IQE Ltd Newport Semi-Conductor Facility

Bespoke permit

The permit number is: EPR/AB3893FZ

The Operator / Operator is: IQE Compounds Limited

The Installation is located at: Imperial Park, Celtic Way, Celtic Lakes, Newport, NP10 8BE

We have decided to grant the permit for Newport Semiconductor Facility operated by IQE Compounds Limited.

We consider in reaching that 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:

- explains how the application has been determined
- provides a record of the decision-making process
- shows how all relevant factors have been taken into account
- justifies the specific conditions in the permit other than those in our generic permit template.

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

Structure of this document

- Table of contents
- Key issues
- Annex 1 – Improvement Conditions
- Annex 2 - consultation responses

Contents

Key issues of the decision

1 Our decision

Based on the information currently available to us we are granting a permit to the Operator This will allow it to operate the Installation, subject to the conditions in the Permit.

We consider that, in reaching that decision, we have taken into account all relevant considerations and legal requirements and that the permit will ensure that a high level of protection is provided for the environment and human health.

This Application is to operate an installation which is subject principally to the Industrial Emissions Directive (IED).

The permit contains many conditions taken from our standard Environmental Permit template including the relevant Annexes. We developed these conditions in consultation with industry, having regard to the legal requirements of the Environmental Permitting Regulations and other relevant legislation. This document does not therefore include an explanation for these standard conditions. Where they are included in the permit, we have considered the Application and accepted the details are sufficient and satisfactory to make the standard conditions appropriate.

2 How we reached our decision

2.1 Receipt of Application

The Application was accepted as duly made on 22nd December 2017. This means we considered it was in the correct form and contained sufficient information for us to begin our determination, but not that it necessarily contained all the information we would need to complete that determination.

The Operator made no claim for commercial confidentiality, however they advised that metals and carbon tetrabromide are released in very low levels and a quantity, which they advised cannot be disclosed for commercial reasons, is consumed during the chemical process in the Aixtron G4 reactors.

2.2 Consultation on the Application

We carried out consultation on the Application in accordance with the Environment Permitting Regulations (EPR), our statutory Public Participation Statement (PPS) and our Regulatory Guidance Note RGN 6 for Determinations involving Sites of High Public Interest.

Furthermore we have also considered the Well-Being of Future Generations (Wales) Act 2015 and the Environment (Wales) Act 2016 during our assessment process.

We advertised the Application by a notice placed on our website, which contained all the information required by the EPR/Industrial Emissions Directive (IED), including advising people where and when they could see a copy of the application. The consultation started 9th January 2018 and ended 7th February 2018.

A copy of the Application and all other documents relevant to our determination (see below) are available for the public to view. Anyone wishing to see these documents could arrange for copies to be made.

We sent copies of the Application to the following bodies, which includes those with whom we have “Working Together Agreements”:

- Aneurin Bevan University Health Board/Public Health Wales
- Newport City Council Planning Department
- Newport City Council Environmental Protection Department

These are bodies whose expertise, democratic accountability and/or local knowledge make it appropriate for us to seek their views directly.

Further details along with a summary of consultation comments and our response to the representations we received can be found in Annex 3. We have taken all relevant representations into consideration in reaching our determination.

2.2.1 Draft Permit Consultation

This consultation began on 20th April 2018 and ended on 21st May 2018.

2.3 Requests for Further Information

In order for us to be able to consider the Application duly made, we needed more information. We requested further information relating to payment of the correct application fee. Upon receipt of this information we were able to consider the application Duly Made.

Further information was also requested by way of a Schedule 5 Notice requiring clarification of aspects in the risk assessment and accident management plans. The Schedule 5 Notice was sent on 27th March 2018. The Operators response to the Schedule 5 Notice was provided on 28th March 2018. The additional information supplied satisfied the requirements of the Schedule 5 notice.

A copy of the information notice and e-mails requesting further information were placed on our public register as were the responses when received.

3 The Legal Framework

The Permit will be granted, under Regulation 13 of the EPR. The Environmental Permitting regime is a legal vehicle which delivers most of the relevant legal requirements for activities falling within its scope. In particular, the regulated facility is:

- an *installation* as described by the EPR;
- subject to aspects of the Well-Being of Future Generations (Wales) Act 2015 and the Environment (Wales) Act 2016 which also have to be addressed.

We address the legal requirements directly where relevant in the body of this document. NRW is satisfied that this decision is consistent with its general purpose of pursuing the sustainable management of natural resources (SMNR) in relation to Wales, and applying the principles of SMNR. In particular, NRW acknowledges that it is a principle of sustainable management to take action to prevent significant damage to ecosystems. We consider that, in granting the Permit a high level of protection will be delivered for the environment and human health through the operation of the Installation in accordance with the permit conditions.

4 The Installation

4.1 Description of the Installation and related issues

4.1.1 The permitted activities

The Installation is subject to the EPR because it carries out an activity listed in Part 1 of Schedule 1 of the EPR under Section 4.2 Inorganic Chemicals, Part A (1) (c) Unless falling within any other Section, any manufacturing activity (other than the application of a glaze or vitreous enamel) involving the use of, or the use or recovery of, any compound of any of the following elements—

(i) antimony;
(ii) arsenic;
(iii) beryllium;
(iv) gallium;
(v) indium;
(vi) lead;
(vii) palladium;
(viii) platinum;
(ix) selenium;
(x) tellurium;
(xi) thallium,

where the activity may result in the release into the air of any of those elements or compounds or the release into water of any substance listed in paragraph 7 (1) of Part 1 of this Schedule.

