

CHAPTER – 5

HYDROLOGY

5.1 GENERAL

The hydrological studies of the Tarahn stream have been carried out in order to determine the optimum techno economic power potential of the site, to work out the design flood discharge and other related issues in respect of the Tranha Charroli HEP.

This chapter on hydrology deals with study of the hydro-Meteorological characteristics of the basin in the vicinity of the Tranha Charroli Small Hydro Power Project and the Methodo-logy adopted for establishing various hydro-meteorological parameters which will form the basic inputs for project Planning and design purpose.

Keeping in view of the above, the hydrological investigation and analysis have been carried out for this project to

assess the feasible power generation by establishing a long-term series of average monthly discharge for the project site, study the hydraulic behavior of the stream regime and to establish design flood for the safe design of intake works.

5.2

CATCHMENT AREA

Tarahn stream is the tributary of Sainj khad . The main source of Tarahn stream is the monsoon run-off as well as the run-off on account of snow melting. The elevation of catchment area of the Tarahn stream varies between 3600 meter to 1610 meter and it lies in the Shivalik ranges in Shimla Distt. of Himachal Pradesh. The entire catchment comprises mostly of mountaineous terrain with steep hill slopes but generally of forest cover, being primarily a very less populated area. The flow of the Tarahn stream are low during Nov. to Feb. but starts increasing from February onwards with high flows during July to October due to monsoon rain fall.

It has a medium size fan-shaped catchment area of 14.71 Sq. km. up to the proposed diversion

weir. The index location map and catchment area map is enclosed.

5.3 PRECIPITATION

The precipitation in the catchment of Tarahn stream had take place in the form of snow & rain. The higher reaches experience snow fall whereas the lower reaches experience heavy rain during monsoon i.e. from June to Sep., which occasionally extends up to early October due to south west monsoon. Rain fall is negligible during winter and spring season (Oct. to march) which is generally due to western disturbance that pass over the North-West part of the country. During winter, the precipitation is either in the form of snow or rain depending upon the altitude & other metrological conditions.

5.4 SEDIMENT LOAD

This stream carries significant sediment load during monsoon consisting of silt and suspended particles. In the winter, water is quite clear and free from all kind of impurities.

However, design of the scheme will ensure that rolling bed load as well as silt does not enter the turbine. Intake has been designed to keep in check all floating substances and desilting tank has been designed so as to exclude silt particles greater than and up to 0.25 mm size with about 96% efficiency.

5.5 STREAM FLOW DATA

Discharge observations have been recorded on Tarahn stream at Charroli village since January 2008 to March 2011. This data is available for two years. The discharge have been measured by float method and average ten daily observed data is appended in Annexure 5.1 for the above period.

5.6 EXTENSION OF FLOW DATA

The present scenario presents a grim picture when it comes to planning of small/ mini hydro projects on account of non-availability of stream flow data over a long period. Records which are available are of short durations and do not meet the reliability index in as far as planning of such small projects are concerned.

Project planning and design necessitates at least ten years of historical data. It is also not feasible to collect data over such long periods for planning the project and therefore arises the need for estimation and extension of stream flow data..

It is therefore certain that meteorological characteristics of this project catchment resembles within acceptable limits, with those of Sainj Khad catchment. This data of Sainj Khad has been further reduced on catchment area basis for the establishing of run-of series to carry out preliminary hydrological and power studies in case of Tranha Charroli hydro power project. The average ten days daily discharges computed on catchment area basis w.e.f 1977 to 1983 and 2002 to 2005 has been shown in Annexure 5.3.

5.7 DEPENDABLE YEAR

Diversion of Tranha Charroli small HEP has been designed to divert the flow by building diversion structures in the form of trench weir on the Tarahn stream. The net discharges from this stream are available for power generation

and as shown in Annexure 5.3 have been considered for carrying out power studies in respect of this project. As per CEA standing guidelines, for dependability analysis, the year-wise unrestricted energy generation from 1977 to 1983, 2002 to 2005 and 2008 to 2011, has been used by arranging the same in descending order. Based on data available as contained in Annexure- 5.3, analysis has been carried out to identify the 50%, 75% and 90% dependable years. The guidelines for establishing project capacities in respect of small hydro up to 25 MW requires to adopt the 75% dependable discharge, for this project, 75% dependable flows are considered. The results so obtained for identifying the dependable years are indicated in Annexure-5.4 to Annexure- 5.8

5.7.1 CONSISTENCY OF FLOWS

It is necessary to establish the consistency of observed discharge at Sainj Khad site which is in vicinity of the proposed weir sites. The consistency check studies for flows may be carried out in either of the following two methods;

- i) Flow consistency with respect to rainfall,
- ii) Flow consistency with respect to discharge of other catchment.

An analysis of Discharge data of Sainj Khad with flow of Tarahn stream has been carried out to ascertain the degree of its co-relation. The results so obtained indicates an acceptable degree of consistency. Accordingly, it has been found that 1981 discharges have a 90% dependability, while the year 2005 has a dependability of 75%. However, for this project 75% dependability is being used for fixing the station capacity.

