8.2.3 Upper Kihansi Project

(1) Study on Dam Scale

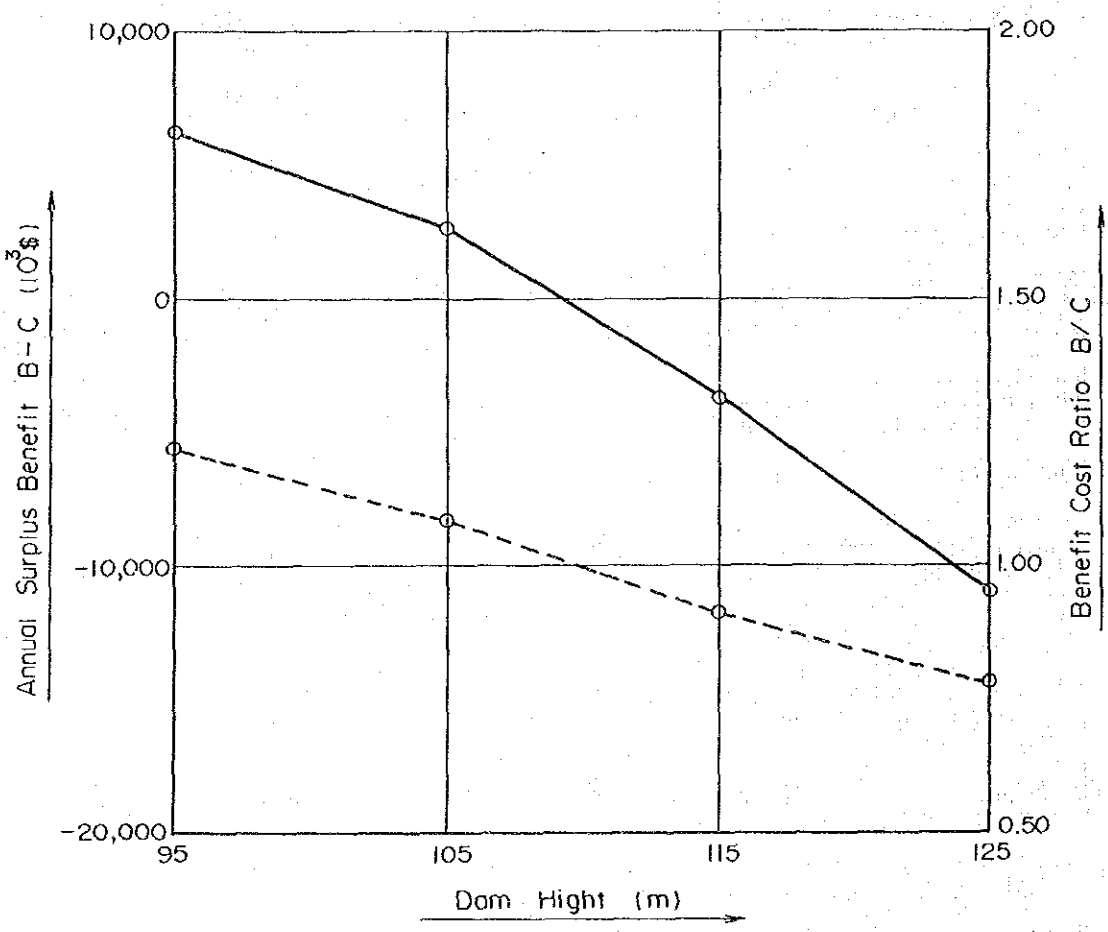
In "8.2.2 Study on Reservoir Scale", a comparison study is made based on the minimum dam scale for securing the storage capacity of each case. The economics when dam scales are increased with the optimum storage capacity fixed at 75.1×10^6 m^3 for the three cases of high water level EL. 1,370 m, 1,380 m and 1,390 m are studied, and the results are given in Table 8-8 and Fig. 8-10.

According to the results of the study, when the dam scale is made large, the head increases by the rise of intake water level through the increase in dam height and decrease in available drawdown, but the dam volume is also increased sharply, and the increase in cost due to this greatly exceeds the increase in benefit, and the economics of the Project is extremely impaired. Therefore, the dam scale with EL. 1,360 m as the high water level, which is the minimum scale of the dam required for securing the optimum storage capacity of 75.1×10^6 m^3, is taken as the optimum dam scale.

Table 8-8 Study on Optimum Dam Height of Upper Kihansi Reservoir

Item	Unit	Case 1'	Case 2'	Case 3'	Case 4
		Upper Kihansi	UpperKihansi	Upper Kihansi	Upper Kihansi
High Water Level	m	1,390.00	1,380.00	1,370.00	1,360.00
Lower Water Level	m	1,380.50	1,368.00	1,351.00	1,330.00
Available Drawdown	m	9.50	12.00	19.00	30.00
Gross Storage Capacity	10^6 m^3	279.30	200.10	140.00	94.90
Effective Storage Capacity	10^6 m^3	75.10	75.10	75.10	75.10
Dam Type		Rockfill	Rockfill	Rockfill	Rockfill
Dam Height x Length	m	125 x 680	115 x 650	105 x 620	95 x 583
Dam Volume	10^3 m^3	11,500	9,200	7,600	5,300
Maximum Discharge	m^3/s	25.70	25.70	25.70	25.70
Standard Intake Water Level	m	1,390.00	1,380.00	1,370.00	1,360.00
Tail Water Level	m	1,138.50	1,138.50	1,138.50	1,138.50
Gross Head	m	251.50	241.50	231.50	221.50
Effective Head	m	244.50	234.50	224.50	214.50
Installed Capacity	MW	54	51	49	47
Firm Peak Power	MW	100.1	96.3	92.1	86.1
Annual Energy Production	10^6 kWh	330.9	317.1	298.3	275.1
Annual Firm Energy Production	10^6 kWh	377.1	366.8	352.9	335.7
Annual Benefit					
Peak Power Benefit	10^3 US$	26,237	25,241	24,140	22,568
Firm Energy Benefit	10^3 US$	12,959	12,605	12,127	11,537
Total Benefit (B)	10^3 US$	39,196	37,846	36,267	34,105
Investment Cost					
Civil Facilities Cost	10^6 US$	443.2	362.5	293.5	239.5
Electro-Mechanical Facilities Cost	10^6 US$	27.5	26.3	22.1	21.5
Total	10^6 US$	470.7	388.8	315.6	261.0
Annual Cost					
Civil Facilities Cost	10^3 US$	46,935	38,389	31,082	25,363
Electro-Mechanical Facilities Cost	10^3 US$	3,264	3,122	2,623	2,552
Total Cost (C)	10^3 US$	50,199	41,511	33,705	27,915
Annual Surplus Benefit (B - C)	103 US$	-11,003	-3,665	2,562	6,190
Benefit Cost Ratio (B/C)		0.781	0.912	1.076	1.221
Unit Annual Cost	US$/kWh	0.133	0.113	0.096	0.083

Fig. 8-10 Study on Optimum Dam Height of Upper Kihansi Reservoir



(2) Study on Maximum Discharge and Installed Capacity

The maximum discharge and installed capacity of a hydroelectric power plant need to be selected to be the most economical considering the peak duration and site characteristics. In "8.1 Comparison Study on Development Scheme", and "8.2.2 Study on Reservoir Scale", it was decided that the peak duration time for a reservoir-type hydroelectric power plant in Tanzania is to be 13 hours as standard considering reserve capacity added to the annual load factor of the whole system, and in the Upper Kihansi Project, based on the peak duration time and firm discharge of 11.80 m^3/s and considering the effect on the Lower Kihansi Project in case of decrease in intake capability due to lowering reservoir water level, the maximum discharge is selected to be 25.7 m^3/s with installed capacity 47 MW.

The final decision on the maximum discharge and installed capacity of the Upper Kihansi Project is to be made at the time of the feasibility study for the Upper Kihansi Project to be carried out hereafter.

(3) Study on the Number of Turbine and Generator Units

The number of turbine and generator units for the Upper Kihansi Project is selected to be 1 unit considering economy of scale of the construction cost.

(4) Optimum Development Plan

The outline of the optimum development plan of the Upper Kihansi Project determined in the studies made up to this point are shown in Table 8-9. The inflows, discharges, spillover quantities when operating Upper Kihansi Reservoir for the 61-year period from 1927 to 1987 are shown in Table 8-10 and Fig. 8-11. The monthly energy production and firm energy production are shown in Tables 8-11 and 8-12, and in Fig. 8-12. The monthly peak power and peak power duration are given in Tables 8-13 and 8-14. The preliminary estimation of construction cost for the optimum development plan is shown in Table 8-15.

Table 8-9 Outline of Optimum Development Plan of Upper Kihansi Project

Reservoir	
Catchment Area	583 km^2
High Water Level	1,360.00 m
Low Water Level	1,330.00 m
Available Drawdown	30.00 m
Gross Storage Capacity	94.90 × 10^6 m^3
Effective Storage Capacity	75.10 × 10^6 m^3
Annual Average Runoff	15.68 m^3/s
Firm Discharge	11.80 m^3/s
Dam	
Type	Rockfill
Height × Length	95 m × 583 m
Volume	5,300 × 10^3 m^3
Power Station	
Standard Intake Water Level	1,360.00 m
Tail Water Level	1,138.50 m
Gross Head	221.50 m
Effective Head	214.50 m
Maximum Discharge	25.70 m^3/s
Installed Capacity	47 MW
Unit Type × Number of Unit	Vertical Francis×1
Firm Peak Power	36.9 MW (86.1 MW)
Annual Total Energy Production	237.1 × 10^6 kWh (275.1 × 10^6 kWh)
Annual Firm Energy Production	175.7 × 10^6 kWh (335.7 × 10^6 kWh)

Note: Figures in ( ) show the values of cases including power generation increase in the Lower Kihansi Project due to regulating effect of the Upper Kihansi Project

Table 8-10 Summary of Operation Study on Upper Kihansi Reservoir

Unit: 10^6 m^3

Year	Inflow	Power Discharge	Spill
1927	343.84	418.92	0.0
1928	367.62	362.46	0.0
1929	331.24	336.40	0.0
1930	398.91	385.88	0.0
1931	517.11	482.81	0.0
1932	535.32	535.59	0.0
1933	453.95	462.80	0.0
1934	430.24	420.24	0.0
1935	422.67	438.22	0.0
1936	591.59	554.66	21.38
1937	464.59	467.56	0.0
1938	282.86	328.10	0.0
1939	438.27	400.14	0.0
1940	429.74	436.79	0.0
1941	409.34	424.21	0.0
1942	506.86	474.87	0.0
1943	350.02	398.23	0.0
1944	388.25	348.31	0.0
1945	442.32	439.30	0.0
1946	362.09	396.48	0.0
1947	470.80	431.16	0.0
1948	425.00	469.62	0.0
1949	350.64	354.23	0.0
1950	380.81	365.44	0.0
1951	357.52	366.21	0.0
1952	535.32	489.06	5.01
1953	303.12	351.05	0.0
1954	280.17	280.17	0.0
1955	472.97	429.39	0.0
1956	483.50	488.18	0.0
1957	533.31	524.00	0.0
1958	531.89	531.89	0.0
1959	429.10	443.37	0.0
1960	532.18	512.63	14.85
1961	414.68	412.73	0.0
1962	720.01	620.53	91.86
1963	724.84	634.73	90.11
1964	707.91	658.32	49.59
1965	555.14	555.14	0.0
1966	547.97	560.33	0.0
1967	577.58	544.46	0.0
1968	888.16	716.93	191.99
1969	539.65	539.64	0.0
1970	543.61	543.61	0.0
1971	525.53	525.53	0.0
1972	656.89	638.13	18.76
1973	678.50	628.56	49.94
1974	636.01	613.86	22.15
1975	474.60	474.60	0.0
1976	513.02	513.06	0.0
1977	438.36	438.32	0.0
1978	476.85	476.85	0.0
1979	709.22	678.36	30.86
1980	449.57	449.57	0.0
1981	388.80	415.47	0.0
1982	412.09	385.42	0.0
1983	579.54	579.54	0.0
1984	531.98	531.98	0.0
1985	639.58	639.58	0.0
1986	755.81	704.54	51.27
1987	543.37	543.37	0.0
Average	494.79	484.78	10.46

Table 8-11 Total Energy Generation of Upper Kihansi Project

UNIT: 10^6 kWh

MONTH / YEAR	< JAN >	< FEB >	< MAR >	< APR >	< MAY >	< JUN >	< JUL >	< AUG >	< SEP >	< OCT >	< NOV >	< DEC >	<TOTAL>
1927	34.78	29.37	14.48	14.23	14.88	14.35	14.67	14.41	13.42	9.70	8.83	13.21	196.33
1928	10.53	10.50	15.93	14.39	15.27	14.85	15.28	15.12	14.42	14.61	13.84	14.13	168.88
1929	13.11	8.85	13.93	14.32	15.40	14.85	15.19	14.93	14.10	13.50	7.89	8.80	154.85
1930	13.53	9.70	22.91	15.78	15.82	15.41	15.92	15.82	15.14	15.41	14.65	14.73	184.83
1931	14.37	13.64	31.90	32.38	22.94	19.66	20.72	17.98	16.25	15.99	15.32	15.66	236.80
1932	26.91	30.46	32.22	32.62	22.02	18.85	20.19	17.76	16.13	15.99	15.33	15.67	264.17
1933	29.62	29.25	27.21	14.72	15.88	15.57	16.09	16.18	15.56	15.94	15.24	15.48	226.76
1934	26.97	23.36	15.16	14.43	15.42	15.26	15.96	16.01	15.48	15.90	15.24	16.17	205.37
1935	26.55	26.07	26.59	14.18	14.81	14.37	14.76	14.56	13.80	13.05	10.57	14.61	203.93
1936	28.27	27.77	15.70	32.02	34.96	24.29	23.35	20.14	18.03	17.53	15.35	17.70	275.11
1937	25.23	21.28	31.69	14.75	18.85	17.89	19.45	17.13	16.23	16.42	15.33	15.65	229.90
1938	16.93	18.45	14.23	13.77	14.37	13.68	11.22	9.47	8.61	9.91	9.27	9.02	148.91
1939	13.96	11.05	13.93	27.83	15.95	15.90	18.02	16.09	15.55	15.92	15.21	15.46	194.89
1940	28.71	26.14	16.35	17.37	15.85	15.47	15.99	15.92	15.27	15.60	14.89	15.20	212.78
1941	15.08	29.02	22.96	14.21	15.16	14.95	15.44	15.35	14.68	14.90	14.24	14.65	200.65
1942	16.30	21.80	30.06	24.25	18.86	18.84	20.09	17.51	15.89	15.98	15.30	17.92	232.80
1943	19.52	21.96	15.49	14.24	15.34	15.22	15.66	15.50	14.80	15.00	14.13	13.31	190.18
1944	10.66	7.89	11.84	14.46	15.86	15.52	16.04	15.94	15.27	15.54	14.82	15.31	169.15
1945	25.40	23.81	16.77	14.69	21.94	16.73	18.46	16.16	15.56	15.92	15.20	15.52	216.14
1946	16.14	17.33	14.31	21.40	15.83	15.41	15.88	15.75	15.03	15.27	14.46	14.53	191.32
1947	14.53	19.43	23.09	14.55	15.69	15.51	16.10	16.10	15.55	15.93	15.21	28.81	210.50
1948	33.58	28.09	27.84	14.29	15.14	14.82	15.32	15.23	14.56	14.76	14.07	14.28	221.98
1949	13.40	16.63	14.45	14.40	15.27	14.79	15.17	14.96	14.16	14.19	8.34	7.51	163.28
1950	7.41	9.37	20.89	14.43	15.52	15.33	15.85	15.77	15.12	15.42	14.68	14.80	174.60
1951	14.35	12.70	13.94	14.01	15.08	14.64	14.99	14.74	13.91	11.83	13.67	14.27	168.13
1952	14.43	23.57	23.00	17.69	34.63	21.94	20.75	17.88	16.06	15.98	18.84	15.71	240.48
1953	18.69	17.35	14.44	14.02	14.77	14.43	14.71	14.38	12.12	8.46	7.53	11.08	161.98
1954	15.94	11.40	11.89	13.48	13.94	10.86	9.60	8.71	7.80	7.62	6.88	6.96	123.07
1955	8.38	12.79	16.91	30.56	20.84	19.99	20.57	17.78	15.94	15.98	15.31	15.62	210.66
1956	30.88	29.14	18.07	29.98	15.96	17.57	19.07	16.61	15.56	15.94	15.22	15.48	239.49
1957	28.11	29.22	20.23	26.18	28.98	17.91	19.64	18.24	17.17	17.42	15.91	19.02	258.03
1958	25.45	25.84	31.02	29.21	22.59	16.74	18.78	17.65	16.97	17.48	15.74	23.72	261.17
1959	26.03	26.12	24.68	14.51	15.47	15.11	15.62	15.59	15.02	15.41	14.80	15.23	213.58
1960	15.17	26.09	31.90	32.34	33.92	17.97	16.81	16.11	15.45	15.77	15.07	15.42	252.01
1961	18.60	25.62	17.98	14.44	15.57	15.31	15.70	15.62	14.98	15.27	14.63	15.26	198.97
1962	34.33	31.58	34.96	33.83	34.96	24.94	24.24	21.58	17.47	19.70	17.06	20.81	315.45
1963	34.02	30.98	34.81	33.83	34.96	23.35	25.12	21.68	19.74	19.45	25.98	17.37	321.28
1964	31.14	30.60	33.39	33.49	34.96	29.50	27.54	25.00	21.86	20.89	18.75	22.19	329.30
1965	29.72	29.28	31.84	32.28	20.14	17.56	20.05	18.83	17.53	18.23	16.82	20.76	273.04
1966	29.24	28.33	32.00	32.87	30.15	19.74	20.07	19.28	17.95	15.93	15.16	15.40	276.11
1967	21.51	28.21	23.57	15.62	27.91	21.63	21.27	19.45	17.71	17.96	19.50	34.77	269.11
1968	35.09	32.71	34.96	33.83	34.96	33.83	33.43	28.11	24.76	22.92	21.96	28.52	365.07
1969	33.57	29.44	29.94	22.06	22.98	17.93	19.91	19.52	17.39	17.08	16.79	19.08	265.69
1970	33.56	30.26	34.16	33.34	15.98	15.57	18.02	17.38	16.39	16.11	15.33	25.20	271.29
1971	27.19	29.30	26.14	27.99	17.72	15.97	20.71	18.09	17.22	21.92	16.76	19.53	258.55
1972	30.12	28.22	32.27	32.70	34.96	24.54	23.02	19.46	20.49	19.90	18.51	32.71	316.90
1973	34.39	31.20	34.56	33.84	34.96	24.62	23.62	20.54	19.56	19.68	18.51	22.55	318.03
1974	33.06	29.89	31.35	32.28	34.89	26.91	23.91	19.73	19.59	19.40	17.82	15.78	304.59
1975	27.56	22.66	15.90	15.67	24.79	20.97	20.54	18.47	18.10	17.04	15.34	17.69	234.73
1976	26.00	26.76	23.51	16.88	25.15	25.24	22.98	20.05	17.89	17.66	15.35	15.70	253.17
1977	24.99	20.50	16.05	14.65	17.05	17.54	18.76	16.68	15.57	15.96	15.42	23.23	216.39
1978	27.40	24.32	21.17	15.62	22.15	19.13	19.16	16.62	15.57	15.96	15.78	22.15	235.04
1979	33.51	29.28	31.89	32.25	34.69	33.83	32.00	24.80	21.18	19.69	18.76	23.90	335.80
1980	29.14	28.09	18.04	14.47	15.69	15.59	18.17	17.14	15.72	15.99	15.33	17.51	220.87
1981	23.09	22.94	17.76	14.46	15.51	15.25	15.76	15.69	15.04	15.36	14.64	14.89	200.40
1982	14.66	13.03	14.37	14.30	15.57	15.51	16.09	16.05	15.43	15.82	15.22	22.24	188.30
1983	33.86	29.79	26.20	21.14	33.14	28.25	25.77	20.39	18.02	17.54	15.58	17.41	287.09
1984	23.80	23.64	22.27	17.06	29.06	25.05	23.57	19.44	17.83	17.90	16.37	26.97	262.98
1985	33.82	29.87	32.02	30.10	30.98	26.18	25.58	20.96	18.86	18.10	19.81	30.13	316.41
1986	33.87	30.47	33.72	33.18	34.96	33.83	31.45	26.20	21.16	19.97	22.34	32.79	353.94
1987	33.80	30.06	32.68	14.83	21.66	21.71	22.21	19.16	16.93	17.54	16.95	22.04	269.56
T O T A L	1467.94	1442.48	1433.55	1322.67	1348.70	1164.15	1180.02	1073.42	994.53	989.21	936.83	1107.22	14460.71
A V E	24.06	23.65	23.50	21.68	22.11	19.08	19.34	17.60	16.30	16.22	15.36	18.15	237.06
M A X	35.09	32.71	34.96	33.84	34.96	33.83	33.43	28.11	24.76	22.92	25.98	34.77	365.07
M I N	7.41	7.89	11.84	13.48	13.94	10.86	9.60	8.71	7.80	7.62	6.88	6.96	123.07

Table 8-12 Firm Energy Generation of Upper Kihansi Project

UNIT: 10^6 kWh

MONTH / YEAR	< JAN >	< FEB >	< MAR >	< APR >	< MAY >	< JUN >	< JUL >	< AUG >	< SEP >	< OCT >	< NOV >	< DEC >	<TOTAL>
1927	15.88	13.26	13.77	13.63	14.33	13.80	14.04	13.67	12.77	9.70	8.83	13.21	156.89
1928	10.53	10.50	13.40	13.86	14.68	14.51	14.89	14.68	13.89	13.96	13.08	13.26	161.46
1929	13.11	8.85	13.00	13.76	15.06	14.50	14.77	14.40	13.45	13.28	7.69	8.80	150.85
1930	12.93	9.70	13.40	14.32	15.67	15.31	15.81	15.67	14.92	15.08	14.22	14.12	171.15
1931	13.61	12.27	14.01	14.53	15.93	15.57	16.09	16.09	15.54	15.91	15.18	15.44	180.15
1932	15.03	13.50	14.21	14.68	16.05	15.57	16.09	16.09	15.54	15.91	15.20	15.46	183.31
1933	15.02	12.93	13.85	14.32	15.76	15.54	16.09	16.09	15.52	15.84	15.06	15.18	181.19
1934	14.85	12.88	13.78	13.92	15.10	15.09	15.86	15.94	15.40	15.79	15.06	15.39	179.05
1935	15.04	12.88	13.78	13.55	14.24	13.83	14.17	13.88	13.03	13.05	10.57	13.95	161.98
1936	14.74	13.34	13.78	14.74	16.09	15.57	16.09	16.09	15.54	15.91	15.22	15.50	182.59
1937	15.04	12.88	13.87	14.36	15.86	15.57	16.09	16.09	15.54	15.91	15.20	15.42	181.81
1938	14.99	12.88	13.42	12.99	13.62	12.86	11.22	9.47	8.61	9.91	9.27	9.02	138.23
1939	13.04	11.05	13.00	14.06	15.86	15.57	16.09	16.09	15.50	15.81	15.02	15.16	176.24
1940	14.85	13.34	13.78	14.32	15.71	15.39	15.91	15.81	15.10	15.35	14.56	14.79	178.92
1941	14.61	12.78	13.79	13.60	14.73	14.65	15.13	15.00	14.27	14.36	13.65	14.01	170.58
1942	14.35	12.88	13.78	14.32	15.87	15.57	16.09	16.09	15.54	15.90	15.15	15.44	180.97
1943	15.04	12.88	13.78	13.64	14.98	15.03	15.44	15.22	14.44	14.51	13.48	13.31	171.75
1944	10.66	7.89	11.84	13.96	15.72	15.47	15.97	15.84	15.10	15.26	14.46	14.93	167.11
1945	14.89	12.88	13.78	14.28	15.83	15.57	16.09	16.09	15.51	15.81	15.00	15.23	180.96
1946	14.95	12.88	13.53	14.15	15.68	15.30	15.75	15.56	14.76	14.88	13.95	13.84	175.21
1947	13.83	12.60	13.78	14.08	15.48	15.45	16.09	16.09	15.51	15.82	15.02	15.35	179.08
1948	15.09	13.40	13.78	13.71	14.70	14.46	14.95	14.83	14.10	14.17	13.41	13.50	170.09
1949	13.05	12.05	13.74	13.88	14.88	14.42	14.75	14.44	13.53	13.36	8.34	7.51	153.95
1950	7.41	9.37	13.40	13.91	15.24	15.19	15.71	15.60	14.89	15.10	14.26	14.22	164.30
1951	13.58	11.91	13.03	13.33	14.62	14.21	14.49	14.14	13.18	11.83	12.84	13.48	160.63
1952	13.69	12.97	13.78	14.32	15.93	15.57	16.09	16.09	15.54	15.90	15.21	15.50	180.59
1953	15.04	12.88	13.71	13.34	14.18	13.91	14.09	13.63	12.12	8.46	7.53	11.08	149.97
1954	13.02	11.40	11.89	12.57	13.01	10.86	9.60	8.71	7.80	7.62	6.88	6.96	120.32
1955	8.36	12.04	13.77	14.32	15.87	15.57	16.09	16.09	15.54	15.89	15.16	15.37	174.09
1956	14.96	13.34	13.78	14.32	15.87	15.57	16.09	16.09	15.53	15.84	15.04	15.18	181.60
1957	14.87	12.91	13.83	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.22	15.51	181.71
1958	15.04	12.88	13.78	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.22	15.51	181.81
1959	15.04	12.88	13.78	14.02	15.17	14.87	15.38	15.34	14.74	15.08	14.44	14.82	175.56
1960	14.75	13.31	14.00	14.89	16.09	15.57	16.09	16.09	15.37	15.59	14.82	15.09	181.64
1961	14.87	12.88	13.78	13.92	15.30	15.16	15.49	15.38	14.70	14.88	14.20	14.86	175.41
1962	15.58	14.53	16.09	15.57	16.09	15.57	16.09	16.09	15.54	15.91	15.22	15.51	187.76
1963	15.38	14.06	16.02	15.57	16.09	15.57	16.09	16.09	15.54	15.91	15.22	15.51	187.02
1964	15.04	13.59	14.97	15.41	16.09	15.57	16.09	16.09	15.54	15.91	15.22	15.51	185.01
1965	15.04	12.95	13.97	14.46	15.93	15.57	16.09	16.09	15.54	15.91	15.22	15.51	182.27
1966	15.04	12.88	14.07	14.85	16.09	15.57	16.09	16.09	15.54	15.82	14.95	15.06	182.04
1967	14.81	12.88	13.78	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.22	15.87	181.94
1968	16.09	15.05	16.09	15.57	16.09	15.57	16.09	16.09	15.54	15.91	15.22	15.51	188.78
1969	15.09	13.06	13.94	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.22	15.51	182.19
1970	15.08	13.58	15.47	15.16	15.90	15.57	16.09	16.09	15.54	15.91	15.18	15.47	185.02
1971	15.04	12.96	13.88	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.22	15.51	181.99
1972	15.04	13.34	14.24	15.05	16.09	15.57	16.09	16.09	15.54	15.91	15.22	15.51	183.67
1973	15.62	14.20	15.73	15.57	16.09	15.57	16.09	16.09	15.54	15.91	15.22	15.51	187.12
1974	15.04	13.34	14.38	14.47	16.05	15.57	16.09	16.09	15.54	15.91	15.22	15.51	183.20
1975	15.04	12.88	13.78	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.21	15.49	181.77
1976	15.04	13.34	13.78	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.21	15.50	182.25
1977	15.05	12.88	13.78	14.23	15.79	15.57	16.09	16.09	15.53	15.87	15.19	15.51	181.55
1978	15.04	12.88	13.78	14.32	15.87	15.57	16.09	16.09	15.53	15.86	15.18	15.51	181.71
1979	15.05	12.95	14.00	14.45	15.96	15.57	16.09	16.09	15.54	15.91	15.22	15.51	182.32
1980	15.04	13.34	13.78	13.97	15.48	15.57	16.09	16.09	15.54	15.90	15.19	15.48	181.46
1981	15.04	12.88	13.78	13.96	15.22	15.07	15.59	15.47	14.77	15.01	14.21	14.35	175.35
1982	14.02	12.37	13.62	13.73	15.30	15.45	16.05	16.00	15.33	15.66	15.04	15.43	178.01
1983	15.27	13.28	13.98	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.22	15.51	182.65
1984	15.04	13.34	13.78	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.22	15.51	182.27
1985	15.25	13.33	14.08	14.32	15.87	15.57	16.09	16.09	15.54	15.91	15.22	15.51	182.77
1986	15.28	13.72	15.19	15.27	16.09	15.57	16.09	16.09	15.54	15.91	15.22	15.51	185.45
1987	15.23	13.45	14.51	14.48	15.85	15.57	16.09	16.09	15.54	15.91	15.22	15.51	183.44
TOTAL	879.13	776.27	849.86	870.90	948.00	926.27	952.38	945.98	906.61	915.76	861.78	887.19	10720.11
AVE	14.41	12.73	13.93	14.28	15.54	15.18	15.61	15.51	14.86	15.01	14.13	14.54	175.74
MAX	16.09	15.05	16.09	15.57	16.09	15.57	16.09	16.09	15.54	15.91	15.22	15.87	188.78
MIN	7.41	7.89	11.84	12.57	13.01	10.86	9.60	8.71	7.80	7.62	6.88	6.96	120.32

