JOHNSON MATTHEY PLC

EPR Application for a Normal Variation to Permit No. BT7086IJ/V015

Section A: PTZ Procat

Section B: Admin Changes

Environment Agency Reference Numbers

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APPENDICES

GLOSSARY

ALARP	As Low As Reasonably Practicable
AQO	Air Quality Objective
BAT	Best Available Technique
BREF	BAT Reference
CHP	Combined Heat and Power
DCE	Dust Collection Extractor
EA	Environment Agency
EAL	Environmental Assessment Level
HAZOP	Hazard and Operability Study
HEPA	High Efficiency Particulate Arrestance
IED	Industrial Emissions Directive
JM	Johnson Matthey
KPI	Key Performance Indicator
MCERTS	(Environment Agency) Monitoring Certification Scheme
OEL	Occupational Exposure Limit
PGM	Platinum Group Metals
PLC	Programmable Logic Controller
PM	Precious Metal
POCP	Photochemical Ozone Creating Potential
PPM	Planned Preventative Maintenance
PTZ	Platinum Zeolite
R&CE	Refining and Chemicals Europe
SCADA	Supervisory Control and Data Acquisition
SETP	Site Effluent Treatment Plant
SSSI	Site of Special Scientific Interest
STW	Sewerage Treatment Works

WEL	Workplace Exposure Limit

SECTION A: PTZ VARIATION

NON-TECHNICAL SUMMARY

PTZ is a new process which will be located in the existing Procat 1 building. The plant will produce platinum on zeolite support using processing techniques which are similar to existing processes undertaken in Procat 1 and elsewhere on site.

These products will be used in the manufacture of light duty diesel vehicle auto catalyst technologies elsewhere onsite. The key benefit of PTZ will be that it reduces vehicle N_2O emissions and removes NH3 emissions in the ammonia slip catalyst. The overall system has an increased conversion of exhaust gas to nitrogen and water.

The air emissions from the new process will be controlled with existing abatement system including caustic scrubbing and bag plant filtration, these are designed to reduce the emissions to below the emission limit values stated within EA guidance.

The main process emissions will feed into the existing Procat stack A11. During drying and calcination steps the process will emit oxides of nitrogen (NO_x), which stack A11 is already authorised to release, Nitric acid (HNO3) which is completely removed in the abatement plant, and nitrous oxide (N_2O), which stack A11 is not currently authorised to release.

A new dispersion model has been commissioned to model the impact of emissions from the Royston installation, including the predicted NO_x and N_2O emissions associated with this process. The dispersion model show that emissions of NOx are within Long and short term AQOs and the process emissions of N_2O are not significant when compared to derived targets for both long and short term emissions scenarios.

Previous stack monitoring of similar existing permitted processes (PtS5 trial work) shows that virtually all the nitric acid will be removed from stack emissions, post scrubbing.

During commissioning of the first PTZ campaign JM will undertake stack emission monitoring by a third party MCERTS authorised contractor to verify the nitric acid (HNO_3), oxides of nitrogen (NO_x) and nitrous oxide (N_2O) emission concentrations from the new process comply with the those specified in this application.

Once the commissioning of the first PTZ campaign is complete JM will write to EA to report the results of the emissions monitoring and to confirm that the new process demonstrates compliance to BAT.

There are no direct liquid emissions from this process and no changes to Procat 1 liquid emissions as an indirect result of this process

The PTZ process will be controlled as a process within Procat 1 under the Refining & Chemicals Europe (R&CE) Royston Site Environmental Management System (ISO14001 accredited).

1 INTRODUCTION

This application is being made under the Environmental Permitting Regulations 2016 to operate Platinum on Zeolite (PTZ) process.

The new plant will be located inside the existing Procat 1 building (See map in Appendix 3).

1.1 SUMMARY DESCRIPTION OF ACTIVITIES

The activity from Schedule 1 of the environmental permit BT7086IJ/V014 affected by this variation is:

Activity listed in Schedule 1 of the EP Regulations	Description of specified activity and WFD Annex I and II operations	Limits of specified activity
S4.2 A1 (c)[1]	Carried out in the manufacture of coatings for the autocatalyst (Fastcat) and catalytic soot filter (CSF) manufacture within the ECT business unit. Also for the manufacture of high purity inorganic chemicals mainly for laboratory use within the FCDP[2] production unit. Also carried out in the manufacturing of other materials (Zeocat) in Chemicals, Catalysts and Refining (CCR) business unit.	From receipt of raw materials to despatch/use of finished product incorporating activities in Table S1.1.

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[1] This proposal appears to be an addition of a new Part A1 activity to the site, A4.2 A1 (c), however this is not the case due to an admin error in the existing permit. Instead it is an addition to an existing Part A1 activity. Please refer to section 2, admin changes of this Permit for further details.

[2] FCDP typo corrected. Please refer to section, admin changes of this Permit for further details.

The process will involve simple impregnation of platinum onto an inert carrier using similar technology to that already used in Procat 1, which represents no change to existing permitted activities. Following the impregnation step a drying and calcination step will reduce and fix the platinum onto the inert carrier. The drying and calcination step will emit nitric acid, oxides of nitrogen (NO_x) and nitrous oxide (N_2O) via existing wet scrubbing tower and existing stack A11. JM has authorisation to emit NO_x from stack A11 and authorisation to emit N_2O is sought as a part of this application.

As with existing processes within the Procat 1 building, the emission of nitric acid is negligible due to the low volatility of nitric acid and will be entirely removed from the process draught by the existing stack A11 scrubbing system and demister.

This plant will provide a model for a similar larger scale plant to be built at the Royston site, in late 2020.

2 MANAGEMENT TECHNIQUES

2.1 ENVIRONMENTAL PERFORMANCE INDICATORS

Procat 1 Environmental performance is monitored, benchmarked and regularly reviewed.

The PTZ process will contribute to the annual KPI data in line with the current KPIs for the EPR permit for Procat which include:

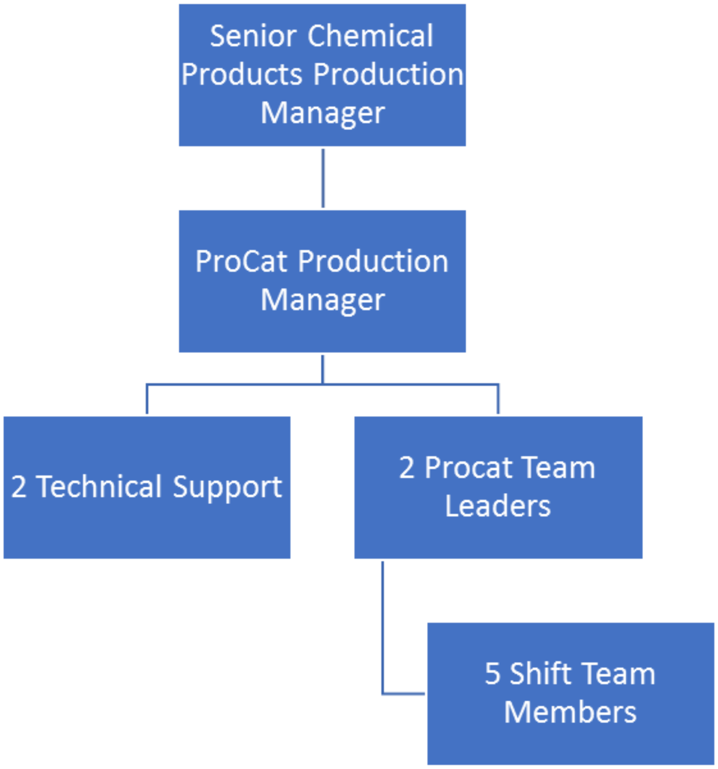
- Units of Production (UoP).
- Energy / UoP.
- Reverts to refining as % metal input
- PGMs to Effluent as % metal input

All environmental improvement plans are incorporated into departmental improvement plans which are followed, monitored, updated and progress reported to senior management at regular EHS management reviews. Departmental improvement plans are reviewed annually, and new targets may be added.

Refining and Chemicals, Europe (R&CE) Business Unit operate management systems accredited to the International Standards of ISO 14001 (Environmental Management Systems, certification held since 1998). R&CE Business Unit is also covered by ISO9001 (Business Management System, certification held since 1995) and OHSAS 18001 (Occupational Health and Safety Management Systems, certification held since 2007). These systems will be extended to cover the operation of the new plant from start-up. New, documented procedures will be introduced with full training provided for operators.

2.2 MANAGEMENT ORGANOGRAM

The Procat is routinely be manned by 4 shift operators including the duty team leader. Responsibilities within the department operating this plant are outlined in the following organogram:



2.3 MANAGEMENT SYSTEMS

The Refining & Chemicals Europe (R&CE) Business Unit, of which the PGMR department is a part, operate management systems accredited to the International Standards of ISO 14001 (Environmental Management Systems, certification held since 1998). R&CE Business Unit is also covered by ISO 9001 (Business Management System, certification held since 1995) and BS OHSAS 18001 (Occupational Health and Safety Management Systems, certification held since 2007). These systems will be extended to cover the operation of the new PTZ plant from start-up. New documented procedures will be introduced with full training provided for operators.

2.4 ACCIDENT MANAGEMENT

The PtZ process design has been assessed using hazard study (HAZOP) methodology in line with BAT and the Johnson Matthey Group EHS Risk Matrix. A copy of the JM risk matrix is shown in appendix 9. Risks are assessed after controls and mitigation to ensure residual risks are tolerable or as low as reasonably practicable (ALARP).

