Permitting Decisions- Variation

We have decided to grant the variation for Less Common Metals Limited operated by Less Common Metals Limited.

The variation number is EPR/RP3233CZ/V006.

This variation permits a new process – the conversion of rare earth metal oxides (principally neodymium oxide and neodymium praseodymium oxide) into rare earth metal fluorides (principally neodymium fluoride and neodymium praseodymium fluoride) using a reaction with hydrogen fluoride (HF) within a fluidised bed reactor by a batch process ('the fluoride plant'). The production capacity of the fluoride plant is 12 tonnes per annum.

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 provides a record of the decision-making process. 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

We have reviewed the measures proposed by the operator and compared them against the indicative BAT set out in our sector guidance note EPR 4.03 How to comply with your environmental permit, additional guidance for: the inorganic chemicals sector. A summary of the key operating techniques is provided below. We are satisfied that these measures represent BAT for the installation.

Fluoride plant process overview

Argon passes through a heat exchanger and is used to heat up a fluidised bed reactor during the start-up phase. HF is heated and pressurised in an evaporator to a saturated vapour. Once the flow rate of the two gases is set, they are mixed in the mixing box. The gas mixture then flows via nozzles into the reactor, which contains rare earth oxide raw material. The powder is fluidized and the reaction begins.

The temperature of the reaction is controlled via the HF: argon ratio, the temperature of the argon itself and by electrical trace heaters surrounding the reactor. The fluidised bed reactor can be vibrated if necessary to improve the fluidisation of certain rare earth powders.

The reaction occurs with an excess of HF compared to the stoichiometric value. The products of the reaction are the desired rare earth fluoride powder and water. Reacted rare earth fluoride powder remains in the reactor while the water vapour leaves the reactor in the flue gas, together with argon and unreacted excess HF.

The flue gas flows through two condensers to remove HF and water. HF is recirculated back into the process. The remaining flue gas flows initially though an in-situ wet scrubber, as well as the site's existing on-site wet scrubber (which discharges to air at the existing emission point A5) to remove HF.

Argon is used to purge and cool the system down after the batch process is complete.

The plant is continuously monitored and controlled by PLC (programmable logic controller) to maintain the process within design parameters, e.g. pressure and temperature. If these parameters are exceeded safeguards are in place such as a pressure relief valve in the reactor, alarms/warnings and automatic safe shut down.

The design of the new plant (both the fluidised bed reactor and the HF storage facility) has been managed through the existing site quality, health, safety and environmental procedures. This consists of two elements: the HAZOP study and the evaluation of environmental aspects and impacts.

Storage and handling of raw materials, products, and wastes

<u>Storage of HF</u>

Two 820 litre cylinders of anhydrous HF will be stored inside a carbon steel enclosure inside a purpose-built annex building, which is located within the currently permitted installation boundary.

On arrival at the site, the cylinders will be unloaded in a designated area on flat ground, which is safely accessible for road vehicles but separate from normal traffic on site and away from personnel and other equipment. Trained personnel follow written procedures for unloading and connecting/disconnecting the cylinders, which includes an automated purging procedure that takes about 80 minutes to complete and ensures there is no HF in the hoses during changeover.

The storage and transfer of HF into the reactor is automatically controlled. Information is continuously updated and displayed on the storage facility as well as remotely in the site control room.

Secondary containment is provided via bunding under the HF storage facility in case of liquid HF leaks. The bunding is constructed of 2mm carbon steel with a HF resistant polypropylene lining; the capacity is $5.2m^3$. In the event of gaseous leaks, air is continuously extracted from inside the enclosure (14 exchanges per minute) to the existing main site scrubber. There is also an air extraction system in the annex building and water curtains in the case of HF leaks. Concrete bunding around the annex (40,000 litres capacity), is present to capture water from water curtains, which is then directed to the existing scrubber system for neutralisation.

Raw material rare earth metal oxides will be stored, along with all other raw materials used within existing processes, within the confines of the factory, under cover and within sealed, labelled containers on dedicated racking in the raw material storage area.

The finished rare earth metal fluoride products will be used as a raw material for the existing electrolysis process on site which manufactures neodymium metal. The rare earth metal fluorides have health hazard classifications for skin, eye and respiratory irritation and their use is controlled by existing COSHH risk assessments. The products are stored in sealed containers, under cover within the factory buildings, prior to use in the process.

<u>Wastes</u>

No solid waste is produced from the process. Any dust generated during the reaction is captured by a cyclone and returned into the plant; any excess, unreacted oxide is reused within the process.