Table 8-13 Monthly Peak Power of Upper Kihansi Project

UNIT: MW

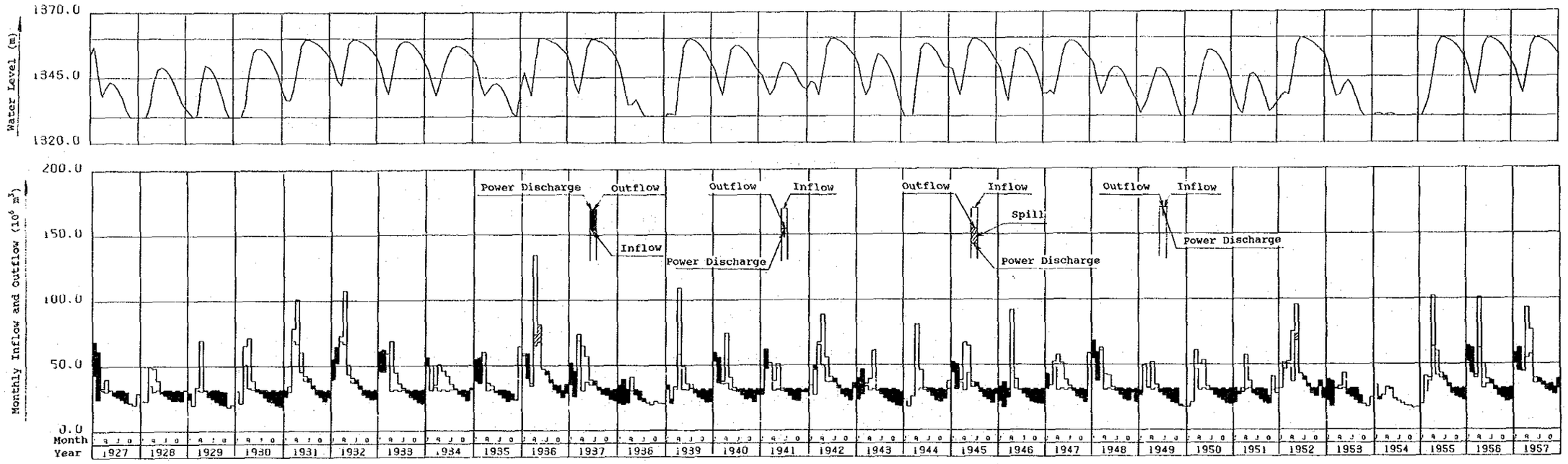
MONTH / YEAR	< JAN >	< FEB >	< MAR >	< APR >	< MAY >	< JUN >	< JUL >	< AUG >	< SEP >	< OCT >	< NOV >	< DEC >	<TOTAL>
1927	46.4	42.9	40.2	41.1	41.9	41.7	41.0	39.9	38.6	28.3	26.6	38.8	467.4
1928	30.8	32.8	39.2	41.8	43.5	43.8	43.5	42.9	41.9	40.8	39.5	38.8	479.3
1929	38.3	28.6	38.0	41.6	44.0	43.8	43.1	42.1	40.6	38.8	23.8	25.7	448.4
1930	37.8	31.4	39.2	43.2	45.8	46.2	46.2	45.8	45.1	44.1	42.9	41.2	508.8
1931	39.8	39.7	40.9	43.9	46.5	47.0	47.0	47.0	46.9	46.5	45.8	45.1	536.1
1932	43.9	42.2	41.5	44.3	46.9	47.0	47.0	47.0	46.9	46.5	45.9	45.2	544.3
1933	43.9	41.8	40.5	43.2	46.0	46.9	47.0	47.0	46.9	46.3	45.5	44.4	539.4
1934	43.4	41.7	40.3	42.0	44.1	45.6	46.4	46.6	46.5	46.1	45.5	45.0	533.0
1935	44.0	41.7	40.3	40.9	41.6	41.8	41.4	40.6	39.3	38.1	31.9	40.8	482.3
1936	43.1	41.7	40.3	44.5	47.0	47.0	47.0	47.0	46.9	46.5	46.0	45.3	542.2
1937	44.0	41.7	40.5	43.4	46.3	47.0	47.0	47.0	46.9	46.5	45.9	45.1	541.2
1938	43.8	41.7	39.2	39.2	39.8	38.8	32.8	27.7	26.0	29.0	28.0	26.3	412.2
1939	38.1	35.8	38.0	42.5	46.3	47.0	47.0	47.0	46.8	46.2	45.3	44.3	524.3
1940	43.4	41.7	40.3	43.2	45.9	46.5	46.5	46.2	45.6	44.8	44.0	43.2	531.3
1941	42.7	41.3	40.3	41.1	43.0	44.2	44.2	43.8	43.1	42.0	41.2	40.9	507.9
1942	41.9	41.7	40.3	43.2	46.4	47.0	47.0	47.0	46.9	46.4	45.7	45.1	538.7
1943	44.0	41.7	40.3	41.2	43.8	45.4	45.1	44.5	43.6	42.4	40.7	38.9	511.4
1944	31.1	24.7	34.6	42.1	45.9	46.7	46.7	46.3	45.6	44.6	43.7	43.6	495.6
1945	43.5	41.7	40.3	43.1	46.3	47.0	47.0	47.0	46.8	46.2	45.3	44.5	538.7
1946	43.7	41.7	39.5	42.7	45.8	46.2	46.0	45.5	44.6	43.5	42.1	40.4	521.7
1947	40.4	40.7	40.3	42.5	45.2	46.6	47.0	47.0	46.8	46.2	45.3	44.9	533.1
1948	44.1	41.9	40.3	41.4	42.9	43.7	43.7	43.3	42.6	41.4	40.5	39.4	505.1
1949	38.1	39.0	40.1	41.9	43.5	43.5	43.1	42.2	40.9	39.0	25.2	21.9	458.5
1950	21.7	30.3	39.2	42.0	44.5	45.9	45.9	45.6	45.0	44.1	43.1	41.5	488.7
1951	39.7	38.5	38.1	40.2	42.7	42.9	42.3	41.3	39.8	34.6	38.8	39.4	478.3
1952	40.0	40.5	40.3	43.2	46.6	47.0	47.0	47.0	46.9	46.5	45.9	45.3	536.2
1953	44.0	41.7	40.1	40.3	41.4	42.0	41.2	39.8	36.6	24.7	22.7	32.4	446.8
1954	38.0	36.9	34.7	38.0	38.0	32.8	28.1	25.5	23.5	22.3	20.8	20.3	358.8
1955	24.5	38.9	40.2	43.2	46.4	47.0	47.0	47.0	46.9	46.4	45.8	44.9	518.4
1956	43.7	41.7	40.3	43.2	46.4	47.0	47.0	47.0	46.9	46.3	45.4	44.4	539.2
1957	43.4	41.8	40.4	43.2	46.4	47.0	47.0	47.0	46.9	46.5	46.0	45.3	540.9
1958	44.0	41.7	40.3	43.2	46.4	47.0	47.0	47.0	46.9	46.5	46.0	45.3	541.2
1959	44.0	41.7	40.3	42.3	44.3	44.9	44.9	44.8	44.5	44.1	43.6	43.3	522.7
1960	43.1	41.6	40.9	44.9	47.0	47.0	47.0	47.0	46.4	45.5	44.8	44.1	539.3
1961	43.4	41.7	40.3	42.0	44.7	45.8	45.3	44.9	44.4	43.5	42.9	43.4	522.2
1962	45.5	47.0	47.0	47.0	47.0	47.0	47.0	47.0	46.9	46.5	46.0	45.3	559.2
1963	44.9	45.5	46.8	47.0	47.0	47.0	47.0	47.0	46.9	46.5	46.0	45.3	556.9
1964	44.0	42.5	43.7	46.5	47.0	47.0	47.0	47.0	46.9	46.5	46.0	45.3	549.3
1965	44.0	41.9	40.8	43.7	46.6	47.0	47.0	47.0	46.9	46.5	46.0	45.3	542.6
1966	44.0	41.7	41.1	44.8	47.0	47.0	47.0	47.0	46.9	46.2	45.1	44.0	541.9
1967	43.3	41.7	40.3	43.2	46.4	47.0	47.0	47.0	46.9	46.5	46.0	46.4	541.6
1968	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	46.9	46.5	46.0	45.3	560.7
1969	44.1	42.2	40.7	43.2	46.4	47.0	47.0	47.0	46.9	46.5	46.0	45.3	542.3
1970	44.1	43.9	45.2	45.8	46.5	47.0	47.0	47.0	46.9	46.5	45.8	45.2	550.9
1971	44.0	41.9	40.6	43.2	46.4	47.0	47.0	47.0	46.9	46.5	46.0	45.3	541.7
1972	44.0	41.7	41.6	45.4	47.0	47.0	47.0	47.0	46.9	46.5	46.0	45.3	545.3
1973	45.7	45.9	46.0	47.0	47.0	47.0	47.0	47.0	46.9	46.5	46.0	45.3	557.2
1974	44.0	43.2	42.0	43.7	46.9	47.0	47.0	47.0	46.9	46.5	46.0	45.3	545.4
1975	44.0	41.7	40.3	43.2	46.4	47.0	47.0	47.0	46.9	46.5	45.9	45.3	541.1
1976	44.0	41.7	40.3	43.2	46.4	47.0	47.0	47.0	46.9	46.5	45.9	45.3	541.1
1977	44.0	41.7	40.3	43.0	46.1	47.0	47.0	47.0	46.9	46.4	45.9	45.3	540.4
1978	44.0	41.7	40.3	43.2	46.4	47.0	47.0	47.0	46.9	46.3	45.8	45.3	540.9
1979	44.0	41.9	40.9	43.6	46.6	47.0	47.0	47.0	46.9	46.5	46.0	45.3	542.7
1980	44.0	41.7	40.3	42.2	45.2	47.0	47.0	47.0	46.9	46.5	45.9	45.2	538.8
1981	44.0	41.7	40.3	42.1	44.5	45.5	45.5	45.2	44.6	43.9	42.9	41.9	522.0
1982	41.0	40.0	39.8	41.4	44.7	46.7	46.9	46.7	46.3	45.8	45.4	45.1	529.8
1983	44.6	43.0	40.9	43.2	46.4	47.0	47.0	47.0	46.9	46.5	46.0	45.3	543.7
1984	44.0	41.7	40.3	43.2	46.4	47.0	47.0	47.0	46.9	46.5	46.0	45.3	541.2
1985	44.6	43.1	41.2	43.2	46.4	47.0	47.0	47.0	46.9	46.5	46.0	45.3	544.1
1986	44.6	44.4	44.4	46.1	47.0	47.0	47.0	47.0	46.9	46.5	46.0	45.3	552.2
1987	44.5	43.5	42.4	43.7	46.3	47.0	47.0	47.0	46.9	46.5	46.0	45.3	546.1
TOTAL	2568.8	2489.7	2483.2	2629.5	2770.0	2796.7	2782.8	2764.1	2737.4	2675.8	2602.0	2592.3	31892.2
AVERAGE	42.1	40.8	40.7	43.1	45.4	45.8	45.6	45.3	44.9	43.9	42.7	42.5	522.8
MAXIMUM	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	46.9	46.5	46.0	46.4	560.7
MINIMUM	21.7	24.7	34.6	38.0	38.0	32.8	28.1	25.5	23.5	22.3	20.8	20.3	358.8

Table 8-14 Peak Power Duration of Upper Kihansi Project

UNIT: MW

NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P
1	3106	47.0	62	6506	47.0	123	8407	47.0	184	3408	46.6	245	8705	46.3	306	8210	45.8	367	3412	45.0	428	7501	44.0	489	7804	43.2	550	5702	41.8	611	4702	40.7	672	5003	39.2
2	3107	47.0	63	6507	47.0	124	8408	47.0	185	6505	46.6	246	8209	46.3	307	4211	45.7	368	5009	45.0	429	7601	44.0	490	8304	43.2	551	3506	41.8	612	6903	40.7	673	4910	39.0
3	3108	47.0	64	6508	47.0	125	8506	47.0	186	5205	46.6	247	5610	46.3	308	7301	45.7	369	6004	44.9	430	7801	44.0	491	8404	43.2	552	2706	41.7	613	4311	40.7	674	4902	39.0
4	3206	47.0	65	6605	47.0	126	8507	47.0	187	3105	46.5	248	3310	46.3	309	4009	45.6	370	6301	44.9	431	8001	44.0	492	8504	43.2	553	3402	41.7	614	2909	40.6	675	5502	38.9
5	3207	47.0	66	6606	47.0	127	8508	47.0	188	6404	46.5	249	4408	46.3	310	4409	45.6	371	5907	44.9	432	8101	44.0	493	3304	43.2	554	3502	41.7	615	3508	40.6	676	4312	38.9
6	3208	47.0	67	6607	47.0	128	8605	47.0	189	4007	46.5	250	4505	46.3	311	5008	45.6	372	6108	44.9	433	8401	44.0	494	4012	43.2	555	3602	41.7	616	7103	40.6	677	3806	38.8
7	3307	47.0	68	6608	47.0	129	8606	47.0	190	3409	46.5	251	6610	46.2	312	3406	45.6	373	5512	44.9	434	4011	44.0	495	7402	43.2	556	3702	41.7	617	3703	40.5	678	2812	38.8
8	3308	47.0	69	6706	47.0	130	8607	47.0	191	3610	46.5	252	4710	46.2	313	6010	45.5	374	5906	44.9	435	5301	44.0	496	2907	43.1	557	3802	41.7	618	5202	40.5	679	2910	38.8
9	3605	47.0	70	6707	47.0	131	8608	47.0	192	3710	46.5	253	3006	46.2	314	8107	45.5	375	4712	44.9	436	7002	43.9	497	8502	43.1	558	4002	41.7	619	4811	40.5	680	5111	38.8
10	3606	47.0	71	6708	47.0	132	8706	47.0	193	5710	46.5	254	4510	46.2	315	6201	45.5	376	4010	44.8	437	3201	43.9	498	4504	43.1	559	4202	41.7	620	3303	40.5	681	2712	38.6
11	3607	47.0	72	6801	47.0	133	8707	47.0	194	5810	46.5	255	3910	46.2	316	8106	45.5	377	6604	44.8	438	3301	43.9	499	4907	43.1	560	4302	41.7	621	4612	40.4	682	2709	38.6
12	3608	47.0	73	6802	47.0	134	8708	47.0	195	6210	46.5	256	4008	46.2	317	6302	45.5	378	5908	44.8	439	3104	43.9	500	4109	43.1	561	4502	41.7	622	4701	40.4	683	5102	38.5
13	3706	47.0	74	6803	47.0	135	3306	46.9	196	6310	46.5	257	4606	46.2	318	3411	45.5	379	6011	44.8	440	8110	43.9	501	6001	43.1	562	4602	41.7	623	5703	40.4	684	2901	38.3
14	3707	47.0	75	6804	47.0	136	3109	46.9	197	6410	46.5	258	3007	46.2	319	3311	45.5	380	6105	44.7	441	4108	43.8	502	3601	43.1	563	5302	41.7	624	4103	40.3	685	3510	38.1
15	3708	47.0	76	6805	47.0	137	3209	46.9	198	6510	46.5	259	7705	46.1	320	4608	45.5	381	8205	44.7	442	2806	43.8	503	5011	43.1	564	5602	41.7	625	3403	40.3	686	4901	38.1
16	3906	47.0	77	6806	47.0	138	3609	46.9	199	6710	46.5	260	3410	46.1	321	7204	45.4	382	8601	44.6	443	3801	43.8	504	4105	43.0	565	5802	41.7	626	3503	40.3	687	3901	38.1
17	3907	47.0	78	6807	47.0	139	3709	46.9	200	6810	46.5	261	8604	46.1	322	5611	45.4	383	8301	44.6	444	2906	43.8	505	8302	43.0	566	5902	41.7	627	3603	40.3	688	5103	38.1
18	3908	47.0	79	6808	47.0	140	4209	46.9	201	6910	46.5	262	3305	46.0	323	8211	45.4	384	8109	44.6	445	4305	43.8	506	7704	43.0	567	6102	41.7	628	4003	40.3	689	5401	38.0
19	4206	47.0	80	6906	47.0	141	5209	46.9	202	7010	46.5	263	4607	46.0	324	4306	45.4	385	4410	44.6	446	6403	43.7	507	4805	42.9	568	6602	41.7	629	4203	40.3	690	5405	38.0
20	4207	47.0	81	6907	47.0	142	5509	46.9	203	7110	46.5	264	7303	46.0	325	4711	45.3	386	4609	44.6	447	8704	43.7	508	3011	42.9	569	6702	41.7	630	4303	40.3	691	3903	38.0
21	4208	47.0	82	6908	47.0	143	5709	46.9	204	7210	46.5	265	5711	46.0	326	3911	45.3	387	8501	44.6	448	5601	43.7	509	2702	42.9	570	7202	41.7	631	4503	40.3	692	2903	38.0
22	4506	47.0	83	7006	47.0	144	5809	46.9	205	7310	46.5	266	5811	46.0	327	5712	45.3	388	5005	44.5	449	4807	43.7	510	5106	42.9	571	7502	41.7	632	4703	40.3	693	5404	38.0
23	4507	47.0	84	7007	47.0	145	6209	46.9	206	7410	46.5	267	6211	46.0	328	5812	45.3	389	4512	44.5	450	4601	43.7	511	8111	42.9	572	7602	41.7	633	4803	40.3	694	3001	37.8
24	4508	47.0	85	7008	47.0	146	6309	46.9	207	7510	46.5	268	6311	46.0	329	6212	45.3	390	8701	44.5	451	7404	43.7	512	2808	42.9	573	7702	41.7	634	5203	40.3	695	5402	36.9
25	4707	47.0	86	7106	47.0	147	6409	46.9	208	7610	46.5	269	6411	46.0	330	6312	45.3	391	5909	44.5	452	4411	43.7	513	6111	42.9	574	7802	41.7	635	5304	40.3	696	5309	36.6
26	4708	47.0	87	7107	47.0	148	6509	46.9	209	7910	46.5	270	6511	46.0	331	6412	45.3	392	3604	44.5	453	4806	43.7	514	4606	42.7	575	8002	41.7	636	5603	40.3	697	3902	35.8
27	5206	47.0	88	7108	47.0	149	6609	46.9	210	8310	46.5	271	6711	46.0	332	6512	45.3	393	4308	44.5	454	6504	43.7	515	5105	42.7	576	8102	41.7	637	5803	40.3	698	5403	34.7
28	5207	47.0	89	7205	47.0	150	6709	46.9	211	8410	46.5	272	6811	46.0	333	6812	45.3	394	8105	44.5	455	4412	43.6	516	4101	42.7	577	8402	41.7	638	5903	40.3	699	4403	34.6
29	5208	47.0	90	7206	47.0	151	6809	46.9	212	8510	46.5	273	6911	46.0	334	6912	45.3	395	8602	44.4	456	7904	43.6	517	4809	42.6	578	7203	41.6	639	6103	40.3	700	5110	34.6
30	5506	47.0	91	7207	47.0	152	6909	46.9	213	8610	46.5	274	7111	46.0	335	7112	45.3	396	6109	44.4	457	4309	43.6	518	4704	42.5	579	3505	41.6	640	6703	40.3	701	2802	32.8
31	5507	47.0	92	7208	47.0	153	7009	46.9	214	8710	46.5	275	7211	46.0	336	7212	45.3	397	8603	44.4	458	5911	43.6	519	3904	42.5	580	6002	41.6	641	7503	40.3	702	5406	32.8
32	5508	47.0	93	7304	47.0	154	7109	46.9	215	3110	46.5	276	7311	46.0	337	7312	45.3	398	5612	44.4	459	4906	43.5	520	6402	42.5	581	2904	41.6	642	7603	40.3	703	3807	32.8
33	5606	47.0	94	7305	47.0	155	7209	46.9	216	3210	46.5	277	7411	46.0	338	7412	45.3	399	3312	44.4	460	8702	43.5	521	8703	42.4	582	5012	41.5	643	7703	40.3	704	5312	32.4
34	5607	47.0	95	7306	47.0	156	7309	46.9	217	4006	46.5	278	7911	46.0	339	7712	45.3	400	3204	44.3	461	2807	43.5	522	4310	42.4	583	3203	41.5	644	7803	40.3	705	3511	31.9
35	5608	47.0	96	7307	47.0	157	7409	46.9	218	8010	46.5	279	8311	46.0	340	7812	45.3	401	5905	44.3	462	4501	43.5	523	5904	42.3	584	8204	41.4	645	8003	40.3	706	3002	31.4
36	5706	47.0	97	7308	47.0	158	7509	46.9	219	7005	46.5	280	8411	46.0	341	7912	45.3	402	3912	44.3	463	4610	43.5	524	5107	42.3	585	5305	41.4	646	8103	40.3	707	4401	31.1
37	5707	47.0	98	7406	47.0	159	7609	46.9	220	5210	46.5	281	8511	46.0	342	8312	45.3	403	4106	44.2	464	6110	43.5	525	6902	42.2	586	4804	41.4	647	8403	40.3	708	2801	30.8
38	5708	47.0	99	7407	47.0	160	7909	46.9	221	4210	46.4	282	8611	46.0	343	8412	45.3	404	4107	44.2	465	4905	43.5	526	4908	42.2	587	4810	41.4	648	5104	40.2	709	5002	30.3
39	5806	47.0	100	7408	47.0	161	8009	46.9	222	5510	46.4	283	8711	46.0	344	8512	45.3	405	3405	44.1	466	2805	43.5	527	8004	42.2	588	3507	41.4	649	5503	40.2	710	3810	29.0
40	5807	47.0	101	7506	47.0	162	8309	46.9	223	2701	46.4	284	3611	46.0	345	8612	45.3	406	5010	44.1	467	5701	43.4	528	3202	42.2	589	4102	41.3	650	2703	40.2	711	2902	28.6
41	5808	47.0	102	7507	47.0	163	8409	46.9	224	6009	46.4	285	4405	45.9	346	8712	45.3	407	6012	44.1	468	6101	43.4	529	4404	42.1	590	5108	41.3	651	4903	40.1	712	2710	28.3
42	6005	47.0	103	7508	47.0	164	8509	46.9	225	6712	46.4	286	7302	45.9	347	5212	45.3	408	4801	44.1	469	6112	43.4	530	8104	42.1	591	3012	41.2	652	5303	40.1	713	5407	28.1
43	6006	47.0	104	7606	47.0	165	8609	46.9	226	4205	46.4	287	7611	45.9	348	3612	45.3	409	6901	44.1	470	3401	43.4	531	4611	42.1	592	4111	41.2	653	8202	40.0	714	3811	28.0
44	6007	47.0	105	7607	47.0	166	8709	46.9	227	5505	46.4	288	5211	45.9	349	4511	45.3	410	3010	44.1	471	4001	43.4	532	2908	42.1	593	4304	41.2	654	5201	40.0	715	3808	27.7
45	6008	47.0	106	7608	47.0	167	7405	46.9	228	5705	46.4	289	5007	45.9	350	7612	45.3	411	7001	44.1	472	3704	43.4	533	6104	42.0	594	5307	41.2	655	2708	39.9	716	2711	26.6
46	6202	47.0	107	7706	47.0	168	8207	46.9	229	5805	46.4	290	7511	45.9	351	6107	45.3	412	5910	44.1	473	4808	43.3	534	7403	42.0	595	8503	41.2	656	5308	39.8	717	3812	26.3
47	6203	47.0	108	7707	47.0	169	7809	46.9	230	6705	46.4	291	4005	45.9	352	7512	45.3	413	2905	44.0	474	5912	43.3	535	3404	42.0	596	2704	41.1	657	5109	39.8	718	3809	26.0
48	6204	47.0	109	7708	47.0	170	3205	46.9	231	6905	46.4	292	3211	45.9	353	8005	45.2	414	6612	44.0	475	6701	43.3	536	5004	42.0	597	6603	41.1	658	3805	39.8	719	2912	25.7
49	6205	47.0	110	7806	47.0	171	7709	46.9	232	7105	46.4	293	3711	45.9	354	4705	45.2	415	7901	44.0	476	3004	43.2	537	5306	42.0	598	4104	41.1	659	8203	39.8	720	5408	25.5
50	6206	47.0	111	7807	47.0	172	5609	46.9	233	7505	46.4	294	7711	45.9	355	8012	45.2	416	7701	44.0	477	4004	43.2	538	4110	42.0	599	2707	41.0	660	3101	39.8	721	4911	25.2
51	6207	47.0	112	7808	47.0	173	3309	46.9	234	7605	46.4	295	8011	45.9	356	8108	45.2	417	3501	44.0	478	4204	43.2	539	2809	41.9	600	8201	41.0	661	3102	39.7	722	5310	24.7
52	6208	47.0	113	7906	47.0	174	4509	46.8	235	7710	46.4	296	5006	45.9	357	7003	45.2	418	3701	44.0	479	5204	43.2	540	4201	41.9	601	4112	40.9	662	5101	39.7	723	4402	24.7
53	6304	47.0	114	7907	47.0	175	4709	46.8	236	7905	46.4	297	7011	45.8	358	7012	45.2	419	4301	44.0	480	5504	43.2	541	8112	41.9	602	3504	40.9	663	4603	39.5	724	5501	24.5
54	6305	47.0	115	7908	47.0	176	3909	46.8	237	6505	46.4	298	7811	45.8	359	3212	45.2	420	5801	44.0	481	5604	43.2	542	7102	41.9	603	3103	40.9	664	2811	39.5	725	2911	23.8
55	6306	47.0	116	8006	47.0	177	6303	46.8	238	8405	46.4	299	3111	45.8	360	6611	45.1	421	5901	44.0	482	5704	43.2	543	6502	41.9	604	6003	40.9	665	4812	39.4	726	5409	23.5
56	6307	47.0	117	8007	47.0	178	8208	46.7	239	8505	46.4	300	4605	45.8	361	4307	45.1	422	6401	44.0	483	5804	43.2	544	7902	41.9	605	7903	40.9	666	5112	39.4	727	5311	22.7
57	6308	47.0	118	8008	47.0	179	4406	46.7	240	5605	46.4	301	5511	45.8	362	3112	45.1	423	6501	44.0	484	6704	43.2	545	4904	41.9	606	4909	40.9	667	3509	39.3	728	5410	22.3
58	6405	47.0	119	8306	47.0	180	4407	46.7	241	3407	46.4	302	3008	45.8	363	4212	45.1	424	6601	44.0	485	6904	43.2	546	2705	41.9	607	8303	40.9	668	3804	39.2	729	4912	21.9
59	6406	47.0	120	8307	47.0	181	8206	46.7	242	7810	46.3	303	3005	45.8	364	8212	45.1	425	7101	44.0	486	7104	43.2	547	4802	41.9	608	6503	40.8	669	3803	39.2	730	5001	21.7
60	6407	47.0	121	8308	47.0	182	4706	46.6	243	3705	46.3	304	7004	45.8	365	3712	45.1	426	7201	44.0	487	7504	43.2	548	2804	41.8	609	2810	40.8	670	2803	39.2	731	5411	20.8
61	6408	47.0	122	8406	47.0	183	7905	46.6	244	3905	46.3	305	6106	45.8	366	3009	45.1	427	7401	44.0	488	7604	43.2	549	3302	41.8	610	3512	40.8	671	3003	39.2	732	5412	20.3