Table 1: ***Environmental Risk Assessment***

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
Accidental	Transfer of Substances – Zeolite Delivery (Broken Bags)	Soil	Soil	Zeolite is an inert carrier medium and poses a low environmental risk. All raw materials used in PTZ process are on existing Royston Installation EPR raw materials list for Procat 1 building. Raw materials MSDS copies are in Appendix 9.	C	0	0C	Tolerable – In the event of spillage. Normal site spillage procedures would be invoked.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
Accidental	Transfer of Substances – Zeolite charging to impregnator vessel	Air	Fugitive dust via extractors or doorways	Zeolite is an inert carrier medium and poses a low environmental risk – Reagents MSDS included in Appendix 9. Appropriate Personal Protection is required during clean up. Mobile extraction unit	C	0	0C	Tolerable – Loss of material is unlikely due to design of transfer mechanism, extraction, HEPA filtration and control systems
Accidental	Overfilling of Platinum Nitrate solution into transport container (in Fine Chem)	Groundwater / Soil	Via soil to groundwater	Dispensing of solution will take place in a fume cupboard within a bunded area inside the dispensing building, and the quantities are very small<10L). Local spillage kit available. Staff trained in use of spillage kit.	E	1	1E	Low.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
Accidental	Overfilling of Platinum Nitrate solution into transport container (in Fine Chem)	Sewer	Via surface water	Controls as listed above. Additionally, all effluent gulleys within Fine chem dispensing area root to the onsite Trade effluent treatment plant, via trade effluent drains, for processing in onsite trade effluent treatment plant prior to discharge to sewer. Routine spot and composite testing of trade effluent discharges are undertaken in SETP to ensure compliance to trade effluent discharge consent.	F	1	1F	Low.
Accidental	Transport of Substances – Platinum Nitrate solution from Fine Chem to	Soil and Groundwater	Via Soil and Groundwater	Transfer quantities will be small (<10 litres per unit/batch). Appropriate sealed containers used. Transfer distance is small. Roadways are tarmac or concrete, no unmade ground is present in	D	1	1D	Low. Platinum Nitrate is produced on site and moved in small quantities a short distance to the Procat plant in sealed containers. The site has

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
	ProCat plant			vicinity of transit solution route. Local spillage kits available. Staff trained in use of spillage kits.				tertiary containment surface water drainage system, an onsite effluent treatment plant and measures trade effluent discharges for any precious metals.
Accidental	Transport of Substances – Platinum Nitrate solution from Fine Chem to ProCat plant	Sewer	Via Surface water	Controls as listed above. Additionally, all surface water drains route to the Site Effluent Treatment Plant (SETP) for treatment prior to discharge to sewer.	D	1	1D	Low. Tertiary containment and SETP to safeguard against abnormal emission to sewer.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
Accidental	Transfer of Substances – Platinum Nitrate solution from transport container to flask in ProCat plant	Groundwater / Soil	Via soil to groundwater	Transfer will take place under vacuum in a bunded area inside the building and the quantities are small (<10 litres). Also, the Pt nitrate system is bunded at 110L (the skid) Local spillage kit available. Staff trained in use of spillage kit.	E	1	1E	Low. Secondary and tertiary containment systems
Accidental	Transfer of Substances – Platinum Nitrate solution from transport container to flask in ProCat plant	Sewer	Via surface water	Controls listed as above. Additionally, all transfer routes from dispensing to Procat 1 have fully made ground, no soakaways, and all surface water drains route to the Site Trade Effluent treatment plant for further treatment and testing prior to discharge offsite.	F	1	1F	Low. Tertiary containment and onsite trade effluent treatment plant.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
Accidental	Overfilling of dilution vessel with Platinum nitrate solution.	Groundwater / Soil	Via soil to groundwater	Transfer will take place in a bunded area inside the building and the quantities are very small (<10 litres) in relation to receipt vessel size (>100 litres). The skid is also bunded at 110L Local spillage kit available. Staff trained in use of spillage kit.	E	1	1E	Low – Transfer under vacuum, volume of Pt nitrate small in comparison to flask capacity.
Accidental	Overfilling of dilution vessel with Platinum nitrate solution.	Sewer	Via surface water	Controls listed as above. Additionally, all transfer routes from dispensing to Procat 1 have fully made ground, no soakaways, and all surface water drains route to the Site Trade Effluent treatment plant for further treatment and testing prior to discharge offsite.	F	1	1F	Low. Tertiary containment and onsite trade effluent treatment plant.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
Accidental	Overfilling of dilution vessel with dilution water.	Groundwater / Soil	Via soil to groundwater	Transfer will take place in a bunded area inside the building on a bunded skid. Water will be weighed out, in advance, before transfer. There will be a visible mark on the vessel to indicate the correct volume – the vessel is glass and located on ground floor (so it is easy to see the contents and level) Small catch-pot on vacuum flask and down-steam use of existing catch-pot with level control Local spillage kit available. Staff trained in use of spillage kit.	E	1	1E	Low –within secondary containment area.
Accidental	Overfilling of dilution	Sewer	Via surface water	Controls listed as above. Additionally, all effluents in Procat	F	1	1F	Low – Secondary and tertiary containment. On

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
	vessel with dilution water.		drainage system	1 wet area routed to Procat effluent treatment tanks for internal treatment with analytical testing prior to discharge to onsite Trade Effluent plant for further treatment.				site effluent treatment plant.
Accidental	Overfilling of impregnator with dilute Platinum Nitrate solution	Groundwater / Soil	Via soil to groundwater	Controls in place to get correct volume of dilute solution. Plant design: dilution vessel size is approximately half the capacity of the impregnator capacity. Piped outlet from dilution vessel to impregnator. Demin water to dilution vessel via spray ball which is manually controlled with a momentary action, normally closed, spring-loaded valve.	F	1	1F	Low – As impregnator volume is approximately. twice that of the dilution flask, overfilling is most unlikely.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
Accidental	Overfilling of impregnator with dilute Platinum Nitrate solution	Sewer	Via surface water drainage system	Controls listed as above. Additionally, all effluents in Procat 1 wet area routed to Procat effluent treatment tanks for internal treatment prior with analytical testing prior to discharge to onsite Trade Effluent plant for further treatment.	G	1	1G	Low – Secondary and tertiary containment. On site effluent treatment plant.
Accidental	Overfilling of impregnator with Zeolite	Soil	Via soil to groundwater	Zeolite raw material is delivered in 75kg capacity drums so overfilling unlikely. Discharge from drum into polythene bags will be completed within decanting booth by trained operators. Transfer from bags into impregnator by operators	E	0	0E	Low – correctly sized product reagent bags. Overfilling worst outcome site issue with operational downtime.
Accidental	Loss of containment of wet solid impregnated	Soil	Via soil to groundwater	Operation conducted inside the building in bunded area. Appropriate capacity wheeled transfer container used to collect	C	1	1C	Tolerable. Operator training preventing occurrence.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
	product during transfer to transfer container.			impregnated material. Wheeler container will be positioned under impregnator. Any spillage locally contained and recovered.				
Accidental	Failure of Containment Vessels and Bunds	Groundwater / Soil	Surface water drains and soakaways.	Inspection and maintenance regime and procedures for inspection of vessels and bunds. Limited quantities of materials in the process. Spillage kits available and staff trained in their use.3 layers of protection, glass vessel sectrans coated, vessel on bunded skid, Procat bund. No unmade ground or soakaways in or near Procat 1 building.	D	2	2D	Tolerable. Unlikely consequence with PPM systems and small operational scale.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
Accidental	Failure of Containment Vessels and Bunds	Sewer	Surface water drains	Controls listed as above. Additionally, all effluents in Procat 1 wet area and tank farm are routed to Procat effluent treatment tanks for internal treatment prior with analytical testing prior to discharge to onsite Trade Effluent plant for further treatment.	E	2	2E	Low. Unlikely consequence with PPM systems, small operational scale, tertiary containment and on site SETP.
Accidental	Fire	Site and Local area	Air – Products of combustion	Fire Risk from this process is small. Site has an on-site Fire Emergency team for rapid response.	3	F	3F	Low risk
Accidental	Fire – Domino Effect	Site and Local area	Air – Products of combustion	Fire Risk from this process is small. Oven drying operations of flammable inventory materials (carbon) may be processed in Procat dry area. All ovens designed with over temperature	3	F	3F	Tolerable risk.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
				cut-off and PLC alarm system. Site has an on-site Fire Emergency team for rapid response.				
Accidental	Fire – Fire Water Run-off	Groundwater and soil	Soil	Risk from this process is small. However, a fire may involve the ProCat plant. Firefighting water is contained by transfer to the Values Recovery Plant. Tertiary containment, adjacent surface water drains, route to Site effluent treatment plant	3	G	3G	Tolerable - Firefighting water will be contained by the Effluent Treatment Plant. Site emergency plans address fire water run-off risks.
Accidental	Fire – Fire Water Run-off	Sewer	Surface Water Drains and Trade Effluent Drains	Controls as listed above, additionally Procat, Effluent Plant and Site Emergency plans ensure firewater run-off is adequately held to protect releases to sewer.	3	G	3G	Tolerable - Firefighting water will be contained by the Effluent Treatment Plant. Site emergency plans address fire water

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
								run-off risks.
Accidental	Fire – Community disruption	Local community	Air	Plant located in the centre of the EPR Installation and impact on the local community from a fire within this plant would be low.	2	G	2G	Low – The local community would only be impacted by significant fire spread (see Fire Domino effect above)
Odour	Odour	Local community	Air	The plant is not expected to release any detectable odour.	1	F	1F	Low risk.
Noise and Vibration	Noise and Vibration from PTZ plant	Local community	Air / Ground	No significant noise or vibration expected from this plant. No impact from the plant within or outside the site boundary. Equipment selected in accordance with JM buy-quiet policy. Dilution flask outlet pump has pulsation damper.	0	F	0F	Low Risk

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
Noise and Vibration	Emergency Alarms	Local community	Air	No impact from the plant outside the site boundary.	1	E	1E	Low risk.
Failure of mains services (Power)	Plant does not fail to safety.	Air /Land / Water	None	The plant will fail to safety in all aspects in the event of power loss.	1	D	1D	Low risk. Power outages probable but unsafe plant shutdown unlikely due to design.
Operator Error	Unplanned release	Air /Land / Water	Air /Land / Water	A programme of operator training will be completed prior to start-up. In addition, plant software control systems will ensure appropriate process control for automated systems. In the event of failure, appropriate automatic alarm and shutdown systems will operate.	1	E	1E	Low risk.
Vandalism and malicious	Unplanned release	Air /Land / Water	Air /Land / Water	Johnson Matthey Royston is a secure site with both manual and electronic surveillance systems.	G	1	1G	Low risk.

TYPE	HAZARD	RECEPTOR	PATHWAY	RISK MANAGEMENT	PROBABILITY OF EXPOSURE	CONSEQUENCE	WHAT IS THE OVERALL RISK	EXPLANATION
acts				Site entry is strictly controlled. Malicious act is unlikely but even if enacted, the consequences from this plant would be low.				
Explosion	Dust explosion	Air /Land / Water	Air /Land / Water	Physical properties of materials (Zeolite) make the risk of a dust explosion not foreseeable. This is a dedicated plant and there is no possibility of potentially explosive dust mixtures co-existing.	3	G	3G	Low risk.

2.5 ENERGY EFFICIENCY

2.5.1 BASIC ENERGY REQUIREMENTS

The PTZ plant will be located within the existing Procat 1 facility so there will be no additional energy requirement for space heating as a result of this project. The space heating for Procat 1 is provided by the CHP steam, or steam make up from site boilers in the event of CHP downtime.

The process off gases will be draughted to the existing building abatement system so no increase in energy will be needed for process extraction and abatement.

A platinum solution is diluted and mixed in an existing vessel with an electrically powder agitator.

The impregnation process is undertaken in ambient temperature with the only energy requirement being for the mixing in the impregnator.

The drying and calcination oven consumes electrical energy.

Material handling steps are completed in a mobile extraction unit for the zeolite raw materials into the impregnator, and an existing fume cupboard for the transfer of the wet product into trays and the dry calcined product from trays into drums. The mobile extraction unit and fume cupboards are served by electrically powered fans.

The grid imported electrical power on site is provided by a supplier sourced from 100% renewable sources. The CHP also provides electrical power to the site.

