Part A

8. "Trishuli Battar Irrigation Project"

श्री ५ को सरकार

जलस्रोत मन्त्रालय

(... ... सिंचाई मंत्र ... शाखा)

फोन नं. २-२६७१६, २-२७६५१, २-२९१२३, २-२८०४६, २-२९१०९

टेलेक्स नं. २३१२
पोष्ट बक्स नं. २१४७
सिंहदरबार
काठमाडौं नेपाल ।
मिति ०४५।१२।१३

पत्र संख्या :- २ ग-६।०४५। ७९ नं
प्राप्त पत्र संख्या र मिति :-

विषय :- त्रिशुली बट्टार सिंचाई योजना ।

श्री सिंचाई विभाग,
पानी पोखरी ।

श्री नेपाल विद्युत प्राधिकरण,
दरबारमार्ग ।

उल्लिखित विषयमा सिंचाई विभाग बाट मिति ०४५।११।२८ मा पेश गर्नु भएको टिप्पणी उपरमा कारबाहि हुंदा श्री ५ को सरकार (राज्य मन्त्री) स्तर बाट मिति ०४५।१२।६ मा निम्न बुंदा निर्णय भएकोले निर्णयानुसार हुन अनुरोध गरिन्छ ।

१. बट्टार सिंचाईको लागि त्रिशुली देविघाट विस्तार आयोजनामा पावरहाउस नं २ मध्ये माथि हेडरेस कुलो बाट ३ क्यूमेक पानीको आवश्यक पर्ने भएको हुंदा उपर्युक्त मात्राको लागि ने.वि.प्रा.ले आवश्यक व्यवस्था गर्ने ।
२. यो गर्दा आयोजनाको डिजाईनमा केही परिवर्तन र थोरै थप गर्नु पर्ने हुन जाने भए यो बारे सहमति गर्न पर्दछ । विश्व बैंक संग परामर्श गरी ने.वि.प्रा.ले पेश गर्ने ।
३. सिंचाई विभाग बाट त्यस पछि नहर तयार गरी पानी वितरण गर्न आवश्यक आर्थिक स्रोतको व्यवस्था गरी कार्य शुरु गर्ने ।

His Majesty's Government
Ministry of Water Resources
(Irrigation Division)

Reference : 2-ga-6/048/49
Subject: Trishuli Battar Irrigation Project

Department of Irrigation
Panipokhari.

Nepal Electricity Authority
Durbar Marg

As regards the Report File on the above mentioned subject submitted by the DOI on March 1992, a HMG/N decision (State Ministerial level) has been made on March 1992 and accordingly you are requested to execute the following points.

1. The NEA should make the necessary provision for providing 3 m3/s of water, which may be necessary for irrigating in Battar from the Trishuli Devighat Hydropower Upgrading Project head race canal upstream of aqueduct no. 2.

2. If upon doing so, some revisions have to be made in the design and if this entails additional expenditure , NEA should consult the World Bank on this matter and submit a report.

3. The DOI should then start making arrangements for the budget to construct the canal system required to distribute the irrigation water.

/Signed/

Part A

9. Report on Water Availability for Trisuli Irrigation Project from Trisuli Hydro Project Februay 1997

Table of Contents

1. SUMMARY AND RECOMMENDATION:

1.1. Water conveyance system from he[illegible] regulator to balancing reservoir can safely carry a discharge of 48.6 m^3/sec. So tappin[illegible] m^3/sec water from balancing reservoir is possible for irrigation purpose.

1.2. NEA has upgraded and rehabilitated Trishuli - Devighat Hydropower Plants for optimum utilization of available water resources. So NEA will agree to provide the spilled over water only for irrigation purposes.

1.3. From the hydrological and water demand analysis it is apparent that during normal year extra water for irrigation is available during whole year. During dry year 4 month from January to April are critical. But probability of such critical year is only 15%.

1.4. By the year 2000/2001 the power demand scenario will be changed to better situation and demand to Trishuli will be less than now. Moreover, it will take at least 2 years to complete the proposed irrigation project and water will be required only after that period.

1.5. The balancing reservoir should be cleaned to its full storage capacity which will provide better operational flexibility for both irrigation and hydropower plants.

1.6. Department of Irrigation should assure NEA that they will be tapping only additional water which is not been used for generation of hydropower. The intake at balancing reservoir will be constructed accordingly.

1.7. Low flow study of Trishuli River should be carried out for 2-3 year, to have more realistic data on low flow.

1.8. Department of Irrigation should look into the possibility of construction of a small balancing reservoir required for storage of Irrigation water for 4-6 hours (21600 - 32,400) m^3 at suitable elevation and place.

2. ASSESMENT OF AVAILABILITY OF WATER FOR IRRIGATION

2.1. Department of Irrigation (DOI) is planning to rehabilitate Trisuli Irrigation Project having a command area of about 1000 ha. The water demand is 1.5 m^3/sec for about 12 hours in a day. DOI wishes to study whether the possibility exist or not to meet the irrigation water demand from Trisuli Hydro-power Project (THP) balancing reservoir without hampering NEA energy generation demand.

2.2. The flow of the river is tapped by Trisuli Hydropower Project (THP) and developed in two stages and completed in 1970 after the installation of the last unit. The plant utilizes 31.15 m^3/sec. of water which is being 90% dependable flow of the river. The catchment of Trisuli at headworks is 4640 sq. km.

In 1984 the tail race water of the plant was further recoursed through 4.5 km conveyance system to Devighat for generating electrical power from Devighat Hydropower Plant (DHP).

2.3. For better utilization of available water resources along with rehabilitation and maintenance Trisuli - Devighat Upgrading and Rehabilitation Project was launched in May 1992. NEA completed the project in December 1995 (through the loan assistance of IDA under Power System Efficiency Project) increasing 31.15 m^3/sec. canal base flow to 90% dependable discharge of 45.6 cumecs by rehabilitating original intake and conveyance system upto the Balancing Reservoir. However, the water conveyance downstream of reservoir is maintained same. The electro-mechanical equipment are also revamped for enhancing the generation capability of the Trisuli Plant from 21 MW to 24 MW.

To meet the requirement of Irrigation and others instead of originally designed 1.32 m, the weir was raised 1.52 to 2.80 m height. Weir was designed for 100 year flood discharge 2780 m^3/sec.

2.4. After completion of the major civil upgrading works water was successfully released on 3rd June, 1995. Whereas, revamping of electromechanical components was completed on 25th December, 1995 and thereby started generating anticipated average yearly energy of 163.8 GWh against previous record of 105 GWh through one number of 3.5 MW and 6 number of 3.25 MW generators.

2.5. The irrigation command area is located at low level (elevation) and downstream of the Balancing Reservoir, so the excess water accumulated in the Balancing Reservoir or spilled over could be well used for irrigation.

2.6. The THP revamped units have rated flow of 7.61 m^3/s each and are operated in the base part of INPS load curve because of its run-off river characteristics. As per upgraded design 45.66 cumecs continuous base flow can be make available to the plant. The irrigation requirement of 1.5 cumecs is 3.2% of the continuous base flow. Considering the 255000 m^3 capacity of Balancing Reservoir and peaking nature of load irrigation water requirement could be made available fully in normal year and partially during dry year.

2.7. From the mean monthly and yearly discharge of Trisuli river at Betrawati gauging station, No. - 447 four months (January, February, March & April) of the year are observed to be critical. So, detail low flow study of Trisuli river is recommended.

2.8. The intake and conveyance system upto the Balancing Reservoir is actually capable of carrying 48.5 m^3/sec. discharge (See daily log sheet from 25th Dec. 1995 to 8th Jan. 1996 and 30th Dec. 1996 - Annex - c - 16 pages) without detrimental effect to the civil structures. Hence, additional 1.5 m^3/sec. discharge required for irrigation on top of 45.66 m^3/sec. base flow through the existing conveyance system right from Intake to Balancing Reservoir is safely allowable throughout the year.

2.9 The irrigation water requirement lies within 5% of the hydrological error margin. Therefore the study on low flow for accessing the availability of enough water during critical months of the year is essential.

3. LOW FLOW ANALYSIS OF TRISULI RIVER (AT BETRAWATI)

3.1 Introduction

Trishuli river is a snow fed river. The river flow is monitored since 1967 by the Department of Hydrology and Meteorology (DHM): There is a permanent hydrological station at Betrawati. The river water is utilized by Nepal Electricity Authority for hydropower production at Trishuli Bazar. The flow of 45.66 m^3/sec. is the present requirement to the hydropower plant.

The following hydrological study is focused to assess the low (winter) flow and find out the excess water which can be used for irrigation. The present minimum water requirement for irrigation is about 1.5 m^3/s for 12 hours a day.

3.2 Long-term Averages:

The mean monthly flow of Trishuli river from 1967 to 1993 is collected from DHM publication. The long-term averages are computed and these values are given in Table 3.1 are presented in Figure 3.1 below in following pages.

Four month of the year: January, February, March and April are seen to be the critical months with low flow. The river flow in April and February is less than 45.5 m^3/s.

3.3 Low flow recession (Annual minimum) :

Annual minimum flow from 1967 to 1993 are arranged in descending order and plotted using Weibull plotting formula. It has been seen that the present water requirement (45.5 m^3/s.) for hydropower production is not available for all the periods. Table 3.2 contains minimum flows during the months February, March and April.

3.4 Low flow recession (Daily) :

The daily river flows of selected year was analyzed. According to the statistic there was below normal rainfall during 1982/83 and 1978/79. The daily flow hydrograph from November to May of these years were analyzed (Table 3.3).

The following relationships were established for daily flows from November to February.

For 1978-79:
$Q_t = 117e^{-0.010\, T_d}$ $[R^2 = 0.95]$

For 1982-83 :
$Q_t = 84e^{-0.0087\, T_d}$ $[R^2 = 0.93]$

For 1983-84 :
$Q_t = 109e^{-0.0112\, T_d}$ $[R^2 = 0.96]$

Where,
Q_t is the river flow on Td^{th} day from first of November and Td is the number of days from the first day of November.

The above equation are valid only from November to February.

3.5 Snow melt effect :

It has been found from low flow analysis that snow melt starts contributing to the flows from February or March. However, there seems no appreciable change of flow in April. Flow starts increasing generally from May (Figure 3.2).

3.6 Flow duration curve:

Two low flow duration curves were prepared [Figure 3.3] - one for normal year (Wet year) and another for dry year. Table 3.4 lists flows and the corresponding percent of time. 45.6 m^3/sec. is found to be 65 % dependable flow in dry year and 85 % in normal year. Table 3.4 contains daily mean river flows. Generally in February, March and April flow is less than 45.5 m^3/s during normal year. However, it is further low in January, February March and April during dry year.

Table 3.1

Longterm mean monthly flows
Trishuli at Betrawati

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1967-93 (27 Yrs)	44.58	39.27	40.51	49.41	82.26	222.78	497.63	575.13	371.48	158.13	82.63	56.29

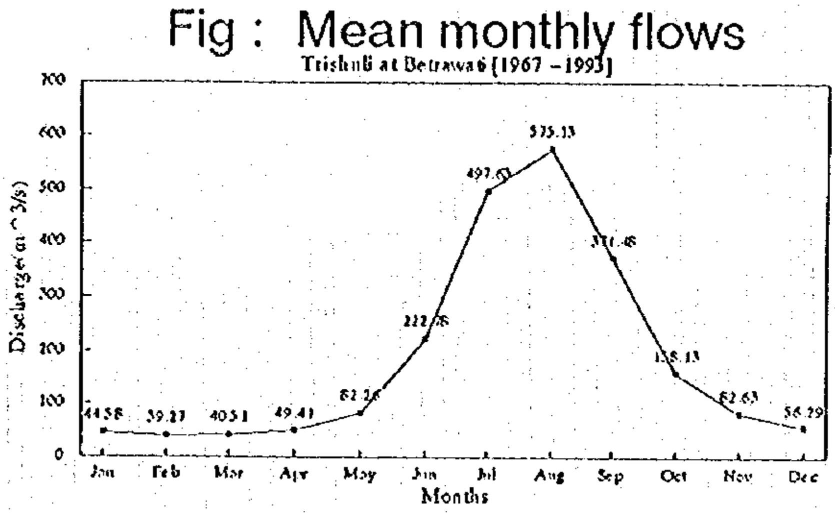


Fig. 3.1

Table 3.2

Trishuli river at Betrawati : Area : 4110

Prob.%	Min-Q	Est-Q	Feb-Q	Mar-Q	Apr-Q	Year
96.4	24.5	26.1	28.0	24.5	26.0	1993
92.9	26.5	26.7	26.5	26.5	27.0	1992
89.3	28.4	27.3	30.5	28.4	28.4	1970
85.7	29.1	28.0	29.8	29.1	30.5	1968
82.1	29.1	28.6	37.0	34.0	29.1	1967
78.6	30.5	29.3	33.3	30.5	32.6	1969
75.0	30.5	29.9	31.0	30.5	31.5	1991
71.4	30.9	30.6	31.8	31.8	30.9	1984
67.9	31.3	31.3	31.3	37.1	38.0	1985
64.3	32.7	32.0	32.7	34.5	34.5	1983
60.7	33.6	32.7	33.6	33.6	35.4	1981
57.1	33.7	33.5	36.1	33.7	35.3	1974
53.6	33.7	34.3	35.1	33.7	33.7	1990
50.0	35.4	35.0	35.4	35.4	38.6	1972
46.4	35.4	35.8	35.4	36.0	43.3	1973
42.9	35.9	36.6	36.7	35.9	37.5	1971
39.3	36.1	37.5	38.8	37.9	36.1	1976
35.7	36.3	38.3	38.1	36.3	42.3	1980
32.1	37.2	39.2	37.2	44.5	67.6	1982
28.6	40.8	40.1	40.8	42.9	42.9	1978
25.0	41.5	41.0	41.5	41.5	42.9	1979
21.4	43.3	41.9	44.2	43.3	44.2	1975
17.9	43.6	42.9	43.6	45.8	49.0	1977
14.3	44.0	43.9	44.8	44.0	51.0	1989
10.7	44.5	44.9	47.8	44.5	49.0	1987
7.1	45.6	45.9	45.6	47.2	55.0	1988
3.6	50.9	46.9	50.9	50.9	52.0	1986