5.7.2 CATCHMENT AREA

The catchment area of Tarahn stream at discharge site have been computed as below.

Tarahn Stream Charroli village (discharge site) = 14.71 sq. km..

Sainj Khad upto Sainj
= 135 sq.km.

Modification Factor = $(14.71/135)^{3/4}$

$$= 0.1896$$

5.8 DESIGN FLOOD DISCHARGE

5.8.1 DESIGN CRITERIA

The proposed diversion structure is a trench weir type. In the event of failure of such a structure, it would not cause any loss of life or damages to the properties downstream of the weir. A flood discharge due to a 50 year return period storm rainfall is considered sufficient. Design flood has been worked out by following methods :-

- i) Dicken's Empirical method.
- ii) Unit Hydrograph Method.

5.8.2 DESIGN FLOOD (BY DICKEN'S EMPIRICAL METHOD)

The catchment area of this Stream is very small i.e. 14.71 sq.km. and therefore, use of empirical formula has been made to access the design flood. The design flood for Tarahn Stream with 1 in 50

years probability works out to 105.16
cumecs as computations below :

$$\begin{aligned} \text{Max. Flood Discharge } Q_{\text{max}} &= C \times A^{3/4} \\ \text{Catchment Area } A_w &= 14.71 \text{ sq.km} \\ \text{Constant for hilly area 'C'} &= 14 \\ \text{Max.Flood Discharge } Q_{\text{max}} &= 14 \times (14.71)^{3/4} \\ &= 105.16 \text{ cumecs} \end{aligned}$$

5.8.3 DESIGN FLOOD (BY UNIT HYDROGRAPH METHOD)

Catchment area at Diversion site (A) = 14.71
sq.km

$$Q_{tp} = 1.747 \times (A)^{0.75}$$

Where

Q_{tp} -Peak load discharge per cm of rainfall excess.

A ----- Catchment area in sq.km

$$Q_{tp} = 1.747 \times (14.71)^{0.75}$$

$$= 13.12 \text{ cumecs/cm}$$

$$t_c = 2.078 \times (A/Q_{tp})^{0.90}$$

$$= 2.078 \times (14.71/13.12)^{0.90}$$

$$= 2.30 \text{ hr.}$$

Design Flood = 50 years , 4 hours

Point rainfall = 80 mm

Area rainfall = 1.02 x 80

$$= 81.60 \text{ mm}$$

Peak of 50 years

Flood Hydrograph = $Q_{tp} \times \text{Area rainfall}$

$$= 13.12 \times 8.16$$

$$= 107.06 \text{ cumecs}$$

5.8.4 DESIGN FLOOD NEAR POWER HOUSE SITE

The tail race channel from the power house discharges into Tarahn Stream. This outfall point is about 3.5 km. downstream of the Tarahn Stream diversion weir site (along the river) , where the catchment area is 34.15 sq.km. The flood discharge Q_{max} at the weir site where the catchment area is 14.71 sq.km is

TRANHA CHARROLI HEP (2 MW)
HYDROLOGICAL DATA OF TRANAH KHAD

MONTH	PERIOD	2008	2009	2010	2011
	I	11	15	10	22
JANUARY	II	11	15	10	22
	III	13.2	16.5	11	24.2
	I	12	15	8.5	20
FEBURARY	II	12	15	9	20
	III	9.6	12	8.7	16
	I	11	15	10.5	20
MARCH	II	11	14	9.5	20
	III	12.1	14.3	9.9	
	I	11	12.1	8	
APRIL	II	10.5	11.5	8	
	III	10	11	8	
	I	10	10.4	9	
MAY	II	9	9.5	11	
	III	9.9	9.7	11	
	I	9	8	12	
JUNE	II	9	8	13.5	
	III	13.5	9	20	
	I	22	13	40	
JULY	II	32.5	25	40	
	III	44	27.5	44	
	I	40	25	40	
AUGUST	II	40	25	40	
	III	44	27.5	44	
	I	35	24.5	30	
SEPTEMBER	II	30	24	30	
	III	30	24	30	
	I	25	23	25	
OCTOBER	II	25	23	25	
	III	27.5	24.3	27.5	
	I	20	17.5	24	
NOVEMBER	II	20	15	24	
	III	20	15	24	
	I	20	12	23	
DECEMBER	II	20	12	23	
	III	18.5	12	25.3	

