SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATES (ASTM C 127-88-01)

GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 127

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Factibilidad Rio Torola
LOCATED : Parte Baja del Rio Torola
DATE EXPERIMENT 18-Ene-02
TEC RESPONSIBLE : Mauricio Najera
FILE No . 24-GE,des-san(O1),31-1-2,swissboring

Sondeo O-1, Muestra M-1,

MUESTRA Nº	PESOS (gr)			ABSORCION		PESOS ESPECIFICOS		
	Sat-Sup-Sec	Sumergido	Seco	(%)	(Kg/M3)	MASA	SAT-SUP-SEC	REAL
1	515 7	321 6	498.0	3 55	91 19	2 566	2 657	2 823
2	429.2	266.5	414 4	3 57	90 96	2 547	2 638	2 802
3	212.2	132 0	204 7	3 66	93 52	2 552	2 646	2.816
			PROMEDIOS =	**3.60**	**91.89**	**2.56**	**2.65**	**2.81**

sample of rock in rough bring for solicitor

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LABORATORIOS
DEPTO. INGENIERIA CIVIL Y ARQUITECTURA
ATLACATL, FEPADE

Ing Joaquín Humberto Montenegro
Jefe Laboratorios control de calidad
Suelos, concrto, asfalto y Materiales

497

GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 127

SOLICITOR : Ing Rodolfo Alvarado, SWISSBORING
PROYECT . Factibilidad Rio Torola
LOCATED Parte Baja del Rio Torola
DATE EXPERIMENT 18-Ene-02
TEC RESPONSIBLE : Mauricio Najera
FILE No 24-GE,(cdb),31-1-2,swissboring

c6p-1
Sondeo ~~CDB~~-1, Muestra M-1, profundidad de 2 05 a 2 40

Sample N°	WEIGTH (gr)			ABSORTION		SPECIFIC GRAVITY		
	Sat-Sup-Sec	Sumergido	Seco	(%)	(Kg / m3)	MASA	SAT-SUP-SEC	REAL
1	357.2	206.0	341.0	4 75	107.14	2.255	2.362	2.526
2	351.6	203 0	335.7	4.74	107 00	2 259	2 366	2.530
3	248.0	143 5	236.9	4.69	106.22	2.267	2 373	2.536
			AVERAGE =	**4.72**	**106.79**	**2.26**	**2.37**	**2.53**

Sample of rock in rough bring for solicitor

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Jefe Laboratorios control de calidad
Suelos, concrto, asfalto y Materiales

GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 127

SOLICITOR : Ing Rodolfo Alvarado, SWISSBORING
PROYECT *Factibilidad Rio Torola*
LOCATED Parte Baja del Rio Torola
DATE EXPERIMENT . 18-Ene-02
TEC RESPONSIBLE . Mauricio Najera
FILE No . 24-GE,(cdb),31-1-2,swissboring

Sondeo C60 CDB-2, Muestra M-1, profundidad de 4.10 a 4 40

Sample N°	WEIGTH (gr)			ABSORTION		SPECIFIC GRAVITY		
	Sat-Sup-Sec	Sumergido	Seco	(%)	(Kg/M3)	MASA	SAT-SUP-SEC	REAL
1	373 3	239 0	370 0	0 89	24.57	2 755	2.780	2.824
2	466.6	298 0	462.2	0 95	26.10	2.741	2.767	2.815
3	258.5	165.5	256.2	0.90	24 73	2 755	2 780	2.825
		PROMEDIOS =		**0.91**	**25.13**	**2.75**	**2.78**	**2.82**

Sample of rock in rough bring for solicitor

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ADHON, EL SALVADOR

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Jefe Laboratorios control de calidad
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499

GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 127

SOLICITOR : Ing Rodolfo Alvarado, SWISSBORING
PROYECT : Estudio Factibilidad Rio Torola
LOCATED : CGP-4
DATE EXPERIMENT : 16-Ene-03
TEC. RESPONSIBLE : Geovanny Mejia
FILE No : 15-01-03,torola,swissboring,cgp4

MUESTRA	PESOS (gr)			ABSORCION		PESOS ESPECIFICOS		
Nº	Sat-Sup-Sec	Sumergido	Seco	(%)	(Kg / m3)	MASA	SAT-SUP-SEC	REAL
1	328.0	200.0	317.3	3.37	83.59	2 479	2 563	2.705
2	352.9	216 0	342 7	2 98	74 51	2.503	2.578	2.705
3	357.0	221.0	347.4	2.76	70.59	2.554	2.625	2.748
			PROMEDIOS =	**3.07**	**77.09**	**2.517**	**2.594**	**2.727**

sampling carrier out by applicant

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Jefe Laboratorios control de calidad
Suelos, concreto, asfalto y Materiales

GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 127

SOLICITOR : Ing Rodolfo Alvarado, SWISSBORING
PROYECT Estudio Factibilidad Rio Torola
LOCATED **CGP-5**
DATE EXPERIMENT : 16-Ene-03
TEC RESPONSIBLE : Geovanny Mejia
FILE No : 15-01-03,torola,swissboring,cgp5

MUESTRA Nº	PESOS (gr)			ABSORCION		PESOS ESPECIFICOS		
	Sat-Sup-Sec	Sumergido	Seco	(%)	(Kg / m3)	MASA	SAT-SUP-SEC	REAL
1	368.0	227.0	359.4	2 39	60.99	2.549	2 610	2 715
2	291.3	180.0	285.0	2.21	56 60	2 561	2 617	2 714
3	402.0	249.0	393 3	2.21	56.86	2.571	2 627	2.726
			PROMEDIOS =	**2.30**	**58.93**	**2.560**	**2.619**	**2.720**

sampling carrier out by applicant

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501

GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 127

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Estudio Factibilidad Rio Toroia
LOCATED . CGP-6
DATE EXPERIMENT : 16-Ene-03
TEC RESPONSIBLE Geovanny Mejia
FILE No : 15-01-03,toroia,swissboring,cgp4

MUESTRA	PESOS (gr)			ABSORCION		PESOS ESPECIFICOS		
Nº	Sat-Sup-Sec	Sumergido	Seco	(%)	(Kg / m3)	MASA	SAT-SUP-SEC	REAL
1	383.4	237.0	373 5	2 65	67.62	2.551	2.619	2.736
2	322.0	199.0	313 6	2.68	68 29	2 550	2 618	2 736
3	295.0	183.0	288.5	2.25	58.04	2 576	2.634	2.735
		PROMEDIOS =		**2.45**	**62.83**	**2.564**	**2.626**	**2.735**

sampling carrier out by applicant

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SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATES (ASTM C 128-97)

503
(504)

GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 128

SOLICITOR Ing Rodolfo Alvarado SWISSBORING
PROYECT Factibilidad Rio Torola
LOCATED Parte Baja del Rio Torola
DATE EXPERIMENT : 18-Ene-02
TEC RESPONSIBLE Mauricio Najera
FILE No 24-GE,des-san-lig,(CGP),31-1-2,swissboring

Sondeo CGP-1 Muestra No M-1, profundidad 0 00 a 1 90 m

MUEST N°	WEIGTH (gr)				ABSORTION		SPECIFIT GRAVITY		
	Sat-Sup-Sec	Mat + agua	Mat+Agua+Are	Seco	(%)	(Kg/M3)	MASA	SAT-SUP-SEC	REAL
1	350 0	1445 0	1650 0	336 8	3 92	91 03	2 323	2.414	2 555
2	350 0	1436 0	1641 0	336 7	3 95	91 72	2 322	2 414	2 557
				AVERAGES =	**3.93**	**91.38**	**2.32**	**2.41**	**2.56**

sampling carrier out by applicant

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Jefe Laboratorios control de calidad
Suelos, concrto, asfalto y Materiales

GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 128

SOLICITOR : Ing Rodolfo Alvarado SWISSBORING
PROYECT . Factibilidad Rio Torola
LOCATED Parte Baja del Rio Torola
DATE EXPERIMENT 16-Ene-02
TEC RESPONSIBLE Mauricio Nojera
FILE No 24-GE,des-san-ig,(CGP),31-1-2 swissboring

Sondeo CGP-2 Muestra No M-1 profundidad 0 00 a 3 00 m.

MUEST	WEIGTH (gr)				ABSORTION		SPECIFIT GRAVITY		
N°	Sat-Sup-Sec	Mat + agua	Mat+Agua+Are	Seco	(%)	(Kg/M3)	MASA	SAT-SUP-SEC	REAL
1	500 0	1445 0	1735 0	473.4	5 62	126 67	2 254	2 381	2 581
2	500 0	1436.0	1730.0	476 5	4 93	114 08	2 313	2 427	2 611
			AVERAGES =		**5.28**	**120.37**	**2.28**	**2.40**	**2.60**

sampling carrier out by applicant

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Jefe Laboratorios control de calidad
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GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 128

SOLICITOR Ing Rodolfo Alvarado SWISSBORING
PROYECT : Factibilidad Rio Torola
LOCATED : Parte Baja del Rio Torola
DATE EXPERIMENT 18-Ene 02
TEC RESPONSIBLE Mauricio Najera
FILE No 24-GE des san-lig (CGP).31-1 2,swissboring

Sondeo CGP-3 Muestra No M-1 profundidad 0 00 a 1 60 m

MUEST	WEIGTH (gr)				ABSORTION		SPECIFIT GRAVITY		
N°	Sat-Sup-Sec	Mat + agua	Mat+Agua+Are	Seco	(%)	(Kg/M3)	MASA	SAT-SUP-SEC	REAL
1	500 0	1445 0	1743 0	482 5	3 63	86 63	2 389	2 475	2 615
2	500 0	1436 0	1734 0	476 8	4 87	114 85	2 360	2 475	2 667
				AVERAGES =	**4.25**	**100.74**	**2.37**	**2.48**	**2.64**

sampling carrier out by applicant

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ADMON. FEPADE

Ing Joaquín Humberto Montenegro
Jefe Laboratorios control de calidad
Suelos, concrto, asfalto y Materiales

GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 128

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT Estudio Factibilidad Rio Torola
LOCATED : **CGP-4**
DATE EXPERIMENT : 22-Ene-03
TEC RESPONSIBLE : Geovanny Mejia
FILE No : 15-01-03,torola,swissboring,cgp4

MUEST Nº	WEIGTH (gr)				ABSORTION		SPECIFIT GRAVITY		
	Sat-Sup-Sec	Mat + agua	Mat+Agua+Ar	Seco	(%)	(Kg/M3)	MASA	SAT-SUP-SEC	REAL
1	500 0	1436 4	1731 3	470 0	6 38	146 27	2 292	2 438	2 684
2	500.0	1436.4	1731.9	472.9	5 73	132 52	2 312	2.445	2 666
			AVERAGES =		**6.06**	**139.39**	**2.302**	**2.441**	**2.675**

sampling carrier out by applicant

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GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 128

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Estudio Factibilidad Rio Torola
LOCATED : **CGP-5**
DATE EXPERIMENT : 21-Ene-03
TEC. RESPONSIBLE : Geovanny Mejia
FILE No : 15-01-03,torola,swissboring,cgp5

MUEST Nº	WEIGTH (gr)				ABSORTION		SPECIFIT GRAVITY		
	Sat-Sup-Sec	Mat + agua	Mat+Agua+Ar	Seco	(%)	(Kg/M3)	MASA	SAT-SUP-SEC	REAL
1	500.0	1437.0	1733.0	472.7	5.78	133.82	2.317	2.451	2.675
2	500.0	1437.0	1734.3	476.1	5.02	117.91	2.349	2.467	2.663
			AVERAGES =		**5.40**	**125.87**	**2.333**	**2.459**	**2.669**

sampling carrier out by applicant

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GRAVEDAD ESPECIFICA Y ABSORCION EN MATERIALES PETREOS

ASTM C 128

SOLICITOR . Ing. Rodolfo Alvarado, SWISSBORING
PROYECT Estudio Factibilidad Rio Torola
LOCATED : **CGP-6**
DATE EXPERIMENT 21-Ene-03
TEC. RESPONSIBLE : Geovanny Mejia
FILE No 15-01-03 torola swissboring,cgp4

MUEST	WEIGTH (gr)				ABSORTION		SPECIFIT GRAVITY		
N°	Sat-Sup-Sec	Mat + agua	Mat+Agua+Ar	Seco	(%)	(Kg/M3)	MASA	SAT-SUP-SEC	REAL
1	500.0	1437 0	1731 2	474 2	5.44	125.36	2.304	2.430	2.634
2	500 0	1437 0	1731 4	475.8	5.09	117.70	2.314	2.432	2 623
				AVERAGES =	**5.26**	**121.53**	**2.309**	**2.431**	**2.629**

sampling carrier out by applicant

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SAN SALVADOR, EL SALVADOR

Ing Joaquín Humberto Montenegro
Jefe Laboratorios control de calidad
Suelos concrto, asfalto y Materiales

RESISTANCE TO DEGRADATION OF LARGE-SIZE COARSE AGGREGATES BY ABRASION AND IMPACT IN THE LOS ANGELES MACHINE (ASTM C 535-96-01)

Resistencia a la Abrasión de los agregados pétreos
Maquina de los Angeles

ASTM C 535

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Factibilidad Río Torola
LOCATED : Parte Baja del Rio Torola
DATE EXPERIMENT : 18-Ene-02
TEC. RESPONSIBLE : Mauricio Najera
FILE No : 24-GE,des-san(O1),31-1-2,swissboring

Sondeo O-1, Muestra M-1,

IDENTIFICACION DE LA MUESTRA	TIPO GRANULOM.	NUMERO ESFERAS	PESO INICIAL (grs)	PESO FINAL (grs)	PORCENTAJE DESGASTE
O-1, M-1	A	12	6,312	5,164	18.19%

sample of rock in rough bring for solicitor

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Jefe Laboratorios control de calidad
Suelos Concreto Asfalto y Materiales

513

Resistencia a la Abrasión de los agregados pétreos
Maquina de los Angeles
ASTM C 535

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Estudio Factibilidad Rio Torola
LOCATED : CGP-4
DATE EXPERIMENT : 16-Ene-03
TEC. RESPONSIBLE : Giovanny Mejia
FILE No : 15-01-03,torola,swissboring,cgp4

IDENTIFICACION DE LA MUESTRA	TIPO GRANULOM.	NUMERO ESFERAS	PESO INICIAL (grs)	PESO FINAL (grs)	PORCENTAJE DESGASTE
tamaño nominal maximo 3""	"A"	12	10,000	8,505	14.95%

sampling carrier out by applicant

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Jefe Laboratorios control de calidad
Suelos Concreto Asfalto y Materiales

Resistencia a la Abrasión de los agregados pétreos
Maquina de los Angeles
ASTM C 535

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Estudio Factibilidad Rio Torola
LOCATED : **CGP-6**
DATE EXPERIMENT : 16-Ene-03
TEC. RESPONSIBLE : Giovanny Mejia
FILE No : 15-01-03,torola,swissboring,cgp4

IDENTIFICACION DE LA MUESTRA	TIPO GRANULOM.	NUMERO ESFERAS	PESO INICIAL (grs)	PESO FINAL (grs)	PORCENTAJE DESGASTE
tamaño nominal maximo 3"	"A"	12	9,992	8,512	14.81%

sampling carrier out by applicant

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Jefe Laboratorios control de calidad
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515
(516)

RESISTANCE TO DEGRADATION OF SMALL-SIZE COARSE AGGREGATES BY ABRATION AND IMPACT IN THE LOS ANGELES MACHINE (ASTM C 131-96)

$17
($18)

Resistencia a la Abrasión de los agregados pétreos

Maquina de los Angeles

ASTM C 131

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Estudio Factibilidad Rio Torola
LOCATED : **CGP-5**
DATE EXPERIMENT : 16-Ene-03
TEC. RESPONSIBLE : Giovanny Mejia
FILE No : 15-01-03,torola,swissboring,cgp5

IDENTIFICACION DE LA MUESTRA	TIPO GRANULOM.	NUMERO ESFERAS	PESO INICIAL (grs)	PESO FINAL (grs)	PORCENTAJE DESGASTE
tamaño nominal maximo 2 1/2"	"A"	12	4,948	4,026	18.63%

sampling carrier out by applicant

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Jefe Laboratorios control de calidad
Suelos Concreto Asfalto y Materiales

5/9
(520)

RESISTANCE TO DEGRADATION OF SMALL-SIZE COARSE AGGREGATES BY ABRASION AND IMPACT IN THE LOS ANGELES MACHINE (ASTM C 131 -96). RESISTANCE TO DEGRADATION OF LARGE-SIZE COARSE AGGREGATES BY ABRASION AND IMPACT IN THE LOS ANGELES MACHINE (ASTM C 535 -96-01)

521
(522)

Resistencia a la Abrasión de los agregados pétreos
Maquina de los Angeles

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Factibilidad Rio Torola
LOCATED : Parte Baja del Rio Torola
DATE EXPERIMENT . 22-Mar-02
TEC. RESPONSIBLE : Daniel Granados, Arleth Moran
FILE No . 13-3-2,desgaste,swissboring

Muestra CGB-1 ASTM C- 131

IDENTIFICACION DE LA MUESTRA	TIPO GRANULOM.	NUMERO ESFERAS	PESO INICIAL (grs)	PESO FINAL (grs)	PORCENTAJE DESGASTE
tamaño máximo 1 1/2"	A	12	5,008	3,982	20.49%

ASTM C- 535

IDENTIFICACION DE LA MUESTRA	TIPO GRANULOM.	NUMERO ESFERAS	PESO INICIAL (grs)	PESO FINAL (grs)	PORCENTAJE DESGASTE
tamaño máximo 3"	A	12	10,088	8,658	14.18%

sample of rock in rough bring for solicitor

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523

Resistencia a la abrasión de los agregados pétreos
Máquina de los Angeles

CGP-2

ASTM C-131

	A	12	5.000	3.907	21.86
	A	12	10.062	8.282	17.69

INSTITUTO TECNOLOGICO
ITCA FEPADE

Resistencia a la Abrasión de los agregados pétreos
Maquina de los Angeles

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Factibilidad Rio Torola
LOCATED : Parte Baja del Rio Torola
DATE EXPERIMENT . 22-Mar-02
TEC. RESPONSIBLE : Daniel Granados, Arleth Moran
FILE No : 13-3-2,desgaste,swissboring

Muestra CGB-3 ASTM C- 131

IDENTIFICACION DE LA MUESTRA	TIPO GRANULOM.	NUMERO ESFERAS	PESO INICIAL (grs)	PESO FINAL (grs)	PORCENTAJE DESGASTE
tamaño máximo 1 1/2"	A	12	5,007	3,960	20.91%

