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ESKOM HENDRINA

DRAFT CONCEPTUAL DESIGN REPORT

**PROPOSED ASH DISPOSAL FACILITY AT SITE E
WITH ASH WATER RETURN DAM'S**

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DAM'S**

EXECUTIVE SUMMARY

A Conceptual Design has been carried out on the selected Site E to accommodate 43 million tons of ash, for proposed new ash disposal facility at the Hendrina Power Station.

The purpose of this report is to provide conceptual design information for the wet ash disposal facilities, and associated pollution control structures for the remaining 17 years of the operational life of the power station.

This report specifically covers the conceptual design of Ash disposal facility on Site E, with AWRD'S and associated storm water control measures, taking into consideration the topographical and physical constraint.

As part of the stormwater control measures on the site, a number of Pollution Control Dams are planned to cater for the facility, and as far as possible these will be integrated into the existing system.

The Pollution Control Dams should be lined with 2,0 mm HDPE, to control seepage, and to contain all storm water runoff from the average rainfall, plus the 1:100 year 24 hour storm, with 0,8 m freeboard.

The water accumulated in a dam should never be more than 10 to 15% of its capacity, at any time, to minimise the likelihood of spilling during a storm event.

A cost estimate for the infrastructure will be prepared at the Preliminary Design stage to give some indication of the expected construction costs for the various facilities related to the ash handling.

As can be seen from the comments made in Section 8, there is a need to obtain additional information from "historic" documents from the "past" and "current" Eskom design team, to be able to finalise this report.

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PROPOSED ASH DISPOSAL FACILITY AT SITE E, WITH ASH WATER RETURN
DAM'S**

1. SCOPE OF WORK

A Conceptual Design has been carried out on the selected Site E to accommodate 43 million tons of ash, for proposed new ash disposal facility at the Hendrina Power Station.

The purpose of this report is to provide conceptual design information for the ash disposal facility at site facilities for the ash facilities and associated pollution control structures for the remaining 17 years of the operational life of the Power Station.

2. SITE SELECTION AND SIZING

The rationale for the selection of the location of the ash ash disposal facility is as follows:

- There is a high level of confidence that the selected areas do not fall within likely areas of viable mineable resources, but if this should change, revised pillar, spacing to accommodate the loadings, would be required.
- The areas are in close proximity to the existing Power Station, as defined by the station's technical requirements/criteria.
- The topography is acceptable in terms of surface gradients to accommodate pollution control measures
- The area is unaffected by sensitive or pristine wet lands and associated flood plains.

3. DESIGN ASSUMPTIONS

The design assumptions used, are given below, with the following comments:

- a) The dam height is subject to review once the detailed Geotechnical investigation has been carried out. The factor of safety given below, will be the minimum allowable, and will be determined from soil and topographical conditions. These will be verified at Preliminary Design Stage.
- b) Design Parameters

- Average Dump side Slope	
- Disposal facility E	1:3,8
- Max Facility height (m)	
- Dump E	TBA
- Design Storm recurrence interval	1:100 years
- Min. factor of safety	1,7

- Slurry pool free board (m)	N.A
- Ash Bulk Density (t/m ³) To be confirmed	1,4
- Dry density of ash (t/m ³)	0,8
- Dump Capacity (x 10 ⁶ tons)	43,0 x 10 ⁶ tons
- Ash production (to be confirmed)	30,7%
- Effective cohesion (C')	5 kPa
- Effective friction angle (Ø')	35°
- Permeability	5m/yr (1,6x10 ⁻⁷ m/sec)

4. ASH DISPOSAL

The ash disposal area comprises various components and the layout is shown on the drawings as:

- Two pollution control dams (AWRD's)
- Wet Ash Disposal facility
- Clean water diversion trench/bund walls
- Dirty water drains/leachate interception and collection systems
- Penstock and outlet pipeline
- Silt Traps

4.1 Production Rates

The expected Ash production is 43 million tons, over the remaining 17 years, based on an earlier feasibility report, provided by Eskom,

The final elevation, footprint and capacity will be decided after further discussion with the Eskom Design Team in January 2013.

