ROSE ENERGY

Proposed Biomass Fuelled Power Plant

Land off Ballyvannon Road, Nr Glenavy, County Antrim

Waste Streams - Ash

FINAL

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Submitted to:

ROSE ENERGY

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Engreen Environmental Consultants Ltd.

Engreen Environmental Consultants have a dedicated team of environmental specialists, with a combined experience of over 30 years working in the environmental sector within the organisation. Qualifications of the authors of this document are listed below.

Authors	**Qualifications**
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Engreen have aided clients in obtaining planning permissions, preparing Environmental Impact Assessment planning applications, obtaining Waste Management Licenses, Integrated Pollution Prevention and Control permits and assisting with technical issues in relation to plant design and environmental protection.

Direct experience in relation to this report covers work to gain waste management licences and to determine the most sustainable recovery and disposal options for waste streams. Key experience has been gained from:

- Assisting clients to gain and modify Waste Management Licences (more recently assisting in the preparation of Environmental Permitting Applications);
- Determining Best Practicable Environmental Options for the recovery and disposal of waste streams;
- Evaluating options to select the most effective waste storage and disposal techniques to meet IPPC permit requirements;
- Providing technical support to NGOs in the assessment of the application of waste legislation to particular waste streams;

Contents

1. INTRODUCTION 3
1.1 General 3
1.2 Report Format 3
2. ASH WASTE 4
2.1 Sources of Ash 4
2.2 Discussion of Ash Sources 4
2.3 Ash Constituents 5
2.4 Waste codes 5
2.5 Risks 6
2.6 Chemical Composition 8
3. WASTE HANDLING AND TESTING 9
3.1 Handling techniques 9
3.2 Removal 10
3.3 Analysis of the Waste Streams 10
4. WASTE REDUCTION AND DISPOSAL 12
4.1 Waste Reduction Techniques 12
4.2 Disposal Routes 12
5. CONCLUSION 14
5.1 Conclusion 14

1. Introduction

1.1 General

1.1.1 Rose Energy proposes to construct a biomass fuelled power plant, fuelled by Poultry Bedding and Meat and Bone Meal (MBM). As part of the Environmental Statement that is being prepared for the proposal there is a requirement to address ash generation and disposal/recovery options, as this will be one of the most significant waste streams for the facility.

1.1.2 It is anticipated that the total volume of ash produced at the facility from the various waste streams is in the order of 40,000 tonnes per annum.

1.2 Report Format

1.2.1 This report discusses the following:

- The sources of ash generation;
- Assessment of potential contaminants;
- Risks associated with the materials;
- Handling of the ash waste streams;
- The disposal options for the waste streams.

2. Ash Waste

2.1 Sources of Ash

2.1.1 The following potential sources will produce ash during the operations of the facility:

- Furnace ash and combustion residues;
- Boiler fly ash and residues;
- Fly ash;
- Reacted flue gas treatment chemical;
- Un-reacted flue gas treatment chemical;
- Bag filter wastes.

2.2 Discussion of Ash Sources

2.2.1 Furnace ash will be extracted from the fluidised bed on a continuous basis and pass through a classifying device. The oversized material will be directed into lidded storage compartments prior to mechanical removal for disposal. The rest of the furnace ash will be returned to the furnace bed by pneumatic conveyor. If there is excess material then this will be pneumatically conveyed to an ash silo.

2.2.2 Fly ash will be collected at the bottom of each boiler pass by gravity. This will be pneumatically conveyed to a screen which will separate out "oversize". The oversize will collect in lidded compartments as per the oversize from the furnace ash. The remaining ash will be pneumatically conveyed to the ash silo.

2.2.3 Further fly ash and residues from the pollution control equipment will be collected from the bag filter unit. A proportion will be recycled by pneumatic conveying back into the pollution control unit. The rest will be pneumatically conveyed to a screen which will separate out "oversize". The oversize will collect in lidded compartments as per the oversize from the furnace ash. The remaining ash will be pneumatically conveyed to the ash silo.

2.2.4 The flue gas treatment system will introduce lime into the flue gas stream to ensure potentially acidic releases are abated and controlled. The plant will be constructed with the ability to add activated charcoal with the lime should commissioning tests prove this is necessary; although it is not felt that this injection will be required a precautionary approach has been adopted and the assessment of ash disposal options has been evaluated on the basis that the stream may contain activated charcoal.

2.2.5 The emission from the treatment process will be treated in a bag filter to capture airborne particulate prior to discharge of the flue gas to air. Some of the collected material will be recycled through the flue gas treatment system to ensure maximum efficiency in the use of the lime and carbon. However, there will inevitably be some un-reacted components in the waste stream from the flue gas treatment system.

