CHAPTER 11 PROJECT DESIGN

CHAPTER 11 PROJECT DESIGN

Calculation of Installed Capacity

Output list of Energy Calculation after LWL revised (without Flushing Operation)

Stability Analysis of Dam Section

Stability Analysis of Spillway Part of Dam

Dissipater Hydraulic Design

Stability Analysis of Spillway Pier

Comparison with Powerhouse Types

Countermeasure of corona interference

Output list of Energy Calculation for F/S design with Every-year Flushing Operation

Calculation of Installed capacity

Calculation of Installed capacity

The installed capacity after determination of tunnel diameters described as follows:

Symbol	Item	Unit	Value
IWL	Rated Intake Water Level	EL. m	405.0
TWL	Rated Tailrace Water Level	EL. m	289.2
Hg	Gross Head (IWL – TWL)	m	115.8
Hl	Head Loss	m	3.3
He	Effective Head (Hg – Hl)	m	112.5
Q	Maximum Discharge	m^3/s	127.4
η t	Efficiency of Turbine	-	0.927
η g	Efficiency of generator	-	0.976
Pe	Installed Capacity (9.8* η t* η g*Q*He)	MW	127

Output list of Energy Calculation after LWL revised

(without Flushing Operation)

Reservoir(1)

Output Time : 2007/

High Water Level	415	(m)
Intake Water Level	405	(m)
Low Water Level	391	(m)
Tail Water Level	289.2	(m)
MAX. Discharge	127.4	(m^3/s)
MIN. Discharge	19.11	(m3/s)
Installed Capacity	127	(MW)
Loss	0.000203	
	0	
	0	(m)
Peak time	6	(h)
Num. of Divisions	20	

Water Level	Area	Storage
(m)	(km^2)	(MCM)
310	0	0
315	0	0
320	0	0
325	0.011059	0.012698
330	0.075022	0.232296
335	0.161819	0.822507
340	0.295238	1.963766
345	0.4497	3.799766
350	0.63122	6.479798
355	0.835245	10.15977
360	1.102092	15.04177
365	1.408941	21.35865
370	1.692081	29.07181
375	2.046022	38.50318
380	2.399674	49.60515
385	2.954407	63.15697
390	3.559411	79.39558
395	4.133232	98.93272
400	4.510401	121
405	5.107591	145
410	5.512504	171
415	5.860826	200
420	6.248732	230
425	6.680698	262
430	0	0
435	0	0

Q/Qmax	Turbine Efficiency			P/Pmax	Generator Efficiency
	H.W.L	N.W.L	L.W.L		
0.3	0.644	0.685	0.646	0.4	0.961
0.4	0.735	0.79	0.765	0.6	0.97
0.5	0.803	0.847	0.825	0.8	0.974
0.6	0.845	0.885	0.868	1	0.975
0.7	0.88	0.916	0.898		
0.8	0.907	0.934015	0.922		
0.9	0.929	0.94	0.934		
1	0.939	0.927	0.93		

Calculated Rule

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
Rule	4	8	12	16	20	20	20	16	12	8	4	0
Water Level	411.01	406.63	401.89	396.78	391.02	391.02	391.02	396.78	401.89	406.63	411.01	415.00
Storage	176.61	153.22	129.82	106.43	83.04	83.04	83.04	106.43	129.82	153.22	176.61	200.00

Inflow (MCM)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	85.17	76.17	80.62	82.68	184.54	202.18	359.71	1233.67	811.56	301.05	212.54	144.1	3773.99	314.5
1965	91.07	71.37	79.55	84.76	97.23	391.39	785.84	986.99	493.26	167.67	121.56	83.83	3454.52	287.88
1966	65.89	53.71	56.25	50.28	59.46	164.59	611.75	695.31	414.2	176.77	100.05	68.3	2516.56	209.71
1967	55.18	50.08	53.84	59.1	65.62	149.82	619.51	571.03	481.59	206.77	112.75	90.53	2515.82	209.65
1968	66.69	51.36	66.16	65.32	93.48	367.8	900.21	768.43	576.98	392.39	109.12	63.48	3521.42	293.45
1969	49.01	35.32	40.71	38.88	44.46	89.16	342.84	843.96	684.29	212.93	104.46	69.91	2555.93	212.99
1970	54.1	41.85	43.66	63.76	94.55	236.39	1020.2	1103.77	523.84	284.18	147.23	89.46	3702.99	308.58
1971	63.48	45.24	50.09	75.43	106.06	486.52	779.95	805.13	551.58	390.24	175.48	107.14	3636.34	303.03
1972	68.83	50.86	51.96	53.14	141.69	276.31	872.35	970.92	652.15	290.61	133.23	89.73	3651.78	304.32
1973	67.23	42.58	48.21	66.87	104.99	456.97	653.53	1041.63	687.66	694.78	192.84	104.73	4162.02	346.84
1974	98.57	81.53	87.32	105.75	104.46	237.69	919.76	1102.43	659.4	352.75	113.53	91.33	3954.52	329.54
1975	88.39	77.66	80.89	59.1	64.28	220.06	1143.68	879.85	791.86	372.57	140.23	81.42	3999.99	333.33
1976	59.73	57.88	53.03	64.54	109.55	493	1018.33	916.82	559.87	236.77	113.01	90.53	3773.06	314.42
1977	60.8	49.35	55.44	78.28	125.62	239.5	772.45	1095.47	643.85	299.45	193.88	115.97	3730.06	310.84
1978	86.51	71.61	72.85	76.2	184.01	420.42	1020.47	936.37	558.84	283.91	166.67	127.76	4005.62	333.8
1979	100.98	81.53	79.82	97.72	139.01	219.54	843.7	1197.24	620.27	287.12	149.04	92.67	3908.64	325.72
1980	67.5	58.13	67.76	68.95	99.37	279.68	1138.59	1195.91	813.11	220.97	113.53	70.17	4193.67	349.47
1981	49.28	36.05	42.59	74.39	109.81	248.57	1105.38	1020.2	629.08	262.22	130.12	99.9	3807.59	317.3
1982	89.73	75.48	97.23	105.75	131.78	254.53	694.78	905.57	538.36	231.41	143.6	122.14	3390.36	282.53
1983	106.6	88.54	94.55	89.42	126.42	242.09	563.54	724.51	717.47	383.55	141.78	106.33	3384.8	282.07
1984	75	53.87	58.12	62.21	168.2	393.98	1191.89	769.24	630.89	257.39	151.89	110.62	3923.3	326.94
1985	98.83	81.04	88.39	101.35	163.65	297.82	892.98	528.98	525.92	338.01	146.45	96.42	3359.84	279.99
1986	66.16	47.9	57.32	73.87	74.73	304.82	698.26	695.85	726.28	396.14	153.45	82.23	3377.01	281.42
1987	62.94	49.35	57.32	61.17	83.3	186.88	749.68	748.61	475.89	233.56	140.49	104.99	2954.18	246.18
1988	80.89	67.4	72.32	74.65	109.01	289.53	708.44	858.43	619.23	274.8	137.12	103.39	3395.21	282.93
1989	90.8	67.25	74.46	79.06	159.1	379.99	673.89	832.18	622.6	305.07	139.45	97.49	3521.34	293.45
1990	75.26	60	69.64	93.05	147.85	396.32	728.26	635.85	503.11	275.07	115.34	73.12	3172.87	264.41
1991	53.57	42.58	45	52.62	89.46	297.82	752.63	858.16	648.26	313.91	145.67	104.46	3404.14	283.68
1992	83.3	69.66	70.98	65.06	95.62	212.54	505.95	775.93	511.66	334.26	130.38	81.69	2937.03	244.75
1993	62.14	49.84	38.84	38.1	80.35	253.5	584.96	860.57	558.58	327.84	147.23	89.19	3091.14	257.6
1994	78.48	66.53	79.82	78.02	99.1	268.27	493.36	626.75	370.14	100.98	45.88	34.55	2341.88	195.16
1995	28.12	23.95	30.27	30.84	75.8	663.29	843.43	519.61	455.93	347.92	222.65	141.15	3382.96	281.91
1996	80.62	54.62	82.76	80.35	100.71	179.37	608	856.55	653.7	288.2	118.71	84.37	3187.96	265.66
1997	72.58	58.06	76.07	84.5	102.85	194.14	614.69	693.44	367.03	165.53	90.72	88.66	2608.27	217.36
1998	64.82	52.01	66.69	75.43	130.44	387.24	771.65	1211.98	537.32	171.95	92.28	69.64	3631.45	302.62
1999	57.05	44.76	45.53	48.73	93.21	241.32	709.24	639.33	451.79	180.52	59.88	40.98	2612.34	217.7
SUM	2605.3	2085.12	2316.06	2559.33	3959.77	10623.04	27693.88	31106.67	21067.55	10359.26	4852.24	3312.38	122540.6	
AVE	72.37	57.92	64.34	71.09	109.99	295.08	769.27	864.07	585.21	287.76	134.78	92.01	3403.91	

Inflow (m3/s)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	31.8	30.4	30.1	31.9	68.9	78	134.3	460.6	313.1	112.4	82	53.8	1427.3	118.94
1965	34	29.5	29.7	32.7	36.3	151	293.4	368.5	190.3	62.6	46.9	31.3	1306.2	108.85
1966	24.6	22.2	21	19.4	22.2	63.5	228.4	259.6	159.8	66	38.6	25.5	950.8	79.23
1967	20.6	20.7	20.1	22.8	24.5	57.8	231.3	213.2	185.8	77.2	43.5	33.8	951.3	79.28
1968	24.9	20.5	24.7	25.2	34.9	141.9	336.1	286.9	222.6	146.5	42.1	23.7	1330	110.83
1969	18.3	14.6	15.2	15	16.6	34.4	128	315.1	264	79.5	40.3	26.1	967.1	80.59
1970	20.2	17.3	16.3	24.6	35.3	91.2	380.9	412.1	202.1	106.1	56.8	33.4	1396.3	116.36
1971	23.7	18.7	18.7	29.1	39.6	187.7	291.2	300.6	212.8	145.7	67.7	40	1375.5	114.63
1972	25.7	20.3	19.4	20.5	52.9	106.6	325.7	362.5	251.6	108.5	51.4	33.5	1378.6	114.88
1973	25.1	17.6	18	25.8	39.2	176.3	244	388.9	265.3	259.4	74.4	39.1	1573.1	131.09
1974	36.8	33.7	32.6	40.8	39	91.7	343.4	411.6	254.4	131.7	43.8	34.1	1493.6	124.47
1975	33	32.1	30.2	22.8	24	84.9	427	328.5	305.5	139.1	54.1	30.4	1511.6	125.97
1976	22.3	23.1	19.8	24.9	40.9	190.2	380.2	342.3	216	88.4	43.6	33.8	1425.5	118.79
1977	22.7	20.4	20.7	30.2	46.9	92.4	288.4	409	248.4	111.8	74.8	43.3	1409	117.42
1978	32.3	29.6	27.2	29.4	68.7	162.2	381	349.6	215.6	106	64.3	47.7	1513.6	126.13
1979	37.7	33.7	29.8	37.7	51.9	84.7	315	447	239.3	107.2	57.5	34.6	1476.1	123.01
1980	25.2	23.2	25.3	26.6	37.1	107.9	425.1	446.5	313.7	82.5	43.8	26.2	1583.1	131.93
1981	18.4	14.9	15.9	28.7	41	95.9	412.7	380.9	242.7	97.9	50.2	37.3	1436.5	119.71
1982	33.5	31.2	36.3	40.8	49.2	98.2	259.4	338.1	207.7	86.4	55.4	45.6	1281.8	106.82
1983	39.8	36.6	35.3	34.5	47.2	93.4	210.4	270.5	276.8	143.2	54.7	39.7	1282.1	106.84
1984	28	21.5	21.7	24	62.8	152	445	287.2	243.4	96.1	58.6	41.3	1481.6	123.47
1985	36.9	33.5	33	39.1	61.1	114.9	333.4	197.5	202.9	126.2	56.5	36	1271	105.92
1986	24.7	19.8	21.4	28.5	27.9	117.6	260.7	259.8	280.2	147.9	59.2	30.7	1278.4	106.53
1987	23.5	20.4	21.4	23.6	31.1	72.1	279.9	279.5	183.6	87.2	54.2	39.2	1115.7	92.98
1988	30.2	26.9	27	28.8	40.7	111.7	264.5	320.5	238.9	102.6	52.9	38.6	1283.3	106.94
1989	33.9	27.8	27.8	30.5	59.4	146.6	251.6	310.7	240.2	113.9	53.8	36.4	1332.6	111.05
1990	28.1	24.8	26	35.9	55.2	152.9	271.9	237.4	194.1	102.7	44.5	27.3	1200.8	100.07
1991	20	17.6	16.8	20.3	33.4	114.9	281	320.4	250.1	117.2	56.2	39	1286.9	107.24
1992	31.3	27.8	26.5	25.1	35.7	82	188.9	289.7	197.4	124.8	50.3	30.5	1109.8	92.48
1993	23.2	20.6	14.5	14.7	30	97.8	218.4	321.3	215.5	122.4	56.8	33.3	1168.5	97.38
1994	29.3	27.5	29.8	30.1	37	103.5	184.2	234	142.8	37.7	17.7	12.9	886.5	73.88
1995	10.5	9.9	11.3	11.9	28.3	255.9	314.9	194	175.9	129.9	85.9	52.7	1281.1	106.76
1996	30.1	21.8	30.9	31	37.6	69.2	227	319.8	252.2	107.6	45.8	31.5	1204.5	100.38
1997	27.1	24	28.4	32.6	38.4	74.9	229.5	258.9	141.6	61.8	35	33.1	985.3	82.11
1998	24.2	21.5	24.9	29.1	48.7	149.4	288.1	452.5	207.3	64.2	35.6	26	1371.5	114.29
1999	21.3	18.5	17	18.8	34.8	93.1	264.8	238.7	174.3	67.4	23.1	15.3	987.1	82.26
SUM	972.7	854.2	864.7	987.4	1478.4	4098.4	10339.7	11613.9	8127.9	3867.7	1872	1236.7	46313.7	
AVE	27.02	23.73	24.02	27.43	41.07	113.84	287.21	322.61	225.78	107.44	52	34.35	1286.49	

Outflow (MCM)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	85.04	75.97	80.27	82.3	184.09	201.71	328.21	1147.16	810.98	320.82	215.47	120.5	3652.52	304.38
1965	114.23	94.49	102.45	107.67	120.13	325.48	733.61	986.35	492.69	214.06	97.9	91.74	3480.8	290.07
1966	91.74	82.88	85.84	49.9	59.01	164.13	494.19	694.67	413.63	223.16	88.78	91.76	2539.69	211.64
1967	91.76	70.66	53.49	58.71	65.17	149.35	501.96	570.39	481.02	253.16	89.09	91.74	2476.5	206.38
1968	91.74	85.84	91.76	71.07	93.02	321.25	828.64	757.79	576.41	391.96	132.24	91.76	3543.48	295.29
1969	91.76	57.31	40.36	38.49	44.01	88.7	325.72	743.12	683.72	259.32	88.78	91.76	2553.05	212.75

1970	91.76	67.37	43.31	63.37	94.09	235.92	902.65	1103.13	523.27	325.24	128.87	91.74	3670.72	305.89
1971	91.74	82.88	74.43	75.04	105.61	368.92	779.28	804.48	551.01	389.81	198.6	91.74	3613.54	301.13
1972	91.74	85.82	91.76	62.91	141.23	275.84	754.8	970.28	651.58	323.44	123.09	91.74	3664.23	305.35
1973	91.74	82.88	73.9	66.48	104.54	339.37	652.86	1040.99	687.09	694.35	215.97	91.74	4141.91	345.16
1974	111.13	104.65	110.22	128.67	127.36	237.22	802.21	1101.79	658.83	352.32	136.65	91.74	3962.79	330.23
1975	91.74	96.6	103.79	88.78	80.43	219.59	1026.12	879.21	791.29	372.14	163.35	91.74	4004.78	333.73
1976	91.76	85.84	75.29	64.15	109.09	375.4	1017.66	916.17	559.3	283.16	89.35	91.74	3758.91	313.24
1977	91.74	82.88	82.28	77.89	125.16	239.03	654.9	1094.82	643.28	321.22	194.81	92.38	3700.39	308.37
1978	109.68	94.74	95.75	99.12	206.91	330.25	992.45	935.73	558.26	325.32	147.98	104.16	4000.35	333.36
1979	124.14	104.65	102.72	120.63	161.91	219.08	726.14	1196.6	619.7	324.41	134.47	91.74	3926.19	327.18
1980	91.74	85.84	91.76	85.98	98.91	279.21	1021.03	1195.26	812.54	267.36	89.86	91.74	4211.23	350.94
1981	91.76	64.98	42.24	74	109.36	248.11	987.82	1019.56	628.51	308.61	106.45	91.74	3773.14	314.43
1982	97.47	98.61	120.13	128.67	154.68	254.07	577.22	904.92	537.79	277.8	119.93	98.54	3369.83	280.82
1983	129.77	111.67	117.45	112.34	149.32	241.63	445.98	723.86	716.9	383.12	164.9	91.74	3388.68	282.39
1984	91.74	85.82	91.76	86.47	167.75	325.92	1141.8	768.59	630.32	303.78	128.23	91.74	3913.92	326.16
1985	117.29	104.17	111.29	124.26	186.55	297.35	775.42	528.34	525.35	337.59	169.57	91.74	3368.92	280.74
1986	91.74	82.88	91.79	75.63	74.27	304.35	580.7	695.21	725.71	395.71	176.57	91.74	3386.3	282.19
1987	91.76	82.88	78.02	60.78	82.84	186.42	632.13	747.97	475.32	279.95	116.82	91.74	2926.63	243.89
1988	93.72	90.5	95.22	97.56	131.91	289.06	590.88	857.78	618.66	321.19	113.45	91.74	3391.67	282.64
1989	102.02	90.38	97.36	101.97	182	323.48	612.26	831.54	622.03	319.91	147.3	91.74	3521.99	293.5
1990	91.74	82.86	91.76	105.91	170.75	326.31	680.13	635.21	502.54	321.46	91.68	91.74	3192.09	266.01
1991	91.76	78.74	44.65	52.23	89	297.35	635.08	857.52	647.69	318.01	164.26	91.74	3368.03	280.67
1992	95.59	92.76	93.88	88.78	117.72	212.08	388.39	775.29	511.09	333.84	153.5	91.74	2954.66	246.22
1993	91.76	82.88	58.68	37.71	79.9	253.03	467.41	859.93	558.01	327.41	170.35	91.74	3078.81	256.57
1994	91.74	82.86	93.32	100.93	122	267.81	375.81	626.1	369.57	147.37	88.8	61.42	2427.73	202.31
1995	27.99	23.76	29.92	30.46	75.34	545.69	842.76	518.97	455.36	347.5	245.77	117.55	3261.07	271.76
1996	103.79	85.82	97.6	103.27	123.61	178.9	490.44	855.91	653.13	324.11	105.52	91.74	3213.84	267.82
1997	91.74	82.88	91.76	88.78	123.07	193.67	497.14	692.79	366.46	211.92	88.78	91.76	2620.75	218.4
1998	91.76	82.88	76.66	75.04	129.98	324.75	716.02	1211.33	536.75	218.34	88.78	91.76	3644.05	303.67
1999	91.76	60.77	45.18	48.34	92.75	240.85	591.69	638.69	451.22	226.91	88.8	81.85	2658.81	221.57
SUM	3422.08	3009.4	2968.05	2934.29	4283.47	9681.28	24571.51	30897.45	21047.01	11345.78	4864.72	3336.96	122362	
AVE	95.06	83.59	82.45	81.51	118.99	268.92	682.54	858.26	584.64	315.16	135.13	92.69	3398.94	

Outflow (m3/s)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	31.75	30.32	29.97	31.75	68.73	77.82	122.54	428.3	312.88	119.78	83.13	44.99	1381.96	115.16
1965	42.65	39.06	38.25	41.54	44.85	125.57	273.9	368.26	190.08	79.92	37.77	34.25	1316.1	109.68
1966	34.25	34.26	32.05	19.25	22.03	63.32	184.51	259.36	159.58	83.32	34.25	34.26	960.44	80.04
1967	34.26	29.21	19.97	22.65	24.33	57.62	187.41	212.96	185.58	94.52	34.37	34.25	937.13	78.09
1968	34.26	34.26	34.26	27.42	34.73	123.94	309.38	286.66	222.38	146.34	51.02	34.26	1338.9	111.58
1969	34.26	23.69	15.07	14.85	16.43	34.22	121.61	277.45	263.78	96.82	34.25	34.26	966.69	80.56
1970	34.26	27.85	16.17	24.45	35.13	91.02	337.01	411.86	201.88	121.43	49.72	34.25	1385.03	115.42
1971	34.25	34.26	27.79	28.95	39.43	142.33	290.95	300.36	212.58	145.54	76.62	34.25	1367.31	113.94
1972	34.25	34.25	34.26	24.27	52.73	106.42	281.81	362.26	251.38	120.76	47.49	34.25	1384.13	115.34
1973	34.25	34.26	27.59	25.65	39.03	130.93	243.75	388.66	265.08	259.24	83.32	34.25	1566.01	130.5
1974	41.49	43.26	41.15	49.64	47.55	91.52	299.51	411.36	254.18	131.54	52.72	34.25	1498.17	124.85
1975	34.25	39.93	38.75	34.25	30.03	84.72	383.11	328.26	305.28	138.94	63.02	34.25	1514.79	126.23
1976	34.26	34.26	28.11	24.75	40.73	144.83	379.95	342.06	215.78	105.72	34.47	34.25	1419.17	118.26
1977	34.25	34.26	30.72	30.05	46.73	92.22	244.51	408.76	248.18	119.93	75.16	34.49	1399.26	116.61
1978	40.95	39.16	35.75	38.24	77.25	127.41	370.54	349.36	215.38	121.46	57.09	38.89	1511.48	125.96
1979	46.35	43.26	38.35	46.54	60.45	84.52	271.11	446.76	239.08	121.12	51.88	34.25	1483.67	123.64
1980	34.25	34.26	34.26	33.17	36.93	107.72	381.21	446.26	313.48	99.82	34.67	34.25	1590.28	132.52
1981	34.26	26.86	15.77	28.55	40.83	95.72	368.81	380.66	242.48	115.22	41.07	34.25	1424.48	118.71
1982	36.39	40.76	44.85	49.64	57.75	98.02	215.51	337.86	207.48	103.72	46.27	36.79	1275.04	106.25
1983	48.45	46.16	43.85	43.34	55.75	93.22	166.51	270.26	276.58	143.04	63.62	34.25	1285.03	107.09
1984	34.25	34.25	34.26	33.36	62.63	125.74	426.3	286.96	243.18	113.42	49.47	34.25	1478.07	123.17
1985	43.79	43.06	41.55	47.94	69.65	114.72	289.51	197.26	202.68	126.04	65.42	34.25	1275.87	106.32
1986	34.25	34.26	34.27	29.18	27.73	117.42	216.81	259.56	279.98	147.74	68.12	34.25	1283.57	106.96
1987	34.26	34.26	29.13	23.45	30.93	71.92	236.01	279.26	183.38	104.52	45.07	34.25	1106.44	92.2
1988	34.99	36.12	35.55	37.64	49.25	111.52	220.61	320.26	238.68	119.92	43.77	34.25	1282.56	106.88
1989	38.09	37.36	36.35	39.34	67.95	124.8	228.59	310.46	239.98	119.44	56.83	34.25	1333.44	111.12
1990	34.25	34.25	34.26	40.86	63.75	125.89	253.93	237.16	193.88	120.02	35.37	34.25	1207.87	100.66
1991	34.26	32.55	16.67	20.15	33.23	114.72	237.11	320.16	249.88	118.73	63.37	34.25	1275.08	106.26
1992	35.69	37.02	35.05	34.25	43.95	81.82	145.01	289.46	197.18	124.64	59.22	34.25	1117.54	93.13
1993	34.26	34.26	21.91	14.55	29.83	97.62	174.51	321.06	215.28	122.24	65.72	34.25	1165.49	97.12
1994	34.25	34.25	34.84	38.94	45.55	103.32	140.31	233.76	142.58	55.02	34.26	22.93	920.01	76.67
1995	10.45	9.82	11.17	11.75	28.13	210.53	314.65	193.76	175.68	129.74	94.82	43.89	1234.39	102.87
1996	38.75	34.25	36.44	39.84	46.15	69.02	183.11	319.56	251.98	121.01	40.71	34.25	1215.07	101.26
1997	34.25	34.26	34.26	34.25	45.95	74.72	185.61	258.66	141.38	79.12	34.25	34.26	990.97	82.58
1998	34.26	34.26	28.62	28.95	48.53	125.29	267.33	452.26	207.08	81.52	34.25	34.26	1376.61	114.72
1999	34.26	25.12	16.87	18.65	34.63	92.92	220.91	238.46	174.08	84.72	34.26	30.56	1005.44	83.79
SUM	1277.64	1232.94	1108.14	1132.05	1599.26	3735.06	9173.95	11535.79	8119.98	4236.02	1876.82	1245.84	46273.49	
AVE	35.49	34.25	30.78	31.45	44.42	103.75	254.83	320.44	225.56	117.67	52.13	34.61	1285.37	

Overflow (MCM)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	0	0	0	0	0	0	0	809.39	503.96	0	0	0	1313.35	109.45
1965	0	0	0	0	0	0	405.99	669.09	185.66	0	0	0	1260.74	105.06
1966	0	0	0	0	0	0	147.61	377.41	106.61	0	0	0	631.63	52.64
1967	0	0	0	0	0	0	155.37	253.14	174	0	0	0	582.51	48.54
1968	0	0	0	0	0	0	495.75	450.53	269.39	74.7	0	0	1290.37	107.53
1969	0	0	0	0	0	0	0	399.75	376.7	0	0	0	776.45	64.7
1970	0	0	0	0	0	0	556.06	785.87	216.25	0	0	0	1558.18	129.85
1971	0	0	0	0	0	33.51	462.02	487.23	243.98	72.56	0	0	1299.3	108.28
1972	0	0	0	0	0	0	408.21	653.02	344.55	0	0	0	1405.78	117.15
1973	0	0	0	0	0	3.97	335.6	723.73	380.06	377.09	0	0	1820.45	151.7
1974	0	0	0	0	0	0	455.62	784.53	351.81	35.06	0	0	1627.02	135.59
1975	0	0	0	0	0	0	679.54	561.96	484.26	54.88	0	0	1780.64	148.39
1976	0	0	0	0	0	39.99	700.4	598.92	252.28	0	0	0	1591.59	132.63
1977	0	0	0	0	0	0	308.31	777.57	336.26	0	0	0	1422.14	118.51
1978	0	0	0	0	0	0	670.22	618.47	251.24	0	0	0	1539.93	128.33
1979	0	0	0	0	0	0	379.56	879.35	312.67	0	0	0	1571.58	130.97
1980	0	0	0	0	0	0	674.45	878.01	505.52	0	0	0	2057.98	171.5
1981	0	0	0	0	0	0	641.24	702.3	321.49	0	0	0	1665.03	138.75
1982	0	0	0	0	0	0	230.64	587.67	230.77	0	0	0	1049.08	87.42
1983	0	0	0	0	0	0	99.4	406.61	409.87	65.86	0	0	981.74	81.81
1984	0	0	0	0	0	0	814.69	451.34	323.3	0	0	0	1589.33	132.44
1985	0	0	0	0	0	0	428.84	211.08	218.32	20.33	0	0	878.57	73.21
1986	0	0	0	0	0	0	234.12	377.95	418.69	78.45	0	0	1109.21	92.43
1987	0	0	0	0	0	0	285.54	430.71	168.3	0	0	0	884.55	73.71

1988	0	0	0	0	0	0	244.3	540.53	311.64	0	0	0	1096.47	91.37
1989	0	0	0	0	0	0	282.2	514.28	315.01	0	0	0	1111.49	92.62
1990	0	0	0	0	0	0	353.47	317.95	195.51	0	0	0	866.93	72.24
1991	0	0	0	0	0	0	288.49	540.26	340.67	0	0	0	1169.42	97.45
1992	0	0	0	0	0	0	41.81	458.03	204.07	16.58	0	0	720.49	60.04
1993	0	0	0	0	0	0	120.82	542.67	250.98	10.15	0	0	924.62	77.05
1994	0	0	0	0	0	0	29.22	308.85	62.54	0	0	0	400.61	33.38
1995	0	0	0	0	0	210.29	525.5	201.71	148.34	30.24	0	0	1116.08	93.01
1996	0	0	0	0	0	0	143.86	538.65	346.11	0	0	0	1028.62	85.72
1997	0	0	0	0	0	0	150.55	375.54	59.43	0	0	0	585.52	48.79
1998	0	0	0	0	0	0	387.51	894.08	229.73	0	0	0	1511.32	125.94
1999	0	0	0	0	0	0	245.1	321.43	144.19	0	0	0	710.72	59.23
SUM	0	0	0	0	0	287.76	12382.01	19429.61	9994.16	835.9	0	0	42929.44	
AVE	0	0	0	0	0	7.99	343.94	539.71	277.62	23.22	0	0	1192.48	

