Decision document variation

We have decided to grant the variation for II-VI Compound Semiconductors operated by II-VI Compound Semiconductors Limited.

The variation number is EPR/PP3231YU/V005.

This variation allows the use of Indium Phosphide (InP) in the manufacturing of semiconductor wafer devices by introducing scheduled activity Section 4.2 A (1) (c) (v) of the Environmental Permitting Regulations into the permit. The variation also incorporates and additional seven air emission points A11-A17 into the permit and corrects previous inaccurate air emission reference points and outdated listed activity descriptions.

We consider in reaching the decision we have taken into account all relevant considerations and legal requirements and that the permit will ensure that the appropriate level of environmental protection is provided.

Purpose of this document

This decision document provides a record of the decision making process. It summarises the decision-making process to show how the main relevant factors have been taken into account. We have assessed the aspects that are changing as part of this variation, we have not revisited any other sections of the permit. It:

- highlights key issues in the determination
- summarises the decision making process in the decision considerations section to show how the main relevant factors have been taken into account
- shows how we have considered the consultation responses

Unless the decision document specifies otherwise we have accepted the applicant's proposals.

Read the permitting decisions in conjunction with the environmental permit and the variation notice.

Key issues of the decision

1. **BAT Deficiencies**

BAT Conclusions (BATC) document - Common Waste Water and Waste Gas Treatment / Management Systems in the Chemical Sector; and, Sector Guidance Note - EPR4.03 have been used to assess the application against Best Available Techniques (BAT). See the 'General operating techniques' section of this document below.

Deficiencies in demonstrating BAT have been identified in both documents as:

- CWW BATC 12 and EPR 4.03 section 3.2 - applying Associated Emission Levels (AEL) and water quality standards to surface water discharges;
- CWW BATC 14 – reducing waste sludge volumes;
- CWW BATCs 15 and 16 – waste gas treatment techniques;
- CWW BAT 19 and EPR 4.03 sections 2.3, 2.4, and 3.4 – assess / prevent / minimise point source and fugitive / diffuse emissions of VOCs and other organic solvents to air and water;
- EPR 4.03 section 3.1 and 3.7 – monitoring of point source emissions to air and confirmation that benchmark values listed in Annex 1 of EPR4.03 are being achieved.

Where deficiencies have been identified Improvement Conditions (IC) have been applied which allow the applicant to demonstrate achievement of the standards within a reasonable timeframe. BAT and indicative BAT sections identified as deficient are listed in table 1 below along with the specific remedial actions to be applied.

Table 1: BAT / Indicative BAT Deficiencies and Actions Applied

BAT / Indicative BAT	Deficiencies	Actions (IC)
CWW BATC 12 - Use an appropriate combination of final waste water treatment techniques to reduce emissions to waters and to within AELs. *EPR4.03 3.2 - Control all emissions to avoid a breach of water quality standards as a minimum.*	The submitted H1 assessment does not sufficiently demonstrate that point source emissions of pollutants to surface waters resulting from the permit variation will be within AELs and comply with water quality standards.	IC8 requires screening tests on discharges to sewer and surface water for potentially hazardous chemicals and elements to gauge levels of contaminants following the introduction InP activities. Specific substances to be screened should be inclusive of indium and phosphide and

		those chemicals and elements used in the site's processes as well as parameters such as COD and TOC.
CWW BATC 14 - Use one or a combination of stated techniques to reduce the volume of waste water sludge requiring further treatment or disposal.	Although weak slurries are produced in relatively small quantities there are nevertheless no methods employed to reduce volume by dewatering for example.	IC9 requires the operator to submit a report for the adoption of techniques for sludge reduction destined for off-site treatment or disposal.
CWW BATC 15 - Enclose emission sources and to treat the emissions to air, where possible. *CWW BATC 16 - Use an integrated waste gas management and treatment strategy that includes process-integrated and waste gas treatment techniques.*	Not all point source emissions to air have a form of abatement / treatment equipment attached or have abatement method confirmed in the application.	IC7 requires the operator to propose methods of abatement on all emission points as part of an impact assessment on emissions to air.
CWW BATC 19 - Use a combination of stated techniques in order to prevent or, where that is not practicable, to reduce diffuse VOC emissions to air. *EPR4.03 2.3 - Consider potential emissions from plant systems and equipment. Assess the potential for the release to air of VOCs and other pollutants along with discharged purge gas and use abatement.* *EPR4.03 2.4 - Minimise the potential for vapour release to air from pressure relief systems and the potential for emissions of organic solvents into air or water, by formal consideration at the design stage or review of the existing arrangements.*	A solvent mass balance calculation was carried out by the applicant indicating that annual solvent losses to the environment are 138kg, of which 13kg are thought to be lost through diffuse / fugitive emissions to air, water or waste. The operator uses n-methyl-pyrrolidone (NMP) which is a recognised hazardous substance with risks to the unborn child.	IC10 requires the operator to submit a Solvent Management Plan which identifies potential sources of fugitive and diffuse emissions to air and water; procedures for eliminating or minimising sources. IC10 also requires options for substituting or reducing the hazardous substances for less harmful alternatives as well as considering future options for reducing on-site use of organic solvents.

Review operating practices and review vent flows. Minimise liquid losses from reaction systems. Minimise vapour losses from reaction systems. Consider opportunities to enhance the performance of abatement systems. *EPR4.03 3.4 - Identify potential sources and develop procedures for monitoring and eliminating or minimising fugitive emission leaks.*		
EPR 4.03 3.1 - Formally consider the information and recommendations in the BREF on Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector as part of the assessment of BAT for point-source releases to air, in addition to the information in this note. The benchmark values for point source emissions to air listed in Annex 1 should be achieved unless we have agreed alternative values. Identify the main chemical constituents of the emissions, including VOC speciation where practicable. Assess vent and chimney heights for dispersion capability and assess the fate of the substances emitted to the environment. EPR4.03 3*.7 - Carry out an analysis covering a broad spectrum of substances emitted to air to establish that all relevant substances have been taken into account when setting the release limits. Monitor more regularly any substances found to be of concern, or any other individual substances to which the local environment may be*	The applicant did submit a completed H1 assessment, using the Environment Agency's H1 screening tool but the data input was based on servicing data and assumptions on achieving Annex 1 benchmark values. The applicant recognises the need to understand the types and quantities of pollutants being emitted to air. Emission points A1-A3 emissions points serve existing boilers which will need to comply with the Medium Combustion Plant Directive requirements including testing boilers and emissions as part of MCPD 2025 tranche.	IC6 and IC7 requires the operator submit a monitoring programme for testing emissions to air from A4–A17, under normal conditions. The suite of noxious gaseous to be tested will be those that can reasonably be expected to be produced from on-site activities and will include speciated VOCs. Testing will identify the chemical constituents and emission levels, and based on Annex 1 benchmark values, confirm whether or not future periodic or continuous monitoring will be required; and what if any further abatement equipment are required.

susceptible and upon which the operations may impact.		

2. Nature conservation

Conservation screening identified five Local Wildlife Sites and one Protected Species which could be impacted by discharges to air and surface water. It is considered that through the implementation of Improvement Conditions 6, 7 and 8 adherence to EPR 4.03 Annex 1 benchmark values and Environmental Quality Standards (EQS) for fresh water emissions will be confirmed, giving confidence that protection of the designated wildlife sites and species will be maintained.

3. Emissions to air and improvement conditions 6 and 7

Table 2 below lists the ten existing point source emissions to air numbered A1 – A10 and seven new point source emissions to air numbered A11- A17 introduced as part of this variation. Potential pollution type and abatement methods are also included in the table. Air emission points A1 - A3 serve three boilers and A4 –A10 serve semiconductor manufacturing process operations such as those involving, MOCVD, CVD, etching, general exhausts, ovens and grinding activities. The additional seven air emission points A11-A17 will be rolled out for commissioning as production expands and new equipment is adopted. The new equipment and processes will be extensions or adaptions of existing processes, and will particularly include extended use of MOCVD and CVD processes as well as new dicing saw and laser ablation processes. It is not yet known which piece of new equipment will connect to which new emission point.

Table 2: Point Source Emissions to Air Existing and Planned

Emission Point	II-VI Identifier	Source	Potential Pollutants	Abatement
A1	601	Boiler	Nitrous oxides, Carbon Monoxide	None
A2	602	Boiler	Nitrous oxides, Carbon Monoxide	None
A3	603	Boiler	Nitrous oxides, Carbon Monoxide	None
A4	SC902	Cleanroom Processes	Gallium, Indium, Phosphine, Arsine, Di-Silane, Zinc, Hydrogen	MOCVD Cleansorb Absorber PICO Absorber for Arsine & Phosphine gas cabinets
A5	SC 906	Cleanroom processes Developer Hood, Hot Plate,	Tetramethyl Ammonium Hydroxide (TMAH),	Ammonia Wet Scrubber

		LEV serving base chemical wet bench, Gold plating, Chemical storage extract.	Ammonia Hydroxide, Hydrogen Peroxide, Sodium Nitrate, Sodium Meta-bisulphate, Tetra-potassium, Pyrophosphate, Thallium compounds.	
A6	SC 908	Dry Plasma Etching for GaAs wafers.	Gallium, Arsenide, Boron, Chlorides Fluorides, Bromine, Potassium, Hydrogen, Sulphide.	Cleansorb Absorber Acid Wet Scrubber
		Metal sputtering, Etching processes, Developer hood, Hot plate extract, General exhaust, Acid cabinet extract, LEV base chemical wet bench, Wafer grinder	Gallium, Arsenide Indium, Phosphide Fluorides, Chlorides.	Wet Scrubber + Heavy Smoker (particle remover) for Wafer grinder
A7	EX 909	Coater / Developer benches, Solvent strip / lift off benches, Gold etch, benches Bonder benches	VOCs including NMP, PGMEA, IPA, Ether, Acetate, Ethyl Acetate Potassium Iodide, Iodine, Acetone.	To Be Confirmed
A8	EX 910	Cleanroom hot air exhaust linked to all sources of heat including ovens, hotplates, heat exchanger.	Nitrogen, VOCs	To Be Confirmed
A9	EF91 3	Cleanroom north of gridline 17 hot air exhaust. Future - Dicing Saw & Laser Ablation		To Be Confirmed Future – Particle separator linked to Laser Ablation
A10	SC90 4	CVD Processes	Silane, Ammonia, Hexafluoroethane, Nitrous oxides	Pyrophoric Conditioning System (Burn Box), Wet Scrubber

To Be Confirmed	To Be Confirmed	MOCVD Processes	Gallium, Indium, Phosphine, Arsine, Di-Silane, Zinc, Hydrogen	Cleansorb Absorber Wet Scrubber
To Be Confirmed	To Be Confirmed	Dry Plasma Etch for InP	Indium, Chlorine, Silicon Tetra-Chloride	Cleansorb Absorber Wet Scrubber
To Be Confirmed	To Be Confirmed	CVD Processes	Silane, Ammonia, Hexafluoroethane, Nitrous oxides	To Be Confirmed
To Be Confirmed	To Be Confirmed	Bake ovens, General extract	To Be Confirmed	To Be Confirmed
To Be Confirmed	To Be Confirmed	Coater / Developer benches, Solvent strip / lift off benches, Gold etch, benches Bonder benches	VOCs including NMP, PGMEA, IPA, Ether Acetate, Potassium Iodide, Iodine, Acetone.	To Be Confirmed
A11	899	To Be Confirmed	To Be Confirmed	To Be Confirmed
A12	900			
A13	901			
A14	903			
A15	907			
A16	911			
A17	912			

Air emission abatement methods
Extracted gases from the MOCVD and Dry Plasma Etching reaction chambers are channelled toward Cleansorb dry absorption abatement systems before emission to atmosphere, currently via air emission points A4 and A6.

