Option IIIa

Basic Parameters OP3a- 405

Waterway Length		
Headrace Tunnel	m	137.3
Penstock	m	162.6
Tailrace Tunnel	m	1480
	m	1779.9
Sedimentation Level	m	386.2

Specification

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	65.4	70.2	75	79.8	84.6	89.3	94.1	98.9	103.7	108.5
FSL	EL.m	405	405	405	405	405	405	405	405	405	405
MOL	EL.m	397	397.4	397.6	398	398.2	398.6	399	399.2	399.4	399.8
TWL	EL.m	288.6	288.7	288.7	288.8	288.8	288.9	288.9	288.9	289	289
Loss	m	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Effective Head	m	113	112.9	112.9	112.8	112.8	112.7	112.7	112.7	112.6	112.6
Pmax	MW	66	71	76	80	85	90	95	99	104	109
Primary Energy	GWh	136.43	146.02	155.63	164.75	173.87	182.24	190.45	197.98	205.33	212.51
Pfirm	MW	54.76	59.02	63.21	67.04	70.18	70.87	64.87	59.47	52.92	52.28
Benefit	1000USD	41,029	44,037	47,027	49,821	52,407	54,121	53,794	53,525	52,878	53,978
Cost	1000USD	35,036	35,438	35,781	36,135	36,469	36,854	37,238	37,525	37,845	38,222
B/C		1.17	1.24	1.31	1.38	1.44	1.47	1.44	1.43	1.40	1.41

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	117
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877
Concrete	m3	316,564	316,564	316,564	316,564	316,564	316,564	316,564	316,564	316,564	316,564
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	3.5									
MOL	EL.m	397	397.4	397.6	398	398.2	398.6	399	399.2	399.4	399.8
Waterway Diameter	m	4.9	5.1	5.2	5.4	5.5	5.7	5.9	6	6.1	6.3
Available Height	m	8	7.6	7.4	7	6.8	6.4	6	5.8	5.6	5.2

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	4,795	4,930	5,075	5,193	5,326	5,427	5,525	5,640	5,751	5,832
Concrete	m3	3,562	3,685	3,819	3,929	4,052	4,147	4,239	4,348	4,453	4,531
Reinforce Bar	t	142	147	153	157	162	166	170	174	178	181
Intake Gate	t	78	84	89	95	101	106	112	117	123	128
Intake Screen	t	43	47	50	53	56	59	62	65	68	71

(3) Power Tunnel

Tunnel Inner Diameter	m	4.9	5.1	5.2	5.4	5.5	5.7	5.9	6	6.1	6.3
Concerete Thickness	m	0.6									
Tunnel Length	m	137.3									
Number	-	1									

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	4,087	4,360	4,499	4,785	4,931	5,229	5,537	5,694	5,853	6,179
Lining Concrete	m3	1,498	1,555	1,583	1,640	1,669	1,726	1,783	1,812	1,841	1,899
Reinforce Bar	t	60	62	63	66	67	69	71	72	74	76

(3') Srevice Adit

Tunnel Length	m	1148

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	34,174	36,451	37,618	40,006	41,227	43,725	46,297	47,610	48,942	51,660

(4) Penstocks

Design Velocity 1	m/s	3.5	
Penstock Length 1	m	5	
Design Velocity 2	m/s	5.2	
Penstock Length 2	m	124.3	
Design Velocity 3	m/s	6.08	
Penstock Length 3	m	18.3	
Design Velocity 4	m/s	8.76	2 penstocks
Penstock Length 4	m	15	
Mean Velocity	m/s	5.844167	

Dm	m	3.774702	3.91077	4.042261	4.169608	4.293178	4.410822	4.527814	4.641859	4.753168	4.861929
tm	mm	15.75245	16.23595	16.7146	17.16511	17.61455	18.02862	18.45376	18.86819	19.2578	19.65269

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	3,160	3,336	3,510	3,682	3,854	4,020	4,190	4,358	4,526	4,693
Lining Concrete	m3	1,341	1,383	1,423	1,462	1,500	1,536	1,572	1,607	1,641	1,674
Reinforce Bar	t	16	17	17	18	18	18	19	19	20	20
Penstock	t	299	320	340	360	381	401	421	441	461	481

(5) Powerhouse Undergroundtype

A	m2	781.9489	809.8971	837.1281	863.2458	888.829	912.915	937.1291	960.7332	983.4799	1005.984
d	m	30									

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	51,609	53,453	55,250	56,974	58,663	60,252	61,851	63,408	64,910	66,395
Concrete	m3	11,729	12,148	12,557	12,949	13,332	13,694	14,057	14,411	14,752	15,090
Reinforce Bar	t	47	49	50	52	53	55	56	58	59	60

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	4.9	5.1	5.2	5.4	5.5	5.7	5.9	6	6.1	6.3
Concerete Thickness	m	0.6									
Tunnel Length	m	1480									
Number	-	1									

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	44,057	46,993	48,497	51,575	53,150	56,370	59,685	61,379	63,095	66,600
Lining Concrete	m3	16,148	16,759	17,066	17,680	17,987	18,604	19,223	19,533	19,843	20,465
Reinforce Bar	t	646	670	683	707	719	744	769	781	794	819

(7) Tailrace

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	4,494	4,739	4,938	5,179	5,373	5,610	5,848	6,037	6,225	6,460
Concrete	m3	1,301	1,404	1,489	1,594	1,680	1,786	1,895	1,984	2,072	2,185
Reinforce Bar	t	21	22	22	23	24	25	26	26	27	28

(8) P/H Access Tunnel

Tunnel Length	m	1975

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875
Lining Concrete	m3	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750
Reinforce Bar	t	593	593	593	593	593	593	593	593	593	593

Civil Work Cost 1,000USD

Item	FSL=405									
	1	2	3	4	5	6	7	8	9	10
(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	44,980	44,980	44,980	44,980	44,980	44,980	44,980	44,980	44,980	44,980
Concrete	41,153	41,153	41,153	41,153	41,153	41,153	41,153	41,153	41,153	41,153
Others	17,227	17,227	17,227	17,227	17,227	17,227	17,227	17,227	17,227	17,227
(2)Intake										
Excavation	91	94	96	99	101	103	105	107	109	111
Concrete	427	442	458	471	486	498	509	522	534	544
Reinforce Bar	118	122	127	130	135	138	141	144	148	150
Others	159	165	170	175	180	185	189	193	198	201
(3)Power Tunnel										
Tunnel Excavation	286	305	315	335	345	366	388	399	410	432
Lining Concrete	210	218	222	230	234	242	250	254	258	266
Reinforce Bar	53	55	56	58	59	61	63	64	65	67
Others	82	87	89	93	96	100	105	107	110	115
(3')Service Adit										
Tunnel Excavation	2,392	2,552	2,633	2,800	2,886	3,061	3,241	3,333	3,426	3,616

(4)Penstock										
Tunnel Excavation	442	467	491	515	539	563	587	610	634	657
Lining Concrete	188	194	199	205	210	215	220	225	230	234
Reinforce Bar	15	16	16	17	17	18	18	18	19	19
Others	129	135	141	147	153	159	165	171	176	182
(5)Power House										
Excavation	3,097	3,207	3,315	3,418	3,520	3,615	3,711	3,805	3,895	3,984
Concrete	2,229	2,308	2,386	2,460	2,533	2,602	2,671	2,738	2,803	2,867
Reinforce Bar	41	43	44	46	47	48	49	51	52	53
Others	2,683	2,779	2,873	2,962	3,050	3,133	3,216	3,297	3,375	3,452
(6)Tailrace Tunnel										
Tunnel Excavation	3,304	3,524	3,637	3,868	3,986	4,228	4,476	4,603	4,732	4,995
Lining Concrete	3,068	3,184	3,242	3,359	3,418	3,535	3,652	3,711	3,770	3,888
Reinforce Bar	568	590	601	622	633	655	677	688	698	720
Others	2,082	2,190	2,244	2,355	2,411	2,525	2,642	2,701	2,760	2,881
(7)Tailrace										
Excavation	54	57	59	62	64	67	70	72	75	78
Concrete	169	183	194	207	218	232	246	258	269	284
Reinforce Bar	17	18	18	19	20	21	21	22	23	23
Others	60	64	68	72	76	80	84	88	92	96
(8)P/H Access Tunnel										
Tunnel Excavation	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219
Lining Concrete	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568
Reinforce Bar	521	521	521	521	521	521	521	521	521	521
Others	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862
(9)Miscellaneous Works	7,127	7,179	7,214	7,266	7,300	7,352	7,404	7,438	7,472	7,525
Total	149,676	150,759	151,492	152,576	153,300	154,382	155,481	156,201	156,914	158,024

Hydro- mechanical Works

1,000USD

Item	FSL=405									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	514	551	588	624	661	697	733	769	806	842
Screen	285	306	326	347	367	387	407	427	448	468
(3)Penstock	1,138	1,215	1,293	1,370	1,447	1,522	1,599	1,676	1,752	1,829
(4)Tailrace										
Gate	514	551	588	624	661	697	733	769	806	842
(5)Others	2,866	2,900	2,935	2,969	3,003	3,036	3,070	3,104	3,138	3,171
Total	17,194	17,400	17,607	17,811	18,017	18,216	18,419	18,624	18,827	19,029

Project Cost Summary

1,000USD

Item	FSL=405									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	2,994	3,015	3,030	3,052	3,066	3,088	3,110	3,124	3,138	3,160
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280
3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	103,360	103,360	103,360	103,360	103,360	103,360	103,360	103,360	103,360	103,360
(3) Intake	796	823	852	876	902	923	943	967	989	1,006
(4) Power Tunnel	3,023	3,216	3,314	3,516	3,619	3,829	4,046	4,156	4,268	4,496
(5) Penstock	775	812	848	884	920	954	989	1,024	1,058	1,093
(6) Power House	8,050	8,337	8,618	8,886	9,150	9,398	9,647	9,890	10,124	10,356
(7) Tailrace Tunnel	9,023	9,488	9,725	10,204	10,448	10,943	11,447	11,703	11,961	12,485
(8) Tailrace	300	322	339	361	378	400	422	440	458	481
(9)P/S Access Tunnel	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170
(10) Others	7,127	7,179	7,214	7,266	7,300	7,352	7,404	7,438	7,472	7,525
4. Hydro- Mechanical Works	17,194	17,400	17,607	17,811	18,017	18,216	18,419	18,624	18,827	19,029
5. Electro- Mechanical Works	27,257	28,628	29,959	31,012	32,294	33,560	34,794	35,766	36,974	38,152
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	233,571	236,251	238,538	240,900	243,127	245,695	248,254	250,164	252,303	254,814
7. Administration Fee	35,036	35,438	35,781	36,135	36,469	36,854	37,238	37,525	37,845	38,222
8. Preliminary Cost	23,357	23,625	23,854	24,090	24,313	24,569	24,825	25,016	25,230	25,481
9. Interest During Construction	58,393	59,063	59,634	60,225	60,782	61,424	62,063	62,541	63,076	63,704
Total	350,356	354,376	357,806	361,350	364,691	368,542	372,381	375,247	378,454	382,221

Basic Parameters OP3a- 410

Waterway Length		
Headrace Tunnel	m	137.3
Penstock	m	162.6
Tailrace Tunnel	m	1480
	m	1779.9
Sedimentation Level	m	386.2

Specification

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	73.7	78.2	82.8	87.3	91.9	96.4	101	105.5	110.1	114.6
FSL	EL.m	410	410	410	410	410	410	410	410	410	410
MOL	EL.m	397.6	397.8	398.2	398.4	398.8	399	399.4	399.6	399.8	400.2
TWL	EL.m	288.7	288.8	288.8	288.8	288.9	288.9	289	289	289	289.1
Loss	m	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Effective Head	m	117.9	117.8	117.8	117.8	117.7	117.7	117.6	117.6	117.6	117.5
Pmax	MW	78	82	87	92	97	101	106	111	116	120
Primary Energy	GWh	157.72	166.57	176.06	185.03	193.70	201.83	210.03	217.58	224.75	230.87
Pfirm	MW	61.35	65.19	69.35	71.82	75.20	79.10	78.48	70.00	66.72	58.68
Benefit	1000USD	46,844	49,592	52,551	54,909	57,486	60,123	61,412	60,220	60,524	59,208
Cost	1000USD	37,207	37,501	37,886	38,210	38,589	38,870	39,246	39,558	39,868	40,203
B/C		1.26	1.32	1.39	1.44	1.49	1.55	1.56	1.52	1.52	1.47

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	122
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144
Concrete	m3	353,122	353,122	353,122	353,122	353,122	353,122	353,122	353,122	353,122	353,122
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	3.5									
MOL	EL.m	397.6	397.8	398.2	398.4	398.8	399	399.4	399.6	399.8	400.2
Waterway Diameter	m	5.2	5.3	5.5	5.6	5.8	5.9	6.1	6.2	6.3	6.5
Available Height	m	12.4	12.2	11.8	11.6	11.2	11	10.6	10.4	10.2	9.8

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	5,946	6,108	6,249	6,398	6,526	6,664	6,781	6,909	7,037	7,136
Concrete	m3	4,640	4,796	4,932	5,077	5,203	5,338	5,454	5,581	5,708	5,807
Reinforce Bar	t	186	192	197	203	208	214	218	223	228	232
Intake Gate	t	91	97	102	108	113	119	124	130	135	141
Intake Screen	t	51	54	57	60	63	66	69	72	75	78

(3) Power Tunnel

Tunnel Inner Diameter	m	5.2	5.3	5.5	5.6	5.8	5.9	6.1	6.2	6.3	6.5
Concerete Thickness	m	0.6									
Tunnel Length	m	137.3									
Number	-	1									

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	4,499	4,641	4,931	5,079	5,382	5,537	5,853	6,015	6,179	6,512
Lining Concrete	m3	1,583	1,612	1,669	1,697	1,755	1,783	1,841	1,870	1,899	1,956
Reinforce Bar	t	63	64	67	68	70	71	74	75	76	78

(3') Srevice Adit

Tunnel Length	m	1148

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	37,618	38,802	41,227	42,467	45,002	46,297	48,942	50,292	51,660	54,452

(4) Penstocks

Design Velocity 1	m/s	3.5									
Penstock Length 1	m	5									
Design Velocity 2	m/s	5.2									
Penstock Length 2	m	124.3									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	18.3									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	15									
Mean Velocity	m/s	5.844167									
Dm	m	4.007075	4.127596	4.247261	4.361149	4.474572	4.582815	4.690881	4.794242	4.897646	4.996732
tm	mm	17.21362	17.65828	18.11224	18.54428	18.96055	19.37084	19.76578	20.15723	20.54886	20.90848

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	3,463	3,625	3,789	3,949	4,112	4,271	4,432	4,589	4,748	4,904
Lining Concrete	m3	1,412	1,449	1,486	1,521	1,555	1,589	1,622	1,653	1,685	1,715
Reinforce Bar	t	17	17	18	18	19	19	19	20	20	21
Penstock	t	347	367	387	407	427	447	467	487	507	526

(5) Powerhouse Undergroundtype

A	m2	841.9152	866.9921	892.1275	916.0494	939.6077	962.3373	984.7511	1006.45	1028.157	1048.661
d	m	30									

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	55,566	57,221	58,880	60,459	62,014	63,514	64,994	66,426	67,858	69,212
Concrete	m3	12,629	13,005	13,382	13,741	14,094	14,435	14,771	15,097	15,422	15,730
Reinforce Bar	t	51	52	54	55	56	58	59	60	62	63

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	5.2	5.3	5.5	5.6	5.8	5.9	6.1	6.2	6.3	6.5
Concerete Thickness	m	0.6									
Tunnel Length	m	1480									
Number	-	1									

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	48,497	50,024	53,150	54,748	58,016	59,685	63,095	64,836	66,600	70,199
Lining Concrete	m3	17,066	17,372	17,987	18,296	18,913	19,223	19,843	20,154	20,465	21,088
Reinforce Bar	t	683	695	719	732	757	769	794	806	819	844

(7) Tailrace

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	4,897	5,084	5,318	5,502	5,735	5,916	6,147	6,326	6,506	6,732
Concrete	m3	1,471	1,552	1,655	1,737	1,843	1,927	2,035	2,120	2,207	2,317
Reinforce Bar	t	22	23	24	24	25	26	27	28	28	29

(8) P/H Access Tunnel

Tunnel Length m 1975

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875
Lining Concrete	m3	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750
Reinforce Bar	t	593	593	593	593	593	593	593	593	593	593

Civil Work Cost 1,000USD

Item	FSL=410									
	1	2	3	4	5	6	7	8	9	10
(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	45,813	45,813	45,813	45,813	45,813	45,813	45,813	45,813	45,813	45,813
Concrete	45,906	45,906	45,906	45,906	45,906	45,906	45,906	45,906	45,906	45,906
Others	18,344	18,344	18,344	18,344	18,344	18,344	18,344	18,344	18,344	18,344
(2)Intake										
Excavation	113	116	119	122	124	127	129	131	134	136
Concrete	557	575	592	609	624	641	654	670	685	697
Reinforce Bar	154	159	164	169	173	177	181	185	190	193
Others	206	213	219	225	230	236	241	247	252	256
(3)Power Tunnel										
Tunnel Excavation	315	325	345	356	377	388	410	421	432	456
Lining Concrete	222	226	234	238	246	250	258	262	266	274
Reinforce Bar	56	57	59	60	62	63	65	66	67	69
Others	89	91	96	98	103	105	110	112	115	120
(3')Service Adit										

