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ROSHCON (PTY) LIMITED

KOMATI POWER STATION ASH DAMS
OPERATING MANUAL

REPORT NO: JW??/07/A784

1. INTRODUCTION

Komati Power Station was originally commissioned between 1961 and 1966. The Power Station was then mothballed in 1988. Due to power shortages predicted for the near future, Komati is being upgraded and is planned to be recommissioned end February 2007. The remaining capacity of the ash dams is limited, particularly as the ash deposition rate will be considerably higher than when originally operational on account of higher load factors and poorer quality coal. The time required to select a site, design, permit and construct a new ash dam is estimated to be in the region of three years and hence it is not feasible to construct a new dam within the available time frame. The existing dams are therefore to be recommissioned and a new extension to the dams constructed to cater for the shortfall in capacity until a new dam can be commissioned.

1.1 Terms of Reference

Jones and Wagener (J&W) were appointed in 2006 by Roshcon to complete a feasibility study for recommissioning the ash dams. The study indicated that there was a shortfall in capacity and that Extension 3 would be required within 18 months of recommissioning the Power Station (refer J&W report JW44/06/A542). J&W were then appointed by Roshcon to complete the detailed design of remedial works to the existing ash dams as well as the design of Extension 3.

Roshcon have subsequently requested that J&W compile an Operation Manual for the Ash Dams. This manual includes for the recommissioning of the existing dams, operation of the existing dams as well as commissioning and operation of Extension 3. Note however that the detailed design of Extension 3 was not complete at the time of writing this manual and hence the manual may need to be updated at a later stage.

1.2 Background

There are currently three separate ash dams, the original dam (Dam 1) which was extended twice (Extension 1 and Extension 2), Dam 2 located south of Dam 1 and Dam 3 located to the west of Dam 1. A layout of the ash dams is indicated in Figure 1. The ash dams were operated as ring-dykes with ash hydraulically deposited using the daywall method.

Supernatant and storm water were decanted from dam to dam by means of overflow pipes or trenches installed through the daywalls. A single penstock was installed on Dam 1 Extension 2 to decant water off the dam. A series of canals then lead decanted and seepage water from the ash dams under the Komati Road to the Ash Water Return Dam, which in turn overflows to Lake Stoffel and Lake Fin.

The ash dams are not underdrained, although a seepage collection drain was intercepted on the east flank of the dam during the geotechnical investigation. The drain is a "sausage drain" consisting of 19mm stone wrapped in a geofabric. A perforated drain pipe is installed in the bottom of the drain. The geofabric was blinded by fine ash and hence is not considered functional. The position of the outlet to the drain is not known.

The ash is pozolanic which has resulted in the development of a hard crust on the surface and wall slopes.

Since mothballing, the power station has continued to be maintained as a zero effluent discharge operation. The two compartments of Extension 2 have been used as evaporation areas for storm water collected from the power station's catchment area.

The Ash Dam Site has been also utilised for the disposal of asbestos removed from the power station. There are three separate deposits, on the southern site boundary adjacent to Dam 2, on the northern extent of Dam 2 and the in the basin of Dam 1 on the south flank. The deposits are indicated in Figure 1.