Overflow (m3/s)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	0	0	0	0	0	0	0	302.19	194.43	0	0	0	496.62	41.39
1965	0	0	0	0	0	0	151.58	249.81	71.63	0	0	0	473.02	39.42
1966	0	0	0	0	0	0	55.11	140.91	41.13	0	0	0	237.15	19.76
1967	0	0	0	0	0	0	58.01	94.51	67.13	0	0	0	219.65	18.3
1968	0	0	0	0	0	0	185.09	168.21	103.93	27.89	0	0	485.12	40.43
1969	0	0	0	0	0	0	0	149.25	145.33	0	0	0	294.58	24.55
1970	0	0	0	0	0	0	207.61	293.41	83.43	0	0	0	584.45	48.7
1971	0	0	0	0	0	12.93	172.5	181.91	94.13	27.09	0	0	488.56	40.71
1972	0	0	0	0	0	0	152.41	243.81	132.93	0	0	0	529.15	44.1
1973	0	0	0	0	0	1.53	125.3	270.21	146.63	140.79	0	0	684.46	57.04
1974	0	0	0	0	0	0	170.11	292.91	135.73	13.09	0	0	611.84	50.99
1975	0	0	0	0	0	0	253.71	209.81	186.83	20.49	0	0	670.84	55.9
1976	0	0	0	0	0	15.43	261.5	223.61	97.33	0	0	0	597.87	49.82
1977	0	0	0	0	0	0	115.11	290.31	129.73	0	0	0	535.15	44.6
1978	0	0	0	0	0	0	250.23	230.91	96.93	0	0	0	578.07	48.17
1979	0	0	0	0	0	0	141.71	328.31	120.63	0	0	0	590.65	49.22
1980	0	0	0	0	0	0	251.81	327.81	195.03	0	0	0	774.65	64.55
1981	0	0	0	0	0	0	239.41	262.21	124.03	0	0	0	625.65	52.14
1982	0	0	0	0	0	0	86.11	219.41	89.03	0	0	0	394.55	32.88
1983	0	0	0	0	0	0	37.11	151.81	158.13	24.59	0	0	371.64	30.97
1984	0	0	0	0	0	0	304.17	168.51	124.73	0	0	0	597.41	49.78
1985	0	0	0	0	0	0	160.11	78.81	84.23	7.59	0	0	330.74	27.56
1986	0	0	0	0	0	0	87.41	141.11	161.53	29.29	0	0	419.34	34.95
1987	0	0	0	0	0	0	106.61	160.81	64.93	0	0	0	332.35	27.7
1988	0	0	0	0	0	0	91.21	201.81	120.23	0	0	0	413.25	34.44
1989	0	0	0	0	0	0	105.36	192.01	121.53	0	0	0	418.9	34.91
1990	0	0	0	0	0	0	131.97	118.71	75.43	0	0	0	326.11	27.18
1991	0	0	0	0	0	0	107.71	201.71	131.43	0	0	0	440.85	36.74
1992	0	0	0	0	0	0	15.61	171.01	78.73	6.19	0	0	271.54	22.63
1993	0	0	0	0	0	0	45.11	202.61	96.83	3.79	0	0	348.34	29.03
1994	0	0	0	0	0	0	10.91	115.31	24.13	0	0	0	150.35	12.53
1995	0	0	0	0	0	81.13	196.2	75.31	57.23	11.29	0	0	421.16	35.1
1996	0	0	0	0	0	0	53.71	201.11	133.53	0	0	0	388.35	32.36
1997	0	0	0	0	0	0	56.21	140.21	22.93	0	0	0	219.35	18.28
1998	0	0	0	0	0	0	144.68	333.81	88.63	0	0	0	567.12	47.26
1999	0	0	0	0	0	0	91.51	120.01	55.63	0	0	0	267.15	22.26
SUM	0	0	0	0	0	111.02	4622.91	7254.18	3855.78	312.09	0	0	16155.98	
AVE	0	0	0	0	0	3.08	128.41	201.51	107.11	8.67	0	0	448.78	

Evaporation (MCM)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	0.13	0.2	0.35	0.39	0.46	0.47	0.48	0.59	0.54	0.4	0.29	0.19	4.49	0.37
1965	0.21	0.27	0.48	0.47	0.48	0.54	0.64	0.64	0.54	0.4	0.26	0.19	5.12	0.43
1966	0.21	0.24	0.4	0.39	0.46	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.76	0.4
1967	0.19	0.19	0.35	0.39	0.46	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.64	0.39
1968	0.21	0.25	0.4	0.41	0.46	0.52	0.62	0.64	0.54	0.43	0.29	0.19	4.96	0.41
1969	0.19	0.19	0.35	0.39	0.46	0.47	0.46	0.56	0.54	0.4	0.26	0.19	4.46	0.37
1970	0.19	0.19	0.35	0.39	0.46	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.64	0.39
1971	0.21	0.24	0.4	0.39	0.46	0.62	0.67	0.64	0.54	0.43	0.29	0.19	5.08	0.42
1972	0.21	0.28	0.43	0.41	0.46	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.85	0.4
1973	0.21	0.24	0.4	0.39	0.46	0.62	0.67	0.64	0.54	0.43	0.29	0.19	5.08	0.42
1974	0.21	0.27	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.43	0.29	0.19	5.03	0.42
1975	0.21	0.27	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.43	0.29	0.19	5.03	0.42
1976	0.21	0.23	0.4	0.39	0.46	0.62	0.67	0.64	0.54	0.4	0.26	0.19	5.01	0.42
1977	0.21	0.24	0.4	0.39	0.46	0.47	0.56	0.64	0.54	0.4	0.29	0.19	4.79	0.4
1978	0.21	0.27	0.48	0.47	0.48	0.57	0.64	0.64	0.54	0.4	0.26	0.19	5.15	0.43
1979	0.21	0.27	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.97	0.41
1980	0.21	0.25	0.43	0.41	0.46	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.82	0.4
1981	0.19	0.19	0.35	0.39	0.46	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.64	0.39
1982	0.21	0.27	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.97	0.41
1983	0.21	0.27	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.43	0.29	0.19	5.03	0.42
1984	0.21	0.28	0.46	0.44	0.46	0.54	0.64	0.64	0.54	0.4	0.26	0.19	5.06	0.42
1985	0.21	0.27	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.43	0.29	0.19	5.03	0.42
1986	0.21	0.24	0.4	0.39	0.46	0.47	0.56	0.64	0.54	0.43	0.29	0.19	4.82	0.4
1987	0.21	0.22	0.4	0.39	0.46	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.74	0.4
1988	0.21	0.28	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.98	0.42
1989	0.21	0.27	0.48	0.47	0.48	0.54	0.62	0.64	0.54	0.4	0.29	0.19	5.13	0.43
1990	0.21	0.27	0.46	0.47	0.48	0.54	0.64	0.64	0.54	0.4	0.26	0.19	5.1	0.43
1991	0.19	0.22	0.35	0.39	0.46	0.47	0.56	0.64	0.54	0.4	0.29	0.19	4.7	0.39
1992	0.21	0.28	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.43	0.29	0.19	5.04	0.42
1993	0.21	0.22	0.4	0.39	0.46	0.47	0.56	0.64	0.54	0.43	0.29	0.19	4.8	0.4
1994	0.21	0.27	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.4	0.23	0.13	4.88	0.41
1995	0.13	0.19	0.35	0.39	0.46	0.62	0.67	0.64	0.54	0.43	0.29	0.19	4.9	0.41
1996	0.21	0.28	0.48	0.47	0.48	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.98	0.42
1997	0.21	0.24	0.43	0.47	0.48	0.47	0.56	0.64	0.54	0.4	0.26	0.19	4.89	0.41
1998	0.19	0.22	0.37	0.39	0.46	0.54	0.64	0.64	0.54	0.4	0.26	0.16	4.81	0.4
1999	0.16	0.19	0.35	0.39	0.46	0.47	0.56	0.64	0.54	0.4	0.23	0.13	4.52	0.38
SUM	7.23	8.76	15.22	15.35	16.86	18.02	20.94	22.91	19.44	14.73	9.75	6.69	175.9	
AVE	0.2	0.24	0.42	0.43	0.47	0.5	0.58	0.64	0.54	0.41	0.27	0.19	4.89	

Evaporation (m3/s)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	0.05	0.08	0.13	0.15	0.17	0.18	0.18	0.22	0.21	0.15	0.11	0.07	1.7	0.14
1965	0.08	0.11	0.18	0.18	0.18	0.21	0.24	0.24	0.21	0.15	0.1	0.07	1.95	0.16
1966	0.08	0.1	0.15	0.15	0.17	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.81	0.15
1967	0.07	0.08	0.13	0.15	0.17	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.76	0.15
1968	0.08	0.1	0.15	0.16	0.17	0.2	0.23	0.24	0.21	0.16	0.11	0.07	1.88	0.16
1969	0.07	0.08	0.13	0.15	0.17	0.18	0.17	0.21	0.21	0.15	0.1	0.07	1.69	0.14
1970	0.07	0.08	0.13	0.15	0.17	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.76	0.15
1971	0.08	0.1	0.15	0.15	0.17	0.24	0.25	0.24	0.21	0.16	0.11	0.07	1.93	0.16
1972	0.08	0.11	0.16	0.16	0.17	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.84	0.15
1973	0.08	0.1	0.15	0.15	0.17	0.24	0.25	0.24	0.21	0.16	0.11	0.07	1.93	0.16
1974	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.16	0.11	0.07	1.91	0.16
1975	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.16	0.11	0.07	1.91	0.16
1976	0.08	0.09	0.15	0.15	0.17	0.24	0.25	0.24	0.21	0.15	0.1	0.07	1.9	0.16
1977	0.08	0.1	0.15	0.15	0.17	0.18	0.21	0.24	0.21	0.15	0.11	0.07	1.82	0.15
1978	0.08	0.11	0.18	0.18	0.18	0.22	0.24	0.24	0.21	0.15	0.1	0.07	1.96	0.16
1979	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.89	0.16
1980	0.08	0.1	0.16	0.16	0.17	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.83	0.15
1981	0.07	0.08	0.13	0.15	0.17	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.76	0.15
1982	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.89	0.16
1983	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.16	0.11	0.07	1.91	0.16
1984	0.08	0.11	0.17	0.17	0.17	0.21	0.24	0.24	0.21	0.15	0.1	0.07	1.92	0.16
1985	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.16	0.11	0.07	1.91	0.16
1986	0.08	0.1	0.15	0.15	0.17	0.18	0.21	0.24	0.21	0.16	0.11	0.07	1.83	0.15
1987	0.08	0.09	0.15	0.15	0.17	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.8	0.15
1988	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.89	0.16
1989	0.08	0.11	0.18	0.18	0.18	0.21	0.23	0.24	0.21	0.15	0.11	0.07	1.95	0.16
1990	0.08	0.11	0.17	0.18	0.18	0.21	0.24	0.24	0.21	0.15	0.1	0.07	1.94	0.16
1991	0.07	0.09	0.13	0.15	0.17	0.18	0.21	0.24	0.21	0.15	0.11	0.07	1.78	0.15
1992	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.16	0.11	0.07	1.91	0.16
1993	0.08	0.09	0.15	0.15	0.17	0.18	0.21	0.24	0.21	0.16	0.11	0.07	1.82	0.15
1994	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.15	0.09	0.05	1.86	0.16
1995	0.05	0.08	0.13	0.15	0.17	0.24	0.25	0.24	0.21	0.16	0.11	0.07	1.86	0.16
1996	0.08	0.11	0.18	0.18	0.18	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.89	0.16
1997	0.08	0.1	0.16	0.18	0.18	0.18	0.21	0.24	0.21	0.15	0.1	0.07	1.86	0.16
1998	0.07	0.09	0.14	0.15	0.17	0.21	0.24	0.24	0.21	0.15	0.1	0.06	1.83	0.15
1999	0.06	0.08	0.13	0.15	0.17	0.18	0.21	0.24	0.21	0.15	0.09	0.05	1.72	0.14
SUM	2.74	3.57	5.69	5.9	6.27	6.93	7.84	8.59	7.56	5.51	3.73	2.47	66.8	
AVE	0.08	0.1	0.16	0.16	0.17	0.19	0.22	0.24	0.21	0.15	0.1	0.07	1.86	

Power Discharge (MCM)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	78.61	69.96	73.84	76.08	177.66	195.49	321.78	331.34	300.8	314.39	209.25	114.07	2263.27	188.61
1965	107.81	88.69	96.02	101.45	113.7	319.26	321.19	310.83	300.8	207.63	91.68	85.31	2144.37	178.7
1966	85.31	77.08	79.41	43.68	52.58	157.9	340.16	310.83	300.8	216.74	82.56	85.33	1832.38	152.7
1967	85.33	64.86	47.06	52.49	58.74	143.13	340.16	310.83	300.8	246.73	82.87	85.31	1818.31	151.53
1968	85.31	79.83	85.33	64.85	86.59	315.03	326.47	310.83	300.8	310.83	126.02	85.33	2177.22	181.44
1969	85.33	51.5	33.94	32.27	37.58	82.48	319.29	336.94	300.8	252.89	82.56	85.33	1700.91	141.74
1970	85.33	61.57	36.88	57.15	87.66	229.7	340.16	310.83	300.8	318.81	122.65	85.31	2036.85	169.74
1971	85.31	77.08	68	68.82	99.18	329.18	310.83	310.83	300.8	310.83	192.38	85.31	2238.55	186.55
1972	85.31	79.8	85.33	56.69	134.8	269.62	340.16	310.83	300.8	317.02	116.87	85.31	2182.54	181.88
1973	85.31	77.08	67.47	60.26	98.11	329.18	310.83	310.83	300.8	310.83	209.74	85.31	2245.75	187.15
1974	104.7	98.85	103.79	122.45	120.93	231	340.16	310.83	300.8	310.83	130.43	85.31	2260.08	188.34
1975	85.31	90.79	97.36	82.56	74	213.37	340.16	310.83	300.8	310.83	157.13	85.31	2148.45	179.04
1976	85.33	79.83	68.86	57.93	102.66	329.18	310.83	310.83	300.8	276.73	83.13	85.31	2091.42	174.29
1977	85.31	77.08	75.85	71.67	118.73	232.81	340.16	310.83	300.8	314.79	188.59	85.95	2202.57	183.55
1978	103.25	88.93	89.32	92.9	200.48	324.03	315.81	310.83	300.8	318.89	141.76	97.73	2384.73	198.73
1979	117.72	98.85	96.29	114.41	155.48	212.86	340.16	310.83	300.8	317.98	128.25	85.31	2278.94	189.91
1980	85.31	79.83	85.33	79.76	92.49	272.99	340.16	310.83	300.8	260.93	83.64	85.31	2077.38	173.12
1981	85.33	59.17	35.81	67.78	102.93	241.89	340.16	310.83	300.8	302.18	100.23	85.31	2032.42	169.37
1982	91.04	92.8	113.7	122.45	148.25	247.85	340.16	310.83	300.8	271.38	113.71	92.11	2245.08	187.09
1983	123.34	105.86	111.02	106.12	142.89	235.41	340.16	310.83	300.8	310.83	158.68	85.31	2331.25	194.27
1984	85.31	79.8	85.33	80.25	161.32	319.7	320.68	310.83	300.8	297.36	122.01	85.31	2248.7	187.39
1985	110.86	98.36	104.86	118.04	180.12	291.13	340.16	310.83	300.8	310.83	163.35	85.31	2414.65	201.22
1986	85.31	77.08	85.36	69.41	67.84	298.13	340.16	310.83	300.8	310.83	170.35	85.31	2201.41	183.45
1987	85.33	77.08	71.59	54.56	76.41	180.2	340.16	310.83	300.8	273.52	110.6	85.31	1966.39	163.87
1988	87.29	84.49	88.79	91.34	125.48	282.84	340.16	310.83	300.8	314.77	107.23	85.31	2219.33	184.94
1989	95.59	84.58	90.93	95.75	175.57	317.26	323.63	310.83	300.8	313.48	141.08	85.31	2334.81	194.57
1990	85.31	77.05	85.33	99.69	164.32	320.09	320.23	310.83	300.8	315.03	85.46	85.31	2249.45	187.45
1991	85.33	72.94	38.22	46.01	82.58	291.13	340.16	310.83	300.8	311.58	158.03	85.31	2122.92	176.91
1992	89.16	86.74	87.45	82.56	111.29	295.86	340.16	310.83	300.8	310.83	147.28	85.31	2158.27	179.86
1993	85.33	77.08	52.26	31.49	73.47	246.81	340.16	310.83	300.8	310.83	164.13	85.31	2078.5	173.21
1994	85.31	77.05	86.89	94.71	115.57	261.58	340.16	310.83	300.8	140.94	82.58	54.99	1951.41	162.62
1995	21.56	17.95	23.49	24.24	68.92	329.18	310.83	310.83	300.8	310.83	239.55	111.13	2069.31	172.44
1996	97.36	79.8	91.17	97.04	117.18	172.68	340.16	310.83	300.8	317.69	99.3	85.31	2109.32	175.78
1997	85.31	77.08	85.33	82.56	116.64	187.45	340.16	310.83	300.8	205.49	82.56	85.33	1959.54	163.3
1998	85.33	77.08	70.23	68.82	123.55	318.53	322.08	310.83	300.8	211.92	82.56	85.33	2057.06	171.42
1999	85.33	54.96	38.76	42.12	86.32	234.63	340.16	310.83	300.8	220.49	82.58	75.42	1872.4	156.03
SUM	3190.62	2798.56	2736.6	2710.36	4052.02	9169.56	11958.16	11236.5	10828.8	10278.49	4640.78	3105.49	76705.94	
AVE	88.63	77.74	76.02	75.29	112.56	254.71	332.17	312.13	300.8	285.51	128.91	86.26	2130.72	

Power Discharge (m3/s)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	29.35	27.92	27.57	29.35	66.33	75.42	120.14	123.71	116.05	117.38	80.73	42.59	856.54	71.38
1965	40.25	36.66	35.85	39.14	42.45	123.17	119.92	116.05	116.05	77.52	35.37	31.85	814.28	67.86
1966	31.85	31.86	29.65	16.85	19.63	60.92	127	116.05	116.05	80.92	31.85	31.86	694.49	57.87
1967	31.86	26.81	17.57	20.25	21.93	55.22	127	116.05	116.05	92.12	31.97	31.85	688.68	57.39
1968	31.85	31.86	31.86	25.02	32.33	121.54	121.89	116.05	116.05	116.05	48.62	31.86	824.98	68.75
1969	31.86	21.29	12.67	12.45	14.03	31.82	119.21	125.8	116.05	94.42	31.85	31.86	643.31	53.61
1970	31.86	25.45	13.77	22.05	32.73	88.62	127	116.05	116.05	118.03	47.32	31.85	771.78	64.32
1971	31.85	31.86	25.39	26.55	37.03	127	116.05	116.05	116.05	116.05	74.22	31.85	849.95	70.83
1972	31.85	31.85	31.86	21.87	50.33	104.02	127	116.05	116.05	118.36	45.09	31.85	826.18	68.85
1973	31.85	31.86	25.19	23.25	36.63	127	116.05	116.05	116.05	116.05	80.92	31.85	852.75	71.06
1974	39.09	40.86	38.75	47.24	45.15	89.12	127	116.05	116.05	116.05	50.32	31.85	857.53	71.46
1975	31.85	37.53	36.35	31.85	27.63	82.32	127	116.05	116.05	116.05	60.62	31.85	815.15	67.93
1976	31.86	31.86	25.71	22.35	38.33	127	116.05	116.05	116.05	116.05	103.32	32.07	31.85	792.5	66.04
1977	31.85	31.86	28.32	27.65	44.33	89.82	127	116.05	116.05	116.05	117.53	72.76	32.09	835.31	69.61
1978	38.55	36.76	33.35	35.84	74.85	125.01	117.91	116.05	116.05	116.05	119.06	54.69	36.49	904.61	75.38
1979	43.95	40.86	35.95	44.14	58.05	82.12	127	116.05	116.05	116.05	118.72	49.48	31.85	864.22	72.02
1980	31.85	31.86	31.86	30.77	34.53	105.32	127	116.05	116.05	116.05	97.42	32.27	31.85	786.83	65.57

1981	31.86	24.46	13.37	26.15	38.43	93.32	127	116.05	116.05	112.82	38.67	31.85	770.03	64.17
1982	33.99	38.36	42.45	47.24	55.35	95.62	127	116.05	116.05	101.32	43.87	34.39	851.69	70.97
1983	46.05	43.76	41.45	40.94	53.35	90.82	127	116.05	116.05	116.05	61.22	31.85	884.59	73.72
1984	31.85	31.85	31.86	30.96	60.23	123.34	119.73	116.05	116.05	111.02	47.07	31.85	851.86	70.99
1985	41.39	40.66	39.15	45.54	67.25	112.32	127	116.05	116.05	116.05	63.02	31.85	916.33	76.36
1986	31.85	31.86	31.87	26.78	25.33	115.02	127	116.05	116.05	116.05	65.72	31.85	835.43	69.62
1987	31.86	31.86	26.73	21.05	28.53	69.52	127	116.05	116.05	102.12	42.67	31.85	745.29	62.11
1988	32.59	33.72	33.15	35.24	46.85	109.12	127	116.05	116.05	117.52	41.37	31.85	840.51	70.04
1989	35.69	34.96	33.95	36.94	65.55	122.4	120.83	116.05	116.05	117.04	54.43	31.85	885.74	73.81
1990	31.85	31.85	31.86	38.46	61.35	123.49	119.56	116.05	116.05	117.62	32.97	31.85	852.96	71.08
1991	31.86	30.15	14.27	17.75	30.83	112.32	127	116.05	116.05	116.33	60.97	31.85	805.43	67.12
1992	33.29	34.62	32.65	31.85	41.55	79.42	127	116.05	116.05	116.05	56.82	31.85	817.2	68.1
1993	31.86	31.86	19.51	12.15	27.43	95.22	127	116.05	116.05	116.05	63.32	31.85	788.35	65.7
1994	31.85	31.85	32.44	36.54	43.15	100.92	127	116.05	116.05	52.62	31.86	20.53	740.86	61.74
1995	8.05	7.42	8.77	9.35	25.73	127	116.05	116.05	116.05	116.05	92.42	41.49	784.43	65.37
1996	36.35	31.85	34.04	37.44	43.75	66.62	127	116.05	116.05	118.61	38.31	31.85	797.92	66.49
1997	31.85	31.86	31.86	31.85	43.55	72.32	127	116.05	116.05	76.72	31.85	31.86	742.82	61.9
1998	31.86	31.86	26.22	26.55	46.13	122.89	120.25	116.05	116.05	79.12	31.85	31.86	780.69	65.06
1999	31.86	22.72	14.47	16.25	32.23	90.52	127	116.05	116.05	82.32	31.86	28.16	709.49	59.12
SUM	1191.24	1146.54	1021.74	1045.65	1512.86	3537.64	4464.64	4195.21	4177.8	3837.53	1790.42	1159.44	29080.71	
AVE	33.09	31.85	28.38	29.05	42.02	98.27	124.02	116.53	116.05	106.6	49.73	32.21	807.8	

Power Discharge During Peaking Time (m3/s)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	117.39	111.7	110.26	117.39	119.22	119.22	121.72	123.71	116.05	117.38	119.21	117.62	1410.87	117.57
1965	117.62	121.8	127	124.18	121.02	123.98	119.92	116.05	116.05	119.49	121.8	120.23	1449.14	120.76
1966	124.13	125.37	118.6	67.39	78.52	119.22	127	116.05	116.05	119.49	123.27	125.01	1360.1	113.34
1967	124.69	107.22	70.26	80.99	87.72	119.22	127	116.05	116.05	119.49	121.8	119.62	1310.11	109.18
1968	122.34	125.96	122.07	100.08	119.22	122.74	121.89	116.05	116.05	116.05	117.62	122.38	1422.45	118.54
1969	125.24	85.14	50.66	49.79	56.12	119.22	120.73	125.79	116.05	119.49	122.73	123.56	1214.52	101.21
1970	125.37	101.79	55.06	88.19	119.22	119.22	127	116.05	116.05	119.03	121.23	119.71	1327.92	110.66
1971	122.98	125.25	101.56	106.19	119.22	127	116.05	116.05	116.05	116.05	117.62	118.23	1402.25	116.85
1972	118.87	125.41	123.57	87.47	119.22	119.22	127	116.05	116.05	118.36	120.4	119.69	1411.31	117.61
1973	122.46	125.58	100.78	92.99	119.22	127	116.05	116.05	116.05	116.05	117.62	118.42	1388.27	115.69
1974	118.42	121.8	127	124.18	121.02	119.22	127	116.05	116.05	116.05	117.62	119.54	1443.95	120.33
1975	119.92	122.28	127	123.75	110.5	119.22	127	116.05	116.05	116.05	117.62	120.46	1435.9	119.66
1976	125.75	124.39	102.82	89.39	119.22	127	116.05	116.05	116.05	119.49	121.8	119.62	1397.63	116.47
1977	123.04	125.3	113.29	110.59	119.22	119.22	127	116.05	116.05	117.53	119.38	117.62	1424.29	118.69
1978	117.62	121.8	127	124.18	121.02	125.44	117.91	116.05	116.05	119.06	121.27	117.62	1445.02	120.42
1979	117.62	121.8	127	124.18	121.02	119.22	127	116.05	116.05	118.72	120.84	119.43	1448.93	120.74
1980	121.76	126.7	123.49	120.72	119.22	119.22	127	116.05	116.05	119.49	121.8	121.62	1453.12	121.09
1981	126.07	97.85	53.46	104.59	119.22	119.22	127	116.05	116.05	119.49	121.8	118.81	1339.61	111.63
1982	118.81	121.8	127	124.18	121.02	119.22	127	116.05	116.05	119.49	121.8	117.62	1450.04	120.84
1983	117.62	121.8	127	124.18	121.02	119.22	127	116.05	116.05	116.05	117.62	118.29	1441.9	120.16
1984	118.5	123.47	125.01	121.22	119.22	124.11	119.73	116.05	116.05	119.49	121.8	117.96	1442.61	120.22
1985	117.96	121.8	127	124.18	121.02	119.22	127	116.05	116.05	116.05	117.62	119.1	1443.05	120.25
1986	121.1	126.56	122.13	107.13	101.32	119.22	127	116.05	116.05	116.05	117.62	120.39	1410.62	117.55
1987	125.01	124.54	106.91	84.19	114.12	119.22	127	116.05	116.05	119.49	121.8	118.4	1392.78	116.07
1988	118.4	121.8	127	124.18	121.02	119.22	127	116.05	116.05	119.49	121.8	118.53	1450.54	120.88
1989	118.53	121.8	127	124.18	121.02	123.39	120.83	116.05	116.05	117.04	118.8	119.01	1443.7	120.31
1990	120	124.57	125.78	123.54	121.02	124.23	119.56	116.05	116.05	119.49	121.8	121.31	1453.4	121.12
1991	126.67	120.59	57.06	70.99	119.35	119.22	127	116.05	116.05	116.33	117.95	118.44	1325.7	110.48
1992	118.44	121.8	127	124.13	120.96	119.22	127	116.05	116.05	116.05	117.62	120.44	1444.76	120.4
1993	125.29	124.4	78.04	48.59	109.72	119.22	127	116.05	116.05	116.05	117.62	119.74	1317.77	109.81
1994	121.32	125.1	126.46	124.18	121.02	119.22	127	116.05	116.05	119.49	125.85	82.13	1423.87	118.66
1995	32.19	29.7	35.06	37.39	102.92	127	116.05	116.05	116.05	116.05	117.62	117.62	1063.7	88.64
1996	117.62	122.74	126.54	124.18	121.02	119.22	127	116.05	116.05	118.61	120.7	120.18	1449.91	120.83
1997	123.11	126.5	123.98	122.61	120.83	119.22	127	116.05	116.05	119.49	124.53	124.76	1464.13	122.01
1998	126.6	122.99	104.9	106.19	119.22	123.77	120.25	116.05	116.05	119.49	124.31	127.36	1427.18	118.93
1999	124	90.89	57.86	64.99	119.22	119.22	127	116.05	116.05	119.49	126.67	112.62	1294.06	107.84
SUM	4282.46	4209.99	3832.61	3716.47	4124.18	4356.16	4467.74	4195.2	4177.8	4250.45	4338.96	4273.09	50225.11	
AVE	118.96	116.94	106.46	103.24	114.56	121	124.1	116.53	116.05	118.07	120.53	118.7	1395.14	

QU=
IJTWL=
Ijeff=

Average Water Level (m)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE	Days
1964	391.02	391.02	391.02	391.02	391.02	391.02	394.91	407.37	415	413.33	411.3	413.06	4801.09	400.09	1964
1965	413.06	408.87	404.3	399.39	394.02	398.87	410.58	415	415	411.01	408.87	410.28	4889.25	407.44	1965
1966	407.07	401.45	394.8	391.02	391.02	391.02	404.3	415	415	411.01	407.69	406.47	4835.85	402.99	1966
1967	400.26	393.7	391.02	391.02	391.02	391.02	404.3	415	415	411.01	408.87	410.89	4823.11	401.93	1967
1968	408.43	402.47	395.79	391.85	391.02	396.69	408.8	415	415	415	413.06	408.39	4861.5	405.13	1968
1969	401.23	393.87	391.02	391.02	391.02	391.02	393.2	405.97	415	411.01	408.11	407.48	4799.95	400	1969
1970	401.44	394.3	391.02	391.02	391.02	391.02	404.3	415	415	411.49	409.37	410.79	4826.77	402.15	1970
1971	407.92	401.23	394.18	391.02	391.02	404.3	415	415	415	415	413.06	412.35	4875.08	406.26	1971
1972	411.66	406.21	398.34	392.37	391.02	391.02	404.3	415	415	412.21	410.12	410.82	4858.07	404.84	1972
1973	408.33	401.8	394.34	391.02	391.02	404.3	415	415	415	415	413.06	412.14	4876.01	406.33	1973
1974	412.14	408.87	404.3	399.39	394.02	391.02	404.3	415	415	415	413.06	410.96	4883.06	406.92	1974
1975	410.59	408.48	404.3	398.65	393.19	391.02	404.3	415	415	415	413.06	410.06	4878.65	406.55	1975
1976	405.99	399.74	393.93	391.02	391.02	404.3	415	415	415	411.01	408.87	410.89	4861.77	405.15	1976
1977	407.87	401.33	394.48	391.02	391.02	391.02	404.3	415	415	413.16	411.12	413.06	4848.38	404.03	1977
1978	413.06	408.87	404.3	399.39	394.02	401.47	412.72	415	415	411.46	409.33	413.06	4897.68	408.14	1978
1979	413.06	408.87	404.3	399.39	394.02	391.02	404.3	415	415	411.82	409.72	411.08	4877.58	406.47	1979
1980	408.91	403.77	398.2	393.3	391.02	391.02	404.3	415	415	411.01	408.87	409.02	4849.42	404.12	1980
1981	402.66	394.7	391.02	391.02	391.02	391.02	404.3	415	415	411.01	408.87	411.72	4827.34	402.28	1981
1982	411.72	408.87	404.3	399.39	394.02	391.02	404.3	415	415	411.01	408.87	413.06	4876.56	406.38	1982
1983	413.06	408.87	404.3	399.39	394.02	391.02	404.3	415	415	415	413.06	412.28	4885.3	407.11	1983
1984	412.06	407.54	400.82	394.17	391.02	399.1	410.78	415	415	411.01	408.87	412.65	4878.02	406.5	1984
1985	412.65	408.87	404.3	399.39	394.02	391.02	404.3	415	415	415	413.06	411.41	4884.02	407	1985
1986	409.48	403.52	395.89	391.31	391.02	391.02	404.3	415	415	415	413.06	410.14	4854.74	404.56	1986
1987	406.47	400	393.74	391.02	391.02	391.02	404.3	415	415	411.01	408.87	412.17	4839.62	403.3	1987
1988	412.17	408.87	404.3	399.39	394.02	391.02	404.3	415	415	411.01	408.87	412.03	4875.98	406.33	1988
1989	412.03	408.87	404.3	399.39	394.02	397.83	409.72	415	415	413.74	411.74	411.51	4893.15	407.76	1989
1990	410.51	406.76	402.15	398.29	394.02	399.31	410.95	415	415	411.01	408.87	409.3	4881.17	406.76	1990
1991	403.71	395.55	391.02	391.02	391.02	391.02	404.3	415	415	414.63	412.67	412.12	4837.06	403.09	1991
1992	412.12	408.87	404.3	399.3	393.92	391.02	404.3	415	415	415	413.06	410.09	4881.58	406.83	1992
1993	406.28	399.77	393.64	391.02	391.02	391.02	404.3	415	415	415	413.06	410.77	4845.88	403.82	1993
1994	409.28	406.41	403.34	399.39	394.02	391.02	404.3	415	415	411.01	402.27	394.45	4845.49	403.79	1994
1995	391.02	391.02	391.02	391.02	391.02	404.3	415	415	415	415	413.06	413.06	4845.52	403.79	1995
1996	413.06	408.1	403.48	399.39	394.02	391.02	404.3	415	415	411.94	409.84	410.33	4875.48	406.29	1996
1997	407.82	403.41	399.05	396.7	393.7	391.02	404.3	415	415	411.01	406.79	406.63	4850.43	404.2	1997
1998	403.6	397.35	392.39	391.02	391.02	398.49	410.27	415	415	411.01	406.94	405.06	4837.15	403.1	1998