Fig : Yearly Minimum Flow

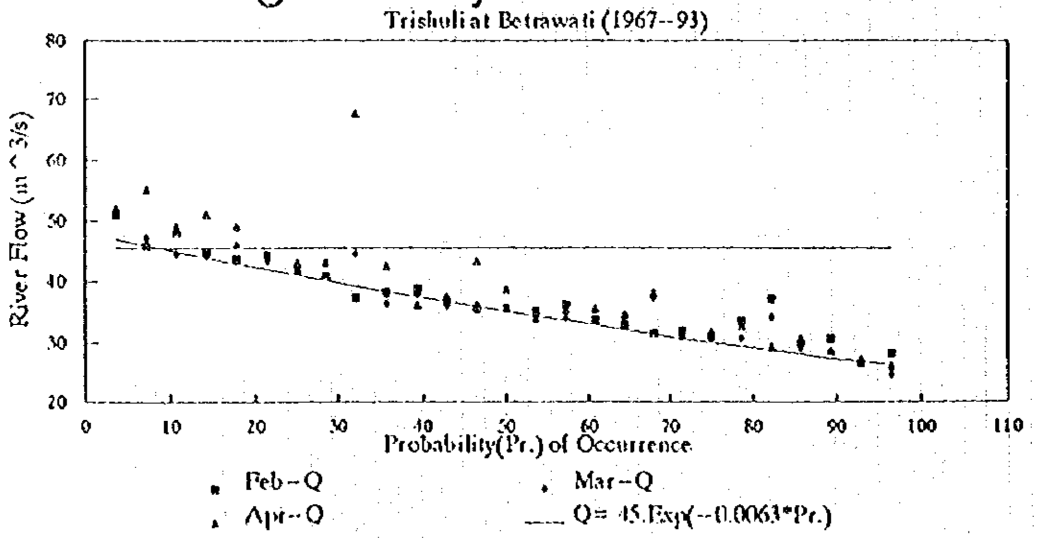


Fig. 3.2

Table 3.3

Flows of Trishuli river at Betrawati
November - May

Day	River Flow in [illegible] year			Available Flow		Balance Flow	
	1978/79	1[illegible]83	1983/84	Dry	Normal	Dry	Normal
Nov-1	140	91	123	91	140	46.0	95.0
5	123	86	112	86	123	41.0	78.0
10	112	81	102	81	112	36.0	67.0
15	104	76	92	76	104	31.0	59.0
20	97	71	84	71	97	26.0	52.0
25	90	66	78	66	90	21.0	45.0
30	84	62	72	62	84	17.0	39.0
Dec-5	79	58.5	68	58.5	79	13.5	34.0
10	74	56	63	56	74	11.0	29.0
15	70	53	58	53	70	8.0	25.0
20	66	50	55	50	66	5.0	21.0
25	62	48	51	48	62	3.0	17.0
30	59	45.5	48	45.5	59	0.5	14.0
Jan-5	56	43	45	43	56	-2.0	11.0
10	53	41	42	41	53	-4.0	8.0
15	50	40	40	40	50	-5.0	5.0
20	48	38	38	38	48	-7.0	3.0
25	46	36	36	36	46	-9.0	1.0
30	45	35	35	35	45	-10.0	0.0
Feb-5	43.5	33.5	32.5	32.5	44	-12.5	-1.5
10	43.3	33	31.5	31.5	43	-13.5	-1.7
15	43	34	33.5	33.5	43	-11.5	-2.0
20	42.5	36	34	34	43	-11.0	-2.5
25	42	35.5	33	33	42	-12.0	-3.0
Mar-1	41.5	35	32	32	42	-13.0	-3.5
5	44	34.5	33.5	33.5	44	-11.5	-1.0
10	45	37	33	33	45	-12.0	0.0
15	44.5	36.5	33.5	33.5	45	-11.5	-0.5
20	44	36.3	34	34	44	-11.0	-1.0
25	43.5	36	35	35	44	-10.0	-1.5
30	43	35.7	34.5	34.5	43	-10.5	-2.0
Apr-5	44.5	35.5	33	33	45	-12.0	-0.5
10	46	35.3	32.5	32.5	46	-12.5	1.0
15	48.5	35	32	32	49	-13.0	3.5
20	51	35.5	34	34	51	-11.0	6.0
25	56	38	36	36	56	-9.0	11.0
30	62	41	38	38	62	-7.0	17.0
May-5	70	45	42	42	70	-3.0	25.0
10	80	50	46	46	80	1.0	35.0
15	85	55	65	55	85	10.0	40.0
20	90	60	100	60	100	15.0	55.0

Table 3.4

Flow Duration Curve

Percent of Time	River Discharge		NEA needs	Balance Discharge		
	Dry	Normal		Dry	Normal	
45.1	91	140	45.5	45.5	94.5	
46.2	86	123	45.5	40.5	77.5	
47.5	81	112	45.5	35.5	66.5	
48.9	76	104	45.5	30.5	58.5	
50.3	71	100	45.5	25.5	54.5	
51.6	66	97	45.5	20.5	51.5	
53.0	62	90	45.5	16.5	44.5	
54.4	60	85	45.5	14.5	39.5	
55.7	58.5	84	45.5	13.0	38.5	
57.1	56	80	45.5	10.5	34.5	
58.5	55	79	45.5	9.5	33.5	
59.8	53	74	45.5	7.5	28.5	
61.2	50	70	45.5	4.5	24.5	
62.8	48	70	45.5	2.5	24.5	
64.2	46	66	45.5	0.5	20.5	
65.6	45.5	62	45.5	0.0	16.5	
66.9	43	62	45.5	-2.5	16.5	
68.3	42	59	45.5	-3.5	13.5	
69.7	41	56	45.5	-4.5	10.5	
71.3	40	56	45.5	-5.5	10.5	
72.7	38	53	45.5	-7.5	7.5	
74.0	38	51	45.5	-7.5	5.5	
75.4	36	50	45.5	-9.5	4.5	
76.8	36	49	45.5	-9.5	3.0	
77.6	35	48	45.5	-10.5	2.5	
79.0	35	46	45.5	-10.5	0.5	
80.3	34.5	46	45.5	-11.0	0.5	
81.7	34	45	45.5	-11.5	-0.5	
83.1	34	45	45.5	-11.5	-0.5	
84.4	34	45	45.5	-11.5	-1.0	
85.8	33.5	45	45.5	-12.0	-1.0	
87.4	33.5	44	45.5	-12.0	-1.5	
88.8	33.5	44	45.5	-12.0	-1.5	
90.2	33	44	45.5	-12.5	-2.0	
91.5	33	44	45.5	-12.5	-2.0	
92.9	33	43	45.5	-12.5	-2.2	
94.3	32.5	43	45.5	-13.0	-2.5	
95.6	32.5	43	45.5	-13.0	-2.5	
97.0	32	43	45.5	-13.5	-3.0	
98.4	32	42	45.5	-13.5	-3.5	
99.7	31.5	42	45.5	-14.0	-4.0	

