Chlorobenzene	Chlorobenzene (C_6H_5Cl) 2mg/ Nm^3
A24	New	3A/001	Building 3A	Acetone 2-propanol	20 mg/Nm$_3$ (TVOC)
A25	New	3A/002	Building 3A	Acetone 2-propanol	20 mg/ Nm^3 (TVOC)
A26	New	3A/003	Building 3A	Acetone 2-propanol	20 mg/ Nm^3 (TVOC)
A27	New	3A/004	Building 3A	Acetone 2-propanol	20 mg/ Nm^3 (TVOC)
A28	New	3A/005	Building 3A	Acetone 2-propanol	20 mg/ Nm^3 (TVOC)
A29	New	3A/006	Building 3A	Acetone 2-propanol	20 mg/ Nm^3 (TVOC)
A37	New	3C/028	Building 3C	Acetone 2-propanol	20 mg/ Nm^3 (TVOC)
A38	New	3C/029	Building 3C	Acetone 2-propanol	20 mg/ Nm^3 (TVOC)

Emission Point Reference	New or Existing	Location of Emission Point on Site Plan	Building	Substance	BAT AEL
A79	Existing	30/068	Building 30	Dinonyl phthalate ($C_{26}H_{42}O_4$)	Does not meet BAT CMR1B - 1-5 mg/l.
				Acetone 2-propanol	20 mg/ Nm^3 (TVOC)
A81	Existing	30/008	Building 30	Acetone 2-propanol	20 mg/Nm^3 (TVOC)

5.3.3 Where the emitted VOCs are acetone or 2-propanol, the BAT-AEL for total VOCs (20 mg/Nm³) has been applied. These substances are not carcinogenic, mutagenic or reprotoxic (CMR) and therefore this BAT AEL is appropriate. Emissions monitoring data for the existing emission points support that this BAT AEL can be achieved for relevant emission points.

5.3.4 Emissions Point A15 will release small quantities of chlorobenzene. There is no specific BAT-AEL for chlorobenzene. Chlorobenzene does not present the same range of hazards as other named substances such as benzene. It is also not a CMR substance. The H1 emissions to air assessment screened chlorobenzene out at 2 mg/Nm^3 and based on available monitoring data this ELV can be achieved. On this bass an ELV of mg/Nm^3 is proposed.

5.3.5 Emission Point A79 is an existing emission point that currently emits a phthalate ester comprising dinonyl phthalate. Emissions from this release point will not change as a consequence of this variation. Dinonyl phthalate presents hazard H302, Acute Toxicity 4 (oral), it is not a CMR substance. On a conservative bases a BAT AEL of 5mg/Nm^3 was selected. Available monitoring data for the site records emissions of total VOCs, as a conservative approach emissions screening has been carried out assuming each VOC present is at the total VOC concentration. On this basis as set out in paragraph 5.2.7 the five year maximum release concentration of 48.55 mg/m^3. However, given the conservatism in the assumption further monitoring to speciate the VOCs for this emission point and better understand the potential concentrations of di-nonyl phthalate is recommended. The emissions from this release point are not changing as a consequence of this variation and therefore a programme of improvements as set out in paragraph 5.2.7 is proposed.

5.4 Emissions to Water

Abatement Plant

5.4.1 A review of the effluent collection, segregation and treatment strategy has been undertaken against the Common Waste Water (CWW) BAT Conclusions[4]. As the ETP treats both process effluents, the CWW BAT Conclusions are applicable to the installation.

5.4.2 Compliance with the relevant CWW BAT AELs will be demonstrated at the emission point of the combined effluent.

5.4.3 The sanitary and process waters produced at the Lumentum site are combined and treated within the ETP.

5.4.4 The new RO system generates a greater volume of RO reject (purge). The RO treatment concentrates contaminants into the reject stream and as the towns water supply remains unchanged, the composition of the reject stream is expected to remain unchanged and consistent with existing monitoring data. The only change will be the slightly larger discharge volume. This increase represents a very small or negligible proportion of the total combined outfall flow and does not materially alter the overall pollutant load.

5.4.5 Details on the effluent treatment plant are outlined in Section 3.3. A nitrification tank has been installed within the ETP to provide additional control of ammonia emissions from the site. Treated water from the nitrification stage is recycled back to the settling stage to optimise biological treatment performance. Continuous monitoring of nitrates This is an improvement in treatment efficiency compared with the currently permitted configuration.

5.4.6 There will be no change to the types or concentrations of sanitary pollutants received by the ETP as a result of this variation. No additional staff are required, and therefore no increase in sanitary effluent is expected. There is no change in the capacity of the ETP. The outfall will continue to receive sanitary effluent and process waters from the RO unit, however the volume of the RO discharge will increase by up to 0.03 l/s increasing the mean total flowrate from 0.69 l/s to 0.72l/s.

5.4.7 The effluent treatment plant uses a combination of treatment steps that are appropriate for the characteristics of the combined effluent, and consistent with the expectations of the CWW BAT Conclusions. The system includes biological treatment with and nitrification treatment stage, and solids separation within the settling process. The recirculation between these stages helps maintain stable biological conditions and improves overall treatment performance. These measures provide effective control of the key pollutants present in the discharge.

