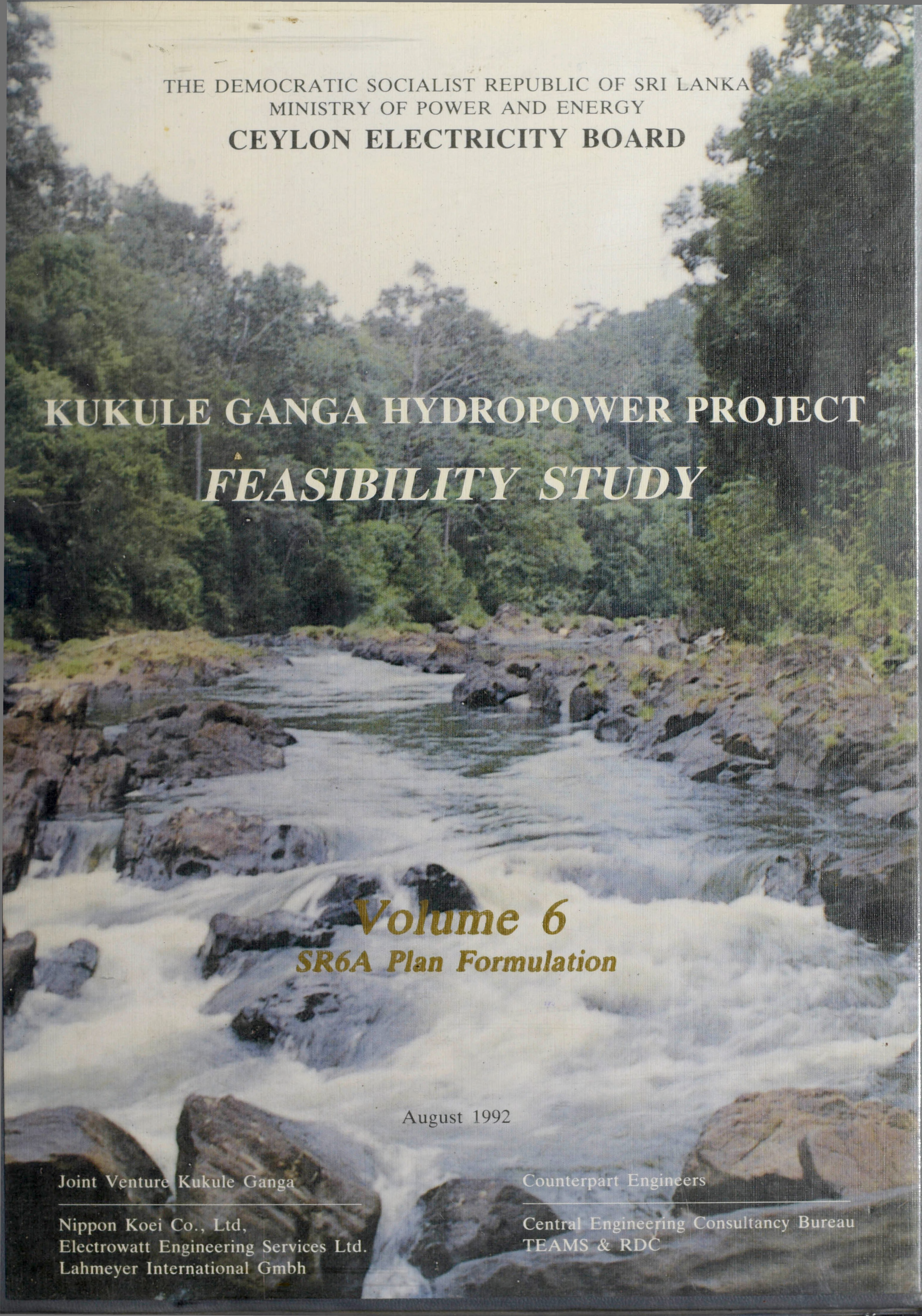

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF POWER AND ENERGY
CEYLON ELECTRICITY BOARD

KUKULE GANGA HYDROPOWER PROJECT

FEASIBILITY STUDY

Volume 6
SR6A Plan Formulation

August 1992

Joint Venture Kukule Ganga

Nippon Koei Co., Ltd,
Electrowatt Engineering Services Ltd.
Lahmeyer International Gmbh

Counterpart Engineers

Central Engineering Consultancy Bureau
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FEASIBILITY STUDY
OF
KUKULE GANGA HYDROPOWER PROJECT

FEASIBILITY STUDY REPORT

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Volume 1	Main Report	
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FEASIBILITY STUDY

OF THE

KUKULE GANGA HYDROPOWER PROJECT

SR6A PLAN FORMULATION

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Annex-6A.1

Previous Studies

ANNEX 6A.1 PREVIOUS STUDIES

1. Reports

Hydropower development scheme on the Kukule Ganga has been studied since late 1960's, including reports of:

- Feasibility Study on Multipurpose Development of the Nilwala Ganga, Gin Ganga and Kalu Ganga Basins, 1968 (abbreviated as <u>Three basins study</u> report)

- Masterplan for The Electricity Supply of Sri Lanka, 1989 (<u>Masterplan study</u> report)

- Pre-Feasibility Study for Kalu Ganga Multipurpose Project, 1989 (<u>Pre-F/S</u> report)

Table 6A.1 gives the contents of the reports listed above.

2. Project Plan Formulation

Plan of the Kukule project was formulated in the previous reports as summarized below.

Three basins study (1968)

(1) Table 6A.2 shows salient feature of the project.

The project was formulated to be multi-purpose for flood control and hydropower production. The dam is located on the Kukule Ganga with its full supply level (FSL) at 282 masl and active storage of 1,050 MCM, and a power system is composed of a 6.3 km long trans-basin diversion tunnel to an open-air power station equipped with power generating facility of 102 MW to be located on the Peleng Ganga at a tailwater level of 38 masl. The project aimed to control the floods in the downstream reach for agricultural development purpose (protection of about 5,700 ha area with controls of Kukule and Ratnapura dams) as well as to produce hydroelectric power with firm capacity of 50.8 MW and firm and average energies respectively at 445 and 456 GWh/yr. Inundation effect due to reservoir, 60.7 km^2 at FSL, was estimated at 4,700 persons and 2,800 ha agricultural land.

Economic viability under the current situation was gauged relatively low due to project's heavy reliance on the hydroelectric power benefits.

(2) A tentative analysis of trans-basin diversion of the water to the South-East-Dry-Zone (SEDZ) for agricultural development purpose was reported to contribute to an appreciable betterment of the economic viability of the project.

Master Plan study (1989)

(1) The Table 6A.2 shows the salient feature of the project.

The project was single-purpose for hydropower development with an implication of contributions to irrigation and flood control. The dam is located on the same site as that of the Three basins study with FSL at 279 masl and active storage of 1,154 MCM, and the power system is composed of an underground powerhouse with 116 MW generating equipment located on the midway of a 5.9 km long trans-basin tunnel with its outfall level at 38 masl on the Peleng Ganga, with which the project will yield a firm capacity of 59.2 MW and firm and average energies respectively of 508 and 512 GWh/yr. Inundation effect, with reservoir area of 49.6 km^2, was estimated at 9,100 in population and 4,260 ha in agricultural land.

The project was concluded to be marginally attractive according to the results of analysis of the CEB's integrated power system to seek for the least cost generation expansion plan (LCGEP) in 1991/2010.

(2) Re-analysis of LCGEP with the lower dam scheme as proposed in the Pre-F/S however revealed that the project is viable in the integrated power system to be ranked at the third or fourth for commissioning in 1998 among candidates for future hydropower development schemes.

(3) Further it should be noted that Watugala site on Ging Ganga, which has been taken up for additional irrigation water source to the SEDZ as explained in the succeeding paragraph (Pre-F/S), has also listed in the Masterplan study as GING074 which is ranked at third or fourth among hydro candidates in the LCGEP.

Pre-F/S (1989)

(1) The Table 6A.2 shows the salient feature of the project for single-purpose hydropower development and Figure 6.1 in Volume 1 (Main Report) illustrates arrangement and sections of the dam and power system.

The dam is to be located at a site about 400 m in the upstream of the proposed site in the above introduced studies (Three basins study and Masterplan study), with FSL at 242 masl and active storage of 300 MCM, and the power system has an underground power house with 144 MW installed capacity located on the mid point of a 6 km long trans-basin tunnel with its outfall level at 38 masl on the Peleng Ganga, with which the project will yield a firm capacity of 43.2 MW and firm and average energies respectively of 379 and 414 GWh/yr. Inundation effect, with reservoir area of 20.8 km^2, was estimated at 9,500 in population (1,900 households) and 1,580 ha in agricultural land.

The project was concluded to be feasible with an economic internal rate of return (EIRR) at 14% in comparison to alternative thermal generation and about 20% when evaluated on a willingness to pay approach. The LCGEP analysis showed that the Kukule competes well with other hydropower projects, with an indication of preferably two stage construction; 72 MW initially in 1998 and a further 72 MW in 2007.

(2) Table 6A.3 shows salient feature of multi-purpose development of the project for hydropower and irrigation.

The dam is the same as that for the single-purpose hydropower development. The power system has also the same alignment as the single-purpose case except for the installed capacity which is 72 MW instead of 144 MW. The irrigation system aims to convey the water in the Kukule reservoir to the SEDZ in an average amount of 14.1 m3/s through a trans-basin diversion works composed of a 33 km long tunnel, 37 km long main canal and Mau Ara reservoir with active storage of 38 MCM.

The power system will yield a firm power of 72 MW and a firm energy of 190 GWh/yr. The irrigation system will supply water to a net area of 21,650 ha in the SEDZ for a 'diversified perennial and tree crops' including oil palm, sugar, paddy, etc.

The study showed the EIRR to be 16.5 % for power component, 9.0% for irrigation component and 11.7% for the integrated system, where the benefit of power was gauged with the willingness to pay approach, and concluded that the multi-purpose development cannot be recommended for further study.

(3) A variation of the multi-purpose development, which introduce an additional flows from Watugala site in Gin Ganga, average flow at the intake site of which was estimated at 16 m^3/s, showed a significant improvement of the project; EIRR of 17.5% for hydropower, 10.4% for irrigation and 13.2% for the integrated system.

It was recommended to examine in the future study such a possibility of Watugala water transfer to the SEDZ.

Summary

In summary, the conclusions of the previous studies for the plan formulation of the Kukule project are:

- Single-purpose development for hydropower (144 MW), with a low dam (50 m high with its FSL at 242 masl) located on the Kukule Ganga and power outfall at the Peleng Ganga (TWL at 38 masl) should be feasible.

- Trans-basin diversion (14.1 m^3/s in the maximum, about half of the inflow to the reservoir of the K-P Plan) from the Kukule Ganga to the SEDZ is not justified, which may however be improved with an addition of water from the Watugala on the Gin Ganga.

- The reservoir (20.8 km^2) will cause relatively large amount of inundation of cultivated land (1,600 ha) and displacement of population (9,500 persons of 1,900 households).

Table 6A.1 LIST OF PREVIOUS STUDY REPORTS

Pre-Feasibility Report (1989,TAMS)

Executive Summary

Volume 1-Main Report
Volume 2-Flood Protection
Volume 3-Hydropower and Irrigation

Supporting Report A-Hydrology
Supporting Report B-Geology
Supporting Report C-Land and Resource Balance in SEDZ
Supporting Report D-Land Capability
Supporting Report E-Agriculture
Supporting Report F-Environmental Studies-Parts 1 and 2
-Environmental Studies-Part 3
Supporting Report G-Phase II Work Plan

Masterplan Report (1989,LI)

Executive Summary

Main Report

Appendix Volumes

A-1 Candidate Hydroprojects - Psrt I

-----Project Report GING 074
-----Project Report KUKU022

A-3 Thermal Plant
A-4 Electricity Demand
A-5 System Operation Studies
A-6 System Expansion Studies

Supporting Volumes

S-1 Water Resources Data Base
S-2 Unit Costs for Civilil Works
S-3 Design and Cost Manuals for Hydropower Projects
S-4 Planning Procedures for Irrigated Agriculture
S-5 Socio-Economic and Environmental Impact
S-6 Computer Program Documentations

Three Basins Report (1968,ECI)

Volume 1-Text and Tables

Volume 2-Figures

Table 6A.2 Salient Features of Kukule Hydropower Development in Previous Studies

Item	Unit	Pre-F/S	Masterplan	Three Basin Study
Report submittal year		1989	1989	1968
Reservoir				
Full Supply Level	mASL	242	279	282
Minimum Operating Level	mASL	221	248	259
Active Storage	MCM	300	1154	1050
Total Storage	MCM	400	1603	1850
Reservoir Area	km2	20.8	49.6	60.7
Catchment Area	km2	334	334	322
Kukule Dam				
Type		CFRD	CCRD	CCED
Crest Level	mASL	247	284	291
Crest Length	m	410	516	490
Height	m	53	99	99
Power Plant				
Power Tunnel,D/L	m/km	6.1/4.5	4.9-3.9/4.1	4.9-3.7/6.3
Tailrace Tunnel, D/L	m/km	6.1/1.5	5.3/1.8	None
Powerhouse Type		Cavern	Cavern	Open-air
Powerhouse, Span/Length	m/m	15/70		15/39
Installed Capacity	MW	144	116	102
Tailwater Level	mASL	38	38	38
Performance				
Reservoir Yield	m3/s	28.3	29.6	28.9
Peak Power Discharge	m3/s	85	59.2	51
Firm Capacity	MW	43.2	58	50.8
Firm Energy Production	GWh/yr	379	508	445
Average Energy Production	GWh/yr	414	512	456
Innundation Effect				
Total Submerged Area	km2	20.8	49.6	60.7
Population	persons	10500	9100	4700
Agricultural Land	ha	1580	4260	2800

Note: CFRD: Concrete faced rockfill dam
CCRD: Center core type rockfill dam
CCED: Center core type earthfill dam

Table 6A.3 Salient Features of Kukule Multi-Purpose Project in Pre-F/S

Kukule Dam and Appurtenant Works

Crest Level	247	masl
Full Supply Level (FSL)	242	masl
Minimum Operating Level (MOL)	221	masl
Dam Height above Foundations	53	m
Dam Type	Concrete faced rockfill	
Dead Storage	100	MCM
Active Storage	300	MCM
Total Storage	400	MCM
Long Term Yield	28.3	m^3/s
Reservoir Area at FSL	1,920	ha
Number of Households Displaced	1,890	

Peleng Ganga Hydropower Plant

Average Power Plant Discharge	14.2	m^3/s
Average Net Head	192	m
Plant Factor	0.30	
Installed Capacity and Firm Power	72	MW
Firm Energy Production	190	GWh/year
Power Tunnel Length	4.5	km
Tailrace Tunnel Length	1.5	km
Powerhouse Type	Underground	

Transbasin Diversion Works

Average Transbasin Diversion Discharge		14.2	m^3/s
Transbasin Tunnel	- Length	33	km
	- Diameter (min. possible)	3.40	m
	- Capacity	22.5	m^3/s

South East Dry Zone Irrigation Development

Main Canal to Mau Ara Reservoir			
	- Length	37.5	m
	- Bed Width	5	m
	- Design Capacity	22.5	m^3/s
Mau Ara Reservoir	- FSL	81.0	masl
	- MOL	76.0	masl
	- Active Storage	38	MCM
Mau Ara Dam	- Crest Level	84.0	masl
	- Type	Earthfill	
	- Height	21	m
Net Irrigation Area		21,650	ha

Annex-6A.2

Selection of Alternatives for Optimization

ANNEX 6A.2 SELECTION OF ALTERNATIVES FOR OPTIMIZATION

1. Overview

(1) Project Layout in the Previous Studies

Review was carried out at the outset of the study on the outputs of previous studies with conclusions, as introduced in the foregoing Section 6A.1, that the project for hydropower development has been formulated with an arrangement of a dam on the Kukule Ganga and power outfall on the Peleng Ganga to be linked with about 6 km long trans-basin waterway, or power tunnel, between the two rivers (see Figure 6.1 in Volume 1). This arrangement is named as Kukule-Peleng (K-P) plan hereinafter.

(2) Site Reconnaissance on K-P Plan

Site reconnaissance was carried out, with an aim to confirm and to clarify advantages and disadvantages of the site conditions on topography, geology and hydraulics at the area of the proposed project's arrangement of the K-P plan, the results of which are as briefed below:

- Geology and hydraulics favour the dam on the Kukule Ganga to be located at the downstream site among sites proposed in the previous studies.
- Geotechnical conditions of the foundations and banks are fair to accommodate the proposed project's works; fresh rocks will offer reasonable strength for dam foundation, tunnels and cavern, though some irregular weathering will be encountered subvertical rock beddings.
- Water level at the proposed power outfall on the Peleng Ganga is estimated at around 46 masl, about 8 meters higher than the previous estimate.
- Some 30 meters drop will be gained in the downstream of the proposed power outfall with a distance of about 1.5 km.

- Average flow in the Peleng Ganga is estimated to be so small at several cumecs only that the river over 10 km distance to the junction of the Kukule Ganga proper may be flooded with the proposed peaking power discharge of 85 cumecs.

(3) Map Study on Alternatives to K-P Plan

Map study was carried out on available topographical maps (inch-mile or 1:63,360 and 16 chains-inch or 1:12,672) as well as river profiles produced with inch-mile map (see Drawing No.4), aiming to find out possible alternative arrangements of project other than K-P plan especially for mitigation of inundation in the upstream and downstream reaches of the project works, with findings:

- The reservoir of the K-P plan will cause relatively large amount of inundation of cultivated land (1,600 ha) and displacement of population (1,900 households).

  As shown on Drawing No.3, K-D (Kukule-Delwitiya) plan which relocates the dam about 8 km upstream of the K-P damsite and the outfall on Delwitiya Dola will contribute to the upstream inundation mitigation. K-K (Kukule-Kukule) plan which relocates the outfall on Kukule Ganga itself (about 11 km downstream of the K-P damsite) will contribute to downstream inundation mitigation. These two plans, especially the K-K plan, will be able to enjoy almost the same water head as that of the K-P plan, as seen on Drawing No.4.

- Run-of-river scheme will be another alternative for upstream inundation mitigation, since relatively large part (about 80%) of water head depends on the gap of river bed elevations gained with waterway.

- No prospective basins are found nearby the Kukule site for adduction of water. Transbasin adduction from Watugala site on Ging Ganga however seems to be worth for examination, though the site is out of the Kukule Ganga basin.

- Topographic conditions in the reservoir show that there are two sharp increases in reservoir area at around 208 and 232 masl.

(4) Concept of Screening Alternatives

Main objective of plan formulation is to determine the optimal scales of the dam and power plant, for which development alternatives should be prepared for screening which will adopt system analysis.

Alternatives for plan formulation were identified to be:

a. Alternatives of the K-P plan in its waterway system (to maximize the power benefits).

b. Alternatives of the K-P plan in its location of dam and outfall (to minimize the inundation impact).

c. Alternatives in adduction of water from other basins.

d. Alternatives in dam scale including run-of-river scheme.

e. Alternatives in power plant scale.

f. Alternatives in commissioning year of the power plants

To arrange the alternatives for the system analysis in manageable number, preliminary screening was carried out for the items a, b and c, as explained in the following sections.

2. Alternatives of K-P Plan in Waterway System

(1) Identification of Alternatives

As typically seen on the Figure 6.1 in Volume 1, the Pre-F/S arranged project's works for hydropower development to be the dam on the Kukule Ganga at a section where the river enters into a relatively narrow gorge and the outfall of the power system on the Peleng Ganga nearby the existing Atweltota bridge.

Results of site reconnaissance and examination on topographical map favour the dam to be located in the same gorge but about 0.5 km in the downstream of the site selected in the Pre-F/S, since the downstream site will offer better geological formation especially at the left bank and better hydraulic conditions for locating the power intake.

Figure 6.3 in Volume 1 shows plan of four alternatives of waterway and Table 6A.4 shows the salient features:

Alternative I:	Open-air powerhouse with a straight headrace tunnel toward surge tank and power outfall nearby the Atweltota bridge over the Peleng Ganga
Alternative II:	Open-air powerhouse with a bent headrace tunnel toward surge tank; location of the powerhouse can be the same as the Alternative I while the the tunnel route is bent to get enough rock cover over the route
Alternative III:	Underground powerhouse with power outfall nearby the Atweltota bridge; this layout is the same as that of the Pre-F/S though the location of the power intake and accordingly the tunnel route are changed.
Alternative IV:	Underground powerhouse with power outfall nearby the Morapitiya bridge over the Delwitiya Dola; modified plan of Alternative III to get advantage of additional head

(2) Comparison of Alternatives

Assumptions

- Alternative I was discarded because this alternative has similar layout as that of Alternative II and may be less attractive due to costly provision of steel lining required at the intermediate section of the headrace tunnel where rock cover is thin.

- Reservoir operation levels are the same as determined in Pre-F/S; FSL and MOL are respectively at 242 masl and 221 masl.

- Tailwater level for the Alternatives II and III is revised from the original 38 masl in the Pre-F/S to 46 m and the level for the Alternative IV was estimated at 18 masl; both levels were estimated on a topographic map of scale 1:10,000 with 6 meters contour intervals.

- Diameters of headrace and tailrace tunnels were determined by adopting an empirical equation which has been obtained with statistical processing of the existing data of power tunnels.

- Installed capacity of the power plant was determined with plant discharge of 86 m^3/s (the same as the value of Pre-F/S), rated water level of the reservoir at 235 masl, tailwater levels as estimated above, loss head as calculated with the diameter above, and combined efficiency of the generating equipment of 0.9.

Comparison criteria

- Present worth of net benefit at discount factor of 10% was adopted; EIRR was also calculated for reference purpose.

- Costs and benefits are 1988 price base, as same as the Pre-F/S.

Benefits calculations

- Monthly inflow series and reservoir area-storage curve which has been derived with newly obtained 1:10,000 map, were adopted.

- Firm energy, E_f (GWh/yr) was calculated with 100% guarantee during the period of the same flow series.

- Dependable power, P_d (MW) was calculated with an equation below.

$P_d = E_f / (PF \times 8{,}760)$; PF = Plant Factor = 0.3, as same as Pre-F/S

- Unit benefits of the power production are 0.052 US$/kWh (Energy value) and 100 US$/kW (Capacity value), as same as the Pre-F/S.

Costs calculations

- Where applicable, costs were estimated from the costs in the Pre-F/S with comparison of basic dimensions, in case the dimensions are similar.

- In case the dimensions are different from the those of the Pre-F/S, work quantities were derived and unit prices in the the Pre-F/S were adopted.

- Rate of mobilization cost, rate of O&M costs, conversion factors for economic costs and disbursement of the capital costs are assumed to be the same as those in the Pre-F/S.

Results of comparisons

- Salient features, benefits, costs and economic indicators are listed on the Table 6A.4 as summarized below.

Item		Alt.II	Alt.III	Alt.IV
Dependable capacity	(MW)	126	127	149
Firm energy	(GWh/yr)	331	334	392
Secondary energy	(GWh/yr)	60	60	70
Benefit	(mio $/yr)	29.8	30.1	35.3
Cost	(mio $/yr)	20.0	19.9	20.9
Net benefit	(mio $/yr)	9.8	10.2	14.4
IRR	(%)	12.0	12.2	13.5

- In conclusion:

- Alternative II and III have almost same net benefits and EIRR; slightly in preference to Alternative III from view point of economic indicator as well as operation and maintenance since the latter is underground powerhouse.

- Alternative IV has the largest economic indicators among alternatives, therefore this is deemed the most promising layout of the K-P Plan.

3 Alternatives of K-P Plan in Location of Dam and Outfall

(1) Identification of Alternatives

- Comparison study of the waterway alternatives of the K-P Plan revealed that the Alternative IV is the most promising layout, with which the additional head in the downstream of the original location of the power outfall will be effectuated. This plan however still has unfavorable circumstance in inundation effect in the reservoir area (on Kukule Ganga) and in the downstream reach of the power outfall (on Peleng Ganga).

- Therefore, a review was made to find out competitive general arrangement of project's works to mitigate the same unfavorable circumstances, with findings of two alternatives (K-D and K-K Plans). Drawings No.3 and 4 illustrate the river profiles and locations of the three alternatives. Table 6A.4 shows the salient features of the alternatives, which particulars are:

Kukule-Peleng (K-P) Plan: Alternative IV of the K-P Plan; modified-previously proposed plan to get advantage of developing the additional head (about 30 m) with river drops in the downstream.

Kukule-Delwitiya (K-D) Plan: Alternative to K-P plan with an aim to mitigate reservoir inundation; about half of inundation effect.

Kukule-Kukule (K-K) Plan: Another alternative to mitigate flooding in the downstream of the power outfall due to power discharge; almost no flooding effect.

(2) Comparison of Alternatives

Assumptions, comparison criteria, benefits/costs calculations

- Assumptions, comparison criteria and methods of benefits/costs calculations are the same as adopted for the comparison in the above Section 2. As for K-D Plan estimates of power outputs were worked out by preparing area-storage curve with 1:10,000 map and dam costs were estimated by preparing a preliminary design on a scale 1:3,600 map which was newly obtained.

Results of comparison

- Salient features, benefits, costs and economic indicators are listed on the Table 6A.4, as summarized:below.

Item		K-D	K-K	K-P (Alt.IV)
Dependable capacity	(MW)	99	145	149
Firm energy	(GWh/yr)	259	383	392
Secondary energy	(GWh/yr)	144	71	70
Benefit	(mio $/yr)	23.3	34.5	35.3
Cost	(mio $/yr)	21.0	20.5	20.9
Net benefit	(mio $/yr)	2.3	14.0	14.4
IRR	(%)	9.1	13.4	13.5

- In conclusion:

- K-D Plan is discarded because the economic viability of this plan is too low compared to other plans to be compensated with an appreciable decrease of inundation effect in the reservoir area.

- K-P and K-K Plans are competitive. Final selection of the plan should wait until further comparison study clarifies merits and demerits of respective plan.

4 Preliminary Examination of Run-of-River Scheme

(1) Scheme for Mitigating Inundation Effect of Reservoir

- In the Pre-F/S it is reported that the largest constraint of the project is the inundation due to reservoir, displacement of about 1,900 households (or 9,500 persons) and loss of about 1,600 ha agricultural land.

- To mitigate this constraint, examination was carried out in the foregoing Section 3 for an alternative arrangement 'K-D Plan' which locates the dam at an upstream site with an aim of remarkable decrease of inundation area, however this plan was discarded because economic viability of the project is far inferior to the other alternatives due to considerable increase of dam costs and decrease of power benefits.

- Run-of-river scheme should be another idea of mitigating the inundation effect. Large part of the effective head of the project depends on the gap of river bed elevations gained with waterway; 170 m head (80%) depends on the gap among rated head of 215 m with waterway length of about 7.5 km in the case of the Alternative IV of K-P Plan. Average hydraulic gradient for the 170 m gap is 1:44, which is deemed a feasible value for conventional hydropower scheme, therefore run-of-river scheme should be worth for consideration.

(2) Preliminary Examination of Run-of-River Scheme

<u>Methodology</u>

- Alternative IV of K-P Plan was taken as base scheme. Run-of-river (ROR) scheme is a modified base scheme by changing the dam to diversion facilities which will have a pond for regulating one day inflow volume.

- Plant discharge was assumed to be 59 m3/s; about two times of the average inflow. Dimensions of works were determined and energy output were estimated.

- Project costs were estimated by adopting the unit prices for the base scheme.

- Power outputs and benefits were estimated with the same method and criteria as adopted for the base scheme except for the value of the secondary energy, for which 50% of the total secondary value was assumed to be effectively consumed in the power system.

- Net benefit and EIRR were calculated.

<u>Results of examination</u>

- Table 6A.4 shows results of economic evaluation, as summarized below.

Item		R-O-R	K-P (Alt.IV)
Dependable capacity	(MW)	86	149
Firm energy	(GWh/yr)	50	392
Secondary energy	(GWh/yr)	313	70
Benefit	(mio $/yr)	19.3	35.3
Cost	(mio $/yr)	13.3	20.9
Net benefit	(mio $/yr)	6.0	14.4
IRR	(%)	11.7	13.5

Economic indicator of the run-of-river scheme is inferior to the dam scheme, however the scheme would still remain economically viable and will contribute to drastic decrease of inundation effect due to reservoir, from 20.3 km^2 in case of the dam scheme to an area less than 3 km^2 only.

- One of disadvantage of the run-of-river type power plant is its relatively low rate of producing primary energy, or low capacity dependability, to be compared to dam type plant if the plant should be operated in an isolated power system. The plant of the project is however to be linked to the integrated power grids in which existing dam type plants are also linked. It is therefore expected that the integrated system would effectively absorb both the primary and secondary energies of the run-of-river plant with a mutual compensation effect of multi-reservoir operation of the system, which will be examined in detail in the power system studies to be carried out in further screening of development alternatives.

5. Adduction of Water from Other Basins to Kukule

(1) Identification and Selection of Adduction Site

Identification

- On inch-mile map, possible sites for adduction were identified, assuming that the operation levels of the Kukule reservoir are at FSL 242 masl and MOL 221 masl. Target area was in principle within the Kalu Ganga basin and adjacent basin area nearby the Kukule basin, eg. Watugala basin which is in another basin of the Gin Ganga but has been identified and suggested to be attractive for joint use of its water with the water of the Kukule basin

- Drawing No.5 illustrates the locations of identified two prospective adduction schemes with their basin boundaries, they are 'Watugala' and 'Hangamuwa Oya-Niriell Ganga' schemes. Other possible sites were identified on the map but discarded with reasons of small basin area and/or long distance to the Kukule reservoir.

Selection

- Unit cost of water for adduction from the identified site to the Kukule reservoir was estimated by analyzing the basin average flow (m^3/s), by estimating the construction costs of diverting works including intake dam and trans-basin tunnel, and calculating the unit cost as a term of 'construction costs/average flow', which were estimated at 59 million Rs/m^3/s for Watugala and 440 million Rs/m^3/s for Hangamuwa-Nirielle. Watugala site was selected for the adduction site for further examinations.

(2) Effect of Watugala Water Adduction to Hydropower Development

Objective

- Watugala site has been identified in the Masterplan study for hydropower development as 'GING074' with salient feature as listed in Table 6A.4. This scheme was ranked third or fourth for the future hydropower development in LCGEP.

- Objective of the study was to compare benefits of Watugala water for hydropower development in case diverted to Kukule and in case used as GING074.

Methodology

- Incremental net benefit of the Alternative IV of the K-P due to Watugala water adduction was compared with the net benefit of GING074.

- To evaluate the incremental benefit of the Alternative IV, dam at Watugala site was assumed as same as that of GING074, 50 m high concrete gravity dam with FSL at 263 masl.

- Adduction tunnel with diameter of 3.5 m, from the Watugala reservoir to the Kukule reservoir, was routed as shown on the Drawing N0.5.

  Dam at the Kukule site was assumed as same as that of the Alternative IV of the K-P Plan, while the dimensions of the power system was changed according to the change of the plant discharge, from the original 86 m^3/s to 124.5 m^3/s (= (29.7 + 13.1) x 2.91), where 13.1 m^3/s is the average inflow from Watugala to Kukule which will be effective after the regulation of the inflows to Watugala (average 16.4 m^3/s) with the Watugala reservoir.

- Reservoir operation was carried out with the inflow series into the Kukule and Watugala reservoirs to estimate the power outputs, with the results of which power benefit was calculated.

- To make even the comparison level, cost of GING074 was assumed to be 33% higher than the cost estimated in the Masterplan study, and power outputs were assumed as same as estimated in the Masterplan study but the benefits were re-calculated by adopting the same unit power values as adopted for the Alternative IV.

Results of comparison

- Referring to the Table 6A.4, incremental benefit of the adduction scheme is estimated negative at (-) 2.2(=12.2-14.4) million \$/year to be compared to the net benefit of the GING074 at 4.6 million \$/year.

- It is therefore concluded that Watugala water adduction to Kukule is less feasible than the water use for GING074 for single-purpose hydropower development, and eliminated from further consideration.

6. Topographical Effect on Inundation of the Reservoir

Referring to the 1:10,000 map, topographical conditions in the reservoir area show the following particulars:

- The reservoir surface area at FSL of 242 masl, which was proposed in the Pre-F/S, is obtained to be 18.3 km^2 for the K-P damsite. In addition to the reservoir area above, 41 islands having a total area of 2.3 km^2 would be isolated in the reservoir of K-P Plan. Areas of these islands range from 0.2 ha to 40.5 ha.

- The reservoir area of K-P plan will much increase when FSL exceeds about 207 - 210 masl because of the start of inundation of the flood plain on both river banks; it will again remarkably increase at about 232 masl because of the reservoir starting extension towards the Kalawana area in the Koswatta Ganga basin. A series of water fall and rapids create a drop of more than 30 m on the Koswatta Ganga near the confluence with the Kukule Ganga. These block the Kukule reservoir from extending to Koswatta Ganga as far as FSL of the Kukule reservoir is set at or below 232 masl.

Table 6A.2-1 (1/9) Features, Benefits and Economic Comparisons of Alternatives

Abbreviations for Alternative Plans

- . Pre-F/S : Single-purpose hydropower development plan presented in Pre-F/S.
- . KUKU022 : The same feature as above with some modifications in dimensions and costs, presented in Masterplan study.
- . KP2 : Alternative II of K-P Plan; open-air powerhouse
- . KP3 : Alternative III of K-P Plan; underground powerhouse; principally same as Pre-F/S.
- . KP4 : Alternative IV of K-P Plan; underground powerhouse with additional head gain
- . KK : Alternative to KP4; power outfall is relocated to Kukule Ganga proper
- . KD : Alternative to KP4; Dam axis is relocated toward upstream site.
- . KP4 + W : Modified KP4 with adduction of water from Watugala dam.
- . KP4 + ROR: Modified KP4 to run-of-rier scheme, without dam.
- . GING074 : Single purpose hydropower development plan at Watugala, presented in Masterplan study.

		Unit	Pre-F/S	KUKU022	KP2	KP3	KP4	KK	KD	KP4+ROR	GING074	Watugala	KP4+W
1.0	**Principal Features for Hydropower Generation**												
1.1	Full supply level (FSL)	masl	242.00	242.00	242.00	242.00	242.00	242.00	242.00	205	263.00	263.00	242.00
1.2	Rated reservoir water level (RWL)	masl	235.00	235.00	235.00	235.00	235.00	235.00	235.00	204	259.00	261.00	235.00
1.3	Minimum operation level (MOL)	masl	221.00	221.00	221.00	221.00	221.00	221.00	221.00	200	250.00	257.00	221.00
1.4	Tailwater level (TWL)	masl	38.00	38.00	51.00	51.00	18.00	22.00	36.00	18.00	77.40	242.00	20.00
	(elevation on map + allowance)	masl			(45+6)	(45+6)	(12+6)	(18+4)	(30+6)	(12+6)			(12+8)
1.5	Gross head at rated RWL (Hg)	m	197.0	197.0	184.0	184.0	217.0	213.0	199.0	186.0	181.6	-	215.0
1.6	Average inflow	m3/s	29.6	29.6	29.7	29.7	29.7	30.0	28.7	29.7	16.4	16.4	42.8
1.7	Drainage area	km2	305.2	305.2	305.2	305.2	305.2	308.4	294.6	305.2	154.0	154.0	459.2
1.8	Ratio to 304.0 km2 at Kukulegama GS	%	100.4	100.4	100.4	100.4	100.4	101.4	96.9	100.4	-	-	-
1.9	Installed capacity factor (ICF)		2.91	2.90	2.91	2.91	2.91	2.91	2.91	2.00	2.00	-	2.91
1.10	Plant discharge (Q)	m3/s	86.0	85.8	86.0	86.0	86.0	87.0	83.0	59.0	32.8	20.0	125.0
1.11	Assumed loss of head	m	-	-	15.6	13.9	17.3	18.5	19.2	20.7	-	-	15.1
1.12	Installed capacity	MW	144.0	140.6	128.0	129.0	151.0	149.0	132.0	86.0	49.6	-	220.0
1.13	Calculated loss of head (Hl)	m	7.7	9.5	15.6	13.9	17.3	18.5	19.2	20.7	10.5	-	15.1
1.14	Loss coefficient (C = Hl / Q^2)	x 0.001	1.04	1.29	2.11	1.88	2.34	2.44	2.79	5.95	9.77	-	0.96
1.15	Net head at rated RWL	m	189.3	187.5	168.4	170.1	199.7	194.5	179.8	165.3	171.5	-	199.9

Table 6A.2-1 (2/9) Features, Benefits and Economic Comparisons of Alternatives

		Unit	Pre-F/S	KUKU022	KP2	KP3	KP4	KK	KD	KP4+ROR	GING074	Watugala	KP4+W
2.0	**Preliminary Hydraulic Design of Waterway**												
2.1	Design discharge	m3/s	86.0	85.8	86.0	86.0	86.0	87.0	83.0	59.0	32.8	20.0	125.0
2.2	Intake												
	Invert elevation (MOL - 2D - 0.5 m)	masl	208.0	208.0	209.0	209.0	209.0	209.0	210.0	190.0	241.0	249.0	207.0
2.3	Headrace tunnel												
	Length	m	4,250	3,865	5,760	4,380	4,420	5,690	4,640	4,420	7,440	15,300	4,420
	Internal diameter (D)	m	6.1	5.8	5.3	5.3	5.3	5.3	5.2	4.4	4.2	3.5	6.3
	Velocity	m/s	2.9	3.2	3.9	3.9	3.9	3.9	3.9	3.9	2.4	2.1	4.0
	Manning's n		0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
	Loss of head	m	3.5	4.2	10.2	7.7	7.8	10.3	8.4	9.9	6.6	13.4	6.6
	Hydraulic gradient	1/i	1,199	920	566	566	566	554	549	446	1,126	1,146	674
2.4	Headrace surge tank												
	Upsurge WL (n-0.002)	masl	N.A.	N.A.	269.4	265.7	267.0	270.6	267.5	225.9	N.A.	-	269.1
	Downsurge WL (n+0.002)	masl	N.A.	N.A.	199.0	202.7	201.3	197.6	199.8	180.8	N.A.	-	201.5
	Invert elevation of tunnel	masl	N.A.	N.A.	186.0	190.0	188.0	185.0	187.0	170.0	N.A.	-	186.0
	(LWL- 2D - 2 m)												
	Tank diameter	m	N.A.	24.6	12.0	12.0	12.0	12.0	12.0	12.0	13.6	-	12.0
	Tank height	m	65.0	53.1	74.4	67.0	69.7	77.0	71.7	49.1	63.5	-	71.6
2.5	Pressure shaft												
	Horizontal length (Lh)	m	N.A.	N.A.	700	100	260	152	220	260	N.A.	-	260
	Vertical height (H)	m	N.A.	N.A.	125	129	160	153	141	142	N.A.	-	156
	Length (Lh + H)	m	290	280	830	230	420	310	360	400	424	-	420
	Average head	m	N.A.	N.A.	146	140	159	162	151	127	N.A.	-	161
	Internal diameter	m	5.3	4.7	4.6	4.6	4.5	4.5	4.5	3.9	3.1	-	5.3
	Velocity	m/s	3.90	4.95	5.17	5.17	5.41	5.47	5.22	4.94	4.35	-	5.67
	Manning's n		0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	-	0.012
	Loss of head	m	0.4	0.8	2.7	0.7	1.5	1.1	1.2	1.5	1.6	-	1.3
	Hydraulic gradient	1/i	665	352	312	312	278	271	298	275	262	-	315

Table 6A.2-1 (3/9) Features, Benefits and Economic Comparisons of Alternatives

		Unit	Pre-F/S	KUKU022	KP2	KP3	KP4	KK	KD	KP4+ROR	GING074	Watugala	KP4+W
2.6	Powerhouse												
	Type		UG	UG	AG	UG	UG	UG	UG	UG	AG	-	UG
	Plant capacity	MW	144	140.6	128	129	151	149	132	86	49.6	-	220
	Number of unit	nos.	4	4	4	4	4	4	4	4	2	-	4
	Turbine centre elevation	masl	N.A.	N.A.	48.0	43.0	10.0	14.0	28.0	10.0	N.A.	-	12.0
	(TWL -3 or -8 m)											-	
	TWL	masl	38.0	38.0	51.0	51.0	18.0	22.0	36.0	18.0	77.4	242.0	20.0
2.7	Tailrace Surge Tank												
	Upsurge WL (n +0.002)	masl	N.A.	N.A.	-	59.5	31.4	33.8	52.3	31.1	-	-	33.7
	Downsurge WL (n -0.002)	masl	N.A.	N.A.	-	44.8	7.8	13.2	24.0	8.4	-	-	10.1
	Invert elevation of tunnel	masl	N.A.	N.A.	-	32.2	-4.8	0.6	11.6	-2.4	-	-	-4.5
	(LWL - 2D - 2.0 m)										-	-	
	Tank diameter	m	N.A.	N.A.	-	15.0	15.0	15.0	15.0	15.0	-	-	15.0
	Tank height	m	23.0	N.A.	-	18.7	27.6	24.6	32.3	26.7	-	-	27.6
2.8	Tailrace Tunnel												
	Length	m	1,500	1,840	-	1,500	2,940	2,370	3,730	2,940	-	-	2,940
	Internal diameter	m	6.1	5.8	-	5.3	5.3	5.3	5.2	4.4	-	-	6.3
	Velocity	m/s	2.9	3.2	-	3.9	3.9	3.9	3.9	3.9	-	-	4.0
	Manning's n		0.013	0.013	-	0.013	0.013	0.013	0.013	0.013	-	-	0.013
	Loss of head	m	1.3	2.0	0.0	2.6	5.2	4.3	6.8	6.6	-	-	4.4
	Hydraulic gradient	1/i	1,199	920	-	566	566	554	549	446	-	-	674

Table 6A.2-1 (4/9) Features, Benefits and Economic Comparisons of Alternatives

		Unit	Pre-F/S	KUKU022	KP2	KP3	KP4	KK	KD	KP4+ROR	GING074	Watugala	KP4+W
2.9	Outfall Structure												
	Outlet loss of head	m	0.4	0.5	0.8	0.8	0.8	0.8	0.8	0.8	0.3	0.2	0.8
2.10	Summary of Waterway Length												
	Headrace tunnel	m	4,250	3,865	5,760	4,380	4,420	5,690	4,640	4,420	7,440	15,300	4,420
	Pressure shaft	m	290	280	830	230	420	310	360	400	424	-	420
	Tailrace tunnel	m	1,500	1,840	-	1,500	2,940	2,370	3,730	2,940	-	-	2,940
	Total	m	6,040	5,985	6,590	6,110	7,780	8,370	8,730	7,760	7,864	15,300	7,780
2.11	Summary of Loss of Head												
	Headrace tunnel	m	3.54	4.20	10.17	7.73	7.80	10.28	8.45	9.91	6.61	13.36	6.56
	Pressure shaft	m	0.44	0.80	2.66	0.74	1.51	1.14	1.21	1.45	1.62	-	1.33
	Tailrace tunnel	m	1.25	2.00	0.00	2.65	5.19	4.28	6.79	6.59	-	-	4.36
	Outlet loss	m	0.44	0.54	0.78	0.78	0.78	0.79	0.78	0.77	0.29	0.22	0.82
	Miscellaneous	m	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	Total	m	7.67	9.53	15.60	13.89	17.28	18.50	19.22	20.72	10.51	15.58	15.07
2.12	Overall hydraulic gradient	1/i	787	628	422	440	450	453	454	375	748	982	516

Table 6A.2-1 (5/9) Features, Benefits and Economic Comparisons of Alternatives

3	**Benefit Assessment**	Unit	Pre-F/S	KUKU022	KP2	KP3	KP4	KK	KD	KP4+ROR	GING074	Watugala	KP4+W
3.1	Reservoir Operation Study												
	Installed capacity (Pi)	MW	144.0	140.6	128.0	129.0	151.0	149.0	132.0	86.0	49.6	-	220.0
	Installed capacity factor (ICF)		2.91	2.90	2.91	2.91	2.91	2.91	2.91	2.00	2.00	-	2.91
	Dependable peak power	MW	144.2	123.6	125.8	127.1	149.0	145.9	98.5	86.0	48.3	-	190.9
	Firm energy (Ef)	GWh/yr	379.0	345.8	330.6	334.1	391.5	383.4	258.8	49.6	153.7	-	501.8
	Secondary energy (Es)	GWh/yr	35.0	76.8	59.9	60.3	70.0	71.2	144.0	312.8	55.7	-	164.6
	Annual energy (E = Ef + Es)	GWh/yr	414.0	422.6	390.5	394.4	461.5	454.6	402.8	362.4	209.4	-	666.4
	Annual plant factor (E / (Pi x 8.76))		0.33	0.34	0.35	0.35	0.35	0.35	0.35	0.48	0.48	-	0.35
3.2	Power Values												
	kW	S/kW	100	100	100	100	100	100	100	100	100	-	100
	kWh, firm	S/kWh	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	-	0.052
	kWh, secondary	S/kWh	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.000	-	0.000
3.3	Annual Power Benefit												
	kW	million S	14.4	12.4	12.6	12.7	14.9	14.6	9.8	8.6	4.8	-	19.1
	kWh, firm	million S	19.7	18.0	17.2	17.4	20.4	19.9	13.5	2.6	8.0	-	26.1
	kWh, secondary (50% only for ROR)	million S	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.1	0.0	-	0.0
	Total (B)	million S	34.1	30.4	29.8	30.1	35.3	34.5	23.3	19.3	12.8	-	45.2
4.0	**Construction Cost**			/0.75							/0.75		
	Investment cost (I)	million S	196.8	197.0	210.5	209.9	219.9	215.6	221.0	139.9	85.9	82.6	347.8
	Standard conversion factor (SCF)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
	Economic cost (C = I x SCF)	million S	187.0	187.2	200.0	199.4	208.9	204.9	209.9	132.9	81.6	78.5	330.4
	Annual cost (CRF=0.1)	million S	18.7	18.7	20.0	19.9	20.9	20.5	21.0	13.3	8.2	7.9	33.0
	O&M cost	million S	0.91	0.84	0.93	0.90	0.97	0.94	0.97	0.74	0.41	0.27	1.50
	Replacement cost	million S	37.9	39.1	37.6	35.0	39.0	38.3	36.0	33.5	21.1	4.3	55.4
	Note: Refer to Item 4.0-A for breakdown of the investment cost.												
5.0	**Economic Comparison**												
	Annual net benefit (B- C)	million S	15.4	11.7	9.8	10.2	14.4	14.0	2.3	6.0	4.6	-	12.2
	B/C ratio		1.82	1.62	1.49	1.51	1.69	1.68	1.11	1.45	1.57	-	1.37
	EIRR	%	14.4	13	12	12.2	13.5	13.4	9.1	11.7	12.6	-	11.1

Table 6A.2-1 (6/9) Features, Benefits and Economic Comparisons of Alternatives

4.0-A	Breakdown of Investment Cost	Unit	Pre-F/S	KUKU022	KP2	KP3	KP4	KK	KD	KP4-ROR	GING074	Watugala	KP4+W
1.0	Direct construction cost	1,000 $											
1.1	Mobilaization (20%)		22,207	10,428	22,940	22,812	24,064	23,550	25,292	16,967	6,795	9,307	38,877
1.2	Preparatory works (access roads etc.)		5,791	1,647	5,791	5,791	5,791	7,511	5,212	5,791	1,840	1,840	7,631
				1.1053								1.3333	
1.3	Civil works total		66,694	50,493	70,681	72,658	74,867	71,355	84,666	44,925	18,978	40,412	130,627
1.3.1	Dam and appurtenant works		32,847	28,697	32,847	32,847	32,847	35,295	38,417	12,409	9,639	12,852	45,699
	1) River diversion		12,773	8,687	12,773	12,773	12,773	12,773	257	6,387	1,125	1,500	14,273
	2) Dam		12,239	17,788	12,239	12,239	12,239	14,687	38,160	3,672	8,072	10,763	23,002
	3) Spillway		7,834	2,223	7,834	7,834	7,834	7,834	-	2,350	442	589	8,423
1.3.2	Waterway		26,532	14,634	33,386	31,473	34,315	27,528	39,056	26,645	8,371	27,560	75,368
	1) Intake		2,635	1,375	2,635	2,635	2,635	2,665	2,543	1,808	487	649	3,829
	2) Work adit		2,339	-	2,836	2,631	2,339	1,403	5,496	2,339	-	8,185	10,524
	3) Headrace tunnel		15,676	7,077	16,038	12,196	12,307	15,843	12,437	8,482	6,876	18,578	35,968
	4) Headrace surge tank		813	1,907	931	838	872	964	897	614	888	-	896
	5) Pressure shaft		612	628	1,319	365	639	471	547	457	120	-	886
	6) Tailrace surge tank		163	-	-	133	196	175	230	190	-	-	196
	7) Tailrace tunnel/channel		3,661	3,419	-	2,764	5,417	4,367	6,616	3,733	-	-	7,654
	8) Outfall structure/connection channel		633	229	350	633	633	640	611	434	0	147	1,067
	9) Reregulating pondage		-	-	3,478	3,478	3,478	1,000	3,401	2,788	-	-	4,478
	10) Improvement of Peleng river		-	-	5,800	5,800	5,800	-	6,280	5,800	-	-	9,870
1.3.3	Powerhouse		7,316	7,161	4,447	8,338	7,705	8,532	7,193	5,871	968	-	9,560
	1) Access tunnel		2,365	2,305	-	3,784	2,568	3,446	2,568	2,568	-	-	2,568
	2) Powerhouse		3,124	4,857	2,916	3,003	3,170	3,170	2,994	2,284	968	-	4,124
	3) Switchyard		1,827	-	1,531	1,551	1,967	1,916	1,632	1,019	0	-	2,868
1.4	Metal works		11,004	14,683	13,054	10,289	11,081	10,596	10,817	15,168	7,439	4,281	16,080
1.5	Generating equipment		21,339	21,121	18,968	19,116	22,376	22,080	19,561	12,744	11,904	-	32,601
1.6	Transmission line		6,206	3,644	6,206	6,206	6,206	6,206	6,206	6,206	1,909	-	7,447
	Sub-total of item 1.		133,241	102,017	137,639	136,872	144,386	141,297	151,754	101,801	48,865	55,841	233,263
2.0	Physical contingency		27,528	16,276	35,558	35,720	37,366	36,557	40,039	25,423	7,552	16,110	61,560
3.0	Engineering & administration		16,077	9,463	17,320	17,259	18,175	17,785	19,179	12,722	4,513	7,195	29,482
4.0	Reservoir relocation works		20,000	-	20,000	20,000	20,000	20,000	10,000	0	-	3,500	23,500
				'(20,000)							'(3,500)		
5.0	Total Investment Cost	1,000 $	196,846	127,757	210,516	209,851	219,928	215,640	220,972	139,946	60,931	82,646	347,805
	Note: Refer to Item 4.0-AA for detailed features and work quantities.												

Table 6A.2-1 (7/9) Features, Benefits and Economic Comparisons of Alternatives

4.0-AA Detailed Features and Work Quantities		Unit	Pre-F/S	KUKU022	KP2	KP3	KP4	KK	KD	KP4+ROR	GING074	Watugala	KP4+W
1.3.1	Dam and appurtenant works												
	01) River diversion												
	Design discharge	m3/s	N.A.	1,450	1,450	1,450	1,450	1,450	1,450		730	730	-
	Nos. of diversion tunnel	nos.	2	1	2	2	2	2	Open	Open	N.A.		-
	Diameter of diversion tunnel	m	6.0	11.2	6.0	6.0	6.0	6.0	-	-	N.A.		-
	Length of diversion tunnel	m	600	700	600	600	600	600	-	-	N.A.		-
	02) Dam												
	Dam type		CFRF	CFRF	CFRF	CFRF	CFRF	CFRF	Combined	CG	CG	CG	-
	Crest elevation (m)	masl	247.0	246.0	247.0	247.0	247.0	247.0	247.0	208.0	264.0	256.0	-
	Riverbed elevation (masl)	masl	N.A.	N.A.	192.0	192.0	192.0	184.5	208.0	192.0	220.8	220.8	-
	Dam height above foundation (m)	m	53.0	51.0	55.0	55.0	55.0	62.5	C56/RF46	18.0	49.7	39.0	-
	Crest width	m	15.0	7.2	8.0	8.0	8.0	8.0	5.2/10.0	4.0	5.2	5.2	-
	Crest length	m	410.0	560.1	246.0	246.0	246.0	248.0	360/420	115.0	230.9	175.0	-
	Upstream slope		1:1.4	1:1.40	1:1.4	1:1.4	1:1.4	1:1.4	:0.10/1:2.5	1:0.10	1:0.10	1:0.10	-
	Downstream slope		1:1.4	1:1.40	1:1.4	1:1.4	1:1.4	1:1.4	:0.75/1:2.0	1:0.75	1:0.74	1:0.75	-
	Total excavation volume	1,000 m3	661	570	108	108	108	172	260/415	130	33	19.3	-
	Total embankment volume	1,000 m3	810	834	453	453	453	575	-/1,200	-	-	-	-
	Total concrete volume	m3	8,845	5,355	3,150	3,150	3,150	3,350	300/-	18,500	93.4	64.4	-
	03) Spillway												
	Inflow design flood	m3/s	2,690	3,200	3,200	3,200	3,200	3,200	3,200	2,000	1,600	1,600	-
	Spillway design discharge	m3/s	(1,225h)	1,980	2,000	2,000	2,000	2,000	2,000	2,000	1,600	1,600	-
	Nos. of spillway gates	nos.	3	4	4	4	4	4	4	4	4	4	-
	Width of spillway gate	m	N.A.	6.0	6.0	6.0	6.0	6.0	6.0	10.0	6.7	6.7	-
	Height of spillway gate	m	8.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	-

Table 6A.2-1 (8/9) Features, Benefits and Economic Comparisons of Alternatives

		Unit	Pre-F/S	KUKU022	KP2	KP3	KP4	KK	KD	KP4+ROR	GING074	Watugala	KP4+W
1.3.2	Waterway												
	01) Design discharge	m3/s	86.0	85.8	86.0	86.0	86.0	87.0	83.0	59.0	32.8	20.0	125.0
	02) Total length of work adit	m	400	N.A.	485	450	400	240	940	400	N.A.	1,400	1,800
	03) Headrace tunnel												
	Internal diameter	m	6.1	5.8	5.3	5.3	5.3	5.3	5.2	4.4	4.2	3.5	6.3
	Length	m	4,250	3,865	5,760	4,380	4,420	5,690	4,640	4,420	7,440	15,300	4,420
	04) Headrace surge tank												
	Tank diameter	m	N.A.	D24.6	D12.0	D12.0	D12.0	D12.0	D12.0	D12.0	D13.6	-	D12.0
	Height	m	65.0	53.1	74.4	67.0	69.7	77.0	71.7	49.1	63.5	-	71.6
	05) Pressure shaft												
	Internal diameter	m	5.3	4.7	4.6	4.6	4.5	4.5	4.5	3.9	3.1	-	5.3
	Length	m	290	280	830	230	420	310	360	400	424	-	420
	06) Tailrace surge tank												
	Tank diameter	m	N.A.	N.A.	D15.0	D15.0	D15.0	D15.0	D15.0	D15.0	-	-	D15.0
	Height	m	23.0	N.A.	-	18.7	27.6	24.6	32.3	26.7	-	-	27.6
	07) Tailrace tunnel												
	Internal diameter	m	6.1	5.8	-	5.3	5.3	5.3	5.2	4.4	-	-	6.3
	Length	m	1,500	1,840	-	1,500	2,940	2,370	3,730	2,940	-	-	2,940
	08) Length of connencting channel	m	-	-	700	-	-	-	-	-	-	-	-
	09) Reregulating pondage		Not provided										
	Load factor		-	-	0.30	0.30	0.30	0.30	0.30	0.30	-	-	0.30
	Required capacity	MCM	-	-	1.56	1.56	1.56	0.47	1.51	1.07	-	-	2.27
	Drawdown	m	-	-	5.0	5.0	5.0	5.0	5.0	5.0	-	-	5.0
	Required surface area	ha	-	-	31	31	31	9	30	21	-	-	45
	Total length of dike	m	-	-	3,520	3,520	3,520	1,350	3,410	2,540	-	-	4,940
	Dike height	m	-	-	5.5	5.5	5.5	5.5	5.5	5.5	-	-	5.5
	Crest width	m	-	-	5.0	5.0	5.0	5.0	5.0	5.0	-	-	5.0
	Slope		-	-	2	2	2	2	2	2	-	-	2
	Section area of dike	m	-	-	88.0	88.0	88.0	88.0	88.0	88.0	-	-	88.0
	Total embankment volume	MCM	-	-	0.31	0.31	0.31	0.12	0.30	0.22	-	-	0.43

Table 6A.2-1 (9/9) Features, Benefits and Economic Comparisons of Alternatives

		Unit	Pre-F/S	KUKU022	KP2	KP3	KP4	KK	KD	KP4+ROR	GING074	Watugala	KP4+W
	10) River improvement works		Not provided										
	Length along Peleng Ganga	m	-	-	8,000	8,000	8,000	-	8,000	8,000	-	-	8,000
	Length along Delwitiya Dola	m	-	-	2,000	2,000	2,000	-	3,000	2,000	-	-	3,000
	Total length of river course	m	-	-	10,000	10,000	10,000	-	11,000	10,000	-	-	11,000
	Average dike height	m	-	-	2.5	2.5	2.5	-	2.5	2.5	-	-	3.5
	Average crest width	m	-	-	5.0	5.0	5.0	-	5.0	5.0	-	-	5.0
	Slope		-	-	2	2	2	-	2	2	-	-	2
	Section area of dike	m	-	-	25.0	25.0	25.0	-	25.0	25.0	-	-	42.0
	Total embankment volume	MCM	-	-	0.60	0.60	0.60	-	0.66	0.60	-	-	1.11
1.3.3	Powerhouse												
	01) Access tunnel												
	Road width	m	N.A.	D6.0	-	D6.0	D6.0	D6.0	D6.0	D6.0	-	-	D6.0
	Tunnel length	m	700	950	-	1,120	760	1,020	760	760	-	-	760
	02) Powerhouse												
	Type		UG	UG	AG	UG	UG	UG	UG	UG	AG	-	UG
	Installed capacity (Pi)	MW	144.0	140.6	128.0	129.0	151.0	149.0	132.0	86.0	49.6	-	220.0
	Turbine design head (He)	m	189.3	187.5	168.4	170.1	199.7	194.5	179.8	165.3	171.5	-	199.9
	03) Switchyard												
1.4	Metal works												
	Steel liner	million $	1,774										
	Gates, stoplogs, valves	million $	9,229									323 ton	
1.5	Generating equipment												
	Installed capacity (Pi)	MW	144.0	140.6	128.0	129.0	151.0	149.0	132.0	86.0	49.6	-	220.0
1.6	Transmission line length	km	64.0	26.0	64.0	64.0	64.0	64.0	64.0	64.0	23.1	-	64.0
	Voltage	kV	220	220	220	220	220	220	220	220	220	-	220
2.0	Rate of physical contingency												
	Civil works	%	25	20	30	30	30	30	30	30	20	30	30
	Metal and generating equipment	%	10	10	15	15	15	15	15	15	10	15	15
	Transmission line	%	10	5	15	15	15	15	15	15	5	15	15
3.0	Rate of administration & engineering	%	10	8	10	10	10	10	10	10	8	10	10

Annex-6A.3

Data and Results of Analysis for Optimization

Annex 6A.3 Data and Results of Analysis for Optimization

TABLE OF CONTENTS

ANNEX A of 6A.3

DATA EMPLOYED

Included in this annex are the data used for :

Kukule Alternative 'K'

Planimetered from 1 inch =16 chain maps, on ....