Table 2: Predicted estimation of energy consumption

Energy Source	Yearly Usage, maximum (MWh)	Primary Energy Usage, maximum* (MWh)	% of Primary Total
Mechanical equipment	3.0	7.7	1.3%
Heating – Drying & Calcination	231.7	593.2	98.7%
Total energy	234.7	600.9	100%

***Note:** It is assumed that 60% of the Electricity will be supplied rom the national grid via sustainable supply. A conversion factor of 2.6 has been used to convert electricity to Primary Energy (this assumes all electricity derives from the National Grid) – Reference: *Environment Agency Guidance IPPC H2. Energy Efficiency (page 13).*

The remaining 40% will be supplied from CHP generated electricity. Metering information from September 2019 shows that the CHP primary energy conversion factor is 2.5.

The expected primary energy usage for this process represents 0.3% of the primary energy usage of the entire JM Royston site.

2.5.2 ENERGY EFFICIENCY MEASURES

- High efficiency motors on impregnator and oven fans.
- Low energy lighting and use of natural light wherever possible.
- Automated drying and calcination oven cycles.

2.6 EFFICIENT USE OF RAW MATERIALS AND WATER

2.6.1 WATER USE

The process uses pre-set quantities of water to dilute the Platinum nitrate solution which area measured prior to use to ensure there is no wastage of water.

The vacuum flask contents will discharge down to a pump that will send the liquor to the impregnator, designed for minimum/no holdup (there is a flush out at the end to ensure we get all the Pt into the impregnator)

This process will only be used to process the same product using high purity raw materials so will require minimal wash down between batches. A momentary action valve with spray ball will be used to provide high efficiency washing of the flask and pipework and minimise wash water usage.

Given the limited use of water in this process, and the fact that all water carries forward into the wet impregnated product for calcination there is no scope for recirculation or re-use or water.

2.6.2 RAW MATERIALS SELECTION

Table 3: Raw Materials Selection

Raw Material	Chemical Composition and State	Typical Usage per Annum	Fate: % to product; % to Sewer; % to water; % to air	Environmental hazard where known (e.g. degradability, bioaccumulation potential, toxicity to relevant species)	Is there a suitable alternative for those with significant impact potential?
Zeolite	Alumino silicate structure (solid powder)	4 tonnes (4 tonnes PTZ)	99% to product 0% to sewer <<1% to waste/ land 0% to air	None known	No
Platinum nitrate	Solution	1.850 tonnes (1.1 tonnes PTZ)	>99% to product, balance recycled via JM Brimsdown	Very toxic to aquatic life with long lasting effects	No

The plant has been designed to run using stoichiometric quantities of raw materials and delivering high yields thus minimising waste.

The raw materials information is held within the Raw Materials list that is reviewed frequently.

2.7 AVOIDANCE, RECOVERY AND DISPOSAL OF WASTE

Table 4: Sources and quantities of wastes predicted to be generated.

Waste Type	Source	Typical quantity (approximate per annum)	Characteristics	Disposal Route
2.7.1 GENERAL WASTES				
Packaging waste	Raw materials	0.30 tonne per annum	Wooden Pallets	Re-use for internal reverts transfer to Brimsdown. Ultimate fate of wooden pallets is recycled by waste partner.
2.7.2 WASTES (RECOVERED WITHIN JOHNSON MATTHEY)				
PGM containing waste stream	Production (bag filter abatement system)	<<5 kg (as Pt)	As finished product fines collected in bag plant	PGMs recovered at JM Brimsdown
2.7.3 HAZARDOUS WASTE				
No additional wastes				

Recycling and reusing will be applied where possible:

Any solid potentially containing PGMs are sent to our JM refining site in Brimsdown for recovery.

3 OPERATIONS

3.1 DESIGN OF A NEW PROCESS

The process will be subject to a full Hazard Study (Hazard Study steps 1-6).

PTZ is being designed using a formal six–stage hazard study which will give full regard to potential environmental impacts arising from the processes used. This study considers the identification and characterisation of all potential releases, containment of spills and fugitive emissions.

Consideration of the above has been dealt with as part of the accident risk assessment in section 2.4.

Records of the Hazard Studies are available on request.

3.2 STORAGE AND HANDLING OF RAW MATERIALS, PRODUCTS AND WASTES

Non-Hazardous Raw materials will be kept in the existing permitted storage area for Procat. This consists of racking in purpose-built warehouse on site.

The platinum nitrate solution will not be stored within the Procat building, except when in use during dilution and impregnation processes. The exact amount required for each batch (~10 litres) will be transferred from the existing dispensing building on site. This does not represent any change to either the existing Dispensing or Procat operations. It is likely that 10 L carboys of Pt nitrate will be stored in ProCat 1 strong room.

Both the existing Procat wet area and the Dispensing areas have appropriately sealed floors which fall away to sumps to provide adequate secondary containment for all liquid raw materials and liquids in-process.

Use of vents for storage of raw materials or wastes are not appropriate.

There is no potential for contamination of storage tanks as a result of this change.

As mentioned in section 3.1, all operations involving the storage & handling of chemicals & wastes which present a risk to the environment will be identified within a Hazard Study.

The solid PGM reverts generated is sent for precious metal recovery at our Brimsdown (Enfield) site and stored in 200 litre loose-head steel UN approved drums whilst awaiting transport off-site.

All non-hazardous waste packaging will be disposed of via the licenced waste management company and is stored in a steel skip.

3.3 PLANT SYSTEMS AND EQUIPMENT

As part of the Hazard study and project management procedures all potential emissions from plant systems and equipment have been considered and no substance or noise pollution is envisaged. If at some point there are some issues found with either noise or substances from the plant system or equipment, improvements to these will be included on the Procat continuous improvement plan.

The liquid reagents will be transferred into the impregnator via a vacuum flask which represents no change for existing liquid transfer within the Procat 1 building. The nominal capacity of the vacuum flask is approximately 10 times larger the volume of platinum nitrate used, and this is diluted by demineralised water that is weighed out in advance so over filling of the flask is not envisaged. Should an accidental over-filling occur the vacuum system is protected by a new local catch pot and also an existing vacuum catch-pot with high level protection to shut of the vacuum system. The capacity of the impregnator is approximately twice the capacity of the vacuum flask so over filling with dilute platinum nitrate solution is not envisaged.

The impregnator and calcination oven will be manufactured of suitable materials and to the appropriate British standard or national standard for the duty. The impregnator will be a closed vessel whilst in use and a mobile local exhaust ventilation system with HEPA filter will be used during loading operations.

Following impregnation, the wet zeolite will be loaded into trays for drying and calcination within an existing LEV dust booth served by a bag plant before emission via stack A178. This represents no change to existing Procat material handling operations.

The calcination oven will be connected to the existing scrubbed draught system and operated under negative pressure to prevent fugitive emission. The calcination oven will be fitted with control instrumentation to monitor process temperatures.

The calcined product does not require blending or homogenisation like other existing Procat products and so is simply loaded into 210 litre steel drums within the existing LEV dust booth for dispatch to customers. This step represents no change to existing Procat material handling operations.

The existing floor areas in the plant are sealed and cambered to gullies and sumps to retain spillages.

3.4 VENTILATION SYSTEMS

The design concept for the new plant will be one of containment to minimise escape of process gases into the workplace. Nevertheless, all process areas will be fitted with adequate ventilation installed and operated as appropriate to ensure that occupational exposure limits (OEL) are not exceeded. See section 4.4 fugitive emissions.

The long-term exposure limit for soluble platinum compounds is 0.002 mg/m^3, there is no short-term limit.
There are no OELs for zeolite.
Platinum Metal has a long term OEL of 5 mg/m^3, there is no short-term limit.

Transfer of the concentrated platinum nitrate solution into the dilution flask will be completed under vacuum to ensure containment. Transfer of the un-calcined platinum impregnated zeolite into trays will be undertaken in the LEV dust booth with appropriate use of PPE as necessary. At this stage the product is thoroughly wetted and not volatile so the potential for soluble platinum exposure is minimal. This does not represent any change to existing Procat operations.

The same dust booth is used to empty the calcined platinum on zeolite into 210 litre UN approved drums, appropriate PPE is used for this operation as necessary. At this stage there is no soluble platinum, however the product is dry so there is some potential for dust. As stated in 3.3 the dust booth LEV is served by a bag plant with appropriate abatement for diffuse dust emissions.

3.5 OVER-PRESSURE PROTECTION SYSTEMS

Over-pressure scenarios are not envisaged with this process. Any potential abnormal equipment over-pressure hazards are considered though the HAZOP process (available on request).

All vacuum flasks will be core-wrapped with a Sectrans coating to safeguard persons in the area in the event of an over pressurisation.

3.6 VACUUM SYSTEMS, PUMPS, COMPRESSORS, AGITATORS, VALVES, PIPE JOINTS AND VESSELS

a. Vacuum systems

PTZ will use a new vacuum flask for platinum nitrate and demineralised water addition, and a small (2 litre) new catch-pot to safeguard against over-filling. The new flask will be connected to the existing building vacuum catch pot which has high level protection that interlocks the vacuum supply to the building.

The Procat vacuum is supplied from the existing site vacuum system which has a central vacuum catch-pot with high level control, and caustic scrubber for the exhaust vacuum draught. The site vacuum system scrubbed off-gases vent to stack A35.

b. Pumps

Air operated double diaphragm pump will be used to pump the liquor to the impregnator

c. Agitators

An electrically driven agitator will be used to mix the platinum nitrate solution and demin water before addition to impregnator.

d. Valves

All valves used on plant will be the most reliable available for use in the process conditions encountered. They will conform to the business unit piping specifications. Typically, diaphragm valves will be used on process lines and globe and ball valves on service lines.

e. Pipework

Material of construction of the pipe work will be chosen dependant on the corrosive nature of the process fluid and will conform to site-wide piping specifications.

f. Vessels

The vacuum flasks will be Sectrans core-wrapped glass construction and the impregnator is a steel construction horizontal ribbon U-trough mixer.

The vacuum flask is designed to contain harmful substances by operating under negative pressure.

Specifications for all new equipment purchased will be made by qualified engineers issuing invitations to tender to pre-vetted suppliers.

The plant will be covered by the existing Planned Preventative Maintenance (PPM) procedures, and breakdown maintenance will be coordinated by the Support Engineering Department on a priority basis agreed with the Production department.

3.7 HEAT EXCHANGERS AND COOLING SYSTEMS

No new heat exchangers or cooling systems will be introduced or used for the PTZ process.

3.8 PURGING FACILITIES

There is no requirement for purging facilities in this application.

3.9 REACTION STAGE

No reactor vessels are used in this impregnation process. The horizontal ribbon mixer has been selected for the impregnation stage to achieve the best mixing and optimise this step, with regards to raw materials use.

The only reactions which will take place in this process will be the calcination stage of the process in the drying and calcination oven.