ASTM C- 535

IDENTIFICACION DE LA MUESTRA	TIPO GRANULOM.	NUMERO ESFERAS	PESO INICIAL (grs)	PESO FINAL (grs)	PORCENTAJE DESGASTE
tamaño máximo 3"	A	12	10,026	8,250	17 71%

sample of rock in rough bring for solicitor

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Jefe Laboratorios control de calidad
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525
(526)

CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES (ASTM C 142-97). LIGHT WEIGHT PIECES IN AGGREGATE (ASTM C 123-94)

527
(528)

Particulas Ligeras y Desmenuzables

ASTM C 142, ASTM C 123

SOLICITOR . Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Factibilidad Rio Torola
LOCATED : Parte Baja del Rio Torola
DATE EXPERIMENT : 21-Ene-02
TEC. RESPONSIBLE : Daniel Granados
FILE No : 24-GE,des-san-lig,(CGP),31-1-2,swissboring

Light Particles

CGP-1, M-1 Profundidad 1.90 m	Added tipe	I weigh initial	I weigh light	% that floats
passes the mesh # 4 and the retains in the mesh #	Fine	200.0	3.2	1.60%

Salt employee to obtain liquidates heavy: chloride of zinc

Particles that are crumbled, (clay clots)

passes the mesh # 4 and the retains in the mesh #	Fine	300.0	5 0	1.67%

I weigh end obtained after sifting for the mesh # 20

sampling carrier out by applicant

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CENTROAMERICANO ITCA
LABORATORIOS
DEPTO. INGENIERIA CIVIL Y ARQUITECTURA
ADMON. FEPADE

Ing. Joaquin Humberto Montenegro
Jefe Laboratorios control de calidad
Suelos Concreto Asfalto y Materiales

529

Particulas Ligeras y Desmenuzables

ASTM C 142, ASTM C 123

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Factibilidad Rio Torola
LOCATED : Parte Baja del Rio Torola
DATE EXPERIMENT : 21-Ene-02
TEC. RESPONSIBLE : Daniel Granados
FILE No : 24-GE,des-san-lig,(CGP),31-1-2,swissboring

Light Particles

CGP-2, M-1 Profundidad 3.00 m.	Added tipe	I weigh initial	I weigh light	% that floats
It passes the mesh # 4 and the retains in the mesh # 50	Fine	200.0	2.2	1.10%

Salt employee to obtain liquidates heavy: chloride of zinc

Particles that are crumbled, (clay clots)

It passes the mesh # 4 and the retains in the mesh # 16	Fine	300.0	2.0	0.67%

I weigh end obtained after sifting for the mesh # 20

sampling carrier out by applicant

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Particulas Ligeras y Desmenuzables

ASTM C 142, ASTM C 123

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT . Factibilidad Rio Torola
LOCATED : Parte Baja del Rio Torola
DATE EXPERIMENT :
TEC. RESPONSIBLE :
FILE No : 24-GE,des-san-lig,(CGP),31-1-2,swissboring

Light Particles

CGP-3. M-1 Profundidad 1.60 m.	Added tipe	I weigh initial	I weigh light	% that floats
It passes the mesh # 4 and the retains in the mesh # 50	Fine	200.0	4 3	2 15%

Salt employee to obtain liquidates heavy: chloride of zinc

Particles that are crumbled, (clay clots)

It passes the mesh # 4 and the retains in the mesh # 16	Fine	300.0	3 7	1 23%

I weigh end obtained after sifting for the mesh # 20

sampling carrier out by applicant

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Particulas Ligeras y Desmenuzables

ASTM C 142, ASTM C 123

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Estudio Factibilidad Rio Torola
LOCATED : **CGP-4**
DATE EXPERIMENT : 16-Ene-03
TEC. RESPONSIBLE : Haydee Hernandez
FILE No : 15-01-03,torola,swissboring,cgp4

Light Particles

	Added tipe	I weigh initial	I weigh light	% that floats
passes the mesh # 4 and the retains in the mesh #	Fine	200.0	1.0	0.50%

Salt employee to obtain liquidates heavy: chloride of zinc

Particles that are crumbled, (clay clots)

passes the mesh # 4 and the retains in the mesh #	Fine	200.0	0.7	0.35%

I weigh end obtained after sifting for the mesh # 20

sampling carrier out by applicant

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Suelos Concreto Asfalto y Materiales

Particulas Ligeras y Desmenuzables

ASTM C 142, ASTM C 123

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : *Estudio Factibilidad Rio Torola*
LOCATED : **CGP-5**
DATE EXPERIMENT : 16-Ene-03
TEC. RESPONSIBLE . Haydee Hernandez
FILE No : 15-01-03,torola,swissboring,cgp5

Light Particles

	Added tipe	I weigh initial	I weigh light	% that floats
passes the mesh # 4 and the retains in the mesh #	Fine	200.0	0.0	0.00%

Salt employee to obtain liquidates heavy: chloride of zinc

Particles that are crumbled, (clay clots)

passes the mesh # 4 and the retains in the mesh #	Fine	200.0	0.9	0.45%

I weigh end obtained after sifting for the mesh # 20

sampling carrier out by applicant

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ADMON. FEPADE

Ing. Joaquin Humberto Montenegro
Jefe Laboratorios control de calidad
Suelos Concreto Asfalto y Materiales

Particulas Ligeras y Desmenuzables

ASTM C 142, ASTM C 123

SOLICITOR : Ing. Rodolfo Alvarado, SWISSBORING
PROYECT : Estudio Factibilidad Rio Torola
LOCATED . **CGP-6**
DATE EXPERIMENT : 16-Ene-03
TEC. RESPONSIBLE : Haydee Hernandez
FILE No : 15-01-03,torola,swissboring,cgp4

Light Particles

	Added tipe	I weigh initial	I weigh light	% that floats
passes the mesh # 4 and the retains in the mesh #	Fine	200.0	0.0	0.00%

Salt employee to obtain liquidates heavy: chloride of zinc

Particles that are crumbled, (clay clots)

passes the mesh # 4 and the retains in the mesh #	Fine	200.0	1.1	0.55%

I weigh end obtained after sifting for the mesh # 20

sampling carrier out by-applicant

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LABORATORIOS
DEPTO. INGENIERIA CIVIL Y ARQUITECTURA
ADMON. FEPADE

Ing. Joaquin Humberto Montenegro
Jefe Laboratorios control de calidad
Suelos Concreto Asfalto y Materiales

POTENTIAL ALKALI-SILICA REACTIVITY OF AGGREGATES (ASTM C 289)

CENTRO DE INVESTIGACIONES DE INGENIERIA
FACULTAD DE INGENIERIA
UNIVERSIDAD DE SAN CARLOS DE GUATEMALA

No. 14814
No. Informe Lab. 013-02

Interesado: **SWISSBORING**
Muestra: 1 muestras de roca
Fecha: 20 de Febrero de 2002

Análisis de Reactividad Potencial según norma C-289.

Resultados

MUESTRA	REACTIVIDAD POTENCIAL	REDUCCIÓN POR ALCALINIDAD (R_c) milimol /litro	SILICA DISUELTA (S_c) milimol/litro	SiO_2 (%)
No. 1 (O-1)	INOCUO	427.35	0.8546	51.20

Muestra proporcionada por el interesado

Atentamente,

Ing. César A. García
Jefe
Sección Química Industrial –CII–

Vo.Bo. Ing. Francisco Javier Quiñónez de la Cruz
DIRECTOR
Centro de Investigaciones de Ingeniería –CII–

FACULTAD DE INGENIERIA -USAC
Edificio T-5, Ciudad Universitaria zona 12
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(538)

POTENTIAL ALKALI REACTIVITY OF CEMENT AGGREGATES COMBINATIONS (ASTM C 227)

539
(590)

CENTRO DE INVESTIGACIONES DE INGENIERIA
FACULTAD DE INGENIERIA
UNIVERSIDAD DE SAN CARLOS DE GUATEMALA

O. T. No. 14828

INFORME No. S-A.M. 004-2002

INTERESADO: **Swiss Boring**
ASUNTO: Evaluar reactividad alcalina potencial de las combinaciones de cemento y agregado (Metodo de la barra de mortero), según ASTM C-227
FECHA: 11 de Marzo de 2002

1. GENERALIDADES

El interesado proporcionó los materiales, siendo éstos los siguientes:

- 1 bolsa de cemento, sin identificación.
- 1 muestra de roca, identificada 0-1 M1 basalto alterado.

2. PROCEDIMIENTO

Se trabajo de acuerdo a los procedimientos indicados en la norma ASTM C-227, tomando lecturas a los 7 y 14 días, a solicitud del interesado.

3. RESULTADOS

Promedio de expansiones 4 barras a 7 días: % 0.003

Atentamente,

Ing. Sergio Vinicio Castañeda Lemus
Jefe Sección Aglomerantes y Morteros

Vo. Bo.
Ing. Francisco Javier Quiñónez de la Cruz
DIRECTOR CII/USAC

c.c.: Archivo.

CENTRO DE INVESTIGACIONES DE INGENIERIA - GUATEMALA C. A. - DIRECCION

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7-11-54

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CENTRO DE INVESTIGACIONES DE INGENIERIA
FACULTAD DE INGENIERIA
UNIVERSIDAD DE SAN CARLOS DE GUATEMALA

O. T. No. 14828

COMPLEMENTO INFORME No. S-A.M. 004-2002

INTERESADO: **Swiss Boring**
ASUNTO: Evaluar reactividad alcalina potencial de las combinaciones de cemento y agregado (Método de la barra de mortero), según ASTM C-227
FECHA: 15 de Marzo de 2002

1. RESULTADOS

Promedio de expansiones 4 barras a 14 días: 0.001%

2. OBSERVACIONES FINALES

Ninguna.

Atentamente,

Ing. Sergio Vinicio Castañeda Lemus
Jefe Sección Aglomerantes y Morteros

Vo. Bo.
Ing. Francisco Javier Quiñónez de la Cruz
DIRECTOR CII/USAC

CENTRO DE INVESTIGACIONES DE INGENIERIA – GUATEMALA, C. A. – DIRECCION

c.c.: Archivo.

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PETROGRAPHIC ANALYSIS

543
(549)

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La Libertad, El Salvador, C.A
Teléfonos:(503)211-6700 Fax:(503)211-6746
Email: info@gesal.com.sv

January 24, 2002

Engr. Rodolfo Alvarado
Swissboring Overseas Corporation Ltd.
Present

Dear Sir:

Attached are the petrographic and XRD analyses of five samples collected in Río Torola, Morazan.

We hope that these analyses will be of great help for the technical study being undertaken by CEL and the government of Japan.

Sincerely yours,

Julio A. Guidos

GEOTERMICA SALVADOREÑA, S.A. de C.V. GERENCIA DE ESTUDIOS Y EVALUACION

JAG/ecdh

PETROGRAPHIC ANALYSIS

INTERESTED:	SWISSBORING
SAMPLE:	(O-1)
COLOR:	DARK
TEXTURE:	APHANITIC
COMPOSITION:	MICROPHENOCRYSTS OF FELDSPAR (PLAGIOCLASE), MANY CRYSTAL OF PIROXENES AND MINOR AMOUNT OF OLIVINES.
NAME:	OLIVINE BASALT
ROCK TYPE:	VOLCANIC
OBSERVATIONS:	THIS REPORT WAS MADE BY ANALYSIS OF TWO THIN SECTIONS WITH A PETROGRAPHIC MICROSCOPE.

CENT. DE ESTUDIOS S. de
DE ENERGIA Y MINAS
CESEM
FAC. DE INGENIERIA
USAC

Appendix 7.12

Other data

Coordination of Drillhole

Area	Drillhole	Coordination		Remarks
		X	Y	
Dam Site	DDB-1	305,092	569,624	
	DDB-2	305,147	569,702	
	CDB-3	305,195	569,771	
	CDB-4	305,252	569,852	
	CDB-5A	305,355	569,995	
	CDB-6A	305,320	570,159	
	CDB-7	305,221	569,651	
	CDB-8	305,324	569,802	
Borrow Area	DGB-1	304,419	570,590	
	DGB-2	304,415	570,718	
	DGB-3	304,378	570,846	
	DGB-4	304,317	571,067	
	DGB-5	304,183	571,200	
	DGB-6			close to CGB-2

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Thickness of Upper Velocity Layer in Borrow Area

Line		CGS-1			CGS-2	CGS-3	CGS-4	CGS-5			CGS-6	CGS-7
		Profile1	Profile2	Profile3				Profile1	Profile2	Profile3		
Length (m)												
Velocity of upper layer (m/sec)		1600	600	720	659	800	600	760	950	1100	400	1000
Velocity of lower layer (m/sec)		2200	2600	2200	2500	3000	2500	2350	2100	2300	2000	2300
Thickness of	Start	2	5.5	5	5.5	5	7	3	3	3	0.5	0
Upper Velocity Layer (m)	1	3.5	3	5	5.5	5	7	4	2.5	4	0.5	0.5
	2	4	3	5.5	4.5	7.5	6	4.5	3	4	1	2
	3	5	3	6	1	8.5	5	5	4	4.5	1	2.5
	4	5	3	6	1.5	7	4	5	4.5	4	1	3
	5	5	2.5	5	2.5	6	3	4.5	4.5	2.5	2	4
	6	4.5	3	5	4	4	2.5	4.5	4.5	4.5	2	5
	7	4.5	4	4.5	5	3	2	4	4.5	5	2	7
	8	5	5	4	5.5	1	1.5	4.5	4	5.5	2	8
	9	4.5	5	4.5	6	4.5	2	4	3.5	5	2	9
	10	6	5	3.5	5	5.5	2	3.5	3	4	2	9
	11	6	4.5	3	5.5	5	1.5	3.5	2	3	2.5	9
	12	5.5	5	1.5	5.5	4	0.5	3	2	3	3	8.5
	End			1.5	5	3.5	0.5			2	2	8.5
Average Thickness(m)		4.7	4.0	4.3	4.4	5.0	3.2	4.1	3.5	3.9	1.7	5.4

Average of Thickness of All Lines 4.0 m

(55)

Percentage of Particles larger than 100mm in Diameter

Pit	Measure	Weight (pounds)		% weight	
		< 100 mm	> 100 mm	< 100 mm	> 100 mm
CGP-4	1st measure	18.37	18.94	49.24	50.76
	2 nd measure	33.19	26.44	55.66	44.34
	3 erd measure	26.50	19.50	57.60	42.40
	4 th measure	24.37	34.44	41.44	58.56
	5 th measure	11.75	26.37	30.82	69.18
CGP-5	1ert measure	21.75	19.81	52.33	47.67
	2 nd measure	15.44	35.75	30.16	69.84
	3 erd measure	22.19	12.12	64.68	35.32
	4 th measure	7.50	25.62	22.64	77.36
	5 th measure	7.56	42.56	15.08	84.92
Average				41.97	58.04

note: these measures ware conducted at the site.

Chapter 9: Development Plan

Appendix 9.1: Reservoir V-H, A-H Curve for El Chaparral and La Honda Site

Appendix 9.2: Comparison of Project Cost for Scale Examination Study (El Chaparral and La Honda Project)

Appendix 9.3: Comparison of Project Cost for Alternative (1) (La Honda Upstream Alternative)

Appendix 9.4: Comparison of Project Cost for Alternative (2) (El Chaparral Alternatives)

Appendix 9.5: Comparison of Project Cost for Joint Development (La Honda- El Chaparral)

Appendix 9.6: Energy Calculation for El Chaparral Project (E=220.6 GWh)

Appendix 9.7: Dynamic Programming (DP)