Fig. 8-11 Upper Kihansi Reservoir Operation



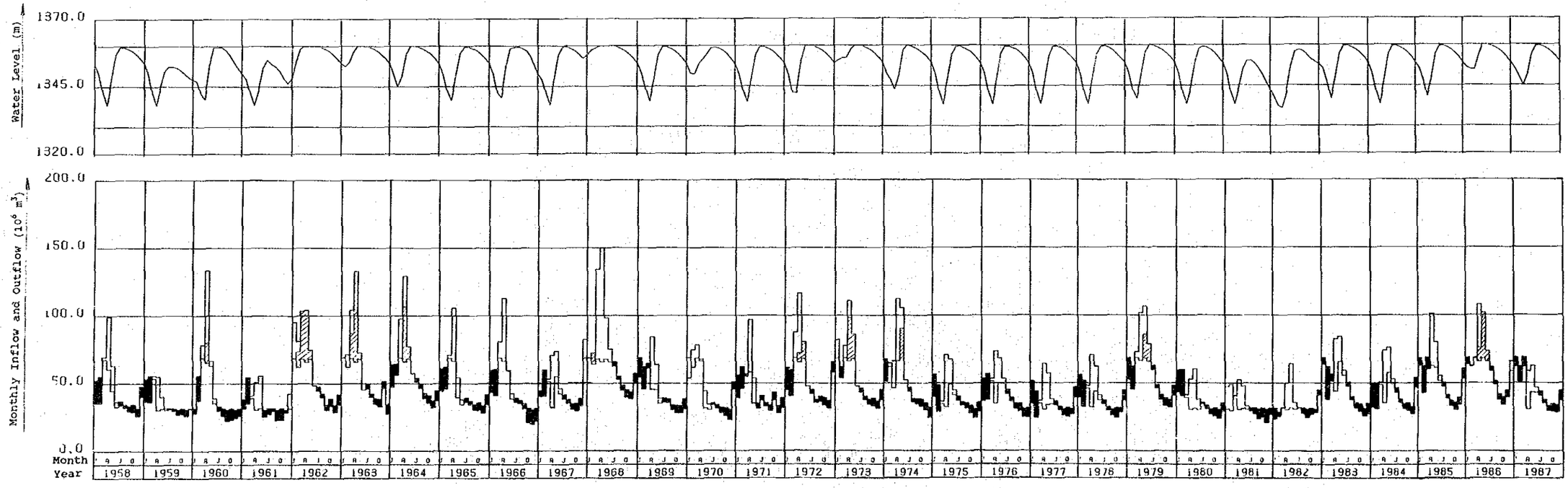


Fig. 8-12 Energy Generation of Upper Kihansi Project

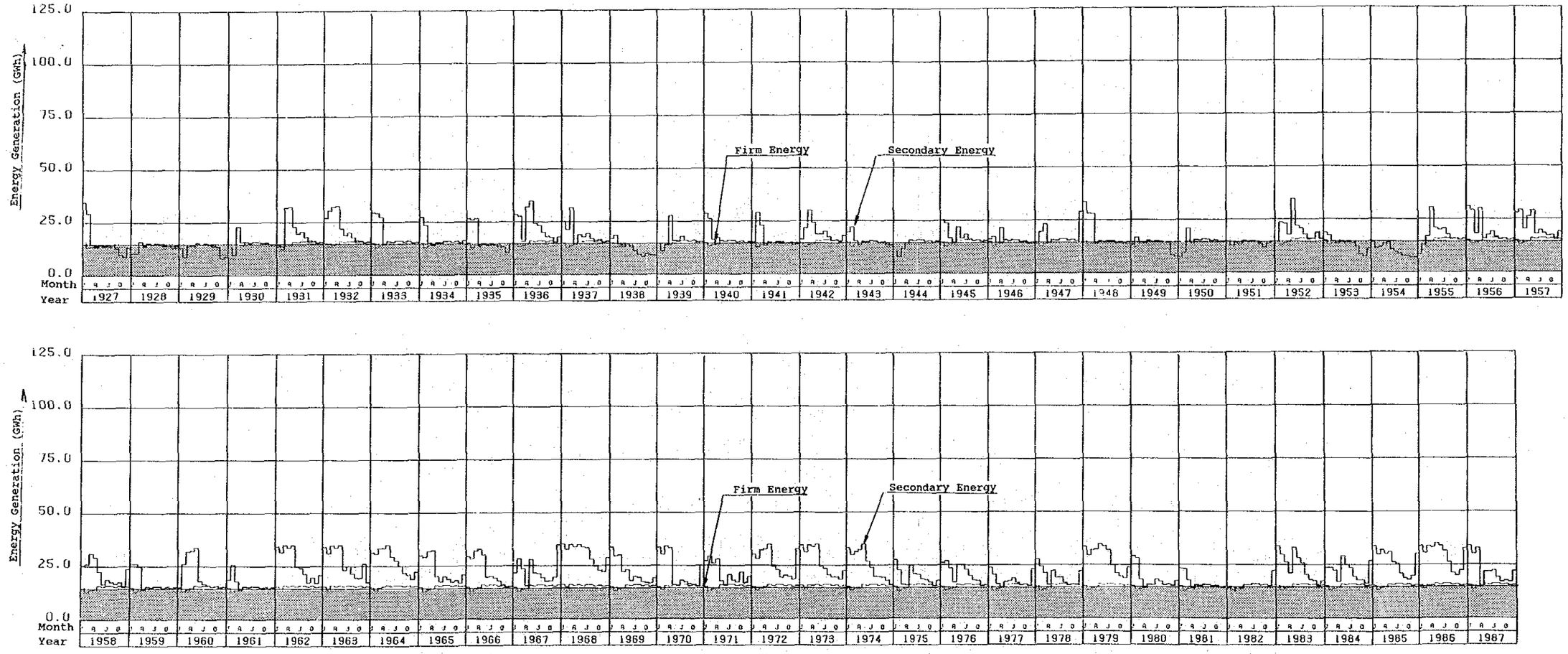


Table 8-15 Preliminary Estimation of Construction Cost of Upper Kihansi Project

Unit: 10^3S

	Upper Kihansi		
	F.C.	F.C.	Total
1. Preparatory Work			
1-1 Access Road	0	0	0
1-2 Camp Facility & Others	3,600	1,000	4,600
Sub Total	3,600	1,000	4,600
2. Compensation	0	5	5
3. Civil Works			
3-1 Diversion & Coffer Dam	2,059	641	2,700
3-2 Dam & Spillway	107,801	33,599	141,400
3-3 Intake	3,621	1,079	4,700
3-4 Headrace Tunnel	1,733	567	2,300
3-5 Penstock	1,698	502	2,200
3-6 Powerhouse & Switchyard	4,436	1,264	5,700
3-7 Tailrace Tunnel	1,878	622	2,500
3-8 Tailrace Outlet	610	190	800
Sub Total	123,836	38,464	162,300
4. Hydraulic Equipment	2,000	500	2,500
5. Electro-mechanical Equipment	10,700	3,400	14,100
6. Transmission Line	100	100	200
7. Total Cost (1+2+3+4+5+6)	40,236	43,469	183,705
8. Engineering & Administration 7 x 7.5%	11,034	2,760	13,794
9. Physical Contingency (1+2+3) x 15% + (4+5+6) x 10%	20,395	6,320	26,715
10. Interest during Construction	28,163	8,623	36,786
11. Grand Total (7+8+9+10)	199,828	61,172	261,000

8.2.4 Lower Kihansi Project

(1) Study on Regulating Reservoir Scale

(a) Study on Storage Capacity

The scale of the regulating reservoir is decided to have effective capacity so taht the discharge of Lower Kihansi Power Station is able to be completely regulated regardless of what the inflow condition may be. So, 0.48×10^6 m^3 is to be the storage capacity of the regulating reservoir corresponding to the maximum discharge of 22.2 m^3/s.

(b) Study on Dam Scale

The annual sedimentation at Lower Kihansi Dam, when considering the sediment trapping rate depending on the regulating reservoir capacity is to be 2,500 m^3/yr. It is scheduled for Upper Kihansi Dam to be completed 3 years after completion of Lower Kihansi Dam and it is sufficient for the sedimentation capacity of Lower Kihansi Dam to consider only this period, but in planning, the sedimentation capacity of Lower Kihansi Dam is set for 0.1×10^6 m^3 of sedimentation during a 50-year period assuming that Upper Kihansi Dam does not exist. As a consequence, the sedimentation level is to be EL. 1,125 m. A dam of minimum scale with the effective capacity of 0.48×10^6 m^3 needed for maximum discharge of 22.2 m^3/s is the high water level of 1,135 m in view of the dead storage capacity and the structure of the intake. Further, since the discharge water level of the

Upper Kihansi Project is EL. 1,140 m, the maximum dam scale is to the high water level of EL. 1,140 m.

The results of study for the cases of minimum and maximum dam scales are given in Table 8-16.

As a result of study, the incremental benefit due to head increase because of increase in dam scale is to exceed the incremental cost of increase in dam volume, and the optimum dam scale is determined as to be the dam of high water level of 1,140 m.

Table 8-16 Study on Optimum Dam Height of Lower Kihansi Reservoir

Item	Unit	Case 4	Case 4'
		Lower Kihansi	Lower Kihansi
High Water Level	m	1,140.00	1,135.00
Lower Water Level	m	1,137.00	1,129.00
Available Drawdown	m	3.00	6.00
Gross Storage Capacity	10^6 m^3	1.39	0.68
Effective Storage Capacity	10^6 m^3	0.48	0.48
Dam Type		Concrete gravity	Concrete gravity
Dam Height x Length	m	35 x 177	30 x 165
Dam Volume	10^3 m^3	54	47
Maximum Discharge	m^3/s	22.20	22.20
Standard Intake Water Level	m	1,140.00	1,135.00
Tail Water Level	m	296.50	296.50
Gross Head	m	843.50	838.50
Effective Head	m	813.00	808.00
Installed Capacity	MW	153	152
Firm Peak Power	MW	101.8	101.0
Annual Energy Production	10^6 kWh	868.9	861.9
Annual Firm Energy Production	10^6 kWh	551.0	546.6
Annual Benefit			
Peak Power Benefit	10^3 US$	26,683	26,469
Firm Energy Benefit	10^3 US$	18,936	18,784
Total Benefit (B)	10^3 US$	45,619	45,253
Investment Cost			
Civil Facilities Cost	10^6 US$	119.9	117.9
Electro-Mechanical Facilities Cost	10^6 US$	86.4	85.9
Total	10^6 US$	206.3	203.6
Annual Cost			
Civil Facilities Cost	10^3 US$	12,697	12,486
Electro-Mechanical Facilities Cost	10^3 US$	10,256	10,196
Total Cost (C)	10^3 US$	22,953	22,682
Annual Surplus Benefit (B - C)	10^3 US$	22,666	22,571
Benefit Cost Ratio (B/C)		1.987	1.995
Unit Annual Cost	US$/kWh	0.042	0.041

(2) Study on Maximum Discharge and Installed Capacity

In "8.2.2 Study on Reservoir Scale", the peak duration time for the Lower Kihansi Project is taken as 13 hours, with the firm discharge 11.9 m^3/s adding the firm discharge 0.1 m^3/s of the remaining catchment area to the firm discharge of the Upper Kihansi Project of 11.8 m^3/s, and the maximum discharge is selected to be 22.2 m^3/s with installed capacity 153 MW.

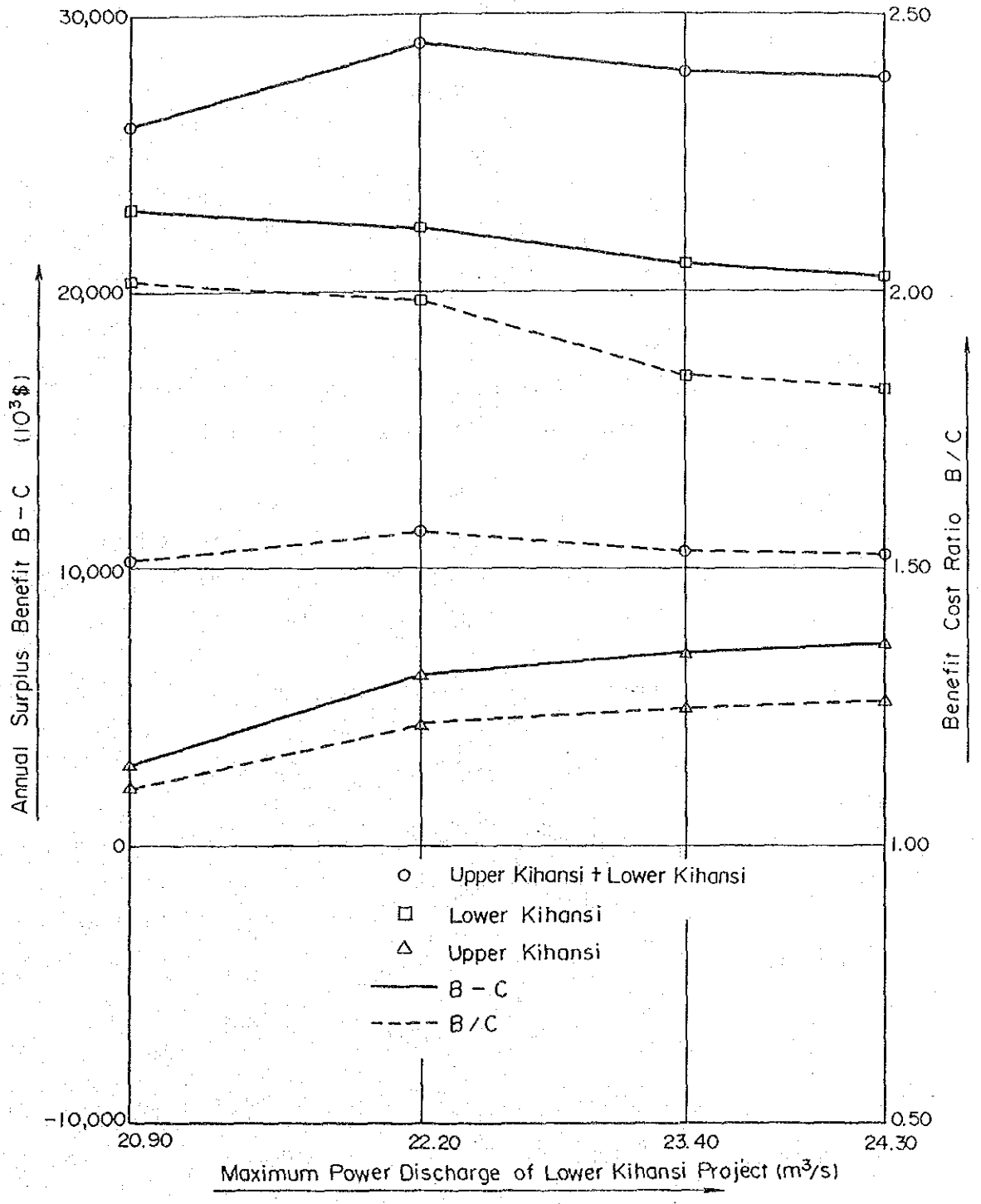
If the maximum discharge is to be increased over 22.2 m^3/s, it will result in a slight increase in firm energy in spite of increase in firm peak power because the maximum discharge of the Upper Kihansi Project is set larger than the project. A comparison study is made in the cases that maximum discharge is increased to 24.3 m^3/s and 23.4 m^3/s and is decreased to 20.9 m^3/s. The result is shown in Table 8-17 and Fig. 8-13.

As a result of the study if the maximum discharge is increased the incremental cost due to increase in maximum discharge is to exceed the incremental benefit and if the maximum discharge is decreased the reduction benefit due to decrease in maximum discharge is to exceed the reduction cost. Thus the maximum discharge is determined to be 22.2m^3/s with installed capacity 153MW.

Table 8-17 Study on Optimum Discharge of Lower Kihansi Project

Item	Unit	Case 2'			Case 3'			Case 4			Case 5'		
		Upper Kihansi	Lower Kihansi	Total	Upper Kihansi	Lower Kihansi	Total	Upper Kihansi	Lower Kihansi	Total	Upper Kihansi	Lower Kihansi	Total
High Water Level	m	1,360.00	1,140.00		1,360.00	1,140.00		1,360.00	1,140.00		1,360.00	1,140.00	
Lower Water Level	m	1,330.00	1,137.00		1,330.00	1,137.00		1,330.00	1,137.00		1,330.00	1,137.00	
Available Drawdown	m	30.00	3.00		30.00	3.00		30.00	3.00		30.00	3.00	
Gross Storage Capacity	$10^6 m^3$	94.90	1.39		94.90	1.39		94.90	1.39		94.90	1.39	
Effective Storage Capacity	$10^6 m^3$	75.10	0.48		75.10	0.48		75.10	0.48		75.10	0.48	
Dam Type		Rockfill	Concrete gravity		Rockfill	Concrete gravity		Rockfill	Concrete gravity		Rockfill	Concrete gravity	
Dam Height x Length	m	95x583	35x177		95x583	35x177		95x583	35x177		95x583	35x177	
Dam Volume	$10^3 m^3$	5,300	54		5,300	54		5,300	54		5,300	54	
Maximum Discharge	m^3/s	25.70	24.30		25.70	23.40		25.70	22.20		25.70	20 90	
Standard Intake Water Level	m	1,360.00	1,140.00		1,360.00	1,140.00		1,360.00	1,140.00		1,360.00	1,140.00	
Tail Water Level	m	1,138.50	296.50		1,138.50	296.50		1,138.50	296.50		1,138.50	296.50	
Gross Head	m	221.50	843.50		221.50	843.50		221.50	843.50		221.50	843.50	
Effective Head	m	214.50	813.00		214.50	813.00		214.50	813.00		214.50	813.00	
Installed Capacity	MW	47	167		47	161		47	153		47	144	
Firm Peak Power	MW	86.1	101.8	187.9	86.1	101.8	187.9	86.1	101.8	187.9	78.9	101.8	180.7
Annual Energy Production	10^6 kWh	275.4	886.6	1,162.0	275.4	880.1	1,155.5	275.1	868.9	1,144.0	274.9	854.8	1,129.7
Annual Firm Energy Production	10^6 kWh	366.5	551.0	917.5	357.8	551.0	908.8	335.7	551.0	886.7	297.5	551.0	848.5
Annual Benefit													
Peak Power Benefit	10^3 US$	22,568	26,683	49,251	22,568	26,683	49,251	22,568	26,683	49,251	20,681	26,683	47,364
Firm Energy Benefit	10^3 US$	12,595	18,936	31,531	12,297	18,936	31,233	11,537	18,936	30,473	10,224	18,936	29,160
Total Benefit (B)	10^3 US$	35,163	45,619	80,782	34,865	45,619	80,484	34,105	45,619	79,724	30,905	45,619	76,524
Investment Cost													
Civil Facilities Cost	10^6 US$	239.5	126.8	366.3	239.5	125.0	364.5	239.5	119.9	359.4	239.5	118.3	357.8
Electro-Mechanical Facilities Cost	10^6 US$	21.5	97.9	119.4	21.5	96.3	117.8	21.5	86.4	107.9	21.5	85.3	106.8
Total	10^6 US$	261.0	224.7	485.7	261.0	221.3	482.3	261.0	206.3	467.3	261.0	203.6	464.6
Annual Cost													
Civil Facilities Cost	10^3 US$	25,363	13,428	38,781	25,363	13,238	38,060	25,363	12,697	38,060	25,363	12,528	37,891
Electro-Mechanical Facilities Cost	10^3 US$	2,552	11,621	14,173	2,552	11,431	12,808	2,552	10,256	12,808	2,552	10,125	12,677
Total Cost (C)	10^3 US$	27,915	25,049	52,964	27,915	24,669	52,584	27,915	22,953	50,868	27,915	22,653	50,568
Annual Surplus Benefit (B - C)	10^3 US$	7,248	20,570	27,818	6,950	20,950	27,900	6,190	22,666	28,856	2,990	22,966	25,956
Benefit Cost Ratio (B/C)		1.260	1.821	1.525	1.249	1.849	1.531	1.221	1.987	1.567	1.107	2.014	1.513
Unit Annual Cost	US$/kWh	0.076	0.045	0.058	0.078	0.045	0.058	0.083	0.042	0.057	0.094	0.041	0.060

Fig. 8-13 Study on Optimum Discharge of Lower Kihansi Project



(3) Study of Number of Turbine and Generator Units

For an installed capacity of 153 MW, the four alternatives of 1 unit, 2 units, 3 units and 4 units are conceivable when considering the number of turbine and generator units, and the following can be said about the four alternatives.

- In case of the 1-unit alternative, economy of scale in the construction cost can be expected, but the capacity of the single unit is too large compared with the capacity of the power system and the frequency drops in the system of a tripping accident are great.

- With the 2-unit alternative, the capacity of one unit is 76.5 MW and still large, and in case of a tripping accident the frequency drop in the system exceed the limit.

- With the 3-unit alternative the degree of freedom in operation is considered to be adequate. There is also no problem in system operation.

- With the 4-unit alternative, there is also no problem in system operation, but the construction cost is to be comparatively high.

Therefore, 3 units of unit capacity 51 MW which is the most reasonable from the standpoints of development scale and the economics is to be selected.

(4) Installed Capacity of Lower Kihansi Project Prior to Start-up of Upper Kihansi Project

The Lower Kihansi Project has headrace, penstock, and tailrace in a single line, so that in independent operation of the Lower Kihansi Project prior to start-up of the Upper Kihansi Project, the dam and waterways are all to be completed at the time of starting independent operation, but it is possible for turbines and generators to be partially commissioned at the time of independent operation. The number of turbine and generator units for the Lower Kihansi Project is decided as 3. If 2 units are to be commissioned at the time of independent start-up, the maximum available discharge is 14.8 m^3/s and the installed capacity 102 MW. Since the firm output at the time of independent start-up of the Lower Kihansi Project is to be 101.8 MW, there is no shortage in firm output even with commissioning of 2 units. The plant factor of firm energy of 551 x 10^6 kWh is to be 61.7 per cent and lower than the annual load factor of the system of 64 per cent, so that all of the firm energy can be consumed within the system. Therefore, at the time of independent start-up of the Lower Kihansi Project, it is thought that partial commissioning with 102 MW of initial capacity makes it possible to avoid unnecessary advance investment. This may be suitable in its way, from a view point focussing on the advance investment.

However, independent start up with a full capacity of 153 MW is recommended due to the following reasons.

At the time of independent start-up of the Lower Kihansi Project, there are thermal power stations amounting to 110 MW included in the power system, and in case the energy production of hydroelectric power stations is considered in terms of firm energy, 226 x 10^6 kWh in 1997 and 375 x 10^6 kWh in 1998 are to be generated at these thermal power stations. Since it is desirable for power generation by these thermal power stations to be continuous operation for base load, the operating capacity is to be 26 MW in 1997 and 43 MW in 1998. When the inflow of hydro power stations has become 17 per cent over firm discharge, there is no necessity for thermal power generation in both 1997 and 1998. The results of study in case of making the installed capacity of the Lower Kihansi Project at the time of independent start-up partial commissioning with 102 MW are shown in Table 8-18.

Table 8-18 Actual Reserved Margin in 1997 and 1998

Year	System Demand			System Availability															
				Hydro Firm Base								Hydro 17% Incremental Base							
				Hydro		Thermal		Total		System Reserve		Hydro		Thermal		Total		System Reserve	
	GWh	MW	MW with 15% Reserve	GWh	MW	GWh	MW	GWh	MW	MW	%	GWh	MW	GWh	MW	GWh	MW	MW	%
1997	2,449	437	502	2,226	475	223	26	2,449	501	64	14.6	2,601	475	0	0	2,601	475	38	8.7
1998	2,601	463	534	2,226	475	375	43	2,601	581	55	11.9	2,601	475	0	0	2,601	475	12	2.6

According to the results of study, in order to secure reserve capacity of 15 per cent within the system, in case of considering inflow at hydro power plants on the basis of firm discharge, it is to be necessary for standby operation of thermal power stations of 1 MW and 16 MW, respectively, for 1997 and 1998, and in case of considering 17 per cent extra over firm discharge, 28 MW and 59 MW, respectively.

If the Lower Kihansi Project at the time of independent start-up is to be started up with all 153 MW of installed capacity, it becomes unnecessary for such standby operation of thermal power plants, while it is also unnecessary for back-up by thermal power stations in case of faulting of power sources so that probability of faulting within the system is resulted to be lowered, and it is extremely effective for improving the reliability of the system. Therefore, the Lower Kihansi Project is to be started up independently with its fully installed capacity of 153 MW.

(5) Optimum Development Plan

The outline of the optimum development plan of the Lower Kihansi Project determined as a result of the studies made up to this point are shown in Table 8-19. The monthly energy productions and firm energies with independent start-up of the Lower Kihansi Project for the 61-year period from 1927 to 1987 are shown in Tables 8-20 and 8-21, and in Fig. 8-19. The monthly peak power and peak power durations are shown in Tables 8-22 and 8-23. The monthly energy productions and firm energy production of the Lower Kihansi Project after commissioning of the Upper Kihansi Project are shown

in Tables 8-24 and 8-25, and in Fig. 8-15. The monthly peak power and peak power duration are given in Tables 8-26 and 8-27. The preliminary estimation of construction cost of the optimum development plan is given in Table 8-28.

Table 8-19 Outline of Optimum Development Plan of Lower Kihansi Project

Reservoir	
Catchment Area	590 km^2
High Water Level	1,140.00 m
Low Water Level	1,137.00 m
Available Drawdown	3.00 m
Gross Storage Capacity	1.39 × 10^6 m^3
Effective Storage Capacity	0.48 × 10^6 m^3
Annual Average Runoff	15.87 m^3/s
Firm Discharge	9.40 m^3/s
Dam	
Type	Concrete Gravity
Height × Length	35 m × 177 m
Volume	54 × 10^3 m^3
Power Station	
Standard Intake Water Level	1,140.00 m
Tail Water Level	296.50 m
Gross Head	843.50 m
Effective Head	813.00 m
Maximum Discharge	22.20 m^3/s
Installed Capacity	153 MW
Unit Type × Number of Unit	Vertical Pelton×3
Firm Peak Power	151.0 MW (101.8 MW)
Annual Total Energy Production	906.9 × 10^6 kWh (868.9 × 10^6 kWh)
Annual Firm Energy Production	710.9 × 10^6 kWh (511.0 × 10^6 kWh)

Note: Figures in ( ) show the values of cases without the Upper Kihansi Project.

