

\*\* RESERVOIR OPERATION STUDY OF KAHAN D.D.1 DAM PLAN A-3 TUL = 165,000 \*\* NIPPON KOEI TOKYO/JAPAN

HIGH WATER LEVEL IN METER 280.000 LOW WATER LEVEL IN METER 250.000 RATED HEAD IN METER ..... 96.500  
 INSTALLED CAPACITY IN MW 127.000 DEPENDABLE CAPACITY IN MW 103.397 TARGET OPERATION HOUR A DAY 3.79  
 RATED DISCHARGE IN CMS 156.154 TYPE OF RULE CURVE .. VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 14.938 14.938 14.938 14.938 14.938 14.938 14.938 14.938 14.938 14.938 14.938 14.938

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 95.0

0. HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D  
 2550.0 160.25 0.0234  
 1950.0 111.76 0.0425  
 0. 63.35 0.0682

YEAR	DEPENDABLE ANNUAL ENERGY		ANNUAL POWER ENERGY		TOTAL ENERGY		BENEFIT		PRESENT OPERATION	
	(MW)	(GWH)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	WORTH (M US D)
1994	127.0	383.02	20.35	8.96	29.31	0.90909	26.65	3019.	3019.	
1995	127.0	383.02	20.35	8.96	29.31	0.82645	24.23	3019.	3019.	
...	...	...	...	...	...	...	...	...	...	...
2042	127.0	383.02	20.35	8.96	29.31	0.00937	0.27	3019.	3019.	
2043	127.0	383.02	20.35	8.96	29.31	0.00852	0.25	3019.	3019.	
SUMMARY	127.0	383.02	20.35	8.96	29.31	9.91481	290.65	3019.	3019.	



\*\* RESERVOIR OPERATION STUDY OF KAMAN NO.1 DAM PLAN A-3 T.WL = 155.000 \*\* NIPPON KOEI TOKYO/JAPAN  
 HIGH WATER LEVEL IN METER 280.000 LOW WATER LEVEL IN METER 250.000 RATED HEAD IN METR \*\*\*\*\* 104.100  
 INSTALLED CAPACITY IN MW 135.000 DEPENDABLE CAPACITY IN MW 108.455 TARGET OPERATION HOUR A DAY 3.77  
 RATED DISCHARGE IN CMS 153.872 TYPE OF RULE CURVE .. VARIABLE MASS CURVE  
 RULE CURVE IN MHH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 15.781 15.781 15.781 15.781 15.781 15.781 15.781 15.781 15.781 15.781 15.781 15.781

LENGTH OF INFLOW SERIES IN YEAR 20

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN X 95.0

O. HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D  
 2550.0 160.25 0.0234  
 1950.0 111.76 0.0425  
 0. 63.35 0.0682

YEAR	DEPENDABLE POWER (MW)	ANNUAL ENERGY (GWH)	ANNUAL POWER (M US D)	BENEFIT ENERGY (M US D)	TOTAL BENEFIT (M US D)	P.W.f.	PRESENT WORTH (M US D)	OPERATION HOUR (H)
1994	135.0	404.50	21.63	9.47	31.10	0.90909	28.27	3001.
1995	135.0	404.50	21.63	9.47	31.10	0.82645	25.70	3001.
...	...	...	...	...	...	...	...	...
2042	135.0	404.50	21.63	9.47	31.10	0.00937	0.29	3001.
2043	135.0	404.50	21.63	9.47	31.10	0.00852	0.26	3001.
SUMMARY	135.0	404.50	21.63	9.47	31.10	9.91481	308.34	3001.



\*\* RESERVOIR OPERATION STUDY OF KANAN NO.1 DAM PLAN A-3 TML = 145,000 \*\* NIPPON KOEI TOKYO/JAPAN  
 HIGH WATER LEVEL IN METER 280,000 LOW WATER LEVEL IN METER 250,000 RATED HEAD IN METER \*\*\*\*\* 112,000  
 INSTALLED CAPACITY IN MW 144,000 DEPENDABLE CAPACITY IN MW 117,964 TARGET OPERATION HOUR A DAY 3.80  
 RATED DISCHARGE IN CMS 152,553 TYPE OF RULE CURVE .. VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 16,969 16,969 16,969 16,969 16,969 16,969 16,969 16,969 16,969 16,969 16,969 16,969

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 95.0

0 HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D  
 2550.0 160.25 0.0234  
 1950.0 111.76 0.0425  
 0. 83.35 0.0682

YEAR	DEPENDABLE POWER (MW)	ANNUAL ENERGY (GWH)	POWER (MW)	ENERGY (M US D)	TOTAL ENERGY (M US D)	P.M.F.	PRESENT OPERATION WORTH (M US D)	OPERATION HOUR
1994	144.0	432.65	23.08	10.12	33.20	0.90909	30.18	3009.
1995	144.0	432.65	23.08	10.12	33.20	0.82665	27.44	3009.
..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..
2042	144.0	432.65	23.08	10.12	33.20	0.00937	0.31	3009.
2043	144.0	432.65	23.08	10.12	33.20	0.00852	0.28	3009.
SUMMARY	144.0	432.65	23.08	10.12	33.20	9.91481	329.17	3009.



NIPPON KOEI TOKYO/JAPAN

DAH \*\* PLAN A-3 KANAN HML 300

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 175.000 LOW WATER LEVEL IN METER 135.000 RATED HEAD IN METER \*\*\*\*\* 108.000  
 INSTALLED CAPACITY IN MW 152.000 DEPENDABLE CAPACITY IN MW 117.500 TARGET OPERATION HOUR A DAY 8.22  
 RATED DISCHARGE IN CMS 166.992 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. 38.750 FEB. 38.750 MAR. 38.750 APR. 38.750 MAY 38.750 JUNE 38.750 JULY 38.750 AUG. 38.750 SEP. 38.750 OCT. 38.750  
 NOV. 38.750 DEC. 38.750

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 95.0

O. HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D.

2530.0 100.25 0.0234  
 1950.0 113.26 0.0425  
 0. 63.35 0.0682

YEAR	DEPENDABLE ANNUAL ENERGY		ANNUAL POWER		ANNUAL ENERGY		ANNUAL BENEFIT		TOTAL (M US D)	P.M.F.	PRESENT OPERATION	
	(MW)	(GWH)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)			WORTH (M US D)	HOUR (H)
1989	152.0	222.92	24.36	18.09	42.44	0.20909	38.59	5093				
1990	152.0	758.94	24.36	17.71	42.07	0.82645	34.77	4990				
1991	152.0	740.96	24.36	17.34	41.70	0.75131	31.33	4885				
1992	152.0	726.99	24.36	16.96	41.32	0.68301	28.22	4779				
1993	152.0	709.01	24.36	16.59	40.95	0.62092	25.43	4674				
1994	152.0	693.03	24.36	16.22	40.57	0.56647	22.90	4569				
1995	152.0	682.61	24.36	15.86	39.86	0.51314	20.46	4368				
1996	152.0	632.19	24.36	14.79	39.15	0.46651	18.26	4167				
1997	152.0	601.77	24.36	14.08	38.44	0.42410	16.30	3867				
1998	152.0	571.35	24.36	13.37	37.73	0.38554	14.55	3766				
1999	152.0	540.93	24.36	12.66	37.02	0.35049	12.97	3565				
2000	152.0	510.51	24.36	11.95	36.30	0.31863	11.52	3363				
2001	152.0	494.08	24.36	11.56	35.92	0.28966	10.40	3256				
2002	152.0	477.66	24.36	11.18	35.54	0.26333	9.36	3148				
2003	152.0	461.23	24.36	10.79	35.15	0.23939	8.41	3040				
2004	152.0	444.80	24.36	10.41	34.77	0.21763	7.57	2931				
2005	152.0	428.38	24.36	10.02	34.38	0.19784	6.80	2823				
2006	152.0	417.39	24.36	9.77	34.12	0.17984	6.14	2715				
2007	152.0	406.40	24.36	9.51	33.87	0.16351	5.54	2608				
2008	152.0	395.42	24.36	9.25	33.61	0.14864	5.00	2500				
2009	152.0	384.43	16.99	16.34	33.33	0.13513	4.50	2333				
2010	152.0	384.43	16.99	16.34	33.33	0.12285	4.09	2533				
2037	152.0	384.43	16.99	16.34	33.33	0.00937	0.31	2533				
2038	152.0	384.43	16.99	16.34	33.33	0.00852	0.28	2533				
SUMMARY	152.0	459.51	19.94	15.16	35.09	9.91481	381.26	3028				

\*\*\* RESULTS OF THE CASE HML= 175.000 INSTALLED CAPACITY= 152.0 STORED IN DISK FILE A1818-02.NO. 1

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KAMAN MHL 300

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 175,000 LOW WATER LEVEL IN METER 155,000 RATED HEAD IN METER 106,000  
 INSTALLED CAPACITY IN MW 152,000 DEPENDABLE CAPACITY IN MW 117,209 TARGET OPERATION HOUR A DAY 8.22  
 RATED DISCHARGE IN CMS 166,992 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MW: JAN. 38,750 FEB. 38,750 MAR. 38,750 APR. 38,750 MAY 38,750 JUNE 38,750 JULY 38,750 AUG. 38,750 SEP. 38,750 OCT. 38,750 NOV. 38,750 DEC. 38,750

LENGTH OF INFLOW SERIES IN YEAR 20

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW (CMS)	EVAPOR. (CMS)	SPILL (CMS)	Q24 (CMS)	QG (CMS)	S2 (CMS)	R.V.L. (CM)	T.W.L. (CM)	E.HEAD EFFICI.	POWER (MW)	O. HOUR (HR)	P. E. (GWH)	S. E. (GWH)	T. E. (GWH)
1989	100.74	1.06	18.52	81.13	141.07	605.85	171.273	39.299	127.826	0.860	151.6	5097.2	469.00	507.92
1994	84.08	1.06	8.43	73.07	141.69	596.10	170.875	39.261	127.434	0.860	151.6	4568.6	477.75	215.28
2000	82.38	1.07	5.87	53.69	142.07	585.51	170.371	39.253	128.914	0.860	151.6	3366.8	281.63	228.88
2005	81.99	1.07	5.16	54.94	142.38	579.52	170.087	39.221	128.021	0.860	151.5	2821.0	198.38	230.00
2009	81.85	1.06	4.76	40.25	142.56	576.20	169.922	39.251	128.451	0.860	151.5	2553.1	154.50	229.93

\*\*\* DEPENDABLE DISCHARGE & ENERGY OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	100.0 % DEPENDABLE (CMS)	95.0 % DEPENDABLE (CMS)	90.0 % DEPENDABLE (CMS)	85.0 % DEPENDABLE (CMS)	80.0 % DEPENDABLE (CMS)	75.0 % DEPENDABLE (CMS)	70.0 % DEPENDABLE (CMS)	65.0 % DEPENDABLE (CMS)	60.0 % DEPENDABLE (CMS)	55.0 % DEPENDABLE (CMS)	50.0 % DEPENDABLE (CMS)	45.0 % DEPENDABLE (CMS)	40.0 % DEPENDABLE (CMS)	35.0 % DEPENDABLE (CMS)	30.0 % DEPENDABLE (CMS)	25.0 % DEPENDABLE (CMS)	20.0 % DEPENDABLE (CMS)	15.0 % DEPENDABLE (CMS)	10.0 % DEPENDABLE (CMS)	
1989	46.87	48.81	50.75	52.69	54.63	56.57	58.51	60.45	62.39	64.33	66.27	68.21	70.15	72.09	74.03	75.97	77.91	79.85	81.79	83.73
1994	48.19	50.13	52.07	54.01	55.95	57.89	59.83	61.77	63.71	65.65	67.59	69.53	71.47	73.41	75.35	77.29	79.23	81.17	83.11	85.05
2000	28.47	29.91	31.35	32.79	34.23	35.67	37.11	38.55	40.00	41.44	42.88	44.32	45.76	47.20	48.64	50.08	51.52	52.96	54.40	55.84
2005	20.02	21.46	22.90	24.34	25.78	27.22	28.66	30.10	31.54	32.98	34.42	35.86	37.30	38.74	40.18	41.62	43.06	44.50	45.94	47.38
2009	15.60	17.04	18.48	19.92	21.36	22.80	24.24	25.68	27.12	28.56	30.00	31.44	32.88	34.32	35.76	37.20	38.64	40.08	41.52	42.96



NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KAMAN HML 290

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 175.000 LOW WATER LEVEL IN METER 135.000 RATED HEAD IN METER \*\*\*\*\* 108.000  
 INSTALLED CAPACITY IN MW 152.000 DEPENDABLE CAPACITY IN MW 117.202 TARGET OPERATION HOUR A DAY 8.22  
 RATED DISCHARGE IN CMS 166.992 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MMH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 95.0

0. HOUR / YEAR KW VALUE IN US D .KWH VALUE IN US D  
 2550.0 160.25 0.0234  
 3950.0 111.74 0.0425  
 0. 65.55 0.0682

YEAR	DEPENDABLE POWER (MW)	ANNUAL ENERGY		POWER		BENEFIT		P.W.F.		PRESENT OPERATION	
		(GWH)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	WORTH (M US D)	OPERATION HOUR (HR)
1989	152.0	722.92	24.36	18.09	42.64	0.90309	38.59	0.82645	34.77	5035.	
1990	152.0	756.81	24.36	17.71	42.07	0.82645	31.32	0.75131	28.22	4883.	
1991	152.0	740.70	24.36	17.33	41.69	0.68301	25.42	0.62092	22.89	4670.	
1992	152.0	724.60	24.36	16.96	40.94	0.56847	20.43	0.51116	18.26	4165.	
1993	152.0	708.49	24.36	16.58	40.20	0.46651	16.30	0.42410	14.54	3766.	
1994	152.0	692.38	24.36	16.20	39.45	0.35049	11.57	0.28946	10.41	3258.	
1995	152.0	676.27	24.36	15.82	38.71	0.26333	8.42	0.23939	7.57	2934.	
1996	152.0	660.16	24.36	15.44	37.96	0.21703	6.80	0.19784	6.14	2711.	
1997	152.0	644.05	24.36	15.06	37.21	0.17288	5.54	0.16351	5.00	2608.	
1998	152.0	627.94	24.36	14.68	36.46	0.14866	4.51	0.13513	4.10	2536.	
1999	152.0	611.83	24.36	14.30	35.71	0.12285	3.34	0.10937	0.31	2536.	
2000	152.0	595.72	24.36	13.92	34.96	0.0852	2.28	0.0852	0.28	2536.	
2001	152.0	579.61	24.36	13.54	34.21	0.0682	1.25	0.0682	0.25	3030.	
2002	152.0	563.50	24.36	13.16	33.46	0.0512	0.20	0.0512	0.20		
2003	152.0	547.39	24.36	12.78	32.71	0.0342	0.15	0.0342	0.15		
2004	152.0	531.28	24.36	12.40	31.96	0.0172	0.10	0.0172	0.10		
2005	152.0	515.17	24.36	12.02	31.21	0.0002	0.05	0.0002	0.05		
2006	152.0	499.06	24.36	11.64	30.46	0.0000	0.00	0.0000	0.00		
2007	152.0	482.95	24.36	11.26	29.71	0.0000	0.00	0.0000	0.00		
2008	152.0	466.84	24.36	10.88	28.96	0.0000	0.00	0.0000	0.00		
2009	152.0	450.73	24.36	10.50	28.21	0.0000	0.00	0.0000	0.00		
2010	152.0	434.62	24.36	10.12	27.46	0.0000	0.00	0.0000	0.00		
2037	152.0	384.81	16.99	16.35	33.34	0.00937	0.31	0.00937	0.31	2536.	
2038	152.0	384.81	16.99	16.35	33.34	0.00852	0.28	0.00852	0.28	2536.	
SUMMARY	152.0	459.73	19.94	15.17	35.10	9.91481	381.25	3030.			

\*\*\* RESULTS OF THE CASE HML= 175.000 INSTALLED CAPACITY= 152.0 STORED IN DISK FILE A181B=02 NO. 2

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KAMAN HWL 290

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 175,000 LOW WATER LEVEL IN METER 135,000 RATED HEAD IN METER \*\*\*\*\* 108,000  
 INSTALLED CAPACITY IN MW 152,000 DEPENDABLE CAPACITY IN MW 117,200 TARGET OPERATION HOUR A DAY 8-22  
 RATED DISCHARGE IN CMS 166,992 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. 38,750 FEB. 38,750 MAR. 38,750 APR. 38,750 MAY 38,750 JUNE 38,750 JULY 38,750 AUG. 38,750 SEP. 38,750 OCT. 38,750 NOV. 38,750 DEC. 38,750

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW (CMS)	EVAPOR. (CMS)	SPILL (CMS)	Q24 (CMS)	QG (CMS)	SZ (CMS)	R.W.L. (CM)	T.W.L. (CM)	E. HEAD EFFICI. (M)	POWER (MW)	O. HOUR (H)	P.E. (GWH)	S.E. (GWH)	T.F. (GWH)
1989	100.74	1.09	18.52	81.13	141.07	605.95	171.273	39.299	127.826	0.860	151.6	5095.2	465.00	307.92
1994	84.27	1.08	9.01	72.88	141.30	598.31	171.028	39.462	127.606	0.860	151.6	4544.0	463.50	278.88
2000	82.57	1.07	6.21	53.64	141.90	587.31	170.453	39.254	127.012	0.860	151.5	3566.6	268.88	241.84
2005	82.18	1.07	5.38	44.91	142.21	581.31	170.470	39.252	126.724	0.860	151.5	2825.4	286.00	242.21
2009	82.04	1.07	4.97	40.22	142.59	577.61	169.992	39.251	126.544	0.860	151.4	2335.7	142.50	242.51

\*\*\* DEPENDABLE DISCHARGE \* POWER OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	Q (CMS)	P (MW)	E (GWH)	% DEPENDABLE	Q (CMS)	P (MW)	E (GWH)	% DEPENDABLE	Q (CMS)	P (MW)	E (GWH)	% DEPENDABLE
1989	46.87	120.11	38.75	47.36	152.00	38.75	48.25	48.74	38.75	48.58	152.00	38.75
1994	46.77	119.13	38.62	47.11	152.00	38.63	47.77	48.42	38.63	48.70	152.00	38.63
2000	27.13	118.11	22.41	27.39	152.00	22.41	27.88	28.12	22.41	28.34	152.00	22.41
2005	18.75	118.87	15.50	18.93	152.00	15.50	19.32	19.48	15.50	19.64	152.00	15.50
2009	14.58	118.98	11.87	14.51	152.00	11.88	14.81	14.95	11.88	15.06	152.00	11.88

NIPPON KOEI TOKYO/JAPAN

\*\* RESERVOIR OPERATION STUDY OF AGOS DAM \*\* PLAN A-3 KANAN HUL 280

HIGH WATER LEVEL IN METER 175.000 LOW WATER LEVEL IN METER 135.000 HATED HEAD IN METER \*\*\*\*\* 108.000  
 INSTALLED CAPACITY IN MW 152.000 DEPENDABLE CAPACITY IN MW 112.209 TARGET OPERATION HOUR A DAY 8.72  
 RATED DISCHARGE IN CMS 160.992 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MW JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750

LENGTH OF INFLOW SERIES IN YEAR 20

\*\*\* BENEFIT CALCULATION \*\*\*

DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 95.0  
 O-HOUR 7-YEAR KW VALUE IN US.D KW VALUE IN US.D  
 2550.0 160.25 0.0234  
 1950.0 11.74 0.0425  
 0. 63.35 0.0682

YEAR	DEPENDABLE POWER (MW)	ANNUAL ENERGY (GWH)	ANNUAL POWER (M US.D)	BENEFIT ENERGY (M US.D)	TOTAL (M US.D)	P.M.F.	PRESENT OPERATION	
							MONTH (M US.D)	HOUR (H)
1989	152.0	222.92	24.36	18.09	42.44	0.90909	38.59	5095
1990	152.0	755.93	24.36	17.69	42.05	0.82645	34.75	4983
1991	152.0	748.95	24.36	17.29	41.65	0.75131	31.29	4872
1992	152.0	721.96	24.36	16.89	41.25	0.68101	28.18	4760
1993	152.0	704.98	24.36	16.50	40.85	0.62092	25.37	4648
1994	152.0	687.99	24.36	16.10	40.46	0.56447	22.84	4536
1995	152.0	658.20	24.36	15.40	39.26	0.51316	20.40	4340
1996	152.0	628.40	24.36	14.70	39.06	0.46651	18.22	4143
1997	152.0	598.61	24.36	14.01	38.37	0.42410	16.22	3947
1998	152.0	568.81	24.36	13.31	37.67	0.38554	14.52	3751
1999	152.0	539.02	24.36	12.61	36.97	0.35049	12.96	3554
2000	152.0	509.22	24.36	11.92	36.27	0.31863	11.56	3358
2001	152.0	492.95	24.36	11.53	35.89	0.28966	10.40	3250
2002	152.0	476.67	24.36	11.15	35.51	0.26333	9.33	3143
2003	152.0	460.39	24.36	10.77	35.13	0.23939	8.41	3035
2004	152.0	444.11	24.36	10.39	34.75	0.21763	7.56	2928
2005	152.0	427.83	24.36	10.01	34.37	0.19784	6.80	2820
2006	152.0	416.95	24.36	9.74	34.11	0.17884	6.14	2749
2007	152.0	406.07	24.36	9.50	33.86	0.16351	5.54	2677
2008	152.0	395.19	24.36	9.25	33.61	0.14864	5.00	2605
2009	152.0	384.31	16.99	16.33	33.32	0.13513	4.50	2533
2010	152.0	384.31	16.99	16.33	33.32	0.12285	4.09	2533
2037	152.0	384.31	16.99	16.33	33.32	0.00937	0.31	2533
2038	152.0	384.31	16.99	16.33	33.32	0.00852	0.28	2533
SUMMARY	152.0	458.69	19.94	15.14	35.07	9.91481	380.82	3024

\*\*\* RESULTS OF THE CASE HUL= 175.000 INSTALLED CAPACITY 152.0 STORED IN DISK FILE A1818-02.NO. 3

NIPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KAMAN HWL 280

\*\* RESERVOIR OPERATION STUDY OF AGOS.