Appendix 9.1

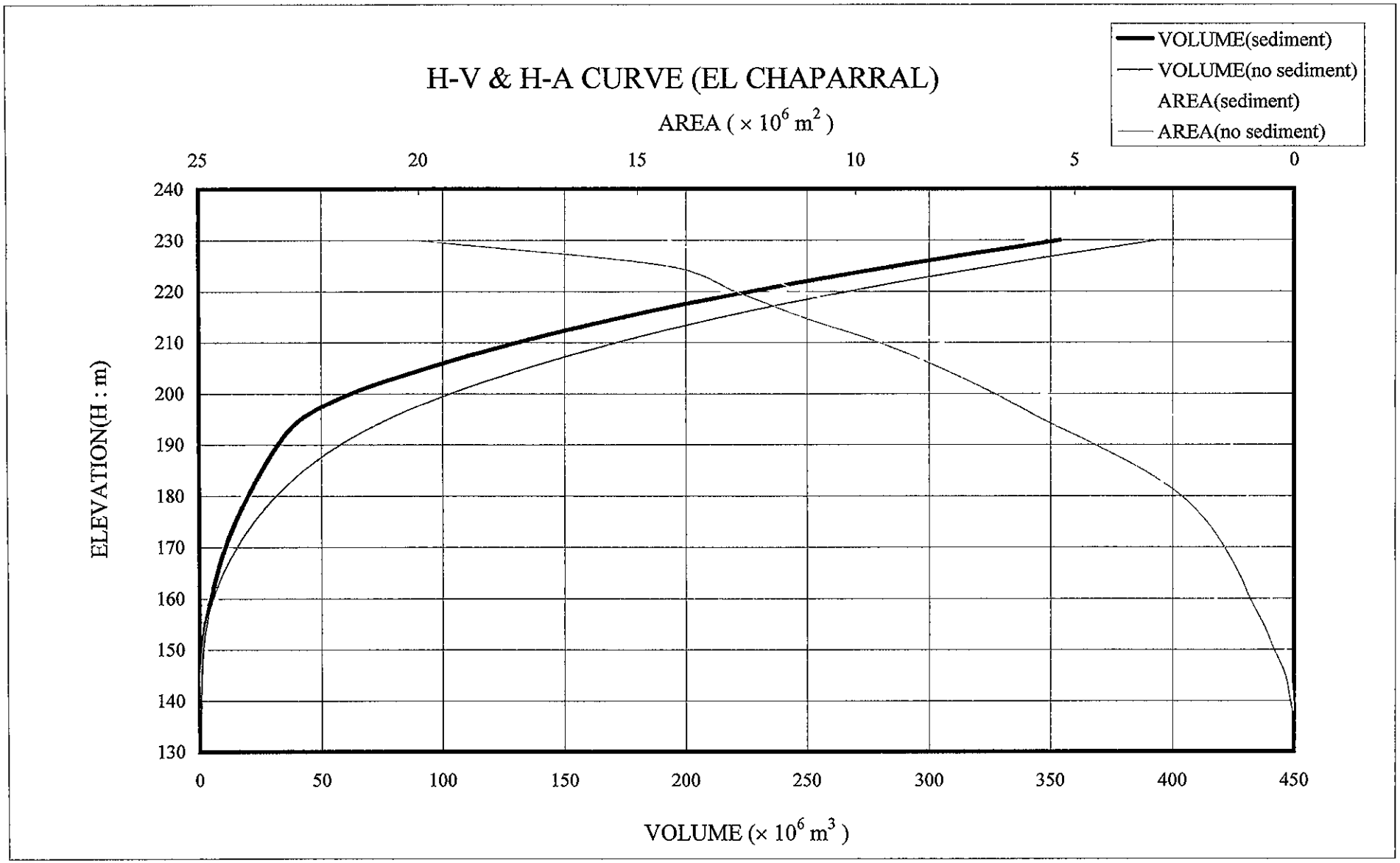
Reservoir V-H, A-H Curve

for

El Chaparral and La Honda Site

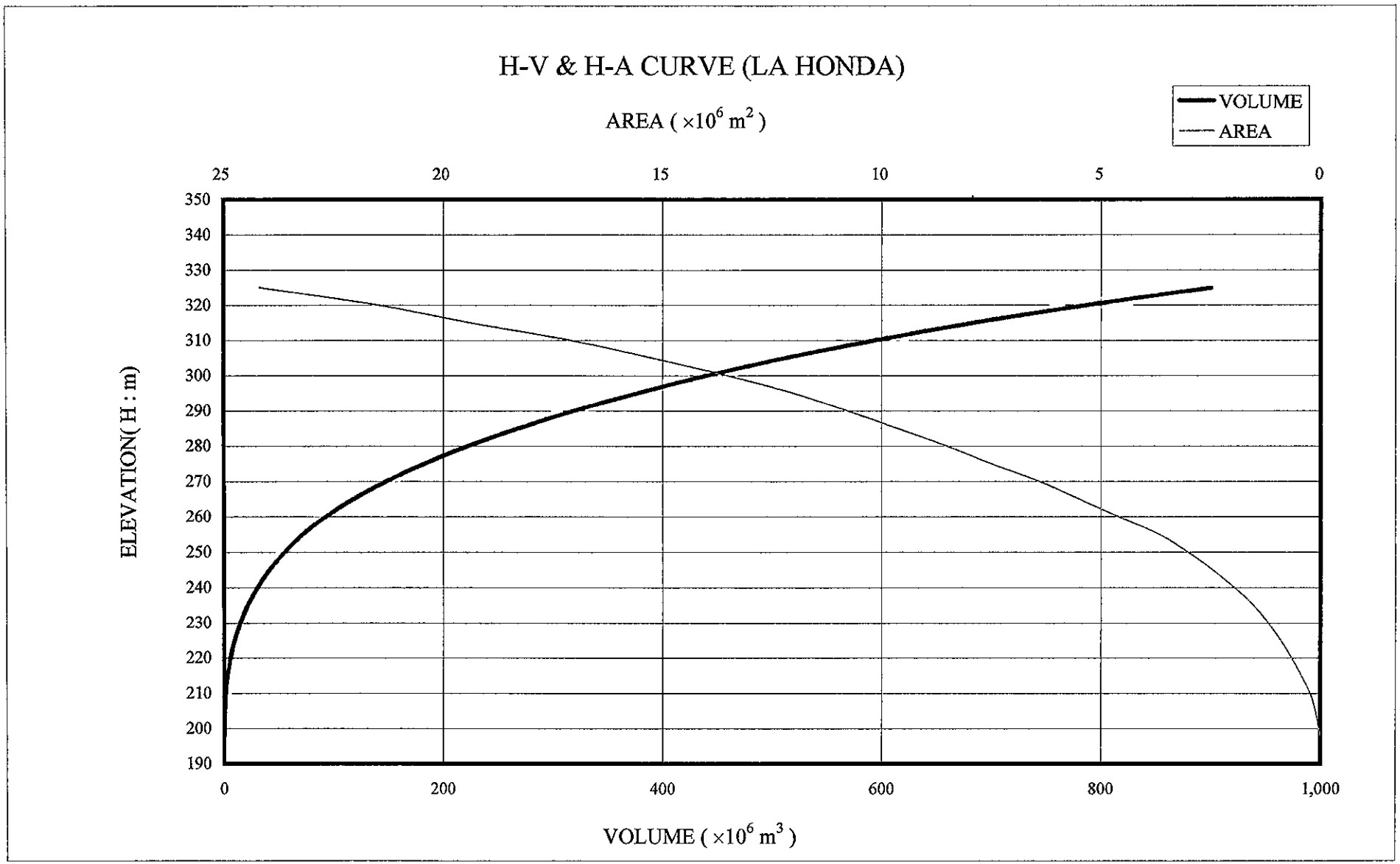
El Chaparral V-H, A-H Curve (no sediment)

elevation (m)	Δh (m)	A (m2)	average A (m2)	V (m3)	ΣV (m3)	ΣV (x 10^6 m3)
138		0		0	0	0
	2		12,226			
140		24,452		24,452	24,452	0
	5		52,774			
145		81,096		263,870	288,322	0
	5		138,799			
150		196,501		693,993	982,315	1
	5		322,539			
155		448,577		1,612,695	2,595,010	3
	5		572,159			
160		695,740		2,860,793	5,455,802	5
	5		853,931			
165		1,012,122		4,269,655	9,725,457	10
	5		1,140,860			
170		1,269,598		5,704,300	15,429,757	15
	5		1,433,281			
175		1,596,964		7,166,405	22,596,162	23
	5		1,798,711			
180		2,000,457		8,993,553	31,589,715	32
	5		2,283,112			
185		2,565,766		11,415,558	43,005,272	43
	5		2,989,499			
190		3,413,232		14,947,495	57,952,767	58
	5		3,965,196			
195		4,517,159		19,825,978	77,778,745	78
	5		5,119,029			
200		5,720,899		25,595,145	103,373,890	103
	5		6,267,468			
205		6,814,037		31,337,340	134,711,230	135
	5		7,426,197			
210		8,038,357		37,130,985	171,842,215	172
	5		8,741,811			
215		9,445,265		43,709,055	215,551,270	216
	5		10,332,803			
220		11,220,341		51,664,015	267,215,285	267
	5		11,983,879			
225		12,747,416		59,919,393	327,134,677	327
	5		13,514,142			
230		14,280,868		67,570,710	394,705,387	395


H-V & H-A CURVE (EL CHAPARRAL)
VOLUME(sediment)
VOLUME(no sediment)
AREA(sediment)
AREA(no sediment)
AREA (× 10^6 m^2)
25
20
15
10
5
0
ELEVATION(H : m)
240
230
220
210
200
190
180
170
160
150
140
130
0
50
100
150
200
250
300
350
400
450
VOLUME (× 10^6 m^3)

La Honda V-H, A-H Curve (no sediment)

elevation (m)	Δh (m)	A (m2)	average A (m2)	V (m3)	ΣV (m3)	ΣV (x 10^6 m3)
198		0	0	0	0	0
	2		15,752			
200		31,504		31,504	31,504	0
	5		72,240			
205		112,975		361,198	392,702	0
	5		172,513			
210		232,050		862,563	1,255,264	1
	5		333,968			
215		435,886		1,669,840	2,925,104	3
	5		543,526			
220		651,166		2,717,630	5,642,734	6
	5		777,013			
225		902,859		3,885,063	9,527,797	10
	5		1,046,967			
230		1,191,075		5,234,835	14,762,632	15
	5		1,358,600			
235		1,526,124		6,792,998	21,555,629	22
	5		1,746,145			
240		1,966,165		8,730,723	30,286,352	30
	5		2,215,476			
245		2,464,786		11,077,378	41,363,729	41
	5		2,744,024			
250		3,023,262		13,720,120	55,083,849	55
	5		3,349,235			
255		3,675,208		16,746,175	71,830,024	72
	5		4,138,530			
260		4,601,851		20,692,648	92,522,672	93
	5		5,052,675			
265		5,503,499		25,263,375	117,786,047	118
	5		5,954,252			
270		6,405,005		29,771,260	147,557,307	148
	5		6,951,269			
275		7,497,533		34,756,345	182,313,652	182
	5		8,002,816			
280		8,508,098		40,014,078	222,327,729	222
	5		9,073,708			
285		9,639,318		45,368,540	267,696,269	268
	5		10,213,790			
290		10,788,261		51,068,948	318,765,217	319
	5		11,396,240			
295		12,004,218		56,981,198	375,746,414	376
	5		12,761,787			
300		13,519,355		63,808,933	439,555,347	440
	5		14,379,655			
305		15,239,955		71,898,275	511,453,622	511
	5		16,165,467			
310		17,090,979		80,827,335	592,280,957	592
	5		18,250,743			
315		19,410,507		91,253,715	683,534,672	684
	5		20,455,069			
320		21,499,631		102,275,345	785,810,017	786
	5		22,839,207			
325		24,178,782		114,196,033	900,006,049	900


H-V & H-A CURVE (LA HONDA)
VOLUME
AREA
AREA (×10^6 m^2)
25
20
15
10
5
0
350
340
330
320
310
300
290
280
270
260
250
240
230
220
210
200
190
ELEVATION(H : m)
0
200
400
600
800
1,000
VOLUME (×10^6 m^3)

Appendix 9.2

Comparison of Project Cost

for

Scale Examination Study

(El Chaparral and La Honda Project)

561
(562)

Table 9.8 Scale Examination of El Chaparral Project by Single Development Scheme

Case			CH1-1	CH1-2	CH1-3	CH2-1	CH2-2	CH2-3	CH3-1	CH3-2	CH3-3
High Water Level	HWL	EL m	212	212	212	204	204	204	198	198	198
Low Water Level	LWL	EL m	195	196	198	194	195	197	191	193	194
Drawdown Depth	Hd	EL m	17	16	14	10	9	7	7	5	4
Normal Water Level	NWL	EL m	206	207	207	201	201	202	196	196	197
Sedimentation Level	SL	EL m	185	185	185	185	185	185	185	185	185
Tail Water Level	TWL	EL m	133	133	133	133	133	133	133	133	133
Penstock Dia	(V=5m/s)	m	4 2	5 0	5 8	3 6	4.5	5 5	2 3	3 2	3 9
Gross Storage Capacity	Vg	10^6m^3	189	189	189	128	128	128	93	93	93
Effective Storage Capacity	Ve	10^6m^3	111	106	96	54	50	40	31	23	19
Peaking Time		hr	4	4	4	4	4	4	4	4	4
Firm Discharge Qf without 2m^3/s		m^3/s	8 9	8 6	8.0	4 9	4 5	3 8	3 0	2 3	2 0
Maximum Discharge	Qmax	m^3/s	70	100	130	50	80	120	20	40	60
Gross Head	Hg	m	73 0	74 0	74 0	68 0	68 0	69 0	63 0	63 0	64 0
Effective Head	He	m	71 8	72 8	72 8	66 8	66 8	67 8	61.8	61 8	62 8
Installed Capacity P1max (main)		MW	44 5	64 4	83 7	29 5	47 3	72 0	10 9	21 9	33 3
Installed Capacity P2max (sub)		MW	1 3	1 3	1 3	1 2	1 2	1 2	1 1	1 1	1 1
Pmax=P1max+P2max		MW	45.8	65 7	85 1	30 8	48 5	73 2	12 0	23 0	34 4
Dependable Capacity Pf1 (main)		MW	29 3	26 6	21 5	14 6	10 8	0 0	5 5	4 1	0 0
Dependable Capacity Pf2 (sub)		MW	1 1	1 1	1 1	1 0	1 1	1 1	1 0	1 0	1 0
Pf=Pf1+Pf2		MW	30 4	27 7	22 6	15 6	11 9	1 1	6 5	5 1	1 0
Annual Average Inflow		10^6m^3	1489 1	1489 1	1489 1	1489 1	1489 1	1489 1	1489 1	1489 1	1489 1
Annual Average Power Discharge		10^6m^3	1065 9	1226 9	1304 7	844 0	1088 4	1303 1	419 6	697.9	921 6
Annual Average Overflow		10^6m^3	355 4	194 9	117 7	578 4	334 0	153.0	1003 6	726 0	513 1
Annual Average Energy E1 (main)		GWh	190 2	219 7	235 9	139 0	178 9	210.4	64 9	107.0	140 2
Annual Average Energy E2 (sub)		GWh	10 5	10 6	10 7	9 8	9 9	10 0	9 1	9 3	9 4
Annual Average Energy E3 (15Sep)		GWh	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0
E=E1+E2+E3		GWh	202 7	232 3	248 6	150 8	190 7	222.4	76 0	118 3	151 6
Plant Factor		%	51	40	33	56	45	35	72	59	50
Project Cost		$10^6$$	128 5	135 3	142 2	110 3	117 0	125 7	95 8	100 1	104 3
Energy cost per kw		$/kW	2806	2059	1672	3586	2413	1717	7958	4356	3029
Energy cost per kwh		$/kWh	0 071	0 065	0 064	0 081	0 068	0 063	0 140	0 094	0 077
B/C			1 00	1 01	0 96	0 77	0 82	0 74	0 43	0 56	0 61
B-C		$10^6$$	0 00	0 16	-0 67	-2 72	-2 26	-3 51	-5 98	-4 76	-4.38

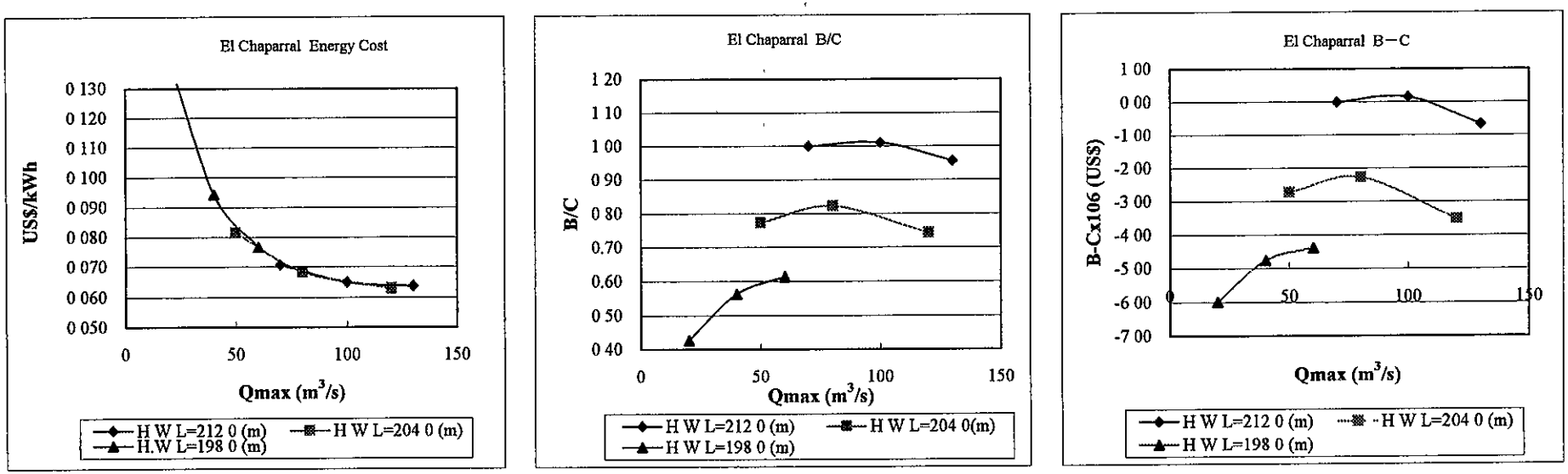


Fig.9.9 Energy Cost, B/C, B−C

Table 12.2 EL CHAPARRAL PROJECT
SUMMARY of PROJECT COST
(price in Jan. 2003)