An installation may also comprise “directly associated activities”, which at this Installation includes pre-treatment of process water by reverse osmosis and the discharge of effluent from process emissions via sewer emission S1. Together, these listed and directly associated activities comprise the Installation.

4.1.2 The Site

The Newport Semiconductor Facility will be located in an existing building located on a largely industrialised area in the eastern part of Imperial Park, approximately three miles south east of Newport City Centre. Imperial Park houses a number of industrial, distribution and administration facilities which are located to the north and west of the site.

The site is bordered by Next Generation Data (NGD) to the north and Celtic Way to the west. There is an area of unmade land to the south of the site, whilst South Lake Drive, including the roundabout with Imperial Way, borders the site to the east.
The site itself is not subject to any environmentally sensitive designations. It is located approximately 0.6km north of the Gwent Levels-St Brides Site of Special Scientific Interest (SSSI). There are nearby local wildlife sites at Celtic Springs approximately 1km to the north west, the LG Duffryn sites 1 and 2 on South Lake Drive approximately 0.3km to the south of the main building and the Duffryn Pond approximately 1km to the east. The Severn Estuary Special Area of Conservation (SAC) is further afield at approximately 3km to the South East.

4.1.3 What the Installation does

The operator manufactures advanced electronic and opto-electronic Group III - Group V semiconductor structures using a process known as Metal-Organic Chemical Vapour Deposition (MOCVD). This process involves the growth of semiconductors using substrates such as gallium arsenide and indium phosphide in a wafer form and the deposit of material onto these substrates using carrier gases. Small quantities of gaseous dopants are also introduced to produce the desired crystals.

Each reactor in which MOCVD is undertaken is located in a bay. Inputs to the process are supply gases and wafers, which are manually loaded into the reactors. Arsine, nitrogen and hydrogen are gases used in the proposed reactors. These are reacted in the reactors, at temperatures up to 1200ºC, producing finished wafers and process exhaust gases. The process is undertaken in batches, with each batch lasting five to six hours.

4.2 The site and its protection

4.2.1 Assessment of site baseline condition report

The operator has stated in the Site Condition Report that "*based on the site-specific assessment of substances to be used, stored, handled and produced in relation to permitted activities at the site, no substances have been identified which represent a significant potential pollution risk. Therefore, the collection of baseline data is considered to be a precautionary approach*".

NRW agree with the conclusions in relation to potential pollution risk. The process in relation to relevant hazardous substance as outlined by the European Commission guidance on baseline reports has been adequately followed. However, based on that guidance and their conclusion, no baseline report is required (lifetime records approach only).

NRW are therefore satisfied that baseline data is not necessary and do not formally agree with the data submitted. This is especially valid due to the quality of data being insufficient to fully characterise the site. For example, only a single round of groundwater monitoring from one borehole was collected. Consequently, an intrusive site investigation at the surrender stage will not be required unless there are significant compliance issues during the life of the permit.

NRW was satisfied with all other sections of the site condition report.

4.2.2 Proposed site design: potentially polluting substances and prevention measures

There is no bulk storage of potentially polluting liquids, therefore fugitive releases to land and water are unlikely to arise from chemical or oil spills and leaks. Gases will be stored in cylinders in the service yard in dedicated gas storage bays. Other products for the formation of wafers will be stored in sealed bubbler containers within reactors and also within sealed containers in a secure storage unit. Maintenance oils and other fluids will be stored and used on site in small quantities. Oils will be stored in drums provided with secondary containment in a dedicated storage facility within the building. Deliveries of oil will be supervised by site operatives. Spill kits will be available with materials suitable for absorbing and containing minor spills and site staff will be trained in their use and in the spill clean-up procedures.

The sites main process areas will be surfaced with impermeable surfacing comprising high quality reinforced concrete with sealed construction joints and a sealed drainage system. There will be no external areas where contaminated process water may enter surface water drainage systems, as these are segregated from process water systems.

The service yard and the access road is also surfaced with impermeable hard standing with sealed construction joints and are laid with falls towards the drainage system so that all run-off drains to the main surface water drainage system for the business park via an oil interceptor to emission point W1. The interceptor will be inspected on a regular basis to check its integrity and be maintained to prevent overfilling.

There are further release points for discharge of uncontaminated roof water which are outside of the Installation boundary as these releases are not connected with the regulated activity or directly associated activities. The operator has a duty to ensure that soil and groundwater are protected in order to meet the requirements of Articles 14 (1)(b), 14(1)(e) and 16(2) of the IED".

4.2.3 Closure and decommissioning

Permit condition 1.1.1 requires the Operator to have a written management system in place which identifies and minimises risks of pollution including those arising from closure. We have included improvement condition 1 in the permit requiring the operator to provide a detailed closure plan.

At the definitive cessation of activities, the Operator has to satisfy us that the necessary measures have been taken so that the site ceases to pose a risk to soil or groundwater, taking into account both the baseline conditions and the site's current or approved future use. To do this, the Operator has to apply to us for surrender, which we will not grant unless and until we are satisfied that these requirements have been met.