Cleansorb uses high surface inorganic granules contained within a series of cartridges (including one overspill cartridge) set within a sealed column which chemically react with the indium based and phosphide based oxides and chlorides gases to form solid by-products on the media surface (chemisorption). Granules are changed periodically with each batch fully tested so that treatment performance can be guaranteed. Maximum outlet concentrations of toxic gases passing through the Cleansorb absorbers are extremely low, with concentration for some gas species expected to be below detection levels. Outlet toxic gases would include phosphine <0.05ppm and arsine <0.1ppm, hydrogen chloride <2ppm and fluoride <1ppm, chlorine gas <0.5ppm and boron trichloride <1ppm.

Cleansorb also monitors for gas breakthrough as well as incorporating flow and pressure monitoring instruments.

Arsine and phosphine gases used in the MOCVD reactor are stored in gas cabinets have a PICO dry bed absorber cartridge installed to capture and detoxify purged gases. This is particularly relevant during gas bottle changeovers. Both PICO and Cleansorb abatement systems are especially designed for use in the semiconductor, photovoltaic industries.

Air emissions from CVD reactors, Coater / Developer, Grinding and Cutting and some etching processes are channelled toward one of the three wet scrubbing abatement units currently in operation before discharge from one of the associated air emission points A5, A6 and A10. All three scrubbers are of the same packed bed absorption column design that scrub VOC gases consisting largely of hydrofluoric acid, hydrochloric acid and peroxides, though other VOCs and compounds can be present also. The gases are introduced at the bottom of the column which is packed with rings and topped with a knitted mesh mist eliminator. The rising gases come into contact with a counter current flow of a re-circulating acidic solution which entrains the noxious gas components within droplets that fall under gravity into the sump section of the column and allowing the treated gases to be emitted through the stack.

Bleed systems on the scrubbers enable the acidic concentration of acidic material within the re-circulating liquor to be maintained at a sufficiently low levels to allow absorption to occur. Pressure gauges are provided on the pumps to monitor performance and initiate automatic changeover to a standby pump in the advent of pump failure. Drain valves with hose connections are positioned at the pump inlets to facilitate drainage of liquors into the dedicated storage and collection tank known as sludge tank 01WRT for transfer off-site. Differential pressure connections are also installed across the packed beds to monitor for pressure drop. To initiate automatic fan changeover in the advent of fan failure, differential pressure switches are installed across each fan and are connected to the facility's Distribution Control System DCS.

Emissions from the CVD reactions initially pass through a Pyrophoric Conditioning System (PCS) that removes silane and other pyrophoric gases and particles to below flammable limits by self-oxidation. The system has a positive fan driven air supply for reaction/dilution air and has a self-cleaning inlet. Oxidation within the reaction chamber occurs within a cyclonic swirl of air to remove particles to >10 micron. The treated gases which will contain ammonia, hexafluoroethane and nitrous oxides, then flow through a wet scrubbing unit before emission to atmosphere via emission stack A10.

Air emissions from grinding and cutting processes initially pass through a mist filtration system, (known as the Heavy Smoker) which collects GaAs and InP particles greater than 0.3 microns with a projected efficiency of above 99.9%.

The continuing gas flows, containing the particles as well as fluorides and chlorides, are then channelled to a wet scrubbing unit before emission to atmosphere via air emission point A6.

Air emission points currently without abatement
Table 2 above identifies that boiler air emissions A1, A2 A3 and current manufacturing related air emissions A7 – A9 do not have any form of abatement and none is currently required by the permit. Likewise, new air emission points A11 – A17 have as yet no abatement fitted and no definitive proposals.

Boiler air emissions A1, A2, A3 consist of oxides of nitrogen and carbon monoxide pollutants. The existing permit does not impose limits on the emissions nor does it require monitoring or abatement. As existing plant with no identifiable emission alterations resulting from the variation, air emission points A1-A3 have been excluded from this determination assessment. However, with each of the three boilers having a rated 7Mwth and running off natural gas under normal conditions, the boilers will fall within the Medium Combustion Plant Directive 2015 (MCPD), which will require the emissions to be periodically tested from January 2025.

Air emission point A7 serves the coater developer processes along with the strip off / lift off and bonder benches which involve the use of solvents: ethyl acetate, propylene, PGMEA, NMP, IPA, potassium iodide, iodine and acetone.
Spent solutions used in the metal lift off process are stored in drums located within the alarmed self-ventilated cabinet which is also exhausted via A7.
Solvent mass balance calculations carried out by the applicant indicate that on average 125kg of VOCs are emitted to air through emission stacks and in particular A7.

Air emission points A8 and A9 serve some of the drying ovens, hotplates and general air extractors which remove heat and maintain Cleanroom temperature and humidity. VOC quantities within these emissions are expected to be minimal.

New air emission points A11-A17 and any associated abatement systems have yet to be settled and confirmed, but are anticipated to serve similar processes to those currently carried out and served by existing A4 –A10 emission points and associated abatement methods.

Air emissions H1 assessment
There were no emission limits or monitoring requirements within the existing permit and although InP substrates have been formatted onsite for research and development purposes, the quantities involved are very slight and insufficient to gain emission data. Consequently there was no quantitative and qualitative testing data available to have carried out a meaningful assessment on the impact from the changes to air quality. The applicant did submit an assessment using the Environment Agency's H1 screening tool. The results, copied below in table

3, indicated that all pollutants were screened out as insignificant at either stage 1 or stage 2 of the assessment. However the data input was based on servicing data and assumptions based on achieving Emission Limit Values (ELV) as stated in EPR 4.03. Therefore the assessment was of limited worth.

Table 3: H1 Assessment					
Emission point(s) & source	**Pollutants Sampled**	**Input Data Source**	**Abatement Method**	**Stage 1 Screening Result**	**Stage 2 Screening Result**
A1, A2, A3. Gas boilers with emergency oil back up.	Nitrogen Oxides (NOx) expressed as Nitrogen Dioxide (NO2) Carbon Monoxide (CO)	Service reports	Assorted scrubbers	NOx Short Term (ST) screened out as insignificant at stage 1.	NOx Long Term (LT) screened out as insignificant stage 2. LT Predicted Environmental Concentration (PEC) 23.93% of Air Quality Standard. Results based on the sum of the three boilers. CO N/A.
A4. MOCVD process	Arsine (AsH3) Phosphine (PH3)	Suggested maximum Emission Limit Values (ELV) benchmarks in EPR 4.03 guidance.	MOCVD Dry scrubber Cleansorb	Arsine ST screened out as insignificant at stage 1. Phosphine ST screened out as insignificant at stage 1.	Arsine LT screened out as insignificant at stage 2. LT PEC 21.79% of AQS. Phosphine LT N/A.
A5, A10, A13, A15. Clean Room Operations Chemical Vapour Deposition (CVD)	Ammonia (NH3)	Suggested maximum ELV benchmarks in EPR 4.03. Volumetric flow rates input data taken from actual flow rates measured	Ammonia Wet scrubber		Ammonia ST screened out as insignificant at stage 2. ST PC contribution 12.11%. Ammonia LT screened out at stage 2. PEC 23.93% of Environmental

		at exhaust fan.			Assessment Levels (EAL). Results based on the sum of the four emission points.
A6, A12, A14	Chlorine (Cl)	Suggested maximum Emission Limit Values (ELV) benchmarks in EPR 4.03 guidance.	Acid Scrubber	ST screened as significant LT NA.	ST screened out as insignificant. ST PC 0.17%.
A7, A17	TVOC	Suggested maximum Emission Limit Values (ELV) benchmarks in EPR 4.03 guidance	TBC	ST screened as significant LT N/A	ST screened out as insignificant. ST PC 16.25%.
A8, A9, A11 Bake ovens	Acids	Not tested	TBC	Not tested	Not tested
A16 Assembly & test		Not tested	TBC		

Testing of emissions to air

All parties have recognised the need to understand the types and quantities of pollutants being emitted. In the absence of reliable testing data on point source emission to air, the following IC6 and IC7 have been inserted into the improvement programme which will require the applicant to carry out an air emission testing and assessments for emissions points to air.

IC6 The operator shall submit to the Environment Agency for agreement in writing a monitoring programme for testing emissions to air from air emission points A4–A17, under normal mass production conditions. The programme must include a proposed suite of gaseous determinants, including VOC speciation where practicable, with justification for any exclusion from the suite of determinants which can be associated with all on-site processes following the introduction of Indium Phosphide. Methods of monitoring must be in line with

Environment Agency online guidance 'Air emissions risk assessment for your environmental permit', taking into account the requirements of Environment Agency Technical Guidance Notes 'Sampling requirements for stack emission monitoring' (M1); and, 'Monitoring stack emissions: techniques and standards for periodic monitoring'.