TRANHA CHARROLI HEP (2 MW)
AVERAGE 10-DAILY DISCHARGE OF SAINJ KHAD
 CATCHMENT AREA = 135 SQKM

MONTH	PERIOD	1977	1978	1979	1980	1981	1982	1983	2002
	I	1.42	1.38	2.94	2.72	3.3	1.97	2.53	3.75
JANUARY	II	1.4	2.04	3.01	2.51	2.55	2.06	2.22	3.87
	III	1.4	2.21	2.65	2.55	2.66	3.97	2.71	3.89
	I	1.42	2	2.76	2.64	2.67	9.95	5.51	4.04
FEBURARY	II	1.51	2.68	2.68	2.93	2.92	7.96	5.92	6.04
	III	1.54	1.94	2.61	2.66	3.37	6.78	6.13	5.12
	I	1.54	2.38	1.83	3.7	3.92	13.61	8.23	7.97
MARCH	II	1.59	3.73	2.47	3.07	2.65	12.14	6.28	6.76
	III	1.65	3.35	1.82	2.96	9.6	9.98	5.82	6
	I	1.66	2.39	2.55	2.47	4.2	9.17	9.17	4.73
APRIL	II	1.85	3.16	2.63	1.96	2.69	9.86	8.83	4.3
	III	2.39	3.45	2.7	1.51	3.69	10.93	7.06	3.79
	I	3.21	3.82	2.79	1.44	4.34	11.64	7.23	4.12
MAY	II	3.45	3.84	2.92	2.28	5.03	12.01	9.94	3.65
	III	3.48	3.4	2.67	2.22	3.54	12.81	12.14	3.48
	I	3.84	3.29	3.01	2.8	2.49	14.69	6.48	1.74
JUNE	II	3.79	3.09	3.22	2.73	2.16	16.62	3.99	16.85
	III	4.9	3.24	3.25	4.06	2.31	19.23	19.23	12.18
	I	8.1	4.23	3.75	6.99	2.74	20.03	20.03	11.56
JULY	II	7.31	6.52	4.58	19.07	3.92	17.06	17.06	14.37
	III	14.36	7.95	9.58	16.36	5.11	19.1	19.1	15.42
	I	15.5	11.67	6.38	28.95	4.85	14.59	14.59	14.77
AUGUST	II	8.4	12.58	5.79	25.02	6.52	15.25	15.25	12.34
	III	15.71	10.38	4.82	12.63	4.43	15.97	15.97	10.42
	I	24.33	14.78	3.75	7.32	4.3	11.32	11.32	8.78
SEPTEMBER	II	17.55	9.01	3.97	5.99	3.53	7.8	7.8	6.82
	III	10.21	7.64	4.48	4.39	3.31	7.33	7.33	6.45
	I	7.49	7.06	4.4	3.54	5.03	4.83	4.83	5.56
OCTOBER	II	6.46	5.61	4.37	3.29	4.21	4.12	4.12	5.24
	III	4.71	3.56	4.33	2.67	3.53	3.49	3.49	4.82
	I	3.69	3.75	2.74	2.99	5.32	3.1	3.56	4.57
NOVEMBER	II	6.46	5.61	4.37	3.29	4.21	4.12	4.12	5.78
	III	2.57	3.42	3.5	2.14	4.26	2.64	6.27	4.2
	I	2.29	3.39	2.63	2.46	3.88	1.91	4.76	3.67
DECEMBER	II	2.13	3.3	3.03	2.13	3.4	1.9	4.1	3.42
	III	2.6	3.49	1.84	2.65	1.78	1.77	3.96	2.98

2003	2004	2005
2.71	4.13	3.02
2.45	3.95	3.26
2.46	3.93	3.89
2.47	3.79	4.77
3.33	3.53	6.38
7.06	3.52	4.69
12.68	2.89	4.86
13.85	2.67	5.41
7.48	2.55	5.17
6.55	2.41	3.11
6.23	2.36	2.12
5.25	2.36	2.3
5.72	2.4	3.04
5.46	2.52	1.94
5.02	4.11	1.76
2.34	2.43	1.83
26.12	2.52	1.71
13.94	3.22	2.73
16.96	7.86	6.92
19.29	11.47	10.47
15.96	16.21	13.36
7.7	17.1	12.57
12.04	18.52	10.36
15.65	8.96	7.8
11.03	6.56	5.49
8.31	6.16	9.87
19.67	9.12	10.59
13.75	6.07	7.07
32.25	5.68	5.29
18.74	5.16	3.7
10.09	4.8	2.76
7.78	4.44	2.5
6.79	4.27	2.18
5.24	4.14	4.28
4.72	3.96	3.73
4.44	4.21	3.35

TRANHA CHARROLI HEP (2 MW)