Item	Unit Price	Ch1-1 Quantity	Unit	Total Cost	Ch1-2 Quantity	Unit	Total Cost	Ch1-3 Quantity	Unit	Total Cost	Ch2-1 Quantity	Unit	Total Cost	Ch2-2 Quantity	Unit	Total Cost	Ch2-3 Quantity	Unit	Total Cost	Ch3-1 Quantity	Unit	Total Cost	Ch3-2 Quantity	Unit	Total Cost	Ch3-3 Quantity	Unit	Total Cost
PROJECT COST																												
1 Preparatory Works																												
Construction road 1 (Improved existing road , B=6m)	$ 15,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400
Construction road 2 (new permanent road , B=6m)	$ 185,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000
Construction road 3 (new temporary road , B=11m)	$ 37,200	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400
Camp & office facility	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000
Temporary constructon facility	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000
Temporary constructon yard development	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000
2 Civil Works																												
Care of River																												
Upstream Cofferdam																												
Common Excavation	$ 4	3,800	m³	$ 15,200	3,800	m³	$ 15,200	3,800	m³	$ 15,200	3,800	m³	$ 15,200	3,800	m³	$ 15,200	3,800	m³	$ 15,200	3,800	m³	$ 15,200	3,800	m³	$ 15,200	3,800	m³	$ 15,200
Rock Excavation	$ 10	1,600	m³	$ 16,000	1,600	m³	$ 16,000	1,600	m³	$ 16,000	1,600	m³	$ 16,000	1,600	m³	$ 16,000	1,600	m³	$ 16,000	1,600	m³	$ 16,000	1,600	m³	$ 16,000	1,600	m³	$ 16,000
Roller Compacted Concrete	$55~$60	14,400	m³	$ 792,000	14,400	m³	$ 792,000	14,400	m³	$ 792,000	14,400	m³	$ 820,800	14,400	m³	$ 820,800	14,400	m³	$ 820,800	14,400	m³	$ 864,000	14,400	m³	$ 864,000	14,400	m³	$ 864,000
Others	40000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000
Downstream Cofferdam																												
Common Excavation	$ 4	3,500	m³	$ 14,000	3,500	m³	$ 14,000	3,500	m³	$ 14,000	3,500	m³	$ 14,000	3,500	m³	$ 14,000	3,500	m³	$ 14,000	3,500	m³	$ 14,000	3,500	m³	$ 14,000	3,500	m³	$ 14,000
Rock Excavation	$ 10	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000
Embankment	$ 7	3,000	m³	$ 21,000	3,000	m³	$ 21,000	3,000	m³	$ 21,000	3,000	m³	$ 21,000	3,000	m³	$ 21,000	3,000	m³	$ 21,000	3,000	m³	$ 21,000	3,000	m³	$ 21,000	3,000	m³	$ 21,000
Others	40000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000
Diversion Tunnel																												
Common Excavation	$ 4	8,200	m³	$ 32,800	8,200	m³	$ 32,800	8,200	m³	$ 32,800	8,200	m³	$ 32,800	8,200	m³	$ 32,800	8,200	m³	$ 32,800	8,200	m³	$ 32,800	8,200	m³	$ 32,800	8,200	m³	$ 32,800
Tunnel Excavation	$ 150	24,000	m³	$ 3,600,000	24,000	m³	$ 3,600,000	24,000	m³	$ 3,600,000	24,000	m³	$ 3,600,000	24,000	m³	$ 3,600,000	24,000	m³	$ 3,600,000	24,000	m³	$ 3,600,000	24,000	m³	$ 3,600,000	24,000	m³	$ 3,600,000
Tunnel Lining Concrete	$ 230	2,100	m³	$ 483,000	2,100	m³	$ 483,000	2,100	m³	$ 483,000	2,100	m³	$ 483,000	2,100	m³	$ 483,000	2,100	m³	$ 483,000	2,100	m³	$ 483,000	2,100	m³	$ 483,000	2,100	m³	$ 483,000
Reinforced Bar	$ 1,500	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000
Others	25%	1	ls	$ 1,051,450	1	ls	$ 1,051,450	1	ls	$ 1,051,450	1	ls	$ 1,051,450	1	ls	$ 1,051,450	1	ls	$ 1,051,450	1	ls	$ 1,051,450	1	ls	$ 1,051,450	1	ls	$ 1,051,450
Dam																												
Dam																												
Common Excavation	$ 4	124,500	m³	$ 498,000	124,500	m³	$ 498,000	124,500	m³	$ 498,000	97,923	m³	$ 391,692	97,923	m³	$ 391,692	97,923	m³	$ 391,692	81,086	m³	$ 324,344	81,086	m³	$ 324,344	81,086	m³	$ 324,344
Rock Excavation	$ 10	186,700	m³	$ 1,867,000	186,700	m³	$ 1,867,000	186,700	m³	$ 1,867,000	146,845	m³	$ 1,468,450	146,845	m³	$ 1,468,450	146,845	m³	$ 1,468,450	121,596	m³	$ 1,215,960	121,596	m³	$ 1,215,960	121,596	m³	$ 1,215,960
Roller Compacted Concrete(Inner Concrete)	$55~$60	247,600	m³	$ 13,618,000	247,600	m³	$ 13,618,000	247,600	m³	$ 13,618,000	176,940	m³	$ 10,085,580	176,940	m³	$ 10,085,580	176,940	m³	$ 10,085,580	137,301	m³	$ 8,238,060	137,301	m³	$ 8,238,060	137,301	m³	$ 8,238,060
Conventional Concrete(Dam Crest Con + Outer Con)	$ 100	121,600	m³	$ 12,160,000	121,600	m³	$ 12,160,000	121,600	m³	$ 12,160,000	86,898	m³	$ 8,689,800	86,898	m³	$ 8,689,800	86,898	m³	$ 8,689,800	67,431	m³	$ 6,743,100	67,431	m³	$ 6,743,100	67,431	m³	$ 6,743,100
Consolidation Groutng Drilling	$ 60	4,400	m	$ 264,000	4,400	m	$ 264,000	4,400	m	$ 264,000	3,998	m	$ 239,880	3,998	m	$ 239,880	3,998	m	$ 239,880	3,746	m	$ 224,760	3,746	m	$ 224,760	3,746	m	$ 224,760
Consolidation Groutng Cement	$ 700	90	t	$ 63,000	90	t	$ 63,000	90	t	$ 63,000	82	t	$ 57,400	82	t	$ 57,400	82	t	$ 57,400	77	t	$ 53,900	77	t	$ 53,900	77	t	$ 53,900
Curtain Groutng Drilling	$ 130	46,800	m	$ 6,084,000	46,800	m	$ 6,084,000	46,800	m	$ 6,084,000	42,521	m	$ 5,527,730	42,521	m	$ 5,527,730	42,521	m	$ 5,527,730	39,847	m	$ 5,180,110	39,847	m	$ 5,180,110	39,847	m	$ 5,180,110
Curtain Groutng Cement	$ 700	2,200	t	$ 1,540,000	2,200	t	$ 1,540,000	2,200	t	$ 1,540,000	1,999	t	$ 1,399,300	1,999	t	$ 1,399,300	1,999	t	$ 1,399,300	1,873	t	$ 1,311,100	1,873	t	$ 1,311,100	1,873	t	$ 1,311,100
Others	10%	1	ls	$ 3,609,400	1	ls	$ 3,609,400	1	ls	$ 3,609,400	1	ls	$ 2,785,990	1	ls	$ 2,785,990	1	ls	$ 2,785,990	1	ls	$ 2,329,140	1	ls	$ 2,329,140	1	ls	$ 2,329,140
Spillway																												
Structural Concrete(Piers,Chute,Walls,etc)	$ 130	23,000	m³	$ 2,990,000	23,000	m³	$ 2,990,000	23,000	m³	$ 2,990,000	23,000	m³	$ 2,990,000	23,000	m³	$ 2,990,000	23,000	m³	$ 2,990,000	23,000	m³	$ 2,990,000	23,000	m³	$ 2,990,000	23,000	m³	$ 2,990,000
Reinforced Bar	$ 1,500	640	t	$ 960,000	640	t	$ 960,000	640	t	$ 960,000	640	t	$ 960,000	640	t	$ 960,000	640	t	$ 960,000	640	t	$ 960,000	640	t	$ 960,000	640	t	$ 960,000
Others	10%	1	ls	$ 395,000	1	ls	$ 395,000	1	ls	$ 395,000	1	ls	$ 395,000	1	ls	$ 395,000	1	ls	$ 395,000	1	ls	$ 395,000	1	ls	$ 395,000	1	ls	$ 395,000
Water way																												
Intake																												
Structural Concrete(Piers,etc)	$ 130	992	m³	$ 128,960	1,200	m³	$ 156,000	1,358	m³	$ 176,540	690	m³	$ 89,700	893	m³	$ 116,090	1,094	m³	$ 142,220	358	m³	$ 46,540	503	m³	$ 65,390	626	m³	$ 81,380
Reinforced Bar	$ 1,500	50	t	$ 75,000	60	t	$ 90,000	68	t	$ 102,000	35	t	$ 52,500	45	t	$ 67,500	55	t	$ 82,500	18	t	$ 27,000	25	t	$ 37,500	31	t	$ 46,500
Others	10%	1	ls	$ 20,400	1	ls	$ 24,600	1	ls	$ 27,860	1	ls	$ 14,220	1	ls	$ 18,360	1	ls	$ 22,480	1	ls	$ 7,360	1	ls	$ 10,290	1	ls	$ 12,790
Penstock																												
Incline Shaft Excavation	$ 200	1,693	m³	$ 338,600	2,400	m³	$ 480,000	3,229	m³	$ 645,800	1,244	m³	$ 248,800	1,944	m³	$ 388,800	2,904	m³	$ 580,800	508	m³	$ 101,600	983	m³	$ 196,600	1,460	m³	$ 292,000
Filling Concrete	$ 190	564	m³	$ 107,160	800	m³	$ 152,000	1,076	m³	$ 204,440	415	m³	$ 78,850	648	m³	$ 123,120	968	m³	$ 183,920	169	m³	$ 32,110	328	m³	$ 62,320	487	m³	$ 92,530
Structural Concrete(Anchor Block)	$ 130	353	m³	$ 45,890	500	m³	$ 65,000	673	m³	$ 87,490	259	m³	$ 33,670	405	m³	$ 52,650	605	m³	$ 78,650	106	m³	$ 13,780	205	m³	$ 26,650	304	m³	$ 39,520
Rainforced Bar	$ 1,500	14	t	$ 21,000	20	t	$ 30,000	27	t	$ 40,500	10	t	$ 15,000	16	t	$ 24,000	24	t	$ 36,000	4	t	$ 6,000	8	t	$ 12,000	12	t	$ 18,000
Others	10%	1	ls	$ 51,270	1	ls	$ 72,700	1	ls	$ 97,830	1	ls	$ 37,640	1	ls	$ 58,860	1	ls	$ 87,940	1	ls	$ 15,350	1	ls	$ 29,760	1	ls	$ 44,210
Powerhouse																												
Powerhouse																												
Common Excavation	$ 4	30,515	m³	$ 122,060	35,900	m³	$ 143,600	41,285	m³	$ 165,140	26,925	m³	$ 107,700	32,310	m³	$ 129,240	39,490	m³	$ 157,960	21,540	m³	$ 86,160	25,130	m³	$ 100,520	28,720	m³	$ 114,880
Rock Excavation	$ 10	121,975	m³	$ 1,219,750	143,500	m³	$ 1,435,000	165,025	m³	$ 1,650,250	107,625	m³	$ 1,076,250	129,150	m³	$ 1,291,500	157,850	m³	$ 1,578,500	86,100	m³	$ 861,000	100,450	m³	$ 1,004,500	114,800	m³	$ 1,148,000
Structural Concrete(Slab, Barrel)	$ 130	9,945	m³	$ 1,292,850	11,700	m³	$ 1,521,000	13,455	m³	$ 1,749,150	8,775	m³	$ 1,140,750	10,530	m³	$ 1,368,900	12,870	m³	$ 1,673,100	7,020	m³	$ 912,600	8,190	m³	$ 1,064,700	9,360	m³	$ 1,216,800
Reinfored Bar	$ 1,500	629	t	$ 943,500	740	t	$ 1,110,000	851	t	$ 1,276,500	555	t	$ 832,500	666	t	$ 999,000	814	t	$ 1,221,000	444	t	$ 666,000	518	t	$ 777,000	592	t	$ 888,000
Others	20%	1	ls	$ 715,640	1	ls	$ 841,920	1	ls	$ 968,210	1	ls	$ 631,440	1	ls	$ 757,730	1	ls	$ 926,120	1	ls	$ 505,160	1	ls	$ 589,350	1	ls	$ 673,540
Control Building																												
Control Building	$ 40		inner m³	$ 418,200	12,300	inner m³	$ 492,000		inner m³	$ 565,800		inner m³	$ 369,000		inner m³	$ 442,800		inner m³	$ 541,200		inner m³	$ 295,200		inner m³	$ 344,400		inner m³	$ 393,600
Outlet																												
Common Excavation	$ 4	4,165	m³	$ 16,660	4,900	m³	$ 19,600	5,635	m³	$ 22,540	3,675	m³	$ 14,700	4,410	m³	$ 17,640	5,390	m³	$ 21,560	2,940	m³	$ 11,760	3,430	m³	$ 13,720	3,920	m³	$ 15,680
Rock Excavation	$ 10	9,605	m³	$ 96,050	11,300	m³	$ 113,000	12,995	m³	$ 129,950	8,475	m³	$ 84,750	10,170	m³	$ 101,700	12,430	m³	$ 124,300	6,780	m³	$ 67,800	7,910	m³	$ 79,100	9,040	m³	$ 90,400
Others	20%	1	ls	$ 22,550	1	ls	$ 26,520	1	ls	$ 30,500	1	ls	$ 19,890	1	ls	$ 23,870	1	ls	$ 29,180	1	ls	$ 15,920	1	ls	$ 18,570	1	ls	$ 21,220
Switchyard																												
Common Excavation	$ 4	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600
Structural Concrete(Foundation)	$ 130	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000
Others	20%	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720
3 Hydromechanical Equipment																												
Spillway Gate	$ 7,000	1,130	t	$ 7,910,000	1,130	t	$ 7,910,000	1,130	t	$ 7,910,000	1,130	t	$ 7,910,000	1,130	t	$ 7,910,000	1,130	t	$ 7,910,000	1,130	t	$ 7,910,000	1,130	t	$ 7,910,000	1,130	t	$ 7,910,000
Intake Gate	$ 6,000	63	t	$ 378,000	90	t	$ 540,000	116	t	$ 696,000	43	t	$ 258,000	69	t	$ 414,000	102	t	$ 612,000	16	t	$ 96,000	32	t	$ 192,000	48	t	$ 288,000
Intake Screen	$ 3,000	14	t	$ 42,000	20	t	$ 60,000	26	t	$ 78,000	10	t	$ 30,000	15	t	$ 45,000	23	t	$ 69,000	4	t	$ 12,000	7	t	$ 21,000	11	t	$ 33,000
Penstock Tube	$ 5,000	247	t	$ 1,235,000	350	t	$ 1,750,000	471	t	$ 2,355,000	181	t	$ 905,000	284	t	$ 1,420,000	424	t	$ 2,120,000	74	t	$ 370,000	143	t	$ 715,000	213	t	$ 1,065,000
Outlet Gate	$ 6,000	59	t	$ 354,000	70	t	$ 420,000	80	t	$ 480,000	49	t	$ 294,000	63	t	$ 378,000	77	t	$ 462,000	31	t	$ 186,000	44	t	$ 264,000	54	t	$ 324,000
Slucceway Gate & Steel liner	$ 1,040,000	1	ls	$ 1,040,000	1	ls	$ 1,040,000	1	ls	$ 1,040,000	1	ls	$ 1,040,000	1	ls	$ 1,040,000	1	ls	$ 1,040,000	1	ls	$ 1,040,000	1	ls	$ 1,040,000	1	ls	$ 1,040,000

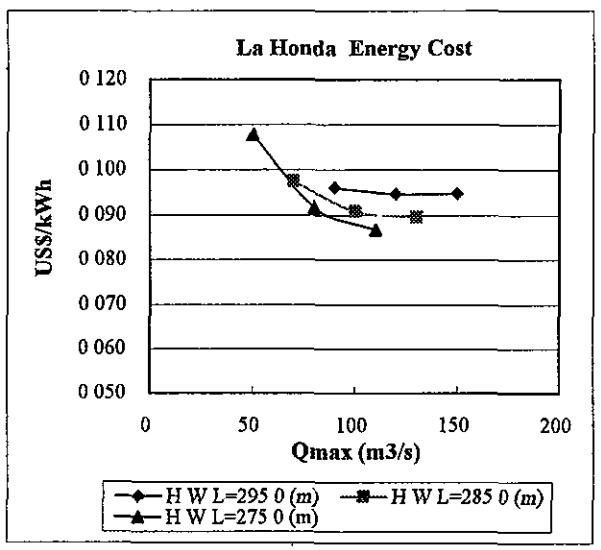
9-2-3

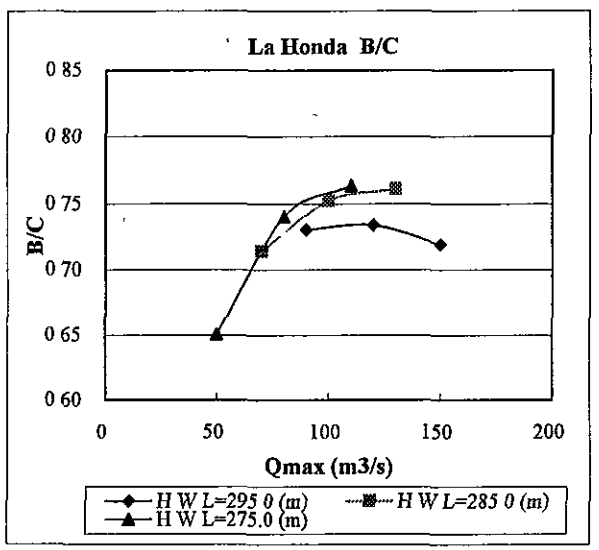
Table 12.2 EL CHAPARRAL PROJECT
SUMMARY of PROJECT COST
(price in Jan. 2003)

Item	Unit Price	Ch1-1 Quantity	Ch1-1 Unit	Ch1-1 Total Cost	Ch1-2 Quantity	Ch1-2 Unit	Ch1-2 Total Cost	Ch1-3 Quantity	Ch1-3 Unit	Ch1-3 Total Cost	Ch2-1 Quantity	Ch2-1 Unit	Ch2-1 Total Cost	Ch2-2 Quantity	Ch2-2 Unit	Ch2-2 Total Cost	Ch2-3 Quantity	Ch2-3 Unit	Ch2-3 Total Cost	Ch3-1 Quantity	Ch3-1 Unit	Ch3-1 Total Cost	Ch3-2 Quantity	Ch3-2 Unit	Ch3-2 Total Cost	Ch3-3 Quantity	Ch3-3 Unit	Ch3-3 Total Cost
4 Electric equipment																												
Main Turbine and Speed Governing System		1	ls	$ 3,803,183	1	ls	$ 5,466,000	1	ls	$ 7,104,102	1	ls	$ 2,613,865	1	ls	$ 4,253,069	1	ls	$ 6,332,382	1	ls	$ 1,013,323	1	ls	$ 2,017,434	1	ls	$ 3,015,668
Main Generator and Excitation System		1	ls	$ 3,011,375	1	ls	$ 4,328,000	1	ls	$ 5,625,056	1	ls	$ 2,069,669	1	ls	$ 3,367,597	1	ls	$ 5,014,005	1	ls	$ 802,353	1	ls	$ 1,597,412	1	ls	$ 2,387,818
Main Power Transformer		1	ls	$ 725,708	1	ls	$ 1,043,000	1	ls	$ 1,355,576	1	ls	$ 498,767	1	ls	$ 811,553	1	ls	$ 1,208,319	1	ls	$ 193,358	1	ls	$ 384,959	1	ls	$ 575,438
Small Turbine and Speed Governing System		1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000
Small Generator and Excitation System		1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000
Overhead Travel Crane		1	ls	$ 596,291	1	ls	$ 857,000	1	ls	$ 1,113,834	1	ls	$ 409,821	1	ls	$ 666,828	1	ls	$ 992,838	1	ls	$ 158,876	1	ls	$ 316,308	1	ls	$ 472,819
Switchyard Equipment		1	ls	$ 349,286	1	ls	$ 502,000	1	ls	$ 652,444	1	ls	$ 240,059	1	ls	$ 390,604	1	ls	$ 581,569	1	ls	$ 93,064	1	ls	$ 185,282	1	ls	$ 276,960
Powerplant Equipment	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000
5 Transmission Equipment																												
Receiving Switch	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000
Transmission Line	$ 2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000
6 Environmental Cost																												
Infrastructure																												
New Public Road	$ 25,000	11	km	$ 275,000	11	km	$ 275,000	11	km	$ 275,000	11	km	$ 275,000	11	km	$ 275,000	11	km	$ 275,000	11	km	$ 275,000	11	km	$ 275,000	11	km	$ 275,000
Improved Public Road	$ 15,000	33	km	$ 495,000	33	km	$ 495,000	33	km	$ 495,000	33	km	$ 495,000	33	km	$ 495,000	33	km	$ 495,000	33	km	$ 495,000	33	km	$ 495,000	33	km	$ 495,000
New Bridge (two bridges)		1	ls	$ 4,000,000	1	ls	$ 4,000,000	1	ls	$ 4,000,000	1	ls	$ 4,000,000	1	ls	$ 4,000,000	1	ls	$ 4,000,000	1	ls	$ 4,000,000	1	ls	$ 4,000,000	1	ls	$ 4,000,000
Environmental Mitigation																												
Environmental Mitigation	$ 192,000	1	ls	$ 192,000	1	ls	$ 192,000	1	ls	$ 192,000	1	ls	$ 192,000	1	ls	$ 192,000	1	ls	$ 192,000	1	ls	$ 192,000	1	ls	$ 192,000	1	ls	$ 192,000
Environmental Mitigation inherent to project	$ 2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000
7 Land Acquisition and Resettlement																												
Land Acquisition for Reservoir (suitable for agriculture)	$ 8,000	234	ha	$ 1,872,000	234	ha	$ 1,872,000	234	ha	$ 1,872,000	180	ha	$ 1,440,000	180	ha	$ 1,440 000	180	ha	$ 1,440,000	143	ha	$ 1,144,000	143	ha	$ 1,144,000	143	ha	$ 1,144,000
Land Acquisition for Reservoir (not suitable for agriculture)	$ 5,900	645	ha	$ 3,805,500	645	ha	$ 3,805,500	645	ha	$ 3,805,500	495	ha	$ 2,920,500	495	ha	$ 2,920,500	495	ha	$ 2,920,500	393	ha	$ 2,318,700	393	ha	$ 2 318,700	393	ha	$ 2,318,700
Land Acquisition for Reservoir (steep land)	$ 4,200	81	ha	$ 340,200	81	ha	$ 340,200	81	ha	$ 340,200	62	ha	$ 260,400	62	ha	$ 260,400	62	ha	$ 260,400	49	ha	$ 205,800	49	ha	$ 205,800	49	ha	$ 205,800
Land Acquisition for Access Road	$ 5,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115 000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000
Land Acquisition for Camp, Temporary Land	$ 5,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000
Land Acquisition for Dam, Powerhouse and Switch yard	$ 5,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000
Right of way for Transmission line	$ 32,000	43	km	$ 1,376,000	43	km	$ 1,376,000	43	km	$ 1,376,000	43	km	$ 1,376,000	43	km	$ 1 376,000	43	km	$ 1,376,000	43	km	$ 1,376,000	43	km	$ 1,376,000	43	km	$ 1,376,000
Relocation and Resettlement Cost	$ 30,000	75	family	$ 2,250,000	75	family	$ 2,250,000	75	family	$ 2,250,000	58	family	$ 1,740,000	58	family	$ 1,740,000	58	family	$ 1,740,000	46	family	$ 1,380,000	46	family	$ 1,380,000	46	family	$ 1,380,000
TOTAL DIRECT COST				**$105,324,053**			**$110,932,610**			**$116,594,182**			**$ 90,424,633**			**$ 95,986,503**			**$103,137,635**			**$ 78,559,858**			**$ 82,089,309**			**$ 85,591,297**
8 Contingency																												
Preparatory Works + Civil Works	10%			$ 6,044,860			$ 6,158,600			$ 6,275,350			$ 5,063,160			$ 5,176,600			$ 5,327,170			$ 4,447,340			$ 4,523,450			$ 4,599,110
Hydromechanical Equipment	5%			$ 547,950			$ 586,000			$ 627,950			$ 521,850			$ 560,350			$ 610,650			$ 480,700			$ 507,100			$ 533,000
Electric Equipment + Transmission Equipment	5%			$ 833,650			$ 1,019,150			$ 1,201,910			$ 700,960			$ 883,840			$ 1,115,810			$ 522,400			$ 634,420			$ 745,790
9 Administration & Engineering Cost																												
Administration & Engineering Cost	15%	1	ls	$ 15,798,610	1	ls	$ 16,639,900	1	ls	$ 17,489,130	1	ls	$ 13,563,700	1	ls	$ 14,397,980	1	ls	$ 15,470,650	1	ls	$ 11,783,980	1	ls	$ 12,313,400	1	ls	$ 12,838,700
TOTAL INDIRECT COST				**$ 23,225,070**			**$ 24,403,650**			**$ 25,594,340**			**$ 19,849,670**			**$ 21,018,770**			**$ 22,524,280**			**$ 17,234,420**			**$ 17,978,370**			**$ 18,716,600**
TOTAL PROJECT CONSTRUCTION COST				**$128,549,123**			**$135,336,260**			**$142,188,522**			**$110,274,303**			**$117,005,273**			**$125,661,915**			**$ 95,794,278**			**$100,067,679**			**$104,307,897**