IC7 The operator shall conduct stack emission monitoring in line with the agreed monitoring programme as detailed in IC6. A report on the monitoring and impacts from the emissions are to be submitted to the Environment Agency for approval, and must include:

- *an assessment of the impact from the emissions using the Environment Agency's H1 tool;*
- *detailed air dispersion modelling if the concentrations are shown to be significant at the second stage of screening on the H1 tool;*
- *any proposed emission limits and monitoring frequency for inclusion in table S3.1 of the permit; and,*
- *proposed methods of abatement on all air emission points and vent flows, and timescales of implementation of new and upgraded systems.*

The report shall be used to assess the requirement for setting any additional monitoring and improvements if applicable to ensure emissions are below the benchmark values listed in Annex 1 of the Environment Agency's guidance note for the Inorganic Chemicals Sector (EPR4.03).

The suite of noxious gaseous to be tested will be those that can reasonably be expected to be produced from on-site activities and will include speciated VOCs. The testing will identify the chemical constituents and emission levels of polluting substances and confirm whether or not the benchmark values for point source emissions to air will be achieved. Where benchmark levels cannot be achieved, dispersion modelling and additional abatement methods will need consideration. The testing will also determine whether future periodic or continuous monitoring and associated reporting will be required; and which emission points require abatement or upgraded abatement.

4. Emissions to water and sewer and improvement condition 8

The applicant has in place an integrated waste water management and treatment strategy with reviews undertaken at regular intervals as part of the management system procedures. A Risk Hazard Assessment carried out by the applicant for the introduction of InP substrates concluded that other than precautionary testing for indium in the sewer discharge (which the applicant has agreed independently to carry out), there would be no need to change the existing waste water strategy and no changes to the disposal routes of process effluents or associated treatment methods.

Weak slurries from the grinding and cutting process which will contain GaAs and InP particles drain to the common and dedicated storage and collection tank known as dedicated 01WRT for off-site treatment and disposal. Solutions comprising of solvents and or strong acids used in the various photolithography and etching processes are collected separate containers and transferred off-site by specialist waste contractors for recovery or disposal.

Tanks containing deionised water used to rinse fabricated wafers will be lightly contaminated with a variety of diluted solvents and acids are initially collected in 02WRT tank system for treatment and testing. Depending on the process source, pollutant load and discharge consent parameters the treated effluent will be directed either to sewer discharge at discharge point S1 or to the 04WRT Effluent Treatment Plant (ETP) for further treatment and testing and discharge to the River Skerne at discharge point W1. Should the treated effluents remain outside the discharge consent parameters for either discharge to surface water or sewer the effluent will be diverted to the out of specification tank for storage, recirculation or if necessary removal off-site disposal. Rainwater drainage is kept separate from trade effluents until discharge and enters the River Skerne at emission point W2.

Sewer discharges
02WRT consists of a four tank treatment system, each tank with a 20m3 capacity. Treatment is undertaken in three stages within three of the tanks while the fourth remains in reserve. Stage 1 involves measuring the flows pH at the inlet tank and dosing with sodium hydroxide to adjust pH and lime sulphate and a polyelectrolyte to reduce Chemical Oxygen Demand (COD) and solid content. Stages 2 and 3 involves recirculating the effluent in phases to trim the pH correction further toward neutral. Analysis of the final tank's contents takes place before batch discharges to sewer three times per week under Northumbrian Water discharge consent (T1864).

The applicant holds three trade effluent discharge consents T1863 serves the out of specification tank, T1864 serves 02WRT, and T1865 serves the cooling towers. All consents have different sampling points and have differing parameter limits imposed. Details of the discharge consent are given in table 4 below.

Table 4 Northumbrian Water discharge consents to sewer T1863 Out of Specification tank.	
Parameters	Limits
Flow	12 litres/second
Temperature	30^{o} c
pH	6 -10
Suspended solids	500 mg/litre
Chemical Oxygen Demand (COD)	500 mg/litre
Ammoniacal Nitrogen (NH_3 as N)	15 mg/litre. The total flow rate containing either NH_3 or P will not exceed. 1500litres/hour

Fluoride (F)	30 mg/litre
Chloride (Cl)	1200 mg/litre
Hydrogen Peroxide (H_2O_2)	50 mg/litre
Total Phosphorous (P)	100 mg/litre. Site total not to exceed 6kg/day.
T1864 Process effluents via 02WRT	
Parameters	Limits
Flow	35m3 /24 hours
pH	6 - 10.5
Chemical Oxygen Demand COD)	600 mg/litre
Suspended Solids (SS)	500mg/litre
N-Methyl Pyrrolidone (NMP)	160 mg/litre
Hydrogen Peroxide (H_2O_2)	200 mg/litre
Gallium (Ga)	50 grams/24 hours
Arsenic (Ar)	50grams/24 hours
Ammoniacal Nitrogen (NH_3 as N)	11kg/24 hours not exceeding 600gr/1hour
Total Phosphorous (P)	11kg/24 hours not exceeding 700gr/hour or site load of 6 kg/hour
Fluoride (F)	25.5kg/24 hours not exceeding 1400gr/hour
T1865 Cooling towers	
Parameters	Limits
Flow	50m3/24 hours (maximum rate 1m3/second
pH	6 -10
Suspended Solids	200mg/litre
Chemical Oxygen Demand (COD	500mg/litre
Free Chlorine (Cl_2)	1.5mg/litre
Total Phosphorous (P)	22mg/litre not exceeding 6 kg/day

Sampling and analysis of all effluent discharges are key performance parameters and are carried out to MCERTS standards. Monitoring for the parameters: ammonia, pH, H_2O_2, Ga, As, P, and F is undertaken at 02WRT by an independent and accredited laboratory for each batch prior to release to sewer. A discharge batch will only be released once the laboratory analysis results have been received by the applicant and compliance confirmed by the data being fed into the facility's DCS. The discharge flow rate will be 1m3/hr or less. If the analysis fails on any of the parameters then the option is available to divert the flow to the out of specification tank for recirculation through the treatment process or disposal off site as contaminated waste water. In addition to the applicant's monitoring requirements Northumbrian Water carry out monthly monitoring of flow rates, NMP, COD and SS. Any concerns with the analysis results are communicated back to the applicant are checked against the applicant's own analysis results covering of every batch discharge.

The applicant in their application stated that there are no changes to emissions to sewer. The applicant formally informed Northumbrian Water of the introduction of InP into the processes. Northumbrian Water confirmed that indium was not listed as an element of concern for Trade Effluent Operators and as such they have not

placed a limit on the indium discharge levels. There is no current Environmental Quality Standard (EQS) for indium discharge to surface water. The applicant advised that InP can be considered to follow the same process route as arsenic to 02WRT. For arsenic the current sewer discharge consent has a discharge limit for arsenic of 50g/24hrs. The applicant has started testing for indium alongside arsenic testing and anticipate the levels will not exceed the limits for arsenic under normal operating conditions. As a way of monitoring indium to sewer the Environment Agency consider it appropriate to formalise the testing for indium by incorporating an annual testing and reporting requirement into the varied permit. A total phosphorus limit of 11kg/24 hours is already applied to the sewer discharge consent.

Surface water discharges
Effluents from the Cleanroom areas which can contain diluted elements of acids from the wafer rinsing processes are directed to the 04WRT for treatment and discharge into the River Skerne. 04WRT consists of a three tank treatment system designed to correct pH and temperature. Stage 1 recirculates the effluent at the inlet and measures for pH prior to dosing with acid or alkali for pH correction. Stage 2 recirculates & trims the pH further towards pH7 by removing hydrogen peroxide from the effluent stream using sodium metabisulphite and neutralising any hydrochloric acid with caustic soda. Stage 3 controls the temperature to <20 degrees. Treatment chemicals are stored close to the ETP within the ancillary building which forms secondary containment. The 04WRT ETP has a treatment capacity of 50 tonne/day.

All monitoring of the treated effluent is carried out automatically using MCERT equipment and standards to ensure compliance with permit before release to the River Skerne. Current monitoring parameters and limits are detailed in table S3.2 of the permit are copied in table 5 below. Monitoring takes place at the purposely constructed Trade Test Pit (TTP) which allows for temporary containment before release. Data from the monitors are recorded on the DCS. There are alarm systems in place and the option to divert flows to the out of specification tank should parameter limits be breached.

Table 5 Discharge parameters and limits to the River Skerne from 04WRT (ETP) W1		
Parameters	Limits	Monitoring frequency
Flow ETP and De-ionisation plant	5300m^3/ day	Continuous
Flow ETP only	4300m^3/day	Continuous
pH	6 -8	Continuous
Suspended solids	25mg/l	Monthly
Biological Oxygen Demand (BOD)	10mg/l	Monthly
Temperature	<20^o c	Continuous
Ammonia (as Nitrogen)	No limit	Monthly
Fluoride	No limit	Monthly
Arsenic	No Limit	Monthly
Mercury	5 µg/l	Annual

Discharge screening

The applicant in their application stated there would be no changes proposed to emissions to water. An environmental risk assessment submitted with the application identified that point source emissions to local surface waters (River Skerne) posed insignificant risks of pollution. Quarterly and annual monitoring submissions linked to the permit indicate overall compliance. However the risk assessment focused on the existing discharge and did not fully take into account the newly introduced chemicals resulting from the variation. No additional screening tests have been submitted which take into account new chemicals introduced into processes as a result of the variation. As well as indium and phosphide new chemicals acids and bases all of which may have the potential of entering the effluents discharged to surface waters. Table 6 below lists aqueous and liquid chemicals that have been introduced as part to the permit variation. Also a solvent mass balance calculation undertaken by the applicant indicated fugitive solvent emissions, albeit in relatively small amounts, may be entering waste waters.

Table 6: Newly Introduced Aqueous and Liquid Chemicals	
Chemical	**State**
Hydrobromic Acid (HBr)	Aqueous 48% concentrate
Bromine (Br_2)	Liquid
Acetic Acid (CH_3COOH)	Liquid
Methanol (CH_3OH)	Liquid

Gov.UK internet guidance issued by the Environment Agency and the Department for the Environment, Food and Rural Affairs entitled: Surface water pollution risk assessment for your environmental permit guidance, published 01 February 2016, last updated 23 June 2020, identifies that an operator:

- *must carry out a screening test when applying to vary an environmental permit and there are potentially hazardous chemicals and elements in your discharge;*
- *but, do not usually need to carry out a screening test when applying to vary an environmental permit if they have not added any additional hazardous chemicals and elements to the water.*

In consideration of the above points and because the River Skerne has been identified as a habitat for endangered species the Environment Agency will require screening tests carried out on discharges to surface water or sewer as part of the improvement programme and the following IC8 has been inserted into the permit.

