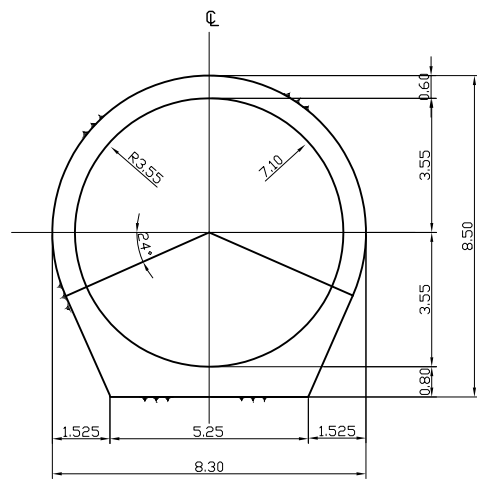
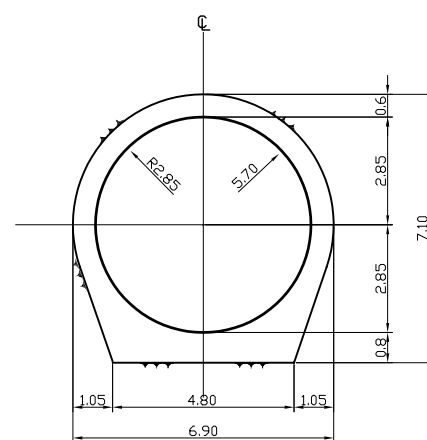


LONGITUDINAL SECTION (SCALE A)



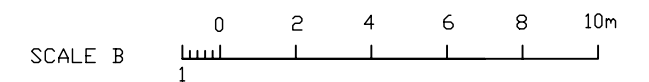
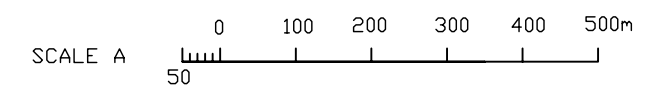
HEADRACE, TAILRACE TUNNEL

SECTION A
SCALE B



PENSTOCK

SECTION B
SCALE B



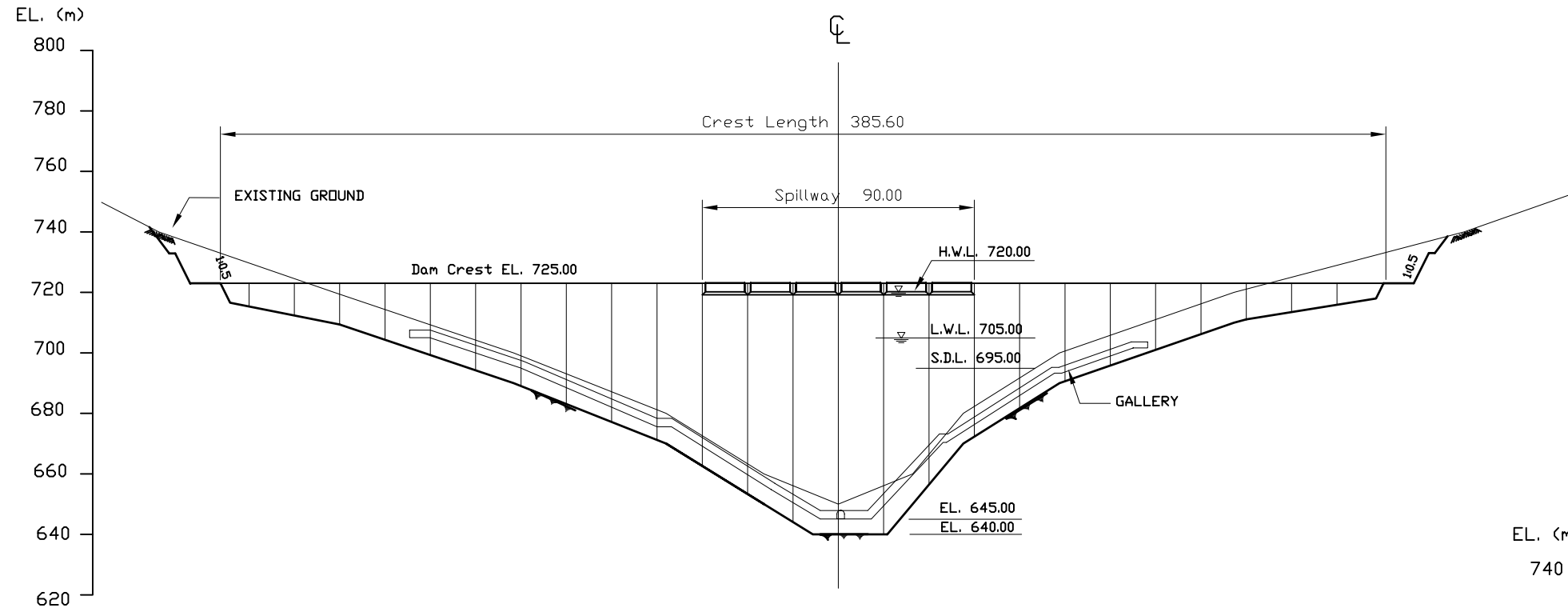
PHU YEN WEST PROJECT

WATERWAY SECTION

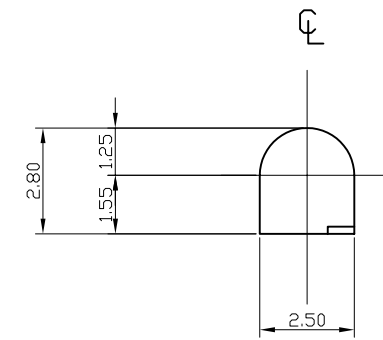
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Date

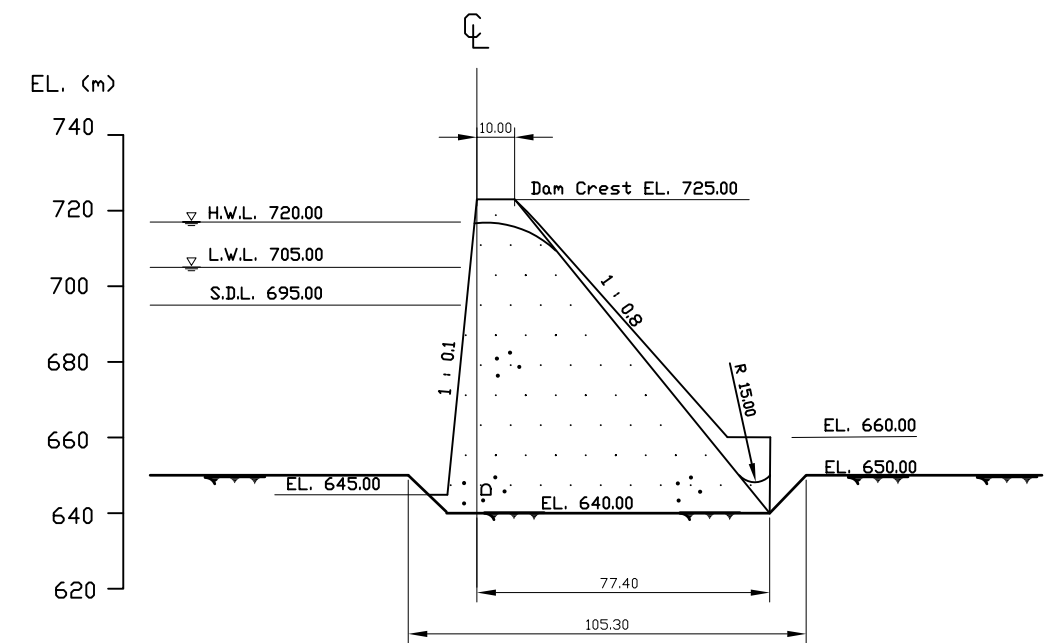
MASTER PLAN ON PUMPED STORAGE POWER PROJECT AND
OPTIMIZATION FOR PEAKING POWER GENERATION IN VIETNAM
ELECTRICITY OF VIETNAM
JICA Study Team



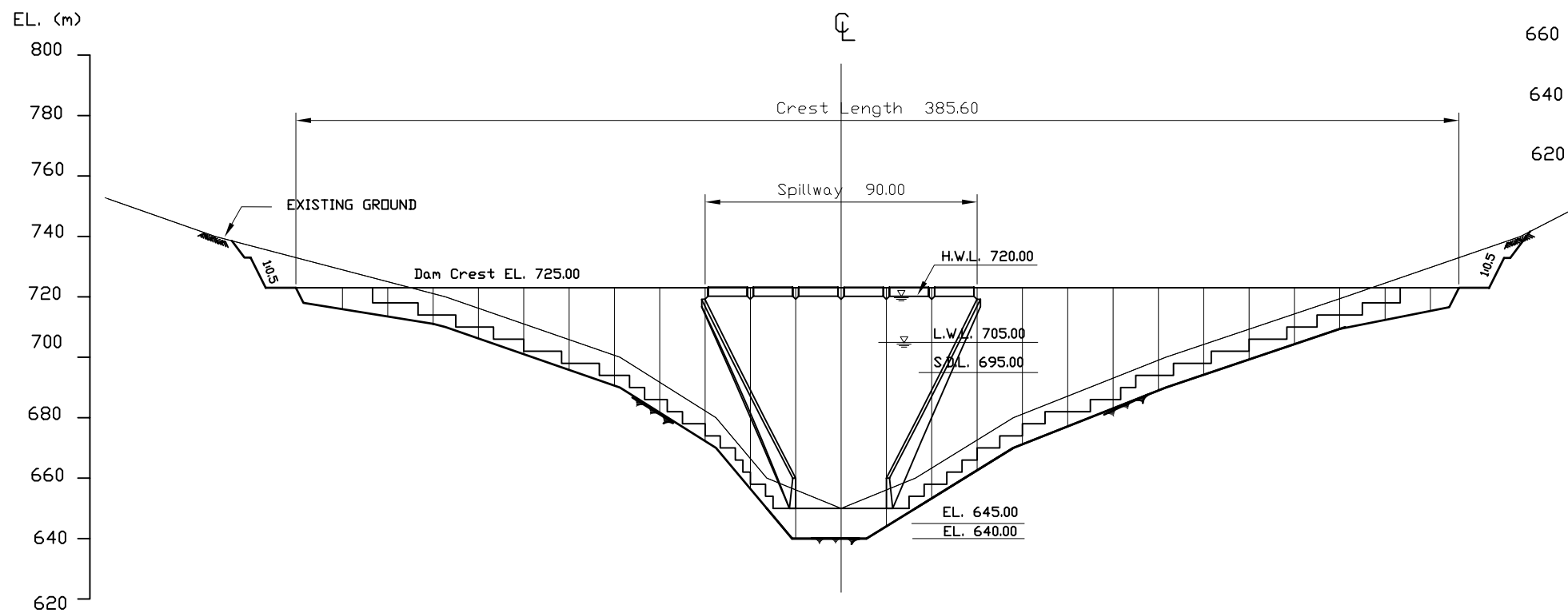
CROSS SECTION OF DAM (UPSTREAM SIDE)
SCALE A