Tunnel Excavation	2,633	2,716	2,886	2,973	3,150	3,241	3,426	3,520	3,616	3,812
(4)Penstock										
Tunnel Excavation	485	507	531	553	576	598	620	642	665	687
Lining Concrete	198	203	208	213	218	222	227	231	236	240
Reinforce Bar	16	17	17	17	18	18	18	19	19	20
Others	140	145	151	157	162	168	173	179	184	189
(5)Power House										
Excavation	3,334	3,433	3,533	3,628	3,721	3,811	3,900	3,986	4,072	4,153
Concrete	2,399	2,471	2,543	2,611	2,678	2,743	2,807	2,868	2,930	2,989
Reinforce Bar	44	46	47	48	50	51	52	53	54	55
Others	2,889	2,975	3,061	3,143	3,224	3,302	3,379	3,454	3,528	3,598
(6)Tailrace Tunnel										
Tunnel Excavation	3,637	3,752	3,986	4,106	4,351	4,476	4,732	4,863	4,995	5,265
Lining Concrete	3,242	3,301	3,418	3,476	3,594	3,652	3,770	3,829	3,888	4,007
Reinforce Bar	601	612	633	644	666	677	698	709	720	742
Others	2,244	2,299	2,411	2,468	2,583	2,642	2,760	2,820	2,881	3,004
(7)Tailrace										
Excavation	59	61	64	66	69	71	74	76	78	81
Concrete	191	202	215	226	240	250	265	276	287	301
Reinforce Bar	18	19	20	20	21	22	22	23	23	24
Others	67	70	75	78	82	86	90	94	97	102
(8)P/H Access Tunnel										
Tunnel Excavation	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219
Lining Concrete	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568
Reinforce Bar	521	521	521	521	521	521	521	521	521	521
Others	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862
(9)Miscellaneous Works	7,560	7,594	7,645	7,679	7,731	7,765	7,817	7,851	7,885	7,938
Total	158,754	159,469	160,554	161,266	162,356	163,065	164,164	164,872	165,585	166,691

Hydro- mechanical Works 1,000USD

Item	FSL=410									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	599	636	672	708	744	780	817	852	889	924
Screen	333	353	373	393	414	434	454	474	494	513
(3)Penstock	1,320	1,395	1,472	1,548	1,624	1,699	1,775	1,850	1,926	2,000
(4)Tailrace										
Gate	599	636	672	708	744	780	817	852	889	924
(5)Others	2,946	2,979	3,013	3,047	3,081	3,114	3,148	3,181	3,215	3,248
Total	17,675	17,876	18,081	18,282	18,485	18,685	18,887	19,087	19,291	19,486

Project Cost Summary 1,000USD

Item	FSL=410									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	3,175	3,189	3,211	3,225	3,247	3,261	3,283	3,297	3,312	3,334
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	28,230	28,230	28,230	28,230	28,230	28,230	28,230	28,230	28,230	28,230
3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	110,062	110,062	110,062	110,062	110,062	110,062	110,062	110,062	110,062	110,062
(3) Intake	1,030	1,063	1,093	1,124	1,151	1,181	1,205	1,233	1,260	1,281
(4) Power Tunnel	3,314	3,414	3,619	3,724	3,937	4,046	4,268	4,381	4,496	4,730
(5) Penstock	838	872	907	940	973	1,006	1,039	1,071	1,104	1,135
(6) Power House	8,667	8,925	9,184	9,430	9,673	9,906	10,137	10,361	10,584	10,795
(7) Tailrace Tunnel	9,725	9,963	10,448	10,694	11,194	11,447	11,961	12,222	12,485	13,018
(8) Tailrace	335	352	373	390	412	429	451	468	485	508
(9)P/S Access Tunnel	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170
(10) Others	7,560	7,594	7,645	7,679	7,731	7,765	7,817	7,851	7,885	7,938
4. Hydro- Mechanical Works	17,675	17,876	18,081	18,282	18,485	18,685	18,887	19,087	19,291	19,486
5. Electro- Mechanical Works	30,045	31,075	32,328	33,557	34,774	35,726	36,908	38,062	39,198	40,107
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	248,049	250,009	252,573	254,730	257,261	259,136	261,641	263,717	265,785	268,018
7. Administration Fee	37,207	37,501	37,886	38,210	38,589	38,870	39,246	39,558	39,868	40,203
8. Preliminary Cost	24,805	25,001	25,257	25,473	25,726	25,914	26,164	26,372	26,578	26,802
9. Interest During Construction	62,012	62,502	63,143	63,683	64,315	64,784	65,410	65,929	66,446	67,004
Total	372,074	375,013	378,860	382,096	385,892	388,705	392,462	395,575	398,677	402,027

Basic Parameters OP3a- 415

Waterway Length		
Headrace Tunnel	m	137.3
Penstock	m	162.6
Tailrace Tunnel	m	1480
	m	1779.9
Sedimentation Level	m	386.2

Specification

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	82.6	87.3	92.1	96.8	101.6	106.3	111.1	115.8	120.6	125.3
FSL	EL.m	415	415	415	415	415	415	415	415	415	415
MOL	EL.m	398.2	398.4	398.8	399	399.4	399.6	400	400.2	400.4	400.8
TWL	EL.m	288.8	288.8	288.9	288.9	289	289	289	289.1	289.1	289.1
Loss	m	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Effective Head	m	122.8	122.8	122.7	122.7	122.6	122.6	122.6	122.5	122.5	122.5
Pmax	MW	90	96	101	106	111	116	122	127	132	137
Primary Energy	GWh	180.47	190.44	200.13	209.50	218.57	226.99	235.45	242.70	249.94	256.44
Pfirm	MW	68.44	72.50	75.68	77.85	82.08	86.11	88.67	75.71	71.44	60.16
Benefit	1000USD	53,071	56,087	58,788	61,127	64,032	66,760	69,053	66,460	66,478	64,255
Cost	1000USD	39,421	39,782	40,163	40,481	40,858	41,170	41,576	41,884	42,190	42,557
B/C		1.35	1.41	1.46	1.51	1.57	1.62	1.66	1.59	1.58	1.51

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	127
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358
Concrete	m3	392,176	392,176	392,176	392,176	392,176	392,176	392,176	392,176	392,176	392,176
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	3.5									
MOL	EL.m	398.2	398.4	398.8	399	399.4	399.6	400	400.2	400.4	400.8
Waterway Diameter	m	5.5	5.6	5.8	5.9	6.1	6.2	6.4	6.5	6.6	6.8
Available Height	m	16.8	16.6	16.2	16	15.6	15.4	15	14.8	14.6	14.2

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	7,086	7,268	7,432	7,602	7,752	7,911	8,050	8,200	8,348	8,469
Concrete	m3	5,757	5,940	6,105	6,277	6,430	6,593	6,735	6,889	7,043	7,169
Reinforce Bar	t	230	238	244	251	257	264	269	276	282	287
Intake Gate	t	105	111	117	123	129	135	141	146	152	158
Intake Screen	t	58	62	65	68	72	75	78	81	85	88

(3) Power Tunnel

Tunnel Inner Diameter	m	5.5	5.6	5.8	5.9	6.1	6.2	6.4	6.5	6.6	6.8
Concerete Thickness	m	0.6									
Tunnel Length	m	137.3									
Number	-	1									

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	4,931	5,079	5,382	5,537	5,853	6,015	6,344	6,512	6,683	7,030
Lining Concrete	m3	1,669	1,697	1,755	1,783	1,841	1,870	1,927	1,956	1,985	2,043
Reinforce Bar	t	67	68	70	71	74	75	77	78	79	82

(3') Srevice Adit

Tunnel Length	m	1148

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	41,227	42,467	45,002	46,297	48,942	50,292	53,047	54,452	55,875	58,778

(4) Penstocks

Design Velocity 1	m/s	3.5									
Penstock Length 1	m	5									
Design Velocity 2	m/s	5.2									
Penstock Length 2	m	124.3									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	18.3									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	15									
Mean Velocity	m/s	5.844167									
Dm	m	4.242128	4.361149	4.479438	4.592313	4.704794	4.812385	4.919838	5.022825	5.125868	5.224796
tm	mm	18.75666	19.2268	19.68003	20.12554	20.55477	20.97909	21.40286	21.7933	22.19935	22.58919

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	3,782	3,949	4,119	4,285	4,453	4,616	4,783	4,945	5,110	5,271
Lining Concrete	m3	1,484	1,521	1,557	1,591	1,626	1,659	1,692	1,723	1,755	1,785
Reinforce Bar	t	18	18	19	19	20	20	20	21	21	21
Penstock	t	401	422	444	466	487	509	530	551	573	594

(5) Powerhouse Undergroundtype

A	m2	903.4819	928.8307	953.7649	977.7981	1001.476	1024.378	1047.25	1068.882	1090.81	1111.862
d	m	30									

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	59,630	61,303	62,948	64,535	66,097	67,609	69,119	70,546	71,993	73,383
Concrete	m3	13,552	13,932	14,306	14,667	15,022	15,366	15,709	16,033	16,362	16,678
Reinforce Bar	t	54	56	57	59	60	61	63	64	65	67

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	5.5	5.6	5.8	5.9	6.1	6.2	6.4	6.5	6.6	6.8
Concerete Thickness	m	0.6									
Tunnel Length	m	1480									
Number	-	1									

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	53,150	54,748	58,016	59,685	63,095	64,836	68,388	70,199	72,035	75,776
Lining Concrete	m3	17,987	18,296	18,913	19,223	19,843	20,154	20,776	21,088	21,401	22,027
Reinforce Bar	t	719	732	757	769	794	806	831	844	856	881

(7) Tailrace

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	5,312	5,502	5,741	5,928	6,164	6,348	6,584	6,766	6,949	7,179
Concrete	m3	1,652	1,737	1,846	1,932	2,043	2,131	2,245	2,334	2,425	2,540
Reinforce Bar	t	24	24	25	26	27	28	28	29	30	31

(8) P/H Access Tunnel

Tunnel Length m 1975

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875
Lining Concrete	m3	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750
Reinforce Bar	t	593	593	593	593	593	593	593	593	593	593

Civil Work Cost 1,000USD

Item	FSL=415									
	1	2	3	4	5	6	7	8	9	10
(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	46,626	46,626	46,626	46,626	46,626	46,626	46,626	46,626	46,626	46,626
Concrete	50,983	50,983	50,983	50,983	50,983	50,983	50,983	50,983	50,983	50,983
Others	19,522	19,522	19,522	19,522	19,522	19,522	19,522	19,522	19,522	19,522
(2)Intake										
Excavation	135	138	141	144	147	150	153	156	159	161
Concrete	691	713	733	753	772	791	808	827	845	860
Reinforce Bar	191	197	203	208	213	219	224	229	234	238
Others	254	262	269	277	283	290	296	303	309	315
(3)Power Tunnel										
Tunnel Excavation	345	356	377	388	410	421	444	456	468	492
Lining Concrete	234	238	246	250	258	262	270	274	278	286
Reinforce Bar	59	60	62	63	65	66	68	69	70	72
Others	96	98	103	105	110	112	117	120	122	128
(3')Service Adit										

Tunnel Excavation	2,886	2,973	3,150	3,241	3,426	3,520	3,713	3,812	3,911	4,114
(4)Penstock										
Tunnel Excavation	530	553	577	600	623	646	670	692	715	738
Lining Concrete	208	213	218	223	228	232	237	241	246	250
Reinforce Bar	17	17	18	18	19	19	19	20	20	20
Others	151	157	162	168	174	179	185	191	196	202
(5)Power House										
Excavation	3,578	3,678	3,777	3,872	3,966	4,057	4,147	4,233	4,320	4,403
Concrete	2,575	2,647	2,718	2,787	2,854	2,919	2,985	3,046	3,109	3,169
Reinforce Bar	48	49	50	52	53	54	55	56	58	59
Others	3,100	3,187	3,273	3,355	3,436	3,515	3,594	3,668	3,743	3,815
(6)Tailrace Tunnel										
Tunnel Excavation	3,986	4,106	4,351	4,476	4,732	4,863	5,129	5,265	5,403	5,683
Lining Concrete	3,418	3,476	3,594	3,652	3,770	3,829	3,948	4,007	4,066	4,185
Reinforce Bar	633	644	666	677	698	709	731	742	753	775
Others	2,411	2,468	2,583	2,642	2,760	2,820	2,942	3,004	3,067	3,193
(7)Tailrace										
Excavation	64	66	69	71	74	76	79	81	83	86
Concrete	215	226	240	251	266	277	292	303	315	330
Reinforce Bar	20	20	21	22	22	23	24	24	25	25
Others	75	78	82	86	90	94	99	102	106	110
(8)P/H Access Tunnel										
Tunnel Excavation	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219
Lining Concrete	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568
Reinforce Bar	521	521	521	521	521	521	521	521	521	521
Others	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862
(9)Miscellaneous Works	8,014	8,049	8,102	8,137	8,190	8,225	8,279	8,314	8,349	8,403
Total	168,284	169,022	170,138	170,871	171,994	172,725	173,862	174,589	175,324	176,468

Hydro- mechanical Works

1,000USD

Item	FSL=415									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	690	728	768	807	846	884	923	962	1,001	1,039
Screen	383	405	427	448	470	491	513	534	556	577
(3)Penstock	1,523	1,605	1,687	1,769	1,851	1,932	2,015	2,095	2,178	2,259
(4)Tailrace										
Gate	690	728	768	807	846	884	923	962	1,001	1,039
(5)Others	3,033	3,069	3,105	3,142	3,178	3,214	3,251	3,286	3,323	3,358
Total	18,195	18,413	18,632	18,849	19,068	19,284	19,503	19,717	19,937	20,151

Project Cost Summary

1,000USD

Item	FSL=415									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	3,366	3,380	3,403	3,417	3,440	3,454	3,477	3,492	3,506	3,529
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	30,180	30,180	30,180	30,180	30,180	30,180	30,180	30,180	30,180	30,180
3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	117,131	117,131	117,131	117,131	117,131	117,131	117,131	117,131	117,131	117,131
(3) Intake	1,271	1,310	1,346	1,383	1,415	1,450	1,481	1,514	1,547	1,574
(4) Power Tunnel	3,619	3,724	3,937	4,046	4,268	4,381	4,612	4,730	4,849	5,092
(5) Penstock	905	940	975	1,009	1,043	1,077	1,111	1,144	1,177	1,210
(6) Power House	9,301	9,562	9,818	10,066	10,309	10,545	10,781	11,003	11,229	11,446
(7) Tailrace Tunnel	10,448	10,694	11,194	11,447	11,961	12,222	12,750	13,018	13,289	13,837
(8) Tailrace	373	390	412	430	452	470	493	511	529	552
(9)P/S Access Tunnel	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170
(10) Others	8,014	8,049	8,102	8,137	8,190	8,225	8,279	8,314	8,349	8,403
4. Hydro- Mechanical Works	18,195	18,413	18,632	18,849	19,068	19,284	19,503	19,717	19,937	20,151
5. Electro- Mechanical Works	32,612	34,049	35,233	36,388	37,536	38,657	39,981	41,080	42,153	43,213
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	262,807	265,214	267,755	269,875	272,387	274,470	277,173	279,226	281,269	283,710
7. Administration Fee	39,421	39,782	40,163	40,481	40,858	41,170	41,576	41,884	42,190	42,557
8. Preliminary Cost	26,281	26,521	26,775	26,988	27,239	27,447	27,717	27,923	28,127	28,371
9. Interest During Construction	65,702	66,303	66,939	67,469	68,097	68,617	69,293	69,807	70,317	70,928
Total	394,210	397,821	401,632	404,813	408,581	411,705	415,759	418,840	421,904	425,566

Basic Parameters OP3a- 420

Waterway Length		
Headrace Tunnel	m	137.3
Penstock	m	162.6
Tailrace Tunnel	m	1480
	m	1779.9
Sedimentation Level	m	386.2

Specification

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	92.3	97.2	102	106.9	111.7	116.6	121.4	126.3	131.1	136
FSL	EL.m	420	420	420	420	420	420	420	420	420	420
MOL	EL.m	398.8	399	399.4	399.6	400	400.2	400.4	400.8	401	401.2
TWL	EL.m	288.9	288.9	289	289	289	289.1	289.1	289.1	289.2	289.2
Loss	m	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Effective Head	m	127.7	127.7	127.6	127.6	127.6	127.5	127.5	127.5	127.4	127.4
Pmax	MW	105	111	116	122	127	133	138	144	149	155
Primary Energy	GWh	206.15	216.41	226.00	235.78	244.60	252.87	260.71	268.52	275.20	281.71
Pfirm	MW	75.67	77.50	80.81	84.92	89.22	93.30	91.47	76.41	73.83	67.59
Benefit	1000USD	59,869	62,266	64,988	67,984	70,865	73,581	74,442	71,318	71,744	71,039
Cost	1000USD	42,307	42,660	43,035	43,381	43,751	44,092	44,397	44,795	45,096	45,426
B/C		1.42	1.46	1.51	1.57	1.62	1.67	1.68	1.59	1.59	1.56

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood		m3/s	8,306
Dam Basis EL.		m	293
Non- overflow Width		m	80.2
Spillway Width		m	77
Sand Drain Width		m	16
Intake Width		m	0
Dam Height (Hd)		m	132
Crest Length (L)		m	173.2
Coefficient for Ex	Y=A*X^B		
	A		32335
	B		0.4384
Coefficient for Conc	Y=C*X^D		
	C		0.0015
	D		1.3058

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583
Concrete	m3	433,788	433,788	433,788	433,788	433,788	433,788	433,788	433,788	433,788	433,788
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	3.5									
MOL	EL.m	398.8	399	399.4	399.6	400	400.2	400.4	400.8	401	401.2
Waterway Diameter	m	5.8	5.9	6.1	6.2	6.4	6.5	6.6	6.8	6.9	7
Available Height	m	21.2	21	20.6	20.4	20	19.8	19.6	19.2	19	18.8

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	8,242	8,442	8,616	8,804	8,966	9,143	9,311	9,461	9,621	9,780
Concrete	m3	6,933	7,141	7,322	7,519	7,689	7,877	8,056	8,215	8,386	8,557
Reinforce Bar	t	277	286	293	301	308	315	322	329	335	342
Intake Gate	t	120	126	132	139	145	151	157	163	169	176
Intake Screen	t	67	70	73	77	80	84	87	91	94	98

(3) Power Tunnel

Tunnel Inner Diameter	m	5.8	5.9	6.1	6.2	6.4	6.5	6.6	6.8	6.9	7
Concerete Thickness	m	0.6									
Tunnel Length	m	137.3									
Number	-	1									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	5,382	5,537	5,853	6,015	6,344	6,512	6,683	7,030	7,207	7,386
Lining Concrete	m3	1,755	1,783	1,841	1,870	1,927	1,956	1,985	2,043	2,073	2,102
Reinforce Bar	t	70	71	74	75	77	78	79	82	83	84