HIGH WATER LEVEL IN METER. 175.000 LOW WATER LEVEL IN METER. 135.000 RATED HEAD IN METER \*\*\*\*\* 108.000  
 INSTALLED CAPACITY IN MW. 152.000 DEPENDABLE CAPACITY IN MW. 112.209 TARGET OPERATION HOUR A DAY. 8.22  
 RATED DISCHARGE IN CMS. 166.992 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MW. JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750 38.750

LENGTH OF INFLOW SERIES IN YEAR 76

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW (CMS)	EVAPORATION (CMS)	SPILL (CMS)	Q24 (CMS)	QG (CMS)	S2 (CMS)	R.W.L. (CM)	T.W.L. (CM)	E-HEAD EFFECT. (CM)	POWER (MW)	O. HOUR (HR)	P.E. (GWH)	S.E. (GWH)	T.E. (GWH)	
1989	100.74	1.00	18.52	81.33	141.07	605.85	171.273	39.299	127.826	0.860	151.6	5095.2	465.00	307.92	772.92
1994	86.43	1.00	22.54	151.71	591.52	170.665	39.264	122.220	0.860	151.6	4536.2	454.50	233.49	687.99	
2000	82.74	1.07	6.46	53.56	142.52	578.84	170.043	39.257	126.587	0.860	151.4	3358.0	261.75	247.47	509.22
2005	82.34	1.06	5.59	54.87	142.63	572.82	169.751	39.255	126.281	0.860	151.4	2820.5	172.63	248.20	427.83
2009	82.20	1.06	5.17	40.20	142.60	569.64	169.600	39.254	126.135	0.860	151.3	2532.9	156.13	248.19	384.31

\*\*\* DEPENDABLE DISCHARGE \* POWER OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	100.0 % DEPENDABLE Q (CMS)	100.0 % DEPENDABLE P (MW)	100.0 % DEPENDABLE E (GWH)	90.0 % DEPENDABLE Q (CMS)	90.0 % DEPENDABLE P (MW)	90.0 % DEPENDABLE E (GWH)	85.0 % DEPENDABLE Q (CMS)	85.0 % DEPENDABLE P (MW)	85.0 % DEPENDABLE E (GWH)	80.0 % DEPENDABLE Q (CMS)	80.0 % DEPENDABLE P (MW)	80.0 % DEPENDABLE E (GWH)
1989	46.87	120.11	38.75	47.36	152.00	38.75	48.75	48.75	48.75	38.75	49.58	38.75
1994	42.83	119.23	37.87	44.25	152.00	37.87	46.98	46.98	46.98	37.88	47.82	37.88
2000	26.39	117.33	21.81	26.82	152.00	21.81	27.45	27.45	27.45	21.81	27.67	21.81
2005	18.12	118.02	14.97	18.80	152.00	14.97	18.88	18.88	18.88	14.97	19.04	14.97
2009	13.74	118.88	11.34	13.87	152.00	11.34	14.15	14.15	14.15	11.34	14.44	11.34

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KANAN HWL 300

\*\* RESERVOIR OPERATION STUDY OF AGDS

HIGH WATER LEVEL IN METER 165,000 LOW WATER LEVEL IN METER 126,000 RATED HEAD IN METER ..... 96,000  
 INSTALLED CAPACITY IN MW 150,000 DEPENDABLE CAPACITY IN MW 108,944 TARGET OPERATION HOUR A-DAY 7.32  
 RATED DISCHARGE IN CMS 167,797 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE

RULE CURVE IN MMH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 31,781 31,781 31,781 31,781 31,781 31,781 31,781 31,781 31,781 31,781 31,781 31,781

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*

DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 95.0

O-HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D  
 2550.0 160.25 0.0234  
 1950.0 111.76 0.0425  
 0. 63.35 0.0682

YEAR	DEPENDABLE POWER (MW)	ANNUAL			BENEFIT			PRESENT OPERATION		
		ENERGY (GWH)	POWER (M US D)	ENERGY (M US D)	ENERGY (M US D)	TOTAL (M US D)	R.W.E. (M US D)	PORTH. (M US D)	MDUR (HR)	
1989	140.0	711.48	22.43	16.65	32.08	0.90902	15.53	5821		
1990	140.0	692.13	22.43	16.51	38.75	0.82645	32.02	4988		
1991	140.0	682.78	22.43	15.98	38.41	0.75131	28.86	4885		
1992	140.0	668.43	22.43	15.64	38.08	0.68301	26.01	4782		
1993	140.0	654.08	22.43	15.31	37.74	0.62092	23.43	4679		
1994	140.0	639.73	22.43	14.97	37.40	0.56447	21.11	4577		
1995	140.0	611.80	22.43	14.52	36.75	0.51316	18.86	4372		
1996	140.0	583.87	22.43	13.66	36.10	0.46651	16.84	4177		
1997	140.0	555.95	22.43	13.01	35.44	0.42410	15.03	3977		
1998	140.0	528.02	22.43	12.36	34.79	0.38554	13.41	3777		
1999	140.0	500.09	22.43	11.70	34.14	0.35049	11.96	3578		
2000	140.0	472.17	22.43	11.05	33.48	0.31883	10.47	3378		
2001	140.0	457.08	22.43	10.70	33.13	0.28966	9.60	3270		
2002	140.0	441.96	22.43	10.34	32.78	0.26333	8.63	3162		
2003	140.0	426.86	22.43	9.99	32.42	0.23939	7.76	3053		
2004	140.0	411.75	22.43	9.64	32.07	0.21763	6.98	2945		
2005	140.0	396.65	22.43	9.28	31.72	0.19784	6.27	2837		
2006	140.0	386.54	22.43	8.94	31.48	0.17886	5.64	2728		
2007	140.0	376.42	22.43	8.61	31.24	0.16351	5.11	2692		
2008	140.0	366.30	22.43	8.27	31.01	0.14864	4.61	2620		
2009	140.0	356.19	15.65	15.14	30.78	0.13513	4.16	2547		
2010	140.0	356.19	15.65	15.14	30.78	0.12385	3.78	2547		
2037	140.0	356.19	15.65	15.14	30.78	0.00937	0.29	2547		
2038	140.0	356.19	15.65	15.14	30.78	0.00082	0.26	2547		
SUMMARY	140.0	425.09	18.36	14.03	35.39	9.91481	331.51	3041		

\*\*\* RESULTS OF THE CASE HWL= 165,000 INSTALLED CAPACITY= 140.0 STORED IN DISK FILE A1018-02 NO. 4

HIPPON KOEI, TOKYO/JAPAN

DAM \*\* PLAN A-3 KANAN HWL 300

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 165.000 LOW WATER LEVEL IN METER 126.000 RATED HEAD IN METER ..... 99.000  
 INSTALLED CAPACITY IN MW 140.000 DEPENDABLE CAPACITY IN MW 108.944 TARGET OPERATION HOUR A DAY 7.52  
 RATED DISCHARGE IN CMS 187.791 TYPE OF RULE CURVE .. VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781

LENGTH OF INFLOW SERIES IN YEAR 20

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW	EVAPD.	SPILL	Q24	QG	SZ	R.W.L.	T.W.L.	E. HEAD	EFFICI.	POWER	O. HOUR	P. E.	S. E.	T. E.
	(CMS)	(CMS)	(CMS)	(CMS)	(CMS)	(CMS)	(CM)	(CM)	(CM)		(MW)	(H)	(GWH)	(GWH)	(GWH)
1989	100.74	0.92	19.39	80.43	139.94	485.73	162.010	39.297	118.863	0.860	139.6	5091.2	381.38	330.11	711.48
1994	84.08	0.90	8.83	23.05	143.45	465.75	160.943	39.262	117.524	0.860	139.7	4526.5	428.00	210.73	439.73
2000	87.38	0.90	6.12	53.72	141.91	458.35	160.526	39.253	117.056	0.860	139.6	3377.9	248.38	225.79	472.17
2005	81.99	0.90	5.29	44.98	142.20	456.02	160.288	39.231	116.851	0.860	139.6	2837.1	168.75	222.90	396.45
2009	81.85	0.89	4.89	40.29	142.37	451.50	160.143	39.250	116.703	0.860	139.6	2547.3	127.88	228.31	356.19

\*\*\* DEPENDABLE DISCHARGE \* POWER OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	100.0	% DEPENDABLE	P(MW)	E(GWH)	Q(CMS)	90.0	% DEPENDABLE	P(MW)	E(GWH)	Q(CMS)	85.0	% DEPENDABLE	P(MW)	E(GWH)	Q(CMS)	80.0	% DEPENDABLE	P(MW)	E(GWH)	
1989	41.58	110.55	31.78	42.14	140.00	31.78	43.12	140.00	31.78	43.63	140.00	31.78	44.23	140.00	31.78	44.23	140.00	31.78	44.23	140.00
1994	46.84	112.06	35.75	47.20	140.00	35.75	48.03	140.00	35.75	48.65	140.00	35.75	48.95	140.00	35.75	48.95	140.00	35.75	48.95	140.00
2000	26.89	110.28	20.53	27.14	140.00	20.53	27.69	140.00	20.53	27.96	140.00	20.53	28.28	140.00	20.53	28.28	140.00	20.53	28.28	140.00
2005	18.45	111.47	14.06	18.65	140.00	14.06	19.01	140.00	14.06	19.18	140.00	14.06	19.39	140.00	14.06	19.39	140.00	14.06	19.39	140.00
2009	13.99	112.21	10.66	14.17	140.00	10.66	16.43	140.00	10.66	16.55	140.00	10.66	16.73	140.00	10.66	16.73	140.00	10.66	16.73	140.00

NIPPON KOEI TOKYO/JAPAN

DAH \*\* PLAN A-3 KANAN HWL 290

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 165.000 LOW WATER LEVEL IN METER 128.000 RATED HEAD IN METER \*\*\*\*\* 99.000  
 INSTALLED CAPACITY IN MW 140.000 DEPENDABLE CAPACITY IN MW 108.044 TARGET OPERATION HOUR A-DAY 7.32  
 RATED DISCHARGE IN CMS 167.791 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781  
 FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 0.

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*

DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 95.0

0. HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D  
 2550.0 160.25 0.0234  
 1950.0 111.26 0.0425  
 0. 63.35 0.0682

YEAR	DEPENDABLE		ANNUAL ENERGY		POWER		BENEFIT ENERGY		TOTAL		P.M.F.		PRESENT OPERATION	
	(MW)	(MWH)	(M US D)	(GHR)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(H)
1989	140.0	711.48	22.43	16.31	38.74	0.20903	35.53	5091.						
1990	140.0	696.98	22.43	15.97	38.60	0.82645	37.02	4987.						
1991	140.0	682.47	22.43	15.63	38.07	0.75131	28.85	4883.						
1992	140.0	667.96	22.43	15.29	37.73	0.68301	26.00	4780.						
1993	140.0	653.46	22.43	14.95	37.39	0.62092	23.42	4676.						
1994	140.0	638.95	22.43	14.60	36.74	0.56447	21.10	4572.						
1995	140.0	611.22	22.43	14.30	36.24	0.51315	18.85	4323.						
1996	140.0	583.48	22.43	13.65	36.09	0.46651	16.84	4175.						
1997	140.0	555.75	22.43	13.00	35.44	0.42410	15.03	3976.						
1998	140.0	528.02	22.43	12.36	34.79	0.38554	13.41	3778.						
1999	140.0	500.28	22.43	11.71	34.14	0.35049	11.97	3580.						
2000	140.0	472.55	22.43	11.06	33.49	0.31863	10.62	3381.						
2001	140.0	457.82	22.43	10.70	33.14	0.28966	9.60	3273.						
2002	140.0	442.28	22.43	10.35	32.78	0.26333	8.63	3168.						
2003	140.0	427.15	22.43	10.00	32.43	0.23939	7.76	3056.						
2004	140.0	412.02	22.43	9.64	32.08	0.21784	6.98	2948.						
2005	140.0	396.88	22.43	9.29	31.72	0.19784	6.28	2839.						
2006	140.0	380.76	22.43	8.93	31.35	0.17986	5.66	2762.						
2007	140.0	376.64	22.43	8.81	31.25	0.16551	5.11	2694.						
2008	140.0	366.52	22.43	8.58	31.01	0.14864	4.61	2622.						
2009	140.0	356.40	15.65	15.15	30.79	0.13513	4.16	2549.						
2010	140.0	356.40	15.65	15.15	30.79	0.12285	3.78	2549.						
2037	140.0	356.40	15.65	15.15	30.79	0.00937	0.29	2549.						
2038	140.0	356.40	15.65	15.15	30.79	0.00852	0.26	2549.						
SUMMARY	140.0	425.21	18.36	14.03	32.40	9.91481	351.49	3042.						

\*\*\* RESULTS OF THE CASE HWL= 165.000 INSTALLED CAPACITY= 140.0 STORED IN DISK FILE A1818-02 NO. 5

\*\* RESERVOIR OPERATION STUDY OF AGOS DAM \*\* PLAN A-3 KANAN HVL 200 NIPPON KOEI TOKYO/JAPAN  
 HIGH WATER LEVEL IN METER 145.000 LOW WATER LEVEL IN METER 128.000 RATED HEAD IN METER \*\*\*\*\* 99.000  
 INSTALLED CAPACITY IN MW 140.000 DEPENDABLE CAPACITY IN MW 108.984 TARGET OPERATION HOUR A DAY 2.32  
 RATED DISCHARGE IN CMS 167.791 TYPE OF RULE CURVE .. VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781  
 FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW (CMS)	EVAPOR. (CMS)	SPILL (CMS)	Q24 (CMS)	QC (CMS)	S2 (CMS)	R.W.L. (CM)	T.W.L. (CM)	E.HEAD EFFICI. (M)	POWER (MW)	O.HOUR (HR)	P.E. (GWH)	S.E. (GWH)	T.E. (GWH)
1989	100.74	0.92	18.39	80.45	159.94	485.73	182.010	39.297	118.663	0.860	5091.2	381.38	330.11	711.48
1994	84.27	0.93	2.25	72.82	141.35	488.28	181.312	38.522	112.117	0.860	4571.8	415.50	223.42	638.92
2000	82.58	0.90	6.36	53.67	141.69	400.19	160.631	39.253	117.220	0.860	3381.1	234.00	258.55	472.55
2005	82.18	0.90	5.52	44.95	142.05	454.73	160.311	39.251	116.888	0.860	132.5	2832.4	122.20	396.88
2009	82.04	0.89	5.11	40.26	142.74	451.95	160.153	39.251	116.725	0.860	139.5	2549.2	117.00	356.40

\*\*\* DEPENDABLE DISCHARGE / POWER OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	Q (CMS)	P (MW)	% DEPENDABLE	E (GWH)	Q (CMS)	P (MW)	% DEPENDABLE	F (GWH)	Q (CMS)	P (MW)	% DEPENDABLE	F (GWH)	P (MW)	% DEPENDABLE	E (GWH)
1989	41.58	110.55	31.78	42.14	140.00	31.78	43.12	140.00	31.78	43.63	46.99	140.00	31.78	44.23	140.00
1994	45.31	110.78	34.62	45.65	140.00	34.63	46.51	140.00	34.63	46.99	140.00	34.63	47.50	140.00	34.63
2000	35.54	111.18	19.50	28.72	140.00	32.50	28.28	140.00	26.58	140.00	19.50	26.76	140.00	19.50	19.50
2005	17.18	110.96	13.12	17.39	140.00	13.13	17.76	140.00	13.13	17.94	140.00	13.13	18.10	140.00	13.13
2009	12.77	111.86	9.75	12.93	140.00	9.75	13.22	140.00	9.75	13.54	140.00	9.75	13.48	140.00	9.75



NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KANAN HML 280

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 165.000 LOW WATER LEVEL IN METER 128.000 RATED HEAD IN METER 99.000  
 INSTALLED CAPACITY IN MW 140.000 DEPENDABLE CAPACITY IN MW 108.944 TARGET OPERATION HOUR A DAY 232  
 RATED DISCHARGE IN CMS 167.791 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MHW JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*  
 POWER DEPENDABILITY IN % 95.0

O. HOUR / YEAR. KW VALUE IN US. D. KWH VALUE IN US. D  
 2550.0 160.25 0.0234  
 1350.0 111.76 0.0425  
 0. 63.35 0.0882

YEAR	DEPENDABLE		ANNUAL ENERGY		POWER		BENEFIT ENERGY		TOTAL		P.W.E.		PRESENT OPERATION	
	(MW)	(MWH)	(M US D)	(GWH)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)
1989	140.0	711.48	22.43	16.65	32.08	0.90909	35.53	5091.						
1990	140.0	696.02	22.43	16.29	38.72	0.85645	32.00	4981.						
1991	140.0	680.55	22.43	15.92	38.36	0.75131	28.82	4870.						
1992	140.0	665.08	22.43	15.56	38.00	0.68301	25.95	4760.						
1993	140.0	649.61	22.43	15.20	37.64	0.62092	23.37	4650.						
1994	140.0	634.15	22.43	14.84	37.27	0.56447	21.04	4539.						
1995	140.0	618.68	22.43	14.48	36.85	0.51316	18.80	4434.						
1996	140.0	603.22	22.43	14.12	36.00	0.46651	16.79	4349.						
1997	140.0	587.75	22.43	13.76	35.36	0.42410	15.00	4253.						
1998	140.0	572.28	22.43	13.40	34.72	0.38554	13.39	4158.						
1999	140.0	497.69	22.43	11.65	34.08	0.35049	11.95	4063.						
2000	140.0	470.50	22.43	11.01	33.44	0.31863	10.66	3968.						
2001	140.0	455.43	22.43	10.66	33.09	0.28966	9.59	3860.						
2002	140.0	440.45	22.43	10.31	32.74	0.26333	8.62	3753.						
2003	140.0	425.48	22.43	9.96	32.39	0.23939	7.75	3646.						
2004	140.0	410.51	22.43	9.61	32.04	0.21763	6.97	3538.						
2005	140.0	395.54	22.43	9.26	31.69	0.19784	6.27	3431.						
2006	140.0	380.57	22.43	8.92	31.46	0.17986	5.64	3324.						
2007	140.0	365.60	22.43	8.59	31.22	0.16351	5.11	3217.						
2008	140.0	350.63	22.43	8.25	30.99	0.14864	4.61	3110.						
2009	140.0	335.66	15.65	15.11	30.75	0.13513	4.16	3003.						
2010	140.0	320.69	15.65	15.11	30.75	0.12285	3.78	2896.						
2037	140.0	355.46	15.65	15.11	30.75	0.00932	0.29	2543.						
2038	140.0	355.46	15.65	15.11	30.75	0.00852	0.26	2543.						
SUMMARY	140.0	423.73	18.36	13.99	32.35	9.91481	350.96	3032.						