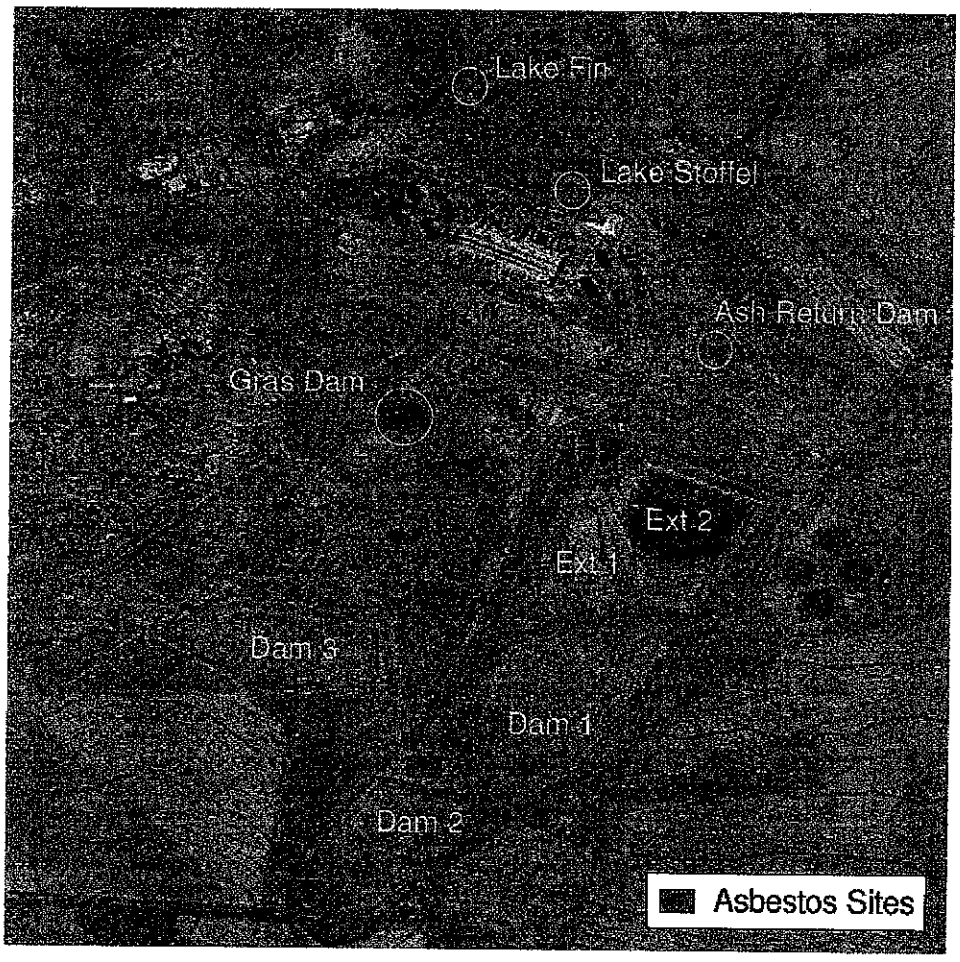


Figure 1: Site Layout

1.3 Future Deposition Capacity

The feasibility study recommended that Dams 2 and 3 be closed permanently. Development of the dams is restricted by shallow undermining and their contribution to the available deposition capacity is relatively small. It would therefore not be cost effective to recommission the dams. Note that Dam 3 was originally designed to be enlarged towards the southern and eastern property boundaries. Deposition had to be stopped however due to shallow undermining and seepage concerns.

The existing Dam 1 and its extensions are to be operated as two compartments with Extension 1 and the southern portion of Extension 2 combined to form the first compartment and Dam 1 the second. The existing dams have sufficient capacity for approximately 18 months based on the recommissioning programme of the 9 units with a 3-month delay between units. Extension 3 is to be constructed during this period and will be utilised with the existing dams until at approximately 2020 (depending on load factors), after which a new dam will have to be provided.

The existing ash water return dams do not have sufficient capacity to contain the design storm decanted off the ash dam. The dams are to be replaced by the northern extent of Extension 2. This area has sufficient capacity to store the design storm decanted off the dam and 5 to 7 days ash water pumped with the slurry.

2. DESIGN PHILOSOPHY

2.1 Existing Ash Dams

Civil Works

A 10m wide step-in is to be provided on the perimeter of the existing dams. The step-in will improve the stability of the dam by flattening the outer slope as well as to provide access and placing the ring-feed and valves.

The initial daywall will be constructed 20m wide. This yields an average floor to wall ratio of 5.5:1. Bund walls are to be constructed to define the inner and outer edges of the daywall to assist in re-commissioning. The bund walls will be 0.5m high constructed from nominally compacted ash. Note that due to the current configuration, it will not be possible to construct the inner bund wall on the eastern and northern flanks of Extension 2. These areas will need to be partially filled with ash to provide a suitable platform on which the new daywall can be formed.

Drainage

All surface water drains will be cleared prior to commissioning. These include the storm water diversion trench uphill of Dam 3 and the seepage trench at the toe of Dam 1 and its extensions.