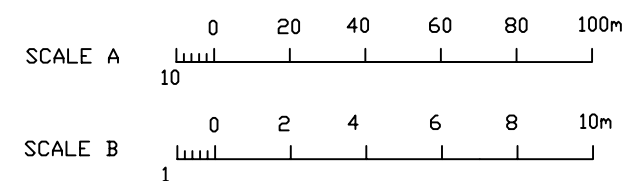
TYPICAL CROSS SECTION
OF GALLERY
SCALE B



SECTION ALONG CENTERLINE OF DAM CREST
SCALE A



CROSS SECTION OF DAM (DOWNSTREAM SIDE)
SCALE A



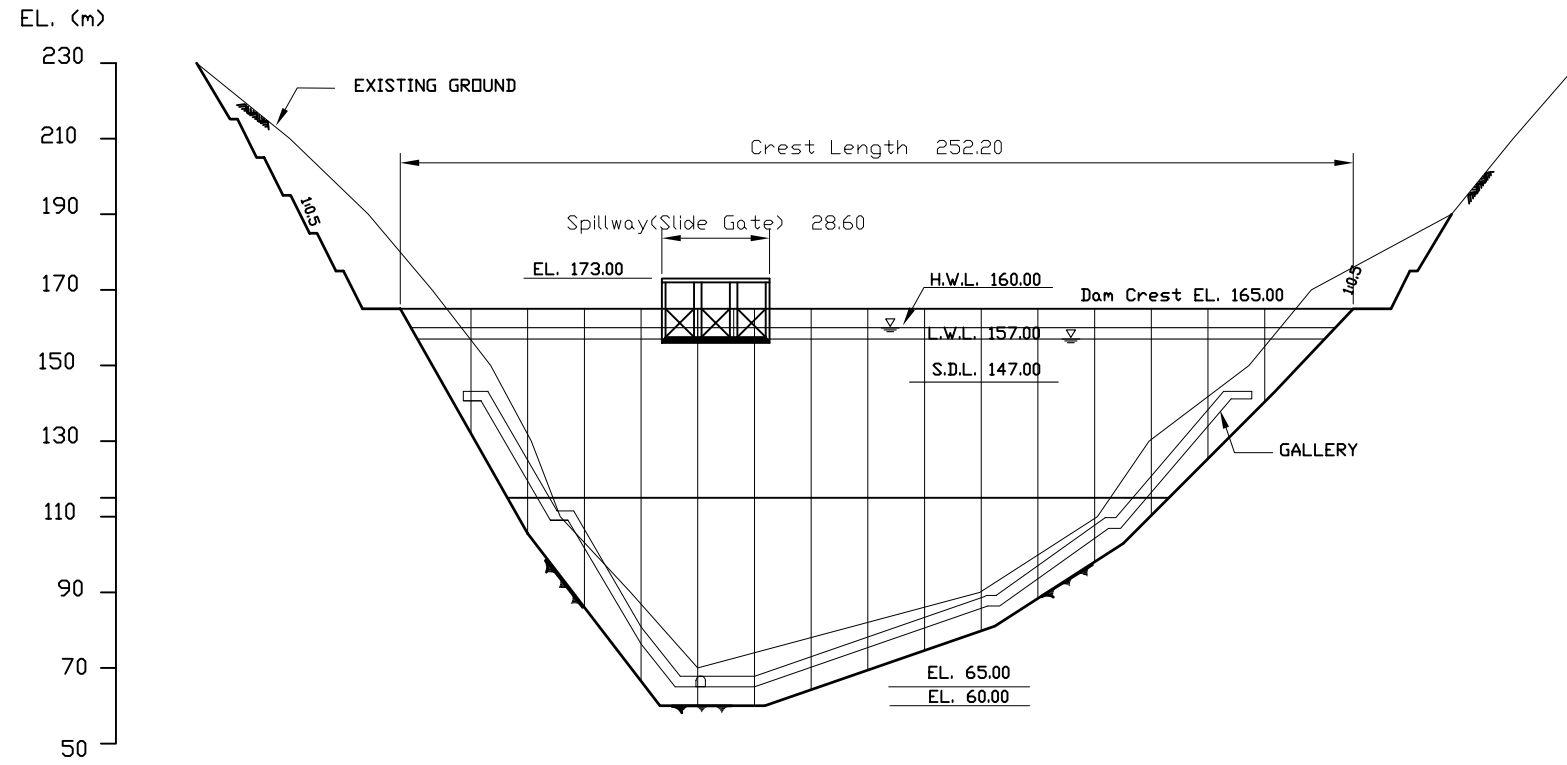
PHU YEN WEST PROJECT

UPPER DAM PLAN

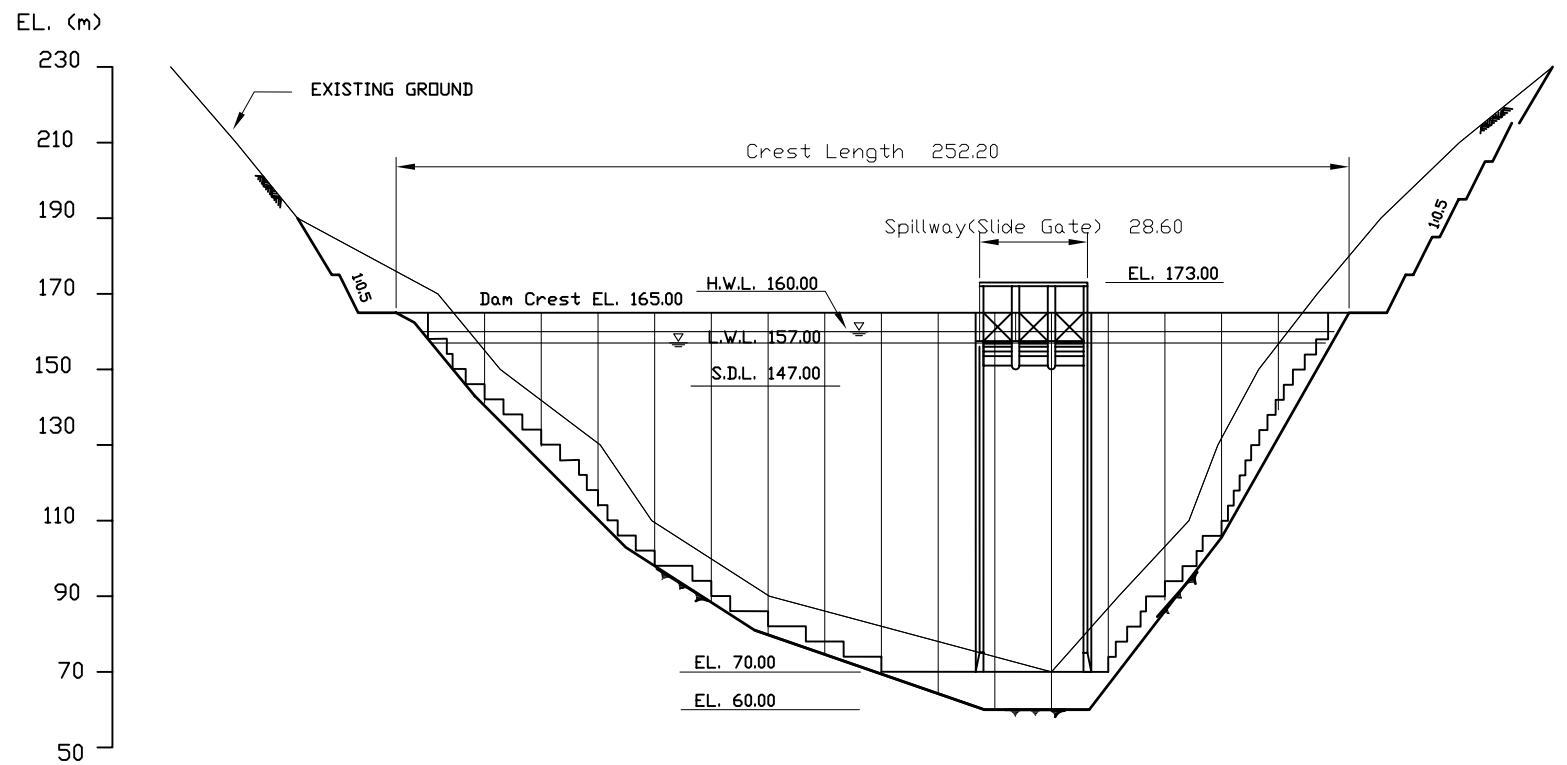
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Date

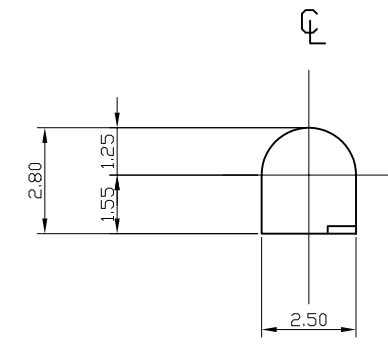
MASTER PLAN ON PUMPED STORAGE POWER PROJECT AND
OPTIMIZATION FOR PEAKING POWER GENERATION IN VIETNAM
ELECTRICITY OF VIETNAM
JICA Study Team



