REPORT

Phase 4 - Woodsmith Mine Emissions to Atmosphere - NYMNPA-91

Woodsmith Mine Phase 4 – Generator Emissions

Client: Sirius Minerals PLC

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Table of Contents

Table of Tables

1 Introduction

1.1.1 In 2014 a planning application (reference NYM/2014/0676/MEIA) was submitted to North York Moors National Park Authority (NYMNPA) for permission to develop a polyhalite mine and underground Mineral Transport System (MTS). Planning consent was subsequently granted in 2015, subject to conditions.

1.1.2 This document has been prepared on behalf of Sirius Minerals plc (Sirius Minerals) and details the requirements with respect to emission to atmosphere for Phase 4 of the development at Woodsmith Mine (see paragraph 1.1.5 below). This document is required to partially discharge condition 91 of the NYMNPA planning permission NYM/2014/0676/MEIA and has been prepared in accordance with current good practice. The planning condition states that:

"The final specification and configuration of generators to be employed at Doves Nest Farm and Lady Cross Plantation, such to be fitted with Selective Catalytic Reduction (SCR), or other such emissions control measures as are necessary, will be submitted to the MPA for approval prior to commencement of their use. Results of air dispersion modelling will be submitted at the same time to verify that the identified configuration will lead to nutrient nitrogen and acid deposition at levels no greater than those that were demonstrated in the York Potash Environmental Statement (September 2014 as updated by the Supplementary Environmental Statement dated February 2015) as not leading to a significant effect on the integrity of the North York Moors SAC, SPA and SSSI."

1.1.3 This document also relates to the consideration of condition 50 of the NYMNPA planning permission NYM/2014/0676/MEIA. This is not a pre-commencement condition as such, and is included here for reference. The planning condition states that:

"In accordance with the details in the document "York Potash Project: Habitats Regulations Assessment" prepared by Amec Foster Wheeler dated June 2015 with document reference 35190CGos064R, diesel generators installed at the Dove's Nest Farm site during the construction period

a. shall be fitted with Selective Catalytic Reduction (SCR) abatement technology on their exhausts which shall be shown by the suppliers to achieve a reduction in oxides of nitrogen within the generator exhausts of at least 88% when compared to what would be expected without SCR; and

b. shall at all times demonstrably be operated and maintained in a way to ensure a reduction in oxides of nitrogen within the generator exhausts of at least 88% when compared to what would be expected without SCR."

1.1.4 The specific requirements of the planning condition are detailed in **Table 1-1**.

Table 1-1 Condition NYMNPA-91 Emissions to Atmosphere

Condition NYMNPA-91	Compliance with Condition NYMNPA-91
The specification and configuration of generators and Selective Catalytic Reduction (SCR) / emission control measures.	Section 2.2 Section 3.2
Confirmation that Phase 4 nutrient nitrogen and acid deposition rates are below those presented in the York Potash Environmental Statement (ES) and Supplementary Environmental Information Report (SEI).	Section 3.1

1.1.5 This assessment considers only the Phase 4 Works at Woodsmith Mine and does not include any activities at Lady Cross Plantation, as these works are deferred. Updates to this assessment will be prepared for subsequent construction phases and following any design review or method change.

1.1.6 The activities required for the Phase 4 Works comprise the following:

- Operation of the concrete batch plant;
- Installation, commissioning and operation of the bentonite plant and associated temporary structures;
- Installation of concrete guide walls (excavate to -3.5m and concrete wall down to -1.5 to -1.75 m);
- Mobilisation to site of diaphragm walling equipment (cutters, cranes, workshops etc.);
- Diaphragm wall construction to -60m below ground level at the Production, Service and Mineral Transport System shafts; and,
- Limited continuation of earthworks to create an area for future storage of spoil.

2 Methodology

2.1 Introduction

2.1.1 This assessment considered the impact of nutrient nitrogen and acid deposition from plant installed as part of the Phase 4 scope of works. As required by Condition NYMNPA-91, dispersion modelling was conducted to assess emissions from proposed power generation plant used within Phase 4. The results are compared to the deposition rates presented within the York Potash Environmental Statement (ES) and Supplementary Environmental Information report (SEI).

2.2 Phase 4 Emission Calculations

2.2.1 This assessment was based on the air dispersion modelling assessment presented in the ES and SEI which supported the 2014 planning application. A more detailed energy demand profile is now available for the Phase 4 Works, and the specification and site location of individual generators has been incorporated in to this assessment. The following input data were retained from the model used in the ES and SEI:

- the receptor locations used for nutrient nitrogen and acid deposition predictions;
- the NOx emission rate from Non-Road Mobile Machinery (NRMM);
- off-site road link emission sources; and
- meteorological data.

2.2.2 The following input data were replaced or modified to reflect emissions during the stated Phase 4 scope of works:

- use of the most recent ADMS dispersion model (v5.2);
- modified routes on the local road network, as all vehicles will approach the site from the east (B1416) during Phase 4;
- the representation of emissions from NRMM as an area source, rather than a line source, to represent the areas on site that plant will be operating during Phase 4; and,
- all generator emissions were replaced with those proposed to be used in Phase 4.

2.2.3 Emission parameters for the proposed Phase 4 generators were based upon power requirements, generator specifications and operating times provided by Sirius Minerals and the Phase 4 Contractors.

2.2.4 For the largest (1 Mega Volt Amp (MVA)) generators, the NOx concentration in the exhaust gas and other emission parameters were provided by the generator manufacturer. The calculated NOx emission rate and release parameters used in the dispersion model are presented in **Table 2-1**.