A large volume of seepage is emanating from the floor of the ash dam. The general flow direction is to the North West towards the Gras Dam. A 4.5m deep seepage cut-off drain is to be installed to intercept the flow. A series of manholes will be provided on the drain for monitoring flows and to enable any blockages to be cleared. Seepage intercepted by the drain will be pumped from one of two manholes to the new return water dam for use in the power station.

Deposition Strategy and Capacity

The capacity of the ash dams is controlled by the maximum height and limiting rate of rise of the dams as per Table 3-2.

The deposition strategy is based on Extensions 1 and 2 being operated first up to their limiting rate of rise. All ash in excess of this will then be deposited on Dam1. Extension 3 will then to be commissioned once the rate of rise on Dam 1 is at its limit. This strategy then allows the southern portion of Extension 2 to be filled to develop the daywalls as well as allow the southern portion of Extension 2 to catch up to the level of Extension 1.

Ash Delivery Piping

A ring feed is to be provided on the perimeter of the dams and the division wall between Dam 1 and Extension 1. The ring feed will be located on the new roadway. Deliveries will be placed at each corner of the dam to ensure no water is trapped in the corners. The maximum spacing between deliveries is 300m. Day and night deliveries will be provided at each deposition point.

The ring feed will be connected to the ash pipeline from the power station on the north west corner of the ash dams. A Tee-piece and valves will be provided such that deposition can occur on either side of the dams as required.

Penstocks

Two new penstock inlets are to be installed in Dam 1 and Extension 1 to decant storm and ash water off the dams. The penstocks will discharge into the new ash return water dam. The pool will be relocated to these inlets during recommissioning through controlled cycling of ash deposition. The inlets will be used for the remaining life of the dams.

Ash Return Water Dam

The northern section of Extension 2 is to be used as the new ash return water dam. Water will be gravitated from the dam to the power station through the existing penstock and pipeline.

Storm Water Management

Storm water falling uphill of the ash dams is to be diverted into the natural drainage path to Gras Dam.

Storm water falling onto the closed ash dams will be stored on the dams and be allowed to evaporate.

Storm water falling onto the active ash dams will be decanted to the ash return water dam and then to the power station for reuse.

2.2 Extension 3

Civil Works

A primary starter wall will be constructed to contain the ash whilst the rate of rise is above the limiting rate of rise. The primary starter wall will consist of a compacted earth

embankment. A secondary starter wall will be constructed on the remainder of the perimeter of the dam.

Deposition Strategy and Capacity

The footprint of Extension 3 is restricted by the existing ash dams, undermining and the power line on the western boundary. The footprint has been made as large as possible within these constraints to maximise available capacity.

Ash Delivery Piping

A ring feed will be provided on the perimeter of the ash dam similar to the existing dams. The ring feed will be connected to the ash pipe line from the power station on the north west corner of the existing ash dams.

Drainage

Toe, blanket and herringbone drains are to be installed to control the position of the phreatic level at the toe, to aid consolidation of the outer wall zone and to reduce seepage into the subsoils. The drains will be conventional Terzhagi filter drains using natural materials as the filter media.

Penstocks

A single penstock will be constructed. A final inlet and two intermediate inlets will be provided on the same outfall pipe. The intermediate inlets are to be used whilst the pool is being moved towards the final inlet. The intermediate inlets are to be sealed to specification once they are no longer required.

Ash Return Water Dam

A sump is to be provided to pump water decanted off Extension 3 to the ash return water dam. The water will then gravitate back to the power station for re-use.

Storm Water Management

All storm water falling up hill of the dam will be diverted past the dam to the natural drainage path leading to Gras Dam.

3. KEY DATA

Key data pertaining to the dams is summarised in Table 3-1.

Table 3-1: Ash Dam Key Data

Dam	Footprint (ha)	Upper Surface Area (ha)	Current Maximum Height (m)

Dam	Footprint (ha)	Upper Surface Area (ha)	Current Maximum Height (m)	
Dam 1	29.92	21.43	24	1652.52
Dam 1 Ext 1	18.83	11.15	26	1644.61
Dam 1 Ext 2 (South)	19.62	7.57	21	1639.44

Key data and assumptions used for the investigation are summarised in Table 3-2.