IC8 The operator shall carry out screening tests on discharges to sewer and surface water for potential discharges of hazardous chemicals and elements. Specific substances to be screened should be inclusive of indium and phosphide and hazardous chemicals and elements used in the site's processes as well as

parameters such as COD and TOC. The screening tests shall follow the 'three stages to screening' detailed in Environment Agency guidance entitled: 'Surface water pollution risk assessment for your environmental permit guidance', published 01 February 2016, last updated 23 June 2020, found at Gov.UK.

Sampling of discharges shall be in line with Environment Agency guidance: 'Monitoring discharges to water: guidance on selecting a monitoring approach', published 11 June 2020, found at Gov.UK; and, assessment of the collected data shall be carried out using the Environment Agency's H1 software tool, obtainable along with the user guide via contacting the Environment Agency. As a minimum 12 samples of the surface water discharge and 12 samples of the sewer discharge. The samples should be evenly distributed and representative.

Once the screening assessment is completed a written report shall be submitted to the Environment Agency for approval in writing. The report should include detail of the methods used, results and conclusions. The report shall also consider the need for setting discharge limits, monitoring and reporting requirements and / or improvements to the effluent treatment (if applicable). Any discharge limits and / or monitoring deemed necessary following submission of the report will be inserted into the permit. If screening tests results show a risk to the environment then the operator will carry out detailed modelling of potential impacts.

5. Sludges and improvement condition 9

Weak slurries are produced from the wafer grinding and cutting processes. Though amounts are relatively small there is currently no method of volume reduction carried out.

During previous periods of peak GaAs wafer production the process generated around 30-40kg of GaAs waste per week in a sludge containing approximately 2.6kg GaAs per cubic metre of water. The estimated mass of indium waste generated is 5kg per week, produced from 500 wafers.

Despite relatively small quantities of sludge being produced BATC14 does require the reduction of waste water sludge for treatment or disposal to be at least considered. The water particle ratio specified above indicates scope for beneficial improvement. The applicant recognises this and has indicated a willingness to look at ways for reducing the waste sludge as part of their waste water reduction programme. The most suitable sludge reduction techniques are thought to be thickening and dewatering but the ultimate method needs to be determined by the applicant.

In consideration of the above points the following improvement condition has been incorporated into the permit.

Improvement Condition

IC9 The operator is to submit a report together with timelines for the adoption of one or a combination of techniques for sludge reduction destined for off-site treatment or disposal.

6. Solvents and improvement condition 10

The primary solvents used at the facility are: NMP, IPA and ethyl acetate. Lesser used solvents include PGMEA, acetone, and ether acetate. Of the solvents NMP is considered the most hazardous with an allotted hazardous property code HP10, notifying that it carries a risk to the unborn child. The applicant is currently looking to source alternative substance to NMP but have advised that within the semiconductor industry there is little scope for identifying less harmful solvents.

The applicant has provided a mass balance calculation for the solvents used, consigned off-site for recovery and lost to the environment primarily through evaporation. Based on an average of the previous three years the annual calculated figures are:

Solvent Inputs	19452kg/year
Solvent Recovered	19314kg/year
Solvent Lost	138kg/year

Of the estimated 138kg annual loss to the environment it is calculated that 125kg escapes to atmosphere through point source emissions to air, likely A7, with the remaining 13kg lost through diffuse / fugitive emissions to air, water or waste.

The permit does not require monitoring of solvent use and it is anticipated there will be no significant increase in solvent used and lost as a result of this variation, though no estimation has been provided. Nevertheless it is considered there is reasonable scope to further investigate limiting the amounts of organic solvents used at the site, in particular NMP and to reduce the amounts lost to the environment. The following improvement condition has therefore been added to the improvement programme requiring the applicant to submit a Solvent Management Plan covering all aspects of solvent use.

Improvement condition 10
IC10 The operator shall submit a Solvent Management Plan which identifies:

- *all potential sources of fugitive and diffuse emissions to air and water;*
- *procedures for monitoring and eliminating or minimising sources, including during the purification of products stages;*
- *options for substituting hazardous solvents, in particular N-methyl pyrrolidone, with less harmful alternatives, or where that is not feasible, reducing use; and*
- *future options for reducing the on-site use of organic solvents.*

The Plan should include time-scales for the implementation of identified improvements.

Decision considerations

Confidential information

A claim for commercial or industrial confidentiality has been made.

We have accepted the claim for confidentiality.
The claim for confidentiality was made by the applicant. Six documents are excluded:

- InP Materials Process Flow Diagram received 29.10.2020:
- Gas Systems Overview received 29.10.2020:
- BOC 2 Way Valve diagram received 29.10.2020
- Process Flows – Waste Gases, received 03.02.2021
- Process Flows – Waste Waters, received 03.02.2021; and,
- GE-EHS-PR-011- Risk Hazard Assessment for Indium Phosphide introduction, received 08.02.2021.

We assessed the documents as being of sufficient detail in depicting the practiced manufacturing processes techniques that making the information available on the public register could prejudice the applicant's interests to an unreasonable degree. It was considered that the information on emissions contained within the excluded documents have been sufficiently outlined in this decision document. Further, a fuller picture on site emissions will be forthcoming when the improvement condition programme, required as part of this decision, is complete.

Identifying confidential information

We have not identified information provided as part of the application that we consider to be confidential.

The decision was taken in accordance with our guidance on confidentiality.

Consultation

The consultation requirements were identified in accordance with the Environmental Permitting (England and Wales) Regulations (2016) and our public participation statement.

We consulted the local authority. No response was received.

We consulted the following organisations:

Food Standards Agency; Local Authority Environmental Health; Sewerage Authorities; and, Director of Public Health England.

The comments and our responses are summarised in the consultation responses section below.

The regulated facility

We considered the extent and nature of the facility at the site in accordance with RGN2 'Understanding the meaning of a regulated facility', Appendix 2 of RGN 2 'Defining the scope of the installation', Appendix 1 of RGN 2 'Interpretation of Schedule 1'.

The activities are defined in table S1.1 of the permit.

Site processes
The facility was purposely built by Fujitsu in 1991 to manufacture microchips. Site operations were downscaled dramatically following the departure of Fujitsu and remains well below potential capacity. The facility was issued with an environmental permit in 2005 for the production of semiconductor wafer devices using Gallium Arsenide (GaAs). The permit incorporated: a trade effluent treatment plants with consents to discharge treated effluent to sewer and the River Skerne, subject to monitoring and discharge limits and ten air emission points A1-A10, for which there were no monitoring or emission limit requirements.

This permit variation allows Indium Phosphide (InP) based wafer substrates to be structured alongside those substrates based on Gallium Arsenide (GaAs). This will expand the types and quantities of electronic and photonic devices produced onsite. The variation also incorporates seven additional air emission points A11–A17 into the permit. The techniques used and waste streams produced in fabricating InP based wafers are largely similar to those associated with existing GaAs based wafer production although new etch chemistries will require supplementary chemicals to be stored and used onsite. The new chemicals are listed below in table 7.

Table 7: Newly Introduced Chemicals

Chemical	**State**
Hydrobromic Acid (HBr)	Aqueous 48% concentrate
Bromine (BR_2)	Liquid
Acetic Acid (CH_3COOH)	Liquid
Potassium Dichromate ($K_2Cr_20_7$)	Solid
Methanol (CH_3OH)	Liquid
Potassium Permanganate ($KMnO_4$)	Solid
Hydrogen Bromide (HBr)	Gas
Silicon Tetrachloride ($SiCl_4$)	Gas
Trifluormethane (CHF_3)	Gas
Methane (CH_4)	Gas
Propane (C_3H_8)	Gas

The basic processes for fabricating the substrates are the same for InP and GaAs based substrates. They involve a sequence of engineering and chemical steps undertaken within cleanroom environments for laying down films or metals, known as Chemical Vapour Deposition (CVD) or Metal Organic Chemical Vapour Deposition (MOCVD), which are then patterned and etched to produce a live micro-electronic structures. Other manufacturing steps performed onsite will include grinding, sawing and cleaning the wafers.

Vapour deposition
CVD reactions take place in a vacuum within sealed chambers where reactants gases such as silane, hexafluoromethane are injected and gradually migrate to the gallium or indium wafer surfaces. By-product and excess gases from the rector chambers, which may contain ammonia and nitrous oxides, are channelled through a Pyrophoric Conditioning System and wet scrubber before emission to atmosphere. The process involves no emission to water other than contaminated scrubber waters.

MOCVD is the preferred method for structuring InP based wafers. This process uses arsine, phosphine and disilane as carrier gases that pass through a di-methyl zinc source which modifies the electrical or optical properties of the wafer. The excess and by-product gases are then extracted from the reaction chambers toward a dry absorption abatement system before emission to atmosphere. There are no effluent discharges associated with this process.

Dry etching
Dry plasma etching is similar to CVD but is accomplished using different gases to remove excess GaAs and InP from the wafers. Dry etching is used for etching InP wafers but requires different species of gases from those used for GaAs wafers. Fumes from the dry etch process include gallium, arsenide, indium phosphide, boron tri-chloride, chlorine, sulphur hexafluoride, carbon tetrafluoride, bromine and helium. The gases are channelled to the dry absorption abatement system for primary treatment and then onto an acid scrubber for secondary treatment before emission to atmosphere.

Photolithography
Photolithography is the process which deposits photosensitive layers onto GaAs and InP wafers then exposing the wafer surface to an image of the final structured pattern before chemically developing the image. Surplus photosensitive material left on the wafers are removed using Photo Resist Strip process. This involves immersing wafers in a 9 litre tank of organic solvents before rinsing and washing. Fumes from the tanks are channelled to an air emission point unabated. The solvents in the tanks are drained periodically for reclaim. Deionised water used to rinse the wafers which are lightly contaminated with solvents, are initially drained to a four tank treatment system 02WRT and then onto a three tank effluent treatment plant known as 04WRT for further treatment, testing and release to the River Skerne.

