Table 3.1
3CR Production of Speciality Inorganic Chemicals BREF BAT Assessment

This BAT Assessment is for the new 3CR process only.

BAT Requirement	Specific Measures
General BAT conclusions	
Raw and Auxiliary Materials Supply, Storage, Handling and Preparation	
BAT 5.1. BAT is to reduce the amount of packaging materials disposed of by, e.g., recycling 'hard' and 'soft' used packaging materials (see Sections 4.2.1 and 4.2.2), unless safety or hazard considerations prevent it.	JM recycle packaging material (i.e., plastic / cardboard) where possible. Wooden pallets are also returned to the supplier for re-use.
Synthesis/Reaction/Calcination	
BAT 5.2. BAT is to reduce emissions and the number of residues generated by implementing one or more of the following measures: a. using high purity feedstock (see Section 4.3.1) b. improving reactor efficiencies (see Section 4.3.2) c. improving catalyst systems (see Section 4.3.3).	a.JM work with a supplier to procure high quality feedstock. b. The 3CR reactors will comprise agitators with the appropriate motor to the viscosity of the liquid. Pumps will constantly monitor; with manual additions of dosing to ensure the most efficient reactions possible. c. Not applicable, 3CR is a precious metals refinery. The 3CR process follows a series of chemical reaction stages and separation stages to isolate and purify the precious metals.
BAT 5.3. For discontinuous processes, BAT is to optimise yields, lower emissions and reduce waste by sequencing the addition of reactants and reagents (see Section 4.3.4).	JM use a basic process control system (BPCS) computer-controlled systems which analyses the process continuously to allow optimisation of the 3CR process and greater control over when the process finishes.
BAT 5.4. For discontinuous processes, BAT is to minimise cleaning operations by optimising the sequences for addition of raw and auxiliary materials (see Section 4.3.4).	The refining of precious metals is a batched process that is computer controlled. The addition of raw materials will be strictly controlled. Cleaning is carefully planned and only undertaken when necessary. When cleaning is required, spray balls are used to reduce water use. The 3CR buildings have been designed for ease of cleaning.

BAT Requirement	Specific Measures
Product Handling and Storage	
BAT 5.5. BAT is to reduce the amount of residues generated by, e.g., using returnable product transportation containers/drums (see Section 4.2.1).	JM return containers and drums to suppliers where possible.
Waste Gas Emissions Abatement	
BAT 5.6. BAT is to minimise emissions of total dust in off-gases and achieve emission levels of 1 – 10 mg/Nm^3 by using one or more of the following techniques: a. cyclone (see Section 4.4.2.1.2) b. fabric or ceramic filter (see Section 4.4.2.1.5) c. wet dust scrubber (see Section 4.4.2.1.3) d. ESP (see Section 4.4.2.1.4). The lower end of the range may be achieved by using fabric filters in combination with other abatement techniques. However, the range may be higher, depending on the carrier gas and particle characteristics (see Section 4.4.2.1). Using fabric filters is not always possible e.g., when other pollutants have to be abated (e.g., SO_x) or when the off gases present humid conditions (e.g., presence of liquid acid). The particulate matters recovered/removed are recycled back into production when this is feasible. The scrubbing medium is recycled when this is feasible.	Not applicable. The process is 'wet' and waste gases are abated with wet scrubbers so dust generation will be minimal.
BAT 5.7. BAT is to reduce HCN emissions and achieve emission levels of <1 mg/m^3 by scrubbing with an alkaline solution. The scrubbing medium is recycled when this is feasible (see Section 4.4.2.2.5).	Not applicable HCN is not emitted by the process.