Table 3-2: Key Data and Assumptions

Deposition rate (tpm)	*Maximum*: 11 751tpm per unit (90% peak load factor, 32% ash content) *Average*: 8 750tpm per unit (67% annual average load factor, 32% ash content)
Planned overall life	15 years per unit, total 20 years, potentially extendable to 25 years
Slurry relative density	1.1 to 1.25
Insitu dry density of ash	0.9t/m^3
Design storm	1:50 year storm with 24 hour duration (130mm)
Design freeboard	800mm above the design storm and operating level
Assumed maximum rate of rise (m/yr)	Sustained: 3.0m/yr Absolute: 3.5m/yr
Maximum design height	40m
Return water dam capacity	120 000m^3

4. OPERATIONS

4.1 Operating Methodology

Both coarse and fly ash will be pumped to the dam in the same ash pipeline. The coarse ash will be pumped in batches when necessary whereas the fly ash will be pumped continuously over a 24 hour period. Only fly ash is to be deposited in the daywalls. Coarse ash is to be deposited in the basin of the dam. Fly ash will also be deposited in the basin during night shift and weekends.

It is essential that good communication be established between the operator and the power station so that the operator can divert the ash stream between daywall and basin timeously as required.

A small excavator will be required on site during commissioning for constructing daywall bund and cross walls where necessary.

4.2 Recommissioning of Existing dams

Bund walls for a 20m wide daywall will be provided on the dam prior to re-commissioning. The daywall width will however need to be altered to suit the operations and deposition rate as the dam develops and more units are placed on line.

Deposition will first take place on Extension 1 and 2 with the majority of deposition occurring on Extension 2. It is important that extension 2 is raised as quickly as practical within the rate of rise limitations such that it can be combined with Extension 1 to form the lower compartment.

4.3 Deposition Strategy

Stage capacity curves have been developed for each of the dams. Plots of the curves are included in Appendix A. Summaries of the deposition strategy and relative growth of the dams, including Extension 3, are given in Figure 3 and Figure 4.