\*\*\* RESULTS OF THE CASE HML= 165.000 INSTALLED CAPACITY= 140.0 STORED IN DISK FILE A1818-02 ND. 6

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KANAN HWL 280

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 165.000 LOW WATER LEVEL IN METER 128.000 RATED HEAD IN METER \*\*\*\*\* 99.000  
 INSTALLED CAPACITY IN MW 140.000 DEREGULABLE CAPACITY IN MW 108.944 TARGET OPERATION MODE A-DAY 7.32  
 RATED DISCHARGE IN CMS 167.791 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781  
 FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781 31.781

LENGTH OF INFLOW SERIES IN YEAR 20

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW (CMS)	EVAPOR. (CMS)	SPIILL (CMS)	Q24 (CMS)	QG (CMS)	SZ (MCM)	R.U.L. (M)	T.W.L. (M)	F-HEAD EFFICI. (M)	POWER (MW)	O-HOUR (CM)	P.E. (GWH)	S.E. (GWH)	T.E. (GWH)
1989	100.74	0.92	19.39	80.43	139.94	485.73	162.010	39.297	118.663	139.6	5091.2	381.38	330.11	711.48
1994	84.44	0.90	9.77	72.67	141.21	451.22	160.676	39.257	117.242	139.6	4339.3	406.13	228.02	634.15
2000	82.74	0.89	6.65	53.54	142.24	451.74	160.129	39.258	116.701	139.4	3367.5	226.88	243.52	470.40
2005	82.34	0.89	5.77	44.86	142.59	446.21	159.808	39.256	116.380	139.4	2831.0	151.13	244.42	393.54
2009	82.20	0.89	5.34	40.20	142.81	442.91	159.615	39.255	116.188	139.3	2543.5	111.38	244.09	353.46

\*\*\* DEPENDABLE DISCHARGE / POWER OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	100.0 % DEPENDABLE (CMS)	P (CMS)	F (GWH)	Q (CMS)	E (GWH)	90.0 % DEPENDABLE (CMS)	P (MW)	F (GWH)	85.0 % DEPENDABLE (CMS)	P (MW)	F (GWH)	80.0 % DEPENDABLE (CMS)	P (MW)	E (GWH)
1989	41.58	110.55	31.78	42.14	140.00	43.12	140.00	31.78	43.63	140.00	31.78	46.23	140.00	31.78
1994	44.27	111.03	33.84	44.74	140.00	45.47	140.00	33.84	45.96	140.00	33.84	46.38	140.00	33.84
2000	24.76	110.19	18.91	25.05	140.00	18.91	140.00	18.91	25.27	140.00	18.91	26.07	140.00	18.91
2005	16.47	110.48	12.59	16.67	140.00	12.59	140.00	12.59	17.22	140.00	12.59	17.40	140.00	12.59
2009	12.15	110.64	9.28	12.30	140.00	9.28	140.00	9.28	12.71	140.00	9.28	12.86	140.00	9.28

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KAMAN HNL 300

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 155.000 LOW WATER LEVEL IN METER 121.000 RATED HEAD IN METER \*\*\*\*\* 91.000  
 INSTALLED CAPACITY IN MW 128.000 DEPENDABLE CAPACITY IN MW 99.312 TARGET OPERATION HOUR A DAY 4.58  
 RATED DISCHARGE IN CMS 166.895 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MHH JAN. 26.125 FEB. 26.125 MAR. 26.125 APR. 26.125 MAY 26.125 JUNE 26.125 JULY 26.125 AUG. 26.125 SEP. 26.125 OCT. 26.125 NOV. 26.125 DEC. 26.125

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 95.0

0. HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D  
 2550.0 0.0234  
 9950.0 31.26  
 0. 63.35 0.0682

YEAR	DEPENDABLE POWER (MHW)	ANNUAL ENERGY (GWH)	POWER (M US D)	ENERGY (M US D)	TOTAL ENERGY (M US D)	P.W.F.	PRESENT OPERATION MONTH (M US D)	PRESENT OPERATION HOUR (H)
1989	128.0	651.80	20.51	15.25	35.26	0.80909	29.31	5000
1990	128.0	638.85	20.51	14.95	35.46	0.82645	29.31	5000
1991	128.0	625.90	20.51	14.65	35.16	0.75131	26.41	4899
1992	128.0	612.95	20.51	14.34	34.85	0.68301	23.81	4797
1993	128.0	600.00	20.51	14.04	34.55	0.62092	21.45	4696
1994	128.0	587.04	20.51	13.74	34.25	0.56447	19.33	4594
1995	128.0	574.08	20.51	13.44	33.95	0.51316	17.22	4394
1996	128.0	561.12	20.51	13.14	33.65	0.46651	15.42	4193
1997	128.0	548.16	20.51	12.84	33.35	0.42410	13.76	3993
1998	128.0	535.20	20.51	12.54	33.05	0.38554	12.28	3792
1999	128.0	522.24	20.51	12.24	32.75	0.35049	10.95	3592
2000	128.0	509.28	20.51	11.94	32.45	0.31883	9.72	3391
2001	128.0	496.32	20.51	11.64	32.15	0.28966	8.79	3283
2002	128.0	483.36	20.51	11.34	31.85	0.26333	7.90	3175
2003	128.0	470.40	20.51	11.04	31.55	0.23939	7.11	3067
2004	128.0	457.44	20.51	10.74	31.25	0.21765	6.39	2960
2005	128.0	444.48	20.51	10.44	30.95	0.19784	5.75	2852
2006	128.0	431.52	20.51	10.14	30.65	0.17986	5.18	2749
2007	128.0	418.56	20.51	9.84	30.35	0.16351	4.68	2707
2008	128.0	405.60	20.51	9.54	30.05	0.14864	4.22	2634
2009	128.0	392.64	20.51	9.24	29.75	0.13513	3.81	2562
2010	128.0	379.68	20.51	8.94	29.45	0.12285	3.46	2562
2037	128.0	327.52	20.51	7.66	28.18	0.00937	0.24	2582
2038	128.0	327.52	20.51	7.66	28.18	0.00852	0.24	2562
SUMMARY	128.0	390.51	20.51	9.14	29.65	9.97481	321.77	3055

\*\*\* RESULTS OF THE CASE HNL= 155.000 INSTALLED CAPACITY= 128.0 STORED IN DISK FILE A181B=02 NO. 7

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KANAN HML 300

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 155.000 LOW WATER LEVEL IN METER 121.000 RATED HEAD IN METER ..... 91.000  
 INSTALLED CAPACITY IN MW 128.000 DEPENDABLE CAPACITY IN MW 99.317 TARGET OPERATION HOUR A DAY 6.58  
 RATED DISCHARGE IN CMS 166.895 TYPE OF RULE CURVE ... VARIABLE MASS CURVE  
 RULE CURVE IN MMH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW (CMS)	EVAPOR. (CMS)	SPILL (CMS)	Q24 (CMS)	Q6 (CMS)	S2 (CMS)	R.W.L. (CM)	T.W.L. (CM)	E. HEAD EFFICI. (CM)	POWER (MW)	O. HOUR (H)	P. E. (GWH)	S. E. (GWH)	T. E. (GWH)
1989	100.74	0.77	19.97	80.00	138.86	386.15	152.548	39.295	109.278	0.860	127.6	5101.7	313.50	338.30
1994	84.08	0.25	9.06	22.92	140.81	361.05	151.229	39.260	107.851	0.860	127.7	4534.5	327.63	209.42
2000	82.98	0.75	6.24	53.75	141.91	353.91	150.542	39.253	107.119	0.860	127.7	3391.0	215.63	217.77
2005	81.99	0.74	5.40	45.03	142.12	351.02	150.352	39.251	106.923	0.860	127.6	2821.7	144.00	220.54
2009	81.85	0.74	4.99	40.33	142.29	348.85	150.203	39.250	106.783	0.860	127.6	2561.8	106.50	221.02

\*\*\* DEPENDABLE DISCHARGE & POWER OUTPUT AND ENERGY QUIBVL \*\*\*

YEAR	Q (CMS)	% DEPENDABLE	P (MW)	E (GWH)	Q (CMS)	% DEPENDABLE	P (MW)	E (GWH)	Q (CMS)	% DEPENDABLE	P (MW)	E (GWH)	Q (CMS)	% DEPENDABLE	P (MW)	E (GWH)
1989	37.23	99.62	26.12	37.73	128.00	26.13	38.55	128.00	26.13	32.10	128.00	26.13	39.89	128.00	26.13	
1994	44.84	99.78	31.47	45.66	128.00	31.47	48.43	128.00	31.47	46.72	128.00	31.47	47.29	128.00	31.47	
2000	25.59	102.62	17.97	25.88	128.00	17.97	26.80	128.00	17.97	26.80	128.00	17.97	27.11	128.00	17.97	
2005	17.11	103.52	12.90	17.32	128.00	12.90	17.75	128.00	12.90	17.93	128.00	12.90	18.14	128.00	12.90	
2009	12.60	103.77	8.87	12.82	128.00	8.88	13.13	128.00	8.88	13.48	128.00	8.88	13.62	128.00	8.88	

NIPPON KOEI TOKYO/JAPAN

\*\* RESERVOIR OPERATION STUDY OF AGOS DAM \*\* PLAN A-5 KANAN HWL 290

HIGH WATER LEVEL IN METER 155.000 LOW WATER LEVEL IN METER 121.000 RATED HEAD IN METER ..... 91.000  
 INSTALLED CAPACITY IN MW 128.000 DEPENDABLE CAPACITY IN MW 99.317 TARGET OPERATION HOUR A DAY 1.58  
 RATED DISCHARGE IN CMS 166.895 TYPE OF RULE CURVE .. VARIABLE MASS CURVE  
 JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 RULE CURVE IN MW 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*

DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 95.0  
 O. HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D  
 2550.0 160.25  
 1850.0 111.64  
 0. 63.35

YEAR	DEPENDABLE		ANNUAL		ENERGY		POWER		BENEFIT		P.M.F.		PRESENT OPERATION	
	(MW)	(GWH)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)
1989	128.0	651.80	20.51	25.76	15.24	25.76	0.90909	32.51	5102.	10.95	3590.			
1990	128.0	638.55	20.51	35.45	14.94	35.45	0.87645	29.30	5998.	9.77	3421.			
1991	128.0	825.29	20.51	14.53	35.14	14.53	0.75131	26.40	4894.	8.78	3283.			
1992	128.0	612.03	20.51	14.52	34.83	14.52	0.68301	23.79	4791.	7.90	3175.			
1993	128.0	598.78	20.51	14.01	34.52	14.01	0.62092	21.44	4687.	7.11	3067.			
1994	128.0	585.52	20.51	13.70	34.21	13.70	0.56447	19.31	4584.	6.39	2959.			
1995	128.0	570.12	20.51	13.41	33.62	13.41	0.51316	17.85	4485.	5.75	2851.			
1996	128.0	534.77	20.51	12.51	33.03	12.51	0.46651	15.41	4386.	5.18	2742.			
1997	128.0	509.40	20.51	11.82	32.43	11.82	0.42410	13.75	4287.	4.68	2634.			
1998	128.0	484.02	20.51	11.33	31.84	11.33	0.38554	12.27	4189.	4.22	2526.			
1999	128.0	458.65	20.51	10.73	31.24	10.73	0.35049	10.95	4092.	3.81	2418.			
2000	128.0	433.28	20.51	10.14	30.65	10.14	0.31883	9.77	4000.	3.46	2310.			
2001	128.0	419.49	20.51	9.82	30.33	9.82	0.28966	8.78	3912.	3.17	2202.			
2002	128.0	405.71	20.51	9.49	30.01	9.49	0.26333	7.90	3824.	2.92	2094.			
2003	128.0	391.92	20.51	9.17	29.68	9.17	0.23939	7.11	3736.	2.67	1986.			
2004	128.0	378.14	20.51	8.85	29.36	8.85	0.21763	6.39	3648.	2.42	1878.			
2005	128.0	364.36	20.51	8.53	29.04	8.53	0.19784	5.75	3560.	2.17	1770.			
2006	128.0	350.58	20.51	8.21	28.72	8.21	0.17986	5.18	3472.	1.92	1662.			
2007	128.0	345.88	20.51	8.09	28.61	8.09	0.16351	4.68	3384.	1.67	1554.			
2008	128.0	336.64	20.51	7.88	28.39	7.88	0.14864	4.22	3296.	1.42	1446.			
2009	128.0	327.40	20.51	7.66	28.17	7.66	0.13513	3.81	3208.	1.17	1338.			
2010	128.0	327.40	20.51	7.66	28.17	7.66	0.12285	3.46	3120.	0.92	1230.			
2017	128.0	327.40	20.51	7.66	28.17	7.66	0.00937	0.26	2582.	0.00	622.			
2038	128.0	327.40	20.51	7.66	28.17	7.66	0.00852	0.24	2562.	0.00	602.			
SUMMARY	128.0	390.23	20.51	9.13	29.64	9.13	9.91481	321.65	3054.					

\*\*\* RESULTS OF THE CASE HWL= 155.000 INSTALLED CAPACITY= 128.0 STORED IN DISK FILE A1818-02 NO. 8

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KAHAN MW 290

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 155.000 LOW WATER LEVEL IN METER 121.000 RATED HEAD IN METER ..... 91.000  
 INSTALLED CAPACITY IN MW 128.889 DEPENDABLE-CAPACITY IN MW 99.317 TARGET OPERATION-HOUR A-DAY 6.58  
 RATED DISCHARGE IN CMS 168.895 TYPE OF RULE CURVE .. VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125

LENGTH OF INFLOW SERIES IN YEAR 26

\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*

YEAR	INFLOW (CMS)	EVAP. (CMS)	SPILL (CMS)	O24 (CMS)	OG (CMS)	S2 (CMS)	R.W.L. (M)	T.W.L. (M)	E-HEAD EFFICI. (%)	POWER (MW)	O-HOUR (H)	P.E. (GWH)	S.E. (GWH)	T.E. (GWH)	
1989	100.74	0.77	19.97	80.00	138.86	384.15	152.548	39.295	109.278	0.860	127.6	5101.7	313.50	338.30	651.80
1994	88.27	0.74	9.53	72.69	140.72	365.95	151.302	39.262	102.940	0.860	127.6	4583.6	346.38	218.15	585.52
2000	82.58	0.75	6.53	53.85	141.82	354.98	150.674	39.254	107.237	0.860	127.6	3391.3	204.00	229.28	433.28
2005	82.18	0.74	5.66	44.95	141.96	350.69	150.929	39.252	106.934	0.860	127.5	2851.4	133.50	230.86	364.36
2009	82.04	0.74	5.26	40.26	142.17	348.33	150.168	39.251	106.769	0.860	127.5	2561.6	98.38	231.03	327.40

\*\*\* DEPENDABLE DISCHARGE \* POWER OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	100.0 % DEPENDABLE (CMS)	P (MW)	E (GWH)	95.0 % DEPENDABLE (CMS)	P (MW)	E (GWH)	90.0 % DEPENDABLE (CMS)	P (MW)	E (GWH)	85.0 % DEPENDABLE (CMS)	P (MW)	E (GWH)	80.0 % DEPENDABLE (CMS)	P (MW)	E (GWH)
1989	37.23	99.62	26.12	37.73	128.00	26.13	38.55	128.00	26.13	39.10	128.00	26.13	39.89	128.00	26.13
1994	43.50	101.09	30.53	44.73	128.00	30.53	44.84	128.00	30.53	45.25	128.00	30.53	45.78	128.00	30.53
2000	24.24	102.28	17.00	24.50	128.00	17.00	25.07	128.00	17.00	25.34	128.00	17.00	25.64	128.00	17.00
2005	15.88	102.35	11.12	16.07	128.00	11.13	16.42	128.00	11.13	16.59	128.00	11.13	16.82	128.00	11.13
2009	11.44	103.32	8.03	11.61	128.00	8.03	11.87	128.00	8.03	12.01	128.00	8.03	12.17	128.00	8.03

NIPPON KOEI TOKYO/JAPAN

\*\* RESERVOIR OPERATION STUDY OF AGOS DAM \*\* PLAN A-3 KAWA HML 280

HIGH WATER LEVEL IN METER 155.000 LOW WATER LEVEL IN METER 121.000 RATED HEAD IN METER \*\*\*\*\* 91.000  
 INSTALLED CAPACITY IN MW 128.000 DEPENDABLE CAPACITY IN MW 99.312 TARGET OPERATION-HOUR-A-DAY 6.58  
 RATED DISCHARGE IN CMS 106.895 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 RULE CURVE IN MHW 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 90.0

0 HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D  
 2550.0 160.25 0.0834  
 1950.0 111.26 0.0625  
 0. 63.35 0.0682

YEAR	DEPENDABLE POWER (MW)	ANNUAL ENERGY (GWH)	POWER (MW)	BENEFIT ENERGY (M US D)	TOTAL ENERGY (M US D)	R.W.F.	PRESENT OPERATION WORTH (M US D)	PRESENT OPERATION HOUR (H)
1989	128.0	551.80	20.51	15.25	35.26	0.90909	32.51	5102.
1990	128.0	637.59	20.51	14.92	35.45	0.89645	29.28	4991.
1991	128.0	623.37	20.51	14.59	35.10	0.75131	26.17	4881.
1992	128.0	609.16	20.51	14.25	34.77	0.68301	23.75	4771.
1993	128.0	594.95	20.51	13.92	34.43	0.62092	21.38	4660.
1994	128.0	580.73	20.51	13.59	34.10	0.56447	19.25	4550.
1995	128.0	566.51	20.51	13.26	33.77	0.51316	17.20	4354.
1996	128.0	552.29	20.51	12.93	33.44	0.46651	15.36	4158.
1997	128.0	538.07	20.51	12.60	33.11	0.42410	13.72	3962.
1998	128.0	523.85	20.51	12.27	32.78	0.38554	12.24	3765.
1999	128.0	455.64	20.51	10.66	31.17	0.35049	10.93	3569.
2000	128.0	430.52	20.51	10.08	30.59	0.31863	9.75	3373.
2001	128.0	417.04	20.51	9.76	30.27	0.28966	8.77	3266.
2002	128.0	403.46	20.51	9.44	29.95	0.26333	7.89	3159.
2003	128.0	389.88	20.51	9.12	29.64	0.23939	7.09	3053.
2004	128.0	376.30	20.51	8.81	29.32	0.21763	6.38	2946.
2005	128.0	362.72	20.51	8.49	29.00	0.19784	5.74	2839.
2006	128.0	349.14	20.51	8.22	28.73	0.17986	5.18	2732.
2007	128.0	344.46	20.51	8.06	28.57	0.16351	4.67	2626.
2008	128.0	335.33	20.51	7.85	28.36	0.14864	4.22	2524.
2009	128.0	326.20	20.51	7.63	28.15	0.13513	3.80	2522.
2010	128.0	326.20	20.51	7.63	28.15	0.12285	3.46	2552.
2037	128.0	326.20	20.51	7.63	28.15	0.00937	0.26	2552.
2058	128.0	326.20	20.51	7.63	28.15	0.00852	0.24	2552.
SUMMARY	128.0	588.51	20.51	9.09	29.60	9.91481	32.11	3041.

\*\*\* RESULTS OF THE CASE HML= 155.000 INSTALLED CAPACITY= 128.0 STORED IN DISK FILE A1818-02.ND. 9

\*\* RESERVOIR OPERATION STUDY OF AGOS DAM \*\* PLAN A-3 KANAN HWL 280 NIPPON KOEI TOKYO/JAPAN

HIGH WATER LEVEL IN METER 155.000 LOW WATER LEVEL IN METER 121.000 RATED HEAD IN METER 91.000  
 INSTALLED CAPACITY IN MW 128.000 DEPENDABLE CAPACITY IN MW 99.317 TARGET OPERATION HOUR A-DAY 6.58  
 RATED DISCHARGE IN CMS 166.895 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE

JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 RULE CURVE IN MWH 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125 26.125

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW (CMS)	EVAPOR. (CMS)	SPILL (CMS)	Q24 (CMS)	QG (CMS)	S2 (CMS)	R.H.L. (M)	T.W.L. (M)	E-HEAD (M)	EFFICI. (%)	POWER (MW)	O-HOUR (H)	P.E. (GWH)	S.E. (GWH)	T.E. (GWH)
1989	100.74	0.77	19.97	80.00	138.86	384.15	152.548	59.295	109.278	0.860	127.6	5101.7	313.50	338.30	651.80
1994	84.34	0.75	10.21	22.18	146.89	362.25	151.083	59.266	107.716	0.860	127.5	4520.1	312.11	228.61	580.71
2000	82.34	0.74	6.00	53.64	143.24	377.83	150.104	59.259	106.687	0.860	127.4	5375.0	196.13	234.49	430.62
2005	82.34	0.74	6.00	44.77	143.46	375.86	149.987	59.256	106.569	0.860	127.4	2839.0	125.25	237.57	362.72
2009	82.20	0.74	5.58	40.11	143.62	344.09	149.869	59.255	106.451	0.860	127.4	2532.2	88.13	238.08	326.20

\*\*\* DEPENDABLE DISCHARGE & POWER OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	Q (CMS)	P (MW)	F (GWH)	% DEPENDABLE	Q (CMS)	E (GWH)	% DEPENDABLE	P (MW)	E (GWH)	% DEPENDABLE	Q (CMS)	E (GWH)	% DEPENDABLE	P (MW)	E (GWH)
1989	37.23	99.62	26.12	26.13	39.10	128.00	26.13	39.89	128.00	26.13	39.10	128.00	26.13	39.89	128.00
1994	41.80	101.62	29.34	29.34	43.63	128.00	29.34	46.06	128.00	29.34	43.63	128.00	29.34	46.06	128.00
2000	23.29	100.59	16.34	16.34	24.34	128.00	16.34	24.69	128.00	16.34	23.29	128.00	16.34	24.69	128.00
2005	14.89	101.17	10.44	10.44	15.61	128.00	10.44	15.83	128.00	10.44	14.89	128.00	10.44	15.83	128.00
2009	10.48	101.18	7.34	7.34	10.98	128.00	7.34	11.13	128.00	7.34	10.48	128.00	7.34	11.13	128.00



NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KAWAN HWL 300

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 145.000 LOW WATER LEVEL IN METER 114.000 RATED HEAD IN METER \*\*\*\*\* 82.500  
 INSTALLED CAPACITY IN MW 116.000 DEPENDABLE CAPACITY IN MW 90.368 TARGET OPERATION HOUR A DAY 5.88  
 RATED DISCHARGE IN CMS 166.832 TYPE OF FULF CURVE \*\* VARIABLE MASS CURVE  
 FULF CURVE IN MMH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 90.0