ELEVATION-AREA DATA

ELEVATION (M)	AREA (KM2)
185.00	0.00
190.00	0.02
195.00	0.10
200.00	1.85
205.00	3.17
210.00	4.68
215.00	6.50
220.00	8.53
225.00	10.56
230.00	12.78
235.00	15.01
240.00	17.44
242.00	18.55
246.00	21.27
250.00	23.89

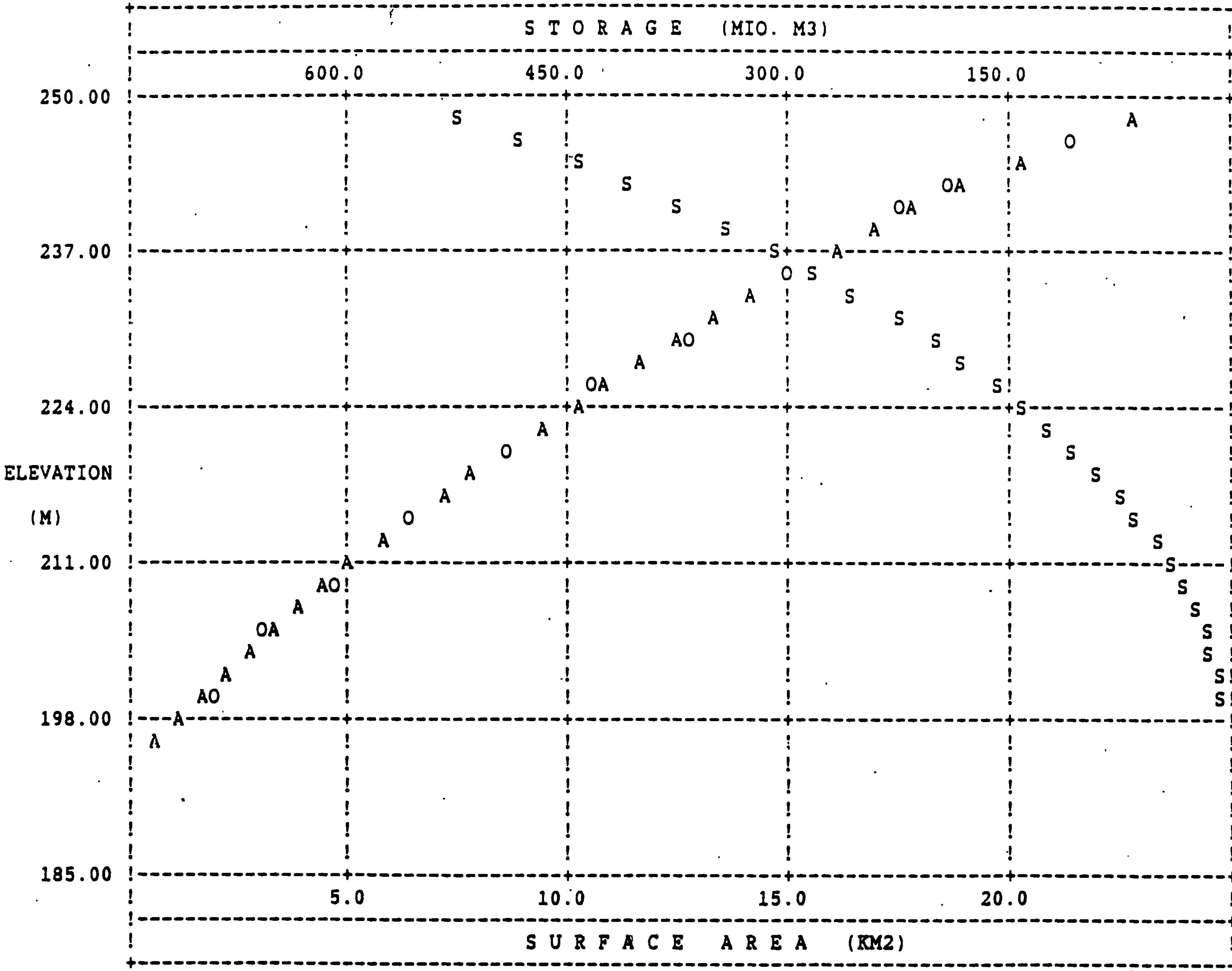
LINEAR INTERPOLATION FOR ELAVATION-AREA CURVE

RESULTS STORED IN RESERVOIR FILE Rkukul-k

Kukule Alternative 'K'

Planimetered from 1 inch =16 chain maps, on ....

ELEVATION-AREA-STORAGE RELATIONSHIP



ELEVATION (M)	AREA (KM2)	STORAGE (MIO. M3)
248.14	22.7	523.6
246.29	21.5	481.7
244.43	20.2	443.9
242.57	18.9	407.0
240.71	17.8	372.4
238.86	16.9	341.0
237.00	16.0	310.9
235.14	15.1	280.8
233.29	14.2	254.6
231.43	13.4	228.8
229.57	12.6	204.0
227.71	11.8	182.3
225.86	10.9	160.6
224.00	10.2	141.1
222.14	9.4	123.4
220.29	8.6	105.6
218.43	7.9	91.1
216.57	7.1	77.2
214.71	6.4	63.7
212.86	5.7	53.4
211.00	5.0	43.0
209.14	4.4	33.8
207.29	3.9	26.0
205.43	3.3	19.3
203.57	2.8	13.9
201.71	2.3	8.8
199.86	1.8	5.0
198.00	1.1	2.7
196.14	0.5	0.8
194.29	0.1	0.3
192.43	0.1	0.2
190.57	0.0	0.1
188.71	0.0	0.0
186.86	0.0	0.0

O = MEASURED AREA
A = INTERPOLATED AREA
S = COMPUTED STORAGE

KUKULE-PELENG (KUKU022) STATION CODE KUKP ELEVATION 189 M LATITUDE 06-33-30N LONGITUDE 80-20-02E
KUKULE GANGA R? ? BASIN : KALU (03) DRAINAGE AREA: 305.2 KM2

NET EVAPORATION (mm)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY MEAN
1949/50	-56.5	64.4	74.0	94.5	102.3	122.4	96.5	43.3	55.1	32.3	18.9	20.0	55.2
1950/51	-15.0	84.8	67.2	57.0	117.1	104.9	62.5	18.0	-110.0	9.1	94.7	24.3	42.6
1951/52	30.7	11.0	86.1	65.5	101.5	111.4	31.1	-19.2	30.3	70.6	61.3	91.0	55.8
1952/53	-84.2	39.7	67.0	58.7	72.4	101.8	63.1	92.6	73.7	-33.9	77.7	35.8	46.8
1953/54	-102.0	44.3	44.8	57.9	84.8	89.5	35.3	-31.9	57.8	71.1	43.3	49.8	36.6
1954/55	8.1	80.4	12.1	89.7	74.8	72.0	79.2	-41.6	-24.9	20.6	88.4	14.7	39.2
1955/56	14.7	3.3	76.8	92.7	99.5	98.9	49.3	41.1	-26.4	84.9	32.8	25.8	49.5
1956/57	30.9	7.2	39.2	90.5	71.5	114.3	72.8	30.1	-4.3	30.9	58.1	85.5	52.2
1957/58	33.0	-41.7	-5.1	78.1	77.5	88.6	56.2	2.8	-0.5	70.6	31.8	72.4	38.5
1958/59	2.9	61.3	51.8	69.0	92.2	122.1	21.9	52.5	-19.1	15.1	24.7	18.8	42.6
1959/60	37.4	38.5	61.3	78.6	79.1	121.6	75.5	38.2	39.9	23.4	72.1	7.8	56.1
1960/61	54.3	62.1	79.1	91.0	115.1	118.6	76.8	41.4	52.7	46.5	13.7	20.4	64.0
1961/62	18.3	60.2	71.2	86.9	109.8	97.7	99.2	-48.0	64.2	64.5	81.4	43.1	62.0
1962/63	51.0	59.9	78.0	62.5	102.3	99.9	46.9	32.7	44.8	25.0	36.7	0.3	53.1
1963/64	28.3	53.3	45.8	84.1	110.9	101.0	74.7	-19.5	33.5	-28.7	66.2	0.3	45.4
1964/65	42.9	49.8	73.1	96.2	93.1	107.4	60.0	-10.2	55.6	80.4	-28.7	1.3	51.5
1965/66	49.9	18.3	39.4	72.0	120.5	75.8	38.3	83.5	65.2	46.1	43.8	-77.4	47.3
1966/67	20.9	58.7	60.3	77.6	107.0	84.4	64.3	73.0	5.3	21.6	29.6	50.7	54.2
1967/68	-40.5	8.5	49.0	75.9	113.7	102.8	59.4	39.3	-38.4	12.4	66.1	-9.2	36.3
1968/69	48.4	62.7	22.7	94.4	106.1	117.5	61.9	-108.0	39.9	83.7	39.2	58.6	51.8
1969/70	39.6	59.8	11.6	90.7	94.0	85.3	53.7	45.3	17.3	22.0	40.4	49.7	50.5
1970/71	-7.3	40.3	78.5	48.2	111.5	109.3	37.4	33.4	27.5	42.9	31.4	-33.3	43.1
1971/72	17.9	28.8	59.1	93.8	117.7	112.1	60.4	-2.1	10.0	61.1	56.1	-28.7	48.7
1972/73	18.3	31.8	84.8	89.6	103.3	68.0	91.7	41.7	6.9	40.2	39.6	77.9	57.5
1973/74	19.6	52.3	73.6	106.5	74.9	90.3	10.3	-38.7	1.9	-5.9	53.0	15.0	37.7
1974/75	84.9	83.0	63.5	96.9	95.0	62.2	50.3	25.4	25.9	74.2	57.0	35.0	62.7
1975/76	31.6	6.9	72.3	104.9	125.0	106.3	30.3	77.5	72.0	38.0	37.8	82.4	65.2
1976/77	38.9	18.9	22.6	94.5	110.8	107.7	85.6	-28.2	20.1	85.4	48.1	61.9	55.2
1977/78	15.8	42.8	36.0	79.8	108.5	104.5	71.6	-51.8	53.9	58.6	45.3	-15.0	45.5
1978/79	34.8	-10.2	71.6	96.4	94.8	117.1	82.5	45.3	22.5	19.3	94.2	-22.6	53.9
1979/80	20.5	32.0	64.7	103.2	123.5	123.6	6.9	64.2	47.2	48.1	55.0	66.4	62.3
1980/81	40.3	7.9	51.5	78.5	110.7	127.2	52.2	24.8	15.2	73.2	88.6	39.5	59.1
1981/82	70.4	73.4	86.4	100.2	126.4	110.4	63.0	27.2	18.3	74.1	73.0	55.1	73.0
1982/83	38.9	32.6	96.6	105.5	123.2	125.6	92.5	14.3	62.0	70.8	36.0	6.1	66.8
1983/84	59.8	70.1	66.1	91.3	107.9	111.2	75.1	67.8	84.2	37.0	92.3	73.4	77.8
1984/85	56.9	40.9	68.9	70.1	108.4	104.9	84.9	34.5	-11.4	59.2	58.5	51.3	60.4
1985/86	11.2	61.0	42.0	91.1	89.4	107.0	64.9	55.5	76.2	71.4	49.2	-37.6	56.7
1986/87	44.4	54.3	53.7	84.6	125.6	119.2	71.1	55.6	62.3	90.2	-36.2	20.7	61.8
1987/88	10.5	41.9	53.2	86.6	89.7	108.3	72.8	72.5	20.6	31.1	1.9	-34.6	46.1
1988/89	72.1	48.8	76.7	93.9	125.5	121.1	69.6	40.5	1.8	-11.2	62.4	26.0	60.4
1989/90	34.0	52.2	79.7	93.4	101.7	107.0	68.0	35.8	54.6	50.2	87.8	86.1	70.7
MEAN	22.6	41.4	58.7	84.7	102.9	104.4	61.5	23.2	26.4	43.3	49.3	27.0	53.6
MAX	84.9	84.8	96.6	106.5	126.4	127.2	99.2	92.6	84.2	90.2	94.7	91.0	77.8
MIN	-102.0	-41.7	-5.1	48.2	71.5	62.2	6.9	-108.0	-110.0	-33.9	-36.2	-77.4	36.3
STDV	38.0	27.0	22.7	14.5	15.9	16.0	22.0	43.1	38.0	31.4	29.6	39.6	10.1
% MEAN	3.5	6.4	9.1	13.2	16.0	16.2	9.6	3.6	4.1	6.7	7.7	4.2	