	1999	399.08	393.14	391.02	391.02	391.02	391.02	404.3	415	415	411.01	403.72	396.1	4801.43	400.12	1999
SUM		14670.82	14495.34	14324.02	14205.55	14120.47	14184.46	14620.83	14923.34	14940	14854.94	14763.09	14755.68	174858.5		
AVE		407.52	402.65	397.89	394.6	392.24	394.01	406.13	414.54	415	412.64	410.09	409.88	4857.18		

Effective Head (m)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	99.02	99.28	99.34	99.01	98.93	98.93	102.7	115.06	123.06	121.33	119.21	121.04	1296.91	108.08
1965	121.04	116.65	111.82	107.05	101.84	106.54	118.46	123.06	123.06	118.91	116.65	118.15	1383.23	115.27
1966	114.73	109.05	102.74	100.89	100.56	98.93	111.82	123.06	123.06	118.91	115.4	114.09	1333.24	111.1
1967	107.9	102.17	100.81	100.48	100.25	98.93	111.82	123.06	123.06	118.91	116.65	118.78	1322.82	110.24
1968	116.18	110.04	103.56	100.61	98.93	104.42	116.58	123.06	123.06	123.06	121.04	116.15	1356.69	113.06
1969	108.84	103.2	101.29	101.31	101.18	98.93	101.03	113.55	123.06	118.91	115.85	115.18	1302.33	108.53
1970	109.04	102.99	101.2	100.24	98.93	98.93	111.82	123.06	123.06	119.41	117.18	118.68	1324.54	110.38
1971	115.64	108.84	102.88	99.52	98.93	111.82	123.06	123.06	123.06	123.06	121.04	120.31	1371.22	114.27
1972	119.59	113.81	106.04	101.62	98.93	98.93	111.82	123.06	123.06	120.16	117.98	118.7	1353.7	112.81
1973	116.08	109.4	103.08	100.06	98.93	111.82	123.06	123.06	123.06	123.06	121.04	120.09	1372.74	114.4
1974	120.09	116.65	111.82	107.05	101.84	98.93	111.82	123.06	123.06	123.06	121.04	118.86	1377.28	114.77
1975	118.46	116.24	111.82	106.34	101.51	98.93	111.82	123.06	123.06	123.06	121.04	117.91	1373.25	114.44
1976	113.58	107.39	102.58	100.19	98.93	111.82	123.06	123.06	123.06	118.91	116.65	118.78	1358.01	113.17
1977	115.59	108.94	102.67	99.33	98.93	98.93	111.82	123.06	123.06	121.15	119.03	121.04	1343.55	111.96
1978	121.04	116.65	111.82	107.05	101.84	109.07	120.69	123.06	123.06	119.37	117.14	121.04	1391.83	115.99
1979	121.04	116.65	111.82	107.05	101.84	98.93	111.82	123.06	123.06	119.76	117.55	118.98	1371.56	114.3
1980	116.69	111.31	105.9	101.13	98.93	98.93	111.82	123.06	123.06	118.91	116.65	116.81	1343.2	111.93
1981	110.23	103.55	101.24	99.59	98.93	98.93	111.82	123.06	123.06	118.91	116.65	119.65	1325.62	110.47
1982	119.65	116.65	111.82	107.05	101.84	98.93	111.82	123.06	123.06	118.91	116.65	121.04	1370.48	114.21
1983	121.04	116.65	111.82	107.05	101.84	98.93	111.82	123.06	123.06	123.06	121.04	120.24	1379.61	114.97
1984	120.01	115.24	108.44	101.99	98.93	106.77	118.66	123.06	123.06	118.91	116.65	120.62	1372.34	114.36
1985	120.62	116.65	111.82	107.05	101.84	98.93	111.82	123.06	123.06	123.06	121.04	119.33	1378.28	114.86
1986	117.3	111.07	103.66	99.78	99.73	98.93	111.82	123.06	123.06	123.06	121.04	117.99	1350.5	112.54
1987	114.09	107.65	102.22	100.38	99.17	98.93	111.82	123.06	123.06	118.91	116.65	120.12	1336.06	111.34
1988	120.12	116.65	111.82	107.05	101.84	98.93	111.82	123.06	123.06	118.91	116.65	119.97	1369.88	114.16
1989	119.97	116.65	111.82	107.05	101.84	105.53	117.56	123.06	123.06	121.76	119.67	119.43	1387.4	115.62
1990	118.39	114.41	109.73	105.99	101.84	106.97	118.84	123.06	123.06	118.91	116.65	117.1	1374.95	114.58
1991	111.25	103.39	101.15	100.79	98.92	98.93	111.82	123.06	123.06	122.68	120.64	120.07	1335.76	111.31
1992	120.07	116.65	111.82	106.97	101.75	98.93	111.82	123.06	123.06	123.06	121.04	117.94	1376.17	114.68
1993	113.89	107.42	103.2	101.34	99.37	98.93	111.82	123.06	123.06	123.06	121.04	118.65	1344.84	112.07
1994	117.09	114.02	110.89	107.05	101.84	98.93	111.82	123.06	123.06	118.91	109.85	103.88	1340.4	111.7
1995	101.61	101.64	101.57	101.53	99.66	111.82	123.06	123.06	123.06	123.06	121.04	121.04	1352.15	112.68
1996	121.04	115.84	111.03	107.05	101.84	98.93	111.82	123.06	123.06	119.88	117.68	118.2	1369.43	114.12
1997	115.53	110.96	106.72	104.45	101.53	98.93	111.82	123.06	123.06	118.91	114.44	114.27	1343.68	111.97
1998	111.14	105.08	100.96	99.52	98.93	106.18	118.13	123.06	123.06	118.91	114.6	112.56	1332.13	111.01
1999	106.75	102.26	101.14	100.96	98.93	98.93	111.82	123.06	123.06	118.91	111.25	104.32	1301.39	108.45
SUM	4154.34	3981.69	3824.06	3711.57	3611.8	3666.01	4096.75	4412.65	4430.16	4341.72	4245.41	4241.01	48717.17	
AVE	115.4	110.6	106.22	103.1	100.33	101.83	113.8	122.57	123.06	120.6	117.93	117.81	1353.25	

Power (MW)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	103.7	98.66	97.34	103.7	105.23	105.23	111.55	127	127	127	127	127	1360.41	113.37
1965	127	127	125.91	118.42	110	117.69	127	127	127	127	127	127	1488.02	124
1966	127	121.59	108.86	53.83	65.39	105.23	125.91	127	127	127	127	127	1342.81	111.9
1967	119.77	97.24	56.82	67.94	74.82	105.23	125.91	127	127	127	127	127	1282.73	106.89
1968	127	123.14	112.79	88.26	105.23	114.32	127	127	127	127	127	127	1432.74	119.4
1969	121.25	74.6	36.61	35.67	42.43	105.23	108.86	127	127	127	127	127	1159.65	96.64
1970	121.57	92.44	41.32	75.3	105.23	105.23	125.91	127	127	127	127	127	1302	108.5
1971	127	121.26	92.09	93.49	105.23	125.91	127	127	127	127	127	127	1426.98	118.92
1972	127	127	116.79	75.74	105.23	105.23	125.91	127	127	127	127	127	1417.9	118.16
1973	127	122.13	91.44	80.21	105.23	125.91	127	127	127	127	127	127	1413.92	117.83
1974	127	127	125.91	118.42	110	105.23	125.91	127	127	127	127	127	1474.47	122.87
1975	127	127	125.91	117.28	99.85	105.23	125.91	127	127	127	127	127	1463.18	121.93
1976	127	118.96	93.12	76.51	105.23	125.91	127	127	127	127	127	127	1408.73	117.39
1977	127	121.4	103.82	97.64	105.23	105.23	125.91	127	127	127	127	127	1421.23	118.44
1978	127	127	125.91	118.42	110	121.67	127	127	127	127	127	127	1492	124.33
1979	127	127	125.91	118.42	110	105.23	125.91	127	127	127	127	127	1474.47	122.87
1980	127	125.12	116.58	108.96	105.23	105.23	125.91	127	127	127	127	127	1449.03	120.75
1981	123.44	88.74	39.62	91.94	105.23	105.23	125.91	127	127	127	127	127	1315.11	109.59
1982	127	127	125.91	118.42	110	105.23	125.91	127	127	127	127	127	1474.47	122.87
1983	127	127	125.91	118.42	110	105.23	125.91	127	127	127	127	127	1474.47	122.87
1984	127	127	120.62	110.34	105.23	118.05	127	127	127	127	127	127	1470.24	122.52
1985	127	127	125.91	118.42	110	105.23	125.91	127	127	127	127	127	1474.47	122.87
1986	127	124.74	112.96	94.69	88.71	105.23	125.91	127	127	127	127	127	1414.24	117.85
1987	127	119.37	96.98	71.23	100.87	105.23	125.91	127	127	127	127	127	1381.59	115.13
1988	127	127	125.91	118.42	110	105.23	125.91	127	127	127	127	127	1474.47	122.87
1989	127	127	125.91	118.42	110	116.08	127	127	127	127	127	127	1486.41	123.87
1990	127	127	122.66	116.71	110	118.37	127	127	127	127	127	127	1483.74	123.65
1991	125.02	111.35	43.41	57.58	105.33	105.23	125.91	127	127	127	127	127	1308.83	109.07
1992	127	127	125.91	118.28	109.85	105.23	125.91	127	127	127	127	127	1474.18	122.85
1993	127	119.01	66.86	34.37	96.83	105.23	125.91	127	127	127	127	127	1310.21	109.18
1994	127	127	124.47	118.42	110	105.23	125.91	127	127	127	122.84	71.86	1413.73	117.81
1995	17.18	14.84	20.01	22.38	90.31	125.91	127	127	127	127	127	127	1052.63	87.72
1996	127	127	124.68	118.42	110	105.23	125.91	127	127	127	127	127	1473.24	122.77
1997	127	124.57	117.89	114.24	109.49	105.23	125.91	127	127	127	127	127	1459.33	121.61
1998	124.85	115.25	93.64	93.49	105.23	117.11	127	127	127	127	127	127	1411.57	117.63
1999	117.94	79.98	44.23	51.33	105.23	105.23	125.91	127	127	127	125.03	104.94	1240.82	103.4
SUM	4403.72	4146.39	3580.62	3353.73	3671.87	3957.68	4513.34	4572	4572	4572	4565.87	4494.8	50404.02	
AVE	122.33	115.18	99.46	93.16	102	109.94	125.37	127	127	127	126.83	124.86	1400.11	

Peak Hours (h)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	6	6	6	6	13.33	15.15	23.69	24	24	24	16.25	8.69	173.11	14.43
1965	8.21	7.22	6.77	7.56	8.4	23.84	24	24	24	15.57	6.97	6.36	162.9	13.58
1966	6.16	6.1	6	6	6	12.24	24	24	24	16.25	6.2	6.12	143.07	11.92
1967	6.13	6	6	6	6	11.09	24	24	24	18.5	6.3	6.39	144.41	12.03
1968	6.25	6.07	6.26	6	6.5	23.76	24	24	24	24	9.92	6.25	167.01	13.92
1969	6.1	6	6	6	6	6.39	23.7	24	24	18.96	6.23	6.19	139.57	11.63
1970	6.1	6	6	6	6.58	17.8	24	24	24	24	9.37	6.39	160.24	13.35
1971	6.22	6.1	6	6	7.44	24	24	24	24	24	15.14	6.47	173.37	14.45
1972	6.43	6.1	6.18	6	10.11	20.9	24	24	24	24	8.99	6.39	167.1	13.93
1973	6.24	6.09	6	6	7.36	24	24	24	24	24	16.51	6.46	174.66	14.56

1974	7.92	8.05	7.32	9.12	8.94	17.9	24	24	24	24	10.27	6.39	171.91	14.33
1975	6.37	7.37	6.87	6.17	6	16.54	24	24	24	24	12.37	6.35	164.04	13.67
1976	6.08	6.14	6	6	7.7	24	24	24	24	20.75	6.32	6.39	161.38	13.45
1977	6.21	6.1	6	6	8.91	18.04	24	24	24	24	14.63	6.55	168.44	14.04
1978	7.87	7.24	6.3	6.92	14.82	23.92	24	24	24	24	10.82	7.45	181.34	15.11
1979	8.97	8.05	6.79	8.52	11.49	16.5	24	24	24	24	9.83	6.4	172.55	14.38
1980	6.28	6.03	6.19	6.11	6.94	21.16	24	24	24	19.57	6.36	6.29	156.93	13.08
1981	6.06	6	6	6	7.72	18.75	24	24	24	22.66	7.62	6.43	159.24	13.27
1982	6.87	7.56	8.02	9.12	10.96	19.21	24	24	24	20.35	8.64	7.02	169.75	14.15
1983	9.4	8.62	7.83	7.91	10.56	18.25	24	24	24	24	12.49	6.46	177.52	14.79
1984	6.45	6.19	6.11	6.13	12.1	23.85	24	24	24	22.3	9.28	6.48	170.89	14.24
1985	8.42	8.01	7.4	8.79	13.31	22.56	24	24	24	24	12.86	6.42	183.77	15.31
1986	6.31	6.04	6.25	6	6	23.11	24	24	24	24	13.41	6.35	169.47	14.12
1987	6.12	6.14	6	6	6	13.97	24	24	24	20.51	8.41	6.46	151.61	12.63
1988	6.51	6.64	6.26	6.81	9.28	21.92	24	24	24	23.6	8.15	6.45	167.72	13.98
1989	7.23	6.89	6.41	7.13	12.98	23.81	24	24	24	24	11	6.42	177.87	14.82
1990	6.37	6.14	6.08	7.47	12.15	23.86	24	24	24	23.62	6.5	6.3	170.49	14.21
1991	6.04	6	6	6	6.19	22.56	24	24	24	24	12.41	6.45	167.65	13.97
1992	6.75	6.82	6.17	6.15	8.23	15.96	24	24	24	24	11.59	6.35	164.02	13.67
1993	6.1	6.14	6	6	6	19.13	24	24	24	24	12.92	6.38	164.67	13.72
1994	6.3	6.11	6.15	7.06	8.54	20.27	24	24	24	10.57	6.07	6	149.07	12.42
1995	6	6	6	6	6	24	24	24	24	24	18.86	8.47	177.33	14.78
1996	7.42	6.23	6.45	7.23	8.66	13.38	24	24	24	24	7.62	6.36	159.35	13.28
1997	6.21	6.04	6.16	6.23	8.64	14.53	24	24	24	15.41	6.14	6.13	147.49	12.29
1998	6.04	6.21	6	6	9.27	23.83	24	24	24	15.89	6.15	6	157.39	13.12
1999	6.16	6	6	6	6.47	18.19	24	24	24	16.53	6.04	6	149.39	12.45
SUM	240.4	234.44	227.97	238.43	311.58	698.37	863.39	864	864	781.04	358.64	234.46	5916.72	
AVE	6.68	6.51	6.33	6.62	8.66	19.4	23.98	24	24	21.7	9.96	6.51	164.35	

Total Energy(GWh)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	19.29	17.17	18.1	18.67	43.47	47.83	81.92	94.49	91.44	94.49	61.92	34.22	623.01	51.92
1965	32.34	25.68	26.44	26.85	28.66	84.18	94.49	94.49	91.44	61.3	26.55	25.03	617.45	51.45
1966	24.25	20.75	20.25	9.69	12.16	38.64	93.67	94.49	91.44	63.99	23.63	24.08	517.04	43.09
1967	22.76	16.34	10.57	12.23	13.92	35.02	93.67	94.49	91.44	72.84	24	25.16	512.44	42.7
1968	24.6	21.67	21.88	15.89	21.19	81.5	94.49	94.49	91.44	94.49	37.8	24.59	624.03	52
1969	22.94	12.53	6.81	6.42	7.89	20.18	79.97	94.49	91.44	74.66	23.73	24.36	465.42	38.79
1970	22.98	15.53	7.68	13.55	21.45	56.2	93.67	94.49	91.44	94.49	35.7	25.14	572.32	47.69
1971	24.47	20.72	17.13	16.83	24.27	90.65	94.49	94.49	91.44	94.49	57.7	25.46	652.14	54.35
1972	25.32	22.45	22.39	13.63	32.98	65.97	93.67	94.49	91.44	94.49	34.25	25.15	616.23	51.35
1973	24.58	20.81	17.01	14.44	24.01	90.65	94.49	94.49	91.44	94.49	62.91	25.41	654.73	54.56
1974	31.19	28.63	28.58	32.41	30.48	56.52	93.67	94.49	91.44	94.49	39.12	25.18	646.2	53.85
1975	25.1	26.2	26.81	21.72	18.57	52.21	93.67	94.49	91.44	94.49	47.13	24.99	616.82	51.4
1976	23.94	21.19	17.32	13.77	25.12	90.65	94.49	94.49	91.44	81.7	24.08	25.16	603.35	50.28
1977	24.46	20.73	19.31	17.58	29.05	56.97	93.67	94.49	91.44	94.49	55.73	25.78	623.7	51.98
1978	30.97	25.75	24.6	24.59	50.54	87.3	94.49	94.49	91.44	94.49	41.24	29.32	689.22	57.44
1979	35.31	28.63	26.51	30.28	39.19	52.08	93.67	94.49	91.44	94.49	37.45	25.2	648.74	54.06
1980	24.72	21.89	22.36	19.99	22.63	66.8	93.67	94.49	91.44	77.03	24.23	24.75	584	48.67
1981	23.2	14.91	7.37	16.55	25.18	59.18	93.67	94.49	91.44	89.21	29.03	25.33	569.56	47.46
1982	27.03	26.88	31.31	32.41	37.37	60.64	93.67	94.49	91.44	80.12	32.94	27.63	635.93	52.99
1983	37	30.66	30.57	28.09	36.02	57.6	93.67	94.49	91.44	94.49	47.59	25.44	667.06	55.59
1984	25.4	22.8	22.86	20.27	39.47	84.47	94.49	94.49	91.44	87.79	35.34	25.51	644.33	53.69
1985	33.16	28.49	28.87	31.24	45.41	71.23	93.67	94.49	91.44	94.49	48.99	25.27	686.75	57.23
1986	24.85	21.1	21.9	17.04	16.5	72.95	93.67	94.49	91.44	94.49	51.09	25	624.52	52.04
1987	24.08	20.51	18.04	12.82	18.76	44.09	93.67	94.49	91.44	80.75	32.03	25.42	556.1	46.34
1988	26.01	24.47	24.45	24.18	31.63	69.2	93.67	94.49	91.44	92.93	31.06	25.39	628.92	52.41
1989	28.45	24.49	25.04	25.34	44.26	82.91	94.49	94.49	91.44	94.49	41.9	25.29	672.59	56.05
1990	25.08	21.82	23.1	26.14	41.42	84.72	94.49	94.49	91.44	93.01	24.75	24.81	645.27	53.77
1991	23.39	18.71	8.07	10.37	20.22	71.23	93.67	94.49	91.44	94.49	47.27	25.41	598.76	49.9
1992	26.56	25.13	24.08	21.84	28.03	50.37	93.67	94.49	91.44	94.49	44.17	24.99	619.26	51.61
1993	24.02	20.47	12.44	6.19	18.01	60.39	93.67	94.49	91.44	94.49	49.23	25.14	589.98	49.17
1994	24.81	21.73	23.75	25.07	29.13	64	93.67	94.49	91.44	41.61	22.39	13.37	545.46	45.46
1995	3.2	2.49	3.72	4.03	16.8	90.65	94.49	94.49	91.44	94.49	71.85	33.33	600.98	50.08
1996	29.2	22.94	24.95	25.69	29.54	42.25	93.67	94.49	91.44	94.49	29.02	25.04	602.72	50.23
1997	24.45	21.08	22.52	21.34	29.31	45.87	93.67	94.49	91.44	60.67	23.39	24.13	552.36	46.03
1998	23.37	20.04	17.42	16.83	30.23	83.72	94.49	94.49	91.44	62.56	23.43	23.63	581.65	48.47
1999	22.53	13.44	8.23	9.24	21.12	57.41	93.67	94.49	91.44	65.09	22.64	19.52	518.82	43.24
SUM	915.01	768.83	712.44	683.22	1003.99	2326.23	3355.69	3401.64	3291.84	3075.06	1365.28	908.63	21807.86	
AVE	25.42	21.36	19.79	18.98	27.89	64.62	93.21	94.49	91.44	85.42	37.92	25.24	605.77	

Primary Energy(GWh)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	19.29	17.17	18.1	18.67	19.57	18.94	20.75	23.62	22.86	23.62	22.86	23.62	249.07	20.76
1965	23.62	21.34	23.42	21.32	20.46	21.18	23.62	23.62	22.86	23.62	22.86	23.62	271.54	22.63
1966	23.62	20.43	20.25	9.69	12.16	18.94	23.42	23.62	22.86	23.62	22.86	23.62	245.09	20.42
1967	22.28	16.34	10.57	12.23	13.92	18.94	23.42	23.62	22.86	23.62	22.86	23.62	234.28	19.52
1968	23.62	21.43	20.98	15.89	19.57	20.58	23.62	23.62	22.86	23.62	22.86	23.62	262.27	21.86
1969	22.55	12.53	6.81	6.42	7.89	18.94	20.25	23.62	22.86	23.62	22.86	23.62	211.97	17.66
1970	22.61	15.53	7.68	13.55	19.57	18.94	23.42	23.62	22.86	23.62	22.86	23.62	237.88	19.82
1971	23.62	20.37	17.13	16.83	19.57	22.66	23.62	23.62	22.86	23.62	22.86	23.62	260.38	21.7
1972	23.62	22.1	21.72	13.63	19.57	18.94	23.42	23.62	22.86	23.62	22.86	23.62	259.58	21.63
1973	23.62	20.52	17.01	14.44	19.57	22.66	23.62	23.62	22.86	23.62	22.86	23.62	258.02	21.5
1974	23.62	21.34	23.42	21.32	20.46	18.94	23.42	23.62	22.86	23.62	22.86	23.62	269.1	22.43
1975	23.62	21.34	23.42	21.11	18.57	18.94	23.42	23.62	22.86	23.62	22.86	23.62	267	22.25
1976	23.62	20.7	17.32	13.77	19.57	22.66	23.62	23.62	22.86	23.62	22.86	23.62	257.84	21.49
1977	23.62	20.4	19.31	17.58	19.57	18.94	23.42	23.62	22.86	23.62	22.86	23.62	259.42	21.62
1978	23.62	21.34	23.42	21.32	20.46	21.9	23.62	23.62	22.86	23.62	22.86	23.62	272.26	22.69
1979	23.62	21.34	23.42	21.32	20.46	18.94	23.42	23.62	22.86	23.62	22.86	23.62	269.1	22.43
1980	23.62	21.77	21.68	19.61	19.57	18.94	23.42	23.62	22.86	23.62	22.86	23.62	265.19	22.1
1981	22.96	14.91	7.37	16.55	19.57	18.94	23.42	23.62	22.86	23.62	22.86	23.62	240.3	20.03
1982	23.62	21.34	23.42	21.32	20.46	18.94	23.42	23.62	22.86	23.62	22.86	23.62	269.1	22.43
1983	23.62	21.34	23.42	21.32	20.46	18.94	23.42	23.62	22.86	23.62	22.86	23.62	269.1	22.43
1984	23.62	22.1	22.44	19.86	19.57	21.25	23.62	23.62	22.86	23.62	22.86	23.62	269.04	22.42
1985	23.62	21.34	23.42	21.32	20.46	18.94	23.42	23.62	22.86	23.62	22.86	23.62	269.1	22.43
1986	23.62	20.96	21.01	17.04	16.5	18.94	23.42	23.62	22.86	23.62	22.86	23.62	258.07	21.51
1987	23.62	20.05	18.04	12.82	18.76	18.94	23.42	23.62	22.86	23.62	22.86	23.62	252.23	21.02
1988	23.62	22.1	23.42	21.32	20.46	18.94	23.42	23.62	22.86	23.62	22.86	23.62	269.86	22.49
1989	23.62	21.34	23.42	21.32	20.46	20.89	23.62	23.62	22.86	23.62	22.86	23.62	271.25	22.6
1990	23.62	21.34	22.81	21.01	20.46	21.31	23.62	23.62	22.86	23.62	22.86	23.62	270.75	22.56
1991	23.25	18.71	8.07	10.37	19.59	18.94	23.42	23.62	22.86	23.62	22.86	23.62	238.93	19.91

1992	23.62	22.1	23.42	21.29	20.43	18.94	23.42	23.62	22.86	23.62	22.86	23.62	269.8	22.48
1993	23.62	19.99	12.44	6.19	18.01	18.94	23.42	23.62	22.86	23.62	22.86	23.62	239.19	19.93
1994	23.62	21.34	23.15	21.32	20.46	18.94	23.42	23.62	22.86	23.62	22.11	13.37	257.83	21.49
1995	3.2	2.49	3.72	4.03	16.8	22.66	23.62	23.62	22.86	23.62	22.86	23.62	193.1	16.09
1996	23.62	22.1	23.19	21.32	20.46	18.94	23.42	23.62	22.86	23.62	22.86	23.62	269.63	22.47
1997	23.62	20.93	21.93	20.56	20.37	18.94	23.42	23.62	22.86	23.62	22.86	23.62	266.35	22.2
1998	23.22	19.36	17.42	16.83	19.57	21.08	23.62	23.62	22.86	23.62	22.86	23.62	257.68	21.47
1999	21.94	13.44	8.23	9.24	19.57	18.94	23.42	23.62	22.86	23.62	22.51	19.52	226.91	18.91
SUM	819.04	703.27	666	603.73	682.93	712.33	839.48	850.32	822.96	850.32	821.86	835.97	9208.21	
AVE	22.75	19.54	18.5	16.77	18.97	19.79	23.32	23.62	22.86	23.62	22.83	23.22	255.78	

