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TUTUKA KRAGSTASIE
INSTANDHOUDINGSDIENSTE

		PARAF.	DATUM	RAPPORTEER TERUG
ASST. SUPT. (MEGANIES)	A.	[illegible]	12/10/84	
ASST. SUPT. (ELEKTRIES)	A.	[illegible]	17/12/84	
ASST. SUPT. (INSTRUMENTE)	A.	[illegible]	5/12/84	AFSKRIF GEMAAK.
EERSTE ING.ASST. (BEPLANNING)	A.	[illegible]	8/8	
SEN. TOESIGHOUER (DORPS)				

OPMERKINGS

REPORT MI.3155

FEBRUARY 1984

REVISED MARCH 1984

STEFFEN ROBERTSON & KIRSTEN

CONSULTING ENGINEERS • RAADGEWENDE INGENIEURS

ELECTRICITY SUPPLY COMMISSION

ASH DUMP OPERATIONS EQUIPMENT SELECTION

AT

TUTUKA POWER STATION

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CONTENTS

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TUTUKA POWER STATION
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1 ASH DUMP FORMATION

1.1 Methodology

The ash dump is to be formed using a spreader/stacker combination. The spreader will operate in an East-West direction, advancing to the East, while the stacker will operate in the North-South plane, always advancing to the North. The stacker will front stack on the first pass from the spreader, return to the spreader conveyor and then back stack on the second pass.

The natural angle of repose for the stacked ash will be approximately 34° (2:3) and this must be flattened to 18° (1:3) for efficient dust suppression.

The proposed method for the cutting of the final slope will involve the deposition of additional ash at the crest of the stacking profile (Fig 1).

This material will then be cut at the crest of the profile and dozed to fill at the toe to create a 1:3 slope. This activity will be undertaken by a tracked bulldozer.

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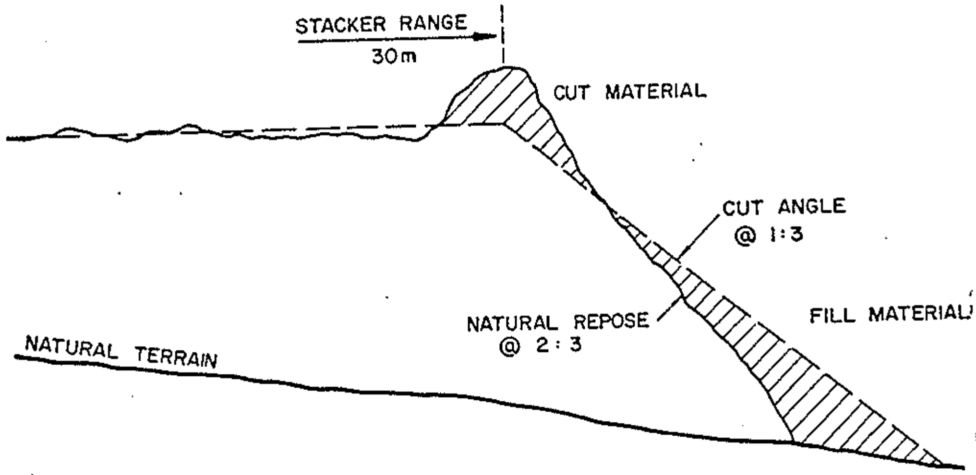

FIGURE 1 METHOD OF ACHIEVING 1:3 CUT SLOPE

FIGURE 1 : METHOD OF ACHIEVING 1:3 CUT SLOPE

Prior to the front stacking of the fly ash, the natural soil cover will be removed and placed on the backstack material for rehabilitation purposes.

The average depth of natural soil cover exceeds the 500 mm of soil cover required for rehabilitation purposes. No requirement for a topsoil stockpile is anticipated.

The removal and placement of topsoil is seen to be a loader/truck operation. This operation will be intermittent in nature. Suitable plant is likely to be involved in operations at the terrace and coal stockyard plants. It is considered that optimal utilisation of capital will only be achieved if the requirements of the three operations are rationalised through the purchase, and operation, of a common earthmoving fleet.

The average depth of the front stack profile will be 20 metres, fluctuating between 5m and 35m across the valley. All calculations have been based on a front stacking depth of 20 m and the selection of plant has been based on the assumption that dozing operations must keep up with the stacker advance. Using these assumptions, with reference to Appendix 1.1, the average volume to be dozed per day will be 1 500 m^3.