Table 8-20 Total Energy Generation of Lower Kihansi Project without Upper Kihansi Project

UNIT: 10^6 kWh

MONTH / YEAR	< JAN >	< FEB >	< MAR >	< APR >	< MAY >	< JUN >	< JUL >	< AUG >	< SEP >	< OCT >	< NOV >	< DEC >	<TOTAL>
1927	83.60	66.80	64.00	77.50	61.30	53.60	50.60	47.00	43.10	42.20	38.80	56.20	664.70
1928	45.40	44.90	96.20	93.10	74.90	56.80	53.40	48.60	45.40	46.10	45.30	60.70	710.80
1929	47.20	38.50	64.80	110.00	60.30	51.40	47.80	43.80	39.70	38.50	35.60	39.00	616.60
1930	59.60	41.70	113.60	110.00	74.40	62.50	56.50	50.20	44.50	42.80	38.50	36.80	731.10
1931	51.10	66.80	113.60	110.00	113.60	81.90	73.00	63.60	54.50	50.50	44.50	50.50	873.60
1932	76.50	100.70	113.60	110.00	98.50	78.90	71.00	62.80	54.10	50.40	46.70	47.70	910.90
1933	87.80	87.40	113.60	110.00	86.00	70.00	63.50	56.90	49.80	47.00	42.20	40.70	854.90
1934	95.20	59.20	67.80	97.80	88.40	81.20	69.10	62.20	54.60	51.10	44.70	60.80	832.10
1935	73.20	70.40	113.60	70.50	66.50	57.40	53.70	48.90	44.00	47.00	45.30	113.60	804.10
1936	111.70	77.40	70.10	110.00	113.60	91.40	83.00	71.80	61.30	56.50	49.10	55.20	951.10
1937	68.00	50.70	113.60	110.00	110.30	75.20	68.10	60.40	54.40	52.20	46.40	44.30	853.60
1938	40.90	39.00	41.50	79.50	53.10	46.40	44.00	41.40	38.00	43.10	40.50	39.80	547.20
1939	67.40	40.30	64.90	110.00	95.30	69.40	62.70	55.60	49.30	46.40	42.30	42.50	746.10
1940	102.30	70.70	72.80	110.00	78.90	63.50	57.70	52.20	46.10	47.70	41.70	53.10	796.70
1941	53.60	91.90	100.30	73.90	99.20	62.30	57.00	51.00	44.90	43.60	57.10	56.80	791.60
1942	96.50	52.80	113.60	110.00	108.10	78.80	70.60	61.80	53.20	49.30	44.00	62.60	901.30
1943	45.30	53.50	69.20	76.40	113.60	58.00	52.90	47.40	42.40	40.90	36.90	35.90	672.40
1944	45.90	35.30	50.20	110.00	88.70	62.20	56.60	50.30	43.90	41.70	46.50	72.80	704.10
1945	85.40	61.10	74.60	110.00	113.60	70.80	64.40	56.70	49.00	45.60	40.60	53.80	825.60
1946	42.30	34.30	48.50	110.00	75.40	59.30	53.90	48.00	42.10	40.60	39.40	38.90	632.70
1947	83.20	66.60	101.30	110.00	99.20	74.40	65.50	57.60	49.70	46.60	41.10	113.60	908.80
1948	105.90	73.30	113.60	82.00	80.30	63.20	57.70	52.00	45.60	43.50	55.30	41.70	814.10
1949	51.70	95.60	62.20	100.10	66.90	55.10	50.70	45.70	40.70	39.30	35.50	34.60	678.10
1950	34.20	40.50	113.60	97.30	102.80	64.20	58.20	51.70	47.30	44.30	39.80	38.60	732.50
1951	40.40	51.80	55.50	110.00	72.30	53.50	50.70	45.10	40.20	38.60	78.80	54.40	691.30
1952	81.20	89.90	100.90	110.00	113.60	82.60	73.10	63.20	53.80	49.60	63.70	46.70	928.30
1953	42.60	34.40	60.40	64.40	83.30	51.60	47.80	43.30	38.80	37.80	34.30	47.40	586.10
1954	65.80	43.40	50.40	62.40	57.10	45.10	41.90	38.70	35.20	34.90	32.10	32.70	541.70
1955	37.50	78.30	76.00	110.00	113.60	83.20	72.40	62.80	53.30	48.80	46.50	42.90	825.30
1956	99.90	83.00	80.10	110.00	96.60	74.40	66.70	58.40	50.20	46.60	41.10	43.20	850.20
1957	98.40	86.00	86.10	110.00	113.60	75.30	68.90	64.60	58.00	56.10	51.40	60.10	928.50
1958	68.80	69.40	113.60	110.00	113.60	70.80	65.60	62.40	57.30	56.30	50.80	78.40	917.00
1959	71.20	70.60	107.90	106.80	77.90	61.20	60.20	57.70	52.60	52.80	50.50	60.50	829.90
1960	54.40	72.70	113.60	110.00	113.60	75.50	58.10	50.20	43.10	45.00	47.70	50.90	834.80
1961	60.80	68.50	79.70	98.10	107.60	49.10	53.40	57.40	44.40	44.90	55.80	82.20	801.90
1962	113.60	102.60	113.60	110.00	113.60	93.90	86.30	77.30	59.20	64.80	55.90	67.10	1057.90
1963	113.60	102.60	113.60	110.00	113.60	87.90	89.70	77.70	67.80	63.80	90.20	53.70	1084.20
1964	91.50	106.30	113.60	110.00	113.60	110.00	98.90	90.30	75.80	69.30	52.40	72.50	1114.20
1965	85.80	89.10	113.60	110.00	105.30	74.00	70.40	66.90	59.40	59.10	54.90	66.90	955.40
1966	83.90	79.70	113.60	110.00	113.60	82.30	70.50	68.50	61.00	40.90	38.80	43.40	906.20
1967	78.10	79.20	103.30	110.00	113.60	89.40	75.10	69.20	60.10	58.10	65.20	113.60	1014.90
1968	113.60	106.30	113.60	110.00	113.60	110.00	113.60	102.10	86.80	77.10	74.70	97.10	1218.50
1969	105.60	88.90	113.60	110.00	113.60	75.40	69.90	69.50	58.90	54.80	54.80	60.40	975.40
1970	104.40	102.60	113.60	110.00	85.60	67.00	66.10	61.30	55.00	51.00	45.00	88.60	950.20
1971	75.80	89.90	106.80	110.00	103.80	67.90	72.90	64.00	58.20	73.20	54.70	62.10	939.30
1972	87.40	79.20	113.60	110.00	113.60	92.40	81.70	69.20	70.60	65.50	61.40	113.40	1058.00
1973	113.60	102.60	113.60	110.00	113.60	92.70	84.00	73.30	67.10	64.70	61.50	73.90	1070.60
1974	99.10	102.60	89.90	110.00	113.60	101.30	85.10	70.20	67.20	63.60	58.80	47.50	1008.90
1975	77.20	56.30	70.90	110.00	113.60	86.90	72.30	65.50	61.50	54.60	47.50	56.90	873.20
1976	71.00	73.20	103.00	110.00	113.60	103.20	81.60	71.50	60.80	57.00	48.40	48.00	941.30
1977	67.10	47.40	71.50	110.00	110.80	73.90	65.50	58.70	50.70	48.70	52.80	76.50	833.60
1978	76.60	63.20	93.20	110.00	113.60	79.90	67.00	58.50	50.90	47.30	55.40	72.30	887.90
1979	101.60	87.70	113.60	110.00	113.60	110.00	113.60	89.50	73.30	64.70	62.40	79.10	1119.10
1980	83.50	78.70	79.90	102.30	113.60	73.70	67.10	60.40	52.50	50.00	46.90	57.40	866.00
1981	59.50	57.50	78.80	101.30	92.60	63.90	57.40	53.30	46.10	48.30	40.50	52.60	751.80
1982	45.50	49.30	61.80	96.70	113.60	68.80	61.40	53.90	47.80	52.50	55.00	80.30	786.60
1983	113.60	73.90	99.70	110.00	113.60	110.00	92.20	72.80	61.30	56.50	50.10	53.90	1007.60
1984	62.30	60.40	97.80	110.00	113.60	102.50	83.80	69.20	60.50	57.90	53.20	91.10	962.30
1985	113.60	83.00	113.60	110.00	113.60	106.80	91.50	74.90	64.40	58.70	66.40	103.30	1099.80
1986	113.60	102.60	113.60	110.00	113.60	110.00	113.60	94.80	73.20	65.80	76.20	113.60	1200.60
1987	113.60	98.80	113.60	110.00	113.60	89.70	78.60	68.10	57.10	56.50	55.40	71.90	1026.90
TOTAL	4739.60	4351.00	5642.00	6320.10	6071.40	4633.70	4210.20	3742.00	3271.70	3132.70	3079.00	3806.70	53000.10
AVERAGE	77.70	71.33	92.49	103.61	99.53	75.96	69.02	61.34	53.63	51.36	50.48	62.40	868.85
MAXIMUM	113.60	106.30	113.60	110.00	113.60	110.00	113.60	102.10	86.80	77.10	90.20	113.60	1218.50
MINIMUM	34.20	34.30	41.50	62.40	53.10	45.10	41.90	38.70	35.20	34.90	32.10	32.70	541.70

Table 8-21 Firm Energy Generation of Lower Kihansi Project without Upper Kihansi Project

UNIT: 10^6 kWh

MONTH / YEAR	< JAN >	< FEB >	< MAR >	< APR >	< MAY >	< JUN >	< JUL >	< AUG >	< SEP >	< OCT >	< NOV >	< DEC >	<TOTAL>
1927	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.00	43.10	42.20	38.80	47.60	544.10
1928	45.30	44.50	47.60	46.00	47.60	46.00	47.60	47.60	45.30	46.10	45.30	47.60	556.50
1929	47.20	38.40	47.60	46.00	47.60	46.00	47.60	43.70	39.70	38.50	35.50	38.90	516.70
1930	47.60	41.70	47.60	46.00	47.60	46.00	47.60	47.60	44.40	42.70	38.50	36.80	534.10
1931	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	44.40	47.60	558.60
1932	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	561.70
1933	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.00	42.20	40.60	548.80
1934	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	44.70	47.60	558.90
1935	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	44.00	47.00	45.30	47.60	556.90
1936	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	561.70
1937	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	44.30	556.90
1938	40.90	38.90	41.40	46.00	47.60	46.00	44.00	41.30	38.00	43.00	40.40	39.70	507.20
1939	47.60	40.30	47.60	46.00	47.60	46.00	47.60	47.60	46.00	46.30	42.30	42.40	547.30
1940	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	41.70	47.60	557.40
1941	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	44.80	43.50	46.00	47.60	554.90
1942	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	44.00	47.60	558.20
1943	45.20	43.00	47.60	46.00	47.60	46.00	47.60	47.30	42.30	40.90	36.90	35.80	526.20
1944	45.80	35.30	47.60	46.00	47.60	46.00	47.60	47.60	43.90	41.70	46.00	47.60	542.70
1945	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	45.60	40.50	47.60	552.70
1946	42.30	34.30	47.60	46.00	47.60	46.00	47.60	47.60	42.00	40.60	39.30	38.90	519.80
1947	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	46.60	41.00	47.60	554.20
1948	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	45.50	43.40	46.00	41.70	551.10
1949	47.60	43.00	47.60	46.00	47.60	46.00	47.60	45.70	40.70	39.30	35.50	34.50	521.10
1950	34.20	40.40	47.60	46.00	47.60	46.00	47.60	47.60	46.00	44.30	39.80	38.50	525.60
1951	40.30	43.00	47.60	46.00	47.60	46.00	47.60	45.00	40.10	38.60	46.00	47.60	535.40
1952	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	46.70	560.80
1953	42.50	34.40	47.60	46.00	47.60	46.00	47.60	43.30	38.80	37.80	34.30	47.40	513.30
1954	47.60	43.00	47.60	46.00	47.60	45.10	41.90	38.70	35.20	34.90	32.10	32.70	492.40
1955	37.50	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	42.80	545.30
1956	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	46.60	41.00	43.20	551.30
1957	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1958	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1959	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1960	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	43.10	45.00	46.00	47.60	556.20
1961	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	44.30	44.80	46.00	47.60	555.70
1962	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1963	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1964	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	561.70
1965	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1966	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	40.90	38.80	43.40	542.10
1967	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1968	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	561.70
1969	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1970	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	44.90	47.60	559.10
1971	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1972	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	561.70
1973	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1974	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.50	560.10
1975	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1976	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	561.70
1977	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1978	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.30	46.00	47.60	559.90
1979	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1980	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	561.70
1981	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	40.50	47.60	554.70
1982	45.50	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	558.10
1983	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1984	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	561.70
1985	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1986	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
1987	47.60	43.00	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	560.20
TOTAL	2846.70	2603.70	2897.40	2806.00	2903.60	2805.10	2894.30	2874.80	2739.20	2788.20	2669.70	2782.60	33611.30
AVERAGE	46.67	42.68	47.50	46.00	47.60	45.99	47.45	47.13	44.90	45.71	43.77	45.62	551.00
MAXIMUM	47.60	44.50	47.60	46.00	47.60	46.00	47.60	47.60	46.00	47.60	46.00	47.60	561.70
MINIMUM	34.20	34.30	41.40	46.00	47.60	45.10	41.90	38.70	35.20	34.90	32.10	32.70	492.40

Table 8-22 Monthly Peak Power of Lower Kihansi Project without Upper Kihansi Project

UNIT: MW

MONTH / YEAR	< JAN >	< FEB >	< MAR >	< APR >	< MAY >	< JUN >	< JUL >	< AUG >	< SEP >	< OCT >	< NOV >	< DEC >	<TOTAL>
1927	118.00	118.00	118.00	118.00	118.00	118.00	118.00	116.57	110.43	104.73	99.49	118.00	1375.21
1928	112.52	118.00	118.00	118.00	118.00	118.00	118.00	118.00	116.26	114.28	116.07	118.00	1403.13
1929	117.10	105.62	118.00	118.00	118.00	118.00	118.00	108.54	101.81	95.53	91.08	96.63	1306.30
1930	118.00	114.45	118.00	118.00	118.00	118.00	118.00	118.00	113.96	106.08	98.63	91.20	1350.30
1931	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	113.93	118.00	1411.93
1932	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1933	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	116.61	108.22	100.78	1387.61
1934	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	114.57	118.00	1412.57
1935	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	112.79	116.58	116.13	118.00	1407.50
1936	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1937	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	109.93	1407.93
1938	101.42	106.94	102.79	118.00	118.00	118.00	109.11	102.59	97.46	106.75	103.64	98.56	1283.26
1939	118.00	110.59	118.00	118.00	118.00	118.00	118.00	118.00	118.00	114.95	108.35	105.26	1383.15
1940	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	106.94	118.00	1404.94
1941	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	114.94	108.06	118.00	118.00	1402.99
1942	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	112.72	118.00	1410.72
1943	112.27	118.00	118.00	118.00	118.00	118.00	118.00	117.43	108.56	101.49	94.58	88.91	1331.25
1944	113.68	93.54	118.00	118.00	118.00	118.00	118.00	118.00	112.45	103.44	118.00	118.00	1367.11
1945	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	113.04	103.90	118.00	1396.94
1946	104.95	94.24	118.00	118.00	118.00	118.00	118.00	118.00	107.77	100.63	100.80	96.49	1312.87
1947	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	115.63	105.23	118.00	1400.86
1948	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	116.72	107.77	118.00	103.39	1389.88
1949	118.00	118.00	118.00	118.00	118.00	118.00	118.00	113.34	104.28	97.52	90.93	85.65	1317.73
1950	84.84	111.11	118.00	118.00	118.00	118.00	118.00	118.00	118.00	109.81	101.94	95.62	1329.32
1951	100.09	118.00	118.00	118.00	118.00	118.00	118.00	111.73	102.95	95.70	118.00	118.00	1354.47
1952	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	115.78	1413.78
1953	105.49	94.51	118.00	118.00	118.00	118.00	118.00	107.34	99.40	93.71	87.89	117.60	1295.94
1954	118.00	118.00	118.00	118.00	118.00	115.59	103.85	95.92	90.27	86.56	82.30	81.04	1245.54
1955	93.06	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	106.26	1379.31
1956	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	115.56	105.19	107.20	1389.95
1957	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1958	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1959	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1960	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	110.53	111.57	118.00	118.00	1402.10
1961	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	113.67	111.24	118.00	118.00	1404.91
1962	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1963	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1964	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1965	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1966	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	101.51	99.46	107.71	1370.68
1967	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1968	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1969	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1970	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	115.25	118.00	1413.25
1971	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1972	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1973	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1974	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	117.83	1415.83
1975	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1976	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1977	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1978	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	117.31	118.00	118.00	1415.31
1979	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1980	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1981	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	103.73	118.00	1401.73
1982	112.86	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1410.86
1983	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1984	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1985	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1986	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
1987	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
TOTAL	7058.27	7084.98	7182.79	7198.00	7198.00	7195.59	7174.96	7127.48	7026.25	6914.06	6846.98	6899.82	84907.18
AVERAGE	115.71	116.15	117.75	118.00	118.00	117.96	117.62	116.84	115.18	113.35	112.25	113.11	1391.92
MAXIMUM	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	118.00	1416.00
MINIMUM	84.84	93.54	102.79	118.00	118.00	115.59	103.85	95.92	90.27	86.56	82.30	81.04	1245.54

Table 8-23 Peak Power Duration of Lower Kihansi Project without Upper Kihansi Project

UNIT: MW

NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P
1	2701	118.0	62	3402	118.0	123	4009	118.0	184	4708	118.0	245	5508	118.0	306	6103	118.0	367	6606	118.0	428	7111	118.0	489	7701	118.0	550	8205	118.0	611	8706	118.0	672	4011	106.9
2	2702	118.0	63	3403	118.0	124	4010	118.0	185	4709	118.0	246	5509	118.0	307	6104	118.0	368	6607	118.0	429	7112	118.0	490	7702	118.0	551	8206	118.0	612	8707	118.0	673	3802	106.9
3	2703	118.0	64	3404	118.0	125	4012	118.0	186	4712	118.0	247	5510	118.0	308	6105	118.0	369	6608	118.0	430	7201	118.0	491	7703	118.0	552	8207	118.0	613	8708	118.0	674	3810	106.7
4	2704	118.0	65	3405	118.0	126	4101	118.0	187	4801	118.0	248	5511	118.0	309	6106	118.0	370	6609	118.0	431	7202	118.0	492	7704	118.0	553	8208	118.0	614	8709	118.0	675	5512	106.3
5	2705	118.0	66	3406	118.0	127	4102	118.0	188	4802	118.0	249	5601	118.0	310	6107	118.0	371	6701	118.0	432	7203	118.0	493	7705	118.0	554	8209	118.0	615	8710	118.0	676	3010	106.1
6	2706	118.0	67	3407	118.0	128	4103	118.0	189	4803	118.0	250	5602	118.0	311	6108	118.0	372	6702	118.0	433	7204	118.0	494	7706	118.0	555	8210	118.0	616	8711	118.0	677	2902	105.6
7	2707	118.0	68	3408	118.0	129	4104	118.0	190	4804	118.0	251	5603	118.0	312	6111	118.0	373	6703	118.0	434	7205	118.0	495	7707	118.0	556	8211	118.0	617	8712	118.0	678	5301	105.5
8	2712	118.0	69	3409	118.0	130	4105	118.0	191	4805	118.0	252	5604	118.0	313	6112	118.0	374	6704	118.0	435	7206	118.0	496	7708	118.0	557	8212	118.0	618	7412	117.8	679	3912	105.3
9	2802	118.0	70	3410	118.0	131	4106	118.0	192	4806	118.0	253	5605	118.0	314	6201	118.0	375	6705	118.0	436	7207	118.0	497	7709	118.0	558	8301	118.0	619	5312	117.6	680	4711	105.2
10	2803	118.0	71	3412	118.0	132	4107	118.0	193	4807	118.0	254	5606	118.0	315	6202	118.0	376	6706	118.0	437	7208	118.0	498	7710	118.0	559	8302	118.0	620	4308	117.4	681	5611	105.2
11	2804	118.0	72	3501	118.0	133	4108	118.0	194	4808	118.0	255	5607	118.0	316	6203	118.0	377	6707	118.0	438	7209	118.0	499	7711	118.0	560	8303	118.0	621	7810	117.3	682	4601	104.9
12	2805	118.0	73	3502	118.0	134	4111	118.0	195	4811	118.0	256	5608	118.0	317	6204	118.0	378	6708	118.0	439	7210	118.0	500	7712	118.0	561	8304	118.0	622	2901	117.1	683	2710	104.7
13	2806	118.0	74	3503	118.0	135	4112	118.0	196	4901	118.0	257	5609	118.0	318	6205	118.0	379	6709	118.0	440	7211	118.0	501	7801	118.0	562	8305	118.0	623	4809	116.7	684	4909	104.3
14	2807	118.0	75	3504	118.0	136	4201	118.0	197	4902	118.0	258	5701	118.0	319	6206	118.0	380	6710	118.0	441	7212	118.0	502	7802	118.0	563	8306	118.0	624	3310	116.6	685	4511	103.9
15	2808	118.0	76	3505	118.0	137	4202	118.0	198	4903	118.0	259	5702	118.0	320	6207	118.0	381	6711	118.0	442	7301	118.0	503	7803	118.0	564	8307	118.0	625	3510	116.6	686	5407	103.9
16	2812	118.0	77	3506	118.0	138	4203	118.0	199	4904	118.0	260	5703	118.0	321	6208	118.0	382	6712	118.0	443	7302	118.0	504	7804	118.0	565	8308	118.0	626	2708	116.6	687	8111	103.7
17	2903	118.0	78	3507	118.0	139	4204	118.0	200	4905	118.0	261	5704	118.0	322	6209	118.0	383	6801	118.0	444	7303	118.0	505	7805	118.0	566	8309	118.0	627	2809	116.3	688	3811	103.6
18	2904	118.0	79	3508	118.0	140	4205	118.0	201	4906	118.0	262	5705	118.0	323	6210	118.0	384	6802	118.0	445	7304	118.0	506	7806	118.0	567	8310	118.0	628	3511	116.1	689	4410	103.4
19	2905	118.0	80	3512	118.0	141	4206	118.0	202	4907	118.0	263	5706	118.0	324	6211	118.0	385	6803	118.0	446	7305	118.0	507	7807	118.0	568	8311	118.0	629	2811	116.1	690	4812	103.4
20	2906	118.0	81	3601	118.0	142	4207	118.0	203	5003	118.0	264	5707	118.0	325	6212	118.0	386	6804	118.0	447	7306	118.0	508	7808	118.0	569	8312	118.0	630	5212	115.8	691	5109	102.9
21	2907	118.0	82	3602	118.0	143	4208	118.0	204	5004	118.0	265	5708	118.0	326	6301	118.0	387	6805	118.0	448	7307	118.0	509	7809	118.0	570	8401	118.0	631	4710	115.6	692	3803	102.8
22	3001	118.0	83	3603	118.0	144	4209	118.0	205	5005	118.0	266	5709	118.0	327	6302	118.0	388	6806	118.0	449	7308	118.0	510	7811	118.0	571	8402	118.0	632	5406	115.6	693	3808	102.6
23	3003	118.0	84	3604	118.0	145	4210	118.0	206	5006	118.0	267	5710	118.0	328	6303	118.0	389	6807	118.0	450	7309	118.0	511	7812	118.0	572	8403	118.0	633	5610	115.6	694	5011	101.9
24	3004	118.0	85	3605	118.0	146	4212	118.0	207	5007	118.0	268	5711	118.0	329	6304	118.0	390	6808	118.0	451	7310	118.0	512	7901	118.0	573	8404	118.0	634	7011	115.3	695	2909	101.8
25	3005	118.0	86	3606	118.0	147	4302	118.0	208	5008	118.0	269	5712	118.0	330	6305	118.0	391	6809	118.0	452	7311	118.0	513	7902	118.0	574	8405	118.0	635	3910	114.9	696	6610	101.5
26	3006	118.0	87	3607	118.0	148	4303	118.0	209	5009	118.0	270	5801	118.0	331	6306	118.0	392	6810	118.0	453	7312	118.0	514	7903	118.0	575	8406	118.0	636	4109	114.9	697	4310	101.5
27	3007	118.0	88	3608	118.0	149	4304	118.0	210	5102	118.0	271	5802	118.0	332	6307	118.0	393	6811	118.0	454	7401	118.0	515	7904	118.0	576	8407	118.0	637	3411	114.6	698	3801	101.4
28	3008	118.0	89	3609	118.0	150	4305	118.0	211	5103	118.0	272	5803	118.0	333	6308	118.0	394	6812	118.0	455	7402	118.0	516	7905	118.0	577	8408	118.0	638	3002	114.4	699	4611	100.8
29	3101	118.0	90	3610	118.0	151	4306	118.0	212	5104	118.0	273	5804	118.0	334	6309	118.0	395	6901	118.0	456	7403	118.0	517	7906	118.0	578	8409	118.0	639	2810	114.3	700	3312	100.8
30	3102	118.0	91	3611	118.0	152	4307	118.0	213	5105	118.0	274	5805	118.0	335	6310	118.0	396	6902	118.0	457	7404	118.0	518	7907	118.0	579	8410	118.0	640	3009	114.0	701	4610	100.6
31	3103	118.0	92	3612	118.0	153	4403	118.0	214	5106	118.0	275	5806	118.0	336	6311	118.0	397	6903	118.0	458	7405	118.0	519	7908	118.0	580	8411	118.0	641	3111	113.9	702	5101	100.1
32	3104	118.0	93	3701	118.0	154	4404	118.0	215	5107	118.0	276	5807	118.0	337	6312	118.0	398	6904	118.0	459	7406	118.0	520	7909	118.0	581	8412	118.0	642	4401	113.7	703	2711	99.5
33	3105	118.0	94	3702	118.0	155	4405	118.0	216	5111	118.0	277	5808	118.0	338	6401	118.0	399	6905	118.0	460	7407	118.0	521	7910	118.0	582	8501	118.0	643	6109	113.7	704	6611	99.5
34	3106	118.0	95	3703	118.0	156	4406	118.0	217	5112	118.0	278	5809	118.0	339	6402	118.0	400	6906	118.0	461	7408	118.0	522	7911	118.0	583	8502	118.0	644	4908	113.3	705	5309	99.4
35	3107	118.0	96	3704	118.0	157	4407	118.0	218	5201	118.0	279	5810	118.0	340	6403	118.0	401	6907	118.0	462	7409	118.0	523	7912	118.0	584	8503	118.0	645	4510	113.0	706	3011	98.6
36	3108	118.0	97	3705	118.0	158	4408	118.0	219	5202	118.0	280	5811	118.0	341	6404	118.0	402	6908	118.0	463	7410	118.0	524	8001	118.0	585	8504	118.0	646	8201	112.9	707	3812	98.6
37	3109	118.0	98	3706	118.0	159	4411	118.0	220	5203	118.0	281	5812	118.0	342	6405	118.0	403	6909	118.0	464	7411	118.0	525	8002	118.0	586	8505	118.0	647	3509	112.8	708	4910	97.5
38	3110	118.0	99	3707	118.0	160	4412	118.0	221	5204	118.0	282	5901	118.0	343	6406	118.0	404	6910	118.0	465	7501	118.0	526	8003	118.0	587	8506	118.0	648	4211	112.7	709	3809	97.5
39	3112	118.0	100	3708	118.0	161	4501	118.0	222	5205	118.0	283	5902	118.0	344	6407	118.0	405	6911	118.0	466	7502	118.0	527	8004	118.0	588	8507	118.0	649	2801	112.5	710	2912	96.6
40	3201	118.0	101	3709	118.0	162	4502	118.0	223	5206	118.0	284	5903	118.0	345	6408	118.0	406	6912	118.0	467	7503	118.0	528	8005	118.0	589	8508	118.0	650	4409	112.5	711	4612	96.5
41	3202	118.0	102	3710	118.0	163	4503	118.0	224	5207	118.0	285	5904	118.0	346	6409	118.0	407	7001	118.0	468	7504	118.0	529	8006	118.0	590	8509	118.0	651	4301	112.3	712	5408	95.9
42	3203	118.0	103	3711	118.0	164	4504	118.0	225	5208	118.0	286	5905	118.0	347	6410	118.0	408	7002	118.0	469	7505	118.0	530	8007	118.0	591	8510	118.0	652	5108	111.7	713	5110	95.7
43	3204	118.0	104	3804	118.0	165	4505	118.0	226	5209	118.0	287	5906	118.0	348	6411	118.0	409	7003	118.0	470	7506	118.0	531	8008	118.0	592	8511	118.0	653	6010	111.6	714	5012	95.6
44	3205	118.0	105	3805	118.0	166	4506	118.0	227	5210	118.0	288	5907	118.0	349	6412	118.0	410	7004	118.0	471	7507	118.0	532	8009	118.0	593	8512	118.0	654	6110	111.2	715	2910	95.5
45	3206	118.0	106	3806	118.0	167	4507	118.0	228	5211	118.0	289	5908	118.0	350	6501	118.0	411	7005	118.0	472	7508	118.0	533	8010	118.0	594	8601	118.0	655	5002	111.1	716	4311	94.6
46	3207	118.0	107	3901	118.0	168	4508	118.0	229	5303	118.0	290	5909	118.0	351	6502	118.0	412	7006	118.0	473	7509	118.0	534	8011	118.0	595	8602	118.0	656	3902	110.6	717	5302	94.5
47	3208	118.0	108	3903	118.0	169	4509	118.0	230	5304	118.0	291	5910	118.0	352	6503	118.0	413	7007	118.0	474	7510	118.0	535	8012	118.0	596	8603	118.0	657	6009	110.5	718	4602	94.2
48	3209	118.0	109	3904	118.0	170	4512	118.0	231	5305	118.0	292	5911	118.0	353	6504	118.0	414	7008	118.0	475	7511	118.0	536	8101	118.0	597	8604	118.0	658	2709	110.4	719	5310	93.7
49	3210	118.0	110	3905	118.0	171	4603	118.0	232	5306	118.0	293	5912	118.0	354	6505	118.0	415	7009	118.0	476	7512	118.0	537	8102	118.0	598	8605	118.0	659	3712	109.9	720	4402	93.5
50	3211	118.0	111	3906	118.0	172	4604	118.0	233	5307	118.0	294	6001	118.0	355	6506	118.0	416	7010	118.0	477	7601	118.0	538	8103	118.0	599	8606	118.0	660	5010	109.8	721	5501	93.1
51	3212	118.0	112	3907	118.0	173	4605	118.0	234	5401	118.0	295	6002	118.0	356	6507	118.0	417	7012	118.0	478	7602	118.0	539	8104	118.0	600	8607	118.0	661	3807	109.1	722	3012	91.2
52	3301	118.0	113	3908	118.0	174	4606	118.0	235	5402	118.0	296	6003	118.0	357	6508	118.0	418	7101	118.0	479	7603	118.0	540	8105	118.0	601	8608	118.0	662	4309	108.6	723	2911	91.1
53	3302	118.0	114	3909	118.0	175	4607	118.0	236	5403	118.0	297	6004	118.0	358	6509	118.0	419	7102	118.0	480	7604	118.0	541	8106	118.0	602	8609	118.0	663	2908	108.5	724	4911	90.9
54	3303	118.0	115	4001	118.0	176	4608	118.0	237	5404	118.0	298	6005	118.0	359	6510	118.0	420	7103	118.0	481	7605	118.0	542	8107	118.0	603	8610	118.0	664	3911	108.4	725	5409	90.3
55	3304	118.0	116	4002	118.0	177	4701	118.0	238	5405	118.0	299	6006	118.0	360	6511	118.0	421	7104	118.0	482	7606	118.0	543	8108	118.0	604	8611	118.0	665	3311	108.2	726	4312	88.9
56	3305	118.0	117	4003	118.0	178	4702	118.0	239	5502	118.0	300	6007	118.0	361	6512	118.0	422	7105	118.0	483	7607	118.0	544	8109	118.0	605	8612	118.0	666	4110	108.1	727	5311	87.9
57	3306	118.0	118	4004	118.0	179	4703	118.0	240	5503	118.0	301	6008	118.0	362	6601	118.0	423	7106	118.0	484	7608	118.0	545	8110	118.0	606	8701	118.0	667	4810	107.8	728	5410	86.6
58	3307	118.0	119	4005	118.0	180	4704	118.0	241	5504	118.0	302	6011	118.0	363	6602	118.0	424	7107	118.0	485	7609	118.0	546	8112	118.0	607	8702	118.0	668	4609	107.8	729	4912	85.7
59	3308	118.0	120	4006	118.0	181	4705	118.0	242	5505	118.0	303	6012	118.0	364	6603	118.0	425	7108	118.0	486	7610	118.0	547	8202	118.0	608	8703	118.0	669	6612	107.7	730	5001	84.8
60	3309	118.0	121	4007	118.0	182	4706	118.0	243	5506	118.0	304	6101	118.0	365	6604	118.0	426	7109	118.0	487	7611	118.0	548	8203	118.0	609	8704	118.0	670	5308	107.3	731	5411	82.3
61	3401	118.0	122	4008	118.0	183	4707	118.0	244	5507	118.0	305	6102	118.0	366	6605	118.0	427	7110	118.0	488	7612	118.0	549	8204	118.0	610	8705	118.0	671	5612	107.2	732	5412	81.0