SOURCE OF RAW DATA: MISSING DATA INDICATED BY A DASH

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TKUKUL-K             Valley X-sections for project  KUKK                19 SEP 1991
T QH-curve(s) given as pairs of Elevation-Discharge Ordinates
T Kukule KK-outfall                                                      19 SEP 1991
T       1       19        1    .0350  .003700    200.0
T  16.74      .00   17.24     8.59    17.74    28.77   18.24    57.42   19.74   101.13
T  19.24   166.59   19.74   255.94    20.24   362.26   20.74   485.51   21.24   625.80
T  21.74   783.33   22.24   958.37    22.74  1151.25   23.24  1362.30   23.74  1591.91
T  24.24  1840.44   24.74  2108.29    25.24  2396.68   25.74  2708.20
```

KUKULE-KUKULE ('ATION CODE KUKK ELEVATION 184 M LATITUDE 06-31-00N LONGITUDE 80-19-40E
KUKULE GANGA (VER BASIN : KALU (03) DRAINAGE AREA: 308.4 KM2

RESERVOIR INFLOW (m3/s)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY MEAN
1949/50	71.9	43.3	25.3	9.9	10.3	9.6	15.2	30.3	33.9	28.0	40.9	33.4	29.5
1950/51	50.8	19.4	8.2	18.0	12.5	9.8	27.7	26.2	110.7	47.5	7.9	27.9	30.5
1951/52	33.9	44.4	14.4	17.5	11.5	10.1	29.8	54.2	40.3	16.2	11.4	9.8	24.5
1952/53	47.2	35.4	18.9	15.3	9.8	20.8	26.5	11.7	20.6	71.5	23.1	15.9	26.5
1953/54	65.2	27.1	17.0	15.2	12.3	20.8	33.7	79.4	35.9	17.5	27.7	17.7	30.9
1954/55	62.7	19.3	23.7	13.8	15.7	26.9	19.2	148.7	71.6	40.3	8.8	24.6	39.9
1955/56	37.5	45.9	19.2	9.9	6.2	13.2	31.1	39.8	93.6	18.1	29.1	37.0	31.7
1956/57	41.8	45.4	22.6	7.5	8.0	7.7	14.1	23.6	68.7	39.7	17.5	4.4	25.1
1957/58	25.4	50.0	41.7	26.8	20.7	23.9	23.5	55.5	74.8	22.3	28.7	11.1	33.7
1958/59	54.5	36.4	32.3	16.2	10.3	6.9	21.5	27.3	108.7	42.9	37.9	68.4	38.6
1959/60	36.2	38.2	24.9	23.2	20.0	14.3	18.7	27.2	29.3	37.0	13.4	25.6	25.7
1960/61	19.0	37.7	16.1	13.4	7.6	12.0	11.4	38.7	39.2	36.0	53.2	46.5	27.7
1961/62	47.1	41.1	23.5	15.8	9.4	11.8	14.2	67.5	26.2	25.5	24.4	33.3	28.5
1962/63	45.2	33.9	17.2	19.5	15.6	12.7	21.2	41.8	47.3	52.4	46.3	68.2	35.2
1963/64	69.2	50.1	32.0	21.6	10.1	14.2	15.1	70.7	40.6	86.3	32.9	48.8	41.2
1964/65	26.1	36.9	13.8	4.7	5.4	7.5	15.2	65.9	29.9	8.3	38.8	48.9	25.2
1965/66	51.6	42.1	29.0	25.9	12.1	14.9	33.4	21.1	20.7	18.5	20.5	63.6	29.5
1966/67	58.0	37.0	20.3	17.7	10.4	17.6	13.5	30.4	57.4	37.1	34.4	25.2	30.0
1967/68	84.8	45.0	25.0	18.1	8.3	9.2	21.8	30.6	83.0	63.3	23.9	44.9	38.3
1968/69	24.5	30.3	19.9	7.3	5.4	5.3	11.0	100.4	45.2	10.8	14.5	20.2	24.7
1969/70	35.6	30.7	43.4	33.7	15.4	16.3	33.7	25.9	46.9	41.5	37.3	26.1	32.3
1970/71	53.7	31.2	22.8	15.1	11.8	14.6	34.2	37.5	43.9	37.5	46.0	65.0	34.5
1971/72	62.2	44.1	28.9	13.7	7.8	11.1	17.2	66.7	57.6	26.4	28.3	53.2	34.9
1972/73	49.7	49.8	14.4	5.8	6.2	15.3	42.3	22.7	49.3	34.3	33.7	17.0	28.6
1973/74	43.7	39.8	30.1	13.6	12.1	13.1	34.5	65.3	56.3	57.0	37.7	55.7	38.3
1974/75	30.7	9.8	13.3	7.8	5.3	11.7	22.7	59.4	70.1	16.1	31.0	37.3	26.4
1975/76	60.5	90.6	31.1	15.1	6.1	9.6	27.9	40.4	14.6	18.7	19.8	8.9	28.7
1976/77	32.4	38.9	43.0	10.0	8.0	14.1	13.1	62.4	48.3	14.4	18.1	8.3	26.1
1977/78	47.3	43.9	27.5	17.1	15.5	18.5	23.2	98.8	29.3	24.9	27.7	26.3	33.5
1978/79	38.4	60.3	20.7	8.8	10.9	5.3	21.3	39.5	31.8	37.3	9.8	58.7	28.6
1979/80	41.6	43.9	31.8	9.2	4.6	5.1	17.1	31.3	47.8	40.6	43.0	22.1	28.3
1980/81	35.1	45.4	23.3	12.9	9.4	6.3	15.6	51.4	52.0	19.6	11.8	38.6	26.9
1981/82	24.0	45.0	18.0	6.1	4.3	10.3	29.5	54.3	94.3	38.1	32.5	13.3	30.8
1982/83	62.9	57.5	20.0	6.0	4.6	5.3	8.1	19.4	28.3	21.5	22.1	39.3	24.7
1983/84	22.2	36.4	31.6	29.0	17.8	24.5	80.6	45.7	46.0	53.3	9.7	17.6	34.5
1984/85	32.8	42.7	25.0	22.9	14.0	12.6	15.5	41.9	104.6	32.2	31.3	17.5	32.8
1985/86	69.5	46.8	37.2	20.3	16.1	13.6	26.1	34.5	22.9	12.6	28.9	56.3	32.1
1986/87	51.4	30.1	16.1	12.4	6.2	6.1	13.1	17.3	25.9	6.6	48.3	35.3	22.5
1987/88	50.0	49.0	23.4	14.3	22.4	31.9	26.7	30.1	52.6	34.5	62.6	58.3	38.1
1988/89	12.9	38.6	12.9	5.4	3.4	5.7	9.2	28.2	82.4	72.0	34.3	31.3	28.1
1989/90	32.6	51.1	14.0	7.7	5.0	14.2	13.5	47.0	30.3	33.4	11.3	4.4	22.1
MEAN	44.9	41.1	23.7	14.7	10.4	13.1	23.0	46.6	51.6	34.0	28.3	33.4	30.5
MAX	84.8	90.6	43.4	33.7	22.4	31.9	80.6	148.7	110.7	86.3	62.6	68.4	41.2
MIN	12.9	9.8	8.2	4.7	3.4	5.1	8.1	11.7	14.6	6.6	7.9	4.4	22.1
STDV	16.3	12.7	8.5	6.9	4.8	6.2	12.4	26.5	25.6	18.3	13.2	18.9	4.9
% MEAN	12.3	11.2	6.5	4.0	2.9	3.6	6.3	12.7	14.1	9.3	7.7	9.1	

SOURCE OF RAW DATA:

MISSING DATA INDICATED BY A DASH

EFFECTIVE FLOWS FOR RoR ALTERNATIVES

October 1991

Oud - Lahmeyer International
Siriwardena - CECB

6A.3 - 7

DETERMINATION OF MONTHLY EFFECTIVE FLOWS FOR ROR ALTERNATIVES

1. METHODOLOGY

The hydrological data base for the Kukule Feasibility Study contains reconstitued monthly time series for the period 1949-1989. It is clear however that the direct use of monthly inflow series would lead to a significant overestimation of the energy production, and hence the benefits, of the Kukule run-of-river alternatives.

Daily, partly infilled, flow series are available for the Kukulegama hydrometric station for the period 1972 to 1989. These daily series were subjected to an analysis in which values exceeding the product of installed capacity factor (ICF) and mean flow (equivalent to the turbine discharge capacity) have been cut off at this level. Then the resulting daily series were aggregated in monthly time series and compared to the original monthly flow series. This was done for ICF's of 1.0 to 3.0.

2. RESULTS

The results of the analysis are presented in Annexes 1 and 2, showing a scatter diagram with original versus cut-off monthly flows for the period 1972-1989. Annex 1 with the first set of 5 figures shows the diagrams for the full series for ICF's of 1.0, 1.5, 2.0, 2.5 and 3.0.

Annex 2 with the second set of 12 figures show the same sort of diagram on a calendar-monthly basis for an ICF of 1.5. These monthly diagrams contain too few data points to draw general conclusions.

The relationship between cutoff flow series and original flow series for the full data set can however quite well be used to transform the extended monthly flow series 1949-1989 for the Run-of-River alternatives to be studied. Basically low monthly flows can be used for 100%. A straight line or exponential curve can then be fitted through the remaining data points which cannot be turbined for the full 100%, ignoring however those exceeding the turbine discharge capacity.

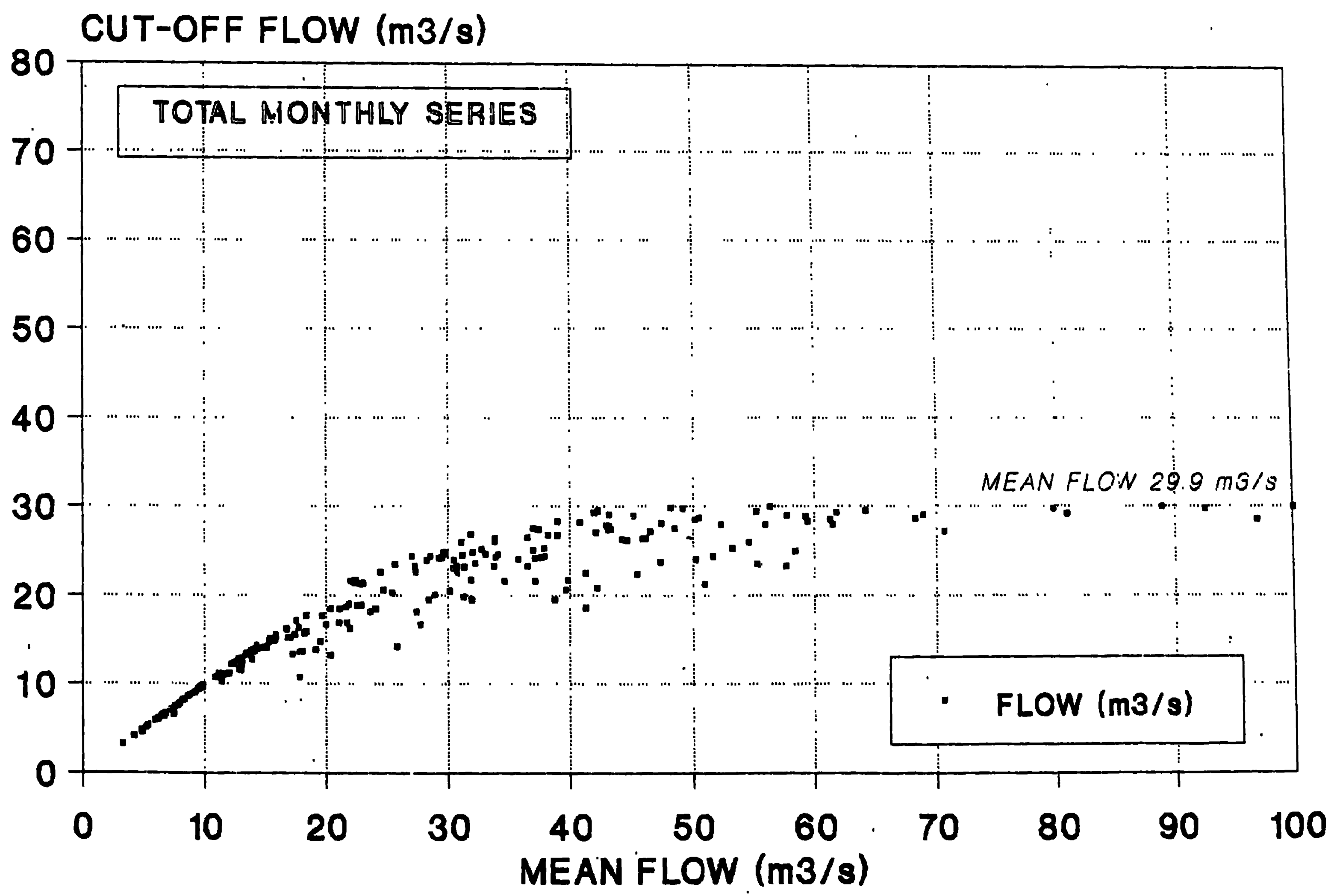
Applying such a relationship to the original flow series will split these into two, i.e. one series of flows which can be used for hydropower generation and the difference between these and the original series, being the spill.

EFFECTIVE FLOWS FOR RoR ALTERNATIVES

October 1991

Annex 1

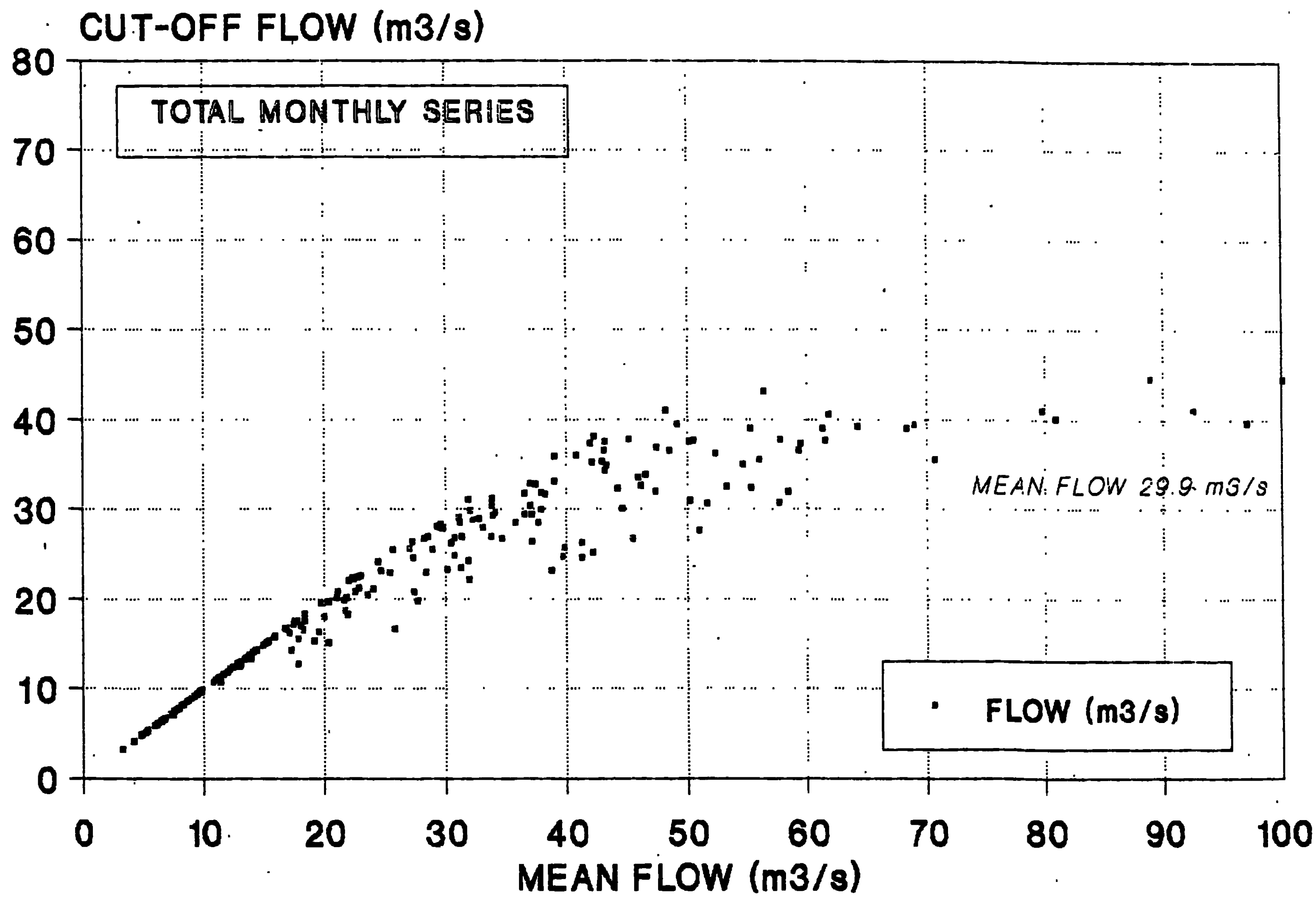
PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.0 x MEAN FLOW



Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

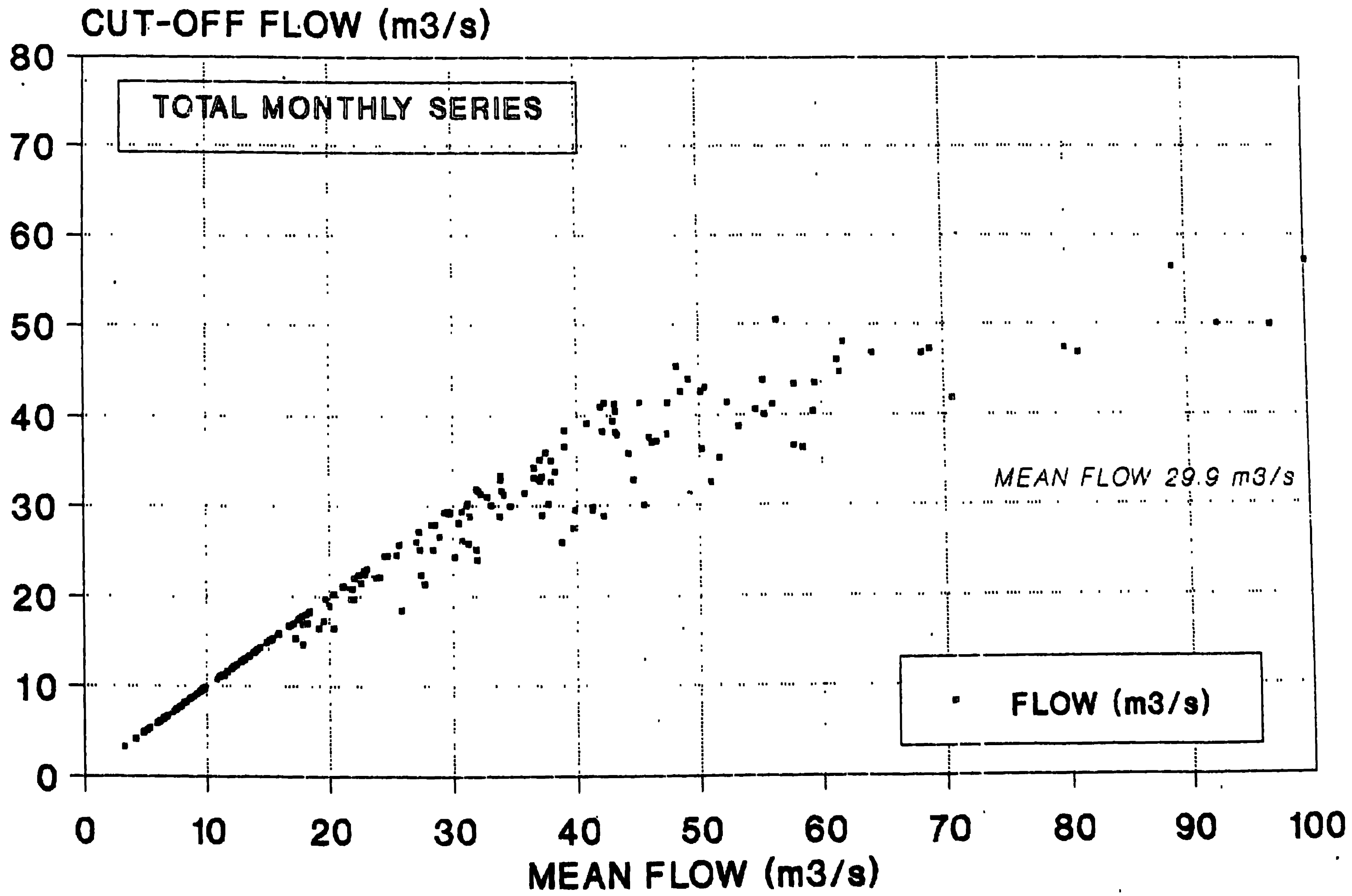
PLOT OF MEAN FLOW Vs CUT-OFF FLOW

CUT-OFF AT 1.5 x MEAN FLOW



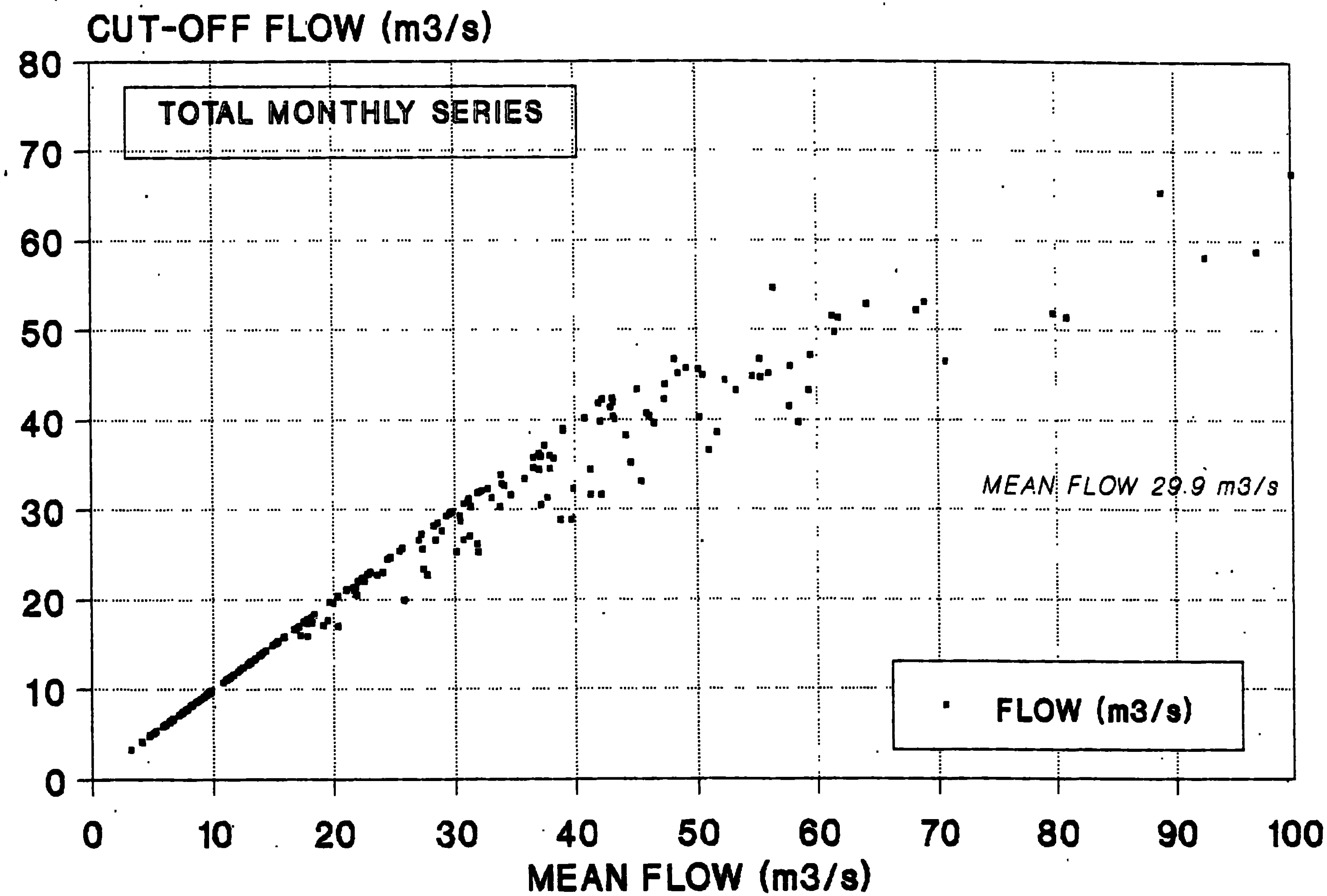
Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 2.0 x MEAN FLOW



Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

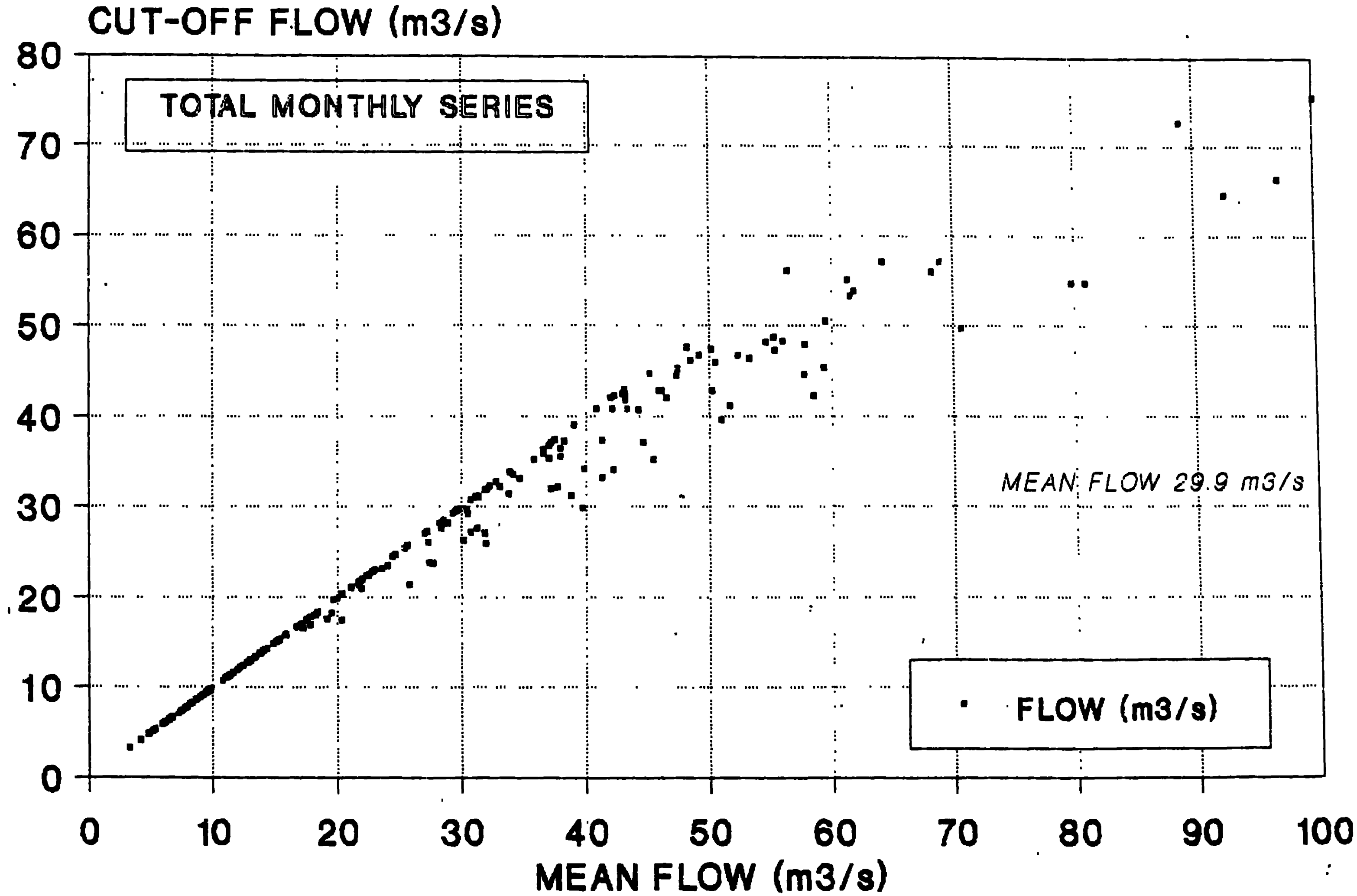
PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 2.5 x MEAN FLOW



Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW

CUT-OFF AT 3.0 x MEAN FLOW

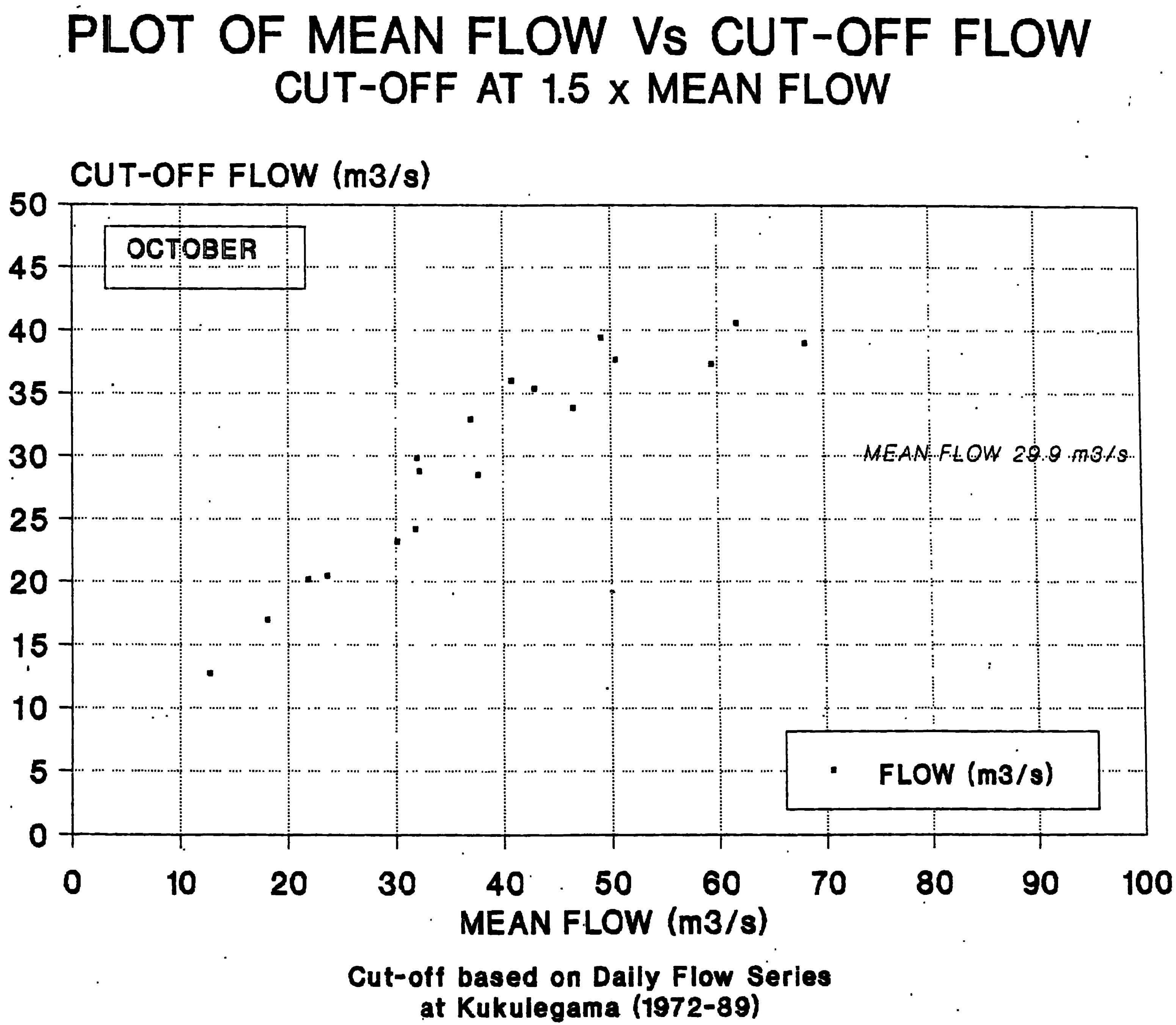


Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

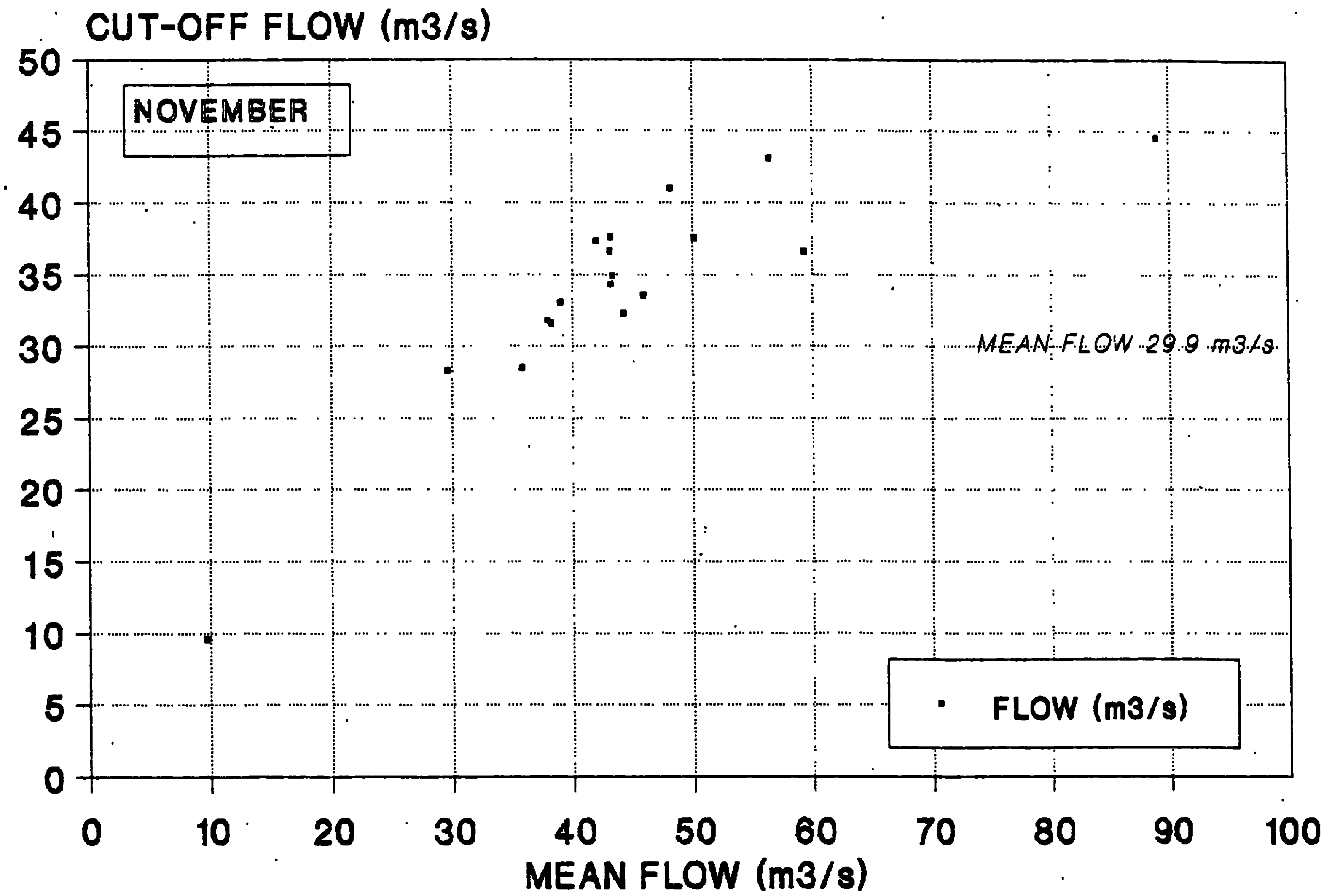
EFFECTIVE FLOWS FOR RoR ALTERNATIVES

October 1991

Annex 2

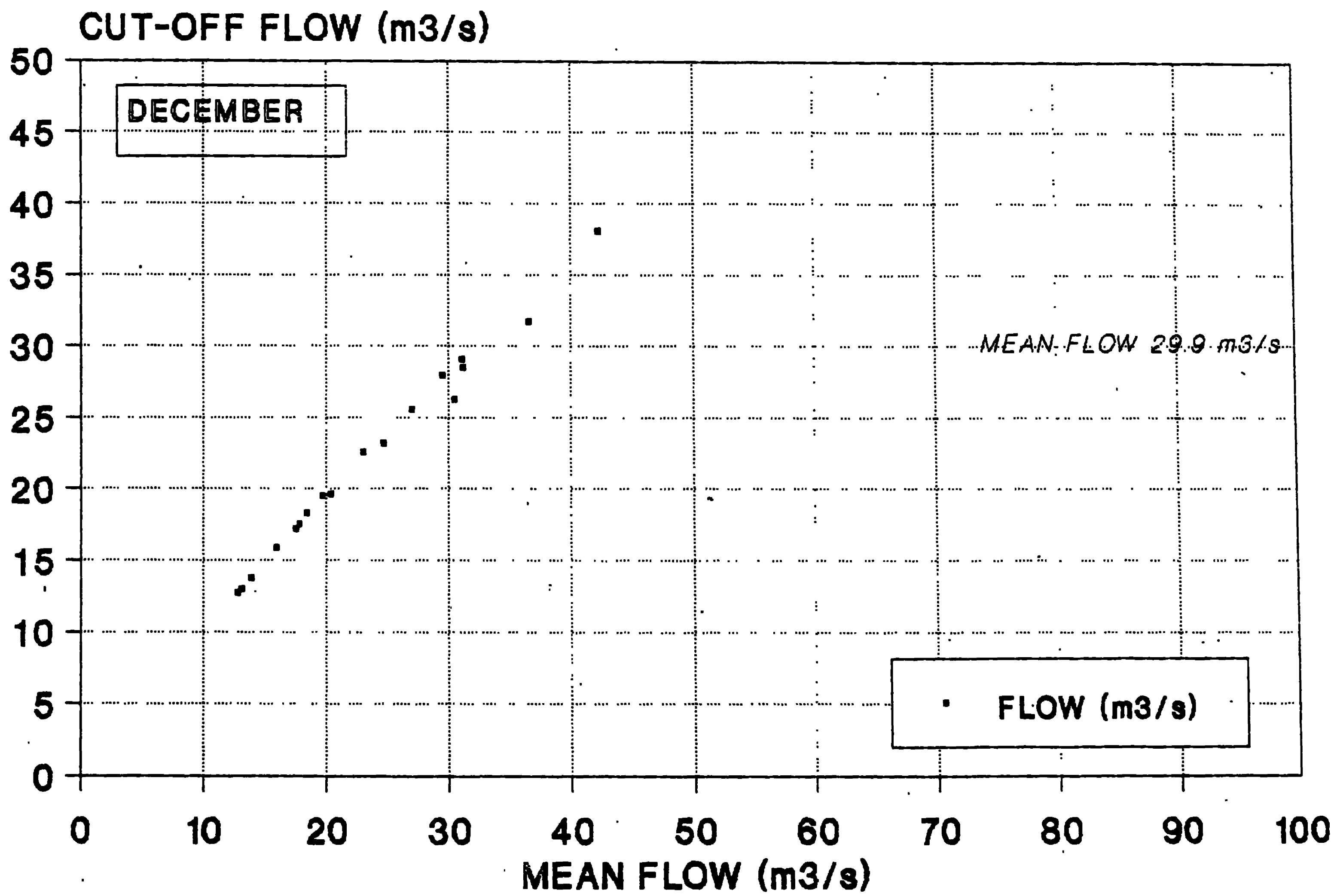

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW
CUT-OFF FLOW (m3/s)
OCTOBER
MEAN FLOW 29.9 m3/s
FLOW (m3/s)
0
5
10
15
20
25
30
35
40
45
50
0
10
20
30
40
50
60
70
80
90
100
MEAN FLOW (m3/s)
Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



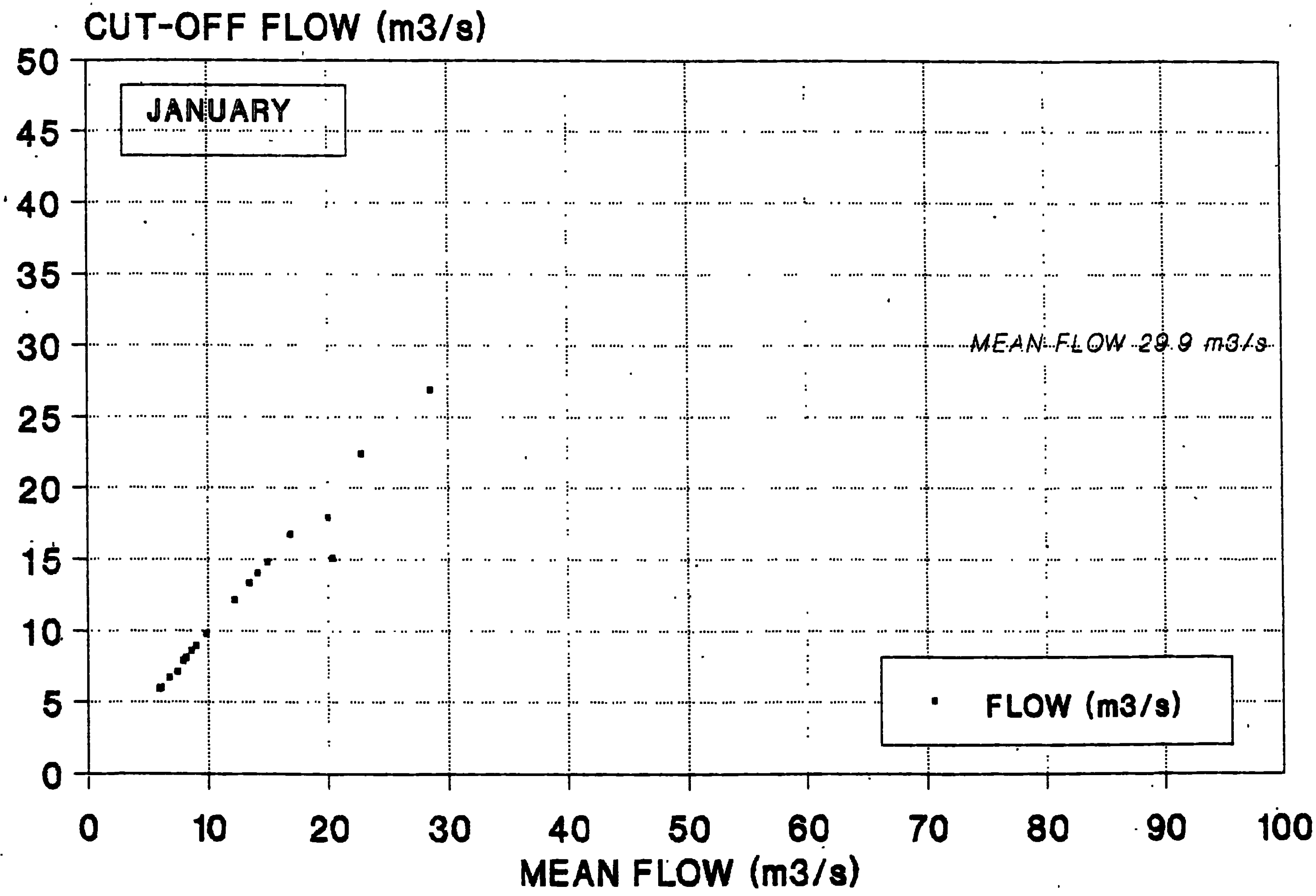
Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



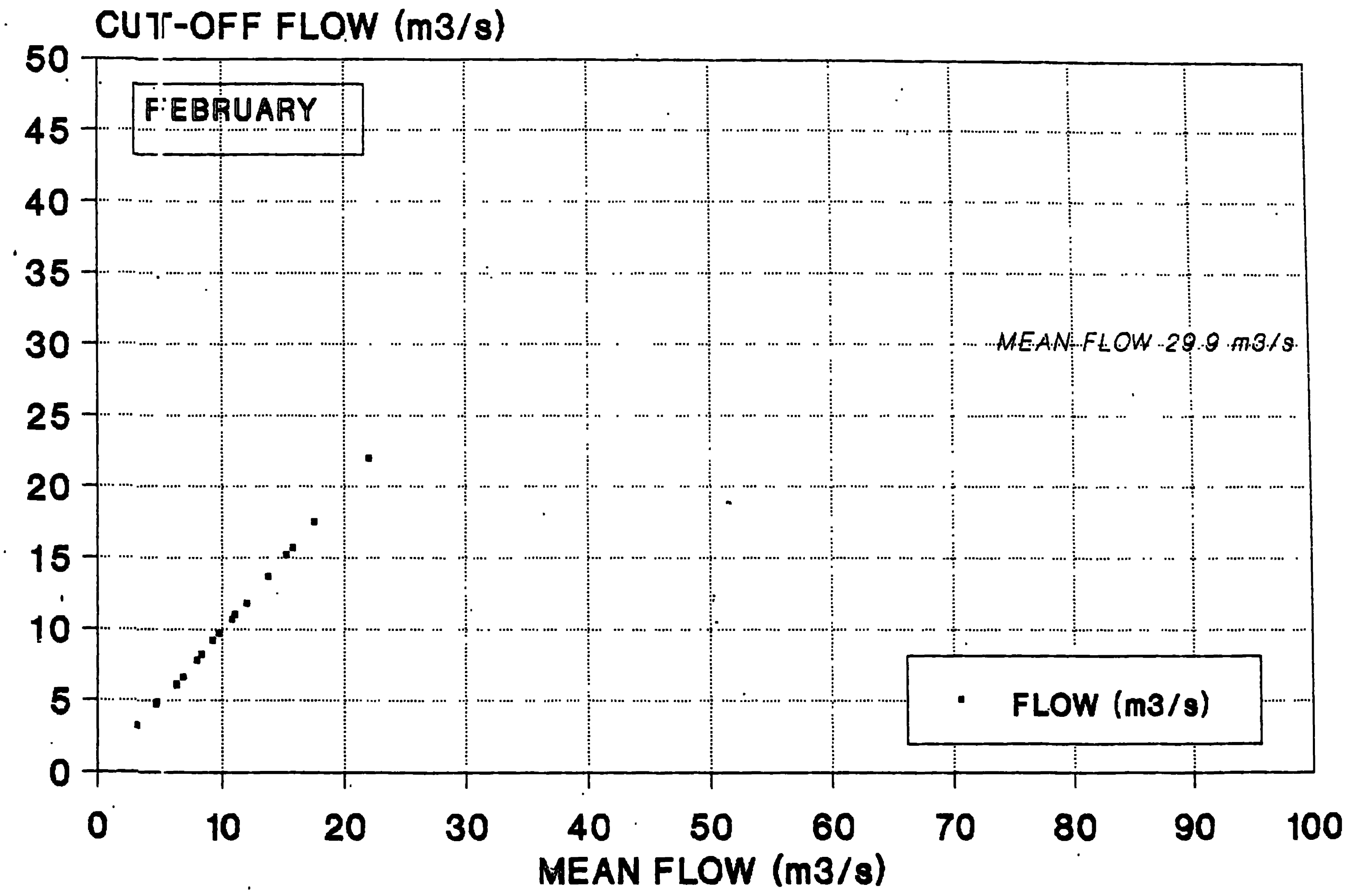
Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



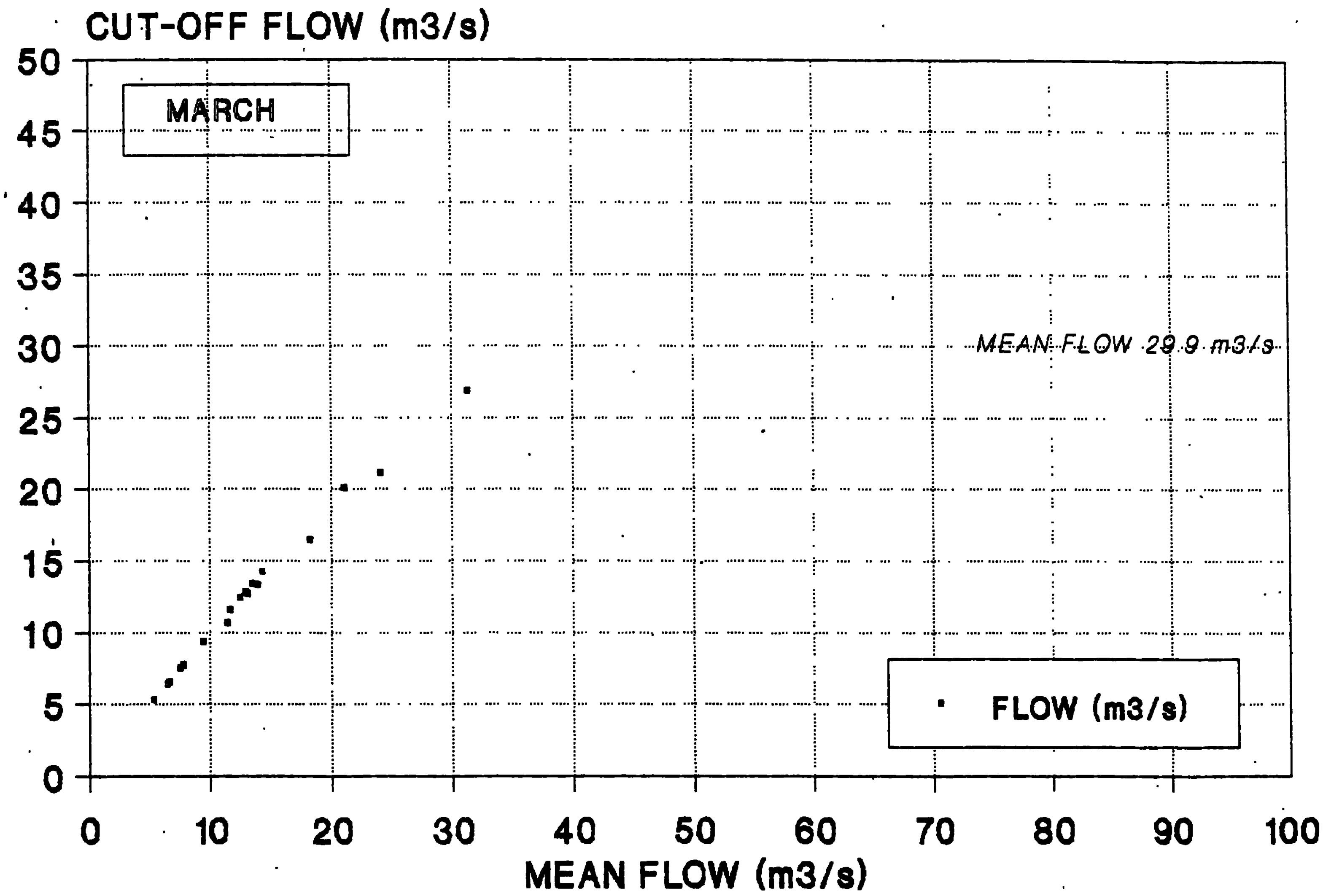
Cut-off based on Daily Flow Series at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



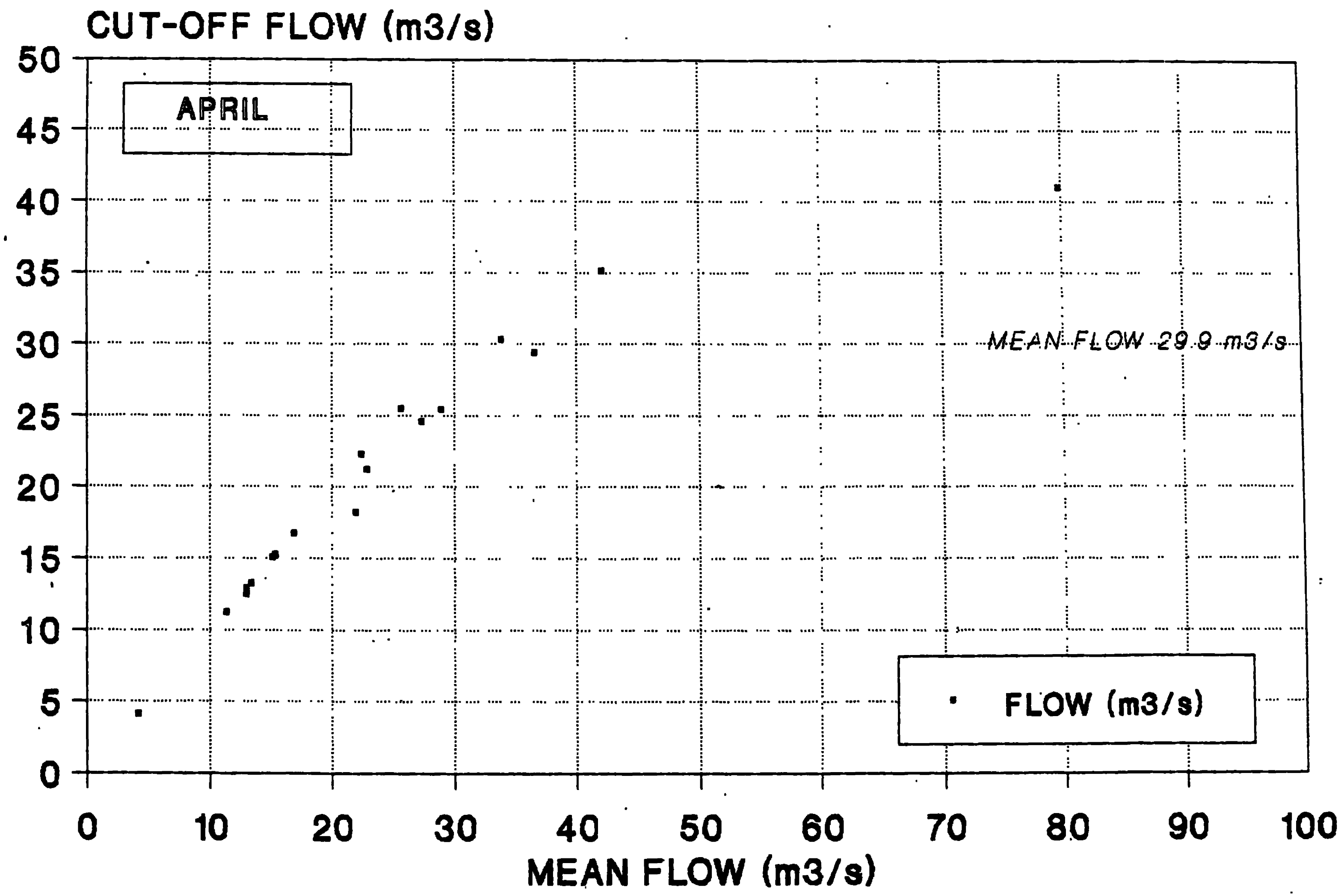
Cut-off based on Daily Flow Series at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



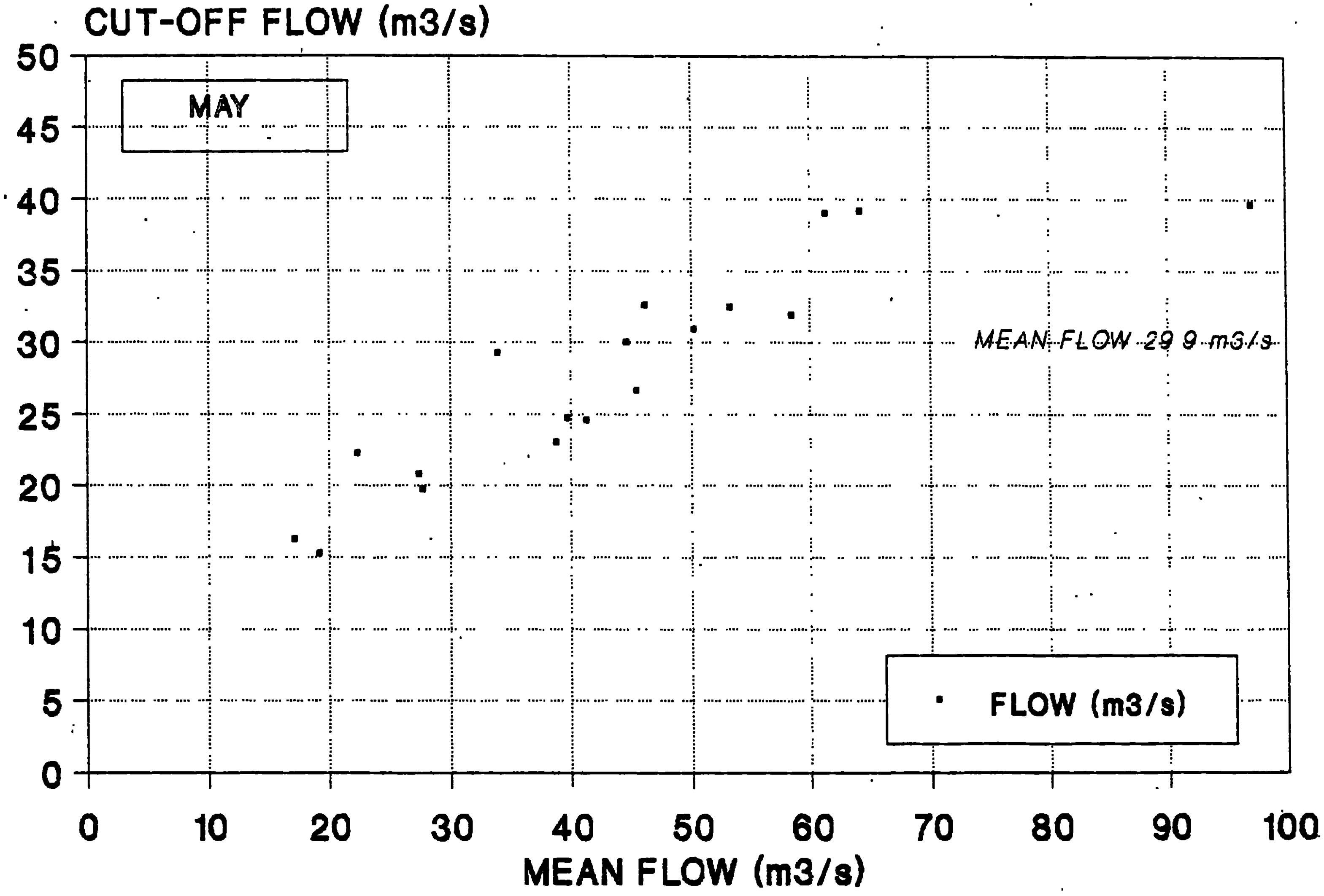
Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



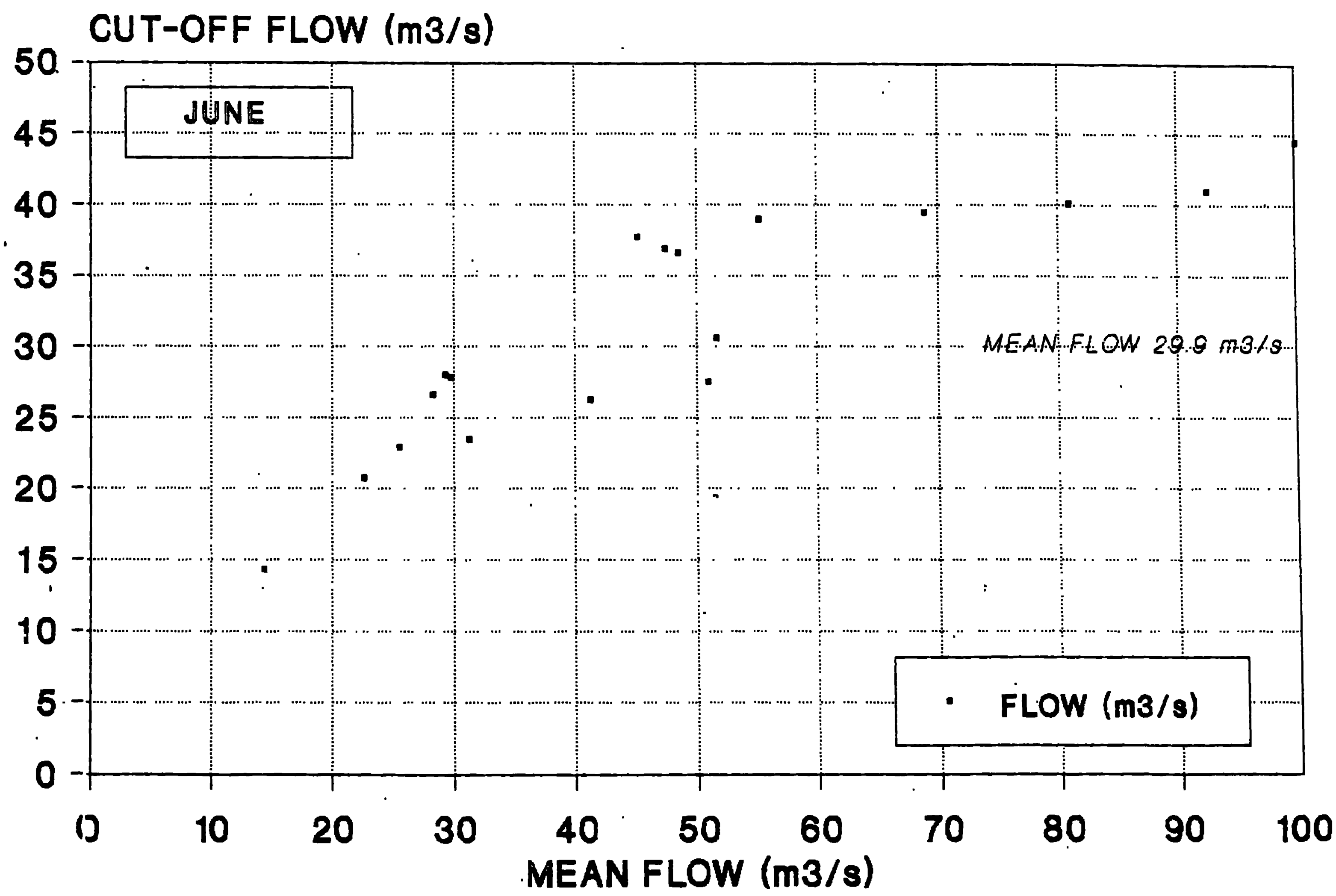
Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



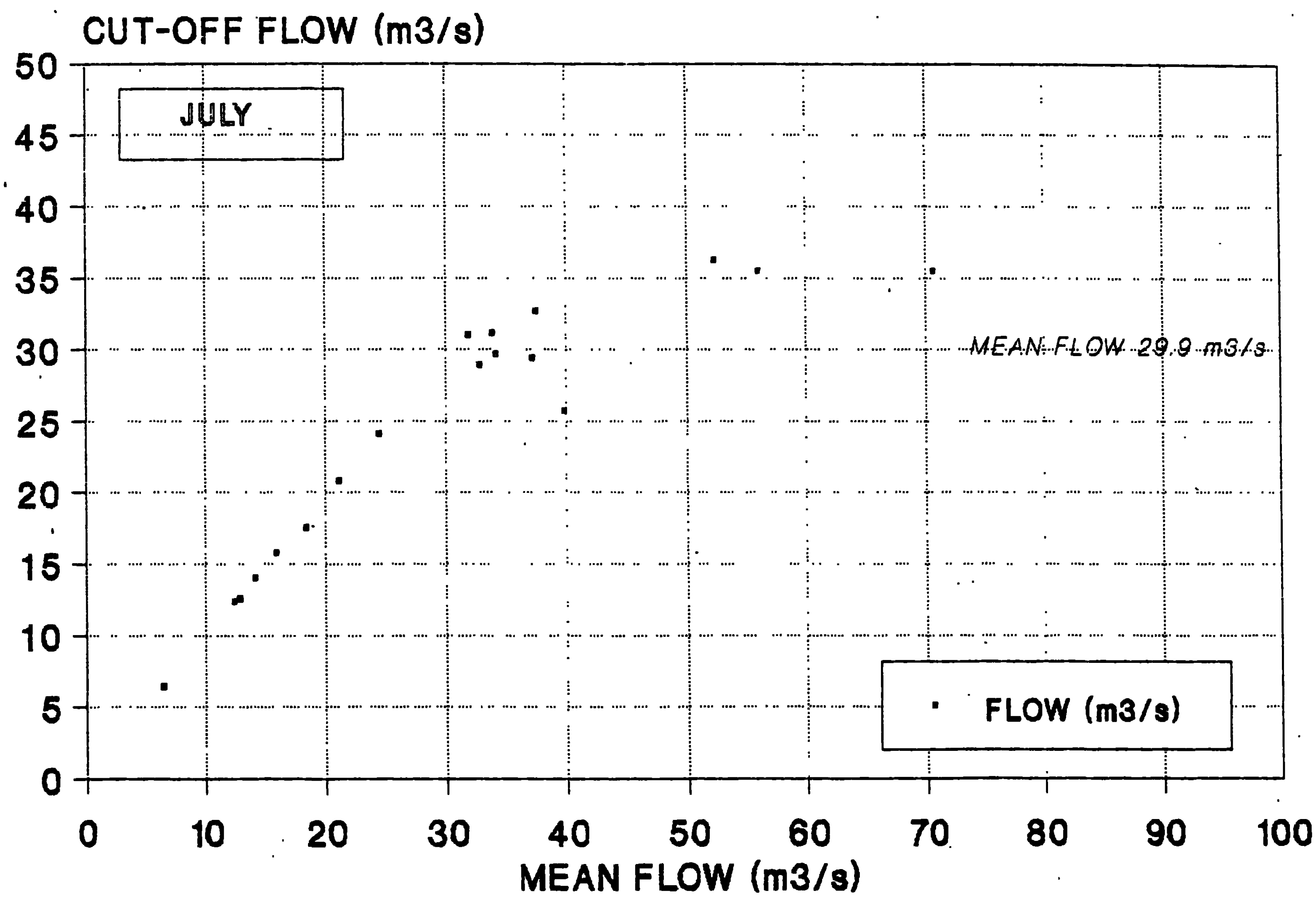
Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



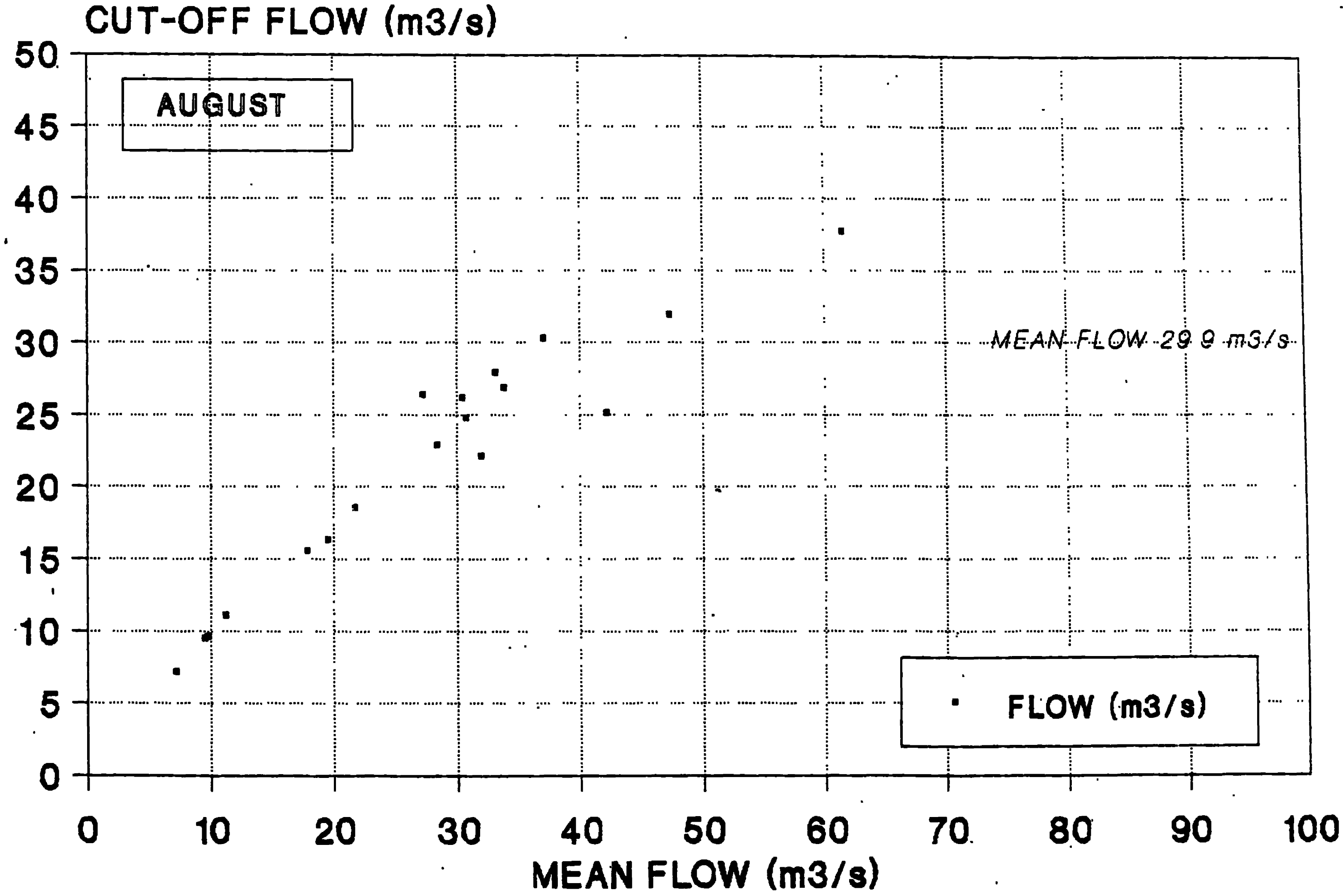
Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



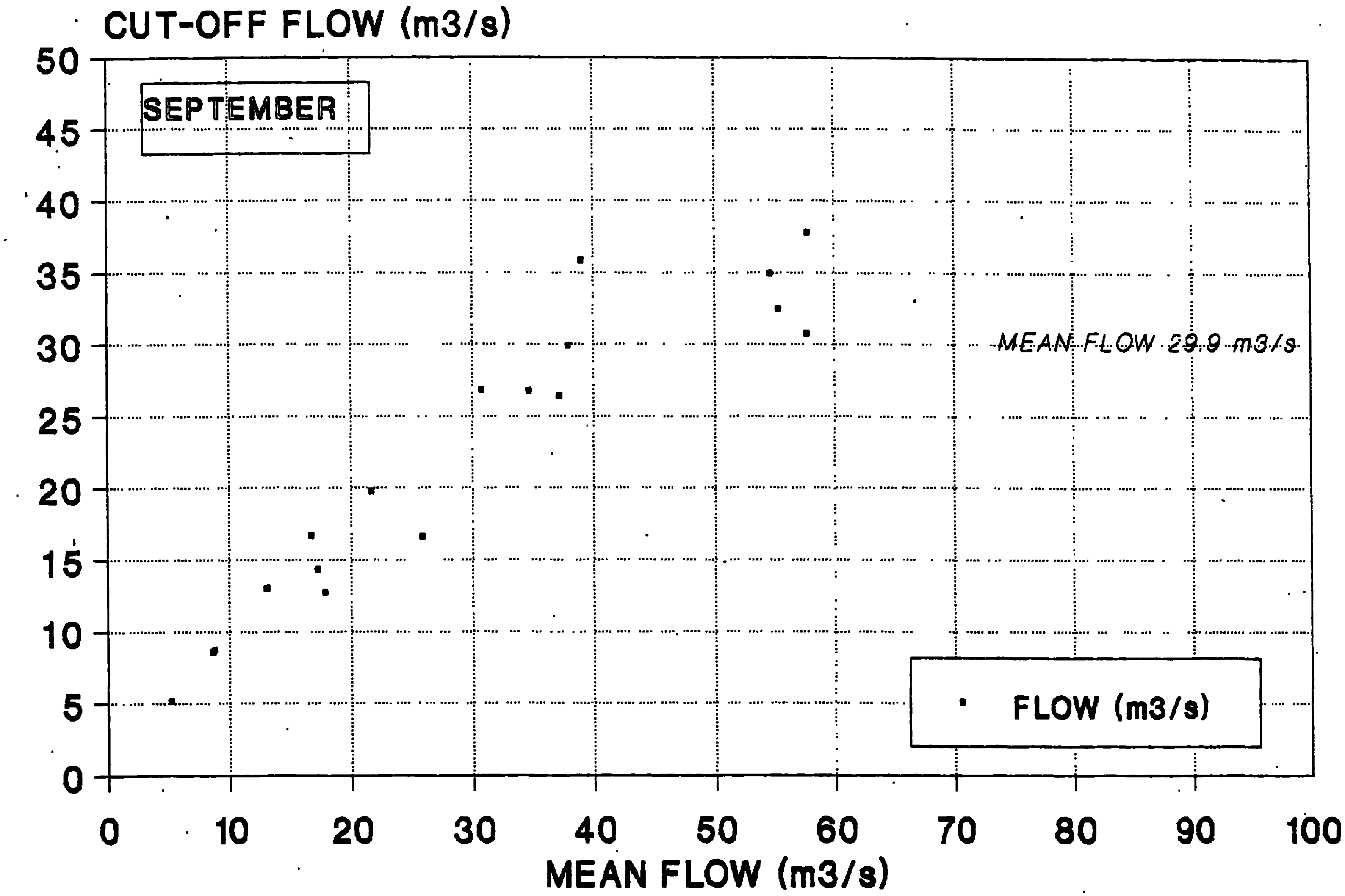
Cut-off based on Daily Flow Series at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



Cut-off based on Daily Flow Series at Kukulegama (1972-89)

PLOT OF MEAN FLOW Vs CUT-OFF FLOW
CUT-OFF AT 1.5 x MEAN FLOW



Cut-off based on Daily Flow Series
at Kukulegama (1972-89)

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dum           CEB   MASTERPLAN  FOR  THE  ELECTRICITY  SUPPLY  OF  SRI LANKA
P
P KUKU022   ROR - POWER PLANT  - ICF 1.25
P  1      5    13
P  1 2 0 01112
P  1 2 2  1111 204.0 204.1 204.2 204.3 204.4 204.5 204.6 204.7 204.8 204.9 205.0
P  1 2 1   5.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1 2 2  6.00  8.46  8.47  8.47  8.47  8.48  8.48  8.48  8.49  8.49  8.49  8.50
P  1 2 3  8.96 14.15 14.16 14.17 14.17 14.18 14.19 14.19 14.20 14.21 14.21 14.22
P  1 2 4 11.92 19.66 19.67 19.68 19.69 19.70 19.71 19.72 19.73 19.74 19.75 19.76
P  1 2 5 14.88 24.46 24.47 24.49 24.50 24.51 24.53 24.54 24.56 24.57 24.58 24.60
P  1 2 6 17.84 27.98 27.99 28.00 28.02 28.03 28.04 28.05 28.07 28.08 28.09 28.11
P  1 2 7 20.80 33.51 33.53 33.54 33.56 33.57 33.59 33.61 33.62 33.64 33.66 33.67
P  1 2 8 23.76 38.73 38.75 38.77 38.79 38.81 38.83 38.85 38.87 38.89 38.91 38.93
P  1 2 9 26.72 43.61 43.64 43.66 43.69 43.71 43.74 43.76 43.79 43.81 43.84 43.86
P  1 210 29.68 47.79 47.82 47.85 47.88 47.91 47.94 47.97 48.00 48.03 48.06 48.09
P  1 211 32.64 51.42 51.45 51.49 51.52 51.56 51.59 51.63 51.66 51.70 51.73 51.77
P  1 212 35.60 53.61 53.57 53.61 53.65 53.70 53.74 53.79 53.83 53.87 53.92 53.96
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PMAT17        CEB   MASTERPLAN  FOR  THE  ELECTR  ITY  SUPPLY  OF  SRI LANKA
P
P KUKU022   ROR - POWER PLANT  - ICF 1.5
P  1     5    13
P  1 2 0 01112
P  1 2 2  1111 204.0 204.1 204.2 204.3 204.4 204.5 204.6 204.7 204.8 204.9 205.0
P  1 2 1   5.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1 2 2  6.00  8.43  8.43  8.44  8.44  8.45  8.45  8.45  8.46  8.46  8.46  8.47
P  1 2 3  9.66 15.47 15.48 15.49 15.49 15.50 15.51 15.51 15.52 15.52 15.53 15.54
P  1 2 4 13.32 22.65 22.66 22.67 22.68 22.70 22.71 22.72 22.73 22.74 22.75 22.76
P  1 2 5 16.98 29.10 29.11 29.13 29.15 29.16 29.18 29.19 29.21 29.22 29.24 29.26
P  1 2 6 20.64 33.32 33.34 33.35 33.37 33.38 33.40 33.41 33.43 33.44 33.46 33.47
P  1 2 7 24.30 40.32 40.34 40.36 40.38 40.40 40.42 40.44 40.46 40.48 40.50 40.52
P  1 2 8 27.96 46.98 47.01 47.03 47.05 47.08 47.10 47.13 47.15 47.18 47.20 47.23
P  1 2 9 31.62 53.13 53.16 53.19 53.22 53.25 53.28 53.31 53.34 53.37 53.40 53.43
P  1 210 35.28 58.34 58.38 58.41 58.45 58.48 58.52 58.56 58.59 58.63 58.66 58.70
P  1 211 38.94 62.73 62.77 62.82 62.86 62.90 62.94 62.99 63.03 63.07 63.11 63.16
P  1 212 42.60 64.00 64.00 64.00 64.00 64.00 64.00 64.00 64.00 64.00 64.00 64.00
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PMAT18          CEB   MASTERPLAN  FOR  THE  ELECTRICITY  SUPPLY  OF  SRI LANKA
P
P KUKU022   ROR   POWER PLANT  - ICF 2.0
P  1      5    13
P  1 2 0 01112
P  1 2 2  1111 204.0 204.1 204.2 204.3 204.4 204.5 204.6 204.7 204.8 204.9 205.0
P  1 2 1   7.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1 2 2  8.00 10.29 10.29 10.30 10.30 10.30 10.31 10.31 10.32 10.32 10.33 10.33
P  1 2 3 13.28 19.52 19.53 19.54 19.55 19.55 19.56 19.57 19.58 19.59 19.60 19.60
P  1 2 4 18.56 29.21 29.23 29.24 29.25 29.27 29.28 29.30 29.31 29.33 29.34 29.35
P  1 2 5 23.84 37.91 37.93 37.95 37.97 37.99 38.01 38.03 38.05 38.07 38.09 38.11
P  1 2 6 29.12 43.42 43.44 43.46 43.48 43.50 43.52 43.54 43.56 43.58 43.60 43.62
P  1 2 7 34.40 52.75 52.78 52.81 52.83 52.86 52.89 52.92 52.94 52.97 53.00 53.02
P  1 2 8 39.68 61.53 61.56 61.59 61.63 61.66 61.69 61.73 61.76 61.79 61.83 61.86
P  1 2 9 44.96 69.60 69.64 69.68 69.72 69.76 69.80 69.84 69.88 69.92 69.96 70.00
P  1 210 50.24 76.34 76.38 76.43 76.48 76.53 76.58 76.62 76.67 76.72 76.77 76.81
P  1 211 55.52 81.86 81.92 81.97 82.03 82.08 82.14 82.20 82.25 82.31 82.36 82.42
P  1 212 60.80 42.50 42.50 42.50 42.50 42.50 84.60 84.68 84.76 84.84 84.92 85.00
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PMAT19        CEB   MASTERPLAN  FOR  THE  ELECTRICITY  SUPPLY  OF  SRI LANKA
P
P KUKU022   ROR - POWER PLANT  - ICF 2.5
P  1      5    13
P  1 2 0 01112.
P  1 2 2  1111 204.0 204.1 204.2 204.3 204.4 204.5 204.6 204.7 204.8 204.9 205.0
P  1 2 1   9.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1 2 2 10.00 12.84 12.85 12.85 12.86 12.86 12.87 12.87 12.88 12.88 12.89 12.89
P  1 2 3 16.60 24.38 24.39 24.40 24.41 24.43 24.44 24.45 24.46 24.47 24.48 24.49
P  1 2 4 23.20 36.48 36.49 36.51 36.53 36.55 36.56 36.58 36.60 36.62 36.63 36.65
P  1 2 5 29.80 47.36 47.38 47.41 47.43 47.46 47.48 47.51 47.54 47.56 47.59 47.61
P  1 2 6 36.40 54.17 54.20 54.22 54.25 54.27 54.29 54.32 54.34 54.37 54.39 54.41
P  1 2 7 43.00 65.81 65.84 65.87 65.90 65.94 65.97 66.00 66.03 66.06 66.10 66.13
P  1 2 8 49.60 76.76 76.80 76.85 76.89 76.93 76.97 77.01 77.06 77.10 77.14 77.18
P  1 2 9 56.20 86.79 86.84 86.89 86.94 86.99 87.04 87.09 87.14 87.18 87.23 87.28
P  1 210 62.80 95.17 95.23 95.29 95.35 95.41 95.47 95.53 95.59 95.65 95.71 95.77
P  1 211  69.4 102.0 102.0 102.1 102.2 102.3 102.3 102.4 102.5 102.5 102.6 102.7
P  1 212  76.0 105.3 105.2 105.3 105.4 105.5 105.6 105.7 105.7 105.8 105.9 106.0
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PMAT20         CEB   MASTERPLAN  FOR  THE  ELECTRICITY  SUPPLY  OF  SRI LANKA
P
P KUKU022   MOL230 - POWER PLANT  - ICF 1.5
P  1      5    13
P  1 2 0 01112
P  1 2 2  1111 210.0 212.0 214.0 216.0 218.0 220.0 222.0 224.0 226.0 228.0 230.0
P  1 2 1   5.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1 2 2  6.00  8.55  8.63  8.72  8.80  8.88  8.96  9.03  9.10  9.18  9.25  9.32
P  1 2 3  9.96 16.25 16.41 16.56 16.72 16.87 17.01 17.15 17.28 17.42 17.55 17.68
P  1 2 4 13.92 23.99 24.25 24.50 24.75 25.00 25.25 25.49 25.73 25.97 26.21 26.44
P  1 2 5 17.88 30.76 31.13 31.50 31.86 32.23 32.59 32.94 33.29 33.64 33.99 34.33
P  1 2 6 21.84 35.99 36.35 36.71 37.07 37.56 38.03 38.51 38.90 38.90 39.10 39.42
P  1 2 7 25.80 43.48 43.95 44.40 44.86 45.31 45.77 46.21 46.65 47.09 47.52 47.95
P  1 2 8 29.76 50.53 51.13 51.69 52.24 52.80 53.35 53.91 54.44 54.97 55.50 56.03
P  1 2 9 33.72 56.80 57.52 58.23 58.90 59.58 60.25 60.93 61.59 62.23 62.87 63.50
P  1 210 37.68 61.91 62.75 63.58 64.39 65.18 65.97 66.76 67.55 68.32 69.09 69.85
P  1 211 41.64 66.12 67.00 67.89 68.78 69.68 70.58 71.49 72.41 73.33 74.23 75.13
P  1 212 45.60 66.36 67.51 68.64 69.76 70.90 72.06 73.19 74.32 75.46 76.60 77.76
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PMAT21          CEB   MASTERPLAN  FOR  THE  ELECTRICITY  SUPPLY  OF  SRI LANKA
P
P KUKU022   MOL230 - POWER PLANT  - ICF 2.0
P  1     5    13
P  1 2 0 01112
P  1 2 2  1111 210.0 212.0 214.0 216.0 218.0 220.0 222.0 224.0 226.0 228.0 230.0
P  1 2 1   7.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1 2 2  8.00 11.71 11.82 11.91 12.01 12.11 12.21 12.30 12.40 12.49 12.59 12.67
P  1 2 3 13.28 22.24 22.44 22.62 22.81 22.99 23.17 23.36 23.54 23.72 23.89 24.06
P  1 2 4 18.56 32.98 33.32 33.65 33.98 34.31 34.64 34.95 35.26 35.56 35.87 36.17
P  1 2 5 23.84 42.50 42.99 43.47 43.95 44.43 44.91 45.36 45.81 46.25 46.69 47.13
P  1 2 6 29.12 49.48 50.13 50.78 51.43 51.50 51.55 51.99 52.42 52.84 53.25 53.67
P  1 2 7 34.40 59.59 60.20 60.82 61.42 62.02 62.61 63.21 63.77 64.32 64.86 65.40
P  1 2 8 39.68 69.34 70.10 70.84 71.58 72.31 73.04 73.77 74.48 75.16 75.83 76.49
P  1 2 9 44.96 78.13 79.06 79.98 80.88 81.78 82.65 83.52 84.39 85.24 86.05 86.85
P  1 210 50.24 85.29 86.37 87.46 88.55 89.61 90.67 91.70 92.74 93.78 94.80 95.79
P  1 211  55.5  91.0  92.2  93.5  94.7  96.0  97.2  98.5  99.7 101.0 102.2 103.0
P  1 212  60.8  92.4  93.9  95.5  97.1  98.6 100.1 101.7 103.0 103.0 103.0 103.0
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PMAT22          CEB   MASTERPLAN  FOR  THE  ELECTRICITY  SUPPLY  OF  SRI LANKA
P
P KUKU022   MOL230 - POWER PLANT  - ICF 2.5
P  1      5    13
P  1  2  0 01112
P  1  2  2  1111 210.0 212.0 214.0 216.0 218.0 220.0 222.0 224.0 226.0 228.0 230.0
P  1  2  1   9.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1  2  2 10.00 13.93 14.05 14.17 14.29 14.40 14.52 14.63 14.74 14.86 14.97 15.07
P  1  2  3 16.60 26.48 26.71 26.93 27.15 27.37 27.58 27.80 28.01 28.23 28.44 28.63
P  1  2  4 23.20 39.23 39.63 40.03 40.42 40.81 41.20 41.57 41.94 42.30 42.66 43.02
P  1  2  5 29.80 50.57 51.15 51.73 52.30 52.87 53.44 53.98 54.51 55.03 55.56 56.08
P  1  2  6 36.40 58.91 59.68 60.45 61.23 62.00 62.78 63.54 64.29 64.70 64.70 64.70
P  1  2  7 43.00 70.96 71.69 72.42 73.13 73.84 74.55 75.26 75.92 76.58 77.22 77.86
P  1  2  8 49.60 82.65 83.56 84.44 85.32 86.19 87.06 87.92 88.76 89.57 90.37 91.15
P  1  2 9   56.2  93.2  94.3  95.4  96.5  97.5  98.6  99.6 100.6 101.6 102.6 103.5
P  1  210   62.8 101.9 103.2 104.5 105.8 107.0 108.3 109.5 110.8 112.0 113.2 114.4
P  1  211   69.4 108.8 110.3 111.8 113.3 114.8 116.3 117.8 119.2 120.7 122.1 123.5
P  1  212   76.0 110.7 112.6 114.5 116.4 118.2 120.1 121.9 123.7 125.6 127.5 129.4
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PMAT55        CEB   MASTERPLAN  FOR  THE  ELECTRICITY  SUPPLY  OF  SRI LANKA
P
P KUKU022   MOL242 - POWER PLANT  - ICF 1.5
P  1     5    13
P  1 2 0 01112
P  1 2 2  1111 210.0 213.2 216.4 219.6 222.8 226.0 229.2 232.4 235.6 238.8 242.0
P  1 2 1   5.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1 2 2  6.00  8.33  8.47  8.59  8.72  8.83  8.95  9.06  9.16  9.27  9.38  9.47
P  1 2 3  9.96 15.84 16.08 16.32 16.56 16.77 16.98 17.19 17.39 17.60 17.79 17.97
P  1 2 4 13.92 23.38 23.78 24.17 24.56 24.94 25.32 25.69 26.04 26.39 26.74 27.08
P  1 2 5 17.88 29.97 30.55 31.12 31.69 32.24 32.78 33.33 33.84 34.35 34.85 35.34
P  1 2 6 21.84 35.06 35.64 36.21 36.96 37.70 38.44 39.18 39.91 40.61 41.15 41.15
P  1 2 7 25.80 42.37 43.10 43.81 44.52 45.22 45.90 46.57 47.23 47.87 48.48 49.08
P  1 2 8 29.76 49.24 50.14 51.03 51.89 52.75 53.58 54.40 55.22 56.00 56.76 57.51
P  1 2 9 33.72 55.34 56.45 57.54 58.58 59.63 60.66 61.64 62.63 63.58 64.51 65.40
P  1 210 37.68 60.32 61.63 62.89 64.13 65.36 66.59 67.77 68.95 70.13 71.25 72.36
P  1 211 41.64 64.42 65.80 67.19 68.59 70.01 71.44 72.86 74.25 75.66 77.01 78.32
P  1 212 45.60 64.68 66.46 68.16 69.96 71.83 73.55 75.28 77.17 79.01 80.68 82.30
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PMAT56          CEB   MASTERPLAN  FOR  THE  ELECTRICITY  SUPPLY  OF  SRI LANKA
P
P KUKU022    MOL242 - POWER PLANT  - ICF 2.0
P  1       5    13
P  1  2  0  01112
P  1  2  2   1111 210.0 213.2 215.4 219.6 222.8 226.0 229.2 232.4 235.6 238.8 242.0
P  1  2  1    7.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1  2  2   8.00 11.13 11.31 11.48 11.65 11.80 11.95 12.10 12.25 12.39 12.53 12.66
P  1  2  3  13.28 21.17 21.50 21.81 22.13 22.41 22.69 22.97 23.25 23.52 23.78 24.02
P  1  2  4  18.56 31.23 31.77 32.29 32.81 33.32 33.82 34.32 34.80 35.27 35.73 36.19
P  1  2  5  23.84 39.99 40.77 41.53 42.29 43.03 43.76 44.49 45.18 45.86 46.52 47.19
P  1  2  6  29.12 46.77 47.55 48.30 49.25 50.24 51.23 52.22 53.20 54.14 54.50 54.50
P  1  2  7  34.40 56.46 57.44 58.40 59.35 60.29 61.20 62.10 63.00 63.85 64.67 65.48
P  1  2  8  39.68 65.54 66.76 67.95 69.10 70.25 71.38 72.47 73.57 74.62 75.65 76.65
P  1  2  9  44.96 73.56 75.06 76.52 77.93 79.32 80.73 82.04 83.36 84.66 85.90 87.10
P  1  210  50.24 80.03 81.77 83.48 85.16 86.80 88.44 90.05 91.62 93.21 94.73 96.23
P  1  211   55.5  85.4  87.2  89.1  91.0  92.8  94.7  96.7  98.5 100.4 102.3 104.0
P  1  212   60.8  85.4  87.8  90.2  92.5  94.8  97.2  99.6 101.9 104.2 106.7 109.0
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PMAT57        CEB   MASTERPLAN  FOR  THE  ELECTRICITY  SUPPLY  OF  SRI LANKA
P
P KUKU022   MOL242 - POWER PLANT  - ICF 2.5
P  1     5    13
P  1 2 0 01112
P  1 2 2  1111 210.0 213.2 216.4 219.6 222.8 226.0 229.2 232.4 235.6 238.8 242.0
P  1 2 1   9.9   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
P  1 2 2 10.00 13.97 14.18 14.40 14.61 14.80 14.99 15.18 15.36 15.54 15.71 15.88
P  1 2 3 16.60 26.57 26.98 27.38 27.78 28.14 28.49 28.83 29.18 29.53 29.85 30.16
P  1 2 4 23.20 39.15 39.82 40.48 41.14 41.77 42.41 43.04 43.63 44.22 44.80 45.37
P  1 2 5 29.80 50.12 51.10 52.05 53.01 53.94 54.85 55.77 56.64 57.49 58.33 59.16
P  1 2 6 36.40 58.63 59.61 60.55 61.71 62.95 64.18 65.43 66.65 67.84 68.15 68.15
P  1 2 7 43.00 70.73 71.96 73.17 74.36 75.54 76.68 77.81 78.94 80.00 81.04 82.06
P  1 2 8 49.60 82.08 83.62 85.13 86.57 88.01 89.43 90.81 92.19 93.52 94.81 96.07
P  1 2 9  56.2  92.1  94.0  95.8  97.6  99.3 101.1 102.7 104.4 106.0 107.6 109.1
P  1 210  62.8 100.1 102.3 104.5 106.6 108.7 110.7 112.7 114.7 116.7 118.6 120.5
P  1 211  69.4 106.8 109.1 111.4 113.7 116.1 118.5 120.9 123.2 125.6 127.9 130.2
P  1 212  76.0 106.8 109.7 112.6 115.5 118.5 121.6 124.6 127.5 130.4 133.4 136.3
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Year	Sales (GWh)	Annual Growth(%)	Losses (% of gen--ration)	Generation (GWh)	Load Factor(%)	Peak Demand(MW)
1989	2353	-0.8	17.7	2859	52.8	618
1990	2608	10.8	17.2	3150	56.2	640
1991	2804	7.5	16.0	3338	54.0	706
1992	3014	7.5	15.0	3546	54.0	750
1993	3240	7.5	14.5	3789	54.5	794
1994	3483	7.5	14.0	4050	55.0	841
1995	3744	7.5	13.0	4304	56.0	877
1996	4025	7.5	13.0	4626	57.0	927
1997	4327	7.5	13.0	4973	58.0	979
1998	4651	7.5	12.0	5286	58.0	1040
1999	5000	7.5	12.0	5682	58.0	1118
2000	5375	7.5	12.0	6108	58.0	1202
2001	5805	8.0	12.0	6597	58.0	1298
2002	6270	8.0	12.0	7125	58.0	1402
2003	6771	8.0	12.0	7695	58.0	1514
2004	7313	8.0	12.0	8310	58.0	1636
2005	7898	8.0	12.0	8975	58.0	1766
2006	8530	8.0	12.0	9693	58.0	1908
2007	9212	8.0	12.0	10468	58.0	2060
2008	9949	8.0	12.0	11306	58.0	2225
2009	10745	8.0	12.0	12210	58.0	2403
2010	11605	8.0	12.0	13187	58.0	2595
2011	12533	8.0	12.0	14242	58.0	2803

Table 4.2 – Base Forecast 1991

Table 8.1- Results of Generation Expansion Planning Studies - BASE CASE 1991

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS	LOLP %
1992	-	-	-	1.121
1993	Samanalawewa 120 MW	-	-	0.269
1994	-	-	-	1.008
1995	-	Sapugaskanda Ext. Diesel 40 MW	-	0.857
1996	-	Diesel 20 MW	-	1.799
1997	Broadlands 40 MW	Gas Turbine 44 MW	-	1.307
1998	-	-	-	4.101
1999	-	Coal Mawella Unit1 150 MW	-	0.344
2000	-	-	-	2.539
2001	-	Coal Mawella Unit2 150 MW	KPS Oil Steam 2*25 MW	1.231
2002	-	Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW	1.403
2003	-	Refurbished GT 3*20 MW	Gas Turbine 3*18 MW	5.317
2004	-	Coal Trinco Unit2 150 MW Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW	2.670
2005	-	Coal Trinco Unit3 300 MW	-	1.330
2006	-	-	-	3.593
Total PV cost upto 2011		1069.7 million US$ (42,789.4 million Rs.)		
Long Term average generation cost upto 2011		5.61 USCts/kWh (2.24 Rs/kWh)		

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

THERMAL PLANTS

NAME	NO. OF SETS	CAPACITY MW	HEAT RATES kCal/kWh MIN. LOAD	HEAT RATES kCal/kWh AVGE INCR	FUEL COSTS USCENTS/ MILLION KCAL	FULL LOAD EFFICIENCY %	FORCED OUTAGE RATE %	SCHL MAIN (DAYS/YR)	O&M COST (FIXED) $/kW-MONTH	O&M COST (VARIABLE) USCts/kWh
KELENITISSA (GT)	6	18.	3754.	3754.	1959.0	22.9	20.0	40	0.250	0.439
KELENITISSA (ST)	2	24.	3496.	3245.	1415.0	26.0	20.0	40	0.206	0.372
SAPU (DIESEL)	4	18.	2457.	2297.	1132.0	36.8	25.0	60	1.086	0.325

KELANITISSA (GT) - to be overhauled in 2001 and 2002, three units each year
KELANITISSA (ST) - to be retired by end of 2000
SAPU (DIESEL) - to be retired by end of 2003 and 2007, two units each year

HYDRO PLANTS

Hydro Project	Installed Capacity (MW)	Annual Energy (GWh)	Storage (MCM)	Remarks
Canyon	2 x 30	161	123.4	
Wimalasurendra	2 x 25	112	44.8	
New Laxapana	2 x 50	491	1.2	
Old Laxapana	3 x 8.33 |			
	2 x 12.5 |	289	0.4	
Polpitiya	2 x 37.5	427	0.4	
Kotmale	3 x 67	482	172.6	
Victoria	3 x 70	726	721.2	
Randenigala	2 x 61	378	875.0	
Rantambe	2 x 24.5	216	21.0	
Ukuwela	2 x 19	177	1.2	
Bowatenna	1 x 40	53	49.9	
Samanalawewa	2 x 60	357	278.0	To be Commissioned before the begining of 1993.

Operation and maintenance costs 1.872 US$/kW.year

Table 3.4 - Characteristics of Existing and Firmly Committed Generating Plants, as input to planning studies. All costs are in January 1991 US$ border prices.

THERMAL PLANTS

NAME	CAPA CITY MW	HEAT RATES kCal/kWh MIN. LOAD	AVGE INCR	FUEL COSTS USCENTS/ MILLION KCAL	FULL LOAD EFFICIENCY %	FORCED OUTAGE RATE %	SCHL MAIN (DAYS/YR)	O&M COST (FIXED) $/kW-MONTH	O&M COST (VARIABLE) USCts/kWh
DIESEL	20.	2301.	2134.	1132.0	39.6	15.0	30	1.086	0.325
DIESEL(SAPU EXT)	20.	2301.	2134.	1132.0	39.8	15.0	30	1.086	0.325
COAL MAWELLA	146.	3200.	2269.	755.0	34.4	17.0	35	.453	0.0
COAL TRINCO UNIT1/2	143.	3386.	2285.	635.0	33.6	17.0	35	.453	0.0
COAL TRINCO UNIT3/4	285.	3546.	2232.	635.0	33.6	20.0	50	.453	0.439
GAS TURBINE	22.	2908.	2908.	1959.0	29.6	15.0	30	.250	0.439
COMBINED CYCLE	68.	2025.	2025.	1959.0	42.2	15.0	30	.693	0.0
GAS TURBINE(REHAB)	20.	3754.	3754.	1959.0	22.9	20.0	40	.250	0.439

HYDRO PLANTS

Hydro Project	Installed Capacity (MW)	Annual Energy (GWh)	Storage (MCM)
GING GANGA	49	194	17.5
UPPER KOTMALE	248	791	32.0
MORGOLLA	27	111	5.0
KUKULE	144	398	300.0
BROADLANDS	40	145	0.2
UMA OYA (SEDZ)	150	425	18.0
BELIHUL OYA	17	64	5.8

Operation and maintenance costs 1.872 US$/kW.year

Table 5.3 - Characteristics of Generating Plants Considered as Expansion Candidates. All Costs are in January 1991 US$ boarder prices.

Plant	Effective Unit Size(MW)	Pure construction cost US$/kW		Total Cost (US$/kW)	Const period (yrs)	Interest during const (IDC) at 10% (% of pure costs)	Total including IDC (US$/kW)		Economic Life (years)
THERMAL		Local	Foreign				Local	Foreign	
Diesel	20	166.0	963.2	1129.2	3	13.54	188.4	1093.6	20
Diesel(Sapu Ext)	20	98.3	662.9	761.2	3	13.54	111.6	752.6	20
Combined Cycle	68	154.4	716.3	870.7	3	13.54	175.3	813.3	20
Coal Mavella Units 1&2	146	185.3	1325.4	1510.7	6	29.31	239.6	1713.9	30
Coal Trinco Units 1&2	143	228.8	1189.1	1417.9	6	29.31	295.9	1537.6	30
Units 3&4	285	141.2	814.8	956.0	6	29.31	182.6	1053.6	30
Gas turbine	22	54.7	468.9	523.6	2	8.79	59.5	510.2	20
Gas turbine (Rehabilit.)	20	12.5	112.5	125.0	1	4.29	13.0	117.3	20

Candidate Plant	Capacity (MW)	Pure construction cost US$/kW		Total Cost (US$/kW)	Const period (yrs)	Interest during const (IDC) at 10% (% of pure costs)	Total including IDC (US$/kW)		Economic Life (years)
HYDRO		Local	Foreign				Local	Foreign	
Upper Kotmale	248	551.5	720.2	1271.7	6	29.31	713.2	931.3	50
Ginganga	49	361.0	1173.8	1534.8	4	18.53	427.9	1391.3	50
Broadlands	40	291.1	1186.1	1477.2	4	18.53	345.0	1405.9	50
Moragolla	27	433.5	1734.8	2168.3	4	18.53	513.8	2056.2	50
Kukule	144	486.9	1168.7	1655.6	6	29.31	629.6	1511.2	50
Belihuloya	17	533.9	1897.3	2431.2	4	18.53	632.8	2248.9	50
Uma Oya/SEDZ	150	280.9	966.0	1246.9	4	18.53	333.0	1145.0	50

Table 5.2- Capital cost details of expansion candidates considered in the study. All costs are in January 1991 prices. Exchange rate US$1 = Rs 40.

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY MEAN
1949/50	7.22	2.84	1.62	19.47	15.00	22.78	18.53	22.61	24.01	22.90	21.64	19.25	16.50
1950/51	3.99	4.02	15.63	0.99	12.34	22.78	20.48	18.11	19.11	16.89	23.96	17.52	14.66
1951/52	18.60	1.54	2.74	1.83	21.25	17.34	11.07	12.78	25.31	13.79	23.96	13.30	13.58
1952/53	11.74	13.59	18.22	2.57	14.93	7.58	10.27	27.63	23.81	7.62	22.35	1.36	13.47
1953/54	2.79	1.65	14.10	1.97	10.62	13.36	10.17	24.39	25.86	16.75	20.69	23.34	13.82
1954/55	2.32	2.89	2.14	1.31	11.31	17.86	15.02	12.86	25.75	23.79	20.66	12.46	12.35
1955/56	14.55	2.61	12.21	4.39	23.16	18.48	5.41	21.85	19.28	23.79	23.96	22.41	15.99
1956/57	6.19	4.17	2.06	6.71	13.37	25.78	24.79	11.65	21.88	21.55	23.96	23.68	15.46
1957/58	11.32	1.54	1.15	12.84	17.57	21.12	10.44	11.52	26.61	21.62	20.14	23.68	14.94
1958/59	14.18	2.76	10.19	7.21	15.18	17.76	4.16	17.22	21.88	21.06	12.21	20.38	13.69
1959/60	16.37	1.61	5.30	18.07	0.99	25.18	18.90	25.97	25.27	5.92	21.00	17.10	15.24
1960/61	13.88	5.24	3.67	2.98	4.10	7.25	23.49	18.60	17.65	12.78	21.30	17.85	12.42
1961/62	3.02	1.65	9.84	5.02	22.89	19.31	11.81	13.38	24.12	22.50	22.74	21.85	14.78
1962/63	11.53	2.39	2.40	13.32	8.39	19.45	17.51	18.56	25.16	16.89	20.47	15.08	14.30
1963/64	2.41	1.54	8.23	8.61	1.28	14.44	21.73	23.23	21.08	20.05	19.82	16.57	13.32
1964/65	20.34	7.32	13.27	23.83	19.29	27.47	19.23	14.04	26.61	23.79	17.95	14.10	18.96
1965/66	2.98	2.00	2.24	17.25	18.50	5.28	11.53	27.63	25.49	23.11	21.98	9.93	13.98
1966/67	7.42	2.08	1.66	11.64	6.75	24.88	22.60	26.49	21.27	16.98	23.96	23.12	15.79
1967/68	2.80	2.17	4.75	16.79	23.79	17.66	17.65	25.86	24.82	22.62	23.96	17.99	16.70
1968/69	7.68	6.15	10.50	15.98	20.82	23.67	14.00	12.60	18.58	22.15	15.20	17.95	15.41
1969/70	4.18	2.58	1.15	17.03	1.00	14.51	9.38	13.77	24.84	23.45	19.81	19.34	12.66
1970/71	17.55	2.17	5.67	10.61	12.37	12.52	13.94	27.41	6.65	22.90	19.96	14.71	13.93
1971/72	16.04	15.05	2.40	21.62	23.79	24.31	24.43	18.70	26.46	23.79	23.96	14.74	19.57
1972/73	3.16	2.60	2.51	8.61	23.79	20.11	16.63	18.70	16.32	22.97	23.60	20.19	14.88
1973/74	2.31	1.94	2.16	24.04	16.80	20.70	9.59	21.07	19.59	23.15	22.85	18.02	15.20
1974/75	14.46	4.57	2.48	11.16	18.18	3.50	13.30	14.21	15.39	23.11	22.96	14.13	13.10
1975/76	19.79	5.48	1.54	15.14	22.73	16.73	8.73	26.34	25.68	23.79	23.42	23.68	17.74
1976/77	8.80	1.54	4.25	23.51	14.68	24.77	14.14	23.82	22.84	22.43	20.58	20.85	16.89
1977/78	2.62	2.15	10.07	23.11	8.14	15.60	18.09	10.11	26.53	23.79	23.71	19.66	15.34
1978/79	9.68	1.96	5.27	19.67	22.57	22.89	17.62	26.24	26.61	20.01	23.96	17.77	17.84
1979/80	3.83	2.05	4.77	19.66	23.58	26.63	22.59	14.96	25.53	23.46	23.20	20.00	17.48
1980/81	14.17	2.97	12.77	14.03	19.40	22.99	15.58	23.89	26.08	17.81	20.84	23.68	17.84
1981/82	4.95	9.94	10.24	24.04	23.79	8.12	4.16	19.89	16.23	16.66	18.75	23.68	14.99
1982/83	2.49	1.54	7.06	19.93	23.79	27.47	24.39	27.27	26.61	20.98	16.65	19.59	18.11
1983/84	4.14	4.37	4.15	4.09	1.06	11.18	11.46	25.83	24.62	22.22	23.85	17.89	12.98
1984/85	4.83	2.41	17.85	18.54	12.08	9.58	17.78	23.54	16.01	22.52	23.40	12.96	15.18
1985/86	3.04	3.70	7.58	2.80	19.47	5.23	5.96	24.34	26.61	23.66	17.78	21.16	13.39
1986/87	3.49	2.92	16.06	11.21	23.79	18.45	19.66	18.20	26.61	23.79	22.37	13.77	16.65
1987/88	2.47	7.24	15.86	17.48	20.59	9.64	12.86	26.90	21.66	15.45	23.00	21.66	16.21
1988/89	12.48	2.69	10.32	7.58	17.12	18.71	21.74	12.64	23.58	16.70	23.96	16.85	15.34
MEAN	8.40	3.74	7.15	12.67	15.76	17.57	15.27	20.12	22.70	20.23	21.51	18.08	15.27
MAX	20.34	15.05	18.22	24.04	23.79	27.47	24.79	27.63	26.61	23.79	23.96	23.68	19.57
MIN	2.31	1.54	1.15	0.99	0.99	3.50	4.16	10.11	6.65	5.92	12.21	1.36	12.35
STDV	5.83	3.09	5.28	7.47	7.28	6.74	5.82	5.66	4.34	4.42	2.71	4.55	1.83
% MEAN	4.6	2.0	3.9	6.9	8.6	9.6	8.3	11.0	12.4	11.0	11.7	9.9	

SOURCE OF RAW DATA:

MISSING DATA INDICATED BY A DASH

MAU-ARA RESERVOIR
MAU ARA

STATION CODE: MAUR
RIVER BASIN : WALAWE (18)

DRAINAGE AREA: 240 KM2

RESERVOIR INFLOW (m3/s)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY MEAN
1949/50	0.085	1.793	1.188	0.292	0.050	0.761	0.783	0.847	0.029	0.000	0.000	0.000	0.487
1950/51	0.000	2.846	0.676	0.128	0.128	0.064	0.640	1.003	0.968	0.085	0.000	0.000	0.542
1951/52	0.000	3.885	2.334	2.355	0.078	1.651	8.581	2.213	0.121	0.000	0.000	0.000	1.766
1952/53	0.021	0.164	0.000	0.000	0.000	6.390	6.589	3.145	0.000	0.000	0.000	0.000	1.366
1953/54	6.568	3.871	1.573	2.981	2.924	0.868	9.791	1.508	0.057	0.000	0.000	0.000	2.499
1954/55	0.164	1.487	2.903	0.868	0.420	3.522	10.030	1.309	0.057	0.000	0.000	0.000	1.727
1955/56	0.000	0.804	0.647	0.285	0.000	0.484	0.121	0.043	0.000	0.000	0.000	0.000	0.200
1956/57	0.000	4.027	0.199	0.021	0.021	1.715	0.904	0.726	0.121	0.000	0.000	0.000	0.642
1957/58	2.113	7.414	13.540	3.081	0.178	3.522	1.131	6.347	0.043	0.000	0.000	0.000	3.147
1958/59	0.021	3.302	0.164	0.000	0.000	0.000	3.423	0.889	0.078	0.000	0.000	0.000	0.650
1959/60	0.114	1.693	1.103	0.455	0.249	3.373	3.316	1.494	0.021	0.000	0.000	0.000	0.987
1960/61	0.043	0.398	0.036	0.021	0.000	0.626	0.000	0.534	0.014	0.000	0.000	0.000	0.141
1961/62	0.704	2.818	1.900	0.818	0.128	0.861	2.661	1.508	0.071	0.000	0.000	0.000	0.957
1962/63	0.021	0.526	1.089	0.441	0.142	0.021	0.320	0.406	0.021	0.000	0.000	0.000	0.250
1963/64	5.963	2.903	1.067	0.626	0.199	0.441	0.946	1.010	0.043	0.000	0.000	0.000	1.108
1964/65	0.057	0.406	0.000	0.000	0.078	0.078	0.100	0.662	0.000	0.000	0.000	0.000	0.115
1965/66	0.213	4.718	3.387	1.380	0.128	0.811	4.910	1.736	0.021	0.000	0.000	0.000	1.441
1966/67	0.427	4.355	4.497	1.957	0.292	1.067	0.249	1.003	0.007	0.000	0.000	0.000	1.161
1967/68	0.270	2.803	0.391	0.206	0.007	0.733	0.519	0.747	0.007	0.000	0.000	0.000	0.473
1968/69	4.234	4.504	1.366	0.498	0.085	0.982	0.911	1.323	0.071	0.000	0.000	0.000	1.170
1969/70	0.690	1.907	2.469	1.074	0.292	4.945	3.978	1.829	0.029	0.000	0.000	0.000	1.442
1970/71	0.078	1.679	0.797	0.569	0.121	0.747	1.907	1.772	0.093	0.000	0.000	0.000	0.648
1971/72	0.192	3.650	1.843	0.647	0.064	0.982	0.584	0.996	0.043	0.000	0.000	0.000	0.752
1972/73	0.825	4.974	1.878	0.477	0.036	0.911	1.480	1.060	0.007	0.000	0.000	0.000	0.971
1973/74	0.278	1.395	1.153	0.477	0.071	0.847	2.462	1.416	0.036	0.000	0.000	0.000	0.679
1974/75	0.050	0.612	0.192	0.100	0.021	0.669	4.070	2.042	0.100	0.000	0.000	0.000	0.653
1975/76	0.085	3.053	0.982	0.370	0.036	1.110	0.825	0.818	0.000	0.000	0.000	0.000	0.607
1976/77	0.221	1.629	1.608	0.598	0.078	0.861	4.945	1.893	0.071	0.000	0.000	0.000	0.992
1977/78	0.633	3.842	1.807	0.776	0.135	0.754	0.690	1.160	0.064	0.000	0.000	0.000	0.823
1978/79	0.206	3.522	1.487	0.149	0.021	0.832	0.178	0.633	0.029	0.000	0.000	0.000	0.589
1979/80	1.822	3.878	4.191	0.918	0.050	1.096	1.039	0.982	0.021	0.000	0.000	0.000	1.174
1980/81	0.149	1.437	0.455	0.249	0.029	0.818	0.292	0.719	0.014	0.000	0.000	0.000	0.348
1981/82	0.100	0.904	0.114	0.085	0.000	0.740	0.242	0.598	0.057	0.000	0.000	0.000	0.238
1982/83	0.071	3.593	1.089	0.206	0.000	1.971	0.050	0.270	0.000	0.000	0.000	0.000	0.605
1983/84	0.171	0.804	0.804	0.598	0.313	11.150	21.600	4.412	0.057	0.000	0.000	0.000	3.323
1984/85	0.057	1.651	0.299	0.278	0.050	0.526	0.285	0.825	0.085	0.000	0.000	0.000	0.338
1985/86	0.441	1.352	1.530	1.025	0.228	0.754	4.227	2.049	0.036	0.000	0.000	0.000	0.971
1986/87	0.562	1.110	0.128	0.043	0.000	0.477	0.256	0.733	0.029	0.000	0.000	0.000	0.279
1987/88	0.313	2.626	0.747	0.228	0.029	1.067	5.685	2.576	0.057	0.000	0.000	0.000	1.108
1988/89	0.057	0.946	0.249	0.100	0.000	1.188	0.149	0.541	0.029	0.000	0.000	0.000	0.273
MEAN	0.701	2.482	1.547	0.634	0.167	1.510	2.772	1.394	0.065	0.002	0.000	0.000	0.941
MAX	6.568	7.414	13.540	3.081	2.924	11.150	21.600	6.347	0.968	0.085	0.000	0.000	3.323
MIN	0.000	0.164	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.000	0.000	0.000	0.115
STDV	1.503	1.603	2.230	0.755	0.459	2.045	4.094	1.150	0.150	0.014	0.003	0.003	0.734
% MEAN	6.2	22.0	13.7	5.6	1.5	13.4	24.5	12.3	0.6	0.0	0.0	0.0	

SOURCE OF RAW DATA:

MISSING DATA INDICATED BY A DASH

A12 1/1

WATUGALA　　　　　　STATION CODE　G074　　ELEVATION　220 M　　LATITUDE 06-22-00N　LONGITUDE 80-28-00E
GIN GANGA　　KM 74.0　　RIVER BASIN :　GIN　　(09)　　　　　　DRAINAGE AREA:　154 KM2

RESERVOIR INFLOW (m3/s)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY MEAN
1949/50	25.3	16.5	14.7	7.5	5.9	9.0	15.3	12.8	15.6	9.3	11.0	15.2	13.2
1950/51	20.6	14.8	11.5	16.6	10.4	10.6	10.1	21.8	52.0	20.3	7.7	23.4	18.3
1951/52	17.9	20.5	10.1	12.2	9.0	10.5	18.7	30.5	21.3	10.4	8.6	6.5	14.7
1952/53	22.1	19.3	13.5	9.7	5.6	13.1	15.7	7.2	11.1	36.8	14.0	8.1	14.8
1953/54	27.2	16.0	13.6	11.9	10.9	15.3	17.5	42.7	17.7	8.0	10.8	8.3	16.7
1954/55	26.8	12.2	13.1	9.6	9.4	15.2	13.7	61.0	37.4	16.0	7.1	16.0	19.9
1955/56	13.3	13.2	7.9	6.0	3.5	6.8	10.2	15.6	29.4	6.0	10.0	13.2	11.2
1956/57	17.7	25.7	13.5	6.7	6.1	5.3	11.5	14.1	29.0	15.1	8.0	4.3	13.1
1957/58	10.9	26.6	17.8	14.5	11.6	16.2	13.9	30.8	31.1	9.3	12.5	7.9	16.9
1958/59	29.0	24.2	14.4	9.1	5.9	6.6	15.4	22.6	46.2	18.3	17.2	25.9	19.6
1959/60	16.5	25.8	16.3	13.4	13.5	9.2	15.5	16.5	12.4	19.3	9.8	13.7	15.2
1960/61	11.4	15.3	9.3	7.6	4.6	5.7	11.6	23.8	18.5	16.9	28.0	20.9	14.5
1961/62	30.0	24.0	14.0	11.2	6.7	8.2	16.0	31.4	15.7	14.5	16.6	17.9	17.3
1962/63	19.5	22.4	15.6	15.3	9.2	8.3	18.6	29.0	23.8	34.5	23.1	27.9	20.7
1963/64	39.5	31.4	17.8	13.9	6.8	11.1	15.0	31.3	21.1	36.4	15.2	21.4	21.9
1964/65	18.1	18.0	12.4	6.6	4.4	8.8	11.2	28.1	14.1	6.6	17.5	23.2	14.1
1965/66	32.2	22.1	15.2	9.7	6.2	14.0	23.0	14.1	9.3	8.2	10.5	29.5	16.2
1966/67	32.7	18.2	12.2	10.2	6.6	10.1	11.2	15.0	22.7	15.9	14.2	15.6	15.4
1967/68	40.7	23.8	13.9	12.1	5.2	7.4	9.5	13.1	34.2	28.6	13.1	14.9	18.1
1968/69	13.9	15.5	12.1	6.3	4.1	5.2	12.9	70.4	25.5	5.8	9.6	13.1	16.3
1969/70	20.5	14.5	18.1	19.6	9.6	11.9	17.5	19.8	19.7	17.4	16.4	11.3	16.4
1970/71	17.9	17.1	10.1	12.1	6.6	9.2	15.0	18.4	18.2	15.8	19.5	27.0	15.6
1971/72	25.4	26.1	16.3	8.8	3.6	5.0	12.9	37.1	23.3	10.5	10.9	26.9	17.3
1972/73	30.7	26.1	11.9	4.3	5.2	13.9	22.4	17.0	28.5	20.8	11.3	4.1	16.4
1973/74	20.7	17.9	12.4	5.4	3.3	6.4	24.3	30.5	25.4	29.1	16.9	30.5	18.6
1974/75	13.0	5.8	6.2	3.4	3.5	10.4	21.1	44.0	38.2	7.5	10.5	16.1	15.0
1975/76	31.6	48.7	18.8	8.2	3.2	4.6	15.6	19.7	7.6	8.7	7.8	3.1	14.8
1976/77	24.9	18.7	22.1	5.3	4.8	11.6	11.8	33.3	23.3	7.2	7.4	4.4	14.6
1977/78	26.7	23.6	17.5	13.3	10.8	13.9	17.8	60.8	14.1	9.9	13.7	13.6	19.7
1978/79	19.0	41.8	12.8	6.0	8.8	4.8	13.6	19.2	18.4	20.5	5.8	38.6	17.4
1979/80	24.8	32.6	21.6	7.7	2.5	4.6	17.3	14.4	18.4	13.6	10.4	7.3	14.7
1980/81	18.1	35.3	17.3	12.2	6.5	5.8	18.2	27.5	23.0	12.2	8.0	18.4	16.9
1981/82	11.3	19.8	10.7	7.6	3.4	8.3	19.4	24.3	50.3	19.7	14.1	7.2	16.4
1982/83	29.0	36.0	14.9	4.2	2.6	4.2	3.2	9.3	15.4	9.3	10.0	22.8	13.4
1983/84	11.9	17.8	17.8	16.4	10.9	13.9	25.5	27.3	25.5	29.8	8.8	12.3	18.2
1984/85	10.2	25.1	11.3	11.4	10.3	8.8	10.2	24.5	59.3	15.2	24.4	7.2	18.2
1985/86	36.0	20.0	20.3	8.1	6.1	6.7	14.9	17.9	14.4	4.2	7.8	24.3	15.1
1986/87	25.8	21.0	8.8	8.3	4.7	4.9	11.2	9.1	11.4	3.3	30.0	18.6	13.1
1987/88	33.8	23.6	9.0	6.1	4.5	15.8	16.3	31.3	19.9	15.1	26.1	34.8	19.8
1988/89	7.0	18.9	9.1	4.7	2.2	3.1	6.8	12.7	36.0	30.1	17.6	15.4	13.6
1989/90	17.3	26.3	12.3	6.6	4.7	10.9	11.1	21.5	14.6	15.8	5.3	3.2	12.5
MEAN	22.5	22.5	13.8	9.5	6.4	9.2	14.9	25.6	24.2	15.9	13.4	16.4	16.2
MAX	40.7	48.7	22.1	19.6	13.5	16.2	25.5	70.4	59.3	36.8	30.0	38.6	21.9
MIN	7.0	5.8	6.2	3.4	2.2	3.1	3.2	7.2	7.6	3.3	5.3	3.1	11.2
STDV	8.4	8.1	3.8	3.8	2.9	3.7	4.6	14.1	11.9	8.9	6.1	9.1	2.4
% MEAN	11.5	11.5	7.1	4.9	3.3	4.7	7.7	13.2	12.4	8.2	6.9	8.4	

SOURCE OF RAW DATA:　　　　　　MISSING DATA INDICATED BY A DASH

WATUGALA
GIN GANGA KM 74.0 STATION CODE G074 ELEVATION 220 LATITUDE 06-22-00N LONGITUDE 80-28-00E
RIVER BASIN : GIN (09) DRAINAGE AREA: 154 KM2

NET EVAPORATION (mm)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY MEAN
1949/50	-7.5	51.9	65.3	101.7	101.6	103.5	61.5	53.6	61.3	77.3	61.8	45.5	64.6
1950/51	18.2	51.8	82.6	74.5	91.9	100.0	67.6	42.9	25.0	49.9	100.9	19.5	60.4
1951/52	33.3	35.3	92.3	80.9	87.6	82.6	7.8	10.3	66.2	95.3	85.4	87.7	63.7
1952/53	17.3	40.7	54.3	79.6	96.8	98.2	68.9	97.3	80.5	-24.1	96.3	72.8	64.6
1953/54	-12.3	72.3	66.2	90.3	104.0	61.8	20.0	-21.0	86.9	88.1	64.8	81.5	58.1
1954/55	-12.0	73.5	11.5	86.7	75.2	91.9	86.3	-9.7	39.0	51.7	103.4	39.2	52.8
1955/56	12.2	43.2	96.8	83.2	112.0	83.5	63.7	83.4	40.4	97.3	86.0	52.6	71.7
1956/57	19.9	54.4	68.8	99.8	105.3	135.2	75.7	41.1	25.1	54.4	89.1	97.5	72.0
1957/58	69.5	-1.6	13.7	74.3	115.8	74.0	27.5	18.0	47.0	96.4	89.5	77.5	58.3
1958/59	49.0	38.5	75.7	77.6	112.6	133.4	36.7	50.1	-11.5	57.0	59.2	33.3	59.3
1959/60	55.3	53.2	76.5	97.4	82.4	122.7	43.1	58.6	71.7	3.9	88.2	72.6	68.8
1960/61	49.4	53.4	74.1	79.7	116.9	113.5	69.4	39.8	52.1	52.9	32.3	30.5	63.4
1961/62	53.4	62.5	34.8	78.7	119.6	100.4	68.7	17.0	66.5	77.4	36.9	45.3	63.0
1962/63	29.0	25.6	67.4	92.2	92.4	77.0	23.0	-1.0	50.9	-2.4	55.9	-15.4	41.1
1963/64	15.9	4.4	58.7	104.6	105.6	89.6	79.8	22.5	65.3	29.4	81.6	54.8	59.1
1964/65	61.3	69.6	74.5	98.8	118.6	120.3	71.1	29.0	80.2	89.2	15.8	10.2	69.6
1965/66	15.1	78.5	51.8	74.9	125.3	126.2	27.9	99.0	76.5	75.2	90.3	1.7	70.0
1966/67	-12.6	78.7	74.4	93.5	109.8	118.5	83.3	56.2	48.6	62.9	74.3	66.5	70.9
1967/68	18.2	54.5	74.4	102.9	127.6	76.9	36.5	92.3	20.8	57.4	95.6	69.5	68.7
1968/69	91.6	82.7	86.4	106.4	112.1	144.0	52.6	-24.6	82.4	100.7	66.2	77.1	81.3
1969/70	54.6	70.6	19.4	90.9	92.2	90.9	35.9	19.8	32.9	54.2	87.2	63.5	59.2
1970/71	30.7	65.6	72.0	93.2	108.0	113.1	53.3	71.4	46.1	74.8	66.6	26.2	68.3
1971/72	8.9	84.7	56.7	99.0	124.3	116.6	57.1	4.9	47.2	84.2	93.4	51.7	68.7
1972/73	33.2	42.8	77.0	103.1	125.6	107.9	47.2	62.9	42.7	35.1	83.6	89.4	70.6
1973/74	27.0	30.4	69.1	111.4	93.8	111.5	24.9	5.9	46.8	28.5	85.9	26.6	55.1
1974/75	93.9	100.7	63.4	90.4	109.2	81.6	31.0	-15.2	26.6	69.3	73.6	45.7	64.0
1975/76	49.8	-20.0	63.3	110.5	127.0	113.7	50.2	87.2	77.3	82.3	65.7	96.7	75.2
1976/77	34.1	56.7	18.3	113.0	97.6	72.9	66.7	-21.8	53.8	95.3	75.4	80.9	61.6
1977/78	16.8	77.2	77.9	96.7	119.1	106.8	83.3	4.1	67.4	87.5	94.3	83.4	75.9
1978/79	65.3	33.7	60.5	103.4	117.7	120.5	88.7	62.5	24.4	68.0	92.9	-10.1	69.0
1979/80	16.7	31.5	29.9	112.9	131.2	114.9	55.0	59.7	62.5	81.3	68.0	30.6	65.9
1980/81	60.7	26.9	68.5	81.3	122.3	88.3	79.0	27.5	60.4	80.8	79.6	50.0	68.5
1981/82	35.6	58.8	71.3	110.1	131.8	102.3	78.3	62.5	21.7	72.1	66.9	70.9	73.3
1982/83	24.5	-18.8	76.1	90.8	130.7	129.6	103.5	51.9	71.8	74.9	60.7	-7.2	65.5
1983/84	99.3	45.4	14.8	52.1	67.1	88.4	22.1	31.1	46.0	53.0	66.2	68.5	54.5
1984/85	66.8	23.0	99.4	80.0	64.2	98.6	92.5	36.0	13.0	92.4	62.0	57.0	65.6
1985/86	23.1	46.7	21.9	88.8	101.5	99.8	65.9	72.2	85.4	97.7	69.6	43.3	67.8
1986/87	71.4	66.4	67.1	95.1	130.1	122.8	84.4	58.2	63.9	102.6	3.5	68.9	77.6
1987/88	-19.7	44.5	92.7	109.4	91.7	111.8	72.3	64.6	46.3	39.7	29.9	23.2	58.7
1988/89	106.5	57.7	71.8	86.1	128.7	139.6	77.3	73.6	26.5	35.7	87.2	25.3	76.3
1989/90	39.0	54.4	81.9	88.4	127.0	84.6	80.3	50.3	67.2	48.8	104.1	96.2	76.5
MEAN	36.6	48.8	62.8	92.3	108.6	104.3	59.0	39.6	51.3	64.6	72.9	51.2	65.8
MAX	106.5	100.7	99.4	113.0	131.8	144.0	103.5	99.0	86.9	102.6	104.1	97.5	81.3
MIN	-19.7	-20.0	11.5	52.1	64.2	61.8	7.8	-24.6	-11.5	-24.1	3.5	-15.4	41.1
STDV	31.3	26.4	23.7	13.3	17.8	19.9	23.7	34.0	22.5	29.3	23.1	30.3	7.8
% MEAN	4.6	6.2	7.9	11.7	13.8	13.2	7.5	5.0	6.5	8.2	9.2	6.5	

SOURCE OF RAW DATA: MISSING DATA INDICATED BY A DASH

ANNEX B of 6A.3

RESULTS FROM PROJECT APPROACH

Included in this annex are the results of:

KUKULE COST ESTIMATES FOR PROJECT OPTIMIZATION

October 1991

Annex 1

EVALS

KUKUL-K

Alternative .... A

Installed capacity factor 2.0

Date generated .... 02 OCT 1991

Contents Page

Project Alternative A

-EMBANKMENT COFFERDAM WITH SHEETPILE WALL

-Elevation cofferdam crest	195.0 msl
-Maximum height of cofferdam	12.0 m
-Length of cofferdam	200.0 m
-Hauling distance fill material	1.0 km

-Calculated physical parameters

-Larsen profile IV (185 kg/m2)	
-Area of steel in sheetpile wall	2500.0 m2
-Total weight of steel	462.5 ton

COST ESTIMATE FOR CIVIL STRUCTURES

Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
13	C00013	-supply+install sheetpile str.	463	to	29.49	488	-	517	13639	225528	-	239167
17	C00017	-earth fill to straight wall	25550	m3	1.05	4.58	-	5.64	26889	117231	-	144120
18	C00018	-extra transport earth fill	25550	m3km	0.02	0.50	-	0.52	727	12811	-	13538