Emission Limits

5.4.8 The combined effluent has been assessed against the relevant CWW BAT AELs as shown in Table 5-3 below. The maximum and average concentrations are based on historic monitoring data from 04/01/2021 – 01/09/2025.

5.4.9 BOD, COD, chloride and cadmium do not have applicable BAT AELs set within the CWW BAT Conclusions. These parameters will continue to be monitored in accordance with the permit.

[4] CWW BAT Guidance

Table 5-3: Effluent BAT AELs

Parameter	CWW BAT AEL	Permit Emission Limit	Maximum Measured Concentration	Average Measured Concentration	Comment
Total Suspended Solids	5-35 mg/l	30 mg/l	44.4 mg/l	6.51 mg/l	Within BAT range
Biochemical Oxygen Demand	N/A	30 mg/l	26 mg/l	4.16 mg/l	No BAT AEL
Total Phosphorous	0.5 – 3.0 mg/l	3 mg/l	4.9 mg/l	2.71 mg/l	Within BAT range
Chemical Oxygen Demand	30 – 100 mg/l	No limit	108 mg/l	27.67 mg/l	Within BAT range
Ammoniacal Nitrogen	'5-25 TN or 5-20 N inorg	5mg/l	9.5 mg/l	0.55 mg/l	Meets BAT AEL
Chloride	N/A	1,600 mg/l	857.4 mg/l	635.42 mg/l	No BAT AEL
Cadmium	N/A	0.01 mg/l	1 mg/l	0.11 mg/l	No BAT AEL
Chromium	'0.005-0.025 mg/l	0.5 mg/l	3.9 mg/l	0.26 mg/l	Does not meet BAT AEL
Nickel	0.005 – 0.05 mg/l	0.5 mg/l	5 mg/l	1.97 mg/l	Does not meet BAT AEL
Zinc	0.02 – 0.3 mg/l	2 mg/l	152.74 mg/l	26.06 mg/l	Does not meet BAT AEL
Copper	0.005 – 0.5	0.5 mg/l	34 mg/l	7.52 mg/l	Meets BAT AEL

5.4.10 Total suspended solids, COD, total phosphorus, ammoniacal nitrogen and copper are performing within the relevant BAT-AEL ranges.

5.4.11 Parameters without BAT-AELs (BOD, chloride and cadmium) require no further action, as the variation does not increase pollutant loads.

5.4.12 For chromium, nickel and zinc, the existing permit limits are higher than the BAT-AEL ranges. This reflects the existing performance of the installation rather than any change arising from the proposed variation. Compliance with BAT-AELs for chromium, nickel and zinc therefore cannot be demonstrated based on the current monitoring dataset. However, an assessment of the impacts to water from

discharges to surface water (Appendix D) concluded that these parameters do not pose a risk to the receiving environment.

5.4.13 For the parameters that cannot meet BAT-AELs, Lumentum propose to review potential options for improving control of these parameters through an improvement condition agreed with the Environment Agency. This will include consideration of alternative treatment or optimisation measures.

BAT Summary for Emissions to Water

5.4.14 The effluent treatment plant remains consistent with the CWW BAT Conclusions and continues to provide effective treatment of the combined sanitary and process effluent.

5.4.15 The increase in RO reject volume does not materially change pollutant loads. Key parameters including suspended solids, COD, phosphorus, ammoniacal nitrogen and copper meet the relevant BAT AELs.

5.4.16 Chromium, nickel and zinc do not currently meet BAT AELs, reflecting existing performance rather than changes from this variation. This will be reviewed through an improvement condition.

APPENDICES

Appendix AApplication Forms

Appendix B Site Plans

1. Site Location Plan
2. Emission Point LEV Site Plan - Whole Site
3. Emission Point LEV Site Plan (zoomed in) - north of site
4. Emission Point LEV Site Plan – (zoomed in) south of site

Appendix C Environmental Risk Assessment

Appendix D Water Discharge Assessment

Appendix E Air Emissions Assessment

Appendix F Air Quality Assessment

Appendix G Substances Referenced

Table 5-4: List of Substances Referenced

Substance	Formula / Abbreviation
Aluminium trichloride	$AlCl_3$
Aluminium tribromide	$AlBr_3$
Arsine	AsH_3
Arsenic trichloride	$AsCl_3$
Arsenic tribromide	$AsBr_3$
Bis(cyclopentadienyl)magnesium	Cp_2Mg
Chlorine	Cl_2
Diethylzinc	DEZn
Dimethylzinc	DMZn
Disilane	Si_2H_6
Fluorine	F_2
Gallium trichloride	$GaCl_3$
Gallium tribromide	$GaBr_3$
Hydrogen	H_2
Hydrogen bromide	HBr
Hydrogen chloride	HCl
Hydrogen fluoride	HF
Hydrogen sulphide	H_2S
Indium trichloride	$InCl_3$
Indium tribromide	$InBr_3$
Nitrogen	N_2
Oxygen	O_2
Phosphorus pentachloride	PCl_5
Phosphorus trichloride	PCl_3
Phosphorus tribromide	PBr_3
Phosphine	PH_3
Silicon tetrabromide	$SiBr_4$
Silicon tetrachloride	$SiCl_4$
Silicon tetrafluoride	SiF_4
Trimethylaluminium	TMAl
Trimethylgallium	TMGa
Trimethylindium	TMIn
Triethylgallium	TEGa