Table 8-24 Total Energy Production of Lower Kihansi Project with Upper Kihansi Project

UNIT: 10^6 kWh

MONTH / YEAR	< JAN >	< FEB >	< MAR >	< APR >	< MAY >	< JUN >	< JUL >	< AUG >	< SEP >	< OCT >	< NOV >	< DEC >	<TOTAL>
1927	113.60	102.60	61.20	59.40	61.10	59.10	61.00	61.00	58.10	42.20	38.80	56.20	774.30
1928	45.40	44.90	68.80	59.50	61.30	59.10	61.00	61.00	59.00	60.90	59.00	61.10	701.00
1929	57.10	38.50	61.20	60.00	61.10	59.10	61.00	60.90	58.90	58.20	35.60	39.00	650.60
1930	59.60	41.70	98.80	64.30	61.30	59.20	61.10	61.00	59.00	60.90	58.90	60.80	746.60
1931	61.00	58.20	113.60	110.00	88.00	74.80	78.70	68.20	61.60	61.00	59.00	61.00	895.10
1932	106.60	106.30	113.60	110.00	83.80	71.80	76.70	67.40	61.20	61.00	59.00	61.00	978.40
1933	113.60	102.60	113.60	60.00	61.40	59.30	61.10	61.40	59.00	61.00	58.90	60.90	872.80
1934	107.90	95.90	64.00	59.60	61.40	59.40	61.20	61.10	59.10	61.00	59.00	63.20	812.80
1935	105.10	102.60	112.20	59.30	61.20	59.10	61.00	61.00	59.00	55.00	45.30	61.90	842.70
1936	113.60	106.30	66.30	110.00	113.60	91.40	88.80	76.40	68.40	66.90	59.00	68.70	1029.40
1937	99.90	87.30	113.60	59.90	72.70	68.10	73.90	65.00	61.50	62.60	59.00	60.90	884.40
1938	67.10	75.60	60.90	59.40	61.00	59.00	47.70	41.40	38.00	43.10	40.50	39.80	633.50
1939	61.20	46.50	61.20	110.00	61.50	60.60	68.50	61.10	59.00	60.90	58.90	60.90	770.30
1940	113.60	106.30	69.00	70.70	61.30	59.20	61.10	61.00	59.00	61.00	58.90	61.00	842.10
1941	61.00	102.60	96.90	59.30	61.60	59.20	61.10	61.00	59.00	60.90	59.10	61.10	802.80
1942	67.20	89.40	113.60	98.30	72.70	71.70	76.30	66.40	60.30	61.00	59.00	69.80	905.70
1943	77.20	90.10	85.40	59.40	61.80	59.10	61.00	61.00	58.90	60.90	58.90	55.40	769.10
1944	45.90	35.30	50.20	60.30	61.40	59.20	61.10	61.00	59.00	60.90	59.00	61.30	674.60
1945	101.40	97.70	70.80	60.00	84.60	63.70	70.20	61.30	59.00	60.90	58.90	61.00	849.50
1946	64.20	71.00	61.00	87.80	61.30	59.10	61.00	61.00	58.90	60.90	58.90	60.90	766.00
1947	61.40	81.10	97.50	59.80	61.60	59.30	61.20	61.10	59.00	60.90	58.90	112.90	834.70
1948	113.60	106.30	113.60	59.40	61.30	59.20	61.10	61.00	59.00	60.90	59.10	60.90	875.40
1949	58.50	72.00	61.10	59.60	61.20	59.10	61.00	60.90	58.90	60.90	37.10	34.60	684.90
1950	34.20	40.50	90.10	59.60	61.60	59.20	61.10	61.00	59.00	60.90	58.90	60.90	707.00
1951	60.90	55.20	61.00	59.80	61.30	59.10	61.00	60.90	58.90	49.60	59.40	61.00	708.10
1952	61.40	98.90	97.10	71.90	113.60	82.60	78.90	67.80	60.90	61.00	72.50	60.90	927.50
1953	73.90	71.10	61.10	59.20	61.40	59.10	61.00	60.90	50.60	37.80	34.30	47.40	677.80
1954	61.20	48.00	50.40	59.20	61.10	46.30	41.90	38.70	35.20	34.90	32.10	32.70	541.70
1955	37.50	55.50	71.40	110.00	80.20	76.10	78.20	67.50	60.40	61.00	59.00	60.90	817.70
1956	113.60	106.30	76.30	110.00	61.50	66.90	72.50	63.00	59.00	60.90	58.90	60.90	909.80
1957	112.40	102.60	85.20	106.10	111.40	68.20	74.60	69.20	65.10	66.50	61.20	73.80	996.30
1958	100.70	102.60	113.60	110.00	86.90	63.70	71.40	67.00	64.40	66.70	60.50	92.10	999.60
1959	103.00	102.60	104.10	59.70	61.30	59.20	61.10	61.10	59.10	61.00	59.00	61.10	852.30
1960	61.00	106.30	113.60	110.00	113.60	68.40	63.90	61.00	59.00	60.90	59.00	61.00	937.70
1961	74.30	102.60	75.90	59.60	61.70	59.00	61.00	61.10	59.00	60.90	59.10	61.40	795.60
1962	113.60	102.60	113.60	110.00	113.60	93.90	92.10	81.90	66.30	75.20	65.60	80.80	1109.20
1963	113.60	102.60	113.60	110.00	113.60	87.90	95.50	82.30	74.90	74.20	100.00	67.40	1135.60
1964	113.60	106.30	113.60	110.00	113.60	110.00	104.70	94.90	82.90	79.70	72.10	86.20	1187.60
1965	113.60	102.60	113.60	110.00	77.20	66.90	76.20	71.50	66.50	69.50	64.70	80.60	1012.90
1966	113.60	102.60	113.60	110.00	113.60	75.20	76.30	73.20	68.10	60.90	58.90	60.90	1026.90
1967	86.30	102.60	99.50	63.60	107.30	82.30	80.90	73.80	67.20	68.50	75.00	113.60	1020.60
1968	113.60	106.30	113.60	110.00	113.60	110.00	113.60	106.70	93.90	87.50	84.50	110.80	1264.10
1969	113.60	102.60	113.60	89.50	88.40	68.30	75.70	74.10	66.00	65.20	64.50	74.10	995.60
1970	113.60	102.60	113.60	110.00	61.40	59.20	68.50	66.00	62.10	61.40	59.00	98.10	975.50
1971	107.70	102.60	109.70	110.00	68.30	60.80	78.70	68.70	65.30	83.60	64.50	75.80	995.70
1972	113.60	106.30	113.60	110.00	113.60	92.40	87.50	73.90	77.70	75.90	71.20	113.60	1149.30
1973	113.60	102.60	113.60	110.00	113.60	92.70	89.80	78.00	74.20	75.10	71.20	87.60	1122.00
1974	113.60	102.60	113.60	110.00	113.60	101.30	90.90	74.90	74.30	74.00	68.50	61.20	1098.50
1975	109.10	93.00	67.10	63.80	95.30	79.80	78.10	70.10	68.60	65.00	59.00	68.80	917.70
1976	102.90	106.30	99.20	68.70	96.70	96.10	87.40	76.10	67.90	67.40	59.00	61.00	988.70
1977	98.90	84.10	67.70	59.90	66.10	66.80	71.30	63.30	59.00	61.00	59.40	90.20	847.70
1978	108.50	99.80	89.40	63.60	85.20	72.80	72.80	63.10	59.00	61.00	60.80	86.00	922.00
1979	113.60	102.60	113.60	110.00	113.60	110.00	113.60	94.10	80.40	75.10	72.20	92.80	1191.60
1980	113.60	106.30	76.10	59.70	61.80	59.30	69.10	65.00	59.60	61.00	59.00	68.10	858.60
1981	91.40	94.10	75.00	59.60	61.50	59.20	61.10	61.00	59.00	61.00	58.90	61.00	802.80
1982	60.90	55.10	61.10	59.60	61.90	59.30	61.10	61.00	59.00	61.00	59.10	86.70	745.80
1983	113.60	102.60	109.30	85.80	113.60	107.50	97.90	77.40	68.40	66.90	59.90	67.60	1070.50
1984	94.20	97.00	94.00	69.40	111.70	95.40	89.60	73.80	67.60	68.30	62.90	104.80	1028.70
1985	113.60	102.60	113.60	110.00	113.60	99.70	97.20	79.50	71.50	69.10	76.20	113.60	1160.20
1986	113.60	102.60	113.60	110.00	113.60	110.00	113.60	99.50	80.30	76.20	85.90	113.60	1232.50
1987	113.60	102.60	113.60	59.80	83.40	82.60	84.40	72.70	64.20	66.90	65.20	85.60	994.60
TOTAL	5560.90	5446.60	5560.00	4974.10	4983.20	4416.00	4511.00	4138.30	3847.30	3856.60	3689.80	4338.90	55322.70
AVERAGE	91.16	89.29	91.15	81.54	81.69	72.39	73.95	67.84	63.07	63.22	60.49	71.13	906.93
MAXIMUM	113.60	106.30	113.60	110.00	113.60	110.00	113.60	106.70	93.90	87.50	100.00	113.60	1264.10
MINIMUM	34.20	35.30	50.20	59.20	61.00	46.30	41.90	38.70	35.20	34.90	32.10	32.70	541.70

Table 8-25 Firm Energy Production of Lower Kihansi Project with Upper Kihansi Project

UNIT: 10^6 kWh

MONTH / YEAR	< JAN >	< FEB >	< MAR >	< APR >	< MAY >	< JUN >	< JUL >	< AUG >	< SEP >	< OCT >	< NOV >	< DEC >	<TOTAL>
1927	61.50	55.60	61.20	59.40	61.10	59.10	61.00	61.00	58.10	42.20	38.80	56.20	675.20
1928	45.40	44.90	61.50	59.50	61.30	59.10	61.00	61.00	59.00	60.90	59.00	61.10	693.70
1929	57.10	38.50	61.20	59.60	61.10	59.10	61.00	60.90	58.90	58.20	35.60	39.00	650.20
1930	59.60	41.70	61.50	59.60	61.30	59.20	61.10	61.00	59.00	60.90	58.90	60.80	704.60
1931	61.00	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.00	59.00	61.00	722.40
1932	61.50	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.00	59.00	61.00	724.90
1933	61.50	55.60	61.50	59.60	61.40	59.30	61.10	61.40	59.00	61.00	58.90	60.90	721.20
1934	61.50	55.60	61.50	59.60	61.40	59.40	61.20	61.10	59.10	61.00	59.00	61.50	721.90
1935	61.50	55.60	61.50	59.30	61.20	59.10	61.00	61.00	59.00	55.00	45.30	61.50	701.00
1936	61.50	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.00	61.50	725.90
1937	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.00	60.90	723.30
1938	61.50	55.60	60.90	59.40	61.00	59.00	47.70	41.40	38.00	43.10	40.50	39.80	607.90
1939	61.20	46.50	61.20	59.60	61.50	59.60	61.50	61.10	59.00	60.90	58.90	60.90	711.90
1940	61.50	57.60	61.50	59.60	61.30	59.20	61.10	61.00	59.00	61.00	58.90	61.00	722.70
1941	61.00	55.60	61.50	59.30	61.50	59.20	61.10	61.00	59.00	60.90	59.10	61.10	720.30
1942	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.00	59.00	61.50	723.40
1943	61.50	55.60	61.50	59.40	61.50	59.10	61.00	61.00	58.90	60.90	58.90	55.40	714.70
1944	45.90	35.30	50.20	59.60	61.40	59.20	61.10	61.00	59.00	60.90	59.00	61.30	673.90
1945	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.30	59.00	60.90	58.90	61.00	721.90
1946	61.50	55.60	61.00	59.60	61.30	59.10	61.00	61.00	58.90	60.90	58.90	60.90	719.70
1947	61.40	55.60	61.50	59.60	61.50	59.30	61.20	61.10	59.00	60.90	58.90	61.50	721.50
1948	61.50	57.60	61.50	59.40	61.30	59.20	61.10	61.00	59.00	60.90	59.10	60.90	722.50
1949	58.50	55.60	61.10	59.60	61.20	59.10	61.00	60.90	58.90	60.90	37.10	34.60	668.50
1950	34.20	40.50	61.50	59.60	61.50	59.20	61.10	61.00	59.00	60.90	58.90	60.90	678.30
1951	60.90	55.20	61.00	59.60	61.30	59.10	61.00	60.90	58.90	49.60	59.40	61.00	707.90
1952	61.40	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.00	59.60	60.90	725.30
1953	61.50	55.60	61.10	59.20	61.40	59.10	61.00	60.90	50.60	37.80	34.30	47.40	649.90
1954	61.20	48.00	50.40	59.20	61.10	46.30	41.90	38.70	35.20	34.90	32.10	32.70	541.70
1955	37.50	55.50	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.00	59.00	60.90	698.70
1956	61.50	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.00	60.90	58.90	60.90	724.00
1957	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1958	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1959	61.50	55.60	61.50	59.60	61.30	59.20	61.10	61.10	59.10	61.00	59.00	61.10	721.10
1960	61.00	57.60	61.50	59.60	61.50	59.60	61.50	61.00	59.00	60.90	59.00	61.00	723.20
1961	61.50	55.60	61.50	59.60	61.50	59.00	61.00	61.10	59.00	60.90	59.10	61.40	721.20
1962	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1963	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1964	61.50	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	726.50
1965	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1966	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	60.90	58.90	60.90	722.60
1967	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1968	61.50	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	726.50
1969	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1970	61.50	55.60	61.50	59.60	61.40	59.20	61.50	61.50	59.60	61.40	59.00	61.50	723.30
1971	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1972	61.50	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	726.50
1973	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1974	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.20	724.20
1975	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.00	61.50	723.90
1976	61.50	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.00	61.00	725.40
1977	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.00	61.00	59.40	61.50	723.20
1978	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.00	61.00	59.60	61.50	723.40
1979	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1980	61.50	57.60	61.50	59.60	61.50	59.30	61.50	61.50	59.60	61.00	59.00	61.50	725.10
1981	61.50	55.60	61.50	59.60	61.50	59.20	61.10	61.00	59.00	61.00	58.90	61.00	720.90
1982	60.90	55.10	61.10	59.60	61.50	59.30	61.10	61.00	59.00	61.00	59.10	61.50	720.20
1983	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1984	61.50	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	726.50
1985	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1986	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
1987	61.50	55.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	724.50
TOTAL	3655.70	3322.80	3725.40	3633.30	3747.30	3611.60	3708.50	3696.90	3563.20	3625.10	3462.30	3613.60	43365.70
AVERAGE	59.93	54.47	61.07	59.56	61.43	59.21	60.80	60.60	58.41	59.43	56.76	59.24	710.91
MAXIMUM	61.50	57.60	61.50	59.60	61.50	59.60	61.50	61.50	59.60	61.50	59.60	61.50	726.50
MINIMUM	34.20	35.30	50.20	59.20	61.00	46.30	41.90	38.70	35.20	34.90	32.10	32.70	541.70

Table 8-26 Monthly Peak Power of Lower Kihansi Project with Upper Kihansi Project

UNIT: 10^6 kWh

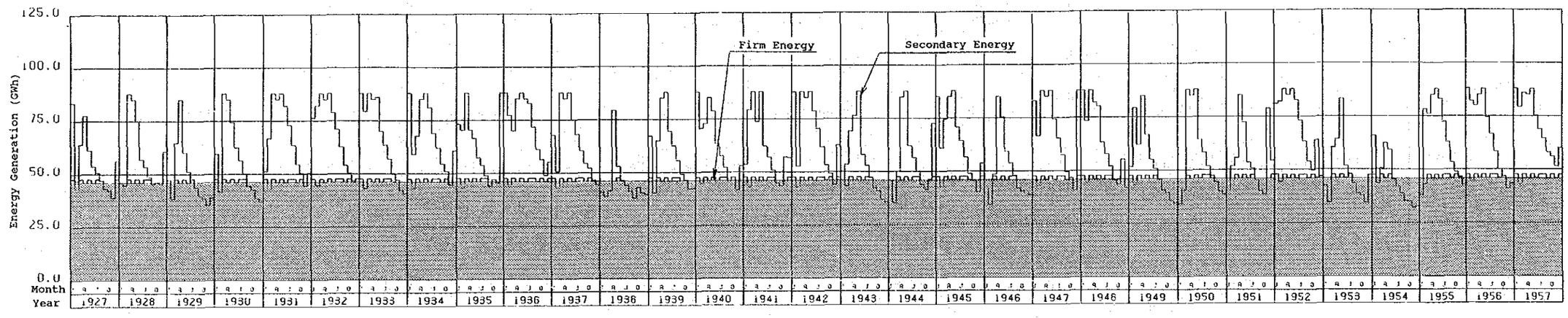
MONTH / YEAR	< JAN >	< FEB >	< MAR >	< APR >	< MAY >	< JUN >	< JUL >	< AUG >	< SEP >	< OCT >	< NOV >	< DEC >	<TOTAL>
1927	152.72	152.72	151.74	152.22	151.66	151.49	151.35	151.24	149.07	104.83	99.59	139.47	1708.08
1928	112.63	119.04	152.72	152.69	152.06	151.59	151.43	151.29	151.24	151.22	151.24	151.65	1748.78
1929	141.68	105.73	151.77	152.72	151.63	151.42	151.26	151.15	151.07	144.31	91.17	96.72	1640.62
1930	147.87	114.56	152.72	152.72	152.05	151.76	151.52	151.34	151.21	151.12	151.03	150.94	1778.83
1931	151.36	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.34	151.21	151.34	1826.99
1932	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.34	151.28	151.26	1828.33
1933	152.72	152.72	152.72	152.72	152.39	151.99	151.73	152.39	151.37	151.24	151.14	151.06	1824.17
1934	152.72	152.72	152.72	152.72	152.46	152.33	151.89	151.69	151.52	151.36	151.22	152.72	1826.05
1935	152.72	152.72	152.72	152.00	151.82	151.60	151.44	151.30	151.20	136.41	116.24	152.72	1772.88
1936	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.35	152.72	1831.22
1937	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.27	151.16	1829.59
1938	152.72	152.72	151.08	152.28	151.42	151.27	118.45	102.69	97.56	106.85	103.74	98.65	1539.42
1939	151.84	127.68	151.77	152.72	152.66	152.72	152.72	151.50	151.36	151.22	151.15	151.11	1798.43
1940	152.72	152.72	152.72	152.72	152.18	151.79	151.56	151.40	151.26	151.26	151.13	151.42	1822.86
1941	151.44	152.72	152.72	152.11	152.72	151.75	151.54	151.36	151.22	151.14	151.60	151.53	1821.83
1942	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.31	151.20	152.72	1829.66
1943	152.72	152.72	152.72	152.18	152.72	151.62	151.42	151.25	151.15	151.06	150.98	137.41	1807.94
1944	113.79	93.63	124.66	152.72	152.47	151.75	151.52	151.34	151.19	151.09	151.27	152.00	1697.43
1945	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.13	151.35	151.20	151.09	151.44	1826.22
1946	152.72	152.72	151.29	152.72	152.08	151.66	151.44	151.27	151.14	151.05	151.06	151.00	1820.14
1947	152.31	152.72	152.72	152.72	152.72	152.12	151.79	151.55	151.37	151.23	151.11	152.72	1825.06
1948	152.72	152.72	152.72	152.35	152.22	151.78	151.56	151.39	151.24	151.14	151.54	151.09	1822.46
1949	145.23	152.72	151.69	152.72	151.83	151.54	151.35	151.20	151.10	151.02	95.05	85.73	1691.17
1950	84.92	111.21	152.72	152.72	152.72	151.81	151.57	151.38	151.30	151.16	151.07	150.99	1713.57
1951	151.05	151.55	151.35	152.72	151.99	151.49	151.35	151.19	151.08	123.11	152.26	151.46	1790.57
1952	152.25	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.32	152.72	151.23	1829.24
1953	152.72	152.72	151.64	151.82	152.31	151.43	151.27	151.13	129.81	93.80	87.97	117.71	1644.32
1954	151.80	131.95	125.14	151.76	151.60	118.77	103.95	96.02	90.35	86.65	82.38	81.12	1371.47
1955	93.15	152.41	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.29	151.27	151.12	1768.25
1956	152.72	152.72	152.72	152.72	152.70	152.72	152.72	152.72	151.38	151.23	151.11	151.13	1826.57
1957	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1958	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1959	152.72	152.72	152.72	152.72	152.15	151.72	151.63	151.56	151.46	151.41	151.40	151.64	1823.82
1960	151.46	152.72	152.72	152.72	152.72	152.72	152.72	151.34	151.17	151.18	151.31	151.36	1824.11
1961	152.72	152.72	152.72	152.72	152.72	151.35	151.43	151.55	151.21	151.18	151.56	152.28	1824.13
1962	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1963	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1964	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1965	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1966	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.06	151.04	151.14	1827.68
1967	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1968	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1969	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1970	152.72	152.72	152.72	152.72	152.38	151.90	152.72	152.72	152.72	152.47	151.23	152.72	1829.70
1971	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1972	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1973	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1974	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.95	1831.82
1975	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.30	152.72	1831.17
1976	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.33	151.27	1829.76
1977	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.40	151.29	152.30	152.72	1829.43
1978	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	151.41	151.25	152.72	152.72	1829.82
1979	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1980	152.72	152.72	152.72	152.72	152.72	152.10	152.72	152.72	152.72	151.33	151.28	152.72	1829.15
1981	152.72	152.72	152.72	152.72	152.58	151.80	151.55	151.43	151.26	151.28	151.09	151.41	1823.26
1982	151.20	151.47	151.68	152.72	152.72	151.95	151.67	151.44	151.31	151.40	151.53	152.72	1821.80
1983	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1984	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1985	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1986	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
1987	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
TOTAL	9076.18	9047.71	9249.58	9310.62	9303.28	9256.84	9206.14	9176.84	9133.94	8997.64	8876.11	8969.54	109604.42
AVERAGE	148.79	148.32	151.63	152.63	152.51	151.75	150.92	150.44	149.74	147.50	145.51	147.04	1796.79
MAXIMUM	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	152.72	1832.59
MINIMUM	84.92	93.63	124.66	151.76	151.42	118.77	103.95	96.02	90.35	86.65	82.38	81.12	1371.47

Table 8-27 Peak Power Duration of Lower Kihansi Project with Upper Kihansi Project