		-Miscellaneous items	10	%					4126	35557	-	39683
	TOTAL	(w/o taxes)	in US$						45381	391127	-	436508

Project Alternative A

-CONVENTIONAL CONCRETE GRAVITY DAM		-Calculated physical parameters	
-Elevation dam crest	207.3 msl	-Height of dam	28.3 m
		-Width of dam crest	4.7 m
-Embankment slope upstream	0.10	-Length of dam crest	120.3 m
-Embankment slope downstream	0.74	-Length of dam perimeter	131.8 m
-Hauling distance concrete aggregates	1.0 km	-Maximum dam width at dam base	23. m
-Clearing area covered with heavy jungle		-Dam base area	1349. m2
		-Total dam volume	12539. m3
		-Average depth of excavation	7.8 m
-Cross-section identification number	1		
-Cross-section id number excavated section	3	-Reinforcement per m3 conventional concrete	5.0 kg
		-Crushed rock used as concrete aggregate in the absence of gravel and sand deposits	
-Sediment level at power intake after 50 years	185.0 msl		

COST ESTIMATE FOR DAM Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
2	DA0002	-site clearing heavy jungle	0.26	ha	409	4107	-	4516	110	1108	-	1218
3	DA0003	-excavation for dam base	10516	m3	0.83	5.90	-	6.73	8787	62053	-	70840
4	DA0004	-preparation of foundation	1349	m2	2.49	7.67	-	10.16	3361	10352	-	13713
25	DA0025	-clay backfill to dam base	5932	m3	1.00	5.16	-	6.16	5970	30616	-	36586
36	DA0036	-crushed stone concrete S	12539	m3	5.02	52.39	-	57.42	63037	656946	-	719984
39	DA0039	-extra transport crushed stone	12539	m3km	0.03	0.43	-	0.47	446	5506	-	5953
40	DA0040	-bar reinforcement complete	62.69	to	28.08	895	-	923	1761	56091	-	57851
41	DA0041	-formwork S	5601	m2	7.64	14.03	-	21.68	42799	78630	-	121429
		-Miscellaneous items	15.	%					18941	135195	-	154136
	TOTAL	(w/o taxes)		in US$					145213	1036498	-	1181710

Project Alternative A

-Foundation rock mass is moderately pervious

-Consolidation grouting

-Grouting area	812. m2
-Average grout depth	6.8 m
-Number of rows of drainage holes	2
-Spacing of holes	4.0 m

-Deep curtain grouting

-Grouting area	1999. m2
-Average grout depth	16.6 m
-Number of rows of drainage holes	1
-Spacing of holes	3.0 m

COST ESTIMATE FOR GROUTING FOR DAM Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
46	DA0046	-percussion drillind open	1068	m	4.19	28.80	-	33	4485	30771	-	35256
49	DA0049	-grouting open incl. cement	66.64	to	106	324	-	430	7053	21603	-	28656
53	DA0053	-rotary drilling (check hole)	33.31	m	4.19	28.80	-	33	140	960	-	1099
		-Miscellaneous items	15	%					1752	8000	-	9752
	TOTAL	(w/o taxes)	in US$						13429	61333	-	74762

Project Alternative A

-RADIAL GATED SPILLWAY IN A CONCRETE DAM		-Calculated physical parameters	
-Peak inflow	2365.0 m3/s	-Spillway design discharge	2365.0 m3/s
-Maximum dam height	28.3 m	-Number of radial gates	4
-Maximum flood level	205.0 msl	-Gate width	8.5 m
-Maximum operating level	205.0 msl	-Gate height	10.0 m
-Spillway crest level	195.0 msl	-Surcharge all gates operating	0.0 m
		-Surcharge one gate malfunctioning	2.3 m
		-Crest width (wall to wall)	40.2 m
		-Thickness of piers	2.0 m
		-Hydraulically effective crest width	32.8 m
		-Thickness of side walls	1.0 m
		-Total force on each pier	4250.0 kN
		-Number of pre-stressed bars of 500 kN	32

COST ESTIMATE FOR CIVIL STRUCTURES | Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
3	SP0003	-concrete to bridges	15.98	m3	6.72	55.12	-	61.85	108	881	-	988
4	SP0004	-concrete to structures	2494	m3	6.55	50.64	-	57.20	16349	126300	-	142649
5	SP0005	-reinforcement	301	to	28.08	895	-	923	8458	269461	-	277919
6	SP0006	-formwork	3483	m2	9.31	23.59	-	32.91	32457	82159	-	114616
7	SP0007	-prestressing	8	to	148	3653	-	3801	1187	29223	-	30410
		-Miscellaneous items	10	%					5856	50802	-	56658
	TOTAL	(w/o taxes)	in US$						64414	558826	-	623240

Project Alternative A

-Calculated physical parameters

-Number of gates	4	-Number of stop logs	3
-Height of gates	10.0 m	-Height of stop logs	3.3 m
-Width of gates	8.5 m		

COST ESTIMATE FOR MECHANICAL EQUIPMENT AND HYDRAULIC STEEL STRUCTURES Cost level: Sep 1991

NE	CODE	DESCRIPTION		UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
19	MECH19	-Radial spillway gates		....	Lumpsum	Value	....	49122	1596457	-	1645579
20	MECH20	-Spillway stop logs		....	Lumpsum	Value	....	10214	331945	-	342159
21	MECH21	-Stop log slots for spillway		....	Lumpsum	Value	....	4596	149375	-	153971
		-Miscellaneous items	5 %					3197	103889	-	107085
	TOTAL	(w/o taxes)	in US$					67128	2181666	-	2248795

TOTAL COST SPILLWAY Cost level: Sep 1991

ELEMENT	PERCENTAGE OF TOTAL COST Loc	For	Tax	Total	TOTAL COST (1000 US$) Loc	For	Tax	Total
CIVIL STRUCTURES	2.2	19.5	0.0	21.7	64.	559.	0.	623.
MECHANICAL EQUIPMENT AND HYDRAULIC STEEL STRUCTURES	2.3	76.0	0.0	78.3	67.	2182.	0.	2249.
OVERALL TOTAL (without taxes)	4.6	95.4	0.0	100.0	132.	2740.	0.	2872.

-INTEGRATED INTAKE STRUCTURE		-Calculated physical parameters	
-Surface slope < 35 degrees			
-Elevation of dam crest	207.3 masl	-Freeboard	2.3 m
-Maximum flood level	205.0 masl	-Surcharge	0.0 m
-Maximum operating level	205.0 masl	-Roof of conduit below min op level	4.7 m
-Minimum operating level	205.0 masl	-Shaft height (incl open air structure)	26.4 m
-Design discharge	56.8 m3/s	-Length of underground intake section	36.7 m
-Number of intake structures	1	-Width of intake canal	13.0 m
-Inner conduit diameter	4.9 m	-Width of entrance	6.5 m
lope at intake face	30.0 deg	-Width of trash rack	5.5 m
-Geological rating	good rock	-Height of trash rack (inclined)	12.1 m
		-Diameter of tunnel excavation	5.7 m
		-Inlet centerline below max op level	7.2 m
		-Wall thickness in gate section	1.1 m

COST ESTIMATE FOR CIVIL STRUCTURES Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
3	IN0003	-shaft excavat.cl.1-2-3 L 20m2	635	m3	7.75	26.17	-	33.92	4924	16606	-	21530
11	IN0011	-shortcrete lining > 20 m2	24.93	m3	11.47	84.22	-	95.70	286	2100	-	2386
13	IN0013	-concrete lining > 20 m2	1054	m3	10.35	55.50	-	65.86	10916	58534	-	69450
14	IN0014	-steel reinforcement	78.33	to	28.08	895	-	923	2200	70086	-	72286
?	IN0019	-formw.intake struc.tunnel 60m2	1171	m2	1.59	10.90	-	12.50	1873	12772	-	14645
21	IN0021	-rockbolt	1.06	to	88.80	1111	-	1200	94.48	1182	-	1277
24	IN0024	-excavation open cut	15285	m3	0.71	6.96	-	7.68	10985	106491	-	117476
25	IN0025	-concrete in superstructure	299	m3	6.91	46.09	-	53.00	2066	13780	-	15846
26	IN0026	-reinforcement superstructure	35.87	to	28.08	895	-	923	1007	32099	-	33106
27	IN0027	-formwork in superstructure	1098	m2	9.64	25.02	-	34.66	10583	27469	-	38051
30	IN0030	-tun.exc. cl. 1-2-3, 30m2, 500m	1085	m3	1.82	21.60	-	23.43	1982	23436	-	25418
		-Miscellaneous items	10	%					4692	36456	-	41147
	TOTAL	(w/o taxes)	in US$						51608	401011	-	452619

-HYDRAULIC STEEL STRUCTURES

-Type of turbine(s)	Francis	-Number of gate sets	1
-Number of turbines	2	-Width of gate(s)	3.8 m
-Total turbine design discharge	56.8 m3/s	-Height of gate(s)	4.9 m
-Maximum operating water level	205.0 masl		
-Minimum operating water level	205.0 masl		

-Calculated physical parameters

COST ESTIMATE FOR MECHANICAL EQUIPMENT Cost level: Sep 1991

LINE	CODE	DESCRIPTION	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
3	MECH03	-Intake gates	....	Lumpsum	Value	....	5709	365384	-	371093
4	MECH04	-Rake	....	Lumpsum	Value	....	2946	188542	-	191488
5	MECH05	-Trashrack	....	Lumpsum	Value	....	1619	103592	-	105210
	TOTAL	(w/o taxes) in US$					10274	657517	-	667791

)TAL COST INTAKE STRUCTURE Cost level: Sep 1991

ELEMENT	PERCENTAGE OF TOTAL COST Loc	For	Tax	Total	TOTAL COST (1000 US$) Loc	For	Tax	Total
CIVIL STRUCTURES	4.6	35.8	0.0	40.4	52.	401.	0.	453.
MECHANICAL EQUIPMENT AND HYDRAULIC STEEL STRUCTURES	0.9	58.7	0.0	59.6	10.	658.	0.	668.
OVERALL TOTAL (without taxes)	5.5	94.5	0.0	100.0	62.	1059.	0.	1120.

-HEADRACE TUNNEL STRUCTURE

-Number of tunnels	1
-Tunnel length	4960.0 m
in very good rock	60.8 %
in good rock	15.2 %
in fair rock	21.4 %
in poor rock	2.6 %
-Flow velocity	3.1 m/s
-Head losses	5.0 m
-Type of lining	Concrete
-No steel lined section specified	

-Calculated physical parameters

-Inner tunnel diameter	4.9 m
-Thickness of lining / Diameter of excavation	
in very good rock	29 cm / 5.5 m
in good rock	29 cm / 5.5 m
in fair rock	44 cm / 5.7 m
in poor rock	44 cm / 5.7 m

COST ESTIMATE FOR TUNNEL CIVIL STRUCTURES Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
12	PT0012	-tun.exc. cl.1-2-3, 30m2, 5000m	129443 m3	3.54	41.66	-	45.21	458642	5393572	-	5852214
32	PT0032	-tun.excavat. cl.4, 30m2, 5000m	3605 m3	3.56	42.79	-	46.35	12834	154273	-	167108
63	PT0063	-concrete lining < 20m2	31123 m3	11.51	113	-	125	358285	3532062	-	3890347
65	PT0065	-reinforcement	703 to	34.65	888	-	923	24370	624543	-	648914
66	PT0066	-mesh reinforcement	25.05 to	12.28	680	-	692	308	17030	-	17338
84	PT0084	-formwork tunnels 5000m, 30m2	75596 m2	4.33	2.45	-	6.78	327408	185537	-	512945
87	PT0087	-rockbolt	66.23 to	185	2315	-	2500	12255	153340	-	165595
[illegible]	PT0088	-steel rib	416 to	27.47	1667	-	1694	11417	692602	-	704019
		-Miscellaneous items	10 %					120552	1075296	-	1195848
	TOTAL	(w/o taxes)	in US$					1326071	11828256	-	13154328

-SURGE TANK STRUCTURE

-Number of headrace tunnels	1
-Type of lining	concrete
-Tunnel diameter	4.9 m
-Length of headrace tunnel	4960.0 m
-Flow velocity in tunnel	3.1 m/s
-Turbine discharge (all units)	56.8 m3/s
ound elevation at tank site	300.0 masl
-Ground slope at surge tank site	30.0 deg
-Geological site rating	good rock
-Maximum operating level	205.0 masl
-Minimum operating level	205.0 masl
-Length of waterway surge tank to powerhouse	320.0 m

-Calculated physical parameters

-Inner surge tank diameter selected	17.7 m
-Min surge tank diameter (Thoma cross section)	9.4 m
-Maximum upsurge	16.0 m
-Maximum downsurge	-19.9 m
-Oscillation without friction	18.9 m
-Bottom elevation of surge tank	180.5 masl
-Top elevation of surge tank	220.3 masl
-Height of surge tank	39.9 m
-Tunnel slope (v/h)	5.0 o/oo
-Head losses at min roughness	4.7 m
-Head losses at max roughness	7.9 m
-Excavation diameter at upper tank section	19.7 m
-Excavation diameter at lower tank section	19.7 m
-Ground level at suggested tank site	225.3 masl
-Height of ventilation shaft of 2.0 m of diameter	5.0 m

COST ESTIMATE FOR CIVIL STRUCTURES Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
3	ST0003	-shaft excavat.cl.1-2-3 L 20m2	12591	m3	7.75	26.17	-	33.92	97698	329510	-	427208
10	ST0010	-shortcrete lining	126	m3	11.28	76.89	-	88.18	1428	9724	-	11152
	ST0011	-concrete lining	2838	m3	8.29	61.50	-	69.80	23546	174559	-	198105
12	ST0012	-reinforcement	85.14	to	34.65	888	-	923	2950	75611	-	78561
14	ST0014	-formwork	2402	m2	6.12	30.39	-	36.51	14709	73001	-	87711
15	ST0015	-rockbolt	8.94	to	88.80	1111	-	1200	795	9942	-	10737
18	ST0018	-excavation open cut	57812	m3	0.71	6.96	-	7.68	41547	402774	-	444321
		-Miscellaneous items	10	%					18267	107512	-	125779
	TOTAL	(w/o taxes)	in US$						200941	1182633	-	1383573

-PRESSURE SHAFT STRUCTURE

-Number of pressure shafts	1	
-Inner shaft diameter	3.8	m
-Pressure shaft length	400.0	m
in very good rock	100.0	%
-Flow velocity	5.0	m/s
-Head losses	1.0	m
-No intake to be provided		

-Calculated physical parameters

-Maximum diameter of excavation 4.4 m

COST ESTIMATE FOR CIVIL STRUCTURES

Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
4	PS0004	-shaft excavat.cl.1-2-3 M 10m2	6365	m3	11.82	60.85	-	72.68	75235	387349	-	462585
20	PS0020	-concrete lining	1824	m3	11.64	86.35	-	98.00	21241	157470	-	178711
24	PS0024	-rockbolt	0.40	to	185	2315	-	2500	74.39	931	-	1005
		-Miscellaneous items	15	%					14483	81862	-	96345
	TOTAL	(w/o taxes)		in US$					111034	627612	-	738646

-PRESSURE SHAFT MECHANICAL COMPONENT

-Program decision on safety valve

-Type of turbine(s)	Francis	-Inner pressure shaft diameter	3.8 m
-Total turbine design discharge	56.8 m3/s	-Calc length upper/lower press shaft	165.3 / 228.4 m
-Gross head	186.8 m	-Thickness upper/lower press shaft	1.1 / 1.9 cm
-Horizontal distance surge tank to powerhouse	393.7 m	-Max theor/actual waterhammer	82.7 / 82.7 m

-Calculated physical parameters

ST ESTIMATE FOR MECHANICAL EQUIPMENT AND HYDRAULIC STEEL STRUCTURES Cost level: Sep 1991

LINE	CODE	DESCRIPTION	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
10	MECH10	-Penstock/pressure shaft stlin	....	Lumpsum	Value	....	55232	2043570	-	2098801
11	MECH11	-Safety valve	....	Lumpsum	Value	....	3009	111338	-	114347
		TOTAL (w/o taxes) in US$					58241	2154907	-	2213148

TAL COST PRESSURE SHAFT Cost level: Sep 1991

ELEMENT	PERCENTAGE OF TOTAL COST Loc	For	Tax	Total	TOTAL COST (1000 US$) Loc	For	Tax	Total
CIVIL STRUCTURES	3.8	21.3	0.0	25.0	111.	628.	0.	739.
MECHANICAL EQUIPMENT AND HYDRAULIC STEEL STRUCTURES	2.0	73.0	0.0	75.0	58.	2155.	0.	2213.
OVERALL TOTAL (without taxes)	5.7	94.3	0.0	100.0	169.	2783.	0.	2952.

TAILRACE TUNNEL STRUCTURE

-Number of tunnels	1	-Calculated physical parameters	
-Inner tunnel diameter	4.9 m	-Maximum diameter of excavation	5.7 m
-Tunnel length	2370.0 m		
in very good rock	67.1 %		
in good rock	22.4 %		
in fair rock	9.4 %		
in poor rock	1.1 %		
-Flow velocity	3.1 m/s		
ead losses	2.4 m		
-Type of lining	Concrete		
-No steel lined section specified			

COST ESTIMATE FOR TUNNEL CIVIL STRUCTURES Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
12	PT0012	-tun.exc. cl.1-2-3, 30m2, 5000m	62619 m3	3.54	41.66	-	45.21	221872	2609185	-	2831057
32	PT0032	-tun.excavat. cl.4, 30m2, 5000m	729 m3	3.56	42.79	-	46.35	2595	31187	-	33782
63	PT0063	-concrete lining < 20m2	14044 m3	11.51	113	-	125	161678	1593865	-	1755543
65	PT0065	-reinforcement	294 to	34.65	888	-	923	10184	260980	-	271164
66	PT0066	-mesh reinforcement	5.21 to	12.28	680	-	692	64.05	3543	-	3607
84	PT0084	-formwork tunnels 5000m, 30m2	36122 m2	4.33	2.45	-	6.78	156443	88654	-	245097
87	PT0087	-rockbolt	18.63 to	185	2315	-	2500	3448	43141	-	46589
8	PT0088	-steel rib	84.01 to	27.47	1667	-	1694	2308	140014	-	142322
		-Miscellaneous items	10 %					55859	477057	-	532916
	TOTAL	(w/o taxes)	in US$					614450	5247626	-	5862076

-OUTLET STRUCTURE

-Elevation of dam crest	207.3 masl	-Width of outlet canal	9.7 m
-Maximum flood level	205.0 masl	-Depth of outlet canal	9.1 m
-Maximum operating level	205.0 masl	-Length of outlet canal	15.0 m
-Minimum operating level	205.0 masl		
-Slope of face at outlet structure	30.0 deg		
-Slope outlet structure	85.0 deg		

COST ESTIMATE FOR OUTLET CIVIL STRUCTURES Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
1	OL0001	-excavation in open cut	2331	m3	0.71	6.96	-	7.68	1675	16237	-	17912
2	OL0002	-shotcrete lining < 20 m2	3.62	m3	9.70	72.62	-	82.32	35.19	264	-	299
4	OL0004	-concrete lining < 20 m2	304	m3	4.38	43.20	-	47.58	1334	13150	-	14484
6	OL0006	-steel reinforcement	27.39	to	28.08	895	-	923	769	24508	-	25277
10	OL0010	-formw.intake struc.tunnel 30m2	480	m2	1.51	5.45	-	6.96	727	2618	-	3345
13	OL0013	-rockbolt	0.11	m	0.75	9.45	-	10.21	0.08	1.12	-	1.21
14	OL0014	-steel rib	26.01	m	27.47	1667	-	1694	715	43348	-	44063
18	OL0018	-tun.exc. cl.1-2-3, 30m2, 500m	421	m3	0.91	10.80	-	11.71	385	4548	-	4933
		-Miscellaneous items	10	%					564	10467	-	11031
	TOTAL	(w/o taxes)	in US$						6203	115142	-	121345

-POWERHOUSE (CAVERN) AND SWITCHYARD

-Calculated physical parameters

-Length		27.9 m
-Depth/width below generator floor	15.9 /	18.9 m
-Height/width above generator floor	15.6 /	13.8 m
-Volume above generator floor		9854.1 m3
-Volume below generator floor		8937.0 m3

COST ESTIMATE FOR CIVIL STRUCTURES Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
8	PH0008	-excavat.cavern cl.1-2-3, 120m2	18791	m3	3.42	19.48	-	22.91	64403	366156	-	430559
15	PH0015	-rock bolt	30.43	to	185	2315	-	2500	5630	70451	-	76081
16	PH0016	-wire mesh	23.71	to	12.28	680	-	692	291	16120	-	16411
17	PH0017	-shortcrete lining	568	m3	20.78	159	-	180	11812	90485	-	102297
18	PH0018	-concrete to cavern	6722	m3	10.35	55.50	-	65.86	69587	373133	-	442720
19	PH0019	-reinforcement to cavern	742	to	34.65	888	-	923	25722	659186	-	684907
20	PH0020	-formwork to cavern lining	11252	m2	22.06	16.93	-	38.99	248264	190534	-	438798
		-Miscellaneous items	37	%					157513	653444	-	810957
	TOTAL	(w/o taxes)		in US$					583222	2419509	-	3002731

-MECHANICAL EQUIPMENT FOR POWERHOUSE

-Turbine type selected by user	Francis
-Target number of turbines set by user	2
-Gross head	186.8 m
-Maximum operating level	205.0 masl
-Minimum operating level	205.0 masl
-Maximum tailwater level	24.7 masl
-Normal tailwater level	18.2 masl
-Low tailwater level	16.7 masl
-Total head loss	8.4 m
-Total design discharge	56.8 m3/s

-Calculated physical parameters

-User-selected number of turbines	2
-Rated head	178.4 m
-Turbine rated efficiency	90.0 %
-Turbine design discharge	28.4 m3/s
-Turbine design capacity	44.7 MW
-Turbine design speed	375.0 rpm
-Approx. runner inlet diameter	2.0 m
-Approx. runner outlet diameter	1.8 m
-Type of turbine valve	Spherical valve
-Dimension of valve	1.9 m

COST ESTIMATE FOR MECHANICAL EQUIPMENT AND HYDRAULIC STEEL STRUCTURES Cost level: Sep 1991

LINE	CODE	DESCRIPTION		UNIT RATE (US$) Loc For Tax Total	TOTAL COST (US$) Loc	For	Tax	Total
1	MECH01	-Turbines		.... Lumpsum Value	-	5180295	-	5180295
2	MECH02	-Emergency turbine valves		.... Lumpsum Value	21515	1742680	-	1764195
12	MECH12	-Powerhouse crane		.... Lumpsum Value	14175	864675	-	878850
13	MECH13	-Workshop		.... Lumpsum Value	2406	146760	-	149166
14	MECH14	-Air conditioning		.... Lumpsum Value	8893	542453	-	551346
	MECH15	-Drainage		.... Lumpsum Value	11694	713320	-	725014
16	MECH16	-Draft tube stop logs		.... Lumpsum Value	1702	114012	-	115714
17	MECH17	-Slot lin. draft tube stop logs		.... Lumpsum Value	255	17102	-	17357
18	MECH18	-Lift for draft tube stop logs		.... Lumpsum Value	449	30108	-	30558
		-Miscellaneous items	10 %		6109	935141	-	941249
	TOTAL	(w/o taxes)	in US$		67197	10286548	-	10353744

-ELECTRICAL EQUIPMENT FOR POWERHOUSE

-Net frequency	50.0 Hz	-Unit generator capacity	53.0 MVA
-Generator efficiency	97.2 %	-Unit transformer capacity	43.8 MW
-Transformer efficiency	97.2 %		
-Power factor	0.85		

-Calculated physical parameters

COST ESTIMATE FOR ELECTRICAL EQUIPMENT — Cost level: Sep 1991

LINE	CODE	DESCRIPTION	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
1	EL0001	-Synchronous generator	....	Lumpsum	Value	....	67027	6903776	-	6970803
2	EL0002	-Step-up transformer	....	Lumpsum	Value	....	21544	2219021	-	2240565
3	EL0003	-High voltage switchyard	....	Lumpsum	Value	....	19176	1975082	-	1994257
4	EL0004	-Control,protection & telemet	....	Lumpsum	Value	....	8828	909267	-	918095
5	EL0005	-Electrical auxiliaries	....	Lumpsum	Value	....	8176	842087	-	850262
	TOTAL	(w/o taxes) in US$					124750	12849232	-	12973982

TOTAL COST POWERHOUSE — Cost level: Sep 1991

ELEMENT	PERCENTAGE OF TOTAL COST Loc	For	Tax	Total	TOTAL COST (1000 US$) Loc	For	Tax	Total
CIVIL STRUCTURES	2.2	9.2	0.0	11.4	583.	2420.	0.	3003.
MECHANICAL EQUIPMENT AND HYDRAULIC STEEL STRUCTURES	0.3	39.1	0.0	39.3	67.	10287.	0.	10354.
ELECTRICAL EQUIPMENT	0.5	48.8	0.0	49.3	125.	12849.	0.	12974.
OVERALL TOTAL (without taxes)	2.9	97.1	0.0	100.0	775.	25555.	0.	26330.

-TRANSMISSION LINE AND NETWORK CONNECTION

-Power	103.0 MVA
-Distance to feeder point	64.0 km
-Network voltage	220.0 kV
-Mountainous terrain, cost increased by	5.0 %
-Power factor	0.850
-Economic line loading per mm2	1.0 A
-Interconnection to substation of higher voltage	

-Calculated design parameters

-Conductor cross-section	490.0 mm2
-Line length	70.4 km
-Line voltage	132.0 kV
-Number of conductors per phase	1
-Number of circuits	2
-Number of towers	281

COST ESTIMATE FOR TRANSMISSION LINES Cost level: Sep 1991

LINE	CODE	DESCRIPTION		UNIT RATE (US$) Loc For Tax Total	TOTAL COST (US$) Loc	For	Tax	Total
7	TL0007	-Towers	132 kV	.... Lumpsum Value	-	2487282	-	2487282
8	TL0008	-Conductors	132 kV	.... Lumpsum Value	71065	2274087	-	2345152
9	TL0009	-Hardware	132 kV	.... Lumpsum Value	-	142130	-	142130
10	TL0010	-Insulators	132 kV	.... Lumpsum Value	-	497456	-	497456
11	TL0011	-Foundation	132 kV	.... Lumpsum Value	426391	-	-	426391
12	TL0012	-Miscellaneous	132 kV	.... Lumpsum Value	142130	71065	-	213196
20	TL0020	-Feeders		.... Lumpsum Value	-	713000	-	713000
	TOTAL	(w/o taxes)	in US$		639587	6185021	-	6824608

Project Alternative A

-CABLE TUNNEL STRUCTURE - CONCRETE LINED

-Inner tunnel diameter	3.0 m	-Tunnel diameter within permissible range	
-Tunnel length	250.0 m	-Max diameter of excavation	3.5 m
in very good rock	90.0 %		
in good rock	8.0 %		
in fair rock	2.0 %		

-Calculated physical parameters

COST ESTIMATE FOR CIVIL STRUCTURES Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
1	TU0001	-tun.exc. cl.1-2-3, 5m2, 500m	2774	m3	8.43	48.81	-	57.24	23407	135412	-	158820
61	TU0061	-shotcrete < 20 m2	93.70	m3	14.25	166	-	180	1335	15532	-	16867
63	TU0063	-concrete lining < 20m2	755	m3	9.02	88.97	-	98	6812	67157	-	73970
65	TU0065	-reinforcement	22.64	to	34.65	888	-	923	785	20109	-	20893
66	TU0066	-mesh reinforcement	2.78	to	12.28	680	-	692	34.16	1890	-	1924
67	TU0067	-formwork tunnels 500m, 5m2	1938	m2	5.62	6.36	-	11.99	10913	12334	-	23246
87	TU0087	-rockbolt	4.84	to	185	2315	-	2500	896	11205	-	12101
		-Miscellaneous items	10	%					4418	26364	-	30782
	TOTAL	(w/o taxes)	in US$						48600	290002	-	338602

Project Alternative A

-ACCESS TUNNEL STRUCTURE

-Type of lining to be selected by program

-Inner tunnel diameter	6.0 m
-Tunnel length	760.0 m
in very good rock	90.0 %
in good rock	8.0 %
in fair rock	2.0 %

-Calculated physical parameters

-Tunnel diameter within permissible range

-Max diameter of excavation 6.9 m

COST ESTIMATE FOR CIVIL STRUCTURES

Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
2	TU0002	-tun.exc. cl.1-2-3, 5m2, 1000m	25500 m3	9.23	52.43	-	61.67	235609	1337132	-	1572741
61	TU0061	-shotcrete < 20 m2	1975 m3	14.25	166	-	180	28150	327391	-	355541
63	TU0063	-concrete lining < 20m2	147 m3	9.02	88.97	-	98	1325	13061	-	14386
65	TU0065	-reinforcement	53.56 to	34.65	888	-	923	1856	47570	-	49427
66	TU0066	-mesh reinforcement	0.32 to	12.28	680	-	692	4.03	223	-	227
72	TU0072	-formwork tunnels 1000m, 5m2	236 m2	5.62	3.18	-	8.81	1327	750	-	2077
87	TU0087	-rockbolt	2.68 to	185	2315	-	2500	496	6205	-	6701
		-Miscellaneous items	10 %					26877	173233	-	200110
	TOTAL	(w/o taxes)	in US$					295643	1905566	-	2201209

-WIDE ACCESS ROAD

-Calculated physical parameters

-Road length	20.0 km
-Ground cross slope	15.0 deg
-Transport distance of metal	10.0 km
-Width of pavement	4.5 m
-Width of embankment	7.0 m

COST ESTIMATE FOR CIVIL STRUCTURES — Cost level: Sep 1991

LINE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
1	AR0001	-site clearing light jungle	10	ha	58.72	246	-	305	587	2462	-	3049
2	AR0002	-site clearing heavy jungle	10	ha	409	4107	-	4516	4085	41074	-	45159
3	AR0003	-removal of top soil	190045	m3	0.39	4.39	-	4.79	75831	835908	-	911738
5	AR0005	-rock excavation and form bank	126697	m3	0.77	7.14	-	7.91	97845	905496	-	1003341
7	AR0007	-hardcore foundation	11250	m3	0.70	10.63	-	11.34	7957	119619	-	127575
8	AR0008	-upper layer of ballast	9000	m3	0.70	10.63	-	11.34	6365	95695	-	102060
9	AR0009	-ashalt base and wearing course	90000	m2	0.69	13.12	-	13.82	62879	1181476	-	1244355
10	AR0010	-extra transport for road metal	931500	m3km	0.03	0.43	-	0.47	33168	409068	-	442236
12	AR0012	-rock excavation f.side drain	7500	m3	4.28	19.77	-	24.06	32168	148340	-	180508
		-Miscellaneous items	10	%					32089	373914	-	406002
	TOTAL	(w/o taxes)	in US$						352974	4113051	-	4466025

Project Alternative A

-CONCRETE BRIDGE(S) IN HIGHLANDS

-Calculated physical parameters

-Number of bridges	2	-Number of spans	2
-Total length of bridge	15.0 m		
-Depth of water during design flood	15.0 m	-Height of columns	17.5 m
-Depth of water during design flood (default)	15.0 m	-Height of columns	17.5 m

COST ESTIMATE FOR CIVIL STRUCTURES

Cost level: Sep 1991

NE	CODE	DESCRIPTION	QUANTITY	UNIT	UNIT RATE (US$) Loc	For	Tax	Total	TOTAL COST (US$) Loc	For	Tax	Total
1	BR0001	-excavation common, foundation	3150	m3	0.16	2.55	-	2.71	511	8033	-	8543
3	BR0003	-excavation rock to foundation	494	m3	1.33	8.67	-	10.00	657	4284	-	4941
4	BR0004	-backfill with excavat.material	6975	m3	0.45	1.71	-	2.16	3143	11940	-	15082
9	BR0009	-lean concrete	19	m3	5.58	30.60	-	36.18	106	581	-	688
10	BR0010	-reinforced concrete	3612	m3	5.58	48.27	-	53.86	20182	174371	-	194553
11	BR0011	-reinforcement	368	to	28.08	895	-	923	10335	329267	-	339601
12	BR0012	-formwork	5926	m2	9.64	25.02	-	34.66	57135	148298	-	205433
13	BR0013	-bridge beam precast	56	m3	7.54	85.71	-	93.25	422	4800	-	5222
14	BR0014	-bridge hand rail	289	m	0.62	52.11	-	52.74	182	15072	-	15253
		-Miscellaneous items	5	%					4634	34832	-	39466
	TOTAL	(w/o taxes)	in US$						97306	731478	-	828784

COST ESTIMATE (DIRECT) FOR CIVIL STRUCTURES   Cost level: Sep 1991

ELEMENT	PERCENTAGE OF TOTAL COST				TOTAL COST (1000 US$)			
	Loc	For	Tax	Total	Loc	For	Tax	Total
Cofferdam	0.1	1.1	0.0	1.3	45.	391.	0.	437.
	0.5	3.1	0.0	3.6	159.	1098.	0.	1256.
Spillway	0.2	1.6	0.0	1.8	64.	559.	0.	623.
Power intake	0.1	1.2	0.0	1.3	52.	401.	0.	453.
Headrace tunnel	3.8	33.9	0.0	37.7	1326.	11828.	0.	13154.
Surge tank	0.6	3.4	0.0	4.0	201.	1183.	0.	1384.
Pressure shaft	0.3	1.8	0.0	2.1	111.	628.	0.	739.
Access tunnel	0.8	5.5	0.0	6.3	296.	1906.	0.	2201.
Cable tunnel	0.1	0.8	0.0	1.0	49.	290.	0.	339.
Powerhouse, including switchyard	1.7	6.9	0.0	8.6	583.	2420.	0.	3003.
Tailrace tunnel	1.8	15.1	0.0	16.8	614.	5248.	0.	5862.
Outlet structure	0.0	0.3	0.0	0.3	6.	115.	0.	121.
Access road	1.0	11.8	0.0	12.8	353.	4113.	0.	4466.
Bridges	0.3	2.1	0.0	2.4	97.	731.	0.	829.
SUBTOTAL (w/o taxes)	11.3	88.7	0.0	100.0	3956.	30910.	0.	34866.

COST ESTIMATE (DIRECT + INDIRECT) FOR MECHANICAL EQUIPMENT AND HYDRAULIC STEEL STRUCTURES   Cost level: Sep 1991

ELEMENT	PERCENTAGE OF TOTAL COST				TOTAL COST (1000 US$)			
	Loc	For	Tax	Total	Loc	For	Tax	Total
Spillway	0.4	14.1	0.0	14.5	67.	2182.	0.	2249.
Power intake	0.1	4.2	0.0	4.3	10.	658.	0.	668.
Pressure shaft	0.4	13.9	0.0	14.3	58.	2155.	0.	2213.
Powerhouse, including switchyard	0.4	66.4	0.0	66.9	67.	10287.	0.	10354.
SUBTOTAL (w/o taxes)	1.3	98.7	0.0	100.0	203.	15281.	0.	15483.

COST ESTIMATE (DIRECT + INDIRECT) FOR ELECTRICAL EQUIPMENT Cost level: Sep 1991

ELEMENT	PERCENTAGE OF TOTAL COST				TOTAL COST (1000 US$)			
	Loc	For	Tax	Total	Loc	For	Tax	Total
Powerhouse, including switchyard	1.0	99.0	0.0	100.0	125.	12849.	0.	12974.
SUBTOTAL (w/o taxes)	1.0	99.0	0.0	100.0	125.	12849.	0.	12974.

COST ESTIMATE (DIRECT + INDIRECT) FOR TRANSMISSION FEEDER LINE Cost level: Sep 1991

ELEMENT	PERCENTAGE OF TOTAL COST				TOTAL COST (1000 US$)			
	Loc	For	Tax	Total	Loc	For	Tax	Total
Transmission feeder line	9.4	90.6	0.0	100.0	640.	6185.	0.	6825.
SUBTOTAL (w/o taxes)	9.4	90.6	0.0	100.0	640.	6185.	0.	6825.

BREAKDOWN OF COST ITEMS

Cost level: Sep 1991

ELEMENT	PERCENTAGE OF TOTAL COST				TOTAL COST (1000 US$)			
	Loc	For	Tax	Total	Loc	For	Tax	Total
/IL WORKS								
- Direct cost	4.0	31.2	0.0	35.2	3956.	30910.	0.	34866.
- Indirect cost	4.1	9.8	0.0	13.9	4100.	9693.	0.	13793.
- Contingencies	1.6	8.2	0.0	9.8	1611.	8120.	0.	9732.
- Total for civil works	9.8	49.2	0.0	59.0	9668.	48723.	0.	58391.
MECHANICAL EQUIPMENT AND HYDRAULIC STEEL STRUCTURES								
- Direct and indirect cost	0.2	15.4	0.0	15.6	203.	15281.	0.	15483.
- Contingencies	0.0	2.3	0.0	2.3	30.	2292.	0.	2323.
- Total for mechanical equipment	0.2	17.8	0.0	18.0	233.	17573.	0.	17806.
ELECTRICAL EQUIPMENT								
- Direct and indirect cost	0.1	13.0	0.0	13.1	125.	12849.	0.	12974.
- Contingencies	0.0	1.9	0.0	2.0	19.	1927.	0.	1946.
- Total for electrical equipment	0.1	14.9	0.0	15.1	143.	14777.	0.	14920.
.ANSMISSION FEEDER LINE								
- Direct and indirect cost	0.6	6.2	0.0	6.9	640.	6185.	0.	6825.
- Contingencies	0.1	0.9	0.0	1.0	96.	928.	0.	1024.
- Total for transmission feeder line	0.7	7.2	0.0	7.9	736.	7113.	0.	7848.
TOTAL DIRECT AND INDIRECT CONSTRUCTION COST	10.9	89.1	0.0	100.0	10780.	88185.	0.	98965.
- Engineering, administration & supervision	1.2	6.8	0.0	8.0	1139.	6778.	0.	7917.
- clients own cost	0.1	0.4	0.0	0.5	54.	441.	0.	495.
BASIC PROJECT COST (w/o taxes)	12.1	96.4	0.0	108.5	11973.	95404.	0.	107377.

Project Alternative A — Installed Capacity Factor ICF= 2.00

-Plant factor		45.5 %
-Mean streamflow (-1-1989), 480 months of data		28.4 m3/s
-Total spillage / total inflow		10.0 %
-Reservoir surface area		3.2 km2
-Reservoir operating levels: Minimum/Maximum (Run-of-river project)		205.0 msl
-Tailwater elevation:	Maximum	24.7 msl
	Mean	18.2 msl
	Minimum	16.7 msl
-Total head losses		8.4 m
-Reservoir storage volume:	Maximum	17.8 MCM
	Mean	17.8 MCM
	Minimum	17.8 MCM
-Degree of regulation		15.9 %
-Capacity / inflow ratio		2.0 %
rbines installed	Francis	2 turb
-Generated capacity:	Maximum	85.1 MW
	Mean	84.8 MW
	Minimum	83.6 MW
	Guaranteed (95. %)	84.3 MW
-Continuous power:	Maximum	84.5 MW
	Mean	38.6 MW
	Minimum	3.6 MW
	Guaranteed (95. %)	6.9 MW
-Annual energy output for 40 years time series:	Maximum	669.7 GWh
	Mean	339.5 GWh
	3rd driest year	108.6 GWh
	2nd driest year	78.3 GWh
	Driest year	76.3 GWh

-Marginal cost of 1 kW of guaranteed capacity		375.0 $
-Marginal cost of 1 kWh of guaranteed energy		5.6 cents
-Marginal cost of 1 kWh of secondary energy		2.8 cents
(Used for optimising arrangement of power components)		
-Basic project cost		107.4 Mio $
-Annual OMR cost		0.9 Mio $
-Cash disbursement (%) over 5 years of construction 11.9/ 23.1/ 30.0/ 23.1/ 11.9		
-PV Project cost (Lifetime 50 years)	@ 10.0 % discount rate	153.1 Mio $
-Cost per kW capacity	@ 8.0 % discount rate	1601. $
	@ 10.0 % discount rate	1695. $
	@ 12.0 % discount rate	1794. $
-Cost per kWh average	@ 8.0 % discount rate	3.5 cents
	@ 10.0 % discount rate	4.5 cents
	@ 12.0 % discount rate	5.7 cents
-Cost per kWh weighted	@ 8.0 % discount rate	6.0 cents
Guaranteed = 100 %	@ 10.0 % discount rate	7.7 cents
Secondary = 50 %	@ 12.0 % discount rate	9.6 cents
-Energy production per MCM of inflow		379.3 MWh
-Employment (local direct labour during construct		7300 M-yrs

File name	Activity	Contents
zucost.***	Input	Unit cost file system
evals.fix	Input	File with fixed input data
ucost.wgt	Input	File with cost weighting factors
evals.turb	Input	File with turbine characteristics
PKUKUL-K	Input	Project definition file
RKUKUL-K	Input	File with reservoir data
VKUKUL-K	Input	File with valley cross section data
TKUKUL-K	Input	File with tailwater rating curve
XUKUL-K	Input	Hydrology master file
RIMDKUKUL-PA	Input	Monthly streamflow data file
HMHXKUKK	Input	Spillway design flood data file
HMHXKUKK	Input	Diversion design flood data file
KUKUL-K.lp	Output	Results to line printer
KUKUL-K.sum	Update	Project evaluation summary

ECHOPRINT OF PROJECT DEFINITION FILE PKUKUL-K

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TI  PKUKUL-K    KUKULE HYDROPOWER PROJECT, ALTERNATIVE K-K
AL  GRAVITY DAM (WEIR), FSL 205 M ASL, POWERHOUSE AT KUKULE A
AL  1 -1  1 -1 205.0 185.0 999.0   -1.   -1.   -1.   -1.   -1.   -1.   -1.   -1.
AL  ROCKFILL DAM, FSL 230 M ASL, POWERHOUSE AT KUKULE      B
AL  1 -1  1 -1 230.0 193.7  5.00   -1.   -1.   -1.   -1.   -1.   -1.   -1.   -1.
AL  ROCKFILL DAM, FSL 242 M ASL, POWERHOUSE AT KUKULE      C
AL  1 -1  1 -1   242 193.7  5.00   -1.   -1.   -1.   -1.   -1.   -1.   -1.   -1.
CO  IN-RIVER DIVERSION                                     A
CO  4 -1 -1 -1 195.0 195.0 12.00 200.0   -1.   -1.   -1. 5.00  1.00   -1.  2.00
CO  UPSTREAM COFFERDAM                                     BC
CO  1 -1 11 12 210.0 210.0  0.00  0.00  0.00  0.00  0.00  0.00  1.00   -1.  2.00
CO  DOWNSTREAM COFFERDAM                                   BC
CO  2 -1 11 12 197.0 197.0  0.00  0.00  0.00  0.00  1.00  0.00  1.00   -1.  2.00
DA  MAIN DAM (CONCRETE WEIR)                               A
DA  6  0  1  3   -1.   -1.   -1.   -1.   -1.   -1.  1.00   -1.  1.00  1.00  2.00
DA  MAIN DAM (ROCKFILL DAM)                                B
DA  4  0 11 12  0.00   -1.   -1.   -1.   -1.   -1.  1.00   -1.  2.00  1.00  2.00
DA  MAIN DAM (ROCKFILL DAM)                                C
DA  4  0 11 12  0.00   -1.   -1.   -1.   -1.   -1.  1.00   -1.  2.00  1.00  2.00
SP  SERVICE SPILLWAY (10000 YR FLOOD)                      A
SP  2 -1 -1 -1 40.00 40.00  0.00 195.0  0.00  0.00  0.00  0.00  0.00  0.00  2.00
SP  GATED SPILLWAY WITH CHUTE                              B
SP  4 -1 -1 -1 40.00 40.00  0.00 220.0 100.0  6.66 10.00  5.00100000  1.00  2.00
SP  GATED SPILLWAY WITH CHUTE                              C
SP  4 -1 -1 -1    40    40  0.00   232   120     7 10.00  5.00100000  1.00  2.00
DT  DIVERSION TUNNEL                                       BC
DT  0  1 -1 -1 600.0   -1.   -1. 35.00  2.00   -1. 50.00 30.00 20.00  0.00  0.00
CT  VERTICAL SHAFT FOR POWER CABLES                        ABC
CT  2 -1 -1 -1 250.0  3.00   -1.   -1.   -1.   -1. 90.00  8.00  2.00  0.00  0.00
AT  ACCESS TO POWER CAVERN                                 ABC
AT  0 -1 -1 -1 760.0  6.00   -1.   -1.   -1.   -1. 90.00  8.00  2.00  0.00  0.00
HR  HEADRACE TUNNEL                                        A
HR -1  1  2  1 4960.  0.00   -1. 30.00  2.00   -1. 60.80 15.20 21.40  2.60  0.00
HR  HEADRACE TUNNEL                                        BC
HR -1  1  2  1 5690.  0.00   -1. 30.00  2.00   -1. 60.80 15.20 21.40  2.60  0.00
PS  VERTICAL PRESSURE SHAFT                                ABC
PS -1  0  0 -1 400.0   -1.   -1.   -1.   -1.   -1. 100.0  0.00  0.00  0.00  0.00
TR  TAILRACE TUNNEL                                        ABC
TR -1 -1  2 -1 2370.  0.00 30.00 30.00  2.00   -1. 67.1  22.4   9.40  1.10  0.00
ST  UNDERGROUND SURGE TANK                                 ABC
ST  1 -1 -1 -1 320.0 30.00 300.0 30.00  0.00  0.00   -1.   -1.   -1.   -1.  2.00
PH  POWER CAVERN                                           ABC
PH  2  2  1  0  2.00  -1.0  0.00  0.00   -1.   -1.   -1.   -1.   -1.   -1.   -1.
TL  FEEDER LINE TO PANNIPYTIA                              ABC
TL  2  2 -1 -1 64.00 220.0   -1.   -1.   -1.   -1.   -1.   -1.   -1.   -1.   -1.
AR  ACCESS ROAD TO DAM SITE                                ABC
AR  1 -1 -1 -1 20.00 15.00 10.00  1.00 100.0   -1.   -1.   -1.   -1.   -1.   -1.
BR  BRIDGES IN ACCESS ROAD                                 ABC
BR  3 -1 -1 -1  2.00  0.00  0.00 15.00 15.00   -1.   -1.   -1.   -1.   -1.   -1.
CP  5-YEAR CONSTRUCTION PERIOD                             ABC
CP  5 -1 -1 -1  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
EN

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KUKULE COST ESTIMATES FOR PROJECT OPTIMIZATION

October 1991

Annex 2

Data for Hydroproject KUKUL-K ICF= 1.25 Alternative A

HYDROLOGY

-Data Period	-1-1989
-Mean Inflow (QM)	28.4 m3/s
-Catchment Area	305.2 km2

RESERVOIR

-Max Storage	17.8 MCM
-Ave Storage	17.8 MCM
-Min Storage	17.8 MCM
-Max Operating Level	205.0 m asl
-Ave Operating Level	205.0 m asl
-Min Operating Level	205.0 m asl
-Reservoir Area	3.2 km2

WATER MANAGEMENT

-Spillage as % Inflow	23.3 % QM
-Degree of Regulation	15.9 %
-Ave Water Demand	0.0 m3/s

TAILWATER LEVELS

-Max Level (Design Flood)	24.7 m asl
-Ave Level (Max Power Rel)	17.9 m asl
-Min Level (Zero Outflow)	16.7 m asl

POWER CHARACTERISTICS

-Installed Capacity Factor	1.25
-Ave Plant Factor	61.8 %
-Ave Head Losses	6.1 m
-No. of Turbines	2
-Turbine Type	FRANCIS

TRANSMISSION

-Transmitted Power	55.4 MVA
-Transmission Voltage	132.0 kV
-No. of Circuits	2
-Distance to Feeder Point	64.0 km

CAPACITY

-Max Generating Capacity	53.9 MW
-Ave Generating Capacity	53.7 MW
-Min Generating Capacity	52.9 MW
-Guar Generating Capacity	44.6 MW
-Max Continuous Power	53.6 MW
-Ave Continuous Power	32.6 MW
-Min Continuous Power	3.7 MW
-Guar Continuous Power	7.0 MW

ENERGY OUTPUT

-Max Annual Energy Output	459.8 GWh
-Ave Annual Energy Output	285.5 GWh
-Output in 3rd Driest Year	110.0 GWh
-Output in 2nd Driest Year	79.3 GWh
-Output in Driest Year	77.3 GWh
-Energy per MCM Inflow	326.0 MWh

COST (Million US$)

-Basic Project Cost	88.9
-Local Cost Component	11.3 %
-Foreign Cost Component	88.7 %
-Taxes & Govt Charges	0.0 %
-Annual Costs for OMR	0.8

CONSTRUCTION

-Man-Years (Local Labour)	6070
-Duration of Construction	5 Yrs
-Split-Up over Years	/12./23./30./23./12./

SPECIFIC CAPACITY COST (US$/kW)

-at 8.0 % Discount Rate	2096.
-at 10.0 % Discount Rate	2219.
-at 12.0 % Discount Rate	2349.

AVERAGE SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	3.41
-at 10.0 % Discount Rate	4.37
-at 12.0 % Discount Rate	5.46

WEIGHED SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	5.62
-at 10.0 % Discount Rate	7.22
-at 12.0 % Discount Rate	9.01

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Data for Hydroproject   KUKUL-K         ICF= 1.50                 Alternative  A

HYDROLOGY                               RESERVOIR
-Data Period              -1-1989       -Max Storage                  17.8 MCM
-Mean Inflow (QM)           28.4 m3/s   -Ave Storage                  17.8 MCM
-Catchment Area            305.2 km2    -Min Storage                  17.8 MCM
                                        -Max Operating Level         205.0 m asl
                                        -Ave Operating Level         205.0 m asl
                                        -Min Operating Level         205.0 m asl
                                        -Reservoir Area                3.2 km2

WATER MANAGEMENT                        TAILWATER LEVELS
-Spillage as % Inflow       17.6 % QM   -Max Level (Design Flood)     24.7 m asl
-Degree of Regulation       15.9 %      -Ave Level (Max Power Rel)    18.0 m asl
-Ave Water Demand            0.0 m3/s   -Min Level (Zero Outflow)     16.7 m asl

POWER CHARACTERISTICS                   TRANSMISSION
-Installed Capacity Factor  1.50        -Transmitted Power            66.0 MVA
-Ave Plant Factor           55.5 %      -Transmission Voltage        132.0 kV
-Ave Head Losses             7.6 m      -No. of Circuits                 2
-No. of Turbines               2        -Distance to Feeder Point     64.0 km
-Turbine Type            FRANCIS

CAPACITY                                ENERGY OUTPUT
-Max  Generating Capacity   64.1 MW     -Max Annual Energy Output    535.4 GWh
-Ave  Generating Capacity   63.9 MW     -Ave Annual Energy Output    311.5 GWh
-Min  Generating Capacity   63.0 MW     -Output in 3rd Driest Year   109.1 GWh
-Guar Generating Capacity   48.7 MW     -Output in 2nd Driest Year    78.7 GWh
-Max  Continuous Power      63.7 MW     -Output in Driest Year        76.6 GWh
-Ave  Continuous Power      35.5 MW
-Min  Continuous Power       3.6 MW     -Energy per MCM Inflow       348.1 MWh
-Guar Continuous Power       6.9 MW

COST (Million US$)                      CONSTRUCTION
-Basic Project Cost         94.5        -Man-Years (Local Labour)    6420
-Local   Cost Component     11.2 %      -Duration of Construction       5 Yrs
-Foreign Cost Component     88.8 %      -Split-Up over Years
-Taxes & Govt Charges        0.0 %       /12./23./30./23./12./
-Annual Costs for OMR        0.8

SPECIFIC CAPACITY COST (US$/kW)         AVERAGE SPECIFIC GENERATION COST (c/kWh)
-at  8.0 % Discount Rate   1872.        -at  8.0 % Discount Rate      3.40
-at 10.0 % Discount Rate   1982.        -at 10.0 % Discount Rate      4.36
-at 12.0 % Discount Rate   2098.        -at 12.0 % Discount Rate      5.44

                                        WEIGHED SPECIFIC GENERATION COST (c/kWh)
                                        -at  8.0 % Discount Rate      5.68
                                        -at 10.0 % Discount Rate      7.28
                                        -at 12.0 % Discount Rate      9.09
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Data for Hydroproject KUKUL		ICF= 1.75	Alternative A
HYDROLOGY		**RESERVOIR**	
-Data Period	-1-1989	-Max Storage	17.8 MCM
-Mean Inflow (QM)	28.4 m3/s	-Ave Storage	17.8 MCM
-Catchment Area	305.2 km2	-Min Storage	17.8 MCM
		-Max Operating Level	205.0 m asl
		-Ave Operating Level	205.0 m asl
		-Min Operating Level	205.0 m asl
		-Reservoir Area	3.2 km2
WATER MANAGEMENT		**TAILWATER LEVELS**	
-Spillage as % Inflow	13.3 % QM	-Max Level (Design Flood)	24.7 m asl
-Degree of Regulation	15.9 %	-Ave Level (Max Power Rel)	18.1 m asl
-Ave Water Demand	0.0 m3/s	-Min Level (Zero Outflow)	16.7 m asl
POWER CHARACTERISTICS		**TRANSMISSION**	
-Installed Capacity Factor	1.75	-Transmitted Power	76.6 MVA
-Ave Plant Factor	50.1 %	-Transmission Voltage	132.0 kV
-Ave Head Losses	8.5 m	-No. of Circuits	2
-No. of Turbines	2	-Distance to Feeder Point	64.0 km
-Turbine Type	FRANCIS		
CAPACITY		**ENERGY OUTPUT**	
-Max Generating Capacity	74.4 MW	-Max Annual Energy Output	604.0 GWh
-Ave Generating Capacity	74.2 MW	-Ave Annual Energy Output	326.7 GWh
-Min Generating Capacity	73.1 MW	-Output in 3rd Driest Year	108.5 GWh
-Guar Generating Capacity	73.7 MW	-Output in 2nd Driest Year	78.3 GWh
-Max Continuous Power	73.9 MW	-Output in Driest Year	76.2 GWh
-Ave Continuous Power	37.2 MW		
-Min Continuous Power	3.6 MW	-Energy per MCM Inflow	365.0 MWh
-Guar Continuous Power	6.9 MW		
COST (Million US$)		**CONSTRUCTION**	
-Basic Project Cost	100.0	-Man-Years (Local Labour)	6720
-Local Cost Component	11.1 %	-Duration of Construction	5 Yrs
-Foreign Cost Component	88.9 %	-Split-Up over Years	
-Taxes & Govt Charges	0.0 %	/12./23./30./23./12./	
-Annual Costs for OMR	0.9		
SPECIFIC CAPACITY COST (US$/kW)		**AVERAGE SPECIFIC GENERATION COST (c/kWh)**	
-at 8.0 % Discount Rate	1706.	-at 8.0 % Discount Rate	3.43
-at 10.0 % Discount Rate	1806.	-at 10.0 % Discount Rate	4.40
-at 12.0 % Discount Rate	1912.	-at 12.0 % Discount Rate	5.49
		WEIGHED SPECIFIC GENERATION COST (c/kWh)	
		-at 8.0 % Discount Rate	5.78
		-at 10.0 % Discount Rate	7.41
		-at 12.0 % Discount Rate	9.25

Data for Hydroproject	KUKUL-K	ICF= 2.00	Alternative A

HYDROLOGY		RESERVOIR	
-Data Period	-1-1989	-Max Storage	17.8 MCM
-Mean Inflow (QM)	28.4 m3/s	-Ave Storage	17.8 MCM
-Catchment Area	305.2 km2	-Min Storage	17.8 MCM
		-Max Operating Level	205.0 m asl
		-Ave Operating Level	205.0 m asl
		-Min Operating Level	205.0 m asl
		-Reservoir Area	3.2 km2

WATER MANAGEMENT		TAILWATER LEVELS	
-Spillage as % Inflow	10.0 % QM	-Max Level (Design Flood)	24.7 m asl
-Degree of Regulation	15.9 %	-Ave Level (Max Power Rel)	18.2 m asl
-Ave Water Demand	0.0 m^3/s	-Min Level (Zero Outflow)	16.7 m asl

POWER CHARACTERISTICS		TRANSMISSION	
-Installed Capacity Factor	2.00	-Transmitted Power	87.6 MVA
-Ave Plant Factor	45.5 %	-Transmission Voltage	132.0 kV
-Ave Head Losses	8.4 m	-No. of Circuits	2
-No. of Turbines	2	-Distance to Feeder Point	64.0 km
-Turbine Type	FRANCIS		

CAPACITY		ENERGY OUTPUT	
-Max Generating Capacity	85.2 MW	-Max Annual Energy Output	669.7 GWh
-Ave Generating Capacity	84.8 MW	-Ave Annual Energy Output	325.0 GWh
-Min Generating Capacity	83.6 MW	-Output in 3rd Driest Year	108.6 GWh
-Guar Generating Capacity	50.8 MW	-Output in 2nd Driest Year	78.3 GWh
-Max Continuous Power	84.5 MW	-Output in Driest Year	76.3 GWh
-Ave Continuous Power	37.1 MW		
-Min Continuous Power	3.6 MW	-Energy per MCM Inflow	379.3 MWh
-Guar Continuous Power	6.9 MW		

COST (Million US$)		CONSTRUCTION	
-Basic Project Cost	107.4	-Man-Years (Local Labour)	7300
-Local Cost Component	11.1 %	-Duration of Construction	5 Yrs
-Foreign Cost Component	88.9 %	-Split-Up over Years	
-Taxes & Govt Charges	0.0 %	/12./23./30./23./12./	
-Annual Costs for OMR	0.9		

SPECIFIC CAPACITY COST (US$/kW)		AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	1601.	-at 8.0 % Discount Rate	3.55
-at 10.0 % Discount Rate	1695.	-at 10.0 % Discount Rate	4.55
-at 12.0 % Discount Rate	1794.	-at 12.0 % Discount Rate	5.67

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	6.01
-at 10.0 % Discount Rate	7.71
-at 12.0 % Discount Rate	9.62