4.3 Operation of the Installation – general issues

4.3.1 Administrative issues

The Operator is the sole Operator of the Installation. We are satisfied that the Operator is the person who will have control over the operation of the Installation if the Permit were to be granted; and that the Operator will be able to operate the Installation so as to comply with the conditions included in the Permit, if issued.

We are satisfied that the Operator's submitted OPRA profile is accurate. The OPRA score will be used as the basis for subsistence and other charging, in accordance with our Charging Scheme.
OPRA is Natural Resources Wales method of ensuring application and subsistence fees are appropriate and proportionate for the level of regulation required.

Relevant Convictions

NRW's COLINS Database has been checked to ensure that all relevant convictions have been declared. No relevant convictions were found. The operator satisfies the criteria in RGN 5 on Operator Competence.

Financial Provision

There is no known reason to consider that the operator will not be financially able to comply with the permit. The decision was taken in accordance with RGN 5 on Operator Competence.

4.3.2 Management

The Operator has stated in the Application that they will implement an Environmental Management System (EMS) that will meet the requirements for an EMS in our "*How to comply with your environmental permit guidance*". The Operator submitted a summary of the EMS with their application and have stated that they will be implementing an Environmental Management System (EMS) to the standard of ISO14001:2015 which will include all activities connected to the proposed Newport Semiconductor Facility. The Operator will aim to achieve certification of the EMS at the earliest opportunity. NRW recognises that certification of the EMS cannot take place until the Installation is operational, however NRW requires that this is obtained within 12 months of operating. We have included improvement condition 2 in the draft permit to require the Operator to report on progress towards obtaining ISO14001 accreditation of their management system.

We are satisfied that appropriate management systems and management structures will be in place for this Installation, and that sufficient resources are available to the Operator to ensure compliance with all the Permit conditions.

4.3.3 Accident management

The operator has produced an Accident Management Plan (AMP) which considers potential accidents which may arise during operation using three elements:

- identification of hazards;
- assessment of the risks (and possible consequences); and
- identification and implementation of techniques to reduce the risks of accidents (and contingency plans for any accidents that may occur).

A qualitative assessment has been carried out for foreseeable accident scenarios which concludes that the risk to the environment is low in all scenarios considered. The operator concluded that the specific accidents that could occur. They considered:

- Hydrogen Bank failure – Vehicle impact could result in loss of containment and total loss of contents to atmosphere and /or ignition followed by explosion if an ignition source is available.
- Fire and fire water run-off – Fire resulting from the ignition of combustible materials or gases may lead to fire water run-off entering the surface water drains.
- Toxic release – Cylinder failure. If a cylinder fell from the delivery vehicle during transfer operations the cylinder could catastrophically fail leading to a total loss of contents to atmosphere.
- Polluting Material Spillage – Minor spill from chemical drums or cooling system.

Based on IQE‘s current operations, the likelihood of occurrence has been considered as follows:

- Hydrogen Bank failure – IQE estimates the probability of such an accident as “highly unlikely” with an estimated rate of occurrence of 10-4 or once in every 10,000 refill operations.
- Fire and fire water run-off – IQE estimates the worst case estimate for likelihood of a fire occurring anywhere on site is a probability rate of 10-3 - “unlikely” - or 1 chance in 1000 operations for the ignition of gases. The likelihood of fire water run-off directly into the surface water network as a result of this is lower as this does not take into account any consideration of fire location or scale.

- Toxic gas release – All cylinders are manufactured and tested to International transport specifications. A toxicity assessment carried out on behalf of IQE indicates that the probability of catastrophic cylinder failure by any mechanism is considered to be 1 in a million/ yr ($1x10^{-7}$ / yr)
- Polluting Material Spillage – Chemicals are stored and used in very small quantities, appropriate to the scale of use at the site. No liquids are stored externally to the building and all chemicals are stored in dedicated storage facilities. A chemical spill which reaches the environment is highly unlikely. Coolant is only used within the main building and chemical concentrations will be very dilute minimising impact in the event of a spill.

The operators AMP considers the consequences of these failures as follows:

- Hydrogen Bank failure - total loss of containment would lead to the release of up to 0.55 tonnes of hydrogen over a period of several minutes as all maxi-packs drain off to atmosphere. All emissions under this scenario would be released directly to atmosphere assuming no ignition source is present
- Fire and fire water run-off - In the event of a fire which could not be dealt with by the on-site emergency response team it is assumed that fire and rescue service responders would use several thousand litres of water to bring such a fire under control. The fire water run-off may contain high levels of particulate matter including Arsenic and other toxic solids such as indium or phosphorus. The insolubility of these compounds mean they will only be transported to the environment via entrainment, and therefore concentrations which will enter the surface water network are expected to be low. Fire combustion products would contain toxic gases which could impact local receptors. In the event of a significant fire it is assumed that potentially all, of the water will find its way to both surface and foul water drains on site
- Toxic release - Catastrophic cylinder failure during an unloading operation would result in the instantaneous release of the entire contents of the cylinder. The most toxic release from catastrophic cylinder failure would be 22.7kg of arsine which is the volume of one cylinder. Whilst there could be a significant

local environmental impact from such a release, only site near neighbours to the release point would be at immediate risk of harm.