Table 9.9 Scale Examination of La Honda Project by Single Development Scheme

Case			LH1-1	LH1-2	LH1-3	LH2-1	LH2-2	LH2-3	LH3-1	LH3-2	LH3-3
High Water Level	HWL	EL m	295	295	295	285	285	285	275	275	275
Low Water Level	LWL	EL m	255	256	258	254	255	257	253	254	256
Drawdown Depth	Hd	EL m	40	39	37	31	30	28	22	21	19
Normal Water Level	NWL	EL m	282	282	283	275	275	276	268	268	269
Sedimentation Level	SL	EL m	244	244	244	244	244	244	244	244	244
Tail Water Level	TWL	EL m	198	198	198	198	198	198	198	198	198
Penstock Dia (V=5m/s)		m	5	6	6	4	5	6	4	5	5
Gross Storage Capacity	Vg	10^6m^3	376	376	376	268	268	268	182	182	182
Effective Storage Capacity	Ve	10^6m^3	304	300	292	200	196	188	117	114	106
Peaking Time		hr	4	4	4	4	4	4	4	4	4
Firm Discharge Qf without		$2m^3/s$	19	18	18	14	14	13	9	9	8
Maximum Discharge	Qmax	m^3/s	90	120	150	70	100	130	50	80	110
Gross Head	Hg	m	84	84	85	77	77	78	70	70	71
Effective Head	He	m	83	83	84	76	76	77	69	69	70
Installed Capacity P1max (main)		MW	66	88	111	47	67	89	31	49	68
Installed Capacity P2max (sub)		MW	2	2	2	1	1	1	1	1	1
Pmax=P1max+P2max		MW	68	90	113	49	69	90	32	50	69
Dependable Capacity Pf1 (main)		MW	36	37	36	29	32	32	22	25	25
Dependable Capacity Pf2 (sub)		MW	1	1	1	1	1	1	1	1	1
Pf=Pf1+Pf2		MW	37	38	37	30	32	33	23	26	26
Annual Average Inflow		10^6m^3	1301	1301	1301	1301	1301	1301	1301	1301	1301
Annual Average Power Discharge		10^6m^3	1124	1158	1193	1014	1114	1164	839	1031	1120
Annual Average Overflow		10^6m^3	108	75	40	219	120	70	395	204	114
Annual Average Energy E1 (main)		GWh	239	251	258	195	219	230	145	179	199
Annual Average Energy E2 (sub)		GWh	11	12	12	11	11	11	10	10	10
Annual Average Energy E3 (15Sep)		GWh	2	2	2	2	2	2	2	2	2
E=E1+E2+E3		GWh	252	264	272	208	231	243	156	191	211
Plant Factor		%	43	34	27	49	38	31	56	44	35
Project Cost		$10^6$$	217.7	224 5	231 6	182 2	188 8	195 7	151 2	157 6	164 2
Energy cost per kw		$/kW	3213	2501	2047	3753	2748	2173	4749	3143	2364
Energy cost per kwh		$/kWh	0 096	0 095	0 095	0 098	0 091	0 090	0 108	0 092	0 087
B/C			0 73	0 73	0 72	0 71	0 75	0 76	0 65	0 74	0 76
B-C		$10^6$$	-6 39	-6 51	-7 08	-5 68	-5 10	-5 10	-5 75	-4 46	-4 23





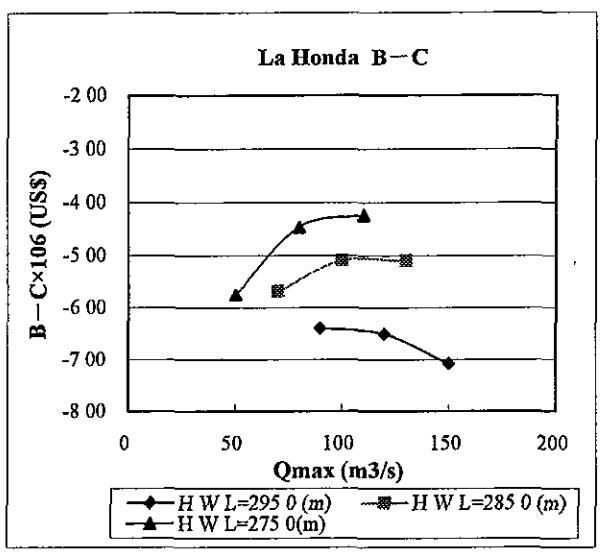


Fig.9.10 Energy Cost, B/C, B−C

Table 12.2 LA HONDA PROJECT
SUMMARY of PROJECT COST
(price in Jan. 2003)

Item	Unit Price	LH1-1 Quantity	Unit	LH1-1 Total Cost	LH1-2 Quantity	Unit	LH1-2 Total Cost	LH1-3 Quantity	Unit	LH1-3 Total Cost	LH2-1 Quantity	Unit	LH2-1 Total Cost	LH2-2 Quantity	Unit	LH2-2 Total Cost	LH2-3 Quantity	Unit	LH2-3 Total Cost	LH3-1 Quantity	Unit	LH3-1 Total Cost	LH3-2 Quantity	Unit	LH3-2 Total Cost	LH3-3 Quantity	Unit	LH3-3 Total Cost
PROJECT COST																												
1 Preparatory Works																												
Construction road 1 (Improved existing road , B=6m)	$ 15,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400	6.0	km	$ 92,400
Construction road 2 (new permanent road , B=6m)	$ 185,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000	3.0	km	$ 555,000
Construction road 3 (new temporary road , B=11m)	$ 37,200	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400	2.0	km	$ 74,400
Camp & office facilty	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000
Temporary constructon facility	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000
Temporary constructon yard development	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000	1	ls	$ 850,000
2 Civil Works																												
Care of River																												
Upstream Cofferdam																												
Common Excavation	$ 4	3,100	m³	$ 12,400	3,100	m³	$ 12,400	3,100	m³	$ 12,400	3,100	m³	$ 12,400	3,100	m³	$ 12,400	3,100	m³	$ 12,400	3,100	m³	$ 12,400	3,100	m³	$ 12,400	3,100	m³	$ 12,400
Rock Excavation	$ 10	1,400	m³	$ 14,000	1,400	m³	$ 14,000	1,400	m³	$ 14,000	1,400	m³	$ 14,000	1,400	m³	$ 14,000	1,400	m³	$ 14,000	1,400	m³	$ 14,000	1,400	m³	$ 14,000	1,400	m³	$ 14,000
Roller Compacted Concrete	$50～$54	21,100	m³	$ 1,055,000	21,100	m³	$ 1,055,000	21,100	m³	$ 1,055,000	21,100	m³	$ 1,097,200	21,100	m³	$ 1,097,200	21,100	m³	$ 1,097,200	21,100	m³	$ 1,139,400	21,100	m³	$ 1,139,400	21,100	m³	$ 1,139,400
Others	40000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000
Downstream Cofferdam																												
Common Excavation	$ 4	3,400	m³	$ 13,600	3,400	m³	$ 13,600	3,400	m³	$ 13,600	3,400	m³	$ 13,600	3,400	m³	$ 13,600	3,400	m³	$ 13,600	3,400	m³	$ 13,600	3,400	m³	$ 13,600	3,400	m³	$ 13,600
Rock Excavation	$ 10	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000	1,500	m³	$ 15,000
Embankment	$ 7	11,100	m³	$ 77,700	11,100	m³	$ 77,700	11,100	m³	$ 77,700	11,100	m³	$ 77,700	11,100	m³	$ 77,700	11,100	m³	$ 77,700	11,100	m³	$ 77,700	11,100	m³	$ 77,700	11,100	m³	$ 77,700
Others	40000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000	1	ls	$ 40,000
Diversion Tunnel																												
Common Excavation	$ 4	28,300	m³	$ 113,200	28,300	m³	$ 113,200	28,300	m³	$ 113,200	28,300	m³	$ 113,200	28,300	m³	$ 113,200	28,300	m³	$ 113,200	28,300	m³	$ 113,200	28,300	m³	$ 113,200	28,300	m³	$ 113,200
Tunnel Excavation	$ 150	13,100	m³	$ 1,965,000	13,100	m³	$ 1,965,000	13,100	m³	$ 1,965,000	13,100	m³	$ 1,965,000	13,100	m³	$ 1,965,000	13,100	m³	$ 1,965,000	13,100	m³	$ 1,965,000	13,100	m³	$ 1,965,000	13,100	m³	$ 1,965,000
Tunnel Lining Concrete	$ 230	1,400	m³	$ 322,000	1,400	m³	$ 322,000	1,400	m³	$ 322,000	1,400	m³	$ 322,000	1,400	m³	$ 322,000	1,400	m³	$ 322,000	1,400	m³	$ 322,000	1,400	m³	$ 322,000	1,400	m³	$ 322,000
Reinforced Bar	$ 1,500	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000	60	t	$ 90,000
Others	25%	1	ls	$ 622,550	1	ls	$ 622,550	1	ls	$ 622,550	1	ls	$ 622,550	1	ls	$ 622,550	1	ls	$ 622,550	1	ls	$ 622,550	1	ls	$ 622,550	1	ls	$ 622,550
Dam																												
Dam																												
Common Excavation	$ 4	174,637	m³	$ 698,548	174,637	m³	$ 698,548	174,637	m³	$ 698,548	145,400	m³	$ 581,600	145,400	m³	$ 581,600	145,400	m³	$ 581,600	118,571	m³	$ 474,284	118,571	m³	$ 474,284	118,571	m³	$ 474,284
Rock Excavation	$ 10	261,836	m³	$ 2,618,360	261,836	m³	$ 2,618,360	261,836	m³	$ 2,618,360	218,000	m³	$ 2,180,000	218,000	m³	$ 2,180,000	218,000	m³	$ 2,180,000	177,775	m³	$ 1,777,750	177,775	m³	$ 1,777,750	177,775	m³	$ 1,777,750
Roller Compacted Concrete(Inner Concrete)	$50～$54	801,331	m³	$ 40,066,550	801,331	m³	$ 40,066,550	801,331	m³	$ 40,066,550	602,400	m³	$ 31,324,800	602,400	m³	$ 31,324,800	602,400	m³	$ 31,324,800	438,423	m³	$ 23,674,842	438,423	m³	$ 23,674,842	438,423	m³	$ 23,674,842
Conventional Concrete(Dam Crest Con + Outer Con)	$ 100	393,615	m³	$ 39,361,500	393,615	m³	$ 39,361,500	393,615	m³	$ 39,361,500	295,900	m³	$ 29,590,000	295,900	m³	$ 29,590,000	295,900	m³	$ 29,590,000	215,354	m³	$ 21,535,400	215,354	m³	$ 21,535,400	215,354	m³	$ 21,535,400
Consolidation Grouting Drilling	$ 60	9,303	m	$ 558,180	9,303	m	$ 558,180	9,303	m	$ 558,180	8,400	m	$ 504,000	8,400	m	$ 504,000	8,400	m	$ 504,000	7,497	m	$ 449,820	7,497	m	$ 449,820	7,497	m	$ 449,820
Consolidation Grouting Cement	$ 700	177	t	$ 123,900	177	t	$ 123,900	177	t	$ 123,900	160	t	$ 112,000	160	t	$ 112,000	160	t	$ 112,000	143	t	$ 100,100	143	t	$ 100,100	143	t	$ 100,100
Curtain Grouting Drilling	$ 130	66,784	m	$ 8,681,920	66,784	m	$ 8,681,920	66,784	m	$ 8,681,920	60,300	m	$ 7,839,000	60,300	m	$ 7,839,000	60,300	m	$ 7,839,000	53,816	m	$ 6,996,080	53,816	m	$ 6,996,080	53,816	m	$ 6,996,080
Curtain Grouting Cement	$ 700	3,101	t	$ 2,170,700	3,101	t	$ 2,170,700	3,101	t	$ 2,170,700	2,800	t	$ 1,960,000	2,800	t	$ 1,960,000	2,800	t	$ 1,960,000	2,499	t	$ 1,749,300	2,499	t	$ 1,749,300	2,499	t	$ 1,749,300
Others	10%	1	ls	$ 9,427,970	1	ls	$ 9,427,970	1	ls	$ 9,427,970	1	ls	$ 7,409,140	1	ls	$ 7,409,140	1	ls	$ 7,409,140	1	ls	$ 5,675,760	1	ls	$ 5,675,760	1	ls	$ 5,675,760
Spillway																												
Structural Concrete(Piers,Chute,Walls,etc)	$ 130	27,100	m³	$ 3,523,000	27,100	m³	$ 3,523,000	27,100	m³	$ 3,523,000	27,100	m³	$ 3,523,000	27,100	m³	$ 3,523,000	27,100	m³	$ 3,523,000	27,100	m³	$ 3,523,000	27,100	m³	$ 3,523,000	27,100	m³	$ 3,523,000
Reinforced Bar	$ 1,500	670	t	$ 1,005,000	670	t	$ 1,005,000	670	t	$ 1,005,000	670	t	$ 1,005,000	670	t	$ 1,005,000	670	t	$ 1,005,000	670	t	$ 1,005,000	670	t	$ 1,005,000	670	t	$ 1,005,000
Others	10%	1	ls	$ 452,800	1	ls	$ 452,800	1	ls	$ 452,800	1	ls	$ 452,800	1	ls	$ 452,800	1	ls	$ 452,800	1	ls	$ 452,800	1	ls	$ 452,800	1	ls	$ 452,800
Water way																												
Intake																												
Structural Concrete(Piers,etc)	$ 130	1,796	m³	$ 233,480	2,082	m³	$ 270,660	2,314	m³	$ 300,820	1,412	m³	$ 183,560	1,700	m³	$ 221,000	1,929	m³	$ 250,770	1,027	m³	$ 133,510	1,317	m³	$ 171,210	1,534	m³	$ 199,420
Reinforced Bar	$ 1,500	85	t	$ 127,500	98	t	$ 147,000	109	t	$ 163,500	66	t	$ 99,000	80	t	$ 120,000	91	t	$ 136,500	48	t	$ 72,000	62	t	$ 93,000	72	t	$ 108,000
Others	10%	1	ls	$ 36,100	1	ls	$ 41,770	1	ls	$ 46,440	1	ls	$ 28,260	1	ls	$ 34,100	1	ls	$ 38,730	1	ls	$ 20,560	1	ls	$ 26,430	1	ls	$ 30,750
Penstock																												
Incline Shaft Excavation	$ 200	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -
Filling Concrete	$ 190	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -
Structural Concrete(Anchor Block)	$ 130	461	m³	$ 59,930	605	m³	$ 78,650	769	m³	$ 99,970	353	m³	$ 45,890	500	m³	$ 65,000	673	m³	$ 87,490	259	m³	$ 33,670	405	m³	$ 52,650	562	m³	$ 73,060
Rainforced Bar	$ 1,500	18	t	$ 27,000	24	t	$ 36,000	31	t	$ 46,500	14	t	$ 21,000	20	t	$ 30,000	27	t	$ 40,500	10	t	$ 15,000	16	t	$ 24,000	22	t	$ 33,000
Others	10%	1	ls	$ 8,700	1	ls	$ 11,470	1	ls	$ 14,650	1	ls	$ 6,690	1	ls	$ 9,500	1	ls	$ 12,800	1	ls	$ 4,870	1	ls	$ 7,670	1	ls	$ 10,610
Powerhouse																												
Powerhouse																												
Common Excavation	$ 4	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -	-	m³	$ -
Rock Excavation	$ 10	7,315	m³	$ 73,150	8,470	m³	$ 84,700	9,625	m³	$ 96,250	6,545	m³	$ 65,450	7,700	m³	$ 77,000	8,855	m³	$ 88,550	5,775	m³	$ 57,750	6,930	m³	$ 69,300	8,085	m³	$ 80,850
Structural Concrete(Slab, Barrel)	$ 130	19,475	m³	$ 2,531,750	22,550	m³	$ 2,931,500	25,625	m³	$ 3,331,250	17,425	m³	$ 2,265,250	20,500	m³	$ 2,665,000	23,575	m³	$ 3,064,750	15,375	m³	$ 1,998,750	18,450	m³	$ 2,398,500	21,525	m³	$ 2,798,250
Reinforced Bar	$ 1,500	1,169	t	$ 1,753,500	1,353	t	$ 2,029,500	1,538	t	$ 2,307,000	1,046	t	$ 1,569,000	1,230	t	$ 1,845,000	1,415	t	$ 2,122,500	923	t	$ 1,384,500	1,107	t	$ 1,660,500	1,292	t	$ 1,938,000
Others	20%	1	ls	$ 871,680	1	ls	$ 1,009,140	1	ls	$ 1,146,900	1	ls	$ 779,940	1	ls	$ 917,400	1	ls	$ 1,055,160	1	ls	$ 688,200	1	ls	$ 825,660	1	ls	$ 963,420
Control Building																												
Control Building	$ 40		inner m³	$ 467,400		inner m³	$ 541,200		inner m³	$ 615,000		inner m³	$ 418,200	12,300	inner m³	$ 492,000		inner m³	$ 565,800		inner m³	$ 369,000		inner m³	$ 442,800		inner m³	$ 516,600
Outlet																												
Common Excavation	$ 4	1,330	m³	$ 5,320	1,540	m³	$ 6,160	1,750	m³	$ 7,000	1,190	m³	$ 4,760	1,400	m³	$ 5,600	1,610	m³	$ 6,440	1,050	m³	$ 4,200	1,260	m³	$ 5,040	1,470	m³	$ 5,880
Rock Excavation	$ 10	3,135	m³	$ 31,350	3,630	m³	$ 36,300	4,125	m³	$ 41,250	2,805	m³	$ 28,050	3,300	m³	$ 33,000	3,795	m³	$ 37,950	2,475	m³	$ 24,750	2,970	m³	$ 29,700	3,465	m³	$ 34,650
Others	20%	1	ls	$ 7,340	1	ls	$ 8,500	1	ls	$ 9,650	1	ls	$ 6,570	1	ls	$ 7,720	1	ls	$ 8,880	1	ls	$ 5,790	1	ls	$ 6,950	1	ls	$ 8,110
Switchyard																												
Common Excavation	$ 4	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600	13,900	m³	$ 55,600
Structural Concrete(Faundation)	$ 130	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000	100	m³	$ 13,000
Others	20%	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720	1	ls	$ 13,720
3 Hydromechanical Equipment																												
Spillway Gate	$ 7,000	1,030	t	$ 7,210,000	1,030	t	$ 7,210,000	1,030	t	$ 7,210,000	1,030	t	$ 7,210,000	1,030	t	$ 7,210,000	1,030	t	$ 7,210,000	1,030	t	$ 7,210,000	1,030	t	$ 7,210,000	1,030	t	$ 7,210,000
Intake Gate	$ 6,000	120	t	$ 720,000	160	t	$ 960,000	200	t	$ 1,200,000	91	t	$ 546,000	130	t	$ 780,000	168	t	$ 1,008,000	63	t	$ 378,000	100	t	$ 600,000	137	t	$ 822,000
Intake Screen	$ 3,000	19	t	$ 57,000	25	t	$ 75,000	31	t	$ 93,000	14	t	$ 42,000	20	t	$ 60,000	26	t	$ 78,000	10	t	$ 30,000	15	t	$ 45,000	21	t	$ 63,000
Penstock Tube	$ 5,000	276	t	$ 1,380,000	363	t	$ 1,815,000	461	t	$ 2,305,000	212	t	$ 1,060,000	300	t	$ 1,500,000	404	t	$ 2,020,000	156	t	$ 780,000	243	t	$ 1,215,000	337	t	$ 1,685,000
Outlet Gate	$ 6,000	66	t	$ 396,000	77	t	$ 462,000	86	t	$ 516,000	59	t	$ 354,000	70	t	$ 420,000	80	t	$ 480,000	49	t	$ 294,000	63	t	$ 378,000	73	t	$ 438,000
Sluiceway Gate & Steel liner	$ 1,144,000	1	ls	$ 1,144,000	1	ls	$ 1,144,000	1	ls	$ 1,144,000	1	ls	$ 1,144,000	1	ls	$ 1,144,000	1	ls	$ 1,144,000	1	ls	$ 1,144,000	1	ls	$ 1,144,000	1	ls	$ 1,144,000