UNIT: MW

NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P	NO.	DATE	P
1	2701	152.7	62	3907	152.7	123	5506	152.7	184	6212	152.7	245	6804	152.7	306	7309	152.7	367	7907	152.7	428	8604	152.7	489	3901	151.8	550	4512	151.4	611	4608	151.3	672	5011	151.1
2	2702	152.7	63	4001	152.7	124	5507	152.7	185	6301	152.7	246	6805	152.7	307	7310	152.7	368	7908	152.7	429	8605	152.7	490	4905	151.8	551	3507	151.4	612	3806	151.3	673	2909	151.1
3	2803	152.7	64	4002	152.7	125	5508	152.7	186	6302	152.7	247	6806	152.7	308	7311	152.7	369	7909	152.7	430	8606	152.7	491	5304	151.8	552	4101	151.4	613	5307	151.3	674	6610	151.1
4	2904	152.7	65	4003	152.7	126	5509	152.7	187	6303	152.7	248	6807	152.7	309	7312	152.7	370	7910	152.7	431	8607	152.7	492	3505	151.8	553	2807	151.4	614	2907	151.3	675	4310	151.1
5	3003	152.7	66	4004	152.7	127	5601	152.7	188	6304	152.7	249	6808	152.7	310	7401	152.7	371	7911	152.7	432	8608	152.7	493	5006	151.8	554	6107	151.4	615	4010	151.3	676	4611	151.1
6	3004	152.7	67	4102	152.7	128	5602	152.7	189	6305	152.7	250	6809	152.7	311	7402	152.7	372	7912	152.7	433	8609	152.7	494	8106	151.8	555	5306	151.4	616	3212	151.3	677	3312	151.1
7	3102	152.7	68	4103	152.7	129	5603	152.7	190	6306	152.7	251	6810	152.7	312	7403	152.7	373	8001	152.7	434	8610	152.7	495	5401	151.8	556	8108	151.4	617	8109	151.3	678	4610	151.1
8	3103	152.7	69	4105	152.7	130	5604	152.7	191	6307	152.7	252	6811	152.7	313	7404	152.7	374	8002	152.7	435	8611	152.7	496	4006	151.8	557	2906	151.4	618	4009	151.3	679	5101	151.0
9	3104	152.7	70	4201	152.7	131	5606	152.7	192	6308	152.7	253	6812	152.7	314	7405	152.7	375	8003	152.7	436	8612	152.7	497	4707	151.8	558	4012	151.4	619	4308	151.3	680	6611	151.0
10	3105	152.7	71	4202	152.7	132	5607	152.7	193	6309	152.7	254	6901	152.7	315	7406	152.7	376	8004	152.7	437	8701	152.7	498	4806	151.8	559	3805	151.4	620	7810	151.3	681	3011	151.0
11	3106	152.7	72	4203	152.7	133	5608	152.7	194	6310	152.7	255	6902	152.7	316	7407	152.7	377	8005	152.7	438	8702	152.7	499	3903	151.8	560	4307	151.4	621	4809	151.2	682	4910	151.0
12	3107	152.7	73	4204	152.7	134	5701	152.7	195	6311	152.7	256	6903	152.7	317	7408	152.7	378	8007	152.7	439	8703	152.7	500	2903	151.8	561	5910	151.4	622	3310	151.2	683	4612	151.0
13	3108	152.7	74	4205	152.7	135	5702	152.7	196	6312	152.7	257	6904	152.7	318	7409	152.7	379	8008	152.7	440	8704	152.7	501	3006	151.8	562	7809	151.4	623	2708	151.2	684	5012	151.0
14	3109	152.7	75	4206	152.7	136	5703	152.7	197	6401	152.7	258	6905	152.7	319	7410	152.7	380	8009	152.7	441	8705	152.7	502	5404	151.8	563	8112	151.4	624	2809	151.2	685	4311	151.0
15	3201	152.7	76	4207	152.7	137	5704	152.7	198	6402	152.7	259	6906	152.7	320	7411	152.7	381	8012	152.7	442	8706	152.7	503	4106	151.8	564	8210	151.4	625	2811	151.2	686	3012	150.9
16	3202	152.7	77	4208	152.7	138	5705	152.7	199	6403	152.7	260	6907	152.7	321	7501	152.7	382	8101	152.7	443	8707	152.7	504	4406	151.8	565	7709	151.4	626	5212	151.2	687	2709	149.1
17	3203	152.7	78	4209	152.7	139	5706	152.7	200	6404	152.7	261	6908	152.7	322	7502	152.7	383	8102	152.7	444	8708	152.7	505	2703	151.7	566	4008	151.4	627	4710	151.2	688	3001	147.9
18	3204	152.7	79	4212	152.7	140	5707	152.7	201	6405	152.7	262	6909	152.7	323	7503	152.7	384	8103	152.7	445	8709	152.7	506	3307	151.7	567	5911	151.4	628	5610	151.2	689	4901	165.2
19	3205	152.7	80	4301	152.7	141	5708	152.7	202	6406	152.7	263	6910	152.7	324	7504	152.7	385	8104	152.7	446	8710	152.7	507	5906	151.7	568	4808	151.4	629	7011	151.2	690	2910	144.3
20	3206	152.7	81	4302	152.7	142	5709	152.7	203	6407	152.7	264	6911	152.7	325	7505	152.7	386	8204	152.7	447	8711	152.7	508	3408	151.7	569	5609	151.4	630	3910	151.2	691	2901	141.7
21	3207	152.7	82	4303	152.7	143	5710	152.7	204	6408	152.7	265	6912	152.7	326	7506	152.7	387	8205	152.7	448	8712	152.7	509	4903	151.7	570	5008	151.4	631	4109	151.2	692	2712	139.5
22	3208	152.7	83	4305	152.7	144	5711	152.7	205	6409	152.7	266	7001	152.7	327	7507	152.7	388	8212	152.7	449	5605	152.7	510	8203	151.7	571	3309	151.4	632	3411	151.2	693	4312	137.4
23	3209	152.7	84	4404	152.7	145	5712	152.7	206	6410	152.7	267	7002	152.7	328	7508	152.7	389	8301	152.7	450	2804	152.7	511	8207	151.7	572	4709	151.4	633	2810	151.2	694	3510	136.4
24	3301	152.7	85	4501	152.7	146	5801	152.7	207	6411	152.7	268	7003	152.7	329	7509	152.7	390	8302	152.7	451	3905	152.7	512	4606	151.7	573	3101	151.4	634	3009	151.2	695	5402	131.9
25	3302	152.7	86	4502	152.7	147	5802	152.7	208	6412	152.7	269	7004	152.7	330	7510	152.7	391	8303	152.7	452	8105	152.6	513	2705	151.7	574	3410	151.4	635	3111	151.2	696	5309	129.8
26	3303	152.7	87	4503	152.7	148	5803	152.7	209	6501	152.7	270	7007	152.7	331	7512	152.7	392	8304	152.7	453	4405	152.5	514	2812	151.6	575	4108	151.4	636	6109	151.2	697	3902	127.7
27	3304	152.7	88	4504	152.7	149	5804	152.7	210	6502	152.7	271	7008	152.7	332	7601	152.7	393	8305	152.7	454	7010	152.5	515	5912	151.6	576	3909	151.4	637	4908	151.2	698	5403	125.1
28	3401	152.7	89	4505	152.7	150	5805	152.7	211	6503	152.7	272	7009	152.7	333	7602	152.7	394	8306	152.7	455	3405	152.5	516	5303	151.6	577	6012	151.4	638	4510	151.2	699	4403	124.7
29	3402	152.7	90	4506	152.7	151	5806	152.7	212	6504	152.7	273	7012	152.7	334	7603	152.7	395	8307	152.7	456	5502	152.4	517	2905	151.6	578	5103	151.4	639	8201	151.2	700	5110	123.1
30	3403	152.7	91	4507	152.7	152	5807	152.7	213	6505	152.7	274	7101	152.7	335	7604	152.7	396	8308	152.7	457	3305	152.4	518	5907	151.6	579	6106	151.4	640	3509	151.2	701	2802	119.0
31	3404	152.7	92	4601	152.7	153	5808	152.7	214	6506	152.7	275	7102	152.7	336	7605	152.7	397	8309	152.7	458	3308	152.4	519	4306	151.6	580	4907	151.4	641	4211	151.2	702	5406	118.8
32	3412	152.7	93	4602	152.7	154	5809	152.7	215	6507	152.7	276	7103	152.7	337	7606	152.7	398	8310	152.7	459	7005	152.4	520	3506	151.6	581	3611	151.4	642	4409	151.2	703	3807	118.4
33	3501	152.7	94	4604	152.7	155	5810	152.7	216	6508	152.7	277	7104	152.7	338	7607	152.7	399	8311	152.7	460	4804	152.4	521	5405	151.6	582	5107	151.3	643	5108	151.2	704	5312	117.7
34	3502	152.7	95	4702	152.7	156	5811	152.7	217	6509	152.7	278	7105	152.7	339	7608	152.7	400	8312	152.7	461	3406	152.3	522	4111	151.6	583	2707	151.3	644	6010	151.2	705	3511	116.2
35	3503	152.7	96	4703	152.7	157	5812	152.7	218	6510	152.7	279	7106	152.7	340	7609	152.7	401	8401	152.7	462	5305	152.3	523	2806	151.6	584	4509	151.3	645	6110	151.2	706	3002	114.6
36	3512	152.7	97	4704	152.7	158	5901	152.7	219	6511	152.7	280	7107	152.7	341	7610	152.7	402	8402	152.7	463	4701	152.3	524	5007	151.6	585	3110	151.3	646	6009	151.2	707	4401	113.8
37	3601	152.7	98	4705	152.7	159	5902	152.7	220	6512	152.7	281	7108	152.7	342	7701	152.7	403	8403	152.7	464	7711	152.3	525	4007	151.6	586	3112	151.3	647	3712	151.2	708	2801	112.6
38	3602	152.7	99	4712	152.7	160	5903	152.7	221	6601	152.7	282	7109	152.7	343	7702	152.7	404	8404	152.7	465	6112	152.3	526	4807	151.6	587	3210	151.3	648	5010	151.2	709	5002	111.2
39	3603	152.7	100	4801	152.7	161	5904	152.7	222	6602	152.7	283	7110	152.7	344	7703	152.7	405	8405	152.7	466	3804	152.3	527	6111	151.6	588	4408	151.3	649	4309	151.1	710	3810	106.8
40	3604	152.7	101	4802	152.7	162	6002	152.7	223	6603	152.7	284	7111	152.7	345	7704	152.7	406	8406	152.7	467	5111	152.3	528	5908	151.6	589	6008	151.3	650	2908	151.1	711	2902	105.7
41	3605	152.7	102	4803	152.7	163	6003	152.7	224	6604	152.7	285	7112	152.7	346	7705	152.7	407	8407	152.7	468	5201	152.2	529	4708	151.6	590	3008	151.3	651	3911	151.1	712	2710	104.8
42	3606	152.7	103	4902	152.7	164	6004	152.7	225	6605	152.7	286	7201	152.7	347	7706	152.7	408	8408	152.7	469	4805	152.2	530	6108	151.5	591	7611	151.3	652	3311	151.1	713	5407	104.0
43	3607	152.7	104	4904	152.7	165	6005	152.7	226	6606	152.7	287	7202	152.7	348	7707	152.7	409	8409	152.7	470	2704	152.2	531	8107	151.5	592	8010	151.3	653	4110	151.1	714	3811	103.7
44	3608	152.7	105	5003	152.7	166	6006	152.7	227	6607	152.7	288	7203	152.7	349	7708	152.7	410	8410	152.7	471	4304	152.2	532	5102	151.5	593	5210	151.3	654	4810	151.1	715	3808	102.7
45	3609	152.7	106	5004	152.7	167	6007	152.7	228	6608	152.7	289	7204	152.7	350	7712	152.7	411	8411	152.7	472	4005	152.2	533	4811	151.5	594	8209	151.3	655	4609	151.1	716	2711	99.6
46	3610	152.7	107	5005	152.7	168	6101	152.7	229	6609	152.7	290	7205	152.7	351	7801	152.7	412	8412	152.7	473	5905	152.2	534	4107	151.5	595	6011	151.3	656	6612	151.1	717	3812	98.7
47	3612	152.7	108	5104	152.7	169	6102	152.7	230	6701	152.7	291	7206	152.7	352	7802	152.7	413	8501	152.7	474	4508	152.1	535	4906	151.5	596	4210	151.3	657	5308	151.1	718	3809	97.6
48	3701	152.7	109	5202	152.7	170	6103	152.7	231	6702	152.7	292	7207	152.7	353	7803	152.7	414	8502	152.7	475	4706	152.1	536	8211	151.5	597	7511	151.3	658	5612	151.1	719	2912	96.7
49	3702	152.7	110	5203	152.7	171	6104	152.7	232	6703	152.7	293	7208	152.7	354	7804	152.7	415	8503	152.7	476	4104	152.1	537	4112	151.5	598	3508	151.3	659	4011	151.1	720	5408	96.0
50	3703	152.7	111	5204	152.7	172	6105	152.7	233	6704	152.7	294	7209	152.7	355	7805	152.7	416	8504	152.7	477	8006	152.1	538	4407	151.5	599	5009	151.3	660	5512	151.1	721	4911	95.1
51	3704	152.7	112	5205	152.7	173	6201	152.7	234	6705	152.7	295	7210	152.7	356	7806	152.7	417	8505	152.7	478	4605	152.1	539	3007	151.5	600	5510	151.3	661	3010	151.1	722	5310	93.8
52	3705	152.7	113	5206	152.7	174	6202	152.7	235	6706	152.7	296	7211	152.7	357	7807	152.7	418	8506	152.7	479	2805	152.1	540	3409	151.5	601	7710	151.3	662	3912	151.1	723	4402	93.6
53	3706	152.7	114	5207	152.7	175	6203	152.7	236	6707	152.7	297	7212	152.7	358	7808	152.7	419	8507	152.7	480	3005	152.0	541	3908	151.5	602	2808	151.3	663	4711	151.1	724	5501	93.1
54	3707	152.7	115	5208	152.7	176	6204	152.7	237	6708	152.7	298	7301	152.7	359	7811	152.7	420	8508	152.7	481	3504	152.0	542	2706	151.5	603	4603	151.3	664	5611	151.1	725	2911	91.2
55	3708	152.7	116	5209	152.7	177	6205	152.7	238	6709	152.7	299	7302	152.7	360	7812	152.7	421	8509	152.7	482	4412	152.0	543	5106	151.5	604	8011	151.3	665	4909	151.1	726	5409	90.4
56	3709	152.7	117	5211	152.7	178	6206	152.7	239	6710	152.7	300	7303	152.7	361	7901	152.7	422	8510	152.7	483	3306	152.0	544	8202	151.5	605	8110	151.3	666	4511	151.1	727	5311	88.0
57	3710	152.7	118	5301	152.7	179	6207	152.7	240	6711	152.7	301	7304	152.7	362	7902	152.7	423	8511	152.7	484	5105	152.0	545	6001	151.5	606	3211	151.3	667	8111	151.1	728	5410	86.6
58	3801	152.7	119	5302	152.7	180	6208	152.7	241	6712	152.7	302	7305	152.7	363	7903	152.7	424	8512	152.7	485	8206	152.0	546	5112	151.5	607	5511	151.3	668	4410	151.1	729	4912	85.7
59	3802	152.7	120	5503	152.7	181	6209	152.7	242	6801	152.7	303	7306	152.7	364	7904	152.7	425	8601	152.7	486	7412	151.9	547	5909	151.5	608	7612	151.3	669	4812	151.1	730	5001	84.9
60	3904	152.7	121	5504	152.7	182	6210	152.7	243	6802	152.7	304	7307	152.7	365	7905	152.7	426	8602	152.7	487	7006	151.9	548	8208	151.4	609	4411	151.3	670	5109	151.1	731	5411	82.4
61	3906	152.7	122	5505	152.7	183	6211	152.7	244	6803	152.7	305	7308	152.7	366	7906	152.7	427	8603	152.7	488	3407	151.9	549	4607	151.4	610	3711	151.3	671	3803	151.1	732	5412	81.1

Fig. 8-14 Energy Generation of Lower Kihansi Project without Upper Kihansi Project



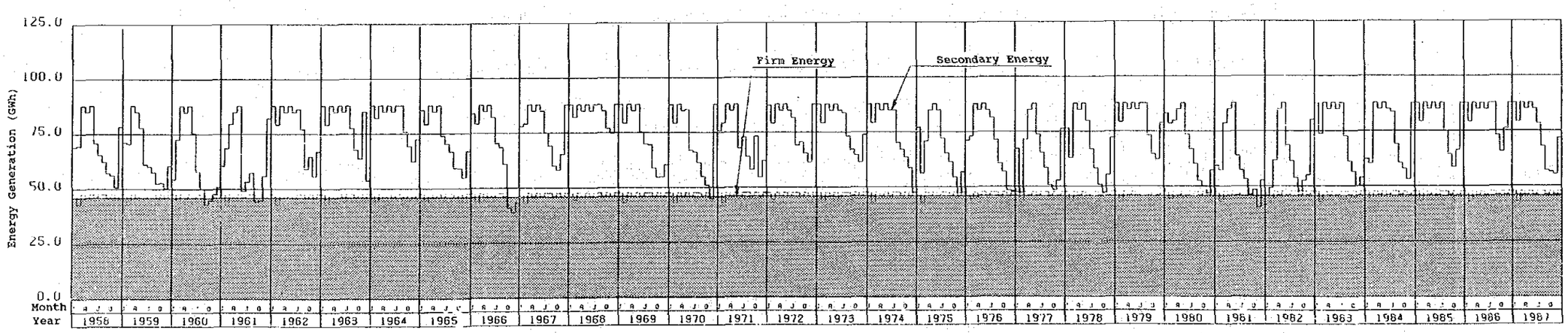
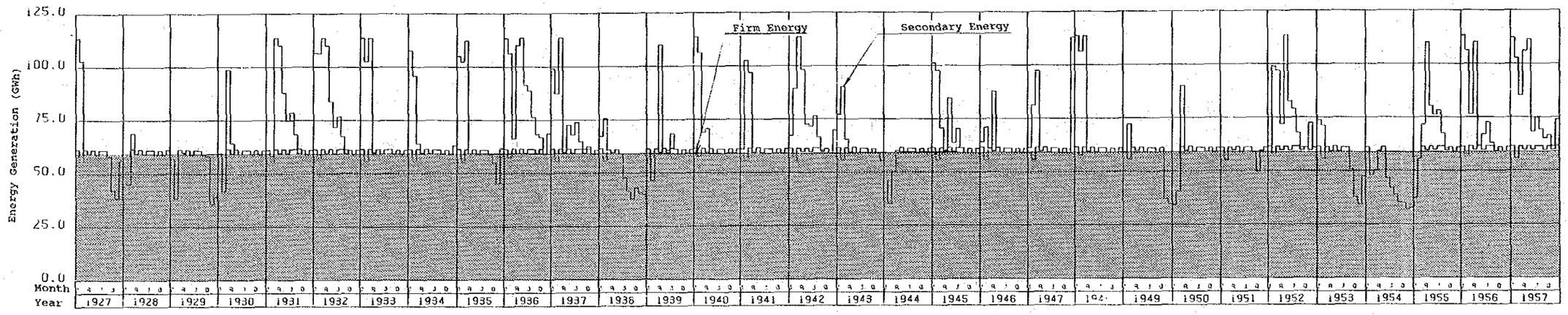


Fig. 8-15 Energy Generation of Lower Kihansi Project with Upper Kihansi Project



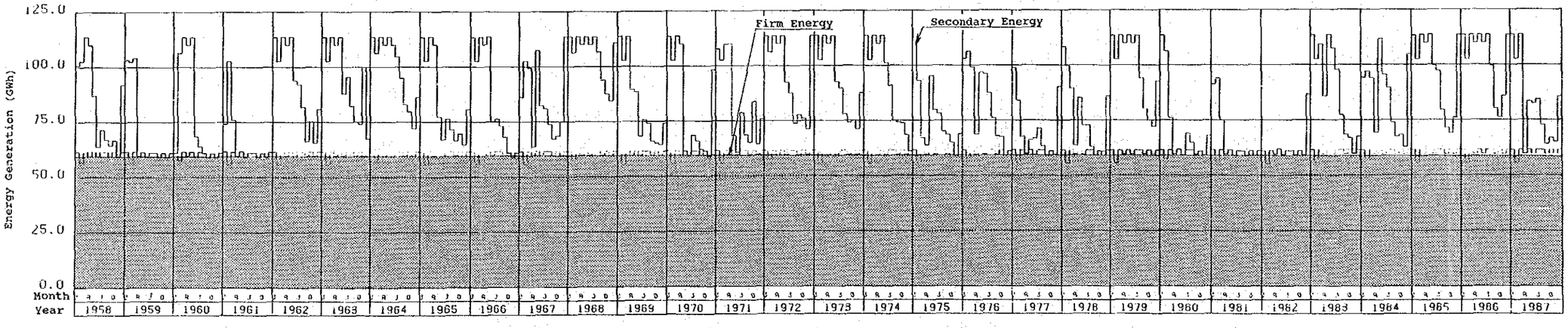


Table 8-28 Preliminary Estimation of Construction Cost of Lower Kihansi Project

Unit ; $10^3$$

	Lower Kihansi		
	F.C.	L.C.	Total
1. Preparatory Work			
1-1 Access Road	0	19,100	19,100
1-2 Camp Facility & Others	7,700	5,600	13,300
Sub total	7,700	24,700	32,400
2. Compensation	0	2	2
3. Civil Works			
3-1 Diversion & Coffer Dam	160	40	200
3-2 Dam & Spillway	7,631	2,169	9,800
3-3 Intake	1,087	313	1,400
3-4 Headrace Tunnel	2,253	747	3,000
3-5 Penstock Tunnel	7,364	2,836	10,200
3-6 Powerhouse & Switchyard	9,880	2,720	12,600
3-7 Tailrace Tunnel	1,203	397	1,600
3-8 Tailrace Outlet	390	110	500
Sub Total	29,968	9,332	39,300
4. Hydraulic Equipment	5,760	1,440	7,200
5. Electro-mechanical Equipment	27,700	8,700	36,400
6. Transmission Line	11,000	7,900	18,900
7. Total Cost (1+2+3+4+5+6)	82,128	52,074	134,202
8. Engineering & Administration 7 x 7.5%	8,042	2,011	10,053
9. Physical Contingency (1+2+3)x15% + (4+5+6)x10%	10,096	6,909	17,005
10. Interest during Construction	24,680	20,360	45,040
11. Grand Total (7+8+9+10)	124,946	81,354	206,300

Chapter 9 POWER SYSTEM EXPANSION PLAN AND POWER SYSTEM ANALYSIS

Chapter 9

POWER SYSTEM EXPANSION PLAN AND POWER SYSTEM ANALYSIS

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Chapter 9 POWER SYSTEM EXPANSION PLAN AND POWER SYSTEM ANALYSIS

9.1 Power System Expansion Plan

The power system expansion plan of the ACRES Report is presented in Table 9-1. The construction of an additional 220 kV transmission line from Kidatu Power Station to Ubungo Substation is planned to deal with the increased power flow in this section and to improve the supply reliability to Dar Es Salaam. The construction of a new 220 kV line from Singida to Arusha is designed to deal with the voltage drop and increased power flow of the eastern power system and to improve the supply reliability in this area. It is expected that the Grid System will have sufficient reliability in supplying the power of Kihansi Power Stations to the load centers with high stability.

9.2 Transmission Line Plan

9.2.1 General

Kihansi Site is located approximately 480 km to the west of Dar Es Salaam, and the generating capacity is 200 MW composed of the 153 MW power generated by Lower Kihansi Power Station and the 47 MW power generated by Upper Kihansi Power Station. It is not expected that this amount of power is consumed in the vicinity of the power station site, and most of the power will be consumed at Dar Es Salaam and in the Eastern 132 kV power system. In our study, only the transmission line connecting the power station site to Iringa Substation has been examined, and it was assumed that the power from Iringa Substation will be transmitted to the load centers by the Grid System.

The outline of the transmission line plan is as follows.

a) Receiving Substation: Iringa Substation

b) Transmission Voltage: 220 kV

c) Conductor Size : 380 mm^2 ACSR (Bison) single conductor

d) Number of Transmission Line Circuits:
220 kV double circuit (with Upper Power Station connected to one circuit by a π-branch)

e) Transmission Line Lengths:

From Lower Power Station to Upper Power Station	:	8 km
From Upper Power Station to Iringa Substation	:	105 km

Table 9-1 Transmission System Development Plan

Year	System Additions
1992	Kidatu-Morogoro-Dar Es Salaam (new substation) - 300 km, 220 kV, conductor Tern Dar Es Salaam (new substation)-Ubungo - 10 km, 220 kV, conductor Bluejay (Transformer addition) D.E.S. (new substation) 220/132/33 kV, 90/90/40 MVA
1993	Pangani Falls-Hale - 16 km, 132 kV, conductor Wolf
1995	Singida-Arusha - 300 km, 220 kV, conductor Bison
1996	Lower Kihansi-Iringa* - 113 km, 220 kV, conductor Bison
1999	Upper Kihansi connection* - 0.4 km, 220 kV, conductor Bison
2002	Masigira-Mufindi - 145 km, 220 kV, conductor Bison
2005	Hale-Tanga - 60 km, 132 kV, conductor Wolf Rumakali-Mbeya - 85 km, 220 kV, conductor Bison Mufindi-Iringa-Kidatu - 290 km, 220 kV, conductor Bison Kidatu-Morogoro-D.E.S. (new substation) - 300 km, 220 kV, conductor Bluejay

Note: * Based on JICA plan

Source: 1) Power Sector Development Plan 1985 to 2010, TANESCO/ACRES, 1985

2) Review of 1985 Power Sector Development Plan, TANESCO/ACRES, 1989

9.2.2 Receiving Substation

The nearest substation is Iringa Substation which is located in Iringa, about 100 km from Kihansi Site. Iringa Substation is a main substation of the Grid System and it has three entrances of 220 kV transmission lines which come from Kidatu Power Station, Mtera Power Station and western part of Tanzania. It is possible to send the electric power of Kihansi Power Stations stably to the load centers from Iringa Substation by the Grid System.

There is a space in Iringa Substation to construct two entrances from Kihansi Power Stations. As the transmission lines from Kihansi Power Stations will cross over the existing 220 kV transmission line from the western part of Tanzania, just before Iringa Substation, it will be necessary to move the existing switching equipment of Iringa Substation.

9.2.3 Transmission Line Route

The following two alternative routes can be considered for the transmission line from Upper Power Station to Iringa Substation (see Fig. 9-1).

Route A: The transmission line runs from Upper Kihansi Power Station to the north along the existing road, and directly goes to Iringa Substation. (The line length from Upper Kihansi Power Station to Iringa Substation is 105 km.)

Route B: The transmission line runs to the west from Upper Kihansi Power Station and is connected to the existing 220 kV transmission line near Mafinga, to deliver power to Iringa Substation.

(The line length from Upper Kihansi Power Station to Mafinga is 80 km.)

Based on the following analyses, we decided to select Route A.

a) While the transmission line can be constructed along the existing road for Route A, almost one half of the line has to be built along a region far away from existing road if Route B is adopted. In constructing a transmission line, the presence of existing road for transmission of materials and equipment influences the construction cost a great deal. Line maintenance is also easy when there is an existing road along the line.

b) There are some potential hydroelectric sites to the southwest of Iringa. When these sites are developed, a large amount of power will be transmitted through the transmission line between Iringa and Mufindi. It is desirable to transmit the power of Kihansi Power Stations directly to Iringa Substation belonging to the main power grid in order to avoid concentration of power flow and maintain high reliability of power supply.

The transmission line route from Lower Power Station to Upper Power Station first runs on the left bank of Kihansi River, crosses the river near Upper Power Station to reach Upper Power Station. The connection to Upper Power Station will be a single circuit π-branch, which will be connected on the crossarm of the transmission tower just before Upper Power Station. After Lower Power Station is commissioned and before Upper Power Station is operated, this π-branch will be short-circuited on the transmission tower. The diagram of the transmission line from

Lower Power Station to Iringa Substation is illustrated in Fig. 9-2.

Fig. 9-1 Power Transmission Line Route

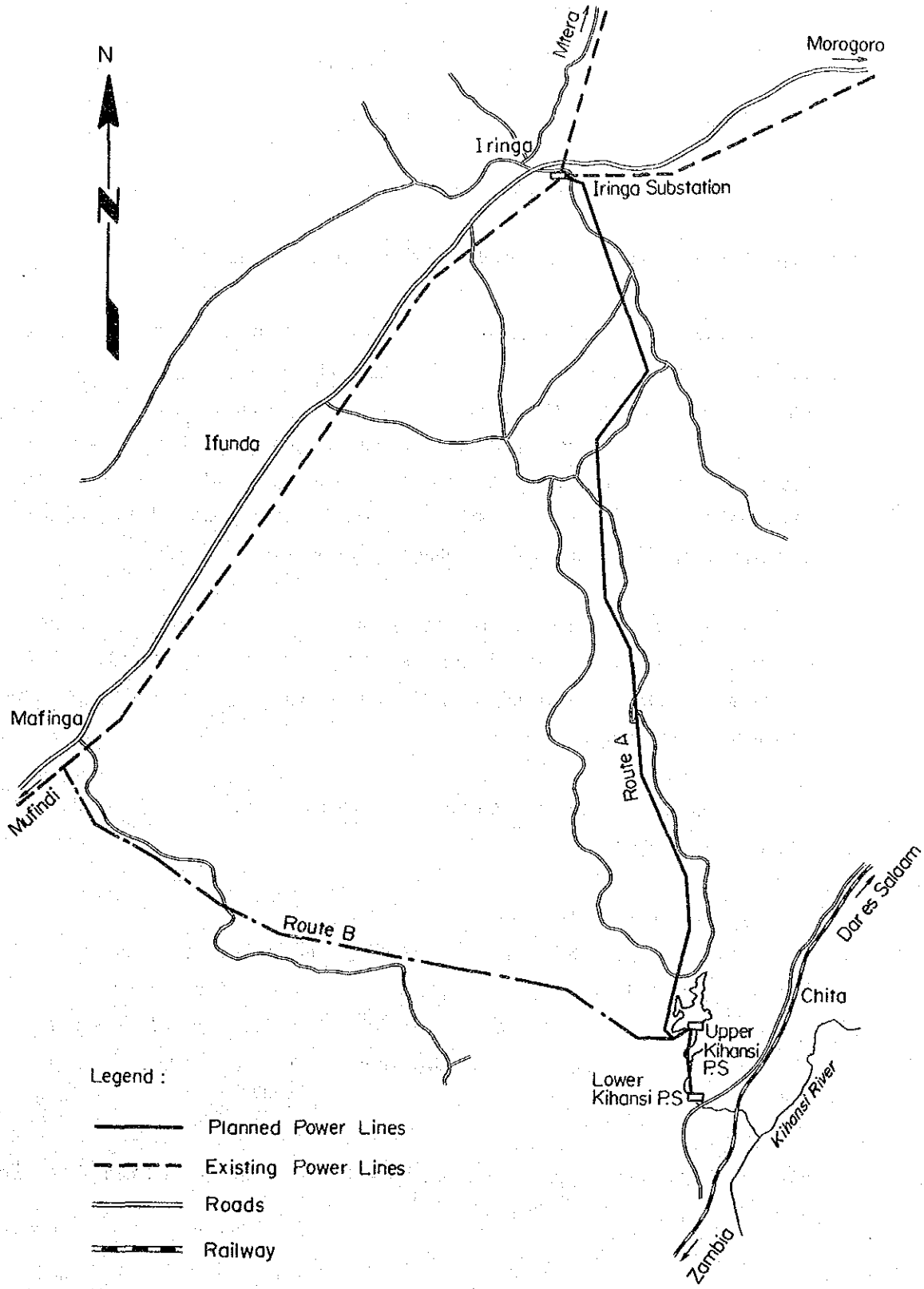
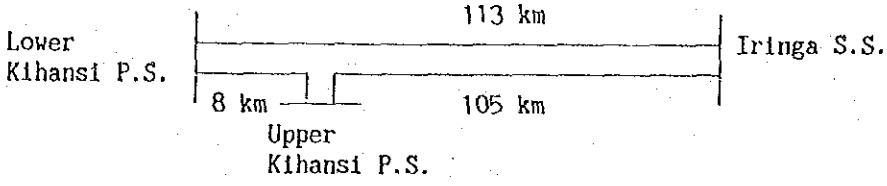


Fig. 9-2 Diagram of Power Transmission Lines



9.2.4 Transmission Voltage and Number of Transmission Line Circuits

It is more economical, and the operation of the system is easier, to select the transmission voltage from the existing voltage classes. In this transmission plan, 132 kV line does not have sufficient capacity, considering the transmission power of 200 MW and the transmission distance of 113 km to Iringa Substation, therefore, the 220 kV voltage class was selected.