- Polluting Material Spillage – as materials are stored and used within the building, the spillage would be maintained within the building therefore risk of environmental impact is negligible.

The operator has identified the necessary measures for the prevention of accidents follows:

- Hydrogen Bank failure - The controls in place for prevention of hydrogen bank failure are as follows: Each individual cylinder pack is protected by a structural steel cage. These are located within a secure compound to prevent acts of vandalism which could potentially lead to loss of containment. The structural steel cages are protected from vehicle impact by lorry wheel stops. Site speed limits are in place to reduce the risk of damage by vehicles.
- Fire and fire water run-off - The controls in place to mitigate fire hazards are as follows: The site is protected by fire and hydrogen detection equipment which is linked to an alarm system which is continuously monitored by a remote service provider to ensure prompt response by the fire service in the event of an emergency. An emergency response team is present at all times whilst the site is in production mode. This team is fully trained to respond to any alarm or incident which may occur, following the installation emergency plan. In the event of a fire all combustible gases and hydride sources will be isolated, power to all operational equipment will by isolated by the safety control system and a general fire alarm will sound ensuring that the building is evacuated. Activities will be managed and operated in accordance with a management system (which will include site security measures to prevent unauthorised access). All plant and equipment and electrical installations will be kept maintained and in good working condition and subject to routine inspection and maintenance. Firefighting equipment will be maintained on site in accordance with fire regulations. Control or elimination of potential sources of ignition and combustible materials A site security system (entry or sabotage) is in place. Appropriate access for emergency vehicles has been incorporated into the installation design.

Fire in the facility at the point of use of arsine results in the complete isolation and purging of all toxic and flammable gas lines and the controlled shut down of all equipment. In addition to this the negative pressure created by the extraction in each individual growth bay will ensure that all gases are exhausted to atmosphere via the dry chemisorption abatement systems. The production area is also protected by an automatic fire sprinkler system which is activated via heat sensitive head units. Drainage can be isolated in the event of an incident and drain seals are available on site to seal the surface water drains in the event of a fire to contain any fire water runoff. Firewater within process areas will be captured by drains which are served by an interceptor. All drains are colour coded to aid identification in the event of a fire. All hot works (if required) are controlled by means of a permit to work system. Smoking is not permitted in any internal area of the building. Designated smoking areas are provided external to the building, located to reduce the risk of fire.

Toxic Release -The potential for catastrophic cylinder failure or accidental valve damage resulting in a release to air is mitigated through the following measures: All cylinders are manufactured to international specifications. All cylinders are fitted with orifice flow restrictors which limit the maximum release rate following accidental valve sheer or damage. All toxic gases are carried in double contained pipework where required. All cylinders are changed by a minimum of two persons using Self Contained Breathing Apparatus. All employees have received training in correct cylinder handling procedures. All cylinders are leak checked upon arrival at site so that emergency actions can be taken to mitigate the effects of any detected leak. All cylinders are fitted with protective steel caps during transit and whilst in storage to prevent accidental damage to the cylinder valve. Cylinders are delivered to site in a secure transport cage to prevent a cylinder falling from the delivery vehicle during unloading operations. Cylinders are lifted from the vehicle bed using a fork lift truck and are immediately lowered to the minimum safe travelling distance above ground before being transported the storage bunker. All cylinders are secured whilst in storage. The air within the building and external storage areas is monitored 24/7 for the presence of hydride gases.

The detection system is connected to the general building monitoring system and the alarm panel which is monitored internally by site employees and externally by a remote alarm monitoring centre. All cylinder deliveries are received in line with documented safety procedures. All cylinder bank change operations are conducted in line with documented safety procedures. IQE uses a gas manifold system for the delivery of hydride gases to the growth bays. Hydride gas is fed to this manifold via two banks of cylinders. At any time only one bank of cylinders is “live” whilst the other is in “standby”. The use of the manifold system reduces the frequency of cylinder change operations thereby reducing the risk of accidental release during this activity. All cylinder connections are vented to the dry chemisorption abatement system prior to disconnection and tested under inert gas procedures. Hydride gas detectors are installed to identify chemisorption column breakthrough. Once new cylinders have been connected the delivery lines undergo a cycle of vacuum cycle checks to confirm the integrity of all connections prior to the cylinder valves being opened. IQE regularly audits cylinder bank change operations to confirm the adequacy of existing procedures and to ensure that the document procedure is adhered to. The main building is fitted with wet sprinkler systems to cool the cylinders in the event of a fire in a worst case event, the maximum volume of hydride which could be released would be limited to the contents of one cylinder. At no point in the system are cylinders directly interconnected. Indirect downstream connection is achieved through the manifold system. In the event of a release from any cylinder in the bank it is possible to isolate that cylinder. Arsine is delivered to site routinely depending on production output and demand. This delivery frequency will be as low as is reasonably practicable whilst keeping the site operational at all times. To the best of IQE and the Semi-Conductor Safety Associations knowledge there has not been a single documented case of catastrophic arsine cylinder failure in over 17 million handling operations worldwide. Bollards and curbing are in place around the external gas storage bunker to prevent collision. Site security system (entry or sabotage). Drivers/visitors to the site will be given health and safety inductions and instructions on safe routing. Sensitive plant and equipment will be located away from vehicle routes wherever practicable or protected by crash barriers and appropriate signage if considered to be at risk.