O. HOUR / YEAR KW VALUE IN US D. KWH VALUE IN US D  
 2550.0 160.25 0.0254  
 1950.0 133.76 0.0423  
 0. 63.35 0.0662

YEAR	DEPENDABLE		ANNUAL ENERGY		POWER		BENEFIT		TOTAL		PRESENT OPERATION	
	(MW)	(GWH)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)	(M US D)
1989	116.0	592.75	18.59	13.87	32.46	0.90909	29.51	5117	26.60	5018	21.156	21.156
1990	116.0	581.29	18.59	13.60	32.19	0.89645	26.60	4920	23.98	4822	21.156	21.156
1991	116.0	569.84	18.59	13.33	31.92	0.73131	31.92	4822	19.49	4723	21.156	21.156
1992	116.0	558.38	18.59	13.07	31.66	0.68301	19.49	4625	15.69	4219	21.156	21.156
1993	116.0	546.93	18.59	12.80	31.39	0.62092	15.69	4016	11.15	3813	21.156	21.156
1994	116.0	535.47	18.59	12.53	31.12	0.56447	11.15	3610	8.37	3507	21.156	21.156
1995	116.0	511.99	18.59	11.99	30.87	0.51316	8.37	3299	7.97	3190	21.156	21.156
1996	116.0	488.51	18.59	11.43	30.62	0.46651	7.97	3081	6.45	2973	21.156	21.156
1997	116.0	465.03	18.59	10.88	29.47	0.42410	6.45	2864	5.21	2720	21.156	21.156
1998	116.0	441.55	18.59	10.33	28.92	0.38554	5.21	2720	4.24	2648	21.156	21.156
1999	116.0	418.07	18.59	9.78	28.37	0.35049	4.24	2576	3.66	2576	21.156	21.156
2000	116.0	394.58	18.59	9.23	27.82	0.31863	3.66	2576	3.14	2576	21.156	21.156
2001	116.0	372.01	18.59	8.94	27.53	0.28966	3.14	2576	2.82	2576	21.156	21.156
2002	116.0	369.44	18.59	8.64	27.23	0.26333	2.82	2576	2.57	2576	21.156	21.156
2003	116.0	356.86	18.59	8.35	26.94	0.23939	2.57	2576	2.37	2576	21.156	21.156
2004	116.0	344.29	18.59	8.06	26.65	0.21763	2.37	2576	2.22	2576	21.156	21.156
2005	116.0	331.71	18.59	7.76	26.35	0.19784	2.22	2576	2.11	2576	21.156	21.156
2006	116.0	323.39	18.59	7.52	26.16	0.17986	2.11	2576	2.02	2576	21.156	21.156
2007	116.0	315.06	18.59	7.37	25.96	0.16351	2.02	2576	1.94	2576	21.156	21.156
2008	116.0	306.74	18.59	7.18	25.77	0.14864	1.94	2576	1.88	2576	21.156	21.156
2009	116.0	298.41	18.59	6.98	25.57	0.13513	1.88	2576	1.83	2576	21.156	21.156
2010	116.0	298.41	18.59	6.98	25.57	0.12285	1.83	2576	1.78	2576	21.156	21.156
2037	116.0	298.41	18.59	6.98	25.57	0.00937	1.78	2576	1.74	2576	21.156	21.156
2038	116.0	298.41	18.59	6.98	25.57	0.00852	1.74	2576	1.70	2576	21.156	21.156
SUMMARY	116.0	355.72	18.59	8.32	26.91	9.91681	292.14	3071	292.14	3071	21.156	21.156

\*\*\* RESULTS OF THE CASE HWL= 145.000 INSTALLED CAPACITY= 116.0 STORED IN DISK FILE A1818-02.NO. 10

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KANAN HWL 300

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 145,000 LOW WATER LEVEL IN METER 116,000 RATED HEAD IN METER 82.500  
 INSTALLED CAPACITY IN MW 116,000 DEPENDABLE CAPACITY IN MW 90,368 TARGET OPERATION HOUR A-DAY 5.88  
 RATED DISCHARGE IN CMS 166,832 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MMH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156

LENGTH OF INFLOW SERIES IN YEAR 20

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW (CMS)	EVAP. (CMS)	SPIII (CMS)	Q24 (CMS)	OG (CMS)	SZ (CMS)	R.W.L. (CM)	T.W.L. (CM)	E-HEAD EFFICI. (CM)	POWER (MW)	O. HOUR (H)	P.E. (GWH)	S.E. (GWH)	T.E. (GWH)
1989	100.74	0.64	20.50	79.59	137.67	309.11	145.117	30.291	92.924	115.7	5116.6	255.88	358.87	592.75
1994	84.08	0.63	9.30	72.85	139.76	286.45	144.788	39.256	92.487	115.7	4625.1	322.75	207.72	535.47
2000	82.39	0.62	6.38	53.74	141.64	272.94	140.685	39.253	97.302	115.6	3407.2	184.13	210.66	394.58
2005	81.99	0.61	5.50	45.06	142.35	267.14	140.199	39.252	96.785	115.5	2864.3	123.00	208.21	331.21
2009	81.85	0.61	5.09	40.37	142.49	265.93	140.109	39.251	96.692	115.5	2575.9	88.88	209.53	298.41

\*\*\* DEPENDABLE DISCHARGE, POWER OUIPUT AND ENERGY OUIPUT \*\*\*

YEAR	Q (CMS)	P (MW)	E (GWH)	% DEPENDABLE	Q (CMS)	P (MW)	E (GWH)	% DEPENDABLE	Q (CMS)	P (MW)	E (GWH)	% DEPENDABLE
1989	33.25	92.59	21.16	34.55	116.00	21.16	35.25	116.00	27.31	36.56	116.00	21.16
1994	47.88	92.73	27.31	44.16	116.00	27.31	44.50	116.00	27.31	45.18	116.00	21.31
2000	26.02	94.61	15.34	24.50	116.00	15.34	25.23	116.00	15.34	25.58	116.00	15.34
2005	16.03	94.02	10.25	16.68	116.00	10.25	16.86	116.00	10.25	17.15	116.00	10.25
2009	11.58	95.30	7.41	12.06	116.00	7.41	12.21	116.00	7.41	12.43	116.00	7.41

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KAMAN HWL 290

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 145.000 LOW WATER LEVEL IN METER 114.000 RATED HEAD IN METER \*\*\*\*\* 82.500  
 INSTALLED CAPACITY IN MW 146.000 DEPENDABLE CAPACITY IN MW 90.368 TARGET OPERATION-HOUR-A-DAY 5-88  
 RATED DISCHARGE IN CMS 166.832 TYPE OF RULE CURVE .. VARIABLE MASS CURVE  
 RULE CURVE IN MWH JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156

LENGTH OF INFLOW SERIES IN YEAR 24

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 90.0

0-HOUR / YEAR KW VALUE IN US D. KWH VALUE IN US D  
 2550.0 160.25 0.0234  
 1950.0 111.26 0.0425  
 0. 63.35 0.0682

YEAR	DEPENDABLE POWER (MW)	ANNUAL ENERGY (GWH)	POWER		BENEFIT		TOTAL (M US D)	P.W.F.	PRESENT OPERATION	
			(M US D)	(M US D)	(M US D)	(M US D)			WORTH (M US D)	HOUR (H)
1989	116.0	592.25	18.59	13.82	32.46	0.90909	29.31	5117		
1990	116.0	580.81	18.59	13.59	32.18	0.87645	26.90	5015		
1991	116.0	568.87	18.59	13.31	31.90	0.75131	23.97	4913		
1992	116.0	556.94	18.59	13.03	31.62	0.68301	21.00	4811		
1993	116.0	545.00	18.59	12.75	31.34	0.62092	19.46	4709		
1994	116.0	533.07	18.59	12.47	31.06	0.56447	17.93	4607		
1995	116.0	508.83	18.59	11.93	30.52	0.51316	15.66	4406		
1996	116.0	486.59	18.59	11.39	29.98	0.46651	13.98	4206		
1997	116.0	463.36	18.59	10.84	29.43	0.42410	12.48	4005		
1998	116.0	440.12	18.59	10.30	28.89	0.38554	11.14	3804		
1999	116.0	416.89	18.59	9.76	28.34	0.35049	9.93	3603		
2000	116.0	393.65	18.59	9.23	27.80	0.31863	8.86	3402		
2001	116.0	381.19	18.59	8.92	27.51	0.28966	7.97	3294		
2002	116.0	368.74	18.59	8.43	27.22	0.26333	7.17	3186		
2003	116.0	356.28	18.59	8.34	26.93	0.23939	6.45	3078		
2004	116.0	343.82	18.59	8.05	26.63	0.21763	5.80	2970		
2005	116.0	331.36	18.59	7.75	26.34	0.19784	5.21	2863		
2006	116.0	323.05	18.59	7.56	26.15	0.17986	4.70	2790		
2007	116.0	314.74	18.59	7.36	25.95	0.16331	4.24	2718		
2008	116.0	306.43	18.59	7.17	25.76	0.14864	3.83	2646		
2009	116.0	298.11	18.59	6.98	25.56	0.13513	3.45	2574		
2010	116.0	298.11	18.59	6.98	25.56	0.12285	3.14	2574		
2037	116.0	298.11	18.59	6.98	25.56	0.00937	0.24	2574		
2038	116.0	298.11	18.59	6.98	25.56	0.00852	0.22	2574		
SUMMARY	116.0	355.14	18.59	8.31	26.90	9.91481	291.91	3067		

\*\*\* RESULTS OF THE CASE HWL= 145.000 INSTALLED CAPACITY= 116.0 STORED IN DISK FILE A1818-02.ND. 11

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KANAN HWI 290

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 145.000 LOW WATER LEVEL IN METER 114.000 RATED HEAD IN METER \*\*\*\*\* 82.500  
 INSTALLED CAPACITY IN MW 116.000 DEPENDABLE CAPACITY IN MW 90.368 TARGET OPERATION HOUR A DAY 5.88  
 RATED DISCHARGE IN CMS 166.832 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 RULE CURVE IN MHW JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLOW (CMS)	EVAPD. (CMS)	SPILL (CMS)	Q24 (CMS)	Q6 (CMS)	S2 (CMS)	R.W.L. (CM)	T.W.L. (CM)	E-HEAD EFFICI. (CM)	POWER (MW)	O-HOUR (H)	P.E. (GWH)	S.E. (GWH)	T.E. (GWH)
1989	100.74	0.61	20.50	79.59	137.67	303.11	143.117	39.291	99.924	0.860	115.7	5116.6	253.88	338.87
1994	84.27	0.63	2.84	72.51	138.66	286.51	143.725	39.238	98.438	0.860	115.6	4607.4	315.88	216.19
2000	87.58	0.62	6.70	53.61	141.65	271.48	140.567	39.254	97.161	0.860	115.5	3401.6	175.88	217.78
2005	82.18	0.61	5.81	54.93	142.10	287.51	140.221	39.233	96.316	0.860	115.4	2842.5	133.25	218.11
2009	82.06	0.61	5.40	40.25	142.23	266.54	140.149	39.252	96.741	0.860	115.4	2574.0	79.13	218.99

\*\*\* DEPENDABLE DISCHARGE & POWER OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	100.0 % DEPENDABLE (CMS)	P (CMS)	F (GWH)	95.0 % DEPENDABLE (CMS)	P (CMS)	F (GWH)	90.0 % DEPENDABLE (CMS)	P (CMS)	F (GWH)	85.0 % DEPENDABLE (CMS)	P (CMS)	F (GWH)	80.0 % DEPENDABLE (CMS)	P (CMS)	F (GWH)
1989	33.26	92.59	21.16	33.74	116.00	21.16	34.55	116.00	21.16	35.25	116.00	21.16	36.56	116.00	21.16
1994	41.27	92.43	26.41	41.93	116.00	26.41	42.73	116.00	26.41	43.18	116.00	26.41	43.81	116.00	26.41
2000	22.91	93.84	14.66	23.27	114.80	14.66	23.79	116.00	14.66	24.04	116.00	14.66	24.42	116.00	14.66
2005	14.77	92.10	9.44	14.98	113.80	9.44	15.33	116.00	9.44	15.57	116.00	9.44	15.76	116.00	9.44
2009	10.33	91.65	6.59	10.48	113.84	6.59	10.72	116.00	6.59	10.86	116.00	6.59	11.03	116.00	6.59

NIPPON KOEI TOKYO/JAPAN

DAM \*\* PLAN A-3 KAMAN HWL 280

\*\* RESERVOIR OPERATION STUDY OF AGOS

HIGH WATER LEVEL IN METER 145.000 LOW WATER LEVEL IN METER 116.000 RATED HEAD IN METER 82.500  
 INSTALLED CAPACITY IN MW 116.000 DEPENDABLE CAPACITY IN MW 90.368 TARGET OPERATION HOUR A DAY 5.88  
 RATED DISCHARGE IN CMS 166.832 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE  
 JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 RULE CURVE IN MWH 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* BENEFIT CALCULATION \*\*\*  
 DISCOUNT RATE 10.0 POWER DEPENDABILITY IN % 90.0

0. HOUR / YEAR KW VALUE IN US D KWH VALUE IN US D  
 2550.0 160.25 0.0234  
 1950.0 111.24 0.0425  
 0. 63.35 0.0682

YEAR	DEPENDABLE POWER (MW)	ANNUAL ENERGY (GWH)	POWER (M US D)	BENEFIT ENERGY (M US D)	TOTAL ENERGY (M US D)	P.W.F.	PRESENT OPERATION MONTH (M US D)	PRESENT OPERATION HOUR (H)
1989	116.0	522.75	18.59	13.87	32.46	0.90909	22.51	5111.
1990	116.0	500.19	18.59	13.58	32.17	0.87645	26.58	5009.
1991	116.0	567.64	18.59	13.28	31.87	0.75131	23.95	4901.
1992	116.0	555.09	18.59	12.99	31.58	0.68301	21.57	4793.
1993	116.0	562.53	18.59	12.70	31.28	0.62092	19.43	4685.
1994	116.0	529.98	18.59	12.40	30.99	0.56447	17.49	4577.
1995	116.0	507.15	18.59	11.87	30.66	0.51316	15.63	4380.
1996	116.0	484.30	18.59	11.53	29.92	0.46651	13.96	4182.
1997	116.0	461.46	18.59	10.80	29.39	0.42410	12.46	3985.
1998	116.0	438.62	18.59	10.26	28.85	0.38554	11.12	3788.
1999	116.0	415.78	18.59	9.73	28.32	0.35049	9.93	3590.
2000	116.0	392.94	18.59	9.19	27.78	0.31804	8.83	3393.
2001	116.0	380.48	18.59	8.90	27.49	0.28966	7.96	3285.
2002	116.0	368.02	18.59	8.61	27.20	0.26333	7.16	3178.
2003	116.0	355.57	18.59	8.32	26.91	0.23939	6.44	3070.
2004	116.0	343.11	18.59	8.03	26.62	0.21763	5.79	2963.
2005	116.0	330.65	18.59	7.74	26.33	0.19784	5.21	2855.
2006	116.0	322.32	18.59	7.44	26.03	0.17986	4.70	2747.
2007	116.0	313.98	18.59	7.15	25.94	0.16351	4.24	2711.
2008	116.0	305.65	18.59	7.15	25.74	0.14864	3.83	2639.
2009	116.0	297.31	18.59	6.96	25.55	0.13513	3.45	2567.
2010	116.0	297.31	18.59	6.96	25.55	0.12285	3.14	2567.
2037	116.0	297.31	18.59	6.96	25.55	0.00937	0.24	2567.
2038	116.0	297.31	18.59	6.96	25.55	0.00832	0.22	2567.
SUMMARY	116.0	354.15	18.59	8.29	26.88	9.91481	291.61	3058.

\*\*\* RESULTS OF THE CASE HWL= 145.000 INSTALLED CAPACITY= 116.0 STORED IN DISK FILE A1818-02 MD. 12

\*\* RESERVOIR OPERATION STUDY OF AGUS DAM \*\* PLAN A-3 KANAN HWL 280 NIPPON KOEI TOKYO/JAPAN

HIGH WATER LEVEL IN METER 145,000 LOW WATER LEVEL IN METER 114,000 RATED HEAD IN METER \*\*\*\*\* 82,500  
 INSTALLED CAPACITY IN MW 116,000 DEPENDABLE CAPACITY IN MW 90,368 TARGET OPERATION-MQWS A-DAY 5.88  
 RATED DISCHARGE IN CMS 169,832 TYPE OF RULE CURVE \*\* VARIABLE MASS CURVE

JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.  
 RULE CURVE IN MWH 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156 21.156

LENGTH OF INFLOW SERIES IN YEAR 26

\*\*\* SUMMARY OF RESERVOIR OPERATION STUDY FOR EACH TARGET YEAR \*\*\*

YEAR	INFLW	EVAPD.	SPILL	Q24	QC	S2	R.W.L.	T.W.L.	E HEAD	EFFECT.	POWER	O HOUR	P.E.	S.E.	T.E.
	(CMS)	(CMS)	(CMS)	(CMS)	(CMS)	(MCM)	(M)	(M)	(M)	(%)	(MW)	(H)	(GWH)	(GWH)	(GWH)
1989	100.74	0.64	20.50	79.59	137.67	303.11	143.117	39.291	99.924	0.860	115.7	5116.6	253.88	338.87	592.75
1994	84.44	0.63	10.71	73.70	139.18	291.26	142.176	39.260	98.914	0.860	115.7	4526.9	296.35	233.73	524.98
2000	82.74	0.62	7.26	53.20	140.76	278.86	141.166	39.253	97.833	0.860	115.6	3393.1	155.63	237.31	392.94
2005	82.35	0.62	6.26	44.64	141.48	272.30	140.625	39.252	97.266	0.860	115.4	2855.1	96.38	236.28	330.65
2009	82.20	0.62	5.79	40.02	141.89	268.75	140.293	39.252	96.921	0.860	115.3	2566.8	65.25	232.06	297.31

\*\*\* DEPENDABLE DISCHARGE \* POWER OUTPUT AND ENERGY OUTPUT \*\*\*

YEAR	100.0 % DEPENDABLE		95.0 % DEPENDABLE		90.0 % DEPENDABLE		85.0 % DEPENDABLE		80.0 % DEPENDABLE	
	Q(CMS)	P(MW)	Q(CMS)	P(MW)	Q(CMS)	P(MW)	Q(CMS)	P(MW)	Q(CMS)	P(MW)
1989	33.26	92.59	21.16	33.74	116.00	21.16	35.25	116.00	21.16	36.56
1994	33.60	90.44	24.69	39.13	116.00	24.69	40.34	116.00	24.69	41.11
2000	20.28	92.30	12.97	20.62	115.59	12.97	21.32	116.00	12.97	21.60
2005	17.56	91.72	8.03	12.76	112.88	8.03	13.15	116.00	8.03	13.40
2009	8.50	91.44	5.44	8.65	113.51	5.44	8.91	116.00	5.44	9.03

\*\* OPERATION STUDY OF KALWA P/T \*\* (W.S. AND P.G. BY EXCESS WATER)  
 \*\* CASE 1 \*\* PR = 280 MM, MAX.T.W.L. = 175.000 M, DIA. OF H.R. TUNNEL = 6.3 M  
 OR = 392.63 CMS, RH = 75.550 M, ALPHA = 0.0000451

KWH VALUE IN US D (POWER GENERATION) KWH COST IN US D (PUMP OPERATION)  
 TIME 0, 0.0882, 0.0425, 2550, TIME 0, COST 0, 0.0425  
 KWH V, 0.0882, 0.0425

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F.	OPERATION HOUR (H)	ENERGY GENERATED (GWH)	ANNUAL BENEFIT (M US D)	PRESENT WORTH (M US D)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M US D)	PRESENT WORTH (M US D)
1994	0.90909	75	18.8	1.28	1.96	56	13.9	0.59	0.59
1995	0.82645	68	16.9	1.15	0.95	303	50.7	2.15	1.96
1996	0.75131	60	15.1	1.03	0.77	350	87.4	3.72	3.07
1997	0.68301	53	13.2	0.90	0.61	497	124.2	5.28	3.97
1998	0.62092	48	11.3	0.77	0.48	644	161.0	6.64	4.67
1999	0.56447	38	9.5	0.65	0.36	791	197.7	8.00	5.22
2000	0.51316	30	7.6	0.52	0.27	938	234.5	9.37	5.63
2001	0.46551	28	7.1	0.48	0.23	1019	254.7	10.82	5.55
2002	0.42110	26	6.6	0.45	0.19	1099	274.8	11.68	5.45
2003	0.38554	24	6.0	0.41	0.16	1180	295.0	12.54	5.32
2004	0.35049	22	5.3	0.38	0.13	1260	315.1	13.39	5.18
2005	0.31863	20	5.0	0.34	0.11	1341	335.3	14.23	4.99
2006	0.28966	19	4.7	0.32	0.09	1396	349.0	14.83	4.73
2007	0.26333	18	4.5	0.31	0.08	1451	362.7	15.41	4.44
2008	0.23939	17	4.3	0.29	0.07	1506	376.4	16.00	4.21
2009	0.21763	16	4.0	0.27	0.06	1560	390.1	16.58	3.97
2010	0.19784	15	4.0	0.27	0.05	1560	390.1	16.58	3.61
2042	0.00937	16	4.0	0.27	0.00	1560	390.1	16.58	0.17
2043	0.00852	16	4.0	0.27	0.00	1560	390.1	16.58	0.14
SUMMARY	9, 91461	22	5.5	0.38	0.30	1367	341.7	14.52	107.09

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.H.L. (M)	T.W.L. (M)	E.HEAD (M)	LOSS (M)	ETA (%)	POWER (MW)	EXCESS WATER (GWH)	OPERATION HOUR (H)	ENERGY (GWH)	O.HOUR ENERGY (GWH)	O.HOUR ENERGY (GWH)	N.HEAD (M)	G.HEAD (M)	W.S. (CMS)	W.S. (CMS)
1994	257.51	171.03	89.09	5.01	0.86	250.0	327.49	75	18.8	13.9	87.57	204.35	1.66	1.66	
2000	257.51	170.45	89.45	4.96	0.86	250.0	324.43	30	7.6	93.8	86.65	202.32	23.50	23.50	
2005	257.51	170.17	90.06	4.89	0.86	250.0	323.34	20	5.0	134.1	305.3	87.10	88.95	33.07	
2009	257.51	169.99	90.06	4.89	0.86	250.0	323.14	16	4.0	1560.1	390.1	87.33	89.18	200.96	36.17