Fig: Flow Duration Curve

Trishuli River at Betrawati

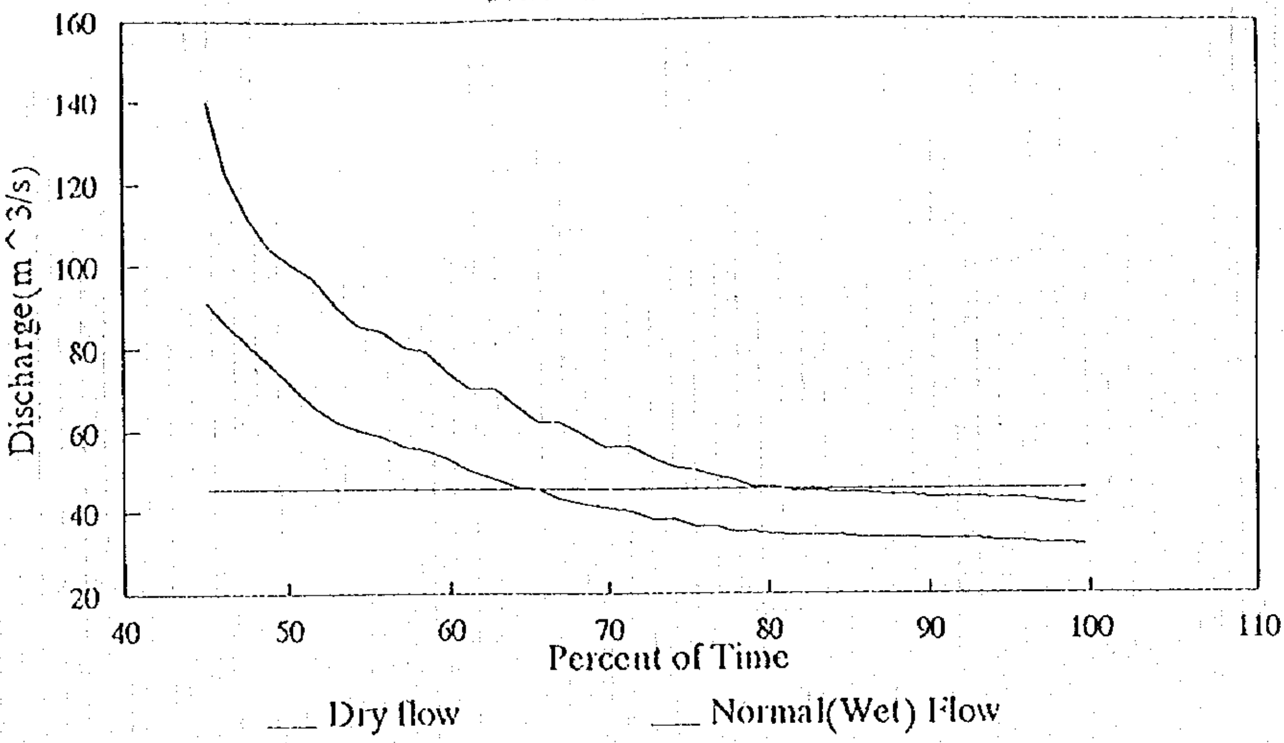


Fig. 3.3

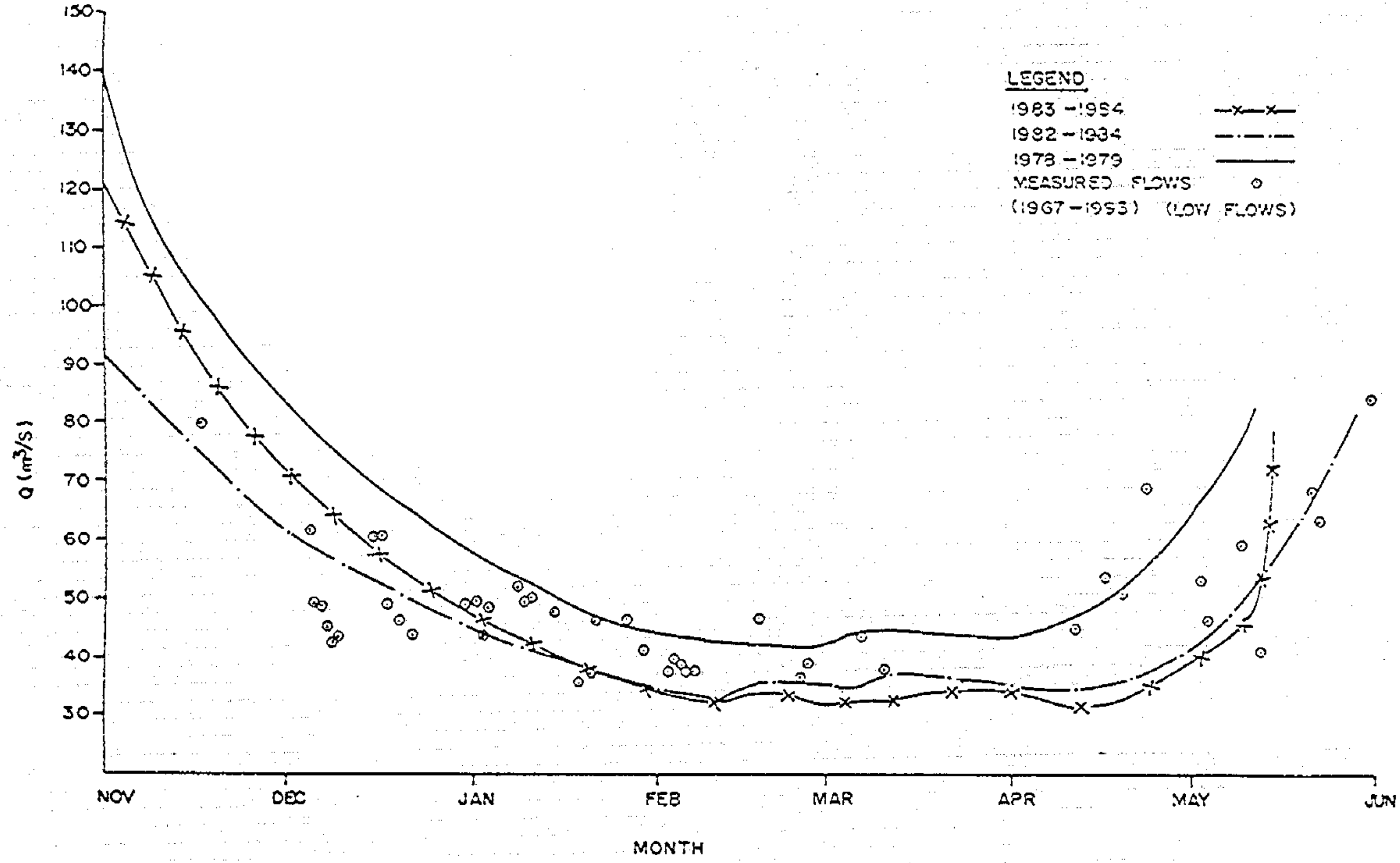


FIG 3.4 – LOW FLOW RECESSION CURVES

Station No : 447
River : Trisuli
Station Name : Betrawati

Table 3.5

MEAN MONTHLY AND YEARLY DISCHARGES - FOR TRISHULI RIVER AT BETRAWATI

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
1967	47.4	38	35.6	41.2	63.7	137	429	518	326	199	66.9	48.2	162.5
1968	37.9	32.1	31	38.7	64.9	220	486	479	281	170	75.8	51	164.0
1969	40.5	35.5	33.2	38.1	62.3	133	398	451	335	126	67.7	47.4	147.3
1970	36.7	31.9	29.9	40.5	65.3	162	468	512	290	152	83.6	57.9	160.8
1971	45	38.6	36.8	46.5	65.1	348	448	549	320	154	81.5	54.8	182.3
1972	42.9	37.3	38.9	42.9	101	163	431	473	283	106	62.5	43	152.0
1973	37.3	36.8	40.2	60.4	96.6	366	510	663	525	288	100	65.7	232.4
1974	50.8	39.7	36.2	53.8	82.2	200	546	640	390	106	86.4	60.6	191.0
1975	51.2	46.2	44.2	60.2	91.6	264	548	561	516	222	110	69.8	215.4
1976	49.3	41.9	40.3	46.6	85.2	207	367	487	372	165.8	99	65.5	168.9
1977	48.1	46.5	49.8	54.9	77.8	192	591	609	368	164	94	61.7	196.4
1978	46.6	44.1	45.4	57.4	151	335	520	625	332	215	108	70.1	212.5
1979	51.3	43.5	43.9	52.4	91.9	185	468	504	280	137	83	55.6	166.3
1980	43.5	40.2	40.8	59.4	80.6	276	663	678	390	162	91	58.9	215.3
1981	42.5	36.4	37.2	50	85	290	714	619	369	140	87.1	56	210.5
1982	43.8	39.8	56	74.6	81.4	212	407	596	393	120	77.5	54.1	179.6
1983	40.1	34.8	36.3	38.5	69.9	161	377	506	438	200	94.9	60.4	171.4
1984	46.6	33.4	34.2	34.5	107	298	619	517	417	117	69.5	48.9	195.2
1985	35.6	33.8	41.9	46.3	54.6	156	486	432	369	200	91.7	69.1	168.0
1986	55.1	54.5	53.9	64.6	77.1	319	694	595	454	169	96.4	67.9	225.0
1987	54.2	50.1	48.8	56.7	69.9	177	396	-	-	116	78.7	61.8	110.9
1988	52.2	48.5	49.3	59.7	86.3	178	488	566	260	109	71.8	58.8	169.0
1989	53.8	47.5	48.4	57.2	105	188	356	441	282	120	65.1	-	160.4
1990	-	37.1	36.1	47.9	91.2	315	815	650	452	167	77.1	49.1	248.9
1991	38.5	32.5	32.5	38	86.4	210	448	802	-	-	-	45.1	192.6
1992	35.4	29.1	28.6	34.6	43.1	122	325	709	410	140	66.5	41.8	165.4
1993	33.2	30.5	27.2	38.2	84.5	192	446	728	422	166	67.7	42.1	189.8
AVG	44.60	39.27	39.87	49.40	82.24	222.44	497.93	573.46	370.96	158.88	82.82	56.36	184.9
MAX	55.1	54.5	56	74.6	151	366	815	802	525	288	110	70.1	248.9
MIN	33.2	29.1	27.2	34.5	43.1	122	325	432	260	106	62.5	41.8	110.9

3.7 **Conclusion & Recommendations:**

From the present data it has been seen that generally there is no surplus of water in February to April for irrigation when Hydropower plant runs in its full capacity at 45.6 m³/s. However, this is not the actual case. Due to fluctuation in load, the generation also fluctuates and water demand varies accordingly.

The water requirement for irrigation is only about 3.5 % of the water requirement for hydropower plant and this amount falls within the error of data collection - staff gauge readings and discharge measurements as well as rating curve fitting. Hence, to have a clear picture it is strongly recommended to have low flow data collection for two to three years and its analysis. Such study would help to revise the low flow part of the rating curves and find out the actual amount of water available for irrigation use.

4. ASSESSMENT OF INTAKE AND WATER CONVEYANCE STRUCTURES

The Trisuli Hydropower plant is located about 75 km North West of Kathmandu which is constructed on Trisuli river. The installed capacity of this power plant was 21 MW and was completed in year 1970. It is a run-off the river scheme with a Balancing Reservoir of 2,55,000 m³ capacity designed to provide peaking for about 4.5 hours daily.

With the aim to better utilize the available water resources a rehabilitation and upgrading program was launched. Trisuli was upgraded to 24 MW installed capacity. The following changes are made in various existing hydraulic structures.

For hydropower upgrading, weir height was planned to raise 1.32 m only. But considering irrigation and other demand, the crest elevation of the existing weir was raised by 1.5m to divert the whole dry weather flow through the head regulator. The number of head regulator has been increased to six from original three.

The closed reinforced concrete ducts (Twin Barrel) installed after the head regulator was cleaned during upgrading work and is presently being used under pressure flow to carry the designed discharge.

The depth of the power channel between the twin barrel and the desilting basin has been increased between 0.4 to 1.4 m to make it capable to carry the designed discharge 45.6 m³/s. The energy generation log sheet shows that the water conveyance system from head regulator to balancing reservoir can safely carry a discharge of 48.6 m³/s.

Two new aqueduct of similar capacity has been constructed in parallel to the existing aqueduct No. 1 and No. 2 to carry the designed discharge after upgrading.

The Balancing Reservoir was nearly filled and cleaned partially during upgrading work. It is again filled during last year monsoon. About 250 lps of discharge was found leaking from the flushing structure. The balance reservoir was sufficient to provide about 4.5 hours of daily peak load operation. At present there are four lateral Kholas which drain into the balancing reservoir bringing substantial load of sediment. The measure taken to check the flow of debris into reservoir was not fully successful.

The existing seasonal stream called Khahare on west side of the Balancing Reservoir is bringing a huge amount of sand and debris flow during monsoon. The debris flow have to be controlled by constructing several check dams upstream of those Kholas.

Regular cleaning of the balancing reservoir will enhance live storage capacity, limit the abrasion damage to hydraulic turbines and limit the accumulation of bed load at the head race forebay. Enhancement of storage capacity of the balancing reservoir will provide better flexibility of water availability for irrigation.

5. POWER GENERATION PATTERN OF TRISULI

5.1 Power generation pattern of Trisuli Power House after the completion of upgrading and rehabilitation works are studied through daily log sheets of power house from 1st Jan. 1996 till 12th Jan. 1997. The study indicate that the power plant is used as a base load station in the operation of Integrated Nepal Power System (INPS).

5.2 Even during the dry season (Jan, Feb, March and April) of the year, the maximum load registered varies from 17.2 MW to 22 MW, while the minimum load is from 0.2 MW to 10 MW with monthly load factor well above 77%. The least monthly energy generation recorded is more than 10.7 GWh.

5.3 Similarly during the wet season (July, Aug, Sept, Oct) maximum demand has registered as high as 22.8 MW and minimum demand 0.4 MW with load factor well above 77%. The monthly energy generation is highest in the month of October attaining 14.4 GWh.

5.4. The plant is designed for average yearly generation of 163.8 GWh with annual firm energy as 144.2 GWh. The annual energy generation of 1996 is 153.94 GWh which is already 94% of the designed figure. The plant will generate 100% of the average yearly energy in 1997 with plant load factor registering well above 75%.

5.5 The study of daily log sheets confirms that the plant will share its optimum role in INPS load distribution curve in terms of capacity and energy till 2000/2001.

6. ANTICIPATED FUTURE OPERATION REGIME

6.1 Trisuli and Devighat hydropower stations together are operated as base load stations to meet the daily load demands of INPS. They are run-off-river type plants with balancing reservoir for daily peak hours.

6.2 Load dispatching center of NEA has sensible link to interacts with Trisuli-Devighat complex for the daily operation of power stations, so is making optimum generation for meeting the anticipated daily demands of the system regularly.

6.3 The typical daily load distribution curve of INPS is presented in Annex b. The curve shows that Trisuli-Devighat power generation pattern lies in the base part of the INPS load curve. The operational regime of Trisuli-Devighat is assumed to remain the same in the subsequent years.

The following committed or anticipated new generation is considered for assessing the future operation regime of Trisuli-hydro power plant.

- Puwa Khola Hydro power project under construction by NEA, a run-off-river type, with 2000 cu.m. capacity balancing reservoir for average annual generation of 48 GWh and deliver winter peak power of 6.2 MW is expected to commence generation by February 1998.
- Modi Khola Hydropower Project also is under construction by NEA, a run-off-river type, having 26640 cu.m. capacity regulating pondage for annual average energy generation of 91 GWh and deliver a winter peak of 14 MW is scheduled to be commissioned by FY 2054/55 (1997/98).
- Chilime Hydropower Project is under construction by a public company is scheduled to be commissioned by the middle of 1998. The project is with an installed capacity of 20 MW for average annual energy generation 137 GWh.

- Kali Gandaki - A, a priority hydropower project is of the run-off-river type having a daily pondage with a peaking capacity of about 6 hours. This project will generate 840 GWh in an average year and deliver a winter peak power of 144 MW to the INPS from 'uly 2000 only.

- Khimti Khola Hydro power project - a rapid action project, under construction by Himal Power Ltd under the Power Purchase Agreement by NEA, is of the run-off-river type. It is scheduled to join INPS from June 2000 on wards. The project is expected to generate 350 GWh in an average year and deliver a winter peak power of 60 MW.

6.4 Energy

During 1996/97 winter NEA could manage to meet the electrical power demands without having to resort to load shedding inside the Valley like last year and year before. It was possible due to import of power and operation of Diesel generators at Duhabi, Biratnagar and Hetauda.

The hydro power generation scenario is presented below which explains the likely hydro power deficit till the year 2000 both in peak power as well as in terms of energy.

The assessment of energy is done based on expected energy generation capability of INPS against the anticipated increase of loads over the future years.

The attached table 6.1 shows the energy generation capability of the various power stations based on their past performances. Long term maintenance of any hydro stations has not been considered.

Table 6.1

Year	1995 GWh	1996 GWh	1997 GWh	1998 GWh	1999 GWh	2000 GWh	2001 GWh
Marsyangdi	430	430	430	430	430	430	430
Kulekhani I	165	165	165	165	165	165	165
Kulekhani II	65	65	65	65	65	65	65
Trisuli	139	157	160	160	160	160	160
Devighat	96	109	109	109	109	109	109
Sunkoshi	50	50	50	50	50	50	50
Gandak	50	50	50	50	50	50	50
Small Hydro	20	20	20	20	20	20	20
Andhikhola	20	20	20	20	20	20	20
Jhimruk	78	78	78	78	78	78	78
Khimti Khola						350	350
Upper Bhote Koshi							244
Puwa				44	44	44	44
Chilime				136	136	136	136
Modi					91	91	91
Kaligandaki - A							840
Total	1113	1144	1147	1327	1418	1768	2608
NEA forecast		1272	1392	1530	1688	1860	2047
Energy Balance	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Surplus

Note: The gap between supply and demand is within manageable limit of 20%, which can be met by import or generation by stand by diesel generators.

6.4.1 Hydro Energy Deficit

The energy generation scenario i iewed through table 6.1 and NEA load forecast (F.Y. 95/96 A year in Review). It is evic a that energy deficit persists for few years and improves after Kaligandaki-A joins in the national grid in the year 2000.

The results are summarised below:

Table 6.2

Year	Total Generation Required (GWh)	Total Possible Hydro (GWh)	Deficit (GWh)	Surplus (GWh)
1996	1272	1144	128	
1997	1392	1147	245	
1998	1530	1327	203	
1999	1688	1418	270	
2000	1860	1768	92	
2001	2047	2608		561

After Kaligandaki-A joining the system, the energy surplus is apparent and present operation regime of Trisuli will be relieved from hard pressed situation after 2001 and thereafter. Till 2001 both Trisuli and Devighat will be generating the energy to maximum possible limit of 160 GWh and 118 GWh annually.

6.4.2 Peak Power

The attached table 6.3 shows the available hydro peak power likely to be generated in the coming years. No provision is made of the major maintenance during this period.

Table 6.3

Peaks Station	Winter Peak Capacity (MW)						
	1995	1996	1997	1998	1999	2000	2001
Marsyangdi	69	69	69	69	69	69	69
Kulekhani 1	60	60	60	60	60	60	60
Kulekhani 2	28	28	28				28
Trisuli	18	22	22	22	22	22	22
Devighat	14	14	14	14	14	14	14
Sunkoshi	7	7	7	7	7	7	7
Gandaki	8	8	8	8	8	8	8
Small Hydro	4	4	4	4	4	4	4
Andhi Khola	4	4	4	4	4	4	4
Jhimruk	5	5	5	5	5	5	5
Khimti						60	60
Upper Bhote Koshi							36
Puwa				36	36	36	36
Chilime				20	20	20	20
Modi					14	14	14
Upper Modi							
Kaligandaki-A							144
Total	217	221	221	277	291	351	531
Compared to NEA forecast	244	275	303	328	354	383	413
Peak Balance	Deficit	Deficit	Deficit	Deficit	Deficit	Surplus	Surplus

6.4.4 Water Balance Status after upgrading of Trishuli Power House

Installated Capacity	- 24 MW
Firm Capacity	- 19.5 MW
Annual Firm	- 144.2 GWh
Secondary	- 19.6 GWh
Yearly Average	- 163.8 GWh
Plant Flow	- 45.66 m^3/sec
Firm Flow	- 31.15 m^3/sec

To generate 21 MW the water requirement is 45.6 m^3/sec.