Arsine cylinders to be housed in ventilated cabinets in gas bunker. No more than two cylinders will be stored per cabinet. Each cylinder will have a control valve with integral vacuum and nitrogen purge which vents to an abatement system before disconnection. The arsine gas cabinets will include an emergency stop button and a key switch for each cylinder that actuates the respective cylinder shut-off valve. Within the dopant gas cabinets there are two valves to provide manual isolation of the line, and one automatic shutdown valve.

- Polluting Material Spillage - the potential for release of polluting materials resulting in a pollution to watercourses, land or groundwater is mitigated through the following measures: Concrete hardstanding is installed in operational and storage areas with sealed construction joints. There are minimal liquids stored on site and all potentially polluting liquids are provided with secondary containment at least 110% of the volume of the container. Incompatible materials are not stored together. Spillage containment and clean up measures are in place. Chemicals are stored in very small quantities in sealed containers within a dedicated storage area in the main manufacturing building. In the unlikely event of a spill outside of the containment area, spill kits will be used to clear the spill. runoff will be directed through an interceptor which can be isolated . The interceptor is subject to regular inspections and integrity checks and maintained in accordance with the manufacturer's instructions. Clean up procedures will be implemented to deal with fuel or other spillages or leaks of potentially polluting liquids. All staff will be trained in the procedures and correct use of equipment and sufficient spill kits will be maintained on site. Wastes generated by the clean-up process will be disposed of via authorised waste contractor. The building is surfaced with concrete hard standing with process drains directed to sewer. Drivers/visitors to the site will be given health and safety inductions and instructions on safe routing. Records will be available and kept up to date of all drainage structures including the routing of all drains.

In order to ensure that the management system proposed by the Operator sufficiently manages the residual risk of accidents, permit condition 1.1.1a requires the

implementation of a written management system which addresses the pollution risks associated with, amongst other things, accidents.

4.3.4 Site security

The site will benefit from a perimeter security fence and CCTV and have access control systems in place. Having considered the information submitted in the Application, we are satisfied that appropriate infrastructure and procedures will be in place prior to start up to ensure that the site remains secure.

4.3.5 Operating techniques

The operator will operate in accordance with the following technical guidance:

- How to comply with your Environmental Permit, National Resources Wales, Version 8, October 2014;
- How to comply with your Environmental Permit, Additional Guidance for the Inorganic Chemicals Sector (EPR 4.03), Natural Resources Wales, September 2014 ‘EPR 4.03’;

BAT Assessment

Abatement plant will be provided to prevent releases of arsine, tributylphosphine, trimethylgallium, trimethylindium, trimethylaluminium, carbon tetrabromide, hydrogen sulphide and disilane via emission points A1 and A2. The following options were identified as potentially applicable for abatement of emissions:

1. carbon based chemical absorption;
2. filtration
3. wet scrubbing;
4. chemical absorption (chemisorb scrubbing);
5. oxidation by combustion; and
6. combined burner washer.

The gases released are highly complex and contain materials which require specialist abatement technologies. Certain raw materials used in the process are pyrophoric and

may ignite on contact with air; consequently, there are limited options for abatement of potential emissions.

Chemical absorption, using dry granular media, converts the arsine, tributylphosphine, trimethylgallium, trimethylindium, trimethylaluminium, carbon tetrabromide, hydrogen sulphide and disilane in the process emissions into stable inorganic solids at room temperature (which will be removed by the abatement manufacturer for regeneration off-site) and produces no aqueous emissions. The system does not require heat to be applied to enable effective scrubbing of emissions. It is passive therefore it only traps the pollutants it is designed to abate increasing column lifetime and reducing waste. The disadvantage to this technique is that it uses raw materials (granular substance to absorb pollutants) and produces a solid material however as this is regenerated and re-used, raw material use and waste generation are minimised. Given the restrictions relating to safe handling of pyrophoric materials, it is concluded that chemical absorption represents the most suitable technology with the lowest environmental impact for the removal of arsine, tributylphosphine, trimethylgallium, trimethylindium, trimethylaluminium, carbon tetrabromide, hydrogen sulphide and disilane in the emissions released from the Installation.

The chemisorb scrubbers (LabLine, Primeline and CleanProtect systems) will be designed to reduce emissions of pollutants to the following performance guarantees replicated from the manufacture's website and as stated in the manufacturer's product specification:

- Arsine <50ppb
- Tertiarybutylphosphine <0.1ppm (PH_3)
- Trimethylgallium <3mg/m3 (Ga_2O_3)
- Trimethylindium <0.1mg/m3 (In)
- Trimethylaluminium <2mg/m3 (Al).
- Carbon tetrabromide <1ppm (HBr)
- Hydrogen sulphide <5ppm
- Disilane <5ppm

Actual levels are likely to be even lower, at non-detectable levels. The proposed Installation meets indicative BAT requirements for minimisation of emissions laid out in 'EPR S4.03'.

BAT for Water treatment

Options for water pre-treatment technologies were reviewed to determine the best methods for achieving the required feedwater specification. Reverse Osmosis was chosen as this removes dissolved minerals in water to very low levels by pushing water back through a membrane and retaining impurities. It requires high quality feed water. The effluent generated from RO reject water is low in toxicity. RO is preferred technology and can produce adequate purity water for feedwater. Membranes are not cleaned on-site therefore no effluent is generated at point of use.