Metal etch, Metal lift off
Following photolithography wafers undergo various metal coating processes using the techniques of electron beam evaporation, sputtering, or electroplating for coating surfaces with: titanium, platinum, germanium, nickel gold and tungsten. Once applied excess metals are removed by using one of two techniques: Metal etch' or 'Metal lift off. Metal etch involves immersing the wafers in a treatment tank containing a solution of iodine and potassium iodide. Once complete the wafer is transferred to a rinse tank containing deionised water. Metal lift off follows the same immersion process as metal etch but uses a solution containing n-methyl pyrrolidone (NMP) to dissolve the remaining photosensitive layer. Other solutions used include ether acetate, ethyl acetate, isopropyl alcohol (IPA) and propylene glycol monomethyl ethyl acetate (PGMEA). Fumes from the tanks are captured and channelled via local exhaust ventilation to an air emission point unabated.

The spent solutions from the tanks are drained into drums and stored in the chemical storeroom for reclaim. There are no discharges to sewer or surface water from the metal etch and metal lift off processes other than rinse waters used to wash the product which may contain traces of solvent. These rinse waters are discharged to 02WRT or 04WRT for treatment, testing and discharge to sewer or the River Skerne.

Wet etching
Other wet etch processes used to remove left over material from previous processes and are the same for both GaAs and InP wafers. Wafers are wetted in a solution of water and various chemical mixtures dependant on the process stage performed. Some stages require the wafer to be immersed in tanks while others stages only need the solution to be in contact with the wafer surface. Chemicals used in the wet etching process can be highly corrosive and include hydrogen chloride, hydrogen peroxide, hydrogen fluoride, phosphoric acid and nitric acid, while others such as potassium permanganate are relatively innocuous. Once spent the chemical solutions are collected and consigned as hazardous waste. Deionised water used to rinse the etched wafers are diverted to 02WRT or 04WRT depending on the source and discharge consent limits for discharge to sewer or surface water. Fumes from the etching tanks are collected and channelled to an air emission point unabated.

Grinding and cutting
The methods for grinding and cutting the InP based wafers are on the whole the same as for GaAs based wafers. These processes take place in the presence of deionised water within sealed chambers served by local exhaust ventilation systems consisting of primary and intermediate stage particle filtration before being channelled onto a wet scrubber and emission to atmosphere. Demisters within the grinding and cutting chambers are attached to a slurry drain that discharges into a common and dedicated storage and collection tank 01WRT.

The weak slurry is then tankered off-site for treatment and disposal. The collected slurry will be a hazardous waste containing solid particles of both GaAs and InP. The water from the wafers final washings, which will be slightly contaminated, are channelled to the 02WRT or 04WRT for treatment and testing prior to discharge to either sewer or the River Skerne.

The site

The applicant has provided site layout plans drawings ECL.079.01.01/03 and ECL.079.01.01/04, dated 12th March 2020 which we consider satisfactory in identifying air emission points, sewer and surface water discharge points and routes. However the plans did not correctly show the extent of site boundary which remains the same as defined in the existing 'Overall site layout' plan, drawing CP/L/0014, dated 20th October 2015. CP/L/0014 shows the correct extent of the site of the facility and has been amended only to integrate air emission and water discharge point locations as identified in drawings ECL.079.01.01/03 and ECL.079.01.01/04, dated 12th March 2020. The amended CP/L/0014 plan is included in the permit.

Site setting
II-VI Compound Semiconductors are located at Aycliffe Business Park, Millennium Way, Newton Aycliffe, Co. Durham, DL5 6JW. To the west the site borders Lidl's Regional Distribution Centre and to the east abuts the A167 trunk road. To the north it borders St Andrews Way and to the south lies open land designated for development. The nearest residential property is Hill House Farm located approximately 40m south east of the site boundary.

The closest residential centre is Aycliffe Village, located approximately 730m to the north. The nearest surface water is the River Skerne which lies approximately 500m to the west and is hydraulically connected with the facility.
Much of the permitted area consists of landscaped grounds intersected with tarmac roads, paths and car parking areas. Production and ancillary activities take place within two separate purpose built buildings divided by a 'west road' access strip. Parts of the site are identified as at risk of long term flooding which is recognised within the facility's Environmental Management System (EMS).

Site condition report

The operator has provided a description of the site condition which we consider satisfactory. The decision was taken in accordance with our guidance on site condition reports and baseline reporting under the Industrial Emissions Directive.

Nature conservation, landscape, heritage and protected species and habitat designations

We have checked the location of the application to assess if it is within the screening distances we consider relevant for impacts on nature conservation, landscape, heritage and protected species and habitat designations. The application is within our screening distances for these designations.

Conservation screening for discharge to air identified the following five Local Wildlife Sites - Aycliffe Quarry (291m); Cumby Pond (1295m); Whiley Hill Sandpit (1648m); The Snipe (1815m); and, Coatham Grange Marsh (1900m). Conservation screening for discharge to water identified the European eel as a Protected Species (relating to the River Skerne).

We have assessed the potential for the variation to affect sites of nature conservation, landscape, heritage and protected species and habitat designations identified in the nature conservation screening report as part of the permitting process.

We consider that the application will not affect any site of nature conservation, landscape and heritage, and/or protected species or habitats identified.

The following conditions have been placed on the permit to protect the identified local wildlife sites and protected habitat / species:

- Improvement condition 6 requires the applicant to produce a monitoring programme for monitoring all potential pollutants from point source emissions to air.
- Improvement condition 7 requires the applicant to conduct monitoring tests on emissions to air using the monitoring programme agreed by IC6, followed by a report assessing the need to set additional monitoring and emission limits.
- Improvement condition 8 requires the applicant to carry out screening tests on discharges to sewer and surface water for potential discharges of hazardous chemicals and elements followed by a report considering the need for future monitoring and discharge limits and if necessary modelling of potential impacts.

We have not consulted Natural England. The decision was taken in accordance with our guidance.

See also Key issues of the decision.

Environmental risk

We have reviewed the operator's assessment of the environmental risk from the facility.

The operator's risk assessment is unsatisfactory and required additional Environment Agency assessment.

The applicant's submitted environmental risk assessment document (ECL.079.01.01/ERA) which assessed point source emissions to air and points source emissions to surface water and sewer as ' not significant if procedures are adhered to'. The applicant did submit a completed H1 assessment, using the Environment Agency's H1 screening tool which indicated emissions to air and surface water were insignificant. However the data input for air emissions was based servicing data and assumptions based on achieving Emission Limit Values (ELV) as stated in EPR 4.03. Data input for the surface water calculation was obtained from on contemporary monitoring data but lacked a full suite of parameters that would need to be examined as a result of InP wafer production.

Additional information by way or a more complete H1 assessment is therefore required. This will be achieved by way of an improvement condition programme which in part requires the applicant to undertake emissions monitoring to air water and sewer following the full introduction of InP and associated chemicals.

See Key issues of the decision.

General operating techniques

We have reviewed the techniques used by the operator and compared these with the relevant guidance notes and we consider them to represent appropriate techniques for the facility.

The operating techniques that the applicant must use are specified in table S1.2 in the environmental permit.

We have reviewed the variation application against: 1. BAT Conclusions (BATC) – Common Waste Water and Waste Gas Treatment / Management Systems in the Chemical Sector (CWW) dated June 2016; and, 2. Sector Guidance Note (SGN) – The Inorganics Chemical Sector EPR4.03 dated March 2009. EPR4.03 is considered indicative BAT for BREF documents: 'Large Volume Inorganic Chemicals: Ammonia, Acids and Fertilizers' (08 2007); and 'Large Volume Inorganic Chemicals: Solids and other Industry' (08 2008), both of which do not have corresponding BAT Conclusion documents.

BAT documents not referenced
BREF document 'Production of Speciality Inorganic Chemicals' (SIC) 2007, was not considered applicable due to its lack in referencing the semiconductor industry or GaAs and InP. Rather it concentrated chemicals found in pigments, explosives, cyanides, silicones and phosphorus compounds.

The applicant's chemical storage review was undertaken with regard to BREF document 'Emissions from Storage' (EFS) 2006 and HSE guidance on chemical

warehousing (HSG71), 2009. While we consider these documents address issues around storage safety and fugitive emissions to air, we concluded the best practices cited are sufficiently replicated in the CWW BATC and EPR4.03. A similar conclusion was reached in relation to BREF reference document 'Industrial Cooling Systems' 2001.

We consider CWW BATC and EPR4.03 are the most appropriate for assessing this application against BAT. Although there is repetition between the two documents together they cover all the relevant issues associated with the application. CWW BATC is the most up to date while EPR4.03 identifies itself as applicable to those activities regulated under Schedule 1, Section 4.2 (inorganic chemicals) of the Environmental Permitting Regulations. This includes manufacturing activities involving the use of arsenic, gallium, and indium – where the activity may result in the release into the air or water of those elements or compounds. EPR 4.03 also specifies Hazard Operability Studies (HAZOP), to assess the risks associated with introducing a new process to a permit.

BAT documents assessment findings
There are 23 CWW BAT conclusions and 20 EPR4.03 sections detailing indicative BAT all of which are summarised below. BATC 17 and 18 deal with flares and are not applicable as no flaring takes place at the facility. BATC 6, 20 and 21 relate to odour control and BAT 22 and 23 relate to noise control. Likewise EPR 4.03 section 3.5 relates to odour and section 3.6 to noise. There is no history or expectation of off-site odour or noise pollution therefore full applicability of BAT and appropriate measures for odour or noise control have not been applied. As a safeguard standard permit conditions do allow for full compliance with standards should off-site noise or odour pollution develop. EPR 4.03 section 2.1 covers the design of a new project for manufacturing chemicals. As no chemicals are manufactured onsite this section is also not applicable.

BATC 12, 14, 15 and 16 are assessed as not being fully met and require further action. As does EPR 4.03 sections 2.3, 2.4, 3.1, 3.2, 3.4 and 37. These deficiencies as well as actions to be taken are discussed in further detail in Key issues of the decision, above.

The following lists summaries of CWW BATC and EPR4.03 Indicative BAT requirements together with a brief assessment of findings.

CWW BAT Conclusions
BATC 1 - implement and adhere to an environmental management system (EMS) that incorporates listed features.

The applicant has provided an overview of the facility's EMS, which encompasses all elements of international environmental standards BS ISO 14001:2015 and those listed features identified in BATC1. The management system has been updated to include the processes specific to InP.

A copy of the applicant's Environmental Policy confirms a commitment to continuous improvement in all aspects of their business activity including in the training and educating of employees.

BATC 2 - establish and to maintain an inventory of waste water and waste gas streams as part of an EMS that incorporates information about the chemical production processes and the characteristics of the waste water and waste gas streams.