Use contiguous rotary calcination ovens were assessed at the development stage for this process, however these were discounted due to material processing problems with this product in this type of continuous oven.

The use of a dual-function drying, and calcination oven will deliver the benefit of reduced materials handling during this process. Furthermore, the depth of the products in the calcination trays along with the relatively low thermal conductivity of the product will mean that there is a very gradual release of calcination products during this process step.

All processes will be designed to ensure maximum yields are achieved.

There is no potential for release of vapours to air or water from this process.

3.9.1 THE PRINCIPAL REACTIONS AND MATERIAL FLOWS

3.9.1.1 PRINCIPLE REACTIONS

The process involves only simple chemistry during impregnation and drying, as follows:

Step 1. Impregnation:

$Pt(NO_2)(NO_3).2HNO_3(aq) + Zeolite(s) \rightarrow Pt(NO2)(NO_3).Zeolite(s) + 2HNO_3(g)$

Step 2. Drying and Calcination:

$Pt(NO_2)(NO_3).Zeolite(s) + 2HNO_3(aq) \rightarrow Pt(NO_2)(NO_3).Zeolite(s) + 2HNO_3(g)$

The stoichiometry of the decomposition during calcination is not fully understood, however, from development trials the proportion of N2O and N2O in the off-gases is given in the equation below

$Pt(NO_2)(NO_3).Zeolite(s) + HNO_3(g) \rightarrow PtO.Zeolite(s) + aNO_2(g) + bN_2O(g) + cHNO_3(g)$

aq. = aqueous solution

s = solid

g = gas

Gas mass fractions:

a = 95%	NO_2
b = 3%	N_2O
c = 4%	HNO_3

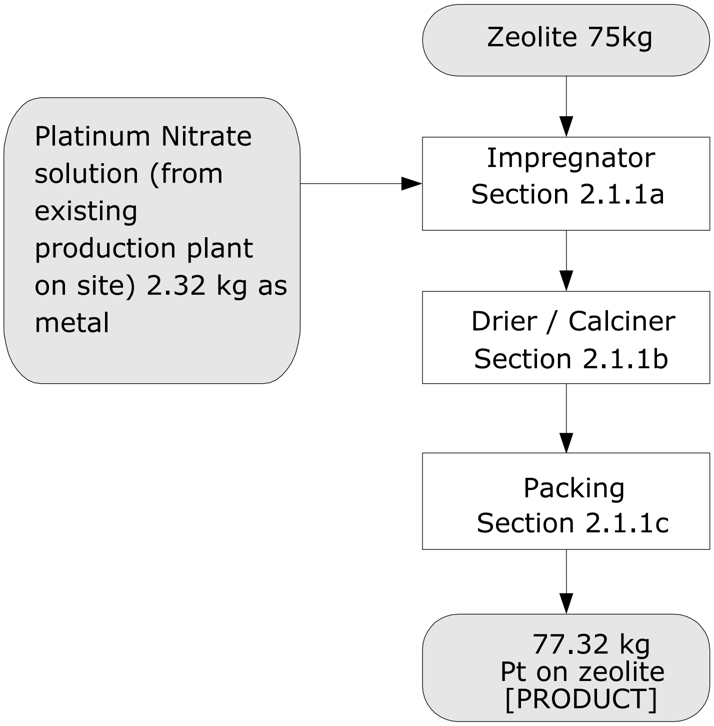
All other manufacturing steps employ standard physical processes. Process Flow Diagram

The production process overview is shown in Figure 1. Each element of the process is described below, setting out the impregnation, calcination and packing stages.

The section addresses the following processes in turn:

- Impregnation
- Calcination
- Packing

Figure 1 Process Flow Diagram PTZ



3.9.2 MINIMISATION OF LIQUID LOSSES FROM REACTION SYSTEMS

The system has been designed for highly contained processing.
Consideration of low inventory continuous reactors was made at the design stage. Use of a batch blender is needed in order to achieve the required mixing at the impregnation stage and use of a continuous rotary calciner was found to be technically infeasible at the process development stage due to material handling issues associated with this product.

Use of wash water is minimised though use of high efficiency spray nozzles systems and momentary action valves. All Process vessels have bottom outlets with facility to flush directly to other vessels. The vessels have smooth walls, minimal internal baffles and obstructions

The impregnator is raised from the floor to allow for the routine collection of product and non-routine washings.

Minimal pipework has been used in order to eliminate hold-up and to assist drainage. Pipework will be designed to allow for water washing.

There is no need for the systems to be kept warm during the dilution or impregnation steps as the liquid components are of low viscosity.

The potential for the choking of lines by high-melting-point material was not considered as there are no plans for using high melting point materials.

The process is designed to run only one product so there is no requirement to change-over and wash down between campaigns.

The process has been designed to minimise locations for solids to settle-out.
The duplication or dedication of equipment where it can reduce the need for cleaning that is difficult has been considered.

Minimisation of liquid loss from vessels is also discussed in section 3.3, plant systems and equipment. Liquid transfers will be undertaken by vacuum using appropriately designed and sized vessels to avoid liquid losses from the process.

Minimisation of liquid wastes and effluents are considered as a part of the Hazard study process.

3.9.3 MINIMISATION OF VAPOUR LOSSES

The products are of low volatility and the impregnation process will take place at ambient temperatures, so vapour losses are not envisaged as a part of this process.

Vapour emissions are expected as a part of the design intent of the drying and calcination stage. The use of wet caustic scrubbing tower with demister will capture most of the water vapour, and the scrub liquor is used to neutralise acidic trade effluent.

The draught route from the drying and calcination oven has been reviewed within the Hazard Study.

3.10 SEPARATION STAGE

3.10.1 LIQUID-VAPOUR SEPARATIONS

No liquid-vapour separation steps being introduced in this this process. Vapour is driven from the oven at the drying stage, this will be collected in the existing wet scrubbing tower and demister.

Formal operating instructions will be issued before commissioning to ensure effective operation of the process and minimisation of losses.

Design conditions will be specified in the process design stage and adhered too.

Instrumentation to warn of faults in the oven will be implemented in the design.

3.10.2 LIQUID-LIQUID SEPARATIONS

There are no liquid-liquid separation processes being introduced in this process.

3.10.3 SOLID-LIQUID SEPARATIONS

There are no solid-liquid separation processes being introduced in this process.

3.11 PURIFICATION STAGE

High purity raw materials are used in this process, so no purification stages are required.

3.11.1 CHEMICAL PROCESS CONTROL

The impregnation stage is a simple mixing process and does not require any specific process controls.

The drying and calcination processes will be monitored to ensure the correct air pressures and temperature are maintained. Appropriate alarms and interlocks will be implemented to ensure that the process does not go out of the required operating range and the safe operating envelope of the oven.

3.11.1.1 CONTROL DURING ROUTINE CONDITIONS

All processes have a detailed operating procedure that will be followed during production. The operating procedure is a controlled document within an ISO 9001 accredited Quality

Management System. People operating the processes will be trained and accredited in the process.

Quantities of raw materials are used based on stoichiometric requirements.

There is a high degree of automation of heating cycle in the oven through instrumentation therefore minimising operator error. The heating cycle is controlled via PLC and oven safety interlocks to prevent out of control conditions will be implemented.

The oven has 10 thermocouples, 7 are used to monitor and control oven internal temperatures. The thermocouples detect when conditions have moved outside set limits to give audio and visual alarms when appropriate. The 3 other thermocouples are used to raise an extra high temperature alarm and initiate automatic power isolation of the oven where necessary, to safeguard against high temperature events.

3.11.1.2 CONTROL DURING ABNORMAL CONDITIONS

As PTZ is a batch process, start up and shut down is a routine part of the process and does not give rise to any abnormal conditions or elevated emissions.

As discussed in section 3.11.1.1 *control during routine operations* in the event of any abnormal oven temperature conditions, such that the process is at risk of moving outside the designed safe operating envelope, visual and auditable process alarms will activate and ultimately power to the calcination oven will be automatically isolated.

Operating procedures will have guidance for abnormal situations and process operators and team leaders are trained to recognise these situations and respond correctly, in accordance with procedures. Process problems that cannot be dealt with by the Production Team are directed to the Technical Support Team.

All staff are trained in departmental emergency procedures.

3.11.1.3 CONTROL DURING EMERGENCY CONDITIONS

Please see accident management section 2.4.

There is a three-tier site emergency plan in place which includes a departmental plan, a business unit plan and a site plan. The Procat departmental emergency plan will be reviewed to ensure it covers the PTZ process.

Where necessary, in the event of an emergency crossing the boundary of the Procat building, the business unit (R&CE) plan will be enacted. In the event of the emergency crossing the business unit boundary the site emergency plan will be enacted.

Control of the processes in emergency conditions will be the same as in abnormal conditions. Processes will be controlled in line with design parameters as approved by HAZOP.

3.12 ANALYSIS

High purity raw materials are used in this process and are issued to Pt nitrate is analysed and results fed into a PTZ Process calculator to verify exact amounts of zeolite and dilution water to be used.

The only analysis tests needed for this process are for product quality purposes and are; a simple loss-on-drying test of the zeolite to ensure the correct exact weight of platinum to zeolite is applied in process, and an absorption test to check for successful coating of the Platinum onto the zeolite support.

Prior to processing the exact weight of platinum nitrate solution is dispensed by the dispensing team and the exact required weight of zeolite is weighed into 15 kg bags for loading in to the impregnator.

The impregnation stage is a simple mechanical mixing step with no in-process measurement required. The drying and calcination steps are controlled by PLC with temperature detection to ensure effective calcination of the impregnated zeolite. This ensures effective control of process is maintained.

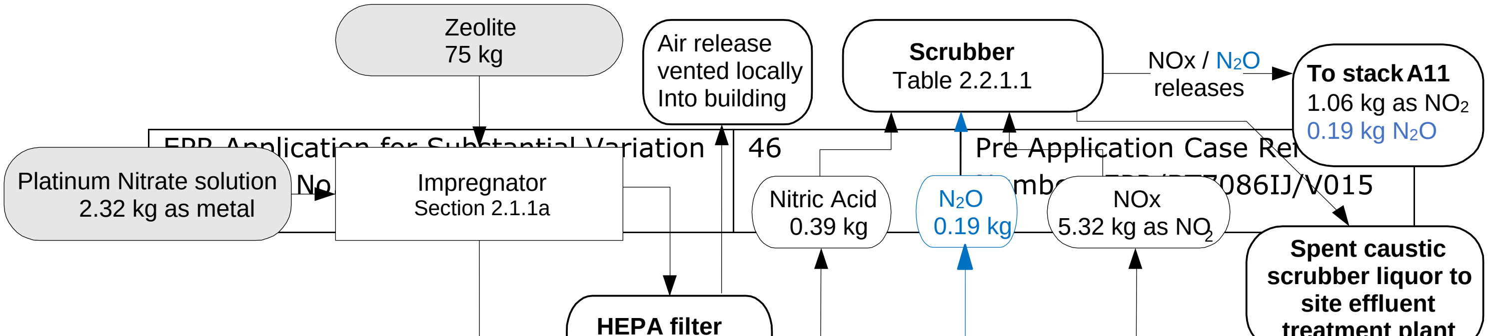
There are no liquid effluents form this process which require analysis.