(3') Srevice Adit

Tunnel Length	m	1148

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	45,002	46,297	48,942	50,292	53,047	54,452	55,875	58,778	60,256	61,753

(4) Penstocks

Design Velocity 1	m/s	3.5									
Penstock Length 1	m	5									
Design Velocity 2	m/s	5.2									
Penstock Length 2	m	124.3									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	18.3									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	15									
Mean Velocity	m/s	5.844167									
Dm	m	4.4843	4.601791	4.714046	4.825948	4.933105	5.040145	5.142841	5.245603	5.344353	5.443312
tm	mm	20.40101	20.88313	21.329	21.78783	22.22721	22.65033	23.07109	23.49213	23.87999	24.28514

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	4,126	4,299	4,467	4,637	4,804	4,973	5,138	5,306	5,469	5,636
Lining Concrete	m3	1,558	1,594	1,629	1,663	1,696	1,729	1,760	1,792	1,822	1,852
Reinforce Bar	t	19	19	20	20	20	21	21	21	22	22
Penstock	t	461	484	506	530	552	575	598	621	643	666

(5) Powerhouse Undergroundtype

A	m2	967.5969	992.9486	1016.905	1041.044	1064.16	1086.966	1109.114	1131.276	1152.271	1173.607
d	m	30									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	63,861	65,535	67,116	68,709	70,235	71,740	73,202	74,664	76,050	77,458
Concrete	m3	14,514	14,894	15,254	15,616	15,962	16,304	16,637	16,969	17,284	17,604
Reinforce Bar	t	58	60	61	62	64	65	67	68	69	70

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	5.8	5.9	6.1	6.2	6.4	6.5	6.6	6.8	6.9	7
Concerete Thickness	m	0.6									
Tunnel Length	m	1480									
Number	-	1									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	58,016	59,685	63,095	64,836	68,388	70,199	72,035	75,776	77,682	79,612
Lining Concrete	m3	18,913	19,223	19,843	20,154	20,776	21,088	21,401	22,027	22,341	22,655
Reinforce Bar	t	757	769	794	806	831	844	856	881	894	906

(7) Tailrace

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	5,747	5,939	6,176	6,366	6,601	6,788	6,971	7,207	7,388	7,571
Concrete	m3	1,849	1,938	2,049	2,139	2,253	2,345	2,436	2,554	2,647	2,741
Reinforce Bar	t	25	26	27	28	29	29	30	31	31	32

(8) P/H Access Tunnel

Tunnel Length	m	1975									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875
Lining Concrete	m3	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750
Reinforce Bar	t	593	593	593	593	593	593	593	593	593	593

Civil Work Cost 1,000USD

Item	FSL=420									
	1	2	3	4	5	6	7	8	9	10
(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	47,422	47,422	47,422	47,422	47,422	47,422	47,422	47,422	47,422	47,422
Concrete	56,392	56,392	56,392	56,392	56,392	56,392	56,392	56,392	56,392	56,392
Others	20,763	20,763	20,763	20,763	20,763	20,763	20,763	20,763	20,763	20,763
(2)Intake										
Excavation	157	160	164	167	170	174	177	180	183	186
Concrete	832	857	879	902	923	945	967	986	1,006	1,027
Reinforce Bar	230	237	243	250	255	262	267	273	278	284
Others	305	314	321	330	337	345	353	360	367	374
(3)Power Tunnel										
Tunnel Excavation	377	388	410	421	444	456	468	492	504	517
Lining Concrete	246	250	258	262	270	274	278	286	290	294
Reinforce Bar	62	63	65	66	68	69	70	72	73	74
Others	103	105	110	112	117	120	122	128	130	133
(3')Service Adit										

Tunnel Excavation	3,150	3,241	3,426	3,520	3,713	3,812	3,911	4,114	4,218	4,323
(4)Penstock										
Tunnel Excavation	578	602	625	649	673	696	719	743	766	789
Lining Concrete	218	223	228	233	237	242	246	251	255	259
Reinforce Bar	18	18	19	19	19	20	20	20	21	21
Others	163	169	174	180	186	192	197	203	208	214
(5)Power House										
Excavation	3,832	3,932	4,027	4,123	4,214	4,304	4,392	4,480	4,563	4,647
Concrete	2,758	2,830	2,898	2,967	3,033	3,098	3,161	3,224	3,284	3,345
Reinforce Bar	51	52	54	55	56	57	59	60	61	62
Others	3,320	3,407	3,489	3,572	3,652	3,730	3,806	3,882	3,954	4,027
(6)Tailrace Tunnel										
Tunnel Excavation	4,351	4,476	4,732	4,863	5,129	5,265	5,403	5,683	5,826	5,971
Lining Concrete	3,594	3,652	3,770	3,829	3,948	4,007	4,066	4,185	4,245	4,304
Reinforce Bar	666	677	698	709	731	742	753	775	786	797
Others	2,583	2,642	2,760	2,820	2,942	3,004	3,067	3,193	3,257	3,322
(7)Tailrace										
Excavation	69	71	74	76	79	81	84	86	89	91
Concrete	240	252	266	278	293	305	317	332	344	356
Reinforce Bar	21	22	22	23	24	24	25	26	26	27
Others	83	86	91	94	99	103	106	111	115	118
(8)P/H Access Tunnel										
Tunnel Excavation	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219
Lining Concrete	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568
Reinforce Bar	521	521	521	521	521	521	521	521	521	521
Others	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862
(9)Miscellaneous Works	8,490	8,526	8,580	8,616	8,671	8,706	8,742	8,797	8,833	8,868
Total	178,295	179,053	180,185	180,939	182,084	182,833	183,576	184,743	185,483	186,233

Hydro- mechanical Works

1,000USD

Item	FSL=420									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	787	829	869	910	950	991	1,032	1,073	1,113	1,154
Screen	437	460	483	506	528	551	573	596	618	641
(3)Penstock	1,751	1,839	1,924	2,013	2,099	2,185	2,271	2,359	2,443	2,530
(4)Tailrace										
Gate	787	829	869	910	950	991	1,032	1,073	1,113	1,154
(5)Others	3,128	3,167	3,204	3,243	3,281	3,319	3,357	3,395	3,433	3,471
Total	18,768	19,001	19,227	19,459	19,685	19,916	20,143	20,373	20,597	20,828

Project Cost Summary

1,000USD

Item	FSL=420									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	3,566	3,581	3,604	3,619	3,642	3,657	3,672	3,695	3,710	3,725
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	35,570	35,570	35,570	35,570	35,570	35,570	35,570	35,570	35,570	35,570
3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	124,578	124,578	124,578	124,578	124,578	124,578	124,578	124,578	124,578	124,578
(3) Intake	1,523	1,568	1,607	1,649	1,685	1,726	1,764	1,798	1,834	1,871
(4) Power Tunnel	3,937	4,046	4,268	4,381	4,612	4,730	4,849	5,092	5,216	5,341
(5) Penstock	976	1,012	1,046	1,081	1,115	1,149	1,183	1,217	1,250	1,283
(6) Power House	9,961	10,222	10,468	10,717	10,955	11,189	11,417	11,646	11,862	12,081
(7) Tailrace Tunnel	11,194	11,447	11,961	12,222	12,750	13,018	13,289	13,837	14,115	14,395
(8) Tailrace	413	431	454	472	495	513	531	555	574	592
(9)P/S Access Tunnel	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170
(10) Others	8,490	8,526	8,580	8,616	8,671	8,706	8,742	8,797	8,833	8,868
4. Hydro- Mechanical Works	18,768	19,001	19,227	19,459	19,685	19,916	20,143	20,373	20,597	20,828
5. Electro- Mechanical Works	35,679	37,029	38,144	39,451	40,524	41,804	42,847	44,082	45,111	46,316
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	282,048	284,403	286,899	289,207	291,675	293,949	295,977	298,632	300,640	302,841
7. Administration Fee	42,307	42,660	43,035	43,381	43,751	44,092	44,397	44,795	45,096	45,426
8. Preliminary Cost	28,205	28,440	28,690	28,921	29,167	29,395	29,598	29,863	30,064	30,284
9. Interest During Construction	70,512	71,101	71,725	72,302	72,919	73,487	73,994	74,658	75,160	75,710
Total	423,072	426,605	430,349	433,811	437,512	440,923	443,965	447,948	450,960	454,261

Basic Parameters OP3a- 425

Waterway Length		
Headrace Tunnel	m	137.3
Penstock	m	162.6
Tailrace Tunnel	m	1480
	m	1779.9
Sedimentation Level	m	386.2

Specification

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	102.9	107.8	112.6	117.5	122.3	127.2	132	136.9	141.7	146.6
FSL	EL.m	425	425	425	425	425	425	425	425	425	425
MOL	EL.m	399.4	399.8	400	400.2	400.6	400.8	401	401.4	401.6	401.8
TWL	EL.m	289	289	289	289.1	289.1	289.1	289.2	289.2	289.3	289.3
Loss	m	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Effective Head	m	132.6	132.6	132.6	132.5	132.5	132.5	132.4	132.4	132.3	132.3
Pmax	MW	122	128	133	139	145	150	156	162	167	173
Primary Energy	GWh	234.21	244.44	253.83	261.01	267.61	272.46	283.93	293.26	300.79	306.91
Pfirm	MW	81.13	84.26	88.25	92.26	96.56	97.50	91.53	74.72	74.04	68.42
Benefit	1000USD	66,562	69,345	72,235	74,734	77,215	78,371	78,640	75,263	76,413	75,825
Cost	1000USD	45,309	45,713	46,020	46,357	46,753	47,055	47,384	47,777	48,073	48,396
B/C		1.47	1.52	1.57	1.61	1.65	1.67	1.66	1.58	1.59	1.57

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	137
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877
Concrete	m3	478,021	478,021	478,021	478,021	478,021	478,021	478,021	478,021	478,021	478,021
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	3.5									
MOL	EL.m	399.4	399.8	400	400.2	400.6	400.8	401	401.4	401.6	401.8
Waterway Diameter	m	6.1	6.3	6.4	6.5	6.7	6.8	6.9	7.1	7.2	7.3
Available Height	m	25.6	25.2	25	24.8	24.4	24.2	24	23.6	23.4	23.2

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	9,429	9,621	9,817	10,012	10,182	10,367	10,544	10,703	10,872	11,040
Concrete	m3	8,182	8,386	8,597	8,808	8,992	9,194	9,387	9,562	9,747	9,933
Reinforce Bar	t	327	335	344	352	360	368	375	382	390	397
Intake Gate	t	136	142	149	155	161	168	174	180	187	193
Intake Screen	t	76	79	83	86	90	93	97	100	104	107

(3) Power Tunnel

Tunnel Inner Diameter	m	6.1	6.3	6.4	6.5	6.7	6.8	6.9	7.1	7.2	7.3
Concerete Thickness	m	0.6									
Tunnel Length	m	137.3									
Number	-	1									

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	5,853	6,179	6,344	6,512	6,855	7,030	7,207	7,567	7,750	7,936
Lining Concrete	m3	1,841	1,899	1,927	1,956	2,014	2,043	2,073	2,131	2,160	2,189
Reinforce Bar	t	74	76	77	78	81	82	83	85	86	88

(3') Srevice Adit

Tunnel Length	m	1148

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	48,942	51,660	53,047	54,452	57,317	58,778	60,256	63,269	64,802	66,354

(4) Penstocks

Design Velocity 1	m/s	3.5									
Penstock Length 1	m	5									
Design Velocity 2	m/s	5.2									
Penstock Length 2	m	124.3									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	18.3									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	15									
Mean Velocity	m/s	5.844167									
Dm	m	4.734798	4.84622	4.952939	5.059559	5.161869	5.26426	5.362666	5.461293	5.55621	5.651461
tm	mm	22.15509	22.62939	23.08367	23.5217	23.95689	24.39242	24.79423	25.21344	25.5995	26.00407

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	4,498	4,669	4,835	5,004	5,169	5,336	5,500	5,667	5,829	5,995
Lining Concrete	m3	1,635	1,669	1,702	1,735	1,766	1,797	1,828	1,858	1,887	1,916
Reinforce Bar	t	20	20	20	21	21	22	22	22	23	23
Penstock	t	528	552	576	599	623	647	670	694	716	740

(5) Powerhouse Undergroundtype

A	m2	1034.552	1058.897	1082.215	1105.234	1127.583	1149.95	1171.151	1192.69	1213.114	1233.91
d	m	30									

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	68,280	69,887	71,426	72,945	74,420	75,897	77,296	78,718	80,066	81,438
Concrete	m3	15,518	15,883	16,233	16,579	16,914	17,249	17,567	17,890	18,197	18,509
Reinforce Bar	t	62	64	65	66	68	69	70	72	73	74

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	6.1	6.3	6.4	6.5	6.7	6.8	6.9	7.1	7.2	7.3
Concerete Thickness	m	0.6									
Tunnel Length	m	1480									
Number	-	1									

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	63,095	66,600	68,388	70,199	73,893	75,776	77,682	81,566	83,543	85,544
Lining Concrete	m3	19,843	20,465	20,776	21,088	21,714	22,027	22,341	22,970	23,285	23,600
Reinforce Bar	t	794	819	831	844	869	881	894	919	931	944

(7) Tailrace

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	6,202	6,440	6,626	6,813	7,046	7,231	7,413	7,647	7,827	8,008
Concrete	m3	2,061	2,175	2,265	2,357	2,473	2,567	2,659	2,780	2,874	2,969
Reinforce Bar	t	27	28	29	29	30	31	32	32	33	34

(8) P/H Access Tunnel

Tunnel Length	m	1975									

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875
Lining Concrete	m3	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750
Reinforce Bar	t	593	593	593	593	593	593	593	593	593	593

Civil Work Cost 1,000USD

Item	FSL=425									
	1	2	3	4	5	6	7	8	9	10
(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	48,202	48,202	48,202	48,202	48,202	48,202	48,202	48,202	48,202	48,202
Concrete	62,143	62,143	62,143	62,143	62,143	62,143	62,143	62,143	62,143	62,143
Others	22,069	22,069	22,069	22,069	22,069	22,069	22,069	22,069	22,069	22,069
(2)Intake										
Excavation	179	183	187	190	193	197	200	203	207	210
Concrete	982	1,006	1,032	1,057	1,079	1,103	1,126	1,147	1,170	1,192
Reinforce Bar	272	278	285	292	299	305	312	317	324	330
Others	358	367	376	385	393	401	410	417	425	433
(3)Power Tunnel										
Tunnel Excavation	410	432	444	456	480	492	504	530	543	556
Lining Concrete	258	266	270	274	282	286	290	298	302	307
Reinforce Bar	65	67	68	69	71	72	73	75	76	77
Others	110	115	117	120	125	128	130	135	138	141
(3')Service Adit										

Tunnel Excavation	3,426	3,616	3,713	3,812	4,012	4,114	4,218	4,429	4,536	4,645
(4)Penstock										
Tunnel Excavation	630	654	677	701	724	747	770	793	816	839
Lining Concrete	229	234	238	243	247	252	256	260	264	268
Reinforce Bar	19	19	19	20	20	20	21	21	22	22
Others	175	181	187	193	198	204	209	215	220	226
(5)Power House										
Excavation	4,097	4,193	4,286	4,377	4,465	4,554	4,638	4,723	4,804	4,886
Concrete	2,948	3,018	3,084	3,150	3,214	3,277	3,338	3,399	3,457	3,517
Reinforce Bar	55	56	57	58	60	61	62	63	64	65
Others	3,550	3,634	3,714	3,792	3,869	3,946	4,019	4,093	4,163	4,234
(6)Tailrace Tunnel										
Tunnel Excavation	4,732	4,995	5,129	5,265	5,542	5,683	5,826	6,117	6,266	6,416
Lining Concrete	3,770	3,888	3,948	4,007	4,126	4,185	4,245	4,364	4,424	4,484
Reinforce Bar	698	720	731	742	764	775	786	809	820	831
Others	2,760	2,881	2,942	3,004	3,130	3,193	3,257	3,387	3,453	3,519
(7)Tailrace										
Excavation	74	77	80	82	85	87	89	92	94	96
Concrete	268	283	295	306	322	334	346	361	374	386
Reinforce Bar	22	23	24	24	25	26	26	27	27	28
Others	91	96	99	103	108	112	115	120	124	128
(8)P/H Access Tunnel										
Tunnel Excavation	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219
Lining Concrete	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568
Reinforce Bar	521	521	521	521	521	521	521	521	521	521
Others	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862	1,862
(9)Miscellaneous Works	8,991	9,046	9,082	9,118	9,173	9,210	9,245	9,302	9,337	9,374
Total	188,806	189,965	190,720	191,476	192,641	193,400	194,148	195,335	196,085	196,844

Hydro- mechanical Works 1,000USD

Item	FSL=425									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	893	935	976	1,019	1,059	1,102	1,143	1,184	1,225	1,267
Screen	496	520	542	566	589	612	635	658	681	704
(3)Penstock	2,008	2,099	2,188	2,278	2,367	2,458	2,545	2,636	2,722	2,813
(4)Tailrace										
Gate	893	935	976	1,019	1,059	1,102	1,143	1,184	1,225	1,267
(5)Others	3,234	3,273	3,312	3,352	3,390	3,430	3,469	3,508	3,546	3,586
Total	19,402	19,640	19,874	20,110	20,342	20,580	20,811	21,048	21,278	21,515