Monthly average water Balance for 1996 in m^3 /sec

Month 1996	Energy Generation in KWh	Average Generation MW	Average water consumtion correspoing to energy gen. m^3/sec	From hydrological records of 27 years m^3/sec		Balance m^3/sec		No of hourly required to meet irrigation demand	
				Min	Average	Min	Average	Min	Aver
January	12,757,140	17.13	37.20	33.20	44.60	(4.04)	7.40	-	133.26
February	10,506,160	15.09	32.77	29.10	39.27	(3.70)	6.50	-	117.06
March	10,730,580	14.72	31.96	27.20	39.87	(4.80)	7.91	-	142.32
April	11,859,030	16.5	35.83	34.50	49.40	(1.30)	13.57	-	244.29
May	12,786,600	17.16	37.26	43.10	82.24	5.84	44.98	3.08	809.61
June	13,667,570	18.97	41.19	122.00	222.44	80.81	181.25	0.22	3262.46
July	14,106,726	18.89	41.02	325.00	497.93	283.98	456.91	0.06	8224.41
August	12,962,910	17.7	38.43	432.00	573.46	393.57	535.03	0.05	9630.46
Sept.	12,701,500	17.72	38.48	260.00	370.96	221.52	332.48	0.08	5984.68
Oct.	14,498,000	19.52	42.39	106.00	158.88	63.61	116.49	0.28	2096.89
Nov.	13,890,600	18.47	40.11	62.50	82.82	22.39	42.71	0.80	768.85
Dec.	13,480,700	18.01	39.11	41.80	56.36	2.69	17.25	6.69	310.55
Total	153,947,516								

Daily water demand for irrigation = 1.5x12x60x60 m^3
= 64,800 m^3

Result: If water demand forecast is based on minimum discharge only, then from January to April no water is avalable for irrigation purposes. Based on average discharge water is available throughout the year.

JANUARY, 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Genera-tion (KWH)
1	20.3	15	17.85	89.25	428430
2	22	16.2	17.5	79.58	420200
3	20	16	17.88	89.41	429180
4	20	17	18.14	90.7	435390
5	21	15.8	17.87	85.09	428890
6	21	17	17.69	84.24	424600
7	21	15	17.35	82.63	416500
8	21	15.1	17.27	82.26	414620
9	21	15	17.27	82.25	414550
10	20	15	16.69	83.45	400600
11	21	4	16.03	76.37	384910
12	21	14.7	17.11	81.49	410740
13	20	16	17.02	85.12	408590
14	21	15	16.97	80.85	407510
15	22	15	17.47	79.41	419290
16	21	18	18.72	89.18	449490
17	19.5	15	17.38	89.14	417190
18	19.5	18	18.24	93.56	437900
19	19.6	16	17.36	88.58	416720
20	20	14.9	17.29	86.45	414990
21	20	15.5	17.76	87.35	419320
22	19.5	15	17.26	88.54	414400
23	19.5	16	16.72	85.76	401370
24	19.7	15.2	16.68	84.69	400430
25	19	16	16.07	87.77	400240
26	19	15	16.22	85.37	389290
27	16.8	16	16.37	97.44	392900
28	17.3	16	16.45	95.13	395020
29	17	16.6	16.14	94.97	387480
30	17	16.7	16.16	95.11	388050
31	17.2	15.2	16.18	94.07	388350
Average of Avg. Load			17.13		
Total Month Generation					12757140

Source: Abstract from daily log sheet of Trisuli PH.

Annex a.2

FEBRUARY, 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Genera-tion (KWH)
1	17	15.5	15.88	93.45	388350
2	17	15.5	15.86	93.33	380790
3	17	10.5	14.76	86.86	354390
4	17	15	15.36	90.38	368780
5	17	15	15.61	90.23	374660
6	17.1	13.5	15.53	90.86	372930
7	17.5	15	15.42	88.15	370240
8	18	15	15.42	85.71	370280
9	17	14	15.19	89.39	364750
10	16.7	14.4	15.6	93.45	374570
11	17	15.5	15.66	92.11	375840
12	17.6	16	16.08	91.37	385950
13	17	13.5	14.67	86.33	352260
14	17	14	15.17	89.25	364160
15	17	14	15.19	89.37	364650
16	17.6	14	15.34	83.98	354760
17	18.1	13	14.44	79.83	346790
18	18	13	14.31	79.54	343650
19	18	10	14	77.79	336060
20	18	14	15.49	86.08	371900
21	18	13	14.49	80.54	347940
22	17.5	13	14.32	81.55	343800
23	17.5	13	14.39	82.25	345460
24	17.5	13	14.58	83.36	350120
25	17.5	13	14.55	83.15	349270
26	17.5	14	15.29	87.42	367190
27	18	13.8	15.17	84.28	364100
28	18	14	15.22	84.56	365340
29	18	14	14.88	82.68	357180
Average of Avg. Load			15.09896552		
Total Month Generation					10506160

Source: Abstract from daily log sheet of Trisuli PH.

MARCH, 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Generation (KWH)
1	17	14	14.71	86.54	353110
2	17	14	14.56	85.7	349670
3	14.8	14.8	14.8	96.88	344140
4	14.8	14.8	14.8	95.94	340800
5	14.8	14.6	14.32	96.77	343730
6	14.8	12.9	13.87	93.76	333070
7	14.1	13.8	13.38	94.89	321120
8	14.5	14	13.68	94.37	328440
9	14.5	14	13.58	93.67	326000
10	16	14	14.03	87.74	336950
11	16.5	16	15.24	92.4	365940
12	16.9	16	15.67	92.74	376160
13	17	12	15.78	92.84	378800
14	17	16	15.95	93.85	382910
15	17	0.5	13.55	76.42	311800
16	17	16	15.07	88.66	361740
17	16.8	16	15.61	92.93	374710
18	17.2	15.8	15.98	92.92	383580
19	17.1	17.1	17.1		389090
20	17.2	16.5	16.12	93.74	386990
21	17	16.5	15.98	94.05	383730
22	17	16.5	15.7		377070
23	17.3	17	15.98	93.1	386590
24	17.1	14.5	15.32	89.63	364710
25	17	14	15.17	89.38	364710
26	17.1	13.2	14.85	86.89	356620
27	16	16	15.03	93.93	360720
28	16	16	15.1	94.41	362550
29	16	0.2	7.54	47.17	18140
30	16	0.2	14.05	87.81	337210
31	16	10.6	13.74	85.88	329780
Average of Avg. Load			14.72		
Total Month Generation					10730580

Source: Abstract from daily log sheet of Trisuli PH.

APRIL, 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Generation (KWH)
1	16	0.4	13.7	85.65	328920
2	16	16	15	93.91	360620
3	16	15.7	15.1	94.39	362490
4	16	15.4	15.05	95.25	358910
5	16	15.7	15.96	94.14	361520
6	16	11.2	14.84	92.77	356250
7	16	16	15.11	94.49	362860
8	16	12.7	14.7	91.88	352820
9	16	7	14.84	92.75	356190
10	17.6	16	15.59	88.58	374170
11	18	10	16.58	92.12	397960
12	18	16.8	16.99	94.4	407840
13	18.2	0.4	16.62	90.81	398880
14	18	17.7	17	94.44	408020
15	18.1	3.4	16.79	92.79	403110
16	18	18	16.74	93	401760
17	18	17.8	17.11	95.08	410760
18	18	13	16.42	91.24	394180
19	18	8.9	16.47	91.52	395390
20	19	12.6	16.8	88.46	403390
21	19	7	17.12	90.12	410970
22	19.5	17	17.84	91.5	428230
23	19	13	17.08	89.91	410040
24	19.5	7	17.53	89.92	420860
25	20.5	17.5	17.74	86.56	425880
26	19.5	18	17.99	92.3	431990
27	19.5	18	18.33	94.04	440150
28	19.5	18	17.88	91.71	429240
29	20	7	17.79	88.98	427140
30	20	18	18.27	91.35	438490
Average Value			16.50		
Total Month Generation					11859030

Source: Abstract from daily log sheet of Trisuli PH.

MAY, 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Genera-tion (KWH)
1	19	13	17.56	92.42	421460
2	19	7	14.47	91.95	419300
3	19	17.5	17.57	92.52	421900
4	18.3	6.3	14.76	80.65	295210
5	14.5	0.7	12.1	83.5	290580
6	18	13	14.77	82.08	354610
7	18	10	15.49	86.05	371770
8	18.2	14.8	16.11	88.53	386700
9	18	13.5	16.57	92.1	397910
10	18.3	14.8	17.04	93.14	409100
11	19.5	0.2	14.87	76.27	356970
12	20.9	12.5	17.61	84.28	422770
13	19.5	15.7	17.53	89.93	420910
14	18.3	18.3	17.37	94.96	417090
15	19.6	18.3	17.67	90.18	424240
16	18.8	7	17.21	91.56	413130
17	19.4	18.3	17.42	89.81	418160
18	19.4	18.5	18.02	92.92	432660
19	19.5	8	17.73	90.95	425670
20	20	19.3	18.92	94.63	454260
21	20.5	19.2	19.04	92.9	457070
22	21	18	19.5	92.86	468040
23	21.5	21	20.26	94.24	486290
24	21.5	21	20.47	92.2	491500
25	21.5	0.6	16.6	77.21	398450
26	21	4.6	13.23	63.03	317680
27	22	18	19.05	86.61	457310
28	22	19	19.88	90.39	477300
29	22	0.4	16.24	73.87	389780
30	21	0.4	17.16		411900
31	22	18	19.87	90.31	476880
Average Value			17.16		
Total Month Generation					12786600

Source: Abstract from daily log sheet of Trisuli PH.

JUNE 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Genera-tion (KWH)
1	22	7	15.63	71.05	375150
2	22	19	19.68	89.49	472540
3	21	18	18.72	88.14	449290
4	22	19	19.34	87.95	464390
5	21.3	12	19.33	90.79	464150
6	22	10	18.58	84.49	446120
7	22	18.8	19.53	86.81	468930
8	22	18	19.97	90.72	479030
9	22	18	19.49	88.6	467820
10	22	19	19.7	89.57	477960
11	22.5	8.5	18.94	84.18	454620
12	22.5	19	20.02	88.99	480550
13	22	19	19.22	87.4	461490
14	21.4	9	18.56	86.73	445470
15	22	0.8	19.05	86.68	457380
16	22	18.7	19.78	89.94	474900
17	22	9.6	19.43	88.33	466390
18	22	19.4	20.21	91.88	485140
19	22.5	11	19.54	86.88	469180
20	22.5	16.4	19.27	85.66	462600
21	22	9.2	18.26	83.03	438410
22	22	13.3	17.98	81.76	431710
23	21	13	18.35	87.41	440570
24	22	10	17.37	78.99	417110
25	22	11	18.84	85.67	452340
26	22.5	12	18.29	81.3	439050
27	22.5	12	19.11	89.96	458830
28	22.1	18	19.33	87.46	463930
29	22	10	18.27	87.06	438600
30	22.5	12	19.33	85.91	463920
Average Value			18.97		
Total Month Generation					13667570

Source: Abstract from daily log sheet of Trisuli PH.

JULY 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Generation (KWH)
1	22.5	13.0	19.63	87.26	471240
2	22.5	12.0	18.84	83.76	452310
3	22	12.4	19.09	86.8	458350
4	22.6	12.0	19.11	84.56	458680
5	22	13.0	18.8	85.49	451400
6	22	10.0	19.34	87.94	464350
7	22	12.5	19.45	88.43	466960
8	22	0.4	18.21	82	437250
9	22	13.0	19.11	86.86	458670
10	22	12.0	19.3	87.75	463350
11	22	12.0	18.8	85.47	451320
12	22	14.0	19.7	89.56	472910
13	22	12.0	19.58	89.01	469990
14	22	12.0	19.53	88.77	468740
15	22	12.0	17.63	80.17	423310
16	22	14.0	18.89	85.89	453520
17	21	3.0	17.51	92.47	466090
18	22	10.0	18.26	83.01	438320
19	22	14.0	19.57	88.98	469840
20	22	13.4	19.33	80.88	464040
21	22	13.0	19.55	88.86	469200
22	22.5	4.0	16.53	73.46	396720
23	22	10.5	18.5	84.09	444000
24	22	13.0	18.83	85.63	452140
25	22	13.0	19.01	86.41	456290
26	21.3	12.0	19.11	89.76	458866
27	22	12.0	18.51	84.17	444420
28	22	12.0	18.21	86.33	436880
29	22	12.0	19.01	86.45	456460
30	22	12.0	19.74	89.72	473770
31	22	14.0	19.05	86.61	457340
Average Value			18.89		
Total Month Generation					14106726

Source: Abstract from daily log sheet of Trisuli PH.