4 EMISSIONS AND MONITORING

4.1 POINT SOURCE EMISSIONS TO AIR

The PTZ process will emit process off gases during drying and calcination, which will be served by the existing Procat packed tower wet scrubbing system with point source emission to air via stack A11. Emissions from this stack will meet compliance with the Inorganic Chemicals Sector (EPR 4.03) emissions benchmarks. All processes and abatement are covered in the existing Royston installation environmental permit for the materials coating scheduled activity in the Procat 1 area with the exception of the calcination stage and the associated emission of nitrous oxide shown in blue.

Figure 2. Abatement Plant



PTZ process emissions to air after abatement will be oxides of nitrogen (NO_x), which stack A11 has authorisation to emit, and nitrous oxide (NO_2). Nitric acid will be scrubbed to negligible levels.

Materials transfer operations will take place within either a new mobile LEV containment booth with HEPA filtration of extraction and return of clean filtered air back into the workplace (Procat 1 has two exiting mobile LEV containment booths), or within an existing permanent LEV containment booth with bag plant abatement that emits to existing stack A178.

Use of these systems and barrier filtration meet the requirements of BAT to prevent diffuse emissions from dusty operations.

Dispersion modelling from the site has been completed and includes the process emissions from stack A11. (See section 5.3.1)

Table 5: Emissions benchmarks of released substances

Released substance	Current limit for existing plant (mg/Nm^3)	Sector Guidance[3] Benchmark value (mg/Nm^3)	Emission Benchmark Procat 1 (Stack A11) will adhere to (mg/Nm^3)
Oxides of Nitrogen	200	50 – 200[4]	200
Nitrous Oxide	No limit set[5]	200	200

General conditions:

- The reference conditions applicable to the above levels are:
    - temperature 273 K (0 °C),
    - pressure 101.3 kPa (1 standard atmosphere),
    - no correction for water vapour or oxygen.
- Releases should be essentially colourless, free from persistent mist or fume and free from droplets. Releases should not give rise to an offensive odour noticeable outside the site where the process is carried on.

In line with existing Procat drying processes, no emission limit for nitric acid is required as there will be negligible emission of this substance from stack A11 following the existing wet scrubbing process. This have previously been verified though emission monitoring of stack A11 and will be verified for PTZ as a part of the commissioning stage to ensure compliance to BAT requirements for the process.

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[3] The Inorganic Chemicals Sector (EPR 4.03), March 2009

[4] 200 mg/Nm^3 for wet scrubbing.

[5] No current Nitrous Oxide limit for Procat 1 as existing processes do not emit this parameter.

4.1.1 CHANGES TO EXISITING EMISSION POINT SOURCES (STACKS)

There will be no changes to existing emission point sources as a result of this application. All associated vents are detailed on the site stack map – see appendix 4.

4.2 POINT SOURCE EMISSION TO WATER

There will be no direct or indirect point source emissions to surface water, sewer or ground water as a result of this process.

There is no increase in caustic scrub liquor effluent. The emissions from the Platinum on Zeolite process do not represent any change in scale or inventory when compared to the emissions from existing coating and drying operations undertaken in Procat 1 and therefore will not generate any additional volumes of scrub liquor.

This is because production within the area is completed on a campaign basis and when the platinum on zeolite process is in production, the production campaigns of other products with similar emissions inventories will stop.

4.3 POINT SOURCE EMISSIONS TO LAND

There are no point source emissions to land from the Procat 1 building and none will be introduced as a result of the PTZ process.

4.4 FUGITIVE EMISSIONS

4.4.1 FUGITIVE EMISSIONS TO AIR

The plant has been designed to minimise fugitive emissions. See section 3.1 and 3.3. Foreseeable sources of fugitive emissions have been identified and will be suitably draughted and ducted to the scrubber systems.

Potentially dusty operations will be completed within LEV containment booths with barrier filtration to prevent fugitive emission.

Process batch size has been chosen to fit within a single UN-approved transport container to minimise potential for fugitive emissions from raw material and product handling.

The PTZ process will be added to the Procat 1 planned preventative maintenance systems.

4.4.2 FUGITIVE EMISSIONS TO SURFACE WATER, SEWER AND GROUNDWATER

There will be no fugitive emissions to surface water, sewer and groundwater under normal operating conditions.

To avoid fugitive emissions to surface water, sewer and/or groundwater, all floors internally and externally associated with the plant will be constructed from impermeable materials. Planned preventative maintenance will ensure regular observational checks of all surfacing.

All floors internally and externally associated with the plant will be cambered to direct any spills or leaks into sumps for recovery or treatment as appropriate to avoid contaminated surface run-offs discharging to ground.

Spill kits will be provided at strategic locations as required. The used spill-kits will be disposed of in leak-proof containers before final disposal off-site in accordance with JM waste management and disposal policy.

All process line including effluent will be piped above ground and sumps and bunds will be checked weekly in line with Royston site protection and monitoring plans (RS.EHS.018B). Secondary containment bunds and sumps are inspected by an approved contractor on a 6-monthly basis in line with bund specifications and Ciria guidance C736; Containment systems for the prevention of pollution: Secondary, tertiary and other measures for industrial and commercial premises.

4.5 ODOUR

There will be no odorous releases from this process.

4.6 NOISE AND VIBRATION

This process will be housed inside the Procat 1 building and will not introduce any significant noise or vibration. No impact from this plant is expected at the site boundary.

The site carries out noise monitoring every two years and reports this to the EA as part of the current permit requirement; the survey will be reviewed and extended at the next scheduled monitoring to ensure no noise from the PTZ process present at the boundary.

4.7 MONITORING

4.7.1 MONITORING AND REPORTING EMISSIONS TO AIR

The PTZ process will emit to the A11 stack with the parameters listed below.

Given that the PTZ process is not expected significantly change the low emissions from the new Procat 1 building, the following emission monitoring techniques are proposed with no change to the current annual monitoring frequency, in line with sector guidance.

Table 6: Monitoring techniques and frequency

	Monitoring technique	Justification	Frequency
NOx	EN14792:2017	EA requirement	Annual
N_2O	EN21258:2010	EA requirement. Best monitoring techniques for N_2O are recommended by EA in M2 guidance, version 12, August 2017: FTIR provides simultaneous monitoring with many other pollutants. Faster response and less interference than NDIR.	Annual

The emission benchmarks that will be followed are described in Table 5: Emissions benchmarks of released substances.

The emissions monitoring reporting will be completed at standard temperature and pressure with no correction for moisture or oxygen, in according with current Royston installation permit variation, EPR/BT7086IJ/V014, Schedule 6 Interpretation guidance;

Unless otherwise stated, any references in this permit to concentrations of substances in emissions into air means:

- *in relation to emissions from non-combustion sources, the concentration at a temperature of 273K and at a pressure of 101.3 kPa, with no correction for water vapour content.*

4.7.2 MONITORING AND REPORTING WASTE EMISSIONS

This plant will not generate any hazardous wastes. The waste from this plant will be included within the scope of the existing waste management system for the R&CE and includes but is not limited to monitoring and recording:

- the physical and chemical composition of the waste
- its hazard characteristics
- handling precautions and substances with which it cannot be mixed.

4.7.3 ENVIRONMENTAL MONITORING (BEYOND THE INSTALLATION BOUNDARY)

This plant will be included within the scope of the existing environmental monitoring systems for the installation including 2-yearly noise survey, 6-monthly groundwater monitoring.

A site-wide dispersion model has been completed as part of this variation application (see section 5.3.1).

4.7.4 MONITORING OF PROCESS VARIABLES

The process variables that will be monitored include:

Scrub draught and abatement - The scrubbing philosophy is to scrub acid gases with caustic scrubbers; prior to scrubbing, acid condensate will be removed from scrubbed draught with demisters and collected locally via gravity for recovery of PGMs. The NOx scrubber uses sodium hydroxide solution. Key process variables which are monitored include: scrub liquor flow, pH of scrub liquor, specific gravity of scrub liquor, pressure drops across system, level alarms on scrubbing tanks also - all of which will use BAT as required by site standards.

Process control; no continuous level detection is required as measured quantities of water are added to process via the dilution vessel. There is high level detection on the existing vacuum system overflow catch pot and temperature control of the PTZ drying and calcination oven.

Key oven parameters (temperature and pressure) will be monitored and recorded on the Supervisory Control And Data Acquisition (SCADA) system (the computer process management and monitoring system).

Water flow – measured quantities of water are added to the process.

Electricity - consumption of the building is monitored to allow for energy efficiency tracking in line with departmental continuous improvement plan.

4.8 PLANS IN THE EVENT OF SITE CLOSURE

The Procat 1 section of the site closure plan has been reviewed, no update was required as raw materials and processes are the same as existing Procat 1 processes. See appendix 5.

4.9 INSTALLATION ISSUES (E.G.: MULTI-OPERATOR OR CHANGES TO BOUNDARY)

N/A - no changes to boundary or multiple operators. Site Layout drawing in Appendix 3.

5 ENVIRONMENTAL IMPACT ASSESSMENT

5.1 ENVIRONMENTAL IMPACT SUMMARY

Table 7. Identification of the environmental impacts relevant to the assessment

Impact	**Relevant?**	**Description of the pathway and receptor where relevant,**
	Yes/No	**or reason why not relevant**
Emissions to air	Yes	Via stacks to air, receptors include local community, flora and fauna
Deposition from air to land	Yes	Via stacks to air and deposition to land via precipitation.
Emissions to surface water	No	Not relevant because process effluent goes via a site effluent treatment plant before entering the Anglian water sewage treatment works.
Noise and vibration	No	PTZ process is entirely housed within existing Procat 1 building. Plant items designed and located to minimalise noise and vibration to the environment beyond

		the installation boundary.
Odour	No	PTZ is not an odorous process.
Risk of accidents and their consequences	Yes	Loss of process control. Hazard Study (HAZOP), PPM, automated oven control. See section 2.4.
Visual impacts associated with operation	Yes	Via stacks as visual plume. Wet scrubbing abatement of the pollutants to meet limits will occasionally produce a visible water vapour plume during cool conditions with high humidity.
Global warming (energy use)	Yes	Via greenhouse gas emissions: N_2O is a greenhouse gas but PTZ has low mass emission rates (well within emission limits) so global warming potential will not be significant. Also, via electricity use within the plant. Energy efficient plant will be purchased. Ongoing monitoring of the electricity use. See section 2.5.
Photochemical ozone creation	Yes	Via NOx emissions. Scrubbing system will ensure emission limits are met.
Waste treatment and disposal	Yes	Process PGM containing waste via internal refining at our Brimsdown site. Packaging waste via 3rd party waste contractor.