Project Cost Summary 1,000USD

Item	FSL=425									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	3,776	3,799	3,814	3,830	3,853	3,868	3,883	3,907	3,922	3,937
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	40,960	40,960	40,960	40,960	40,960	40,960	40,960	40,960	40,960	40,960
3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	132,413	132,413	132,413	132,413	132,413	132,413	132,413	132,413	132,413	132,413
(3) Intake	1,791	1,834	1,880	1,925	1,964	2,007	2,048	2,085	2,125	2,164
(4) Power Tunnel	4,268	4,496	4,612	4,730	4,970	5,092	5,216	5,467	5,595	5,725
(5) Penstock	1,053	1,088	1,121	1,156	1,189	1,223	1,256	1,290	1,322	1,355
(6) Power House	10,650	10,901	11,141	11,377	11,608	11,838	12,056	12,278	12,488	12,702
(7) Tailrace Tunnel	11,961	12,485	12,750	13,018	13,562	13,837	14,115	14,677	14,962	15,250
(8) Tailrace	456	479	497	516	539	558	576	600	619	638
(9)P/S Access Tunnel	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170	11,170
(10) Others	8,991	9,046	9,082	9,118	9,173	9,210	9,245	9,302	9,337	9,374
4. Hydro- Mechanical Works	19,402	19,640	19,874	20,110	20,342	20,580	20,811	21,048	21,278	21,515
5. Electro- Mechanical Works	38,948	40,217	41,260	42,504	43,721	44,722	45,921	47,093	48,071	49,218
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	302,061	304,751	306,797	309,050	311,687	313,700	315,893	318,512	320,485	322,643
7. Administration Fee	45,309	45,713	46,020	46,357	46,753	47,055	47,384	47,777	48,073	48,396
8. Preliminary Cost	30,206	30,475	30,680	30,905	31,169	31,370	31,589	31,851	32,049	32,264
9. Interest During Construction	75,515	76,188	76,699	77,262	77,922	78,425	78,973	79,628	80,121	80,661
Total	453,092	457,126	460,195	463,575	467,530	470,551	473,839	477,768	480,728	483,964

Basic Parameters OP3a- 435

Waterway Length		
Headrace Tunnel	m	137.3
Penstock	m	162.6
Tailrace Tunnel	m	1480
	m	1779.9
Sedimentation Level	m	386.2

Specification

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	124.6	129.5	134.4	139.4	144.3	149.2	154.1	159.1	164	168.9
FSL	EL.m	435	435	435	435	435	435	435	435	435	435
MOL	EL.m	400.6	401	401.2	401.4	401.6	402	402.2	402.4	402.6	402.8
TWL	EL.m	289.1	289.2	289.2	289.2	289.3	289.3	289.3	289.4	289.4	289.4
Loss	m	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Effective Head	m	142.5	142.4	142.4	142.4	142.3	142.3	142.3	142.2	142.2	142.2
Pmax	MW	158	165	171	177	183	189	196	202	208	214
Primary Energy	GWh	293.48	303.28	309.44	313.95	318.67	328.98	339.00	349.20	354.14	359.26
Pfirm	MW	95.14	99.32	103.36	107.50	108.88	93.35	87.07	77.79	73.70	68.38
Benefit	1000USD	81,445	84,466	86,790	88,847	90,112	87,296	87,211	86,255	85,914	85,236
Cost	1000USD	54,068	54,491	54,818	55,145	55,468	55,856	56,203	56,523	56,838	57,153
B/C		1.51	1.55	1.58	1.61	1.62	1.56	1.55	1.53	1.51	1.49

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood		m3/s	8,306
Dam Basis EL.		m	293
Non- overflow Width		m	80.2
Spillway Width		m	77
Sand Drain Width		m	16
Intake Width		m	0
Dam Height (Hd)		m	147
Crest Length (L)		m	173.2
Coefficient for Ex	Y=A*X^B		
	A		32335
	B		0.4384
Coefficient for Conc	Y=C*X^D		
	C		0.0015
	D		1.3058

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876
Concrete	m3	574,583	574,583	574,583	574,583	574,583	574,583	574,583	574,583	574,583	574,583
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	3.5									
MOL	EL.m	400.6	401	401.2	401.4	401.6	402	402.2	402.4	402.6	402.8
Waterway Diameter	m	6.7	6.9	7	7.1	7.2	7.4	7.5	7.6	7.7	7.8
Available Height	m	34.4	34	33.8	33.6	33.4	33	32.8	32.6	32.4	32.2

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	11,815	12,016	12,226	12,436	12,637	12,818	13,011	13,204	13,389	13,570
Concrete	m3	10,797	11,023	11,261	11,499	11,728	11,936	12,157	12,379	12,592	12,803
Reinforce Bar	t	432	441	450	460	469	477	486	495	504	512
Intake Gate	t	169	176	183	189	196	203	209	216	222	229
Intake Screen	t	94	98	101	105	109	113	116	120	124	127

(3) Power Tunnel

Tunnel Inner Diameter	m	6.7	6.9	7	7.1	7.2	7.4	7.5	7.6	7.7	7.8
Concerete Thickness	m	0.6									
Tunnel Length	m	137.3									
Number	-	1									

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	6,855	7,207	7,386	7,567	7,750	8,124	8,314	8,506	8,700	8,897
Lining Concrete	m3	2,014	2,073	2,102	2,131	2,160	2,219	2,248	2,277	2,307	2,336
Reinforce Bar	t	81	83	84	85	86	89	90	91	92	93

(3') Srevice Adit

Tunnel Length	m	1148

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	57,317	60,256	61,753	63,269	64,802	67,925	69,514	71,121	72,746	74,390

(4) Penstocks

Design Velocity 1	m/s	3.5									
Penstock Length 1	m	5									
Design Velocity 2	m/s	5.2									
Penstock Length 2	m	124.3									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	18.3									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	15									
Mean Velocity	m/s	5.844167									
Dm	m	5.210181	5.31164	5.411198	5.510933	5.606953	5.701356	5.794221	5.887472	5.977446	6.066086
tm	mm	25.79318	26.23988	26.69422	27.14936	27.57001	28.00052	28.42402	28.83086	29.2409	29.64485

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	5,247	5,415	5,582	5,751	5,917	6,082	6,247	6,415	6,579	6,742
Lining Concrete	m3	1,781	1,812	1,842	1,873	1,902	1,931	1,960	1,988	2,016	2,043
Reinforce Bar	t	21	22	22	22	23	23	24	24	24	25
Penstock	t	677	702	728	754	779	804	830	855	880	906

(5) Powerhouse Undergroundtype

A	m2	1166.077	1188.506	1210.783	1233.099	1254.29	1275.409	1296.183	1316.735	1336.858	1356.682
d	m	30									

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	76,961	78,441	79,912	81,385	82,783	84,177	85,548	86,904	88,233	89,541
Concrete	m3	17,491	17,828	18,162	18,496	18,814	19,131	19,443	19,751	20,053	20,350
Reinforce Bar	t	700	713	726	740	753	765	778	790	802	814

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	6.7	6.9	7	7.1	7.2	7.4	7.5	7.6	7.7	7.8
Concerete Thickness	m	0.6									
Tunnel Length	m	1480									
Number	-	1									

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	73,893	77,682	79,612	81,566	83,543	87,569	89,617	91,689	93,785	95,904
Lining Concrete	m3	21,714	22,341	22,655	22,970	23,285	23,916	24,233	24,549	24,867	25,184
Reinforce Bar	t	869	894	906	919	931	957	969	982	995	1,007

(7) Tailrace

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	7,110	7,345	7,529	7,714	7,895	8,128	8,308	8,490	8,668	8,846
Concrete	m3	2,505	2,624	2,719	2,815	2,910	3,033	3,130	3,228	3,325	3,423
Reinforce Bar	t	30	31	32	33	33	34	35	35	36	37

(8) P/H Access Tunnel

Tunnel Length m 1975

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875	88,875
Lining Concrete	m3	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750
Reinforce Bar	t	5,925	5,925	5,925	5,925	5,925	5,925	5,925	5,925	5,925	5,925

Civil Work Cost 1,000USD

Item	FSL=435									
	1	2	3	4	5	6	7	8	9	10
(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	49,714	49,714	49,714	49,714	49,714	49,714	49,714	49,714	49,714	49,714
Concrete	74,696	74,696	74,696	74,696	74,696	74,696	74,696	74,696	74,696	74,696
Others	24,882	24,882	24,882	24,882	24,882	24,882	24,882	24,882	24,882	24,882
(2)Intake										
Excavation	224	228	232	236	240	244	247	251	254	258
Concrete	1,296	1,323	1,351	1,380	1,407	1,432	1,459	1,485	1,511	1,536
Reinforce Bar	358	366	374	382	389	396	404	411	418	425
Others	470	479	489	499	509	518	527	537	546	555
(3)Power Tunnel										
Tunnel Excavation	480	504	517	530	543	569	582	595	609	623
Lining Concrete	282	290	294	298	302	311	315	319	323	327
Reinforce Bar	71	73	74	75	76	78	79	80	81	82
Others	125	130	133	135	138	144	146	149	152	155
(3')Service Adit										

Tunnel Excavation	4,012	4,218	4,323	4,429	4,536	4,755	4,866	4,978	5,092	5,207
(4)Penstock										
Tunnel Excavation	735	758	781	805	828	852	875	898	921	944
Lining Concrete	249	254	258	262	266	270	274	278	282	286
Reinforce Bar	20	21	21	21	22	22	22	23	23	23
Others	201	206	212	218	223	229	234	240	245	251
(5)Power House										
Excavation	4,618	4,706	4,795	4,883	4,967	5,051	5,133	5,214	5,294	5,372
Concrete	3,323	3,387	3,451	3,514	3,575	3,635	3,694	3,753	3,810	3,867
Reinforce Bar	616	628	639	651	662	673	684	695	706	716
Others	4,278	4,361	4,442	4,524	4,602	4,679	4,756	4,831	4,905	4,978
(6)Tailrace Tunnel										
Tunnel Excavation	5,542	5,826	5,971	6,117	6,266	6,568	6,721	6,877	7,034	7,193
Lining Concrete	4,126	4,245	4,304	4,364	4,424	4,544	4,604	4,664	4,725	4,785
Reinforce Bar	764	786	797	809	820	842	853	864	875	886
Others	3,130	3,257	3,322	3,387	3,453	3,586	3,654	3,722	3,790	3,859
(7)Tailrace										
Excavation	85	88	90	93	95	98	100	102	104	106
Concrete	326	341	353	366	378	394	407	420	432	445
Reinforce Bar	25	26	27	27	28	28	29	29	30	30
Others	109	114	118	121	125	130	134	138	142	145
(8)P/H Access Tunnel										
Tunnel Excavation	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219	6,219
Lining Concrete	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568	2,568
Reinforce Bar	5,214	5,214	5,214	5,214	5,214	5,214	5,214	5,214	5,214	5,214
Others	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800
(9)Miscellaneous Works	10,381	10,438	10,476	10,514	10,551	10,610	10,647	10,685	10,723	10,760
Total	217,991	219,200	219,991	220,788	221,572	222,802	223,592	224,384	225,173	225,962

Hydro- mechanical Works 1,000USD

Item	FSL=435									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	1,113	1,157	1,200	1,244	1,288	1,331	1,374	1,418	1,461	1,505
Screen	619	643	667	691	715	739	763	788	812	836
(3)Penstock	2,572	2,668	2,765	2,864	2,959	3,056	3,152	3,249	3,345	3,442
(4)Tailrace										
Gate	1,113	1,157	1,200	1,244	1,288	1,331	1,374	1,418	1,461	1,505
(5)Others	3,459	3,500	3,542	3,584	3,625	3,667	3,708	3,750	3,792	3,833
Total	20,754	21,001	21,251	21,505	21,752	22,000	22,249	22,501	22,749	22,998

Project Cost Summary 1,000USD

Item	FSL=435									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	4,360	4,384	4,400	4,416	4,431	4,456	4,472	4,488	4,503	4,519
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	61,990	61,990	61,990	61,990	61,990	61,990	61,990	61,990	61,990	61,990
3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	149,292	149,292	149,292	149,292	149,292	149,292	149,292	149,292	149,292	149,292
(3) Intake	2,348	2,396	2,447	2,497	2,546	2,590	2,637	2,684	2,729	2,774
(4) Power Tunnel	4,970	5,216	5,341	5,467	5,595	5,856	5,988	6,122	6,257	6,394
(5) Penstock	1,205	1,239	1,272	1,307	1,340	1,373	1,406	1,439	1,472	1,504
(6) Power House	12,835	13,082	13,327	13,573	13,806	14,038	14,267	14,493	14,715	14,933
(7) Tailrace Tunnel	13,562	14,115	14,395	14,677	14,962	15,540	15,832	16,127	16,424	16,724
(8) Tailrace	545	569	588	607	626	650	669	689	708	727
(9)P/S Access Tunnel	16,801	16,801	16,801	16,801	16,801	16,801	16,801	16,801	16,801	16,801
(10) Others	10,381	10,438	10,476	10,514	10,551	10,610	10,647	10,685	10,723	10,760
4. Hydro- Mechanical Works	20,754	21,001	21,251	21,505	21,752	22,000	22,249	22,501	22,749	22,998
5. Electro- Mechanical Works	45,190	46,529	47,652	48,762	49,872	50,958	52,211	53,286	54,338	55,380
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	360,455	363,273	365,453	367,630	369,787	372,376	374,684	376,818	378,923	381,018
7. Administration Fee	54,068	54,491	54,818	55,145	55,468	55,856	56,203	56,523	56,838	57,153
8. Preliminary Cost	36,045	36,327	36,545	36,763	36,979	37,238	37,468	37,682	37,892	38,102
9. Interest During Construction	90,114	90,818	91,363	91,908	92,447	93,094	93,671	94,205	94,731	95,254
Total	540,682	544,910	548,180	551,446	554,681	558,564	562,026	565,227	568,385	571,527

Option IIIb

Basic Parameters OP3b3- 405

Waterway Length		
Headrace Tunnel	m	1074.8
Penstock	m	162.6
Tailrace Tunnel	m	247.2
	m	1484.6
Sedimentation Level	EL.m	386.2

Specification

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	65.4	70.2	75	79.8	84.6	89.3	94.1	98.9	103.7	108.5
FSL	EL.m	405	405	405	405	405	405	405	405	405	405
MOL	EL.m	396.4	396.6	397	397.2	397.6	397.8	398.2	398.4	398.6	399
TWL	EL.m	288.6	288.7	288.7	288.8	288.8	288.9	288.9	288.9	289	289
Loss	m	3	3	3	3	3	3	3	3	3	3
Effective Head	m	113.4	113.3	113.3	113.2	113.2	113.1	113.1	113.1	113	113
Pmax	MW	66	71	76	81	85	90	95	100	105	109
Primary Energy	GWh	136.55	146.23	155.91	165.22	174.08	182.57	190.96	198.94	206.13	213.00
Pfirm	MW	54.56	58.65	62.97	67.10	69.85	73.87	68.27	61.09	55.14	51.98
Benefit	1000USD	40,991	43,963	47,005	49,923	52,345	55,083	54,908	54,185	53,690	53,976
Cost	1000USD	35,311	35,665	36,092	36,480	36,861	37,238	37,660	38,024	38,385	38,764
B/C		1.16	1.23	1.30	1.37	1.42	1.48	1.46	1.43	1.40	1.39

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	117
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877	2,498,877
Concrete	m3	316,564	316,564	316,564	316,564	316,564	316,564	316,564	316,564	316,564	316,564
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	4									
MOL	EL.m	396.4	396.6	397	397.2	397.6	397.8	398.2	398.4	398.6	399
Waterway Diameter	m	4.6	4.7	4.9	5	5.2	5.3	5.5	5.6	5.7	5.9
Available Height	m	8.6	8.4	8	7.8	7.4	7.2	6.8	6.6	6.4	6

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	4,851	5,007	5,135	5,277	5,390	5,516	5,617	5,735	5,848	5,932
Concrete	m3	3,612	3,755	3,875	4,006	4,113	4,231	4,326	4,438	4,546	4,627
Reinforce Bar	t	144	150	155	160	165	169	173	178	182	185
Intake Gate	t	78	84	90	95	101	106	112	118	123	129
Intake Screen	t	44	47	50	53	56	59	62	65	68	71

(3) Power Tunnel

Tunnel Inner Diameter	m	4.6	4.7	4.9	5	5.2	5.3	5.5	5.6	5.7	5.9
Concerete Thickness	m	0.6									
Tunnel Length	m	1074.8									
Number	-	1									

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	28,925	29,931	31,995	33,052	35,219	36,328	38,598	39,759	40,937	43,345
Lining Concrete	m3	11,063	11,284	11,727	11,949	12,393	12,616	13,063	13,287	13,511	13,960
Reinforce Bar	t	443	451	469	478	496	505	523	531	540	558

(3') Srevice Adit

Tunnel Length	m	1055

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	28,392	29,380	31,405	32,443	34,570	35,659	37,887	39,027	40,183	42,546

(4) Penstocks

Design Velocity 1	m/s	4									
Penstock Length 1	m	5									
Design Velocity 2	m/s	4.47									
Penstock Length 2	m	124.2									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	25.8									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	7.6									
Mean Velocity	m/s	5.083373									
Dm	m	4.047324	4.19322	4.334208	4.470752	4.603247	4.729387	4.854829	4.97711	5.096458	5.213075
tm	mm	16.7457	17.26412	17.77734	18.26039	18.74229	19.18626	19.64211	20.08647	20.50422	20.92763

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	3,516	3,715	3,911	4,107	4,301	4,490	4,682	4,873	5,063	5,252
Lining Concrete	m3	1,424	1,469	1,512	1,554	1,595	1,633	1,672	1,709	1,746	1,782
Reinforce Bar	t	17	18	18	19	19	20	20	21	21	21
Penstock	t	327	349	372	394	416	438	460	483	504	527

(5) Powerhouse Undergroundtype

A	m2	782.8704	810.8525	838.1156	864.265	889.8784	913.9938	938.2365	961.8684	984.6431	1007.174
d	m	30									

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	51,669	53,516	55,316	57,041	58,732	60,324	61,924	63,483	64,986	66,473
Concrete	m3	11,743	12,163	12,572	12,964	13,348	13,710	14,074	14,428	14,770	15,108
Reinforce Bar	t	470	487	503	519	534	548	563	577	591	604

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	4.9	5.1	5.2	5.4	5.5	5.7	5.9	6	6.1	6.3
Concerete Thickness	m	0.6									
Tunnel Length	m	247.2									
Number	-	1									