AUGUST 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Genera-tion (KWH)
1	22	14	19.7	89.56	472880
2	22	14	18.44	83.83	442640
3	22	12	17.43	79.23	418370
4	22	14	18.69	84.96	448640
5	22	14	18.17	82.6	436140
6	22	12	18.93	86.04	454330
7	22	13	18.85	85.69	452480
8	22	12	18.43	83.88	442510
9	22	14	18.92	86.04	454310
10	22	10	18.87	85.8	453030
11	22	14	19.29	87.69	463020
12	21	12	19.68	97.73	472410
13	21	1.1	16.7	79.52	400810
14	20	12	15.77	78.88	362890
15	21	11	18.54	88.31	445100
16	21	12	19.17	91.33	460310
17	21	12	17.94	85.46	430740
18	21.6	13	18.16	84.1	436000
19	21.3	12	18.4	85.92	415000
20	22	0.6	16.5	75	396000
21	21	10	16.74	79.72	401800
22	22	12	16.09	73.14	386200
23	21	11	16.35	77.87	392500
24	19	12	15.84	83.44	380500
25	19	10	16.75	88.15	402000
26	19.5	11	16.58	85.04	398000
27	19	12	15.33	80.69	337300
28	19	8	15.7	82.67	361300
29	21	13	17.61	83.88	422800
30	21	10.2	17.73	84.44	425600
31	22.8	5	17.48	76.7	297300
Average Value			17.70		
Total Month Generation					12962910

Source: Abstract from daily log sheet of Trisuli PH.

SEPTEMBER, 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Generation (KWH)
1	22.5	13	17.52	77.90	420700
2	23	10	17.85	77.67	428500
3	21	12	17.96	85.55	431200
4	21	12	17.88	85.17	429300
5	22	12	18.18	82.67	436500
6	22	14	18.6	84.58	446600
7	21	11	18.32	87.26	439800
8	22	13	18.92	86.04	454300
9	22	11	18.34	83.39	440300
10	21	13	18.2	86.7	437000
11	21	3	13.31	63.39	213000
12	18	13	16.59	91.89	397000
13	20	12	17.22	86.14	413500
14	20	9.5	16.82	84.1	403700
15	20.5	10.8	18.47	90.1	443300
16	20.5	13	17.83	8.01	428100
17	21	12	18.1	86.19	434400
18	21	14	17.85	85.01	428500
19	21	12	17.79	84.72	427000
20	21.5	13	18.13	84.34	425200
21	21	10	17.65	84.08	423800
22	20	13	17.39	86.97	471500
23	20	12	18.27	91.35	438500
24	21	17	17.56	83.63	421500
25	21	4	17.79	54.72	427000
26	21	12	17.79	55.59	431400
27	21	12	18.54	88.29	445000
28	21	55	16.38	77.99	393100
28	21	11	18.24	86.88	437900
30	21	12	18.07	86.09	433900
Average Value			17.72		
Total Month Generation					12701600

Source: Abstract from daily log sheet of Trisuli PH.

OCTOBER, 1996

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Genera-tion (KWH)
1	19.2	8	19.39	8,181.00	377000
2	22	12	17.22	78.31	413500
3	21.6	18	19.2	88.92	461000
4	22	17.2	19.4	88.18	465600
5	21	10.5	17.97	85.59	431400
6	22	17	19	86.36	456000
7	22	17	19.02	86.45	456500
8	22	19	19.84	90.41	477400
9	22	21	20.81	94.62	499600
10	22	21	20.56	93.46	493500
11	22	21	21.06	95.73	505500
12	22	11	20.96	87.4	461500
13	22	18	20.03	91.07	480900
14	21.5	19	19.16	89.14	460000
15	21.5	18.6	19.47	90.58	467400
16	22	18.5	20.07	90.96	480300
17	22	19	20.57	93.5	493700
18	22	18	20.48	93.12	491700
19	22	12	19.84	90.18	476200
20	22	21	21.06	92.48	488300
21	22	18	16.76	89.82	474300
22	22	18	20.32	92.38	487800
23	22	11	19.66	89.37	471900
24	22	21	20.84	94.75	500300
25	22	18	20.25	92.08	486200
26	22	18.8	20.52	93.27	492500
27	22	18.9	19.33	87.87	464000
28	,19	13	17.95	94.51	431000
29	21	18	18.56	88.39	445500
30	21	14	18.95	90.27	455000
31	20.5	17.3	18.85	91.97	452500
Average Value			19.58		
Total Month Generation					14498000

Source: Abstract from daily log sheet of Trisuli PH.

DECEMB~~R, 1996

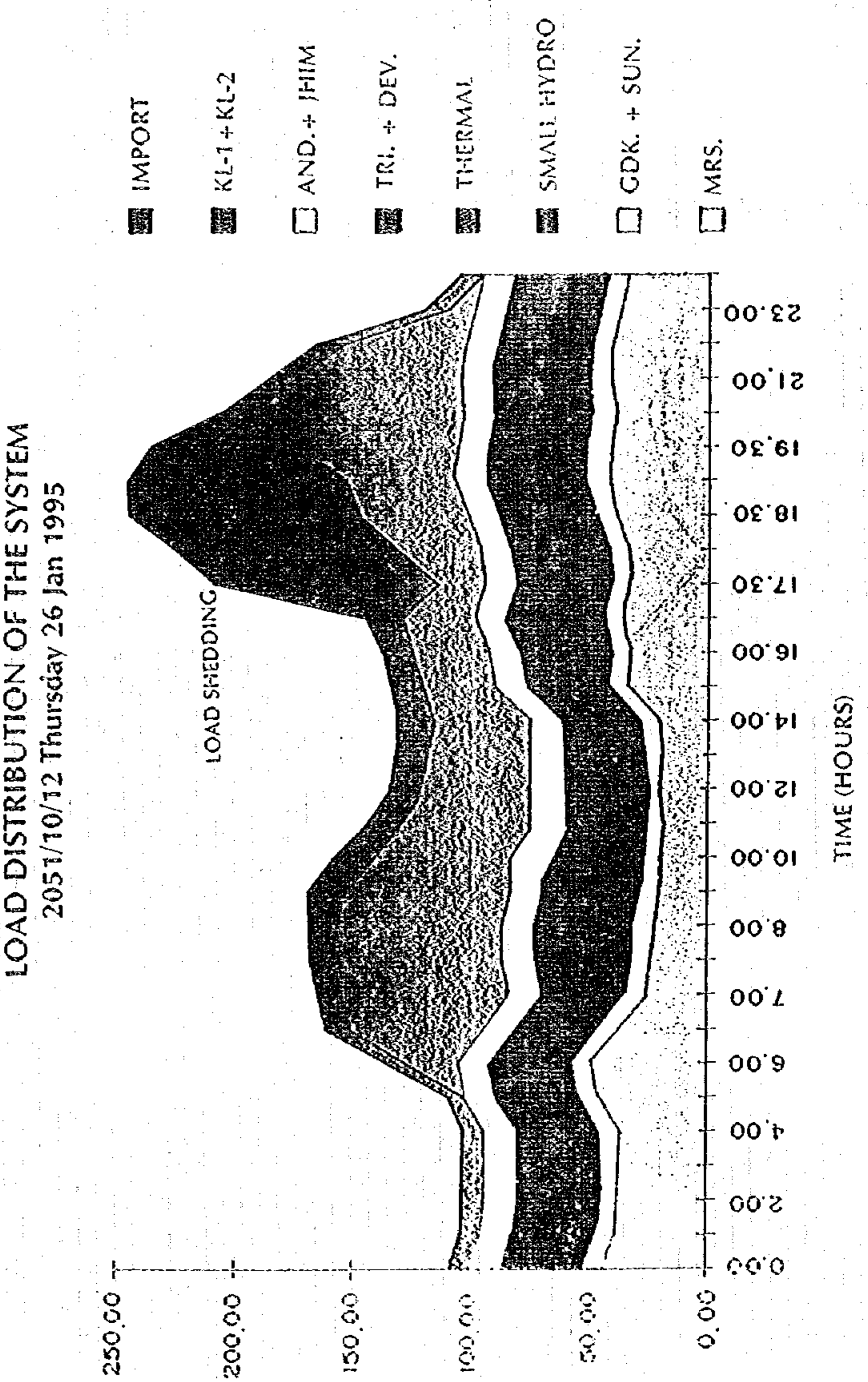
Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Generation (KWH)
1	20.5	19.5	16.78	91.64	450900
2	21.5	19.5	19.65	91.41	471700
3	22	19.5	19.55	88.86	469200
4	19.5	19.5	18.57	95.27	445900
5	19.5	19.5	18.84	96.9	453500
6	19.5	8	16.57	85.01	397850
7	17.5	16.6	16.49	94.25	395850
8	18.5	17.5	16.93	91.53	406400
9	19	17.5	16.5	91.97	419400
10	18.5	18.5	17.84	96.44	428200
11	18.5	8.5	17.42	94.18	418200
12	18.2	18.2	17.09	93.93	410300
13	18.2	17	17.33	95.26	416100
14	18	8.5	15.99	88.86	383900
15	18	1.7	17.1	95.02	410500
16	18	8.5	16.56	92.01	397500
17	20	17.7	17.4	87.02	417700
18	20	19	18.3	91.82	439300
19	20	17	17.95	89.75	430800
20	20	18.7	16.65	93.27	447700
21	20.5	19.5	19.43	94.81	466500
22	20.5	18.5	18.75	91.46	450000
23	20.2	19	19.92	93.67	454100
24	20.6	18.6	18.49	89.76	443800
25	19.7	18.5	18.38	93.33	441300
26	20	18.5	18.53	92.66	444800
27	20.2	12.2	18.52	91.68	444500
28	20.3	19	18.62	91.74	447000
29	20.5	19.3	19.06	92.98	457500
30	20.5	19.2	19.15	93.45	459800
31	20.8	19.2	19.8	92.24	460500
Average Value			18.01		
Total Month Generation					13480700

Source: Abstract from daily log sheet of Trisuli PH.

JANUARY, 1997

Date	Max Load (MW)	Min Load (MW)	Avg. Load (MW)	Load Factor (%)	Generation (KWH)
1	21	17.6	19.32	92.04	463900
2	20	19	19.47	92.71	467300
3	21	19.5	19.5	92.85	468000
4	21	18.8	19.33	92.06	464000
5	20	19	19.34	92.12	464300
6	21	19	18.88	89.92	453200
7	21	18	18.52	88.19	444500
8	20	18	18.5	92.54	444200
9	21	12.3	17.89	85.19	429400
10	21	18	17.96	85.53	431100
11	21	14	18.01	85.77	432300
12	21	17	17.89	85.21	429500
Average Value			18.72		
Total Month Generation					5391700

Source: Abstract from daily log sheet of Trisuli PH.


LOAD DISTRIBUTION OF THE SYSTEM
2051/10/12 Thursday 26 Jan 1995
LOAD SHEDDING
IMPORT
KL-1+KL-2
AND. + JHIM
TRI. + DEV.
THERMAL
SMALL HYDRO
GDK. + SUN.
MRS.
LOAD (MW)
250.00
200.00
150.00
100.00
50.00
0.00
0.00
2.00
4.00
6.00
7.00
8.00
10.00
12.00
14.00
16.00
17.30
18.30
19.30
21.00
23.00
TIME (HOURS)

RAPID ACTION PROJECTS			Expected commencing
Khimti Khola	60 MW 350 GWh	IPP, Himal Power Ltd. MOU on 2nd ammendment to PPA	June 2000
Upper Bhote Khosi	36 MW 244 GWh	IPP, Himal International Power Co. MOU for Project development sigend	July 2000
PUWA	6.2 MW 44 GWh	NEA Tender awarded for civil works	Feb. 1998
Chilime	20 MW 136 GWh	NEA/privated Joint Venture Preparatory works for construction started	July 1998
Modi Khola	14 MW 91 GWh	NEA/private Joint Venture Preparation works for construction	July 1998
Upper Modi Khola	14 MW 84 GWh	NEA/private Joint Venture Feasibility study completed and solicitation for Project Development published.	
Middle Marsyangdi	43 MW 255 GWh	Germany Feasibility study completed. MOU signed	
Upper Marsyangdi	42 MW 350 GWh	IPP Matthews International Canada Feasibility study being made. MOU for project development sigend	
Lower Bhote Koshi	35 MW 253 GWh	Feasibility study to be made	
Kaligandaki - A	144 MW 840 GWh	A priority project under construction by NEA financed by loan assistance by ADB and another donor agency	July 2000

त्रिशुली देबीघा जल बिद्युत सुदृढिकरण आयोजना
एक परिचय

काठमाण्डौबाट ७५ कि.मी. उत्तर पश्चिम दिशामा रहेको नुवाकोट जिल्लाको बिदुर न.पा. मा त्रिशुली नदीको किनारामा अवस्थित त्रिशुली तथा देबीघाट जल विद्युत केन्द्रहरु नेपालकै पुराना जल विद्युत केन्द्रहरु मध्ये पर्दछन । यि जल विद्युत केन्द्रहरु मध्ये त्रिशुली जल विद्युत केन्द्रबाट ई.सं. १९५६ देखि ई.सं. १९७० भित्र सर्वप्रथम ३ वटा युगोस्लाभियामा निर्मित ३ मे.वा क्षमतामा युनिटहरु र पुन: पछि ४ वटा (फुजी कम्पनी) जापानमा निर्मित ३ मेगावाट विद्युत क्षमताका युनिटहरु (टवाईन र जेनेरेटर सेट) जडान गरि विद्युत उत्पादन शुरु गरिएको थियो । ति सात युनिटहरु मध्ये एउटा आकस्मिक प्रयोगको लागि जगेडा राखि बांकी ६ वटा युनिटहरुबाट विद्युत उत्पादन गरिएको थियो । ई.सं. १९८४ सालमा त्रिशुली जल विद्युत केन्द्रले प्रयोग गरि यसको टेलरेस पण्डमा खसालेको पानीलाई नदीमा नखसाली सिधा पण्डबाटै खुला नहर र सुरुङ्को माध्यमबाट देबीघाट पुरयाई त्यहां अर्को जल विद्युत केन्द्र देबीघाट जल विद्युत केन्द्रको स्थापना भयो । त्यस विद्युत केन्द्रको क्षमता भारतमा निर्मित ३ वटा प्रत्येक ४.७ मे.वा. क्षमताका (टवाईन जेनेरेटर सेट) युनिटहरुको मद्धतले कुल १४.१ मे.वा. रहेको थियो ।