Updated inventories and process flow sheets for waste water and waste gas streams have been provided. The information identifies production processes and emission routes from source to discharge point. The chemical characteristics of waste gas and waste water streams have being provided as well as abatement methods.

BATC 3 - monitor key process parameters (including continuous monitoring of waste water flow, pH and temperature) at key locations.

Monitoring for discharge to the River Skerne is undertaken at the Trade Test Pit (TTP) and at 02WRT for discharges to sewer. Continuous monitoring for waste water flows, pH, BOD and temperature are applied to discharges to the River Skerne. Monitoring of discharges to sewer is undertaken in batches primarily in line with the parameters listed on the trade effluent discharge consents which include flow rates, pH and COD.

This variation will require the applicant to carry out screening tests on the discharge to surface water. Specific substances to be screened will be inclusive of indium and phosphide and all hazardous chemicals and elements used in the site's processes as well as parameters such as COD and TOC.

BATC 4 - monitor emissions to water in accordance with EN standards with at least states minimum frequencies. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

The hierarchy of monitoring standards have been applied to all monitoring of water emissions resulting from this variation.

BATC 5 - periodically monitor diffuse VOC emissions to air from relevant sources by using an appropriate combination of techniques.

The facility monitors for fugitive and diffuse emissions of gases continuously. Two standalone Gas Leak Detection (GLD) systems used at the facility include strategically mounted sensors capable of detecting a variety of toxic gases including VOCs. Monitoring data are fed to the DCS which allows for permanent trending of gas release and alarm activation.

Maintenance of gas sensors and alarms are incorporated into pre planned maintenance schedules which form part of the EMS.

BATC 6 - periodically monitor odour emissions from relevant sources in accordance with EN standards where cases of odour nuisance can be expected or has been substantiated.

There are no sources of detectable odours on-site and no history of odour nuisance at nearby sensitive receptors. No odour nuisance is expected as a result of the variation application and therefore full applicability to this BAT requirement has not been applied to this variation.

BATC 7 - reduce the volume and/or pollutant load of waste water streams, to enhance the reuse of waste water within the production process and to recover and reuse raw materials.

The EMS includes targets for key performance indicators which are designed to continually refine measures to reduce waste water and reuse chemical solutions used in the processes. Data collated on effluent produced per kg of product allows for year on year comparisons and indicates a continuing decrease in the ratio since 2017. There is nothing to suggest this variation will interrupt this trend.

Permit conditions 1.3 and 1.4 obliges the applicant to continually work toward efficient use of water by reducing and recovering wastes using waste hierarchy methodology.

BATC 8 - segregate uncontaminated waste water streams from waste water streams that require treatment.

Other than site rainwater drainage all waste waters flows go through a form of treatment according to source, pollutant type and load for either for: off-site treatment / disposal; sewer discharge; or surface water discharge. The introduction of InP wafers will not require changes to treatment methods or disposal routes.

BATC 9 - provide an appropriate buffer storage capacity for waste water incurred during other than normal operating conditions and to control, treat, and reuse waste waters.

Washings from the grinding process contaminated with GaAs and InP particles are channelled directly to the adequately sized storage tank 01WRT for timely off-site transfers. Effluents destined for sewer discharge flow into the 02WRT four tank treatment system each with a capacity of 20m_3 capacity one of which is backup.

Lightly contaminated waters from washing and rinsing processes flow to 04WRT treatment system before discharge to the River Skerne. None compliant flows are diverted to an ‘out of specification tank’ for storage before either recirculating for further treatment or discharged to sewer. The out of specification tank was constructed during Fujitsu’s occupancy and has sufficient capacity to contain significant emergency flows including fire waters.

Rain waters are kept separate from process effluents and flow to an interceptor pit /sump where continuous monitoring for pH is performed before discharge to the River Skerne. If abnormal pH levels are detected or a yard spillage occurs the option for directing flows to the out of specification tank is available.

BATC 10 - use an integrated waste water management and treatment strategy based on an inventory of waste water streams that includes an appropriate combination of techniques in a stated priority order.

Waste water management and treatment strategy reviews are undertaken regularly to assess system performance. Sampling and analysis of all effluent discharge are key performance parameters and are carried out to MCERTS standards. Data on solvents used are collated as are the quantities sent for off-site recycling.

BATC 11 - carry out wastewater pre-treatment as part of an integrated waste water management and treatment strategy.

The facility incorporates waste water pre-treatment methods based on effluent source, separation, contaminant load, and disposal destination.

BATC 12 - use an appropriate combination of final waste water treatment techniques to reduce emissions to waters and to within AELs.

The facility incorporates pH and hydrochloric acid neutralisation as final treatments before discharge to the River Skerne. Final waste water treatment methods and monitoring of discharge will be carried out as part of an integrated waste water management strategy based on compliance with relevant AELs.

Consideration for testing discharges to water will be required to be carried out by the applicant as part of the improvement conditions programme.

BATC 13 - set up and implement a waste management plan as part of the EMS that ensures waste is prevented, prepared for reuse, recycled or otherwise recovered.

A waste management plan forms part of the facility’s EMS. Procedures are in place for handling all wastes at the installation. The procedures are regularly reviewed to assess performance and refine efforts to reduce waste disposal.

Permit condition 1.3.1 requires the applicant to take appropriate measures to ensure that raw materials and water are used efficiently and permit condition 1.4.1 requires the waste hierarchy, referred to in Article 4 of the Waste Framework Directive, to be applied in the generation of waste.

BATC 14 - use one or a combination of stated techniques to reduce the volume of waste water sludge requiring further treatment or disposal.

Weak slurries are produced from the wafer grinding and cutting processes. Though amounts are relatively small there are no current method of volume reduction carried out. An improvement condition has been incorporated into the permit to require the applicant to submit a report for the adoption of methods to reduce sludge volume. The condensed sludge will be considered a hazardous waste.

BATC 15 - enclose the emission sources and to treat the emissions to air, where possible.

Contaminated air flows from the various clean room operations are drawn through enclosed ventilation systems and emitted to atmosphere through designated emissions points, though not all air emissions are channelled through an abatement system. Consideration for treating all point source emissions to air will be required of the applicant as part of the improvement conditions programme.

BATC 16 - use an integrated waste gas management and treatment strategy that includes process-integrated and waste gas treatment techniques.

Site activities operate under an integrated waste gas management strategy that incorporates dry adsorption and wet scrubbing as the major methods for treating waste gases. Not all was gas streams currently undergo a form of treatment before emission to the atmosphere. Consideration for treating all point source emissions to air will be required of the applicant as part of the improvement conditions programme.

BATC 17 and 18 deal with flares.
Not applicable. No flaring takes place at the facility.

BATC 19 - use a combination of stated techniques in order to prevent or, where that is not practicable, to reduce diffuse VOC emissions to air.

Gas emissions from the processes are controlled by exhaust ventilations systems which channelled to air emission points to atmosphere. Mechanical joints fitted to pipe work carrying waste gases are fitted with leak detection such that supply

valves are automatically shut should there be a detection. The systems covers gases under extract.

Maintenance and check schedules on the joints, GLD valves and alarms are incorporated into the EMS. Process controls for deliveries and storage of gases and chemicals are also incorporated within the EMS, including emergency chemical spill procedures.

The hazard and operability study carried out to assess the introduction of InP concluded gases and chemicals associated with InP processes would not contribute to increased fugitive VOC emissions.

Mass balance calculations carried out by the applicant indicate that annual solvent losses to the environment are 138kg, of which 13kg are thought to be lost through diffuse / fugitive emissions to air, water or waste.

Consideration for the applicant to further identify sources of fugitive and diffuse emissions and procedures for monitoring and eliminating or minimising those sources have been inserted into the permit as part of the improvement condition programme
.

BATC 20 - prevent or reduce odour emissions, by implementing regular reviews of an odour management plan, as part of the EMS. Applicability is restricted to cases where odour nuisance can be expected or has been substantiated.

There are no cases of off-site odour nuisance and none are expected as a result of this permit variation. Therefore BATC20 is not applicable.

As a safeguard permit condition 3.3.2 (a) requires the applicant to submit an odour management plan to be approved by the Environment Agency if it is found that the activities are giving rise to odour pollution outside the site.

BATC 21 is to prevent or, where that is not practicable reduce odour emissions from waste water collection and treatment and from sludge treatment, by using one or a combination of listed techniques.

The presence of odours from the site's waste water collection and treatment systems are minimal and contained. The residence time of a batch of waste water storage is marginal. Chemicals used on-site in the treatment of the waste water may also play a role in suppressing or eliminating potential odours. The weak sludges largely consist of water with particles of gallium and indium and are therefore odourless.

BATC 22 - prevent or reduce noise emissions by implementing a noise management plan as part of the environmental management system which

incorporates particular protocols and measures. Applicability is restricted to cases where noise nuisance can be expected or has been substantiated.

There are no cases of noise nuisance originating from the site and none are expected as a result of this permit variation. Therefore BATC22 is not applicable.

As a safeguard permit condition 3.4.2 (a) requires the applicant to submit a noise management plan to be approved by the Environment Agency if it is found that the activities are giving rise to noise and vibration pollution outside the site.

BATC 23 - prevent or reduce noise emission by using one or a combination of listed techniques.

There are no cases of noise nuisance originating from the site and none are expected as a result of this permit variation. The risk of noise disturbance is therefore considered low.

Other than yard activities all process and ancillary activities are carried out within noise insulated buildings. Buildings also assist in shielding yard activities from receptors. Maintenance of related equipment are carried out routinely with equipment. All operations are carried out by experienced staff.

Inorganic Chemicals Sector EPR 4.03 Indicative BAT

1.1 Environmental Performance indicators – Monitor and benchmark environmental performance. Plans for minimising environmental impacts should be incorporated into on-going Improvement Programmes.

The site specific EMS is BS EN ISO 14001 certified and encompasses all elements of the international standard.

1.2 Accident Management – The facility incorporates an Accident Management Plan (AMP) which identifies potential accidents, including those associated with equipment breakdowns, forced shutdowns, fires, vandalism and flooding. Emergency responses are also covered in the AMP.

1.3 Energy efficiency – Assess environmental impact of each process and choose the one with the lowest environmental impact.

Project designs are guided by EMS objectives which include efficiency, energy usage and safety. The manufacturing processes practised are however complex and constrained by the technologies on offer.

1.4 Efficient use of raw materials and water – Assess the environmental impact of each process and choose the one with the lowest environmental impact.