BAT for fugitive emissions to air

There are extensive controls in place to prevent accidental release from storage of gases on-site. All storage vessels, will be subject to leak testing and have permanently installed leak detection equipment which is connected to alarms. Gases are stored within cabinets in dedicated bunkers or internally in the building close to the point of use within bays which have chemisorption units installed to prevent release of polluting materials. HAZOP and DSEAR studies will be carried out to identify and minimise risks to the environment and to human health

BAT for odour control.

A review of the impact of odour releases from the gases which will be used and stored has been undertake. It is considered unlikely that odour releases will cause an offsite nuisance arising. Materials are only used within the main process building and release is via 20.45m flue aiding dispersion. Abatement is installed to minimise release of potentially odorous gas. Release concentrations are well below odour thresholds. Arsine gases are stored within cabinets in dedicated bunkers which are provisioned with abatement and gas detection equipment.

BAT for fugitive emission to water

The main process areas will be surfaced with high quality reinforced concrete hardstanding with sealed construction joints sealed drainage systems. There will be no external areas where contaminated process water may enter surface water drainage systems, which are segregated from process water systems. No sumps (aside from the oil interceptor) or storage vessels (aside from gas storage) are included in the design. No subsurface pipework which will contain materials which present a significant risk to the environment aside from sealed drainage pipelines.
There are no bulk liquid containing tanks on-site aside from liquid nitrogen and fire suppressant water. All liquids are appropriately contained in secure storage areas within the main building.

We have reviewed the techniques used by the operator and compared these with the relevant guidance notes. We consider that the emission limits included in the permit reflect the BAT for the installation.

We have specified that the operator must operate the permit in accordance with descriptions in the application, including all additional information received as part of the determination process. These are specified in the Operating Techniques table in the permit.

4.3.6 Energy efficiency

The main energy intensive activities are the Aixtron G4 reactors which use gas and mains electricity and ancillary plant such as chillers and fans. A number of measures have been incorporated into the design of the facility to minimise energy use:

- heat recovery is installed on ventilation systems;
- heating and cooling plant is high efficiency;
- where process demands vary, for example the cooling circuits, pumps and fans will be of variable speed and can therefore react to process demands optimising energy use;
- energy efficient lighting has been installed; and
- all plant and equipment in the Installation will be subject to the Operator's preventative maintenance programme. This will ensure it is maintained to maximise operational efficiency.

The Operator has stated that any further opportunities were available, they would be incorporated now rather than included in an Energy Efficiency Plan. The Operator will regularly review energy use and if opportunities to reduce energy consumption are identified as a result of regular energy reviews, an Energy Efficiency Plan will be developed for the Installation.

We are satisfied that the Operator will ensure that energy is used as efficiently as possible. The Operator is required to report energy usage under condition 4.2 and Schedule 4.

Electricity and water use are required to be reported. This will enable Natural Resources Wales to monitor energy recovery efficiency at the Installation

4.3.7 Avoidance, recovery or disposal of wastes produced by the activities

This requirement addresses wastes produced at the facility.

There will be minimal waste generated at the facility which will comprise predominantly solid waste from air emissions abatement equipment, packaging waste, and maintenance fluids such as oils. Any wastes generated will be stored and disposed of to minimise environmental impact whilst adhering to the waste hierarchy. Chemisorption granulate will be re-used by the manufacturer for regeneration. Waste oils will be sent off site for recycling and general waste will be recycled wherever practical. The operator currently recycles >60% of its general waste at its other facilities.

Having considered the information submitted in the Application, we are satisfied that the waste hierarchy referred to in Article 4 of the WFD will be applied to the generation of waste and that any waste generated will be treated in accordance with this Article.

We are satisfied that waste from the Installation that cannot be recovered will be disposed of offsite using a method that minimises any impact on the environment. Permit condition 1.4.1 will ensure that this position is maintained.

5 Minimising the Installation's environmental impact

Regulated activities can present different types of risk to the environment, these include odour, noise and vibration; accidents, fugitive emissions to air and water; as

well as point source releases to air, water, sewer and discharges to ground or groundwater, global warming potential and generation of waste. All these factors are discussed in this and other sections of this document.

For an installation of this kind, the principal emissions are air emissions and emissions to surface or groundwater. The next sections of this document explain how we have approached the critical issue of assessing the likely impact of emissions from the Installation on human health and the environment and what measures we are requiring to ensure a high level of protection.

We have reviewed the operator's assessment of the environmental risk from the facility. The operator's risk assessment is satisfactory. The operator identified the sensitive receptors which may be affected by the facility as those in village of Duffryn which lies around 500m to the east of the Installation, Maes-Glas which lies 2km to the east and the smaller village of St Brides 2.5km to the south. There are a number of schools and community establishments in the Duffryn and Maes-Glas urban area close to the eastern boundary of the Installation. The closest human receptors are non-residential, adjacent to the site to the north and additional industrial units to the west of Celtic Way, some 50m from the Installation boundary. Further to the north, is the A48 around 350m from the site with additional office and industrial facilities on the northern side of the A48.
All European and International ecologically designated sites and nationally designated sites have been considered within 15 km of the Installation boundary, which is more conservative than NRW's recommended distance of 10 km. The operator has also considered national and local non-statutory local wildlife sites within 2 km. The site is located approximately 0.6km north of the Gwent Levels-St Brides Site of Special Scientific Interest (SSSI). The Severn Estuary is also designated as a Special Protection Area (SPA), Special Area of Conservation (SAC), Ramsar Site and SSSI and is located 3.5km south east of the site boundary.
We will discuss the operators risk assessment in more detail as follows:

5.1 Assessment of Impact on Air Quality

This section of the decision document deals primarily with the dispersion modelling of emissions to air from the stack and its impact on local air quality.