\*\*\*\*\* POWER GENERATION BY EXCESS WATER \*\*\*\*\*

\*\*\*\*\* PUMP OPERATION FOR WATER SUPPLY \*\*\*\*\*

\*\* OPERATION STUDY OF KALINA P/T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)  
 \*\* CASE 3 \*\* PR = 250 MM ; MAX.Y.H.L. = 175,000 M ; DIA. OF H.R.TUNNEL = 8.3 M  
 QR = 392.63 CMS ; RH = 75,950 M ; ALPHA = 0.0000451

KW KWH VALUE IN US D KWH COST IN US D  
 (POWER GENERATION) (PUMP OPERATION)  
 TIME 1950. 2550. TIME 0. COST 0.  
 0. 0.0682 0.0425 0.0294 0.0425  
 63.55 111.76 100.25

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F. (M)	OPERATION HOUR (H)	95% POWER (MW)	ANNUAL P.E.B. (M.D.)	GENERATION (GWH)	ANNUAL E.B. (M.D.)	PRESENT NORTH (M.D.)	OPERATION HOUR (H)	PRESENT NORTH (M.D.)	PUMP CONSUMED (GWH)	OPERATION HOUR (H)	ANNUAL COST (M.D.)	PRESENT NORTH (M.D.)
1994	0.80909	1460	201.8	12.78	354.8	24.20	33.62	2585	27.46	646.2	2585	27.46	27.46
1995	0.82645	1460	202.9	12.85	355.0	24.21	33.63	2586	27.47	646.4	2586	27.47	27.47
1996	0.84381	1460	203.9	12.92	355.2	24.22	33.63	2587	27.48	646.7	2587	27.48	27.48
1997	0.86117	1460	205.0	12.99	355.4	24.24	33.64	2588	27.49	647.1	2588	27.49	27.49
1998	0.87853	1460	206.0	13.05	355.6	24.25	33.64	2589	27.50	647.4	2589	27.50	27.50
1999	0.89589	1460	207.1	13.12	355.8	24.27	33.65	2590	27.51	647.7	2590	27.51	27.51
2000	0.91325	1460	208.1	13.19	356.0	24.28	33.65	2591	27.52	648.0	2591	27.52	27.52
2001	0.93061	1460	209.2	13.26	356.2	24.29	33.66	2592	27.53	648.3	2592	27.53	27.53
2002	0.94797	1460	209.7	13.32	356.3	24.30	33.66	2593	27.54	648.6	2593	27.54	27.54
2003	0.96533	1460	210.2	13.38	356.4	24.31	33.67	2594	27.55	648.9	2594	27.55	27.55
2004	0.98269	1460	210.8	13.45	356.5	24.32	33.67	2595	27.56	649.2	2595	27.56	27.56
2005	0.99999	1460	211.1	13.51	356.6	24.33	33.68	2596	27.57	649.5	2596	27.57	27.57
2006	0.28966	1460	211.4	13.59	356.7	24.33	33.68	2597	27.58	649.8	2597	27.58	27.58
2007	0.28333	1460	211.7	13.64	356.8	24.34	33.69	2598	27.59	650.1	2598	27.59	27.59
2008	0.27666	1460	212.1	13.73	356.9	24.34	33.69	2599	27.60	650.4	2599	27.60	27.60
2009	0.27000	1460	212.1	13.83	356.9	24.34	33.69	2600	27.60	650.7	2600	27.60	27.60
2010	0.19784	1460	212.1	13.93	356.9	24.34	33.69	2601	27.60	651.0	2601	27.60	27.60
2042	0.00937	1460	212.1	13.43	356.9	24.34	33.69	2602	27.60	651.3	2602	27.60	27.60
2043	0.00852	1460	212.1	13.43	356.9	24.34	33.69	2603	27.60	651.6	2603	27.60	27.60
SUMMARY	9,91481	1460	210.8	13.35	356.6	24.32	371.27	2592	648.0	27.54	300.10		

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.H.L. (M)	E.HEAD (M)	H.LOSS (M)	PEAK POWER (MW)	GENERATION (GWH)	ANNUAL COST (M.D.)	OPERATION HOUR (H)	PRESENT NORTH (M.D.)	PUMP CONSUMED (GWH)	OPERATION HOUR (H)	ANNUAL COST (M.D.)	PRESENT NORTH (M.D.)
1994	257.51	171.03	80.67	5.83	0.86	243.0	358.61	1460	354.6	2585	646.2	86.50	88.38
1995	257.51	170.45	81.29	5.78	0.86	243.9	357.33	1460	356.0	2590	647.5	87.07	88.93
2000	257.51	170.17	81.60	5.75	0.86	244.2	356.54	1460	356.0	2592	648.0	87.35	89.20
2005	257.51	169.99	81.79	5.73	0.86	244.4	356.00	1460	356.9	2593	648.3	87.53	89.37
2009	257.51	169.99	81.79	5.73	0.86	244.4	356.00	1460	356.9	2593	648.3	87.53	89.37





\*\* OPERATION STUDY OF KALIWA P/T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)

\*\* CASE 2 \*\* PR = 250 MW , MAX. T.M.L. = 165,000 M , DIA. OF H.P. TUNNEL = 8.3 M  
 OR = 341.86 CMS , RH = 86,770 M , ALPHA = 0.0000491

KWH COST IN US D (PUMP OPERATION) TIME G. 0.10425  
 KW KWH VALUE IN US D (POWER GENERATION) TIME G. 0.0234  
 KW V. 63.35 111.76 160.25  
 KW V. 0.0082 0.0425 0.0234

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.M.F.	OPERATION HOUR (H)	95% ANNUAL POWER (MW)	ANNUAL P.B. (M.D.)	GENERATION ENERGY (GWH)	ANNUAL E.B. (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR (H)	PUMP ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1994	0.20909	1460	207.5	13.15	355.5	24.24	33.99	2533	633.3	26.91	26.91
1995	0.92645	1460	208.0	13.18	355.6	24.25	30.93	2533	633.5	26.92	24.48
1996	0.75131	1460	208.4	13.21	355.8	24.26	28.15	2533	633.7	26.93	22.26
1997	0.68301	1460	208.9	13.23	355.9	24.28	25.62	2533	633.9	26.94	20.24
1998	0.62092	1460	209.4	13.26	356.1	24.29	23.32	2533	634.1	26.95	18.41
1999	0.56447	1460	209.8	13.29	356.3	24.30	21.22	2533	634.3	26.96	16.74
2000	0.51316	1460	210.3	13.32	356.4	24.31	19.31	2533	634.5	26.97	15.22
2001	0.46651	1460	210.8	13.36	356.5	24.32	17.57	2533	634.7	26.98	13.84
2002	0.42410	1460	211.4	13.39	356.7	24.32	15.99	2533	634.9	26.98	12.58
2003	0.38554	1460	211.9	13.42	356.8	24.33	14.56	2533	635.0	26.99	11.44
2004	0.35049	1460	212.4	13.46	356.9	24.34	13.25	2540	635.1	26.99	10.40
2005	0.31863	1460	212.9	13.49	357.0	24.35	12.06	2541	635.2	27.00	9.46
2006	0.28966	1460	213.4	13.52	357.1	24.35	10.97	2541	635.3	27.00	8.60
2007	0.26333	1460	213.8	13.54	357.1	24.36	9.98	2541	635.3	27.00	7.82
2008	0.23939	1460	214.2	13.57	357.2	24.36	9.08	2542	635.3	27.01	7.11
2009	0.21763	1460	214.6	13.60	357.3	24.36	8.26	2542	635.4	27.01	6.46
2010	0.19784	1460	214.6	13.60	357.3	24.36	7.51	2542	635.4	27.01	5.88
2042	0.00937	1460	214.6	13.60	357.3	24.36	0.36	2542	635.4	27.01	0.28
2043	0.00852	1460	214.6	13.60	357.3	24.36	0.32	2542	635.4	27.01	0.25
SUMMARY	9.91481	1460	213.5	13.52	357.0	24.35	373.64	2541	635.1	26.99	294.10

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.W.L. (M)	E.V. HEAD (M)	W. LOSS (M)	EATA (M)	POWER (MW)	Q (CMS)	O. HOUR ENERGY (GWH)	HEAD (M)	PUMP ENERGY (GWH)	N. HEAD (M)	G. HEAD (M)
1994	257.51	161.12	91.48	4.93	0.86	207.5	318.62	1460	355.5	2533	633.3	96.40
2000	257.51	160.63	91.99	4.90	0.86	208.4	315.73	1460	356.4	2538	634.5	95.80
2005	257.51	160.31	92.33	4.88	0.86	209.4	315.09	1460	357.0	2541	635.1	95.84
2009	257.51	160.15	92.50	4.87	0.86	209.8	314.75	1460	357.3	2542	635.4	95.37

\*\* OPERATION STUDY OF KALINA P/T \*\* (M.S. AND P.G. BY EXCESS WATER)

\*\* CASE 3 \*\* PR = 250 MM & MAX. T.W.L. = 155,000 M ; DIA. OF M.R. TUNNEL = 8.3 M  
 OR = 304.55 CMS ; RH = 97,400 M ; ALPHA = 0.0000543

KWH VALUE IN US \$ KWH COST IN US \$  
 (POWER GENERATION) (PUMP OPERATION)  
 TIME 0. 1950. 2550. TIME 0.  
 KWH Y. 0.0682 0.0425 0.0425 0.0334 COST 0.0425 0.0425

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.M.F.	POWER GENERATION			PUMP OPERATION			PRESENT WORTH (M US \$)
		OPERATION HOUR (H)	ENERGY GENERATED (GWH)	ANNUAL BENEFIT (M US \$)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M US \$)	
1994	0.90909	93.	23.2	1.58	68.	17.0	0.72	0.72
1995	0.82645	84.	20.9	1.42	247.	61.8	2.63	2.39
1996	0.75131	74.	18.6	1.27	427.	106.7	4.53	3.75
1997	0.68301	65.	16.3	1.11	606.	151.6	6.44	4.84
1998	0.62092	56.	14.0	0.95	786.	196.4	8.35	5.70
1999	0.56447	47.	11.7	0.80	965.	241.3	10.25	6.37
2000	0.51316	37.	9.4	0.64	1145.	286.1	12.16	6.86
2001	0.46651	27.	8.1	0.60	1243.	310.7	13.20	6.78
2002	0.42410	32.	8.1	0.55	1341.	335.2	14.25	6.85
2003	0.38554	30.	7.4	0.51	1439.	359.8	15.29	6.48
2004	0.35049	27.	6.8	0.46	1537.	384.3	16.33	6.30
2005	0.31863	25.	6.1	0.42	1635.	408.9	17.38	6.09
2006	0.28966	23.	5.8	0.40	1702.	425.5	18.08	5.76
2007	0.26333	22.	5.6	0.38	1769.	442.2	18.79	5.44
2008	0.23939	21.	5.3	0.36	1835.	458.8	19.50	5.13
2009	0.21763	20.	5.0	0.34	1902.	475.5	20.21	4.84
2010	0.19784	20.	5.0	0.34	1902.	475.5	20.21	4.40
2042	0.00937	20.	5.0	0.34	1902.	475.5	20.21	0.21
2043	0.00852	20.	5.0	0.34	1902.	475.5	20.21	0.19
SUMMARY	9.91481	27.	6.8	0.47	1666.	416.5	17.70	130.50

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

--- POWER GENERATION BY EXCESS WATER ---

YEAR	R.W.L. (M)	T.W.L. (M)	E HEAD (M)	H. LOSS (M)	EXTRA POWER (MW)	EXCESS WATER (CMS)	0. HOUR ENERGY (GWH)	0. HOUR ENERGY N. HEAD (M)	W.S. (CMS)						
1994	257.51	151.30	110.11	3.95	0.86	250.0	265.28	93.	23.2	68.	17.0	105.36	106.90	167.37	1.46
2000	257.51	150.62	110.45	3.92	0.86	250.0	263.06	37.	9.4	1145.	286.1	136.46	107.97	165.81	23.50
2005	257.51	150.33	111.04	3.88	0.86	250.0	262.25	25.	6.1	1635.	408.9	106.93	105.43	165.20	35.07
2009	257.51	150.17	111.02	3.86	0.86	250.0	262.10	20.	5.0	1902.	475.5	107.15	105.64	164.88	38.17

--- PUMP OPERATION FOR WATER SUPPLY ---

\*\* OPERATION STUDY OF KALINA P/T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)  
 \*\* CASE 3 \*\* PK = 250 MW \* MAX.T.W.L. = 155,000 M \* DIA. OF H.R. TUNNEL = 8.3 M  
 OR = 304.55 CMS \* RH = 97,400 M \* ALPHA = 0.0000543

KWH VALUE IN US D KWH COST IN US D  
 (POWER GENERATION) (PUMP OPERATION)  
 TIME 0. 0.0682 1950. 0.0425 2550. 0.1024 0. 0.0425  
 KWH V. 65.35 111.76 160.125

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F. (M)	POWER GENERATION				PUMP OPERATION				PRESENT WORTH (M.D.)	
		OPERATION HOUR	95% ANNUAL POWER (MW)	ANNUAL ENERGY GENERATED (GWH)	E.B. (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR	ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)		
1994	0.90309	1460	208.1	33.18	3551.9	24.27	34.05	2503	625.7	26.59	26.59
1995	0.82845	1460	208.5	33.21	3561	24.28	30.99	2504	626.0	26.60	24.19
1996	0.75331	1460	209.0	33.24	3562	24.30	28.20	2505	626.2	26.61	22.00
1997	0.68301	1460	209.5	33.27	3561	24.31	25.67	2506	626.5	26.62	20.00
1998	0.62092	1460	210.0	33.30	3561.6	24.32	23.36	2507	626.7	26.63	18.19
1999	0.56447	1460	210.4	33.33	3561.8	24.33	21.26	2508	626.9	26.64	16.54
2000	0.51316	1460	210.9	33.36	3571.0	24.35	19.35	2509	627.2	26.65	15.05
2001	0.46511	1460	211.4	33.39	3571.1	24.35	17.61	2509	627.3	26.66	13.68
2002	0.42110	1460	211.6	33.42	3571.2	24.36	16.02	2510	627.4	26.66	12.44
2003	0.38554	1460	212.3	33.45	3571.3	24.37	14.58	2510	627.5	26.67	11.31
2004	0.35049	1460	212.8	33.48	3571.4	24.37	13.27	2510	627.6	26.67	10.28
2005	0.31863	1460	213.2	33.51	3571.4	24.38	12.07	2511	627.7	26.68	9.35
2006	0.28966	1460	213.6	33.54	3571.5	24.38	10.99	2511	627.8	26.68	8.50
2007	0.26333	1460	214.3	33.58	3571.6	24.39	10.00	2511	627.9	26.68	7.73
2008	0.23939	1460	214.8	33.61	3571.6	24.39	9.10	2512	628.0	26.69	7.03
2009	0.21763	1460	215.4	33.64	3571.7	24.39	8.23	2512	628.0	26.69	6.39
2010	0.19784	1460	215.4	33.64	3571.7	24.39	7.53	2512	628.0	26.69	5.81
SUMMARY											
2042	0.00937	1460	215.4	33.64	357.7	24.39	0.36	2512	628.0	26.69	0.28
2043	0.00852	1460	215.4	33.64	357.7	24.39	0.32	2512	628.0	26.69	0.25
SUMMARY 9.91481 1460 214.2 33.57 357.5 24.38 374.31 2511 627.7 26.68 290.66											

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	P.W.L. (M)	T.W.L. (M)	PEAK POWER GENERATION				PUMP OPERATION							
			E-HEAD (M)	LOSS (M)	E-HEAD (M)	POWER (MW)	Q (CMS)	0.1 HOUR ENERGY (GWH)	0.1 HOUR ENERGY (M)	0.1 HOUR ENERGY (M)	N. HEAD (M)	G. HEAD (CMS)		
1994	257.51	151.30	101.81	4.41	0.86	243.8	284.62	1460	355.9	2503	625.7	106.22	107.74	166.02
2000	257.51	150.62	102.52	4.38	0.86	244.5	283.56	1460	357.0	2509	627.2	106.90	108.39	165.03
2005	257.51	150.33	102.83	4.36	0.86	244.6	283.09	1460	357.4	2511	627.7	107.19	108.68	164.61
2009	257.51	150.17	103.00	4.35	0.86	245.0	282.82	1460	357.7	2512	628.0	107.35	108.83	164.38

\*\* OPERATION STUDY OF KALINA P/T \*\* (U.S. AND P.G. BY EXCESS WATER)

\*\* CASE 4 \*\* PR = 250 MW ; MAX.T.H.L. = 145,000 M ; DIA. OF H.R.TUNNEL = 8.13 M  
 GR = 275.76 CMS ; RM = 107,570 M ; ALPHA = 0.0000348

KWH VALUE IN US D KWH COST IN US D  
 (POWER GENERATION) (PUMP OPERATION)  
 TIME 0, 1950, 2550, 0, 0.0234  
 KWH V, 0.0682 0.0425 0.0425 0.0425 0.0425

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.M.F.	OPERATION HOUR (H)	POWER GENERATION ENERGY (GWH)	ANNUAL BENEFIT (M US D)	PRESENT WORTH (M US D)	OPERATION HOUR (H)	CONSUMED ENERGY (GWH)	ANNUAL COST (M US D)	PRESENT WORTH (M US D)
1994	0.20909	101	25.3	1.72	1.57	74	18.5	0.79	0.79
1995	0.22645	91	22.8	1.55	1.28	270	67.6	2.87	2.61
1996	0.25131	81	20.3	1.38	1.04	467	116.6	4.96	4.10
1997	0.28301	71	17.7	1.21	0.83	665	165.7	7.04	5.29
1998	0.32092	61	15.2	1.04	0.65	859	214.8	9.13	6.23
1999	0.36447	51	12.7	0.87	0.49	1055	263.0	11.21	6.96
2000	0.41316	41	10.2	0.70	0.36	1252	312.9	13.30	7.51
2001	0.46651	38	9.5	0.65	0.30	1350	339.7	14.44	7.41
2002	0.52410	35	8.8	0.60	0.25	1466	366.9	15.58	7.27
2003	0.58554	32	8.1	0.55	0.21	1574	393.4	16.72	7.09
2004	0.65049	30	7.4	0.50	0.18	1681	420.2	17.86	6.89
2005	0.71863	27	6.7	0.46	0.15	1788	447.1	19.00	6.66
2006	0.78966	25	6.4	0.43	0.13	1861	465.2	19.77	6.30
2007	0.86333	24	6.1	0.41	0.11	1935	483.2	20.54	5.95
2008	0.93939	23	5.7	0.39	0.09	2005	501.9	21.31	5.61
2009	1.01763	22	5.4	0.37	0.08	2078	519.4	22.08	5.28
2010	1.09784	22	5.4	0.37	0.07	2078	519.4	22.08	4.80
2042	0.00937	22	5.4	0.37	0.00	2078	519.4	22.08	0.23
2043	0.00852	22	5.4	0.37	0.00	2078	519.4	22.08	0.21
SUMMARY	9.91481	30	7.4	0.51	0.48	1820	455.1	19.34	142.72

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.H.L. (M)	E.HEAD (M)	H.LOSS (M)	Q (CMS)	POWER (MW)	ENERGY (GWH)	O.HOUR ENERGY (GWH)	0.HOUR ENERGY (GWH)	PUMP OPERATION FOR WATER SUPPLY					
										W.S. (CMS)					
1994	257.51	141.77	120.08	3.96	0.86	250.0	243.33	101	25.3	74	18.5	114.84	116.38	153.73	1.46
2000	257.51	140.55	120.43	3.93	0.86	250.0	241.36	41	10.2	1252	312.9	116.55	118.05	151.63	25.50
2005	257.51	140.22	121.01	3.89	0.86	250.0	240.63	27	6.7	1785	447.1	117.04	118.53	151.07	38.07
2009	257.51	140.15	120.99	3.89	0.86	250.0	240.50	22	5.4	2078	519.4	117.17	118.66	150.92	38.17

\*\* OPERATION STUDY OF KALIHA PAT \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY).