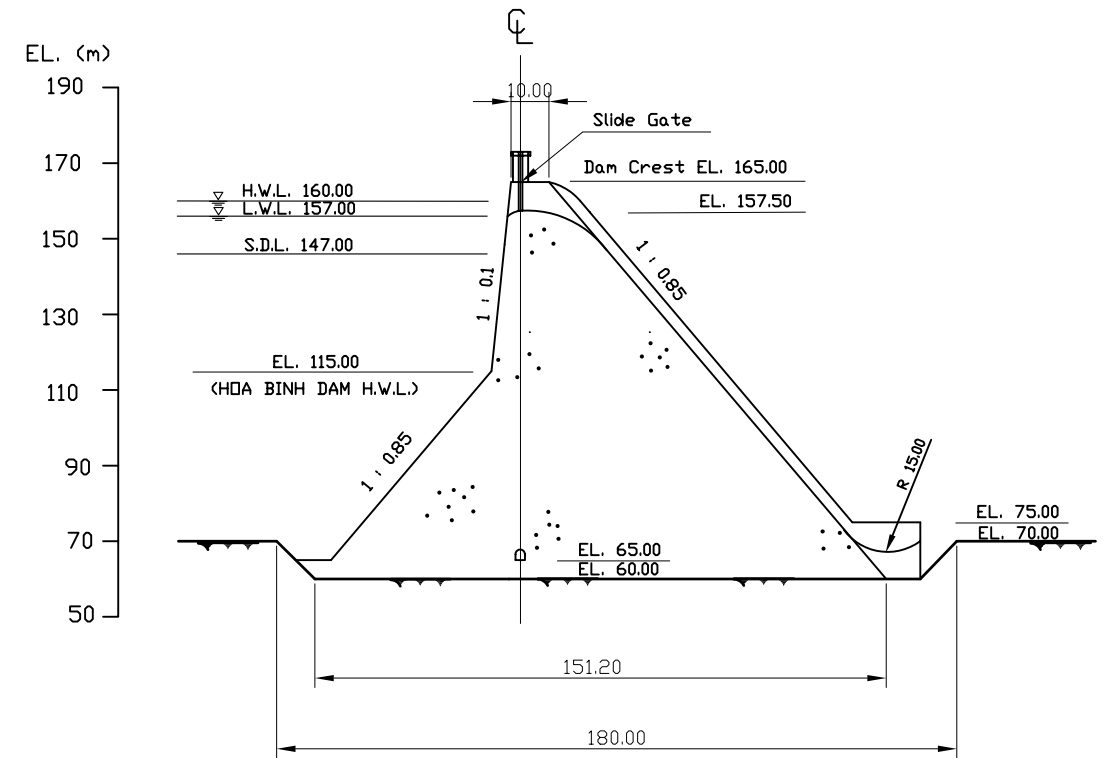
CROSS SECTION OF DAM (UPSTREAM SIDE)
SCALE A



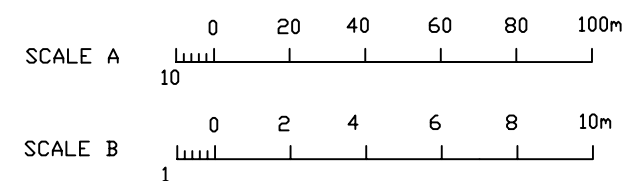
CROSS SECTION OF DAM (DOWNSTREAM SIDE)
SCALE A



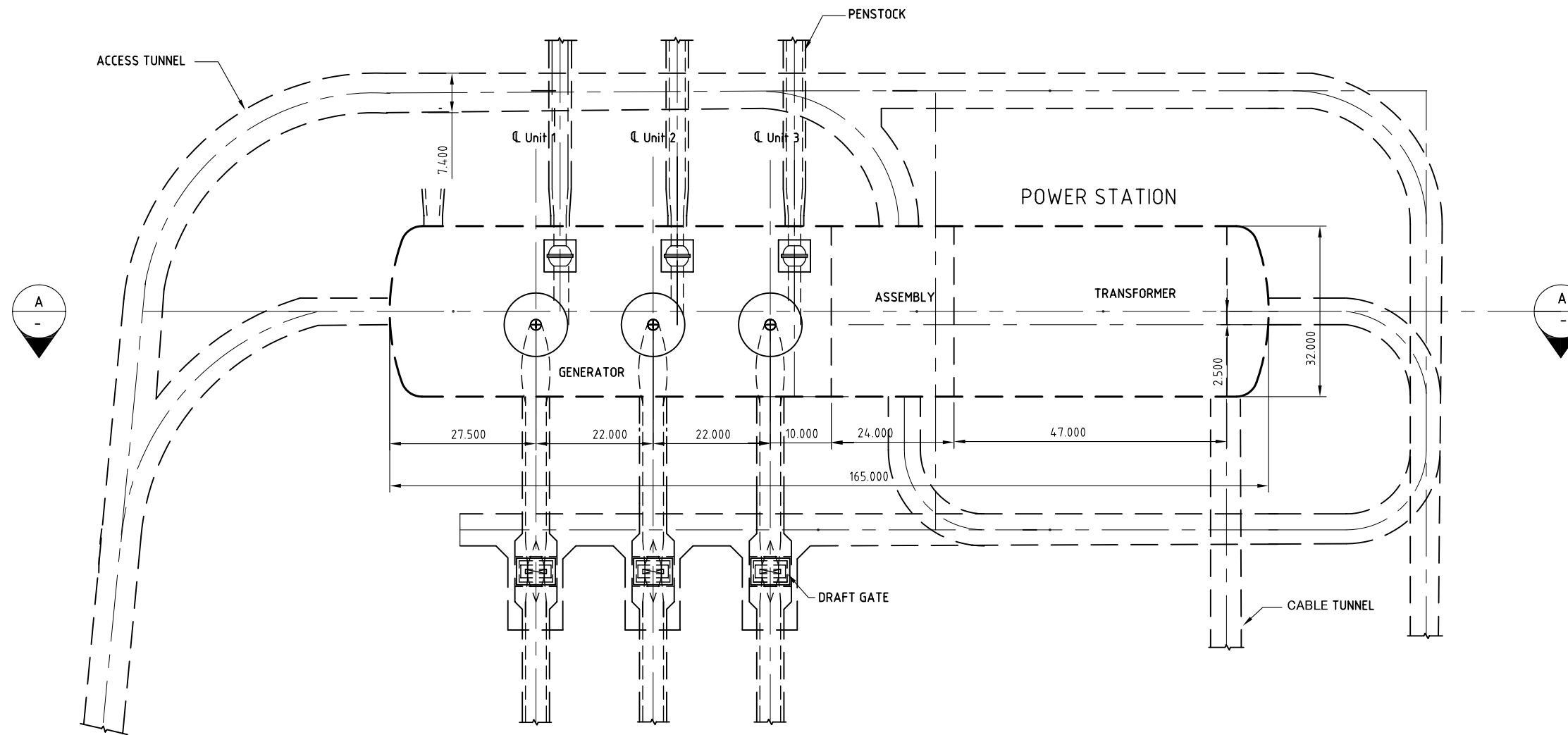
TYPICAL CROSS SECTION
OF GALLERY
SCALE B



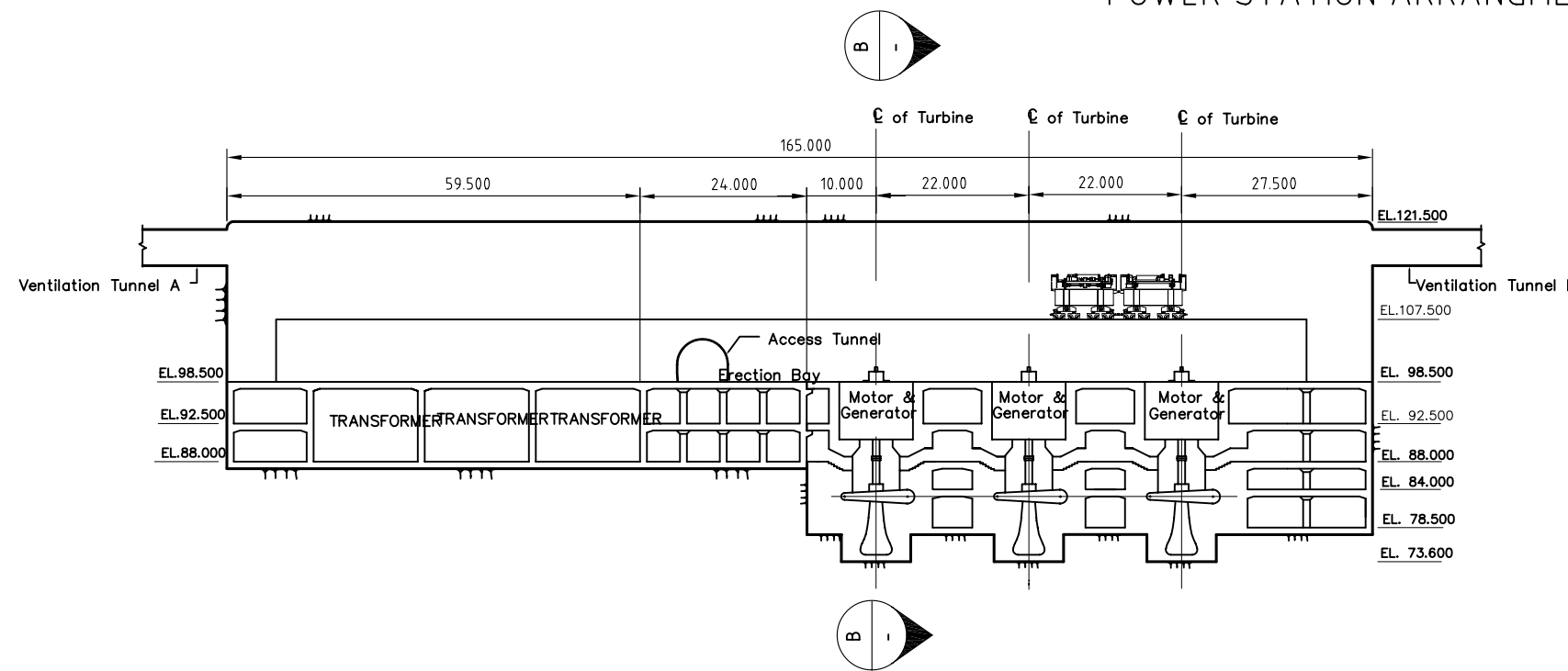
SECTION ALONG CENTERLINE OF DAM CREST
SCALE A