4.2 Construction of the disposal facility

a) The ring dyke or paddock systems.

The impoundment wall, or daywall, is formed by a perimeter outer paddock wall and a parallel inner paddock wall. These walls are constructed between 30 m and 60 m apart, and are formed into paddocks by the construction of perpendicular ash cross walls. The water pond lies within the daywall in the night paddock.

The ash deposited in these paddocks comprises about 80% fly ash and 20% coarse or bottom ash. The ash is mixed with water, at a water to solid ratio of 9:1 by volume for both fly ash and coarse or bottom ash. The ash is then pumped as a slurry to the ash dam complex through large steel pipes. Only fly ash is used for wall construction (daywalls), while coarse or bottom ash or fly ash is deposited in

the inner portion or night paddock of the ash dam.

The drawings in Appendix A provide conceptual details of the proposed layout, which involves the following construction process.

- Phase I – Remove topsoil and subsoil to a depth of 700 mm, and stockpile separately
- Phase II – Carry out earthworks and compact in situ material beneath the dump. Construct a “cut-off” key if necessary, with interceptor drains to accept any seepage, which will be directed into proposed AWRD’s.
- Phase III – Place 2,0 mm HDPE liner in sections and anchor
- Phase IV – Construct perimeter start walls.
- Phase V – Construct paddocks and deposit ash as described above.

Vibrating wire electronic Piezometers, should be installed **during construction** to monitor porewater pressure levels, for stability evaluation in critical areas. The positions will be determined at the detailed design stage, based on the underlying soils and stability analysis

The Dam may be constructed by ring main discharge system, or single outlet slurry discharge system.

5. HYDROLOGY

The site is not affected by floodlines and all drains and AWRD’s will be sized in terms of the criteria set out in the ILANDA Water Services, water balance report, which will be issued under separate cover.

6. DESIGN OF ASH DISPOSAL FACILITY

6.1 Water Balance

A water balance will be carried out to assess the water utilisation and to size the AWRD’s. The interaction of the proposed ash disposal areas with this resource will be given in the ILANDA Report.

6.2 Seepage Control

Because of the possibility of seepage occurring into the subsoils beneath the disposal area, under-drainage and an HDPE liner will be provided to control the leachate, which will then be led into the AWRD’s, from where it will be pumped back to the plant for reuse.

6.3 Stormwater Control

As shown on the drawings the open drains and berms separate the “clean” water runoff, from the “dirty” water, to divert clean run-off around the AWRD’s and Ash dump.

The AWRD’s will be sized to collect the average dirty water seepage from the ash disposal facility and rainfall runoff, via the penstock from the “top” of the ash disposal facility.

Discussions need to be held with the “past” and “present” Eskom Design Team to verify this.

Where velocities in the open drains are likely to exceed 1.5 m/sec, they will be lined with concrete filled Geocells. Where velocities are lower, gabion erosion inhibitors will in all probability be used, depending on the soils encountered.

6.4 Capping/rehabilitation

The Contractor shall, in accordance with the requirements of the Operations and Maintenance Manual be responsible for the:

- Gradual stripping and stockpiling of topsoil
- Gradual shaping of side slopes and top of the ash dam
- Gradual spreading of topsoil to cover shaped ash dam side slopes and top surface
- Planting of grass for erosion control on prepared slopes
- Establishment of veld grass on the prepared areas
- Establishment of indigenous trees and shrubs
- Aftercare of rehabilitated areas to ensure continued stability and eventual self sustainability
- The upkeep of a complete rehabilitation progress manual.

7. ASH WATER RETURN DAMS

All the dirty water run-off which accumulates on and around the dump will find its way into one of the pollution control dams. Water from the penstocks will be separated and its management will be discussed with the Eskom Design Team.

Spillways will be provided for from each dam, to cater for the unlikely event of an overflow occurring.

The storage facilities will be formed by excavating into the virgin subsoils or importing fill from other sources, to create the required capacity, in a “cut and fill” operation, taking the ground water table level into account.

At this stage it would appear that two AWRD’s will be sufficient, for the proposed Ash disposal facility, details of which will be shown on the drawings, at Preliminary design stage.