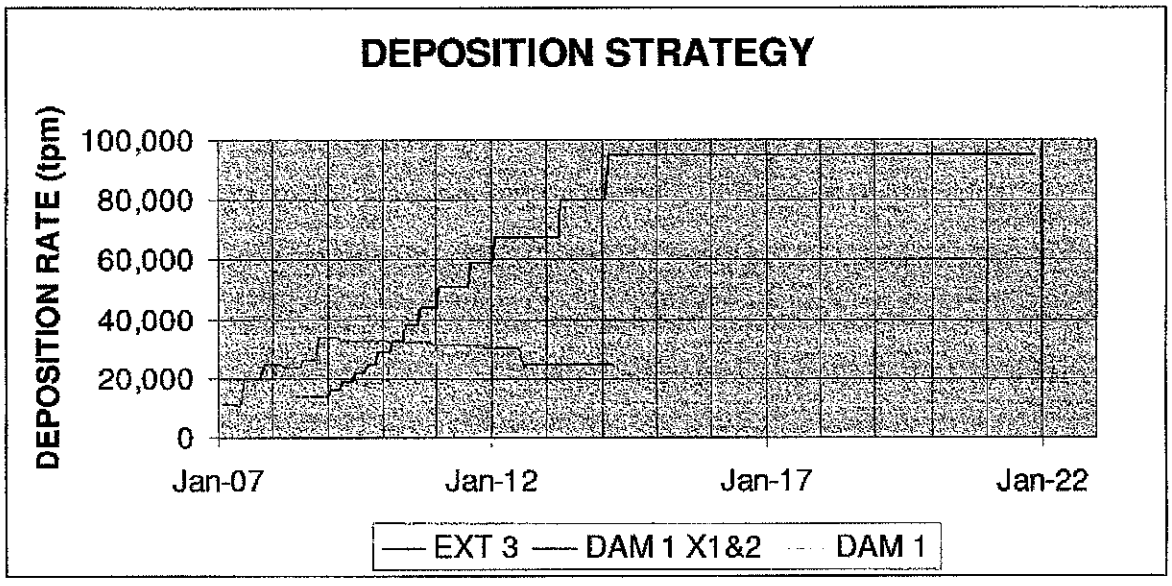


Figure 2: Deposition Strategy

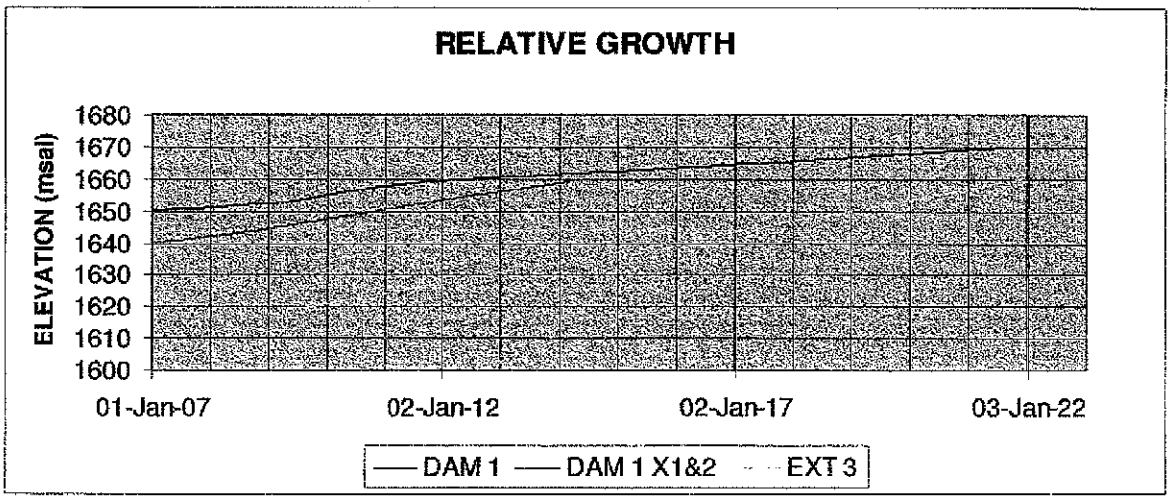
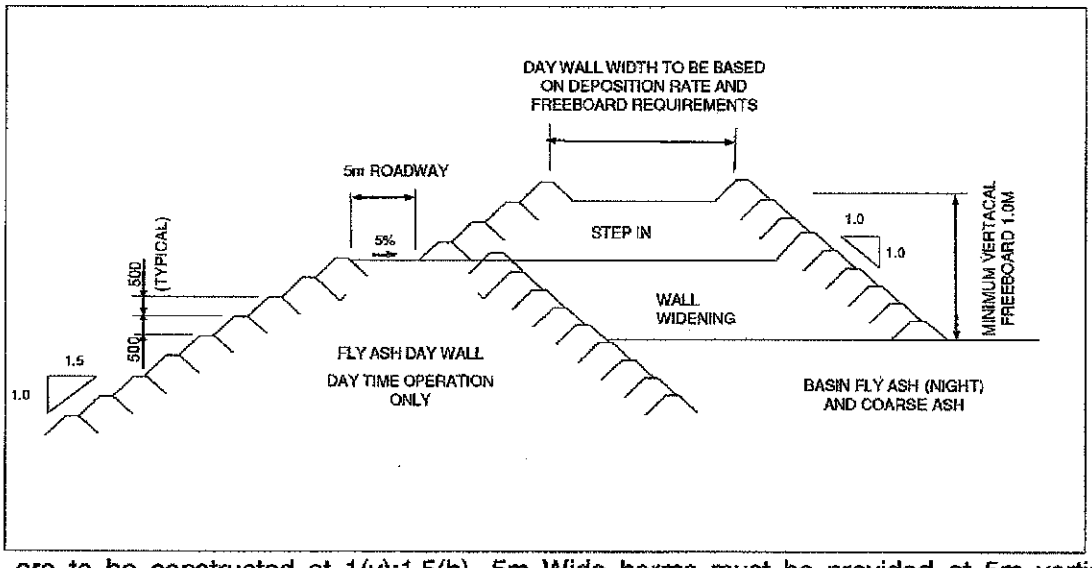


Figure 3: Relative growth of ash dams

4.4 Wall Building

Day wall bunds are to be constructed at least 0.5m high and 0.6m wide either by hand or small excavator. The profile of the wall is to be according to Figure 4. Intermediate slopes



are to be constructed at 1(v):1.5(h). 5m Wide berms must be provided at 5m vertical intervals for access, storm water control and to flatten the overall slope to 1(v):2.5(h).