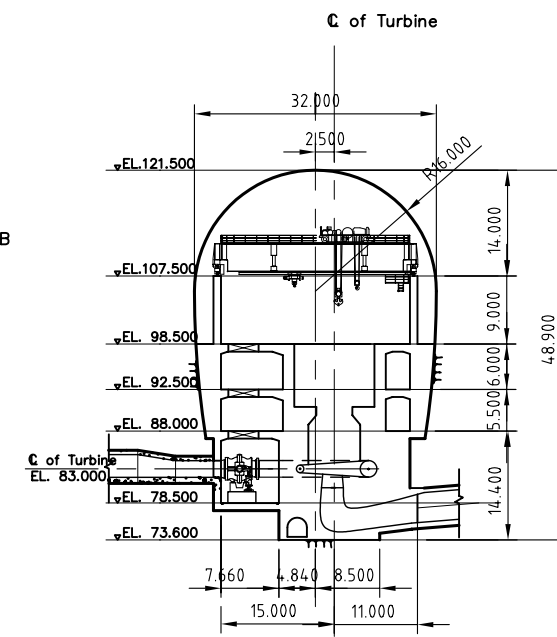
PHU YEN WEST PROJECT	
LOWER DAM PLAN	Sheet of 4/5
Date	
MASTER PLAN ON PUMPED STORAGE POWER PROJECT AND OPTIMIZATION FOR PEAKING POWER GENERATION IN VIETNAM	
ELECTRICITY OF VIETNAM JICA Study Team	



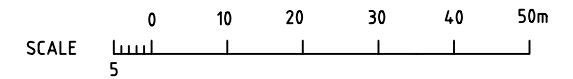
POWER STATION ARRANGMENT



POWER STATION LONGITUDINAL SECTION
(SECTION A)



POWER STATION SECTION
(SECTION B)



PHU YEN WEST PROJECT	
POWER STATION PLAN	Sheet of 5/5
Date	
MASTER PLAN ON PUMPED STORAGE POWER PROJECT AND OPTIMIZATION FOR PEAKING POWER GENERATION IN VIETNAM	
ELECTRICITY OF VIETNAM JICA Study Team	

APPENDIX 4-8-2

Cost estimation of Phu Yen West site

Total Project Cost Estimated for Phu Yen West PSPP site

Cost Items	Unit	Unit price (USD)	Phu Yen West (1,050MW)	
			Quantity	Cost
I Construction Cost				
1.1 Preparatory Works				
Operation Roads in area	km	360,000	24.0	8,640,000
Construction Roads in area	km	280,000	5.0	1,400,000
Roads to Project Area	km	570,000	13.6	7,752,000
Bridge	m2	2,015	4,680	9,430,200
Base camp	%	5.0		1,361,110
Construction power supply	km	42,718	13.6	580,971
Others	%	5.0		1,458,214
Total				30,622,000
1.2 Civil Work				
1) Site installation	%	5.0		12,935,588
2) Temporary river diversion				
#	m3	42.4	91,880	3,895,712
#	%	15.0		584,357
#	m3	116.5	8,750	1,019,200
#	t	790.0	875	691,250
#	m3	1.9	166,000	308,760
#	m3	4.5	664,000	2,961,440
#	%	10.0		946,072
Sub Total				10,407,000
3) Upper Dam/Reservoir (common)				
#	m3	2.5	9,500	23,750
#	m3	6.0	180,500	1,079,390
#	m3	82.0	530,000	43,460,000
#	m3	94.0	5,300	498,200
#	t	700.0	530	371,000
#	m	29.9	8,400	251,160
#	m	67.9	241,400	16,391,060
Re-bar, open	t	790.0	1,160	916,400
#	%	5.0		3,149,548
Sub Total				66,141,000
4) Lower Dam/Reservoir				
#	m3	2.5	3,800	9,500
#	m3	6.0	186,200	1,113,476
#	m3	82.0	670,000	54,940,000
#	m3	94.0	67,000	6,298,000
#	t	700.0	6,700	4,690,000
#	m	29.9	8,900	266,110
#	m	67.9	212,400	14,421,960
#	m2	2,000.0	780	1,560,000
Work adit	m3	42.4	26,000	1,102,400
#	%	5.0		4,220,072
Sub Total				88,622,000
5) Power intake				
Excavation, common	m3	2.5	950	2,375
Excavation, rock	m3	6.0	18,050	107,939
Excavation, tunnel	m3	42.4	1,170	49,608
Excavation, shaft	m3	62.0	2,610	161,820
Tunnel, shaft supporting work	%	15.0		31,714
Concrete, structure	m3	94.0	4,525	425,350
Concrete, tunnel	m3	116.5	370	43,098
Concrete, shaft	m3	161.9	160	25,901
Re-bar, open	t	700.0	453	316,750
Re-bar, tunnel	t	790.0	37	29,230
Re-bar, shaft	t	790.0	16	12,640
Others	%	10.0		120,642
Sub Total				1,327,000

Total Project Cost Estimated for Phu Yen West PSPP site

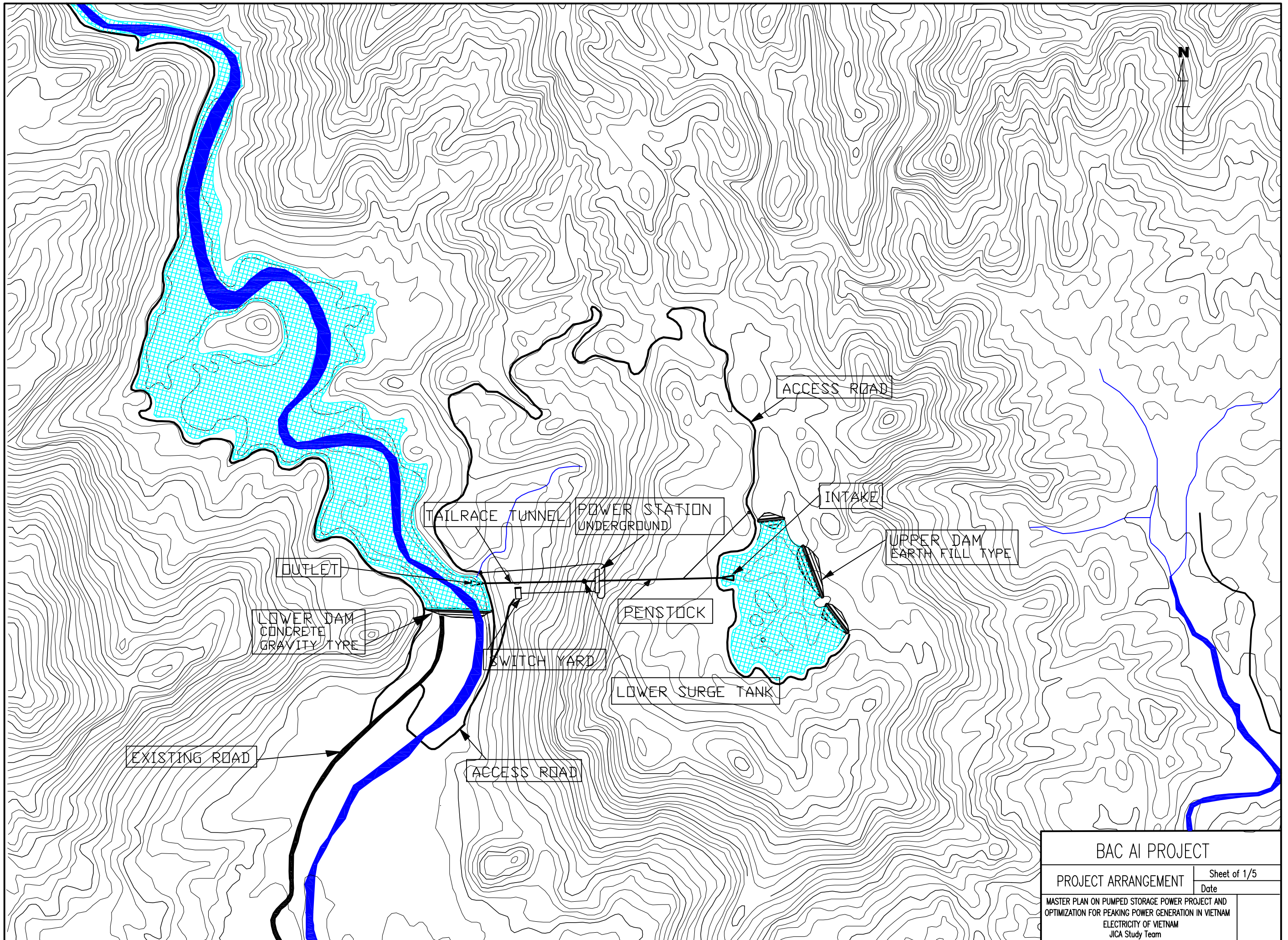
Cost Items	Unit	Unit price (USD)	Phu Yen West (1,050MW)	
			Quantity	Cost
6) Headrace tunnel				
Excavation, tunnel	m3	42.4	85,346	3,618,676
Tunnel supporting work	%	15.0		542,801
Concrete, lining	m3	116.5	27,176	3,165,405
Re-bar, tunnel	t	790.0	5,435	4,293,733
Work adit	m3	42.4	30,000	1,272,000
Others (Work adits etc.)	%	10.0		1,289,262
Sub Total				12,893,000
7) Surge tank (headrace)				
Excavation, common	m3	2.5	2,000	5,000
Excavation, rock	m3	6.0	2,000	11,960
Excavation, tunnel	m3	42.4	21,000	890,400
Excavation, shaft	m3	78.0	43,960	3,428,880
Tunnel supporting work	%	15.0		647,892
Concrete, lining	m3	161.9	8,360	1,353,484
Re-bar	t	790.0	836	660,440
Others	%	10.0		699,806
Sub Total				7,698,000
8) Penstock				
Excavation, common	m3	2.5	1,000	2,500
Excavation, rock	m3	6.0	3,000	17,940
Excavation, tunnel	m3	42.4	12,819	543,514
Excavation, inclined shaft	m3	62.0	53,411	3,311,507
Tunnel supporting work	%	15.0		578,253
Concrete, backfill, tunnel	m3	186.5	3,000	559,380
Concrete, backfill, shaft	m3	192.2	19,937	3,831,804
Re-bar, tunnel	t	790.0	300	237,000
Re-bar, shaft	t	790.0	1,994	1,574,987
Others	%	10.0		1,065,689
Sub Total				11,723,000
9) Powerhouse and switchyard				
Excavation, common	m3	2.5	2,100	5,250
Excavation, rock	m3	6.0	39,900	238,602
Excavation, tunnel	m3	42.4	31,700	1,344,080
Tunnel supporting work	%	10.0		134,408
Excavation, cavern	m3	34.9	185,000	6,456,500
Cavern supporting work	%	15.0		968,475
Concrete, structure, open	m3	94.0	1,050	98,700
Concrete, structure, cavern	m3	116.5	74,000	8,619,520
Re-bar, open	t	700.0	52.5	36,750
Re-bar, cavern	t	790.0	11,100	8,769,000
Others	%	10.0		2,667,129
Sub Total				29,338,000
10) Tailrace				
Excavation, tunnel	m3	42.4	24,390	1,034,136
Tunnel supporting work	%	15.0		155,120
Concrete, lining, tunnel	m3	116.5	7,770	905,050
Re-bar, tunnel	t	790.0	1,554	1,227,660
Work adit	m3	42.4	15,000	636,000
Others (Work adits etc.)	%	10.0		395,797
Sub Total				4,353,763