आर्थिक दृष्टिकोणबाट कुनै पनि जलविद्युत केन्द्रहरुको उमेर सरदर २५ देखि ३० वर्षको हुन्छ । तत्पश्चात यदि त्यसलाई तुरुन्तै सुदृढिकरण नगरिएको खण्डमा त्यो टुटफुट हुने, बिग्रिने र त्यसको आर्थिक प्रयोजनतै समाप्त भएर अन्त्यमा त्यसको परिणाम शुन्य सालभेज मुल्य (salvage value) हुन जाने हुन्छ ।

विगतका अनुभवहरुबाट के पनि देखिएको छ भने पुराना ज.वि.केन्द्रका विभिन्न संरचनाहरु तथा ईलेक्ट्रोमेकानीकल पार्टपुर्जाहरुको समय समयमा गरिरहनु पर्ने मर्मत खर्चे त्यस जलविद्युत केन्द्रको वार्षिक संचालन बजेटको निकै प्रतिशत हुनुको साथ साथै ती ज.वि. केन्द्रहरुको समयमै सम्पुर्ण रुपमा मर्मत संभार (Rehabilitation) नभएको खण्डमा तिनीहरुको थप २०-२५ बर्ष लम्बीन सक्ने आर्थिक जीवन (Economic Life) मा नकारात्मक असर पर्नुको साथै तिनीहरु बन्दनै हुन सक्ने अवस्थामा पनि पुग्न सक्छन् ।

त्रिशुली जल विद्युत केन्द्र करिब २५ बर्ष पुरानो भई आफनो आर्थिक जीवन समाप्त गरिसकेको परिप्रेक्षमा यि दुवै जल विद्युत केन्द्रहरुबाट निम्न कारणहरुले गर्दा तिनको वास्तवीक डिजाईन क्षमताको दुई तिहाई शक्ति मात्र उत्पादन गरिरहेका थिए ।

क) नहरको मुहान देखि टर्वाईनको पेनाश्टक पाईप सम्म पानी लैजादां भएका अत्यधीक हेडलस, चुहावट तथा बालुवा र ग्रेभर जम्नु र रिजभ्भायरमा बालुवा तथा माटो जम्नाले यसले आफनो सम्पुर्ण Live Storage Capacity गुमाई मात्र ३१.२ क्युमेक पानी जलविद्युत केन्द्रहरुमा आपुर्ती गर्न सक्नु । यसबाट त्रिशुली केन्द्रले १२ मेगावाट (उत्पादन गर्नु पर्ने १८ मे.वा.) र देबीघाट ज.वि. केन्द्रले ९.४ मे.वा. (उत्पादन गर्नु पर्ने १४.१ मे.वा.) मात्र भरपर्दो विद्युत शक्ति उत्पादन गर्न सकिरहेको थियो ।

ख) देबीघाट जल विद्युत संरचनामा भएको अत्यधिक हेडलस, लिकेज तथा माटो बालुवा जम्नाले डिजाईन ४५.६ क्युमेक क्षमतामा ३५ क्युमेक मात्र पानी जाने स्थिति हुनु ।

ग) त्रिशूली जल विद्युत केन्द्रमा रहेका टर्वाईनहरु धेरै पुरानो भईसकेकोले त्यसको रनरहरु खिईसकेको र तिनमा लिकेज हुनको साथै तिनको न्युन Efficiency भएको कारणले तिनीहरुको क्षमतामा ह्रास हुनु, : ८ ।

आयोजनाको उद्देश्य:

क) त्रिशूली तथा देवीघाट केन्द्रहरुको उत्पादन क्षमतामा आएको ह्रास हटाउनुको (rehabilitation) साथ साथै क्षमतामा बृद्धि (upgrading) समेत गर्न त्रिशुली केन्द्रको ईन्टेक देखि रिजोर्भ्वायर सम्म पानी लैजाने नहरको क्षमता बृद्धि गरि ३१.२ क्युमेक बाट ४५.६ क्युमेक बेस फ्लो कायम गर्ने ।

ख) रिजोर्भ्वायरमा भईरहेको माटो तथा बालुवा जम्ने प्रकृया रोक्न यसमा बग्ने खोलाहरुमा ग्राभेल ट्राप (Gravel Trap) बनाउने ।

ग) डिसेण्डर (Desander) पोखरीको Efficiency अभिवृद्धि गर्न त्यहां एउटा Tranquilizer Rack राख्ने ।

घ) त्रिशुली तथा देवीघाट ज.वि.के. हरुको Electro-Mechanical equipment हरुको मर्मत संभार तथा आवश्यक नयां पार्टपुर्जाहरु समेत फेरेर त्यसको उत्पादन क्षमतामा बृद्धि गर्ने ।

ङ.) आयोजनाको डिजाईन तथा निर्माण सुपरिवेक्षण कार्यहरुमा कन्सलटेण्टहरु सित अधिकतम नेपाली ईन्जिनियरहरुलाई संलग्न गराएर तत्सम्बन्धी टेक्नीकल कार्य बारे बढि से बढि अनुभव हासील गराई भविश्यमा यस्ता किसिमका साना तथा मझौला आयोजनाहरु नेपाल विद्युत प्राधिकरणले आफनै जनशक्ति प्रयोग गरि परामर्शदातृ विदेशी संघ संस्थाहरुको सहयोग नलिएरै सम्पन्न गर्न सक्ने क्षमता विकास गर्ने आदी ।

आयोजनाको छोटो विवरण:

क) कार्यको किसिम : मर्मत सम्भार तथा सुदृढिकरण (Rehabilitation & Upgrading)

ख) ठेकेदार

i) सिभिल कार्य तर्फ लार्सन एण्ड टुब्रो लि. (ईन्डीया)
ii) ईलेक्ट्रोमेकानीकल कार्य तर्फ मल्टीपावर हाईड्रो ईलेक्ट्रीक डेभलपमेण्ट कर्पोरेशन (चाईना) ।

ग) परामर्शदातृ संस्था : क्यानेडियन ईण्टरनेशनल वाटर एण्ड ईनर्जी कन्सल्टेण्ट (CIWEC)

घ) आयोजना प्रमुख : गणेश बहादुर श्रेष्ठ

ङ.) कार्यकारी संस्था(Executive Agency): ने.वि.प्रा. ।

च) आर्थिक ऋण सहयोग : विश्व बैंक (IDA), श्री ५ को सरकार तथा ने.वि.प्रा.

छ) विद्युत शक्ति उत्पादन :

5. **ENERGY SENARIO :**

A) **Condition Before Upgrading:**

	Capacity (MW)		Energy (GWH)		Canal Capacity
	Installed	Firm	Annual Firm	Yearly Average	31.2
Trishuli	21.0	12.0	105.0	105.0	m3/sec
Devighat	14.1	9.4	82.0	82.0	
Total	35.1	21.4	187.0	187.0	

B) **Condition After Upgrading:**

Capacity (MW)	Annual Energy (GWH)	Canal Capacity

	Installed	Firm	Annual Firm	Secondary	Yearly Average	
Trishuli	24.0	19.5	144.2	19.6	163.8	45.6
Devighat	14.1	14.1	109.7	8.8	118.5	m3/sec
Total	38.1	33.6	253.7	28.4	282.3	

C) Benefit

Increase in Firm Power : 33.6 - 21.4 = 12.2 MW

Net Increase in Energy : 282.3 - 187.00 = 95.3 GWH

Incremental Energy Cost: US $ 0.042 per KWh or NRs. 2.39 per KWh at power station at present exchange rate.

NRs. 1.82 per KWh at Contract Award (1 US $ = NRs. 42.80)

4. Marginal benefit / cost :

NEA system : 2.7

Multifuel : 3.2

6. **SAILENT FEATURES :**

A. **TRISHULI**

Location Trishuli River

Plant type Run-of-the river type with peaking capability utilizing Balancing Reservoir.

	Before Upgrading	After Upgrading
HEAD		
Gross Head	54.0 m	
Net Head	51.4 m	
Barrage		
o Total length	139.00 m	139.50 m
o Design discharge	3770 m3/s	3770 m3/s (1 in 100 years flood)
Upstream Training wall		
o Type of structure	gabion wall of 68.5 m length	67.7 m Conc. wall
Overflow weir		
Length		92.0 m
1 in 100 Years Flood discharge		3770 m3/sec
Head regulator		
o No. of intake	3	6 (2 old + 4 new)
o Opening of intakes	2.88 m(w)x 2.8m(h)	3.05m(w)x2.8m (h) for both old & new gates
Conveyance System	5.40 km	
Canal Bank raising & Slabs repair	1330 mm to 300 mm	
Power Channel (Twin Barrel)		
o Type	Closed reinforced concrete ducts	

o	Length	1036.32 m	
o	Size	3.35 X 3.35 m	
o	Number	2	

Superpass

o	Flume	RCC(old)	RCC(new) 4m wide x 2.4 m high

Aqueduct # I- Bridge

A new bridge has been constructed at u/s of and parallel to the old bridge.

o	Type of abutment	RMM	a coordination of old wing wall of existing RRM masonry and a new RCC wall & deadman beam behind the wing wall at each bank.
o	Well foundation		

The new bridge foundation on left & right bank were installed in the form of sunk wells.

o	Central Pier			
-	Type of structure		RRM	Mass conc. with stone facing connected flexibly with old pier
o	Scour protection around			Old blocks repaired and new blocks added with an increased height.
o	Bridge Type	Old bridge - Steel truss		New bridge- 59.50 m span steel truss and 29.10 m self supporting Pre-Stressed Concrete Flume.
o	Steel liner in existing flume			

The old existing flume overtopped regularly at the u/s end when flow in the canal were above 35 cusecs. Thus, a steel liner was installed in the flume. The width of the flume was reduced to 2.8 m from 3.66 m and height increased to 3.6 m from 3.09 m.

o	PSC Flume	29.10 m (a new technology applied)
o	RCC Flume	2.8m (w)x3.7 m (h)

Aqueduct #II

A new bridge paralle to the old bridge has been constructed at the u/s of the old bridge.

o	Type of abutment	RMM	a coordination of old wing wall of existing RRM masonry and a new RCC wall & deadman beam behind the wing wall at each bank.
o	Well foundation		

The new bridge foundation on left & right bank were installed in the form of sunk wells.

Central pier

-	Type of structure	RRM	Mass conc. with stone facing connected flexibly with old pier.
o	Bridge type	Old bridge	New bridge

			Steel truss double span of 57.95 m of first and 27.42 m second span.	Steel truss double span. of 60.13m and 29.06 m
o		**Penstock pipe**		
	a)	**Old steel & concrete pipe**		
	-	**Diameter (inside)**		3.66m
	-	**Steel pipe length on bridge**		87.68 m
	-	**Concrete pipe length**		63.92 m (L/B)and 101.94m (R/B)
	b)	**New steel pipe**		
	-	**Inside diameter**		2.6m
	-	**Length**		253.433
Desanding Basin				
o		**Inlet gates**	2 nos	3 nos of 2.67m width and 1.3m increased ht with new hoisting mechanism and hoisting bridge
Tranquilizer rack				
o		**Type of structure**	Baffle deflector	Steel racks supported on RCC foundation.
o		**Outlet gates**	2 nos of 2.67m (w)	New hoisting mechanism and
hoisting				bridge with stream lined curve at
outlet to				reduce head loss.
o		**Flushing channel**		Repair with new cut off wall and a new layer of 300 mm thick RCC placed over old surface.
		Flushing chute		
o		**Gates**		New hoisting mechanism new steel plat form provided.
Overflow Spillway at Bypass Canal				
o		Type of structure	Mass concrete	
o		Objective	- As a safeguard against overtopping of the canal through accidental closure of	
the			Desander Intake Gates.	
Balancing Reservoir				
o		**Length**	1219.2m	
o		**Gross**	765,000 m3	
o		**Net**	255,000 m3	
		Reclaimed	147,000 cum	
Forebay and Intake				
o		**Forebay**		Trapezoidal canal with 4 intakes
Penstocks				
o		**No.**		3 + 1
o		**Diameter**		2.13 m & 1.52 m
o		**Length**		118 m & 125 m
Powerhouse				
o		**Height**		15.69 m
o		**No of generating units**		7

o	Capacity of units	3 MW	3.5 MW
o	Plant flow	45.31 m3/s	45.66 m3/s
o	Fir[illegible]ow		31.1[illegible] m3/s

Turbine + Generators

o	Yugoslav make	3 nos	Refurbished by MHDC
o	Japanese make (Fuji)	4 nos	Refurbished by MHDC
o	Capacity of each units	3 MW	3.5 MW
o	Turbine type	Francis	
o	Rated head	51.4 m	
o	Rated flow	7.61 m3/s	
o	Generator rated capacity	3.75 MVA	3.89 MVA
o	Power factor	0.8	0.90

Tailwater Conditions

o	Minimum elevation	149.61 m	
o	Normal elevation	150.26 m	149.007
o	Maximum elevation	150.87 m	

The right bank retaining wall was modified from 90 degree bend to a smooth curved transition.

Painting

Appropriate types of paints were used to paint all the steel structures as well as power house building.