Secondary Energy(GWh)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	0	0	0	0	23.9	28.89	61.17	70.87	68.58	70.87	39.06	10.6	373.94	31.16
1965	8.72	4.34	3.02	5.53	8.2	63	70.87	70.87	68.58	37.68	3.69	1.41	345.91	28.83
1966	0.63	0.32	0	0	0	19.7	70.25	70.87	68.58	40.37	0.77	0.46	271.95	22.66
1967	0.48	0	0	0	0	16.08	70.25	70.87	68.58	49.22	1.14	1.54	278.16	23.18
1968	0.98	0.24	0.9	0	1.62	60.92	70.87	70.87	68.58	70.87	14.94	0.97	361.76	30.15
1969	0.39	0	0	0	0	1.24	59.72	70.87	68.58	51.04	0.87	0.74	253.45	21.12
1970	0.37	0	0	0	1.88	37.26	70.25	70.87	68.58	70.87	12.84	1.52	334.44	27.87
1971	0.85	0.35	0	0	4.7	67.99	70.87	70.87	68.58	70.87	34.84	1.84	391.76	32.65
1972	1.7	0.35	0.67	0	13.41	47.03	70.25	70.87	68.58	70.87	11.39	1.53	356.65	29.72
1973	0.96	0.29	0	0	4.44	67.99	70.87	70.87	68.58	70.87	40.05	1.79	396.71	33.06
1974	7.57	7.29	5.16	11.09	10.02	37.58	70.25	70.87	68.58	70.87	16.26	1.56	377.1	31.43
1975	1.48	4.86	3.39	0.61	0	33.27	70.25	70.87	68.58	70.87	24.27	1.37	349.82	29.15
1976	0.32	0.49	0	0	5.55	67.99	70.87	70.87	68.58	58.08	1.22	1.54	345.51	28.79
1977	0.84	0.33	0	0	9.48	38.03	70.25	70.87	68.58	70.87	32.87	2.16	364.28	30.36
1978	7.35	4.41	1.18	3.27	30.08	65.4	70.87	70.87	68.58	70.87	18.38	5.7	416.96	34.75
1979	11.69	7.29	3.09	8.96	18.73	33.14	70.25	70.87	68.58	70.87	14.59	1.58	379.64	31.64
1980	1.1	0.12	0.68	0.38	3.06	47.86	70.25	70.87	68.58	53.41	1.37	1.13	318.81	26.57
1981	0.24	0	0	0	5.61	40.24	70.25	70.87	68.58	65.59	6.17	1.71	329.26	27.44
1982	3.41	5.54	7.89	11.09	16.91	41.7	70.25	70.87	68.58	56.5	10.08	4.01	366.83	30.57
1983	13.38	9.32	7.15	6.77	15.56	38.66	70.25	70.87	68.58	70.87	24.73	1.82	397.96	33.16
1984	1.78	0.7	0.42	0.41	19.9	63.22	70.87	70.87	68.58	64.17	12.48	1.89	375.29	31.27
1985	9.54	7.15	5.45	9.92	24.95	52.29	70.25	70.87	68.58	70.87	26.13	1.65	417.65	34.8
1986	1.23	0.14	0.89	0	0	54.01	70.25	70.87	68.58	70.87	28.23	1.38	366.45	30.54
1987	0.46	0.46	0	0	0	25.15	70.25	70.87	68.58	57.13	9.17	1.8	303.87	25.32
1988	2.39	2.37	1.03	2.86	11.17	50.26	70.25	70.87	68.58	69.31	8.2	1.77	359.06	29.92
1989	4.83	3.15	1.62	4.02	23.8	62.02	70.87	70.87	68.58	70.87	19.04	1.67	401.34	33.45
1990	1.46	0.48	0.29	5.13	20.96	63.41	70.87	70.87	68.58	69.39	1.89	1.19	374.52	31.21
1991	0.14	0	0	0	0.63	52.29	70.25	70.87	68.58	70.87	24.41	1.79	359.83	29.99
1992	2.94	3.03	0.66	0.55	7.6	31.43	70.25	70.87	68.58	70.87	21.31	1.37	349.46	29.12
1993	0.4	0.48	0	0	0	41.45	70.25	70.87	68.58	70.87	26.37	1.52	350.79	29.23
1994	1.19	0.39	0.6	3.75	8.67	45.06	70.25	70.87	68.58	17.99	0.28	0	287.63	23.97
1995	0	0	0	0	0	67.99	70.87	70.87	68.58	70.87	48.99	9.71	407.88	33.99
1996	5.58	0.84	1.76	4.37	9.08	23.31	70.25	70.87	68.58	70.87	6.16	1.42	333.09	27.76
1997	0.83	0.15	0.59	0.78	8.94	26.93	70.25	70.87	68.58	37.05	0.53	0.51	286.01	23.83
1998	0.15	0.68	0	0	10.66	62.64	70.87	70.87	68.58	38.94	0.57	0.01	323.97	27
1999	0.59	0	0	0	1.55	38.47	70.25	70.87	68.58	41.47	0.13	0	291.91	24.33
SUM	95.97	65.56	46.44	79.49	321.06	1613.9	2516.21	2551.32	2468.88	2224.74	543.42	72.66	12599.65	
AVE	2.67	1.82	1.29	2.21	8.92	44.83	69.89	70.87	68.58	61.8	15.1	2.02	349.99	

Storage at start of each month(MCM)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	83.04	83.04	83.04	83.04	83.04	83.04	83.04	114.07	200	200	179.81	176.61	1451.77	120.98
1965	200	176.61	153.22	129.82	106.43	83.04	148.41	200	200	200	153.22	176.61	1927.36	160.61
1966	168.51	142.44	113.04	83.04	83.04	83.04	83.04	200	200	200	153.22	164.22	1673.59	139.47
1967	140.59	103.82	83.04	83.04	83.04	83.04	83.04	200	200	200	153.22	176.61	1589.44	132.45
1968	175.2	149.94	115.22	89.19	83.04	83.04	129.06	200	200	200	200	176.61	1801.3	150.11
1969	148.15	105.22	83.04	83.04	83.04	83.04	83.04	99.71	200	200	153.22	168.63	1490.13	124.18
1970	146.6	108.76	83.04	83.04	83.04	83.04	83.04	200	200	200	158.54	176.61	1605.71	133.81
1971	174.13	145.66	107.78	83.04	83.04	83.04	200	200	200	200	200	176.61	1853.3	154.44
1972	191.81	168.69	133.46	93.21	83.04	83.04	83.04	200	200	200	166.76	176.61	1779.66	148.31
1973	174.4	149.67	109.13	83.04	83.04	83.04	200	200	200	200	200	176.61	1858.93	154.91
1974	189.4	176.61	153.22	129.82	106.43	83.04	83.04	200	200	200	200	176.61	1898.17	158.18
1975	176.01	172.44	153.22	129.82	99.66	83.04	83.04	200	200	200	200	176.61	1873.84	156.15
1976	166.1	133.87	105.68	83.04	83.04	83.04	200	200	200	200	153.22	176.61	1784.6	148.72
1977	175.2	144.05	110.29	83.04	83.04	83.04	83.04	200	200	200	177.82	176.61	1716.13	143.01
1978	200	176.61	153.22	129.82	106.43	83.04	172.64	200	200	200	158.19	176.61	1956.56	163.05
1979	200	176.61	153.22	129.82	106.43	83.04	83.04	200	200	200	162.32	176.61	1871.09	155.92
1980	177.35	152.89	124.93	100.5	83.04	83.04	83.04	200	200	200	153.22	176.61	1734.62	144.55
1981	154.85	112.18	83.04	83.04	83.04	83.04	83.04	200	200	200	153.22	176.61	1612.06	134.34
1982	184.58	176.61	153.22	129.82	106.43	83.04	83.04	200	200	200	153.22	176.61	1846.57	153.88
1983	200	176.61	153.22	129.82	106.43	83.04	83.04	200	200	200	200	176.61	1908.77	159.06
1984	191.01	174.04	141.82	107.73	83.04	83.04	150.55	200	200	200	153.22	176.61	1861.06	155.09
1985	195.29	176.61	153.22	129.82	106.43	83.04	83.04	200	200	200	200	176.61	1904.06	158.67
1986	181.1	155.3	120.08	85.21	83.04	83.04	83.04	200	200	200	200	176.61	1767.42	147.29
1987	166.9	137.89	104.13	83.04	83.04	83.04	83.04	200	200	200	153.22	176.61	1670.91	139.24
1988	189.67	176.61	153.22	129.82	106.43	83.04	83.04	200	200	200	153.22	176.61	1851.66	154.31
1989	188.06	176.61	153.22	129.82	106.43	83.04	139.01	200	200	200	184.75	176.61	1937.55	161.46
1990	182.17	165.47	142.35	119.77	106.43	83.04	152.49	200	200	200	153.22	176.61	1881.55	156.8
1991	157.8	119.41	83.04	83.04	83.04	83.04	83.04	200	200	200	195.48	176.61	1664.5	138.71
1992	189.13	176.61	153.22	129.82	105.62	83.04	83.04	200	200	200	200	176.61	1897.09	158.09
1993	166.37	136.55	103.28	83.04	83.04	83.04	83.04	200	200	200	200	176.61	1714.97	142.91
1994	173.87	160.39	143.79	129.82	106.43	83.04	83.04	200	200	200	153.22	110.05	1743.65	145.3
1995	83.04	83.04	83.04	83.04	83.04	83.04	200	200	200	200	200	176.61	1674.85	139.57
1996	200	176.61	145.13	129.82	106.43	83.04	83.04	200	200	200	163.69	176.61	1864.37	155.36
1997	169.04	149.67	124.62	108.49	103.75	83.04	83.04	200	200	200	153.22	154.89	1729.76	144.15
1998	151.61	124.48	93.39	83.04	83.04	83.04	144.98	200	200	200	153.22	156.44	1673.24	139.44
1999	134.15	99.26	83.04	83.04	83.04	83.04	83.04	200	200	200	153.22	124.04	1525.87	127.16
SUM	6145.13	5320.88	4387.86	3720.4	3330.03	2989.44	3913.14	7013.78	7200	7200	6198.88	6176.57	63596.11	
AVE	170.7	147.8	121.89	103.34	92.5	83.04	108.7	194.83	200	200	172.19	171.57	1766.56	

Hight at start of each month(m)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	391.02	391.02	391.02	391.02	391.02	391.02	391.02	398.5	415	415	411.58	411.01	4788.23	399.02
1965	415	411.01	406.63	401.89	396.78	391.02	405.68	415	415	415	406.63	411.01	4890.65	407.55
1966	409.54	404.49	398.28	391.02	391.02	391.02	391.02	415	415	415	406.63	408.74	4836.76	403.06

1967	404.12	396.17	391.02	391.02	391.02	391.02	391.02	415	415	415	406.63	411.01	4818.03	401.5
1968	410.76	405.98	398.76	392.65	391.02	391.02	401.73	415	415	415	415	411.01	4862.93	405.24
1969	405.63	396.49	391.02	391.02	391.02	391.02	391.02	395.19	415	415	406.63	409.56	4798.6	399.88
1970	405.32	397.31	391.02	391.02	391.02	391.02	391.02	415	415	415	407.66	411.01	4821.4	401.78
1971	410.57	405.13	397.09	391.02	391.02	391.02	415	415	415	415	415	411.01	4871.86	405.99
1972	413.65	409.57	402.65	393.65	391.02	391.02	391.02	415	415	415	409.21	411.01	4857.8	404.82
1973	410.62	405.93	397.4	391.02	391.02	391.02	415	415	415	415	415	411.01	4873.02	406.09
1974	413.24	411.01	406.63	401.89	396.78	391.02	391.02	415	415	415	415	411.01	4882.6	406.88
1975	410.91	410.26	406.63	401.89	395.18	391.02	391.02	415	415	415	415	411.01	4877.92	406.49
1976	409.09	402.74	396.6	391.02	391.02	391.02	415	415	415	415	406.63	411.01	4859.13	404.93
1977	410.76	404.81	397.66	391.02	391.02	391.02	391.02	415	415	415	411.23	411.01	4844.55	403.71
1978	415	411.01	406.63	401.89	396.78	391.02	410.3	415	415	415	407.59	411.01	4896.23	408.02
1979	415	411.01	406.63	401.89	396.78	391.02	391.02	415	415	415	408.38	411.01	4877.74	406.48
1980	411.15	406.56	400.85	395.38	391.02	391.02	391.02	415	415	415	406.63	411.01	4849.64	404.14
1981	406.95	398.08	391.02	391.02	391.02	391.02	391.02	415	415	415	406.63	411.01	4822.77	401.9
1982	412.42	411.01	406.63	401.89	396.78	391.02	391.02	415	415	415	406.63	411.01	4873.41	406.12
1983	415	411.01	406.63	401.89	396.78	391.02	391.02	415	415	415	415	411.01	4884.36	407.03
1984	413.52	410.55	404.36	397.08	391.02	391.02	406.1	415	415	415	406.63	411.01	4876.29	406.36
1985	414.23	411.01	406.63	401.89	396.78	391.02	391.02	415	415	415	415	411.01	4883.59	406.97
1986	411.81	407.03	399.81	391.6	391.02	391.02	391.02	415	415	415	415	411.01	4854.32	404.53
1987	409.24	403.57	396.24	391.02	391.02	391.02	391.02	415	415	415	406.63	411.01	4835.77	402.98
1988	413.29	411.01	406.63	401.89	396.78	391.02	391.02	415	415	415	406.63	411.01	4874.28	406.19
1989	413.02	411.01	406.63	401.89	396.78	391.02	403.79	415	415	415	412.45	411.01	4892.6	407.72
1990	412	408.97	404.47	399.74	396.78	391.02	406.48	415	415	415	406.63	411.01	4882.1	406.84
1991	407.52	399.66	391.02	391.02	391.02	391.02	391.02	415	415	415	414.26	411.01	4832.55	402.71
1992	413.2	411.01	406.63	401.89	396.59	391.02	391.02	415	415	415	415	411.01	4882.37	406.86
1993	409.14	403.29	396.04	391.02	391.02	391.02	391.02	415	415	415	415	411.01	4843.56	403.63
1994	410.52	408.01	404.76	401.89	396.78	391.02	391.02	415	415	415	406.63	397.6	4853.23	404.44
1995	391.02	391.02	391.02	391.02	391.02	391.02	415	415	415	415	415	411.01	4832.13	402.68
1996	415	411.01	405.03	401.89	396.78	391.02	391.02	415	415	415	408.54	411.01	4876.4	406.37
1997	409.64	405.93	400.78	397.25	396.15	391.02	391.02	415	415	415	406.63	406.95	4850.37	404.2
1998	406.31	400.75	393.69	391.02	391.02	391.02	405	415	415	415	406.63	407.25	4837.69	403.14
1999	402.8	395.08	391.02	391.02	391.02	391.02	391.02	415	415	415	406.63	400.66	4805.27	400.44
SUM	14748.01	14589.51	14395.56	14248.24	14160.7	14076.72	14274.58	14903.69	14940	14940	14762.08	14761.06	174800.2	
AVE	409.67	405.26	399.88	395.78	393.35	391.02	396.52	413.99	415	415	410.06	410.03	4855.56	

Number of Generator(−)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1965	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1966	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1967	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1968	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1969	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1970	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1971	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1972	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1973	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1974	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1975	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1976	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1977	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1978	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1979	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1980	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1981	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1982	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1983	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1984	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1985	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1986	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1987	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1988	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1989	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1990	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1991	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1992	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1993	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1994	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1995	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1996	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1997	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1998	1	1	1	1	1	1	1	1	1	1	1	1	12	1
1999	1	1	1	1	1	1	1	1	1	1	1	1	12	1
SUM	36	36	36	36	36	36	36	36	36	36	36	36	432	
AVE	1	1	1	1	1	1	1	1	1	1	1	1	12	

	Power (MW)
1	14.84
0.998	17.18
0.995	20.01
0.993	22.38
0.991	34.37
0.988	35.67
0.986	36.61
0.984	39.62
0.981	41.32
0.979	42.43
0.977	43.41
0.975	44.23
0.972	51.33
0.97	53.83
0.968	56.82
0.965	57.58
0.963	65.39
0.961	66.86
0.958	67.94
0.956	71.23
0.954	71.86
0.951	74.6
0.949	74.82
0.947	75.3
0.944	75.74
0.942	76.51
0.94	79.98
0.938	80.21
0.935	88.26
0.933	88.71
0.931	88.74
0.928	90.31
0.926	91.44
0.924	91.94
0.921	92.09
0.919	92.44
0.917	93.12
0.914	93.49
0.912	93.49
0.91	93.64
0.907	94.69
0.905	96.83
0.903	96.98
0.9	97.24
0.898	97.34
0.896	97.64
0.894	98.66
0.891	99.85
0.889	100.87
0.887	103.7
0.884	103.7
0.882	103.82
0.88	104.94
0.877	105.23
0.875	105.23
0.873	105.23
0.87	105.23
0.868	105.23
0.866	105.23
0.863	105.23
0.861	105.23
0.859	105.23
0.856	105.23
0.854	105.23
0.852	105.23
0.85	105.23
0.847	105.23
0.845	105.23
0.843	105.23
0.84	105.23
0.838	105.23
0.836	105.23
0.833	105.23
0.831	105.23
0.829	105.23
0.826	105.23
0.824	105.23
0.822	105.23
0.819	105.23
0.817	105.23
0.815	105.23
0.813	105.23
0.81	105.23
0.808	105.23
0.806	105.23
0.803	105.23
0.801	105.23
0.799	105.23
0.796	105.23
0.794	105.23
0.792	105.23
0.789	105.33
0.787	108.86
0.785	108.86
0.782	108.96
0.78	109.49
0.778	109.85
0.775	110
0.773	110
0.771	110
0.769	110
0.766	110

0.764	110
0.762	110
0.759	110
0.757	110
0.755	110
0.752	110
0.75	110
0.748	110.34
0.745	111.35
0.743	111.55
0.741	112.79
0.738	112.96
0.736	114.24
0.734	114.32
0.731	115.25
0.729	116.08
0.727	116.58
0.725	116.71
0.722	116.79
0.72	117.11
0.718	117.28
0.715	117.69
0.713	117.89
0.711	117.94
0.708	118.05
0.706	118.28
0.704	118.37
0.701	118.42
0.699	118.42
0.697	118.42
0.694	118.42
0.692	118.42
0.69	118.42
0.688	118.42
0.685	118.42
0.683	118.42
0.681	118.42
0.678	118.42
0.676	118.96
0.674	119.01
0.671	119.37
0.669	119.77
0.667	120.62
0.664	121.25
0.662	121.26
0.66	121.4
0.657	121.57
0.655	121.69
0.653	121.67
0.65	122.13
0.648	122.66
0.646	122.84
0.644	123.14
0.641	123.44
0.639	124.47
0.637	124.57
0.634	124.68
0.632	124.74
0.63	124.85
0.627	125.02
0.625	125.03
0.623	125.12
0.62	125.91
0.618	125.91
0.616	125.91
0.613	125.91
0.611	125.91
0.609	125.91
0.606	125.91
0.604	125.91
0.602	125.91
0.6	125.91
0.597	125.91
0.595	125.91
0.593	125.91
0.59	125.91
0.588	125.91
0.586	125.91
0.583	125.91
0.581	125.91
0.579	125.91
0.576	125.91
0.574	125.91
0.572	125.91
0.569	125.91
0.567	125.91
0.565	125.91
0.563	125.91
0.56	125.91
0.558	125.91
0.556	125.91
0.553	125.91
0.551	125.91
0.549	125.91
0.546	125.91
0.544	125.91
0.542	125.91
0.539	125.91
0.537	125.91
0.535	125.91
0.532	127
0.53	127
0.528	127
0.525	127

0.523	127
0.521	127
0.519	127
0.516	127
0.514	127
0.512	127
0.509	127
0.507	127
0.505	127
0.502	127
0.5	127
0.498	127
0.495	127
0.493	127
0.491	127
0.488	127
0.486	127
0.484	127
0.481	127
0.479	127
0.477	127
0.475	127
0.472	127
0.47	127
0.468	127
0.465	127
0.463	127
0.461	127
0.458	127
0.456	127
0.454	127
0.451	127
0.449	127
0.447	127
0.444	127
0.442	127
0.44	127
0.438	127
0.435	127
0.433	127
0.431	127
0.428	127
0.426	127
0.424	127
0.421	127
0.419	127
0.417	127
0.414	127
0.412	127
0.41	127
0.407	127
0.405	127
0.403	127
0.4	127
0.398	127
0.396	127
0.394	127
0.391	127
0.389	127
0.387	127
0.384	127
0.382	127
0.38	127
0.377	127
0.375	127
0.373	127
0.37	127
0.368	127
0.366	127
0.363	127
0.361	127
0.359	127
0.356	127
0.354	127
0.352	127
0.35	127
0.347	127
0.345	127
0.343	127
0.34	127
0.338	127
0.336	127
0.333	127
0.331	127
0.329	127
0.326	127
0.324	127
0.322	127
0.319	127
0.317	127
0.315	127
0.313	127
0.31	127
0.308	127
0.306	127
0.303	127
0.301	127
0.299	127
0.296	127
0.294	127
0.292	127
0.289	127
0.287	127
0.285	127

0.282	127
0.28	127
0.278	127
0.275	127
0.273	127
0.271	127
0.269	127
0.266	127
0.264	127
0.262	127
0.259	127
0.257	127
0.255	127
0.252	127
0.25	127
0.248	127
0.245	127
0.243	127
0.241	127
0.238	127
0.236	127
0.234	127
0.231	127
0.229	127
0.227	127
0.225	127
0.222	127
0.22	127
0.218	127
0.215	127
0.213	127
0.211	127
0.208	127
0.206	127
0.204	127
0.201	127
0.199	127
0.197	127
0.194	127
0.192	127
0.19	127
0.188	127
0.185	127
0.183	127
0.181	127
0.178	127
0.176	127
0.174	127
0.171	127
0.169	127
0.167	127
0.164	127
0.162	127
0.16	127
0.157	127
0.155	127
0.153	127
0.15	127
0.148	127
0.146	127
0.144	127
0.141	127
0.139	127
0.137	127
0.134	127
0.132	127
0.13	127
0.127	127
0.125	127
0.123	127
0.12	127
0.118	127
0.116	127
0.113	127
0.111	127
0.109	127
0.106	127
0.104	127
0.102	127
0.1	127
0.097	127
0.095	127
0.093	127
0.09	127
0.088	127
0.086	127
0.083	127
0.081	127
0.079	127
0.076	127
0.074	127
0.072	127
0.069	127
0.067	127
0.065	127
0.063	127
0.06	127
0.058	127
0.056	127
0.053	127
0.051	127
0.049	127
0.046	127
0.044	127

0.042	127
0.039	127
0.037	127
0.035	127
0.032	127
0.03	127
0.028	127
0.025	127
0.023	127
0.021	127
0.019	127
0.016	127
0.014	127
0.012	127
0.009	127
0.007	127
0.005	127
0.002	127

2.4 m3/s
310 El.m
0.83

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
31	28.25	31	30	31	30	31	31	30	31	30	31		
1.18	1.07	1.18	1.14	1.18	1.14	1.23	1.41	1.48	1.50	1.42	1.50	15.42	1.29
1.50	1.31	1.37	1.26	1.22	1.25	1.46	1.53	1.48	1.47	1.39	1.46	16.68	1.39
1.41	1.21	1.23	1.14	1.18	1.14	1.37	1.53	1.48	1.47	1.37	1.40	15.92	1.33
1.31	1.11	1.18	1.14	1.18	1.14	1.37	1.53	1.48	1.47	1.39	1.47	15.74	1.31
1.43	1.22	1.26	1.15	1.18	1.22	1.43	1.53	1.48	1.53	1.45	1.43	16.28	1.36
1.33	1.11	1.18	1.14	1.18	1.14	1.21	1.39	1.48	1.47	1.38	1.42	15.41	1.28
1.33	1.12	1.18	1.14	1.18	1.14	1.37	1.53	1.48	1.47	1.40	1.46	15.78	1.31
1.42	1.21	1.22	1.14	1.18	1.33	1.53	1.53	1.48	1.53	1.45	1.49	16.48	1.37
1.48	1.27	1.28	1.16	1.18	1.14	1.37	1.53	1.48	1.48	1.41	1.46	16.23	1.35
1.43	1.22	1.22	1.14	1.18	1.33	1.53	1.53	1.48	1.53	1.45	1.48	16.49	1.37
1.48	1.31	1.37	1.26	1.22	1.14	1.37	1.53	1.48	1.53	1.45	1.47	16.59	1.38
1.46	1.30	1.37	1.25	1.21	1.14	1.37	1.53	1.48	1.53	1.45	1.45	16.52	1.38
1.39	1.19	1.22	1.14	1.18	1.33	1.53	1.53	1.48	1.47	1.39	1.47	16.29	1.36
1.42	1.21	1.23	1.14	1.18	1.14	1.37	1.53	1.48	1.50	1.42	1.50	16.10	1.34
1.50	1.31	1.37	1.26	1.22	1.29	1.49	1.53	1.48	1.47	1.40	1.50	16.80	1.40
1.50	1.31	1.37	1.26	1.22	1.14	1.37	1.53	1.48	1.48	1.40	1.47	16.51	1.38
1.44	1.24	1.28	1.17	1.18	1.14	1.37	1.53	1.48	1.47	1.39	1.44	16.11	1.34
1.35	1.12	1.18	1.14	1.18	1.14	1.37	1.53	1.48	1.47	1.39	1.48	15.80	1.32
1.48	1.31	1.37	1.26	1.22	1.14	1.37	1.53	1.48	1.47	1.39	1.50	16.50	1.37
1.50	1.31	1.37	1.26	1.22	1.14	1.37	1.53	1.48	1.53	1.45	1.49	16.62	1.39
1.48	1.29	1.32	1.18	1.18	1.25	1.46	1.53	1.48	1.47	1.39	1.49	16.52	1.38
1.49	1.31	1.37	1.26	1.22	1.14	1.37	1.53	1.48	1.53	1.45	1.47	16.60	1.38
1.44	1.24	1.25	1.14	1.18	1.14	1.37	1.53	1.48	1.53	1.45	1.45	16.19	1.35
1.40	1.19	1.22	1.14	1.18	1.14	1.37	1.53	1.48	1.47	1.39	1.48	15.97	1.33
1.48	1.31	1.37	1.26	1.22	1.14	1.37	1.53	1.48	1.47	1.39	1.48	16.49	1.37
1.48	1.31	1.37	1.26	1.22	1.23	1.45	1.53	1.48	1.51	1.43	1.47	16.73	1.39
1.46	1.28	1.34	1.24	1.22	1.26	1.47	1.53	1.48	1.47	1.39	1.44	16.56	1.38
1.36	1.13	1.18	1.14	1.18	1.14	1.37	1.53	1.48	1.52	1.44	1.48	15.94	1.33
1.48	1.31	1.37	1.26	1.22	1.14	1.37	1.53	1.48	1.53	1.45	1.45	16.57	1.38
1.40	1.19	1.21	1.14	1.18	1.14	1.37	1.53	1.48	1.53	1.45	1.46	16.06	1.34
1.44	1.28	1.36	1.26	1.22	1.14	1.37	1.53	1.48	1.47	1.30	1.23	16.05	1.34
1.18	1.07	1.18	1.14	1.18	1.33	1.53	1.53	1.48	1.53	1.45	1.50	16.06	1.34
1.50	1.30	1.36	1.26	1.22	1.14	1.37	1.53	1.48	1.48	1.40	1.46	16.48	1.37
1.42	1.24	1.29	1.22	1.22	1.14	1.37	1.53	1.48	1.47	1.36	1.40	16.12	1.34
1.36	1.16	1.20	1.14	1.18	1.24	1.46	1.53	1.48	1.47	1.36	1.38	15.94	1.33

1.29	1.10	1.18	1.14	1.18	1.14	1.37	1.53	1.48	1.47	1.32	1.25	15.43 583.99 16.22	1.29 48.67 1.35

Stability Analysis of Dam Section

Stability Analysis of Dam Section

1. Basic Conditions

(1) Analysis Method

Analysis is executed for dam section to study stability of issues as follows;

1) Shaearing force

2) No vertical tension stress at upstream side

3) Inner stresses don't exceed allowable compression and tennsior

(2) Load acting Case

Stability analysis is done for loading cases as follows;

Load acting Case

Case	Comments
Earth quake at HWL	Water Level is at N.W.L 415.000m Earthquake force acts from U/S to D/S
Design Flood	Design flood occurs. Earthquake force not considered
Before Impounding	Before impounding Half DEF acts from D/S to U/S

(3) Loads to be taken into consideration

Load as follows are taken into consideration.

Load taken into consideration

Item	Load acting case		
	NWL, Earthquake	Design Flood	Before Impounding
Self Weight	*	*	*
Earthquake	*		*
Static Pressure	*	*	
Dynamic Pressure	*		
Sedimentation	*	*	
Uplift	*	*	

(4) Input Values

1) Elevation Level of each part

Top of non-overflow part	EL.	420.000	m
Planned Sedimentation Level	EL.	386.200	m
Normal High Water Level	WL.	415.000	m
Design Flood level	WL.	416.000	m
Base rock elevation	EL.	280.000	m

2) Height of each part

Non-overflow part	140.000	m
Depth at HWL	135.000	m
Max Sedimentation Level	106.200	m

3) Specific weight of materials

Concrete	22.6	KN/m^3	(2.30×9.81)
Sedimentation (in water)	8.8	KN/m^3	(0.9×9.81)
Water	9.8	KN/m^3	(1.0×9.81)

4) Rock shearing stress

Shearing stress	2,943	KN/m^2	(300×9.81)

5) Others

Inner Friction Coefficient (Rock)	1.000	(tan 45°)
Safety factor for Shearing friction	more than 4.0	
Horizontal earthquake coefficient (at HWL)	0.15	
Vertical earthquake coefficient	0.00	

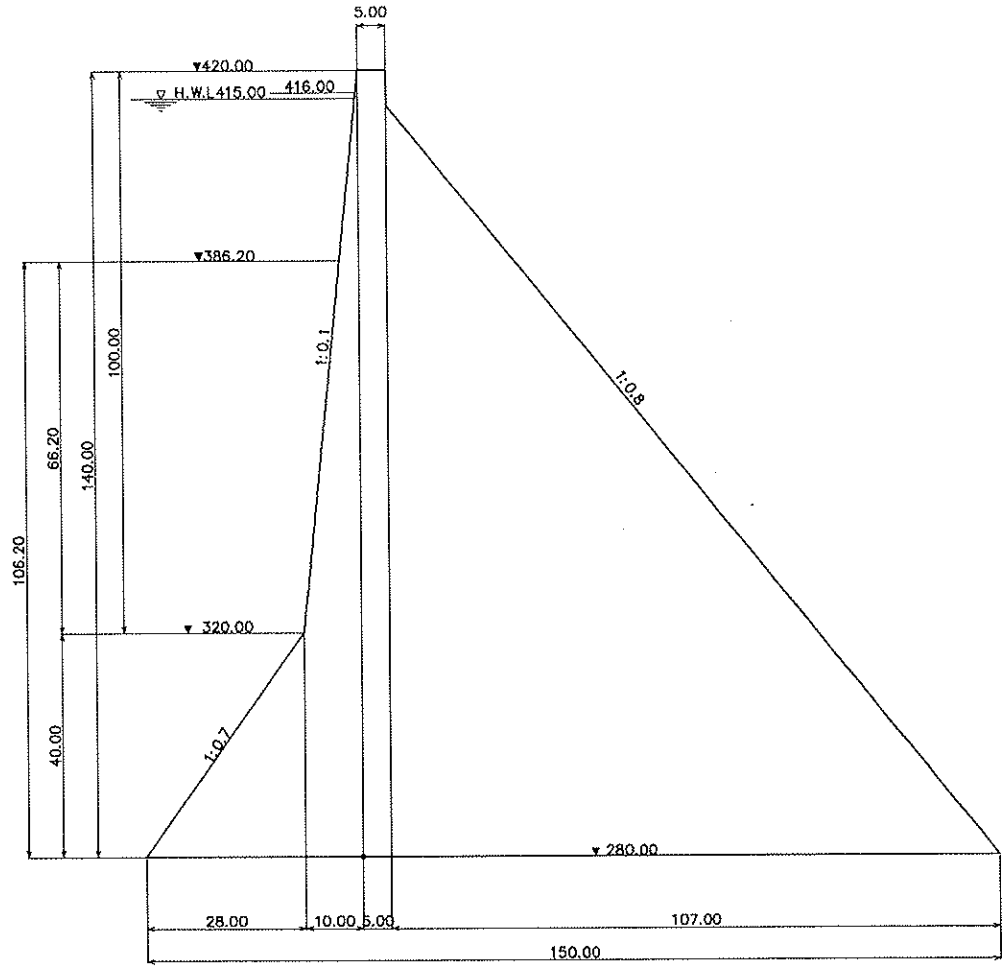
(5) Analysis method

Stability analysis is made at EL. 280 for Non-overflow part and overflow part.