A working year has been assumed to contain 260 working days.

1.2 Volumes to be moved

At average production rates approximately 7 100 m^3 of ash will be deposited per 24 hour day. A 10 hour day has been selected as the working duration for the mobile machinery in order to avoid the neccessity for work to be undertaken on the ash dump during the hours of darkness.

For approximately four months of the year ash will be deposited at an average rate of 9500 m^3 per 24 hour day. As this four month period forms a substantial part of the working year, the equipment selected has been rated for this level of production.

The depth of deposition on the forward stacking cycle will be directly related to the topography. The various depth and rate of advance relationships to be encountered at Tutuka are shown in Appendix 1.1.

1.3 Equipment Selection

The dozing of flyash is a relatively light duty activity for a tracked bulldozer. Cognizance must be taken of the potential mechanical problems of working with any form of fine material. The detrimental effects of the ash on the moving parts of the machinery, especially rollers, bearings and final drives, must be anticipated.

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1.3.1 Machine availability

In assessing the probable availability of an earthmoving machine in a new operation one must err on the side of caution. Experience in earthmoving applications has suggested that an overall availability of 60%, comprised of the components - mechanical availability 80% and operational utilisation 75% - is a good rule of thumb. These factors are applied to the planned hours per day which, for this study, have been set at ten (Section 1.2).

Reference to an alternative method of estimating availability, combining job and management conditions (Table 1) would place the 60% factor in the poor conditions - fair/good management band.

This is considered reasonable for a new operation.

	MANAGEMENT CONDITIONS			
JOB CONDITIONS	Excellent	Good	Fair	Poor
Excellent	0,83	0,80	0,77	0,77
Good	0,76	0,73	0,70	0,64
Fair	0,72	0,69	0,66	0,60
Poor	0,63	0,61	0,59	0,54

TABLE 1 : UTILISATION FACTORS

1.3.2 Machine Output

Calculations of machine productivity for a range of track dozers and rubber tyre dozers are given in Appendix 1.2.

From the productivity figures it can be seen that, if one assumes that the 80% mechanical availability holds, the respective operational utilisation figures required of the tracked dozers are:

	Hrs	Operation Utilisation (%)
D8	2,73	34
D7	4,72	59
D6	9,62	-

The utilisation required of the D6 is impractically high, while the D8 would work well below capacity.

In addition to the dozing activities outlined, the track dozer will be used to advance the conveyor of the stacker. The frequency of movement does not exceed two times per annum, and moves should take no longer than three days. This represents an additional utilisation which does not materially change the utilisation shown.

It is considered that the D7, whilst generally having excess capacity, will be able to match the productivity required over the periods when dozing demand increases.

The ability of the D7 to effect the conveyor moves is, however, in doubt (Appendices 1.4, 1.5). Cost figures for the D8 size tracked dozer are shown in Appendix 1.3 (a).

The cost of a D8 is very much higher than for the D7 and careful consideration must be given to the degree of security required in respect of the ability of the machine to move the conveyor.

1.3.3 Back-up Equipment

Throughout the selection process for the earthmoving equipment it has been estimated that planned work-loads can be handled by one unit in its respective work field. The provision for back-up equipment is very much a managerial decision. This decision must be taken in the light of an assessment of the potential disruption of operations caused by excessive downtime, and the number and availability of other earthmoving plant, on site, that could supplement the fleet assigned to the fly ash dump.

From Appendix 1.2 we can see that the 814 bulldozer has a capacity for dozing 492 m^3 per 60 minute hour. This is below the capacity required for cutting the dump slopes but, considering the spare capacity of the D7 this is not considered a problem. The rubber tyred bulldozer is far more mobile than the tracked dozer and can level far more accurately.

In summary, the purchase of a rubber tyred bulldozer to supplement the D7 has the following advantages:

- High mobility - continual site moves are highly detrimental to tracked machinery.

- Improved levelling capability - with good operation a rubber tyred dozer can grade almost as effectively as a grader.

- Productivity - in view of the spare capacity of the D7 the lower productivity of the 814 serves to "match", rather than over supply, the overall duty requirements.

The major disadvantage will be that the 814 would not be suitable for advancing the stacker conveyor system. The total moving time for the stacker conveyor, per annum, should not exceed six days and therefore this should not be a major disadvantage.