CORELATING DISCHARGE BASED ON CATCHMENT AREA BASIS

CATCHMENT AREA (SAINJ KHAD) : 135.00 SQ. KM

CATCHMENT AREA TARANH : 14.71 SQ. KM

Multiplying factor 0.1897

MONTH	PERIOD	1977	1978	1979	1980	1981	1982	1983	2002
	I	0.269	0.262	0.558	0.516	0.626	0.374	0.480	0.711
JANUARY	II	0.266	0.387	0.571	0.476	0.484	0.391	0.421	0.734
	III	0.266	0.419	0.503	0.484	0.504	0.753	0.514	0.738
	I	0.269	0.379	0.523	0.501	0.506	1.887	1.045	0.766
FEBURARY	II	0.286	0.508	0.508	0.556	0.554	1.510	1.123	1.146
	III	0.292	0.368	0.495	0.504	0.639	1.286	1.163	0.971
	I	0.292	0.451	0.347	0.702	0.743	2.581	1.561	1.512
MARCH	II	0.302	0.707	0.468	0.582	0.503	2.302	1.191	1.282
	III	0.313	0.635	0.345	0.561	1.821	1.893	1.104	1.138
	I	0.315	0.453	0.484	0.468	0.797	1.739	1.739	0.897
APRIL	II	0.351	0.599	0.499	0.372	0.510	1.870	1.675	0.816
	III	0.453	0.654	0.512	0.286	0.700	2.073	1.339	0.719
	I	0.609	0.724	0.529	0.273	0.823	2.208	1.371	0.781
MAY	II	0.654	0.728	0.554	0.432	0.954	2.278	1.885	0.692
	III	0.660	0.645	0.506	0.421	0.671	2.429	2.302	0.660
	I	0.728	0.624	0.571	0.531	0.472	2.786	1.229	0.330
JUNE	II	0.719	0.586	0.611	0.518	0.410	3.152	0.757	3.196
	III	0.929	0.614	0.616	0.770	0.438	3.647	3.647	2.310
	I	1.536	0.802	0.711	1.326	0.520	3.799	3.799	2.192
JULY	II	1.386	1.237	0.869	3.617	0.743	3.235	3.235	2.725
	III	2.723	1.508	1.817	3.103	0.969	3.622	3.622	2.924
	I	2.940	2.213	1.210	5.490	0.920	2.767	2.767	2.801
AUGUST	II	1.593	2.386	1.098	4.745	1.237	2.892	2.892	2.340
	III	2.979	1.969	0.914	2.395	0.840	3.029	3.029	1.976
	I	4.614	2.803	0.711	1.388	0.816	2.147	2.147	1.665
SEPTEMBER	II	3.328	1.709	0.753	1.136	0.669	1.479	1.479	1.293
	III	1.936	1.449	0.850	0.833	0.628	1.390	1.390	1.223
	I	1.420	1.339	0.834	0.671	0.954	0.916	0.916	1.054
OCTOBER	II	1.225	1.064	0.829	0.624	0.798	0.781	0.781	0.994
	III	0.893	0.675	0.821	0.506	0.669	0.662	0.662	0.914
	I	0.700	0.711	0.520	0.567	1.009	0.588	0.675	0.867
NOVEMBER	II	1.225	1.064	0.829	0.624	0.798	0.781	0.781	1.096
	III	0.487	0.649	0.664	0.406	0.808	0.501	1.189	0.797
	I	0.434	0.643	0.499	0.467	0.736	0.362	0.903	0.696
DECEMBER	II	0.404	0.626	0.575	0.404	0.645	0.360	0.778	0.649
	III	0.493	0.662	0.349	0.503	0.338	0.336	0.751	0.565

2003	2004	2005
0.514	0.783	0.573
0.465	0.749	0.618
0.467	0.745	0.738
0.468	0.719	0.905
0.632	0.669	1.210
1.339	0.668	0.889
2.405	0.548	0.922
2.627	0.506	1.026
1.419	0.484	0.981
1.242	0.457	0.590
1.182	0.448	0.402
0.996	0.448	0.436
1.085	0.455	0.577
1.036	0.478	0.368
0.952	0.779	0.334
0.444	0.461	0.347
4.954	0.478	0.324
2.644	0.611	0.518
3.217	1.491	1.312
3.658	2.175	1.986
3.027	3.074	2.534
1.460	3.243	2.384
2.283	3.512	1.965
2.968	1.699	1.479
2.092	1.244	1.041
1.576	1.168	1.872
3.730	1.730	2.008
2.608	1.151	1.341
6.116	1.077	1.003
3.554	0.979	0.702
1.914	0.910	0.523
1.475	0.842	0.474
1.288	0.810	0.413
0.994	0.785	0.812
0.895	0.751	0.707
0.842	0.798	0.635