Analysis is made for 1 m width.

2. Stability analysis for non-overflow part

(1) Studied section



Dam top Elevation level EL. 420.000

Design Flood Level W.L 416.000

High Water Level W.L 415.000

Planned Sedimentation Lev EL. 386.200

(2) Wave Height

* Wave by wind (S.M.B Method)

$h_w = 0.00086 \quad V_1 \cdot {}^{1}F^{0.45}$

Here h_w : Wave by wind

V : Average wind velocity during 10 min 30 m/s

F : Distance to opposite embankment 6000m

Design Flood Level, HWL

$h_w = 0.00086 \times 30^{1.1} \times 6000^{0.45} = 1.82 \text{ m} \fallingdotseq 1.8 \text{ m}$

* Wave by earthquake

$$h_e = \frac{K\tau}{2\pi}\sqrt{gH_o}$$

Here h_e : Half wave height by earthquake at dam front surface

K : Horizontal Earthquake 0.15

τ : Earthquake Period 1set

H_o Depth 135.0 m

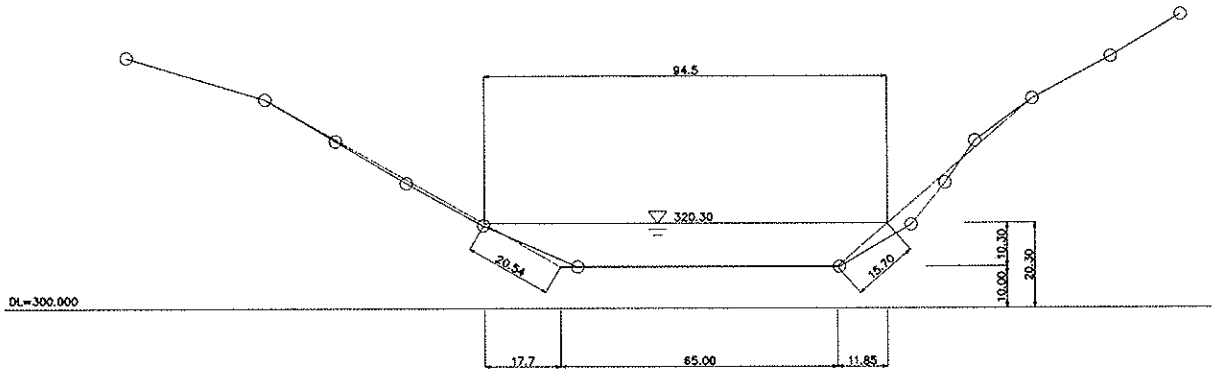
(415.00-280.00=135.00)

HWL (WL415.00)

$$h_e = \frac{0.15 \times 1.0}{2\pi}\sqrt{9.8 \times 135.0} = 0.87 \text{ m} \fallingdotseq 0.9 \text{ m}$$

(3) Water Level at downstream side

・Sected section (300m downstream from dam axis)



$Q \fallingdotseq 7400 m^3/sec$

$I = 1/125$ (Assumed)

・ Flow discharge capacity

Area : $A = (65.0 + 94.5) \times 1/2 \times 10.3 = 821.4 \text{ m}^2$

Wet edge : $P = 20.5 + 65.0 + 15.7 = 101.2 \text{ m}^2$

Radius : $R = A/P = 821.4 / 101.20 = 8.12 \text{ m}$

Velocity : $V = 1/n \cdot R^{2/3} \cdot I^{1/2}$ ..... (Manning Equation)

$= 1 / 0.04 \times (8.12)^{2/3} \times (1 / 125.0)^{1/2}$

$= 9.033$ m/sec

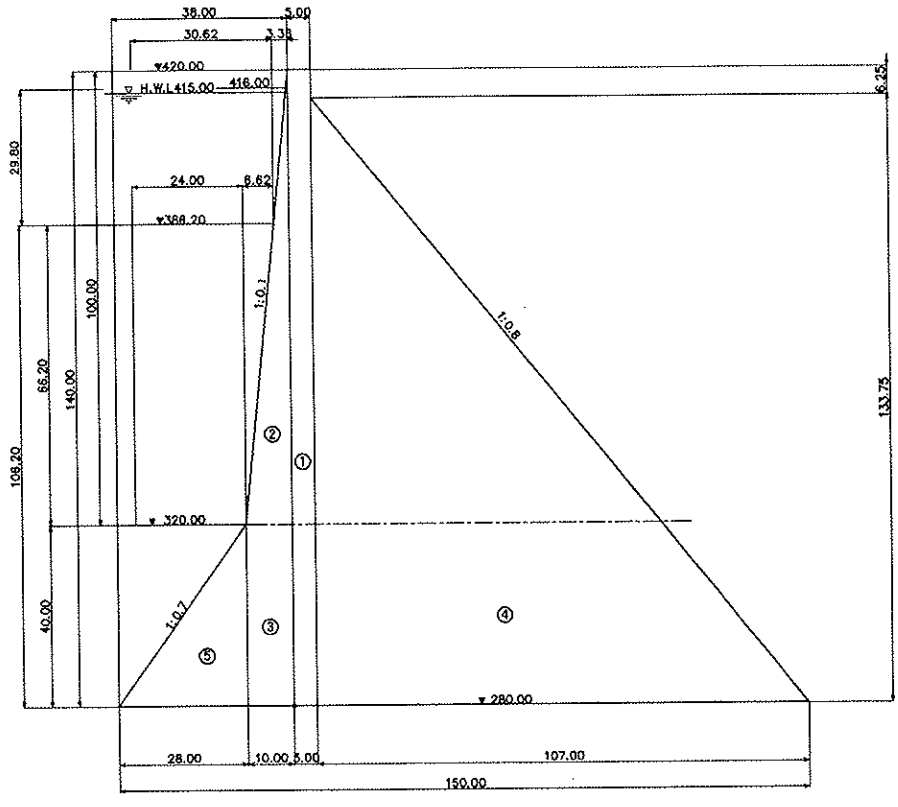
$\therefore$ $Q = V \cdot A = 9.033 \times 821.4 = 7419.7 \text{ m}^3/\text{sec}$

$\fallingdotseq 7400 \text{ m}^3/\text{sec}$

At river bed level of EL. 310, water level is 320.3m, when design discharge of 7,400m^3/s flows.

(4) Outer Force

1) Dam self weight (Water level is at HWL, and Design flood)



No	Equation	Vertical	Arm length		Moment	
		N(KN/m)	X(m)	Y(m)	M·X(KN·m/m)	M·Y(KN·m/m)
①	5.00×140.00×22.6	15,820.00	40.50	70.00	640,710.00	1,107,400.00
②	10.00×100.00×1/2×22.6	11,300.00	34.67	73.33	391,771.00	828,629.00
③	10.00×40.00×22.6	9,040.00	33.00	20.00	298,320.00	180,800.00
④	107.0×133.75×1/2×22.6	161,717.13	78.63	44.58	12,715,817.93	7,209,349.66
⑤	28.00×40.00×1/2×22.6	12,656.00	18.67	13.33	236,287.52	168,704.48
Total		ΣN= 210,533.13			ΣM.X= 14,282,906.45	ΣM.Y= 9,494,883.14

Vertical Force N= 210,533.13 KN/m

Horizontal Force H= 210,533.13 × 0.15 = 31,579.97 KN/m

esultant force acting point X= 67.84 m Y= 45.10 m

Center of gravity $X = \frac{\Sigma M.X}{\Sigma N} = \frac{14,282,906.45}{210,533.13} = 67.84$ m

$Y = \frac{\Sigma M.Y}{\Sigma N} = \frac{9,494,883.14}{210,533.13} = 45.10$ m

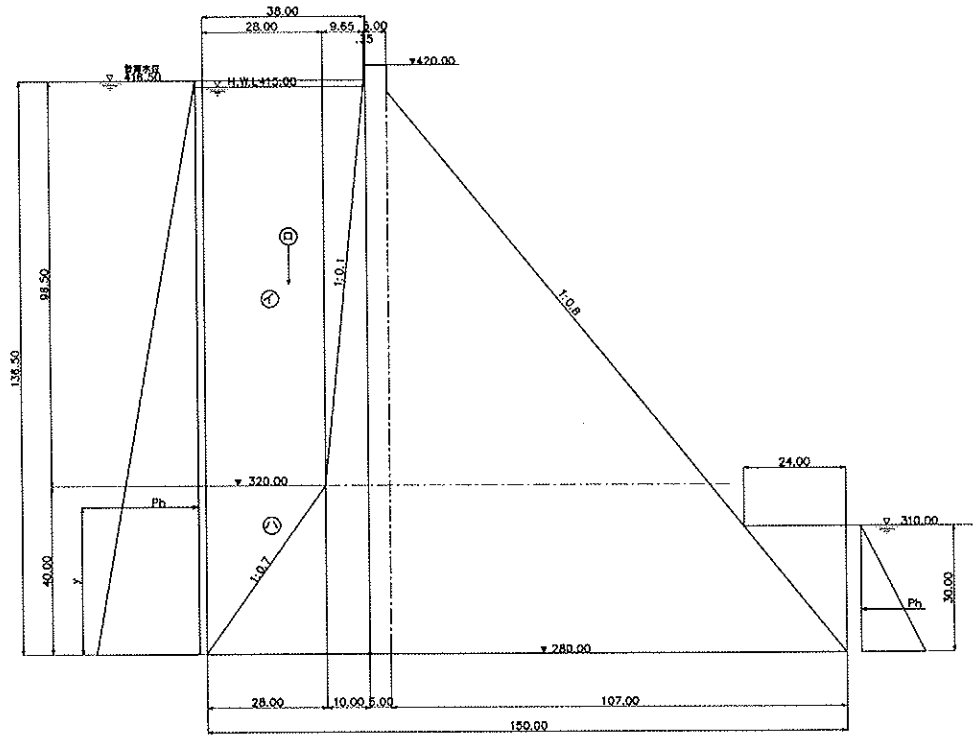
2) Static pressure

(i) Earthquake with HWL

①Upstream side

Caliculated WL = HWL + Wind Wave Height + Earthquake Wave Height

= EL 415.00 + 1.80 + 0.90 = EL 417.70



・Horizontal static pressure resultany force

$Ph = 1/2 \cdot Ww \cdot h^2 = 1/2 \times 9.8 \times 137.70^2 = 92{,}910.32$ KN/m

Acting Point $Y = h/3 = 1/3 \times 137.70 = 45.90$ m

・Vertical static pressure resultant force

No.	Equation	Vertical Force N(KN/m)	Arm X(m)	Momeny M·X(KN·m/m)
①	28.00×96.50×9.8	26,479.60	14.00	370,714.40
②	9.65×96.50×1/2×9.8	4,563.00	31.22	142,456.86
③	28.00×40.00×1/2×9.8	5,488.00	9.33	51,203.04
Total		ΣN= 36,530.60		ΣM.X= 564,374.30

Vertical Force N= 36,530.60 KN/m

Acting point X= 15.45 m

Center of gravity $X = \frac{\Sigma M.X}{\Sigma N} = \frac{564{,}374.30}{36{,}530.60} = 15.45$ m

②Downstream side

River Bed = EL 310.00 m

・Horizontal static pressure

$Ph = 1/2 \cdot Ww \cdot h^2$ = 1/2 × 9.8 × 30.00^2 = 4,410.00 KN/m

Acting point Y = h/3 = 1/3 × 30.00 = 10.00 m

・Vertical static pressure

N = 24.00 × 30.00 × 1/2 × 9.80 = 3,528.00 KN/m

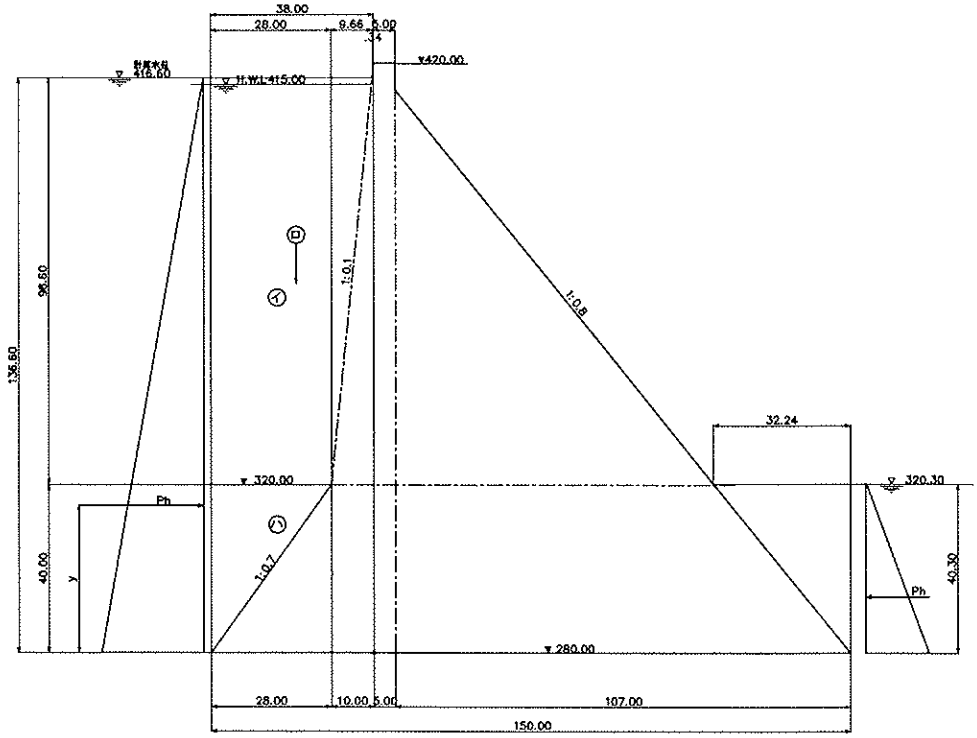
Acting Point X = 150.00 − (24.00 ÷ 3) = 142.00 m

(ii)Design Flood

① Upstream side

Calculated WL ＝ 設計洪水位+風波浪

＝ EL 416.00 ＋ 1.80 ＝ EL 417.80



・Horizontal static pressure resultant force

$Ph = 1/2 \cdot Ww \cdot h^2 = 1/2 \times 9.8 \times 137.80^2 = 93{,}045.32$ KN/m

Acting point $Y = h/3 = 1/3 \times 137.80 = 45.93$ m

・Vertical static pressure

No	Equation	Vertical Force N(KN/m)	Arm X(m)	Moment M・X(KN・m/m)
イ	28.00×96.60×9.8	22,720.32	14.00	318,084.48
ロ	9.66×96.60×1/2×9.8	4,572.46	31.22	142,752.20
ハ	28.00×40.00×1/2×9.8	4,704.00	9.33	43,888.32
Total		ΣN= 31,996.78		ΣM.X= 504,725.00

Vertical Force N= 31,996.78 KN/m

Acting Point X= 15.77 m

Center of gravity $X = \frac{\Sigma M.X}{\Sigma N} = \frac{504{,}725.00}{31{,}996.78} = 15.77$ m

②Downstream side

Calculated Water Level = EL 320.30 m

・Horizontak static pressure

$Ph = 1/2 \cdot Ww \cdot h^2$ = 1/2 × 9.8 × 40.30^2 = 7,958.04 KN/m

Acting point Y = h/3 = 1/3 × 40.30 = 13.43 m

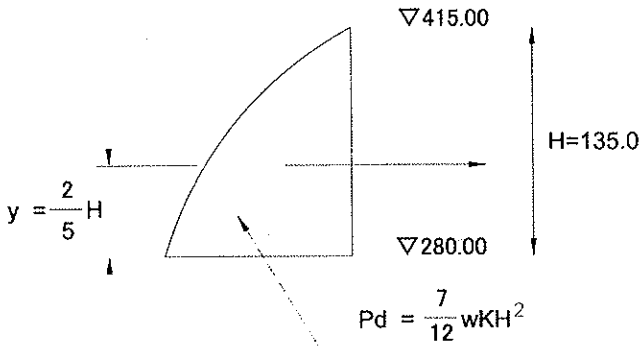
・Vertical static pressure

N = 32.24 × 40.30 × 1/2 × 9.80 = 6,366.43 KN/m

Acting Point X = 150.00 — (32.24 ÷ 3) = 139.25 m

3)Dynamic pressure (Earthquake at HWL)

Dynamic pressure is estimated by next equation.



W : Water specific weight (W=9.8KN/m3

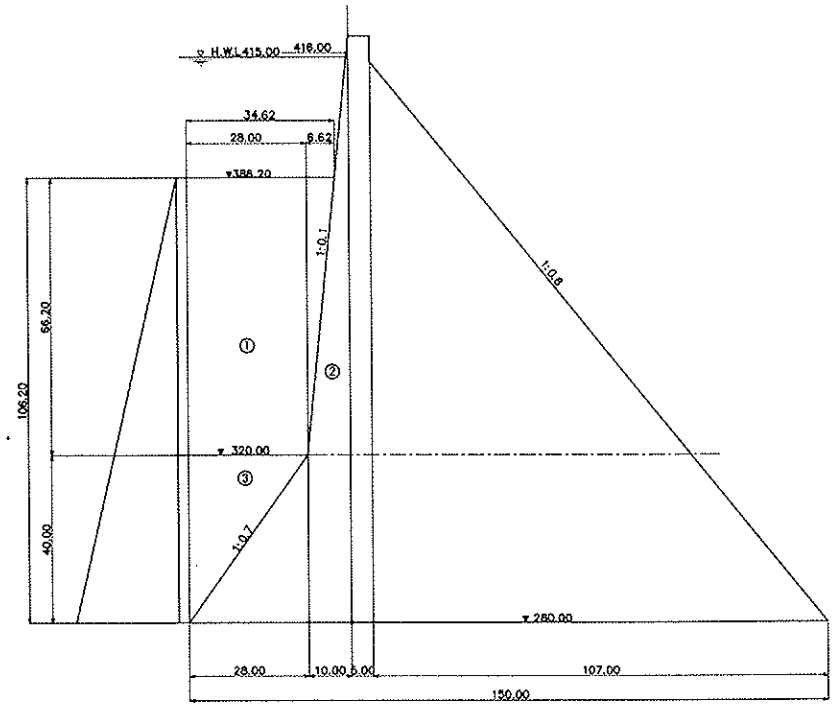
K : Earthquake coefficient

H : Water depth

Pd =	7	/	12	×	9.8	×	0.15	×	135.00	^{2}	=	15,627.94 KN/m
Acting point Y =	2	/	5	×	135.00						=	54.00 m

4)Sedimentation pressure (Earthquake at HWL, Design Flood)

Sedimentation pressure acts lower than EL.386.200m.



・Horizontal sedimentation pressure

$Ps = 1/2Ce \cdot Ws \cdot hs^2$

Here Ps : Resultant force by Sedimentation (KN)

Ce : Mud pressure coefficient = 0.5

Ws : Specific weight by sedimentation = 8.8 KN/m^3

hs : Sedimentation height

$Ps = 1/2 \times 0.5 \times 8.8 \times 106.20^2 = 24,812.57$ KN/m

Acting point $Y = 1/3 \times hs = 1/3 \times 106.20 = 35.40$ m

・Vertical sedimentation pressure

No	Equation	Vertical N(KN/m)	Arm X(m)	Moment M·X(KN·m/m)
①	28.00×66.20×8.8	16,311.68	14.00	228,363.52
②	6.62×66.20×1/2×8.8	1,928.27	30.21	58,253.04
③	28.00×40.00×1/2×8.8	4,928.00	9.33	45,978.24
Total		ΣN= 23,167.95		ΣM.X= 332,594.80

Vertical N= 23,167.95 KN/m

Acting point X= 14.36 m

Center of gravity $X = \frac{\Sigma M.X}{\Sigma N} = \frac{332,594.80}{23,167.95} = 14.36$ m

5)Uplift

Uplift is estimated by next equation

$$U = -\frac{Pd+Pu}{2} LB$$

Here U : Resultant force by Uplift (t f /m)

Pd : Downstream side static pressure (KN/m2)

Pu : Upstream side static pressure (KN/m2)

LB : Length of dam base (m2)

Pod = Dam D/S WL - Dam base EL

= (WL. 310.00 - 280.00) × 9.8 = 294.00 KN/m^2 (Earthquake at HWL)

(WL. 320.30 - 280.00) × 9.8 = 394.94 KN/m^2 (Design Flood)

Pou = (Dam U/S WL) - Dam base EL

= (WL. 415.00 - 280.00) × 9.8 = 1,323.00 KN/m^2 (Earthquake at HWL)

(WL. 416.00 - 280.00) × 9.8 = 1,332.80 KN/m^2 (Design Flood)

(Earthquake at HWL)

Pu= 637.00 KN/m^2 (1,323.00 - 294.00) 1/3 + 294.00

Pd= 294.00 KN/m^2

LB= 150.00 m

No	Equation	Vertical Force N(KN/m)	Arm X(m)	Moment M·X(KN·m/m)
①	294.00 × 150.00	44,100.00	75.00	3,307,500.00
②	(637.00 - 294.00)× 1/2 × 150.00	25,725.00	50.00	1,286,250.00
Total		ΣN= 69,825.00		ΣM.X= 4,593,750.00

Uplift U= 69,825.00 KN/m

Acting Point X= 65.79 m

Center of gravity $X = \frac{\Sigma M.X}{\Sigma N} = \frac{4,593,750.00}{69,825.00} = 65.79$ m

(Design Flood)

Pu= 707.56 KN/m^2 (1,332.80 - 394.94) 1/3 + 394.94

Pd= 394.94 KN/m^2

LB= 150.00 m

No	Equation	Vertical Force N(KN/m)	Arm X(m)	Moment M·X(KN·m/m)
①	394.94 × 150.00	59,241.00	75.00	4,443,075.00
②	(707.56 - 394.94)× 1/2 × 150.00	23,446.50	50.00	1,172,325.00
Total		ΣN= 82,687.50		ΣM.X= 5,615,400.00

Uplift U= 82,687.50 KN/m

Acting point X= 67.91 m

gravity center $X = \frac{\Sigma M.X}{\Sigma N} = \frac{5,615,400.00}{82,687.50} = 67.91$ m

(5) Stability analysis

1) Earthquake at HWL

No	Vertical	Horizontal	Arm		Moment	
	N(KN/m)	H(KN/m)	X(m)	Y(m)	M·X(KN·m/m)	M·Y(KN·m/m)
Dam weight	210,533.13	31,579.97	67.84	45.10	14,282,567.54	1,424,256.65
U/S static pressure	36,530.60	92,910.32	15.45	45.90	564,397.77	4,264,583.69
D/S static pressure	3,528.00	-4,410.00	142.00	10.00	500,976.00	-44,100.00
Dynamic pressure	-	15,627.94	-	54.00	-	843,908.76
Sedimentation Pressure	23,167.95	24,812.57	14.36	35.40	332,691.76	878,364.98
Uplift	-69,825.00	-	65.79	-	-4,593,786.75	
Total	ΣN= 203,934.68	ΣN= 160,520.80	-	-	ΣM.X= 11,086,846.32	ΣM.Y= 7,367,014.08

Resultant force acting point

$$X = \frac{\Sigma M_X + \Sigma M_y}{\Sigma N} = \frac{11,086,846.32 + 7,367,014.08}{203,934.68} = 90.49 \text{ m}$$

i) Turn-over ($e \leqq B/6$)

Eccentric length

$$e = B/2 - X = 150.00 / 2 - 90.49 = -15.49 \text{ m} < B/6 = 25.00 \text{ m}$$

···OK

ii) Sliding ($Fs \geqq 4.0$)

$$Fs = \frac{f\Sigma N + \tau B}{\Sigma H} = \frac{1.000 \times 203,934.68 + 2,943 \times 150.00}{160,520.80} = 4.02 \text{ m}$$

> 4 ···OK

iii) Reaction force from ground

$$\therefore \sigma = \frac{\Sigma N}{B} \times \left(1 \pm \frac{6e}{B} \right)$$

$$= \frac{203,934.68}{150.00} \times \left(1 \pm \frac{6 \times -15.49}{150.00} \right) = 517.2 \text{ KN/m}^2 \quad 2,202.0 \text{ KN/m}^2$$

$< 3,920 \text{ KN/m}^2$

···OK

2) Design Flood

Item	Vertical	Horizontal	Arm length		Moment	
	N(KN/m)	H(KN/m)	X(m)	Y(m)	M·X(KN·m/m)	M·Y(KN·m/m)
Dam weight	210,533.13	-	67.84	-	14,282,567.54	-
U/S static pressure	31,996.78	93,045.32	15.77	45.93	504,589.22	4,273,571.55
D/S static pressure	6,366.43	-7,958.04	139.25	13.43	886,525.38	-106,876.48
Sedimentation pressure	23,167.95	24,812.57	14.36	35.40	332,691.76	878,364.98
Uplift	-82,687.50	-	67.91	-	-5,615,308.13	
Total	ΣN= 189,376.79	ΣN= 109,899.85	-	-	ΣM.X= 10,391,065.77	ΣM.Y= 5,045,060.05

Resultant force acting point

$$X = \frac{\Sigma M_X + \Sigma M_y}{\Sigma N} = \frac{10,391,065.77 + 5,045,060.05}{189,376.79} = 81.51 \text{ m}$$

i) Turn-over ($e \leqq B/6$)

Eccentric length

$$e = B/2 - X = 150.00 / 2 - 81.51 = -6.51 \text{ m} < B/6 = 25.00 \text{ m}$$

···OK

ii) Sliding ($Fs \geqq 4.0$)

$$Fs = \frac{f\Sigma N + \tau B}{\Sigma H} = \frac{1.000 \times 189,376.79 + 2,943 \times 150.00}{109,899.85} = 5.74 \text{ m}$$

> 4 ···OK

iii) Reaction force from ground

$$\therefore \sigma = \frac{\Sigma N}{B} \times \left(1 \pm \frac{6e}{B} \right)$$

$$= \frac{189,376.79}{150.00} \times \left(1 \pm \frac{6 \times -6.51}{150.00} \right) = 933.8 \text{ KN/m}^2 \quad 1,591.3 \text{ KN/m}^2$$

$< 3,920 \text{ KN/m}^2$

···OK

3) Before impounding

No	Vertical	Horizontal	Arm length		Moment	
	N(KN/m)	H(KN/m)	X(m)	Y(m)	M·X(KN·m/m)	M·Y(KN·m/m)
Dam Weight	210,533.13	-15,789.98	67.84	45.10	14,282,567.54	-712,128.31
Static pressure	0.00	0.00	0.00	0.00	0.00	0.00
Sedimentation Pressure	0.00	0.00	0.00	0.00	0.00	0.00
Uplift	0.00	-	0.00	-	0.00	
Total	ΣN= 210,533.13	ΣN= -15,789.98	-	-	ΣM.X= 14,282,567.54	ΣM.Y= -712,128.31

Resultant force acting point

$$X = \frac{\Sigma M_X + \Sigma M_y}{\Sigma N} = \frac{14,282,567.54 + -712,128.31}{210,533.13} = 64.46 \text{ m}$$

i) Turn-over ($e \leqq B/6$)

Eccentric length

$$e = B/2 - X = 150.00 / 2 - 64.46 = 10.54 \text{ m} < B/6 = 25.00 \text{ m}$$

•••OK

ii) Sliding ($Fs \geqq 4.0$)

$$Fs = \frac{f\Sigma N + \tau B}{\Sigma H} = \frac{1.000 \times 210,533.13 + 2,943 \times 150.00}{15,789.98} = 41.29 \text{ m}$$

> 4 •••OK

iii) Reaction force from ground

$$\therefore \sigma = \frac{\Sigma N}{B} \times \left(1 \pm \frac{6e}{B} \right)$$

$$= \frac{210,533.13}{150.00} \times \left(1 \pm \frac{6 \times 10.54}{150.00} \right) = 1,995.3 \text{ KN/m}^2 \quad 811.8 \text{ KN/m}^2$$