Data for Hydroproject	KUKUL	ICF= 2.25	Alternative A

HYDROLOGY

-Data Period	-1-1989
-Mean Inflow (QM)	28.4 m3/s
-Catchment Area	305.2 km2

RESERVOIR

-Max Storage	17.8 MCM
-Ave Storage	17.8 MCM
-Min Storage	17.8 MCM
-Max Operating Level	205.0 m asl
-Ave Operating Level	205.0 m asl
-Min Operating Level	205.0 m asl
-Reservoir Area	3.2 km2

WATER MANAGEMENT

-Spillage as % Inflow	7.5 % QM
-Degree of Regulation	15.9 %
-Ave Water Demand	0.0 m3/s

TAILWATER LEVELS

-Max Level (Design Flood)	24.7 m asl
-Ave Level (Max Power Rel)	18.3 m asl
-Min Level (Zero Outflow)	16.7 m asl

POWER CHARACTERISTICS

-Installed Capacity Factor	2.25
-Ave Plant Factor	41.6 %
-Ave Head Losses	8.7 m
-No. of Turbines	2
-Turbine Type	FRANCIS

TRANSMISSION

-Transmitted Power	98.3 MVA
-Transmission Voltage	220.0 kV
-No. of Circuits	2
-Distance to Feeder Point	64.0 km

CAPACITY

-Max Generating Capacity	95.6 MW
-Ave Generating Capacity	95.3 MW
-Min Generating Capacity	93.9 MW
-Guar Generating Capacity	94.7 MW
-Max Continuous Power	94.8 MW
-Ave Continuous Power	39.7 MW
-Min Continuous Power	3.6 MW
-Guar Continuous Power	6.9 MW

ENERGY OUTPUT

-Max Annual Energy Output	731.3 GWh
-Ave Annual Energy Output	348.7 GWh
-Output in 3rd Driest Year	108.4 GWh
-Output in 2nd Driest Year	78.2 GWh
-Output in Driest Year	76.1 GWh
-Energy per MCM Inflow	389.6 MWh

COST (Million US$)

-Basic Project Cost	114.8
-Local Cost Component	11.1 %
-Foreign Cost Component	88.9 %
-Taxes & Govt Charges	0.0 %
-Annual Costs for OMR	1.0

CONSTRUCTION

-Man-Years (Local Labour)	7610
-Duration of Construction	5 Yrs
-Split-Up over Years	/12./23./30./23./12./

SPECIFIC CAPACITY COST (US$/kW)

-at 8.0 % Discount Rate	1524.
-at 10.0 % Discount Rate	1614.
-at 12.0 % Discount Rate	1708.

AVERAGE SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	3.70
-at 10.0 % Discount Rate	4.74
-at 12.0 % Discount Rate	5.91

WEIGHED SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	6.29
-at 10.0 % Discount Rate	8.07
-at 12.0 % Discount Rate	10.06

Data for Hydroproject	KUKUL-K	ICF= 2.50	Alternative A
HYDROLOGY		**RESERVOIR**	
-Data Period	-1-1989	-Max Storage	17.8 MCM
-Mean Inflow (QM)	28.4 m3/s	-Ave Storage	17.8 MCM
-Catchment Area	305.2 km2	-Min Storage	17.8 MCM
		-Max Operating Level	205.0 m asl
		-Ave Operating Level	205.0 m asl
		-Min Operating Level	205.0 m asl
		-Reservoir Area	3.2 km2
WATER MANAGEMENT		**TAILWATER LEVELS**	
-Spillage as % Inflow	5.5 % QM	-Max Level (Design Flood)	24.7 m asl
-Degree of Regulation	15.9 %	-Ave Level (Max Power Rel)	18.4 m asl
-Ave Water Demand	0.0 m3/s	-Min Level (Zero Outflow)	16.7 m asl
POWER CHARACTERISTICS		**TRANSMISSION**	
-Installed Capacity Factor	2.50	-Transmitted Power	109.1 MVA
-Ave Plant Factor	38.3 %	-Transmission Voltage	220.0 kV
-Ave Head Losses	9.0 m	-No. of Circuits	2
-No. of Turbines	2	-Distance to Feeder Point	64.0 km
-Turbine Type	FRANCIS		
CAPACITY		**ENERGY OUTPUT**	
-Max Generating Capacity	106.1 MW	-Max Annual Energy Output	791.5 GWh
-Ave Generating Capacity	105.7 MW	-Ave Annual Energy Output	339.3 GWh
-Min Generating Capacity	104.2 MW	-Output in 3rd Driest Year	108.2 GWh
-Guar Generating Capacity	53.0 MW	-Output in 2nd Driest Year	78.0 GWh
-Max Continuous Power	105.1 MW	-Output in Driest Year	76.0 GWh
-Ave Continuous Power	38.7 MW		
-Min Continuous Power	3.6 MW	-Energy per MCM Inflow	397.4 MWh
-Guar Continuous Power	6.9 MW		
COST (Million US$)		**CONSTRUCTION**	
-Basic Project Cost	120.0	-Man-Years (Local Labour)	8610
-Local Cost Component	11.5 %	-Duration of Construction	5 Yrs
-Foreign Cost Component	88.5 %	-Split-Up over Years	
-Taxes & Govt Charges	0.0 %	/12./23./30./23./12./	
-Annual Costs for OMR	1.1		
SPECIFIC CAPACITY COST (US$/kW)		**AVERAGE SPECIFIC GENERATION COST (c/kWh)**	
-at 8.0 % Discount Rate	1436.	-at 8.0 % Discount Rate	3.79
-at 10.0 % Discount Rate	1521.	-at 10.0 % Discount Rate	4.86
-at 12.0 % Discount Rate	1609.	-at 12.0 % Discount Rate	6.06
		WEIGHED SPECIFIC GENERATION COST (c/kWh)	
		-at 8.0 % Discount Rate	6.47
		-at 10.0 % Discount Rate	8.30
		-at 12.0 % Discount Rate	10.35

Data for Hydroproject KUKUL ICF= 2.75 Alternative A

HYDROLOGY		
-Data Period	-1-1989	
-Mean Inflow (QM)	28.4	m3/s
-Catchment Area	305.2	km2

RESERVOIR		
-Max Storage	17.8	MCM
-Ave Storage	17.8	MCM
-Min Storage	17.8	MCM
-Max Operating Level	205.0	m asl
-Ave Operating Level	205.0	m asl
-Min Operating Level	205.0	m asl
-Reservoir Area	3.2	km2

WATER MANAGEMENT		
-Spillage as % Inflow	4.1	% QM
-Degree of Regulation	15.9	%
-Ave Water Demand	0.0	m3/s

TAILWATER LEVELS		
-Max Level (Design Flood)	24.7	m asl
-Ave Level (Max Power Rel)	18.5	m asl
-Min Level (Zero Outflow)	16.7	m asl

POWER CHARACTERISTICS		
-Installed Capacity Factor	2.75	
-Ave Plant Factor	35.3	%
-Ave Head Losses	8.8	m
-No. of Turbines	2	
-Turbine Type	FRANCIS	

TRANSMISSION		
-Transmitted Power	120.1	MVA
-Transmission Voltage	220.0	kV
-No. of Circuits	2	
-Distance to Feeder Point	64.0	km

CAPACITY		
-Max Generating Capacity	116.8	MW
-Ave Generating Capacity	116.4	MW
-Min Generating Capacity	114.8	MW
-Guar Generating Capacity	115.7	MW
-Max Continuous Power	115.7	MW
-Ave Continuous Power	41.1	MW
-Min Continuous Power	3.6	MW
-Guar Continuous Power	6.9	MW

ENERGY OUTPUT		
-Max Annual Energy Output	851.4	GWh
-Ave Annual Energy Output	361.6	GWh
-Output in 3rd Driest Year	108.3	GWh
-Output in 2nd Driest Year	78.1	GWh
-Output in Driest Year	76.1	GWh
-Energy per MCM Inflow	404.0	MWh

COST (Million US$)		
-Basic Project Cost	127.4	
-Local Cost Component	11.4	%
-Foreign Cost Component	88.6	%
-Taxes & Govt Charges	0.0	%
-Annual Costs for OMR	1.1	

CONSTRUCTION		
-Man-Years (Local Labour)	9190	
-Duration of Construction	5	Yrs
-Split-Up over Years		
/12./23./30./23./12./		

SPECIFIC CAPACITY COST (US$/kW)	
-at 8.0 % Discount Rate	1385.
-at 10.0 % Discount Rate	1466.
-at 12.0 % Discount Rate	1552.

AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	3.96
-at 10.0 % Discount Rate	5.08
-at 12.0 % Discount Rate	6.33

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	6.78
-at 10.0 % Discount Rate	8.69
-at 12.0 % Discount Rate	10.84

Data for Hydroproject KUKUL ICF= 3.00 Alternative A

HYDROLOGY

-Data Period	-1-1989
-Mean Inflow (QM)	28.4 m3/s
-Catchment Area	305.2 km2

RESERVOIR

-Max Storage	17.8 MCM
-Ave Storage	17.8 MCM
-Min Storage	17.8 MCM
-Max Operating Level	205.0 m asl
-Ave Operating Level	205.0 m asl
-Min Operating Level	205.0 m asl
-Reservoir Area	3.2 km2

WATER MANAGEMENT

-Spillage as % Inflow	3.0 % QM
-Degree of Regulation	15.9 %
-Ave Water Demand	0.0 m3/s

TAILWATER LEVELS

-Max Level (Design Flood)	24.7 m asl
-Ave Level (Max Power Rel)	18.6 m asl
-Min Level (Zero Outflow)	16.7 m asl

POWER CHARACTERISTICS

-Installed Capacity Factor	3.00
-Ave Plant Factor	32.8 %
-Ave Head Losses	9.1 m
-No. of Turbines	2
-Turbine Type	FRANCIS

TRANSMISSION

-Transmitted Power	130.8 MVA
-Transmission Voltage	220.0 kV
-No. of Circuits	2
-Distance to Feeder Point	64.0 km

CAPACITY

-Max Generating Capacity	127.2 MW
-Ave Generating Capacity	126.8 MW
-Min Generating Capacity	125.1 MW
-Guar Generating Capacity	126.0 MW
-Max Continuous Power	125.9 MW
-Ave Continuous Power	41.6 MW
-Min Continuous Power	3.6 MW
-Guar Continuous Power	6.9 MW

ENERGY OUTPUT

-Max Annual Energy Output	904.0 GWh
-Ave Annual Energy Output	365.3 GWh
-Output in 3rd Driest Year	108.2 GWh
-Output in 2nd Driest Year	78.0 GWh
-Output in Driest Year	76.0 GWh
-Energy per MCM Inflow	408.1 MWh

COST (Million US$)

-Basic Project Cost	132.5
-Local Cost Component	11.4 %
-Foreign Cost Component	88.6 %
-Taxes & Govt Charges	0.0 %
-Annual Costs for OMR	1.2

CONSTRUCTION

-Man-Years (Local Labour)	9520
-Duration of Construction	5 Yrs
-Split-Up over Years	
/12./23./30./23./12./	

SPECIFIC CAPACITY COST (US$/kW)

-at 8.0 % Discount Rate	1321.
-at 10.0 % Discount Rate	1399.
-at 12.0 % Discount Rate	1481.

AVERAGE SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	4.08
-at 10.0 % Discount Rate	5.23
-at 12.0 % Discount Rate	6.52

WEIGHED SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	7.00
-at 10.0 % Discount Rate	8.97
-at 12.0 % Discount Rate	11.18

Data for Hydroproject	KUKUL-K	ICF= 1.50	Alternative B

HYDROLOGY

-Data Period	1949-1989	
-Mean Inflow (QM)	30.4	m3/s
-Catchment Area	308.4	km2

RESERVOIR

-Max Storage	209.0	MCM
-Ave Storage	144.9	MCM
-Min Storage	3.6	MCM
-Max Operating Level	230.0	m asl
-Ave Operating Level	223.0	m asl
-Min Operating Level	198.7	m asl
-Reservoir Area	12.8	km2

WATER MANAGEMENT

-Spillage as % Inflow	4.2	% QM
-Degree of Regulation	83.0	%
-Ave Water Demand	0.0	m3/s

TAILWATER LEVELS

-Max Level (Design Flood)	24.7	m asl
-Ave Level (Max Power Rel)	18.0	m asl
-Min Level (Zero Outflow)	16.7	m asl

POWER CHARACTERISTICS

-Installed Capacity Factor	1.50	
-Ave Plant Factor	63.0	%
-Ave Head Losses	8.2	m
-No. of Turbines	2	
-Turbine Type	FRANCIS	

TRANSMISSION

-Transmitted Power	80.0	MVA
-Transmission Voltage	132.0	kV
-No. of Circuits	2	
-Distance to Feeder Point	64.0	km

CAPACITY

-Max Generating Capacity	77.8	MW
-Ave Generating Capacity	74.9	MW
-Min Generating Capacity	60.9	MW
-Guar Generating Capacity	59.8	MW
-Max Continuous Power	77.8	MW
-Ave Continuous Power	43.7	MW
-Min Continuous Power	9.4	MW
-Guar Continuous Power	43.7	MW

ENERGY OUTPUT

-Max Annual Energy Output	526.7	GWh
-Ave Annual Energy Output	382.8	GWh
-Output in 3rd Driest Year	382.8	GWh
-Output in 2nd Driest Year	366.4	GWh
-Output in Driest Year	338.1	GWh
-Energy per MCM Inflow	445.3	MWh

COST (Million US$)

-Basic Project Cost	133.7	
-Local Cost Component	11.5	%
-Foreign Cost Component	88.5	%
-Taxes & Govt Charges	0.0	%
-Annual Costs for OMR	1.1	

CONSTRUCTION

-Man-Years (Local Labour)	9470	
-Duration of Construction	5	Yrs
-Split-Up over Years	/12./23./30./23./12./	

SPECIFIC CAPACITY COST (US$/kW)

-at 8.0 % Discount Rate	2260.
-at 10.0 % Discount Rate	2393.
-at 12.0 % Discount Rate	2532.

AVERAGE SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	3.48
-at 10.0 % Discount Rate	4.47
-at 12.0 % Discount Rate	5.57

WEIGHED SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	3.68
-at 10.0 % Discount Rate	4.72
-at 12.0 % Discount Rate	5.89

Data for Hydroproject KUKUL ICF= 1.75 Alternative B

HYDROLOGY		**RESERVOIR**	
-Data Period	1949-1989	-Max Storage	209.0 MCM
-Mean Inflow (QM)	30.4 m3/s	-Ave Storage	197.8 MCM
-Catchment Area	308.4 km2	-Min Storage	3.6 MCM
		-Max Operating Level	230.0 m asl
		-Ave Operating Level	229.0 m asl
		-Min Operating Level	198.7 m asl
		-Reservoir Area	12.8 km2
WATER MANAGEMENT		**TAILWATER LEVELS**	
-Spillage as % Inflow	5.8 % QM	-Max Level (Design Flood)	24.7 m asl
-Degree of Regulation	53.1 %	-Ave Level (Max Power Rel)	18.2 m asl
-Ave Water Demand	0.0 m3/s	-Min Level (Zero Outflow)	16.7 m asl
POWER CHARACTERISTICS		**TRANSMISSION**	
-Installed Capacity Factor	1.75	-Transmitted Power	92.9 MVA
-Ave Plant Factor	54.3 %	-Transmission Voltage	220.0 kV
-Ave Head Losses	8.9 m	-No. of Circuits	2
-No. of Turbines	2	-Distance to Feeder Point	64.0 km
-Turbine Type	FRANCIS		
CAPACITY		**ENERGY OUTPUT**	
-Max Generating Capacity	90.4 MW	-Max Annual Energy Output	550.5 GWh
-Ave Generating Capacity	90.2 MW	-Ave Annual Energy Output	430.0 GWh
-Min Generating Capacity	85.4 MW	-Output in 3rd Driest Year	352.1 GWh
-Guar Generating Capacity	88.7 MW	-Output in 2nd Driest Year	348.9 GWh
-Max Continuous Power	90.4 MW	-Output in Driest Year	335.0 GWh
-Ave Continuous Power	49.0 MW		
-Min Continuous Power	27.8 MW	-Energy per MCM Inflow	448.0 MWh
-Guar Continuous Power	27.8 MW		
COST (Million US$)		**CONSTRUCTION**	
-Basic Project Cost	142.1	-Man-Years (Local Labour)	9920
-Local Cost Component	11.5 %	-Duration of Construction	5 Yrs
-Foreign Cost Component	88.5 %	-Split-Up over Years	
-Taxes & Govt Charges	0.0 %	/12./23./30./23./12./	
-Annual Costs for OMR	1.2		
SPECIFIC CAPACITY COST (US$/kW)		**AVERAGE SPECIFIC GENERATION COST (c/kWh)**	
-at 8.0 % Discount Rate	1993.	-at 8.0 % Discount Rate	3.70
-at 10.0 % Discount Rate	2110.	-at 10.0 % Discount Rate	4.74
-at 12.0 % Discount Rate	2233.	-at 12.0 % Discount Rate	5.92
		WEIGHED SPECIFIC GENERATION COST (c/kWh)	
		-at 8.0 % Discount Rate	4.71
		-at 10.0 % Discount Rate	6.05
		-at 12.0 % Discount Rate	7.55

Data for Hydroproject KUKUL-K ICF= 2.00 Alternative B

HYDROLOGY	
-Data Period	1949-1989
-Mean Inflow (QM)	30.4 m3/s
-Catchment Area	308.4 km2

RESERVOIR	
-Max Storage	209.0 MCM
-Ave Storage	197.8 MCM
-Min Storage	3.6 MCM
-Max Operating Level	230.0 m asl
-Ave Operating Level	229.0 m asl
-Min Operating Level	198.7 m asl
-Reservoir Area	12.8 km2

WATER MANAGEMENT	
-Spillage as % Inflow	3.8 % QM
-Degree of Regulation	53.1 %
-Ave Water Demand	0.0 m3/s

TAILWATER LEVELS	
-Max Level (Design Flood)	24.7 m asl
-Ave Level (Max Power Rel)	18.3 m asl
-Min Level (Zero Outflow)	16.7 m asl

POWER CHARACTERISTICS	
-Installed Capacity Factor	2.00
-Ave Plant Factor	48.6 %
-Ave Head Losses	9.3 m
-No. of Turbines	2
-Turbine Type	FRANCIS

TRANSMISSION	
-Transmitted Power	106.0 MVA
-Transmission Voltage	220.0 kV
-No. of Circuits	2
-Distance to Feeder Point	64.0 km

CAPACITY	
-Max Generating Capacity	103.1 MW
-Ave Generating Capacity	102.9 MW
-Min Generating Capacity	97.4 MW
-Guar Generating Capacity	67.2 MW
-Max Continuous Power	103.1 MW
-Ave Continuous Power	49.0 MW
-Min Continuous Power	27.7 MW
-Guar Continuous Power	27.7 MW

ENERGY OUTPUT	
-Max Annual Energy Output	573.7 GWh
-Ave Annual Energy Output	430.0 GWh
-Output in 3rd Driest Year	360.3 GWh
-Output in 2nd Driest Year	352.7 GWh
-Output in Driest Year	335.7 GWh
-Energy per MCM Inflow	457.2 MWh

COST (Million US$)	
-Basic Project Cost	149.9
-Local Cost Component	11.4 %
-Foreign Cost Component	88.6 %
-Taxes & Govt Charges	0.0 %
-Annual Costs for OMR	1.3

CONSTRUCTION	
-Man-Years (Local Labour)	10470
-Duration of Construction	5 Yrs
-Split-Up over Years	
/12./23./30./23./12./	

SPECIFIC CAPACITY COST (US$/kW)	
-at 8.0 % Discount Rate	1844.
-at 10.0 % Discount Rate	1952.
-at 12.0 % Discount Rate	2066.

AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	3.82
-at 10.0 % Discount Rate	4.91
-at 12.0 % Discount Rate	6.12

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	4.92
-at 10.0 % Discount Rate	6.31
-at 12.0 % Discount Rate	7.87

Data for Hydroproject	KUKUL	ICF= 2.25	Alternative B

HYDROLOGY		RESERVOIR	
-Data Period	1949-1989	-Max Storage	209.0 MCM
-Mean Inflow (QM)	30.4 m3/s	-Ave Storage	197.8 MCM
-Catchment Area	308.4 km2	-Min Storage	3.6 MCM
		-Max Operating Level	230.0 m asl
		-Ave Operating Level	229.0 m asl
		-Min Operating Level	198.7 m asl
		-Reservoir Area	12.8 km2

WATER MANAGEMENT		TAILWATER LEVELS	
-Spillage as % Inflow	2.5 % QM	-Max Level (Design Flood)	24.7 m asl
-Degree of Regulation	53.1 %	-Ave Level (Max Power Rel)	18.4 m asl
-Ave Water Demand	0.0 m3/s	-Min Level (Zero Outflow)	16.7 m asl

POWER CHARACTERISTICS		TRANSMISSION	
-Installed Capacity Factor	2.25	-Transmitted Power	119.0 MVA
-Ave Plant Factor	43.8 %	-Transmission Voltage	220.0 kV
-Ave Head Losses	9.7 m	-No. of Circuits	2
-No. of Turbines	2	-Distance to Feeder Point	64.0 km
-Turbine Type	FRANCIS		

CAPACITY		ENERGY OUTPUT	
-Max Generating Capacity	115.8 MW	-Max Annual Energy Output	593.5 GWh
-Ave Generating Capacity	115.5 MW	-Ave Annual Energy Output	444.2 GWh
-Min Generating Capacity	109.3 MW	-Output in 3rd Driest Year	363.1 GWh
-Guar Generating Capacity	113.5 MW	-Output in 2nd Driest Year	351.9 GWh
-Max Continuous Power	115.8 MW	-Output in Driest Year	334.9 GWh
-Ave Continuous Power	50.6 MW		
-Min Continuous Power	27.7 MW	-Energy per MCM Inflow	462.8 MWh
-Guar Continuous Power	27.7 MW		

COST (Million US$)		CONSTRUCTION	
-Basic Project Cost	156.2	-Man-Years (Local Labour)	11620
-Local Cost Component	11.7 %	-Duration of Construction	5 Yrs
-Foreign Cost Component	88.3 %	-Split-Up over Years	
-Taxes & Govt Charges	0.0 %	/12./23./30./23./12./	
-Annual Costs for OMR	1.4		

SPECIFIC CAPACITY COST (US$/kW)		AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	1711.	-at 8.0 % Discount Rate	3.94
-at 10.0 % Discount Rate	1811.	-at 10.0 % Discount Rate	5.05
-at 12.0 % Discount Rate	1917.	-at 12.0 % Discount Rate	6.31

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	5.09
-at 10.0 % Discount Rate	6.53
-at 12.0 % Discount Rate	8.15

Data for Hydroproject KUKUL-K ICF= 2.50 Alternative B

HYDROLOGY

-Data Period	1949-1989
-Mean Inflow (QM)	30.4 m3/s
-Catchment Area	308.4 km2

RESERVOIR

-Max Storage	209.0 MCM
-Ave Storage	197.8 MCM
-Min Storage	3.6 MCM
-Max Operating Level	230.0 m asl
-Ave Operating Level	229.0 m asl
-Min Operating Level	198.7 m asl
-Reservoir Area	12.8 km2

WATER MANAGEMENT

-Spillage as % Inflow	1.8 % QM
-Degree of Regulation	53.1 %
-Ave Water Demand	0.0 m3/s

TAILWATER LEVELS

-Max Level (Design Flood)	24.7 m asl
-Ave Level (Max Power Rel)	18.5 m asl
-Min Level (Zero Outflow)	16.7 m asl

POWER CHARACTERISTICS

-Installed Capacity Factor	2.50
-Ave Plant Factor	39.8 %
-Ave Head Losses	8.6 m
-No. of Turbines	2
-Turbine Type	FRANCIS

TRANSMISSION

-Transmitted Power	133.0 MVA
-Transmission Voltage	220.0 kV
-No. of Circuits	2
-Distance to Feeder Point	64.0 km

CAPACITY

-Max Generating Capacity	129.4 MW
-Ave Generating Capacity	129.0 MW
-Min Generating Capacity	122.1 MW
-Guar Generating Capacity	65.8 MW
-Max Continuous Power	129.4 MW
-Ave Continuous Power	48.0 MW
-Min Continuous Power	27.8 MW
-Guar Continuous Power	27.8 MW

ENERGY OUTPUT

-Max Annual Energy Output	608.5 GWh
-Ave Annual Energy Output	420.8 GWh
-Output in 3rd Driest Year	365.0 GWh
-Output in 2nd Driest Year	353.7 GWh
-Output in Driest Year	336.6 GWh
-Energy per MCM Inflow	469.4 MWh

COST (Million US$)

-Basic Project Cost	166.2
-Local Cost Component	11.7 %
-Foreign Cost Component	88.3 %
-Taxes & Govt Charges	0.0 %
-Annual Costs for OMR	1.5

CONSTRUCTION

-Man-Years (Local Labour)	12440
-Duration of Construction	5 Yrs
-Split-Up over Years	/12./23./30./23./12./

SPECIFIC CAPACITY COST (US$/kW)

-at 8.0 % Discount Rate	1629.
-at 10.0 % Discount Rate	1726.
-at 12.0 % Discount Rate	1826.

AVERAGE SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	4.14
-at 10.0 % Discount Rate	5.31
-at 12.0 % Discount Rate	6.62

WEIGHED SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	5.36
-at 10.0 % Discount Rate	6.88
-at 12.0 % Discount Rate	8.58

Data for Hydroproject	KUKUL	ICF= 2.75	Alternative B

HYDROLOGY		**RESERVOIR**	
-Data Period	1949-1989	-Max Storage	209.0 MCM
-Mean Inflow (QM)	30.4 m3/s	-Ave Storage	197.8 MCM
-Catchment Area	308.4 km2	-Min Storage	3.6 MCM
		-Max Operating Level	230.0 m asl
		-Ave Operating Level	229.0 m asl
		-Min Operating Level	198.7 m asl
		-Reservoir Area	12.8 km2
WATER MANAGEMENT		**TAILWATER LEVELS**	
-Spillage as % Inflow	1.2 % QM	-Max Level (Design Flood)	24.7 m asl
-Degree of Regulation	53.1 %	-Ave Level (Max Power Rel)	18.5 m asl
-Ave Water Demand	0.0 m3/s	-Min Level (Zero Outflow)	16.7 m asl
POWER CHARACTERISTICS		**TRANSMISSION**	
-Installed Capacity Factor	2.75	-Transmitted Power	146.3 MVA
-Ave Plant Factor	36.4 %	-Transmission Voltage	220.0 kV
-Ave Head Losses	8.6 m	-No. of Circuits	2
-No. of Turbines	2	-Distance to Feeder Point	64.0 km
-Turbine Type	FRANCIS		
CAPACITY		**ENERGY OUTPUT**	
-Max Generating Capacity	142.3 MW	-Max Annual Energy Output	617.9 GWh
-Ave Generating Capacity	141.9 MW	-Ave Annual Energy Output	453.3 GWh
-Min Generating Capacity	134.2 MW	-Output in 3rd Driest Year	364.9 GWh
-Guar Generating Capacity	139.4 MW	-Output in 2nd Driest Year	353.6 GWh
-Max Continuous Power	142.3 MW	-Output in Driest Year	336.5 GWh
-Ave Continuous Power	51.6 MW		
-Min Continuous Power	27.8 MW	-Energy per MCM Inflow	472.3 MWh
-Guar Continuous Power	27.8 MW		
COST (Million US$)		**CONSTRUCTION**	
-Basic Project Cost	173.2	-Man-Years (Local Labour)	12920
-Local Cost Component	11.7 %	-Duration of Construction	5 Yrs
-Foreign Cost Component	88.3 %	-Split-Up over Years	
-Taxes & Govt Charges	0.0 %	/12./23./30./23./12./	
-Annual Costs for OMR	1.5		
SPECIFIC CAPACITY COST (US$/kW)		**AVERAGE SPECIFIC GENERATION COST (c/kWh)**	
-at 8.0 % Discount Rate	1544.	-at 8.0 % Discount Rate	4.29
-at 10.0 % Discount Rate	1635.	-at 10.0 % Discount Rate	5.50
-at 12.0 % Discount Rate	1730.	-at 12.0 % Discount Rate	6.86
		WEIGHED SPECIFIC GENERATION COST (c/kWh)	
		-at 8.0 % Discount Rate	5.57
		-at 10.0 % Discount Rate	7.14
		-at 12.0 % Discount Rate	8.91

Data for Hydroproject KUKUL ICF= 3.00 Alternative B

HYDROLOGY		
-Data Period	1949-1989	
-Mean Inflow (QM)	30.4	m3/s
-Catchment Area	308.4	km2

RESERVOIR		
-Max Storage	209.0	MCM
-Ave Storage	197.8	MCM
-Min Storage	3.6	MCM
-Max Operating Level	230.0	m asl
-Ave Operating Level	229.0	m asl
-Min Operating Level	198.7	m asl
-Reservoir Area	12.8	km2

WATER MANAGEMENT		
-Spillage as % Inflow	0.8	% QM
-Degree of Regulation	53.1	%
-Ave Water Demand	0.0	m3/s

TAILWATER LEVELS		
-Max Level (Design Flood)	24.7	m asl
-Ave Level (Max Power Rel)	18.6	m asl
-Min Level (Zero Outflow)	16.7	m asl

POWER CHARACTERISTICS		
-Installed Capacity Factor	3.00	
-Ave Plant Factor	33.5	%
-Ave Head Losses	8.9	m
-No. of Turbines	2	
-Turbine Type	FRANCIS	

TRANSMISSION		
-Transmitted Power	159.3	MVA
-Transmission Voltage	220.0	kV
-No. of Circuits	2	
-Distance to Feeder Point	64.0	km

CAPACITY		
-Max Generating Capacity	155.0	MW
-Ave Generating Capacity	154.6	MW
-Min Generating Capacity	146.1	MW
-Guar Generating Capacity	151.8	MW
-Max Continuous Power	155.0	MW
-Ave Continuous Power	51.8	MW
-Min Continuous Power	27.7	MW
-Guar Continuous Power	27.7	MW

ENERGY OUTPUT		
-Max Annual Energy Output	618.7	GWh
-Ave Annual Energy Output	454.4	GWh
-Output in 3rd Driest Year	364.1	GWh
-Output in 2nd Driest Year	352.8	GWh
-Output in Driest Year	335.8	GWh
-Energy per MCM Inflow	473.4	MWh

COST (Million US$)		
-Basic Project Cost	179.7	
-Local Cost Component	11.7	%
-Foreign Cost Component	88.3	%
-Taxes & Govt Charges	0.0	%
-Annual Costs for OMR	1.6	

CONSTRUCTION		
-Man-Years (Local Labour)	13320	
-Duration of Construction	5	Yrs
-Split-Up over Years /12./23./30./23./12./		

SPECIFIC CAPACITY COST (US$/kW)	
-at 8.0 % Discount Rate	1471.
-at 10.0 % Discount Rate	1558.
-at 12.0 % Discount Rate	1648.

AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	4.44
-at 10.0 % Discount Rate	5.69
-at 12.0 % Discount Rate	7.10

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	5.78
-at 10.0 % Discount Rate	7.41
-at 12.0 % Discount Rate	9.24

Data for Hydroproject KUKUL-K ICF= 1.50 Alternative C

HYDROLOGY

-Data Period	1949-1989	
-Mean Inflow (QM)	30.4	m3/s
-Catchment Area	308.4	km2

WATER MANAGEMENT

-Spillage as % Inflow	3.0	% QM
-Degree of Regulation	87.9	%
-Ave Water Demand	0.0	m3/s

POWER CHARACTERISTICS

-Installed Capacity Factor	1.50	
-Ave Plant Factor	64.0	%
-Ave Head Losses	8.2	m
-No. of Turbines	2	
-Turbine Type	FRANCIS	

CAPACITY

-Max Generating Capacity	82.3	MW
-Ave Generating Capacity	80.2	MW
-Min Generating Capacity	68.3	MW
-Guar Generating Capacity	59.8	MW
-Max Continuous Power	82.3	MW
-Ave Continuous Power	43.6	MW
-Min Continuous Power	48.8	MW
-Guar Continuous Power	48.8	MW

COST (Million US$)

-Basic Project Cost	141.5	
-Local Cost Component	11.7	%
-Foreign Cost Component	88.3	%
-Taxes & Govt Charges	0.0	%
-Annual Costs for OMR	1.1	

SPECIFIC CAPACITY COST (US$/kW)

-at 8.0 % Discount Rate	2232.
-at 10.0 % Discount Rate	2364.
-at 12.0 % Discount Rate	2502.

RESERVOIR

-Max Storage	395.6	MCM
-Ave Storage	293.6	MCM
-Min Storage	3.6	MCM
-Max Operating Level	242.0	m asl
-Ave Operating Level	235.4	m asl
-Min Operating Level	198.7	m asl
-Reservoir Area	18.5	km2

TAILWATER LEVELS

-Max Level (Design Flood)	24.7	m asl
-Ave Level (Max Power Rel)	18.0	m asl
-Min Level (Zero Outflow)	16.7	m asl

TRANSMISSION

-Transmitted Power	84.6	MVA
-Transmission Voltage	132.0	kV
-No. of Circuits	2	
-Distance to Feeder Point	64.0	km

ENERGY OUTPUT

-Max Annual Energy Output	558.4	GWh
-Ave Annual Energy Output	382.4	GWh
-Output in 3rd Driest Year	427.7	GWh
-Output in 2nd Driest Year	427.7	GWh
-Output in Driest Year	427.7	GWh
-Energy per MCM Inflow	478.4	MWh

CONSTRUCTION

-Man-Years (Local Labour)	10280	
-Duration of Construction	5	Yrs
-Split-Up over Years		
/12./23./30./23./12./		

AVERAGE SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	3.42
-at 10.0 % Discount Rate	4.39
-at 12.0 % Discount Rate	5.48

WEIGHED SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	3.55
-at 10.0 % Discount Rate	4.55
-at 12.0 % Discount Rate	5.69

Data for Hydroproject. KUKUL ICF= 1.75 Alternative C

HYDROLOGY		
-Data Period	1949-1989	
-Mean Inflow (QM)	30.4	m3/s
-Catchment Area	308.4	km2

RESERVOIR		
-Max Storage	395.6	MCM
-Ave Storage	306.3	MCM
-Min Storage	3.6	MCM
-Max Operating Level	242.0	m asl
-Ave Operating Level	236.3	m asl
-Min Operating Level	198.7	m asl
-Reservoir Area	18.5	km2

WATER MANAGEMENT		
-Spillage as % Inflow	2.0	% QM
-Degree of Regulation	87.1	%
-Ave Water Demand	0.0	m3/s

TAILWATER LEVELS		
-Max Level (Design Flood)	24.7	m asl
-Ave Level (Max Power Rel)	18.2	m asl
-Min Level (Zero Outflow)	16.7	m asl

POWER CHARACTERISTICS		
-Installed Capacity Factor	1.75	
-Ave Plant Factor	55.8	%
-Ave Head Losses	8.9	m
-No. of Turbines	2	
-Turbine Type	FRANCIS	

TRANSMISSION		
-Transmitted Power	98.3	MVA
-Transmission Voltage	220.0	kV
-No. of Circuits	2	
-Distance to Feeder Point	64.0	km

CAPACITY		
-Max Generating Capacity	95.7	MW
-Ave Generating Capacity	93.7	MW
-Min Generating Capacity	82.1	MW
-Guar Generating Capacity	86.6	MW
-Max Continuous Power	95.7	MW
-Ave Continuous Power	53.3	MW
-Min Continuous Power	48.2	MW
-Guar Continuous Power	48.2	MW

ENERGY OUTPUT		
-Max Annual Energy Output	585.3	GWh
-Ave Annual Energy Output	467.5	GWh
-Output in 3rd Driest Year	422.4	GWh
-Output in 2nd Driest Year	422.4	GWh
-Output in Driest Year	422.4	GWh
-Energy per MCM Inflow	484.5	MWh

COST (Million US$)		
-Basic Project Cost	150.1	
-Local Cost Component	11.7	%
-Foreign Cost Component	88.3	%
-Taxes & Govt Charges	0.0	%
-Annual Costs for OMR	1.2	

CONSTRUCTION		
-Man-Years (Local Labour)	10760	
-Duration of Construction	5	Yrs
-Split-Up over Years	/12./23./30./23./12./	

SPECIFIC CAPACITY COST (US$/kW)	
-at 8.0 % Discount Rate	2026.
-at 10.0 % Discount Rate	2145.
-at 12.0 % Discount Rate	2270.

AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	3.58
-at 10.0 % Discount Rate	4.60
-at 12.0 % Discount Rate	5.74

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	3.76
-at 10.0 % Discount Rate	4.83
-at 12.0 % Discount Rate	6.03

Data for Hydroproject KUKUL-K ICF= 2.00 Alternative C

HYDROLOGY			RESERVOIR		
-Data Period	1949-1989		-Max Storage	395.6	MCM
-Mean Inflow (QM)	30.4	m3/s	-Ave Storage	301.9	MCM
-Catchment Area	308.4	km2	-Min Storage	3.6	MCM
			-Max Operating Level	242.0	m asl
			-Ave Operating Level	236.0	m asl
			-Min Operating Level	198.7	m asl
			-Reservoir Area	18.5	km2

WATER MANAGEMENT			TAILWATER LEVELS		
-Spillage as % Inflow	1.1	% QM	-Max Level (Design Flood)	24.7	m asl
-Degree of Regulation	87.4	%	-Ave Level (Max Power Rel)	18.3	m asl
-Ave Water Demand	0.0	m3/s	-Min Level (Zero Outflow)	16.7	m asl

POWER CHARACTERISTICS			TRANSMISSION		
-Installed Capacity Factor	2.00		-Transmitted Power	112.2	MVA
-Ave Plant Factor	49.2	%	-Transmission Voltage	220.0	kV
-Ave Head Losses	9.3	m	-No. of Circuits	2	
-No. of Turbines	2		-Distance to Feeder Point	64.0	km
-Turbine Type	FRANCIS				

CAPACITY			ENERGY OUTPUT		
-Max Generating Capacity	109.2	MW	-Max Annual Energy Output	607.5	GWh
-Ave Generating Capacity	106.7	MW	-Ave Annual Energy Output	416.4	GWh
-Min Generating Capacity	92.4	MW	-Output in 3rd Driest Year	422.9	GWh
-Guar Generating Capacity	65.1	MW	-Output in 2nd Driest Year	422.9	GWh
-Max Continuous Power	109.2	MW	-Output in Driest Year	422.9	GWh
-Ave Continuous Power	47.5	MW			
-Min Continuous Power	48.3	MW	-Energy per MCM Inflow	487.3	MWh
-Guar Continuous Power	48.3	MW			

COST (Million US$)			CONSTRUCTION		
-Basic Project Cost	158.2		-Man-Years (Local Labour)	11330	
-Local Cost Component	11.6	%	-Duration of Construction	5	Yrs
-Foreign Cost Component	88.4	%	-Split-Up over Years		
-Taxes & Govt Charges	0.0	%	/12./23./30./23./12./		
-Annual Costs for OMR	1.3				

SPECIFIC CAPACITY COST (US$/kW)		AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	1877.	-at 8.0 % Discount Rate	3.76
-at 10.0 % Discount Rate	1987.	-at 10.0 % Discount Rate	4.83
-at 12.0 % Discount Rate	2103.	-at 12.0 % Discount Rate	6.02

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	3.96
-at 10.0 % Discount Rate	5.08
-at 12.0 % Discount Rate	6.34

Data for Hydroproject KUKUL ICF= 2.25 Alternative C

HYDROLOGY

-Data Period	1949-1989
-Mean Inflow (QM)	30.4 m3/s
-Catchment Area	308.4 km2

RESERVOIR

-Max Storage	395.6 MCM
-Ave Storage	306.5 MCM
-Min Storage	3.6 MCM
-Max Operating Level	242.0 m asl
-Ave Operating Level	236.3 m asl
-Min Operating Level	198.7 m asl
-Reservoir Area	18.5 km2

WATER MANAGEMENT

-Spillage as % Inflow	0.6 % QM
-Degree of Regulation	87.1 %
-Ave Water Demand	0.0 m3/s

TAILWATER LEVELS

-Max Level (Design Flood)	24.7 m asl
-Ave Level (Max Power Rel)	18.4 m asl
-Min Level (Zero Outflow)	16.7 m asl

POWER CHARACTERISTICS

-Installed Capacity Factor	2.25
-Ave Plant Factor	44.0 %
-Ave Head Losses	9.7 m
-No. of Turbines	2
-Turbine Type	FRANCIS

TRANSMISSION

-Transmitted Power	126.0 MVA
-Transmission Voltage	220.0 kV
-No. of Circuits	2
-Distance to Feeder Point	64.0 km

CAPACITY

-Max Generating Capacity	122.6 MW
-Ave Generating Capacity	119.9 MW
-Min Generating Capacity	105.0 MW
-Guar Generating Capacity	110.7 MW
-Max Continuous Power	122.6 MW
-Ave Continuous Power	53.9 MW
-Min Continuous Power	47.9 MW
-Guar Continuous Power	48.0 MW

ENERGY OUTPUT

-Max Annual Energy Output	626.4 GWh
-Ave Annual Energy Output	472.3 GWh
-Output in 3rd Driest Year	420.2 GWh
-Output in 2nd Driest Year	420.2 GWh
-Output in Driest Year	420.2 GWh
-Energy per MCM Inflow	489.5 MWh

COST (Million US$)

-Basic Project Cost	164.7
-Local Cost Component	11.9 %
-Foreign Cost Component	88.1 %
-Taxes & Govt Charges	0.0 %
-Annual Costs for O&MR	1.4

CONSTRUCTION

-Man-Years (Local Labour)	12500
-Duration of Construction	5 Yrs
-Split-Up over Years	/12./23./30./23./12./

SPECIFIC CAPACITY COST (US$/kW)

-at 8.0 % Discount Rate	1736.
-at 10.0 % Discount Rate	1839.
-at 12.0 % Discount Rate	1946.

AVERAGE SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	3.90
-at 10.0 % Discount Rate	5.00
-at 12.0 % Discount Rate	6.24

WEIGHED SPECIFIC GENERATION COST (c/kWh)

-at 8.0 % Discount Rate	4.12
-at 10.0 % Discount Rate	5.29
-at 12.0 % Discount Rate	6.61

Data for Hydroproject	KUKUL-K	ICF= 2.50	Alternative C

HYDROLOGY		RESERVOIR	
-Data Period	1949-1989	-Max Storage	395.6 MCM
-Mean Inflow (QM)	30.4 m3/s	-Ave Storage	305.5 MCM
-Catchment Area	308.4 km2	-Min Storage	3.6 MCM
		-Max Operating Level	242.0 m asl
		-Ave Operating Level	236.2 m asl
		-Min Operating Level	198.7 m asl
		-Reservoir Area	18.5 km2

WATER MANAGEMENT		TAILWATER LEVELS	
-Spillage as % Inflow	0.4 % QM	-Max Level (Design Flood)	24.7 m asl
-Degree of Regulation	87.2 %	-Ave Level (Max Power Rel)	18.5 m asl
-Ave Water Demand	0.0 m3/s	-Min Level (Zero Outflow)	16.7 m asl

POWER CHARACTERISTICS		TRANSMISSION	
-Installed Capacity Factor	2.50	-Transmitted Power	140.0 MVA
-Ave Plant Factor	39.7 %	-Transmission Voltage	220.0 kV
-Ave Head Losses	9.6 m	-No. of Circuits	2
-No. of Turbines	2	-Distance to Feeder Point	64.0 km
-Turbine Type	FRANCIS		

CAPACITY		ENERGY OUTPUT	
-Max Generating Capacity	136.3 MW	-Max Annual Energy Output	639.0 GWh
-Ave Generating Capacity	133.3 MW	-Ave Annual Energy Output	437.8 GWh
-Min Generating Capacity	116.5 MW	-Output in 3rd Driest Year	420.8 GWh
-Guar Generating Capacity	68.4 MW	-Output in 2nd Driest Year	420.8 GWh
-Max Continuous Power	136.3 MW	-Output in Driest Year	420.7 GWh
-Ave Continuous Power	49.9 MW		
-Min Continuous Power	48.0 MW	-Energy per MCM Inflow	490.9 MWh
-Guar Continuous Power	48.0 MW		

COST (Million US$)		CONSTRUCTION	
-Basic Project Cost	173.9	-Man-Years (Local Labour)	13210
-Local Cost Component	11.9 %	-Duration of Construction	5 Yrs
-Foreign Cost Component	88.1 %	-Split-Up over Years	
-Taxes & Govt Charges	0.0 %	/12./23./30./23./12./	
-Annual Costs for OMR	1.5		

SPECIFIC CAPACITY COST (US$/kW)		AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	1650.	-at 8.0 % Discount Rate	4.11
-at 10.0 % Discount Rate	1747.	-at 10.0 % Discount Rate	5.27
-at 12.0 % Discount Rate	1849.	-at 12.0 % Discount Rate	6.58

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	4.35
-at 10.0 % Discount Rate	5.58
-at 12.0 % Discount Rate	6.96

Data for Hydroproject KUKUL ICF= 2.75 Alternative C

HYDROLOGY		
-Data Period	1949-1989	
-Mean Inflow (QM)	30.4	m3/s
-Catchment Area	308.4	km2

RESERVOIR		
-Max Storage	395.6	MCM
-Ave Storage	306.0	MCM
-Min Storage	3.6	MCM
-Max Operating Level	242.0	m asl
-Ave Operating Level	236.3	m asl
-Min Operating Level	198.7	m asl
-Reservoir Area	18.5	km2

WATER MANAGEMENT		
-Spillage as % Inflow	0.2	% QM
-Degree of Regulation	87.1	%
-Ave Water Demand	0.0	m3/s

TAILWATER LEVELS		
-Max Level (Design Flood)	24.7	m asl
-Ave Level (Max Power Rel)	18.5	m asl
-Min Level (Zero Outflow)	16.7	m asl

POWER CHARACTERISTICS		
-Installed Capacity Factor	2.75	
-Ave Plant Factor	36.1	%
-Ave Head L		
-No. of Turbines	2	
-Turbine Type	FRANCIS	

TRANSMISSION		
-Transmitted Power	154.1	MVA
-Transmission Voltage	220.0	kV
-Distance to Feeder Point	64.0	km

CAPACITY		
-Max Generating Capacity	149.9	MW
-Ave Generating Capacity	146.6	MW
-Min Generating Capacity	128.2	MW
-Guar Generating Capacity	135.2	MW
-Max Continuous Power	149.9	MW
-Ave Continuous Power	54.1	MW
-Min Continuous Power	48.0	MW
-Guar Continuous Power	48.0	MW

ENERGY OUTPUT		
-Max Annual Energy Output	649.1	GWh
-Ave Annual Energy Output	474.6	GWh
-Output in 3rd Driest Year	420.4	GWh
-Output in 2nd Driest Year	420.4	GWh
-Output in Driest Year	420.4	GWh
-Energy per MCM Inflow	491.8	MWh

COST (Million US$)		
-Basic Project Cost	181.0	
-Local Cost Component	11.8	%
-Foreign Cost Component	88.2	%
-Taxes & Govt Charges	0.0	%
-Annual Costs for OMR	1.5	

CONSTRUCTION		
-Man-Years (Local Labour)	13720	
-Duration of Construction	5	Yrs
-Split-Up over Years		
/12./23./30./23./12./		

SPECIFIC CAPACITY COST (US$/kW)	
-at 8.0 % Discount Rate	1562.
-at 10.0 % Discount Rate	1654.
-at 12.0 % Discount Rate	1750.

AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	4.27
-at 10.0 % Discount Rate	5.48
-at 12.0 % Discount Rate	6.84

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	4.53
-at 10.0 % Discount Rate	5.81
-at 12.0 % Discount Rate	7.25

Data for Hydroproject KUKUL ICF= 3.00 Alternative C

HYDROLOGY		
-Data Period	1949-1989	
-Mean Inflow (QM)	30.4	m3/s
-Catchment Area	308.4	km2

RESERVOIR		
-Max Storage	395.6	MCM
-Ave Storage	301.1	MCM
-Min Storage	3.6	MCM
-Max Operating Level	242.0	m asl
-Ave Operating Level	235.9	m asl
-Min Operating Level	198.7	m asl
-Reservoir Area	18.5	km2

WATER MANAGEMENT		
-Spillage as % Inflow	0.1	% QM
-Degree of Regulation	87.5	%
-Ave Water Demand	0.0	m3/s

TAILWATER LEVELS		
-Max Level (Design Flood)	24.7	m asl
-Ave Level (Max Power Rel)	18.6	m asl
-Min Level (Zero Outflow)	16.7	m asl

POWER CHARACTERISTICS		
-Installed Capacity Factor	3.00	
-Ave Plant Factor	33.1	%
-Ave Head Losses	9.8	m
-No. of Turbines	2	
-Turbine Type	FRANCIS	

TRANSMISSION		
-Transmitted Power	167.8	MVA
-Transmission Voltage	220.0	kV
-No. of Circuits	2	
-Distance to Feeder Point	64.0	km

CAPACITY		
-Max Generating Capacity	163.3	MW
-Ave Generating Capacity	159.4	MW
-Min Generating Capacity	137.6	MW
-Guar Generating Capacity	146.0	MW
-Max Continuous Power	163.1	MW
-Ave Continuous Power	54.0	MW
-Min Continuous Power	48.1	MW
-Guar Continuous Power	48.1	MW

ENERGY OUTPUT		
-Max Annual Energy Output	650.1	GWh
-Ave Annual Energy Output	473.6	GWh
-Output in 3rd Driest Year	421.4	GWh
-Output in 2nd Driest Year	421.4	GWh
-Output in Driest Year	421.4	GWh
-Energy per MCM Inflow	490.8	MWh

COST (Million US$)		
-Basic Project Cost	187.6	
-Local Cost Component	11.8	%
-Foreign Cost Component	88.2	%
-Taxes & Govt Charges	0.0	%
-Annual Costs for OMR	1.6	

CONSTRUCTION		
-Man-Years (Local Labour)	14150	
-Duration of Construction	5	Yrs
-Split-Up over Years		
/12./23./30./23./12./		

SPECIFIC CAPACITY COST (US$/kW)	
-at 8.0 % Discount Rate	1489.
-at 10.0 % Discount Rate	1577.
-at 12.0 % Discount Rate	1669.

AVERAGE SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	4.44
-at 10.0 % Discount Rate	5.69
-at 12.0 % Discount Rate	7.10

WEIGHED SPECIFIC GENERATION COST (c/kWh)	
-at 8.0 % Discount Rate	4.69
-at 10.0 % Discount Rate	6.02
-at 12.0 % Discount Rate	7.52

EVALS

SUMMARY

Date generated .... 30 SEP 1991

Project	Altern	Inst Cap Fact	Run date	Alternative description	Page

Alternative A - GRAVITY DAM (WEIR), FSL 205 M ASL, POWERHOUSE AT PELENG ROR
B - ROCKFILL DAM, FSL 230 M ASL, POWERHOUSE AT PELENG

Alt	Inst Cap. Fact	Mean Plant Fact	Long Term Flow	Mean Oper Level	Mean Tail Water	Mean Head Loss	Act. Stor Vol.	Degr of Reg.	Long Term Spill	Capacity Mean	Capacity Guar	Energy Mean	Energy Guar	Cost in millions Project	Cost in millions PrVal	Cost in millions OMR	Specific Capacity Cost	Generation costs Average	Generation costs Weighted
	(-)	(%)	(m3/s)	(m)	(m)	(m)	(MCM)	(%)	(%)	(MW)	(MW)	(GWh)	(%)	(US$)	(US$)	($)	($/kW)	(c/kWh)	(c/kWh)
A	1.50	55.8	28.4	205.0	18.0	7.6	19.5	15	17.5	63.7	63.7	311	19	106.3	150.5	0.8	2234	4.87	8.15
A	1.75	50.4	28.4	205.0	18.0	9.5	19.5	15	13.2	73.9	73.9	326	18	111.8	158.3	0.9	2024	4.89	8.25
A	2.00	45.8	28.4	205.0	18.0	8.4	19.5	15	9.9	84.6	84.6	339	17	117.5	166.6	0.9	1860	4.95	8.40
A	2.25	41.9	28.4	205.0	18.0	8.7	19.5	15	7.5	95.0	95.0	348	17	126.6	179.7	1.0	1785	5.20	8.86
A	2.50	38.5	28.4	205.0	18.0	9.0	19.5	15	5.5	105.3	105.3	355	16	131.8	187.3	1.1	1675	5.31	9.08
A	2.75	35.6	28.4	205.0	18.0	8.0	19.5	15	4.1	116.6	116.6	363	16	140.5	199.8	1.2	1614	5.55	9.50
A	3.00	33.0	28.4	205.0	18.0	8.3	19.5	15	3.0	126.9	126.9	367	16	145.5	207.1	1.2	1535	5.69	9.76
B	1.50	63.3	30.4	223.1	18.0	8.0	144.6	82	4.4	74.7	64.1	429	88	141.0	199.6	1.1	2527	4.69	4.96
B	1.75	54.5	30.4	229.0	18.0	8.2	196.2	53	5.9	90.1	89.0	431	56	149.9	212.3	1.2	2228	4.96	6.33
B	2.00	48.9	30.4	229.0	18.0	8.6	196.2	53	3.9	102.8	101.5	440	55	157.5	223.4	1.3	2053	5.11	6.57
B	2.25	44.1	30.4	229.0	18.0	8.9	196.2	53	2.6	115.4	114.0	446	54	163.6	232.2	1.3	1898	5.25	6.78

Note: -Degree of regulation defined as ratio of reservoir outflow exceeded 95. % of time over mean flow
-Installed capacity factor expresses ratio of combined turbine discharge capacity over mean flow
-Guaranteed capacity level is defined as value 95. % of time exceeded
-Mean energy is the mean annual generation in simulation period 1949-1989
-Guaranteed energy level is defined as ratio of continuous power exceeded 95. % of time over mean output
-Weighted generation cost considers only 50. % of non-guaranteed part of continuous power output
-Specific capacity and generation costs are determined at 10.0 % discount rate, using real term costs and generation values
-Cost base for all calculations is Oct 1990

Alternative B - ROCKFILL DAM, FSL 230 M ASL, POWERHOUSE AT PELENG
C - ROCKFILL DAM, FSL 242 M ASL, POWERHOUSE AT PELENG

Alt	Inst Cap. Fact	Mean Plant Fact	Long Term Flow	Mean Oper Level	Mean Tail Water	Mean Head Loss	Act. Stor Vol.	Degr of Req.	Long Term Spill	Capacity Mean	Capacity Guar	Energy Mean	Energy Guar	Cost in millions Project	Cost in millions PrVal	Cost in millions OMR	Specific Capacity Cost	Generation costs Average	Generation costs Weighted
	(-)	(%)	(m3/s)	(m)	(m)	(m)	(MCM)	(%)	(%)	(MW)	(MW)	(GWh)	(%)	(US$)	(US$)	($)	($/kW)	(c/kWh)	(c/kWh)
B	2.50	40.0	30.4	229.0	18.0	7.9	196.2	53	1.8	128.9	127.4	452	54	173.3	246.1	1.4	1800	5.48	7.11
B	2.75	36.6	30.4	229.0	18.0	8.2	196.2	53	1.2	141.6	139.9	455	53	179.5	255.1	1.5	1698	5.65	7.34
B	3.00	33.7	30.4	229.0	18.0	8.1	196.2	53	0.8	154.5	152.7	457	53	186.6	265.4	1.5	1618	5.85	7.61
C	1.50	64.3	30.4	235.3	18.0	7.4	290.0	87	3.1	80.2	73.1	462	93	149.6	211.5	1.1	2498	4.61	4.78
C	1.75	56.0	30.4	235.8	18.0	8.2	297.4	87	1.9	93.6	85.9	468	91	157.8	223.2	1.2	2259	4.81	5.03
C	2.00	49.5	30.4	236.1	18.0	8.6	301.4	87	1.1	106.9	98.5	472	90	165.8	234.8	1.3	2078	5.01	5.29
C	2.25	44.2	30.4	236.1	18.0	8.9	301.2	87	0.6	120.0	110.5	474	89	172.1	243.9	1.4	1920	5.19	5.48
C	2.50	39.9	30.4	236.1	18.0	8.7	301.2	87	0.4	133.5	123.0	476	89	181.3	257.2	1.5	1819	5.45	5.77
C	2.75	36.4	30.4	236.1	18.0	9.0	301.6	87	0.2	146.7	135.2	476	89	187.6	266.4	1.5	1713	5.63	5.97
C	3.00	33.4	30.4	236.2	18.0	8.1	302.8	86	0.1	160.8	148.6	479	88	195.8	278.1	1.6	1631	5.85	6.21

Note:
- Degree of regulation defined as ratio of reservoir outflow exceeded 95. % of time over mean flow
- Installed capacity factor expresses ratio of combined turbine discharge capacity over mean flow
- Guaranteed capacity level is defined as value 95. % of time exceeded
- Mean energy is the mean annual generation in simulation period 1949-1989
- Guaranteed energy level is defined as ratio of continuous power exceeded 95. % of time over mean output
- Weighted generation cost considers only 50. % of non-guaranteed part of continuous power output
- Specific capacity and generation costs are determined at 10.0 % discount rate, using real term costs and generation values
- Cost base for all calculations is Oct 1990

Alternative A - GRAVITY DAM (WEIR), FSL 205 M ASL, POWERHOUSE AT KUKULE ROR
B - ROCKFILL DAM, FSL 230 M ASL, POWERHOUSE AT KUKULE

Alt	Inst Cap. Fact	Mean Plant Fact	Long Term Flow	Mean Oper Level	Mean Tail Water	Mean Head Loss	Act. Stor Vol.	Degr of Reg.	Long Term Spill	Capacity Mean	Capacity Guar	Energy Mean	Energy Guar	Cost in millions Project	Cost in millions PrVal	Cost in millions OMR	Specific Capacity Cost	Generation costs Average	Generation costs Weighted
	(-)	(%)	(m3/s)	(m)	(m)	(m)	(MCM)	(%)	(%)	(MW)	(MW)	(GWh)	(%)	(US$)	(US$)	($)	($/kW)	(c/kWh)	(c/kWh)
A	1.50	55.5	28.4	205.0	18.0	7.6	17.8	15	17.6	63.9	63.4	311	19	94.5	134.6	0.8	1981	4.36	7.28
A	1.75	50.1	28.4	205.0	18.1	8.5	17.8	15	13.3	74.2	73.7	326	18	100.0	142.5	0.9	1806	4.40	7.41
A	2.00	45.5	28.4	205.0	18.2	8.4	17.8	15	10.0	84.8	84.3	339	17	107.4	153.1	0.9	1695	4.55	7.71
A	2.25	41.6	28.4	205.0	18.3	8.7	17.8	15	7.5	95.3	94.7	348	17	114.8	163.9	1.0	1614	4.74	8.07
A	2.50	38.3	28.4	205.0	18.4	9.0	17.8	15	5.5	105.7	105.0	355	16	120.0	171.4	1.1	1520	4.86	8.30
A	2.75	35.3	28.4	205.0	18.5	7.9	17.8	15	4.1	117.0	116.3	363	16	128.7	183.9	1.2	1473	5.10	8.73
A	3.00	32.8	28.4	205.0	18.6	8.2	17.8	15	3.0	127.4	126.6	367	16	133.6	191.1	1.2	1405	5.25	9.00
B	1.50	63.0	30.4	223.0	18.0	8.2	144.9	83	4.2	74.9	64.2	429	88	133.7	190.2	1.1	2392	4.47	4.72
B	1.75	54.3	30.4	229.0	18.2	8.9	197.8	53	5.8	90.2	88.7	430	56	142.1	202.2	1.2	2110	4.74	6.05
B	2.00	48.6	30.4	229.0	18.3	9.3	197.8	53	3.8	102.9	101.1	438	55	149.9	213.5	1.3	1952	4.91	6.31
B	2.25	43.8	30.4	229.0	18.4	9.7	197.8	53	2.5	115.5	113.5	444	54	156.2	222.6	1.4	1811	5.05	6.53

Note: -Degree of regulation defined as ratio of reservoir outflow exceeded 95. % of time over mean flow
-Installed capacity factor expresses ratio of combined turbine discharge capacity over mean flow
-Guaranteed capacity level is defined as value 95. % of time exceeded
-Mean energy is the mean annual generation in simulation period 1949-1989
-Guaranteed energy level is defined as ratio of continuous power exceeded 95. % of time over mean output
-Weighted generation cost considers only 50. % of non-guaranteed part of continuous power output
-Specific capacity and generation costs are determined at 10.0 % discount rate, using real term costs and generation values