Total Project Cost Estimated for Phu Yen West PSPP site

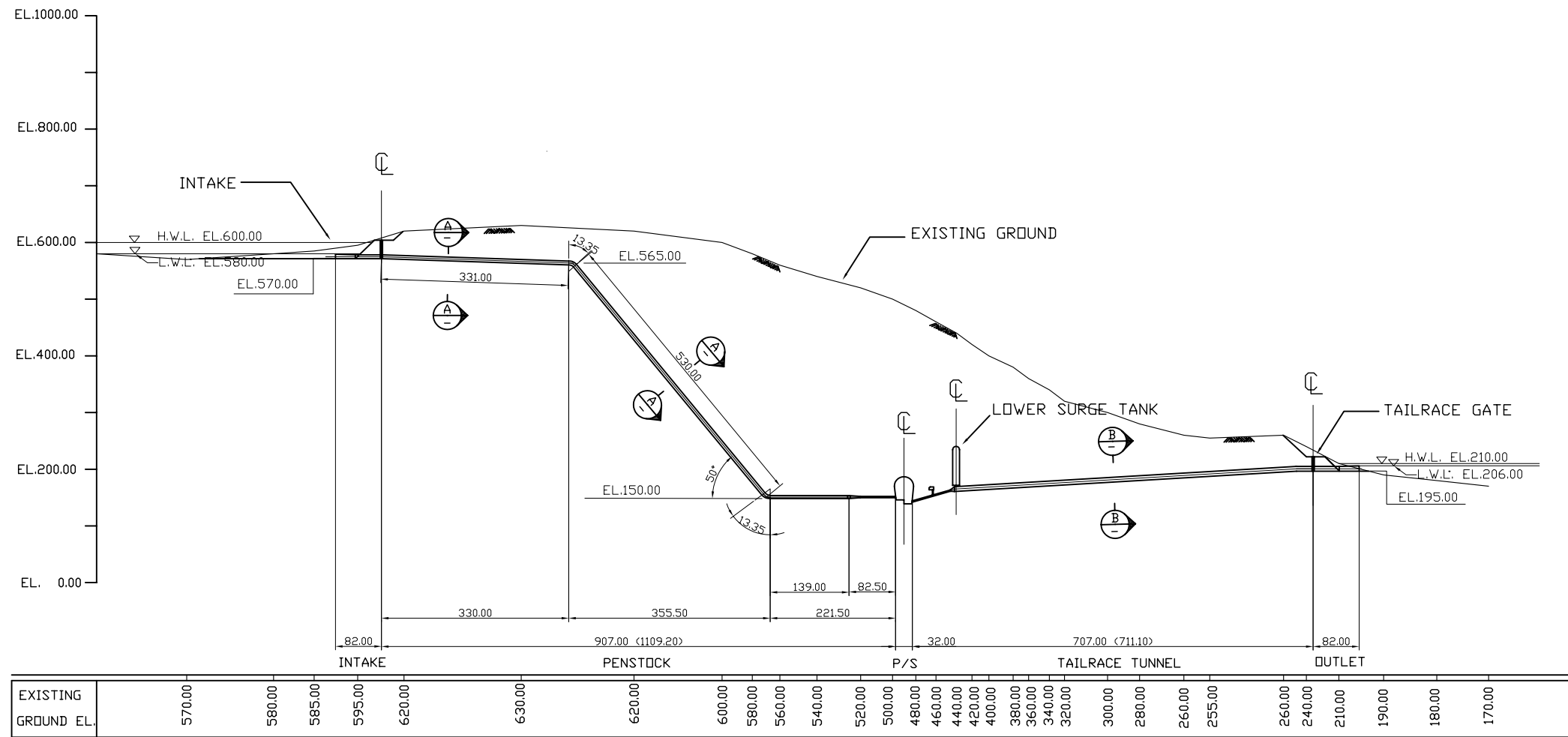
Cost Items	Unit	Unit price (USD)	Phu Yen West (1,050MW)	
			Quantity	Cost
11) Power outlet				
Excavation, common	m3	2.5	949	2,373
Excavation, rock	m3	6.0	18,031	107,825
Excavation, tunnel	m3	42.4	1,170	49,608
Excavation, shaft	m3	62.0	2,610	161,820
Tunnel, shaft supporting work	%	15.0		31,714
Concrete, structure	m3	94.0	4,525	425,350
Concrete, tunnel	m3	116.5	980	114,150
Concrete, shaft	m3	161.9	160	25,901
Re-bar, open	t	700.0	226	158,375
Re-bar, tunnel	t	790.0	49	38,710
Re-bar, shaft	t	790.0	16	12,640
Others	%	10.0		112,847
Sub Total				1,241,000
12) Main Tunnels				
Excavation, tunnel	m3	42.4	205,000	8,692,000
Excavation, shaft	m3	62.0	4,000	248,000
Tunnel, shaft supporting work	%	15.0		1,341,000
Concrete, tunnel	m3	116.5	79,608	9,272,735
Re-bar, tunnel	t	790.0	3,980	3,144,514
Others	%	10.0		2,269,825
Sub Total				24,968,000
TOTAL				271,647,000
1.3 Hydromechanical Works				
Intake gate	t	4,000	500	2,000,000
penstock	t	3,500	6,500	22,750,000
bifercation	t	4,000	300	1,200,000
draft	t	3,500	650	2,275,000
Steel lining tailrace	t	3,500	1,350	4,725,000
draft gate 150ton/unit	t	4,000	450	1,800,000
outlet gate	t	4,000	500	2,000,000
Others	%	16.0		5,880,000
TOTAL				42,630,000
1.4 Hydroelectrical Works				
1) Generating equipment/Transformer	LS			236,760,000
Total Cost of Construction Works				581,659,000
II Engineering Service	%	7.5		43,624,000
III Administration Expense	%	0.5		2,908,000
IV Land compensation and Resettlement	LS			
4.1 Resettlement				
1) Land compensation and Resettlement		32,363	300.0	9,708,750
2) Other compensations	%	10.0		970,875
4.2 Others	%	10.0		1,067,963
Total				11,748,000
V Tax (VAT 10%)	%	10.0		27,939,000
VI Physical Contingency	%	10.0		66,788,000
Total Project Cost (USD)				734,666,000
Construction Unit Cost (USD/kW)				700

APPENDIX 4-9-1

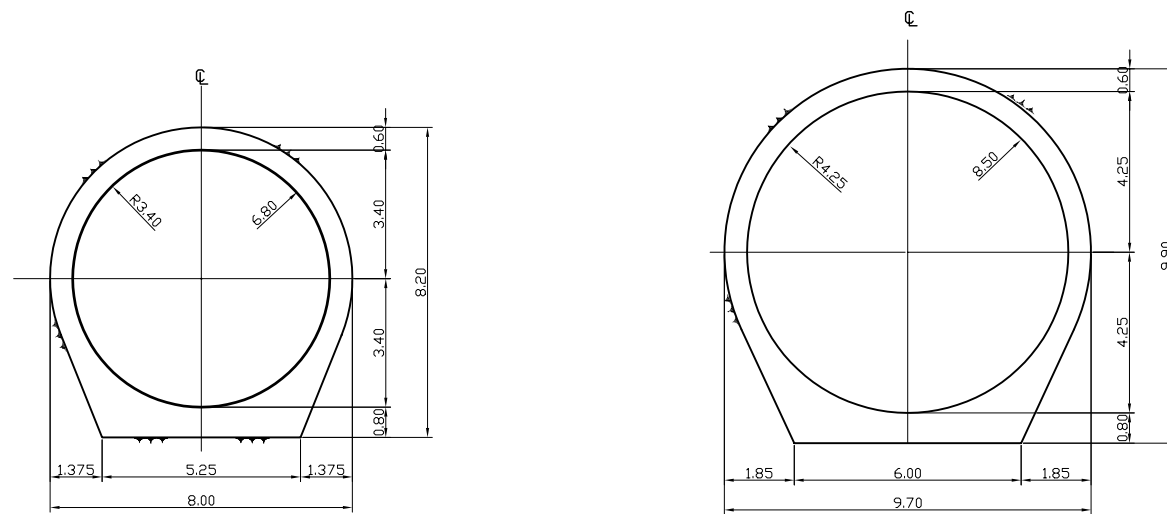
Drawings of Bac Ai site



BAC AI PROJECT	
PROJECT ARRANGEMENT	Sheet of 1/5
	Date
MASTER PLAN ON PUMPED STORAGE POWER PROJECT AND OPTIMIZATION FOR PEAKING POWER GENERATION IN VIETNAM ELECTRICITY OF VIETNAM JICA Study Team	