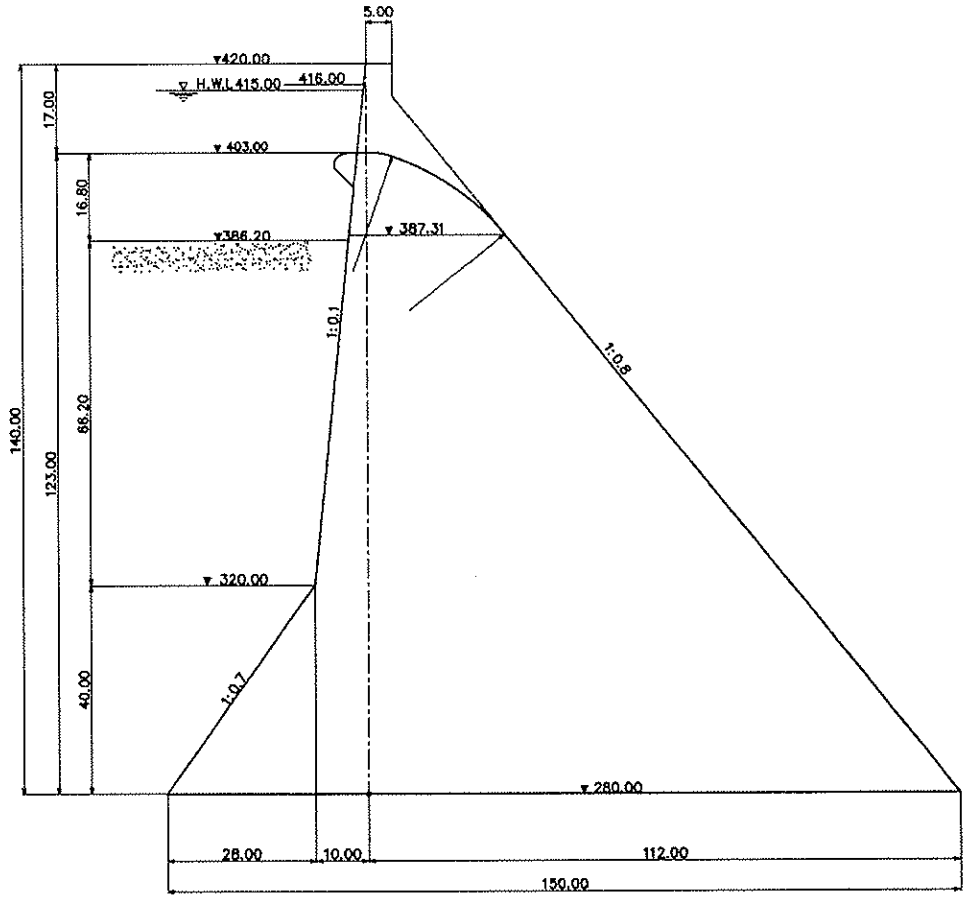
$< 3,920 \text{ KN/m}^2$

•••OK

Stability Analysis of Spillway Part of Dam

Stability Analysis of Spillway Part of Dam

(1) Studied section



Dam top Elevation level	EL.	420.000
Spillway Crest	EL.	403.000
Design Flood Level	W.L	416.000
High Water Level	W.L	415.000
Planned Sedimentation Lev	EL.	386.200

(2) Wave Height

* Wave by wind (S.M.B Method)

h_w = 1.80 m

* Wave by earthquake

h_e = 0.90 m

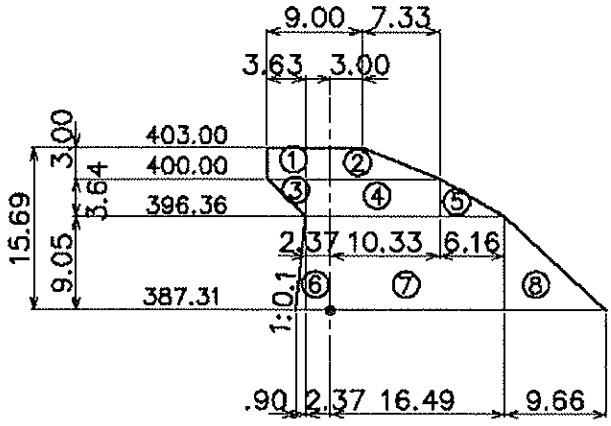
(3) Water Level at downstream side

Design Flood	WL320.30m
HWL	WL310.00m

(4) Outer Force

1) Dam self weight (Water level is at HWL, and Design flood)

(a) Spillway part (higher than EL387.31)



No	Equation	Vertical	Arm length		Moment	
		N(KN/m)	X(m)	Y(m)	M·X(KN·m/m)	M·Y(KN·m/m)
①	9.00× 3.00× 22. 6	610.20	−1.50	14.19	−915.30	8,658.74
②	7.33× 3.00× 1/2× 22. 6	248.49	5.44	13.69	1,351.77	3,401.79
③	3.63× 3.64× 1/2× 22. 6	149.31	−3.58	11.48	−534.53	1,714.07
④	12.70× 3.64× 22. 6	1,044.75	3.98	10.87	4,158.12	11,356.46
⑤	6.16× 3.64× 1/2× 22. 6	253.37	12.38	10.26	3,136.76	2,599.61
⑥	9.05× 0.9× 1/2× 22. 6	92.04	−2.67	3.02	−245.74	277.96
⑦	18.86× 9.05× 22. 6	3,857.44	7.06	4.53	27,233.50	17,474.18
⑧	9.66× 9.05× 1/2× 22. 6	987.88	19.71	3.02	19,471.11	2,983.40
Total		ΣN= 7,243.48			ΣM.X= 53,655.69	ΣM.Y= 48,466.21

Vertical Force 7,243.48 KN/m

Horizontal Force 7,243.48 × 0.15 = 1086.52 KN/m

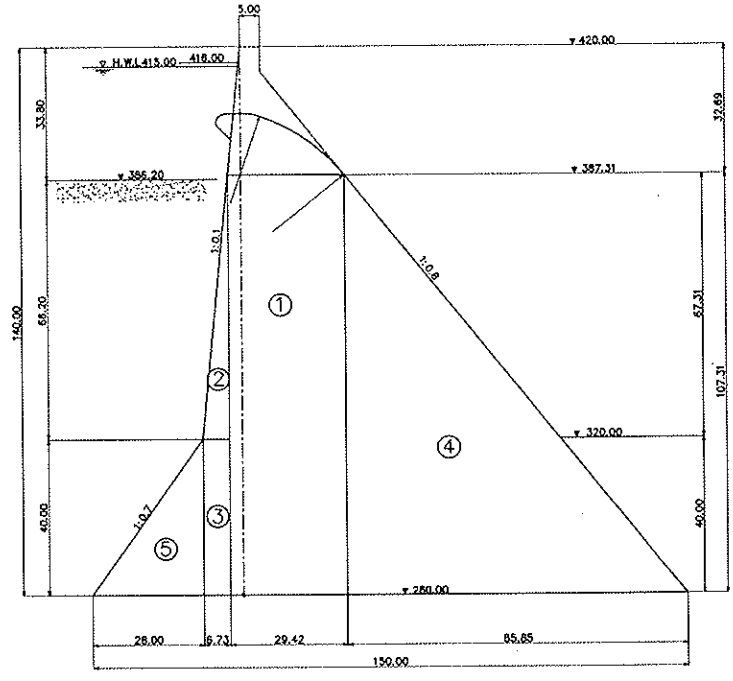
Resultant force acting point 45.41 m Y= 114.00 m

Center of gravity (based on EL280.00m)

$$X = \frac{\Sigma M.X}{\Sigma N} + 38.00 = \frac{53,655.69}{7,243.48} + 38.00 = 45.41 \text{ m}$$

$$Y = \frac{\Sigma M.Y}{\Sigma N} + 107.31 = \frac{48,466.21}{7,243.48} + 107.31 = 114.00 \text{ m}$$

(b) Spillway part (lower than EL387.31)



No	Equation	Vertical	Arm length		Moment	
		N(KN/m)	X(m)	Y(m)	M·X(KN·m/m)	M·Y(KN·m/m)
①	29.42×107.31×22.6	71,349.56	49.44	53.65	3,527,522.25	3,827,903.89
②	6.73×67.31×1/2×22.6	5,118.86	32.49	52.44	166,311.76	268,433.02
③	6.73×40.00×22.6	6,083.92	31.36	20.00	190,791.73	121,678.40
④	85.85×107.31×1/2×22.6	104,101.97	92.77	35.77	9,657,539.76	3,723,727.47
⑤	28.00×40.00×1/2×22.6	12,656.00	18.67	13.33	236,287.52	168,704.48
Total		ΣN= 199,310.31			ΣM.X= 13,778,453.02	ΣM.Y= 8,110,447.26

Vertical Force N= 199,310.31 KN/m

Horizontal Force H= 199,310.31 × 0.15 = 29,896.55 KN/m

Resultant force acting point X= 69.13 m Y= 40.69 m

Center of gravity (based on EL280.00m)

$$X = \frac{\Sigma M.X}{\Sigma N} = \frac{13,778,453.02}{199,310.31} = 69.13 \text{ m}$$

$$Y = \frac{\Sigma M.Y}{\Sigma N} = \frac{8,110,447.26}{199,310.31} = 40.69 \text{ m}$$

2) Pear self weight

Pear weight is quoted in Pea stability analysis.

Pear Weight N1 = 41,984.53 KN/m (higher than EL403.00 m (Rolling device included)

N2 = 11,300.00 KN/m (lower than EL403.00m: (25.0×8.0×1/2×5.0×22.6)

ΣN = 53,284.53 KN/m

Center of gravity based on EL280.00m

Xg = 5.713 + 38.00 = 43.71 m

Yg = 7.843 + 123.00 = 130.84 m

Considering pear width 5.00m, pear interval 12.50m, weight per m is

$$\frac{53,284.53}{15.00} = 3,552.30 \quad KN/m$$

Earthquake horizontal force He = 3,552.30 × 0.15 = 532.8453 KN/m

3) Gate weight

Weight per unit 70.2 t ×9.81 688.66 KN/unit

Pear interval 12.50m

Center of gravity based on EL280.00m

Xg = 2.5 + 38.00 = 40.50 m

Yg = 6.25 + 123.00 = 129.25 m

weight per unit width of spillway part

$$\frac{688.66}{12.5} = 55.09 \quad KN/m$$

Earthquake horizontal force He = 55.09 × 0.15 = 8.26 KN/m

4)Static pressure

same as non-overflow part

(i) Earthquake at HWL

①U/S side

・Horizontal static pressure Ph = 91,298.03 KN/m

Acting point Y = 45.50 m

・Vertical static pressure N = 36,530.60 KN/m

Acting point X = 15.45 m

②D/S side

・Horizontal static pressure Ph = 4,410.00 KN/m

Acting point Y = 10.00 m

・Vertical static pressure N = 3,528.00 KN/m

Acting point X = 142.00 m

(ii)Design Flood

①U/S side

・Horizontal static pressure	Ph =	91,431.84	KN/m
Acting point	Y =	45.53	m
・Vertical static pressure	N =	31996.78	KN/m
Acting point	X =	15.77	m

②D/S side

・Horizontal static pressure	Ph =	7,958.04	KN/m
Acting point	Y =	13.43	m
・Vertical static pressure	N =	6,366.43	KN/m
Acting point	X =	139.25	m

5)Dynamic pressure (Earthquake at HWL)

same as non-overflow part

P_c = 15,628 KN/m

Acting point Y = 35 m

6)Sedimentation pressure

same as non-overflow part

・Horizontal sedimentation pressure

P_s = 24,813 KN/m

Acting point Y = 35 m

・Vertical sedimentation pressure

N= 23,168 KN/m

Acting point X= 14 m

7)Uplift

same as non-overflow part

(Earthquake at HWL)

Uplift

U= 69,825 KN/m

Acting Point X= 66 m

(Design Flood)

Uplift

U= 82,688 KN/m

Acting Point X= 68 m

(5) Stability analysis

1) Earthquake at HWL

Load item	Vertical	Horizontal	Arm length		Moment	
	N(KN/m)	H(KN/m)	X(m)	Y(m)	M·X(KN·m/m)	M·Y(KN·m/m)
Weight of dam (1)	7,243.48	1,086.52	45.41	114.00	328,907.79	123,864.55
Weight of dam	199,310.31	29,896.55	69.13	40.69	13,778,321.73	1,216,490.48
Weight of pier	3,552.30	532.85	43.71	130.84	155,281.78	69,719.08
Weight of gate	55.09	8.26	40.50	129.25	2,231.26	1,068.11
U/S static pressure	36,530.60	91,431.84	15.45	45.50	564,397.77	4,160,148.72
D/S static pressure	3,528.00	-4,410.00	142.00	10.00	500,976.00	-44,100.00
Dynamic pressure	-	15,627.94	-	35.40	-	553,229.08
Sedimentation Pressure	23,167.95	24,812.57	14.36	35.40	332,691.76	878,364.98
Uplift	-69,825.00	-	65.79	-	-4,593,786.75	
Total	ΣN= 203,562.73	ΣH= 158,986.53	-	-	ΣM.X= 11,069,021.34	ΣM.Y= 6,958,785.00

Resultant force acting point

$$X = \frac{\Sigma M_X + \Sigma M_y}{\Sigma N} = \frac{11,069,021.34 + 6,958,785.00}{203,562.73} = 88.56 \text{ m}$$

i) Turn-over ($e \leqq B/6$)

Eccentric length

$$e = B/2 - X = 150.00 / 2 - 88.56 = -13.56 \text{ m} < B/6 = 25.00 \text{ m}$$

•••OK

ii) Sliding ($Fs \geqq 4.0$)

$$Fs = \frac{f\Sigma N + \tau B}{\Sigma H} = \frac{1.000 \times 203,562.73 + 2,943 \times 150.00}{158,986.53} = 4.06 \text{ m}$$

> 4 •••OK

iii) Reaction force from foundation

$$\therefore \sigma = \frac{\Sigma N}{B} \times \left(1 \pm \frac{6e}{B} \right)$$

$$= \frac{203,562.73}{150.00} \times \left(1 \pm \frac{6 \times -13.56}{150.00} \right) = 621.0 \text{ KN/m}^2 \quad 2,093.2 \text{ KN/m}^2$$

$< 3,920 \text{ KN/m}^2$

•••OK

2) dirung Design Flood

Load item	Vertical	Horizontal	Arm length		Moment	
	N(KN/m)	H(KN/m)	X(m)	Y(m)	M·X(KN·m/m)	M·Y(KN·m/m)
Weight of dam (1)	7,243.48	0.00	45.41	114.00	328,907.79	0.00
Weight of dam	199,310.31	0.00	69.13	40.69	13,778,321.73	0.00
Weight of pier	41,984.53	0.00	43.71	0.00	1,835,269.76	0.00
Weight of gate	55.09	0.00	40.50	0.00	2,231.26	0.00
U/S static pressure	31,996.78	91,431.84	15.77	45.53	504,589.22	4,162,891.68
D/S static pressure	6,366.43	-7,958.04	139.25	13.43	886,525.38	-106,876.48
Dynamic pressure	-	0.00	-	0.00	-	0.00
Sedimentation Pressure	23,167.95	24,812.57	14.36	35.40	332,691.76	878,364.98
Uplift	-82,687.50	-	67.91	-	-5,615,308.13	
Total	ΣN= 227,437.07	ΣH= 108,286.37	-	-	ΣM.X= 12,053,228.77	ΣM.Y= 4,934,380.18

Resultant force acting point

$$X = \frac{\Sigma M_X + \Sigma M_y}{\Sigma N} = \frac{12,053,228.77 + 4,934,380.18}{227,437.07} = 74.69 \text{ m}$$

i) Turn-over ($e \leqq B/6$)

Eccentric length

$$e = B/2 - X = 150.00 / 2 - 74.69 = 0.31 \text{ m} < B/6 = 25.00 \text{ m}$$

•••OK

ii) Sliding ($Fs \geqq 4.0$)

$$Fs = \frac{f\Sigma N + \tau B}{\Sigma H} = \frac{1.000 \times 227,437.07 + 2,943 \times 150.00}{108,286.37} = 6.18 \text{ m}$$

> 4 •••OK

iii) Reaction force from ground

$$\therefore \sigma = \frac{\Sigma N}{B} \times \left(1 \pm \frac{6e}{B} \right)$$

$$= \frac{227,437.07}{150.00} \times \left(1 \pm \frac{6 \times 0.31}{150.00} \right) = 1,535.1 \text{ KN/m}^2 \quad 1,497.5 \text{ KN/m}^2$$

$< 3,920 \text{ KN/m}^2$

•••OK

3) Before impounding

Load item	Vertical	Horizontal	Arm length		Moment	
	N(KN/m)	H(KN/m)	X(m)	Y(m)	M·X(KN·m/m)	M·Y(KN·m/m)
Weight of dam (1)	7,243.48	-543.26	45.41	114.00	328,907.79	-61,932.27
Weight of dam	199,310.31	-14,948.27	69.13	40.69	13,778,321.73	-608,245.24
Weight of pier	3,552.30	-266.42	43.71	130.84	155,281.78	-34,859.54
Weight of gate	55.09	-4.13	40.50	129.25	2,231.26	-534.06
U/S static pressure	0.00	0.00	0.00	0.00	0.00	0.00
D/S static pressure	0.00	0.00	0.00	0.00	0.00	0.00
Dynamic pressure	-	0.00	-	0.00	-	0.00
Sedimentation Pressure	0.00	0.00	0.00	0.00	0.00	0.00
Uplift	0.00	-	0.00	-	0.00	
Total	ΣN= 210,161.18	ΣH= -15,762.09	-	-	ΣM.X= 14,264,742.56	ΣM.Y= -705,571.11

Resultant force acting point

$$X = \frac{\Sigma M_X + \Sigma M_y}{\Sigma N} = \frac{14,264,742.56 + -705,571.11}{210,161.18} = 64.52 \text{ m}$$

i) Turn-over ($e \leqq B/6$)

Eccentric length

$$e = B/2 - X = 150.00 / 2 - 64.52 = 10.48 \text{ m} < B/6 = 25.00 \text{ m}$$

•••OK

ii) Sliding ($Fs \geqq 4.0$)

$$Fs = \frac{f\Sigma N + \tau B}{\Sigma H} = \frac{1.000 \times 210,161.18 + 2,943 \times 150.00}{15,722.85} = 41.44 \text{ m}$$

> 4 •••OK

iii) Reaction force from ground

$$\therefore \sigma = \frac{\Sigma N}{B} \times \left(1 \pm \frac{6e}{B} \right)$$

$$= \frac{210,161.18}{150.00} \times \left(1 \pm \frac{6 \times 10.48}{150.00} \right) = 1,988.4 \text{ KN/m}^2 \quad 813.7 \text{ KN/m}^2$$

$< 3,920 \text{ KN/m}^2$

•••OK

Dissipitater Hydraulic Design

Dissipitater Hydraulic Design

1 General

Gorge downstream from dam has river EL310m of river bed and 70m of river width, and is a little bit wider than dam axis. And river bends right embankment direction about 250m downstream from dam axis. Dissiptater should be considered to be able to dissiptate design discharge safely. Considering topographical and geological conditions, Chute type and Ski-jump tyke are nominated for candidates, and comparative study is to be made.

As guide wall is to be set at downstream part of spillway chute, which gradually narrowed down, dissipitator should have capacity to spill design flood discharge of 7,377m^3/s□7,400m^3/s.

2 Hydraulic Study

Hydraulic study is made for candidates of dissipitater which are chute type and ski-jump type.

(1) Chute type dissipitater

(a) length of dissipitater and sill height

a) General

Dissipitater is considered to be horizontal hydraulic jump type with sill, whose base is at EL310.00 and whose width is 70.00m.

b) Design Discharge

Design discharge is same as Design Flood Discharge of 7400m^3/s.

c) Equations

Length of dissipitater and sill height is as follows;

$$h_j/h_1 = \{(1+8F_1^2)^{1/2}-1\}/2$$

here, h_j :conjugate depth(m)

h_1 :supercritical flow depth at the beginning of dissipitater (m)

$= Q/\{0.95B(2gH)^{1/2}\}$

Q : Design Flood Discharge = 7, 400m^3/s

B : Width of dissipitater = 70.00m

g : gravity acceleration = 9.8m^3/s

H : Difference of elevation between reservoir water level and dissipitater base

=416.00−310.00 = 106.00m

F_1 : Frude Number before hydraulic jump

$= v_1/(g h_1)^{1/2}$

v_1 : Velocity of dissipitater entrance (m/s)

$=Q/(h_1B)$

$$E_j = q^2/(2g h_j^2)+h_j$$

Here, E_j : Energy Height (m)

q :Discharge per unit length (m^3/s)

$C = 1.320 + 0.969(E_j - D)/D$

Here, D : Sill height (m)

C : Discharge Coefficient of Sill

$L \geqq 4.5h_j$

Here, L : Dissipitater Length(m)

Calculation result of dissipitater length and sill height are as follos;

- supercritical flow depth at the beginning of dissipitater (m)

  $h_1 = 7{,}400/\{0.95\times70.00\times(2\times9.8\times106.00)^{1/2}\} = 2.441$ m

- Velocity of dissipitater entrance (m/s)

  $v_1 = 7{,}400/(2.441\times70.00) = 43.308$ m/s

- Frude Number before hydraulic jump

  $F_1 = 43.308/(9.8\times2.441)^{1/2} = 8.855$

- conjugate depth(m)

  $h_j = 2.441\times\{(1+8\times8.855^2)^{1/2}-1\}/2 = 29.372$ m

- Discharge per unit length (m^3/s)

  $q = 7{,}400/70.00 = 105.714$ $m^3/s/m$

- Energy Height (m)

  $E_j = 105.714^2/(2\times9.8\times29.372^2)+29.372 = 30.033$ m

d) Sill height

$$\frac{D}{h_1} = \frac{1+2\cdot F_1^2\cdot\sqrt{1+8\cdot F_1^2}-1-5\cdot F_1^2}{1+4\cdot F_1^2-\sqrt{1+8\cdot F_1^2}} - \left(\frac{\sqrt{g\cdot F_1^2}}{c}\right)^{2/3}$$

$c = 1.320+0.969\times(30.033-D)/D$

By try and error analysis for above equation,

$c = 2.136$

$D = 16.335 \fallingdotseq \underline{16.30 \text{ m}}$

e) Dissipitater Length

$L \geqq 4.5\times29.372$

$\geqq 132.174 \fallingdotseq \underline{135.00 \text{ m}}$

(b) Top elevation of guide wall

a) General

Top elevation of guide wall is determined by water level when design floo d discharge of 7,400m^3/s flows over sill.

b) Equation

Top elevation of guide wall is calculated by Gobinda Lao equations.Shape of sill and equations are as follows;

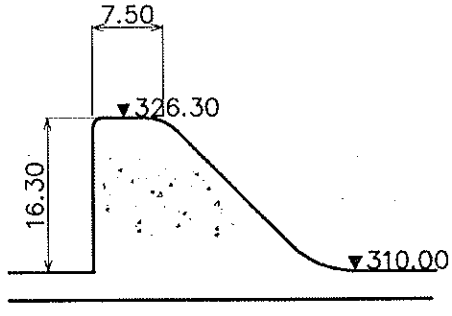


Fig-1. Shape of Sill

$$Q = C B h^{3/2}$$

$$C = 1.785 + 0.237(h/W) \quad : \quad (1.5 \sim 1.9) \leqq h/L$$

$$h_a = v_a^2/2g$$

$$HR = W + h + h_a$$

Here, Q : Design Discharge = 380m^3/s

C : Discharge coefficient of sill

B: Width of overflow= 15.000m

h : Depth of overflow (m)

W : Height of sill = 3.400m

h_a : Head by approaching velocity (m)

v_a : Approaching velocity (m/s)

$= Q/\{B(W+h)\}$

HR : Height of Guide Wall(m)

Calculation results are as follows;

· Overflow depth

$h = \{7,400/(C \times 70.00)\}^{2/3}$

$C = 1.785 + 0.237 \times h / 16.30$

If above equations are solved for "h",

$h = 14.20$ m

· Head by approaching velocity (m)

$v_a = 7,400/\{70.00 \times (16.30 + 14.20)\} = 3.466$ m³/s

$h_a = 3.466^2/(2 \times 9.8) = 0.613$ m

c) Guide wall height

$HR = 16.30 + 14.20 + 0.613 = \underline{31.113}$ m

Therefore, top elevation of guide wall is

$EL = 310.00 + 31.113 \square \underline{342.00}$ m

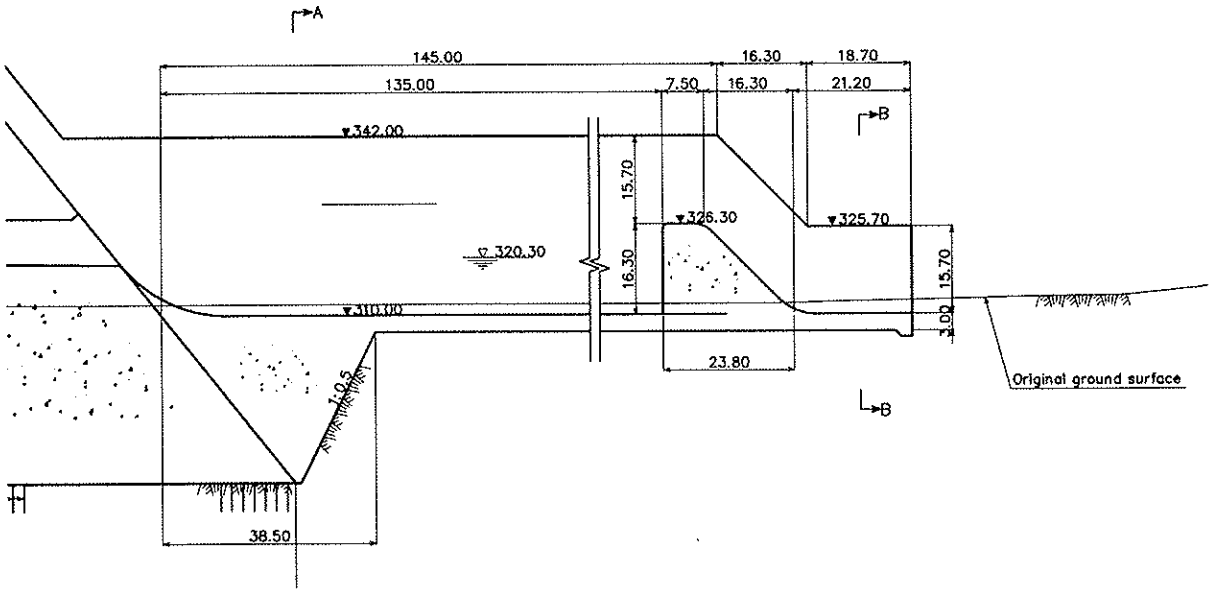


Fig-2 Shape of Chute type dissipitater

(2) Ski-jump type dissipitater

(a) Jump Lendth

a) General

Ski jump type dissipitater is to dissipitate discharge flow energy byhaving water discharge jump out into air and fall at far site from structure with h ydraulic jump and diffusion. Basic shape is as follows;

Elevation of the end of chute: EL330.00 which is 10m higher than flood water level.

Elevation Level of River Bed: EL310.00

Angle of Flip:tan-1 (10.0/29.0) =19.026°

Here, angle of flip is as shown in Fig-3.

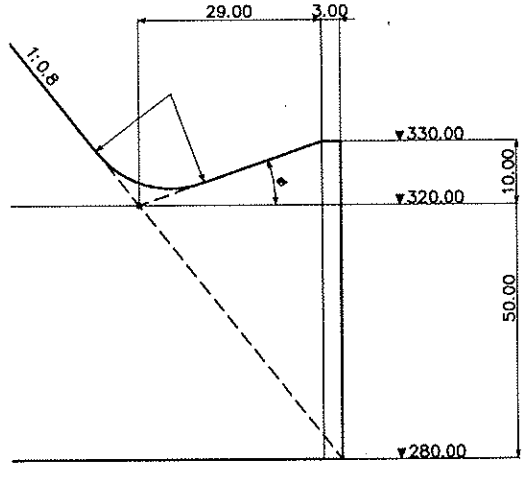


Fig-3. Flip Angle

b) Design Flood Discharge

Design flood discharge is 7400m^3/s which corresponds to Dam designdischa rge.

c) Equation

The distance between end of jump chute and the point where jet falls on t he selected horizontal line is calculated by next equation.

$$\xi = \sin 2\phi + \sqrt{\sin^2 2\phi + 4\cos^2 \phi \bullet \eta}$$

Here,

$$\xi = \frac{x}{H_1 - y_0}, \quad \eta = \frac{y}{H_1 - y}$$

x : Horizontal Distance from end of chute

y : Vertical Distance from end of chute

H_1: Head at Chute end (Design Flood Level – river bed)

y_0: Height from chute end and river bed

ϕ : Flip angle (Angle of jump starting)

c) Point where jet falls

Under this situation, symbols in equation are as follows;

$$y = y_0 = 330.00 - 310.00 = 20.00$$

$$H_1 = 416.00 - 310.00 = 106.00$$

$$\phi = \tan^{-1}\frac{10.0}{29.0} = 19.026^\circ \quad ; 2\phi = 38.051^\circ$$

Therefore,

$$x = (\sin 38.051 + \sqrt{\sin^2 38.051 + 4\cos^2 19.026 \bullet \frac{20}{86}}) \bullet 86 = 156.62 \fallingdotseq 157m$$

But, as water level under flood becomes EL320, the distance where jet falls on water surface is calculated by putting the value of $y = 330 - 320 = 10$.

$$x = (\sin 38.051 + \sqrt{\sin^2 38.051 + 4\cos^2 19.026 \bullet \frac{10}{86}}) \bullet 86 = 129.8 \fallingdotseq 130m$$

Therefore, water jet falls on water surface at 130m from jump chute end. Actually, the distance can be shorten, because of air resistance.

(b) Basic Shape

Basic shape of ski-jump dissipitater is as shown in Fig-4.

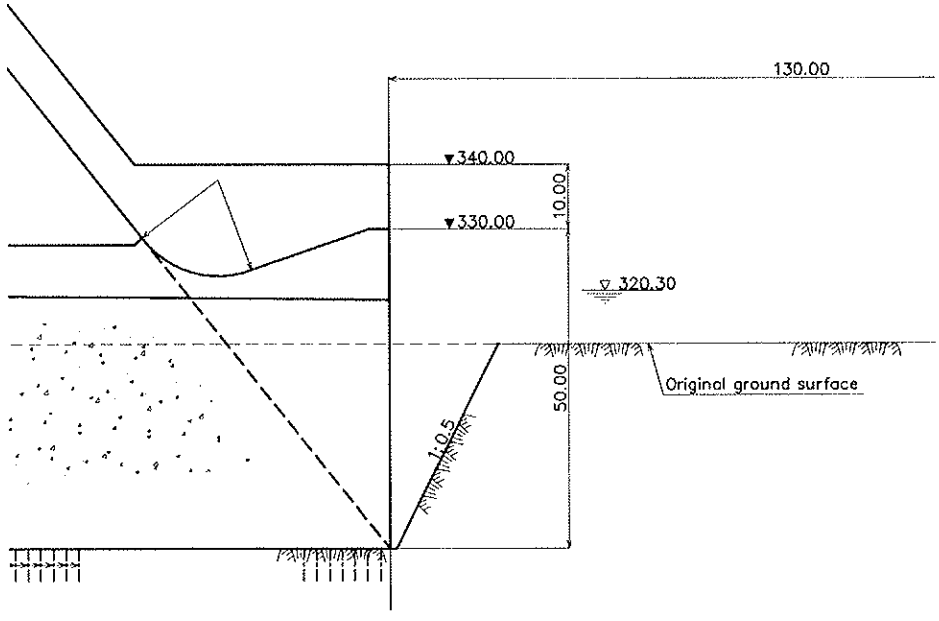


Fig-4. Basic shape of Ski-jump type dissipitater

Stability Analysis of Spillway Pier

Stability Analysis of Spillway Gate Pier

(a) Studied Section

pier stability analysis is executed for next 2 sections.