5.2 LOCATION OF RECEPTORS

Table 8. Location of receptors

	Immediate Locality	Wider Surroundings
North	Johnson Matthey Plant and processes	A505 by-pass with agricultural land and Holland Hall SSSI beyond

South	Johnson Matthey Plant, processes and staff canteen	Light industry, local housing, railway line and Therfield Heath SSSI beyond
East	Johnson Matthey Plant and processes	Local housing and schools, railway line, A505 by-pass with agricultural land beyond
West	Johnson Matthey Noble Metals building	Light industry, A505 by-pass with agricultural land beyond

5.3 IDENTIFICATION OF THE EFFECTS OF THE EMISSIONS

The two nearest protected sites to Johnson Matthey, namely Therfield Heath (700 metres to the southwest at TL 344 401) and Holland Hall Railway Cutting (approximately 2 km to the northeast at TL 364 428), have both been assigned Site of Special Scientific Interest (SSSI) status on account of their chalk-land flora.

Table 9. **Identification of important and sensitive receptors**

Type of receptors which may be affected by emissions from the new plant	List of emissions from the new plant which may have an effect on the receptor
Therfield Heath and Holland Hall Sites of Special Scientific Interest (SSSI)	Nitrogen deposition: Nitrogen dioxide (NO_2) Acid deposition: Nitrogen dioxide (NO_2) (unlikely to affect Chalkland – v well buffered)
Human population – neighbouring properties and supermarket	Nitrogen dioxide (NO_2) within objective levels, Nitrous Oxide (N_20) not significant when compared to derived targets.

5.3.1 IMPACTS OF RELEASES TO AIR

Detailed dispersion modelling for the whole installation which includes predicted Emissions from the PTZ process, within Scenario 2 of the report, has been commissioned. Any further reference to the dispersion model within this application relates specifically to the findings within the scenario 2 section. The full report is provided at Appendix 1.

The study concludes that emissions to air from the Johnson Matthey installation are unlikely to lead to any adverse effects on health or vegetation;

There are no predicted exceedances of the Air Quality Objectives or Environmental Assessment Levels (EALs) for any of the modelled pollutants

Oxides of Nitrogen, as N_2O:

- The maximum offsite 99.79th percentile of hourly average NO_2 PC concentration is 118 µg/m3, 59% of the air quality objective of 200 µg/m3, calculated using meteorological data for the year 2016. Including the background concentration of 32.8 µg/m3, maximum predicted offsite PECs are below the air quality objective of 200 µg/m3.
- The maximum annual average offsite NO_2 PC is 6.9 µg/m3, 17% of the air quality objective of 40 µg/m3, calculated using meteorological data for the year 2017. Including the background concentration of 16.4 µg/m3, maximum predicted offsite PECs are below the air quality objective of 40 µg/m3.

There are no daily or annual average exceedances of Vegetation and Ecosystems Critical Levels for either the nearest SSSIs; Therfield Heath or Holland Hall. The highest Daily average impact is 68% PEC of critical level at Therfield heath in 2015, PC is 45% of critical level for this year. The highest annual average impact is 64% PEC at Holland Hall, for all years, but PC is only 2% of critical level so most of the annual average impact is from background sources.

PTZ is only a minor and intermittent contributor to nitrogen dioxide emissions from the installation

Nitrous Oxide:

PTZ is the only nitrous oxide emission contributor from the installation, however the emissions are small in scale. The are no Target EAL values for Nitrous Oxide so a derived EAL from N_2O long term WEL was derived in accordance with H1 guidance[6]. The long term

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[6] H1 Annex F Air Emissions v2.2 December 2011

WEL for N_2O is 183 mg/m^3, this gave a derived Maximum hourly EAL of 54,900 µg/m^3, and an annual average EAL of 1830 µg/m^3.

Based upon the derived short term EAL all maximum hourly average PCs for 2014 to 2018 were not significant as they were less than 10% of EAL. The highest PC value with 0.5% of EAL was in December 2015.

Based upon the derived long term EAL all annual average PCs for 2014 to 2018 were not significant as they were less than 1% of EAL. All PC values were <0.1% of EAL for 2014 to 2018.

Minimal effect on ozone layer is expected as a result of PTZ and is discussed in section 5.8.

5.3.2 IMPACT OF DEPOSITION TO LAND OF AIRBORNE EMISSIONS AT DESIGNATED CONSERVATION AREAS

The detailed modelling found:
There are no predicted exceedances of the Critical Loads, with the maximum PCs for to nitrogen deposition from NOx screened out as insignificant;

- The maximum PCs to nitrogen deposition are screened out for grassland habitats within the Therfield Heath and Holland Hall SSSI.
- The maximum PC to nitrogen deposition for the woodland habitat within the Therfield Heath SSSI is greater than 1% of the lower value of the Critical Load range. However, when the locations of specific habitat types within Therfield Heath are considered, the PC to nitrogen deposition at Therfield Heath is screened out as insignificant, as it is less than 1% of the Critical Load range relevant to specific locations.

5.3.3 IMPACT OF RELEASES TO WATER

In according with existing processes, the effluent from the abatement process will be tested prior to discharge to the Site Effluent Treatment Plant (SETP) to ensure that it will not compromise the ability to meet Anglian Water Services Discharge Consent before being discharged to the Royston Sewage Treatment Works (STW). This proposed variation represents no change to this directly accosted activity.

The volume fraction of scrubbing liquor generated by the PTZ process will be negligible in comparison to the typical volumes generated by the existing Procat scrubber. No direct trade effluent releases will result from the PTZ process. As such PTZ will have no impact on the capabilities of the SETP and therefore no potential impact on the Royston Sewage

Treatment works (STW) and downstream receptors; Whaddon Brook and ultimately River Cam.

5.4 ASSESSMENT OF NOISE ON SENSITIVE RECEPTORS

A full site environmental noise assessment conducted by INVC consultants in August 2018[7], including a list of representative noise sensitive receptors, can be found in appendix 8.

Johnson Matthey (Royston site) has made a commitment that the noise level when measured at any of the site boundaries shall not exceed those levels stated within the original PPC Application of June 2003 and it is intended that this commitment shall be met with any new plant.

The next site noise survey will be completed in the summer of 2020, during this time any potential noise sources from PTZ will be measured and logged in line with The Control and Management of Environmental Noise and Vibration policy and procedure. The purchase of equipment has been carried out following the Buy-Quiet policy.

It is therefore not anticipated that noise from the new developments will cause undue disturbance at the nearest noise-sensitive sites.

The PTZ process will be housed within the Procat 1 building and will not cause any increase in noise or vibration at the site boundary.

5.5 RISK OF IMPACTS FROM THE CONSEQUENCES OF ACCIDENTS

The plant will be subjected to detailed Hazard Studies (HAZOP). A detailed assessment of the potential risks and consequences of accidents is given in Accident management 2.4 of this Application together with the measures in place to minimise the chance of them happening and the actions planned if the event does occur.

5.6 VISUAL IMPACTS

Wet scrubbing abatement to meet emission limits will occasionally produce a visible water vapour plume during cool conditions with high humidity.

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[7] INVC report 9148, 19 September 2018

The PTZ process will be housed within the existing Procat 1 building which is a two-storey building near the centre of site. This project will not alter the visual profile of the Royston Site.

5.7 IMPACTS OF ODOUR

PTZ is not an odorous process so there will be no odour impacts.

5.8 PHOTOCHEMICAL OZONE CREATION POTENTIAL

The only emissions to air from the PTZ plant which have been attributed photochemical ozone creation potentials (POCPs) are nitric acid (HNO_3) which has a very low volatility and is completely removed from emissions to air by the wet scrubber, and nitrogen dioxide (NO_2)

The POCPs for these are shown below[8]:

Substance	**POCP**
Nitrogen dioxide (NO_2)	2.8
Nitric Acid (HNO_3)	-42.7
Nitrous Oxide	None listed

However, these figures are relatively small in comparison to POCPs for other substances given in the H1 Guidance (POCPs range up to 138) and are therefore not considered significant in this respect.

In view of the low release rates of the PTZ plant, no significant impact on ground level ozone is anticipated.

All releases will conform to the requirements of BAT.

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[8] EA Horizontal Guidance Note H1, Annex F, Air Emissions v 2.2 December 2011

5.9 GLOBAL WARMING POTENTIAL

5.9.1 DIRECT EMISSIONS FROM PROCESS OPERATIONS

The only emission substance from the PTZ process with global warming implications is Nitrous Oxide[9] which has an atmospheric lifetime of 120 years, and global warming potential of 310. Although the atmospheric lifetime is significant the GWP of N2O is a relatively small value when compared to other greenhouse gases (GHG).

In total the PTZ process will emit 21.28kg (2.128×10^{-2} tonnes) of Nitrous Oxide per year. When taking into account the GWP for Nitrous Oxide this represent a GWP of the PTZ process of 15.45 tonnes/yr CO_2 which is an insignificant value.

5.9.2 INDIRECT EMISSIONS FROM ENERGY USE

In the last two years at the JM Royston site there has no energy generated from CHP as the existing plant has been decommissioned and a new plant recently installed and commissioned. Therefore, in the last 2 years only grid imported electricity from 100% renewable sources has been utilised on site with a carbon emission factor of 0.

If this data is used to calculate emissions from energy use, it will return a figure of zero Tonnes CO_2/year which is artificially low as the intention of the site is to maximise the utilisation of the new CHP to gain power and heat efficiency benefits to the site and hence create CO_2 emissions from the associated natural gas combustion.

Historical data shows that the annual average utilisation of the CHP was 33% electrical energy. To take a worst-case approach to CO_2 emissions calculations it is assumed that the future utilisation of the CHP will be 40%, with the remaining 60% electrical energy supplied from grid import of 100% renewable sources.

The CHP plant is a natural gas engine and metering data shows the primary energy conversion factor to natural gas is 2.5. The CO_2 conversion factor for the natural gas is 0.05214 Tonnes CO_2/GJ = 0.187704 Tonnes CO_2/MWh.

Impacts arising from energy use will be minimised through process design incorporating computer control systems to minimise energy use, and through plant maintenance and staff training.

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[9] EA Guidance, H1 Annex H – Global Warming potential

Indirect emissions of carbon dioxide arising from energy use are estimated in Table 12 below.

Table 10. Indirect release of CO_2 through energy consumption

	Annual consumption (MWh)	Equivalent indirect CO_2 emissions (tonnes/year)
Grid Import Electricity (100% renewable)	366	0[10]
CHP Generated	235	44[11]

5.9.3 IMPACTS TO SITE FROM GLOBAL WARMING

The main impact of global warming to site would be an increase in rain fall and the potential for increased flooding. This is not a significant risk as the flood risk impacts from rainfall are very low for the site and there is no risk of flood from rivers or reservoirs[12]. Furthermore the local site area has a low water table, with surface water level more than 20m below ground level.

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[10] 60% of Electrical Energy to Royston Installation is supplied from 100% renewable sources.