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	7,359	7,849	8,100	8,614	8,877	9,415	9,969	10,252	10,539	11,124
Lining Concrete	m3	2,697	2,799	2,850	2,953	3,004	3,107	3,211	3,262	3,314	3,418
Reinforce Bar	t	108	112	114	118	120	124	128	130	133	137

(7) Tailrace

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	4,494	4,739	4,938	5,179	5,373	5,610	5,848	6,037	6,225	6,460
Concrete	m3	1,301	1,404	1,489	1,594	1,680	1,786	1,895	1,984	2,072	2,185
Reinforce Bar	t	21	22	22	23	24	25	26	26	27	28

(8) P/H Access Tunnel

Tunnel Length	m	1220									

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900
Lining Concrete	m3	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200
Reinforce Bar	t	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660

(9) Surge Tank

LWL	EL.m	396.4	396.6	397	397.2	397.6	397.8	398.2	398.4	398.6	399
Available Depth	m	8.6	8.4	8	7.8	7.4	7.2	6.8	6.6	6.4	6
Number of waterway	-	1									

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	14,258	15,304	16,349	17,394	18,439	19,462	20,506	21,551	22,596	23,640
Concrete	m3	4,127	4,430	4,733	5,035	5,338	5,634	5,936	6,239	6,541	6,843
Reinforce Bar	t	206	222	237	252	267	282	297	312	327	342

(9') Srevice Adit

Tunnel Length	m	960									

Item	Unit	FSL=405									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	25,836	26,734	28,577	29,522	31,457	32,448	34,476	35,512	36,564	38,715

Civil Work Cost 1,000USD

Item	FSL=405									
	1	2	3	4	5	6	7	8	9	10
(1) Concrete Dam										

(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	44,980	44,980	44,980	44,980	44,980	44,980	44,980	44,980	44,980	44,980
Concrete	41,153	41,153	41,153	41,153	41,153	41,153	41,153	41,153	41,153	41,153
Others	17,227	17,227	17,227	17,227	17,227	17,227	17,227	17,227	17,227	17,227
(2)Intake										
Excavation	92	95	98	100	102	105	107	109	111	113
Concrete	433	451	465	481	494	508	519	533	546	555
Reinforce Bar	120	125	129	133	137	140	144	147	151	154
Others	161	168	173	178	183	188	192	197	202	205
(3)Power Tunnel										
Tunnel Excavation	2,025	2,095	2,240	2,314	2,465	2,543	2,702	2,783	2,866	3,034
Lining Concrete	1,549	1,580	1,642	1,673	1,735	1,766	1,829	1,860	1,891	1,954
Reinforce Bar	389	397	413	421	436	444	460	468	476	491
Others	594	611	.644	661	695	713	749	767	785	822
(3')Service Adit										
Tunnel Excavation	1,987	2,057	2,198	2,271	2,420	2,496	2,652	2,732	2,813	2,978
Others	397	411	440	454	484	499	530	546	563	596
(4)Penstock										
Tunnel Excavation	492	520	548	575	602	629	655	682	709	735
Lining Concrete	199	206	212	218	223	229	234	239	244	249
Reinforce Bar	16	17	17	18	18	19	19	19	20	20
Others	142	148	155	162	169	175	182	188	195	201
(5)Power House										
Excavation	3,100	3,211	3,319	3,422	3,524	3,619	3,715	3,809	3,899	3,988
Concrete	2,231	2,311	2,389	2,463	2,536	2,605	2,674	2,741	2,806	2,870
Reinforce Bar	413	428	443	456	470	483	495	508	520	532
Others	2,872	2,975	3,075	3,171	3,265	3,353	3,442	3,529	3,613	3,695
(6)Tailrace Tunnel										
Tunnel Excavation	552	589	608	646	666	706	748	769	790	834
Lining Concrete	512	532	542	561	571	590	610	620	630	649
Reinforce Bar	95	99	100	104	106	109	113	115	117	120
Others	348	366	375	393	403	422	441	451	461	481
(7)Tailrace										
Excavation	54	57	59	62	64	67	70	72	75	78
Concrete	169	183	194	207	218	232	246	258	269	284
Reinforce Bar	17	18	18	19	20	21	21	22	23	23
Others	60	64	68	72	76	80	84	88	92	96
(8)P/H Access Tunnel										
Tunnel Excavation	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842
Lining Concrete	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586
Reinforce Bar	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221
Others	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730
(9)Surge Tank										
Excavation	1,996	2,143	2,289	2,435	2,581	2,725	2,871	3,017	3,163	3,310
Concrete	764	820	876	932	987	1,042	1,098	1,154	1,210	1,266
Reinforce Bar	206	222	237	252	267	282	297	312	327	342
Others	593	637	680	724	767	810	853	897	940	984
(9') Service Adit										
Tunnel Excavation	1,808	1,871	2,000	2,066	2,201	2,271	2,413	2,485	2,559	2,709
Others	362	374	400	413	440	454	483	497	512	542
(10)Miscellaneous Works	7,227	6,975	7,018	7,051	7,094	7,127	7,171	7,202	7,233	7,278
Total	151,770	152,543	153,850	154,900	156,212	157,243	158,612	159,609	160,600	161,982

Hydro- mechanical Works

1,000USD

Item	FSL=405									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	515	552	589	626	663	699	735	772	809	845
Screen	286	307	327	348	368	388	409	429	449	469
(3)Penstock	1,243	1,328	1,413	1,497	1,583	1,664	1,749	1,834	1,917	2,001
(4)Tailrace										
Gate	515	552	589	626	663	699	735	772	809	845
(5)Others	2,887	2,923	2,959	2,995	3,031	3,066	3,101	3,137	3,172	3,208
Total	17,325	17,541	17,756	17,971	18,185	18,394	18,607	18,822	19,034	19,245

Project Cost Summary

1,000USD

Item	FSL=405									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	3,035	3,051	3,077	3,098	3,124	3,145	3,172	3,192	3,212	3,240
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280
3. Civil Works										

(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	103,360	103,360	103,360	103,360	103,360	103,360	103,360	103,360	103,360	103,360
(3) Intake	807	838	864	892	916	941	962	986	1,010	1,027
(4) Power Tunnel	6,545	6,739	7,137	7,339	7,752	7,962	8,391	8,609	8,830	9,280
(5) Penstock	850	891	932	972	1,012	1,051	1,090	1,129	1,168	1,206
(6) Power House	8,617	8,925	9,225	9,513	9,795	10,060	10,327	10,587	10,838	11,086
(7) Tailrace Tunnel	1,507	1,585	1,624	1,704	1,745	1,828	1,912	1,955	1,998	2,085
(8) Tailrace	300	322	339	361	378	400	422	440	458	481
(9)P/S Access Tunnel	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378
(10) Surge Tank	5,729	6,065	6,481	6,821	7,245	7,583	8,014	8,362	8,711	9,152
(11) Others	7,227	6,975	7,018	7,051	7,094	7,127	7,171	7,202	7,233	7,278
4. Hydro- Mechanical Works	17,325	17,541	17,756	17,971	18,185	18,394	18,607	18,822	19,034	19,245
5. Electro- Mechanical Works	27,225	28,594	29,924	31,234	32,256	33,521	34,753	35,965	37,167	38,107
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	235,407	237,766	240,617	243,198	245,742	248,253	251,064	253,490	255,899	258,427
7. Administration Fee	35,311	35,665	36,092	36,480	36,861	37,238	37,660	38,024	38,385	38,764
8. Preliminary Cost	23,541	23,777	24,062	24,320	24,574	24,825	25,106	25,349	25,590	25,843
9. Interest During Construction	58,852	59,442	60,154	60,799	61,435	62,063	62,766	63,373	63,975	64,607
Total	353,110	356,650	360,925	364,797	368,613	372,380	376,595	380,235	383,849	387,641

Basic Parameters OP3b3- 410

Waterway Length		
Headrace Tunnel	m	1074.8
Penstock	m	162.6
Tailrace Tunnel	m	247.2
	m	1484.6
Sedimentation Level	EL.m	386.2

Specification

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	73.7	78.2	82.8	87.3	91.9	96.4	101	105.5	110.1	114.6
FSL	EL.m	410	410	410	410	410	410	410	410	410	410
MOL	EL.m	396.8	397.2	397.4	397.8	398	398.2	398.6	398.8	399	399.2
TWL	EL.m	288.7	288.8	288.8	288.8	288.9	288.9	289	289	289	289.1
Loss	m	3	3	3	3	3	3	3	3	3	3
Effective Head	m	118.3	118.2	118.2	118.2	118.1	118.1	118	118	118	117.9
Pmax	MW	78	82	87	92	97	102	106	111	116	121
Primary Energy	GWh	157.85	166.65	176.07	185.27	194.02	202.38	210.26	218.00	225.33	231.64
Pfirm	MW	60.98	64.95	68.94	72.05	74.64	78.51	82.63	75.67	66.37	65.09
Benefit	1000USD	46,756	49,534	52,430	55,021	57,375	60,044	62,702	62,002	60,523	61,274
Cost	1000USD	37,515	37,843	38,219	38,627	38,997	39,352	39,728	40,078	40,428	40,781
B/C		1.25	1.31	1.37	1.42	1.47	1.53	1.58	1.55	1.50	1.50

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	122
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144	2,545,144
Concrete	m3	353,122	353,122	353,122	353,122	353,122	353,122	353,122	353,122	353,122	353,122
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	4									
MOL	EL.m	396.8	397.2	397.4	397.8	398	398.2	398.6	398.8	399	399.2
Waterway Diameter	m	4.8	5	5.1	5.3	5.4	5.5	5.7	5.8	5.9	6
Available Height	m	13.2	12.8	12.6	12.2	12	11.8	11.4	11.2	11	10.8

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	6,013	6,160	6,320	6,453	6,602	6,742	6,861	6,992	7,122	7,244
Concrete	m3	4,705	4,846	5,002	5,131	5,277	5,416	5,533	5,663	5,793	5,916
Reinforce Bar	t	188	194	200	205	211	217	221	227	232	237
Intake Gate	t	91	97	103	108	114	119	125	130	136	141
Intake Screen	t	51	54	57	60	63	66	69	72	75	78

(3) Power Tunnel

Tunnel Inner Diameter	m	4.8	5	5.1	5.3	5.4	5.5	5.7	5.8	5.9	6
Concerete Thickness	m	0.6									
Tunnel Length	m	1074.8									
Number	-	1									

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	30,954	33,052	34,127	36,328	37,455	38,598	40,937	42,132	43,345	44,574
Lining Concrete	m3	11,505	11,949	12,171	12,616	12,839	13,063	13,511	13,735	13,960	14,185
Reinforce Bar	t	460	478	487	505	514	523	540	549	558	567

(3') Srevice Adit

Tunnel Length	m	1055

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	30,384	32,443	33,498	35,659	36,765	37,887	40,183	41,356	42,546	43,753

(4) Penstocks

Design Velocity 1	m/s	4									
Penstock Length 1	m	5									
Design Velocity 2	m/s	4.47									
Penstock Length 2	m	124.2									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	25.8									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	7.6									
Mean Velocity	m/s	5.083373									
Dm	m	4.29648	4.425705	4.554013	4.676126	4.797742	4.913802	5.029673	5.1405	5.251372	5.357614
tm	mm	18.3124	18.78918	19.27592	19.73916	20.1855	20.62542	21.04888	21.46861	21.88852	22.27412

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	3,858	4,042	4,228	4,410	4,594	4,773	4,956	5,134	5,315	5,492
Lining Concrete	m3	1,501	1,540	1,580	1,617	1,654	1,690	1,725	1,759	1,793	1,826
Reinforce Bar	t	18	18	19	19	20	20	21	21	22	22
Penstock	t	380	401	424	446	467	489	511	533	555	576

(5) Powerhouse Undergroundtype

A	m2	842.8662	867.9723	893.1361	917.085	940.6709	963.4263	985.8663	1007.589	1029.321	1049.849
d	m	30									

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	55,629	57,286	58,947	60,528	62,084	63,586	65,067	66,501	67,935	69,290
Concrete	m3	12,643	13,020	13,397	13,756	14,110	14,451	14,788	15,114	15,440	15,748
Reinforce Bar	t	506	521	536	550	564	578	592	605	618	630

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	5.2	5.3	5.5	5.6	5.8	5.9	6.1	6.2	6.3	6.5
Concerete Thickness	m	0.6									
Tunnel Length	m	247.2									
Number	-	1									

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	8,100	8,355	8,877	9,144	9,690	9,969	10,539	10,829	11,124	11,725
Lining Concrete	m3	2,850	2,902	3,004	3,056	3,159	3,211	3,314	3,366	3,418	3,522
Reinforce Bar	t	114	116	120	122	126	128	133	135	137	141

(7) Tailrace

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	4,897	5,084	5,318	5,502	5,735	5,916	6,147	6,326	6,506	6,732
Concrete	m3	1,471	1,552	1,655	1,737	1,843	1,927	2,035	2,120	2,207	2,317
Reinforce Bar	t	22	23	24	24	25	26	27	28	28	29

(8) P/H Access Tunnel

Tunnel Length	m	1220									

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900
Lining Concrete	m3	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200
Reinforce Bar	t	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660

(9) Surge Tank

LWL	EL.m	396.8	397.2	397.4	397.8	398	398.2	398.6	398.8	399	399.2
Available Depth	m	13.2	12.8	12.6	12.2	12	11.8	11.4	11.2	11	10.8
Number of waterway	-	1									

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	16,085	17,065	18,068	19,048	20,051	21,032	22,033	23,014	24,016	24,997
Concrete	m3	4,656	4,940	5,230	5,514	5,804	6,088	6,378	6,662	6,952	7,236
Reinforce Bar	t	233	247	262	276	290	304	319	333	348	362

(9') Srevice Adit

Tunnel Length	m	960									

Item	Unit	FSL=410									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	27,648	29,522	30,482	32,448	33,454	34,476	36,564	37,632	38,715	39,813

Civil Work Cost 1,000USD

Item	FSL=410									
	1	2	3	4	5	6	7	8	9	10

(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	45,813	45,813	45,813	45,813	45,813	45,813	45,813	45,813	45,813	45,813
Concrete	45,906	45,906	45,906	45,906	45,906	45,906	45,906	45,906	45,906	45,906
Others	18,344	18,344	18,344	18,344	18,344	18,344	18,344	18,344	18,344	18,344
(2)Intake										
Excavation	114	117	120	123	125	128	130	133	135	138
Concrete	565	582	600	616	633	650	664	680	695	710
Reinforce Bar	156	161	166	170	175	180	184	188	192	196
Others	209	215	222	227	233	239	245	250	256	261
(3)Power Tunnel										
Tunnel Excavation	2,167	2,314	2,389	2,543	2,622	2,702	2,866	2,949	3,034	3,120
Lining Concrete	1,611	1,673	1,704	1,766	1,798	1,829	1,891	1,923	1,954	1,986
Reinforce Bar	405	421	428	444	452	460	476	483	491	499
Others	627	661	678	713	731	749	785	803	822	841
(3')Service Adit										
Tunnel Excavation	2,127	2,271	2,345	2,496	2,574	2,652	2,813	2,895	2,978	3,063
Others	425	454	469	499	515	530	563	579	596	613
(4)Penstock										
Tunnel Excavation	540	566	592	617	643	668	694	719	744	769
Lining Concrete	210	216	221	226	232	237	242	246	251	256
Reinforce Bar	17	18	18	18	19	19	20	20	20	21
Others	153	160	166	172	179	185	191	197	203	209
(5)Power House										
Excavation	3,338	3,437	3,537	3,632	3,725	3,815	3,904	3,990	4,076	4,157
Concrete	2,402	2,474	2,545	2,614	2,681	2,746	2,810	2,872	2,934	2,992
Reinforce Bar	445	458	472	484	497	509	521	532	543	554
Others	3,092	3,185	3,277	3,365	3,451	3,535	3,617	3,697	3,777	3,852
(6)Tailrace Tunnel										
Tunnel Excavation	608	627	666	686	727	748	790	812	834	879
Lining Concrete	542	551	571	581	600	610	630	640	649	669
Reinforce Bar	100	102	106	108	111	113	117	118	120	124
Others	375	384	403	412	431	441	461	471	481	502
(7)Tailrace										
Excavation	59	61	64	66	69	71	74	76	78	81
Concrete	191	202	215	226	240	250	265	276	287	301
Reinforce Bar	18	19	20	20	21	22	22	23	23	24
Others	67	70	75	78	82	86	90	94	97	102
(8)P/H Access Tunnel										
Tunnel Excavation	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842
Lining Concrete	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586
Reinforce Bar	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221
Others	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730
(9)Surge Tank										
Excavation	2,252	2,389	2,530	2,667	2,807	2,944	3,085	3,222	3,362	3,500
Concrete	861	914	968	1,020	1,074	1,126	1,180	1,232	1,286	1,339
Reinforce Bar	233	247	262	276	290	304	319	333	348	362
Others	669	710	752	793	834	875	917	958	999	1,040
(9') Service Adit										
Tunnel Excavation	1,935	2,066	2,133	2,271	2,341	2,413	2,559	2,633	2,709	2,786
Others	387	413	427	454	468	483	512	527	542	557
(10)Miscellaneous Works	7,670	7,395	7,428	7,470	7,503	7,533	7,578	7,608	7,638	7,671
Total	161,064	162,024	163,060	164,346	165,377	166,345	167,704	168,672	169,652	170,666

Hydro- mechanical Works 1,000USD

Item	FSL=410									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	601	637	674	709	746	782	819	855	891	927
Screen	334	354	374	394	415	435	455	475	495	515
(3)Penstock	1,443	1,525	1,610	1,693	1,776	1,859	1,942	2,024	2,108	2,189
(4)Tailrace										
Gate	601	637	674	709	746	782	819	855	891	927
(5)Others	2,971	3,006	3,042	3,077	3,112	3,147	3,182	3,217	3,253	3,287
Total	17,827	18,036	18,251	18,461	18,674	18,883	19,094	19,303	19,516	19,723

Project Cost Summary 1,000USD

Item	FSL=410									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	3,221	3,240	3,261	3,287	3,308	3,327	3,354	3,373	3,393	3,413
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	28,230	28,230	28,230	28,230	28,230	28,230	28,230	28,230	28,230	28,230