Section Ⅰ EL.411.50m

Section Ⅱ EL.403.00m

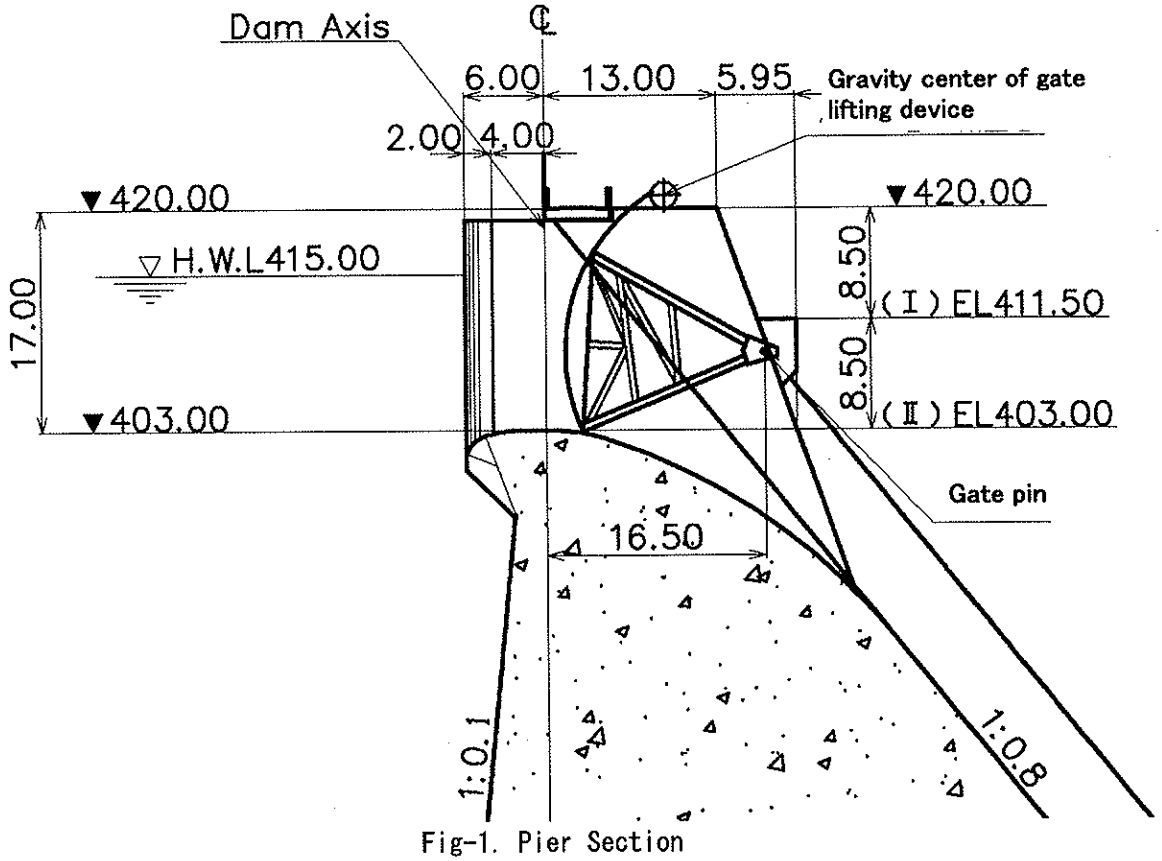


Fig-1. Pier Section

(b) Outer force Calculation

a) Self weight

a. Pier Self weight (W1) and Earthquake force (F1,F2)

(Earthquake at HWL)

No.	VOL	W_1	F_1	Xg	Yg	W_1・Xg	F_1・Yg
	m^3	KN	KN	m	m	KN・m	KN・m
I	808.37	18,269.21	2,740.38	4.686	3.914	85,604.77	10,725.05
II	1,845.55	41,709.53	6,256.43	5.713	7.843	238,274.58	49,072.00

(Before impounding)

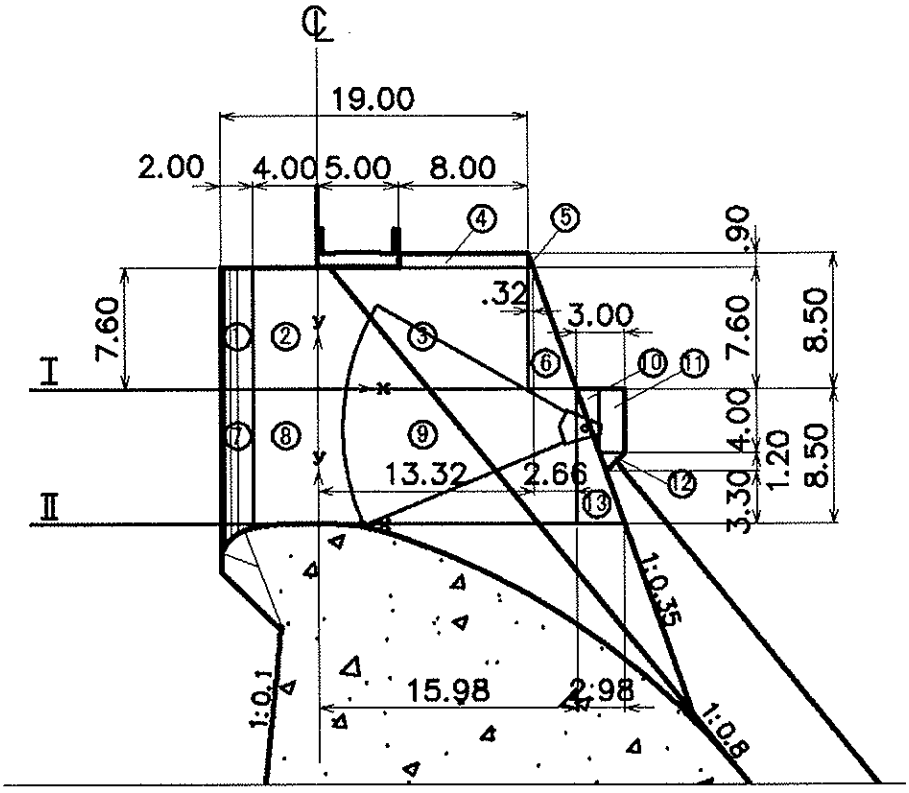
No.	VOL	W_1	F_2	Xg	Yg	W_1・Xg	F_1・Yg
	m^3	KN	KN	m	m	KN・m	KN・m
I	808.37	18,269.21	-1,176.18	4.686	3.914	85,604.77	-4,603.22
II	1,845.55	41,709.53	-2,886.43	5.713	7.843	238,274.58	-22,639.57

(Design Flood)

No.	VOL	W_1	Xg	W_1・Xg
	m^3	KN	m	KN・m
I	808.37	18,269.21	4.686	85,604.77
II	1,845.55	41,709.53	5.713	238,274.58

pier Volume and gravity center (Xg, Yg)

No	VOL Equation (m^3)		X(m)	Y(m)	VOL·X(m^4)	VOL·Y(m^3)
I	① 1/4 × π × 4.00 ^{2} × 1/2 × 7.60	47.75	-5.333	3.800	-254.66	181.46
	①' 2 × 1.00 × 7.60	15.20	-5.000	3.800	-76.00	57.76
	② 4 × 5.00 × 7.60	152.00	-2.000	3.800	-304.00	577.60
	③ 13.32 × 5.00 × 7.60	506.16	6.660	3.800	3371.03	1923.41
	④ 8.00 × 5.00 × 0.90	36.00	9.000	8.050	324.00	289.80
	⑤ 0.32 × 0.90 × 1/2 × 5.00	0.72	13.107	7.900	9.44	5.69
	⑥ 2.66 × 7.60 × 1/2 × 5.00	50.54	14.207	2.533	718.02	128.02
	Total	808.37			3,787.82	3,163.73
					Xg·Yg(m)	
					Xg=	4.686
					Yg=	3.914
II		808.37	4.686	12.414	3787.82	10034.90
	⑦ 1/4 × π × 4.00 ^{2} × 1/2 × 8.50	53.41	-5.333	4.250	-284.82	226.98
	⑦' 2 × 1.00 × 8.50	17.00	-5.000	4.250	-85.00	72.25
	⑧ 4 × 5.00 × 8.50	170.00	-2.000	4.250	-340.00	722.50
	⑨ 15.98 × 5.00 × 8.50	679.15	7.990	4.250	5426.41	2886.39
	⑩ 1.40 × 5.00 × 1/2 × 5.00	17.50	16.913	7.167	295.98	125.42
	⑪ 1.60 × 4.00 × 5.00	32.00	18.180	6.500	581.76	208.00
	⑫ 1.60 × 1.20 × 1/2 × 5.00	4.80	17.950	4.100	86.16	19.68
	⑬ 2.98 × 8.50 × 1/2 × 5.00	63.33	16.973	2.833	1074.82	179.40
	Total	1845.55			10,543.12	14,475.52
					Xg·Yg(m)	
					Xg=	5.713
					Yg=	7.843



b. Bridge self weight (W_2) and Earthquake force (F_3,F_4)

Bridge Weight W2= 5.00 × 12.50 × 0.90 × 23.50 KN/m^3

= 1,321.88 KN

≒ 1,330 KN

(Earthquake at HWL)

No.	W_2	F_3	Xg	Yg	W_2・Xg	F_3・Yg
	m^3	KN	m	m	KN・m	KN・m
I	1,330	199.50	2.500	8.050	3,325.00	1,605.98
II	1,330	199.50	2.500	16.550	3,325.00	3,301.73

(Before impounding)

No.	W_2	F_4	Xg	Yg	W_2・Xg	F_4・Yg
	m^3	KN	m	m	KN・m	KN・m
I	1,330.00	-99.75	2.500	8.050	3,325.00	-802.99
II	1,330.00	-99.75	2.500	16.550	3,325.00	-1,650.86

(Design Flood)

No.	W_2	Xg	W_1・Xg
	KN	m	KN・m
I	1,330.00	2.500	3,325.00
II	1,330.00	2.500	3,325.00

c. Gate lifter weight (W_3) and Earthquake force (F_5,F_6)

Gate lifter (W3) = (62.1 + 8.1) × 40% = 28.08 tf

= 28.08 × 9.80 = 275.18 KN ≒ 275 KN

(Earthquake at HWL)

No.	W_3	F_5	Xg	Yg	W_3・Xg	F_5・Yg
	KN	KN	m	m	KN・m	KN・m
I	275.00	41.25	10.000	8.500	2,750.00	350.63
II	275.00	41.25	10.000	17.000	2,750.00	701.25

(Before impounding)

No.	W_3	F_3	Xg	Yg	W_2・Xg	F_3・Yg
	m^3	KN	m	m	KN・m	KN・m
I	275.00	-20.63	10.000	8.500	2,750.00	-175.31
II	275.00	-20.63	10.000	17.000	2,750.00	-350.63

(Design Flood)

No.	W_3	Xg	W_1・Xg
	KN	m	KN・m
I	275.00	10.000	2,750.00
II	275.00	10.000	2,750.00

b) Static pressure

a. Earthquake at HWL (Ph_1,(EL 415.00 + 0.6 + 0.87 = 416.47)

Wind Wave Earthquake Wave

pier (B= 5.00 m)

No.	EL.	h	Ph_1	Yh	Ph_1・Yh
	m	m	KN	m	KN・m
I	411.50	4.970	605.79	1.657	1,003.59
II	403.00	13.470	4,449.84	4.490	19,979.77

gate (B= 12.50 m)

No.	EL.	h	Ph_2	Yh	Ph_2・Yh
	m	m	KN	m	KN・m
I	411.50	-	-	-	-
II	403.00	13.470	11,124.60	6.000	66,747.57

b. Design Flood (Ph3) (EL 416.00 + 0.6 = 416.60)

Gate is open and no static pressure.

Pier (B= 5.00 m)

No.	EL.	h	Ph_3	Yh	Ph_3・Yh
	m	m	KN	m	KN・m
I	411.50	5.100	637.90	1.700	1,084.42
II	403.00	13.600	4,536.14	4.533	20,563.85

c) Dynamic pressure (EL 415.00)

(Earthquake at HWL) Pier (B= 5.00 m)

No.	EL.	h	Pe_1	Yd	$Pe_1 \cdot Yd$
	m	m	KN	m	KN·m
I	411.50	3.500	326.52	1.400	457.13
II	403.00	12.000	2,072.94	4.800	9,950.09

(Earthquake at HWL) Pier (B= 12.50 m)

No.	EL.	h	Pe_2	Yd	$Pe_2 \cdot Yd$
	m	m	KN	m	KN·m
I	411.50	-	-	-	-
II	403.00	12.000	5,182.34	6.000	31,094.03

d) Uplift (U1、U2)

(Earthquake at HWL) (EL 415.00 + 0.6 + 0.87 = 416.47)

B I = 5.000 m EL= 411.500 m h= 4.970 m

B II = 5.000 m EL= 403.000 m h= 13.470 m

No.	Pd_1	Pu_1	L	U_1	Xu	$U_1 \cdot Xu$
	tf/m^2	KN/m^2	m	KN	m	KN·m
I	0.000	16.25	21.980	-893.04	1.327	-1,184.77
II	0.000	44.05	24.960	-2,748.53	2.320	-6,376.58

(Design Flood) (EL 415.00 + 0.6 = 415.60)

B I = 5.000 m EL= 411.500 m h= 4.100 m

B II = 5.000 m EL= 403.000 m h= 12.600 m

No.	Pd_2	Pu_2	L	U_2	Xu	$U_2 \cdot Xu$
	KN/m^2	KN/m^2	m	KN	m	KN·m
I	0.000	13.41	21.980	-806.02	1.327	-1,069.32
II	0.000	41.20	24.960	-2,645.62	2.320	-6,137.84

(c) Composition of Outer Force

a) Earthquake at HWL

No.	Outer Force	Vertical Force V	Horizontal Force H	Moment M
I	W_1	18,269.21	-	85,604.77
	F_1	-	2,740.38	10,725.05
	W_2	1,330.00	-	3,325.00
	F_3	-	199.50	1,605.98
	W_3	275.00	-	2,750.00
	F_5	-	41.25	350.63
	Ph_1	-	605.79	1,003.59
	Pe_1	-	326.52	457.13
	U_1	-893.04	-	-1,184.77
	Total	18,981.17	3,913.45	104,637.39
II	W_1	41,709.53	-	238,274.58
	F_1	-	6,256.43	49,072.00
	W_2	1,330.00	-	3,325.00
	F_3	-	199.50	3,301.73
	W_3	275.00	-	2,750.00
	F_5	-	41.25	701.25
	Ph_1	-	4,449.84	19,979.77
	Ph_2	-	11,124.60	66,747.57
	Pe_1	-	2,072.94	9,950.09
	Pe_2	-	5,182.34	31,094.03
	U_1	-2,748.53	-	-6,376.58
	Total	40,566.00	29,326.89	418,819.45

b) Before impounding

No.	Outer Force	Vertical Force V	Horizontal Force H	Moment M
I	W_1	18,269.21	-	85,604.77
	F_2	-	-1,176.18	-4,603.22
	W_2	1,330.00	-	3,325.00
	F_4	-	-99.75	-802.99
	W_3	275.00	-	2,750.00
	F_6	-	-20.63	-175.31
	Total	19,874.21	-1,296.56	86,098.25
II	W_1	41,709.53	-	238,274.58
	F_2	-	-2,886.43	-22,639.57
	W_2	1,330.00	-	3,325.00
	F_4	-	-99.75	-1,650.86
	W_3	275.00	-	2,750.00
	F_6	-	-20.63	-350.63
	Total	43,314.53	-3,006.81	219,708.52

c) Design Flood

No.	Outer Force	Vertical Force V	Horizontal Force H	Moment M
I	W_1	18,269.21	-	85,604.77
	W_2	1,330.00	-	3,325.00
	W_3	275.00	-	2,750.00
	Ph_3	-	637.90	1,084.42
	U_2	-806.02	-	-1,069.32
	Total	19,068.19	637.90	91,694.87
II	W_1	41,709.53	-	238,274.58
	W_2	1,330.00	-	3,325.00
	W_3	275.00	-	2,750.00
	Ph_3	-	4,536.14	20,563.85
	U_2	-2,645.62	-	-6,137.84
	Total	40,668.91	4,536.14	258,775.59

(d) Stability Analysis

a) Fs for Sliding

(Earthquake at HWL)

No.	f	ΣV	τ	A	ΣfV+τA	ΣH	n
		KN	KN/m^2	m^2	KN	KN	
I	1.0	18,981.17	2,940	109.90	342087.17	3913.45	87.4
II	1.0	40,566.00	2,940	124.80	407478.00	29326.89	13.9

(Earthquake before impounding)

No.	f	ΣV	τ	A	ΣfV+τA	ΣH	n
		KN	KN/m^2	m^2	KN	KN	
I	1.0	19,874.21	2,940	109.90	342,980.21	1,296.56	264.5
II	1.0	43,314.53	2,940	124.80	410,226.53	3,006.81	136.4

(design Flood)

No.	f	ΣV	τ	A	ΣfV+τA	ΣH	n
		KN	KN/m^2	m^2	KN	KN	
I	0.8	19,068.19	1,962	109.90	230,878.35	637.90	361.9
II	0.8	40,668.91	1,962	124.80	277,392.73	4,536.14	61.2

b) Composed force acting point

(Earthquake at HWL)

No.	ΣV	ΣM	ΣM/ΣV	L	e	L/6
	KN	KN·m	m	m	m	m
I	18,981.17	104,637.39	5.513	21.980	0.523	3.663
II	40,566.00	418,819.45	10.324	24.960	3.844	4.160

(Earthquake before impounding)

No.	ΣV	ΣM	ΣM/ΣV	L	e	L/6
	KN	KN·m	m	m	m	m
I	19,874.21	86,098.25	4.332	21.980	-0.658	3.663
II	43,314.53	219,708.52	5.072	24.960	-1.408	4.160

(design Flood)

No.	ΣV	ΣM	ΣM/ΣV	L	e	L/6
	KN	KN·m	m	m	m	m
I	19,068.19	91,694.87	4.809	21.980	-0.181	3.663
II	40,668.91	258,775.59	6.363	24.960	-0.117	4.160

c) Vertical stress at the end of upstream and downstream

(Earthquake at HWL)

No.	ΣV	A	e	ΣV/A	1+6e/L	1-6e/L	P_1	P_2
	KN	m	m	m	m	m	KN/m^2	KN/m^2
I	18,981.17	109.90	0.523	172.713	1.143	0.857	197.36	148.07
II	40,566.00	124.80	3.844	325.048	1.924	0.076	625.44	24.66

(Earthquake before impounding)

No.	ΣV	A	e	ΣV/A	1+6e/L	1-6e/L	P_1	P_2
	KN	m	m	m	m	m	KN/m^2	KN/m^2
I	19,874.21	109.90	-0.658	180.839	0.820	1.180	148.36	213.31
II	43,314.53	124.80	-1.408	347.072	0.662	1.338	229.63	464.51

(design Flood)

No.	ΣV	A	e	ΣV/A	1+6e/L	1-6e/L	P_1	P_2
	KN	m	m	m	m	m	KN/m^2	KN/m^2
I	19,068.19	109.90	-0.181	173.505	0.951	1.049	164.92	182.09
II	40,668.91	124.80	-0.117	325.873	0.972	1.028	316.71	335.04

- e) Stability Check

  a. Earthquake at HWL

  b. Earthquake before impounding

  c. Design Flood

As shearing safety factor is more than 4, it is safe against sliding for any case of a, b, and c.

As composed force acts within middle third, it is safe against turning over for any case of a, b, and c

As maximum and minimum value of vertical stress are both between 0.00KN/m^2 and 3920KN/m^2, it is safe for reaction force at both upstream and downstream ends for any case of a, b, and c.

Comparison with Powerhouse Types

Comparison with Powerhouse Types

The powerhouse of Option IIIB was planned as an underground type powerhouse, because a surface type powerhouse was considered to cause much excavation for large-scale slopes and to change environment in larger areas. While, JICA Study Team was requested by NEA to conduct the economic comparison between a surface type and an underground type powerhouse. The result of economic comparison explains as follows.

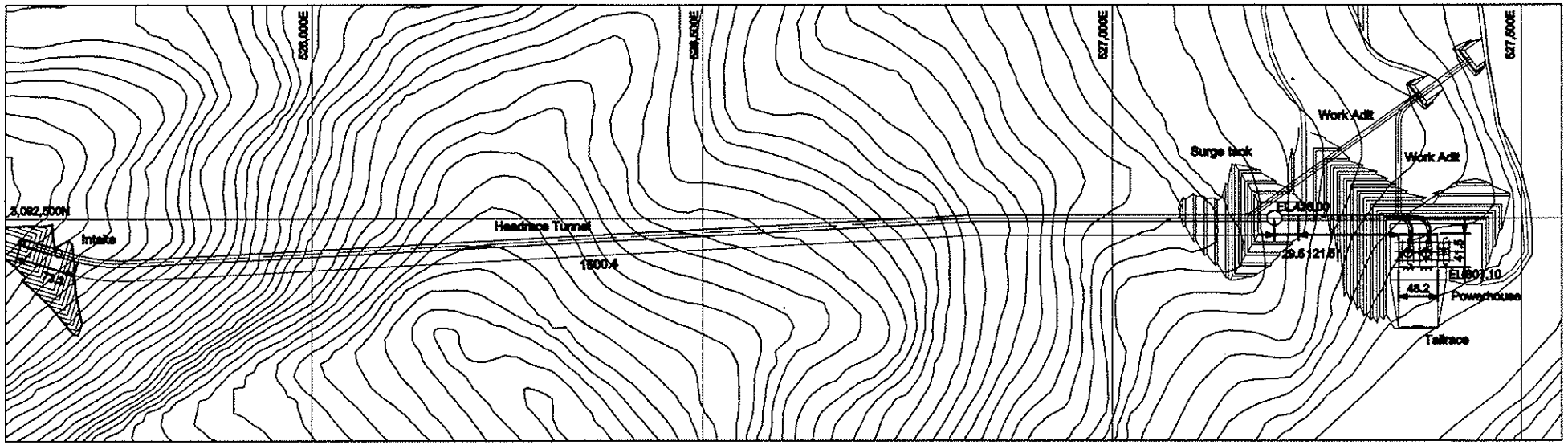
To compare the underground powerhouse selected in the Chapter 10 with a surface type one, an alternative for a surface type powerhouse shown in Fig. A11-1 was prepared. FSL is EL. 415 m in both, and features of powerhouses of both are shown in Table A11-1.

Table A11-1 Comparison of Powerhouse Types

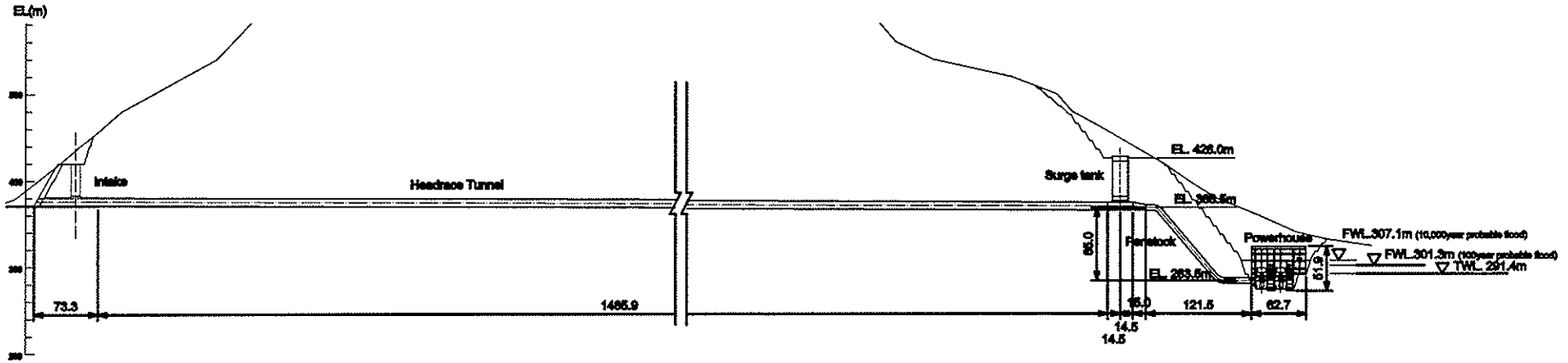
Item	Unit	Underground Type	Surface Type	Remarks
Maximum Discharge	m3/s	127.4	127.4	
Intake Water Level	m	405.0	405.0	
Tailrace Water Level	m	289.2	291.4	
Effective Head	m	112.5	110.3	
Installed Capacity	MW	127	125	
Firm Capacity	MW	94.2	90.8	
Primary Energy	GWh	256.58	251.86	without Flushing
Annual Energy	GWh	604.27	600.53	without Flushing
Project Cost	1,000 US$	420,986	415,694	
Annual Bebefit	1,000 US$	74,520	72,647	
Annual Cost	1,000 US$	46,308	45,726	
B/C		1.61	1.59	

For the two alternatives, annual generating energy and the project cost including, compensation cost, administration and engineering cost, interest during construction, etc were calculated. The construction cost of the surface type powerhouse was a little inexpensive, but its annual generating energy was smaller than that of the underground type powerhouse.

The benefit cost ratio was calculated to use benefit which described value of kW and kWh in Table 10.2.3-3 of Chapter 10. It was concluded that the underground type powerhouse was more economical than the surface type powerhouse.



Plan
SCALE A



Profile
SCALE A

SCALE A 0 50 100 200 METRES

Upgrading Feasibility Study on
Upper Seti (Damauli)
Hydroelectric Project, NEPAL

GENERAL PLAN & PROFILE OF Surface Powerhouse Option

Fig. :A11-1 | *Date : February,2007*

Countermeasure of corona interference

Countermeasure of corona interference

Adopting small size conductor becomes difficult if the transmission voltage is high. Because the surface potential gradient becomes high, and corona discharge is generated. The corona discharge causes corona loss and corona noise. In consequence of this phenomenon, there is a possibility of causing radio disturbance.

At standard temperature and air pressure (20degC, 760mmHg), the potential gradient where the air electrical breakdown is produced is about 21kV/cm (effective value of sine wave alternating current). It is called corona starting potential gradient. Conductor should be selected to be not more than corona starting potential gradient. In Japan, it is thought that the trouble by the corona noise and corona loss is not produced if the surface potential gradient is approximately 15kV/cm or less.

Generally, large-gauge conductor or multi-bundled conductor is adopted in order to decrease the surface potential gradient of conductor.

In the case of voltage 220kV, Bison single conductor, the surface potential gradient of conductor is calculated as follows. There are some construction records which are 15 kV/ cm more of surface gradient. In the case of passing mountainous lands, there are construction records which are more than 15kV/cm of surface gradient in Japan.