The EMS provides drivers for using less harmful chemicals in the production processes where possible or using ones which are more easily recoverable. The applicant's purchasing principles are guided by EMS objectives which include assessing the environmental impact of raw materials used in the processes.

Key performance indicators include measuring annual water and energy usage (and associated CO2 emission reduction) against the annual quantity of product produced. Efficiencies in raw materials, energy and water usage are not anticipated to reduce as a result of the introduction of InP.

1.5 Avoidance, recovery and disposal of wastes – Demonstrate that chosen routes for recovery or disposal represent the best environmental option. Consider avenues for recycling back into the process or reworking for another process wherever possible. Where you cannot avoid disposing of waste, provide a detailed assessment identifying the best environmental options for disposal.

Solvents and slurry represent the major waste streams. Regular performance reviews are carried out for reducing, reusing or recycling solvents where feasible. Part of the purchasing assessments for raw materials is to choose solvents which are more easily recoverable. Duty of care audits are carried out on waste contractor facilities dealing with slurry wastes. The applicant and waste contractors understand the risks associated with the wastes from storage, treatment and disposal routes. Waste contractors have been made aware of the introduction of indium into the slurry waste and have assessed the inclusion as tolerable for existing treatment and disposal routes.

2.1 Design of a new process - Consider all potential environmental impacts from the outset in any new project for manufacturing chemicals.

Not applicable. The facility does not manufacture chemicals.

2.2 Storage and handling of raw materials, products and wastes - Store reactive chemicals in such a way that they remain stable. Use HAZOP studies to identify risks to the environment for all operations involving the storage and handling of chemicals and wastes.

A chemical storage review, including waste storage was conducted in consideration of the additional chemicals required for the InP process. The review concluded there were no additional risks or increased risks posed by the storage of existing and additional chemicals associated with the InP processes.

All chemicals supplied are pre-purchased assessed by appropriately trained staff and in accordance with the Control of Substances Hazardous to Health Regulations 2002 (COSHH). Assessments include health and environmental hazards, risks and appropriate mitigation measures. All assessment information is recorded on the facility's Document Control System (DCS) and Computer Maintenance System in line with EMS procedures.

Chemicals used in the manufacturing processes consist of gases or a variety of acids and alkalis. Liquid chemicals are kept in various sized capped bottles or containers as supplied by manufacturers and are stored separately according to their hazards, into either the ‘Acid / Corrosive’ store room or ‘Solvents / Flammable‘ store room, both located on the ground floor. The rooms are dry and ventilated, are kept secure and serve as secondary containment.

When required most liquid chemicals are transported on trollies via a goods lift to the Cleanroom area where they are kept segregated between flammables and corrosives within chemical cupboards awaiting use. The chemical solvent NMP is supplied directly from storage cabinets located in the flammable room via high grade ‘preliminary risk assessed’ pipelines to the cleanroom area.

Bulk gases and cylinder gases are stored on a tank farm located within the yard area. Bulk liquid gas deliveries are transferred from tanker to tank by pipe. Process carrier gases are supplied from gas cyclinders positioned within distribution cabinets fitted with GLD located within the bunker room on the ground floor of the main building. The room is fitted with leak detection, extraction and sprinkler systems. Manifold purged gas is directed to atmosphere via a scrubber.

Waste solvents are stored externally in a locked compound located in the yard area. The compound has concrete flooring and sealed drainage. Empty containers from the cleanroom are rinsed and disposed of as waste. Solvent wastes are stored in drums either in store rooms or within covered compound located in the yard area that serves as secondary containment.

Finished goods are in small packages and are shipped frequently to minimise storage requirements.

The facility has an established Emergency Response Team trained in deal with spillages of acids alkalis and solvents following in house Chemical Spill Management procedures.

2.3 Plant systems and equipment - Consider potential emissions from plant systems and equipment. Install sufficient instrumentation to detect reduced performance and alarm. Carry out a systematic HAZOP study for all relief systems, to identify and quantify significant risks to the environment from the technique chosen. Consider leak detection, corrosion monitoring and materials of construction. Ensure methods for rapid detection of leaks are in place and a regime of corrosion monitoring in operation at critical points. For cooling water systems, use techniques that compare favourably with relevant techniques described in the “Industrial Cooling Systems” BREF. Assess the potential for the release to air of VOCs and other pollutants along with discharged purge gas and use abatement.

The potential for diffuse / fugitive emissions of VOC and other gaseous emissions are thought to be minimal. Gas leak management is given a high significance at the facility and as such GLD are fitted strategically throughout the cleanroom processing and emission lines. Pressure and leak detection sensors serving individual reactors, gas manifolds, gas storage cabinets and abatement systems are fed to the DCS and monitored for abnormalities and equipment performance. When an alarm is raised the relevant piece of equipment automatically shuts down.

Planned preventative maintenance schedules are in place to maintain critical pieces of plant and equipment, including gas leak sensors and alarms.

A hazard operability study carried out for the introduction of InP substrates indicates no additional implications for existing over pressure systems. The study, which forms part of the EMS, was undertaken by key members of staff, and was based on CWW BATC and EPR4.03 guidance included: - assessment of safety data sheets for newly introduced equipment and chemicals; chemical storage; health and safety of employees; environmental control measures; individual process operations and chemical reactions; and changes to existing waste streams including effluent and gas treatment and emissions to air and water.

The facility operates a water cooling system configured in the 1990s when the facility was designed and constructed. The Industrial Cooling Systems BREF advises that for existing installations, BAT can be considered as a long term goal which fits with equipment replacement cycles.

Consideration for assessing the release to air of VOCs and other pollutants and the use of abatement will be undertaken out by the applicant as part of the improvement conditions programme.

2.4 Reaction stages - Evaluate options for suitable reactor types. Minimise the potential for vapour release to air from pressure relief systems and the potential for emissions of organic solvents into air or water, by formal consideration at the design stage or review of the existing arrangements. Review operating practices and review vent flows. Consider opportunities to enhance the performance of abatement systems. Minimise liquid losses from reaction systems. Review features that contribute to a reduction in waste arisings from clean-outs. Minimise vapour losses from reaction systems. Consider opportunities to enhance the performance of abatement systems.

All reactor processes take place within sealed chambers located within clean room environments that have closely monitored air ventilation and drain systems. GLD is provided throughout the process and storage areas including in areas of ambient air. Vapours produced are captured and channelled to air point source emission stacks.

Control of potential diffuse and fugitive gaseous emissions is a fundamental consideration at the plant's design stage. The introduction of InP will not increase the risk of diffuse / fugitive air emissions.

Because of the nature of the processes waste arising from clean-outs are not significant. It is not anticipated the introduction of InP substrates will contribute to waste arisings. Cleaning of the machinery is minimal and normally takes place as part of the maintenance schedules and carried out in line with the manufacturer's recommendations. The applicant's EMS require consideration of all waste production sources.

2.5 Separation stages - Choose separation techniques following a detailed process design and HAZOP study. Follow formal operating instructions to ensure effective separation and minimisation of losses. Install instrumentation to warn of faults in the system. Use techniques to minimise, re-use and/or recycle rinse water, and to prevent breakthrough of solids. Install instrumentation for detecting malfunction. Have good management procedures to minimise loss of solids, escape of volatiles to air and excessive production of waste water.

A hazard and operability study concluded the introduction of InP substrates would deliver no additional risks or impact than those existing risks and impacts associated with GaAs substrates.

Physical separation of vapour from liquid during wet etching processes. The processes are carried out following written operational procedures. Vapours rising from etching baths are collected and channelled in sealed ducting to air emission points. Not all emission points are provided with abatement.

Mass balance calculations for solvents indicate the annual solvent loss to the environment are given as 138kg of which 125kg are emitted via a point source emission to air and remaining 13kg through diffuse / fugitive emissions to air, water or waste.

Grinding and cutting processes are the major source of solid liquid waste mixtures. This takes the form of contaminated weak sludge made up of GaAs and InP particles suspended in water. A dedicated drain system channels both InP and GaAs based flows to the 01WRT tank for off-site treatment and disposal. A mist filtration system, (known as the Heavy Smoker) is located on the drain line and collects GaAs and InP particles greater than 0.3 microns with a projected efficiency of above 99.9%.

Waste water and sludge production data is collated to be used as environmental performance indicators for trending the quantities of dirty waters and pollutant loads.

2.6 Purification of solid products - Washing activities have the potential to produce large volumes of dilute liquors so counter-current systems should be used wherever possible. During drying, you should aim to produce the maximum concentration of solvent in the gas to allow recovery of the solvent.

Emissions of solvents to air and water from product washing and drying activities are thought to be minimal. Nevertheless assessment of the release to air of gases and organic solvents to water to be required to be carried out by the applicant as part of the improvement conditions programme will be expected to include product washing and drying activities.

2.7 Chemical process controls - Monitor the relevant process controls and set with alarms to ensure they do not go out of the required range.

Process controls maintenance and calibration checks are embedded in the site's EMS which encapsulate procedures for safety, materials, fugitive and diffuse gas and effluent emissions, waste reduction and general site activities.

2.8 Analysis - Analyse the components and concentrations of by products and waste streams to ensure correct decisions are made regarding onward treatment or disposal. Keep detailed records of decisions based on this analysis in accordance with management systems.

Components of waste slurry and spent solvents are periodically analysed and understood. Trade effluents are sampled and analysed with results fed into recorded on the DCS. Close collaboration with the waste contractors and sewage undertakes assists in the appropriate treatment / disposal routes being applied. Waste disposal and water testing procedures form part of the site's EMS.

3.1 Point source emissions to air - Formally consider the information and recommendations in the BREF on Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector as part of the assessment of BAT for point-source releases to air, in addition to the information in this note. The benchmark values for point source emissions to air listed in Annex 1 should be achieved unless we have agreed alternative values. Identify the main chemical constituents of the emissions, including VOC speciation where practicable. Assess vent and chimney heights for dispersion capability and assess the fate of the substances emitted to the environment.

Considerations will be given to the information and recommendations detailed in BREF - Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector. See specifically BATC 2, BATC 15 and BATC 16 assessments above.

Stack emission testing will be carried out as part of the improvement condition programme to determine the types and levels of contaminants in the emissions. The suite of gaseous determinants will include all VOC speciations that can reasonably be associated with on-site activities. Detailed air dispersion modelling will be required if the testing results indicate significant concentrations of pollutants. Any emission limits and monitoring frequency inserted into the permit will be in line with Annex 1 benchmark levels.