BAT Requirement	Specific Measures
BAT 5.8. BAT is to reduce NH_3 emissions and achieve emission levels of <1.2 mg/m^3 by scrubbing with an acidic solution. The scrubbing medium is recycled when this is feasible (see Section 4.4.2.2.5).	NH3 emissions will be routed to the ammonia scrubber and treated with an acidic solution.
BAT 5.9. BAT is to reduce HCl emissions, e.g., by wet gas scrubbing under alkaline conditions (see Section 4.4.2.2.4). If HCl is the main pollutant to be treated and alkali scrubbing is used, BAT is to achieve 3 – 10 mg/Nm^3 HCl.	HCl emissions will be routed to the caustic scrubber and treated with sodium hydroxide to meet the specified emission level.
Wastewater Management and Water Emissions Abatement	
BAT 5.10. BAT is to allocate contaminated wastewater streams according to their pollutant load. Inorganic wastewater without relevant organic components is segregated from organic wastewater and ducted to special treatment facilities (see Section 4.4.1 and Figure 4.1).	Effluent waste streams are segregated according to composition in accordance with the existing site effluent management system. Effluent is treated initially in a Values Recovery Plant to separate a metal rich waste stream for recovery off-site.
BAT 5.11. For rainwater, BAT is to minimise pollution to receiving watercourses by applying all of the following measures: a. minimising the contamination of rainwater from activities carried out at the installation in particular by applying measures for reducing fugitive and diffuse emissions (see BAT 5.12 and BAT 5.13 and BAT 5.17) b. ducting and storing rainwater (see Section 4.7.4) expected to be contaminated from activities carried out at the installation and treating it if necessary. Other rainwater may be directly discharged (see Section 4.7.4) c. monitoring the discharge of this other rainwater as outlined in Section 4.7.4. Rainwater found to be contaminated is treated as in b. above (see Section 4.7.4). In some cases, the use of rainwater as process water to reduce freshwater consumption may be environmentally beneficial.	a. Outdoor waste and chemical storge areas will be covered to minimise the contamination of rainwater. b. Where rainfall enters areas served by the onsite drainage system it will be captured by the sealed effluent drainage system and treated prior to discharge to sewer. c. All water flowing to the effluent treatment plant is monitored prior to discharge.
Infrastructure	

BAT Requirement	Specific Measures
BAT 5.12. For diffuse emissions, BAT is to minimise diffuse dust emissions where dust may arise (in particular from the storage and handling of materials/products) by applying one or more of the following techniques: a. storing materials in closed systems (e.g., silos, see Section 6.3.4.1) b. using covered areas protected from rain and wind (see Section 6.3.4.1) c. having production equipment, e.g., conveyors, totally or partially enclosed (see Section 2.2) d. having equipment designed with hooding and ducting to capture diffuse dust emissions (e.g., during loading into storage) and abating it (e.g., using a fabric filter, see Section 6.3.4.1) e. carrying out housekeeping regularly, e.g., by vacuuming (see Section 4.7.6).	The potential to generate dust from the 'wet' 3CR process is considered to be low. a. Raw materials will be stored within enclosed systems. b. Raw materials and waste storage areas will be protected from rain and wind. c. Production equipment will be totally or partially enclosed. d. Low potential for dust generation due to the nature of the process. e. JM will carry out housekeeping regularly including in areas where raw materials and waste will be handled.
BAT 5.13. BAT is to minimise fugitive gaseous and liquid emissions by applying (according to the substances that may require controlling) one or more of the following techniques: a. having periodic leak detection and repair programmes (see Sections 4.7.1 and 2.6.6) b. operating equipment at slightly below atmospheric pressure (see Section 6.3.4.16) c. replacing flanges by welded connections (see Section 2.6) d. using seal-less pumps and bellow valves (see Section 2.6) e. using high performance sealing systems (e.g., effective gaskets and flanges, valves and pumps with high integrity packing, see Section 2.6) f. carrying out housekeeping regularly (see Section 4.7.6).	JM will operate the draught systems under slight negative pressure (through to scrubbers). (a) Fugitive emissions of VOCs will be very low and it is considered disproportionate to implement a full LDAR programme. Losses will be monitored by mass balance. (c), (d)The design and HAZOP process will ensure that welded connections, seal less pumps and below valves will be used in the process. (e)The design and HAZOP process have included high performance sealing systems. (f) Daily checks and housekeeping will be undertaken on equipment. JM are considered to have met this condition.