\*\* CASE 4 \*\* PH = 250 MM MAX, T.M.L. = 145,000 M, DIA. OF H.R. TUNNEL = 8.13 M  
 OR = 275.76 CMS, RH = 107,570 M, ALPHA = 0.0000348

KW KWH VALUE IN US D KWH COST IN US D  
 (POWER GENERATION) (PUMP OPERATION)  
 TIME 0. 0.0682 1950. 0.0425 2550. 0.0234  
 KWH V. 63.35 111.76 160.25  
 COST 0. 0.0428

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.H.F. (M)	OPERATION HOUR (H)	POWER 95% ANNUAL P.B. (MW)	ANNUAL ENERGY (GWH)	ANNUAL ESB (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR (H)	PUMP OPERATION ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1994	0.00909	1460.	206.8	355.3	24.23	33.94	2486.	621.6	26.42	26.42
1995	0.02645	1460.	209.0	355.7	24.26	30.93	2489.	622.1	26.44	24.03
1996	0.07513	1460.	209.1	356.0	24.28	28.20	2490.	622.5	26.46	21.87
1997	0.08302	1460.	210.3	356.3	24.30	25.70	2492.	623.0	26.48	19.89
1998	0.02092	1460.	211.5	356.7	24.33	23.42	2494.	623.5	26.50	18.10
1999	0.05447	1460.	213.6	357.0	24.35	21.35	2495.	624.0	26.52	16.47
2000	0.01316	1460.	213.8	357.4	24.37	19.46	2496.	624.5	26.54	14.98
2001	0.06651	1460.	214.0	357.4	24.38	17.70	2498.	624.5	26.54	13.62
2002	0.02410	1460.	214.1	357.5	24.38	16.09	2498.	624.6	26.55	12.38
2003	0.08554	1460.	214.3	357.6	24.39	14.64	2499.	624.7	26.55	11.26
2004	0.05049	1460.	214.5	357.7	24.39	13.31	2499.	624.8	26.55	10.24
2005	0.01863	1460.	214.6	357.7	24.40	12.11	2499.	624.8	26.55	9.31
2006	0.08966	1460.	214.7	357.7	24.40	11.01	2499.	624.8	26.55	8.46
2007	0.02333	1460.	214.8	357.7	24.40	10.01	2499.	624.8	26.55	7.69
2008	0.03939	1460.	214.9	357.7	24.40	9.10	2499.	624.8	26.55	6.99
2009	0.01763	1460.	215.0	357.7	24.40	8.27	2499.	624.8	26.55	6.36
2010	0.01794	1460.	215.0	357.7	24.40	7.52	2499.	624.8	26.55	5.78
2042	0.00937	1460.	215.0	357.7	24.40	0.36	2499.	624.8	26.55	0.27
2043	0.00852	1460.	215.0	357.7	24.40	0.32	2499.	624.8	26.55	0.25
SUMMARY	9,91481	1460.	214.13	357.5	24.38	374.73	2498.	624.5	26.54	289.15

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.H.L. (M)	T.M.L. (M)	E. HEAD (M)	H. LOSS (M)	PEAK POWER (MW)	ANNUAL ENERGY (GWH)	ANNUAL ESB (M.D.)	OPERATION HOUR (H)	PUMP OPERATION ENERGY (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1994	257.51	141.77	111.38	4.37	0.86	243.4	259.64	1460.	355.3	24.86	33.94
2000	257.51	140.55	112.64	4.33	0.86	243.8	258.28	1460.	357.4	24.98	30.93
2005	257.51	140.22	112.99	4.31	0.86	245.0	257.76	1460.	357.7	24.99	28.20
2009	257.51	140.15	113.06	4.30	0.86	245.0	257.59	1460.	357.7	24.99	25.70
2010	257.51	140.15	113.06	4.30	0.86	245.0	257.59	1460.	357.7	24.99	23.42



\*\* OPERATION STUDY OF KALIWA P/T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)

\*\* CASE 5 \*\* PR = 250 MW ; MAX.T.M.L. = 175,000 M ; DIA. OF H.R.FUNNEL = 7.6 M  
 GR = 411.70 CMS , RH = 72,050 M , ALPHA = 0.5000617

KWH VALUE IN US D (POWER GENERATION) KWH COST IN US D (PUMP OPERATION)  
 TIME 0. 1950, 2550, 0.0425, 0.0234, TIME 0. 0.0425  
 KWH V, 0.0682, 111.76, 160.25, KWH V, 63.35

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.M.F.	OPERATION HOUR	POWER (MW)	ANNUAL ENERGY GENERATED (GWH)	ANNUAL E.B. (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR	ENERGY CONSUMED (GWH)	ANNUAL COSTY (M.D.)	PRESENT WORTH (M.D.)
1994	0.90909	1460	201.8	12,778	24,50	33.62	2698	674.4	28.66	28.66
1995	0.82645	1460	202.9	12,85	24,21	30.85	2698	674.6	28.67	26.04
1996	0.75131	1460	203.9	12,92	24,22	27.91	2699	674.7	28.67	23.70
1997	0.68301	1460	205.0	12,99	24,24	25.42	2698	674.8	28.68	21.55
1998	0.62092	1460	207.1	13,05	24,25	23.16	2700	674.9	28.69	19.59
1999	0.56447	1460	207.1	13,12	24,27	21.10	2700	675.1	28.69	17.81
2000	0.51316	1460	208.1	13,19	24,28	19.23	2701	675.2	28.70	16.20
2001	0.46651	1460	209.7	13,22	24,29	17.51	2701	675.2	28.70	14.73
2002	0.42410	1460	209.2	13,25	24,30	15.92	2701	675.3	28.70	13.39
2003	0.38554	1460	209.7	13,29	24,30	14.49	2701	675.3	28.70	12.17
2004	0.35049	1460	210.2	13,32	24,31	13.19	2702	675.4	28.71	11.07
2005	0.31863	1460	210.8	13,35	24,32	12.00	2702	675.4	28.71	10.06
2006	0.28966	1460	211.1	13,37	24,32	10.92	2702	675.4	28.71	9.15
2007	0.26333	1460	211.4	13,39	24,33	9.93	2702	675.5	28.71	8.32
2008	0.23939	1460	211.7	13,41	24,33	9.04	2702	675.5	28.71	7.56
2009	0.21763	1460	212.1	13,43	24,34	8.22	2702	675.5	28.71	6.87
2010	0.19784	1460	212.1	13,43	24,34	7.47	2702	675.5	28.71	6.25
2042	0.00937	1460	212.1	13,43	24,34	0.35	2702	675.5	28.71	0.30
2043	0.00852	1460	212.1	13,43	24,34	0.32	2702	675.5	28.71	0.27
SUMMARY	9,91481	1460	210.8	13,35	24,32	371.27	2702	675.4	28.70	312.92

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.M.L.	T.M.L.	E.HEAD (M)	H.LOSS (M)	PEAK POWER (MW)	ANNUAL ENERGY (GWH)	ANNUAL E.B. (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR	ENERGY CONSUMED (GWH)	ANNUAL COSTY (M.D.)	PRESENT WORTH (M.D.)
1994	257.51	171.03	77.93	8.57	0.86	243.0	371.93	1460	354.8	2698	674.4	86.50
2000	257.51	170.45	78.58	8.49	0.86	243.9	370.13	1460	356.0	2701	675.2	87.07
2005	257.51	170.17	78.91	8.44	0.86	244.2	369.17	1460	356.6	2702	675.4	87.35
2009	257.51	169.99	79.12	8.41	0.86	244.4	368.52	1460	356.9	2702	675.5	87.53
2042	257.51	169.99	79.12	8.41	0.86	244.4	368.52	1460	356.9	2702	675.5	87.53
2043	257.51	169.99	79.12	8.41	0.86	244.4	368.52	1460	356.9	2702	675.5	87.53
SUMMARY	9,91481	169.99	79.12	8.41	0.86	244.4	368.52	1460	356.9	2702	675.5	87.53



\*\* OPERATION STUDY OF KALIWA P/T \*\* (M.S. AND P.G. BY EXCESS WATER)

\*\* CASE 6 \*\* PR = 250 MW ; MAX.T.W.L.L. = 165,000 M ; DIA. OF H.R. TUNNEL = 7.6 M  
 OR = 352.42 CMS ; RH = 84,170 M ; ALPHA = 0.0000671

KWH VALUE IN US D  
 (POWER GENERATION) TIME (PUMP OPERATION)  
 KWH V. 0.0682 1950, 2550, 0.0425 0.0254 0.0425 0.0425

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	POWER GENERATION			PUMP OPERATION			PRESENT WORTH		
	OPERATION HOUR (H)	ENERGY GENERATED (GWH)	ANNUAL BENEFIT (M US D)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M US D)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M US D)
1994	83	20.6	1.41	62	15.5	0.66	62	15.5	0.66
1995	74	18.6	1.27	226	56.5	2.40	226	56.5	2.40
1996	66	16.5	1.13	390	97.5	4.14	390	97.5	4.14
1997	58	14.5	0.99	554	138.5	5.69	554	138.5	5.69
1998	50	12.4	0.85	718	179.5	7.63	718	179.5	7.63
1999	42	10.4	0.71	882	220.5	9.37	882	220.5	9.37
2000	33	8.3	0.57	1046	261.5	11.11	1046	261.5	11.11
2001	31	7.8	0.53	1136	284.0	12.07	1136	284.0	12.07
2002	29	7.2	0.49	1226	306.4	13.02	1226	306.4	13.02
2003	26	6.6	0.45	1316	328.9	13.98	1316	328.9	13.98
2004	24	6.0	0.41	1406	351.4	14.93	1406	351.4	14.93
2005	22	5.5	0.37	1495	373.9	15.89	1495	373.9	15.89
2006	21	5.2	0.36	1556	389.1	16.54	1556	389.1	16.54
2007	20	4.9	0.34	1617	404.3	17.18	1617	404.3	17.18
2008	19	4.7	0.32	1678	419.6	17.83	1678	419.6	17.83
2009	18	4.4	0.30	1739	434.8	18.48	1739	434.8	18.48
2010	18	4.4	0.30	1739	434.8	18.48	1739	434.8	18.48
SUMMARY	24	6.1	0.41	1524	380.9	16.19	1524	380.9	16.19
2042	18	4.4	0.30	1739	434.8	18.48	1739	434.8	18.48
2043	18	4.4	0.30	1739	434.8	18.48	1739	434.8	18.48

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	POWER GENERATION BY EXCESS WATER			PUMP OPERATION FOR WATER SUPPLY			
	E. HEAD (M)	LOSS (M)	NETA POWER (MW)	ENERGY (GWH)	O. HEAD (M)	W. S. (CMS)	
1994	97.91	6.17	0.86	250.0	298.10	83	20.6
2000	98.27	6.12	0.86	250.0	295.42	33	8.3
2005	98.89	6.04	0.86	250.0	294.45	22	5.5
2009	98.88	6.04	0.86	250.0	294.28	18	4.4

\*\* OPERATION STUDY OF KALINA P,T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)

\*\* CASE 6 \*\* PR = 250 MM ; MAX.T.P.L. = 165,900 M ; DIA. OF H.R.TUNNEL = 7.6 M  
 OR = 352.42 CMS ; RH = 84,170 M ; ALPHA = 0.000067

KW KWH VALUE IN US \$ KWH COST IN US \$  
 (POWER GENERATION) TIME (PUMP OPERATION)  
 0. 0.0682 1950. 2550. 0.0234 0.0425  
 63.95 111.76 160.25

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F. (M)	OPERATION HOUR (H)	95% ANNUAL POWER (MW)	ANNUAL P.B. (M.D.)	GENERATION ENERGY (GWH)	ANNUAL E.B. (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1994	0.20909	1460	207.5	13.15	355.5	24.24	33.99	2610	652.6	27.74	27.74
1995	0.22645	1460	208.0	13.18	355.6	24.25	30.93	2611	652.8	27.74	25.22
1996	0.25131	1460	208.4	13.20	355.6	24.26	28.15	2612	653.1	27.75	22.93
1997	0.28301	1460	208.9	13.23	355.9	24.28	25.62	2613	653.2	27.76	20.85
1998	0.32092	1460	209.4	13.26	356.1	24.29	23.32	2614	653.4	27.77	18.96
1999	0.36447	1460	209.8	13.29	356.4	24.30	21.22	2614	653.6	27.78	17.24
2000	0.41316	1460	210.3	13.32	356.4	24.31	19.31	2614	653.7	27.78	15.68
2001	0.46651	1460	210.8	13.36	356.5	24.32	17.57	2615	653.8	27.78	14.26
2002	0.52410	1460	211.4	13.39	356.7	24.33	15.99	2615	653.9	27.79	12.96
2003	0.58554	1460	211.9	13.42	356.8	24.33	14.56	2616	654.0	27.79	11.79
2004	0.65049	1460	212.4	13.45	356.9	24.34	13.25	2616	654.1	27.80	10.72
2005	0.71863	1460	212.9	13.49	357.0	24.35	12.06	2616	654.1	27.80	9.74
2006	0.78966	1460	213.4	13.52	357.1	24.35	10.97	2616	654.1	27.80	8.86
2007	0.86333	1460	213.8	13.54	357.1	24.36	9.98	2617	654.2	27.80	8.05
2008	0.93939	1460	214.2	13.57	357.2	24.36	9.08	2617	654.2	27.80	7.32
2009	0.21763	1460	214.6	13.59	357.3	24.36	8.26	2617	654.3	27.81	6.66
2010	0.19784	1460	214.6	13.59	357.3	24.36	7.51	2617	654.3	27.81	6.05
2042	0.00937	1460	214.6	13.59	357.3	24.36	0.36	2617	654.3	27.81	0.29
2043	0.00852	1460	214.6	13.59	357.3	24.36	0.32	2617	654.3	27.81	0.26
SUMMARY	9.91481	1460	213.5	13.52	357.0	24.35	373.63	2616	654.1	27.80	302.194

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.W.L. (M)	E.HEAD (M)	H.HEAD (M)	LOSS (M)	EATA (M)	PEAK POWER (MW)	GENERATION Q. (CMS)	Q. (CMS)	POWER (MW)	ANNUAL ENERGY (GWH)	ANNUAL E.B. (M.D.)	OPERATION HOUR (H)	ENERGY (M)	OPERATION COST (M.D.)	PRESENT WORTH (M.D.)
1994	257.51	161.12	89.32	7.08	0.86	243.5	324.44	1460	355.5	2610	652.6	24.24	2610	652.6	27.74	27.74
1995	257.51	160.63	89.85	7.04	0.86	244.1	323.42	1460	356.4	2614	653.6	24.25	2611	652.8	27.74	25.22
2000	257.51	160.31	90.20	7.01	0.86	244.5	322.69	1460	357.0	2616	654.1	24.28	2612	653.1	27.75	22.93
2009	257.51	160.15	90.38	6.99	0.86	244.7	322.31	1460	357.3	2617	654.3	24.30	2613	653.2	27.76	20.85
2010	257.51	160.15	90.38	6.99	0.86	244.7	322.31	1460	357.3	2617	654.3	24.31	2614	653.4	27.77	18.96
2042	257.51	160.15	90.38	6.99	0.86	244.7	322.31	1460	357.3	2617	654.3	24.36	2615	653.7	27.78	14.26
2043	257.51	160.15	90.38	6.99	0.86	244.7	322.31	1460	357.3	2617	654.3	24.36	2615	653.8	27.78	12.96
SUMMARY	9.91481	1460	213.5	13.52	357.0	24.35	373.63	2616	654.1	27.80	302.194					

\*\* OPERATION STUDY OF KALWA P/T \*\* (W.S. AND P.I.G. BY EXCESS WATER)

\*\* CASE 7 \*\* PH = 250 MW , MAX. T.W.L. = 155.000 M , DIA. OF H.R. TUNNEL = 7.6 M  
 OR = 311.36 CMS , RH = 95.270 M , ALPHA = 0.0000746

KWH VALUE IN US D KWH COST IN US D  
 (POWER GENERATION) (PUMP OPERATION)  
 TIME 0. 1950. 2550. TIME 0.  
 KWH V. 0.0682 0.0425 0.0234 0.0425

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F. (M)	OPERATION HOUR (H)	ENERGY GENERATED (GWH)	ANNUAL BENEFIT (M US D)	PRESENT BENEFIT (M US D)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M US D)	PRESENT COST (M US D)
1994	0.9909	91.	22.8	1.56	1.42	68.	17.1	0.73	0.73
1995	0.8245	82.	20.6	1.40	1.16	249.	62.2	2.64	2.40
1996	0.7513	73.	18.3	1.25	0.94	429.	107.2	4.56	3.77
1997	0.6801	64.	16.0	1.09	0.75	609.	156.3	6.47	4.86
1998	0.6202	55.	13.8	0.94	0.58	790.	197.4	8.39	5.73
1999	0.5647	46.	11.5	0.78	0.44	970.	242.5	10.31	6.40
2000	0.5136	37.	9.2	0.63	0.32	1150.	287.6	12.22	6.90
2001	0.4651	28.	6.8	0.49	0.27	1249.	312.2	13.27	6.81
2002	0.4210	20.	4.3	0.34	0.23	1348.	336.9	14.32	6.68
2003	0.3854	12.	2.7	0.20	0.19	1446.	361.6	15.37	6.52
2004	0.3509	7.	1.6	0.16	0.16	1545.	386.2	16.42	6.33
2005	0.3163	4.	0.9	0.11	0.13	1644.	410.9	17.46	6.12
2006	0.2866	2.	0.5	0.09	0.11	1741.	427.6	18.17	5.79
2007	0.2633	1.	0.3	0.07	0.10	1844.	444.4	18.89	5.47
2008	0.2399	0.	0.2	0.05	0.08	1941.	461.1	19.60	5.16
2009	0.2173	0.	0.1	0.03	0.07	1911.	477.8	20.31	4.84
2010	0.1978	0.	0.1	0.03	0.07	1941.	477.8	20.31	4.42
2042	0.00937	20.	4.9	0.33	0.00	1911.	477.8	20.31	0.21
2043	0.00952	20.	4.9	0.33	0.00	1911.	477.8	20.31	0.19
SUMMARY	9.91481	27.	6.7	0.46	7.67	1674.	416.6	17.79	131.24

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.W.L. (M)	E. HEAD (M)	H. LOSS (M)	DATA POWER (MW)	Q (CMS)	O. HOUR (H)	ENERGY (GWH)	D. HOUR (H)	ENERGY (GWH)	N. HEAD (M)	G. HEAD (M)	W.S. (CMS)		
1994	257.51	151.30	108.47	5.58	0.86	250.0	269.23	91.	22.8	68.	17.1	105.36	107.45	166.54	1.46
2000	257.51	150.62	108.83	5.54	0.86	250.0	266.93	37.	9.2	1150.	287.6	106.46	108.51	164.98	23.50
2005	257.51	150.33	109.44	5.48	0.86	250.0	266.09	24.	6.1	1844.	410.9	106.93	108.96	164.88	33.07
2009	257.51	150.17	109.42	5.48	0.86	250.0	265.94	20.	4.9	1911.	477.8	107.15	109.17	164.06	38.17

\*\* OPERATION STUDY OF KALIWA P/T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)

\*\* CASE 7 \*\* PR = 250 MW ; MAX.T.M.L. = 155,000 M ; DIA. OF H.P. TUNNEL = 7.6 M  
 GR = 311.36 CHS ; RH = 95,270 M ; ALPHA = 0.0000746

KW KWH VALUE IN US D (PUMP OPERATION) KWH COST IN US D  
 (POWER GENERATION) (PUMP OPERATION)  
 TIME 1950, 2550, TIME 0, 0.0435  
 0, 0.0682 0, 0.0425 0.0234  
 KW V, 63.35 111.76 160.25  
 KW V, 63.35

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F. (M)	OPERATION HOUR (H)	95% POWER (MW)	ANNUAL P.B. (M.D.)	POWER GENERATION ENERGY (GWH)	ANNUAL WORTH (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR (H)	PUMP ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1994	0.90909	1460	207.9	13.17	355.8	24.27	34.03	2563	640.7	27.23	27.23
1995	0.82645	1460	208.4	13.20	356.0	24.28	30.97	2584	640.9	27.24	24.76
1996	0.75131	1460	208.8	13.23	356.2	24.29	28.19	2564	641.1	27.25	22.52
1997	0.68301	1460	209.3	13.26	356.4	24.30	25.66	2595	641.3	27.25	20.48
1998	0.62092	1460	209.8	13.29	356.6	24.32	23.35	2566	641.5	27.25	18.62
1999	0.56447	1460	209.2	13.32	356.7	24.33	21.25	2507	641.7	27.27	16.93
2000	0.51316	1460	210.7	13.35	356.9	24.34	19.34	2508	641.9	27.28	15.40
2001	0.46651	1460	211.2	13.38	357.0	24.35	17.60	2568	642.0	27.28	14.00
2002	0.42430	1460	211.6	13.41	357.1	24.35	16.01	2568	642.1	27.29	12.73
2003	0.38554	1460	212.1	13.44	357.2	24.36	14.57	2599	642.2	27.29	11.57
2004	0.35049	1460	212.6	13.47	357.3	24.37	13.26	2599	642.3	27.30	10.52
2005	0.31863	1460	213.0	13.50	357.4	24.37	12.07	2599	642.4	27.30	9.57
2006	0.28966	1460	213.6	13.53	357.4	24.38	10.98	2570	642.5	27.31	8.70
2007	0.26333	1460	214.1	13.56	357.5	24.38	9.99	2570	642.5	27.31	7.91
2008	0.23939	1460	214.6	13.60	357.5	24.39	9.09	2570	642.5	27.31	7.19
2009	0.21763	1460	215.2	13.63	357.6	24.39	8.27	2570	642.6	27.31	6.54
2010	0.19778	1460	215.2	13.63	357.6	24.39	7.52	2570	642.6	27.31	5.94
2042	0.00937	1460	215.2	13.63	357.6	24.39	0.36	2570	642.6	27.31	0.38
2043	0.00892	1460	215.2	13.63	357.6	24.39	0.32	2570	642.6	27.31	0.26
SUMMARY	9.91481	1460	214.0	13.56	357.4	24.37	374.15	2569	642.4	27.30	297.50

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	P.W.F. (M)	H.P. HEAD (M)	T.M.L. (M)	E.HEAD (M)	HILLOSS (M)	EAATA (M)	POWER (MW)	GENERATION ENERGY (GWH)	ANNUAL WORTH (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR (H)	PUMP ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1994	257.51	151.30	99.94	6.28	0.86	243.7	289.99	1460	355.8	2563	640.7	106.22	108.28	135.21
2000	257.51	150.62	100.66	6.23	0.86	244.5	288.84	1460	356.9	2568	641.9	106.90	108.93	134.24
2005	257.51	150.33	100.98	6.21	0.86	244.6	288.32	1460	357.4	2599	642.4	107.19	109.31	133.82
2009	257.51	150.17	101.15	6.20	0.86	244.9	288.03	1460	357.6	2570	642.6	107.35	109.37	133.60