(Calculation Conditions)

- Nominal Voltage 220kV (Maximum Voltage 245kV)
- Normal size of 220kV Tower arrangement

(Calculation Result)

- 16.6 kV/cm

Output list of Energy Calculation for F/S design

With Every-year Flushing Operation

Input

Dam				Remarks
High Water Level	H.W.L.	415	m	
Intake Water Level	I.W.L.	405	m	
Low Water Level	L.W.L.	391	m	
Tail Water Level	T.W.L.	289.2	m	

Turbine, Generator				Remarks
Max. Discharge	Qmax	127.4	m^3/s	
Min. Discharge	Qmin	15	%	Qmin/Qmax
Installed Capacity	Pmax	127	MW	Installed Capacity at Intake Water Level
Peak Hours	Tpeak	6	h	

Others				Remarks
Firm Discharge	Qfirm	31.85	m^3/s	
Total Loss	Loss ($a * x^2$)	3.3	m	Coefficient of Loss = Loss / (Qmax)2
Number of Divisions		20		Number of Divided Storage Capacity

Efficiency (Turbine, Generator)

Turbine				Generator	
Q/Qmax	H.W.L.	I.W.L.	L.W.L.	P/Ptmax	
0.3	0.644	0.685	0.646	0.4	0.961
0.4	0.735	0.790	0.765	0.6	0.970
0.5	0.803	0.847	0.825	0.8	0.974
0.6	0.845	0.885	0.868	1	0.975
0.7	0.880	0.916	0.898		
0.8	0.907	0.934	0.922		
0.9	0.929	0.940	0.934		
1	0.939	0.927	0.930		

Height - Area - Volume

Height (m)	Area (km^2)	Volume (MCM)
310.00	0.00	0.000
315.00	0.00	0.000
320.00	0.00	0.000
325.00	0.01	0.013
330.00	0.08	0.232
335.00	0.16	0.823
340.00	0.30	1.964
345.00	0.45	3.800
350.00	0.63	6.480
355.00	0.84	10.160
360.00	1.10	15.042
365.00	1.41	21.359
370.00	1.69	29.072
375.00	2.05	38.503
380.00	2.40	49.605
385.00	2.95	63.157
390.00	3.56	79.396
395.00	4.13	98.933
400.00	4.51	121.000
405.00	5.11	145.000
410.00	5.51	171.000
415.00	5.86	200.000
420.00	6.25	230.000
425.00	6.68	262.000
430.00		
435.00		

Calclated Rule

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	MOV.	DEC.
Rule	0	0	0	0	20	20	20	0	0	0	0	0
Water Level	415.00	415.00	415.00	415.00	387.23	387.23	387.23	415.00	415.00	415.00	415.00	415.00
Storage	200.00	200.00	200.00	200.00	69.97	69.97	69.97	200.00	200.00	200.00	200.00	200.00

Inflow (MCM)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	78.74	70.16	74.19	76.46	178.11	195.96	353.28	1227.24	805.33	294.62	206.32	137.67	3698.08	308.17
1965	84.64	65.56	73.12	78.54	90.8	385.17	779.41	980.56	487.04	161.24	115.34	77.41	3378.83	281.57
1966	59.46	47.9	49.82	44.06	53.03	158.37	605.32	688.88	407.98	170.35	93.83	61.87	2440.87	203.41
1967	48.75	44.27	47.41	52.88	59.19	143.6	613.09	564.61	475.37	200.34	106.53	84.1	2440.14	203.35
1968	60.26	45.35	59.73	59.1	87.05	361.58	893.78	762	570.76	385.96	102.9	57.05	3445.52	287.13
1969	42.59	29.51	34.28	32.66	38.03	82.94	336.41	837.54	678.07	206.5	98.24	63.48	2480.25	206.69
1970	47.68	36.05	37.23	57.54	88.12	230.17	1013.77	1097.34	517.62	277.75	141	83.03	3627.3	302.28
1971	57.05	39.43	43.66	69.21	99.64	480.3	773.52	798.7	545.36	383.81	169.26	100.71	3560.65	296.72
1972	62.41	44.85	45.53	46.92	135.26	270.09	865.93	964.49	645.93	284.18	127.01	83.3	3575.9	297.99
1973	60.8	36.77	41.78	60.65	98.57	450.75	647.1	1035.2	681.44	688.35	186.62	98.3	4086.33	340.53
1974	92.14	75.72	80.89	99.53	98.03	231.47	913.33	1096	653.18	346.32	107.31	84.91	3878.83	323.24
1975	81.96	71.85	74.46	52.88	57.85	213.84	1137.25	873.43	785.64	366.14	134.01	75	3924.31	327.03
1976	53.3	51.87	46.6	58.32	103.12	486.78	1011.9	910.39	553.65	230.34	106.79	84.1	3697.16	308.1
1977	54.37	43.55	49.01	72.06	119.19	233.28	766.02	1089.04	637.63	293.02	187.66	109.55	3654.38	304.53
1978	80.08	65.8	66.42	69.98	177.58	414.2	1014.04	929.94	552.61	277.48	160.44	121.33	3929.9	327.49
1979	94.55	75.72	73.39	91.5	132.58	213.32	837.27	1190.82	614.04	280.7	142.82	86.24	3832.95	319.41
1980	61.07	52.12	61.34	62.73	92.94	273.46	1132.16	1189.48	806.89	214.54	107.31	63.75	4117.79	343.15
1981	42.85	30.24	36.16	68.17	103.39	242.35	1098.95	1013.77	622.86	255.79	123.9	93.48	3731.91	310.99
1982	83.3	69.67	90.8	99.53	125.35	248.31	688.35	899.14	532.14	224.99	137.38	115.71	3314.67	276.22
1983	100.17	82.74	88.12	83.2	119.99	235.87	557.11	718.08	711.24	377.12	135.56	99.9	3309.1	275.76
1984	68.57	47.86	51.69	55.99	161.78	387.76	1185.46	762.81	624.67	250.97	145.67	104.19	3847.42	320.62
1985	92.4	75.24	81.96	95.13	157.22	291.6	886.55	522.56	519.7	331.59	140.23	89.99	3284.17	273.68
1986	59.73	42.09	50.89	67.65	68.3	298.6	691.83	689.42	720.06	389.71	147.23	75.8	3301.31	275.11
1987	56.51	43.55	50.89	54.95	76.87	180.66	743.26	742.18	469.67	227.13	134.27	98.57	2878.51	239.88
1988	74.46	61.39	65.89	68.43	102.58	283.31	702.01	852	613.01	268.38	130.9	96.96	3319.32	276.61
1989	84.37	61.45	68.03	72.84	152.67	373.77	667.46	825.75	616.38	298.64	133.23	91.07	3445.66	287.14
1990	68.83	54.19	63.21	86.83	141.42	390.1	721.83	629.42	496.89	268.64	109.12	66.69	3097.17	258.1
1991	47.14	36.77	38.57	46.4	83.03	291.6	746.2	851.73	642.04	307.48	139.45	98.03	3328.44	277.37
1992	76.87	63.64	64.55	58.84	89.19	206.32	499.52	769.5	505.44	327.84	124.16	75.26	2861.13	238.43
1993	55.71	44.03	32.41	31.88	73.92	247.28	578.53	854.14	552.36	321.41	141	82.76	3015.43	251.29
1994	72.05	60.72	73.39	71.8	92.67	262.05	486.93	620.32	363.92	94.55	39.66	28.12	2266.18	188.85
1995	21.7	18.14	23.84	24.62	69.37	657.07	837	513.18	449.71	341.5	216.43	134.72	3307.28	275.61
1996	74.19	48.61	76.33	74.13	94.28	173.15	601.57	850.12	647.48	281.77	112.49	77.94	3112.06	259.34
1997	66.16	52.25	69.64	78.28	96.42	187.92	608.26	687.01	360.81	159.1	84.5	82.23	2532.58	211.05
1998	58.39	46.21	60.26	69.21	124.01	381.02	765.22	1205.55	531.1	165.53	86.05	63.21	3555.76	296.31
1999	50.62	38.95	39.1	42.51	86.78	235.09	702.81	632.91	445.56	174.1	53.65	34.55	2536.63	211.39
SUM	2373.87	1874.22	2084.59	2335.41	3728.33	10399.11	27462.43	30875.25	20843.58	10127.88	4628.27	3080.98	119813.9	
AVE	65.94	52.06	57.91	64.87	103.56	288.86	762.85	857.65	578.99	281.33	128.56	85.58	3328.16	

Inflow (m3/s)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	29.4	28	27.7	29.5	66.5	75.6	131.9	458.2	310.7	110	79.6	51.4	1398.5	116.54
1965	31.6	27.1	27.3	30.3	33.9	148.6	291	366.1	187.9	60.2	44.5	28.9	1277.4	106.45
1966	22.2	19.8	18.6	17	19.8	61.1	226	257.2	157.4	63.6	36.2	23.1	922	76.83
1967	18.2	18.3	17.7	20.4	22.1	55.4	228.9	210.8	183.4	74.8	41.1	31.4	922.5	76.88
1968	22.5	18.1	22.3	22.8	32.5	139.5	333.7	284.5	220.2	144.1	39.7	21.3	1301.2	108.43
1969	15.9	12.2	12.8	12.6	14.2	32	125.6	312.7	261.6	77.1	37.9	23.7	938.3	78.19
1970	17.8	14.9	13.9	22.2	32.9	88.8	378.5	409.7	199.7	103.7	54.4	31	1367.5	113.96
1971	21.3	16.3	16.3	26.7	37.2	185.3	288.8	298.2	210.4	143.3	65.3	37.6	1346.7	112.23
1972	23.3	17.9	17	18.1	50.5	104.2	323.3	360.1	249.2	106.1	49	31.1	1349.8	112.48
1973	22.7	15.2	15.6	23.4	36.8	173.9	241.6	386.5	262.9	257	72	36.7	1544.3	128.69
1974	34.4	31.3	30.2	38.4	36.6	89.3	341	409.2	252	129.3	41.4	31.7	1464.8	122.07
1975	30.6	29.7	27.8	20.4	21.6	82.5	424.6	326.1	303.1	136.7	51.7	28	1482.8	123.57
1976	19.9	20.7	17.4	22.5	38.5	187.8	377.8	339.9	213.6	86	41.2	31.4	1396.7	116.39
1977	20.3	18	18.3	27.8	44.5	90	286	406.6	246	109.4	72.4	40.9	1380.2	115.02
1978	29.9	27.2	24.8	27	66.3	159.8	378.6	347.2	213.2	103.6	61.9	45.3	1484.8	123.73
1979	35.3	31.3	27.4	35.3	49.5	82.3	312.6	444.6	236.9	104.8	55.1	32.2	1447.3	120.61
1980	22.8	20.8	22.9	24.2	34.7	105.5	422.7	444.1	311.3	80.1	41.4	23.8	1554.3	129.53
1981	16	12.5	13.5	26.3	38.6	93.5	410.3	378.5	240.3	95.5	47.8	34.9	1407.7	117.31
1982	31.1	28.8	33.9	38.4	46.8	95.8	257	335.7	205.3	84	53	43.2	1253	104.42
1983	37.4	34.2	32.9	32.1	44.8	91	208	268.1	274.4	140.8	52.3	37.3	1253.3	104.44
1984	25.6	19.1	19.3	21.6	60.4	149.6	442.6	284.8	241	93.7	56.2	38.9	1452.8	121.07
1985	34.5	31.1	30.6	36.7	58.7	112.5	331	195.1	200.5	123.8	54.1	33.6	1242.2	103.52
1986	22.3	17.4	19	26.1	25.5	115.2	258.3	257.4	277.8	145.5	56.8	28.3	1249.6	104.13
1987	21.1	18	19	21.2	28.7	69.7	277.5	277.1	181.2	84.8	51.8	36.8	1086.9	90.58
1988	27.8	24.5	24.6	26.4	38.3	109.3	262.1	318.1	236.5	100.2	50.5	36.2	1254.5	104.54
1989	31.5	25.4	25.4	28.1	57	144.2	249.2	308.3	237.8	111.5	51.4	34	1303.8	108.65
1990	25.7	22.4	23.6	33.5	52.8	150.5	269.5	235	191.7	100.3	42.1	24.9	1172	97.67
1991	17.6	15.2	14.4	17.9	31	112.5	278.6	318	247.7	114.8	53.8	36.6	1258.1	104.84
1992	28.7	25.4	24.1	22.7	33.3	79.6	186.5	287.3	195	122.4	47.9	28.1	1081	90.08
1993	20.8	18.2	12.1	12.3	27.6	95.4	216	318.9	213.1	120	54.4	30.9	1139.7	94.98
1994	26.9	25.1	27.4	27.7	34.6	101.1	181.8	231.6	140.4	35.3	15.3	10.5	857.7	71.48
1995	8.1	7.5	8.9	9.5	25.9	253.5	312.5	191.6	173.5	127.5	83.5	50.3	1252.3	104.36
1996	27.7	19.4	28.5	28.6	35.2	66.8	224.6	317.4	249.8	105.2	43.4	29.1	1175.7	97.98
1997	24.7	21.6	26	30.2	36	72.5	227.1	256.5	139.2	59.4	32.6	30.7	956.5	79.71
1998	21.8	19.1	22.5	26.7	46.3	147	285.7	450.1	204.9	61.8	33.2	23.6	1342.7	111.89
1999	18.9	16.1	14.6	16.4	32.4	90.7	262.4	236.3	171.9	65	20.7	12.9	958.3	79.86
SUM	886.3	767.8	778.3	901	1392	4012	10253.3	11527.5	8041.5	3781.3	1785.6	1150.3	45276.9	
AVE	24.62	21.33	21.62	25.03	38.67	111.44	284.81	320.21	223.38	105.04	49.6	31.95	1257.69	

Power (MW)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	117.86	114.97	111.01	107.48	102.83	0	0	125.32	127	127	127	127	1187.47	98.96
1965	127	127	127	127	119.01	0	0	127	127	127	127	127	1262.01	105.17
1966	127	127	118.49	101.76	62.96	0	0	126.78	127	127	127	127	1171.99	97.67
1967	127	120.04	107.56	65.4	72.02	0	0	124.34	127	127	127	127	1124.36	93.7
1968	127	127	120.85	112.15	103.61	0	0	124.48	127	127	127	127	1223.09	101.92
1969	127	113.73	52.23	34.39	40.89	0	0	125.6	127	127	127	127	1001.84	83.49
1970	127	118.86	86.14	72.47	99.31	0	0	124.02	127	127	127	127	1135.8	94.65
1971	127	127	115.65	104.85	100.55	0	0	125.03	127	127	127	127	1208.08	100.67
1972	127	127	119.51	106.6	99.31	0	0	127	127	127	127	127	1214.42	101.2
1973	127	127	115.79	103.76	99.31	0	0	127	127	127	127	127	1207.86	100.66
1974	127	127	127	127	123.89	0	0	124.01	127	127	127	127	1263.9	105.33
1975	127	127	127	127	115.38	0	0	126.13	127	127	127	127	1257.51	104.79
1976	127	126.39	115.42	104.1	99.31	0	0	126.66	127	127	127	127	1206.88	100.57
1977	127	127	117.44	108.71	103.02	0	0	123.94	127	127	127	127	1215.11	101.26
1978	127	127	127	127	115.69	0	0	126.95	127	127	127	127	1258.64	104.89
1979	127	127	127	127	122.98	0	0	124.95	127	127	127	127	1263.93	105.33
1980	127	127	123.99	116.62	106.69	0	0	124.94	127	127	127	127	1234.24	102.85
1981	127	116.34	67.53	88.47	99.31	0	0	127	127	127	127	127	1133.65	94.47
1982	127	127	127	127	123.89	0	0	126.5	127	127	127	127	1266.39	105.53
1983	127	127	127	127	123.89	0	0	127	127	127	127	127	1266.89	105.57
1984	127	127	123.49	113.13	103.84	0	0	124.49	127	127	127	127	1226.95	102.25
1985	127	127	127	127	123.89	0	0	126.09	127	127	127	127	1265.98	105.5
1986	127	127	119.51	110.61	103.63	0	0	126.79	127	127	127	127	1222.54	101.88
1987	127	126.76	115.63	104.6	97.06	0	0	124.18	127	127	127	127	1203.23	100.27
1988	127	127	127	126.31	113.01	0	0	125.81	127	127	127	127	1254.13	104.51
1989	127	127	127	127	116.46	0	0	125.43	127	127	127	127	1257.89	104.82
1990	127	127	127	125.24	114.05	0	0	125.62	127	127	127	127	1253.91	104.49
1991	127	119.86	93.61	55.45	99.41	0	0	125.81	127	127	127	127	1129.14	94.1
1992	127	127	127	125.87	111.84	0	0	124.59	127	127	127	127	1251.3	104.28
1993	127	126.44	111.95	38.51	93.18	0	0	125.84	127	127	127	127	1130.92	94.24
1994	127	127	127	127	114.44	0	0	125.45	127	127	127	121.7	1250.59	104.22
1995	63.55	14.31	19.32	21.61	86.91	0	0	125.86	127	127	127	127	839.56	69.96
1996	127	127	127	126.39	113.58	0	0	125.79	127	127	127	127	1254.76	104.56
1997	127	127	125.4	122.09	111.4	0	0	126.74	127	127	127	127	1247.63	103.97
1998	127	127	120.9	114.17	105.91	0	0	125.1	127	127	127	127	1228.08	102.34
1999	127	120.22	97.75	49.44	99.31	0	0	125.69	127	127	127	127	1127.41	93.95
SUM	4499.41	4392.92	4077.17	3730.18	3741.77	0	0	4523.93	4572	4572	4572	4566.7	43248.08	
AVE	124.98	122.03	113.25	103.62	103.94	0	0	125.66	127	127	127	126.85	1201.34	

Total Energy(GWh)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	23.52	20.73	21.67	20.53	50.41	0	0	90.21	91.44	91.43	66.63	44.79	521.36	43.44
1965	26.92	23.25	25.35	24.22	54.51	0	0	88.34	91.44	50.89	38.98	28.82	452.72	37.73
1966	26.27	21.68	22.62	18.32	11.71	0	0	85.15	91.44	53.66	32.44	27.59	390.88	32.57
1967	25.38	20.59	20.76	11.77	13.4	0	0	83.55	91.44	62.77	36.3	28.91	394.87	32.91
1968	26.51	22.71	22.9	21.12	29.44	0	0	86.63	91.44	96.49	35.19	28.51	460.94	38.41
1969	24.94	19.87	9.71	6.19	7.61	0	0	87.39	91.44	64.65	33.78	28.61	374.19	31.19
1970	25.43	20.46	16.02	13.04	24.64	0	0	89.3	91.44	86.3	46.78	28.9	442.31	36.86
1971	26.43	21.63	22.26	20.19	28.75	0	0	87	91.44	96.49	55.36	33.55	483.1	40.26
1972	26.59	22.87	22.74	19.23	35.74	0	0	88.34	91.44	88.26	42.52	28.9	466.63	38.89
1973	26.5	21.77	22.28	19.1	27.1	0	0	88.34	91.44	96.49	60.64	32.82	486.48	40.54
1974	28.94	23.4	25.82	27.95	65.99	0	0	89.29	91.44	96.49	36.53	28.92	514.77	42.9
1975	26.87	23.24	25.47	23.87	39.38	0	0	87.75	91.44	96.49	44.65	28.78	487.94	40.66
1976	26.07	22.03	22.23	18.9	28.17	0	0	88.12	91.44	71.89	36.38	28.91	434.14	36.18
1977	26.42	21.65	22.48	20.68	36.46	0	0	89.24	91.44	90.95	60.96	38.24	498.52	41.55
1978	26.86	23.13	25.07	23.55	71.11	0	0	88.31	91.44	86.22	52.69	39.82	528.2	44.02
1979	29.67	23.4	25.71	24.82	73.5	0	0	88.95	91.44	87.2	47.33	29.16	521.18	43.43
1980	26.57	22.97	23.28	21.66	34.91	0	0	89.94	91.44	67.09	36.53	28.61	443	36.91
1981	25.33	20.17	12.56	15.92	28.24	0	0	88.34	91.44	79.63	41.58	31.35	434.56	36.21
1982	26.9	23.27	25.72	28.47	73.44	0	0	88.01	91.44	70.27	45.67	38.11	511.3	42.61
1983	31.38	25.06	26.61	25.1	71.98	0	0	85.3	91.44	96.49	45.12	33.31	531.79	44.32
1984	26.69	23.2	23.22	21.24	47.86	0	0	86.64	91.44	78.16	48.19	34.61	481.25	40.11
1985	29.02	23.4	25.82	26.81	82.12	0	0	81.67	91.44	96.49	46.54	30.3	533.61	44.47
1986	26.55	21.96	22.74	20.92	20.93	0	0	85.16	91.44	96.49	48.67	28.8	463.66	38.64
1987	26.16	21.31	22.26	18.83	18.05	0	0	86.43	91.44	70.92	44.73	32.9	433.03	36.08
1988	26.78	23.66	24.5	22.79	47.02	0	0	87.54	91.44	83.46	43.7	32.41	483.3	40.27
1989	26.92	23.18	25.09	23.69	66.03	0	0	87.28	91.44	92.66	44.41	30.62	511.32	42.61
1990	26.69	22.58	23.87	22.67	58.77	0	0	84.4	91.44	83.54	37.08	28.66	479.7	39.97
1991	25.58	20.57	17.41	9.98	19.47	0	0	87.54	91.44	95.34	46.3	32.74	446.37	37.2
1992	26.81	23.78	24.68	22.75	41.71	0	0	86.71	91.44	96.49	41.65	28.79	484.81	40.4
1993	26.12	21.28	21.79	6.93	17.33	0	0	87.56	91.44	96.49	46.78	28.89	444.61	37.05
1994	26.66	22.71	24.53	23.11	46.83	0	0	84.28	91.44	30.61	28.44	25.99	404.6	33.71
1995	11.82	2.4	3.59	3.89	16.16	0	0	81.53	91.44	96.49	69.7	43.89	420.91	35.08
1996	26.77	23.43	24.08	22.8	45.82	0	0	87.52	91.44	87.53	38.11	28.83	476.33	39.69
1997	26.41	22.13	23.45	22.31	42.86	0	0	85.13	91.44	50.24	29.6	27.89	421.46	35.13
1998	26.42	21.83	22.91	21.36	41.49	0	0	90.06	91.44	52.19	30.07	28.61	426.38	35.54
1999	25.49	20.61	18.18	8.9	20.33	0	0	84.44	91.44	54.8	28.67	25.64	378.5	31.54
SUM	944.39	781.91	789.38	703.61	1439.27	0	0	3131.39	3291.84	2892.05	1568.7	1126.18	16898.92	
AVE	26.23	21.72	21.93	19.54	39.98	0	0	86.98	91.44	80.33	43.58	31.28	469.41	

Primary Energy(GWh)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	21.92	20	20.65	19.35	19.13	0	0	21.8	22.86	23.62	22.86	23.62	215.81	17.98
1965	23.62	21.34	23.62	22.86	22.14	0	0	21.34	22.86	23.62	22.86	23.62	227.88	18.99
1966	23.62	21.34	22.04	18.32	11.71	0	0	20.54	22.86	23.62	22.86	23.62	210.53	17.54
1967	23.62	20.17	20.01	11.77	13.4	0	0	20.14	22.86	23.62	22.86	23.62	202.07	16.84
1968	23.62	22.1	22.48	20.19	19.27	0	0	20.91	22.86	23.62	22.86	23.62	221.53	18.46
1969	23.62	19.11	9.71	6.19	7.61	0	0	21.1	22.86	23.62	22.86	23.62	180.3	15.03
1970	23.62	19.97	16.02	13.04	18.47	0	0	21.58	22.86	23.62	22.86	23.62	205.66	17.14
1971	23.62	21.34	21.51	18.87	18.7	0	0	21	22.86	23.62	22.86	23.62	218	18.17
1972	23.62	22.1	22.23	19.19	18.47	0	0	21.34	22.86	23.62	22.86	23.62	219.91	18.33
1973	23.62	21.34	21.54	18.68	18.47	0	0	21.34	22.86	23.62	22.86	23.62	217.95	18.16
1974	23.62	21.34	23.62	22.86	23.04	0	0	21.58	22.86	23.62	22.86	23.62	229.02	19.09
1975	23.62	21.34	23.62	22.86	21.46	0	0	21.19	22.86	23.62	22.86	23.62	227.05	18.92
1976	23.62	21.99	21.47	18.74	18.47	0	0	21.28	22.86	23.62	22.86	23.62	218.53	18.21
1977	23.62	21.34	21.84	19.57	19.16	0	0	21.56	22.86	23.62	22.86	23.62	220.05	18.34
1978	23.62	21.34	23.62	22.86	21.52	0	0	21.33	22.86	23.62	22.86	23.62	227.25	18.94
1979	23.62	21.34	23.62	22.86	22.87	0	0	21.74	22.86	23.62	22.86	23.62	229.01	19.08
1980	23.62	22.1	23.06	20.99	19.84	0	0	21.74	22.86	23.62	22.86	23.62	224.31	18.69
1981	23.62	19.54	12.56	15.92	18.47	0	0	21.34	22.86	23.62	22.86	23.62	204.41	17.03
1982	23.62	21.34	23.62	22.86	23.04	0	0	21.25	22.86	23.62	22.86	23.62	228.69	19.06
1983	23.62	21.34	23.62	22.86	23.04	0	0	20.57	22.86	23.62	22.86	23.62	228.01	19
1984	23.62	22.1	22.97	20.36	19.31	0	0	20.91	22.86	23.62	22.86	23.62	222.23	18.52
1985	23.62	21.34	23.62	22.86	23.04	0	0	19.67	22.86	23.62	22.86	23.62	227.11	18.93
1986	23.62	21.34	22.23	19.91	19.28	0	0	20.54	22.86	23.62	22.86	23.62	219.88	18.32
1987	23.62	21.3	21.51	18.83	18.05	0	0	20.86	22.86	23.62	22.86	23.62	217.13	18.09
1988	23.62	22.1	23.62	22.74	21.02	0	0	21.14	22.86	23.62	22.86	23.62	227.2	18.93
1989	23.62	21.34	23.62	22.86	21.66	0	0	21.07	22.86	23.62	22.86	23.62	227.13	18.93
1990	23.62	21.34	23.62	22.54	21.21	0	0	20.35	22.86	23.62	22.86	23.62	225.64	18.8
1991	23.62	20.14	17.41	9.98	18.49	0	0	21.14	22.86	23.62	22.86	23.62	203.74	16.98
1992	23.62	22.1	23.62	22.66	20.8	0	0	20.93	22.86	23.62	22.86	23.62	226.69	18.89
1993	23.62	21.24	20.82	6.93	17.33	0	0	21.14	22.86	23.62	22.86	23.62	204.04	17
1994	23.62	21.34	23.62	22.86	21.29	0	0	20.32	22.86	23.62	22.86	22.64	225.03	18.75
1995	11.82	2.4	3.59	3.89	16.16	0	0	19.63	22.86	23.62	22.86	23.62	150.45	12.54
1996	23.62	22.1	23.62	22.75	21.13	0	0	21.13	22.86	23.62	22.86	23.62	227.31	18.94
1997	23.62	21.34	23.32	21.98	20.72	0	0	20.53	22.86	23.62	22.86	23.62	224.47	18.71
1998	23.62	21.34	22.49	20.55	19.7	0	0	21.77	22.86	23.62	22.86	23.62	222.43	18.54
1999	23.62	20.2	18.18	8.9	18.47	0	0	20.36	22.86	23.62	22.86	23.62	202.69	16.89
SUM	836.82	744.88	758.32	671.44	695.94	0	0	756.16	822.96	850.32	822.96	849.34	7809.14	
AVE	23.25	20.69	21.06	18.65	19.33	0	0	21	22.86	23.62	22.86	23.59	216.92	

Secondary Energy(GWh)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUM	AVE
1964	1.6	0.73	1.02	1.18	31.28	0	0	68.41	68.58	67.81	43.77	21.17	305.55	25.46
1965	3.3	1.91	1.73	1.36	32.37	0	0	67	68.58	27.27	16.12	5.2	224.84	18.74
1966	2.65	0.34	0.58	0	0	0	0	64.61	68.58	30.04	9.58	3.97	180.35	15.03
1967	1.76	0.42	0.75	0	0	0	0	63.41	68.58	39.15	13.44	5.29	192.8	16.07
1968	2.89	0.61	0.42	0.93	10.17	0	0	65.72	68.58	72.87	12.33	4.89	239.41	19.95
1969	1.32	0.76	0	0	0	0	0	66.29	68.58	41.03	10.92	4.99	193.89	16.16
1970	1.81	0.49	0	0	6.17	0	0	67.72	68.58	62.68	23.92	5.28	236.65	19.72
1971	2.81	0.29	0.75	1.32	10.05	0	0	66	68.58	72.87	32.5	9.93	265.1	22.09
1972	2.97	0.77	0.51	0.04	17.27	0	0	67	68.58	64.64	19.66	5.28	246.72	20.56
1973	2.88	0.43	0.74	0.42	8.63	0	0	67	68.58	72.87	37.78	9.2	268.53	22.38
1974	5.32	2.06	2.2	5.09	42.95	0	0	67.71	68.58	72.87	13.67	5.3	285.75	23.81
1975	3.25	1.9	1.85	1.01	17.92	0	0	66.56	68.58	72.87	21.79	5.16	260.89	21.74
1976	2.45	0.04	0.76	0.16	9.7	0	0	66.84	68.58	48.27	13.52	5.29	215.61	17.97
1977	2.8	0.31	0.64	1.11	17.3	0	0	67.68	68.58	67.33	38.1	14.62	278.47	23.21
1978	3.24	1.79	1.45	0.69	49.59	0	0	66.98	68.58	62.6	29.83	16.2	300.95	25.08
1979	6.05	2.06	2.09	1.96	50.63	0	0	67.21	68.58	63.58	24.47	5.54	292.17	24.35
1980	2.95	0.87	0.22	0.67	15.07	0	0	68.2	68.58	43.47	13.67	4.99	218.69	18.22
1981	1.71	0.63	0	0	9.77	0	0	67	68.58	56.01	18.72	7.73	230.15	19.18
1982	3.28	1.93	2.1	5.61	50.4	0	0	66.76	68.58	46.65	22.81	14.49	282.61	23.55
1983	7.76	3.72	2.99	2.24	48.94	0	0	64.73	68.58	72.87	22.26	9.69	303.78	25.32
1984	3.07	1.1	0.25	0.88	28.55	0	0	65.73	68.58	54.54	25.33	10.99	259.02	21.59
1985	5.4	2.06	2.2	3.95	59.08	0	0	62	68.58	72.87	23.68	6.68	306.5	25.54
1986	2.93	0.62	0.51	1.01	1.65	0	0	64.62	68.58	72.87	25.81	5.18	243.78	20.32
1987	2.54	0.01	0.75	0	0	0	0	65.57	68.58	47.3	21.87	9.28	215.9	17.99
1988	3.16	1.56	0.88	0.05	26	0	0	66.4	68.58	59.84	20.84	8.79	256.1	21.34
1989	3.3	1.84	1.47	0.83	44.37	0	0	66.21	68.58	69.04	21.55	7	284.19	23.68
1990	3.07	1.24	0.25	0.13	37.56	0	0	64.05	68.58	59.92	14.22	5.04	254.06	21.17
1991	1.96	0.43	0	0	0.98	0	0	66.4	68.58	71.72	23.44	9.12	242.63	20.22
1992	3.19	1.68	1.06	0.09	20.91	0	0	65.78	68.58	72.87	18.79	5.17	258.12	21.51
1993	2.5	0.04	0.97	0	0	0	0	66.42	68.58	72.87	23.92	5.27	240.57	20.05
1994	3.04	1.37	0.91	0.25	25.54	0	0	63.96	68.58	6.99	5.58	3.35	179.57	14.96
1995	0	0	0	0	0	0	0	61.9	68.58	72.87	46.84	20.27	270.46	22.54
1996	3.15	1.33	0.46	0.05	24.69	0	0	66.39	68.58	63.91	15.25	5.21	249.02	20.75
1997	2.79	0.79	0.13	0.33	22.14	0	0	64.6	68.58	26.62	6.74	4.27	196.99	16.42
1998	2.8	0.49	0.42	0.81	21.79	0	0	68.29	68.58	28.57	7.21	4.99	203.95	17
1999	1.87	0.41	0	0	1.86	0	0	64.08	68.58	31.18	5.81	2.02	175.81	14.65
SUM	107.57	37.03	31.06	32.17	743.33	0	0	2375.23	2468.88	2041.73	745.74	276.84	9090.23	
AVE	2.99	1.03	0.86	0.89	20.65	0	0	65.98	68.58	56.71	20.72	7.69	252.51	