3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	110,062	110,062	110,062	110,062	110,062	110,062	110,062	110,062	110,062	110,062
(3) Intake	1,044	1,074	1,108	1,136	1,167	1,197	1,223	1,251	1,278	1,305
(4) Power Tunnel	6,937	7,339	7,544	7,962	8,175	8,391	8,830	9,054	9,280	9,509
(5) Penstock	921	959	997	1,035	1,072	1,109	1,146	1,182	1,219	1,254
(6) Power House	9,277	9,554	9,831	10,094	10,354	10,604	10,851	11,091	11,330	11,556
(7) Tailrace Tunnel	1,624	1,664	1,745	1,786	1,870	1,912	1,998	2,041	2,085	2,174
(8) Tailrace	335	352	373	390	412	429	451	468	485	508
(9)P/S Access Tunnel	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378
(10) Surge Tank	6,337	6,739	7,070	7,480	7,815	8,145	8,571	8,905	9,246	9,583
(11) Others	7,670	7,395	7,428	7,470	7,503	7,533	7,578	7,608	7,638	7,671
4. Hydro- Mechanical Works	17,827	18,036	18,251	18,461	18,674	18,883	19,094	19,303	19,516	19,723
5. Electro- Mechanical Works	30,011	31,039	32,291	33,519	34,735	35,921	36,866	38,018	39,154	40,285
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	250,098	252,285	254,794	257,513	259,977	262,345	264,855	267,188	269,519	271,874
7. Administration Fee	37,515	37,843	38,219	38,627	38,997	39,352	39,728	40,078	40,428	40,781
8. Preliminary Cost	25,010	25,228	25,479	25,751	25,998	26,235	26,485	26,719	26,952	27,187
9. Interest During Construction	62,525	63,071	63,698	64,378	64,994	65,586	66,214	66,797	67,380	67,968
Total	375,147	378,427	382,191	386,269	389,966	393,518	397,282	400,782	404,279	407,811

Basic Parameters OP3b3- 415

Waterway Length		
Headrace Tunnel	m	1074.8
Penstock	m	162.6
Tailrace Tunnel	m	247.2
	m	1484.6
Sedimentation Level	EL.m	386.2

Specification

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	82.6	87.3	92.1	96.8	101.6	106.3	111.1	115.8	120.6	125.3
FSL	EL.m	415	415	415	415	415	415	415	415	415	415
MOL	EL.m	397.4	397.8	398	398.4	398.6	398.8	399	399.4	399.6	399.8
TWL	EL.m	288.8	288.8	288.9	288.9	289	289	289	289.1	289.1	289.1
Loss	m	3	3	3	3	3	3	3	3	3	3
Effective Head	m	123.2	123.2	123.1	123.1	123	123	123	122.9	122.9	122.9
Pmax	MW	91	96	101	106	111	117	122	127	132	137
Primary Energy	GWh	180.95	190.74	200.20	209.64	218.69	227.53	235.73	243.08	250.35	256.85
Pfirm	MW	68.03	72.24	75.21	77.68	81.46	85.46	89.57	76.85	71.05	64.99
Benefit	1000USD	53,034	56,063	58,659	61,101	63,867	66,662	69,374	66,871	66,435	65,782
Cost	1000USD	39,845	40,203	40,576	40,982	41,349	41,735	42,096	42,494	42,842	43,194
B/C		1.33	1.39	1.45	1.49	1.54	1.60	1.65	1.57	1.55	1.52

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	127
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358	2,590,358
Concrete	m3	392,176	392,176	392,176	392,176	392,176	392,176	392,176	392,176	392,176	392,176
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	4									
MOL	EL.m	397.4	397.8	398	398.4	398.6	398.8	399	399.4	399.6	399.8
Waterway Diameter	m	5.1	5.3	5.4	5.6	5.7	5.8	5.9	6.1	6.2	6.3
Available Height	m	17.6	17.2	17	16.6	16.4	16.2	16	15.6	15.4	15.2

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	7,149	7,317	7,499	7,654	7,823	7,984	8,144	8,276	8,427	8,569
Concrete	m3	5,820	5,989	6,173	6,329	6,503	6,667	6,832	6,969	7,125	7,273
Reinforce Bar	t	233	240	247	253	260	267	273	279	285	291
Intake Gate	t	105	111	117	123	129	135	141	147	153	159
Intake Screen	t	58	62	65	68	72	75	78	82	85	88

(3) Power Tunnel

Tunnel Inner Diameter	m	5.1	5.3	5.4	5.6	5.7	5.8	5.9	6.1	6.2	6.3
Concerete Thickness	m	0.6									
Tunnel Length	m	1074.8									
Number	-	1									

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	34,127	36,328	37,455	39,759	40,937	42,132	43,345	45,821	47,085	48,366
Lining Concrete	m3	12,171	12,616	12,839	13,287	13,511	13,735	13,960	14,410	14,636	14,862
Reinforce Bar	t	487	505	514	531	540	549	558	576	585	594

(3') Srevice Adit

Tunnel Length	m	1055

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	33,498	35,659	36,765	39,027	40,183	41,356	42,546	44,977	46,217	47,475

(4) Penstocks

Design Velocity 1	m/s	4									
Penstock Length 1	m	5									
Design Velocity 2	m/s	4.47									
Penstock Length 2	m	124.2									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	25.8									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	7.6									
Mean Velocity	m/s	5.083373									
Dm	m	4.54851	4.676126	4.802959	4.923986	5.044591	5.159953	5.275166	5.385591	5.496076	5.602149
tm	mm	19.96689	20.47098	20.95694	21.43463	21.89486	22.34982	22.8042	23.22284	23.65822	24.07622

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	4,220	4,410	4,602	4,789	4,980	5,166	5,354	5,539	5,726	5,909
Lining Concrete	m3	1,578	1,617	1,656	1,693	1,730	1,765	1,801	1,835	1,868	1,901
Reinforce Bar	t	19	19	20	20	21	21	22	22	22	23
Penstock	t	438	462	486	509	533	557	581	604	628	651

(5) Powerhouse Undergroundtype

A	m2	904.4619	929.8381	954.8002	978.8595	1002.563	1025.491	1048.388	1070.044	1091.996	1113.071
d	m	30									

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	59,694	61,369	63,017	64,605	66,169	67,682	69,194	70,623	72,072	73,463
Concrete	m3	13,567	13,948	14,322	14,683	15,038	15,382	15,726	16,051	16,380	16,696
Reinforce Bar	t	543	558	573	587	602	615	629	642	655	668

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	5.5	5.6	5.8	5.9	6.1	6.2	6.4	6.5	6.6	6.8
Concerete Thickness	m	0.6									
Tunnel Length	m	247.2									
Number	-	1									

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	8,877	9,144	9,690	9,969	10,539	10,829	11,423	11,725	12,032	12,657
Lining Concrete	m3	3,004	3,056	3,159	3,211	3,314	3,366	3,470	3,522	3,575	3,679
Reinforce Bar	t	120	122	126	128	133	135	139	141	143	147

(7) Tailrace

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	5,312	5,502	5,741	5,928	6,164	6,348	6,584	6,766	6,949	7,179
Concrete	m3	1,652	1,737	1,846	1,932	2,043	2,131	2,245	2,334	2,425	2,540
Reinforce Bar	t	24	24	25	26	27	28	28	29	30	31

(8) P/H Access Tunnel

Tunnel Length	m	1220									

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900
Lining Concrete	m3	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200
Reinforce Bar	t	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660

(9) Surge Tank

LWL	EL.m	397.4	397.8	398	398.4	398.6	398.8	399	399.4	399.6	399.8
Available Depth	m	17.6	17.2	17	16.6	16.4	16.2	16	15.6	15.4	15.2
Number of waterway	-	1									

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	18,045	19,070	20,118	21,142	22,190	23,215	24,262	25,286	26,333	27,358
Concrete	m3	5,224	5,520	5,824	6,120	6,423	6,720	7,023	7,320	7,623	7,920
Reinforce Bar	t	261	276	291	306	321	336	351	366	381	396

(9') Srevice Adit

Tunnel Length	m	960									

Item	Unit	FSL=415									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	30,482	32,448	33,454	35,512	36,564	37,632	38,715	40,927	42,056	43,200

Civil Work Cost 1,000USD

Item	FSL=415									
	1	2	3	4	5	6	7	8	9	10

(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	46,626	46,626	46,626	46,626	46,626	46,626	46,626	46,626	46,626	46,626
Concrete	50,983	50,983	50,983	50,983	50,983	50,983	50,983	50,983	50,983	50,983
Others	19,522	19,522	19,522	19,522	19,522	19,522	19,522	19,522	19,522	19,522
(2)Intake										
Excavation	136	139	142	145	149	152	155	157	160	163
Concrete	698	719	741	760	780	800	820	836	855	873
Reinforce Bar	193	199	205	210	216	221	227	231	237	241
Others	257	264	272	279	286	293	300	306	313	319
(3)Power Tunnel										
Tunnel Excavation	2,389	2,543	2,622	2,783	2,866	2,949	3,034	3,207	3,296	3,386
Lining Concrete	1,704	1,766	1,798	1,860	1,891	1,923	1,954	2,017	2,049	2,081
Reinforce Bar	428	444	452	468	476	483	491	507	515	523
Others	678	713	731	767	785	803	822	860	879	898
(3')Service Adit										
Tunnel Excavation	2,345	2,496	2,574	2,732	2,813	2,895	2,978	3,148	3,235	3,323
Others	469	499	515	546	563	579	596	630	647	665
(4)Penstock										
Tunnel Excavation	591	617	644	671	697	723	750	775	802	827
Lining Concrete	221	226	232	237	242	247	252	257	262	266
Reinforce Bar	18	18	19	19	20	20	21	21	21	22
Others	166	172	179	185	192	198	204	211	217	223
(5)Power House										
Excavation	3,582	3,682	3,781	3,876	3,970	4,061	4,152	4,237	4,324	4,408
Concrete	2,578	2,650	2,721	2,790	2,857	2,923	2,988	3,050	3,112	3,172
Reinforce Bar	478	491	504	517	529	541	554	565	577	588
Others	3,318	3,412	3,503	3,591	3,678	3,763	3,847	3,926	4,007	4,084
(6)Tailrace Tunnel										
Tunnel Excavation	666	686	727	748	790	812	857	879	902	949
Lining Concrete	571	581	600	610	630	640	659	669	679	699
Reinforce Bar	106	108	111	113	117	118	122	124	126	130
Others	403	412	431	441	461	471	491	502	512	533
(7)Tailrace										
Excavation	64	66	69	71	74	76	79	81	83	86
Concrete	215	226	240	251	266	277	292	303	315	330
Reinforce Bar	20	20	21	22	22	23	24	24	25	25
Others	75	78	82	86	90	94	99	102	106	110
(8)P/H Access Tunnel										
Tunnel Excavation	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842
Lining Concrete	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586
Reinforce Bar	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221
Others	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730
(9)Surge Tank										
Excavation	2,526	2,670	2,816	2,960	3,107	3,250	3,397	3,540	3,687	3,830
Concrete	966	1,021	1,077	1,132	1,188	1,243	1,299	1,354	1,410	1,465
Reinforce Bar	261	276	291	306	321	336	351	366	381	396
Others	751	793	837	880	923	966	1,009	1,052	1,096	1,138
(9') Service Adit										
Tunnel Excavation	2,133	2,271	2,341	2,485	2,559	2,633	2,709	2,864	2,943	3,023
Others	427	454	468	497	512	527	542	573	589	605
(10)Miscellaneous Works	8,150	7,840	7,874	7,917	7,951	7,982	8,016	8,060	8,091	8,124
Total	171,143	172,116	173,184	174,518	175,584	176,588	177,653	179,000	180,015	181,070

Hydro- mechanical Works 1,000USD

Item	FSL=415									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	691	730	769	808	847	886	926	964	1,003	1,042
Screen	384	405	427	449	471	492	514	535	557	579
(3)Penstock	1,666	1,756	1,846	1,936	2,026	2,115	2,207	2,294	2,385	2,474
(4)Tailrace										
Gate	691	730	769	808	847	886	926	964	1,003	1,042
(5)Others	3,062	3,100	3,138	3,176	3,214	3,251	3,290	3,327	3,365	3,403
Total	18,371	18,597	18,828	19,053	19,283	19,509	19,740	19,962	20,192	20,417

Project Cost Summary 1,000USD

Item	FSL=415									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	3,423	3,442	3,464	3,490	3,512	3,532	3,553	3,580	3,600	3,621
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	30,180	30,180	30,180	30,180	30,180	30,180	30,180	30,180	30,180	30,180

3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	117,131	117,131	117,131	117,131	117,131	117,131	117,131	117,131	117,131	117,131
(3) Intake	1,284	1,321	1,360	1,394	1,431	1,466	1,502	1,531	1,565	1,596
(4) Power Tunnel	7,544	7,962	8,175	8,609	8,830	9,054	9,280	9,740	9,974	10,211
(5) Penstock	996	1,035	1,074	1,112	1,151	1,189	1,227	1,264	1,301	1,338
(6) Power House	9,955	10,235	10,509	10,774	11,035	11,288	11,540	11,778	12,020	12,252
(7) Tailrace Tunnel	1,745	1,786	1,870	1,912	1,998	2,041	2,130	2,174	2,220	2,311
(8) Tailrace	373	390	412	430	452	470	493	511	529	552
(9)P/S Access Tunnel	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378
(10) Surge Tank	7,064	7,485	7,831	8,260	8,610	8,955	9,308	9,749	10,105	10,457
(11) Others	8,150	7,840	7,874	7,917	7,951	7,982	8,016	8,060	8,091	8,124
4. Hydro- Mechanical Works	18,371	18,597	18,828	19,053	19,283	19,509	19,740	19,962	20,192	20,417
5. Electro- Mechanical Works	32,818	34,012	35,194	36,349	37,495	38,837	39,938	41,035	42,107	43,166
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	265,636	268,017	270,504	273,213	275,661	278,236	280,638	283,296	285,616	287,958
7. Administration Fee	39,845	40,203	40,576	40,982	41,349	41,735	42,096	42,494	42,842	43,194
8. Preliminary Cost	26,564	26,802	27,050	27,321	27,566	27,824	28,064	28,330	28,562	28,796
9. Interest During Construction	66,409	67,004	67,626	68,303	68,915	69,559	70,159	70,824	71,404	71,990
Total	398,454	402,026	405,756	409,820	413,491	417,354	420,957	424,944	428,424	431,937

Basic Parameters OP3b3- 420

Waterway Length		
Headrace Tunnel	m	1074.8
Penstock	m	162.6
Tailrace Tunnel	m	247.2
	m	1484.6
Sedimentation Level	EL.m	386.2

Specification

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	92.3	97.2	102	106.9	111.7	116.6	121.4	126.3	131.1	136
FSL	EL.m	420	420	420	420	420	420	420	420	420	420
MOL	EL.m	398	398.4	398.6	398.8	399.2	399.4	399.6	399.8	400.2	400.4
TWL	EL.m	288.9	288.9	289	289	289	289.1	289.1	289.1	289.2	289.2
Loss	m	3	3	3	3	3	3	3	3	3	3
Effective Head	m	128.1	128.1	128	128	128	127.9	127.9	127.9	127.8	127.8
Pmax	MW	105	111	116	122	128	133	139	144	149	155
Primary Energy	GWh	206.15	216.64	225.98	235.90	245.03	253.17	261.22	268.66	275.52	282.22
Pfirm	MW	75.19	77.18	80.19	84.28	88.55	92.60	95.04	78.17	75.13	68.82
Benefit	1000USD	59,724	62,211	64,798	67,813	70,741	73,425	75,608	71,872	72,193	71,501
Cost	1000USD	42,785	43,168	43,533	43,922	44,362	44,714	45,091	45,445	45,841	46,214
B/C		1.40	1.44	1.49	1.54	1.59	1.64	1.677	1.58	1.57	1.55

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	132
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583	2,634,583
Concrete	m3	433,788	433,788	433,788	433,788	433,788	433,788	433,788	433,788	433,788	433,788
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	4									
MOL	EL.m	398	398.4	398.6	398.8	399.2	399.4	399.6	399.8	400.2	400.4
Waterway Diameter	m	5.4	5.6	5.7	5.8	6	6.1	6.2	6.3	6.5	6.6
Available Height	m	22	21.6	21.4	21.2	20.8	20.6	20.4	20.2	19.8	19.6

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	8,303	8,489	8,680	8,870	9,033	9,212	9,382	9,552	9,695	9,855
Concrete	m3	6,996	7,190	7,389	7,589	7,761	7,950	8,131	8,312	8,465	8,638
Reinforce Bar	t	280	288	296	304	310	318	325	332	339	346
Intake Gate	t	120	126	132	139	145	151	157	164	170	176
Intake Screen	t	67	70	74	77	80	84	87	91	94	98

(3) Power Tunnel

Tunnel Inner Diameter	m	5.4	5.6	5.7	5.8	6	6.1	6.2	6.3	6.5	6.6
Concerete Thickness	m	0.6									
Tunnel Length	m	1074.8									
Number	-	1									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	37,455	39,759	40,937	42,132	44,574	45,821	47,085	48,366	50,980	52,313
Lining Concrete	m3	12,839	13,287	13,511	13,735	14,185	14,410	14,636	14,862	15,315	15,542
Reinforce Bar	t	514	531	540	549	567	576	585	594	613	622

(3') Srevice Adit

Tunnel Length	m	1055

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	36,765	39,027	40,183	41,356	43,753	44,977	46,217	47,475	50,041	51,349

(4) Penstocks

Design Velocity 1	m/s	4									
Penstock Length 1	m	5									
Design Velocity 2	m/s	4.47									
Penstock Length 2	m	124.2									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	25.8									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	7.6									
Mean Velocity	m/s	5.083373									
Dm	m	4.808171	4.934149	5.054511	5.174495	5.289391	5.404162	5.514275	5.624459	5.730341	5.836447
tm	mm	21.72999	22.24693	22.72501	23.21698	23.68809	24.14177	24.59292	25.04437	25.46024	25.89465