LONGITUDINAL SECTION (SCALE A)

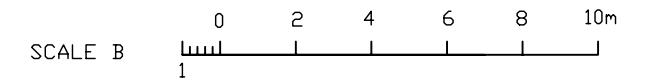
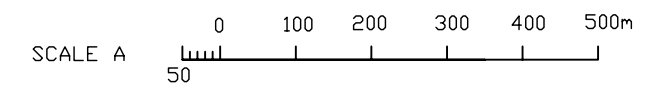


PENSTOCK

SECTION A
SCALE B

TAILRACE TUNNEL

SECTION B
SCALE B



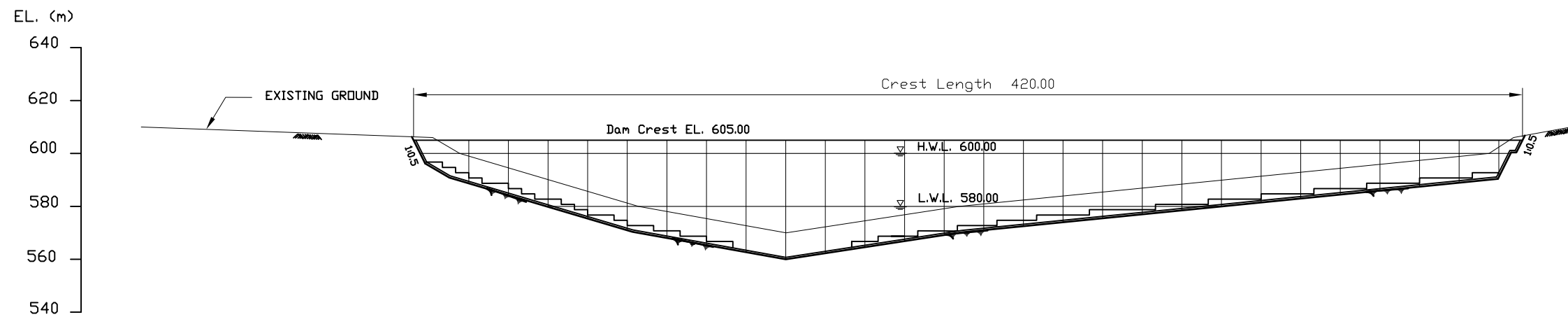
BAC AI PROJECT

WATERWAY SECTION

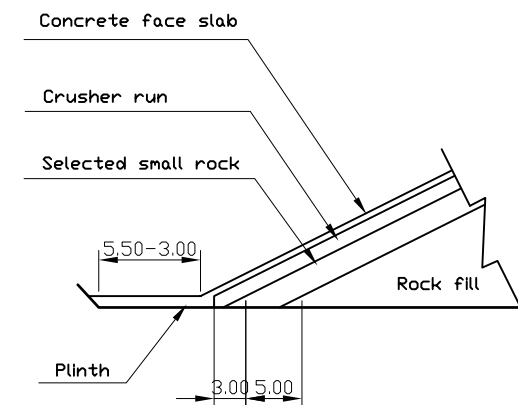
Sheet of 2/5

Date

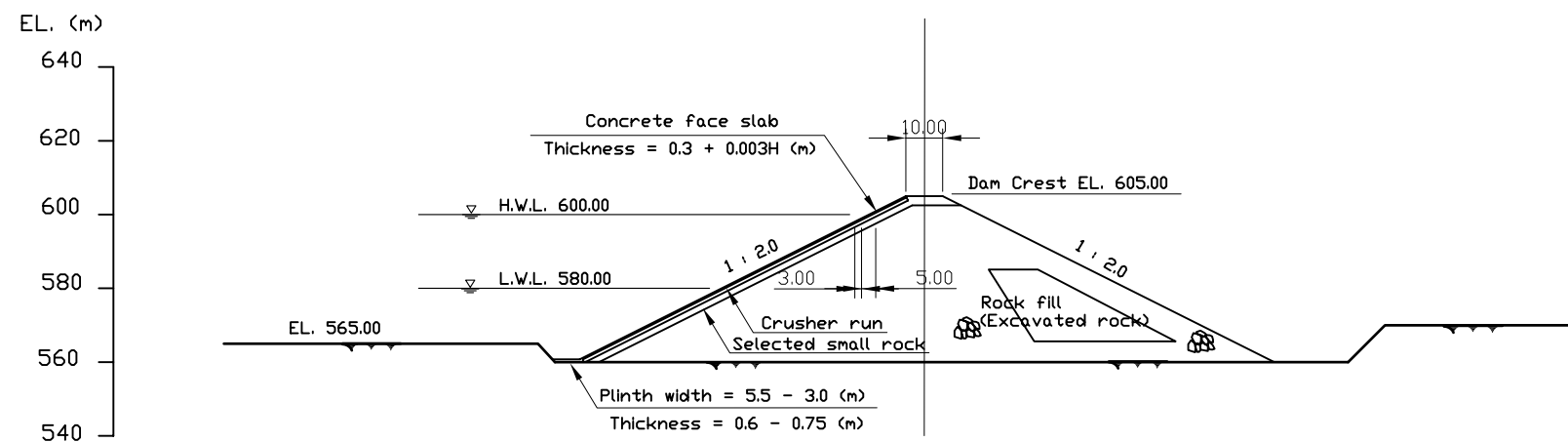
MASTER PLAN ON PUMPED STORAGE POWER PROJECT AND
OPTIMIZATION FOR PEAKING POWER GENERATION IN VIETNAM
ELECTRICITY OF VIETNAM
JICA Study Team



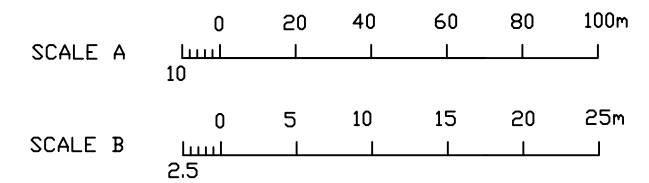
CROSS SECTION OF DAM (UPSTREAM SIDE)
SCALE A



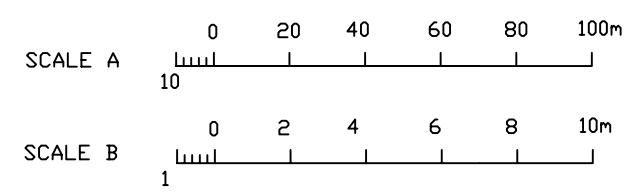
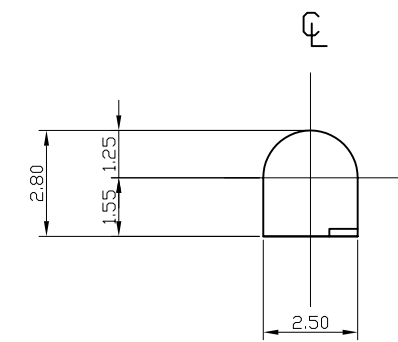
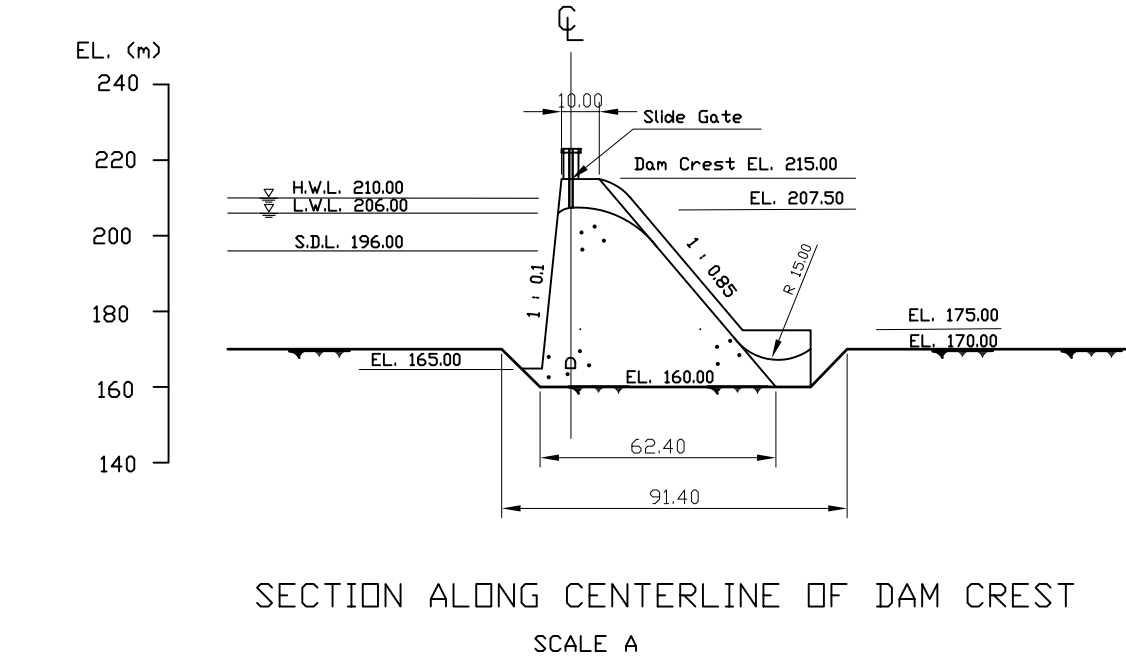
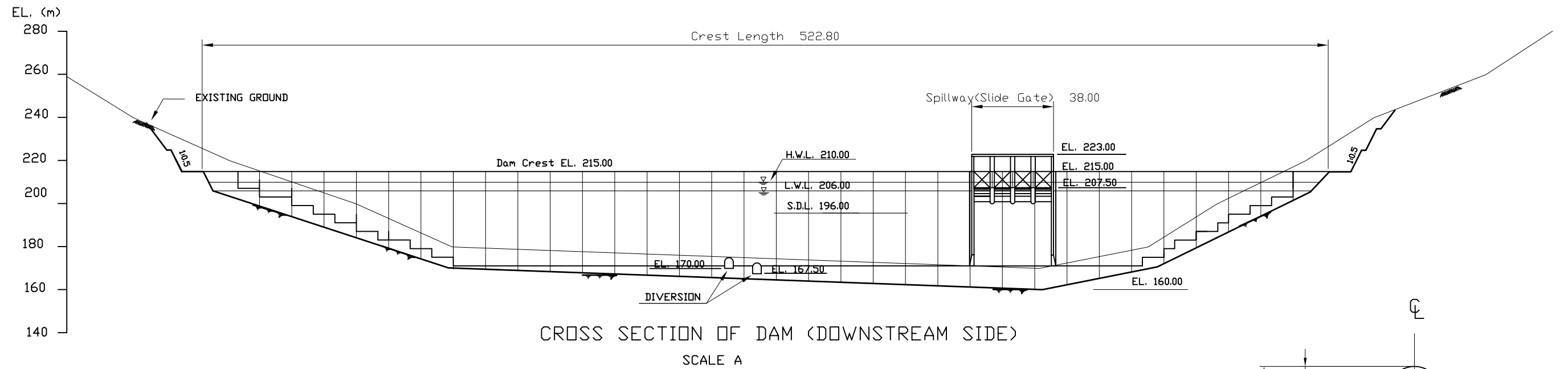
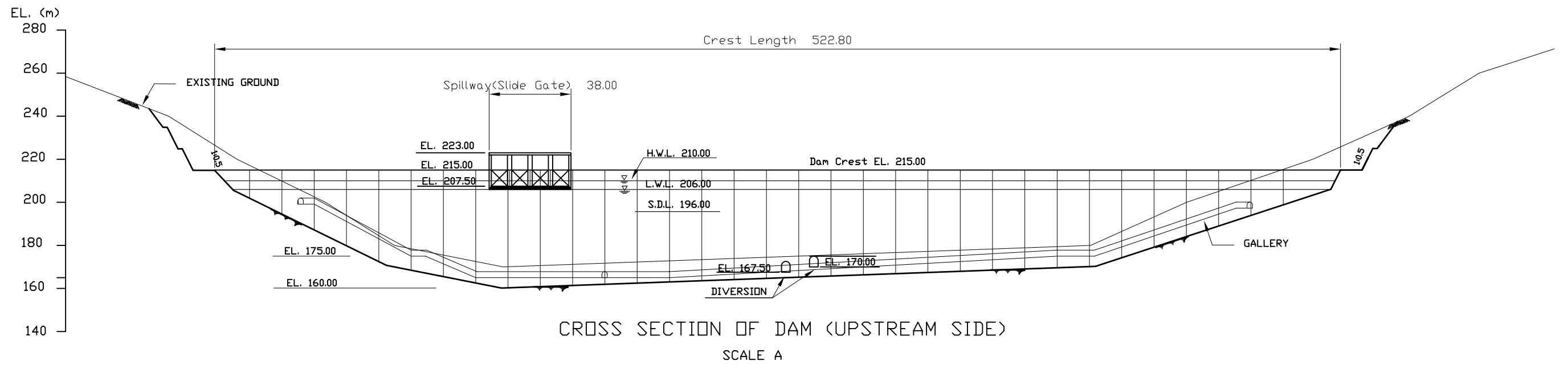
PLINTH DETAIL
SCALE B