[11] 40% is supplied from CHP, metering data shows primary energy conversion factor of 2.5, and CO2 conversion factor for natural gas is 0.05214 Tonnes CO2/GJ = 0.187704 Tonnes CO2/MWh.

[12] Government flood warning information service. https://flood-warning-information.service.gov.uk/long-term-flood-risk

5.10 IMPACTS FROM DISPOSAL OF WASTE

No hazardous wastes will be generated from this process.

Wastes containing precious metals will be sent for internal recovery at our Brimsdown (Enfield) refinery.

The only other wastes will be various types of packaging materials which will be either returned to the supplier, re-used elsewhere on site (wooden pallets, steel drums), or sent off site approves waste partners for recycling. It is therefore unlikely that there will be significant impacts arising from waste from this plant.

6 THE WASTE MANAGEMENT LICENSING REGULATIONS

Not applicable.

7 BAT ASSESSMENT

Consideration of alternative methodologies / techniques

- Precious metals (PM) solutions at the commercially available form are used as starting materials. This avoids unnecessary PM and PM salt dissolution steps in the impregnation preparation steps.
- Highest quality raw materials are used to minimise wastes.
- No potential for side reactions, or by-products. Yields for the process is > 99%.
- Smaller semi-continuous processes and calciners are not a feasible alternative process route due to material handling and product quality requirements. Batch drying processes are a standard unit operation in the Procat 1 building. Although the calcination is completed as a batch process the emission rate of the process is anticipated to be gradual given the thermal conductivity of the product and the depth of loading of the product into the calcination trays.
- Novel techniques for processing of this material (e.g., biological methods, use of supercritical fluids, electrochemical, ultrasonics, radiation induced reactions, photochemistry,) are not applicable.
- PLC sequencing is not necessary in the PM solution preparation and material handling stage but is used in the drying and calcination oven process.
- Wet Caustic Scrubbing is appropriate for controlling NO_x emissions. Selective Catalytic Reduction SCR is a potential alternative way of controlling NO_x and N_2O, however due to the batch nature of the PTZ process this technique is not appropriate. Stack emission from PTZ processes will comply with relevant air

emissions limits for the parameters stated in the EA Inorganic Chemicals Sector Guidance[13].

- Use of enclosed LEV extraction system to prevent diffuse releases of dust represents BAT. Minimal diffuse dust emissions are expected during raw material loading and impregnator unloading due to use of bagged materials and wet condition of product. Packing process, after drying and calcination is expected to be the most dusty operation and will take place in existing extracted LEV, in accordance with existing processes within Procat1.
- Point source dust emissions use of barrier filtration for control of dust emissions, HEPA filter for loading and unloading wet product, and bag plant for packing stage represents compliance to BAT. Emissions from these stages represent no change to existing BAT compliance in Procat 1.

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[13] The Inorganic Chemicals Sector (EPR 4.03), March 2009

SECTION B: ADMIN CHANGES

Changes to correct an error with the listed scheduled activities in table S1.1.

In the EPR 2010 regs and in PPC 2000 regs this particular paragraph was written as S4.2 A1 (d) 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—

- antimony;
- arsenic;
- beryllium;
- gallium;
- indium;
- lead;
- palladium;
- platinum;
- selenium;
- tellurium;
- thallium,

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

In the 2016 EPR regs you find S4.2 A1 (d) Recovering any compound of cadmium or mercury

This has led us to believe that when the Regs were changed in 2016 that a step to review the JM permit was not completed by the Agency and so the scheduled activity as written is not relevant to JM operations at Royston.

We propose to amend the permit to read S4.2 A1 (c) as the scheduled activity instead of S4.2 A1 (d). However doing this would likely omit the other PGM's (Platinum Group Metals and in particular Rhodium nitrate) that we have used in Clean Air since the very start of our operations in Royston. As this is not a specifically listed material in the 2016 S4.2 A1 (c) section it would suggest that logically we would most likely have to add the S4.2 A1 (f) activity to the permit in addition to S4.2 A1 (c). The (f) activity covers materials that emit oxides of nitrogen.

Change to correct a Typo in the permit table of scheduled activities.

In the table of activities these is an incorrect reference to the Fine Chemicals Divisional Products. In the table it is referred to as FDCP when it should be FCDP.

Existing Table S1.1 activities to be changed

S4.2 A1 (d)	Carried out in the manufacture of coatings for the autocatalyst (Fastcat) and catalytic soot filter (CSF) manufacture within the ECT business unit. Also for the manufacture of high purity inorganic chemicals mainly for laboratory use within the FDCP production unit. Also carried out in the manufacturing of other materials (Zeocat) in Chemicals,Catalysts and Refining (CCR) business unit.	From receipt of raw materials to despatch/use of finished product incorporating the activities listed in Table S1.1.

Proposed Table S1.1 activities after changes applies

S4.2 A1 (c)	Carried out in the manufacture of coatings for the autocatalyst (Fastcat) and catalytic soot filter (CSF) manufacture within the ECT business unit. Also for the manufacture of high purity inorganic chemicals mainly for laboratory use within the FCDP production unit. Also carried out in the manufacturing of other materials (Zeocat) in Chemicals,Catalysts and Refining (CCR) business	From receipt of raw materials to despatch/use of finished product incorporating the activities listed in Table S1.1.

	unit.	
S4.2 A1 (f)	Carried out in the manufacture of coatings for the autocatalyst (Fastcat) and catalytic soot filter (CSF) manufacture within the ECT business unit.	From receipt of raw materials to despatch/use of finished product incorporating the activities listed in Table S1.1.

Appendix 1– Dispersion model report:

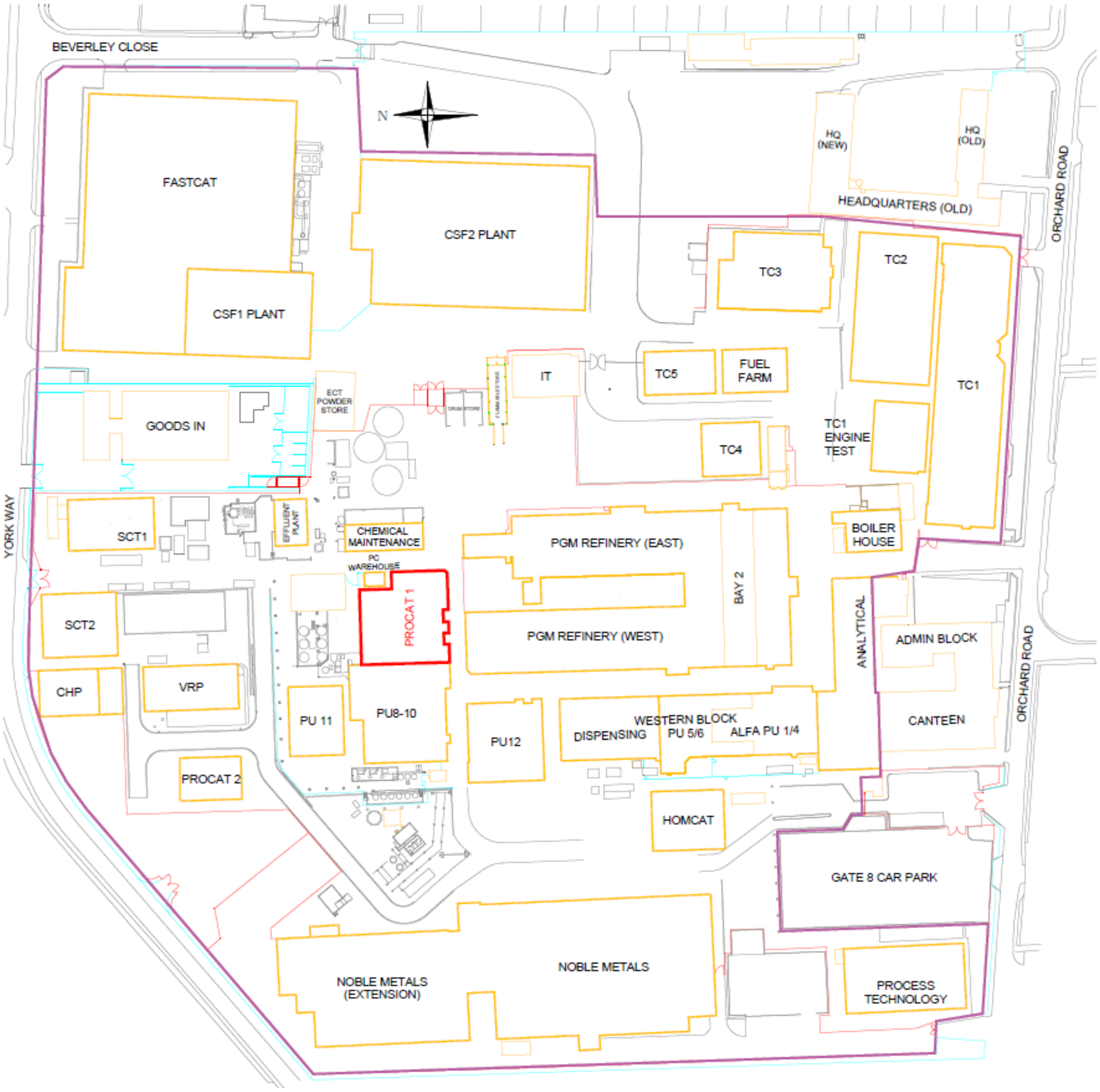
See electronic copy.

Within the report Scenario 1 provides an updated model of the installation with latest stack monitoring data, scenario 2 includes the impact of predicted emissions from proposed new processes including PTZ and the future proposal for a new refinery, for the purpose of this variation Scenario 2 data and associated conclusions are the applicable sections of the dispersion model. Scenario 3 covers the future model based upon the future planned decommissioning of the existing refinery.