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	4,610	4,805	4,996	5,189	5,378	5,570	5,757	5,948	6,134	6,323
Lining Concrete	m3	1,658	1,696	1,733	1,770	1,805	1,840	1,874	1,908	1,940	1,973
Reinforce Bar	t	20	20	21	21	22	22	22	23	23	24
Penstock	t	504	530	554	580	605	630	655	680	704	730

(5) Powerhouse Undergroundtype

A	m2	968.6062	993.9843	1017.966	1042.131	1065.271	1088.102	1110.272	1132.457	1153.475	1174.834
d	m	30									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	63,928	65,603	67,186	68,781	70,308	71,815	73,278	74,742	76,129	77,539
Concrete	m3	14,529	14,910	15,269	15,632	15,979	16,322	16,654	16,987	17,302	17,623
Reinforce Bar	t	581	596	611	625	639	653	666	679	692	705

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	5.8	5.9	6.1	6.2	6.4	6.5	6.6	6.8	6.9	7
Concerete Thickness	m	0.6									
Tunnel Length	m	247.2									
Number	-	1									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	9,690	9,969	10,539	10,829	11,423	11,725	12,032	12,657	12,975	13,297
Lining Concrete	m3	3,159	3,211	3,314	3,366	3,470	3,522	3,575	3,679	3,732	3,784
Reinforce Bar	t	126	128	133	135	139	141	143	147	149	151

(7) Tailrace

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	5,747	5,939	6,176	6,366	6,601	6,788	6,971	7,207	7,388	7,571
Concrete	m3	1,849	1,938	2,049	2,139	2,253	2,345	2,436	2,554	2,647	2,741
Reinforce Bar	t	25	26	27	28	29	29	30	31	31	32

(8) P/H Access Tunnel

Tunnel Length	m	1220									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900
Lining Concrete	m3	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200
Reinforce Bar	t	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660	3,660

(9) Surge Tank

LWL	EL.m	398	398.4	398.6	398.8	399.2	399.4	399.6	399.8	400.2	400.4
Available Depth	m	22	21.6	21.4	21.2	20.8	20.6	20.4	20.2	19.8	19.6
Number of waterway	-	1									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	20,184	21,254	22,303	23,373	24,420	25,490	26,538	27,608	28,655	29,725
Concrete	m3	5,843	6,152	6,456	6,766	7,069	7,379	7,682	7,992	8,295	8,604
Reinforce Bar	t	292	308	323	338	353	369	384	400	415	430

(9') Srevice Adit

Tunnel Length	m	960									

Item	Unit	FSL=420									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	33,454	35,512	36,564	37,632	39,813	40,927	42,056	43,200	45,535	46,725

Civil Work Cost 1,000USD

Item	FSL=420									
	1	2	3	4	5	6	7	8	9	10

(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	47,422	47,422	47,422	47,422	47,422	47,422	47,422	47,422	47,422	47,422
Concrete	56,392	56,392	56,392	56,392	56,392	56,392	56,392	56,392	56,392	56,392
Others	20,763	20,763	20,763	20,763	20,763	20,763	20,763	20,763	20,763	20,763
(2)Intake										
Excavation	158	161	165	169	172	175	178	181	184	187
Concrete	840	863	887	911	931	954	976	997	1,016	1,037
Reinforce Bar	232	239	245	252	258	264	270	276	281	287
Others	307	316	324	333	340	348	356	364	370	378
(3)Power Tunnel										
Tunnel Excavation	2,622	2,783	2,866	2,949	3,120	3,207	3,296	3,386	3,569	3,662
Lining Concrete	1,798	1,860	1,891	1,923	1,986	2,017	2,049	2,081	2,144	2,176
Reinforce Bar	452	468	476	483	499	507	515	523	539	547
Others	731	767	785	803	841	860	879	898	938	958
(3')Service Adit										
Tunnel Excavation	2,574	2,732	2,813	2,895	3,063	3,148	3,235	3,323	3,503	3,594
Others	515	546	563	579	613	630	647	665	701	719
(4)Penstock										
Tunnel Excavation	645	673	699	726	753	780	806	833	859	885
Lining Concrete	232	237	243	248	253	258	262	267	272	276
Reinforce Bar	19	19	20	20	21	21	21	22	22	22
Others	179	186	192	199	205	212	218	224	230	237
(5)Power House										
Excavation	3,836	3,936	4,031	4,127	4,218	4,309	4,397	4,485	4,568	4,652
Concrete	2,761	2,833	2,901	2,970	3,036	3,101	3,164	3,228	3,287	3,348
Reinforce Bar	511	525	537	550	562	575	586	598	609	620
Others	3,554	3,647	3,735	3,824	3,908	3,992	4,074	4,155	4,232	4,310
(6)Tailrace Tunnel										
Tunnel Excavation	727	748	790	812	857	879	902	949	973	997
Lining Concrete	600	610	630	640	659	669	679	699	709	719
Reinforce Bar	111	113	117	118	122	124	126	130	131	133
Others	431	441	461	471	491	502	512	533	544	555
(7)Tailrace										
Excavation	69	71	74	76	79	81	84	86	89	91
Concrete	240	252	266	278	293	305	317	332	344	356
Reinforce Bar	21	22	22	23	24	24	25	26	26	27
Others	83	86	91	94	99	103	106	111	115	118
(8)P/H Access Tunnel										
Tunnel Excavation	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842
Lining Concrete	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586
Reinforce Bar	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221	3,221
Others	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730	1,730
(9)Surge Tank										
Excavation	2,826	2,976	3,122	3,272	3,419	3,569	3,715	3,865	4,012	4,161
Concrete	1,081	1,138	1,194	1,252	1,308	1,365	1,421	1,478	1,535	1,592
Reinforce Bar	292	308	323	338	353	369	384	400	415	430
Others	840	884	928	972	1,016	1,061	1,104	1,149	1,192	1,237
(9') Service Adit										
Tunnel Excavation	2,341	2,485	2,559	2,633	2,786	2,864	2,943	3,023	3,187	3,270
Others	468	497	512	527	557	573	589	605	637	654
(10)Miscellaneous Works	8,655	8,307	8,342	8,374	8,421	8,453	8,485	8,519	8,563	8,595
Total	181,759	182,738	183,814	184,852	186,273	187,308	188,331	189,419	190,804	191,841

Hydro- mechanical Works 1,000USD

Item	FSL=420									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	788	830	870	912	952	993	1,034	1,075	1,115	1,156
Screen	438	461	483	506	529	552	574	597	619	642
(3)Penstock	1,916	2,013	2,107	2,204	2,298	2,393	2,487	2,584	2,676	2,772
(4)Tailrace										
Gate	788	830	870	912	952	993	1,034	1,075	1,115	1,156
(5)Others	3,162	3,202	3,242	3,282	3,322	3,362	3,401	3,442	3,481	3,521
Total	18,971	19,213	19,450	19,693	19,930	20,170	20,408	20,650	20,883	21,125

Project Cost Summary 1,000USD

Item	FSL=420									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	3,635	3,655	3,676	3,697	3,725	3,746	3,767	3,788	3,816	3,837
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	35,570	35,570	35,570	35,570	35,570	35,570	35,570	35,570	35,570	35,570

3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	124,578	124,578	124,578	124,578	124,578	124,578	124,578	124,578	124,578	124,578
(3) Intake	1,537	1,578	1,621	1,664	1,701	1,741	1,780	1,819	1,851	1,888
(4) Power Tunnel	8,175	8,609	8,830	9,054	9,509	9,740	9,974	10,211	10,692	10,937
(5) Penstock	1,076	1,115	1,154	1,193	1,231	1,270	1,308	1,346	1,383	1,421
(6) Power House	10,661	10,941	11,205	11,471	11,725	11,977	12,221	12,465	12,696	12,931
(7) Tailrace Tunnel	1,870	1,912	1,998	2,041	2,130	2,174	2,220	2,311	2,358	2,404
(8) Tailrace	413	431	454	472	495	513	531	555	574	592
(9)P/S Access Tunnel	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378	10,378
(10) Surge Tank	7,848	8,288	8,638	8,995	9,439	9,800	10,157	10,520	10,977	11,344
(11) Others	8,655	8,307	8,342	8,374	8,421	8,453	8,485	8,519	8,563	8,595
4. Hydro- Mechanical Works	18,971	19,213	19,450	19,693	19,930	20,170	20,408	20,650	20,883	21,125
5. Electro- Mechanical Works	35,642	36,990	38,105	39,410	40,694	41,760	43,009	44,036	45,063	46,267
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	285,232	287,789	290,221	292,813	295,749	298,094	300,607	302,969	305,606	308,091
7. Administration Fee	42,785	43,168	43,533	43,922	44,362	44,714	45,091	45,445	45,841	46,214
8. Preliminary Cost	28,523	28,779	29,022	29,281	29,575	29,809	30,061	30,297	30,561	30,809
9. Interest During Construction	71,308	71,947	72,555	73,203	73,937	74,524	75,152	75,742	76,401	77,023
Total	427,848	431,684	435,332	439,220	443,624	447,141	450,910	454,453	458,408	462,136

Basic Parameters OP3b3- 425

Waterway Length		
Headrace Tunnel	m	1074.8
Penstock	m	162.6
Tailrace Tunnel	m	247.2
	m	1484.6
Sedimentation Level	EL.m	386.2

Specification

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	102.9	107.8	112.6	117.5	122.3	127.2	132	136.9	141.7	146.6
FSL	EL.m	425	425	425	425	425	425	425	425	425	425
MOL	EL.m	398.6	399	399.2	399.4	399.6	400	400.2	400.4	400.6	400.8
TWL	EL.m	289	289	289	289.1	289.1	289.1	289.2	289.2	289.3	289.3
Loss	m	3	3	3	3	3	3	3	3	3	3
Effective Head	m	133	133	133	132.9	132.9	132.9	132.8	132.8	132.7	132.7
Pmax	MW	122	128	134	139	145	151	156	162	168	174
Primary Energy	GWh	234.30	244.63	254.17	261.03	268.83	273.01	284.11	293.44	301.38	307.48
Pfirm	MW	80.61	83.65	87.60	91.57	95.56	99.93	91.10	81.01	73.48	71.27
Benefit	1000USD	66,421	69,195	72,101	74,530	77,134	79,201	78,543	77,187	76,351	76,784
Cost	1000USD	45,209	45,582	45,959	46,306	46,686	47,110	47,448	47,824	48,188	48,551
B/C		1.47	1.52	1.57	1.61	1.65	1.68	1.66	1.61	1.58	1.58

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	137
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877	2,677,877
Concrete	m3	478,021	478,021	478,021	478,021	478,021	478,021	478,021	478,021	478,021	478,021
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	4									
MOL	EL.m	398.6	399	399.2	399.4	399.6	400	400.2	400.4	400.6	400.8
Waterway Diameter	m	5.7	5.9	6	6.1	6.2	6.4	6.5	6.6	6.7	6.8
Available Height	m	26.4	26	25.8	25.6	25.4	25	24.8	24.6	24.4	24.2

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	9,489	9,682	9,879	10,076	10,264	10,434	10,612	10,790	10,960	11,130
Concrete	m3	8,245	8,452	8,664	8,877	9,081	9,267	9,462	9,657	9,844	10,032
Reinforce Bar	t	330	338	347	355	363	371	378	386	394	401
Intake Gate	t	136	143	149	155	162	168	174	181	187	193
Intake Screen	t	76	79	83	86	90	93	97	100	104	107

(3) Power Tunnel

Tunnel Inner Diameter	m	5.7	5.9	6	6.1	6.2	6.4	6.5	6.6	6.7	6.8
Concerete Thickness	m	0.6									
Tunnel Length	m	1074.8									
Number	-	1									

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	40,937	43,345	44,574	45,821	47,085	49,664	50,980	52,313	53,663	55,030
Lining Concrete	m3	13,511	13,960	14,185	14,410	14,636	15,088	15,315	15,542	15,769	15,996
Reinforce Bar	t	540	558	567	576	585	604	613	622	631	640

(3') Srevice Adit

Tunnel Length	m	1055

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	40,183	42,546	43,753	44,977	46,217	48,749	50,041	51,349	52,674	54,016

(4) Penstocks

Design Velocity 1	m/s	4									
Penstock Length 1	m	5									
Design Velocity 2	m/s	4.47									
Penstock Length 2	m	124.2									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	25.8									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	7.6									
Mean Velocity	m/s	5.083373									
Dm	m	5.076762	5.196231	5.310657	5.424979	5.534678	5.644463	5.749976	5.855727	5.9575	6.05963
tm	mm	23.61076	24.11932	24.60641	25.07607	25.54269	26.00968	26.4405	26.89	27.30394	27.73773

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	5,031	5,225	5,413	5,605	5,792	5,983	6,168	6,358	6,542	6,730
Lining Concrete	m3	1,740	1,777	1,812	1,847	1,880	1,914	1,946	1,979	2,010	2,041
Reinforce Bar	t	21	21	22	22	23	23	23	24	24	24
Penstock	t	579	605	631	657	682	709	734	760	785	811

(5) Powerhouse Undergroundtype

A	m2	1035.591	1059.961	1083.302	1106.345	1128.717	1151.106	1172.329	1193.89	1214.335	1235.153
d	m	30									

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	68,349	69,957	71,498	73,019	74,495	75,973	77,374	78,797	80,146	81,520
Concrete	m3	15,534	15,899	16,250	16,595	16,931	17,267	17,585	17,908	18,215	18,527
Reinforce Bar	t	62	64	65	66	68	69	70	72	73	74

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	6.1	6.3	6.4	6.5	6.7	6.8	6.9	7.1	7.2	7.3
Concerete Thickness	m	0.6									
Tunnel Length	m	247.2									
Number	-	1									

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	10,539	11,124	11,423	11,725	12,342	12,657	12,975	13,624	13,954	14,288
Lining Concrete	m3	3,314	3,418	3,470	3,522	3,627	3,679	3,732	3,837	3,889	3,942
Reinforce Bar	t	133	137	139	141	145	147	149	153	156	158

(7) Tailrace

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	6,202	6,440	6,626	6,813	7,046	7,231	7,413	7,647	7,827	8,008
Concrete	m3	2,061	2,175	2,265	2,357	2,473	2,567	2,659	2,780	2,874	2,969
Reinforce Bar	t	27	28	29	29	30	31	32	32	33	34

(8) P/H Access Tunnel

Tunnel Length	m	1220

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900
Lining Concrete	m3	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200
Reinforce Bar	t	366	366	366	366	366	366	366	366	366	366

(9) Surge Tank

LWL	EL.m	398.6	399	399.2	399.4	399.6	400	400.2	400.4	400.6	400.8
Available Depth	m	26.4	26	25.8	25.6	25.4	25	24.8	24.6	24.4	24.2
Number of waterway	-	1									

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	22,525	23,596	24,645	25,716	26,766	27,836	28,885	29,955	31,004	32,075
Concrete	m3	6,520	6,830	7,134	7,444	7,748	8,058	8,361	8,671	8,975	9,285
Reinforce Bar	t	326	342	357	372	387	403	418	434	449	464

(9') Srevice Adit

Tunnel Length	m	960

Item	Unit	FSL=425									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	36,564	38,715	39,813	40,927	42,056	44,360	45,535	46,725	47,931	49,152

Civil Work Cost 1,000USD

Item	FSL=425									
	1	2	3	4	5	6	7	8	9	10

(1) Concrete Dam										
(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	48,202	48,202	48,202	48,202	48,202	48,202	48,202	48,202	48,202	48,202
Concrete	62,143	62,143	62,143	62,143	62,143	62,143	62,143	62,143	62,143	62,143
Others	22,069	22,069	22,069	22,069	22,069	22,069	22,069	22,069	22,069	22,069
(2)Intake										
Excavation	180	184	188	191	195	198	202	205	208	211
Concrete	989	1,014	1,040	1,065	1,090	1,112	1,135	1,159	1,181	1,204
Reinforce Bar	274	281	288	295	301	308	314	321	327	333
Others	361	370	379	388	397	404	413	421	429	437
(3)Power Tunnel										
Tunnel Excavation	2,866	3,034	3,120	3,207	3,296	3,477	3,569	3,662	3,756	3,852
Lining Concrete	1,891	1,954	1,986	2,017	2,049	2,112	2,144	2,176	2,208	2,240
Reinforce Bar	476	491	499	507	515	531	539	547	555	563
Others	785	822	841	860	879	918	938	958	978	998
(3')Service Adit										
Tunnel Excavation	2,813	2,978	3,063	3,148	3,235	3,412	3,503	3,594	3,687	3,781
Others	563	596	613	630	647	682	701	719	737	756
(4)Penstock										
Tunnel Excavation	704	731	758	785	811	838	864	890	916	942
Lining Concrete	244	249	254	259	263	268	272	277	281	286
Reinforce Bar	20	20	21	21	21	22	22	23	23	23
Others	194	200	206	213	219	225	232	238	244	250
(5)Power House										
Excavation	4,101	4,197	4,290	4,381	4,470	4,558	4,642	4,728	4,809	4,891
Concrete	2,951	3,021	3,087	3,153	3,217	3,281	3,341	3,403	3,461	3,520
Reinforce Bar	55	56	57	58	60	61	62	63	64	65
Others	3,554	3,637	3,717	3,796	3,873	3,950	4,023	4,097	4,167	4,238
(6)Tailrace Tunnel										
Tunnel Excavation	790	834	857	879	926	949	973	1,022	1,047	1,072
Lining Concrete	630	649	659	669	689	699	709	729	739	749
Reinforce Bar	117	120	122	124	128	130	131	135	137	139
Others	461	481	491	502	523	533	544	566	577	588
(7)Tailrace										
Excavation	74	77	80	82	85	87	89	92	94	96
Concrete	268	283	295	306	322	334	346	361	374	386
Reinforce Bar	22	23	24	24	25	26	26	27	27	28
Others	91	96	99	103	108	112	115	120	124	128
(8)P/H Access Tunnel										
Tunnel Excavation	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842
Lining Concrete	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586
Reinforce Bar	322	322	322	322	322	322	322	322	322	322
Others	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150
(9)Surge Tank										
Excavation	3,154	3,303	3,450	3,600	3,747	3,897	4,044	4,194	4,341	4,491
Concrete	1,206	1,264	1,320	1,377	1,433	1,491	1,547	1,604	1,660	1,718
Reinforce Bar	326	342	357	372	387	403	418	434	449	464
Others	937	982	1,025	1,070	1,114	1,158	1,202	1,246	1,290	1,334
(9') Service Adit										
Tunnel Excavation	2,559	2,709	2,786	2,864	2,943	3,104	3,187	3,270	3,354	3,440
Others	512	542	557	573	589	621	637	654	671	688
(10)Miscellaneous Works	8,977	8,588	8,620	8,652	8,685	8,730	8,761	8,795	8,826	8,857
Total	188,509	189,496	190,514	191,540	192,607	193,996	195,010	196,093	197,107	198,135