Annexure 5.4

TRANHA CHARROLI HEP - POWER AND GENERATION (UNRESTRICTED)										
HYDRAULIC YEAR										
NET HEAD H 200 m										
OVERALL EFFICIENCY n 0.87										
MONTH	PERIOD	1977			1978			1979		
		DISCH	POWER	ENERGY	DISCH	POWER	ENERGY	DISCH	POWER	ENERGY
		CUMECS	KW	MWH	CUMECS	KW	MWH	CUMECS	KW	MWH
	I	0.269	459.691	110.33	0.262	446.74	107.22	0.558	951.75	228.42
JANUARY	II	0.266	453.216	108.77	0.387	660.40	158.50	0.571	974.41	233.86
	III	0.266	453.216	119.65	0.419	715.43	171.70	0.503	857.87	205.89
	I	0.269	459.691	110.33	0.379	647.45	155.39	0.523	893.48	214.44
FEBURARY	II	0.286	488.826	117.32	0.508	867.59	208.22	0.508	867.59	208.22
	III	0.292	498.538	95.72	0.368	628.03	150.73	0.495	844.92	202.78
	I	0.292	498.538	119.65	0.451	770.47	184.91	0.347	592.42	142.18
MARCH	III	0.302	514.724	123.53	0.707	1207.50	289.80	0.468	799.60	191.90
	III	0.313	534.148	141.01	0.635	1084.48	260.28	0.345	589.18	141.40
	I	0.315	537.385	128.97	0.453	773.70	185.69	0.484	825.50	198.12
APRIL	II	0.351	598.893	143.73	0.599	1022.97	245.51	0.499	851.40	204.34
	III	0.453	773.705	185.69	0.654	1116.85	268.05	0.512	874.06	209.77
	I	0.609	1039.160	249.40	0.724	1236.63	296.79	0.529	903.20	216.77
MAY	II	0.654	1116.854	268.05	0.728	1243.11	298.35	0.554	945.28	226.87
	III	0.660	1126.566	297.41	0.645	1100.67	264.16	0.506	864.35	207.44
	I	0.728	1243.107	298.35	0.624	1065.06	255.61	0.571	974.41	233.86
JUNE	II	0.719	1226.921	294.46	0.586	1000.31	240.08	0.611	1042.40	250.18
	III	0.929	1586.257	380.70	0.614	1048.87	251.73	0.616	1052.11	252.51
	I	1.536	2622.180	629.32	0.802	1369.36	328.65	0.711	1213.97	291.35
JULY	II	1.386	2366.436	567.94	1.237	2110.69	506.57	0.869	1482.66	355.84
	III	2.723	4648.704	1227.26	1.508	2573.62	617.67	1.817	3101.29	744.31
	I	2.940	5017.751	1204.26	2.213	3777.88	906.69	1.210	2065.37	495.69
AUGUST	II	1.593	2719.297	652.63	2.386	4072.47	977.39	1.098	1874.37	449.85
	III	2.979	5085.734	1342.63	1.969	3360.27	806.47	0.914	1560.36	374.49
	I	4.614	7876.251	1890.30	2.803	4784.67	1148.32	0.711	1213.97	291.35
SEPTEMBER	II	3.328	5681.389	1363.53	1.709	2916.77	700.02	0.753	1285.19	308.45
	III	1.936	3305.241	793.26	1.449	2473.27	593.58	0.850	1450.29	348.07
	I	1.420	2424.707	581.93	1.339	2285.50	548.52	0.834	1424.39	341.85
OCTOBER	II	1.225	2091.269	501.90	1.064	1816.10	435.86	0.829	1414.68	339.52
	III	0.893	1524.749	402.53	0.675	1152.46	276.59	0.821	1401.73	336.42
	I	0.700	1194.549	286.69	0.711	1213.97	291.35	0.520	887.01	212.88
NOVEMBER	II	1.225	2091.269	501.90	1.064	1816.10	435.86	0.829	1414.68	339.52
	III	0.487	831.976	199.67	0.649	1107.14	265.71	0.664	1133.04	271.93
	I	0.434	741.332	177.92	0.643	1097.431	263.38	0.499	851.40	204.34
DECEMBER	II	0.404	689.536	165.49	0.626	1068.30	256.39	0.575	980.89	235.41
	III	0.493	841.687	222.21	0.662	1129.80	271.15	0.349	595.66	142.96
ENERGY GENERATED (MWH)				16004.46			13622.90			9853.18

TRANHA CHARROLI HEP - POWER AND GENERATION (UNRESTRICTED)