For the number of transmission line circuits, single circuit and double circuits can be considered. The economic comparison of single and double circuits cases is given in Table 9-2.

Annual power transmission loss was calculated with the following equation.

$$P_{lossh} = P_{loss} \cdot P \cdot H$$

P_{lossh}: Annual power transmission loss

P_{loss} : Peak power transmission loss

P: Loss factor, $P = A \cdot f^2 + (1 - A) \cdot f$

f: Load factor, $0.2 \leq A \leq 0.3$

H: 24 x 365

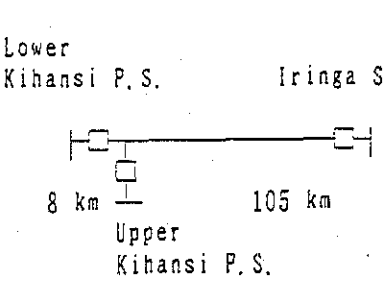
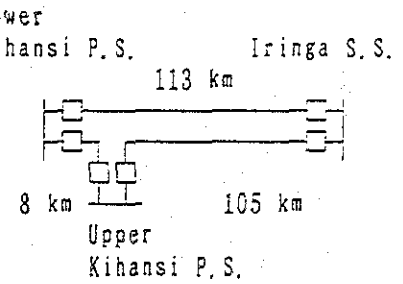
The following value was adopted for the calculation in Table 9-2.

$f = 0.66$

$A = 0.3$

From Table 9-2, the construction cost of the single circuit transmission line is cheaper than that of the double circuits transmission line. However, as Kihansi Power Stations are going to be the major power source of Tanzania, outage of this transmission line may cause an extensive blackout in the Grid System. Therefore, the double circuit transmission line has been adopted to assure high reliability.

Table 9-2 Economic comparison of Transmission Plans

	Case1	Case2
Transmission Pattern		
Transmission Line		
Voltage (kV)	220	220
Length to be constructed (km)	113	113
Conductor	Bison	Bison
Construction Cost (Millions of $)	10.8	16.8
Annual Cost (Millions of $)	1.23	1.92
Station Equipment		
Swich Gear sets		
Lower Kihansi P.S.	1	2
Upper Kihansi P.S.	1	2
Iringa S.S.	1	2
Construction Cost (Millions of $)	2.5	4.9
Annual Cost (Millions of $)	0.29	0.56
Transmission Losses		
Peak Power Loss (MW)	5.8	2.9
Annual Energy Loss (GWh)	30.0	15.0
Annual Cost (Millions of $)	1.05	0.53
Total Annual Cost (Millions of $)	2.57	3.01

Note: 1) Annual Factor: 11.4 %
2) Cost for Power Loss and Energy Loss: ¢3.5/kWh

9.2.5 Electric Power for Construction Work

There is not a distribution power line near the proposed site of Kihansi Power Stations. A power line supplying the electric power for the construction work will have to be constructed all the way from Iringa Substation. Excessively advanced investment is necessary to substitute this power line by advancing the construction of the main transmission line, and also, it would not be possible to construct the transmission line in time for the power plant construction. Therefore, it has been decided not to build a power line for construction work, but rather install diesel generator plants to supply the electric power.

9.3 Power System Analysis

9.3.1 Conditions and Main Results of Power System Analysis

Power system analysis has been done for the Grid System of 1997, the commissioning year of Lower Power Station, and 1999, the commissioning year of Upper Power Station.

It was assumed that the Grid System will be developed based on the plan of the ACRES Report given in Table 9-1 and all the power of the Grid System is supplied by the hydraulic power stations based on the plan of TANESCO. The estimated load of the each substation, based on the demand forecast and the energy consumption by region of the ACRES Report, is given in Table 9-3. The power factor of the load of the each substation was assumed as 0.85.

The following transformers were assumed to be added in accordance with the growth of the demand.

Substations	Voltage (kV)	Capacity (MVA)
Kiyungi	132/33	20
Tanga	132/33	20

The impedance map which was used for the calculation is given in Fig. 9-3.

The main results of the power system analysis are as follows.

a) The voltage of the Grid System becomes low in the eastern area and high in the western area at peak time. The voltage of the western area becomes higher at off-peak time compared with that of peak time. Therefore, it is necessary to arrange reactive power suppliers suitably. The arrangement of reactive power suppliers should be studied in detail according to the development of the Grid System.

b) In the case of the fault which causes the trip of the transmission line between Iringa Substation and Kidatu Power Station, Kihansi and Mtera Power Stations cannot keep synchronism with Kidatu Power Station. So it is desirable to make the transmission line between Iringa Substation and Kidatu Power Station double circuits. It is also desirable to make the transmission line between Iringa Substation and Mtera Power Station double circuits for the reliability of power supply of the Grid system.

Table 9-3 Load Forecast by Load Centers

Load Centers	Peak Load (MW) 1997	1999
Arusha (Njiro)	32.9	37.1
Dar es Salaam (Ubungo+New Substation)	193.1	217.8
Morogoro	28.8	32.5
Moshi (Kiyungi)	25.0	28.3
Tanga	31.2	35.2
Dodoma	8.2	9.2
Iringa	23.1	26.0
Mbeya	17.8	20.1
Musoma	5.5	6.2
Mwanza	24.6	27.8
Shinyanga	20.6	23.2
Singida	1.5	1.7
Tabora	6.1	6.9
Mtoni	18.7	21.1
Total	437.0	493.0
Mufindi	25.0	25.0

Note: Mufindi boiler contractually only uses secondary energy off peak.

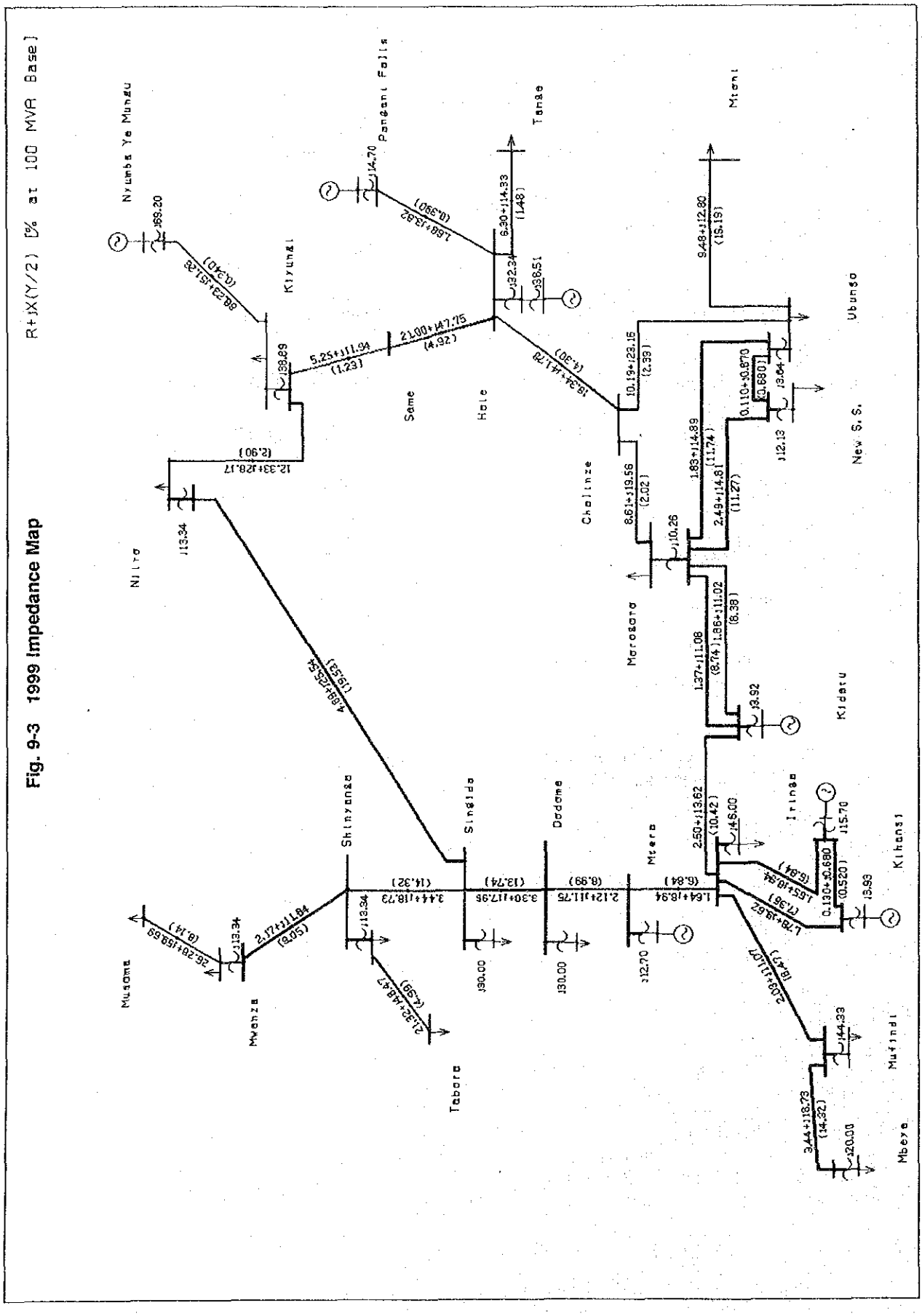


Fig. 9-3 1999 Impedance Map

9.3.2 Power Flow Calculation

The power flow of peak time in 1997, on condition that the Grid System is operated in loop, is given in Fig. 9-4. From Fig. 9-4, it is known that the voltage of the Grid System becomes low in the eastern area and high in the western area. The reason is that the heavy power flow from the power stations located in the central area of Tanzania to the eastern area causes the large voltage drop in the eastern area and, on the contrary, the voltage of the western area is high because of the light power flow of the western power system.

As the measure of this voltage unbalance, it is necessary to connect condensers to the Grid System of the eastern area and reactors to that of the western area. The voltage of the generators of Kihansi Power Stations is needed to be kept high because of the high voltage of the Grid System of the eastern area.

It is desirable for the security of the Grid System to operate the Grid System in loop but loop operation has some difficulty. Therefore, the power flow of the case that the loop of the Grid System is separated between Njiro and Kiyungi, where the power flow of peak time is the lightest in the loop, is studied. The power flow is given in Fig. 9-5. The voltage of the western area of Fig. 9-5 is higher than that of Fig. 9-4.

The power flow of night in 1997, when the voltage of the western area is supposed to become the highest because of light loads, is given in Fig. 9-6.

In addition to the reactive power suppliers in Table 4-2, the following reactive power suppliers are used in calculation to keep the voltage of the Grid System approximately within ±10% of the rated voltage.

Case	Substations	Reactors (MVA)	Condensers (MVA)
1997 Peak	Ubungo		30
	New S.S.		30
	Mtoni		10
	Kiyungi		5
	Mufindi	10	
1997 Night	Ubungo	40	
	Dodoma	10	
	Singida	20	
	Njiro	10	
1999 Peak	Ubungo		20
	New S.S.		10

Note: The facilities which are duplicated with that of former years are omitted.

From the result of the power flow calculation, the voltage of some buses exceeds ±10% of the rated voltage. As the voltage which is over ±10% of the rated voltage exceeds the range of normal operation, the above mentioned reactive power suppliers are not enough for the desirable operation of the Grid System. It is necessary to study the voltage of the Grid System with detailed load distribution in accordance with the development of the Grid System. It is also necessary for voltage regulation to consider the operation of thermal generators located near the main load centers such as Dar Es Salaam.

The power flow of peak time in 1999 was also calculated. The result for the case that the transmission line between Kihansi Power Stations and Iringa Substation is double circuits is given in Fig. 9-7 and the case that this line is single circuit is given in Fig. 9-8.

The voltage drop between Lower Power Station and Iringa Substation becomes 1% larger and the transmission loss of this section becomes double for the single circuit case compared with the double circuits case.

9.3.3 Short Circuit Capacity Calculation

The short circuit capacities of each year are given in Table 9-4. The short circuit current is not so large as to exceed the breaking capacity of breakers.

9.3.4 Stability Calculation

The stability of the Grid System was studied on condition of the power flow at peak time in 1997. The swing curves of the main generators are given in Fig. 9-9 for the case that the Grid System is in loop operation and in Fig. 9-10 for the case that it is in separated operation. The fault that one circuit of the transmission line between Lower Power Station and Iringa Substation was tripped after a three phase short circuit fault at the point near Lower Power Station was assumed for the calculation. This fault is supposed to have the heaviest influence for the stability of Lower Power Station.

The stability on condition of the power flow at peak time in 1999 was also studied. The swing curves are given in Fig. 9-11 for the case that the transmission line between Kihansi Power Stations and Iringa Substation is double circuits and in Fig. 9-12 for the case that the line is single circuit. The same fault with 1997 case was assumed for the double circuit case and the fault that one circuit of the transmission line between Kidatu Power Station and Morogoro Substation was tripped after a three phase short circuit fault at the point near Kidatu Power

Station was assumed for the calculation of the single circuit case. The bus voltage of Iringa substation at the Fig. 9-11 case is given in Fig. 9-13. Judging from the figures, the power swing of the generators in the Grid System becomes stable within several cycles of the power swing after the fault. However, if the transmission line between Iringa Substation and Kidatu Power Station is tripped with a fault, Kihansi and Mtera Power Stations cannot keep synchronism with Kidatu Power Station. Considering the role of Kihansi and Mtera Power Stations for the power supply of the eastern area, it is desirable to make the transmission line between Iringa Substation and Kidatu Power Station double circuits. It is also desirable to make the transmission line between Iringa Substation and Mtera Power Station double circuits for the improvement of the reliability of power supply of the Grid system.

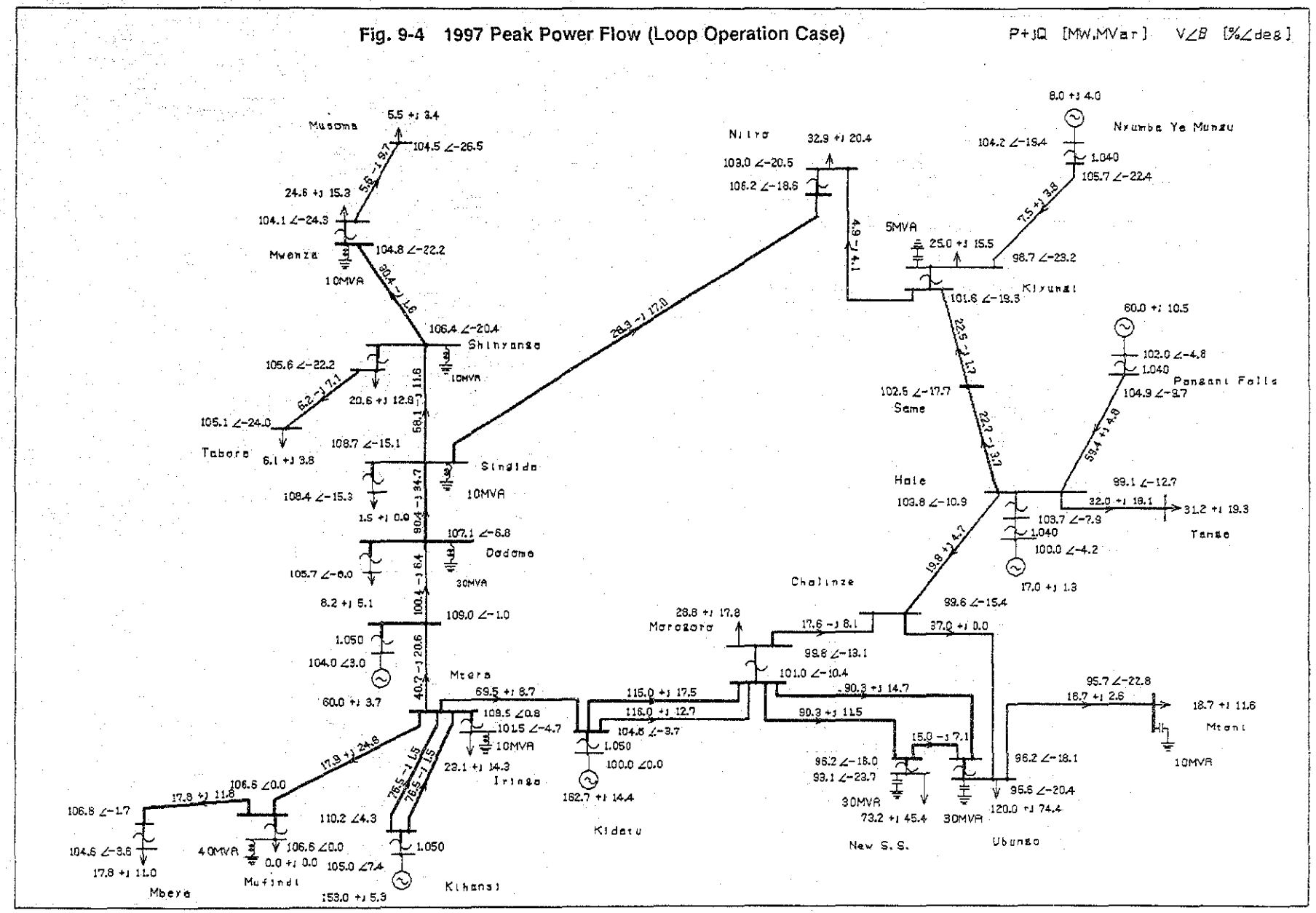
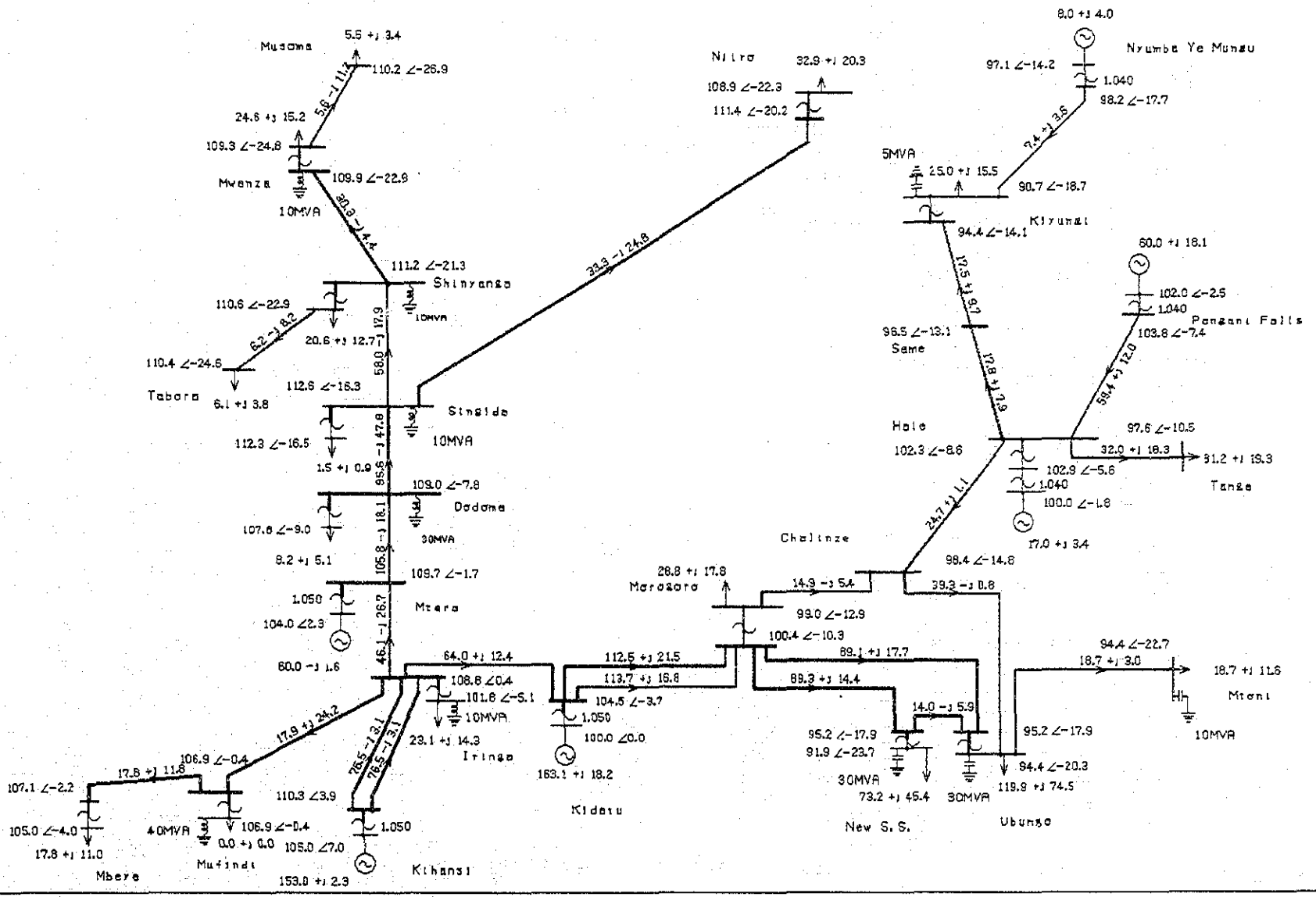


Fig. 9-4 1997 Peak Power Flow (Loop Operation Case)
P+jQ [MW,MVar] V∠θ [%∠deg]
Musoma
5.5 +j 3.4
104.5 ∠-26.5
5.6 -j 9.7
24.6 +j 15.3
104.1 ∠-24.3
Mwanza
104.8 ∠-22.2
10MVA
30.4 -j 1.6
106.4 ∠-20.4
Shinyanga
10MVA
105.6 ∠-22.2
6.2 -j 7.1
20.6 +j 12.8
58.1 -j 11.6
105.1 ∠-24.0
Tabora
6.1 +j 3.8
108.7 ∠-15.1
Singida
10MVA
108.4 ∠-15.3
1.5 +j 0.0
90.4 -j 34.7
107.1 ∠-6.8
Dodoma
30MVA
105.7 ∠-6.0
8.2 +j 5.1
100.4 -j 6.4
109.0 ∠-1.0
1.050
104.0 ∠3.0
60.0 +j 3.7
40.2 -j 20.6
Mtera
69.5 +j 8.7
109.5 ∠0.8
101.5 ∠-4.7
10MVA
23.1 +j 14.3
Iringa
182.7 +j 14.4
Kidatu
115.0 +j 17.5
116.0 +j 12.7
104.6 ∠-3.7
1.050
100.0 ∠0.0
Njiro
32.9 +j 20.4
103.0 ∠-20.5
106.2 ∠-18.6
28.9 -j 17.0
4.9 -j 4.1
5MVA
25.0 +j 15.5
101.6 ∠-18.3
Kiyungi
8.0 +j 4.0
Nyumba Ye Mungu
1.040
104.2 ∠-19.4
105.7 ∠-22.4
7.5 +j 3.8
98.7 ∠-23.2
22.5 -j 1.2
102.5 ∠-17.7
Same
22.2 -j 3.1
60.0 +j 10.5
102.0 ∠-4.8
1.040
Pangani Falls
104.9 ∠-9.7
58.4 +j 4.8
Hale
103.8 ∠-10.9
99.1 ∠-12.7
32.0 +j 19.1
31.2 +j 19.3
Tanga
103.7 ∠-7.9
1.040
100.0 ∠-4.2
17.0 +j 1.3
19.8 +j 4.7
Chalinze
99.6 ∠-15.4
28.8 +j 17.8
Morogoro
17.6 -j 8.1
37.0 +j 0.0
99.8 ∠-13.1
101.0 ∠-10.4
90.3 +j 14.7
90.3 +j 11.5
15.0 -j 7.1
96.2 ∠-18.0
93.1 ∠-23.7
30MVA
73.2 +j 45.4
New S. S.
30MVA
96.2 ∠-18.1
95.6 ∠-20.4
120.0 +j 74.4
Ubungo
95.7 ∠-22.8
18.7 +j 2.6
18.7 +j 11.6
Mtoni
10MVA
17.9 +j 24.8
106.6 ∠0.0
17.8 +j 11.8
106.8 ∠-1.7
104.6 ∠-3.6
17.8 +j 11.0
Mbeya
40MVA
106.6 ∠0.0
0.0 +j 0.0
Mufindi
110.2 ∠4.3
76.5 -j 1.5
76.5 -j 1.5
105.0 ∠7.4
1.050
153.0 +j 5.3
Kihansi

Fig. 9-5 1997 Peak Power Flow (Separate Operation Case)

P+jQ [MW,MVar] V∠θ [%∠deg]