B. DEVIGHAT

Plant Type Run of river with peaking capability

o	Gross Head	40 m
o	Net Head	39 m

Conveyance System (total length) 4.50 Km

o	Cut and Cover (3 reaches)	Length (total)	600 m
o	Tunnel (2 reaches)	Length (total)	2000 m
o	Syphons (4 No.)	Length @ 60 m each	240 m

Forebay

Elevation	147.0 m
Reclamation	10681 cum (twice reclaimed)

Penstock

o	No.	3
o	Diameter	2.5 m
o	length	65 m

Powerhouse

o	Length	30.3 m	
o	Width	13.7	
o	No. of units	3	
o	Capacity of unit	4.7 MW	
o	Firm flow	31.15 m3/s	
o	Plant flow	45.31 m3/s	45.66 m3/s

Turbines and Generators

o	Turbine type	Francis
o	Rated head	38 m
o	Rated flow	15.3 m3/s
o	Generator rated capacity	5.875 MVA
o	Power factor	0.8

Tailwater Conditions

o	Minimum elevation	104.80 m
o	Normal elevation	105.30 m
o	Maximum elevation	115.80 m

Annex c -2

20.0283

NEPAL ELECTRICITY AUTHORITY

GENERATION DEPARTMENT

TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated: 052-9-11
1995-12-26

Particulars

Peak load in MW: 21.4 time 2140 to 2205 hrs
Maximum load in MW: 21.4 minium load in MW 18.4
Average load in MW: 18.95 load factor % - 88.56
Station consumption in kwh. (1) 4504 (2) 440=890
Des, 11 kv local supply in kwh. 7125 CD
Barrage colony consumption in kwh.
Sent out Energy in kwh. 441190
Total Energy Generation in kwh: 454555
Trisuli River level in feet 5 —
Trisuli River Discharge in cusec: 4652
canal Discharge in cusec: 1940
Total Discharge in Cusec: 6552

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchroniizng Time (hrs)
1	24	6	0803	—
2	24	6	—	1017 hrs.
3	24			
4	24			
5	24			
6	22			
7	24			
Total	166			

Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flushing	Remarks
0100	18.4	67.2	1800	0040		
0200	18.4	67.2	"			
0300	18.4	67.2	"			
0400	18.4	67.4	"			
0500	18.4	67.1	1900	0504		
0600	18.4	67.1	"			
0700	19.4	67.1	"			
0800	20.0	67.2	"			
0900	19.3	67.2	"			
1000	19.7	67.3	"			
1100	20.1	67.3	"			
1200	19.7	67.3	"			
1300	19.7	67.2	"			
1400	19.7	67.1	"			
1500	19.7	67.1	"			
1600	20.1	67.0	"			
1700	20.1	67.0	"			
1800	20.1	66.8	"			
1900	20.1	66.8	"			
2000	20.1	66.8	"			
2100	20.1	66.8	"			
2200	21.4	66.8	"			
2300	18.9	66.8	"			
2400	18.9	66.8	"			

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Annex c-4

NEPAL ELECTRICITY AUTHORITY

GENERATION DEPARTMENT
TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated. 052-9-13
1995-12-28

Particulars	Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flushing	Remarks
Peak load in MW: 21.3 time 17.25 to 21.15 hrs	0100	19.0	66.7	1900			
Maximum load in MW: 21.3 minium load in MW 1...	0200	19.0	66.7	"			
Average load in MW: 18.75 load factor% 88.11	0300	19.0	66.8	"			
Station consumption in kwh.: (1) [illegible] (2) [illegible]	0400	19.0	66.8	"			
Des, 11 kv local supply in kwh. [illegible]	0500	19.0	66.0	"			
Barrage colony consumption in kwh.	0600	19.0	66.8	"			
Sent out Energy in kwh. 435 97[illegible]	0700	20.0	66.8	"			
Total Energy Generation in kwh: 455 460	0800	19.9	67.1	"			
Trisuli River level in feet: 4'-0	0900	18.5	67.0	"			
Trisuli River Discharge in cusec:	1000	20.0	67.0	"			
canal Discharge in cusec: 1900	1100	21.6	67.0	"			
Total Discharge in Cusec:	1200	20.1	66.7	"			
	1300	20.1	66.9	"			
	1400	18.0	67.0	"			
	1500	18.4	67.0	"			
	1600	18.4	67.2	"			
	1700	18.5	67.0	"			
	1800	21.3	67.0	"			
	1900	21.3	67.0	"			
	2000	21.3	66.8	"			
	2100	21.3	66.0	"			
	2200	19.0	66.6	"			
	2300	19.0	66.8	"			
	2400	19.0	66.8	"			

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchroniizng Time (hrs)
1	24	6	0815	—
2	24			
3	24	6	—	1025 hrs.
4	24			
5	24			
6	22			
7	22			
Total	166			

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NEPAL ELECTRICITY AUTHORITY

GENERATION DEPARTMENT
TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated. 052-9-14
1995-12-29

Particulars
Peak load in MW: 21.3 time.......... to .... hrs
Maximum load in MW: 21.3 minium load in MW 15.0
Average load in MW: 18.66 load factor %..........
Station consumption in kwh.: (1) 4107.. (2) 410.5820
Des, 11 kv local supply in kwh..........713460..........
Barrage colony consumption in kwh..........
Sent out Energy in kwh. ....433730..........
Total Energy Generation in kwh: ....447950..........
Trisuli River level in feet: ....4.5..........
Trisuli River Discharge in cusec: ....—..........
canal Discharge in cusec: ....1940..........
Total Discharge in Cusec: ....—..........

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchroniizng Time (hrs)
1	24			
2	24	-	-	—
3	24			
4	24			
5	24			
6	24			
7	24			
Total	168			

Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flushing	Remarks
0100	19.0	66.8	1900			
0200	19.0	66.8				
0300	19.0	66.9				
0400	19.0	66.9			—	
0500	19.0	66.9				
0600	19.0	66.9				
0700	21.0	67.0				
0800	21.0	66.8				
0900	21.0	66.8				
1000	19.0	66.8				
1100	19.0	66.8				
1200	19.0	66.9				
1300	19.0	66.9				
1400	19.0	66.9				
1500	19.0	66.9				
1600	19.0	66.9				
1700	19.0	66.8				
1800	21.3	67.0				
1900	21.3	66.9				
2000	21.3	66.7				
2100	19.0	66.6				
2200	19.0	66.6				
2300	19.0	66.7				
2400	19.0	66.7				

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Annexe-7

NEPAL ELECTRICITY AUTHORITY
GENERATION DEPARTMENT
TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated. 052-9-26 (1995-12-31)

Particulars

Peak load in MW: 20.3 time 0530 to 0630 hrs
Maximum load in MW: 20.3 minium load in MW 17.0
Average load in MW: 17.66 load factor % 86.99
Station consumption in kwh. (1) 4607 (2) 440290
Des. 11 kv local supply in kwh. 212800
Barrage colony consumption in kwh.
Sent out Energy in kwh. 410150
Total Energy Generation in kwh: 423855
Trisuli River level in feet: 41.0
Trisuli River Discharge in cusec: —
canal Discharge in cusec: 1900
Total Discharge in Cusec:

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchroniizng Time (hrs)
1	14	1	1401	
2	24	6	0820	
3	24	6	—	1025 hr.
4	24			
5	24			
6	22			
7	24			
Total	156			

Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flushing	Remarks
0100	17.0	66.8	1900			
0200	17.0	67.0				
0300	17.0	67.0				
0400	18.5	67.4				
0500	20.3	67.4				
0600	20.3	67.2				
0700	19.6	67.1				
0800	19.6	67.0				
0900	18.8	66.9				
1000	18.8	66.9	NIL		1010 hrs.	
1100	17.5	65.9	1900	1045		
1200	17.5	66.4				
1300	17.3	66.6				
1400	18.3	66.7				
1500	17.9	67.0				
1600	17.8	67.1				
1700	18.4	67.0				
1800	18.4	67.0				
1900	18.4	67.0				
2000	18.4	67.2	1800	2010		
2100	18.4	67.2				
2200	18.4	67.2				
2300	18.4	67.3				
2400	18.4	67.4				

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NEPAL ELECTRICITY AUTHORITY

Annex e-9

GENERATION DEPARTMENT
TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated: 052-9-18
1996-1-2

Particulars	Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flushing	Remarks
Peak load in MW: 22.0 time 17.25 to 20.55 hrs	0100	15.0	66.7	1800			
Maximum load in MW: 22.0 minium load in MW 16.2	0200	19.0	66.7	"			
Average load in MW: 17.55 load factor% 79.58	0300	19.0	66.7	"			
Station consumption in kwh.: (1) 390.4 (2) 390=780	0400	19.0	66.7	"			
Dcs, 11 kv local supply in kwh. 12100	0500	19.0	66.8	"			
Barrage colony consumption in kwh.	0600	19.0	66.8	"			
Sent out Energy in kwh.: 406320	0700	19.0	66.8	"			
Total Energy Generation in kwh: 420820	0800	17.0	66.8	"			
Trisuli River level in feet: 4'-6	0900	16.7	67.0	"			
Trisuli River Discharge in cusec: —	1000	16.2	67.2	"			
canal Discharge in cusec: 1840	1100	16.5	67.3	1700	1630		
Total Discharge in Cusec: —	1200	16.7	67.3	"			
	1300	16.7	67.3	"			
	1400	16.7	67.4	"			
	1500	16.7	67.4	"			
	1600	16.7	67.4	"			
	1700	20.2	67.5	1900	1645		
	1800	22.0	67.1	1800	1730		
	1900	22.0	66.6				
	2000	22.0	66.5	"			
	2100	18.0	66.4	"			
	2200	18.0	66.6	"			
	2300	18.0	66.9	"			
	2400	15.0	66.9	"			

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchroniizng Time (hrs)
1	24	4	07:15	Due to water leakage from penstock side.
2	24			
3	24	5	07:33	
4	24			
5	15	6	—	1620 hrs
6	15	5		1640 hrs....
7	24			
Total	152			

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NEPAL ELECTRICITY AUTHORITY

GENERATION DEPARTMENT
TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated: 052-9-20
1996-1-4

Particulars

Peak load in MW: 20.0 time 1730 to 2205 hrs
Maximum load in MW: 20.0 minium load in MW 17.0
Average load in MW: 18.14 load factor% 90.70
Station consumption in kwh: (1) 440.1 (2) 430 = 870
Des. 11 kv local supply in kwh 13400
Barrage colony consumption in kwh
Sent out Energy in kwh: 421120
Total Energy Generation in kwh: 435320
Trisuli River level in feet: 460
Trisuli River Discharge in cusec: —
canal Discharge in cusec: 1800
Total Discharge in Cusec: —

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchroniizng Time (hrs)
1	24	3	—	1110 hrs.
2	24	4	1402	
3	13	4	—	1525
4	23			
5	24			
6	24			
7	24			
Total	152			

Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flushing	Remarks
0100	18.0	67.1	1800			
0200	18.0	67.1				
0300	18.0	67.2				
0400	18.0	67.2				
0500	19.0	67.2				
0600	19.0	67.2				
0700	19.7	67.0				
0800	19.6	67.0				
0900	19.3	66.8				
1000	19.3	66.7				
1100	19.3	66.7				
1200	19.3	66.6				
1300	19.3	66.6				
1400	19.3	66.6				
1500	18.7	66.5				
1600	17.0	66.6				
1700	17.0	66.6				
1800	20.0	66.8				
1900	20.0	66.7				
2000	20.0	66.5				
2100	20.0	66.5				
2200	20.0	66.4				
2300	17.0	66.4				
2400	17.0	66.4				

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NEPAL ELECTRICITY AUTHORITY

GENERATION DEPARTMENT
TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated. 052-9-21
1996-1-5

Particulars

Peak load in MW: 21.0 time 17.45 to 20.05 hrs
Maximum load in MW: 21.0 minium load in MW 15.8
Average load in MW: 17.87 load factor % 85.09
Station consumption in kwh: (1) 4500 + (2) 4520 = 8160
Des, 11 kv local supply in kwh. 7132.0
Barrage colony consumption in kwh
Sent out Energy in kwh: 414195
Total Energy Generation in kwh: 428870
Trisuli River level in feet: 4.0
Trisuli River Discharge in cusec: —
canal Discharge in cusec: 1800
Total Discharge in Cusec: —

Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flushing	Remarks
0100	17.0	66.8	1800			
0200	17.0	67.0				
0300	17.0	67.0				
0400	17.0	67.1				
0500	19.5	67.1				
0600	19.5	67.1				
0700	19.5	67.0				
0800	19.7	66.9				
0900	20.2	66.7				
1000	18.6	66.6				
1100	18.0	66.7				
1200	18.0	66.7				
1300	18.0	66.8				
1400	15.8	66.8				
1500	17.0	66.9				
1600	16.7	66.9				
1700	19.9	67.0				
1800	21.0	67.0	1750	1550		
1900	21.0	66.7				
2000	21.0	66.5				
2100	19.0	66.4				
2200	19.0	66.3				
2300	17.0	66.4				
2400	17.0	61.5				

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchroniizng Time (hrs)
1	24	3	1340	—
2	24	3	—	1412 hrs.
3	23	4	1610	—
4	18			
5	24	4	—	1655 hrs
6	24			
7	24			
Total	161			

Prepared by: [signature]

Annex c-14

NEPAL ELECTRICITY AUTHORITY
GENERATION DEPARTMENT
TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated 052-9-23
1996-1-7

Particulars

Peak load in MW: 21.0 time 1735 to 1935 hrs
Maximum load in MW: 21.0 minium load in MW 15.0
Average load in MW: 17.35 load factor % 82.63
Station consumption in kwh: (1) 420.7 (2) 4105.83
Des, 11 kv local supply in kwh. } 1330
Barrage colony consumption in kwh }
Sent out Energy in kwh: 402370
Total Energy Generation in kwh: 416560
Trisuli River level in feet: 460
Trisuli River Discharge in cusec: —
canal Discharge in cusec: 1250
Total Discharge in Cusec: —