4.5 Pool Control

The volume of water stored on the ash dams must be kept to a minimum. The pool must therefore be located at the penstock inlet at all times. Deposition points must be cycled around the dam as required to form an even beach towards the penstock inlet. Wings must be provided at the inlets to aid control of the pool. The wings will be constructed in a similar manner to the daywalls.

4.6 Penstock and Catwalks

The following requirements must be adhered to, mainly for the safety of the operators:

- The penstock is only to be operated during daylight hours.
- A minimum of four rings must be placed above ash level on the penstock inlets to prevent ash or storm water being inadvertently decanted without supervision.
- A minimum of two people must operate the penstock.
- A safety cage must be installed over the inlet at all times.
- A suitable catwalk and platform must be provided and raised as necessary for safely accessing the inlet.
- The platform must not be higher than 500mm above the penstock inlet.
- Only one ring may be removed below water level at a time

4.7 Access

Access ways to and onto the ash dams must be maintained in a reasonable condition such that they are suitable for access by a standard ambulance in an emergency.

A poolwall must be provided for access to the penstock inlet. The poolwall will be constructed in a similar manner to the daywalls.

4.8 Return Water Dam

The return water dam must be operated at as low a water level as possible to provide sufficient capacity to store a storm decanted off the ash dams. The penstock inlet must be kept clear of debris to prevent blockages. The flow path from the penstock discharge must also be maintained free of debris to ensure free flow to the Power Station.

The available capacity in the return water dam must be checked if sufficient prior to decanting water off the ash dams.

It is currently planned that the inlet of the return water dam penstock will be open at all times to provide continuous drainage to the power station. If the inlet is raised either to retain water in the dam or due to siltation, the top ring of the inlet must be a minimum of 800mm below the lowest point on the outer wall. A minimum dry freeboard of 1.0m must be maintained.

5. MONITORING

This section details monitoring functions and responsibilities to ensure the dam remains safe, in a stable condition and legally compliant. Additional detail for the monitoring requirements is included in the relevant Code of Practice.

5.1 Visual Inspection

The following items require frequent inspection:

- Condition of the outer wall, indication of movement such as cracks, bulging or sloughing;
- Freeboard;
- Condition of solution trench and drain outlets;
- Pool volume and position;
- Condition of penstock towers and access platforms/catwalks;
- Condition of catchment paddocks;
- Water level in return water dams;
- Condition of delivery system.

5.2 Daily Inspections:

The operating contractor is to inspect the dam on a daily basis. All deviances are to be reported immediately to the power station.

5.3 Weekly Inspections:

The operating contractor and the appointed power station representative are to inspect the dam on a weekly basis.

5.4 Quarterly Inspections:

A formal inspection is to be carried out on a quarterly basis by the operating contractor, appointed power station representative and professional engineer. The inspection is to be followed by a formal quarterly meeting of which minutes must be taken.

5.5 Piezometers

Piezometers are to be read on a monthly basis by the operating contractor. The readings are to be forwarded to the professional engineer for interpretation and analysis.

A stability analysis is to be carried out on each of the piezometer sections on an annual basis by the professional engineer.

5.6 Freeboard

Freeboard indicator poles are to be placed on the dam by the operating contractor. Freeboard readings are to be taken on a monthly basis by the operating contractor and forwarded to the professional engineer.

A freeboard analysis must be undertaken on an annual basis by the professional engineer in order to set the minimum levels against which the month's readings are measured. The analysis will be based on an annual topographical survey of the dams conducted by the power station.

5.7 Underdrains

Flow rates from the under-drains are to be read on a monthly basis by the operating contractor. The results are to be forwarded to the professional engineer for analysis. The professional engineer shall make recommendations regarding jet-rodding of drain outlets when necessary.

6. CLOSURE

The dams are to be closed on cessation of ash deposition as follows:

- All penstock inlets are to be sealed from the base using an approved method
- The basin of the dams will be paddocked off with 1.5m high paddocks located at 50 to 75m spacings
- The basin and side slopes will be top soiled and vegetated
- All delivery pipes, freeboard poles etc will be removed from the dam

The seepage cut-off drain will need to continue to be pumped for a number of years until the seepage has stopped.

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