Waste potassium hydroxide solution produced from the operation of the wet scrubbers is consigned off-site as hazardous waste.

Point source emissions to air, land and water

Two condensers, located after the reactor, remove both HF and water from the flue gases; HF is recycled back into the process. After the condensers, an ‘in-situ’ scrubber pre-treats the flue gases from the condensers prior to its release via the site’s existing scrubber. Potassium hydroxide is used to remove HF in the flue gases in both the in-situ scrubber and the existing site scrubber.

The in-situ scrubber incorporates an HF detector at the outlet. If the pre-treated flue gases exiting the in-situ scrubber are of concentrations higher than 0.5 mg/m^3 (equivalent to the existing HF emission limit value (ELV) at the site's existing main site wet scrubber, emission point A5) the flue gases are recirculated back into the in-situ scrubber. The recirculation will continue until the concentration of HF in the flue gases exiting the in-situ scrubber is less than 0.5 mg/m^3, at which point the flue gases (predominantly argon) are then either recirculated back into process or vented to the main site scrubber to remove any remaining low levels of HF.

During normal operation the concentration of HF in the flue gas stream from the in situ scrubber to the main site scrubber will be less than the permitted HF ELV at emission point A5.

It is our view that the inclusion of the condensers, the in-situ wet scrubber and cyclone as pre-treatment before discharge via the existing site wet scrubber means the potential for increased risks from point source emissions to air from the new process is unlikely.

The main site scrubber acts a back up to the in situ scrubber and is part of the emergency generator system, so in the event of a power failure the main site scrubber will continue to operate. Prior to the start of each batch, the site scrubber is checked to confirm normal operating condition. If not, the fluoride plant will not be operated. If the site scrubber was disabled due to an unforeseen circumstance, the fluoride plant would be shut down (if it was running) and put into a safe state. HF storage would be put into a safe state by closing all relevant valves. All would remain in a safe state until the main site scrubber was operational again.

There are no emissions to water or land from the new process.

Monitoring

HF emissions from the process will ultimately be discharged through the existing main site wet scrubber on site (emission point A5). The operator undertakes annual monitoring and reporting of HF emissions, against an ELV of 0.5 mg/m^3, from point A5 in accordance with Table S3.1 of the existing permit. This is retained in Table S3.1 of the variation notice. There are no other aerial emissions from the process.

Fugitive emissions

The fluoride plant is housed within a leak-proof container, fitted with an HF detector. If HF potentially arising from leaks within the process is detected the process is automatically shut-down and the air within the container is extracted for treatment to remove HF via the in-situ scrubber/existing site scrubber.

The reactor will not be open to the atmosphere at any time. After a batch completes, HF valves are closed and the whole plant is purged with argon to clear all HF present and reduce the reactor temperature. The automatic valve will only reopen once the HF detector downstream of the reactor confirms there no HF present and the reactor temperature is less than 40 °C. The product is discharged from the bottom of the reactor via a flexible vacuum/cyclone system into stainless-steel drums. The outlet from the vacuum is connected to the main site scrubber.

HF can react with certain metals to produce hydrogen gas which could cause explosion or fire in the presence of an ignition source. The plant has been designed and constructed with suitable materials and ATEX rated components to operate safely in an HF environment, in accordance with relevant guidance (*Recommendation on materials of construction for anhydrous hydrogen fluoride (AHF) and hydrofluoric acid solutions (HF), Eurofluor Group 4, July 2018*).

Materials for each component (either carbon steel, Monel or Inconel) have been chosen according to temperature, pressure, and concentration of HF/ water vapour in each part of the plant, ensuring corrosion is limited as much as possible in pipes, equipment, valves, and seals. There will be a high frequency of comprehensive inspections/checks during commissioning, before moving to a longer-term regular maintenance schedule. The first stage after commissioning will be a full visual inspection of the plant after every run. Physical testing of reactor wall thickness will be completed after the first three runs. If there is no significant degradation, the next testing will be after 10 runs. The frequency going forward will be based on these measurements but will be no less frequently than once per year. Physical testing of the evaporator, mixing box and a sample of the HF pipework will be undertaken at least once per year (but could be more frequent depending on the results from the reactor). This is a research and development plant for the operator and inspection and maintenance procedures will be refined as they learn more about the operation of the plant during commissioning. Plant integrity is pressure tested using argon prior to each run. Critical spares are held on site and are available for replacement if needed, at all times.