BAT Requirement	Specific Measures
BAT 5.14. For new installations, BAT is to: 5.14 use a computerised control system to operate the plant (see Section 4.5.2). However, this does not apply where safety issues do not permit automatic operations (e.g., in the production of SIC explosives).	Onsite processes are controlled by programmable logic controlled (PLC) systems and will be monitored and recorded on the Supervisory control and data acquisition (SCADA) system (the computer process management and monitoring system).
BAT 5.15. For installations where solid hazardous compounds can build up in pipelines, machines and vessels, BAT is to have in place a closed cleaning and rinsing system (see Section 4.5.1).	JM will have a closed cleaning and rinsing system for equipment and pipework where hazardous compounds may build up along the coating lines. Appropriate drains and vents will be installed on pipework to allow for flushing. Clean in place operations are present.
Energy	
BAT 5.16. BAT is to reduce the consumption of energy by optimising plant design, construction and operation, e.g., by using pinch methodology, except if safety issues prevent it (see Section 4.6.1).	Operation of plant will be optimised to reduce consumption of energy. JM will have. JM will not use Pinch-Point assessments for heat exchangers as only small volume of batch processes are run in sequence. As well, the size of our heat exchangers is in anything between 10-150 kW. As well our feeds coming to this plant are very dynamic and the flowsheet is agile enough to "shut" a section down when not in use. While we don’t have a pinch point, our file flowsheet allows us to utilise the flowsheet we need depending on the feed.

BAT Requirement	Specific Measures
	use their computerised systems to undertake assessment of the 'pinch point' on the 3CR process to enable the most efficient heat exchange.
Cross-Boundary Techniques	
BAT 5.17. BAT is to minimise soil and groundwater pollution by designing, building, operating and maintaining facilities, where substances (usually liquids) which represent a potential risk of contamination of ground and groundwater are handled, in such a way that material escapes are minimised (see Section 4.7.1). This includes all of the following: a. having facilities sealed, stable and sufficiently resistant against possible mechanical, thermal or chemical stress. This is particularly important for highly toxic substances – e.g., cyanides, phosphorus compounds b. providing sufficient retention volumes to safely retain spills and leaking substances in order to enable treatment or disposal c. providing sufficient retention volume to safely retain firefighting water and contaminated surface water d. carrying out loading and unloading only in designated areas protected against leakage run-off e. storing and collecting materials awaiting disposal in designated areas protected against leakage run-off f. fitting all pump sumps or other treatment plant chambers from which spillage might occur with high liquid level alarms or having pump sumps regularly inspected by personnel g. establishing programmes for testing and inspecting tanks and pipelines including flanges and valves	a. Indoor and outdoor areas associated with the 3CR building comprise an impermeable surface. Secondary containment and bunding will be in place and designed to specification b & c. Should a spill of raw materials / product occur, or firewater be required onsite then they will enter the drainage system and drain to the effluent treatment plant and end up in one of two 450m^3 effluent holding tanks. d. Loading and unloading will only occur in designated areas protected against leakage run-off. e. waste storage areas will be on an impermeable surface and drain to the sealed drainage system which discharges to the effluent treatment plant prior to release to sewer. f. high level alarms will be present on sumps and effluent tanks associated with the 3CR process. These pieces of equipment will also be inspected daily. g. The 3CR process will be operated under the PPM service at site and regularly maintained. h. Spill kits will be available in areas that handle raw materials, waste and product. i. Testing and demonstrating the integrity of bunds will be undertaken on a 6 monthly basis by an external contractor, once site wide bund improvement