MONTH	PERIOD		1980			1981			1982	
		DISCH.	POWER	ENERGY	DISCH.	POWER	ENERGY	DISCH.	POWER	ENERGY
		CUMECS	KW	MWH	CUMECS	KW	MWH	CUMECS	KW	MWH
	I	0.516	880.534	211.33	0.626	1068.30	256.39	0.374	637.74	153.06
JANUARY	II	0.476	812.552	195.01	0.484	825.50	198.12	0.391	666.88	160.05
	III	0.484	825.501	217.93	0.504	861.11	206.67	0.753	1285.19	308.45
	I	0.501	854.636	205.11	0.506	864.35	207.44	1.887	3221.07	773.06
FEBURARY	II	0.556	948.517	227.64	0.554	945.28	226.87	1.510	2576.86	618.45
	III	0.504	861.111	165.33	0.639	1090.96	261.83	1.286	2194.86	526.77
	I	0.702	1197.786	287.47	0.743	1269.01	304.56	2.581	4405.91	1057.42
MARCH	III	0.582	993.838	238.52	0.503	857.87	205.89	2.302	3930.03	943.21
	III	0.561	958.229	252.97	1.821	3107.77	745.86	1.893	3230.78	775.39
	I	0.468	799.603	191.90	0.797	1359.65	326.32	1.739	2968.57	712.46
APRIL	II	0.372	634.503	152.28	0.510	870.82	209.00	1.870	3191.94	766.06
	III	0.286	488.826	117.32	0.700	1194.55	286.69	2.073	3538.32	849.20
	I	0.273	466.165	111.88	0.823	1404.97	337.19	2.208	3768.17	904.36
MAY	II	0.432	738.095	177.14	0.954	1628.34	390.80	2.278	3887.95	933.11
	III	0.421	718.671	189.73	0.671	1145.99	275.04	2.429	4146.93	995.26
	I	0.531	906.432	217.54	0.472	806.08	193.46	2.786	4755.53	1141.33
JUNE	II	0.518	883.772	212.11	0.410	699.25	167.82	3.152	5380.32	1291.28
	III	0.770	1314.327	315.44	0.438	747.81	179.47	3.647	6225.25	1494.06
	I	1.326	2262.844	543.08	0.520	887.01	212.88	3.799	6484.23	1556.22
JULY	II	3.617	6173.453	1481.63	0.743	1269.01	304.56	3.235	5522.76	1325.46
	III	3.103	5296.156	1398.19	0.969	1654.24	397.02	3.622	6183.16	1483.96
	I	5.490	9371.865	2249.25	0.920	1570.07	376.82	2.767	4723.16	1133.56
AUGUST	II	4.745	8099.622	1943.91	1.237	2110.69	506.57	2.892	4936.82	1184.84
	III	2.395	4088.658	1079.41	0.840	1434.11	344.19	3.029	5169.90	1240.78
	I	1.388	2369.674	568.72	0.816	1392.02	334.09	2.147	3664.58	879.50
SEPTEMBER	II	1.136	1939.118	465.39	0.669	1142.75	274.26	1.479	2525.06	606.01
	III	0.833	1421.157	341.08	0.628	1071.53	257.17	1.390	2372.91	569.50
	I	0.671	1145.990	275.04	0.954	1628.34	390.80	0.916	1563.60	375.26
OCTOBER	II	0.624	1065.058	255.61	0.798	1362.89	327.09	0.781	1333.75	320.10
	III	0.506	864.348	228.19	0.669	1142.75	274.26	0.662	1129.80	271.15
	I	0.567	967.940	232.31	1.009	1722.22	413.33	0.588	1003.55	240.85
NOVEMBER	II	0.624	1065.058	255.61	0.798	1362.89	327.09	0.781	1333.75	320.10
	III	0.406	692.773	166.27	0.808	1379.07	330.98	0.501	854.64	205.11
	I	0.467	796.366	191.13	0.736	1256.056	301.45	0.362	618.32	148.40
DECEMBER	II	0.404	689.536	165.49	0.645	1100.67	264.16	0.360	615.08	147.62
	III	0.503	857.874	226.48	0.338	576.23	138.30	0.336	572.99	137.52
ENERGY GENERATED (MWH)				15753.43			10754.43			26548.89

Annexure 5.6

TRANHA CHARROLI HEP - POWER AND GENERATION (UNRESTRICTED)

MONTH	PERIOD	1983	2002	2003
		DISCH. POWER ENERGY	DISCH. POWER ENERGY	DISCH. POWER ENERGY
		CUMECS KW MWH	CUMECS KW MWH	CUMECS KW MWH
	I	0.480 819.027 196.57	0.711 1213.97 291.35	0.514 877.30 210.55
JANUARY	II	0.421 718.671 172.48	0.734 1252.82 300.68	0.465 793.13 190.35
	III	0.514 877.297 231.61	0.738 1259.29 302.23	0.467 796.37 191.13
	I	1.045 1783.730 428.10	0.766 1307.85 313.88	0.468 799.60 191.90
FEBURARY	II	1.123 1916.457 459.95	1.146 1955.30 469.27	0.632 1078.01 258.72
	III	1.163 1984.440 381.01	0.971 1657.48 397.79	1.339 2285.50 548.52
	I	1.561 2664.264 639.42	1.512 2580.10 619.22	2.405 4104.84 985.16
MARCH	III	1.191 2032.999 487.92	1.282 2188.39 525.21	2.627 4483.60 1076.06
	III	1.104 1884.085 497.40	1.138 1942.36 466.17	1.419 2421.47 581.15
	I	1.739 2968.566 712.46	0.897 1531.22 367.49	1.242 2120.40 508.90
APRIL	II	1.675 2858.500 686.04	0.816 1392.02 334.09	1.182 2016.81 484.03
	III	1.339 2285.505 548.52	0.719 1226.92 294.46	0.996 1699.56 407.89
	I	1.371 2340.538 561.73	0.781 1333.75 320.10	1.085 1851.71 444.41
MAY	II	1.885 3217.835 772.28	0.692 1181.60 283.58	1.036 1767.54 424.21
	III	2.302 3930.032 1037.53	0.660 1126.57 270.38	0.952 1625.10 390.02
	I	1.229 2097.744 503.46	0.330 563.28 135.19	0.444 757.52 181.80
JUNE	II	0.757 1291.666 310.00	3.196 5454.78 1309.15	4.954 8455.72 2029.37
	III	3.647 6225.249 1494.06	2.310 3942.98 946.32	2.644 4512.74 1083.06
	I	3.799 6484.230 1556.22	2.192 3742.27 898.15	3.217 5490.39 1317.69
JULY	II	3.235 5522.764 1325.46	2.725 4651.94 1116.47	3.658 6244.67 1498.72
	III	3.622 6183.165 1632.36	2.924 4991.85 1198.04	3.027 5166.67 1240.00
	I	2.767 4723.161 1133.56	2.801 4781.43 1147.54	1.460 2492.69 598.25
AUGUST	II	2.892 4936.820 1184.84	2.340 3994.78 958.75	2.283 3897.66 935.44
	III	3.029 5169.902 1364.85	1.976 3373.22 809.57	2.968 5066.31 1215.91
	I	2.147 3664.577 879.50	1.665 2842.31 682.16	2.092 3570.70 856.97
SEPTEMBER	II	1.479 2525.062 606.01	1.293 2207.81 529.87	1.576 2690.16 645.64
	III	1.390 2372.911 569.50	1.223 2088.03 501.13	3.730 6367.69 1528.25
	I	0.916 1563.596 375.26	1.054 1799.92 431.98	2.608 4451.23 1068.30
OCTOBER	II	0.781 1333.751 320.10	0.994 1696.32 407.12	6.116 10440.16 2505.64
	III	0.662 1129.803 298.27	0.914 1560.36 374.49	3.554 6066.62 1455.99
	I	0.675 1152.464 276.59	0.867 1479.43 355.06	1.914 3266.39 783.93
NOVEMBER	II	0.781 1333.751 320.10	1.096 1871.14 449.07	1.475 2518.59 604.46
	III	1.189 2029.761 487.14	0.797 1359.65 326.32	1.288 2198.10 527.54
	I	0.903 1540.935 369.82	0.696 1188.074 285.14	0.994 1696.32 407.12
DECEMBER	II	0.778 1327.276 318.55	0.649 1107.14 265.71	0.895 1527.99 366.72
	III	0.751 1281.955 338.44	0.565 964.70 231.53	0.842 1437.34 344.96
ENERGY GENERATED (MWH)		23477.09	18914.66	28088.79