-Cost base for all calculations is Oct 1990

Alternative B - ROCKFILL DAM, FSL 230 M ASL, POWERHOUSE AT KUKULE
C - ROCKFILL DAM, FSL 242 M ASL, POWERHOUSE AT KUKULE

Alt	Inst Cap. Fact	Mean Plant Fact	Long Term Flow	Mean Oper Level	Mean Tail Water	Mean Head Loss	Act Stor Vol.	Degr of Reg.	Long Term Spill	Capacity Mean	Capacity Guar	Energy Mean	Energy Guar	Cost in millions Project	Cost in millions PrVal	Cost in millions OMR	Specific Capacity Cost	Generation costs Average	Generation costs Weighted
	(-)	(%)	(m3/s)	(m)	(m)	(m)	(MCM)	(%)	(%)	(MW)	(MW)	(GWh)	(%)	(US$)	(US$)	($)	($/kW)	(c/kWh)	(c/kWh)
B	2.50	39.8	30.4	229.0	18.5	8.6	197.8	53	1.8	129.0	126.8	450	54	166.2	237.0	1.5	1725	5.31	6.88
B	2.75	36.4	30.4	229.0	18.5	8.6	197.8	53	1.2	141.9	139.4	453	53	173.2	247.1	1.5	1635	5.50	7.14
B	3.00	33.5	30.4	229.0	18.6	8.9	197.8	53	0.8	154.6	151.8	454	53	179.7	256.4	1.6	1557	5.69	7.41
C	1.50	64.0	30.4	235.4	18.0	8.2	293.6	87	2.0	80.2	73.2	461	93	141.5	200.9	1.1	2363	4.39	4.55
C	1.75	55.8	30.4	236.3	18.2	8.9	306.3	87	2.0	93.7	86.6	467	90	150.1	213.2	1.2	2144	4.60	4.83
C	2.00	49.2	30.4	236.0	18.3	9.3	301.9	87	1.1	106.7	97.8	470	90	158.2	225.0	1.3	1987	4.83	5.08
C	2.25	44.0	30.4	236.3	18.4	9.7	306.5	87	0.6	119.9	110.7	472	89	164.7	234.3	1.4	1838°	5.00	5.29
C	2.50	39.7	30.4	236.2	18.5	9.6	305.5	87	0.4	133.3	122.7	473	89	173.9	247.5	1.5	1747	5.27	5.58
C	2.75	36.1	30.4	236.3	18.5	9.6	306.0	87	0.2	146.6	135.2	474	88	181.0	257.9	1.5	1653	5.48	5.81
C	3.00	33.2	30.4	236.3	18.6	8.9	306.4	87	0.1	160.4	148.1	476	88	188.8	269.1	1.6	1576	5.70	6.04

Note: -Degree of regulation defined as ratio of reservoir outflow exceeded 95. % of time over mean flow
-Installed capacity factor expresses ratio of combined turbine discharge capacity over mean flow
-Guaranteed capacity level is defined as value 95. % of time exceeded
-Mean energy is the mean annual generation in simulation period 1949-1989
-Guaranteed energy level is defined as ratio of continuous power exceeded 95. % of time over mean output
-Weighted generation cost considers only 50. % of non-guaranteed part of continuous power output
-Specific capacity and generation costs are determined at 10.0 % discount rate, using real term costs and generation values
-Cost base for all calculations is Oct 1990

KUKULE COST ESTIMATES FOR PROJECT OPTIMIZATION

October 1991

Annex 4

CASE A
F.S.L = 205.0 masl
SETTLEMENT COST = 0.00 million US$

ICF	TOTAL COST ALT P	TOTAL COST ALT K	SPECIFIC COST P(AVG)	SPECIFIC COST P(WTG)	SPECIFIC COST K(AVG)	SPECIFIC COST K(WTG)	SPECIFIC COST (INC SETTLEMENT) P(AVG)	SPECIFIC COST (INC SETTLEMENT) P(WTG)	SPECIFIC COST (INC SETTLEMENT) K(AVG)	SPECIFIC COST (INC SETTLEMENT) K(WTG)
1.00										
1.25										
1.50	106.30	94.50	4.87	8.15	4.36	7.28	4.87	8.15	4.36	7.28
1.75	111.80	100.00	4.89	8.25	4.40	7.41	4.89	8.25	4.40	7.41
2.00	117.50	107.40	4.95	8.40	4.55	7.71	4.95	8.40	4.55	7.71
2.25	126.60	114.80	5.20	8.86	4.74	8.07	5.20	8.86	4.74	8.07
2.50	131.80	120.00	5.31	9.08	4.86	8.30	5.31	9.08	4.86	8.30
2.75	140.50	128.70	5.55	9.50	5.10	8.73	5.55	9.50	5.10	8.73
3.00	145.50	133.60	5.69	9.76	5.25	9.00	5.69	9.76	5.25	9.00

CASE B
F.S.L = 230.0 masl
SETTLEMENT COST = 15.12 million US$ (14.00 * 1.08)

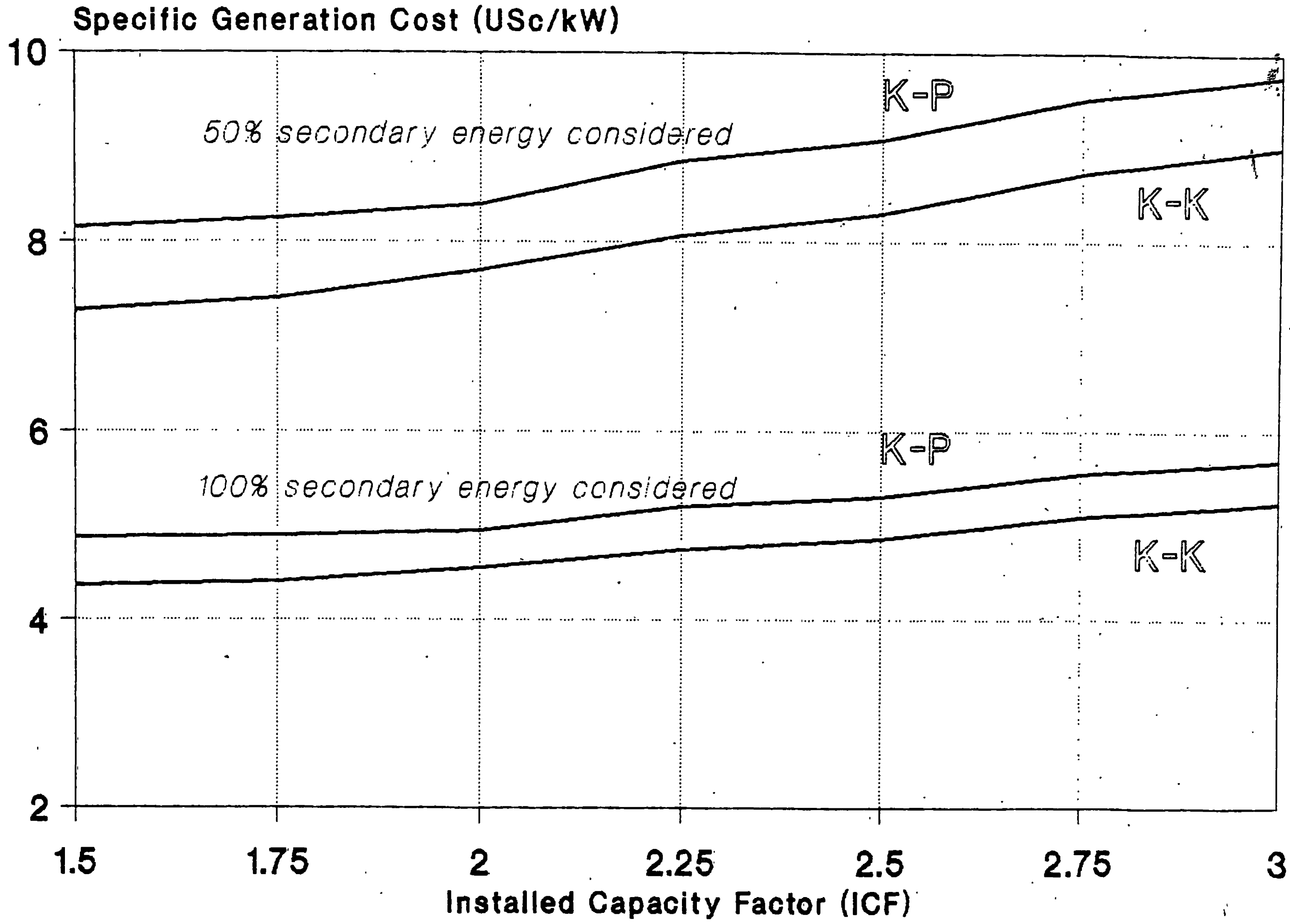
ICF	TOTAL COST ALT P	TOTAL COST ALT K	SPECIFIC COST P(AVG)	SPECIFIC COST P(WTG)	SPECIFIC COST K(AVG)	SPECIFIC COST K(WTG)	SPECIFIC COST (INC SETTLEMENT) P(AVG)	SPECIFIC COST (INC SETTLEMENT) P(WTG)	SPECIFIC COST (INC SETTLEMENT) K(AVG)	SPECIFIC COST (INC SETTLEMENT) K(WTG)
1.00										
1.25										
1.50	141.00	133.70	4.69	4.96	4.47	4.72	5.19	5.49	4.98	5.25
1.75	149.90	142.10	4.96	6.33	4.74	6.05	5.46	6.97	5.24	6.69
2.00	157.50	149.90	5.11	6.57	4.91	6.31	5.60	7.20	5.41	6.95
2.25	163.60	156.20	5.25	6.78	5.05	6.53	5.74	7.41	5.54	7.16
2.50	173.30	166.20	5.48	7.11	5.31	6.88	5.96	7.73	5.79	7.51
2.75	179.50	173.20	5.65	7.34	5.50	7.14	6.13	7.96	5.98	7.76
3.00	186.60	179.70	5.85	7.61	5.69	7.41	6.32	8.23	6.17	8.03

CASE C
F.S.L = 242.0 masl
SETTLEMENT COST = 21.60 million US$ (20.00 * 1.08)

ICF	TOTAL COST ALT P	TOTAL COST ALT K	SPECIFIC COST P(AVG)	SPECIFIC COST P(WTG)	SPECIFIC COST K(AVG)	SPECIFIC COST K(WTG)	SPECIFIC COST (INC SETTLEMENT) P(AVG)	SPECIFIC COST (INC SETTLEMENT) P(WTG)	SPECIFIC COST (INC SETTLEMENT) K(AVG)	SPECIFIC COST (INC SETTLEMENT) K(WTG)
1.00										
1.25										
1.50	149.60	141.50	4.61	4.78	4.39	4.55	5.28	5.47	5.06	5.24
1.75	157.80	150.10	4.81	5.03	4.60	4.83	5.47	5.72	5.26	5.53
2.00	165.80	158.20	5.01	5.29	4.83	5.08	5.66	5.98	5.49	5.77
2.25	172.10	164.70	5.19	5.48	5.00	5.29	5.84	6.17	5.66	5.98
2.50	181.30	173.90	5.45	5.77	5.27	5.58	6.10	6.46	5.92	6.27
2.75	187.60	181.00	5.63	5.97	5.48	5.81	6.28	6.66	6.13	6.50
3.00	195.80	188.80	5.85	6.21	5.70	6.04	6.50	6.90	6.35	6.73

Generation Cost Comparison

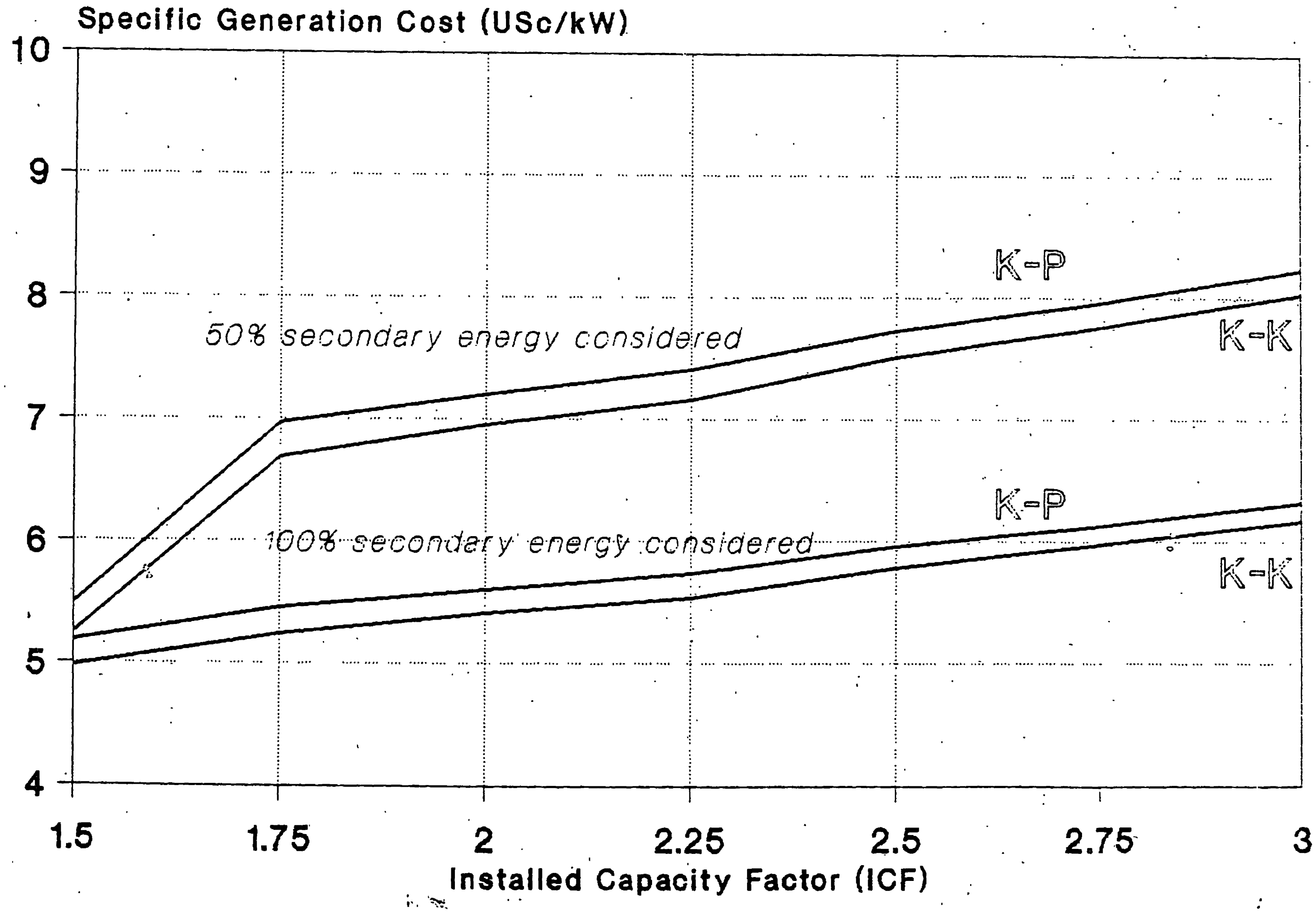
Kukule-P vs Kukule-K for FSL 205 m



EVALS runs of 01 Oct 1991

Generation Cost Comparison

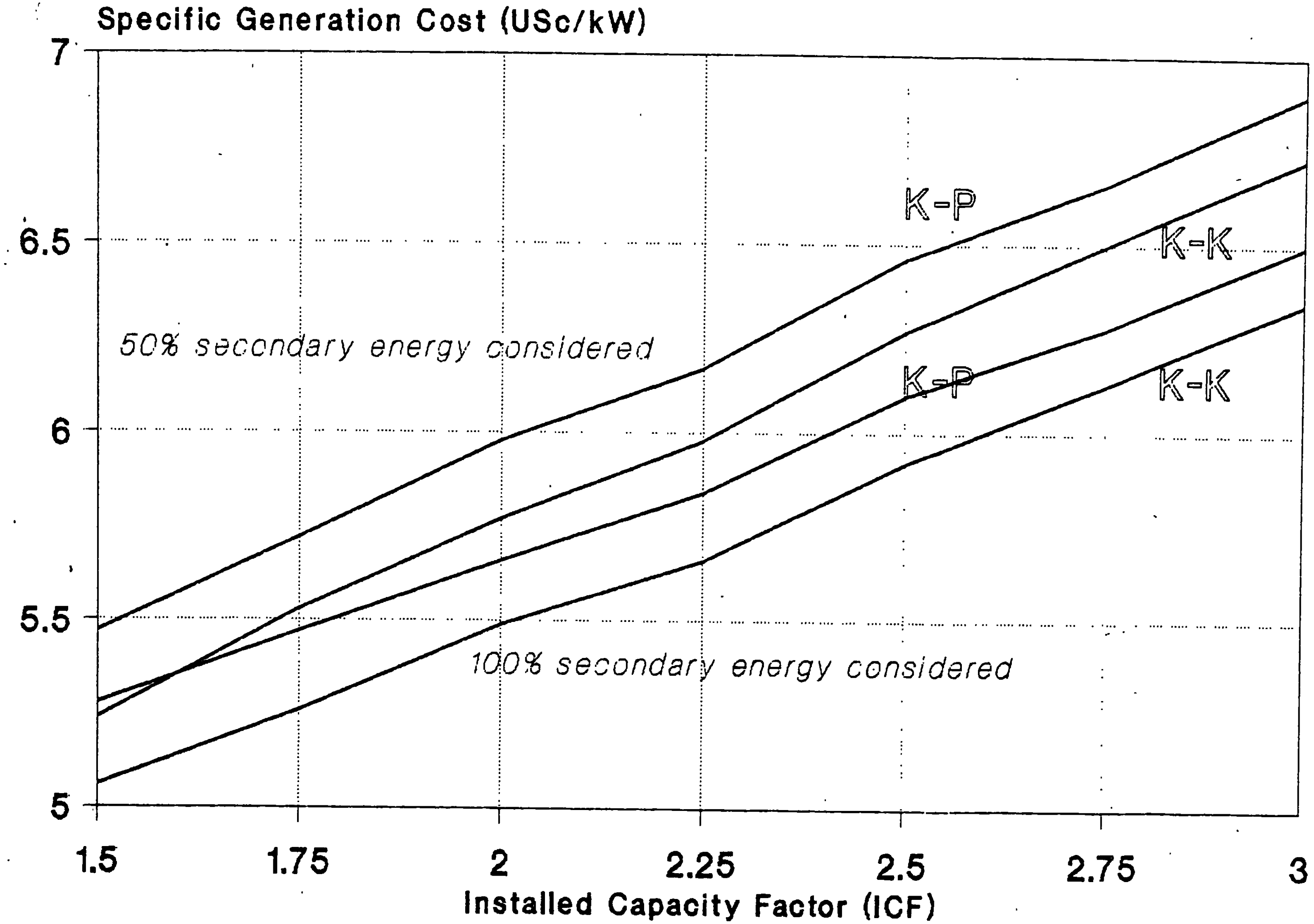
Kukule-P vs Kukule-K for FSL 230 m



EVALS runs of 01 Oct 1991

Generation Cost Comparison

Kukule-P vs Kukule-K for FSL 242 m



EVALS runs of 01 Oct 1991

ANNEX C of 6A.3

RESULTS OF SYSTEM OPERATION ANALYSIS

Included in this annex are detailed simulation results of system operation with SYSIM, as summarized in Section 5.4.4, for the :

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Execution  on 12/10/  91  at  12.44. 0   :   Program revision date  -   11/10/91
===============================================================================

 ******************************************************************************
 *     FILE SYSIM.RD RUN DATA FOR PROGRAM SYSIM - SRI LANKA REV. 10/10/91     *
 *  MP IRRIGATION DEMAND FORECASTS FOR YEAR 1995 :CEB POWER DEMAND FOR 1998   *
 *            10th October 1991          Kukule Feasibility Study             *
 ******************************************************************************
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Reservoir (Power + Irr)	Maximum storage (MCM)	Minimum storage (MCM)	Active storage (MCM)	Initial content (MCM) (80% of max. storage)	Maximum release m3/s (Turbine discharge)
1 KOTMALE	172.60	22.00	150.60	142.48	114.00
2 VICTORIA	721.20	34.00	687.20	583.76	135.00
3 RANDENIGALA	875.00	295.00	580.00	759.00	180.00
4 RANTEMBE	20.97	4.32	16.65	17.64	180.00
7 BOWATENNA	49.90	16.70	33.20	43.26	90.00
8 KAL/DAM/KAN	159.40	14.40	145.00	130:40	-1.00
10 PARAKRAMA SM	134.45	31.45	103.00	113.85	-1.00
11 MIN/GIRI TK	157.92	9.26	148.66	128.19	-1.00
12 KAUDULLA	128.28	25.43	102.85	107.71	-1.00
13 KANTALAI/VEN	160.35	3.11	157.24	128.90	-1.00
14 MADURU OYA	478.00	0.00	478.00	382.40	-1.00
15 ULHIT/RAT	145.78	99.97	45.81	136.62	-1.00
17 MOUSAKELLE	123.40	2.96	120.44	99.31	36.00
18 CASTLEREIGH	44.80	3.82	40.98	36.60	29.73
20 SAMANALAWEWA	278.00	60.00	218.00	234.40	44.00
	-------	-------	-------	-------	
TOTALS :	3650.05	622.42	3027.63	3044.52	

Reference reservoir and monthly adjustment for use in percentage fullness allocation procedure :
(Release rule curve)

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1 KOTMALE	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2 VICTORIA	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3 RANDENIGALA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4 RANTEMBE	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
7 BOWATENNA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
8 KAL/DAM/KAN	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10 PARAKRAMA SM	2	5.00	3.00	2.00	1.00	0.90	0.70	0.50	0.50	0.50	0.90	1.00	3.00
11 MIN/GIRI TK	2	1.00	0.50	0.01	0.01	0.01	0.01	0.01	0.01	0.01	2.00	3.00	4.00
12 KAUDULLA	2	7.00	1.00	0.80	0.80	0.80	0.80	0.80	0.80	1.00	12.00	15.00	15.00
13 KANTALAI/VEN	2	2.00	1.00	0.20	0.20	0.20	0.15	0.15	0.15	1.00	2.00	5.00	5.00
14 MADURU OYA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
15 ULHIT/RAT	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
17 MOUSAKELLE	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18 CASTLEREIGH	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20 SAMANALAWEWA	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Hydroelectric plant		Installed capacity (MW)	Available capacity (MW) (Derated for maintenance)	~~ROR cut-off flow (m3/s)~~ Nos of turbine	~~ROR cut-off slope~~
1	KOTMALE	201.00	177.38	3.00	1.00
2	VICTORIA	210.00	185.50	3.00	1.00
3	RANDENIGALA	127.20	112.36	2.00	1.00
4	RANTEMBE	49.00	45.16	2.00	1.00
7	BOWATENNA	40.00	38.87	2.00	1.00
8	UKUWELA	38.00	37.24	2.00	1.00
10	CANYON	60.00	55.40	2.00	1.00
11	NEW LAXAPANA	100.00	88.33	2.00	1.00
12	WIMALASUREND	50.00	46.17	2.00	1.00
13	OLD LAXAPANA	50.00	45.13	5.00	1.00
14	POLIPITIYA	75.00	66.25	2.00	1.00
16	SAMANALAWEWA	120.00	110.80	2.00	1.00
50	BROADLANDS	40.00	36.87	2.00	1.00
		-------	-------		
Totals :		1160.20	1045.45		

Thermal plant fixed data from files : sexsi.fuel (fuel); wasp.texist (existing and committed plant); wasp.therm (new plant)

Thermal plant		Installed capacity MW	No. of units	Unit cost $ US /MWh	Availability factor	Forced outage rate per cent	Min. stable load MW	Cost at M.S.L. $ US /MWh
4	KELANITIS ST	50.00	2	33.14	0.8906	20.00	0.00	-1.00
5	DS RFO4*20MW	20.00	1	29.66	0.9176	15.00	0.00	-1.00
6	SAPUGAS EXT.	40.00	2	29.26	0.9176	15.00	0.00	-1.00
7	SAPUGASKANDA	72.00	4	29.26	0.8355	25.00	0.00	-1.00
8	GT DO 22MW	44.00	2	64.48	0.9176	15.00	0.00	-1.00
9	KELANITIS GT	108.00	6	78.94	0.8904	20.00	0.00	-1.00

(Derated for scheduled outage)

Maintenance file : wasp...

Monthly plant availabilities after planned and forced outages

			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4	KELANITIS ST	1	0.000	0.544	0.800	0.800	0.800	0.800	[illegible]	0.800	0.800	0.800	0.800	0.800
4	KELANITIS ST	2	0.800	0.800	0.544	0.000	0.800	0.800	[illegible]	0.800	0.800	0.800	0.800	0.800
5	DS RFO4*20MW	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
6	SAPUGAS EXT.	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
6	SAPUGAS EXT.	2	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
7	SAPUGASKANDA	1	0.750	0.750	0.750	0.000	0.022	0.750	0.750	0.750	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	2	0.750	0.750	0.750	0.750	0.750	0.022	0.000	0.750	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	3	0.750	0.750	0.750	0.750	0.750	0.750	0.000	0.045	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	4	0.000	0.000	0.729	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
8	GT DO 22MW	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
8	GT DO 22MW	2	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
9	KELANITIS GT	1	0.800	0.256	0.256	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	2	0.800	0.800	0.800	0.000	0.544	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	3	0.800	0.800	0.544	0.000	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	4	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.752	0.000	0.592	0.800	0.800
9	KELANITIS GT	5	0.800	0.256	0.256	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	6	0.800	0.800	0.800	0.800	0.800	0.560	0.000	0.800	0.800	0.800	0.800	0.800
Total (MW) :.			149.55	229.32	237.80	206.50	251.10	251.38	227.40	255.25	254.40	265.06	268.80	268.80
Maximum unit capacity (MW) :			20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00

Generation demands

Name of Demand File: wasp.gp91 Year: 1998

BASE SCENARIO - SRI LANKA POWER SYSTEM

Load (MW) as Function of Relative Duration

Season	Hours	Dur: 0.00	0.02	0.07	0.15	0.50	0.85	0.95	1.00	1.00
1	744.	964.	926.	851.	671.	566.	432.	394.	336.	0.
2	672.	980.	941.	865.	682.	566.	439.	390.	361.	0.
3	744.	982.	943.	867.	693.	596.	450.	421.	284.	0.
4	720.	983.	944.	858.	703.	587.	431.	362.	313.	0.
5	744.	988.	949.	882.	697.	580.	443.	404.	255.	0.
6	720.	1001.	952.	873.	696.	598.	449.	409.	349.	0.
7	744.	999.	960.	882.	706.	617.	469.	429.	379.	0.
8	744.	1003.	963.	885.	698.	589.	450.	430.	319.	0.
9	720.	1012.	982.	893.	714.	605.	464.	434.	383.	0.
10	744.	1039.	988.	887.	744.	641.	466.	446.	394.	0.
11	720.	1040.	999.	887.	745.	611.	456.	415.	342.	0.
12	744.	1036.	995.	904.	752.	609.	465.	423.	361.	0.

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Energy per day	GWh	13.8021	13.9361	14.3279	14.0974	14.1579	14.3831	14.7785	14.3713	14.7439	15.2465	14.9683	14.9750
Energy per month	GWh	427.87	390.21	444.16	422.92	438.89	431.49	458.13	445.51	442.32	472.64	449.05	464.23

~~Restriction reduction factors :~~

~~Power~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~
~~Energy~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~	~~0.90~~

~~Demand index exponent = 1.50 ; Demand index factor = 1.00 ; Deficit cost = 0.00 mills/KWh ; Excess value = 0.00 mills/KWh~~

INFLOW SERIES
=============

AVERAGE FLOWS IN m3/s

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 KOTMALE/KOTM	44.33	39.44	26.73	17.85	10.84	8.66	13.89	24.23	43.83	48.90	44.95	40.46	30.34
2 MAHAW/POLGOL	55.24	54.76	34.79	14.64	8.92	7.78	18.71	34.58	57.07	53.48	46.56	44.53	35.92
3 MAHAW/VICTOR	27.29	39.96	42.70	31.35	20.56	11.29	15.75	19.28	19.68	20.14	19.93	19.39	23.86
4 MAHAW/RANDEN	17.14	30.15	44.11	40.89	23.30	10.11	10.09	10.35	6.25	7.46	7.91	8.42	18.02
5 MAHAW/RANTEM	18.68	27.38	33.66	34.01	20.76	15.86	22.09	17.25	11.05	10.45	8.57	9.62	19.12
6 MAHAW/AMBAN	45.39	72.38	155.99	177.34	112.39	70.24	51.13	36.26	24.09	18.31	20.29	24.91	67.39
7 BOWATENNA	12.89	20.83	32.97	25.57	15.45	10.97	11.43	8.21	6.30	5.91	5.22	5.33	13.70
8 AMBAN/ELAHER	8.61	16.45	31.85	30.04	15.92	10.59	9.18	6.14	4.19	4.54	3.82	2.52	12.24
9 AMBAN/AMGAM	8.00	23.50	79.59	73.14	52.67	23.67	16.53	5.95	3.99	4.30	4.36	5.15	25.06
10 MOUSAKELLE	16.19	13.22	6.96	4.17	3.45	3.99	7.09	17.44	24.83	19.24	16.29	15.90	12.48
11 CANYON	3.04	2.41	1.24	0.78	0.68	0.81	1.36	3.33	4.77	3.80	3.33	3.28	2.40
12 LAXAPANA PND	3.71	2.92	1.47	0.97	0.93	0.95	1.55	3.51	5.17	4.46	3.84	3.73	2.75
13 CASTLEREIGH	9.94	8.58	5.36	3.24	2.58	2.98	5.18	9.96	13.47	10.53	8.76	9.09	7.47
14 NORTON	3.24	2.66	1.37	0.96	0.35	0.88	1.35	3.06	4.96	4.10	3.50	3.31	2.52
15 KAL/DAM/KAN	6.86	13.83	17.23	5.22	2.67	2.71	6.88	2.56	0.15	0.36	0.22	0.97	4.97
17 MIN/GI	2.77	7.77	11.64	4.21	2.44	1.56	2.87	1.30	0.01	0.26	0.12	0.47	2.95
18 ALUT	3.09	9.93	14.29	4.99	2.63	1.47	2.80	1.57	0.03	0.43	0.26	0.70	3.52
19 KANTALAI/VEN	2.02	6.34	9.32	3.12	2.01	1.21	2.06	0.95	0.01	0.19	0.10	0.36	2.31
20 PARAKRAMA SM	0.68	2.23	3.77	1.36	0.94	0.50	0.71	0.31	0.00	0.09	0.05	0.18	0.90
21 MADURU OYA	5.27	18.50	38.72	26.72	16.14	6.41	5.58	4.25	1.12	1.00	1.09	1.53	10.53
22 ULHIT/RAT	3.24	16.01	25.88	17.68	9.40	3.17	4.95	2.05	0.06	0.28	0.47	0.67	6.99
23 MINIPE L.B.	3.29	13.50	23.05	14.24	7.66	3.25	4.30	1.91	0.17	0.30	0.35	0.58	6.05
24 SAMANALA	15.53	25.95	22.99	15.70	12.09	17.17	26.39	22.49	16.01	10.53	9.08	10.43	17.03
50 BROADLANDS	10.93	9.15	5.21	3.26	2.67	3.02	5.17	11.09	15.79	12.59	10.56	10.69	8.34
TOTALS :	327.38	477.86	670.91	551.74	353.83	219.25	246.03	248.01	262.93	241.67	219.64	223.22	336.87

IRRIGATION AREA
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AVERAGE WATER DEMANDS FOR YEAR 1995 , CASE CB IN m3/s

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 SYSTEM H KK	18.99	33.55	25.51	37.79	34.57	3.05	11.61	28.22	34.81	31.12	12.65	0.26	22.68
2 SYSTEM G	1.04	4.11	2.20	2.38	4.36	1.81	1.08	7.43	9.93	7.73	4.56	0.35	3.91
3 SYSTEM D1 MG	2.21	8.85	5.12	6.64	10.78	4.49	2.48	16.10	21.61	15.96	9.54	0.70	8.71
4 SYSTEM D1 KD	0.67	2.68	1.55	2.01	3.26	1.36	0.75	4.87	6.54	4.83	2.89	0.21	2.63
5 SYSTEM D1 KT	4.32	4.81	1.41	5.91	5.66	3.10	6.56	13.68	15.60	11.59	6.68	3.62	6.91
6 SYSTEM D2	1.87	7.45	4.27	5.06	8.10	3.59	2.06	13.83	18.30	13.58	8.08	0.58	7.23
7 SYSTEM C	12.97	16.10	5.54	8.71	13.75	2.83	14.10	34.00	38.89	32.56	12.94	2.16	16.21
8 SYSTEM B	44.90	27.84	13.74	30.62	14.04	9.95	55.89	72.13	76.35	42.39	4.53	9.10	33.46
9 SYSTEM E	1.12	4.00	2.26	1.56	3.87	2.15	1.17	8.57	11.92	9.85	5.55	0.44	4.37
10 SYSTEM A	1.30	5.14	3.16	4.00	6.34	2.68	1.56	9.52	12.50	9.04	5.01	0.38	5.05
11 SYSTEM MH	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	0.00	0.00	0.00	4.30	3.23
12 SYSTEM IH	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09
14 SMWEWA SM	1.65	0.85	1.25	1.85	2.25	0.95	1.35	1.95	2.65	2.45	2.20	0.00	1.62
TOTALS :	97.43	121.77	72.41	112.92	113.36	42.35	105.00	216.70	251.18	183.19	76.71	24.20	118.10

DEMAND FORECAST FOR YEAR 1998 : SIMULATION PERIOD FROM 1949 TO 1988

MINIMUM THERMAL (MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

GROSS TOTAL SYSTEM STORAGE VOLUMES IN Mm3 BELOW WHICH THE FOLLOWING OPERATING REGIMES APPLY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MAX. HYDRO	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
KL.ST. 50 MW	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NEWDL.1 MW	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NS.DL. 40 MW	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
ES.DL. 80 MW	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NEW GT.22 MW	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95
	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)
KL.GT.120 MW	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95
	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)
WATER RESTNS	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ELECT RESTNS	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

FIGURES IN PARENTHESIS INDICATE FRACTION OF ACTIVE STORAGE

SYSIM rev. 11/10/91 : Run date 10/12 91 : Execution start 12:44: 0 : Finish 1˜ 59:29 : 480 Simulations needing 1.70 secs. each

WATER RESOURCE SUMMARY

RESERVOIR

	Initial content Mm3	Total inflow Mm3	Total release Mm3	Total spill Mm3	Total seepage Mm3	Total evaptn. Mm3	Maximum content Mm3	Average content Mm3	Minimum content Mm3	Final content Mm3	Overall balance Mm3
1 KOTMALE	142.5	38432.9	37879.1	339.8	0.0	183.9	172.6*	142.6	22.0*	172.6	0.0
2 VICTORIA	583.8	75597.8	69407.0	6085.1	0.0	486.8	721.2*	278.2	34.0*	202.6	-0.1
3 RANDENIGALA	759.0	98247.9	94053.9	2963.2	0.0	1125.8	875.0*	767.4	324.6	864.1	-0.1
4 PANTEMBE	17.6	121158.8	114271.1	6771.5	0.0	113.1	21.0*	20.7	20.6	20.6	0.0
7 BOWATENNA	43.3	55555.3	55361.8	0.6	0.0	219.4	49.9*	37.3	16.7*	16.7	0.0
8 KAL/DAM/KAN	130.4	33807.5	30640.9	715.4	0.0	2481.2	159.4*	98.2	14.4*	100.4	0.0
10 PARAKRAMA SM	113.8	11511.3	9095.2	341.5	0.0	2106.0	134.4*	105.0	31.4*	82.5	0.0
11 MIN/GIRI TK	128.2	28153.1	25236.6	930.4	0.0	2093.9	157.9*	107.1	9.3*	20.4	0.0
12 KAUDULLA	107.7	6707.8	3313.6	1366.1	0.0	2083.7	129.3*	97.5	25.4*	52.1	0.0
13 KANTALAI/VEN	128.9	13787.5	8654.3	3169.9	0.0	2046.6	150.4*	101.7	3.1*	45.6	0.0
14 MADURU OYA	382.4	48586.1	42208.3	3478.6	0.0	2973.8	478.0*	340.2	0.0*	307.8	0.0
15 ULHIT/RAT	136.6	60090.1	55635.2	3164.4	0.0	1286.5	145.8*	130.6	100.0*	140.7	0.0
17 MOUSAKELLE	99.3	15799.3	11944.1	3673.2	0.0	157.8	123.4*	63.5	3.0*	123.4	0.0
18 CASTLEREIGH	36.6	9457.7	7016.9	2360.2	0.0	72.4	44.8*	24.4	3.9*	44.8	0.0
20 SAMANALAWEWA	234.4	21506.5	20147.3	1124.7	0.0	265.8	278.0*	157.0	60.0*	203.1	0.0

Minimum recorded total system storage = 708.11 Total system inflow = 425503.4

CONVEYANCE

	Maximum capacity m3/s	Average flow m3/s	Minimum required m3/s	Total inflow Mm3	Total loss Mm3	Total supply Mm3 (Irrigation)	Total outflow Mm3	Balance Mm3	Average utilization %
1 POLGOLLA DIV	56.6	30.3	0.0	38268.5	0.0	0.0	38268.5	0.000	53.6
2 BOWAT-KDK	28.3	26.4	0.0	33239.2	1662.0	4060.7	27516.6	-0.097	93.0
3 KDK-SYSTEM H	1000.0	22.8	0.0	28705.4	0.0	27990.0	715.4	-0.001	2.3
4 ELAHERA-DIYA	42.5	24.2	0.0	30525.7	0.0	4821.8	25703.9	-0.008	56.7
5 DIYA-MIN/GIR	42.5	20.4	0.0	25703.9	1285.2	0.0	24418.7	0.011	47.9
6 MIN/GI-SYSD1	1000.0	9.4	0.0	11833.4	0.0	10903.0	930.4	0.002	0.9
7 MIN/GI-ALUT	34.0	11.4	2.5	14333.6	0.0	0.0	14333.6	0.000	33.4
8 KAU-SYS D1	1000.0	3.7	0.0	4679.7	0.0	3313.6	1366.1	0.004	0.4
9 ALUT-KANTA	34.0	9.6	0.0	12076.9	1207.7	0.0	10869.2	0.000	28.1
10 KANTA-SYS D1	1000.0	9.4	0.0	11824.2	0.0	8654.3	3169.9	-0.003	0.9
11 ANGAM-PARAK	14.2	8.7	0.0	10916.9	545.8	0.0	10371.1	-0.012	60.9
12 PARAK-SYS D2	1000.0	7.5	0.0	9436.7	0.0	9095.2	341.5	0.002	0.7
13 MINI-ULH/RAT	64.0	40.6	0.0	51264.2	0.0	0.0	51264.2	0.000	63.5
14 UL/RAT SYS C	1000.0	16.1	0.0	20344.7	0.0	20344.7	0.0	-0.003	1.6
15 UL/RAT-MADUR	39.1	28.0	0.0	35290.5	0.0	0.0	35290.5	0.000	71.3
16 MADUR-SYS B	1000.0	33.5	0.0	42208.3	0.0	42208.3	0.0	0.007	3.3
17 MINI-TALA	18.4	4.2	1.6	5328.2	0.0	0.0	5328.2	0.000	22.7
18 TALA-SYS E	1000.0	7.3	0.0	9149.9	0.0	5522.8	3627.1	-0.004	0.7
19 ROTA-SYS A	1000.0	135.5	0.0	170895.5	0.0	6366.5	164528.9	0.066	13.5
20 WIMA-OLDLAX	15.0	9.2	0.0	11586.0	0.0	0.0	11586.0	0.000	61.2
21 KDK-SYS IH	35.4	2.1	2.1	2650.8	0.0	2638.2	12.6	0.001	5.9
23 SAMWEWA SM	1000.0	1.6	0.0	2040.1	0.0	2040.1	0.0	0.000	0.2

WATER DEMANDS FOR YEAR 1995 : CASE : CB

(MCM/40 years)

	Demand factor	Total demand	Restricted demand	Total supply	Restricted deficit	Total deficit
11 SYSTEM MH	1.0000	4060.71	4060.71	4060.71	0.00	0.00
1 SYSTEM H KK	1.0000	28548.25	28548.25	27990.03	558.22	558.22
2 SYSTEM G	1.0000	4937.85	4937.85	4821.81	116.04	116.04
3 SYSTEM D1 MG	1.0000	10975.63	10975.63	10902.98	72.65	72.65
4 SYSTEM D1 KD	1.0000	3320.60	3320.60	3313.59	7.01	7.01
5 SYSTEM D1 KT	1.0000	8723.38	8723.38	8654.30	69.08	69.08
6 SYSTEM D2	1.0000	9120.91	9120.91	9095.18	25.73	25.73
7 SYSTEM C	1.0000	20467.52	20467.52	20344.70	122.82	122.82
8 SYSTEM B	1.0000	42297.11	42297.11	42208.27	88.84	88.84
9 SYSTEM E	1.0000	5522.80	5522.80	5522.80	0.00	0.00
10 SYSTEM A	1.0000	6368.04	6368.04	6366.53	1.51	1.51
12 SYSTEM IH	1.0000	2638.22	2638.22	2638.22	0.00	0.00
14 SMWEWA SM	1.0000	2040.29	2040.29	2040.10	0.19	0.19

Deficit occurrences as percentage of monthly demands

% Intervals	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Total
SYSTEM H KK	4	4	5	3	6	0	0	0	0	0	22
SYSTEM G	0	0	0	0	0	1	2	3	1	0	7
SYSTEM D1 MG	1	2	2	0	0	0	0	0	1	0	6
SYSTEM D1 KD	0	1	1	1	0	0	0	1	0	0	4
SYSTEM D1 KT	12	2	1	0	0	1	0	0	0	1	17
SYSTEM D2	12	0	0	0	0	0	0	0	0	0	12
SYSTEM C	1	0	0	1	0	0	0	0	0	1	3
SYSTEM B	1	0	1	1	0	0	0	1	0	0	4
SYSTEM E	0	0	0	0	0	0	0	0	0	0	0
SYSTEM A	1	0	0	0	0	0	0	0	0	0	1
SYSTEM MH	0	0	0	0	0	0	0	0	0	0	0
SYSTEM IH	0	0	0	0	0	0	0	0	0	0	0
SMWEWA SM	1	0	0	0	0	0	0	0	0	0	1

Number of restriction months = 0 : Total water deficit = 1062.09 Mm3 : Average = 26.55 Mm3/a : Weighted value =1401585.25 Mm3

GENERATION SUMMARY

(Dispatch simulation by DRATE)

HYDRO	Installed capacity (MW)	Available capacity (MW)	Bypass flow (Mm3) (Spillout)	Turbine discharge (Mm3)	Average power (MW)	Energy generated (GWh/a)	Excess energy (GWh/a)	Average plant factor
1 KOTMALE	201.0	177.4	410.2	38218.8	184.6	494.4	0.0	0.3182
2 VICTORIA	210.0	185.5	4187.2	75492.2	175.9	762.9	0.0	0.4695
3 RANDENIGALA	127.2	112.4	9524.8	97017.0	100.0	394.6	0.0	0.4009
4 RANTEMBE	49.0	45.2	6920.8	121042.7	48.1	223.0	0.4	0.5637
7 BOWATENNA	40.0	38.9	0.0	22123.2	37.1	50.9	0.0	0.1495
8 UKUWELA	38.0	37.2	290.8	38268.5	37.2	165.4	0.4	0.5071
10 CANYON	60.0	55.4	385.5	15617.3	45.3	162.8	1.4	0.3354
11 NEW LAXAPANA	100.0	88.3	3223.2	18657.1	90.7	503.3	5.5	0.6504
12 WIMALASUREND	50.0	46.2	0.0	9377.1	45.3	112.3	3.7	0.2777
13 OLD LAXAPANA	50.0	45.1	516.7	11586.0	48.0	292.8	6.2	0.7408
14 POLIPITIYA	75.0	66.3	2866.8	33735.5	66.9	436.2	18.0	0.7516
16 SAMANALAWEWA	120.0	110.8	102.2	19231.9	110.6	363.6	6.7	0.3747
50 BROADLANDS	40.0	36.9	1670.9	44295.9	37.1	155.1	17.5	0.4803

Average annual hydro energies : Generated = 4117.31 GWh Excess = 60.03 GWh Dispatched = 4057.28 GWh
Minimum hydro energy dispatched : Per year = 2422.19 GWh Per day = 3.25 GWh

THERMAL	Installed capacity (MW)	Unit cost ($ US /MWh)	Energy generated (GWh/a)	Average plant factor	Energy equivalent GWh/a	Average plant factor	Average fuel consumption t/a
4 KELANITIS ST	50.0	33.1	243.3	0.5554	243.3	0.5554	50681.[illegible]
5 DS RF04+20MW	20.0	29.7	113.4	0.6470	113.4	0.6470	26525.[illegible]
6 SAPUGAS EXT.	40.0	29.3	231.1	0.6595	231.1	0.6595	53335.3
7 SAPUGASKANDA	72.0	29.3	336.1	0.5329	336.1	0.5328	77566.2
8 GT DO 22MW	44.0	64.5	60.9	0.1580	60.9	0.1580	17090.5
9 KELANITIS GT	108.0	78.?	114.9	0.1214	114.9	0.1214	39485.5

Average annual dispatched thermal energy 1099.53 GWh

Maximum deficit in dispatched power = 260.47 MW
Weighted average annual energy deficit = 134.11

Average annual energy deficit 134.11 GWh

Annual (1993) demand 5290.90 GWh

Total demand over simulation period (GWh) = 211636.1 : Total deficit over simulation period (GWh) = 5364.2759

System reliability over simulation period = 97.4653 : Deficit index = 9210.3574 : Maximum deficit = 41.90 %

Deficit occurrences as percentage of monthly demands										
% Intervals	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Total
ENERGY	23	16	19	13	1	0	0	0	0	0	72

Number of restriction months = 0

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ANNUAL FUEL COSTS :
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Maximum  =   93.02 10**6 $ US :  Minimum  =   18.85 10**6 $ US :        Average annual fuel cost  =   41.02 10**6 $ US

Weighted deficit cost =   0.00 $ US /MWh
Excess energy value   =   0.00 $ US /MWh  :                   Average annual net operating cost   =  41.02 10**6 $ US
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Execution on 12/10/ 91 at 13.36. 0 : Program revision date - 11/10/91

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***********************************************************************
*    FILE SYSIM.RD RUN DATA FOR PROGRAM SYSIM - SRI LANKA REV. 10/10/91   *
*  MP IRRIGATION DEMAND FORECASTS FOR YEAR 1995 :CEB POWER DEMAND FOR 1998 *
*          10th October 1991           Kukule Feasibility Study          *
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Reservoir	Maximum storage (MCM)	Minimum storage (MCM)	Active storage (MCM)	Initial content (MCM)	Maximum release m3/s
1 KOTMALE	172.60	22.00	150.60	142.48	114.00
2 VICTORIA	721.20	34.00	687.20	583.76	135.00
3 RANDENIGALA	875.00	295.00	580.00	759.00	180.00
4 RANTEMBE	20.97	4.32	16.65	17.64	180.00
7 BOWATENNA	49.90	16.70	33.20	43.26	90.00
8 KAL/DAM/KAN	159.40	14.40	145.00	130.40	-1.00
10 PARAKRAMA SM	134.45	31.45	103.00	113.85	-1.00
11 MIN/GIRI TK	157.92	9.26	148.66	128.19	-1.00
12 KAUDULLA	128.28	25.43	102.85	107.71	-1.00
13 KANTALAI/VEN	160.35	3.11	157.24	128.90	-1.00
14 MADURU OYA	478.00	0.00	478.00	382.40	-1.00
15 ULHIT/RAT	145.78	99.97	45.81	136.62	-1.00
17 MOUSAKELLE	123.40	2.96	120.44	99.31	36.00
18 CASTLEREIGH	44.80	3.82	40.98	36.60	29.73
20 SAMANALAWEWA	278.00	60.00	218.00	234.40	44.00
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TOTALS :	3650.05	622.42	3027.63	3044.52	

Reference reservoir and monthly adjustment for use in percentage fullness allocation procedure :

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1 KOTMALE	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2 VICTORIA	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3 RANDENIGALA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4 RANTEMBE	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
7 BOWATENNA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
8 KAL/DAM/KAN	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10 PARAKRAMA SM	2	5.00	3.00	2.00	1.00	0.90	0.70	0.50	0.50	0.50	0.90	1.00	3.00
11 MIN/GIRI TK	2	1.00	0.50	0.01	0.01	0.01	0.01	0.01	0.01	0.01	2.00	3.00	4.00
12 KAUDULLA	2	7.00	1.00	0.80	0.80	0.80	0.80	0.80	0.80	1.00	12.00	15.00	15.00
13 KANTALAI/VEN	2	2.00	1.00	0.20	0.20	0.20	0.15	0.15	0.15	1.00	2.00	5.00	5.00
14 MADURU OYA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
15 ULHIT/RAT	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
17 MOUSAKELLE	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18 CASTLEREIGH	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20 SAMANALAWEWA	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

	Hydroelectric plant	Installed capacity (MW)	Available capacity (MW)	ROR cut off flow (m3/s)	ROR cut-off slope.
1	KOTMALE	201.00	177.38	3.00	1.00
2	VICTORIA	210.00	185.50	3.00	1.00
3	RANDENIGALA	127.20	112.36	2.00	1.00
4	RANTEMBE	49.00	45.16	2.00	1.00
7	BOWATENNA	40.00	38.87	2.00	1.00
8	UKUWELA	38.00	37.24	2.00	1.00
10	CANYON	60.00	55.40	2.00	1.00
11	NEW LAXAPANA	100.00	88.33	2.00	1.00
12	WIMALASUREND	50.00	46.17	2.00	1.00
13	OLD LAXAPANA	50.00	45.13	5.00	1.00
14	POLIPITIYA	75.00	66.25	2.00	1.00
16	SAMANALAWEWA	120.00	110.80	2.00	1.00
17	KUKURORI.5	64.10	59.08	20.00	0.42
50	BROADLANDS	40.00	36.87	2.00	1.00
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	Totals :	1224.30	1104.53		

Thermal plant fixed data from files : sexsi.fuel (fuel): wasp.texist (existing and committed plant); wasp.therm (new plant)

	Thermal plant	Installed capacity MW	No. of units	Unit cost $ US /MWh	Availability factor	Forced outage rate per cent	Min. stable load MW	Cost at M.S.L. $ US /MWh
4	KELANITIS ST	50.00	2	33.14	0.8906	20.00	0.00	-1.00
5	DE RFO4*20MW	20.00	1	29.66	0.9176	15.00	0.00	-1.00
6	SAPUGAS EXT.	40.00	2	29.26	0.9176	15.00	0.00	-1.00
7	SAPUGASKANDA	72.00	4	29.26	0.8355	25.00	0.00	-1.00
8	GT DO 22MW	44.00	2	64.48	0.9176	15.00	0.00	-1.00
9	KELANITIS GT	108.00	6	78.94	0.8904	20.00	0.00	-1.00

Maintenance file : wasp.maint
Monthly plant availabilities
after planned and forced outages

			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4	KELANITIS ST	1	0.000	0.544	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
4	KELANITIS ST	2	0.800	0.800	0.544	0.000	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
5	DS RFO4*20MW	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
6	SAPUGAS EXT.	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
6	SAPUGAS EXT.	2	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
7	SAPUGASKANDA	1	0.750	0.750	0.750	0.000	0.022	0.750	0.750	0.750	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	2	0.750	0.750	0.750	0.750	0.750	0.022	0.000	0.750	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	3	0.750	0.750	0.750	0.750	0.750	0.750	0.000	0.045	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	4	0.000	0.000	0.728	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
8	GT DO 22MW	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
8	GT DO 22MW	2	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
9	KELANITIS GT	1	0.800	0.256	0.256	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	2	0.800	0.800	0.800	0.000	0.544	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	3	0.800	0.800	0.544	0.000	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	4	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.752	0.000	0.592	0.800	0.800
9	KELANITIS GT	5	0.800	0.256	0.256	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	6	0.800	0.800	0.800	0.800	0.800	0.560	0.000	0.800	0.800	0.800	0.800	0.800
	Total (MW) :		149.55	229.32	237.80	206.50	251.10	251.38	227.40	255.25	254.40	265.06	268.80	268.80
	Maximum unit capacity (MW) :		20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00

Generation demands

Name of Demand File: wasp.gp91 Year: 1998

BASE SCENARIO - SRI LANKA POWER SYSTEM

Load (MW) as Function of Relative Duration

Season	Hours Dur:	0.00	0.02	0.07	0.15	0.50	0.85	0.95	1.00	1.00
1	744.	964.	926.	851.	671.	566.	432.	394.	336.	0.
2	672.	980.	941.	865.	682.	566.	439.	390.	361.	0.
3	744.	982.	943.	867.	693.	596.	450.	421.	284.	0.
4	720.	983.	944.	858.	703.	587.	431.	362.	313.	0.
5	744.	988.	949.	882.	697.	580.	443.	404.	255.	0.
6	720.	1001.	952.	873.	696.	598.	449.	409.	349.	0.
7	744.	999.	960.	882.	706.	617.	469.	429.	379.	0.
8	744.	1003.	963.	885.	698.	589.	450.	430.	319.	0.
9	720.	1012.	982.	893.	714.	605.	464.	434.	383.	0.
10	744.	1039.	988.	887.	744.	641.	466.	446.	394.	0.
11	720.	1040.	999.	887.	765.	611.	456.	415.	342.	0.
12	744.	1036.	995.	904.	752.	609.	465.	423.	361.	0.

With demand multiplier 1.0588 :

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Energy per day	GWh	14.6137	14.7555	15.1703	14.9263	14.9903	15.2289	15.6475	15.2164	15.6109	16.1430	15.8484	15.8555
Energy per month	GWh	453.02	413.15	470.28	447.79	464.70	456.87	485.07	471.71	468.33	500.43	475.45	491.52

Restriction reduction factors :

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Power	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Energy	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90

Demand index exponent = 1.50 : Demand index factor = 1.00 : Deficit cost = 0.00 mills/KWh : Excess value = 0.00 mills/KWh

INFLOW SERIES

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AVERAGE FLOWS IN m3/s

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 KOTMALE/KOTM	44.33	39.44	26.73	17.85	10.84	8.66	13.89	24.23	43.83	48.90	44.95	40.46	30.34
2 MAHAW/POLGOL	55.24	54.76	34.79	14.64	8.92	7.78	18.71	34.58	57.07	53.48	46.56	44.53	35.92
3 MAHAW/VICTOR	27.29	39.96	42.70	31.35	20.56	11.29	15.75	19.28	19.68	20.14	19.93	18.39	23.86
4 MAHAW/RANDEN	17.14	30.15	44.11	40.89	23.30	10.11	10.09	10.35	6.25	7.46	7.91	8.42	18.02
5 MAHAW/RANTEM	18.68	27.38	33.66	34.01	20.76	15.86	22.09	17.25	11.05	10.45	8.57	9.62	19.12
6 MAHAW/AMBAN	45.39	72.38	155.99	177.34	112.39	70.24	51.13	36.26	24.09	18.31	20.29	24.91	67.39
7 BOWATENNA	12.89	20.83	32.97	25.87	18.45	10.97	11.43	8.21	6.30	5.91	5.22	5.33	13.70
8 AMBAN/ELAHER	8.61	16.45	31.85	30.04	18.92	10.59	8.18	6.14	4.19	4.54	3.82	3.52	12.24
9 AMBAN/AMGAM	8.00	23.50	79.59	73.14	52.67	23.67	16.53	5.95	3.89	4.30	4.36	5.15	25.06
10 MOUSAKELLE	16.19	13.22	6.96	4.17	3.45	3.99	7.09	17.44	24.83	19.24	16.29	16.90	12.48
11 CANYON	3.04	2.41	1.24	0.78	0.68	0.81	1.36	3.33	4.77	3.80	3.33	3.28	2.40
12 LAXAPANA PND	3.71	2.92	1.47	0.97	0.83	0.95	1.55	3.51	5.17	4.46	3.84	3.73	2.76
13 CASTLEREIGH	9.94	8.58	5.36	3.24	2.58	2.98	5.18	9.96	13.47	10.53	8.76	9.09	7.47
14 NORTON	3.24	2.66	1.37	0.98	0.85	0.88	1.35	3.06	4.96	4.10	3.50	3.31	2.52
15 KAL/DAM/KAN	6.86	13.83	17.23	5.22	2.67	2.71	6.88	2.56	0.15	0.36	0.22	0.97	4.97
17 MIN/GI	2.77	7.77	11.64	4.21	2.44	1.56	2.87	1.30	0.01	0.26	0.12	0.47	2.95
18 ALUT	3.09	9.93	14.29	4.99	2.63	1.47	2.80	1.57	0.03	0.43	0.26	0.70	3.52
19 KANTALAI/VEN	2.02	6.34	9.32	3.12	2.01	1.21	2.06	0.95	0.01	0.19	0.10	0.36	2.31
20 PARAKRAMA SM	0.68	2.23	3.77	1.36	0.94	0.50	0.71	0.31	0.00	0.09	0.05	0.18	0.90
21 MADURU OYA	5.27	18.50	38.72	26.72	16.14	6.41	5.58	4.25	1.12	1.00	1.09	1.53	10.53
22 ULHIT/RAT	3.24	16.01	25.88	17.68	9.40	3.17	4.95	2.05	0.06	0.28	0.47	0.67	6.99
23 MINIPE L.B.	3.29	13.50	23.05	14.24	7.66	3.25	4.30	1.91	0.17	0.30	0.35	0.58	6.05
24 SAMANALA	15.53	25.95	22.99	15.70	12.09	17.17	26.39	22.49	16.01	10.53	9.08	10.43	17.03
50 BROADLANDS	10.93	9.15	5.21	3.26	2.67	3.02	5.17	11.09	15.79	12.59	10.56	10.69	8.34
56 KUKU	45.23	40.84	23.99	14.92	10.58	13.03	23.24	46.60	52.09	33.98	28.73	34.09	30.61
TOTALS :	372.61	518.69	694.90	566.65	364.41	232.29	269.27	294.61	315.02	275.65	248.37	257.31	367.48

IRRIGATION AREA
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AVERAGE WATER DEMANDS FOR YEAR 1995 , CASE CB IN m3/s

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 SYSTEM H KK	18.99	33.55	25.51	37.79	34.57	3.05	11.61	28.22	34.81	31.12	12.65	0.26	22.68
2 SYSTEM G	1.04	4.11	2.20	2.38	4.36	1.81	1.08	7.43	9.93	7.73	4.56	0.35	3.91
3 SYSTEM D1 MG	2.21	8.85	5.12	6.64	10.78	4.49	2.48	16.10	21.61	15.96	9.54	0.70	8.71
4 SYSTEM D1 KD	0.67	2.68	1.55	2.01	3.26	1.36	0.75	4.87	6.54	4.83	2.89	0.21	2.63
5 SYSTEM D1 KT	4.32	4.81	1.41	5.91	5.65	3.10	6.56	13.68	15.60	11.59	6.68	3.62	6.91
6 SYSTEM D2	1.87	7.45	4.27	5.06	8.10	3.59	2.06	13.83	18.30	13.58	8.08	0.58	7.23
7 SYSTEM C	12.97	16.10	5.54	8.71	13.75	2.83	14.10	34.00	38.89	32.56	12.94	2.16	16.21
8 SYSTEM B	44.90	27.84	13.74	30.62	14.04	9.95	55.89	72.13	76.35	42.39	4.53	9.10	33.46
9 SYSTEM E	1.12	4.00	2.26	1.56	3.87	2.15	1.17	9.57	11.92	9.85	5.55	0.44	4.37
10 SYSTEM A	1.30	5.14	3.16	4.00	6.34	2.68	1.56	9.52	12.50	9.04	5.01	0.38	5.05
11 SYSTEM MH	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	0.00	0.00	0.00	4.30	3.23
12 SYSTEM IH	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09
14 SMWEWA SM	1.65	0.85	1.25	1.85	2.25	0.95	1.35	1.95	2.65	2.45	2.20	0.00	1.62
TOTALS :	97.43	121.77	72.41	112.92	113.36	42.35	105.00	216.70	251.18	183.19	76.71	24.20	118.10

FRACTION OF DEMAND MET UNDER RESTRICTION REGIME

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 SYSTEM H KK	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
2 SYSTEM G	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
3 SYSTEM D1 MG	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
4 SYSTEM D1 KD	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
5 SYSTEM D1 KT	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
6 SYSTEM D2	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
7 SYSTEM C	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
8 SYSTEM B	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
9 SYSTEM E	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
10 SYSTEM A	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
11 SYSTEM MH	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
12 SYSTEM IH	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
14 SMWEWA SM	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	

DEMAND FORECAST FOR YEAR 1998 : SIMULATION PERIOD FROM 1949 TO 1988

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MINIMUM THERMAL (MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

GROSS TOTAL SYSTEM STORAGE VOLUMES IN Mm3 BELOW WHICH THE FOLLOWING OPERATING REGIMES APPLY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MAX. HYDRO	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
KL.ST. 50 MW	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NEWDL.1 MW	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NS.DL. 40 MW	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
ES.DL. 80 MW	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29	3347.29
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NEW GT.22 MW	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95
	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)
KL.GT.120 MW	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95	1227.95
	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)
WATER RESTNS	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ELECT RESTNS	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42	622.42
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

FIGURES IN PARENTHESIS INDICATE FRACTION OF ACTIVE STORAGE

SYSIM rev. 11/10/91 : Run date 10/12/ 91 : Execution start 13:36: 0 : Finish 13:44: 6 : 480 Simulations needing 0.91 secs. each

WATER RESOURCE SUMMARY

RESERVOIR

	Initial content Mm3	Total inflow Mm3	Total release Mm3	Total spill Mm3	Total seepage Mm3	Total evaptn. Mm3	Maximum content Mm3	Average content Mm3	Minimum content Mm3	Final content Mm3	Overall balance Mm3
1 KOTMALE	142.5	38432.9	37859.7	358.9	0.0	184.2	172.6*	142.9	22.0*	172.6	0.0
2 VICTORIA	583.8	75526.8	69619.4	5319.6	0.0	470.0	721.2*	269.8	34.0*	201.6	0.0
3 RANDENIGALA	759.0	98194.8	94057.1	2911.6	0.0	1121.0	875.0*	761.7	324.6	864.1	-0.1
4 RANTEMBE	17.6	121110.4	114279.8	6714.5	0.0	113.1	21.0*	20.7	20.6	20.6	-0.1
7 BOWATENNA	43.3	55626.0	55433.1	0.6	0.0	218.9	49.9*	37.2	16.7*	16.7	0.0
8 KAL/DAM/KAN	130.4	33812.0	30650.4	707.4	0.0	2484.2	159.4*	98.3	14.4*	100.4	0.0
10 PARAKRAMA SM	113.8	11485.7	9098.6	319.4	0.0	2099.0	134.4*	104.9	31.4*	82.5	0.0
11 MIN/GIRI TK	128.2	29226.4	25302.0	931.5	0.0	2100.6	157.9*	107.1	9.3*	20.4	0.0
12 KAUDULLA	107.7	6690.7	3313.6	1352.3	0.0	2090.5	128.3*	97.2	25.4*	52.1	0.0
13 KANTALAI/VEN	128.9	13858.0	8651.1	3239.9	0.0	2051.3	160.4*	102.2	3.1*	45.6	0.0
14 MADURU OYA	382.4	48557.7	42203.2	3434.7	0.0	2944.4	478.0*	336.1	0.0*	307.8	0.0
15 ULHIT/RAT	136.6	60089.0	55626.8	3172.3	0.0	1285.8	145.8*	130.6	100.0*	140.7	0.0
17 MOUSAKELLE	99.3	15799.3	11776.0	3641.5	0.0	157.7	123.4*	63.7	3.0*	123.4	0.0
18 CASTLEREIGH	36.6	9457.7	6848.4	2528.8	0.0	72.3	44.8*	24.5	3.8*	44.8	0.0
20 SAMANALAWEWA	234.4	21506.5	20126.6	1145.3	0.0	264.6	278.0*	156.3	60.0*	204.4	0.0

Minimum recorded total system storage = 714.74 Total system inflow = 464233.3

CONVEYANCE

	Maximum capacity m3/s	Average flow m3/s	Minimum required m3/s	Total inflow Mm3	Total loss Mm3	Total supply Mm3	Total outflow Mm3	Balance Mm3	Average utilization %
1 POLGOLLA DIV	56.6	30.4	0.0	38339.2	0.0	0.0	38339.2	0.000	53.7
2 BOWAT-KDK	28.3	26.4	0.0	33243.9	1662.2	4060.7	27521.1	-0.098	93.0
3 KDK-SYSTEM H	1000.0	22.8	0.0	28707.0	0.0	27999.6	707.4	0.001	2.3
4 ELAHERA-DIYA	42.5	24.3	0.0	30602.8	0.0	4821.8	25781.0	-0.010	57.0
5 DIYA-MIN/GIR	42.5	20.4	0.0	25781.0	1289.[illegible]	0.0	24492.0	0.015	48.1
6 MIN/GI-SYSD1	1000.0	9.4	0.0	11838.6	0.0	10907.1	931.5	0.001	0.9
7 MIN/GI-ALUT	34.0	11.4	2.5	14395.0	0.0	0.0	14395.0	0.000	33.5
8 KAU-SYS D1	1000.0	3.7	0.0	4665.9	0.0	3313.6	1352.3	0.004	0.4
9 ALUT-KANTA	34.0	9.6	0.0	12155.3	1215.5	0.0	10939.8	0.006	28.3
10 KANTA-SYS D1	1000.0	9.4	0.0	11890.0	0.0	8651.1	3238.9	-0.004	0.9
11 ANGAM-PARAK	14.2	8.6	0.0	10890.0	544.5	0.0	10345.5	-0.013	60.8
12 PARAK-SYS D2	1000.0	7.5	0.0	9418.0	0.0	9098.6	319.4	0.001	0.7
13 MINI-ULH/RAT	64.0	40.6	0.0	51263.0	0.0	0.0	51263.0	0.000	63.5
14 UL/RAT SYS C	1000.0	16.1	0.0	20364.7	0.0	20364.7	0.0	-0.002	1.6
15 UL/RAT-MADUR	39.1	28.0	0.0	35262.1	0.0	0.0	35262.1	0.000	71.4
16 MADUR-SYS B	1000.0	33.5	0.0	42203.2	0.0	42203.2	0.0	0.005	3.3
17 MINI-TALA	18.4	4.2	1.6	5328.2	0.0	0.0	5328.2	0.000	22.9
18 TALA-SYS E	1000.0	7.3	0.0	9149.9	0.0	5522.8	3627.1	-0.004	0.7
19 ROTA-SYS A	1000.0	135.5	0.0	170914.2	0.0	6365.5	164548.7	-0.027	13.5
20 WIMA-OLDLAX	15.0	9.2	0.0	11633.5	0.0	0.0	11633.5	0.000	61.4
21 KDK-SYS IH	35.4	2.1	2.1	2650.8	0.0	2638.2	12.6	0.001	5.9
23 SAMWEWA SM	1000.0	1.6	0.0	2039.9	0.0	2039.9	0.0	0.000	0.2

WATER DEMANDS FOR YEAR 1995 : CASE : CB

	Demand factor	Total demand	Restricted demand	Total supply	Restricted deficit	Total deficit
11 SYSTEM MH	1.0000	4060.71	4060.71	4060.71	0.00	0.00
1 SYSTEM H KK	1.0000	28548.25	28548.25	27999.55	548.69	548.69
2 SYSTEM G	1.0000	4937.85	4937.85	4821.81	116.04	116.04
3 SYSTEM D1 MG	1.0000	10975.63	10975.63	10907.10	68.53	68.53
4 SYSTEM D1 KD	1.0000	3320.60	3320.60	3313.59	7.01	7.01
5 SYSTEM D1 KT	1.0000	8723.38	8723.38	8651.08	72.29	72.29
6 SYSTEM D2	1.0000	9120.91	9120.91	9098.64	22.28	22.28
7 SYSTEM C	1.0000	20467.52	20467.52	20364.69	102.83	102.83
8 SYSTEM B	1.0000	42297.11	42297.11	42203.24	93.87	93.87
9 SYSTEM E	1.0000	5522.80	5522.80	5522.80	0.00	0.00
10 SYSTEM A	1.0000	6368.04	6368.04	6365.50	2.54	2.54
12 SYSTEM IH	1.0000	2638.22	2638.22	2633.22	0.00	0.00
14 SMWEWA SM	1.0000	2040.29	2040.29	2039.89	0.40	0.40

Deficit occurrences as percentage of monthly demands

% Intervals	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Total
SYSTEM H KK	5	3	6	2	6	0	0	0	0	0	22
SYSTEM G	0	0	0	0	0	1	2	3	1	0	7
SYSTEM D1 MG	2	0	3	0	0	0	0	0	1	0	6
SYSTEM D1 KD	0	1	1	1	0	0	0	1	0	0	4
SYSTEM D1 KT	12	3	1	0	0	1	0	0	0	1	18
SYSTEM D2	10	0	0	0	0	0	0	0	0	0	10
SYSTEM C	1	1	0	0	0	0	0	0	0	1	3
SYSTEM B	2	0	1	1	0	0	0	1	0	0	5
SYSTEM E	0	0	0	0	0	0	0	0	0	0	0
SYSTEM A	2	0	0	0	0	0	0	0	0	0	2
SYSTEM MH	0	0	0	0	0	0	0	0	0	0	0
SYSTEM IH	0	0	0	0	0	0	0	0	0	0	0
SMWEWA SM	2	0	0	0	0	0	0	0	0	0	2

Number of restriction months = 0 : Total water deficit = 1034.48 Mm3 : Average = 25.86 Mm3/a : Weighted value =1378523.25 Mm3

GENERATION SUMMARY
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(Dispatch simulation by DRA*

HYDRO =====	Installed capacity (MW)	Available capacity (MW)	Bypass flow (Mm3)	Turbine discharge (Mm3)	Average power (MW)	Energy generated (GWh/a)	Excess energy (GWh/a)	Average plant factor
1 KOTMALE	201.0	177.4	409.8	38218.6	184.6	494.4	0.0	0.3182
2 VICTORIA	210.0	185.5	4038.7	75439.0	174.9	762.2	0.0	0.4690
3 RANDENIGALA	127.2	112.4	9534.7	96968.7	99.3	393.1	0.0	0.3993
4 RANTEMBE	49.0	45.2	6766.5	120994.4	48.1	223.4	0.1	0.5647
7 BOWATENNA	40.0	38.9	0.0	22189.8	37.1	51.1	0.0	0.1502
8 UKUWELA	38.0	37.2	287.3	38339.2	37.2	165.8	0.3	0.5081
10 CANYON	60.0	55.4	392.4	15617.5	45.3	162.9	0.8	0.3357
11 NEW LAXAPANA	100.0	88.3	3185.8	18657.3	90.7	504.9	3.8	0.6525