BAT Requirement	Specific Measures
h. providing spill control equipment, such as containment booms and suitable absorbent material i. testing and demonstrating the integrity of bunds j. equipping tanks with overfill prevention k. storing materials/products in covered areas to keep rainfall out.	project has been completed. Internal and external bunds are routinely maintained, all bunds are under a condition monitoring schedule. j. High- and low-level alarms will be installed on tanks that serve the process lines. k. Raw materials, waste and finished products will be stored indoors or undercover to prevent rainfall ingress. UN approved containers will be used to store raw materials.
BAT 5.18. BAT is to have a high level of education and continuous training of personnel (see Section 4.7.2). This includes all of the following: a. having personnel with sound basic education in chemical engineering and operations b. continuously training plant personnel on the jobs c. regularly evaluating and recording the performance of personnel d. regularly training personnel on how to respond to emergency situations, health and safety at work, and on product and transportation safety regulations.	a. Personnel with qualifications in chemical engineering will operate the process lines. b. & c. Training is recorded under the EMS and will be evaluated on a regular basis to ensure that the equipment is operated by knowledgeable personnel. d. Training on how to reduce accidents and minimise the impact of the installation on the environment is provided to onsite personnel annually.
BAT 5.19. BAT is to apply, if available, the principles of an Industry Code (see Section 4.7.3). This includes all of the following: a. applying very high standards for safety, environmental and quality aspects in the production of the SIC substances b. carrying out activities such as auditing, certification, training of plant personnel (related to BAT number 5.18 and 5.22).	a. 3CR will be operated to the following UK industry codes: • S.I. 2016/1091 Electromagnetic Compatibility Regulations 2016 (UK) • S.I. 2016/1153 Measuring Instruments Regulations 2016 (UK) • S.I. 2016/1107 Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016 (UK) • S.I. 2016/1101 Electrical Equipment (Safety) Regulations 2016 (UK) • S.I. 2008/1597 Supply of Machinery (Safety) Regulations 2008 (UK) • S.I. 2001/ 3958 Noise Emission in the Environment by Equipment for use Outdoors Regulations 2001 • S.I. 2016/ 1105 UK Pressure Equipment (Safety) Regulations 2016 (PER)

BAT Requirement	Specific Measures
	• S.I. 2010/2617 Eco-design for Energy Related Products Regulations 2010 Additional standards i.e., BS EN / EU will also be adhered to where required. b. Regular internal and external audits occur which include review of the training procedure.
BAT 5.20. BAT is to carry out a structured safety assessment for normal operation and to take into account effects due to deviations of the chemical process and deviations in the operation of the plant (see Section 4.7.5).	A HAZOP assessment has been undertaken for 3CR.
BAT 5.21. In order to ensure that a process can be controlled adequately, BAT is to apply one individual or a combination of the following techniques (without ranking, see Section 4.7.5): a. organisational measures b. concepts involving control engineering techniques c. reaction stoppers (e.g., neutralisation, quenching) d. emergency cooling e. pressure resistant construction f. pressure relief.	A structured safety assessment for each reaction will be undertaken. In order to safely control the reactions all of the aspects of BAT5.21 will be put in place.
BAT 5.22. implement and adhere to an Environmental Management System (EMS) that incorporates, as appropriate to individual circumstances, the following features (see Section 4.7.6): a. definition of an environmental policy for the installation by top management (commitment of the top management is regarded as a precondition for the successful application of other features of the EMS)	The Site have an EMS accredited to ISO 14001. The site's EMS will be updated to include all the features in BAT 5.22 relating to the 3CR process.

BAT Requirement	Specific Measures
b. planning and establishing the necessary procedures c. implementation of the procedures, paying particular attention to: • structure and responsibility • training, awareness and competence • communication • employee involvement • documentation • efficient process control • maintenance programmes • emergency preparedness and response • safeguarding compliance with environmental legislation h. checking performance and taking corrective action, paying particular attention to: • monitoring and measurement (see also the Reference Document on General Principles of Monitoring) • corrective and preventive action • maintenance of records • independent (where practicable) internal auditing in order to determine whether or not the environmental management system conforms to planned arrangements and has been properly implemented and maintained e. review by top management. Three further features, which can complement the above stepwise, are considered as supporting measures. However, their absence is generally not inconsistent with BAT. These three additional steps are:	

BAT Requirement	Specific Measures
f. having the management system and audit procedure examined and validated by an accredited certification body or an external EMS verifier g. preparation and publication (and possibly external validation) of a regular environmental statement describing all the significant environmental aspects of the installation, allowing for year-by-year comparison against environmental objectives and targets as well as with sector benchmarks as appropriate h. implementation and adherence to an internationally accepted voluntary system such as EMAS and EN ISO 14001:1996. This voluntary step could give higher credibility to the EMS. In particular EMAS, which embodies all the above-mentioned features, gives higher credibility. However, non-standardised systems can, in principle, be equally effective provided that they are properly designed and implemented.	
Production of speciality inorganic pigment BAT conclusions – Not applicable	
Production route for the manufacture of iron oxide pigments – Not Applicable	
BAT for the production of phosphorus compounds – Not applicable	
BAT for the production of silicones – Not applicable	
BAT for the production of SIC explosives - Not applicable	
BAT conclusions generally applicable to the production of cyanides – Not applicable	