A towable compactor will also be required to compact the ash surface to minimise dust pollution. In addition this compactor will be used to ensure that the dump surfaces are correctly prepared for the application of polymers to aid the suppression of dust, should these be required.

The critical towing mass for a Cat 814 B in the conditions at Tutuka is shown in Appendix 1.6. The maximum compactor mass should be taken to be 7500 kg to allow for a safety margin.

1.4 Capex and Opex

1.4.1 Capex

The following budget prices for plant have been supplied, telephonically, (30.1.84).

Caterpillar D8 bulldozer with universal blade	R380 000
Caterpillar D7 bulldozer with universal blade	R215 000
Caterpillar 814B bulldozer (incl. tyres)	R231 000
Bomag 6 t (static load) towable compactor	R 33 000
(or Bomag 10 t (static load) towable compactor)	R 47 500)

1.4.2 Opex

The operating cost calculations for the above plant are shown in Appendix 1.3. These calculations are considered to have ± 25% cost confidence.

Machine	Ownership Opex/OH (R)	Operating Opex/OH (R)	Total Opex/OH (R)	Operating Hours per Annum	Annual Opex (R)
Cat D8	111,07	39,60	150,67	780	117 520
Cat D7	41,01	32,45	73,46	1300	95 500
Cat814B	34,18	21,42	56,60	1560	88 300
TOTAL	Cat D7 + Cat814B				183 800

TABLE 2: ANNUAL OPEX - ASH PLACEMENT

2 DUST SUPPRESSION

Dust suppression on the surfaces and slopes of the ash dump should be effected with a sprinkler system. For the sprinkling of the slopes and platforms adjacent to the stacker the sprinkling system could be attatched to the stacker conveyor.

Should a small water bowser be considered desirable the choice ranges between a second hand diesel tanker and a custom built off-highway bowser.

	Capacity(l)	Approx. cost (R)
Second hand diesel tanker	9 000	10 000
Mercedes water tanker	9 000	55 000
Custom built off-highway bowser	35 000	320 000

Further investigation of sprinkler methodology must be undertaken before further costing could be justified.

3 REHABILITATION

3.1 Methodology

The rehabilitation of the ash dump will be undertaken concurrently with ash deposition.

The topsoil ahead of the stacker will be removed and placed behind the stacker on the pre-scarified back stack platform. Once the topsoil has been placed and graded to level, surface paddock and bund walls will be formed, penstock arrangements will be installed and dirty and clean stormwater diversion trenches will be constructed.

The equipment selected for the placement of the topsoil must be acceptable for rehabilitation purposes. Attention must be paid to the potential for degradation of the soil as a growth medium through the use of incorrectly sized equipment. The selection of equipment for this phase of operations is, therefore, seen to fall within the scope of the environmental studies for Tutuka.

3.2 Volume to be moved

Approximately 10 hectares of area must be rehabilitated per annum. With a topsoil cover of (say) 500 mm, the annual volume to be moved will be 50 000 m^3.

3.3 Equipment Selection

3.3.1 Topsoil Movement

The removal, transport and placement of topsoil would be undertaken by a FEL/truck combination.

The productivity of the combination of a 3,5 m^3 capacity articulated truck and a 0,8 m^3 capacity (bucket) wheel loader is shown in Appendix 3.1. It can be seen from the data that three trucks will be required to handle the daily topsoil movement.

3.4 Capex and Opex

3.4.1 Capex

The following budget prices have been supplied telephonically:

O + K L7	FEL	R 56 000
Leyland 3,5m^3	Tip truck	R 30 000

3.4.2 Opex

The operating cost calculations for the above plant are shown in Appendix 3.2. These calculations are considered to have ± 25% cost confidence.

Total annual opex is summarised in Table 3.

Machine	Ownership Opex/OH (R)	Operating Opex/OH (R)	Total Opex/OH (R)	Operating Hours per annum	Annual Opex (R)
O + K L7	11,36	12,10	23,46	1040	24 400
Leyland 3,5m^3 tipper	4,46	7,76	12,22	1560	57 180*
TOTAL					81 580

TABLE 3 : ANNUAL OPEX - REHABILITATION

*3 No units @ R12,22/OH.

4 ADDITIONAL EQUIPMENT

In addition to the above equipment the following plant is recommended:

- 1 No O + K RH4 size backhoe - this will be used for the ongoing excavation of trenches for clean and dirty water diversion
- 1 No 14/10 concrete mixer - this will be used for miscellaneous tasks ie pipe support columns etc