\*\* OPERATION STUDY OF KALLWA P/T \*\* (M.S. AND P.G. BY EXCESS WATER)  
 \*\* CASE 6 \*\* PR = 250 MM , MAX. T.M.L. = 145,000 M , DIA. OF H.R. TUNNEL = 7.6 M  
 OR = 281.70 CHS , RH = 105,300 M , ALPHA = 0.0000907

KWH VALUE IN US D (POWER GENERATION) TIME COST  
 0. 1950. 2550. 0. 0.425 0.0234 0. 0.425  
 KWH COST IN US D (PUMP OPERATION)  
 0.0682 0.0425 0.0234

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F. (M)	OPERATION HOUR (H)	ENERGY GENERATED (GWH)	ANNUAL BENEFIT (M US D)	PRESENT WORTH (M US D)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M US D)	PRESENT WORTH (M US D)
1994	0.9090	100	24.9	1.70	1.54	74	18.6	0.79	0.79
1995	0.8264	90	22.4	1.53	1.26	272	67.9	2.89	2.62
1996	0.7513	80	20.0	1.36	1.02	469	117.2	4.98	4.12
1997	0.6830	70	17.5	1.19	0.81	668	166.5	7.08	5.32
1998	0.6202	60	15.0	1.02	0.64	863	213.8	9.17	6.26
1999	0.5647	50	12.5	0.86	0.48	1061	265.1	11.27	7.00
2000	0.5136	40	10.1	0.69	0.35	1258	314.4	13.36	7.54
2001	0.4665	37	9.4	0.64	0.30	1366	341.4	14.51	7.45
2002	0.4240	35	8.7	0.59	0.25	1479	368.4	15.66	7.30
2003	0.3855	32	8.0	0.54	0.21	1581	395.3	16.80	7.13
2004	0.3509	29	7.3	0.50	0.17	1689	422.3	17.95	6.92
2005	0.3186	26	6.6	0.45	0.14	1797	449.3	19.09	6.69
2006	0.2896	25	6.3	0.43	0.12	1870	467.4	19.87	6.33
2007	0.2633	24	6.0	0.41	0.11	1942	485.6	20.64	5.98
2008	0.2399	23	5.6	0.39	0.09	2015	503.8	21.41	5.64
2009	0.2176	21	5.3	0.36	0.08	2088	521.9	22.18	5.31
2010	0.1978	21	5.3	0.36	0.07	2088	521.9	22.18	4.83
2042	0.00937	21	5.3	0.36	0.00	2088	521.9	22.18	0.23
2043	0.00852	21	5.3	0.36	0.00	2088	521.9	22.18	0.21
SUMMARY	9.91481	29	71.3	0.50	0.36	1929	457.3	19.44	143.42

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.M.L. (M)	E. HEAD (M)	H. LOSS (M)	DATA (M)	POWER (MW)	EXCESS WATER (G)	OPERATION HOUR (H)	ENERGY G. (GWH)	ENERGY C. (GWH)	NET HEAD (M)	W.S. (CHS)	
1994	257.51	141.77	119.33	5.70	0.86	250.0	246.87	100	24.9	74	18.6	114.84	152.94
2000	257.51	140.35	118.70	5.67	0.86	250.0	244.84	40	10.1	1258	314.4	116.55	150.88
2005	257.51	140.22	119.30	5.61	0.86	250.0	244.10	26	6.6	1797	449.3	117.04	150.34
2009	257.51	140.15	119.28	5.61	0.86	250.0	243.96	21	5.3	2088	521.9	117.17	150.19
2010	257.51	140.15	119.28	5.61	0.86	250.0	243.96	21	5.3	2088	521.9	117.17	150.19

\*\* OPERATION STUDY OF KALIWA P/T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)

\*\* CASE 8 \*\* PR = 250 MH , MAX. T.W.L. = 145,000 M , DIA. OF H.R. TUNNEL = 7.6 M  
 GR = 281,70 CMS , RM = 105,300 M , ALPHA = 0,0000907

KW KWH VALUE IN US D (PUMP OPERATION) KWH COST IN US D  
 TIME O. 0,0682 2550, 0,0425 0,0254 TIME O. 0,0425  
 KWH V. 63,35 111,76 160,125 COST

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F.	OPERATION HOUR	95% POWER (MW)	ANNUAL ENERGY GENERATED (GWH)	ANNUAL WORTH (M.D.)	OPERATION HOUR	PUMP ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1984	0,90909	1460	206,6	3551,3	33,94	2544	636,1	27,03	27,03
1985	0,82645	1460	208,0	3551,3	30,93	2546	636,5	27,05	24,37
1986	0,75331	1460	209,1	3561,0	28,20	2548	637,4	27,07	20,55
1987	0,68301	1460	210,3	3561,0	24,30	2549	637,8	27,11	18,51
1988	0,62082	1460	211,5	3561,7	21,33	2551	638,2	27,12	16,84
1989	0,56447	1460	212,6	3571,4	18,46	2553	638,7	27,14	15,32
1990	0,51356	1460	213,8	3571,4	16,09	2555	638,7	27,15	13,93
2000	0,46551	1460	214,1	3571,5	14,64	2555	638,8	27,15	12,64
2002	0,42410	1460	214,3	3571,6	13,31	2555	638,8	27,15	11,47
2003	0,38554	1460	214,5	3571,7	12,11	2556	638,9	27,15	10,42
2004	0,35049	1460	214,6	3571,7	11,01	2556	638,9	27,15	9,45
2005	0,31863	1460	214,7	3571,7	10,01	2556	638,9	27,15	8,55
2006	0,28966	1460	214,8	3571,7	9,10	2556	638,9	27,15	7,75
2007	0,26333	1460	214,9	3571,7	8,27	2556	638,8	27,15	7,05
2008	0,23939	1460	215,0	3571,7	7,52	2555	638,8	27,15	6,50
2009	0,21764	1460	215,0	3571,7	6,86	2555	638,8	27,15	6,01
2010	0,19764	1460	215,0	3571,7	6,30	2555	638,8	27,15	5,59
2042	0,00937	1460	215,0	357,7	0,36	2555	638,8	27,15	0,28
2043	0,00852	1460	215,0	357,7	0,32	2555	638,8	27,15	0,25
SUMMARY	9,91481	1460	214,3	357,5	24,36	374,73	638,6	27,14	295,74

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.W.L. (M)	HEAD LOSS (M)	PEAK POWER (MW)	ANNUAL ENERGY (GWH)	ANNUAL WORTH (M.D.)	OPERATION HOUR	PUMP ENERGY (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)				
1994	257,51	141,77	109,40	6,35	0,86	243,4	264,40	1460	355,3	2544	636,1	115,75	117,86	151,72
2000	257,51	140,55	110,49	6,28	0,86	244,8	262,90	1460	357,4	2555	638,9	116,97	118,04	150,25
2005	257,51	140,22	111,04	6,25	0,86	245,0	262,34	1460	357,7	2556	638,9	117,30	119,35	149,67
2009	257,51	140,15	111,12	6,24	0,86	245,0	262,15	1460	357,7	2555	638,8	117,37	119,42	149,18

\*\* OPERATION STUDY OF KALIMA P/T \*\* (H.S. AND P.C. BY EXCESS WATER)

\*\* CASE 9 \*\* PR = 250 MM ; MAX. T.W.L. = 165.000 M ; DIA. OF H.R. TUNNEL = 6.15 M  
 OR = 442.93 CMS ; RH = 66,970 M ; ALPHA = 0.0001302

KWH VALUE IN US D KWH COST IN US D

(POWER GENERATION) (PUMP OPERATION)

TIME 0, 0.0682 0.0425 2550, 0.0234 TIME 0, 0.0425  
 KWH V. 0.0682 0.0425 0.0234 COST 0, 0.0425

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	POWER GENERATION				PUMP OPERATION			
	OPERATION HOUR (H)	ENERGY GENERATED (GWH)	ANNUAL BENEFIT (M US.D)	PRESENT WORTH (M US.D)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M US.D)	PRESENT WORTH (M US.D)
1994	76	19.0	1.29	1.18	65	1519	0.67	0.67
1995	68	17.1	1.17	0.96	231	5717	2.45	2.45
1996	61	15.2	1.04	0.78	398	99.4	4.23	3.19
1997	53	13.3	0.91	0.62	565	141.2	6.00	4.51
1998	46	11.4	0.78	0.48	732	183.0	7.78	5.31
1999	38	9.6	0.65	0.37	899	224.8	9.56	5.93
2000	31	7.7	0.52	0.27	1067	266.6	11.33	6.40
2001	29	7.2	0.49	0.23	1158	285.5	12.31	6.15
2002	27	6.6	0.45	0.19	1250	312.4	13.28	6.19
2003	24	6.1	0.42	0.16	1341	335.3	14.25	6.19
2004	22	5.6	0.38	0.13	1433	358.2	15.22	5.97
2005	20	5.0	0.34	0.11	1524	381.1	16.20	5.68
2006	19	4.8	0.33	0.09	1587	396.6	16.86	5.37
2007	18	4.6	0.31	0.08	1649	412.1	17.52	5.07
2008	17	4.3	0.29	0.07	1711	427.7	18.18	4.79
2009	16	4.1	0.28	0.06	1773	443.2	18.84	4.51
2010	16	4.1	0.28	0.06	1773	443.2	18.84	4.51
2042	16	4.1	0.28	0.00	1773	443.2	18.84	0.19
2043	16	4.1	0.28	0.00	1773	443.2	18.84	0.16
SUMMARY	22	5.6	0.38	0.37	1553	388.3	16.50	121.71

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	POWER GENERATION BY EXCESS WATER				PUMP OPERATION FOR WATER SUPPLY					
	E. HEAD (M)	LOSS (M)	DATA (M)	POWER (MW)	0 HOUR ENERGY (H)	0 HOUR ENERGY (GWH)	N. HEAD (M)	G. HEAD (M)	W.S. (CMS)	
1994	257.51	161.12	89.85	14.23	0.96	250.0	324.14	76	19.0	95.56
2000	257.51	160.93	90.33	14.05	0.86	250.0	320.0	31	7.7	106.7
2005	257.51	160.31	91.14	13.75	0.86	250.0	319.52	20	5.0	132.4
2009	257.51	160.15	91.13	13.80	0.86	250.0	319.31	16	4.1	177.3
2042	257.51	160.15	91.13	13.80	0.86	250.0	319.31	16	4.1	177.3
2043	257.51	160.15	91.13	13.80	0.86	250.0	319.31	16	4.1	177.3
SUMMARY	22	5.6	0.38	0.37	1553	388.3	16.50	121.71	443.2	97.17

\*\* OPERATION STUDY OF KALINA P/T \*\* IPEAK POWER GENERATION T = 4 HOUR/DAY)  
 \*\* CASE 9 \*\* PR = 250 MH, MAX.T.H.L. = 165,000 M, DIA. OF H.R. TUNNEL = 615 M  
 GR = 442.95 CMS, RH = 66,970 M, ALPHA = 0.0001302

KW KWH VALUE IN US D KWH COST IN US D  
 {POWER GENERATION} (PUMP OPERATION)  
 TIME 0, 0.0482 1950, 2550, TIME 0, 0.0435  
 KWH V, 0.0482 0.0425 0.0234 COST 160.25  
 KW V, 68.35 111.76

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F. (M)	OPERATION HOUR (H)	95% ANNUAL POWER (MW)	ANNUAL P.B. (M.D.)	ANNUAL GENERATION (GWH)	ANNUAL E.B. (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1994	0.91009	1460	207.5	13.14	355.4	24.24	33.99	3078	769.4	32.70	33.99
1995	0.82645	1460	207.9	13.17	355.6	24.25	30.93	3076	769.1	32.67	30.93
1996	0.75131	1460	208.4	13.20	355.8	24.26	28.15	3075	768.8	32.66	28.15
1997	0.68301	1460	208.9	13.23	355.9	24.27	25.31	3074	768.5	32.65	25.31
1998	0.62092	1460	209.3	13.26	356.1	24.28	22.63	3073	768.2	32.63	22.63
1999	0.56447	1460	209.8	13.29	356.3	24.30	20.12	3071	767.9	32.62	20.12
2000	0.51316	1460	210.3	13.32	356.4	24.31	17.81	3070	767.6	32.61	17.81
2001	0.46651	1460	210.8	13.35	356.5	24.32	15.77	3069	767.3	32.60	15.77
2002	0.42410	1460	211.3	13.39	356.6	24.33	13.99	3068	767.1	32.59	13.99
2003	0.38554	1460	211.9	13.42	356.8	24.34	12.45	3067	766.8	32.58	12.45
2004	0.35049	1460	212.4	13.45	356.9	24.35	11.12	3066	766.6	32.57	11.12
2005	0.31863	1460	212.9	13.49	357.0	24.36	10.07	3065	766.4	32.56	10.07
2006	0.28966	1460	213.3	13.51	357.1	24.36	9.18	3064	766.1	32.55	9.18
2007	0.26333	1460	213.7	13.54	357.1	24.36	8.48	3063	765.8	32.54	8.48
2008	0.23939	1460	214.1	13.57	357.2	24.36	7.96	3062	765.6	32.54	7.96
2009	0.21763	1460	214.6	13.59	357.2	24.36	7.51	3062	765.6	32.54	7.51
2010	0.19784	1460	214.6	13.59	357.2	24.36	7.14	3062	765.6	32.54	7.14
2042	0.00937	1460	214.6	13.59	357.2	24.36	0.36	3062	765.6	32.54	0.36
2043	0.00952	1460	214.6	13.59	357.2	24.36	0.32	3062	765.6	32.54	0.32
SUMMARY	9.91481	1460	213.4	13.52	357.0	24.35	373.60	3065	766.1	32.56	355.68

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.H.L. (M)	T.M.H.L. (M)	E. HEAD (M)	LOSS (M)	EATA (M)	PEAK POWER (MW)	GENERATION (GWH)	ANNUAL COST (M.D.)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1994	257.51	161.12	77.77	18.64	0.86	243.5	378.40	1460	355.4	3078	769.4	33.99
2000	257.51	160.63	78.50	18.59	0.86	244.1	373.84	1460	356.4	3070	767.6	30.93
2005	257.51	160.34	78.98	18.23	0.86	244.5	372.16	1460	357.0	3065	766.4	10.07
2009	257.51	160.15	79.22	18.14	0.86	244.7	371.29	1460	357.2	3062	765.6	7.51
SUMMARY	9.91481	160.15	79.22	18.14	0.86	244.7	371.29	1460	357.2	3062	765.6	7.51



\*\* OPERATION STUDY OF KALIIHA P/T \*\* (W.S. AND P.G. BY EXCESS WATER)

\*\*\* CASE 10 \*\* PR = 250 MM , MAX.T.W.L. = 155,000 M , DIA. OF H.R. TUNNEL = 6.5 M  
 GR = 350.67 CMS , RH = 84,590 M , ALPHA = 0.0001497

KW KWH VALUE IN US D (PUMP OPERATION)  
 KWH V. (POWER GENERATION)

TIME 0. 1950. 2550. 0.0234 TIME 0. 0.0425  
 KWH V. 0.00682 0.0425 0.0234 COST 0. 0.0425

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F. (M)	POWER GENERATION			PUMP OPERATION			PRESENT WORTH (M US D)
		OPERATION HOUR (H)	ENERGY GENERATED (GMH)	ANNUAL BENEFIT (M US D)	OPERATION HOUR (H)	ENERGY CONSUMED (GMH)	ANNUAL COST (M US D)	
1994	0.90909	86.	21.4	1.46	1.33	69.	17.4	0.74
1995	0.82645	77.	19.3	1.32	1.09	253.	83.2	2.69
1996	0.75331	69.	17.2	1.17	0.88	436.	109.1	4.63
1997	0.68301	60.	15.1	1.03	0.70	620.	154.9	6.58
1998	0.62092	52.	12.9	0.88	0.55	803.	200.7	8.53
1999	0.56447	43.	10.8	0.74	0.42	986.	248.6	10.46
2000	0.51316	35.	8.7	0.59	0.30	1170.	292.4	12.43
2001	0.46651	25.	6.1	0.43	0.26	1270.	317.5	13.49
2002	0.42410	30.	7.5	0.51	0.22	1370.	342.5	14.56
2003	0.38554	28.	6.9	0.47	0.18	1470.	367.6	15.62
2004	0.35049	25.	6.3	0.43	0.15	1571.	392.7	16.69
2005	0.31863	23.	5.7	0.39	0.12	1673.	417.7	17.75
2006	0.28966	22.	5.4	0.37	0.11	1733.	434.7	18.48
2007	0.26333	21.	5.1	0.35	0.09	1807.	451.7	19.20
2008	0.23939	19.	4.9	0.33	0.08	1875.	468.7	19.92
2009	0.21763	18.	4.6	0.31	0.07	1943.	485.7	20.64
2010	0.19784	18.	4.6	0.31	0.06	1943.	485.7	20.64
2042	0.00937	18.	4.6	0.31	0.00	1943.	485.7	20.64
2043	0.00852	18.	4.6	0.31	0.00	1943.	485.7	20.64
SUMMARY	9,91481	25.	6.3	0.43	7.19	1702.	425.6	18.09
								133.43

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.W.L. (M)	POWER GENERATION BY EXCESS WATER			PUMP OPERATION FOR WATER SUPPLY									
			EHEAD (M)	H.L.OSS (M)	EATA (M)	POWER (MW)	0 HOUR ENERGY (GMH)	0 HOUR ENERGY (GMH)	N HEAD (M)						
1994	257.51	151.30	103.62	12.43	0.86	250.0	287.01	86.	21.4	69.	17.4	105.36	109.30	163.69	1.46
2000	257.51	150.62	102.06	12.32	0.86	250.0	284.28	35.	8.7	1170.	292.4	106.46	110.33	142.24	23.50
2005	257.51	150.33	102.76	12.14	0.86	250.0	283.33	23.	5.7	1671.	417.7	106.93	110.77	161.68	33.07
2009	257.51	150.17	102.76	12.14	0.86	250.0	283.15	18.	4.6	1943.	485.7	107.15	110.97	161.39	38.17

\*\* OPERATION STUDY OF KALINA P/T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)  
 \*\* CASE 10 \*\* PR = 250 MM ; MAX. T.M.H. = 159,000 M ; DIA. OF H.R. TUNNEL = 6.5 M  
 CR = 350.67 CHS ; RM = 84,590 M ; ALPHA = 0.0001457

KWH VALUE IN US D (PUMP OPERATION) KWH COST IN US D  
 (POWER GENERATION) TIME COST (PUMP OPERATION)  
 0. 0.0682 1950. 0.0425 0.0234 0. 0.0492  
 KWH V. 63.35 111.76 160.25

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.M.F.	OPERATION HOUR (H)	POWER (MW)	ANNUAL P.B. (M.D.)	GENERATION ENERGY (GWH)	ANNUAL E.B. (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR (H)	PUMP ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)
1994	0.90909	1460	207.9	15,17	355.8	24,27	34.03	2853	713.1	30,31	30,31
1995	0.82645	1460	208.3	15,20	326.0	24,28	30,97	2852	713.1	30,31	27,15
1996	0.75131	1460	208.8	15,23	356.2	24,29	28,19	2852	713.0	30,30	25,04
1997	0.68801	1460	209.3	15,26	356.4	24,30	23,65	2852	713.0	30,30	22,77
1998	0.62092	1460	209.7	15,29	356.5	24,32	24,35	2852	712.9	30,30	20,69
1999	0.56447	1460	210.2	15,32	356.7	24,33	21,25	2851	712.9	30,30	18,81
2000	0.51336	1460	210.7	15,35	356.9	24,34	19,34	2851	712.8	30,29	17,10
2001	0.46851	1460	211.2	15,38	357.0	24,35	17,60	2851	712.7	30,29	15,55
2002	0.42410	1460	211.6	15,41	357.1	24,35	16,01	2851	712.7	30,29	14,13
2003	0.38554	1460	212.1	15,44	357.2	24,36	14,57	2851	712.7	30,29	12,82
2004	0.35049	1460	212.6	15,47	357.3	24,37	13,26	2851	712.7	30,29	11,62
2005	0.31863	1460	213.0	15,50	357.4	24,38	12,07	2851	712.6	30,29	10,52
2006	0.28966	1460	213.6	15,53	357.4	24,38	10,98	2850	712.6	30,28	9,65
2007	0.26339	1460	214.1	15,56	357.5	24,38	9,99	2850	712.6	30,28	8,77
2008	0.23939	1460	214.6	15,60	357.6	24,38	9,09	2850	712.5	30,28	7,97
2009	0.21783	1460	215.1	15,63	357.6	24,39	8,27	2850	712.5	30,28	7,25
2010	0.19784	1460	215.1	15,65	357.6	24,39	7,52	2850	712.5	30,28	6,59
2042	0.00937	1460	215.1	13,63	357.6	24,39	0,36	2850	712.5	30,28	0,31
2043	0.00852	1460	215.1	13,63	357.6	24,39	0,32	2850	712.5	30,28	0,28
SUMMARY	9,91451	1460	214.0	13,55	357.4	24,37	374,13	2850	712.6	30,29	330,40