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchroniizng Time (hrs)
1	21	2	0183	—
2	19	2	—	0605 hrs
3	24	1	1315	—
4	24	1	—	1640 hrs
5	20	5	—	0410 hrs.
6	22	6	0830	—
7	21	6	—	1010 hrs.
Total	151	7	2110	—

Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flushing	Remarks
0100	17.5	66.2	1750			
0200	16.0	66.2				
0300	16.0	66.8				
0400	16.0	66.9				
0500	18.0	67.0				
0600	18.0	67.0				
0700	21.0	66.8				
0800	20.6	66.4				
0900	18.3	66.3				
1000	18.0	66.7				
1100	17.0	66.4				
1200	17.0	66.3				
1300	17.0	66.4				
1400	15.0	66.4				
1500	15.0	66.8				
1600	15.0	67.0				
1700	20.0	67.2				
1800	21.0	67.0				
1900	21.0	66.7				
2000	20.0	66.4				
2100	20.0	66.1				
2200	17.0	66.1				
2300	17.0	66.0				
2400	17.0	66.0	✓			

Prepared by: [signature] 9-7-24

NEPAL ELECTRICITY AUTHORITY

GENERATION DEPARTMENT

TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated: 052-9-24
1996-1-8

Particulars

Peak load in MW: 21.2 time 15.00 to 21.20 hrs

Maximum load in MW: 21.2 minium load in MW 15.1

Average load in MW: 17.27 load factor % 82.76

Station consumption in kwh. (1) 390 t (2) 390 780

Dcs, 11 kv local supply in kwh. 21430

Barrage colony consumption in kwh. —

Sent out Energy in kwh. 397540

Total Energy Generation in kwh: 414620

Trisuli River level in feet: 4' 0

Trisuli River Discharge in cusec: —

canal Discharge in cusec: 1750

Total Discharge in Cusec: —

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchroniizng Time (hrs)
1	24	3	1045	—
2	24	3	—	1645 hr.
3	18	7	~~0605~~	0605 hr.
4	24	6	0830	
5	24	6	—	1035 hr.
6	22			
7	18			
Total	154			

Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flush...	Remarks
0100	17.0	66.1	1750			
0200	17.0	66.2				
0300	17.0	66.4				
0400	17.0	66.7				
0500	17.0	66.9				
0600	18.0	67.1				
0700	21.0	67.0				
0800	21.0	66.7				
0900	19.1	66.4				
1000	19.1	66.2				
1100	17.0	66.0				
1200	16.5	66.0				
1300	16.0	66.0				
1400	16.1	66.2				
1500	15.7	66.3	1700	1450		
1600	16.5	66.5				
1700	15.1	66.8				
1800	15.7	67.0				
1900	21.0	67.0				
2000	21.0	66.9				
2100	21.0	66.4				
2200	17.0	66.3				
2300	17.0	66.4				
2400	17.0	66.5				

Prepared by: [signature]

NEPAL ELECTRICITY AUTHORITY

GENERATION DEPARTMENT
TRISULI DIVISION

DAILY GENERATION REPORT

Station: TRISULI POWER HOUSE

Dated. 053-9-15
1996-12-30

Particulars

Peak load in MW: 20.4 time 1805 to 2150 hrs
Maximum load in MW: 20.5 minium load in MW 19.2
Average load in MW: 19.15 load factor% 93.45
Station consumption in kwh.: (1) 4207 (2) 4110 = 830c
Des, 11 kv local supply in kwh. 9150
Barrage colony consumption in kwh. J
Sent out Energy in kwh.: 447000
Total Energy Generation in kwh: 459800
Trisuli River level in feet: 61-0
Trisuli River Discharge in cusec: —
canal Discharge in cusec: 1700
Total Discharge in Cusec: —

AVAILABLE MACHINES CONDITION:

Unit No	Running hours	Unit No.	Stopped time (hrs)	Synchronijizng Time (hrs)
1	24			
2	24			
3	24			
4	24			
5	24			
6	24			
7	24			
Total	- 168			

Time in hrs	Load in M. W.	D. tank level	Discharge cusec	Discharge Time hrs	head gate Flushing	Remarks
0100	19.3	66.9	1600			
0200	"	"	"			
0300	"	67.0	"			
0400	"	"	1500	0345		
0500	20.5	"	"			
0600	"	66.5	1700			
0700	"	66.7	"			
0800	"	"	"			
0900	"	"	"			
1000	"	"	"			
1100	20.1	"	"			
1200	20.0	"	"			
1300	"	66.5	"			
1400	"	"	"			
1500	"	"	"			
1600	"	"	"			
1700	"	66.6	"			
1800	20.2	66.7	"			
1900	20.4	"	"			
2000	"	66.5	"			
2100	"	66.9				
2200	19.2	66.8	1600	2105		
2300	"	"	"			
2400	"	66.9	"			

Prepared by: ...

Part A

10. M/M on the Progress Report (March 19, 1997)

MINUTES OF MEETING
ON
PROGRESS REPORT
OF
FEASIBILITY STUDY ON TRISHULI IRRIGATION PROJECT

Date : March 19, 1997

Place : Meeting Room of the Department of Irrigation, Ministry of Water Resources

The JICA Study Team submitted the PROGRESS REPORT of the Feasibility Study on Trishuli Irrigation Project in twenty(20) copies with two(2) sets of Topographical Maps on March 19, 1997 to the Department of Irrigation, Ministry of Water Resources.

Subsequently, Mr. Masamitsu Fujioka, Team Leader of the JICA Study Team explained the contents of the Report to the concerned officials of the Department of Irrigation.

Y. L. Vaidya
Director General,
Department of Irrigation,
Ministry of Water Resources,
Kathmandu, Nepal

M. Fujioka
Team Leader of JICA Study Team,
Chuo Kaihatsu Corporation,
Tokyo, Japan

Witnessed by:

A. Uchida
Assistant Representative,
JICA Kathmandu Office,
Nepal

Part A

11. "Shifting the Intake Site of Trishuli Irrigation Project"

HIS MAJESTY'S GOVERNMENT
MINISTRY OF WATER RESOURCES
DEPARTMENT OF IRRIGATION

Ph. No. {4-13733, 4-12374, 4-11686, 4-11119, 4-15603}

Fax No. : 418152

Maharajgunj
Kathmandu, Nepal.

Date ....
March 19, 1997

Ref. No. TIP/ /053.54 - 288

Mr. M. Fujioka
Team Leader,
JICA Study Team
Trishuli Irrigation Project

Subject : Shifting the Intake Site of Trisuli Irrigation Project

Dear Mr. Fujioka

With regard to the shifting of the intake point to Alternative I site as proposed by you, we had thorough discussion with the NEA management. They suggested to look into the following 3 options

Option 1
To fix the intake point before the desanding basin with separate desander for Irrigation . This will not hamper any facility of Trishuli Hydropower System.

Option 2
Fixing of intake point between the balancing reservoir and the desanding basin.

In this case the desanding basin has to accommodate more sand than the designed capacity. So the capacity of desander has to be checked and proper facility to be provided to desand the extra silt which deposits in the desanding basin with the extra Irrigational water of 1.5 cumecs.

Option 3
Fixing the intake point at the end of balancing reservoir.

This option seems to be most suitable as the intake point for Irrigation. But due to this the desander will be overloaded and more silt will be deposited in the balancing reservoir. This might reduce the generating capacity of the Trishuli Hydropower Station. So for this option the capacity of the desanding basin has to be checked as in the case of "Option 2". Besides this the balancing reservoir has to be cleaned/desilted regularly from the additional silt. For this some desilting device has to be installed.

HIS MAJESTY'S GOVERNMENT
MINISTRY OF WATER RESOURCES
DEPARTMENT OF IRRIGATION

Ph. No. 4-13733, 4-12374, 4-11686, 4-11119, 4-15603

Fax No. : 418152

Maharajgunj
Kathmandu, Nepal.

Date ....

Ref. No.

So during the preparation of your draft report please consider the above options and suggest the most optimum solution so that both the Hydropower station and the irrigation systems runs without interfering each other.

Thanking you

With regards.

Sincerely yours

(N. N. Vaidya)
Superintending Engineer

C.C.

1. Ministry of Water Resources
   Singh Durbar

enclosure:
one copy of Progress report submitted by JICA Study Team on Trishuli Irrigation Project

2. The Managing Director
   NEA, Kathmandu

enclosure:
one copy of Progress report submitted by JICA Study Team on Trishuli Irrigation Project

Part A

12. "Request for agreement for shifting of intake of TIP"

Director General,
Department of Irrigation,
Ministry of Water Resources,
Jawalakhel, Lalitpur , Nepal

Subject : Request for agreement for shifting of intake of TIP
Date: 21/3/ 1997

Dear Sir,

We acknowledge the receipt of your letter dated 19/3/1997 regarding the discussion that you had with NEA in connection with the shifting of the intake site for Trisuli Irrigation Project (TIP) . We would like to request you to make decision to fix the intake site as proposed in option 3 of your letter, i.e. down stream of the balancing reservior of Trisuli Hydel Project as we recommended earlier. We also appreciate your opinion about the appropriateness of the proposed intake (option 3). We would like to inform you that we will proceed our further study regarding the irrigation system planning based on the intake site of the option 3.

I would like to inform you that there was a discussion between the Managing Director of NEA and Mr. N. N. Vaidya of DOI along with Mr. A. Uchida, Assistant Representative, JICA and the Mr. Fujioka, Team Leader, JICA Study Team regarding the shifting of the intake for TIP. The Study Team Leader requested to both Managing Director and Mr. Vaidya to specify mutually agreeable terms and the conditions on option 3 of the shifting of intake within one month period.

Please get agreed the terms and conditions with Nepal Electricity Authority (NEA) for shifting of the intake as recommended. Please inform us the progress regarding the terms and conditions within one month to our CKC office in Tokyo.

Regards

Sincerely Yours.

Masamitsu Fujioka
Team Leader, JICA Study Team

PartA

13. M/M on the Draft Final Report (July 24, 1997)

Minutes of Meeting
for
Draft Final Report
on
Feasibility Study on Trisuli Irrigation Project
in the Kingdom of Nepal

Date : July 24, 1997

Place : Meeting Room of the Director General of the Department of Irrigation, Ministry of Water Resources.

Attendants : As listed in the table attached hereto

JICA Study Team submitted the Draft Final Report on the Feasibility Study on Trisuli Irrigation Project in twenty (20) copies in total to the Department of Irrigation, Ministry of Water Resources on July 13 and 17, 1997.

On July 17, 1997, JICA Study Team explained to the officials concerned of the Department of Irrigation and other line agencies on the contents of the Draft Final Report at the conference room of the Department stressing that the project would address poverty alleviation through intensive agricultural development in the project area. At the meeting , high construction cost was pointed out by the Department of Irrigation, compared to other similar hill projects. In reply to the question, JICA Study Team justified its high construction cost due to geographical constraints in the hills, introduction of a pipeline system and limited construction period. The Study Team also explained that the shifting of the original intake from Aqueduct No. 2 to the downstream portion of the balancing reservoir (option 3) as proposed is the best alternative for the project.

As a result of discussions both parties have reached the following concurrence:

1. The Draft Final Report was in general accepted by the Department of Irrigation.

2. The Department of Irrigation agreed to provide comments on the Draft Final Report if any to JICA within one (1) month after receiving the Draft Final Report.

3. JICA Study Team agreed to submit the Final Report in fifty (50) copies to the Department of Irrigation through JICA within two (2) months after the receipt of comments from the Department.

4. The Final Report shall be opened to public whenever it is requested.

M.N.Aryal **Director General** **Department of Irrigation** **Ministry of Water Resources**	**M.Fujioka** **JICA Team Leader**

Witnessed by

M. Kitanaka
Deputy Director
Agricultural Development Study Division
Agriculture, Forestry and Fisheries
Development Study Department
Japan International Cooperation Agency (JICA)

List of Attendants

	Full Name (in Block Letters)	Occupational Status	Name of Organization	Signature
1.	Mahendra N. Aryal	Director General	DOI	[signature]
2.	Nirjana Nanda Vaidya	S.E.	DOI	[signature]
3.	Tejman Singh Bhandari	Chief Hydrogeologist	DOI	[signature]
4.	Sundar Man Shrestha	D.D.G.	DOI	[signature]
5.	Mahesh Bdr. Pradhan	Engineer (Counterpart)	DOI	[signature]
6.	Narendra Gurung	Sr. Program. Officer	JICA	[signature]
7.	Atsushi Uchida	A.R.R.	JICA	[signature]
8.	Yatsuhiro CHIBA	JICA expert to DOI		Y. Chiba
	:			
9.	MAKOTO KITANAKA	Deputy Director	JICA	[signature]
10.	MASAMITSU FUJIOKA	Leader of JICA Study Team		[signature]
11.	KUNIKI IWATA	Member of JICA Study Team		[signature]
12.	NOBUKI TOYOOKA	Member of JICA Study Team		[signature]

List of Attendants

Full Name	Occupational Status	Name of Organization
M.N Aryal	D.G	DOI
N.N Vaidya	S.E	DOI
T.S Bhandari	Chief Hydrogeologist	DOI
S.M Shrestha	DDG	DOI
M.B Pradhan	Engineer	DOI
N. Gurung	Senior Program Officer	JICA
A. Uchida	A.R.R	JICA
Y. Chiba	JICA expert	DOI
M. Kitanaka	Deputy Director	JICA
M. Fujioka	Team Leader	JICA Study Team
K. Iwata	Irrigation and Drainage	JICA Study Team
N. Toyooka	Agro Economy / Project Evaluation	JICA Study Team