The Operator has assessed the Installation's potential emissions to air against the relevant air quality standards, and the potential impact upon human health. These assessments predict the potential effects on local air quality from the Installation's stack emission.

The air impact assessments, and the dispersion modelling has been based on the Installation operating continuously at the relevant long-term or short-term emission limit values, i.e. the maximum permitted emission rate.

We are in agreement with this approach. The assumptions underpinning the model have been checked and are reasonably precautionary. The way in which the Operator used dispersion models, its selection of input data, use of background data and the assumptions it made have been reviewed by Natural Resources Wales modelling specialists to establish the robustness of the Operator's air impact assessment. The output from the model has then been used to inform further assessment of health impacts.

The Newport Semiconductor Facility is located within the Imperial Park commercial and business park, approximately three kilometres to the south west of Newport . It is accessed via Celtic Way from the junction with the A48 to the north west. It is surrounded by industrial and commercial buildings. The nearest residential properties are on Pencarn Avenue, over 375 metres to the north east of the proposed ventilation stack. The Celtic Springs Guest House is a similar distance to the north north west, and a children's nursery is over 550 metres to the north west near the Holiday Inn, between the A48 and the M4 motorway. There are nearby local wildlife sites at Celtic Springs to the north west, the LG Duffryn sites 1 and 2 on South Lake Drive to the south of the IQE building and the Duffryn Pond to the east, close to the superstore and residential areas of Duffryn.

The pollutant under consideration in the detailed study is the gaseous hydride arsine, which is potentially harmful to human health. Arsine is not associated with hazards to either habitats or ecological resources, hence sites of ecological importance are not

assessed further. Air quality criteria for arsine for the protection of human health are found in Environment Agency online risk assessment guidance and are presented in Table 1. These are non- statutory Environmental Assessment Levels (EALs) and if exceeded, an operator may need to take further action to reduce the impact on the environment (e.g. cost benefit analysis or installation of abatement plant).

Table 1

Pollutant	Annual EAL (µg/m^3)	Hourly EAL (µg/m^3)
Arsine, (AsH_3)	1.6	48

This initial phase entails a total of five G4 production tools, which will discharge to atmosphere via a single ventilation stack (emission point A1). The stack discharges are a source of residual trace emissions of arsine, which will be abated prior to discharge using a dry scrubber. Robust assumptions were made regarding the operation of these batch process tools, in that all were assumed to be operating continuously and concurrently for the short-term assessment. Furthermore, no allowance was made in the assessment of the long-term emissions for the proportion of operational hours during the year, hence the results are overestimated to some degree.

Despite these conservative assumptions, the effects of the residual emissions from the emission point on human health at nearby receptors are shown to be insignificant, as the maximum hourly average and the long-term average concentrations of arsine are extremely small fractions of the relevant EALs for this pollutant.

5.2 Assessment of impact to surface and ground water

There will be an emission to surface water from the general collection of rainwater within the service yard area and will be discharged to the main surface water drainage system served by an oil interceptor at emission point W1. This discharge comprises only clean, uncontaminated surface water only. All process activities will be carried out within the building and the entire site will have impermeable surfaces and sealed drainage system as described in section 4.2.2.

This will ensure that there will be no release to groundwater. Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent pollution of ground and surface water.

5.3 Emissions to sewer

Process effluent is discharged to sewer via emission point S1. This comprises reverse osmosis concentrate and softener regeneration, which is a low toxicity effluent stream. The constituents will be limited to dissolved minerals such as calcium and trace contaminants and will be approximately four times the concentration of the levels present in mains water. Reverse Osmosis reject discharged to sewer will be approximately 1.3m^3 per day. Softener regeneration effluent will also be released intermittently in low volumes. Pre-treatment effluent has not been assessed due to the low potential for pollution of the effluent and low quantities released to sewer.

5.4 Fugitive emissions

Fugitive releases are prevented by robust storage systems and installation of gas detection equipment. The gas storage bunker extract will be fitted with abatement equipment as it will house arsine gas and other processes materials. There is no bulk storage of liquids on-site aside from liquid nitrogen and fire suppressant water. Release of fugitive emissions to land and water will be prevented through appropriate infrastructure and management controls as discussed in section 4.3.3 Accident management and 4.3.4 Operating techniques. A qualitative assessment has been carried out on foreseeable releases of fugitive emissions which concludes that the risk to the environment is low in all scenarios considered. Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent or where that is not practicable to minimise fugitive emissions and to prevent pollution from fugitive emissions.

5.5 Assessment of odour impact

It is considered unlikely that offsite nuisance due to odour will occur due to the low release levels of potentially odorous materials. Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent or where not practicable to minimise the effects of odour .