3.2 Point source emissions to water - Control all emissions to avoid a breach of water quality standards as a minimum. Use measures to minimise water use and emissions to water.

Waste waters are segregated according to process source, level of contamination and discharge consent limits for either discharge to sewer of surface water. All flows are monitored and tested to MCERTS standards before discharge. Waste waters are neutralised before discharge to sewer and surface waters. Recirculating water systems with indirect heat exchangers and a cooling tower are installed. Cooling waters are used to dissipate heat from the cleanroom areas. Heat transfers between waste water streams are minimal. Reduction of water usage and effluent production are key performance indicators. Spent solvents are collected for reclaim.

Consideration for testing discharges to water will be required to be carried out by the applicant as part of the improvement conditions programme.

3.3 Point source emissions to land - Use measures to minimise emissions to land.

There are no direct point source emissions to land. Waste slurries are consigned to a waste management contractor who may dispose dewatered sludge solids to landfill as hazardous waste. Solvent wastes and precious metals are collected for off-site reclaim.

3.4 Fugitive emissions - Identify all potential sources and develop and maintain procedures for monitoring and eliminating or minimising leaks. For fugitive emissions to surface water, sewer and groundwater – Provide hard surfacing in areas where accidental spillage or leakage may occur. Hold stocks of suitable absorbents at appropriate locations for use in mopping up minor leaks and spills. Consider undertaking leakage tests and/or integrity surveys to confirm the containment of underground drains and tanks as part of EMS.

All process, yard and ancillary areas are constructed of concrete flooring. Drainage systems are adequately inspected and maintained. The yard area is served with penstock which can be manually closed to contain any spillage to the yard area. Any spillages can be diverted to an emergency tank with a 2500m3 capacity. Operating procedures are in place for chemical transfer including

supervision of deliveries. The AMP includes emergency response procedures for a major spillage, with training and refresher courses undertaken at regular intervals. Emergency spill containment kits are available at strategic locations.

Identification of all potential sources of leaks as stated above is an appropriate measure. Although considered relatively minimal fugitive emissions of solvents to air and water are likely to be the chief pollutant from the site as demonstrated by the solvent mass balance calculation submission.

To establish potential leak locations the applicant will be required to submit a Solvent Management Plan as part of the improvement plan programme which identifies all potential sources of fugitive and diffuse emissions to air and water of solvents and procedures for monitoring and eliminating or minimising sources.

3.5 Odour - Manage the operations to prevent release of odour at all times. Where there is no history of odour problems there can still be an underlying level of annoyance without complaints being made. Where odour generating activities take place in the open, or potentially odorous materials are stored outside, a high level of management control and use of best practice will be expected.

There are no significant odour generating activities undertaken at the facility. The introduction of InP and increased air emission points will see no increase in odour levels. No odours have been detected beyond site boundary and there is no history of odour pollution.

3.6 Noise and vibration - Install particularly noisy machines in a noise control booth or encapsulate the noise source. Where possible without compromising safety, fit suitable silencers on safety valves. Minimise the blow-off from boilers and air compressors, for example during start up, and provide silencers.

All associated process activities take place within acoustic insulated buildings. There are no particularly noisy equipment used at the facility. There is no history of off-site noise pollution and noise levels at site boundaries are negligible. The introduction of InP will see no increase in noise levels.

3.7 Monitoring and reporting of emissions to air - Carry out an analysis covering a broad spectrum of substances to establish that all relevant substances have been taken into account when setting the release limits. The need to repeat such a test will depend upon the potential variability in the process. Monitor more regularly any substances found to be of concern, or any other individual substances to which the local environment may be susceptible and upon which the operations may impact. Monitor and record the physical and chemical composition of the waste, its hazard characteristics and handling precautions and substances with which it cannot be mixed.

The applicant has provided diagrams of gas flow systems and chemical equations which provide evidence of a good understanding of by-products and pollutant constituents. However the H1 assessment provided with the application was considered unsatisfactory. This was due to limited availability of quality input data.

As part of the improvement conditions programme the applicant will be required to undertake a monitoring programme for air emission points A1–A17, following the introduction of InP. This should inform us of the types and quantities of pollutants emitted from each air emission point and whether they are insignificant or above the benchmark levels detailed in Annex 1 and whether emission limits need to be set within the permit.

Sampling of the chemical composition of waste sludge are undertaken and the hazardous characteristics of the material is understood by applicant and waste contractor. Characteristic of spent solvents collected for recovery are known by the applicant and the specialist waste contractors handling the materials.

Environmental monitoring beyond the installation is not carried out as currently not considered necessary. This position can be re-evaluated following completion of air emission monitoring requirements. There are no process variables which will impact on the environment. Monitoring is carried out for all processes.

National Air Pollution Control Programme

We have considered the National Air Pollution Control Programme as required by the National Emissions Ceilings Regulations 2018. By setting emission limit values in line with technical guidance we are minimising emissions to air. This will aid the delivery of national air quality targets. We do not consider that we need to include any additional conditions in this permit.

Odour management

We haven't requested an Odour Management Plan at this time, but we will request one in the future if we consider the site poses a risk of odour. We do not believe the variation increases the odour risks at the facility.

Noise and vibration management

We haven't requested a Noise and Vibration Management Plan at this time, but we will request one in the future if we consider the site poses a risk of noise. We do not believe the variation increases the noise risks at the facility.

Fire prevention plan

We haven't requested a Fire Prevention Plan at this time, but we will request one in the future if we consider the site poses a risk of fire. We do not believe the variation increases the fire risks at the facility.

Improvement programme

Based on the information on the application, we consider that we need to include an improvement programme.

We have included improvement conditions 6, 7 and 8 to confirm the emission assumptions used in the application and to look at whether additional abatement methods are required. Real world emissions data can only be gained when the site's InP processes start in full. We need to ensure that emissions to air, sewer and surface water comply with BAT requirements and to give confidence there will be no impact on human health or the environment as a result of the variation.

We also need to include improvement conditions 9 and 10 to demonstrate compliance with appropriate measures for minimising sludges and fugitive / diffuse emissions of solvent and VOCs.

The five improvement conditions introduced are copied and discussed in the Key issues of the decision section of this document.

Emission limits

No emission limits have been added, amended or deleted as a result of this variation. The option for applying Emission Limit Values (ELVs) and/or equivalent parameters or technical measures based on Best Available Techniques have been left open and is dependent on test and monitoring results following implementation of improvement conditions 6, 7 and 8.

Monitoring

Other than a requirement to sample for indium annually at the sewer discharge monitoring has not changed as a result of this variation at this point. However the option for applying additional monitoring has been left open and is dependent on test and monitoring results following implementation of improvement conditions 6, 7 and 8.

Reporting

We have amended reporting in the permit for the following parameters.

Other than a requirement to report indium sample results for the sewer discharge no reporting requirements have been added, amended or deleted as a result of

this variation at this point. However the option for applying additional reporting requirements has been left open and is dependent on test and monitoring results following implementation of improvement conditions 6, 7 and 8.

We made these decisions in accordance with reference to relevant technical guidance.

Management system

We are not aware of any reason to consider that the operator will not have the management system to enable it to comply with the permit conditions.
The decision was taken in accordance with the guidance on operator competence and how to develop a management system for environmental permits.

We only review a summary of the management system during determination. The applicant submitted their full management system. We have therefore only reviewed the summary points.
A full review of the management system is undertaken during compliance checks.

Financial competence

There is no known reason to consider that the operator will not be financially able to comply with the permit conditions.

Growth duty

We have considered our duty to have regard to the desirability of promoting economic growth set out in section 108(1) of the Deregulation Act 2015 and the guidance issued under section 110 of that Act in deciding whether to grant this permit variation.

Paragraph 1.3 of the guidance says:
“The primary role of regulators, in delivering regulation, is to achieve the regulatory outcomes for which they are responsible. For a number of regulators, these regulatory outcomes include an explicit reference to development or growth. The growth duty establishes economic growth as a factor that all specified regulators should have regard to, alongside the delivery of the protections set out in the relevant legislation.”

We have addressed the legislative requirements and environmental standards to be set for this operation in the body of the decision document above. The guidance is clear at paragraph 1.5 that the growth duty does not legitimise non-

compliance and its purpose is not to achieve or pursue economic growth at the expense of necessary protections.

We consider the requirements and standards we have set in this permit are reasonable and necessary to avoid a risk of an unacceptable level of pollution. This also promotes growth amongst legitimate operators because the standards applied to the operator are consistent across businesses in this sector and have been set to achieve the required legislative standards.

Consultation Responses

The following summarises the responses to consultation with other organisations, and the way in which we have considered these in the determination process.

Responses from organisations listed in the consultation section:

Response received from Public Health England (PHE).
Brief summary of issues raised:

PHE state there are a number of emission points to air, nitrogen dioxide and carbon monoxide from boilers and potentially a wide range of process emissions from existing and proposed activities.

PHE state the H1 assessment submitted as part of the application is lacking in detail.

PHE recommends the results from the emission survey, which the applicant has proposed, is used to confirm the efficacy of the abatement systems and to review the H1 assessment and completing as necessary any detailed assessment. PHE requests any information arising from these recommendations should be sent to themselves for consideration when it becomes available.

Summary of actions taken:

Improvement conditions 6 and 7 have been included into the variation which address the issues raised by PHE. The two conditions combined require the operator to test air emission points A4–A17, for an agreed suite of contaminants under normal mass production conditions. The operator is then required to assess the impact of the emissions tested using the H1 tool to determine whether or not the benchmark values for point source emissions to air, as listed in Annex 1 of EPR 4.03 are achieved. The testing will also determine whether or not future periodic or continuous monitoring and emission limit values need to be inserted into the permit along with associated reporting requirements. Improvement Condition 7 also requires an assessment of abatement equipment.

Emission points A1-A3 serve the boilers producing the nitrogen dioxide and carbon monoxide gases to which PHE refer. When the permit was issued emissions to air of noxious gases from A1-A3 were assessed sufficiently low as not to warrant abatement or monitoring. As existing plant with no identifiable emission alterations resulting from the variation, air emission points A1-A3 have been excluded from this determination assessment. However, with each of the three boilers having a rated 7Mwth and running off natural gas under normal conditions, the boilers will fall within the Medium Combustion Plant Directive 2015 (MCPD), which will require the emissions to be periodically tested from January 2025 as a result of regulatory change.