All HF detectors in the system are electro-chemical probes that do not need to be re-calibrated during their lifetime. They will be replaced every 18 months as per the manufacturer's recommendation.

The operator has assessed a set of "most likely emergency scenarios", which will be used to set actions to limit effects, including external leaks of HF. Ahead of the first hot commissioning run the operator will define an emergency team and involve the emergency services (police, fire, ambulance) in emergency planning. There will be at least one practice emergency per year. Operational and emergency training for operators and management will be reviewed/refreshed on an annual basis to ensure continued competency.

Resource Efficiency

The site is operated in accordance with an Environmental Management System (EMS) that is ISO14001 certified. The EMS includes procedures for environmental performance objectives, including waste minimisation and energy efficiency, which are set annually and monitored and reviewed six-monthly by senior management. The EMS will be updated as a consequence of this variation, including such aspects as a written works instruction for the new plant, monitoring of HF, process risk assessments, accident management and staff training.

The operator describes the optimisation of plant design and energy and resource efficiency in the following ways:

- The fluidisation technology utilised in the reactor provides a high heat transfer due to the effective mixing of particles and gas. Heat transfer in a fluidised bed reactor is approximately 5-10 times higher than a conventional packed bed reactor, and energy consumption can thereby be reduced up to 50%.
- The mixing box mechanism saves energy by removing the need for a high-capacity evaporator to heat HF to the required high operating temperatures. The mixing box utilises heat transfer between high temperature argon and low temperature HF.
- The reactor, evaporator, and pipes that convey the hot gases to the reactor are insulated.
- Water use in the process is minimal. The cooling/heat exchange system uses recirculated water and glycol. Water is not used for cleaning – the plant is purged between batches using argon.
- The high cost of raw materials drives a process design with an approximate conversion rate of 99% into product (rare earth oxides to rare earth fluorides) with no waste. Any particulate matter in the reactor flue gas is captured by a cyclone and returned to the reactor. Any excess unreacted oxide is reused within the process.
- The process operates with an excess of HF with argon. These are recirculated to optimise their use. HF is required to be replenished during the process.

Odour and noise/vibration

The operator has provided an assessment of odour and noise/vibration risk in accordance with our web guidance, ‘Risk assessments for your environmental permit’. The overall risks with respect to odour and noise/vibration are assessed to be low. The closest sensitive receptor is located approximately 850m to the southwest of the site, which is surrounded on three sides by existing industrial units and to the north lies the Manchester ship canal and the river Mersey.

The reactor is fully enclosed within a purpose-built building adjacent to the main factory and the operator does not anticipate any increased noise or vibration levels beyond the installation boundary.

The new activity does not involve substances that have the potential to create odour. HF is an odourless gas and there are no volatile organic compounds present.

Based on the measures put in place for the new plant, we anticipate the changes in risk will not be significant. Consequently we have not required a noise or odour management plan as part of this determination. However, we have retained our standard noise and odour conditions in the variation notice, which allows us to ask for a noise or odour management plan if we become aware of noise or odour-related problems on site.

Decision considerations

Confidential information

A claim for commercial or industrial confidentiality has not been made.

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

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.

The application was publicised on the GOV.UK website.

We consulted the following organisations:

Health and Safety Executive

Local Authority – Environmental Health

Director of Public Health

Public Health England (PHE)

No responses were received, except from PHE who confirmed that, assuming the permit holder will take all appropriate measures to prevent or control pollution, in accordance with the relevant sector guidance and industry best practice, they had no significant concerns regarding the risk to the health of the local population from the installation.

The regulated facility

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

The extent of the facility is defined in the site plan and in the permit. The activities are defined in table S1.1 of the permit.

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.

We have assessed the application and its potential 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.

We have not consulted Natural England.

The decision was taken in accordance with our guidance.

Environmental risk

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

The operator's risk assessment is satisfactory.

Operating techniques

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.

Updating permit conditions during consolidation

We have updated permit conditions to those in the current generic permit template as part of permit consolidation. The conditions will provide the same level of protection as those in the previous permit.

Emission limits

No emission limits have been added, amended or deleted as a result of this variation. The recirculation of the reactor flue gases through the in situ scrubber as described in the key issues section above will ensure that the concentration of HF in the stream from the fluoride plant to the main site scrubber is lower than the existing permitted ELV for HF at the existing emission point A5.

Monitoring

Monitoring has not changed as a result of this variation.

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.

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.