5.6 Noise Assessment

Operations on-site include minimal external noise sources as most plant and equipment is contained within the main process building. Externally, there are chillers and fans. Noise emissions have been calculated and the results and conclusions were presented in the Noise Assessment submitted with the permit application. The report concluded that emissions of noise from the Installation predicted to be negligible:

'The potential noise impacts from operation of external roof mounted chillers and a fan unit at IQE Newport have been assessed. Noise levels from plant were corrected to the nearest noise sensitive receptor locations, including BS4142 penalties, and compared to estimated background noise levels for the area. The background noise levels used were measured during the night-time period to ascertain a representative lowest background noise level.

The distances between the proposed plant and the receptor locations have been measured, and the reduction of noise over this distance is also shown, assuming 50% transmission over acoustically hard ground (such as concrete) and 50% transmission over acoustically soft ground (such as grassland), and a worst case assessment of no acoustic screening has been carried out. Plant noise levels, including penalties for intermittency and potential tonality, are predicted to lead to negligible impacts at all NSRs. Impacts at NSRS are also expected to be negligible during the day.'

Basic good practice measures for the control of noise will be employed throughout the Installation, including planned maintenance of any plant or equipment whose deterioration may give rise to increases in noise. The layout of the site has been designed in such a way that activities will be screened from nearby noise sensitive receptors wherever possible. Plant equipment will be selected with noise minimisation as a priority and guarantees will be required from all manufacturers to meet specific maximum noise levels. All plant which is potentially noise-generating will be included on a comprehensive maintenance programme which will minimise the potential for equipment to develop faults which may lead to an adverse noise impact.

Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent or where that is not practicable to minimise the effects of noise.

5.7 Global warming potential

This section summarises the assessment of greenhouse gas impacts which has been made in the determination of this Permit. Emissions of carbon dioxide (CO_2) and other greenhouse gases differ from those of other pollutants in that, except at gross levels, they have no localised environmental impact. Their impact is at a global level and in terms of climate change.

Global Warming Potential (GWP100) emissions as carbon dioxide equivalents (CO_2e) are estimated for the proposed facility in accordance with the Environment Agency guidance "Assess the impact of air emissions on global warming". The assessment uses the H1 screening tool, developed to support the Environment Agency Risk Assessment methodology. The global warming potential (GWP) of the facility has been calculated as 16,320 which is derived from indirect carbon dioxide emissions from the estimated electricity consumption of the Aixtron G4 reactors. This is based on the facility operating five Aixtron G4 reactors for 8760 hours per year

5.8 Impact on Habitats sites, SSSIs, non-statutory conservation sites etc

European Sites

Habitats Regulations Assessment (HRA) is not required because there is no conceivable impact pathway to any Natura 2000/Ramsar site because the emissions released are not environmentally damaging. Subsequently no assessment has been required for SSSI's and Non Statutory Sites.

6 Setting ELVs and other Permit conditions

We have decided that emission limits should be set for the parameters listed in the permit. These emission limits have been set so that monitoring should be carried out during the commissioning of the plant in order to verify modelling assumptions.

6.1 Translating BAT into Permit conditions

Article 14(3) of IED states that BAT conclusions shall be the reference for permit conditions. Article 15(3) further requires that under normal operating conditions; emissions do not exceed the emission levels associated with the best available techniques as laid down in the decisions on BAT conclusions.

The emission limits described in the air dispersion modelling sets the worst case scenario. If this shows the emissions from the site are low and that they will not cause a breach of air quality objectives in the area then we are satisfied that the emissions from the site will not adversely impact the surrounding environment or the health of the local community.

As detailed in section 5.1, the environmental impact of the installation has been assessed as insignificant. We accept that the operator's proposals are indicative BAT.

6.2 Reporting

We have specified the reporting requirements in Schedule 4 of the Permit to ensure data is reported to enable timely review by Natural Resources Wales to ensure compliance with permit conditions and to monitor the efficiency of material use and waste recovery at the installation.

OPRA

The agreed OPRA score at the installation is 32. This will form the basis for ongoing subsistence fee's.

ANNEX 1: Improvement Conditions

We have requested that the following improvement conditions be complied with

- Appropriate management systems and management structures are in place and that sufficient financial, technical and manpower resources are available to the operator to ensure compliance with all the permit conditions.
- The appropriate measures are in place for the closure and decommissioning of the facility.

ANNEX 2: Consultation Reponses

A) Advertising and Consultation on the Application

The Application has been advertised and consulted upon in accordance with Natural Resources Wales Public Participation Statement. The way in which this has been carried out along with the results of our consultation and how we have taken consultation responses into account in reaching our draft decision is summarised in this Annex. Copies of all consultation responses have been placed on Natural Resources Wales public register.

1) Consultation Responses from Statutory and Non-Statutory Bodies

Response Received from Aneurin Bevan University Health board	
Brief summary of issues raised:	**Summary of action taken / how this has been covered**
Recommended that monitoring be undertaken during commissioning for the full inventory of chemicals to fully inform the risk assessment. Noted that modelling of fugitive arsine release has not been modelled. Suggested that the regulator reviews this with the operator	One off programme of monitoring included in permit Modelling for fugitive releases is not practical. A numerical limit for the release is required to enable modelling with any certainty. The operator has indicated that they are likely to upscale operations in the near future and would carry out further modelling as required under COMAH.

Published by:
Natural Resources Wales
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