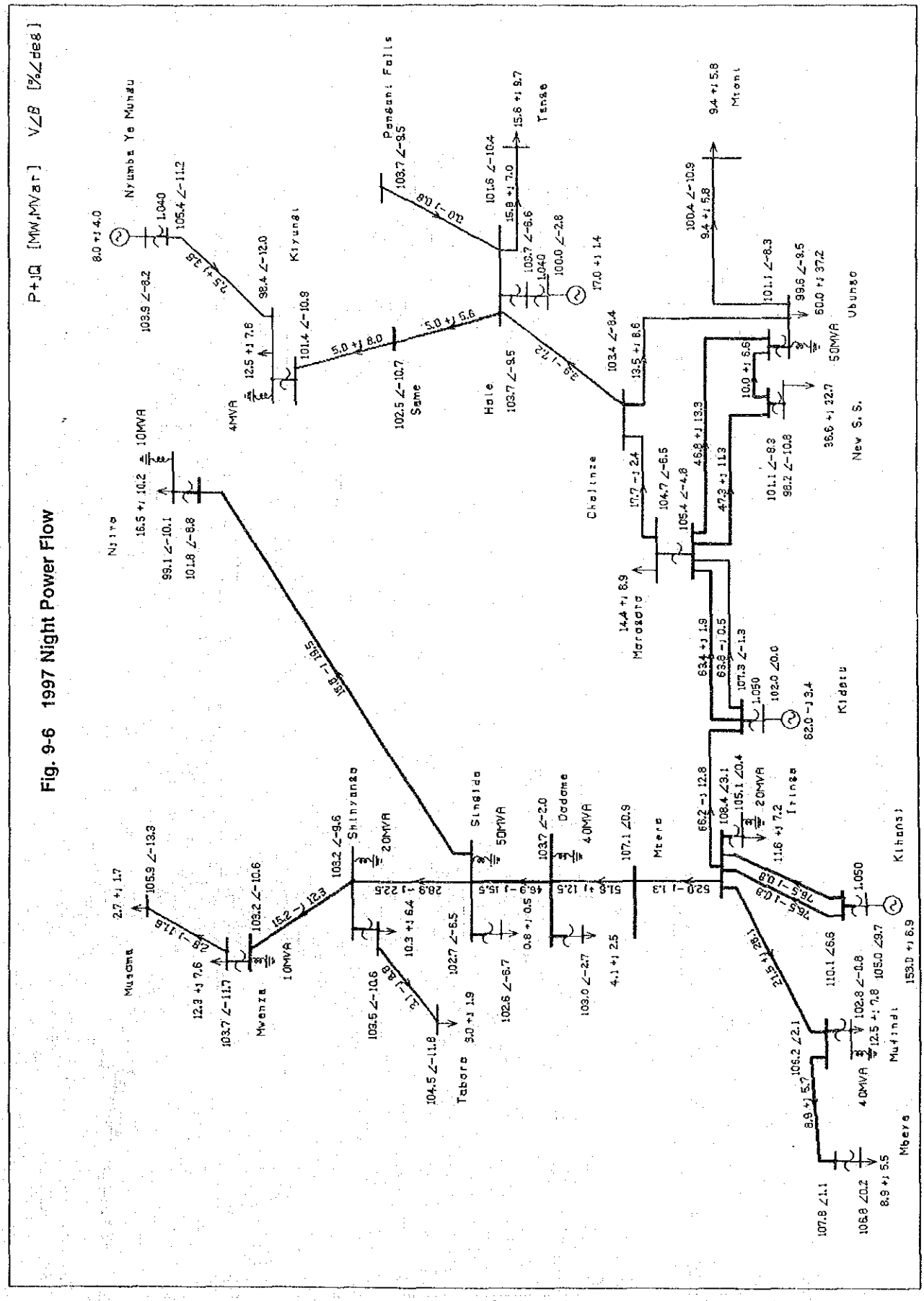


Fig. 9-6 1997 Night Power Flow

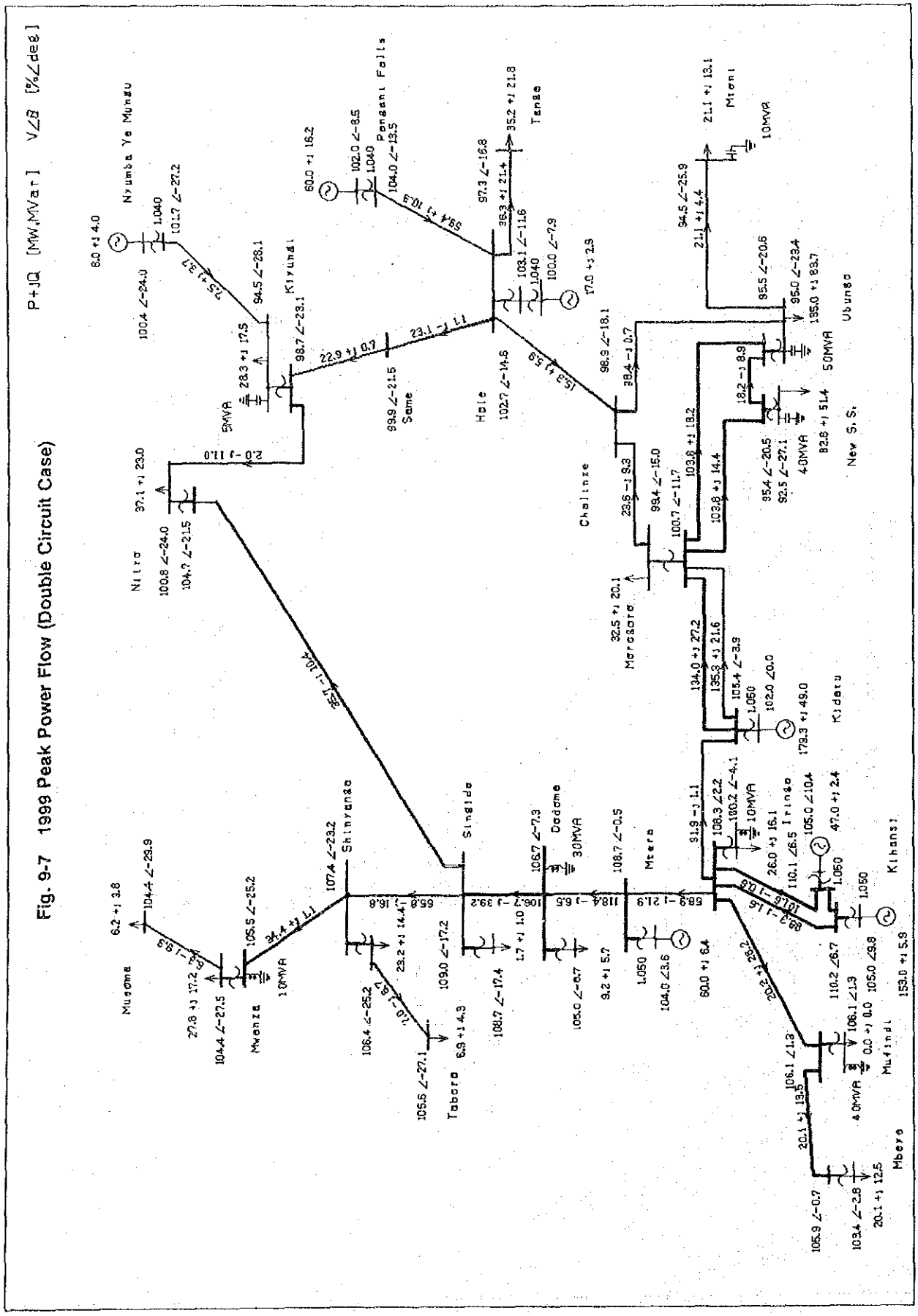


Fig. 9-7 1999 Peak Power Flow (Double Circuit Case)

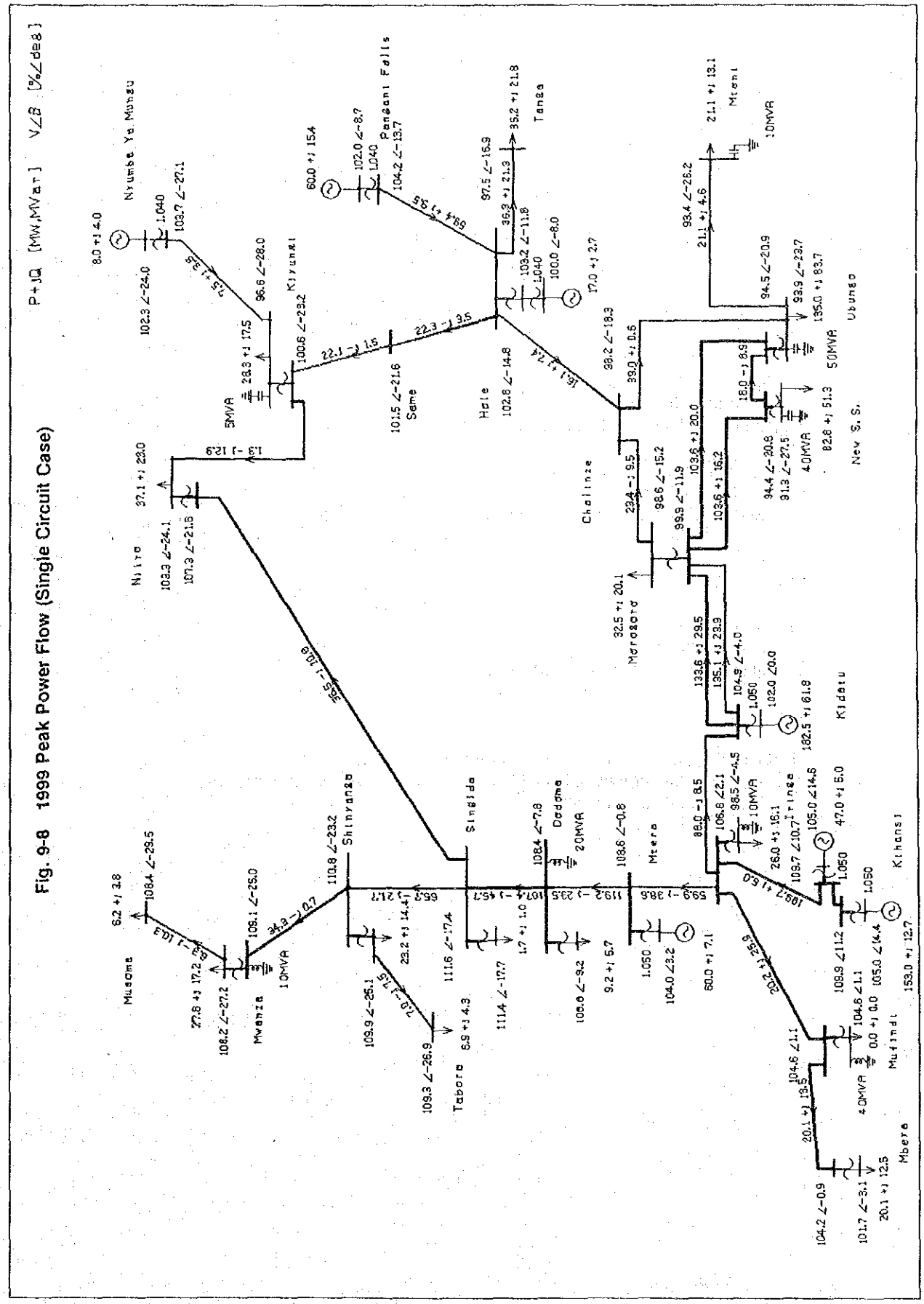


Fig. 9-8 1999 Peak Power Flow (Single Circuit Case)

Table 9-4 Short Circuit Capacity

	Short circuit capacity (MVA)	Short circuit current (kA)
1997		
Loop Operation Case		
Iringa Substation	608	1.6
Lower Kihansi Power Station	643	1.7
Separate Operation Case		
Iringa Substation	510	1.4
Lower Kihansi Power Station	563	1.5
1999		
Loop Operation Case		
Iringa Substation	694	1.9
Lower Kihansi Power Station	765	2.1
Upper Kihansi Power Station	751	2.0

Note: 1) Xd' is used for the calculation
2) The short circuit current is the value at the 220 kV buses.

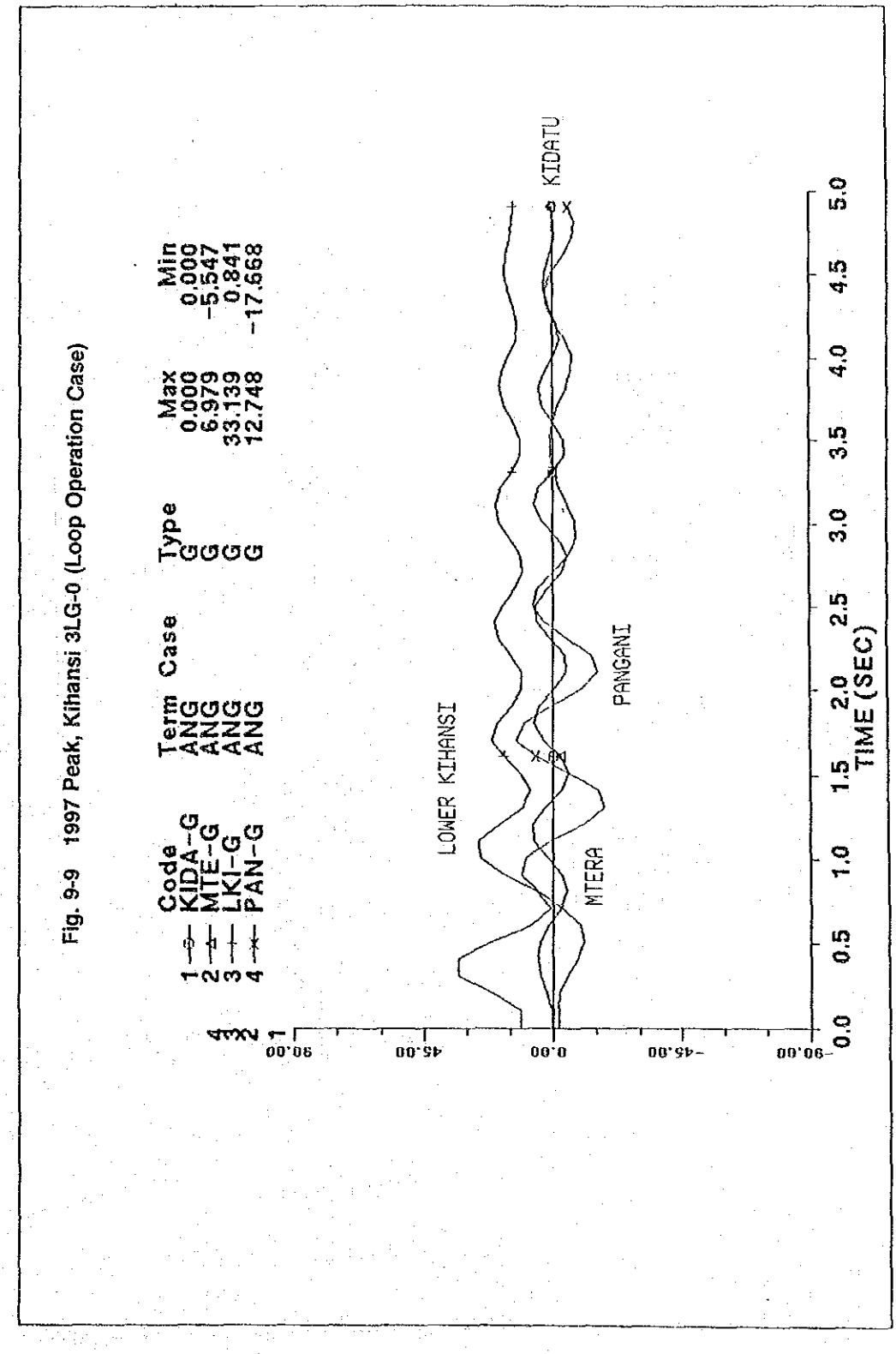


Fig. 9-9 1997 Peak, Kihansi 3LG-0 (Loop Operation Case)

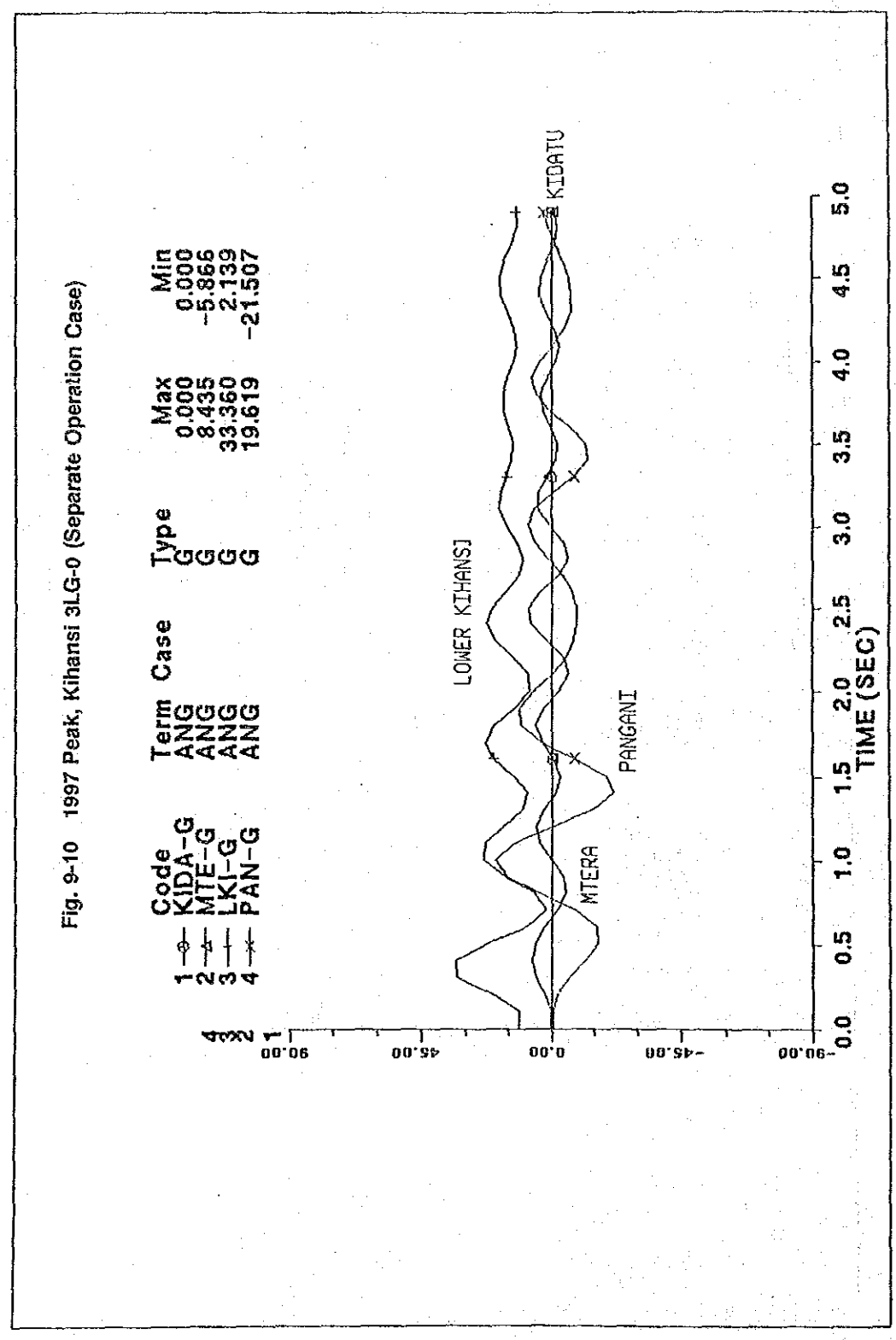
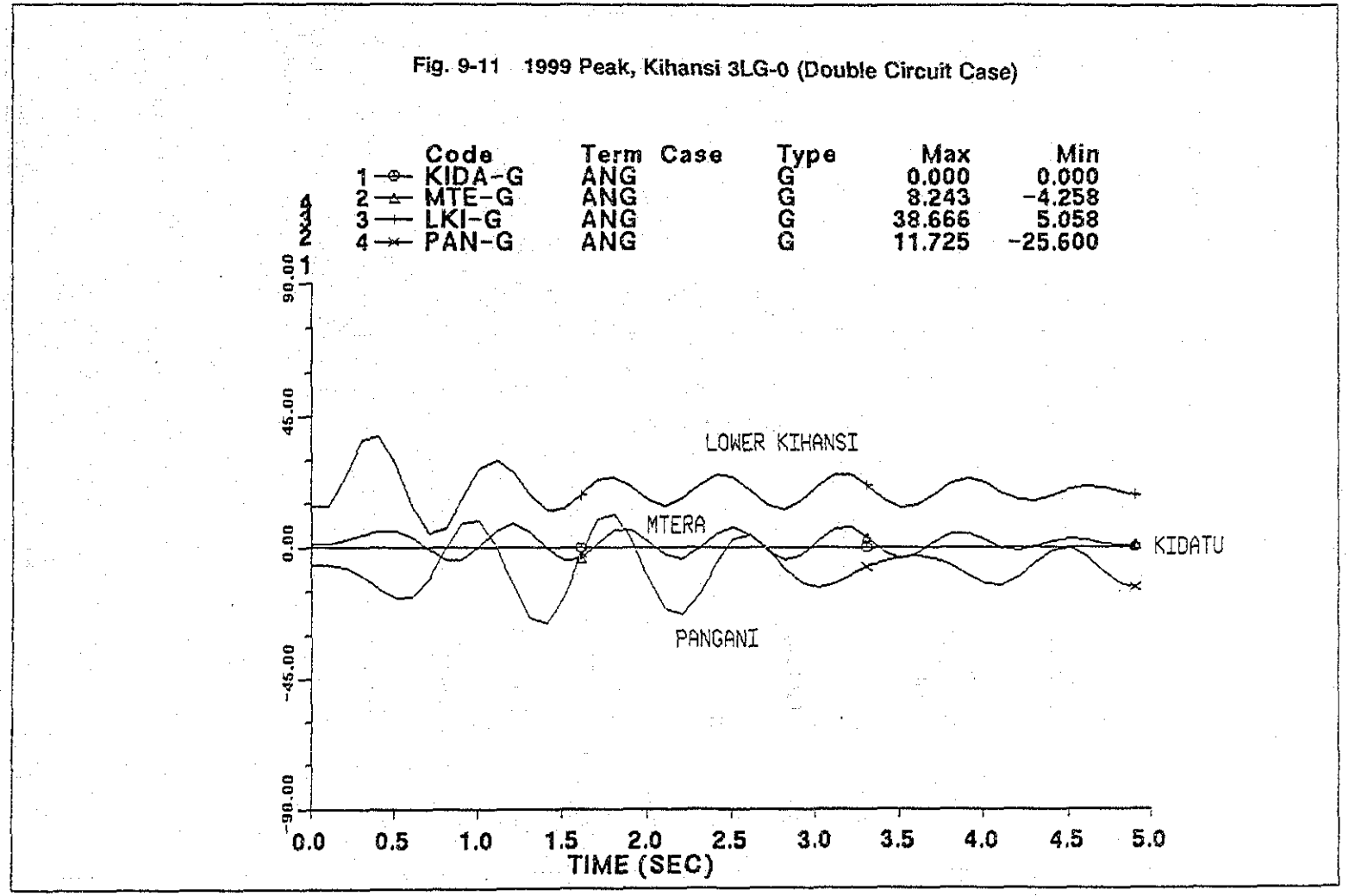


Fig. 9-10 1997 Peak, Kihansi 3LG-0 (Separate Operation Case)

Fig. 9-11 1999 Peak, Kihansi 3LG-0 (Double Circuit Case)



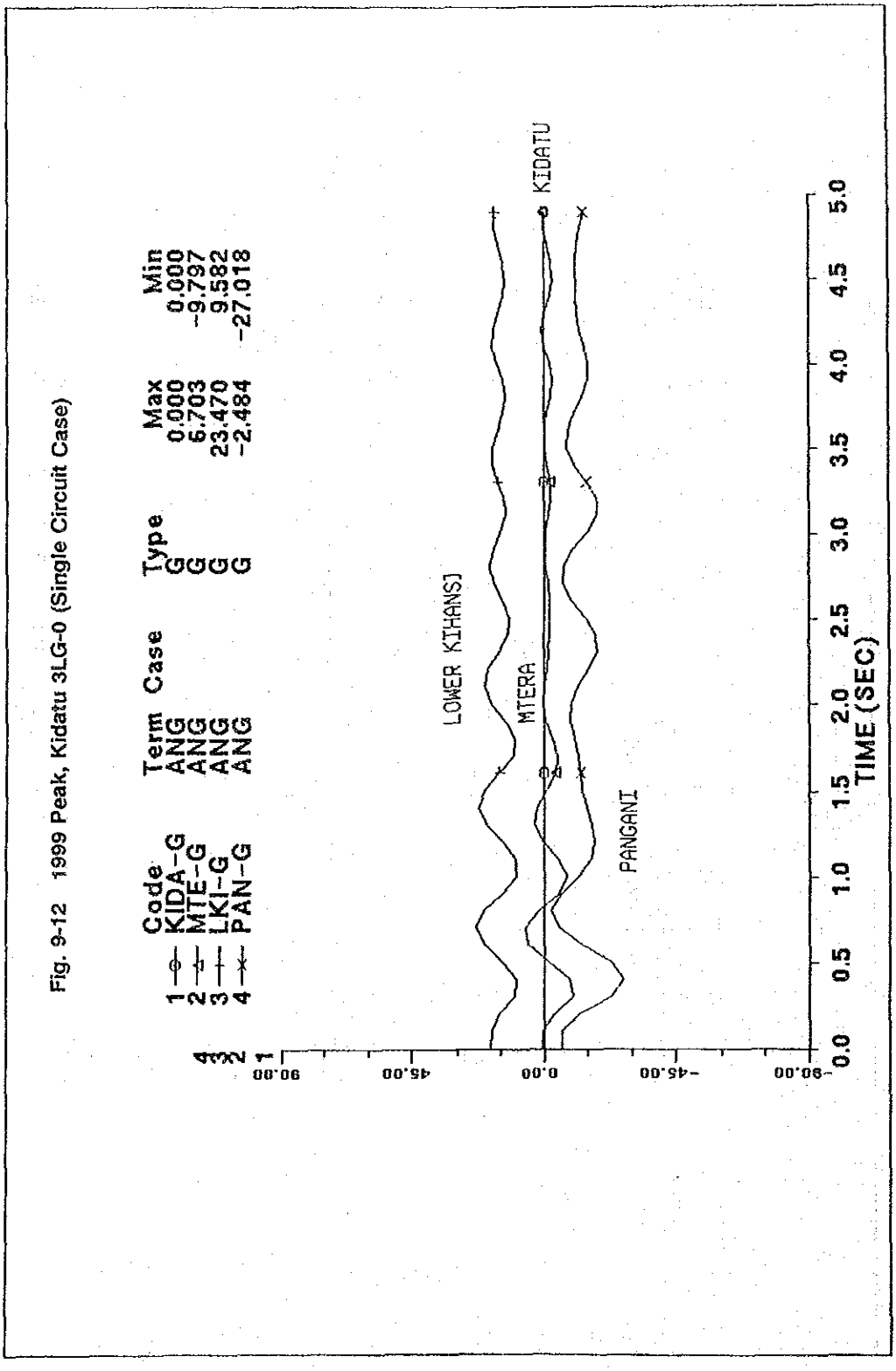


Fig. 9-12 1999 Peak, Kidatu 3LG-0 (Single Circuit Case)

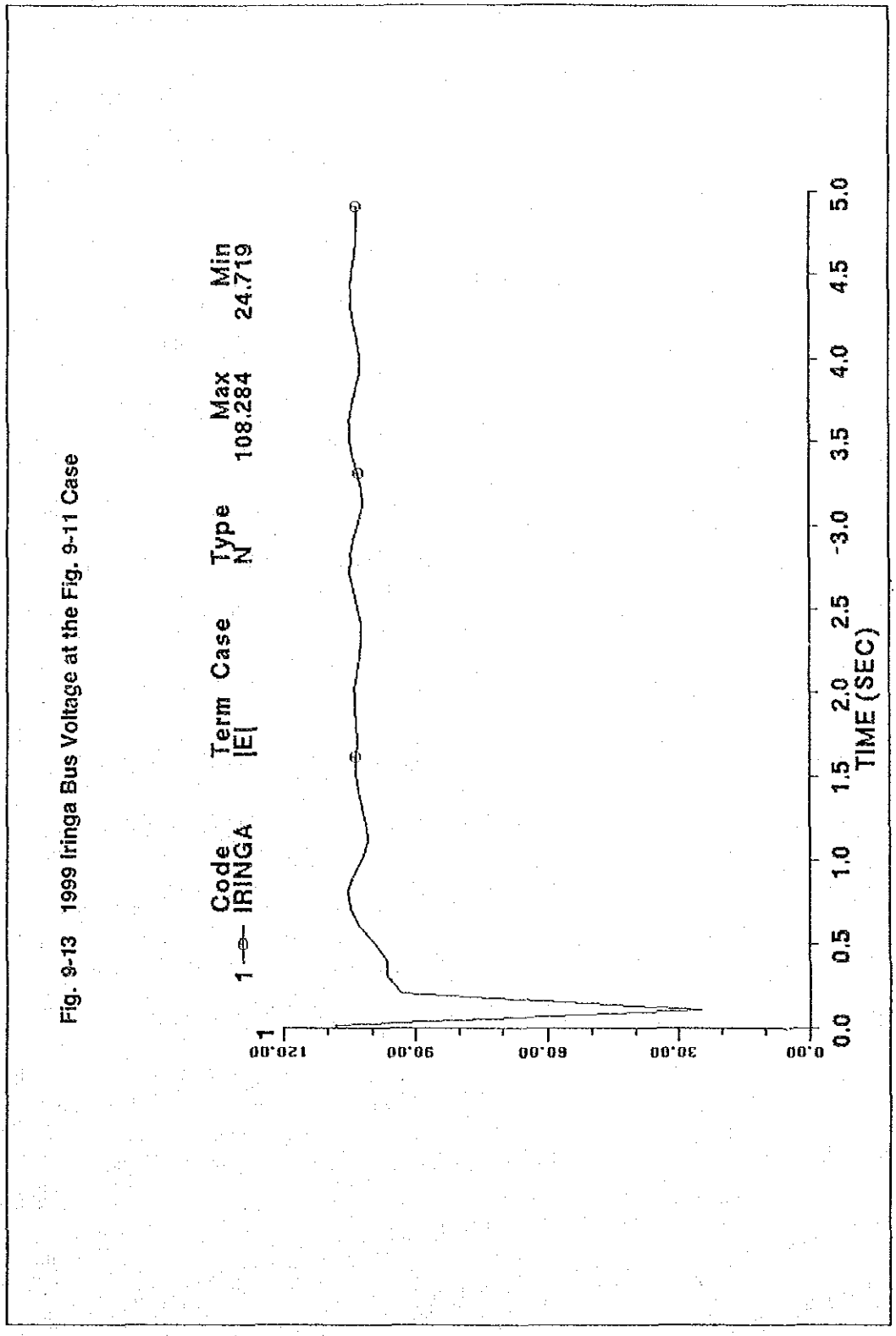


Fig. 9-13 1999 Iringa Bus Voltage at the Fig. 9-11 Case