2.2.6 Bag filters will be present on the ash silo. The solids collected by this bag filter will be re-introduced into the silo and so will not lead to the generation of a separate waste stream.

2.3 Ash Constituents

2.3.1 The exact nature of the ash at this stage is unknown as it will be determined by the fuel mix and final operating conditions. It is proposed that detailed chemical analysis will be undertaken for the ash during the commissioning phase of the plant. In the meantime, following a review of PPC permits elsewhere in the UK, the following assumptions have been made regarding testing to confirm or disprove the presence of specific contaminants for the ash waste streams:

Table 1: Potential Waste Stream Contaminants

Waste Stream	Potential Contaminants / Constituents *
Furnace Ash+	Cadmium; Zinc; Vanadium; Lead; Copper; Chromium; Nickel; Cobalt; Manganese; Thallium; Arsenic; Mercury; Dioxins; Dioxin like substances.
Fly Ash+	Cadmium; Zinc; Vanadium; Lead; Copper; Chromium; Nickel; Cobalt; Manganese; Thallium; Arsenic; Mercury; Dioxins; Dioxin like substances; Calcium compounds (pH).

Notes:

* It should be noted that this is a fully inclusive list based on the precautionary principle until detailed testing of the produced ash has been carried out. The detailed testing is what will confirm or disprove the presence of each of the potential contaminants.

+ The oversized residues associated with each of these streams are expected to have similar contaminants and constituents to the main streams and will be assessed and dealt with in the same manner.

2.4 Waste codes

2.4.1 The primary reason for the plant is energy production. The ash waste streams will have the following European Waste Catalogue (EWC) codes listed in 10.01, ‘wastes from power stations and other combustion plants’:

Table 2: EWC Codes

Ash waste stream	EWC Code [1]	
	Non-hazardous	Hazardous
Furnace Ash	10 01 15	10 01 14*
Reacted & Un-reacted Flue Gas Treatment Chemicals and residual fly ash	10 01 19	10 01 18*

Notes:

1: The decision on whether the material is hazardous or non-hazardous can only be determined with analytical testing of the material during the commissioning phase (see later).

2.5 Risks

2.5.1 Table 3 below details the risk phrases and appropriate hazard phrases that are potentially applicable for the ash waste streams, dependent on findings of detailed chemical analysis to be undertaken during the commissioning phase.

2.5.2 Definitions of "R" numbers and "H" numbers used in Table 3 below:

2.5.3 "R": Risk Phrase for particular substances as defined by the requirements of Directive 67/548/EEC. Together with Directive 88/379/EEC, these have been implemented in the UK through the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002, which are known as CHIP3.

2.5.4 "H" no.: Article 1(4) of the Hazardous Waste Directive (HWD, Council Directive 91/689/EC) defines hazardous waste as wastes featuring on a list drawn up by the European Commission, because they possess one or more of the hazardous properties set out in the HWD. There are 14 hazardous properties set out in Annex III of the HWD.

Table 3: Potential Hazardous Waste Classifications

Contaminant	'R' Phrase	'H' phrase	Hazardous Waste Threshold	Furnace Ash	Reacted & Un-reacted Flue Gas Treatment Chemicals and residual fly ash
Cadmium	R26	H6	>0.1%	✓	✓
	R36 R37 R38	H4	>20%	✓	✓
	R45	H7	>0.1%	✓	✓
Zinc	R15	H3A(v)	Test and/ or calculation	✓	✓
	R17	H3A(ii)	Test	✓	✓
	R50/R53	H14	>0.25%	✓	✓
Vanadium	n/a	n/a	n/a	✓	✓
Lead	R23 R25	H6 (H5)	>3%	✓	✓
Copper	R11	H3A(iii)	Test	✓	✓
	R36 R37 R38	H4	>20%	✓	✓
Chromium	R23 R24 R25	H6 (H5)	>3%	✓	✓
	R36 R37 R38	H4	>20%	✓	✓
	R45	H7	>0.1%	✓	✓
Nickel	R10	H3B	Flashpoint:	✓	✓