12 WIMALASUREND	50.0	46.2	0.0	9377.2	45.4	112.3	2.2	0.2778
13 OLD LAXAPANA	50.0	45.1	469.9	11633.5	48.0	295.0	5.8	0.7463
14 POLIPITIYA	75.0	66.3	2855.8	33783.1	66.9	437.7	12.8	0.7541
16 SAMANALAWEWA	120.0	110.8	123.9	19232.0	110.6	363.1	3.3	0.3741
17 KUKURORI.5	64.1	59.1	10539.5	28566.9	59.5	314.5	19.9	0.6078
50 BROADLANDS	40.0	36.9	1697.2	44343.6	37.1	155.3	18.1	0.4809

Average annual hydro energies : Generated = 4435.71 GWh Excess = 67.11 GWh Dispatched = 4368.61 GWh
Minimum hydro energy dispatched : Per year = 2862.66 GWh Per day = 3.56 GWh

THERMAL =======	Installed capacity (MW)	Unit cost ($ US /MWh)	Energy generated (Gwh/a)	Average plant factor	Energy equivalent GWh/a	Average plant factor	Average fuel consumption t/a
4 KELANITIS ST	50.0	33.1	240.6	0.5494	240.6	0.5494	60027.1
5 DS RFO4+20MW	20.0	29.7	111.1	0.6343	111.1	0.6343	26005.0
6 SAPUGAS EXT.	40.0	29.3	227.9	0.6505	227.9	0.6505	52609.1
7 SAPUGASKANDA	72.0	29.3	333.3	0.5284	333.3	0.5284	76925.4
8 GT DO 22MW	44.0	54.5	61.9	0.1606	61.7	0.1606	17374.?
9 KELANITIS GT	108.0	73.9	115.6	0.1222	115.6	0.1222	39742.3

Average annual dispatched thermal energy 1090.52 GWh

Maximum deficit in dispatched power = 270.41 MW
Weighted average annual energy deficit = 142.38

Average annual energy deficit 142.88 GWh

Annual (1998) demand 5602.02 GWh

Total demand over simulation period (GWh) = 224080.8 : Total deficit over simulation period (GWh) = 5715.1602

System reliability over simulation period = 97.4495 : Deficit index = 9998.5596 : Maximum deficit = 41.54 %

Deficit occurrences as percentage of monthly demands

% Intervals	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Total
ENERGY	21	16	15	16	1	0	0	0	0	0	69

ANNUAL FUEL COSTS :
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Maximum  =   87.89 10**6 $ US : Minimum  =   16.52 10**6 $ US :      Average annual fuel cost  =   40.82 10**6 $ US

Weighted deficit cost =   0.00 $ US /MWh
Excess energy value   =   0.00 $ US /MWh  :              Average annual net operating cost  =  40.82 10**6 $ US
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Execution on 12/10/ 91 at 14.27.13 : Program revision date - 11/10/91

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******************************************************************************
*     FILE SYSIM.RD RUN DATA FOR PROGRAM SYSIM - SRI LANKA REV. 10/10/91     *
*  MP IRRIGATION DEMAND FORECASTS FOR YEAR 1995 :CEB POWER DEMAND FOR 1998   *
*              10th October 1991          Kukule Feasibility Study           *
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Reservoir	Maximum storage (MCM)	Minimum storage (MCM)	Active storage (MCM)	Initial content (MCM)	Maximum release m3/s
1 KOTMALE	172.60	22.00	150.60	142.48	114.00
2 VICTORIA	721.20	34.00	687.20	583.76	135.00
3 RANDENIGALA	875.00	295.00	580.00	759.00	180.00
4 RANTEMBE	20.97	4.32	16.65	17.64	180.00
7 BOWATENNA	49.90	16.70	33.20	43.26	90.00
8 KAL/DAM/KAN	159.40	14.40	145.00	130.40	-1.00
10 PARAKRAMA SM	134.45	31.45	103.00	113.85	-1.00
11 MIN/GIRI TK	157.92	9.26	148.66	128.19	-1.00
12 KAUDULLA	128.28	25.43	102.85	107.71	-1.00
13 KANTALAI/VEN	160.35	3.11	157.24	128.90	-1.00
14 MADURU OYA	478.00	0.00	478.00	332.40	-1.00
15 ULHIT/RAT	145.78	99.97	45.81	136.62	-1.00
17 MOUSAKELLE	123.40	2.96	120.44	99.31	36.00
18 CASTLEREIGH	44.80	3.82	40.98	36.60	29.73
20 SAMANALAWEWA	278.00	60.00	218.00	234.40	44.00
39 KUKU230	209.00	37.40	171.60	174.68	76.00
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TOTALS :	3859.05	659.82	3199.23	3219.20	

Reference reservoir and monthly adjustment for use in percentage fullness allocation procedure :

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1 KOTMALE	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2 VICTORIA	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3 RANDENIGALA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4 RANTEMBE	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
7 BOWATENNA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
8 KAL/DAM/KAN	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10 PARAKRAMA SM	2	5.00	3.00	2.00	1.00	0.90	0.70	0.50	0.50	0.50	0.90	1.00	3.00
11 MIN/GIRI TK	2	1.00	0.50	0.01	0.01	0.01	0.01	0.01	0.01	0.01	2.00	3.00	4.00
12 KAUDULLA	2	7.00	1.00	0.80	0.80	0.80	0.80	0.80	0.80	1.00	12.00	15.00	15.00
13 KANTALAI/VEN	2	2.00	1.00	0.20	0.20	0.20	0.15	0.15	0.15	1.00	2.00	5.00	5.00
14 MADURU OYA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
15 ULHIT/RAT	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
17 MOUSAKELLE	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18 CASTLEREIGH	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20 SAMANALAWEWA	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
39 KUKU230	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

	Hydroelectric plant	Installed capacity (MW)	Available capacity (MW)	ROR cut-off flow (m3/s)	ROR cut-off slope
1	KOTMALE	201.00	177.38	3.00	1.00
2	VICTORIA	210.00	185.50	3.00	1.00
3	RANDENIGALA	127.20	112.36	2.00	1.00
4	RANTEMBE	49.00	45.16	2.00	1.00
7	BOWATENNA	40.00	38.87	2.00	1.00
8	UKUWELA	38.00	37.24	2.00	1.00
10	CANYON	60.00	55.40	2.00	1.00
11	NEW LAXAPANA	100.00	88.33	2.00	1.00
12	WIMALASUREND	50.00	46.17	2.00	1.00
13	OLD LAXAPANA	50.00	45.13	5.00	1.00
14	POLIPITIYA	75.00	66.25	2.00	1.00
16	SAMANALAWEWA	120.00	110.80	2.00	1.00
21	KUKU2302.0	101.50	93.55	1.00	1.00
50	BROADLANDS	40.00	36.87	2.00	1.00
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	Totals :	1261.70	1139.00		

Thermal plant fixed data from files : sexsi.fuel (fuel): wasp.texist (existing and committed plant); wasp.therm (new plant)

	Thermal plant	Installed capacity MW	No. of units	Unit cost $ US /MWh	Availability factor	Forced outage rate per cent	Min. stable load MW	Cost at M.S.L. $ US /MWh
4	KELANITIS ST	50.00	2	33.14	0.8906	20.00	0.00	-1.00
5	DS RFO4*20MW	20.00	1	29.66	0.9176	15.00	0.00	-1.00
6	SAPUGAS EXT.	40.00	2	29.26	0.9176	15.00	0.00	-1.00
7	SAPUGASKANDA	72.00	4	29.26	0.8355	25.00	0.00	-1.00
8	GT DO 22MW	44.00	2	64.48	0.9176	15.00	0.00	-1.00
9	KELANITIS GT	108.00	6	78.94	0.8904	20.00	0.00	-1.00

Maintenance file : wasp.maint
Monthly plant availabilities
after planned and forced outages

			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4	KELANITIS ST	1	0.000	0.544	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
4	KELANITIS ST	2	0.800	0.800	0.544	0.000	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
5	DS RFO4*20MW	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
6	SAPUGAS EXT.	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
6	SAPUGAS EXT.	2	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
7	SAPUGASKANDA	1	0.750	0.750	0.750	0.000	0.022	0.750	0.750	0.750	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	2	0.750	0.750	0.750	0.750	0.750	0.022	0.000	0.750	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	3	0.750	0.750	0.750	0.750	0.750	0.750	0.000	0.045	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	4	0.000	0.000	0.728	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
8	GT DO 22MW	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
8	GT DO 22MW	2	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
9	KELANITIS GT	1	0.800	0.256	0.256	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	2	0.800	0.800	0.800	0.000	0.544	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	3	0.800	0.800	0.544	0.000	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	4	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.752	0.000	0.592	0.800	0.800
9	KELANITIS GT	5	0.800	0.256	0.256	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	6	0.800	0.800	0.800	0.800	0.800	0.560	0.000	0.800	0.800	0.800	0.800	0.800
	Total (MW) :		149.55	229.32	237.80	206.50	251.10	251.38	227.40	255.25	254.40	265.06	268.80	268.80
	Maximum unit capacity (MW) :		20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00

Generation demands

Name of Demand File: wasp.gp91 Year: 1998

BASE SCENARIO - SRI LANKA POWER SYSTEM

Load (MW) as Function of Relative Duration

Season	Hours	Dur: 0.00	0.02	0.07	0.15	0.50	0.85	0.95	1.00	1.00
1	744.	964.	926.	851.	671.	566.	432.	394.	336.	0.
2	672.	980.	941.	865.	682.	566.	439.	390.	361.	0.
3	744.	982.	943.	867.	693.	596.	450.	421.	284.	0.
4	720.	983.	944.	858.	703.	587.	431.	362.	313.	0.
5	744.	988.	949.	982.	697.	580.	443.	404.	255.	0.
6	720.	1001.	952.	873.	696.	598.	449.	409.	349.	0.
7	744.	999.	960.	882.	706.	617.	469.	429.	379.	0.
8	744.	1003.	963.	885.	698.	589.	450.	430.	319.	0.
9	720.	1012.	982.	893.	714.	605.	464.	434.	383.	0.
10	744.	1039.	988.	887.	744.	641.	466.	446.	394.	0.
11	720.	1040.	999.	887.	765.	611.	456.	415.	342.	0.
12	744.	1036.	995.	904.	752.	609.	465.	423.	361.	0.

With demand multiplier 1.0829 :

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Energy per day	GWh	14.9463	15.0914	15.5156	15.2660	15.3316	15.5755	16.0036	15.5627	15.9662	16.5105	16.2092	16.2164
Energy per month	GWh	463.34	422.56	480.98	457.98	475.28	467.27	496.11	482.44	478.99	511.82	486.27	502.71

Restriction reduction factors :

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Power	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Energy	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90

Demand index exponent = 1.50 : Demand index factor = 1.00 : Deficit cost = 0.00 mills/KWh : Excess value = 0.00 mills/KWh

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INFLOW SERIES
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AVERAGE FLOWS IN m3/s

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 KOTMALE/KOTM	44.33	39.44	26.73	17.85	10.84	8.66	13.89	24.23	43.83	48.90	44.95	40.46	30.34
2 MAHAW/POLGOL	55.24	54.76	34.79	14.64	8.92	7.78	18.71	34.58	57.07	53.48	46.56	44.53	35.92
3 MAHAW/VICTOR	27.29	39.96	42.70	31.35	20.56	11.29	15.75	19.28	19.68	20.14	19.93	18.39	23.86
4 MAHAW/RANDEN	17.14	30.15	44.11	40.89	23.30	10.11	10.09	10.35	6.25	7.46	7.91	8.42	18.02
5 MAHAW/RANTEM	18.68	27.38	33.66	34.01	20.76	15.86	22.09	17.25	11.05	10.45	8.57	9.62	19.12
6 MAHAW/AMBAN	45.39	72.38	155.99	177.34	112.39	70.24	51.13	36.26	24.09	18.31	20.29	24.91	67.39
7 BOWATENNA	12.89	20.83	32.97	25.87	18.45	10.97	11.43	8.21	6.30	5.91	5.22	5.33	13.70
8 AMBAN/ELAHER	8.61	16.45	31.85	30.04	18.92	10.59	8.18	6.14	4.19	4.54	3.82	3.52	12.24
9 AMBAN/AMGAM	8.00	23.50	79.59	73.14	52.67	23.67	16.53	5.95	3.89	4.30	4.36	5.15	25.06
10 MOUSAKELLE	16.19	13.22	6.96	4.17	3.45	3.99	7.09	17.44	24.83	19.24	16.29	16.90	12.48
11 CANYON	3.04	2.41	1.24	0.78	0.68	0.81	1.36	3.33	4.77	3.80	3.33	3.28	2.40
12 LAXAPANA PND	3.71	2.92	1.47	0.97	0.83	0.95	1.55	3.51	5.17	4.46	3.84	3.73	2.76
13 CASTLEREIGH	9.94	8.58	5.36	3.24	2.58	2.98	5.18	9.96	13.47	10.53	8.76	9.09	7.47
14 NORTON	3.24	2.66	1.37	0.98	0.85	0.88	1.35	3.06	4.96	4.10	3.50	3.31	2.52
15 KAL/DAM/KAN	6.86	13.83	17.23	5.22	2.67	2.71	6.88	2.56	0.15	0.36	0.22	0.97	4.97
17 MIN/GI	2.77	7.77	11.64	4.21	2.44	1.56	2.87	1.30	0.01	0.26	0.12	0.47	2.95
18 ALUT	3.09	9.93	14.29	4.99	2.63	1.47	2.80	1.57	0.03	0.43	0.26	0.70	3.52
19 KANTALAI/VEN	2.02	6.34	9.32	3.12	2.01	1.21	2.06	0.95	0.01	0.19	0.10	0.36	2.31
20 PARAKRAMA SM	0.68	2.23	3.77	1.36	0.94	0.50	-0.71	0.31	0.00	0.09	0.05	0.18	0.90
21 MADURU OYA	5.27	18.50	38.72	26.72	16.14	6.41	5.58	4.25	1.12	1.00	1.09	1.53	10.53
22 ULHIT/RAT	3.24	16.01	25.88	17.68	9.40	3.17	4.95	2.05	0.06	0.28	0.47	0.67	6.99
23 MINIPE L.B.	3.29	13.50	23.05	14.24	7.66	3.25	4.30	1.91	0.17	0.30	0.35	0.58	6.05
24 SAMANALA	15.53	25.95	22.99	15.70	12.09	17.17	26.39	22.49	16.01	10.53	9.08	10.43	17.03
50 BROADLANDS	10.93	9.15	5.21	3.26	2.67	3.02	5.17	11.09	15.79	12.59	10.56	10.69	8.34
56 KUKU	45.23	40.84	23.99	14.92	10.58	13.03	23.24	46.60	52.09	33.98	28.73	34.09	30.61
TOTALS :	372.61	518.69	694.90	566.65	364.41	232.29	269.27	294.61	315.02	275.65	248.37	257.31	367.48

IRRIGATION AREA
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AVERAGE WATER DEMANDS FOR YEAR 1995 , CASE CB IN m3/s

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 SYSTEM H KK	18.99	33.55	25.51	37.79	34.57	3.05	11.61	28.22	34.81	31.12	12.65	0.26	22.68
2 SYSTEM G	1.04	4.11	2.20	2.38	4.3[illegible]	1.81	1.08	7.43	9.93	7.73	4.56	0.35	3.91
3 SYSTEM D1 MG	2.21	8.85	5.12	6.64	10.78	4.49	2.48	16.10	21.61	15.96	9.54	0.70	8.71
4 SYSTEM D1 KD	0.67	2.68	1.55	2.01	3.26	1.36	0.75	4.87	6.54	4.93	2.89	0.21	2.63
5 SYSTEM D1 KT	4.32	4.81	1.41	5.91	5.66	3.10	6.56	13.68	15.60	11.59	6.68	3.62	6.91
6 SYSTEM D2	1.87	7.45	4.27	5.06	6.10	3.59	2.06	13.83	18.30	13.58	8.08	0.58	7.23
7 SYSTEM C	12.97	16.10	5.54	8.71	13.75	2.83	14.10	34.00	38.89	32.56	12.94	2.16	16.21
8 SYSTEM B	44.90	27.84	13.74	30.62	14.04	9.95	55.89	72.13	76.35	42.39	4.53	9.10	33.46
9 SYSTEM E	1.12	4.00	2.26	1.56	3.87	2.15	1.17	8.57	11.92	9.85	5.55	0.44	4.37
10 SYSTEM A	1.30	5.14	3.16	4.00	6.34	2.68	1.56	9.52	12.50	9.04	5.01	0.38	5.05
11 SYSTEM MH	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	0.00	0.00	0.00	4.30	3.23
12 SYSTEM IH	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09
14 SMWEWA SM	1.65	0.85	1.25	1.85	2.25	0.95	1.35	1.95	2.65	2.45	2.20	0.00	1.62
TOTALS :	97.43	121.77	72.41	112.92	113.36	42.35	105.00	216.70	251.18	183.19	76.71	24.20	118.10

FRACTION OF DEMAND MET UNDER RESTRICTION REGIME

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 SYSTEM H KK	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
2 SYSTEM G	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
3 SYSTEM D1 MG	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
4 SYSTEM D1 KD	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
5 SYSTEM D1 KT	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
6 SYSTEM D2	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
7 SYSTEM C	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
8 SYSTEM B	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
9 SYSTEM E	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
10 SYSTEM A	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
11 SYSTEM MH	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
12 SYSTEM IH	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
14 SMWEWA SM	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	

DEMAND FORECAST FOR YEAR 1998 : SIMULATION PERIOD FROM 1949 TO 1988

MINIMUM THERMAL (MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

GROSS TOTAL SYSTEM STORAGE VOLUMES IN Mm3 BELOW WHICH THE FOLLOWING OPERATING REGIMES APPLY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MAX. HYDRO	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
KL.ST. 50 MW	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NEWDL.1 MW	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NS.DL. 40 MW	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
ES.DL. 80 MW	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13	3539.13
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NEW GT.22 MW	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67
	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)
KL.GT.120 MW	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67	1299.67
	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)
WATER RESTNS	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ELECT RESTNS	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

FIGURES IN PARENTHESIS INDICATE FRACTION OF ACTIVE STORAGE

SYSIM rev. 11/10/91 : Run date 10/12/ 91 : Execution start 14:27:13 : Finish 14:39:21 : 480 Simulations needing 1.39 secs. each

WATER RESOURCE SUMMARY

RESERVOIR

RESERVOIR	Initial content Mm3	Total inflow Mm3	Total release Mm3	Total spill Mm3	Total seepage Mm3	Total evaptn. Mm3	Maximum content Mm3	Average content Mm3	Minimum content Mm3	Final content Mm3	Overall balance Mm3
1 KOTMALE	142.5	38432.9	37866.6	352.0	0.0	184.1	172.6*	142.9	22.0*	172.6	0.0
2 VICTORIA	583.8	75489.4	69325.2	6054.0	0.0	490.4	721.2*	281.6	34.0*	203.5	0.0
3 RANDENIGALA	759.0	98135.0	93867.7	3036.4	0.0	1125.9	875.0*	767.4	324.6	864.1	-0.1
4 RANTEMBE	17.6	121045.8	114145.4	6784.4	0.0	113.1	21.0*	20.7	20.6	20.6	-0.1
7 BOWATENNA	43.3	55663.5	55470.7	0.6	0.0	218.8	49.9*	37.2	16.7*	15.7	0.0
8 KAL/DAM/KAN	130.4	33802.4	30635.1	715.8	0.0	2481.5	159.4*	98.3	14.4*	100.4	0.0
10 PARAKRAMA SM	113.8	11521.4	9099.2	340.4	0.0	2113.2	134.4*	105.3	31.4*	82.5	0.0
11 MIN/GIRI TK	128.2	28235.8	25330.0	932.0	0.0	2081.6	157.9*	106.2	9.3*	20.4	0.0
12 KAUDULLA	107.7	6730.5	3313.6	1393.3	0.0	2079.1	128.3*	97.3	25.4*	52.1	0.0
13 KANTALAI/VEN	128.9	13844.1	8654.2	3220.9	0.0	2052.3	160.4*	101.9	3.1*	45.6	0.0
14 MADURU OYA	382.4	48638.6	42208.3	3536.3	0.0	2968.6	478.0*	339.6	0.0*	307.8	0.0
15 ULHIT/RAT	136.6	60139.0	55681.3	3156.6	0.0	1287.0	145.8*	130.7	100.0*	140.7	0.0
17 MOUSAKELLE	99.3	15799.3	11895.1	3719.9	0.0	160.1	123.4*	65.4	3.0*	123.4	0.0
18 CASTLEREIGH	36.6	9457.7	6978.6	2397.6	0.0	73.3	44.8*	25.1	3.8*	44.8	0.0
20 SAMANALAWEWA	234.4	21506.5	20013.0	1258.3	0.0	270.0	278.0*	160.5	60.0*	199.6	0.0
39 KUKU230	174.7	38733.0	30258.6	8208.6	0.0	231.5	209.0*	126.5	37.4*	209.0	0.0

Minimum recorded total system storage = 746.99

Total system inflow = 464233.3

CONVEYANCE

CONVEYANCE	Maximum capacity m3/s	Average flow m3/s	Minimum required m3/s	Total inflow Mm3	Total loss Mm3	Total supply Mm3	Total outflow Mm3	Balance Mm3	Average utilization %
1 POLGOLLA DIV	56.6	30.4	0.0	38376.7	0.0	0.0	38376.7	0.000	53.7
2 BOWAT-KDK	28.3	26.3	0.0	33233.8	1661.7	4060.7	27511.5	-0.091	93.0
3 KDK-SYSTEM H	1000.0	22.8	0.0	28700.0	0.0	27984.3	715.8	0.002	2.3
4 ELAHERA-DIYA	42.5	24.3	0.0	30612.7	0.0	4821.8	25790.9	-0.006	57.1
5 DIYA-MIN/GIR	42.5	20.4	0.0	25790.9	1289.5	0.0	24501.4	0.002	48.1
6 MIN/GI-SYSD1	1000.0	9.4	0.0	11842.9	0.0	10910.9	932.0	0.002	0.9
7 MIN/GI-ALUT	34.0	11.4	2.5	14419.1	0.0	0.0	14419.1	0.000	33.6
8 KAU-SYS D1	1000.0	3.7	0.0	4706.9	0.0	3313.6	1393.3	0.004	0.4
9 ALUT-KANTA	34.0	9.6	0.0	12139.8	1214.0	0.0	10925.8	0.003	28.3
10 KANTA-SYS D1	1000.0	9.4	0.0	11875.0	0.0	8654.2	3220.9	-0.004	0.9
11 ANGAM-PARAK	14.2	8.7	0.0	10927.6	546.4	0.0	10381.2	-0.010	61.0
12 PARAK-SYS D2	1000.0	7.5	0.0	9439.6	0.0	9099.2	340.4	0.002	0.7
13 MINI-ULH/RAT	64.0	40.7	0.0	51313.0	0.0	0.0	51313.0	0.000	63.5
14 UL/RAT SYS C	1000.0	16.1	0.0	20338.3	0.0	20338.3	0.0	0.001	1.6
15 UL/RAT-MADUR	39.1	28.0	0.0	35342.9	0.0	0.0	35342.9	0.000	71.6
16 MADUR-SYS B	1000.0	33.5	0.0	42208.3	0.0	42208.3	0.0	0.007	3.3
17 MINI-TALA	18.4	4.2	1.6	5328.2	0.0	0.0	5328.2	0.000	22.9
18 TALA-SYS E	1000.0	7.3	0.0	9149.9	0.0	5522.8	3627.1	-0.004	0.7
19 ROTA-SYS A	1000.0	135.3	0.0	170727.3	0.0	6366.5	164360.8	-0.076	13.5
20 WIMA-OLDLAX	15.0	9.2	0.0	11644.3	0.0	0.0	11644.3	0.000	61.5
21 KDK-SYS IH	35.4	2.1	2.1	2650.8	0.0	2638.2	12.6	0.001	5.9
23 SAMWEWA SM	1000.0	1.6	0.0	2039.9	0.0	2039.9	0.0	0.000	0.2

WATER DEMANDS FOR YEAR 1995 : CASE : CB

	Demand factor	Total demand	Restricted demand	Total supply	Restricted deficit	Total deficit
11 SYSTEM MH	1.0000	4060.71	4060.71	4060.71	0.00	0.00
1 SYSTEM H KK	1.0000	28548.25	28548.25	27984.27	563.98	563.98
2 SYSTEM G	1.0000	4937.85	4937.85	4821.81	116.04	116.04
3 SYSTEM D1 MG	1.0000	10975.63	10975.63	10910.90	64.73	64.73
4 SYSTEM D1 KD	1.0000	3320.60	3320.60	3313.59	7.01	7.01
5 SYSTEM D1 KT	1.0000	8723.38	8723.38	8654.17	69.21	69.21
6 SYSTEM D2	1.0000	9120.91	9120.91	9099.20	21.71	21.71
7 SYSTEM C	1.0000	20467.52	20467.52	20338.34	129.17	129.17
8 SYSTEM B	1.0000	42297.11	42297.11	42208.27	88.84	88.84
9 SYSTEM E	1.0000	5522.80	5522.80	5522.80	0.00	0.00
10 SYSTEM A	1.0000	6368.04	6368.04	6366.53	1.51	1.51
12 SYSTEM IH	1.0000	2638.22	2638.22	2638.22	0.00	0.00
14 SMWEWA SM	1.0000	2040.29	2040.29	2039.89	0.40	0.40

Deficit occurrences as percentage of monthly demands

% Intervals	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Total
SYSTEM H KK	4	4	4	4	6	0	0	0	0	0	22
SYSTEM G	0	0	0	0	0	1	2	3	1	0	7
SYSTEM D1 MG	3	2	1	0	0	0	0	0	1	0	7
SYSTEM D1 KD	0	1	1	1	0	0	0	1	0	0	4
SYSTEM D1 KT	12	2	1	0	0	1	0	0	0	1	17
SYSTEM D2	10	0	0	0	0	0	0	0	0	0	10
SYSTEM C	1	0	0	1	0	0	0	0	0	1	3
SYSTEM B	1	0	1	1	0	0	0	1	0	0	4
SYSTEM E	0	0	0	0	0	0	0	0	0	0	0
SYSTEM A	1	0	0	0	0	0	0	0	0	0	1
SYSTEM MH	0	0	0	0	0	0	0	0	0	0	0
SYSTEM IH	0	0	0	0	0	0	0	0	0	0	0
SMWEWA SM	2	0	0	0	0	0	0	0	0	0	2

Number of restriction months = 0 : Total water deficit = 1062.60 Mm3 : Average = 26.57 Mm3/a : Weighted value =1417707.38 Mm3

GENERATION SUMMARY
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(Dispatch simulation by DRATE)

HYDRO =====	Installed capacity (MW)	Available capacity (MW)	Bypass flow (Mm3)	Turbine discharge (Mm3)	Average power (MW)	Energy generated (GWh/a)	Excess energy (GWh/a)	Average plant factor
1 KOTMALE	201.0	177.4	402.7	38218.7	184.6	494.6	0.0	0.3183
2 VICTORIA	210.0	185.5	4078.8	75379.3	176.0	764.5	0.0	0.4704
3 RANDENIGALA	127.2	112.4	9706.2	96904.1	100.0	393.1	0.0	0.3994
4 RANTEMBE	49.0	45.2	6870.3	120929.8	48.1	222.9	0.0	0.5635
7 BOWATENNA	40.0	38.9	0.0	22237.4	37.0	51.2	0.0	0.1502
8 UKUWELA	38.0	37.2	290.8	38376.7	37.2	165.9	0.2	0.5085
10 CANYON	60.0	55.4	310.0	15615.1	45.4	163.8	0.6	0.3375
11 NEW LAXAPANA	100.0	38.3	3050.6	18654.8	90.7	509.0	3.5	0.6578
12 WIMALASUREND	50.0	46.2	0.0	9376.2	45.4	112.4	1.7	0.2779
13 OLD LAXAPANA	50.0	45.1	490.5	11644.3	48.0	295.2	5.2	0.7467
14 POLIPITIYA	75.0	65.3	2648.6	33791.5	66.9	440.5	10.9	0.7590
16 SAMANALAWEWA	120.0	110.8	105.8	19231.4	110.7	363.8	3.0	0.3748
21 KUKU2302.0	101.5	93.5	1636.4	38467.2	93.1	454.3	29.8	0.5544
50 BROADLANDS	40.0	36.9	1564.5	44351.9	37.1	155.8	18.2	0.4824

Average annual hydro energies : Generated = 4586.92 GWh Excess = 73.23 GWh Dispatched = 4513.69 GWh
Minimum hydro energy dispatched : Per year = 2931.89 GWh Per day = 3.56 GWh

THERMAL =======	Installed capacity (MW)	Unit cost ($ US /MWh)	Energy generated (GWh/a)	Average plant factor	Energy equivalent GWh/a	Average plant factor	Average fuel consumption t/a
4 KELANITIS ST	50.0	33.1	240.3	0.5487	240.3	0.5487	59947.0
5 DS RFO4*20MW	20.0	29.7	110.8	0.6325	110.8	0.6325	25931.3
6 SAPUGAS EXT.	40.0	29.3	226.0	0.6449	226.0	0.6449	52154.3
7 SAPUGASKANDA	72.0	29.3	329.9	0.5230	329.9	0.5230	76142.1
8 GT DO 22MW	44.0	64.5	56.4	0.1464	56.4	0.1464	15841.1
9 KELANITIS GT	108.0	78.9	105.3	0.1113	105.3	0.1113	36200.6

Average annual dispatched thermal energy 1068.75 GWh

Maximum deficit in dispatched power = 297.05 MW
Weighted average annual energy deficit = 147.08

Average annual energy deficit 147.08 GWh

Annual (1998) demand 5729.53 GWh

Total demand over simulation period (GWh) = 229181.3 : Total deficit over simulation period (GWh) = 5883.3276

System reliability over simulation period = 97.4329 : Deficit index = 10882.5137 : Maximum deficit = 44.24 %

Deficit occurrences as percentage of monthly demands

% Intervals	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Total
ENERGY	18	13	17	15	2	0	0	0	0	0	65

Number of restriction months = 0

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ANNUAL FUEL COSTS :
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Maximum  =   82.21 10**6 $ US :  Minimum  =   16.73 10**6 $ US :        Average annual fuel cost  =   39.48 10**6 $ US

Weighted deficit cost =   0.00 $ US /MWh
Excess energy value   =   0.00 $ US /MWh  :                      Average annual net operating cost   =  39.48 10**6 $ US
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Execution on 12/10/ 91 at 15.38.58 : Program revision date - 11/10/91

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*****************************************************************************
*     FILE SYSIM.RD RUN DATA FOR PROGRAM SYSIM - SRI LANKA REV. 10/10/91    *
*  MP IRRIGATION DEMAND FORECASTS FOR YEAR 1995 :CEB POWER DEMAND FOR 1998  *
*              10th October 1991         Kukule Feasibility Study           *
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Reservoir	Maximum storage (MCM)	Minimum storage (MCM)	Active storage (MCM)	Initial content (MCM)	Maximum release m3/s
1 KOTMALE	172.60	22.00	150.60	142.48	114.00
2 VICTORIA	721.20	34.00	687.20	593.76	135.00
3 RANDENIGALA	875.00	295.00	580.00	759.00	180.00
4 RANTEMBE	20.97	4.32	16.65	17.64	180.00
7 BOWATENNA	49.90	16.70	33.20	43.26	90.00
8 KAL/DAM/KAN	159.40	14.40	145.00	130.40	-1.00
10 PARAKRAMA SM	134.45	31.45	103.00	113.85	-1.00
11 MIN/GIRI TK	157.92	9.26	148.66	128.19	-1.00
12 KAUDULLA	128.28	25.43	102.85	107.71	-1.00
13 KANTALAI/VEN	160.35	3.11	157.24	128.90	-1.00
14 MADURU OYA	478.00	0.00	478.00	382.40	-1.00
15 ULHIT/RAT	145.78	99.97	45.81	136.62	-1.00
17 MOUSAKELLE	123.40	2.96	120.44	99.31	36.00
18 CASTLEREIGH	44.80	3.82	40.98	36.60	29.73
20 SAMANALAWEWA	278.00	60.00	218.00	234.40	44.00
40 KUKU242	395.60	37.40	358.20	323.96	76.00
TOTALS :	4045.65	659.82	3385.83	3368.48	

Reference reservoir and monthly adjustment for use in percentage fullness allocation procedure :

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1 KOTMALE	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2 VICTORIA	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3 RANDENIGALA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4 RANTEMBE	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
7 BOWATENNA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
8 KAL/DAM/KAN	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10 PARAKRAMA SM	2	5.00	3.00	2.00	1.00	0.90	0.70	0.50	0.50	0.50	0.90	1.00	3.00
11 MIN/GIRI TK	2	1.00	0.50	0.01	0.01	0.01	0.01	0.01	0.01	0.01	2.00	3.00	4.00
12 KAUDULLA	2	7.00	1.00	0.80	0.80	0.80	0.80	0.80	0.80	1.00	12.00	15.00	15.00
13 KANTALAI/VEN	2	2.00	1.00	0.20	0.20	0.20	0.15	0.15	0.15	1.00	2.00	5.00	5.00
14 MADURU OYA	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
15 ULHIT/RAT	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
17 MOUSAKELLE	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18 CASTLEREIGH	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20 SAMANALAWEWA	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40 KUKU242	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Hydroelectric plant		Installed capacity (MW)	Available capacity (MW)	ROR cut-off flow (m3/s)	ROR cut-off slope
1	KOTMALE	201.00	177.38	3.00	1.00
2	VICTORIA	210.00	185.50	3.00	1.00
3	RANDENIGALA	127.20	112.36	2.00	1.00
4	RANTEMBE	49.00	45.16	2.00	1.00
7	BOWATENNA	40.00	38.57	2.00	1.00
8	UKUWELA	38.00	37.24	2.00	1.00
10	CANYON	60.00	55.40	2.00	1.00
11	NEW LAXAPANA	100.00	88.33	2.00	1.00
12	WIMALASUREND	50.00	46.17	2.00	1.00
13	OLD LAXAPANA	50.00	45.13	2.00	1.00
14	POLIPITIYA	75.00	66.25	2.00	1.00
16	SAMANALAWEWA	120.00	110.80	2.00	1.00
50	BROADLANDS	40.00	36.87	3.00	1.00
57	KUKU2422.5	136.20	125.53	3.00	1.00
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Totals :		1296.40	1170.98		

Thermal plant fixed data from files : sexsi.fuel (fuel); wasp.texist (existing and committed plant); wasp.therm (new plant)

Thermal plant		Installed capacity MW	No. of units	Unit cost $ US /MWh	Availability factor	Forced outage rate per cent	Min. stable load MW	Cost at M.S.L. $ US /MWh
4	KELANITIS ST	50.00	2	33.14	0.8906	20.00	0.00	-1.00
5	DS RFO4+20MW	20.00	1	29.66	0.9176	15.00	0.00	-1.00
6	SAPUGAS EXT.	40.00	2	29.26	0.9176	15.00	0.00	-1.00
7	SAPUGASKANDA	72.00	4	29.26	0.8355	25.00	0.00	-1.00
8	GT DO 22MW	44.00	2	64.48	0.9176	15.00	0.00	-1.00
9	KELANITIS GT	108.00	6	78.94	0.8904	20.00	0.00	-1.00

Maintenance file : wasp.maint
Monthly plant availabilities
after planned and forced outages

			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4	KELANITIS ST	1	0.000	0.544	0.800	0.800	0.800	0.900	0.800	0.900	0.900	0.800	0.800	0.800
4	KELANITIS ST	2	0.800	0.800	0.544	0.000	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
5	DS RFO4*20MW	1	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
6	SAPUGAS EXT.	1	0.025	0.850	0.850	0.950	0.950	0.950	0.850	0.850	0.950	0.850	0.950	0.950
6	SAPUGAS EXT.	2	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
7	SAPUGASKANDA	1	0.750	0.750	0.750	0.000	0.022	0.750	0.750	0.750	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	2	0.750	0.750	0.750	0.750	0.750	0.022	0.000	0.750	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	3	0.750	0.750	0.750	0.750	0.750	0.750	0.000	0.045	0.750	0.750	0.750	0.750
7	SAPUGASKANDA	4	0.000	0.000	0.728	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
8	GT DO 22MW	1	0.025	0.950	0.850	0.850	0.850	0.350	0.850	0.850	0.850	0.850	0.850	0.850
8	GT DO 22MW	2	0.025	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
9	KELANITIS GT	1	0.800	0.256	0.256	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	2	0.800	0.800	0.800	0.000	0.544	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	3	0.800	0.800	0.544	0.000	0.800	0.800	0.800	0.800	0.900	0.800	0.800	0.800
9	KELANITIS GT	4	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.752	0.000	0.592	0.800	0.800
9	KELANITIS GT	5	0.800	0.256	0.256	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
9	KELANITIS GT	6	0.800	0.800	0.800	0.800	0.800	0.560	0.000	0.800	0.800	0.800	0.800	0.800
	Total (MW) :		149.55	229.32	237.80	206.50	251.10	251.38	227.40	255.25	254.40	265.06	268.80	268.80
	Maximum unit capacity (MW) :		20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00

Generation demands

Name of Demand File: wasp.gp91 Year: 1998

BASE SCENARIO - SRI LANKA POWER SYSTEM

Load (MW) as Function of Relative Duration

Season	Hours Dur:	0.00	0.02	0.07	0.15	0.50	0.85	0.95	1.00	1.00
1	744.	964.	926.	851.	671.	565.	432.	394.	336.	0.
2	672.	980.	941.	865.	682.	550.	439.	390.	361.	0.
3	744.	982.	943.	867.	693.	595.	450.	421.	284.	0.
4	720.	983.	944.	858.	703.	587.	431.	362.	313.	0.
5	744.	988.	949.	882.	697.	580.	443.	404.	255.	0.
6	720.	1001.	952.	873.	696.	598.	449.	409.	349.	0.
7	744.	999.	960.	882.	706.	617.	469.	429.	379.	0.
8	744.	1003.	963.	885.	698.	589.	450.	430.	319.	0.
9	720.	1012.	982.	893.	714.	605.	464.	434.	383.	0.
10	744.	1039.	988.	887.	744.	641.	466.	446.	394.	0.
11	720.	1040.	999.	887.	765.	611.	456.	415.	342.	0.
12	744.	1036.	995.	904.	752.	609.	465.	423.	361.	0.

With demand multiplier 1.0896 :

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Energy per day GWh	15.0388	15.1847	15.6116	15.3605	15.4264	15.6719	16.1026	15.6590	16.0650	16.6126	16.3094	16.3168
Energy per month GWh	466.20	425.17	483.96	460.81	478.22	470.16	499.18	485.43	481.95	514.99	489.28	505.82

Restriction reduction factors :

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Power	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Energy	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90

Demand index exponent = 1.50 : Demand index factor = 1.00 : Deficit cost = 0.00 mills/KWh : Excess value = 0.00 mills/KWh

INFLOW SERIES
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AVERAGE FLOWS IN m3/s

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 KOTMALE/KOTM	44.33	39.44	26.73	17.85	10.84	8.56	13.89	24.23	43.83	48.90	44.95	40.46	30.34
2 MAHAW/POLGOL	55.24	54.76	34.79	14.64	8.92	7.78	18.71	34.58	57.07	53.46	46.56	44.53	35.92
3 MAHAW/VICTOR	27.29	39.96	42.70	31.35	20.56	11.29	15.75	19.28	19.68	20.14	19.93	18.39	23.86
4 MAHAW/RANDEN	17.14	30.15	44.11	40.89	23.30	10.11	10.09	10.35	5.25	7.45	7.91	8.42	18.02
5 MAHAW/RANTEM	18.68	27.38	33.66	34.01	20.76	15.66	22.09	17.25	11.05	10.45	8.57	9.62	19.12
6 MAHAW/AMBAN	45.39	72.38	155.99	177.34	112.39	70.24	51.13	36.26	24.09	18.31	20.29	24.91	67.39
7 BOWATENNA	12.89	20.83	32.97	25.87	18.45	10.97	11.43	8.21	6.30	5.91	5.22	5.33	13.70
8 AMBAN/ELAHER	8.61	16.45	31.85	30.04	18.92	10.59	8.18	6.14	4.19	4.54	3.82	3.52	12.24
9 AMBAN/AMGAM	8.00	23.50	79.59	73.14	52.67	23.67	16.53	5.95	3.89	4.30	4.36	5.15	25.06
10 MOUSAKELLE	16.19	13.22	6.96	4.17	3.45	3.99	7.09	17.44	24.83	19.24	16.29	16.90	12.48
11 CANYON	3.04	2.41	1.24	0.78	0.68	0.81	1.36	3.33	4.77	3.80	3.33	3.28	2.40
12 LAXAPANA PND	3.71	2.92	1.47	0.97	0.83	0.95	1.55	3.51	5.17	4.46	3.84	3.73	2.76
13 CASTLEREIGH	9.94	8.58	5.36	3.24	2.58	2.98	5.18	9.96	13.47	10.53	8.76	9.09	7.47
14 NORTON	3.24	2.66	1.37	0.98	0.85	0.88	1.35	3.06	4.96	4.10	3.50	3.31	2.52
15 KAL/DAM/KAN	6.86	13.83	17.23	5.22	2.67	2.71	6.88	2.56	0.15	0.36	0.22	0.97	4.97
17 MIN/GI	2.77	7.77	11.64	4.21	2.44	1.56	2.87	1.30	0.01	0.26	0.12	0.47	2.95
18 ALUT	3.09	9.93	14.29	4.99	2.63	1.47	2.80	1.57	0.03	0.43	0.26	0.70	3.52
19 KANTALAI/VEN	2.02	6.34	9.32	3.12	2.01	1.21	2.06	0.95	0.01	0.19	0.10	0.36	2.31
20 PARAKRAMA SM	0.68	2.23	3.77	1.36	0.94	0.50	0.71	0.31	0.00	0.09	0.05	0.18	0.90
21 MADURU OYA	5.27	18.50	38.72	26.72	16.14	6.41	5.58	4.25	1.12	1.00	1.09	1.53	10.53
22 ULHIT/RAT	3.24	16.01	25.88	17.68	9.40	3.17	4.95	2.05	0.06	0.28	0.47	0.67	6.99
23 MINIPE L.B.	3.29	13.50	23.05	14.24	7.66	3.25	4.30	1.91	0.17	0.30	0.35	0.58	6.05
24 SAMANALA	15.53	25.95	22.99	15.70	12.09	17.17	26.39	22.49	16.01	10.53	9.08	10.43	17.03
50 BROADLANDS	10.93	9.15	5.21	3.26	2.67	3.02	5.17	11.09	15.79	12.59	10.56	10.69	8.34
56 KUKU	45.23	40.84	23.99	14.92	10.58	13.03	23.24	46.60	52.09	33.98	28.73	34.09	30.61
TOTALS :	372.61	518.69	694.90	566.65	364.41	232.29	269.27	294.61	315.02	275.65	248.37	257.31	367.48

IRRIGATION AREA
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AVERAGE WATER DEMANDS FOR YEAR 1995 , CASE CB IN m3/s

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 SYSTEM H KK	18.99	33.55	25.51	37.79	34.57	3.05	11.61	28.22	34.81	31.12	12.65	0.26	22.68
2 SYSTEM G	1.04	4.11	2.20	2.38	4.36	1.81	1.08	7.43	9.93	7.73	4.56	0.35	3.91
3 SYSTEM D1 MG	2.21	8.85	5.12	6.64	10.78	4.49	2.48	16.10	21.61	15.96	9.54	0.70	8.71
4 SYSTEM D1 KD	0.67	2.68	1.55	2.01	3.26	1.36	0.75	4.87	6.54	4.83	2.89	0.21	2.63
5 SYSTEM D1 KT	4.32	4.81	1.41	5.91	5.66	3.10	6.56	13.68	15.60	11.59	6.68	3.62	6.91
6 SYSTEM D2	1.87	7.45	4.27	5.06	8.10	3.59	2.06	13.83	18.30	13.58	8.08	0.58	7.23
7 SYSTEM C	12.97	16.10	5.54	8.71	13.75	2.83	14.10	34.00	36.89	32.56	12.94	2.16	16.21
8 SYSTEM B	44.90	27.84	13.74	30.62	14.04	9.95	55.89	72.13	76.35	42.39	4.53	9.10	33.46
9 SYSTEM E	1.12	4.00	2.26	1.56	3.87	2.15	1.17	8.57	11.92	9.85	5.55	0.44	4.37
10 SYSTEM A	1.30	5.14	3.16	4.00	6.34	2.68	1.56	9.52	12.50	9.04	5.01	0.38	5.05
11 SYSTEM MH	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	0.00	0.00	0.00	4.30	3.23
12 SYSTEM IH	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09
14 SMWEWA SM	1.65	0.85	1.25	1.85	2.25	0.95	1.35	1.95	2.65	2.45	2.20	0.00	1.62
TOTALS :	97.43	121.77	72.41	112.92	113.36	42.35	105.00	216.70	251.18	183.19	76.71	24.20	118.10

FRACTION OF DEMAND MET UNDER RESTRICTION REGIME

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1 SYSTEM H KK	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
2 SYSTEM G	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
3 SYSTEM D1 MG	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
4 SYSTEM D1 KD	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
5 SYSTEM D1 KT	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
6 SYSTEM D2	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
7 SYSTEM C	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
8 SYSTEM B	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
9 SYSTEM E	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
10 SYSTEM A	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
11 SYSTEM MH	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
12 SYSTEM IH	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
14 SMWEWA SM	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	

DEMAND FORECAST FOR YEAR 1998 : SIMULATION PERIOD FROM 1949 TO 1988

MINIMUM THERMAL (MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

GROSS TOTAL SYSTEM STORAGE VOLUMES IN Mm3 BELOW WHICH THE FOLLOWING OPERATING REGIMES APPLY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MAX. HYDRO	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99	99999.99
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
KL.ST. 50 MW	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NEWDL.1 MW	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NS.DL. 40 MW	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
ES.DL. 80 MW	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07	3707.07
	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)	(0.9000)
NEW GT.22 MW	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99
	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)
KL.GT.120 MW	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99	1336.99
	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)	(0.2000)
WATER RESTNS	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ELECT RESTNS	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82	659.82
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

FIGURES IN PARENTHESIS INDICATE FRACTION OF ACTIVE STORAGE

WATER RESOURCE SUMMARY

RESERVOIR

	Initial content Mm3	Total inflow Mm3	Total release Mm3	Total spill Mm3	Total seepage Mm3	Total evaptn. Mm3	Maximum content Mm3	Average content Mm3	Minimum content Mm3	Final content Mm3	Overall balance Mm3
1 KOTMALE	142.5	38432.9	37891.9	327.0	0.0	183.9	172.6*	142.4	22.0*	172.6	0.0
2 VICTORIA	583.8	75398.0	69073.8	6173.0	0.0	504.1	721.2*	288.8	34.0*	230.8	0.0
3 RANDENIGALA	759.0	98002.6	93564.5	3203.8	0.0	1129.3	875.0*	771.2	324.5	864.1	0.0
4 RANTEMBE	17.6	120910.1	113790.0	7004.0	0.0	113.1	21.0*	20.7	20.6	20.6	0.0
7 BOWATENNA	43.3	55755.1	55562.4	0.6	0.0	218.8	49.9*	37.2	16.7*	16.7	0.0
8 KAL/DAM/KAN	130.4	33791.4	30631.3	709.5	0.0	2480.6	159.4*	98.2	14.4*	100.4	0.0
10 PARAKRAMA SM	113.8	11547.6	9101.4	352.9	0.0	2124.7	134.4*	105.5	31.4*	82.5	0.0
11 MIN/GIRI TK	128.2	28296.0	25381.5	934.9	0.0	2082.0	157.9*	106.1	9.3*	25.8	0.0
12 KAUDULLA	107.7	6730.1	3313.2	1400.1	0.0	2072.5	128.3*	97.1	25.4*	52.1	0.0
13 KANTALAI/VEN	128.9	13890.0	8654.0	3249.6	0.0	2069.8	160.4*	103.2	3.1*	45.5	0.0
14 MADURU OYA	382.4	48633.4	42208.3	3529.8	0.0	2969.9	478.0*	340.0	0.0*	307.8	0.0
15 ULHIT/RAT	136.6	60135.9	55669.4	3173.2	0.0	1289.3	145.8*	130.9	100.0*	140.7	0.0
17 MOUSAKELLE	99.3	15799.3	12334.5	3280.5	0.0	160.2	123.4*	64.6	3.0*	123.4	0.0
18 CASTLEREIGH	36.6	9457.7	7294.9	2081.3	0.0	73.3	44.8*	24.8	3.8*	44.8	0.0
20 SAMANALAWEWA	234.4	21506.5	19973.7	1301.2	0.0	271.9	278.0*	161.8	60.0*	194.1	0.0
40 KUKU242	324.0	38733.0	32720.2	5628.6	0.0	312.6	395.6*	219.8	37.4*	395.6	0.0

Minimum recorded total system storage = 746.81 Total system inflow = 464233.3

CONVEYANCE

	Maximum capacity m3/s	Average flow m3/s	Minimum required m3/s	Total inflow Mm3	Total loss Mm3	Total supply Mm3	Total outflow Mm3	Balance Mm3	Average utilization %
1 POLGOLLA DIV	56.6	30.5	0.0	38468.4	0.0	0.0	38468.4	0.000	53.9
2 BOWAT-KDK	29.3	26.3	0.0	33222.3	1661.1	4060.7	27500.5	-0.099	92.9
3 KDK-SYSTEM H	1000.0	22.7	0.0	28690.0	0.0	27980.5	709.5	-0.001	2.3
4 ELAHERA-DIYA	42.5	24.3	0.0	30676.1	0.0	4821.8	25854.3	-0.018	57.2
5 DIYA-MIN/GIR	42.5	20.5	0.0	25854.3	1292.7	0.0	24561.6	0.007	48.2
6 MIN/GI-SYSD1	1000.0	9.4	0.0	11846.5	0.0	10911.7	934.9	0.000	0.9
7 MIN/GI-ALUT	34.0	11.5	2.5	14469.8	0.0	0.0	14469.8	0.000	33.7
8 KAU-SYS D1	1000.0	3.7	0.0	4713.3	0.0	3313.2	1400.1	0.002	0.4
9 ALUT-KANTA	34.0	9.7	0.0	12190.8	1219.1	0.0	10971.7	-0.004	28.4
10 KANTA-SYS D1	1000.0	9.4	0.0	11903.6	0.0	8654.0	3249.6	-0.004	0.9
11 ANGAM-PARAK	14.2	8.7	0.0	10955.2	547.8	0.0	10407.4	-0.012	61.1
12 PARAK-SYS D2	1000.0	7.5	0.0	9454.3	0.0	9101.4	352.9	0.002	0.7
13 MINI-ULH/RAT	64.0	40.7	0.0	51309.9	0.0	0.0	51309.9	0.000	63.5
14 UL/RAT SYS C	1000.0	16.1	0.0	20331.6	0.0	20331.6	0.0	-0.002	1.6
15 UL/RAT-MADUR	39.1	28.0	0.0	35337.7	0.0	0.0	35337.7	0.000	71.6
16 MADUR-SYS B	1000.0	33.5	0.0	42208.3	0.0	42208.3	0.0	0.007	3.3
17 MINI-TALA	18.4	4.2	1.6	5328.2	0.0	0.0	5328.2	0.000	22.9
18 TALA-SYS E	1000.0	7.3	0.0	9149.9	0.0	5522.8	3627.1	-0.004	0.7
19 ROTA-SYS A	1000.0	135.2	0.0	170553.3	0.0	6366.0	164187.1	0.121	13.5
20 WIMA-OLDLAX	15.0	9.2	0.0	11619.0	0.0	0.0	11619.0	0.000	61.4
21 KDK-SYS IH	35.4	2.1	2.1	2650.8	0.0	2638.2	12.6	0.001	5.7
23 SAMWEWA SM	1000.0	1.6	0.0	2039.9	0.0	2039.9	0.0	0.000	0.2

WATER DEMANDS FOR YEAR 1995 : CASE : 3B

WATER DEMANDS FOR YEAR 1995 : CASE : C

	Demand factor	Total demand	Restricted demand	Total supply	Restricted deficit	Total deficit
11 SYSTEM MH	1.0000	4060.71	4060.71	4060.71	0.00	0.00
1 SYSTEM H KK	1.0000	28548.25	28548.25	27980.46	567.79	567.79
2 SYSTEM G	1.0000	4937.85	4937.85	4821.81	116.04	116.04
3 SYSTEM D1 MG	1.0000	10975.63	10975.63	10911.67	63.96	63.96
4 SYSTEM D1 KD	1.0000	3320.60	3320.60	3313.22	7.38	7.38
5 SYSTEM D1 KT	1.0000	8723.38	8723.38	8654.01	69.37	69.37
6 SYSTEM D2	1.0000	9120.91	9120.91	9101.38	19.53	19.53
7 SYSTEM C	1.0000	20467.52	20467.52	20331.64	135.88	135.88
8 SYSTEM B	1.0000	42297.11	42297.11	42208.27	88.84	88.84
9 SYSTEM E	1.0000	5522.80	5522.80	5522.80	0.00	0.00
10 SYSTEM A	1.0000	6368.04	6368.04	6366.00	2.03	2.03
12 SYSTEM IH	1.0000	2638.22	2638.22	2638.22	0.00	0.00
14 SMWEWA SM	1.0000	2040.29	2040.29	2039.89	0.40	0.40

Deficit occurrences as percentage of monthly demands

% Intervals	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Total
SYSTEM H KK	3	5	4	4	6	0	0	0	0	0	22
SYSTEM G	0	0	0	0	0	1	2	3	1	0	7
SYSTEM D1 MG	3	1	1	0	0	0	0	0	1	0	6
SYSTEM D1 KD	0	0	2	1	0	0	0	1	0	0	4
SYSTEM D1 KT	12	2	1	0	0	1	0	0	0	1	17
SYSTEM D2	9	0	0	0	0	0	0	0	0	0	9
SYSTEM C	1	0	0	0	1	0	0	0	0	1	3
SYSTEM B	1	0	1	1	0	0	0	1	0	0	4
SYSTEM E	0	0	0	0	0	0	0	0	0	0	0
SYSTEM A	2	0	0	0	0	0	0	0	0	0	2
SYSTEM MH	0	0	0	0	0	0	0	0	0	0	0
SYSTEM IH	0	0	0	0	0	0	0	0	0	0	0
SMWEWA SM	2	0	0	0	0	0	0	0	0	0	2

Number of restriction months = 0 : Total water deficit = 1071.22 Mm3 : Average = 26.78 Mm3/a : Weighted value =1437450.13 Mm3

GENERATION SUMMARY

(Dispatch simulation by DRATE

HYDRO	Installed capacity (MW)	Available capacity (MW)	Bypass flow (Mm3)	Turbine discharge (Mm3)	Average power (MW)	Energy generated (GWh/a)	Excess energy (GWh/a)	Average plant factor
1 KOTMALE	201.0	177.4	394.1	38218.9	184.6	494.5	0.0	0.3183
2 VICTORIA	210.0	185.5	4242.8	75246.9	176.7	762.5	0.0	0.4692
3 RANDENIGALA	127.2	112.4	9890.1	96768.3	100.4	392.2	0.0	0.3985
4 RANTEMBE	49.0	45.2	7047.2	120794.0	48.1	222.0	0.0	0.5611
7 BOWATENNA	40.0	38.9	0.0	22340.6	37.0	51.4	0.0	0.1510
8 UKUWELA	38.0	37.2	290.8	38468.4	37.2	166.2	0.2	0.5094
10 CANYON	60.0	55.4	271.7	15615.0	45.4	163.6	0.6	0.3372
11 NEW LAXAPANA	100.0	88.3	2975.9	18654.8	90.7	511.3	2.7	0.6608
12 WIMALASUREND	50.0	46.2	0.0	9376.2	45.4	112.3	1.5	0.2776
13 OLD LAXAPANA	50.0	45.1	520.8	11619.0	48.0	293.5	5.0	0.7424
14 POLIPITIYA	75.0	66.3	2563.7	33766.2	66.9	440.7	10.8	0.7593
16 SAMANALAWEWA	120.0	110.8	59.0	19235.0	110.7	365.4	3.4	0.3764
50 BROADLANDS	40.0	36.9	1545.9	44326.6	37.1	155.7	9.5	0.4821
57 KUKU2422.5	136.2	125.5	454.8	38348.8	116.1	462.9	29.4	0.4209

Average annual hydro energies : Generated = 4594.14 GWh Excess = 63.09 GWh Dispatched = 4531.05 GWh
Minimum hydro energy dispatched : Per year = 2899.62 GWh Per day = 3.54 GWh

THERMAL	Installed capacity (MW)	Unit cost ($ US /MWh)	Energy generated (GWh/a)	Average plant factor	Energy equivalent GWh/a	Average plant factor	Average fuel consumption t/a
4 KELANITIS ST	50.0	33.1	244.7	0.5587	244.7	0.5587	61050.1
5 DS RFO4+20MW	20.0	29.7	112.3	0.6407	112.3	0.6407	26265.7
6 SAPUGAS EXT.	40.0	29.3	229.8	0.6559	229.8	0.6559	53044.9
7 SAPUGASKANDA	72.0	29.3	332.8	0.5276	332.8	0.5276	76810.9
8 GT DO 22MW	44.0	64.5	55.5	0.1441	55.5	0.1441	15588.3
9 KELANITIS GT	108.0	78.9	108.2	0.1144	108.2	0.1144	37184.0

Average annual dispatched thermal energy 1083.32 GWh

Maximum deficit in dispatched power = 302.13 MW
Weighted average annual energy deficit = 150.61

Average annual energy deficit 150.61 GWh

Annual (1995) demand 5764.97 GWh

Total demand over simulation period (GWh) = 230598.6 : Total deficit over simulation period (GWh) = 6024.2588

System reliability over simulation period = 97.3876 : Deficit index = 11095.3242 : Maximum deficit = 44.67 %

Deficit occurrences as percentage of monthly demands

% Intervals	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Total
ENERGY	17	13	18	14	2	0	0	0	0	0	64

Number of restriction months = 0

ANNUAL FUEL COSTS :
=================