9-2-7

Table 12.2 LA HONDA PROJECT
SUMMARY of PROJECT COST
(price in Jan. 2003)

Item	Unit Price	LH1-1 Quantity	LH1-1 Unit	LH1-1 Total Cost	LH1-2 Quantity	LH1-2 Unit	LH1-2 Total Cost	LH1-3 Quantity	LH1-3 Unit	LH1-3 Total Cost	LH2-1 Quantity	LH2-1 Unit	LH2-1 Total Cost	LH2-2 Quantity	LH2-2 Unit	LH2-2 Total Cost	LH2-3 Quantity	LH2-3 Unit	LH2-3 Total Cost	LH3-1 Quantity	LH3-1 Unit	LH3-1 Total Cost	LH3-2 Quantity	LH3-2 Unit	LH3-2 Total Cost	LH3-3 Quantity	LH3-3 Unit	LH3-3 Total Cost
4 Electric equipment																												
Main Turbine and Speed Governing System		1	ls	$ 5,260,605	1	ls	$ 7,011,487	1	ls	$ 8,820,684	1	ls	$ 3,917,741	1	ls	$ 5,589,643	1	ls	$ 7,313,278	1	ls	$ 2,662,901	1	ls	$ 4,260,642	1	ls	$ 5,902,946
Main Generator and Excitation System		1	ls	$ 4,165,367	1	ls	$ 5,551,723	1	ls	$ 6,984,252	1	ls	$ 3,102,082	1	ls	$ 4,425,901	1	ls	$ 5,790,682	1	ls	$ 2,108,495	1	ls	$ 3,373,593	1	ls	$ 4,673,975
Main Power Transformer		1	ls	$ 1,003,807	1	ls	$ 1,337,904	1	ls	$ 1,683,127	1	ls	$ 747,567	1	ls	$ 1,066,593	1	ls	$ 1,395,490	1	ls	$ 508,124	1	ls	$ 812,998	1	ls	$ 1,126,376
Small Turbine and Speed Governing System		1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000	1	ls	$ 425,000
Small Generator and Excitation System		1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000	1	ls	$ 387,000
Overhead Travel Crane		1	ls	$ 824,796	1	ls	$ 1,099,312	1	ls	$ 1,382,971	1	ls	$ 614,252	1	ls	$ 876,385	1	ls	$ 1,146,629	1	ls	$ 417,509	1	ls	$ 668,014	1	ls	$ 925,507
Switchyard Equipment		1	ls	$ 483,136	1	ls	$ 643,938	1	ls	$ 810,095	1	ls	$ 359,807	1	ls	$ 513,355	1	ls	$ 671,654	1	ls	$ 244,562	1	ls	$ 391,299	1	ls	$ 542,129
Powerplant Equipment	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000
5 Transmission Equipment																												
Receiving Switch	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000
Transmission Line	$ 3,100,000	1	ls	$ 3,100,000	1	ls	$ 3,100,000	1	ls	$ 3,100,000	1	ls	$ 3,100,000	1	ls	$ 3,100,000	1	ls	$ 3,100,000	1	ls	$ 3,100,000	1	ls	$ 3,100,000	1	ls	$ 3,100,000
6 Environmental Cost																												
Infrastructure																												
Infrastructure	$ 5,325,000	1	ls	$ 5,325,000	1	ls	$ 5,325,000	1	ls	$ 5,325,000	1	ls	$ 5,325,000	1	ls	$ 5,325,000	1	ls	$ 5,325,000	1	ls	$ 5,325,000	1	ls	$ 5,325,000	1	km	$ 5,325,000
Environmental Mitigation																												
Environmental Mitigation	$ 215,000	1	ls	$ 215,000	1	ls	$ 215,000	1	ls	$ 215,000	1	ls	$ 215,000	1	ls	$ 215,000	1	ls	$ 215,000	1	ls	$ 215,000	1	ls	$ 215,000	1	ls	$ 215,000
Environmental Mitigation inherent to project	$ 2,744,000	1	ls	$ 2,744,000	1	ls	$ 2,744,000	1	ls	$ 2,744,000	1	ls	$ 2,744,000	1	ls	$ 2,744,000	1	ls	$ 2,744,000	1	ls	$ 2,744,000	1	ls	$ 2,744,000	1	ls	$ 2,744,000
7 Land Acquisition and Resettlement																												
Land Acquisition for Reservoir (suitable for agriculture)	$ 8,000	326	ha	$ 2,608,000	326	ha	$ 2,608,000	326	ha	$ 2,608,000	262	ha	$ 2,096,000	262	ha	$ 2,096,000	262	ha	$ 2,096,000	204	ha	$ 1,632,000	204	ha	$ 1,632,000	204	ha	$ 1,632,000
Land Acquisition for Reservoir (not suitable for agriculture)	$ 5,900	899	ha	$ 5,304,100	899	ha	$ 5,304,100	899	ha	$ 5,304,100	722	ha	$ 4,259,800	722	ha	$ 4,259,800	722	ha	$ 4,259,800	562	ha	$ 3,315,800	562	ha	$ 3,315,800	562	ha	$ 3,315,800
Land Acquisition for Reservoir (steep land)	$ 4,200	113	ha	$ 474,600	113	ha	$ 474,600	113	ha	$ 474,600	91	ha	$ 382,200	91	ha	$ 382,200	91	ha	$ 382,200	71	ha	$ 298,200	71	ha	$ 298,200	71	ha	$ 298,200
Land Acquisition for Access Road	$ 5,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000	23	ha	$ 115,000
Land Acquisition for Camp, Temporary Land	$ 5,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000	7	ha	$ 35,000
Land Acquisition for Dam, Powerhouse and Switch yard	$ 5,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000	6	ha	$ 30,000
Right of way for Transmission line	$ 32,000	55	km	$ 1,760,000	55	km	$ 1,760,000	55	km	$ 1,760,000	55	km	$ 1,760,000	55	km	$ 1,760,000	55	km	$ 1,760,000	55	km	$ 1,760,000	55	km	$ 1,760,000	55	km	$ 1,760,000
Relocation and Resettlement Cost	$ 30,000	105	family	$ 3,150,000	105	family	$ 3,150,000	105	family	$ 3,150,000	84	family	$ 2,520,000	84	family	$ 2,520,000	84	family	$ 2,520,000	65	family	$ 1,950,000	65	family	$ 1,950,000	65	family	$ 1,950,000
TOTAL DIRECT COST				**$177,129,609**			**$182,793,612**			**$188,626,007**			**$148,426,179**			**$153,915,307**			**$159,581,663**			**$123,310,247**			**$128,632,062**			**$134,053,639**
8 Contingency																												
Preparatory Works + Civil Works	10%			$ 12,385,720			$ 12,485,560			$ 12,584,920			$ 10,097,980			$ 10,198,050			$ 10,297,500			$ 8,124,570			$ 8,224,660			$ 8,323,380
Hydromechanical Equipment	5%			$ 545,350			$ 583,300			$ 623,400			$ 517,800			$ 555,700			$ 597,000			$ 491,800			$ 529,600			$ 568,100
Electric Equipment + Transmission Equipment	5%			$ 1,030,240			$ 1,225,570			$ 1,427,410			$ 880,430			$ 1,066,950			$ 1,259,240			$ 740,430			$ 918,680			$ 1,101,900
9 Administration & Engineering Cost																												
Administration & Engineering Cost	15%	1	ls	$ 26,569,450	1	ls	$ 27,419,050	1	ls	$ 28,293,910	1	ls	$ 22,263,930	1	ls	$ 23,087,300	1	ls	$ 23,937,250	1	ls	$ 18,496,540	1	ls	$ 19,294,810	1	ls	$ 20,108,050
TOTAL INDIRECT COST				**$ 40,530,760**			**$ 41,713,480**			**$ 42,929,640**			**$ 33,760,140**			**$ 34,908,000**			**$ 36,090,990**			**$ 27,853,340**			**$ 28,967,750**			**$ 30,101,430**
TOTAL PROJECT CONSTRUCTION COST				**$217,660,369**			**$224,507,092**			**$231,555,647**			**$182,186,319**			**$188,823,307**			**$195,672,653**			**$151,163,587**			**$157,599,812**			**$164,155,069**

573
(574)

Appendix 9.3

Comparison of Project Cost

for

Alternative (1)

(La Honda Upstream Alternative)

575
(576)

Table 9.6 Comparison Study of La Honda and Upstream Alternative

Case		La Honda	Upstream Alternative
Catchment Area	km^2	1,065	1,059
High Water Level HWL	EL m	275	275
Low Water Level LWL	EL m	254	257
Drawdown Depth Hd	EL m	21	18
Normal Water Level NWL	EL m	268	269
Sedimentation Level SL	EL m	244	247
Tail Water Level TWL	EL m	198	204
Penstock Diameter (V=5m/s)	m	4.5	4 5
Gross Storage Capacity Vg	10^6m^3	182	156
Effective Storage Capacity Ve	10^6m^3	114	91
Peaking Time	hr	4	4
Firm Discharge Qf without EMF $2m^3/s$	m^3/s	8.6	7.1
Maximum Discharge Qmax	m^3/s	80 0	80 0
Gross Head Hg	m	70.0	65.0
Effective Head He	m	69.0	64 0
Installed Capacity P1max (main)	MW	48 8	45.3
Installed Capacity P2max (sub)	MW	1.3	1.2
Pmax=P1max+P2max	MW	50 1	46 5
Dependable Capacity Pf1 (main)	MW	24.6	0.0
Dependable Capacity Pf2 (sub)	MW	0.9	0 9
Pf=Pf1+Pf2	MW	25.5	0.9
Annual Average Inflow	10^6m^3	1,300.6	1,293.3
Annual Average Power Discharge	10^6m^3	1,030.5	1,016 0
Annual Average Overflow	10^6m^3	203 9	214 6
Annual Average Energy E1 (main)	GWh	179.5	163.6
Annual Average Energy E2 (sub)	GWh	9.9	7 9
Annual Average Energy E3 (15Sep)	GWh	2 0	2.0
E=E1+E2+E3	GWh	191.3	173.5
Plant Factor	%	44	43
Project Cost	$10^6$$	157.6	152 2
Energy cost per kw	$/kW	3,143	3,273
Energy cost per kwh	$/kWh	0.092	0.098
B/C		0.74	0.48
B-C	$10^6$$	-4 46	-8.64

EMF : Ecological Minimum Flow

SUMMARY of PROJECT COST

(price in Jan. 2003)

Item		Unit Price	La Honda (275m) Quantity	Unit		Total Cost	La Honda Upstream(275m) Quantity	Unit		Total Cost
PROJECT COST										
1 Preparatory Works										
Construction road 1 (Improved existing road , B=6m)	$	15,400	6.0	km	$	92,400	6.0	km	$	92,400
Construction road 2 (new permanent road , B=6m)	$	185,000	3.0	km	$	555,000	4.0	km	$	740,000
Construction road 3 (new temporary road , B=11m)	$	37,200	2.0	km	$	74,400	2.0	km	$	74,400
Camp & office facility	$	1,800,000	1	ls	$	1,800,000	1	ls	$	1,800,000
Temporary construction facility	$	1,100,000	1	ls	$	1,100,000	1	ls	$	1,100,000
Temporary construction yard development	$	850,000	1	ls	$	850,000	1	ls	$	850,000
2 Civil Works										
Care of River										
Upstream Cofferdam										
Common Excavation	$	4	3,100	m^3	$	12,400	3,000	m^3	$	12,000
Rock Excavation	$	10	1,400	m^3	$	14,000	1,300	m^3	$	13,000
Roller Compacted Concrete	$	54	21,100	m^3	$	1,139,400	20,000	m^3	$	1,080,000
Others		40000	1	ls	$	40,000	1	ls	$	40,000
Downstream Cofferdam										
Common Excavation	$	4	3,400	m^3	$	13,600	5,600	m^3	$	22,400
Rock Excavation	$	10	1,500	m^3	$	15,000	2,400	m^3	$	24,000
Embankment	$	7	11,100	m^3	$	77,700	18,500	m^3	$	129,500
Others		40000	1	ls	$	40,000	1	ls	$	40,000
Diversion Tunnel										
Common Excavation	$	4	28,300	m^3	$	113,200	8,600	m^3	$	34,400
Tunnel Excavation	$	150	13,100	m^3	$	1,965,000	15,300	m^3	$	2,295,000
Tunnel Lining Concrete	$	230	1,400	m^3	$	322,000	1,600	m^3	$	368,000
Reinforced Bar	$	1,500	60	t	$	90,000	60	t	$	90,000
Others		25%	1	ls	$	622,550	1	ls	$	696,850
Dam										
Dam										
Common Excavation	$	4	118,571	m^3	$	474,284	111,528	m^3	$	446,112
Rock Excavation	$	10	177,775	m^3	$	1,777,750	167,255	m^3	$	1,672,550
Roller Compacted Concrete(Inner Concrete)	$	54	438,423	m^3	$	23,674,842	409,421	m^3	$	22,108,734
Conventional Concrete(Dam Crest Con + Outer Con)	$	100	215,354	m^3	$	21,535,400	201,137	m^3	$	20,113,700
Consolidation Grouting Drilling	$	60	7,497	m	$	449,820	5,395	m	$	323,700
Consolidation Grouting Cement	$	700	143	t	$	100,100	102	t	$	71,400
Curtain Grouting Drilling	$	130	53,816	m	$	6,996,080	49,922	m	$	6,489,860
Curtain Grouting Cement	$	700	2,499	t	$	1,749,300	2,315	t	$	1,620,500
Others		10%	1	ls	$	5,675,760	1	ls	$	5,284,660
Spillway										
Structural Concrete(Piers,Chute,Walls,etc)	$	130	27,100	m^3	$	3,523,000	27,000	m^3	$	3,510,000
Reinforced Bar	$	1,500	670	t	$	1,005,000	636	t	$	954,000
Others		10%	1	ls	$	452,800	1	ls	$	446,400
Water way										
Intake										
Structural Concrete(Piers,etc)	$	130	1,317	m^3	$	171,210	1,250	m^3	$	162,500
Reinforced Bar	$	1,500	62	t	$	93,000	63	t	$	94,500
Others		10%	1	ls	$	26,430	1	ls	$	25,700
Penstock										
Incline Shaft Excavation	$	200	-	m^3	$	-	-	m^3	$	-
Filling Concrete	$	190	-	m^3	$	-	-	m^3	$	-
Structural Concrete(Anchor Block)	$	130	405	m^3	$	52,650	405	m^3	$	52,650
Reinforced Bar	$	1,500	16	t	$	24,000	16	t	$	24,000
Others		10%	1	ls	$	7,670	1	ls	$	7,670
Powerhouse										
Powerhouse										
Common Excavation	$	4	-	m^3	$	-	-	m^3	$	-
Rock Excavation	$	10	6,930	m^3	$	69,300	6,930	m^3	$	69,300
Structural Concrete(Slab, Barrel)	$	130	18,450	m^3	$	2,398,500	18,450	m^3	$	2,398,500
Reinforced Bar	$	1,500	1,107	t	$	1,660,500	1,107	t	$	1,660,500
Others		20%	1	ls	$	825,660	1	ls	$	825,660
Control Building										
Control Building	$	40		inner m^3	$	442,800		inner m^3	$	442,800
Outlet										
Common Excavation	$	4	1,260	m^3	$	5,040	1,260	m^3	$	5,040
Rock Excavation	$	10	2,970	m^3	$	29,700	2,970	m^3	$	29,700
Others		20%	1	ls	$	6,950	1	ls	$	6,950
Switchyard										
Common Excavation	$	4	13,900	m^3	$	55,600	13,900	m^3	$	55,600
Structural Concrete(Faundation)	$	130	100	m^3	$	13,000	100	m^3	$	13,000
Others		20%	1	ls	$	13,720	1	ls	$	13,720
3 Hydromechanical Equipment										
Spillway Gate	$	7,000	1,030	t	$	7,210,000	1,030	t	$	7,210,000
Intake Gate	$	6,000	100	t	$	600,000	100	t	$	600,000
Intake Screen	$	3,000	15	t	$	45,000	15	t	$	45,000
Penstock Tube	$	5,000	243	t	$	1,215,000	243	t	$	1,215,000
Outlet Gate	$	6,000	63	t	$	378,000	63	t	$	378,000
Sluiceway Gate & Steel liner	$	1,144,000	1	ls	$	1,144,000	1	ls	$	1,144,000