Contaminant	**'R' Phrase**	**'H' phrase**	**Hazardous Waste Threshold**	**Furnace Ash**	**Reacted & Un-reacted Flue Gas Treatment Chemicals and residual fly ash**
			>21^{0}C to 55^{0}C		
	R17	H3A(ii)	Test	✓	✓
	R36 R37 R38	H4	>20%	✓	✓
	R40	H7	>1%	✓	✓
	R42 R43	n/a	n/a	✓	✓
Cobalt	n/a	n/a	n/a	✓	✓
Manganese	R20 R22	H5	>25%	✓	✓
Thallium	R26 R28	H6 (H5)	>0.1%	✓	✓
	R33	n/a	n/a	✓	✓
	R47	n/a	n/a	✓	✓
Arsenic	R23 R25	H6 (H5)	>3%	✓	✓
	R50 R53	H14	>25%	✓	✓
Mercury	R21 R22	H5	>25%	✓	✓
	R23	H6 (H5)	>3%	✓	✓
	R33	n/a	n/a	✓	✓
Dioxins & dioxin like substances [1]	R26, R27, R28	H6	>0.1%	✓	✓
	R45	H7	>0.1%	✓	✓
	R46	H11	>0.1%	✓	✓
Calcium compounds [2]	R41	H4	10%	x	✓
	R36	H4	20%	x	✓

Notes:

1: The concentrations and nature of dioxins and dioxin-like substances will be determined by analysis of the ash streams during commissioning. For this initial evaluation a worst case scenario (precautionary approach) has been assumed and the evaluation has taken the highest risk phrase/lowest hazardous waste thresholds for the materials. This approach is consistent with the precautionary principle approach adopted for the ash disposal routes. The actual risk and hazard classifications will be refined and made more robust following detailed speciated analysis for these substances in the ash waste streams.

2: For calcium compounds, the evaluation has assumed calcium hydroxide (R41) and Calcium chloride (R36) compounds at this stage. Obviously, as with dioxins, more detailed testing when the ash is being generated will allow more detailed assessment of risk phrases and hazard categories.

2.6 Chemical Composition

2.6.1 The following data has been reviewed to assist in the categorisation of the ash material.

2.6.2 Existing 'Biomass Power' Plants in the UK that utilise either Poultry Bedding or MBM as the fuel source. The facilities operate under existing PPC Permits and routinely report the following parameters for all their ash streams (bottom ash; fly ash; APC residues (bag filter collection system)):

  - Dioxins;
  - Furans;
  - PCBs;
  - Metals: Cadmium; Zinc; Vanadium; Lead; Copper; Chromium; Nickel; Cobalt; Manganese; Thallium; Arsenic; Mercury;
  - Soluble metals (list as above).

- The frequency of testing is annual, with the exception of the solubility tests, which are required on change of disposal option;
- The information provided by the EA for the plant which utilises Poultry Bedding as the fuel indicates that the ash waste stream is sent off site for use in the fertiliser industry;
- The plant which utilises MBM as the fuel sends its ash for landfill as inert waste.

2.6.3 Rose Energy management have undertaken some trials for the various potential fuel sources for their proposed facility. At this stage the testing and analysis has been limited, but the following conclusions can be made:

- Analysis of ash from the MBM source suggests that the material would be classified as non-hazardous waste;
- Analysis of ash from a variety of poultry bedding sources has been undertaken. The range of results for certain parameters suggests that the materials could be classified as either non-hazardous waste or hazardous waste.

2.6.4 It should be noted that none of the data available is a direct reflection of the anticipated ash streams from the proposed facility. However the data does provide a useful insight into the types of contaminants that may be present within the ash wastes. The information from the existing facilities also provides information as to the likely parameters that will be required to be analysed under the PPC Permit.

3. Waste Handling and Testing

3.1 Handling techniques

3.1.1 Details have been provided above as to how the ash streams will be generated, transferred and stored. The intention is to operate the plant at a steady state, which will limit potential variability in ash generation as far as possible. Limiting this variability gives a more stable situation for ensuring effective control.

3.1.2 Ash Storage: The combined fly ash and boiler ash streams will be pneumatically conveyed to the main ash silo. This will have a 1,000 m^3 capacity, equivalent to approximately 750 Te of ash, giving over 6 days' storage capacity in the silo.

3.1.3 The silo will have a high level indicator and be fitted with both a visual and an audible high level alarm to ensure overfilling is prevented.

3.1.4 The silo will be fitted with a bag filter on the vent to minimise dust releases during transfer. The silo will be inspected as part of the plant's ongoing and preventative maintenance system.

3.2 Removal

3.2.1 The ash silo will be fitted with twin bottom discharge systems, one a direct, dry discharge system and the second a moistening system to allow water to be added to the ash prior as it is discharged. The dry unloading discharge system will feature a flexible coupling that will be connected directly to the enclosed ash tanker vehicles to prevent fugitive dust releases during loading. The moistened discharge will pass through a dampening system to dampen the ash, preventing any potential dust emissions, prior to direct discharge to a covered trailer unit.