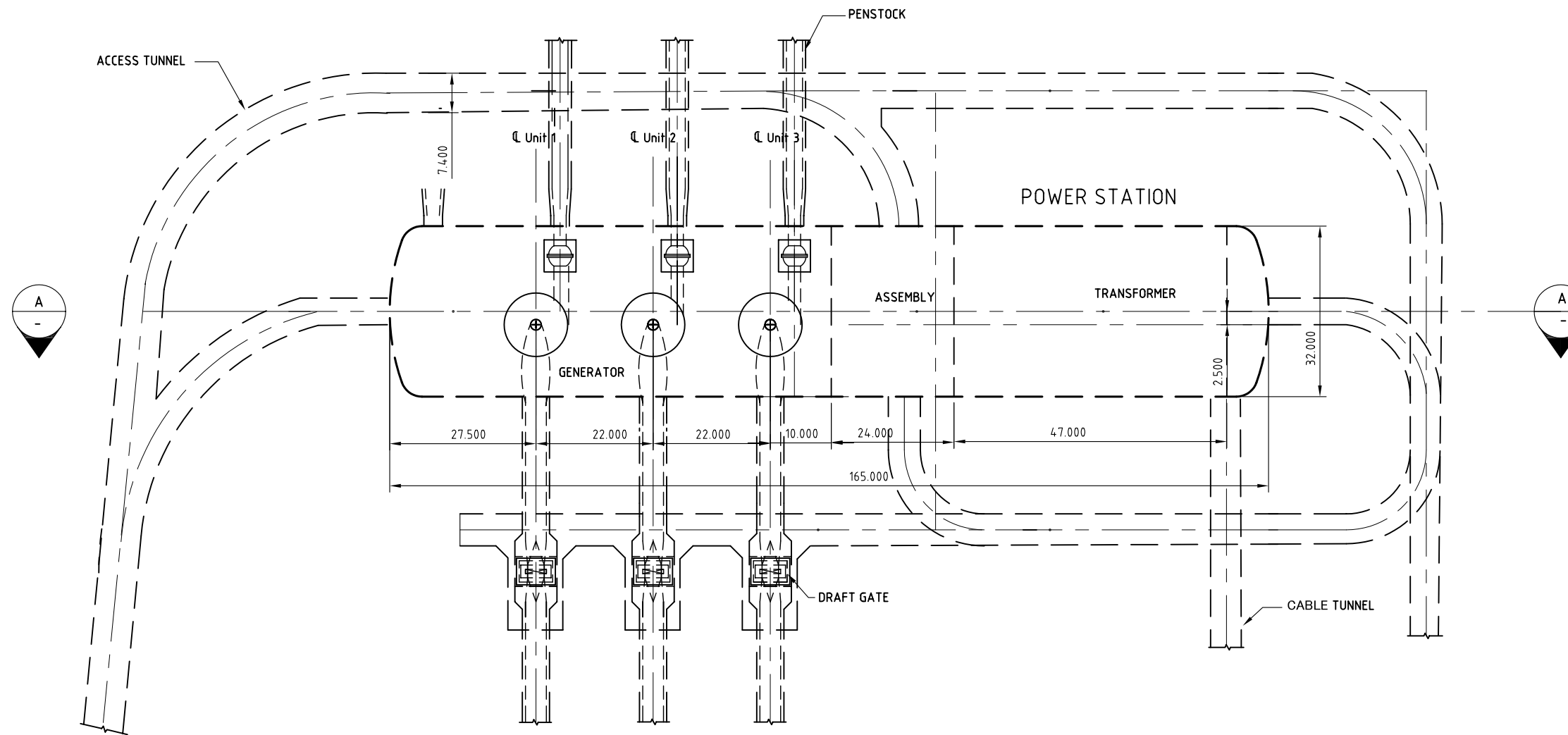
SECTION ALONG CENTERLINE OF DAM CREST
SCALE A



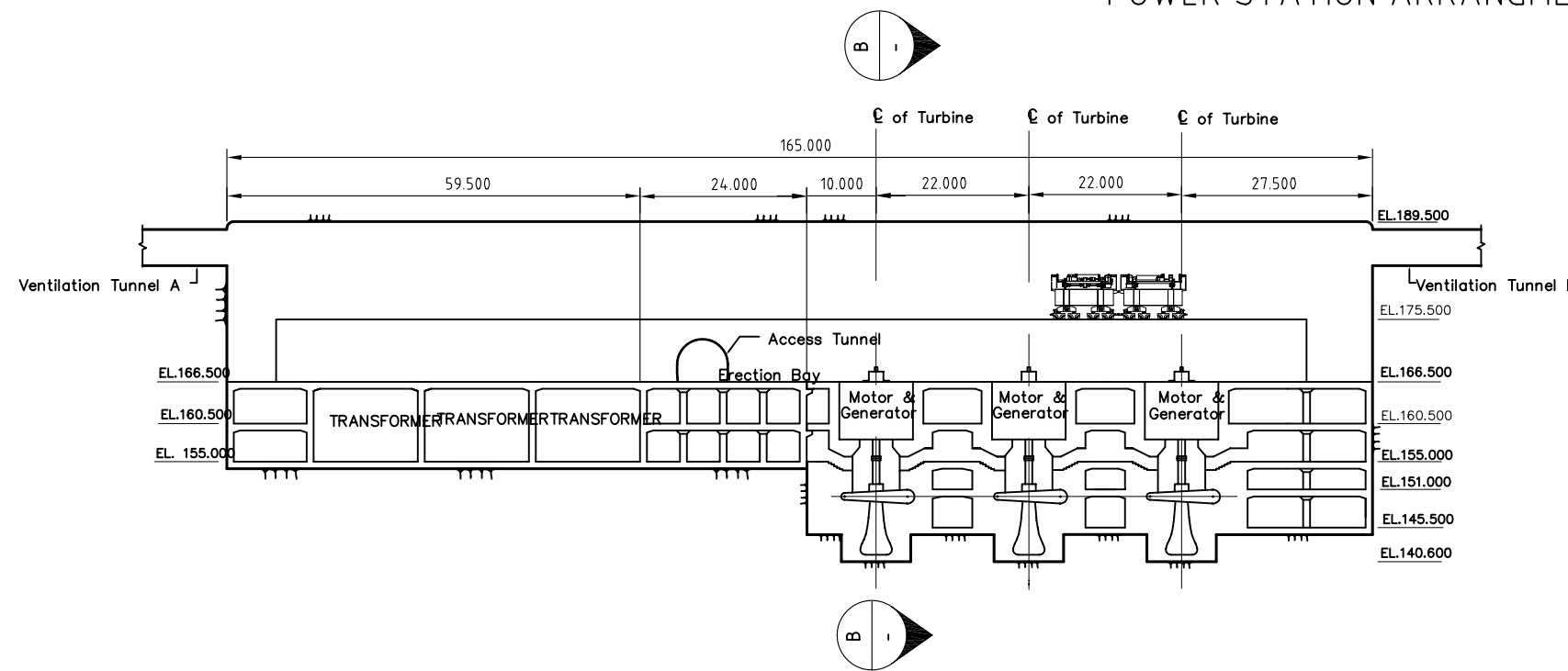
BAC AI PROJECT	
UPPER DAM PLAN	Sheet of 3/5
Date	
MASTER PLAN ON PUMPED STORAGE POWER PROJECT AND OPTIMIZATION FOR PEAKING POWER GENERATION IN VIETNAM ELECTRICITY OF VIETNAM JICA Study Team	