TRANHA CHARROLI HEP - POWER AND GENERATION (UNRESTRICTED)

MONTH	PERIOD		2004			2005	
		DISCH.	POWER	ENERGY	DISCH.	POWER	ENERGY
		CUMECS	KW	MWH	CUMECS	KW	MWH
	I	0.783	1336.988	320.88	0.573	977.65	234.64
JANUARY	II	0.749	1278.717	306.89	0.618	1055.35	253.28
	III	0.745	1272.243	335.87	0.738	1259.29	302.23
	I	0.719	1226.921	294.46	0.905	1544.17	370.60
FEBURARY	II	0.669	1142.752	274.26	1.210	2065.37	495.69
	III	0.668	1139.515	218.79	0.889	1518.27	364.39
	I	0.548	935.568	224.54	0.922	1573.31	377.59
MARCH	III	0.506	864.348	207.44	1.026	1751.36	420.33
	III	0.484	825.501	217.93	0.981	1673.66	401.68
	I	0.457	780.179	187.24	0.590	1006.79	241.63
APRIL	II	0.448	763.993	183.36	0.402	686.30	164.71
	III	0.448	763.993	183.36	0.436	744.57	178.70
	I	0.455	776.942	186.47	0.577	984.13	236.19
MAY	II	0.478	815.789	195.79	0.368	628.03	150.73
	III	0.779	1330.513	351.26	0.334	569.76	136.74
	I	0.461	786.654	188.80	0.347	592.42	142.18
JUNE	II	0.478	815.789	195.79	0.324	553.57	132.86
	III	0.611	1042.397	250.18	0.518	883.77	212.11
	I	1.491	2544.485	610.68	1.312	2240.18	537.64
JULY	II	2.175	3713.136	891.15	1.986	3389.41	813.46
	III	3.074	5247.597	1385.37	2.534	4324.98	1037.99
	I	3.243	5535.713	1328.57	2.384	4069.23	976.62
AUGUST	II	3.512	5995.403	1438.90	1.965	3353.80	804.91
	III	1.699	2900.584	765.75	1.479	2525.06	606.01
	I	1.244	2123.642	509.67	1.041	1777.26	426.54
SEPTEMBER	II	1.168	1994.151	478.60	1.872	3195.17	766.84
	III	1.730	2952.380	708.57	2.008	3428.26	822.78
	I	1.151	1965.016	471.60	1.341	2288.74	549.30
OCTOBER	II	1.077	1838.763	441.30	1.003	1712.51	411.00
	III	0.979	1670.426	440.99	0.702	1197.79	287.47
	I	0.910	1553.884	372.93	0.523	893.48	214.44
NOVEMBER	II	0.842	1437.343	344.96	0.474	809.31	194.24
	III	0.810	1382.310	331.75	0.413	705.72	169.37
	I	0.785	1340.225	321.65	0.812	1385.547	332.53
DECEMBER	II	0.751	1281.955	307.67	0.707	1207.50	289.80
	III	0.798	1362.886	359.80	0.635	1084.48	260.28
ENERGY GENERATED (MWH)				15833.23			14317.49

TRANHA CHARROLI HEP - POWER AND GENERATION (UNRESTRICTED)