SUMMARY of PROJECT COST

(price in Jan. 2003)

Item	Unit Price	La Honda (275m) Quantity	Unit	Total Cost	La Honda Upstream(275m) Quantity	Unit	Total Cost
4 Electric equipment							
Main Turbine and Speed Governing System		1	ls	$ 4,260,642	1	ls	$ 4,108,217
Main Generator and Excitation System		1	ls	$ 3,373,593	1	ls	$ 3,252,902
Main Power Transformer		1	ls	$ 812,998	1	ls	$ 783,913
Small Turbine and Speed Governing System		1	ls	$ 425,000	1	ls	$ 425,000
Small Generator and Excitation System		1	ls	$ 387,000	1	ls	$ 387,000
Overhead Travel Crane		1	ls	$ 668,014	1	ls	$ 644,116
Switchyard Equipment		1	ls	$ 391,299	1	ls	$ 377,300
Powerplant Equipment	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,607,066
5 Transmission Equipment							
Receiving Switch	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000
Transmission Line	$ 3,095,000	1	ls	$ 3,095,000	1	ls	$ 3,095,000
6 Environmental Cost							
Infrastructure							
Infrastructure	$ 5,325,000	1	ls	$ 5,325,000	1	ls	$ 5,325,000
Environmental Mitigation							
Environmental Mitigation	$ 215,000	1	ls	$ 215,000	1	ls	$ 215,000
Environmental Mitigation	$ 2,744,000	1	ls	$ 2,744,000	1	ls	$ 2,744,000
7 Land Acquisition and Resettlement							
Land Acquisition for Reservoir (suitable for agriculture)	$ 8,000	204	ha	$ 1,632,000	204	ha	$ 1,632,000
Land Acquisition for Reservoir (not suitable for agriculture)	$ 5,900	562	ha	$ 3,315,800	562	ha	$ 3,315,800
Land Acquisition for Reservoir (steep land)	$ 4,200	71	ha	$ 298,200	71	ha	$ 298,200
Land Acquisition for Access Road	$ 5,000	23	ha	$ 115,000	23	ha	$ 115,000
Land Acquisition for Camp, Temporary Land	$ 5,000	7	ha	$ 35,000	7	ha	$ 35,000
Land Acquisition for Dam, Powerhouse and Switch yard	$ 5,000	6	ha	$ 30,000	6	ha	$ 30,000
Right of way for Transmission line	$ 32,000	55	km	$ 1,760,000	55	km	$ 1,760,000
Relocation and Resettlement Cost	$ 30,000	65	family	$ 1,950,000	65	family	$ 1,950,000
TOTAL DIRECT COST				**$128,627,062**			**$124,300,871**
8 Contingency							
Preparatory Works + Civil Works	10%			$ 8,224,660			$ 7,843,140
Hydromechanical Equipment	5%			$ 529,600			$ 529,600
Electric Equipment + Transmission Equipment	5%			$ 918,430			$ 892,880
9 Administration & Engineering Cost							
Administration & Engineering Cost	15%	1	ls	$ 19,294,060	1	ls	$ 18,645,140
TOTAL INDIRECT COST				**$ 28,966,750**			**$ 27,910,760**
TOTAL PROJECT CONSTRUCTION COST				**$157,593,812**			**$152,211,631**

579
(580)

Appendix 9.4

Comparison of Project Cost

for

Alternative (2)

El Chaparral Alternatives

(Open Excavation Type P/S – Vertical Shaft Type P/S)

(1 unit P/S – 2 units P/S)

581
(582)

SUMMARY of PROJECT COST

(price in Jan. 2003)

Item		Unit Price	Chaparral (212m open excavation) Quantity	Unit		Total Cost	Chaparral (212m vertical shaft) Quantity	Unit		Total Cost
PROJECT COST										
1 Preparatory Works										
Construction road 1 (Improved existing road , B=6m)	$	15,400	6.0	km	$	92,400	6.0	km	$	92,400
Construction road 2 (new permanent road , B=6m)	$	185,000	3.0	km	$	555,000	3.0	km	$	555,000
Construction road 3 (new temporary road , B=11m)	$	37,200	2.0	km	$	74,400	2.0	km	$	74,400
Camp & office facility	$	1,800,000	1	ls	$	1,800,000	1	ls	$	1,800,000
Temporary constructon facility	$	1,100,000	1	ls	$	1,100,000	1	ls	$	1,100,000
Temporary constructon yard development	$	850,000	1	ls	$	850,000	1	ls	$	850,000
2 Civil Works										
Care of River										
Upstream Cofferdam										
Common Excavation	$	4	3,800	m^3	$	15,200	3,800	m^3	$	15,200
Rock Excavation	$	10	1,600	m^3	$	16,000	1,600	m^3	$	16,000
Roller Compacted Concrete	$	55	14,400	m^3	$	792,000	14,400	m^3	$	792,000
Others		40000	1	ls	$	40,000	1	ls	$	40,000
Downstream Cofferdam										
Common Excavation	$	4	3,500	m^3	$	14,000	3,500	m^3	$	14,000
Rock Excavation	$	10	1,500	m^3	$	15,000	1,500	m^3	$	15,000
Embankment	$	7	3,000	m^3	$	21,000	3,000	m^3	$	21,000
Others		40000	1	ls	$	40,000	1	ls	$	40,000
Diversion Tunnel										
Common Excavation	$	4	8,200	m^3	$	32,800	8,200	m^3	$	32,800
Tunnel Excavation	$	150	24,000	m^3	$	3,600,000	24,000	m^3	$	3,600,000
Tunnel Lining Concrete	$	230	2,100	m^3	$	483,000	2,100	m^3	$	483,000
Reinforced Bar	$	1,500	60	t	$	90,000	60	t	$	90,000
Others		25%	1	ls	$	1,051,450	1	ls	$	1,051,450
Dam										
Dam										
Common Excavation	$	4	124,500	m^3	$	498,000	124,500	m^3	$	498,000
Rock Excavation	$	10	186,700	m^3	$	1,867,000	186,700	m^3	$	1,867,000
Roller Compacted Concrete(Inner Concrete)	$	55	247,600	m^3	$	13,618,000	247,600	m^3	$	13,618,000
Conventional Concrete(Dam Crest Con + Outer Con)	$	100	121,600	m^3	$	12,160,000	121,600	m^3	$	12,160,000
Consolidation Grouting Drilling	$	60	4,400	m	$	264,000	4,400	m	$	264,000
Consolidation Grouting Cement	$	700	90	t	$	63,000	90	t	$	63,000
Curtain Grouting Drilling	$	130	46,800	m	$	6,084,000	46,800	m	$	6,084,000
Curtain Grouting Cement	$	700	2,200	t	$	1,540,000	2,200	t	$	1,540,000
Others		10%	1	ls	$	3,609,400	1	ls	$	3,609,400
Spillway										
Structural Concrete(Piers,Chute,Walls,etc)	$	130	23,000	m^3	$	2,990,000	23,000	m^3	$	2,990,000
Reinforced Bar	$	1,500	640	t	$	960,000	640	t	$	960,000
Others		10%	1	ls	$	395,000	1	ls	$	395,000
Water way										
Intake										
Structural Concrete(Piers,etc)	$	130	1,200	m^3	$	156,000	1,200	m^3	$	156,000
Reinforced Bar	$	1,500	60	t	$	90,000	60	t	$	90,000
Others		10%	1	ls	$	24,600	1	ls	$	24,600
Penstock										
Incline Shaft Excavation	$	200	2,400	m^3	$	480,000	1,600	m^3	$	320,000
Filling Concrete	$	190	800	m^3	$	152,000	600	m^3	$	114,000
Structural Concrete(Anchor Block)	$	130	500	m^3	$	65,000	500	m^3	$	65,000
Reinforced Bar	$	1,500	20	t	$	30,000	20	t	$	30,000
Others		10%	1	ls	$	72,700	1	ls	$	52,900
Powerhouse										
Powerhouse										
Common Excavation	$	4	35,900	m^3	$	143,600	14,000	m^3	$	56,000
Rock Excavation	$	10	143,500	m^3	$	1,435,000	56,000	m^3	$	560,000
Schaft Excavation	$	200	-	m^3	$	-	25,700	m^3	$	5,140,000
Schaft Lining Concrete	$	230	-	m^3	$	-	4,800	m^3	$	1,104,000
Structural Concrete(Slab, Barrel)	$	130	11,700	m^3	$	1,521,000	9,800	m^3	$	1,274,000
Reinfored Bar	$	1,500	740	t	$	1,110,000	920	t	$	1,380,000
Others		20%	1	ls	$	841,920	1	ls	$	1,902,800
Control Building										
Control Building	$	40	12,300	inner m^3	$	492,000	17,400	inner m^3	$	696,000
Outlet										
Common Excavation	$	4	4,900	m^3	$	19,600	4,800	m^3	$	19,200
Rock Excavation	$	10	11,300	m^3	$	113,000	11,200	m^3	$	112,000
Tunnel Excavation	$	150	-	m^3	$	-	5,600	m^3	$	840,000
Tunnel Lining Concrete	$	230	-	m^3	$	-	2,000	m^3	$	460,000
Reinfored Bar	$	1,500	-	t	$	-	120	t	$	180,000
Others		20%	1	ls	$	26,520	1	ls	$	322,240
Switchyard										
Common Excavation	$	4	13,900	m^3	$	55,600	13,900	m^3	$	55,600
Structural Concrete(Faundation)	$	130	100	m^3	$	13,000	100	m^3	$	13,000
Others		20%	1	ls	$	13,720	1	ls	$	13,720
3 Hydromechanical Equipment										
Spillway Gate	$	7,000	1,130	t	$	7,910,000	1,130	t	$	7,910,000
Intake Gate	$	6,000	90	t	$	540,000	90	t	$	540,000
Intake Screen	$	3,000	20	t	$	60,000	20	t	$	60,000
Penstock Tube	$	5,000	350	t	$	1,750,000	290	t	$	1,450,000
Outlet Gate	$	6,000	70	t	$	420,000	70	t	$	420,000
Sluiceway Gate & Steel liner	$	1,040,000	1	ls	$	1,040,000	1	ls	$	1,040,000

SUMMARY of PROJECT COST

(price in Jan. 2003)

Item		Unit Price	Chaparral (212m open excavation) Quantity	Unit	Total Cost	Chaparral (212m vertical shaft) Quantity	Unit	Total Cost
4 Electric equipment								
Main Turbine and Speed Governing System	$	5,466,000	1	ls	$ 5,466,000	1	ls	$ 5,466,000
Main Generator and Excitation System	$	4,328,000	1	ls	$ 4,328,000	1	ls	$ 4,328,000
Main Power Transformer	$	1,043,000	1	ls	$ 1,043,000	1	ls	$ 1,043,000
Small Turbine and Speed Governing System	$	425,000	1	ls	$ 425,000	1	ls	$ 425,000
Small Generator and Excitation System	$	387,000	1	ls	$ 387,000	1	ls	$ 387,000
Overhead Travel Crane	$	857,000	1	ls	$ 857,000	1	ls	$ 857,000
Switchyard Equipment	$	502,000	1	ls	$ 502,000	1	ls	$ 502,000
Powerplant Equipment	$	4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000
5 Transmission Equipment								
Receiving Switch	$	177,000	1	ls	$ 177,000	1	ls	$ 177,000
Transmission Line	$	2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000
6 Environmental Cost								
Infrastructure								
New Public Road	$	25,000	11	km	$ 275,000	11	km	$ 275,000
Improved Public Road	$	15,000	33	km	$ 495,000	33	km	$ 495,000
New Bridge (two bridges)	$	2,000,000	2	ls	$ 4,000,000	2	ls	$ 4,000,000
Environmental Mitigation								
Environmental Mitigation	$	192,000	1	ls	$ 192,000	1	ls	$ 192,000
Environmental Mitigation inherent to project	$	2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000
7 Land Acquisition and Resettlement								
Land Acquisition for Reservoir (suitable for agriculture)	$	8,000	234	ha	$ 1,872,000	234	ha	$ 1,872,000
Land Acquisition for Reservoir (not suitable for agriculture)	$	5,900	645	ha	$ 3,805,500	645	ha	$ 3,805,500
Land Acquisition for Reservoir (steep land)	$	4,200	81	ha	$ 340,200	81	ha	$ 340,200
Land Acquisition for Access Road	$	5,000	23	ha	$ 115,000	23	ha	$ 115,000
Land Acquisition for Camp, Temporary Land	$	5,000	7	ha	$ 35,000	7	ha	$ 35,000
Land Acquisition for Dam, Powerhouse and Switch yard	$	5,000	6	ha	$ 30,000	6	ha	$ 30,000
Right of way for Transmission line	$	32,000	43	km	$ 1,376,000	43	km	$ 1,376,000
Relocation and Resettlement Cost	$	30,000	75	family	$ 2,250,000	75	family	$ 2,250,000
TOTAL DIRECT COST					**$110,932,610**			**$118,758,410**
8 Contingency								
Preparatory Works + Civil Works		10%			$ 6,158,600			$ 6,198,780
Hydromechanical Equipment		5%			$ 586,000			$ 2,852,130
Electric Equipment + Transmission Equipment		5%			$ 1,019,150			$ 2,663,410
9 Administration & Engineering Cost								
Administration & Engineering Cost		15%	1	ls	$ 16,639,900	1	ls	$ 17,813,770
TOTAL INDIRECT COST					**$ 24,403,650**			**$ 29,528,090**
TOTAL PROJECT CONSTRUCTION COST					**$135,336,260**			**$148,286,500**

SUMMARY of PROJECT COST

(price in Jan. 2003)