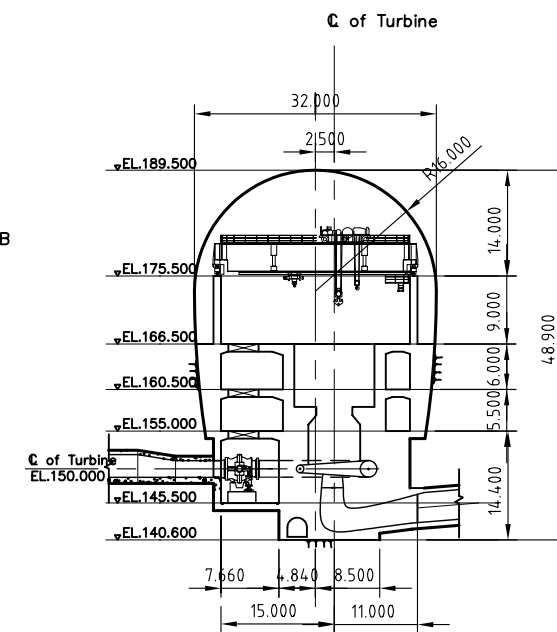
BAC AI PROJECT	
LOWER DAM PLAN	Sheet of 4/5
Date	
MASTER PLAN ON PUMPED STORAGE POWER PROJECT AND OPTIMIZATION FOR PEAKING POWER GENERATION IN VIETNAM ELECTRICITY OF VIETNAM JICA Study Team	



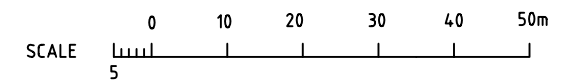
POWER STATION ARRANGMENT



POWER STATION LONGITUDINAL SECTION
(SECTION A)



POWER STATION SECTION
(SECTION B)



BAC AI PROJECT	
POWER STATION PLAN	Sheet of 5/5
Date	
MASTER PLAN ON PUMPED STORAGE POWER PROJECT AND OPTIMIZATION FOR PEAKING POWER GENERATION IN VIETNAM ELECTRICITY OF VIETNAM JICA Study Team	

APPENDIX 4-9-2

Cost estimation of Bac Ai site

Total Project Cost Estimated for Bac Ai PSPP site

Cost Items	Unit	Unit price (USD)	Bac Ai (1,050MW)	
			Quantity	Cost
I Construction Cost				
1.1 Preparatory Works				
Operation Roads in area	km	360,000	29.9	10,764,000
Construction Roads in area	km	280,000	5.0	1,400,000
Bridge	m2	2,015	2,400	4,836,000
Base camp	%	5.0	5.0	850,000
Construction power supply	km	42,718	14.0	598,058
Others	%	5.0		922,403
Total				19,370,000
1.2 Civil Work				
1) Site installation	%	5.0		12,372,976
2) Temporary river diversion				
#	m3	1.9	56,000	104,160
#	m3	4.5	224,000	999,040
#	%	10.0		110,320
Sub Total				1,213,520
3) Upper Dam/Reservoir				
#	m3	2.5	88,550	221,375
#	m3	6.0	1,682,450	10,061,051
#	m3	4.8	745,000	3,583,450
#	m3	11.6	745,000	8,664,350
#	m3	94.0	3,000	282,000
#	m3	93.1	67,500	6,281,550
#	t	700.0	300	210,000
#	m	29.9	42,300	1,264,770
#	m	67.9	200,000	13,580,000
#	%	5.0		2,207,427
Sub Total				46,356,000
4) Lower Dam/Reservoir				
#	m3	2.5	14,250	35,625
#	m3	6.0	270,750	1,619,085
#	m3	82.0	880,000	72,160,000
#	m3	94.0	132,000	12,408,000
#	t	700.0	13,200	9,240,000
#	m	29.9	13,000	388,700
#	m	67.9	165,200	11,217,080
#	m2	2,000.0	1,650	3,300,000
#	%	5.0		5,518,425
Sub Total				115,887,000
5) Power intake				
Excavation, common	m3	2.5	920	2,300
Excavation, rock	m3	6.0	17,480	104,530
Excavation, tunnel	m3	42.4	1,090	46,216
Excavation, shaft	m3	62.0	2,440	151,280
Tunnel, shaft supporting work	%	15.0		29,624
Concrete, structure	m3	94.0	4,450	418,300
Concrete, tunnel	m3	116.5	360	41,933
Concrete, shaft	m3	161.9	150	24,282
Re-bar, open	t	700.0	445	311,500
Re-bar, tunnel	t	790.0	36	28,440
Re-bar, shaft	t	790.0	15	11,850
Others	%	10.0		117,026
Sub Total				1,287,000

Total Project Cost Estimated for Bac Ai PSPP site

Cost Items	Unit	Unit price (USD)	Bac Ai (1,050MW)	
			Quantity	Cost
6) Penstock				
Excavation, common	m3	2.5	1,000	2,500
Excavation, rock	m3	6.0	3,000	17,940
Excavation, tunnel	m3	42.4	17,035	722,274
Excavation, inclined shaft	m3	62.0	73,817	4,576,676
Tunnel supporting work	%	15.0		794,843
Concrete, backfill, tunnel	m3	186.5	3,000	559,380
Concrete, backfill, shaft	m3	192.2	24,270	4,664,702
Re-bar, tunnel	t	790.0	300	237,000
Re-bar, shaft	t	790.0	2,427	1,917,333
Others	%	10.0		1,349,265
Sub Total				14,842,000
7) Powerhouse and switchyard				
Excavation, common	m3	2.5	2,100	5,250
Excavation, rock	m3	6.0	39,900	238,602
Excavation, tunnel	m3	42.4	31,700	1,344,080
Tunnel supporting work	%	10.0		134,408
Excavation, cavern	m3	34.9	185,000	6,456,500
Cavern supporting work	%	15.0		968,475
Concrete, structure, open	m3	94.0	1,050	98,700
Concrete, structure, cavern	m3	116.5	74,000	8,619,520
Re-bar, open	t	700.0	52.5	36,750
Re-bar, cavern	t	790.0	11,100	8,769,000
Others	%	10.0		2,667,129
Sub Total				29,338,000
8) Surge tank (tailrace)				
Excavation, tunnel	m3	42.4	60,000	2,544,000
Excavation, shaft	m3	78.0	41,800	3,260,400
Tunnel supporting work	%	15.0		870,660
Concrete, lining	m3	161.9	7,260	1,175,394
Re-bar	t	790.0	726	573,540
Others	%	10.0		842,399
Sub Total				9,266,000
9) Tailrace				
Excavation, tunnel	m3	42.4	58,530	2,481,672
Tunnel supporting work	%	15.0		372,251
Concrete, lining, tunnel	m3	116.5	16,240	1,891,635
Re-bar, tunnel	t	790.0	3248	2,565,920
Work adit	m3	42.4	25000	1,060,000
Others (Work adits etc.)	%	10.0		837,148
Sub Total				9,209,000
10) Power outlet				
Excavation, common	m3	2.5	1110.5	2,776
Excavation, rock	m3	6.0	21,100	126,175
Excavation, tunnel	m3	42.4	1,570	66,568
Excavation, shaft	m3	62.0	3,470	215,140
Tunnel, shaft supporting work	%	15.0		42,256
Concrete, structure	m3	94.0	4,875	458,250
Concrete, tunnel	m3	116.5	1,150	133,952
Concrete, shaft	m3	161.9	180	29,138
Re-bar, open	t	700.0	244	170,625
Re-bar, tunnel	t	790.0	58	45,425
Re-bar, shaft	t	790.0	18	14,220
Others	%	10.0		130,453
Sub Total				1,435,000

Total Project Cost Estimated for Bac Ai PSPP site

Cost Items	Unit	Unit price (USD)	Bac Ai (1,050MW)	
			Quantity	Cost
11) Main Tunnels				
Excavation, tunnel	m3	42.4	145,000	6,148,000
Excavation, shaft	m3	62.0	4,000	248,000
Tunnel, shaft supporting work	%	15.0		959,400
Concrete, tunnel	m3	116.5	61,402	7,152,155
Re-bar, tunnel	t	790.0	3,070	2,425,396
Others	%	10.0		1,693,295
Sub Total				18,626,000
TOTAL				
				259,832,000
1.3 Hydromechanical Works				
Intake gate	t	4,000	500	2,000,000
penstock	t	3,500	5,100	17,850,000
bifercation	t	4,000	300	1,200,000
draft	t	3,500	650	2,275,000
draft gate 150ton/unit	t	4,000	450	1,800,000
outlet gate	t	4,000	550	2,200,000
Others	%	16.0		4,372,000
TOTAL				31,697,000
1.4 Hydroelectrical Works				
1) Generating equipment/Transformer	LS			236,760,000
Total Cost of Construction Works				
				547,659,000
II Engineering Service	%	7.5		41,074,000
III Administration Expense	%	0.5		2,738,000
IV Land compensation and Resettlement	LS			
4.1 Resettlement				
1) Land compensation and Resettlement		32,363	63.0	2,038,838
2) Other compensations	%	10.0		203,884
4.2 Others				
	%	10.0		224,272
TOTAL				2,466,993
V Tax (VAT 10%)	%	10.0		26,846,000
VI Physical Contingency	%	10.0		62,078,000
Total Project Cost (USD)				
				682,862,000
Construction Unit Cost (USD/kW)				
				650