MONTH	PERIOD		2008			2009			2010	
		DISCH.	POWER	ENERGY	DISCH.	POWER	ENERGY	DISCH.	POWER	ENERGY
		CUMECs	KW	MWH	CUMECs	KW	MWH	CUMECs	KW	MWH
	I	1.100	1877.634	450.63	1.500	2560.41	614.50	1.000	1706.94	409.67
JANUARY	II	1.100	1877.634	450.63	1.500	2560.41	614.50	1.000	1706.94	409.67
	III	1.320	2253.161	594.83	1.650	2816.45	675.95	1.100	1877.63	450.63
	I	1.200	2048.328	491.60	1.500	2560.41	614.50	0.850	1450.90	348.22
FEBURARY	II	1.200	2048.328	491.60	1.500	2560.41	614.50	0.900	1536.25	368.70
	III	0.960	1638.662	314.62	1.200	2048.33	491.60	0.870	1485.04	356.41
	I	1.100	1877.634	450.63	1.500	2560.41	614.50	1.050	1792.29	430.15
MARCH	III	1.100	1877.634	450.63	1.400	2389.72	573.53	0.950	1621.59	389.18
	III	1.210	2065.397	545.26	1.430	2440.92	585.82	0.990	1689.87	405.57
	I	1.100	1877.634	450.63	1.210	2065.40	495.70	0.800	1365.55	327.73
APRIL	II	1.050	1792.287	430.15	1.150	1962.98	471.12	0.800	1365.55	327.73
	III	1.000	1706.940	409.67	1.100	1877.63	450.63	0.800	1365.55	327.73
	I	1.000	1706.940	409.67	1.040	1775.22	426.05	0.900	1536.25	368.70
MAY	II	0.900	1536.246	368.70	0.950	1621.59	389.18	1.100	1877.63	450.63
	III	0.990	1689.871	446.13	0.970	1655.73	397.38	1.100	1877.63	450.63
	I	0.900	1536.246	368.70	0.800	1365.55	327.73	1.200	2048.33	491.60
JUNE	II	0.900	1536.246	368.70	0.800	1365.55	327.73	1.350	2304.37	553.05
	III	1.350	2304.369	553.05	0.900	1536.25	368.70	2.000	3413.88	819.33
	I	2.200	3755.268	901.26	1.300	2219.02	532.57	4.000	6827.76	1638.66
JULY	II	3.250	5547.555	1331.41	2.500	4267.35	1024.16	4.000	6827.76	1638.66
	III	4.400	7510.536	1982.78	2.750	4694.09	1126.58	4.400	7510.54	1802.53
	I	4.000	6827.760	1638.66	2.500	4267.35	1024.16	4.000	6827.76	1638.66
AUGUST	II	4.000	6827.760	1638.66	2.500	4267.35	1024.16	4.000	6827.76	1638.66
	III	4.400	7510.536	1982.78	2.750	4694.09	1126.58	4.400	7510.54	1802.53
	I	3.500	5974.290	1433.83	2.450	4182.00	1003.68	3.000	5120.82	1229.00
SEPTEMBER	II	3.000	5120.820	1229.00	2.400	4096.66	983.20	3.000	5120.82	1229.00
	III	3.000	5120.820	1229.00	2.400	4096.66	983.20	3.000	5120.82	1229.00
	I	2.500	4267.350	1024.16	2.300	3925.96	942.23	2.500	4267.35	1024.16
OCTOBER	II	2.500	4267.350	1024.16	2.300	3925.96	942.23	2.500	4267.35	1024.16
	III	2.750	4694.085	1239.24	2.430	4147.86	995.49	2.750	4694.09	1126.58
	I	2.000	3413.880	819.33	1.750	2987.15	716.91	2.400	4096.66	983.20
NOVEMBER	II	2.000	3413.880	819.33	1.500	2560.41	614.50	2.400	4096.66	983.20
	III	2.000	3413.880	819.33	1.500	2560.41	614.50	2.400	4096.66	983.20
	I	2.000	3413.880	819.33	1.200	2048.328	491.60	2.300	3925.96	942.23
DECEMBER	II	2.000	3413.880	819.33	1.200	2048.33	491.60	2.300	3925.96	942.23
	III	1.850	3157.839	833.67	1.200	2048.33	491.60	2.530	4318.56	1036.45
ENERGY GENERATED (MWH)				29631.11			24182.56			30577.44

TRANHA CHARROLI HEP
IDENTIFYING 75% DEPENDABLE YEAR

YEAR	ENERGH MWH				
1977	16004.46		30577.44	2010	
1978	13622.90		29631.11	2008	
1979	9853.18		28088.79	2003	
1980	15753.43		26548.89	1982	
1981	10754.43		24182.56	2009	
1982	26548.89		23477.09	1983	
1983	23477.09		18914.66	2002	50%
2002	18914.66		16004.46	1977	
2003	28088.79		15833.23	2004	
2004	15833.23		15753.43	1980	
2005	14317.49		14317.49	2005	75%
2008	29631.11		13622.90	1978	
2009	24182.56		10754.43	1981	90%
2010	30577.44		9853.18	1979	

Annexure 5.9