3.3 Analysis of the Waste Streams

3.3.1 Each of the defined waste streams discussed above will be subjected to detailed chemical analysis to determine its waste category and re-use / disposal options. This analysis will be undertaken initially during the commissioning phase for the facility. As a precaution, all materials generated during the commissioning phase will be disposed of as hazardous waste until such time as analysis confirms otherwise.

3.3.2 Each trial will have at least 3 samples of the defined waste streams sampled and sent for analysis at a UKAS accredited laboratory. Where available, all tests will be to the MCERTS standard, or equivalent.

3.3.3 It is envisaged that the initial testing will comprise the analytes listed in Table 4, below. This will be refined as more information is generated on the nature of the waste streams and with dialogue with the E&HS during the IPPC application stage.

3.3.4 Once the plant is fully operational, the waste streams will be tested on a periodic basis for an agreed set of parameters. This will ensure that management and the Regulator have a full understanding of the constituents and that the most applicable disposal option is being maintained for each waste stream.

3.3.5 It is envisaged that the exact details for the waste analysis regime will be determined during the IPPC application and permitting stage. However, the following represents a preliminary testing regime.

Table 4: Waste Analytical Regime

Waste stream	EWC code	Suggested Analysis	Frequency*
Furnace ash+	10 01 15, or 10 01 14*	Cadmium; Zinc; Vanadium; Lead; Copper; Chromium; Nickel; Cobalt; Manganese; Thallium; Arsenic; Mercury; Dioxins; Dioxin like substances.	Bi-annual and at any major change of fuel composition
Fly ash+	10 01 19, or 10 01 18*	Cadmium; Zinc; Vanadium; Lead; Copper; Chromium; Nickel; Cobalt; Manganese; Thallium; Arsenic; Mercury; Dioxins; Dioxin like	

Waste stream	EWC code	Suggested Analysis	Frequency*
		substances; Calcium compounds (pH).	

Notes:

* The frequency reported is for normal operating conditions. During commissioning trials 3 samples per waste stream will be analysed.

+ The oversized residues associated with each of these streams are expected to have similar contaminants and constituents to the main streams and will be assessed in the same manner.

4. Waste Reduction and Disposal

4.1 Waste Reduction Techniques

4.1.1 Segregation of oversize material from the furnace ash, the recovery of re-useable bed material from the waste stream and its re-use in the fluidized bed reduces the volume of the waste stream.

4.1.2 The recirculation of bag filter ash maximises the efficiency of use of the injected flue gas treatment chemicals.

4.2 Disposal Routes

4.2.1 In order to remain consistent with Government waste policy regarding diversion from landfill, the selection of disposal options for waste materials collected for off-site disposal, will use the following hierarchy.

Waste reduction

⇧

Re-use

⇧

Recycling

⇧

Energy recovery with heat and power

⇧

Landfill with energy

⇧

Landfill

4.2.2 Obviously, any choice of disposal option is governed by applicable UK environmental legislation. The actual destination may change dependent on the suitability of materials, emergence of new more suitable markets/end uses and economic factors making one end-use more attractive.

4.2.3 Changes to end-use / disposal options can be notified to the E&HS as required. The general principle for selecting the disposal options for the material will be as follows:

1. Compliance with all relevant Waste legislation;
2. Re-use as a product/additive;

3. Recovery to allow re-use;
4. Disposal as a defined waste stream (landfill / other technology which may become available).

4.2.4 The use of Category 1 MBM as one of the fuels will place restrictions on the potential end-uses for all the ash waste streams. The 2006 TSE Regulations (Statutory Rule 2006 No.202) will prevent the re-use of the ash from an MBM source being used as fertiliser (a known outlet for bottom ash produced by other fuel sources).

4.2.5 At present the following options are being considered, but a definitive disposal route will not be selected until commercial trials are under way which allows for testing of the materials.

- Building materials industry as an additive or filler;
- Landfill – non-hazardous (dependent on analysis of each defined waste stream);
- Landfill – hazardous (dependent on analysis of each defined waste stream).

5. Conclusion

5.1 Conclusion

5.1.1 The proposed biomass fuelled power station will produce ash that will require disposal or recovery. The exact nature of the ash at this stage is unknown as it will be determined by the fuel mix and final operating conditions once the biomass fuelled power plant is operational.

5.1.2 Rose Energy will adopt a precautionary approach and will dispose of the initial ash quantities as hazardous waste until a full evaluation of the ash properties has been completed. Once the ash properties have been more fully evaluated the options for recovery and disposal will be re-assessed to determine the most sustainable option.

5.1.3 Technical and managerial measures will be put in place to ensure that the quantity of ash produced is kept to a minimum.