```
Maximum  =   84 98 10**6 $ US :  Minimum  =   15 21 10**6 $ US .       Average annual fuel cost   =   40 03 10**6 $ US

Weighted deficit cost =   0.00 $ US /MWh
Excess energy value   =   0.00 $ US /MWh  .                  Average annual net operating cost   =  40.03 10**6 $ US
```

ANNEX D of 6A.3

RESULTS OF SYSTEM EXPANSION ANALYSIS

Included in this annex are the WASP system expansion sequences to Year 2006.

Results of Generation Expansion Planning Studies - KUKU ROR ICF = 1.25
Project committed in 1999

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Diesel 20 MW Gas Turbine 22 MW	-
1998	-	Gas Turbine 44 MW	-
1999	Ging 49 MW	-	-
2000	-	Coal Mawella Unit1 150 MW	-
2001	-	-	KPS Oil Steam 2*25 MW
2002	-	Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-
Total PV cost upto 2011		1020.8 million US$ (40832 million Rs.)	
Total PV cost of fixed run with V O&M for Coal = 5$/MWh upto 2011		1075.4 million US$ (43016 million Rs.)	

Note : Discount rate 10%,

205-1.25-2000

Results of Generation Expansion Planning Studies - KUKU ROR ICF = 1.25
Project committed in 2000

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Diesel 20 MW Gas Turbine 22 MW	-
1998	-	-	-
1999	-	Coal Mawella Unit1 150 MW	-
2000	-	-	-
2001	Ging 49 MW	Gas Turbine 22 MW	KPS Oil Steam 2*25 MW
2002	-	Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-
Total PV cost upto 2011		1027.5 million US$ (41100 million Rs.)	
Total PV cost of fixed run with V O&M for Coal = 5$/MWh upto 2011		1084.1 million US$ (43364 million Rs.)	

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

205-1.25-2001

Results of Generation Expansion Planning Studies - KUKU ROR ICF = 1.25
Project committed in 2001

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Diesel 20 MW Gas Turbine 22 MW	-
1998	-	Gas Turbine 22 MW	-
1999	-	Coal Mawella Unit1 150 MW	-
2000	Ging 49 MW	-	-
2001	-	-	KPS Oil Steam 2*25 MW
2002	-	Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011	1033.7 million US$ (41348 million Rs.)
Total PV cost of fixed run with V O&M for Coal = 5$/MWh upto 2011	1090.3 million US$ (43612 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

205-150-1999

Results of Generation Expansion Planning Studies - [illegible] FOR IFF = 1 5
Project committed in 1999

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992		-	-
1993	Samaralawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda E * Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Gas Turbine 22 MW Diesel 2 MW	-
1998	-	Gas Turbine 22 MW	-
1999	Gin 49 MW	-	-
2000	-	Coal Mawella Unit 150 MW	-
2001	-	-	KPS Oil Steam 2*25 MW
2002	-	Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011 — 1017 0 million US$ (40680 million Rs)
Total PV cost of fixed run with
V O&M for Coal = 5$/MWh upto 2011 — 1071 4 million US$ (42856 million Rs)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated

205-1.5-2000

Results of Generation Expansion Planning Studies - RUN FOR ICF = 1.5
Project committed in 2000

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Gas Turbine 44 MW	-
1998	-	-	-
1999	-	Coal Mawella Unit1 150 MW	-
2000	-	-	-
2001	-	Coal Mawella Unit2 150 MW	KPS Oil Steam 2*25 MW
2002	-	-	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW Coal Trinco Unit2 150 MW	Sapu Diesel 2*18 MW
2005	Ging 49 MW	-	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011	1023.7 million US$ (40948 million Rs.)
Total PV cost of fixed run with V O&M for Coal = 5$/MWh upto 2011	1082.9 million US$ (43316 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

205-1.5-2001

Results of Generation Expansion Planning Studies - KUKU ROR ICF = 1.5
Project committed in 2001

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Diesel 20 MW Gas Turbine 22 MW	-
1998	-	Gas Turbine 22 MW	-
1999	-	Coal Mawella Unit1 150 MW	-
2000	Ging 49 MW	-	-
2001		-	KPS Oil Steam 2*25 MW
2002		Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003		Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004		Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011 1030.9 million US$ (41236 million Rs.)
Total PV cost of fixed run with
V O&M for Coal = 5$/MWh upto 2011 1087.4 million US$ (43496 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

205-2.0-1999

Results of Generation Expansion Planning Studies - KUKU ROR ICF = 2.0
Project committed in 1999

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Diesel 20 MW Gas Turbine 22 MW	
1998	-	Gas Turbine 22 MW	-
1999	Ging 49 MW	-	-
2000	-	Coal Mawella Unit1 150 MW	-
2001	-	-	KPS Oil Steam 2*25 MW
2002	-	Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011	1014.3 million US$ (40572 million Rs.)
Total PV cost of fixed run with V O&M for Coal = 5$/MWh upto 2011	1068.6 million US$ (42744 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

205-20-2000

Results of Generation Expansion Planning Studies - KUKU ROR ICF = 2.0

Project committed in 2000

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Diesel 20 MW Gas Turbine 22 MW	-
1998	-	-	-
1999	-	Coal Mawella Unit1 150 MW	-
2000	-	-	-
2001	Ging 49 MW	Gas Turbine 22 MW	KPS Oil Steam 2*25 MW
2002		Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003		Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004		Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011 1022.1 million US$ (40884 million Rs.)
Total PV cost of fixed run with
V O&M for Coal =54/MWh upto 2011 1078.5 million US$ (43140 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

205-20-2001

Results of Generation Expansion Planning Studies - KUKU ROR ICF = 2.0 -
Project committed in 2001

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	-	Diesel 40 MW Gas Turbine 22 MW	
1998	-	-	-
1999	-	Coal Mawella Unit1 150 MW	-
2000	GING 49 MW	-	-
2001	-	Gas Turbine 22 MW	KPS Oil Steam 2*25 MW
2002	-	Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-
Total PV cost upto 2011		1028.9 million US$ (41156 million Rs.)	
Total PV cost of fixed run with V O&M for Coal = 5$/MWh upto 2011		1085.9 million US$ (43436 million Rs.)	

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

230 - 1.5 - 1999

Results of Generation Expansion Planning Studies - KUKU230 ICF = 1.5

Project committed in 1999

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Gas Turbine 44 MW	-
1998	-	Gas Turbine 22 MW	-
1999	-	-	-
2000		Coal Mawella Unit1 150 MW	-
2001		Coal Mawella Unit2 150 MW	KPS Oil Steam 2*25 MW
2002		-	Gas Turbine 3*18 MW
2003		Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004		Refurbished GT 3*20 MW Coal Trinco Unit2 150 MW	Sapu Diesel 2*18 MW
2005	-	-	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011 : 1006.2 million US$ (40248 million Rs.)

Total PV cost of fixed run with V O&M for Coal = 5$/MWh upto 2011 : 1063.3 million US$ (42532 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

230-1.5-2000

Results of Generation Expansion Planning Studies - KUKU230 ICF = 1.5
Project committed in 2000

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Gas Turbine 44 MW	
1998	-	-	-
1999	-	Coal Mawella Unit1 150 MW	-
2000	-	-	-
2001	-	Coal Mawella Unit2 150 MW	KPS Oil Steam 2*25 MW
2002	-	-	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW Coal Trinco Unit2 150 MW	Sapu Diesel 2*18 MW
2005	-	-	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011	1013.3 million US$ (40532 million Rs.)
Total PV cost of fixed run with V O&M for Coal = 5$/MWh upto 2011	1072.5 million US$ (42900 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

230 - 1.5 - 2001

Results of Generation Expansion Planning Studies - YUYU230 ICF = 1.5
Project committed in 2001

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Gas Turbine 44 MW	-
1998	-	-	-
1999	-	Coal Mawella Unit1 150 MW	-
2000	-	-	-
2001	-	Coal Mawella Unit2 150 MW	KPS Oil Steam 2*25 MW
2002	-	-	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW Coal Trinco Unit2 150 MW	Sapu Diesel 2*18 MW
2005	-	-	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011 1021.9 million US$ (40876 million Rs.)
Total PV cost of fixed run with
V O&M for Coal = 5$/MWh upto 2011 1081.2 million US$ (43248 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

230-2.0-1999

Results of Generation Expansion Planning Studies - KUKU230 ICF = 2.0
Project committed in 1999

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	
1993	Samanalawewa 120 MW	-	-
1994	-	-	
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Gas Turbine 22 MW Diesel 20 MW	-
1998	-	Gas Turbine 44 MW	-
1999	-	-	-
2000	-	Coal Mawella Unit1 150 MW	-
2001	-	-	KPS Oil Steam 2*25 MW
2002	-	Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011	996.9 million US$ (39876 million Rs.)
Total PV cost of fixed run with V O&M for Coal =5$/MWh upto 2011	1051.4 million US$ (42056 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

230-2.0-2000

Results of Generation Expansion Planning Studies - KUKU230 ICF = 2.0
Project committed in 2000

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	-
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Gas Turbine 44 MW	-
1998		-	-
1999		Coal Mawella Unit1 150 MW	-
2000		-	-
2001		Coal Mawella Unit2 150 MW	KPS Oil Steam 2*25 MW
2002		-	Gas Turbine 3*18 MW
2003		Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004		Refurbished GT 3*20 MW Coal Trinco Unit2 150 MW	Sapu Diesel 2*18 MW
2005	-	-	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011 1005.9 million US$ (40236 million Rs.)
Total PV cost of fixed run with
V O&M for Coal =5$/MWh upto 2011 10'6.9 million US$ (42596 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

230-2.0-2.001

Results of Generation Expansion Planning Studies - FUKU230 ICF = 2.0
Project committed in 2001

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
1992	-	-	-
1993	Samanalawewa 120 MW	-	
1994	-	-	-
1995	-	Sapugaskanda Ext. Diesel 40 MW	-
1996	-	Diesel 20 MW	-
1997	Broadlands 40 MW	Gas Turbine 22 MW Diesel 20 MW	
1998	-	Gas Turbine 22 MW	-
1999	-	Coal Mawella Unit1 150 MW	-
2000	-	-	-
2001	-	Gas Turbine 22 MW	KPS Oil Steam 2*25 MW
2002	-	Coal Mawella Unit2 150 MW	Gas Turbine 3*18 MW
2003	-	Refurbished GT 3*20 MW Coal Trinco Unit1 150 MW	Gas Turbine 3*18 MW
2004	-	Refurbished GT 3*20 MW	Sapu Diesel 2*18 MW
2005	-	Coal Trinco Unit2 150 MW	-
2006	-	Coal Trinco Unit1 300 MW	-

Total PV cost upto 2011	1015.3 million US$ (40612 million Rs.)
Total PV cost of fixed run with V O&M for Coal = 5$/MWh upto 2011	1072.0 million US$ (42880 million Rs.)

Note : Discount rate 10%, Long term average cost calculation excludes energy contribution from existing hydro plants, plant commissioning and retirement at the begining of the year indicated.

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