All AWRD’s will be lined with a 2.0 mm HDPE liner, underlain by subsurface drainage to intercept any leakage, which will be piped into a sump, and pumped back into the associated dam.

7.1 Water Balance

The size of each of the AWRD’s will follow when the existing and future water balance has been reviewed and discussed with the Eskom Design Team.

No AWRD should ever contain more than 10 to 15% of its capacity, for any length of time, and should be pumped out after each storm event, to minimise the likelihood of spilling during a subsequent storm event.

The Report by ILANDA Water Services will provide details of the design criteria and assumptions made.

8. INFORMATION REQUIRED

In order to progress from this Conceptual Stage design to Preliminary Design (85% CAPEX accuracy) the following additional information is necessary

As can be seen from the comments made, there is a need to obtain additional information from “historic” documents and the “past” and “current” Eskom design team, to be able to finalise this report.

- Finalisation of the expected quantities of ash to be stored in the disposal facility, with pumping rates.
- Specialist Geotechnical investigation and evaluation of the other underlying soil, affecting the stability of the ash disposal facility and AWRD’s.
- The existing Water Balance and related infrastructure.
- The current method of operation.
- The Geohydrological informational of the chosen site.

- Extensive testing of shear strength characteristics between soil and HDPE liner.
- Review of current Code of Practice and its requirements.
- Existing ash disposal facility Stability Reports and geotechnical characteristics of ASH.
- The Operations Manual.
- Aerial Dtm information for the existing and proposed areas.
- Required life of ash disposal facility on Site E.
- A plan of existing services and their relocation
- A plan of any “no-go” areas.

9. CAPEX COSTING

A cost estimate for the various components of the infrastructure, will form part of the Preliminary Design stage.

10. RISK EVALUATION

The following risks will be taken into account during the next phase of the design:

- 10.1 Geotechnical Conditions – the maximum dump height and footprint as well as the positions of the AWRD’s may need to be reviewed, based on the soil conditions encountered on site.
- 10.2 Residue Characterisation – in terms of the Government Gazette, 23 April 2004, No. 26275 (73) the following will be addressed at Preliminary Design stage, by a competent person:
 - a) The Ash will be characterised to identify any potential significant health and safety hazards together with environmental impact that may be associated with the residue being stockpiled.
 - b) The residue deposits will be characterised in terms of their physical characteristics including size, distribution, permeability, void ratios, strength, SG and water content.
 - c) The chemical characteristics which will be identified would include an assessment of the propensity to oxidise or undergo spontaneous combustion. The PH and chemical composition of the leachate water would also be assessed.
 - d) The Ash deposits will also be classified by a competent person.

10.3 Safety Classification

In terms of safety classification the ash disposal facility will be differentiated between high, medium and low hazard on the basis for the potential to be a risk to life and property.

The SABS 0297 Code will be used to classify the Ash deposits in terms of a prescribed classification system that differentiates between high, medium and low hazard potential. The classification as well as the completion of the safety questionnaire will be done during the Risk Assessment on the MRD's.

The initial conclusion is that the Ash dump has a medium to high Hazard Classification.



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APPENDIX A DRAWINGS

Drawing No.	Title
618/050	General layout
618/052	Dump test hole positions
618/054*	Dump setting out
618/056	Ash dump typical details
618/060	Proposed PCD 1 layout
618/061*	Proposed PCD 1 setting out
618/062	PCD 1 safety details
618/063	PCD 1 Wall Section
618/065	PCD 1 spillway
618/067	PCD 1 inlet details
618/070	Proposed PCD 2 layout
618/071*	PCD 2 setting out
618/072	PCD 2 safety details
618/073	PCD 2 Wall Section
618/075	PCD 2 spillway
618/077	PCD 2 inlet details
618/082	HDPE liner details
618/084	Standard details sheet 1
618/086	Energy dissipation structure

- **Note * indicates that these drawings will be available at preliminary design stage.**

**APPENDIX B
WATER BALANCE**

**Report by ILANDA Water Services
(to follow)**