Appendix 2 - EHS POLICY STATEMENT

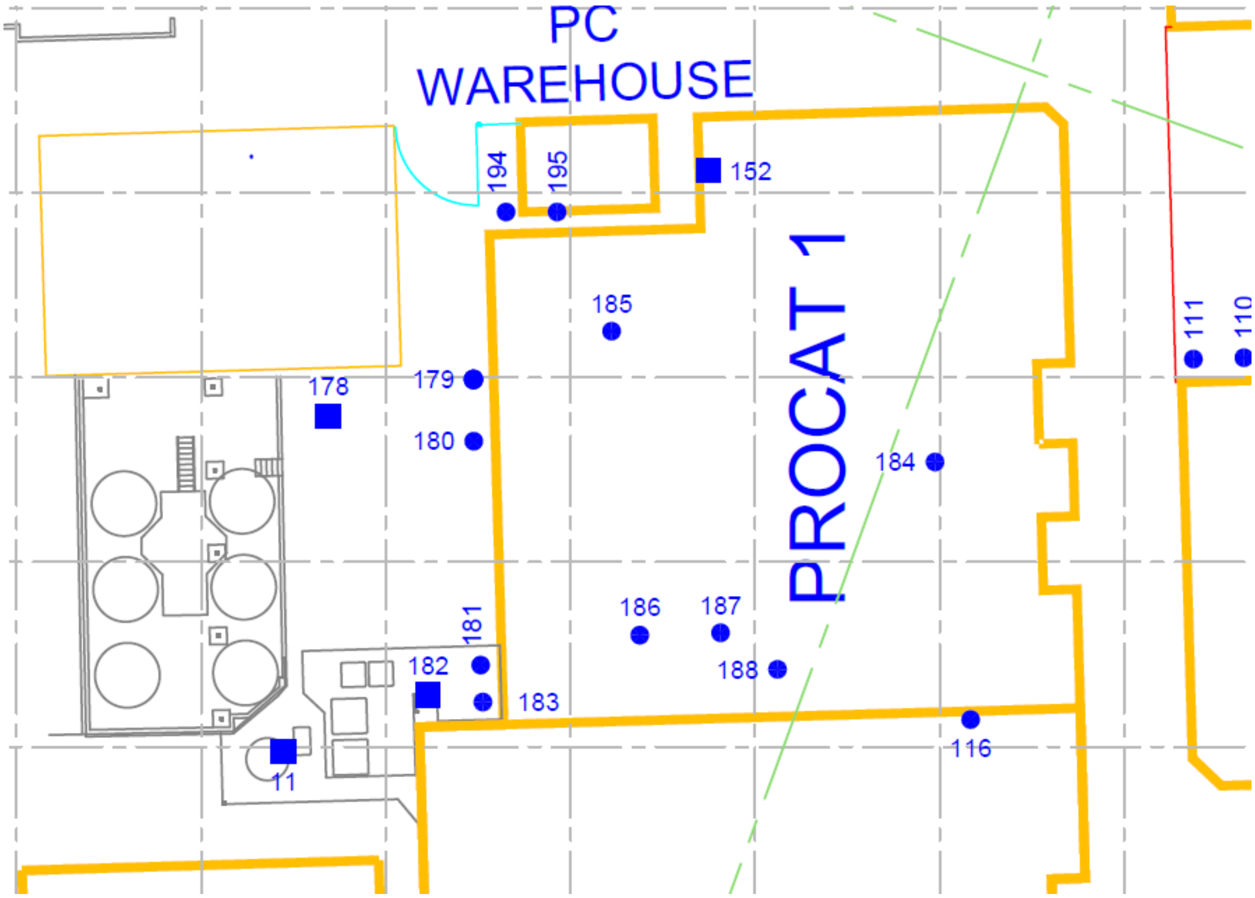
See electronic copy.

Appendix 3 – Procat 1 location within site boundary map



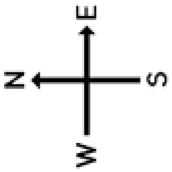
Site plan with EPR installation boundary marked in purple and location of PTZ in red. –

Appendix 4 – Stacks location on PTZ



PTZ Dust emissions routed to A178 or extracted into Procat building via Dust Collection Extractor (DCE) unit with High Efficiency Particulate Arrestance HEPA) filter.

PTZ Gaseous emissions are routed to A11.



N.B. Full pdf of stack map enclosed.

Appendix 5 – Site closure plan

Site Closure plan reviewed. As unit-operations and raw materials are the same as for existing processes within Procat 1, no change to existing, November 2018, plan is required.

Procat 1 section of plan shown below:

Structure	Contents / Hazardous materials /other hazards	Actions for safe decommissioning /unresolved issues
Fine Chem (PU 8-10)/Process Catalyst 1		
General	PM contamination Residual reagents Stored reagents (in IBCs, drums, carboys, etc.)	As described in Site-wide Aspects (above)
Services	Hydrochloric acid Sodium Hydroxide Chlorine gas Natural gas	Once production has ceased, the services to the building will be isolated. For HCl and NaOH the lines will be drained through process vessels and flushed through with water to VRP/SETP. Chlorine lines will be flushed through to a process vessel and to the scrubbers with nitrogen gas. Natural gas lines will be decommissioned by an approved gas contractor.
Demolition	PM contamination Chemical contamination	Once all pipelines have been washed through then they can be removed and disposed of.

Appendix 6 – Noise survey

See attached electronic copy.

Appendix 7: JM Risk Matrix

JM Risk Matrix 2018

			CONSEQUENCE CATEGORY								
CATEGORY A	(5) CATASTROPHIC	Environment	Major / readily identifiable environmental damage many kilometres from the site boundary.	🟨 5H	🟨 5G	🟧 5F	🟧 5E	🟧 5D	🟥 5C	🟥 5B	🟥 5A
		Health	Exposure to workplace health hazards rated as high and there is a high incidence of occupational illness cases with one or more fatality.								
		Safety	Multiple onsite fatalities (greater than 1). Any number of offsite fatalities or major injuries.								
		Authorities	Authorities Fines affecting profitability or significant custodial sentences.								
		Fires	Whole plant or office significantly affected. Over one month of business interruption. Significant damage to multiple plant items. Significant loss of business information								
		Reaction	International attention / outcry threatens business.								
		Financial	Replacement cost / loss > £10M.								
	(4) MAJOR	Environment	Major / readily identifiable environmental damage within a few kilometres of the site boundary.	🟩 4H	🟨 4G	🟨 4F	🟧 4E	🟧 4D	🟧 4C	🟥 4B	🟥 4A
		Health	Exposure to workplace health hazards rated as high and there is a high incidence of occupational illness cases with some resulting in permanent disability								
		Safety	Fatality, life threatening or life changing injury, e.g. amputation of limb or injury resulting in permanent loss of sight or hearing. Any number of offsite severe injuries.								
		Authorities	Severe fines (>£20k) or custodial sentences.								
		Fires	Whole plant or office significantly affected. Up to 4 weeks of business interruption. Significant damage to multiple plant items. Significant loss of business information.								
		Reaction	National headlines and continuing local attention.								
		Financial	Replacement cost / loss of £1M to £10M.								
CATEGORY B	(3) SEVERE	Environment	Observable many kilometres from the site and measurable off-site environmental impact within a kilometre of the site boundary.	🟩 3H	🟩 3G	🟩 3F	🟨 3E	🟨 3D	🟧 3C	🟧 3B	🟥 3A
		Health	Exposure to workplace health hazards rated as high and/or there is a high incidence of occupational illness cases.								
		Safety	Fractures, other than fingers or toes. Amputation of fingers or toes. Significant injury to eyes requiring corrective surgery. Crush injury to head or torso. Burns that cover more than 10% of the body or cause significant injury to eyes or respiratory tract. Loss of consciousness due to head injury or asphyxiation. Any accident involving injury in a confined space. Any injury or illness involving resuscitation or hospitalisation for more than 24 hours. Any number of offsite serious injuries.								
		Authorities	Prosecution with potential for fines up to £20k.								
		Fires	Multiple areas affected. Up to one week of business interruption. Significant heat damage to equipment. Minor loss of business information.								
		Reaction	Public concern and some national press attention.								
		Financial	Replacement cost / loss of £100k to £1M.								
CATEGORY C	(2) SERIOUS	Environment	Measurable on-site environmental impact. Major breach of regulatory consent and/or observable off site.	🟩 2H	🟩 2G	🟩 2F	🟩 2E	🟨 2D	🟨 2C	🟧 2B	🟧 2A
		Health	Exposure to workplace health hazards rated as significant and/or there is a high incidence of occupational illness cases.								
		Safety	An incident involving medical treatment beyond defined first aid. A lost time accident without severe consequences. Any number of offsite first aid injuries.								
		Authorities	Notifiable to regulator with possibility of minor notice of violation.								
		Fires	One plant area or office significantly affected. Up to two days of business interruption. Some heat damage to equipment. Minor loss of business information.								
		Reaction	Some local attention, for example local media coverage.								
		Financial	Replacement cost / loss of £10k to £100k.								
	(1) SIGNIFICANT	Environment	Minor breach of regulatory consent with no measurable environmental impact.	🟩 1H	🟩 1G	🟩 1F	🟩 1E	🟩 1D	🟨 1C	🟨 1B	🟧 1A
		Health	Exposure to workplace health hazards rated as significant and/or occupational illness cases may have occurred.								
		Safety	A first aid incident.								
		Authorities	No expected enforcement action by regulator.								
		Fires	Only one plant area or office affected. Only one day of business interruption. Minor heat damage to equipment. No loss of business information.								
		Reaction	Complaint from local resident.								
		Financial	Replacement cost / loss of £1k to £10k.								
	(0) SITE ISSUE	Environment	No environmental damage or pollution, readily controlled and contained on company property.	🟩 0H	🟩 0G	🟩 0F	🟩 0E	🟩 0D	🟨 0C	🟨 0B	🟧 0A
		Health	Exposure to workplace health hazards rated as low and no cases of occupational illness have occurred.								
		Safety	EHS Learning Event.								
		Authorities	Not applicable.								
		Fires	Not applicable.								
		Reaction	Site issue only.								
		Financial	Replacement cost / loss up to £1k.								
			EVENT FREQUENCY (YR-1)	10-7 (H)	10-6 (G)	10-5 (F)	10-4 (E)	10-3 (D)	10-2 (C)	10-1 (B)	1 (A)
				EXTREMELY UNLIKELY	VERY UNLIKELY		UNLIKELY		POSSIBLE	PROBABLE	REGULAR
				Theoretically possible but extremely remote chance of occurrence	Foreseeable event but very remote chance of occurrence during the lifetime of the plant / facility / process. Requires multiple independent protective layers to fail on demand.		Incidents known in industry. Unlikely events not expected during the lifetime of the plant / facility / process. Requires 1 or 2 independent protective layers to fail on demand.		Possible during the lifetime of the plant / facility / process. Root cause likely to have occurred.	Event or near miss that has occurred during the plant / facility / process life time.	Event occurs regularly on the plant / facility / process.

🟥	Unacceptable risk: Terminate activities immediately.
🟧	Intolerable: - Tasks should not begin or should be terminated. - For new processes or work activities, add safeguards to achieve ALARP before starting the process or activity. - For existing processes or operational activities a Sector approved and prioritised risk reduction plan is required to achieve ALARP. Group EHS approval is also required for consequence categories 4 and 5.
🟨	Tolerable if ALARP: Manage existing safeguards/barriers to ensure continuous risk reduction and demonstrate best practice.
🟩	Broadly acceptable: Manage existing safeguards/barriers and take opportunities for further risk reduction when appropriate.

Appendix 8: JM Electricity REGO certificate

See attached pdf copy of certification.

Appendix 9 – Raw Materials Safety Data Sheets

Please see electronic pdf copies of zeolite MSDS and platinum nitrate msds.

Appendix 10 – Certificate of Company Registration

Please see electronic pdf copies Certificate of Company Registration.

Appendix 11 – Climate Change Levy Agreement

Please see electronic pdf copy of Climate Change Levy Agreement.