Hydro- mechanical Works 1,000USD

Item	FSL=425									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	895	937	978	1,020	1,061	1,103	1,144	1,186	1,228	1,270
Screen	497	520	543	567	590	613	636	659	682	705
(3)Penstock	2,199	2,299	2,397	2,495	2,593	2,693	2,789	2,888	2,984	3,083
(4)Tailrace										
Gate	895	937	978	1,020	1,061	1,103	1,144	1,186	1,228	1,270
(5)Others	3,272	3,314	3,355	3,396	3,437	3,478	3,518	3,560	3,600	3,641
Total	19,635	19,884	20,128	20,376	20,620	20,867	21,109	21,357	21,598	21,846

Project Cost Summary 1,000USD

Item	FSL=425									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	3,770	3,790	3,810	3,831	3,852	3,880	3,900	3,922	3,942	3,963
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	40,960	40,960	40,960	40,960	40,960	40,960	40,960	40,960	40,960	40,960

3. Civil Works										
(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	132,413	132,413	132,413	132,413	132,413	132,413	132,413	132,413	132,413	132,413
(3) Intake	1,804	1,848	1,894	1,939	1,983	2,022	2,064	2,106	2,146	2,186
(4) Power Tunnel	8,830	9,280	9,509	9,740	9,974	10,450	10,692	10,937	11,184	11,434
(5) Penstock	1,161	1,201	1,239	1,277	1,315	1,353	1,390	1,428	1,464	1,502
(6) Power House	10,661	10,911	11,152	11,389	11,619	11,850	12,068	12,290	12,501	12,715
(7) Tailrace Tunnel	1,998	2,085	2,130	2,174	2,265	2,311	2,358	2,452	2,499	2,547
(8) Tailrace	456	479	497	516	539	558	576	600	619	638
(9)P/S Access Tunnel	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900
(10) Surge Tank	8,693	9,141	9,496	9,856	10,213	10,674	11,034	11,402	11,765	12,135
(11) Others	8,977	8,588	8,620	8,652	8,685	8,730	8,761	8,795	8,826	8,857
4. Hydro- Mechanical Works	19,635	19,884	20,128	20,376	20,620	20,867	21,109	21,357	21,598	21,846
5. Electro- Mechanical Works	38,909	40,177	41,425	42,462	43,677	44,876	45,875	47,046	48,215	49,358
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	301,390	303,881	306,395	308,708	311,239	314,067	316,323	318,829	321,253	323,675
7. Administration Fee	45,209	45,582	45,959	46,306	46,686	47,110	47,448	47,824	48,188	48,551
8. Preliminary Cost	30,139	30,388	30,639	30,871	31,124	31,407	31,632	31,883	32,125	32,367
9. Interest During Construction	75,348	75,970	76,599	77,177	77,810	78,517	79,081	79,707	80,313	80,919
Total	452,085	455,821	459,592	463,062	466,858	471,100	474,484	478,243	481,880	485,512

Basic Parameters OP3b3- 435

Waterway Length		
Headrace Tunnel	m	1074.8
Penstock	m	162.6
Tailrace Tunnel	m	247.2
	m	1484.6
Sedimentation Level	EL.m	386.2

Specification

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Qmax	m3/s	124.6	129.5	134.4	139.4	144.3	149.2	154.1	159.1	164	168.9
FSL	EL.m	435	435	435	435	435	435	435	435	435	435
MOL	EL.m	399.8	400	400.2	400.6	400.8	401	401.2	401.4	401.6	401.8
TWL	EL.m	289.1	289.2	289.2	289.2	289.3	289.3	289.3	289.4	289.4	289.4
Loss	m	3	3	3	3	3	3	3	3	3	3
Effective Head	m	142.9	142.8	142.8	142.8	142.7	142.7	142.7	142.6	142.6	142.6
Pmax	MW	159	165	171	178	184	190	196	202	209	215
Primary Energy	GWh	293.91	303.28	312.46	321.39	329.15	336.48	343.23	349.42	354.71	359.75
Pfirm	MW	94.41	98.29	102.29	106.67	110.61	94.74	88.34	84.75	75.42	68.09
Benefit	1000USD	81,302	84,156	87,012	89,937	92,518	89,064	88,354	88,388	86,534	85,236
Cost	1000USD	53,149	53,445	53,809	54,256	54,618	54,985	55,342	55,701	56,081	56,433
B/C		1.53	1.57	1.62	1.66	1.69	1.62	1.60	1.59	1.54	1.51

Civil & Hydromechanical Work Quantity

(1) Dam

Design Flood	m3/s	8,306
Dam Basis EL.	m	293
Non- overflow Width	m	80.2
Spillway Width	m	77
Sand Drain Width	m	16
Intake Width	m	0
Dam Height (Hd)	m	147
Crest Length (L)	m	173.2
Coefficient for Ex	Y=A*X^B	
A		32335
B		0.4384
Coefficient for Conc	Y=C*X^D	
C		0.0015
D		1.3058

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876	2,761,876
Concrete	m3	574,583	574,583	574,583	574,583	574,583	574,583	574,583	574,583	574,583	574,583
Gate	t	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827	1,827

(2) Intake

Number	-	1									
Design Velocity	m3/s	4									
MOL	EL.m	399.8	400	400.2	400.6	400.8	401	401.2	401.4	401.6	401.8
Waterway Diameter	m	6.3	6.4	6.5	6.7	6.8	6.9	7	7.1	7.2	7.3
Available Height	m	35.2	35	34.8	34.4	34.2	34	33.8	33.6	33.4	33.2

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	11,872	12,089	12,300	12,497	12,699	12,897	13,091	13,286	13,472	13,655
Concrete	m3	10,862	11,106	11,345	11,569	11,799	12,026	12,249	12,473	12,689	12,901
Reinforce Bar	t	434	444	454	463	472	481	490	499	508	516
Intake Gate	t	170	176	183	190	196	203	209	216	223	229
Intake Screen	t	94	98	102	105	109	113	116	120	124	127

(3) Power Tunnel

Tunnel Inner Diameter	m	6.3	6.4	6.5	6.7	6.8	6.9	7	7.1	7.2	7.3
Concerete Thickness	m	0.6									
Tunnel Length	m	1074.8									
Number	-	1									

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	48,366	49,664	50,980	53,663	55,030	56,414	57,816	59,234	60,670	62,123
Lining Concrete	m3	14,862	15,088	15,315	15,769	15,996	16,224	16,452	16,681	16,910	17,139
Reinforce Bar	t	594	604	613	631	640	649	658	667	676	686

(3') Srevice Adit

Tunnel Length	m	1055

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	47,475	48,749	50,041	52,674	54,016	55,375	56,751	58,143	59,553	60,979

(4) Penstocks

Design Velocity 1	m/s	4									
Penstock Length 1	m	5									
Design Velocity 2	m/s	4.47									
Penstock Length 2	m	124.2									
Design Velocity 3	m/s	6.08									
Penstock Length 3	m	25.8									
Design Velocity 4	m/s	8.76	2 penstocks								
Penstock Length 4	m	7.6									
Mean Velocity	m/s	5.083373									
Dm	m	5.586478	5.695266	5.802013	5.908952	6.011907	6.113128	6.2127	6.312686	6.409159	6.5042
tm	mm	27.5116	27.99057	28.47772	28.96574	29.41676	29.87837	30.33246	30.76868	31.20833	31.64146

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	5,882	6,072	6,261	6,454	6,642	6,830	7,017	7,208	7,394	7,580
Lining Concrete	m3	1,896	1,929	1,962	1,995	2,027	2,058	2,088	2,119	2,148	2,177
Reinforce Bar	t	23	23	24	24	24	25	25	25	26	26
Penstock	t	742	769	798	826	854	882	910	938	965	993

(5) Powerhouse Undergroundtype

A	m2	1167.167	1189.618	1211.916	1234.253	1255.465	1276.603	1297.396	1317.968	1338.11	1357.953
d	m	30									

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	77,033	78,515	79,986	81,461	82,861	84,256	85,628	86,986	88,315	89,625
Concrete	m3	17,508	17,844	18,179	18,514	18,832	19,149	19,461	19,770	20,072	20,369
Reinforce Bar	t	70	71	73	74	75	77	78	79	80	81

(6) Tailrace Tunnel

Design Velocity	m/s	3.5									
Tunnel Inner Diameter	m	6.7	6.9	7	7.1	7.2	7.4	7.5	7.6	7.7	7.8
Concerete Thickness	m	0.6									
Tunnel Length	m	247.2									
Number	-	1									

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	12,342	12,975	13,297	13,624	13,954	14,626	14,968	15,315	15,665	16,019
Lining Concrete	m3	3,627	3,732	3,784	3,837	3,889	3,995	4,047	4,100	4,153	4,206
Reinforce Bar	t	145	149	151	153	156	160	162	164	166	168

(7) Tailrace

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	7,110	7,345	7,529	7,714	7,895	8,128	8,308	8,490	8,668	8,846
Concrete	m3	2,505	2,624	2,719	2,815	2,910	3,033	3,130	3,228	3,325	3,423
Reinforce Bar	t	30	31	32	33	33	34	35	35	36	37

(8) P/H Access Tunnel

Tunnel Length	m	1220

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900	54,900
Lining Concrete	m3	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200
Reinforce Bar	t	366	366	366	366	366	366	366	366	366	366

(9) Surge Tank

LWL	EL.m	399.8	400	400.2	400.6	400.8	401	401.2	401.4	401.6	401.8
Available Depth	m	35.2	35	34.8	34.4	34.2	34	33.8	33.6	33.4	33.2
Number of waterway	-	1									

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Excavation	m3	27,330	28,403	29,476	30,570	31,643	32,716	33,789	34,884	35,957	37,030
Concrete	m3	7,911	8,222	8,533	8,849	9,160	9,471	9,781	10,098	10,409	10,719
Reinforce Bar	t	396	411	427	442	458	474	489	505	520	536

(9') Srevice Adit

Tunnel Length	m	960

Item	Unit	FSL=435									
		1	2	3	4	5	6	7	8	9	10
Tunnel Excavation	m3	43,200	44,360	45,535	47,931	49,152	50,388	51,640	52,908	54,190	55,488

Civil Work Cost 1,000USD

Item	FSL=435									
	1	2	3	4	5	6	7	8	9	10
(1) Concrete Dam										

(1).1 River Treatment(NEA F/S)	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(1).2 Concrete Dam										
Excavation	49,714	49,714	49,714	49,714	49,714	49,714	49,714	49,714	49,714	49,714
Concrete	74,696	74,696	74,696	74,696	74,696	74,696	74,696	74,696	74,696	74,696
Others	24,882	24,882	24,882	24,882	24,882	24,882	24,882	24,882	24,882	24,882
(2)Intake										
Excavation	226	230	234	237	241	245	249	252	256	259
Concrete	1,303	1,333	1,361	1,388	1,416	1,443	1,470	1,497	1,523	1,548
Reinforce Bar	361	369	377	384	392	399	407	414	421	428
Others	472	483	493	502	512	522	531	541	550	559
(3)Power Tunnel										
Tunnel Excavation	3,386	3,477	3,569	3,756	3,852	3,949	4,047	4,146	4,247	4,349
Lining Concrete	2,081	2,112	2,144	2,208	2,240	2,271	2,303	2,335	2,367	2,399
Reinforce Bar	523	531	539	555	563	571	579	587	595	603
Others	898	918	938	978	998	1,019	1,039	1,060	1,081	1,103
(3')Service Adit										
Tunnel Excavation	3,323	3,412	3,503	3,687	3,781	3,876	3,973	4,070	4,169	4,269
Others	665	682	701	737	756	775	795	814	834	854
(4)Penstock										
Tunnel Excavation	823	850	877	904	930	956	982	1,009	1,035	1,061
Lining Concrete	265	270	275	279	284	288	292	297	301	305
Reinforce Bar	22	22	22	23	23	23	24	24	24	25
Others	222	228	235	241	247	254	260	266	272	278
(5)Power House										
Excavation	4,622	4,711	4,799	4,888	4,972	5,055	5,138	5,219	5,299	5,377
Concrete	3,326	3,390	3,454	3,518	3,578	3,638	3,698	3,756	3,814	3,870
Reinforce Bar	62	63	64	65	66	67	69	70	71	72
Others	4,005	4,082	4,159	4,235	4,308	4,381	4,452	4,522	4,592	4,660
(6)Tailrace Tunnel										
Tunnel Excavation	926	973	997	1,022	1,047	1,097	1,123	1,149	1,175	1,201
Lining Concrete	689	709	719	729	739	759	769	779	789	799
Reinforce Bar	128	131	133	135	137	141	142	144	146	148
Others	523	544	555	566	577	599	610	622	633	645
(7)Tailrace										
Excavation	85	88	90	93	95	98	100	102	104	106
Concrete	326	341	353	366	378	394	407	420	432	445
Reinforce Bar	25	26	27	27	28	28	29	29	30	30
Others	109	114	118	121	125	130	134	138	142	145
(8)P/H Access Tunnel										
Tunnel Excavation	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842
Lining Concrete	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586
Reinforce Bar	322	322	322	322	322	322	322	322	322	322
Others	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150
(9)Surge Tank										
Excavation	3,826	3,976	4,127	4,280	4,430	4,580	4,731	4,884	5,034	5,184
Concrete	1,464	1,521	1,579	1,637	1,695	1,752	1,810	1,868	1,926	1,983
Reinforce Bar	396	411	427	442	458	474	489	505	520	536
Others	1,137	1,182	1,226	1,272	1,317	1,361	1,406	1,451	1,496	1,541
(9') Service Adit										
Tunnel Excavation	3,023	3,104	3,187	3,354	3,440	3,526	3,614	3,702	3,792	3,883
Others	605	621	637	671	688	705	723	740	758	777
(10)Miscellaneous Works	10,105	9,617	9,649	9,694	9,726	9,761	9,793	9,825	9,857	9,889
Total	212,195	212,767	213,809	215,240	216,282	217,384	218,429	219,484	220,530	221,577

Hydro- mechanical Works 1,000USD

Item	FSL=435									
	1	2	3	4	5	6	7	8	9	10
(1)Dam & Spillway										
Gate	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878	11,878
(2)Intake										
Gate	1,115	1,158	1,202	1,246	1,289	1,332	1,376	1,420	1,463	1,507
Screen	619	643	668	692	716	740	764	789	813	837
(3)Penstock	2,819	2,924	3,031	3,139	3,244	3,350	3,457	3,563	3,669	3,775
(4)Tailrace										
Gate	1,115	1,158	1,202	1,246	1,289	1,332	1,376	1,420	1,463	1,507
(5)Others	3,509	3,552	3,596	3,640	3,683	3,727	3,770	3,814	3,857	3,901
Total	21,054	21,313	21,575	21,840	22,099	22,360	22,620	22,883	23,144	23,404

Project Cost Summary 1,000USD

Item	FSL=435									
	1	2	3	4	5	6	7	8	9	10
1. Preparation & Compensation	4,244	4,255	4,276	4,305	4,326	4,348	4,369	4,390	4,411	4,432
(1) Access Road										
(2) Conpensation										
(3) Others										
2. Environmental Mitigation	61,990	61,990	61,990	61,990	61,990	61,990	61,990	61,990	61,990	61,990
3. Civil Works										

(1) River Treatment	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053	6,053
(2) Dam	149,292	149,292	149,292	149,292	149,292	149,292	149,292	149,292	149,292	149,292
(3) Intake	2,362	2,414	2,465	2,512	2,561	2,609	2,657	2,704	2,750	2,795
(4) Power Tunnel	10,211	10,450	10,692	11,184	11,434	11,686	11,942	12,199	12,460	12,723
(5) Penstock	1,333	1,371	1,408	1,447	1,484	1,521	1,558	1,596	1,633	1,669
(6) Power House	12,015	12,246	12,476	12,706	12,924	13,142	13,356	13,567	13,775	13,979
(7) Tailrace Tunnel	2,265	2,358	2,404	2,452	2,499	2,596	2,644	2,694	2,743	2,793
(8) Tailrace	545	569	588	607	626	650	669	689	708	727
(9)P/S Access Tunnel	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900
(10) Surge Tank	10,450	10,815	11,182	11,656	12,027	12,398	12,771	13,151	13,527	13,903
(11) Others	10,105	9,617	9,649	9,694	9,726	9,761	9,793	9,825	9,857	9,889
4. Hydro- Mechanical Works	21,054	21,313	21,575	21,840	22,099	22,360	22,620	22,883	23,144	23,404
5. Electro- Mechanical Works	45,339	46,485	47,607	48,900	50,007	51,090	52,162	53,236	54,461	55,500
6. Transmission Line	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170	10,170
Direct Cost	354,326	356,298	358,727	361,707	364,117	366,566	368,945	371,338	373,871	376,218
7. Administration Fee	53,149	53,445	53,809	54,256	54,618	54,985	55,342	55,701	56,081	56,433
8. Preliminary Cost	35,433	35,630	35,873	36,171	36,412	36,657	36,895	37,134	37,387	37,622
9. Interest During Construction	88,582	89,074	89,682	90,427	91,029	91,641	92,236	92,835	93,468	94,054
Total	531,489	534,447	538,090	542,561	546,175	549,848	553,418	557,007	560,806	564,327