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.H.L. (M)	T.M.H. (M)	E.HEAD LOSS (M)	ETA (%)	PEAK POWER (MW)	Q (CMS)	Q HOUR ENERGY (GWH)	Q HOUR ENERGY N.HEAD (M)	Q HOUR ENERGY G.HEAD (M)	Q HOUR ENERGY (M)	Q HOUR ENERGY (CMS)
1994	257.51	151.30	91.45	14.77	0.86	243.7	317.78	1460	355.8	2853	713.1
1995	257.51	150.62	92.30	14.59	0.86	244.5	315.86	1460	356.9	2851	712.8
2000	257.51	150.33	92.67	14.52	0.86	244.8	315.03	1460	357.4	2851	712.8
2009	257.51	150.17	92.87	14.48	0.86	244.9	314.56	1460	357.6	2850	712.5
2042	257.51	150.17	92.87	14.48	0.86	244.9	314.56	1460	357.6	2850	712.5
2043	257.51	150.17	92.87	14.48	0.86	244.9	314.56	1460	357.6	2850	712.5
SUMMARY	9,91451	150.17	92.87	14.48	0.86	244.9	314.56	1460	357.6	2850	712.5

\*\* OPERATION STUDY OF KALINA P/T \*\* (W.S. AND P.G. BY EXCESS WATER)  
 \*\* CASE 11 \*\* PR = 250 MM ; MAX.T.W.L. = 145.000 M ; DIA. OF H.R. TUNNEL = 815 M  
 OR = 333.23 CMS ; RM = 94.700 M ; ALPHA = 0.001815

KWH V. KWH COST IN US \$  
 (POWER GENERATION) (PUMP OPERATION)  
 TIME 0. 0.0682 0.0425 2550. 0. 0.0425  
 KWH V. 0.0682 0.0425 0.0234 COST 0. 0.0425

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F.	POWER GENERATION				PUMP OPERATION			
		OPERATION HOUR (H)	ENERGY GENERATED (GWH)	ANNUAL BENEFIT (M US \$)	PRESENT WORTH (M US \$)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M US \$)	PRESENT WORTH (M US \$)
1994	0.90909	94	23.4	1.60	1.45	76	18.9	0.80	0.80
1995	0.82645	84	21.1	1.44	1.19	274	69.0	2.93	2.67
1996	0.75131	75	18.8	1.28	0.96	477	119.1	5.06	4.18
1997	0.68301	66	16.4	1.12	0.77	677	169.3	7.19	5.40
1998	0.62092	56	14.1	0.96	0.60	874	219.4	9.32	6.57
1999	0.56447	47	11.6	0.80	0.45	1078	269.5	11.45	7.11
2000	0.51316	38	9.5	0.65	0.35	1278	319.6	13.58	7.67
2001	0.46651	35	8.8	0.60	0.28	1388	347.0	14.75	7.57
2002	0.42410	32	8.2	0.56	0.24	1498	374.4	15.91	7.42
2003	0.38554	30	7.5	0.51	0.20	1607	401.8	17.08	7.24
2004	0.35049	27	6.9	0.47	0.16	1717	429.2	18.24	7.03
2005	0.31863	25	6.2	0.42	0.13	1826	456.6	19.41	6.80
2006	0.28956	24	5.9	0.40	0.12	1900	475.1	20.19	6.43
2007	0.26333	22	5.6	0.38	0.10	1974	493.5	20.97	6.08
2008	0.23939	21	5.3	0.36	0.09	2048	512.0	21.76	5.73
2009	0.21763	20	5.0	0.34	0.07	2122	530.4	22.54	5.40
2010	0.19784	20	2.0	0.34	0.07	2122	530.4	22.54	4.94
2042	0.00937	20	5.0	0.34	0.00	2122	530.4	22.54	0.23
2043	0.00852	20	5.0	0.34	0.00	2122	530.4	22.54	0.21
SUMMARY	9,91481	28	6.9	0.47	7.86	1859	464.8	19.75	145.77

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.W.L. (M)	POWER GENERATION BY EXCESS WATER				PUMP OPERATION FOR WATER SUPPLY								
			HEAD (M)	LOSS (M)	E.A.T.A. (M)	POWER (MW)	OPERATION HOUR (H)	ENERGY O.H. (GWH)	R.HEAD (M)	HEAD (M)	Q (CMS)	W.S. (CMS)			
1994	257.51	141.77	111.07	12.96	0.86	250.0	262.71	94	23.4	76	18.9	114.84	118.98	150.37	1.46
2000	257.51	140.55	111.51	12.85	0.86	250.0	260.33	38	9.5	1278	319.6	116.55	120.57	148.44	23.50
2005	257.51	140.22	112.22	12.68	0.86	250.0	259.49	25	6.2	1826	456.6	117.04	121.04	147.93	33.07
2009	257.51	140.15	112.20	12.69	0.86	250.0	259.34	20	5.0	2122	530.4	117.17	121.16	147.79	38.17

\*\* OPERATION STUDY OF KALINA P/T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)  
 \*\* CASE 11 \*\* PR = 250 MW, MAX. T.W.L. = 145,000 M, DIA. OF H.R. TUNNEL = 6.15 M  
 OR = 313.23 CMS, RH = 94,700 M, ALPHA = 0.0001915

KW KWH VALUE IN US D (POWER GENERATION)  
 TIME 0. 0.0682 1950. 0.0425 2550. 0.0234 0. 0.0425  
 KWH V. 63.35 113.76 160.25  
 KWH COST IN US D (PUMP OPERATION)  
 TIME 0. 0.0425  
 KWH V. 160.25

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.L. (M)	ANNUAL P.W. (MW)	ANNUAL ENERGY GENERATED (GWH)	ANNUAL E.B. (M.D.)	PRESENT WORTH (M.D.)	OPERATION HOUR (H)	PUMP ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)	
1994	0.90909	1460	206.8	13.10	355.3	24.23	33.94	2835	29.91	
1995	0.82645	1460	207.9	13.17	355.6	24.25	30.93	2835	27.19	
1996	0.75131	1460	209.1	13.25	356.0	24.28	28.19	2835	24.72	
1997	0.68301	1460	210.3	13.32	356.3	24.30	25.70	2835	22.18	
1998	0.62092	1460	211.4	13.39	356.7	24.33	23.42	2835	20.14	
1999	0.56447	1460	212.6	13.47	357.0	24.35	21.35	2835	18.58	
2000	0.51316	1460	213.8	13.54	357.4	24.37	19.46	2835	16.90	
2001	0.46651	1460	215.0	13.62	357.7	24.38	17.69	2835	15.36	
2002	0.42440	1460	216.3	13.68	357.9	24.38	16.09	2835	13.96	
2003	0.38554	1460	217.6	13.75	358.1	24.39	14.64	2835	12.69	
2004	0.35049	1460	219.0	13.81	358.2	24.40	13.31	2835	11.54	
2005	0.31863	1460	220.4	13.87	358.3	24.40	12.10	2835	10.49	
2006	0.28966	1460	221.8	13.92	358.4	24.40	11.01	2835	9.53	
2007	0.26333	1460	223.3	13.97	358.5	24.40	10.01	2835	8.66	
2008	0.23939	1460	224.8	14.01	358.6	24.40	9.10	2835	7.88	
2009	0.21763	1460	226.3	14.05	358.7	24.40	8.27	2835	7.16	
2010	0.19784	1460	227.8	14.09	358.7	24.40	7.52	2835	6.51	
2042	0.00937	1460	215.0	13.62	357.7	24.40	0.36	2815	0.31	
2045	0.00852	1460	215.0	13.62	357.7	24.40	0.32	2815	0.28	
SUMMARY	9,91481	1460	214.2	13.57	357.5	24.36	374.70	2815	29.91	326.26

YEAR	R.W.L. (M)	E.HEAD (M)	H.LOSS (M)	PEAK POWER (MW)	ANNUAL ENERGY (GWH)	ANNUAL E.B. (M.D.)	OPERATION HOUR (H)	PUMP ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)				
1994	257.51	141.77	100.66	15.09	0.86	243.4	287.92	1460	357.3	2815	703.7	115.75	119.83	149.35
2000	257.51	140.55	102.13	14.85	0.86	244.8	285.53	1460	357.4	2815	704.3	116.97	120.97	147.97
2005	257.51	140.22	103.54	14.76	0.86	245.0	284.68	1460	357.7	2815	703.9	117.50	121.28	147.61
2009	257.51	140.15	102.64	14.73	0.86	245.0	284.40	1460	357.7	2815	703.6	117.37	121.34	147.53

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.W.L. (M)	E.HEAD (M)	H.LOSS (M)	PEAK POWER (MW)	ANNUAL ENERGY (GWH)	ANNUAL E.B. (M.D.)	OPERATION HOUR (H)	PUMP ENERGY CONSUMED (GWH)	ANNUAL COST (M.D.)	PRESENT WORTH (M.D.)			
1994	257.51	141.77	100.66	15.09	0.86	243.4	287.92	1460	357.3	2815	703.7	115.75	119.83	149.35
2000	257.51	140.55	102.13	14.85	0.86	244.8	285.53	1460	357.4	2815	704.3	116.97	120.97	147.97
2005	257.51	140.22	103.54	14.76	0.86	245.0	284.68	1460	357.7	2815	703.9	117.50	121.28	147.61
2009	257.51	140.15	102.64	14.73	0.86	245.0	284.40	1460	357.7	2815	703.6	117.37	121.34	147.53
SUMMARY	9,91481	1460	214.2	13.57	357.5	24.36	374.70	2815	703.7	29.91	326.26			

OPERATION STUDY OF KALINA P.T. \*\* (W.S. AND P.G. BY EXCESS WATER)

\*\* CASE 12 \*\* PR = 180 MM ; MAX. T.M.L. = 175,000 M ; DIA. OF H.P. TUNNEL = 813 M  
 QR = 270.21 CMS ; RH = 79,040 M ; ALPHA = 0.0000473

KWH VALUE IN US D (PUMP OPERATION) KWH COST IN US D

TIME 0. 0.0682 1950. 2550. TIME 0. 0.025  
 COST 0.0425 0.0234

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.W.F.	POWER GENERATION			PUMP OPERATION			PRESENT WORTH (M US D)
		OPERATION HOUR (H)	ENERGY GENERATED (GWH)	ANNUAL BENEFIT (M US D)	OPERATION HOUR (H)	ENERGY CONSUMED (GWH)	ANNUAL COST (M US D)	
1994	0.90909	107.	19.3	1.32	77.	131.8	0.59	0.59
1995	0.82645	86.	17.4	1.16	279.	501.2	2.13	1.94
1996	0.75131	66.	15.5	1.05	481.	86.6	3.68	3.04
1997	0.68303	75.	18.5	0.92	681.	123.0	5.23	3.93
1998	0.62092	65.	11.6	0.79	899.	153.4	4.74	4.63
1999	0.56447	54.	9.7	0.66	1088.	195.9	8.32	5.17
2000	0.51316	43.	7.8	0.53	1290.	232.5	9.87	5.50
2001	0.46651	40.	7.3	0.50	1401.	252.2	10.72	5.27
2002	0.42410	37.	6.7	0.46	1521.	272.2	11.57	5.11
2003	0.38554	34.	6.2	0.42	1623.	292.2	12.42	4.95
2004	0.35049	31.	5.7	0.39	1734.	312.2	13.27	4.78
2005	0.31863	28.	5.1	0.35	1845.	332.1	14.12	4.62
2006	0.28966	27.	4.6	0.33	1921.	345.7	14.69	4.47
2007	0.26333	26.	4.4	0.32	1996.	359.3	15.27	4.32
2008	0.23939	24.	4.4	0.30	2072.	372.9	15.85	4.17
2009	0.21763	23.	4.1	0.28	2147.	386.5	16.42	3.93
2010	0.19784	23.	4.1	0.28	2147.	386.5	16.42	3.57
2042	0.00937	23.	4.1	0.28	2147.	386.5	16.42	0.17
2043	0.00852	23.	4.1	0.28	2147.	386.5	16.42	0.15
SUMMARY	9,91481	32.	5.7	0.39	1881.	388.5	14.39	106.08

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.W.L. (M)	POWER GENERATION BY EXCESS WATER			PUMP OPERATION FOR WATER SUPPLY								
			E. HEAD (M)	H. LOSS (M)	POWER (MW)	OPERATION HOUR (H)	ENERGY (GWH)	ANNUAL COST (M US D)	PRESENT WORTH (M US D)					
1994	257.51	171.03	91.52	2.58	0.86	180.0	229.84	107.	19.3	1.32	77.	131.8	0.59	0.59
2000	257.51	170.45	91.85	2.56	0.86	180.0	227.58	107.	19.3	1.32	77.	131.8	0.59	0.59
2005	257.51	170.17	92.43	2.52	0.86	180.0	226.83	28.	5.1	1845.	332.1	14.12	4.95	4.95
2009	257.51	169.99	92.43	2.52	0.86	180.0	226.69	23.	4.1	2147.	386.5	16.42	3.57	3.57

\*\* OPERATION STUDY OF KALINA P/T \*\* (PEAK POWER GENERATION T = 4 HOUR/DAY)

\*\* CASE 12 \*\* PR = 180 MW , MAX.T.M.L. = 175,000 M , DIA. OF H.R.TUNNEL = 8.3 M  
 OR = 270.21 CMS , RH = 79,040 M , ALPHA = 0.0000473

KW KWH VALUE IN US D KWH COST IN US D  
 (POWER GENERATION) (PUMP OPERATION)  
 TIME O. 1950, 2550, TIME D. 0.0425  
 KW V, 63.85 111.76 COST 0.0234  
 KW V, 63.85 160.25

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	OPERATION 95				POWER GENERATION				PUMP OPERATION				PRESENT WORTH		
	HOURLY	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL
P.M.F.	(M)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)
1994	0.70909	140.	145.3	9.21	255.5	17.2	24.21	247.1	44.7	18.90	18.90	18.90	18.90	18.90	18.90
1995	0.82645	140.	146.1	9.26	255.6	17.3	24.06	247.2	44.7	18.91	18.91	18.91	18.91	18.91	18.91
1996	0.75131	140.	146.9	9.30	255.8	17.4	24.09	247.3	44.7	18.92	18.92	18.92	18.92	18.92	18.92
1997	0.68301	140.	147.6	9.35	255.9	17.5	24.08	247.4	44.7	18.93	18.93	18.93	18.93	18.93	18.93
1998	0.62092	140.	148.4	9.40	256.1	17.6	24.08	247.5	44.7	18.94	18.94	18.94	18.94	18.94	18.94
1999	0.56447	140.	149.1	9.45	256.2	17.7	24.07	247.6	44.7	18.95	18.95	18.95	18.95	18.95	18.95
2000	0.51316	140.	149.9	9.50	256.3	17.8	24.06	247.7	44.7	18.96	18.96	18.96	18.96	18.96	18.96
2001	0.46651	140.	150.3	9.52	256.4	17.9	24.05	247.8	44.7	18.97	18.97	18.97	18.97	18.97	18.97
2002	0.42410	140.	150.7	9.54	256.5	18.0	24.04	247.9	44.7	18.98	18.98	18.98	18.98	18.98	18.98
2003	0.38554	140.	151.0	9.57	256.6	18.1	24.03	248.0	44.7	18.99	18.99	18.99	18.99	18.99	18.99
2004	0.35049	140.	151.4	9.59	256.7	18.2	24.02	248.1	44.7	19.00	19.00	19.00	19.00	19.00	19.00
2005	0.31863	140.	151.8	9.62	256.8	18.3	24.01	248.2	44.7	19.01	19.01	19.01	19.01	19.01	19.01
2006	0.28966	140.	152.0	9.65	256.9	18.4	24.00	248.3	44.7	19.02	19.02	19.02	19.02	19.02	19.02
2007	0.26333	140.	152.3	9.68	257.0	18.5	24.00	248.4	44.7	19.03	19.03	19.03	19.03	19.03	19.03
2008	0.23939	140.	152.7	9.71	257.1	18.6	24.00	248.5	44.7	19.04	19.04	19.04	19.04	19.04	19.04
2009	0.21763	140.	153.1	9.74	257.2	18.7	24.00	248.6	44.7	19.05	19.05	19.05	19.05	19.05	19.05
2010	0.19784	140.	153.7	9.77	257.3	18.8	24.00	248.7	44.7	19.06	19.06	19.06	19.06	19.06	19.06
2042	0.00937	140.	152.7	9.67	257.0	17.52	0.25	2482.	446.8	18.99	18.99	18.99	18.99	18.99	18.99
2043	0.00852	140.	152.7	9.67	257.0	17.52	0.23	2482.	446.8	18.99	18.99	18.99	18.99	18.99	18.99
SUMMARY	9,91481	1400.	151.8	9.62	256.8	17.51	267.34	2481.	446.5	18.98	18.98	18.98	18.98	18.98	18.98

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	PEAK POWER GENERATION				PUMP OPERATION									
	HOURLY	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL						
R.M.L.	(M)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)	(M.D.)						
1994	257.51	171.03	83.55	2.94	0.86	175.0	249.20	1460.	256.3	2478.	446.8	18.99	18.99	18.99
2000	257.51	170.45	84.15	2.92	0.86	175.6	248.32	1460.	256.3	2478.	446.8	18.99	18.99	18.99
2005	257.51	170.17	84.44	2.91	0.86	175.9	247.84	1460.	256.7	2481.	446.8	18.99	18.99	18.99
2009	257.51	169.99	84.63	2.90	0.86	176.0	247.51	1460.	257.0	2482.	446.8	18.99	18.99	18.99

\*\* OPERATION STUDY OF KALHA P/T \*\* (M.S. AND P.G. BY EXCESS WATER)  
 \*\* CASE 13 \*\* PR = 180 MH , MAX.T.H.L. = 165,000 M , DIA. OF H.P. TUNNEL = 8.3 M  
 OR = 238.50 CMS , RH = 89,550 M , ALPHA = 0.000517

KWH VALUE IN US D (POWER GENERATION) KWH COST IN US D (PUMP OPERATION)  
 TIME 0, 3950, 0.0682 2550, 0.0425 0, 0.0234 0, 0.0425  
 KWH V, 0.0682 0.0425

\*\*\*\*\* BENEFIT AND COST CALCULATION \*\*\*\*\*

YEAR	P.H.F. (M)	OPERATION HOUR (H)	POWER GENERATION ENERGY (GWH)	ANNUAL BENEFIT (M US D)	PRESENT BENEFIT (M US D)	OPERATION HOUR (H)	PUMP OPERATION ENERGY CONSUMED (GWH)	ANNUAL COST (M US D)	PRESENT COST (M US D)
1994	0.70909	119	21.4	1.46	1.33	85	15.3	0.65	0.65
1995	0.82645	107	19.3	1.32	1.09	310	55.8	2.37	2.15
1996	0.75131	95	17.2	1.17	0.86	535	96.2	4.09	3.38
1997	0.68301	84	15.1	1.03	0.70	759	136.7	5.81	4.36
1998	0.62092	72	12.9	0.88	0.55	984	177.1	7.53	5.14
1999	0.56447	60	10.6	0.74	0.42	1209	217.6	9.25	5.74
2000	0.51316	48	8.7	0.59	0.30	1533	258.0	10.96	6.19
2001	0.4651	45	8.1	0.55	0.26	1571	280.2	11.91	6.11
2002	0.4210	42	7.5	0.51	0.22	1680	302.4	12.85	5.99
2003	0.38554	38	6.9	0.47	0.18	1803	324.5	13.79	5.85
2004	0.35049	35	6.3	0.43	0.15	1926	346.7	14.74	5.68
2005	0.31863	32	5.7	0.39	0.12	2050	368.9	15.68	5.50
2006	0.28966	30	5.4	0.37	0.11	2133	381.0	16.32	5.20
2007	0.26333	29	5.1	0.35	0.09	2217	393.0	16.96	4.94
2008	0.23939	27	4.9	0.33	0.08	2300	414.0	17.60	4.63
2009	0.21763	25	4.6	0.31	0.07	2384	429.1	18.24	4.37
2010	0.19784	25	4.6	0.31	0.06	2384	429.1	18.24	4.07
2042	0.00937	25	4.6	0.31	0.00	2384	429.1	18.24	0.19
2043	0.00852	25	4.6	0.31	0.00	2384	429.1	18.24	0.17
SUMMARY	9.91481	35	6.3	0.43	7.19	2088	375.9	15.97	117.81

\*\*\*\*\* SUMMARY OF OPERATION STUDY \*\*\*\*\*

YEAR	R.W.L. (M)	T.W.L. (M)	E. HEAD (M)	H. LOSS (M)	DATA POWER (MW)	EXCESS WATER (GWH)	OPERATION HOUR (H)	ENERGY (GWH)	ANNUAL BENEFIT (M US D)	PRESENT BENEFIT (M US D)	OPERATION HOUR (H)	PUMP OPERATION ENERGY CONSUMED (GWH)	ANNUAL COST (M US D)	PRESENT COST (M US D)	N. HEAD (M)	G. HEAD (M)	W. S. (CMS)
1994	257.51	161.12	101.79	2.26	0.86	180.0	206.57	119	21.4	1.33	85	15.3	0.65	96.50	133.51	1.46	
2000	257.51	160.63	102.12	2.26	0.86	180.0	204.81	48	8.7	0.55	1533	258.0	10.96	97.38	132.40	23.50	
2005	257.51	160.31	102.69	2.24	0.86	180.0	204.17	32	5.7	0.39	2133	368.9	15.68	97.86	131.82	33.07	
2009	257.51	160.15	102.88	2.24	0.86	180.0	204.03	25	4.6	0.31	2384	429.1	18.24	98.07	131.54	38.17	