Table 2-1 Emission Parameters for Phase 4 1MVA Generators

Parameter	Input for Dispersion Model
Provided by Manufacturer	
Release height (m)	7m above ground
Stack diameter (m)	0.4
Volumetric flow rate ($m^3.s^{-1}$)	3.586
Efflux temperature (°C)	472
Oxygen (%) (assumed)	9
NOx concentration (at Standard Temperature and Pressure (STP)) ($mg.m^{-3}$)	2,000
Calculated NOx Emissions	
NO_X emission rate (g/s)	1.97

2.2.5 For the smaller generators, emissions of NO_X were calculated using the required power demand, estimated fuel use, an assumed conservative operational efficiency of 40% and empirical emissions factors.

2.2.6 Emissions for the smaller generators were calculated using the methodology detailed in European Environment Agency (EEA) Guidance[1]. This document details specific emission factors for small combustion plant based on fuel type and source category (commercial/industrial or residential).

2.2.7 The European Monitoring and Evaluation Programme (EMEP)/EEA Emission Inventory Guidebook 2016 provides the following equation to calculate emissions from combustion sources such as generators:

[1] EMEP/EEA (2016) *Emission Inventory Guidebook – Small Combustion*

$$E_{pollutant} = AR_{fuelconsumption} \times EF_{pollutant}$$

Where:

$E_{pollutant}$ = the emission of the specified pollutant ($g.h^{-1}$)
$AR_{fuelconsumption}$ = the activity rate for fuel consumption ($GJ.h^{-1}$)
$EF_{pollutant}$ = the emission factor for the pollutant (g/GJ)

2.2.8 Emissions associated with generators were derived using the Tier 1 approach in EEA Guidance. Fuel consumption was derived using the electrical power of the plant, the electrical efficiency, the load factor and anticipated utilisation rate, as provided by the Contractor. A NO_X emission factor of 303.30 g/GJ was obtained from the EEA Guidance. The model input derivation is detailed in **Table 2-2**.

Table 2-2 Predicted NO_X Emission Rates for Phase 4 Generators

Number of Generators	Power (kVA)	Power (kW*)	Power Load (%)	Hours per day	AR Fuel Consumption ($GJ.h^{-1}$)	EF (Emission Factor) PM_{10} (g/GJ)**	NO_X Emission rate ($g.s^{-1}$)
1	350 kVA	280	50	12	1.26	303.30	0.106
1	100kVA	80	100	12	0.72	303.30	0.061
1	100kVA	80	100	24	0.72	303.30	0.061
1	50 kVA	40	100	24	0.36	303.30	0.030
10	50 kVA	40	100	24	0.36	303.30	0.030
1	20 kVA	16	100	12	0.14	303.30	0.012
1	20 kVA	16	100	24	0.14	303.30	0.012
1	10 kVA	8	100	12	0.07	303.30	0.006

*Based on kVA to kW conversion of 0.8
** The Emission Factor for diesel oil was used

2.2.9 A variable emission file was used to incorporate either a 12 or 24 hour operational profile to reflect emissions from each source.

3 Assessment Results

3.1 Comparison of Dispersion Modelling Results

3.1.1 The results of the assessment are presented in **Table 3-1**, which shows the predicted deposition of nutrient nitrogen and acid associated with the Phase 4 Works, compared to the equivalent value from the ES and SEI.

Table 3-1 Comparison of Nutrient Nitrogen and Acid Deposition

Receptor Ref	Max Modelled Nutrient Nitrogen Deposition Rate $kgN.ha^{-1}.y^{-1}$		Max Modelled Acid Deposition Rate $kEq.ha^{-1}.y^{-1}$		Result
	Phase 4	ES/SEI	Phase 4	ES/SEI	
U1	0.44	1.2	0.03	0.1	The predicted deposition of nutrient nitrogen and acid associated with the Phase 4 Works is within the acceptable values presented in the ES/SEI
U2	0.49	1.1	0.03	0.1	
U4	0.37	0.4	0.026	0.029*	

*reported as 0.0 to one decimal place in the ES, but calculated from the Nutrient Nitrogen deposition rate using the calculator on the Air Pollution Information System website

3.1.2 The results of the assessment show that the predicted Phase 4 deposition rates for both nutrient nitrogen and acid are less than those presented in the ES and SEI.

3.2 Consideration of Phase 4 Emission Controls

3.2.1 The maximum power demand considered in the ES and SEI was $20MW_E$, which assumed the use of retro-fitted SCR abatement technology and a 40m high stack. The deposition rates using this configuration were considered to be acceptable.

3.2.2 The maximum power generation demand for the Phase 4 Works is significantly lower than this previous assumption, at an output of $3.15MW_E$. The results of the Phase 4 generator emissions assessment therefore indicate that there will be a reduction in nutrient nitrogen and acid deposition at ecological receptor locations compared to that presented in the ES and SEI. Given this, it is not considered that additional investment in mitigation controls, including retro-fitted SCR abatement technology required under Condition NYMNPA-50, is necessary.

4 Conclusions/Condition Discharge

4.1.1 This generator emissions assessment shows that emissions from the Phase 4 Works will result in lower nutrient nitrogen and acid deposition at the assessed ecological receptors when compared to those values demonstrated in the ES and SEI. Additional mitigation controls, including those detailed in Condition NYMNPA-50, are therefore not required for Phase 4.

4.1.2 The assessment thereby demonstrates that the requirements of Condition NYMNPA-91 are met.