Item		Unit Price	Chaparral (212m 1 unit) Quantity	Unit		Total Cost	Chaparral (212m 2 units) Quantity	Unit		Total Cost
PROJECT COST										
1 Preparatory Works										
Construction road 1 (Improved existing road , B=6m)	$	15,400	6.0	km	$	92,400	6.0	km	$	92,400
Construction road 2 (new permanent road , B=6m)	$	185,000	3.0	km	$	555,000	3.0	km	$	555,000
Construction road 3 (new temporary road , B=11m)	$	37,200	2.0	km	$	74,400	2.0	km	$	74,400
Camp & office facility	$	1,800,000	1	ls	$	1,800,000	1	ls	$	1,800,000
Temporary construction facility	$	1,100,000	1	ls	$	1,100,000	1	ls	$	1,100,000
Temporary construction yard development	$	850,000	1	ls	$	850,000	1	ls	$	850,000
2 Civil Works										
Care of River										
Upstream Cofferdam										
Common Excavation	$	4	3,800	m³	$	15,200	3,800	m³	$	15,200
Rock Excavation	$	10	1,600	m³	$	16,000	1,600	m³	$	16,000
Roller Compacted Concrete	$	55	14,400	m³	$	792,000	14,400	m³	$	792,000
Others		40000	1	ls	$	40,000	1	ls	$	40,000
Downstream Cofferdam										
Common Excavation	$	4	3,500	m³	$	14,000	3,500	m³	$	14,000
Rock Excavation	$	10	1,500	m³	$	15,000	1,500	m³	$	15,000
Embankment	$	7	3,000	m³	$	21,000	3,000	m³	$	21,000
Others		40000	1	ls	$	40,000	1	ls	$	40,000
Diversion Tunnel										
Common Excavation	$	4	8,200	m³	$	32,800	8,200	m³	$	32,800
Tunnel Excavation	$	150	24,000	m³	$	3,600,000	24,000	m³	$	3,600,000
Tunnel Lining Concrete	$	230	2,100	m³	$	483,000	2,100	m³	$	483,000
Reinforced Bar	$	1,500	60	t	$	90,000	60	t	$	90,000
Others		25%	1	ls	$	1,051,450	1	ls	$	1,051,450
Dam										
Dam										
Common Excavation	$	4	124,500	m³	$	498,000	124,500	m³	$	498,000
Rock Excavation	$	10	186,700	m³	$	1,867,000	186,700	m³	$	1,867,000
Roller Compacted Concrete(Inner Concrete)	$	55	247,600	m³	$	13,618,000	247,600	m³	$	13,618,000
Conventional Concrete(Dam Crest Con + Outer Con)	$	100	121,600	m³	$	12,160,000	121,600	m³	$	12,160,000
Consolidation Grouting Drilling	$	60	4,400	m	$	264,000	4,400	m	$	264,000
Consolidation Grouting Cement	$	700	90	t	$	63,000	90	t	$	63,000
Curtain Grouting Drilling	$	130	46,800	m	$	6,084,000	46,800	m	$	6,084,000
Curtain Grouting Cement	$	700	2,200	t	$	1,540,000	2,200	t	$	1,540,000
Others		10%	1	ls	$	3,609,400	1	ls	$	3,609,400
Spillway										
Structural Concrete(Piers,Chute,Walls,etc)	$	130	23,000	m³	$	2,990,000	23,000	m³	$	2,990,000
Reinforced Bar	$	1,500	640	t	$	960,000	640	t	$	960,000
Others		10%	1	ls	$	395,000	1	ls	$	395,000
Water way										
Intake										
Structural Concrete(Piers,etc)	$	130	1,200	m³	$	156,000	1,200	m³	$	156,000
Reinforced Bar	$	1,500	60	t	$	90,000	60	t	$	90,000
Others		10%	1	ls	$	24,600	1	ls	$	24,600
Penstock										
Incline Shaft Excavation	$	200	2,400	m³	$	480,000	2,700	m³	$	540,000
Filling Concrete	$	190	800	m³	$	152,000	900	m³	$	171,000
Structural Concrete(Anchor Block)	$	130	500	m³	$	65,000	500	m³	$	65,000
Reinforced Bar	$	1,500	20	t	$	30,000	20	t	$	30,000
Others		10%	1	ls	$	72,700	1	ls	$	80,600
Powerhouse										
Powerhouse										
Common Excavation	$	4	35,900	m³	$	143,600	50,700	m³	$	202,800
Rock Excavation	$	10	143,500	m³	$	1,435,000	202,600	m³	$	2,026,000
Structural Concrete(Slab, Barrel)	$	130	11,700	m³	$	1,521,000	14,900	m³	$	1,937,000
Reinforced Bar	$	1,500	740	t	$	1,110,000	940	t	$	1,410,000
Others		20%	1	ls	$	841,920	1	ls	$	1,115,160
Control Building										
Control Building	$	40	12,300	inner m³	$	492,000	16,700	inner m³	$	668,000
Outlet										
Common Excavation	$	4	4,900	m³	$	19,600	12,200	m³	$	48,800
Rock Excavation	$	10	11,300	m³	$	113,000	28,300	m³	$	283,000
Others		20%	1	ls	$	26,520	1	ls	$	66,360
Switchyard										
Common Excavation	$	4	13,900	m³	$	55,600	13,900	m³	$	55,600
Structural Concrete(Faundation)	$	130	100	m³	$	13,000	100	m³	$	13,000
Others		20%	1	ls	$	13,720	1	ls	$	13,720
3 Hydromechanical Equipment										
Spillway Gate	$	7,000	1,130	t	$	7,910,000	1,130	t	$	7,910,000
Intake Gate	$	6,000	90	t	$	540,000	90	t	$	540,000
Intake Screen	$	3,000	20	t	$	60,000	20	t	$	60,000
Penstock Tube	$	5,000	350	t	$	1,750,000	390	t	$	1,950,000
Outlet Gate	$	6,000	70	t	$	420,000	90	t	$	540,000
Sluiceway Gate & Steel liner	$	1,040,000	1	ls	$	1,040,000	1	ls	$	1,040,000

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SUMMARY of PROJECT COST

(price in Jan. 2003)

Item		Unit Price	Chaparral (212m 1 unit) Quantity	Unit	Total Cost	Chaparral (212m 2 units) Quantity	Unit	Total Cost
4 Electric equipment								
Main Turbine and Speed Governing System	$	5,466,000	1	ls	$ 5,466,000	1	ls	$ 6,937,000
Main Generator and Excitation System	$	4,328,000	1	ls	$ 4,328,000	1	ls	$ 5,661,000
Main Power Transformer	$	1,043,000	1	ls	$ 1,043,000	1	ls	$ 1,242,000
Small Turbine and Speed Governing System	$	425,000	1	ls	$ 425,000	1	ls	$ 425,000
Small Generator and Excitation System	$	387,000	1	ls	$ 387,000	1	ls	$ 387,000
Overhead Travel Crane	$	857,000	1	ls	$ 857,000	1	ls	$ 484,000
Switchyard Equipment	$	502,000	1	ls	$ 502,000	1	ls	$ 815,000
Powerplant Equipment	$	4,778,000	1	ls	$ 4,778,000	1	ls	$ 5,176,000
5 Transmission Equipment								
Receiving Switch	$	177,000	1	ls	$ 177,000	1	ls	$ 177,000
Transmission Line	$	2,420,000	1	ls	$ 2,420,000	1	ls	$ 2,420,000
6 Environmental Cost								
Infrastructure								
New Public Road	$	25,000	11	km	$ 275,000	11	km	$ 275,000
Improved Public Road	$	15,000	33	km	$ 495,000	33	km	$ 495,000
New Bridge (two bridges)	$	2,000,000	2	ls	$ 4,000,000	2	ls	$ 4,000,000
Environmental Mitigation								
Environmental Mitigation	$	192,000	1	ls	$ 192,000	1	ls	$ 192,000
Environmental Mitigation inherent to project	$	2,458,000	1	ls	$ 2,458,000	1	ls	$ 2,458,000
7 Land Acquisition and Resettlement								
Land Acquisition for Reservoir (suitable for agriculture)	$	8,000	234	ha	$ 1,872,000	234	ha	$ 1,872,000
Land Acquisition for Reservoir (not suitable for agriculture)	$	5,900	645	ha	$ 3,805,500	645	ha	$ 3,805,500
Land Acquisition for Reservoir (steep land)	$	4,200	81	ha	$ 340,200	81	ha	$ 340,200
Land Acquisition for Access Road	$	5,000	23	ha	$ 115,000	23	ha	$ 115,000
Land Acquisition for Camp, Temporary Land	$	5,000	7	ha	$ 35,000	7	ha	$ 35,000
Land Acquisition for Dam, Powerhouse and Switch yard	$	5,000	6	ha	$ 30,000	6	ha	$ 30,000
Right of way for Transmission line	$	32,000	43	km	$ 1,376,000	43	km	$ 1,376,000
Relocation and Resettlement Cost	$	30,000	75	family	$ 2,250,000	75	family	$ 2,250,000
TOTAL DIRECT COST					**$110,932,610**			**$116,734,990**
8 Contingency								
Preparatory Works + Civil Works		10%			$ 6,158,600			$ 6,372,730
Hydromechanical Equipment		5%			$ 586,000			$ 2,920,690
Electric Equipment + Transmission Equipment		5%			$ 1,019,150			$ 2,658,350
9 Administration & Engineering Cost								
Administration & Engineering Cost		15%	1	ls	$ 16,639,900	1	ls	$ 17,510,250
TOTAL INDIRECT COST					**$ 24,403,650**			**$ 29,462,020**
TOTAL PROJECT CONSTRUCTION COST					**$135,336,260**			**$146,197,010**

Appendix 9.5

Comparison of Project Cost

for

Joint Development

(La Honda – El Chaparral)

Table 9.10 Joint Development of La Honda and El Chaparral

Case		La Honda	Chaparral	Combined
High Water Level HWL	EL m	275	212	
Low Water Level LWL	EL m	254	196	
Drawdown Depth Hd	EL m	21	16	
Normal Water Level NWL	EL m	268	207	
Sedimentation Level SL	EL m	244	161	
Tail Water Level TWL	EL m	198	133	
Penstock Dia (V=5m/s)	m	4.5	5	
Gross Storage Capacity Vg	10^6m^3	182	189	
Effective Storage Capacity Ve	10^6m^3	114	106	
Peaking Time	hr	4	4	
Firm Discharge Qf without	$2m^3/s$	8.6	11 3	
Maximum Discharge Qmax	m^3/s	80	100	
Gross Head Hg	m	70 0	74 0	
Effective Head He	m	69.0	72 8	
Installed Capacity P1max (main)	MW	48.8	64.4	113.2
Installed Capacity P2max (sub)	MW	0.0	1 3	1.3
Pmax=P1max+P2max	MW	48 8	65.7	114.5
Dependable Capacity Pf1 (main)	MW	24.6	29.2	53.8
Dependable Capacity Pf2 (sub)	MW	0.0	1.1	1.1
Pf=Pf1+Pf2	MW	24.6	30 3	54.9
Annual Average Inflow	10^6m^3	1300.6	1502.7	
Annual Average Power Discharge	10^6m^3	1030 5	1271 1	
Annual Average Overflow	10^6m^3	203.9	547.0	
Annual Average Energy E1 (main)	GWh	179.5	229.0	408.5
Annual Average Energy E2 (sub)	GWh	0.0	10.6	10.6
Annual Average Energy E3 (15Sep)	GWh	2 0	2.0	4.0
E=E1+E2+E3	GWh	181.5	241 6	423.1
Plant Factor	%	42	42	
Project Cost	10^6\$	156 6	135 3	292.0
Energy cost per kw	\$/kW	3207	2060	2549
Energy cost per kwh	\$/kWh	0 096	0 062	0.077
B/C		0.71	1.07	0.88
B-C	10^6\$	-4.94	1 00	-3.94

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SUMMARY of PROJECT COST

(price in Jan. 2003)

Item		Unit Price	La Honda (J 275m) Quantity	Unit	Total Cost	Chaparral (J 212m) Quantity	Unit	Total Cost
PROJECT COST								
1 Preparatory Works								
Construction road 1 (Improved existing road , B=6m)	$	15,400	60	km	$ 92,400	60	km	$ 92,400
Construction road 2 (new permanent road , B=6m)	$	185,000	30	km	$ 555,000	30	km	$ 555,000
Construction road 3 (new temporary road , B=11m)	$	37,200	20	km	$ 74,400	20	km	$ 74,400
Camp & office facility	$	1,800,000	1	ls	$ 1,800,000	1	ls	$ 1,800,000
Temporary constructon facility	$	1,100,000	1	ls	$ 1,100,000	1	ls	$ 1,100,000
Temporary constructon yard development	$	850,000	1	ls	$ 850,000	1	ls	$ 850,000
2 Civil Works								
Care of River								
Upstream Cofferdam								
Common Excavation	$	4	3,100	m^3	$ 12,400	3,800	m^3	$ 15,200
Rock Excavation	$	10	1,400	m^3	$ 14,000	1,600	m^3	$ 16,000
Roller Compacted Concrete	$50 to 60		21,100	m^3	$ 1,139,400	14,400	m^3	$ 792,000
Others		40000	1	ls	$ 40,000	1	ls	$ 40,000
Downstream Cofferdam								
Common Excavation	$	4	3,400	m^3	$ 13,600	3,500	m^3	$ 14,000
Rock Excavation	$	10	1,500	m^3	$ 15,000	1,500	m^3	$ 15,000
Embankment	$	7	11,100	m^3	$ 77,700	3,000	m^3	$ 21,000
Others		40000	1	ls	$ 40,000	1	ls	$ 40,000
Diversion Tunnel								
Common Excavation	$	4	28,300	m^3	$ 113,200	8,200	m^3	$ 32,800
Tunnel Excavation	$	150	13,100	m^3	$ 1,965,000	24,000	m^3	$ 3,600,000
Tunnel Lining Concrete	$	230	1,400	m^3	$ 322,000	2,100	m^3	$ 483,000
Reinforced Bar	$	1,500	60	t	$ 90,000	60	t	$ 90,000
Others		25%	1	ls	$ 622,550	1	ls	$ 1,051,450
Dam								
Dam								
Common Excavation	$	4	118,571	m^3	$ 474,284	124,500	m^3	$ 498,000
Rock Excavation	$	10	177,775	m^3	$ 1,777,750	186,700	m^3	$ 1,867,000
Roller Compacted Concrete(Inner Concrete)	$50 to 60		438,423	m^3	$ 23,674,842	247,600	m^3	$ 13,618,000
Conventional Concrete(Dam Crest Con + Outer Con)	$	100	215,354	m^3	$ 21,535,400	121,600	m^3	$ 12,160,000
Consolidation Grouting Drilling	$	60	7,497	m	$ 449,820	4,400	m	$ 264,000
Consolidation Grouting Cement	$	700	143	t	$ 100,100	90	t	$ 63,000
Curtain Grouting Drilling	$	130	53,816	m	$ 6,996,080	46,800	m	$ 6,084,000
Curtain Grouting Cement	$	700	2,499	t	$ 1,749,300	2,200	t	$ 1,540,000
Others		10%	1	ls	$ 5,675,760	1	ls	$ 3,609,400
Spillway								
Structural Concrete(Piers,Chute,Walls,etc)	$	130	27,100	m^3	$ 3,523,000	23,000	m^3	$ 2,990,000
Reinforced Bar	$	1,500	670	t	$ 1,005,000	640	t	$ 960,000
Others		10%	1	ls	$ 452,800	1	ls	$ 395,000
Water way								
Intake								
Structural Concrete(Piers,etc)	$	130	1,317	m^3	$ 171,210	1,200	m^3	$ 156,000
Reinforced Bar	$	1,500	62	t	$ 93,000	60	t	$ 90,000
Others		10%	1	ls	$ 26,430	1	ls	$ 24,600
Penstock								
Incline Shaft Excavation	$	200	-	m^3	$ -	2,400	m^3	$ 480,000
Filling Concrete	$	190	-	m^3	$ -	800	m^3	$ 152,000
Structural Concrete(Anchor Block)	$	130	405	m^3	$ 52,650	500	m^3	$ 65,000
Rainforced Bar	$	1,500	16	t	$ 24,000	20	t	$ 30,000
Others		10%	1	ls	$ 7,670	1	ls	$ 72,700
Powerhouse								
Powerhouse								
Common Excavation	$	4	-	m^3	$ -	35,900	m^3	$ 143,600
Rock Excavation	$	10	6,930	m^3	$ 69,300	143,500	m^3	$ 1,435,000
Structural Concrete(Slab, Barrel)	$	130	18,450	m^3	$ 2,398,500	11,700	m^3	$ 1,521,000
Reinfored Bar	$	1,500	1,107	t	$ 1,660,500	740	t	$ 1,110,000
Others		20%	1	ls	$ 825,660	1	ls	$ 841,920
Control Building								
Control Building	$	40		inner m^3	$ 442,800		inner m^3	$ 492,000
Outlet								
Common Excavation	$	4	1,260	m^3	$ 5,040	4,900	m^3	$ 19,600
Rock Excavation	$	10	2,970	m^3	$ 29,700	11,300	m^3	$ 113,000
Others		20%	1	ls	$ 6,950	1	ls	$ 26,520
Switchyard								
Common Excavation	$	4	13,900	m^3	$ 55,600	13,900	m^3	$ 55,600
Structural Concrete(Faundation)	$	130	100	m^3	$ 13,000	100	m^3	$ 13,000
Others		20%	1	ls	$ 13,720	1	ls	$ 13,720
3 Hydromechanical Equipment								
Spillway Gate	$	7,000	1,030	t	$ 7,210,000	1,130	t	$ 7,910,000
Intake Gate	$	6,000	100	t	$ 600,000	90	t	$ 540,000
Intake Screen	$	3,000	15	t	$ 45,000	20	t	$ 60,000
Penstock Tube	$	5,000	243	t	$ 1,215,000	350	t	$ 1,750,000
Outlet Gate	$	6,000	63	t	$ 378,000	70	t	$ 420,000
Sluiceway Gate & Steel liner	$	1,144,000	1	ls	$ 1,144,000	1	ls	$ 1,040,000

SUMMARY of PROJECT COST

(price in Jan. 2003)

Item	Unit Price	La Honda (J 275m) Quantity	Unit	Total Cost	Chaparral (J 212m) Quantity	Unit	Total Cost
4 Electric equipment							
Main Turbine and Speed Governing System		1	ls	$ 4,260,642	1	ls	$ 5,466,000
Main Generator and Excitation System		1	ls	$ 3,373,593	1	ls	$ 4,328,000
Main Power Transformer		1	ls	$ 812,998	1	ls	$ 1,043,000
Small Turbine and Speed Governing System		1	ls	$ -	1	ls	$ 425,000
Small Generator and Excitation System		1	ls	$ -	1	ls	$ 387,000
Overhead Travel Crane		1	ls	$ 668,014	1	ls	$ 857,000
Switchyard Equipment		1	ls	$ 391,299	1	ls	$ 502,000
Powerplant Equipment	$ 4,778,000	1	ls	$ 4,778,000	1	ls	$ 4,778,000
5 Transmission Equipment							
Receiving Switch	$ 177,000	1	ls	$ 177,000	1	ls	$ 177,000
Transmission Line		1	ls	$ 3,095,000	1	ls	$ 2,420,000
6 Environmental Cost							
Infrastructure							
Infrastructure		1	ls	$ 5,325,000	1	ls	$ 4,770,000
Environmental Mitigation							
Environmental Mitigation		1	ls	$ 215,000	1	ls	$ 192,000
Environmental Mitigation inherent to project		1	ls	$ 2,744,000	1	ls	$ 2,458,000
7 Land Acquisition and Resettlement							
Land Acquisition for Reservoir (suitable for agriculture)	$ 8,000	204	ha	$ 1,632,000	234	ha	$ 1,872,000
Land Acquisition for Reservoir (not suitable for agriculture)	$ 5,900	562	ha	$ 3,315,800	645	ha	$ 3,805,500
Land Acquisition for Reservoir (steep land)	$ 4,200	71	ha	$ 298,200	81	ha	$ 340,200
Land Acquisition for Access Road	$ 5,000	23	ha	$ 115,000	23	ha	$ 115,000
Land Acquisition for Camp, Temporary Land	$ 5,000	7	ha	$ 35,000	7	ha	$ 35,000
Land Acquisition for Dam, Powerhouse and Switch yard	$ 5,000	6	ha	$ 30,000	6	ha	$ 30,000
Right of way for Transmission line	$ 32,000	55	km	$ 1,760,000	43	km	$ 1,376,000
Relocation and Resettlement Cost	$ 30,000	65	family	$ 1,950,000	75	family	$ 2,250,000
TOTAL DIRECT COST				**$127,815,062**			**$110,932,610**
8 Contingency							
Preparatory Works + Civil Works	10%			$ 8,224,660			$ 6,158,600
Hydromechanical Equipment	5%			$ 529,600			$ 586,000
Electric Equipment + Transmission Equipment	5%			$ 877,830			$ 1,019,150
9 Administration & Engineering Cost							
Administration & Engineering Cost	15%	1	ls	$ 19,172,260	1	ls	$ 16,639,900
TOTAL INDIRECT COST				**$ 28,804,350**			**$ 24,403,650**
TOTAL PROJECT CONSTRUCTION COST				**$156,619,412**			**$135,336,260**

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