901 Pek
HH Electrification Ratio
43% (2003) – 100% (2020)

902 Kham
HH Electrification Ratio
34% (2003) – 80% (2020)

906 Phookood
HH Electrification Ratio
36% (2005) – 70% (2020)

903 Nonghed
HH Electrification Ratio
6% (2003) – 70% (2020)

905 Morkmay
HH Electrification Ratio
18% (2003) – 55% (2020)

907 Phaxay
HH Electrification Ratio
27% (2005) – 100% (2020)

904 Khoune
HH Electrification Ratio
18% (2003) – 80% (2020)

900 Xiengkhuang
HH Electrification Ratio
30% (2003) – 84% (2020)

P.XIANGKHOUANG

S.R.XAISOMBOUN

22kV Line
PTD 2

22kV Line
Long Term Plan

Nam Ka HPP

JICA
Nam Xan 3
Pre-FS

JICA
Nam Chao
Map Study

N

10 5 0 10 20 30 40 50 60
Kilometers

Legend

Classified Village
- Electrified by EDL Grid
- Electrified by Import Electricity
- Electrified by Off-grid (Hydro power)
- Electrified by Off-grid (Pico)
- Electrified by Off-grid (Diesel)
- Electrified by Off-grid (Solar)
- None
- EDL Short Term
- EDL Long Term
- JICA Off-grid Pre-FS
- Potential site (Village Hydro Class)
- Existing Plan of Pico-hydro and Diesel
- Existing Plan of Solar Power
- Others

Road
- Paved Road
- Street Road
- Improved Unpaved Road
- Unpaved Road
- Temporary Road
- Footpath

115kv Transmission line
- Existing
- Under Construction
- Planning

22kv Transmission line
- Existing
- Planning
- PTD2 Long Term Plan
- Demand of Province

35kv Transmission line
- Existing
- Planning

Figure 8 Electrification Plan in Xiengkhuan

Attachment-2 Brief Project Features & Drawings for Priority project Sites

1. Nam Likna (Sequence No. 4)

A. Salient Features

1.General	Province	Phongsaly		District	Samphan	
	Electr. Status	Partly electrified by pico-hydros with semi-permanent structures				
2.Demand	Load Center	Samphan (District Center)		H/H Number	123	
	Peak Load	26 kW		Peak Hours	4 hours	
3.Hydrology	River	Nam Likna	Basin	Nam Ou	CA	30 km^2
	Rainfall	1,800 mm	Q_{ave}	0.731 m^3/s	$Q_{95\%}$	0.184 m^3/s
4.Structures						
4.1 Intake	Type	Gabion-core concrete facing	Height	2.5 m	Length	25.5 m
			FSL	618.00 m	FWL	621.38 m
4.2 Desilting Basin	Length	10 m	Width	0.9 m	Side Spillway Length	5 m
4.3 Headrace Channel	Shape	Trapezoidal (1:0.3)	Lining	Wet Masonry	Length	468 m
	Uniform Depth	0.53 m	Base	0.8 m		
4.4 Head Tank	Type	Surface	NWL	616.88 m	MOL	615.88 m
4.5 Penstock	Type	Exposed	Dia.	0.5 m	Length	15.6 m
4.6 Powerhouse	Type	Surface	EL	605.17 m	Turbine	Cross-Flow	Units	1 nos
5.Power and Energy	Q_{design}	0.32 m^3/s	H_{net}	12 m	Installed Capacity	26 kW		
	Energy	117,544 kWh/yr			P.F.	52%		
6.Access Road	Length	0.5 km						
7.Transmission Line	Capacity	400 V			Length	0.5 km		
	Loss	10.0%			Energy Delivered.	105,790 kWh/yr		

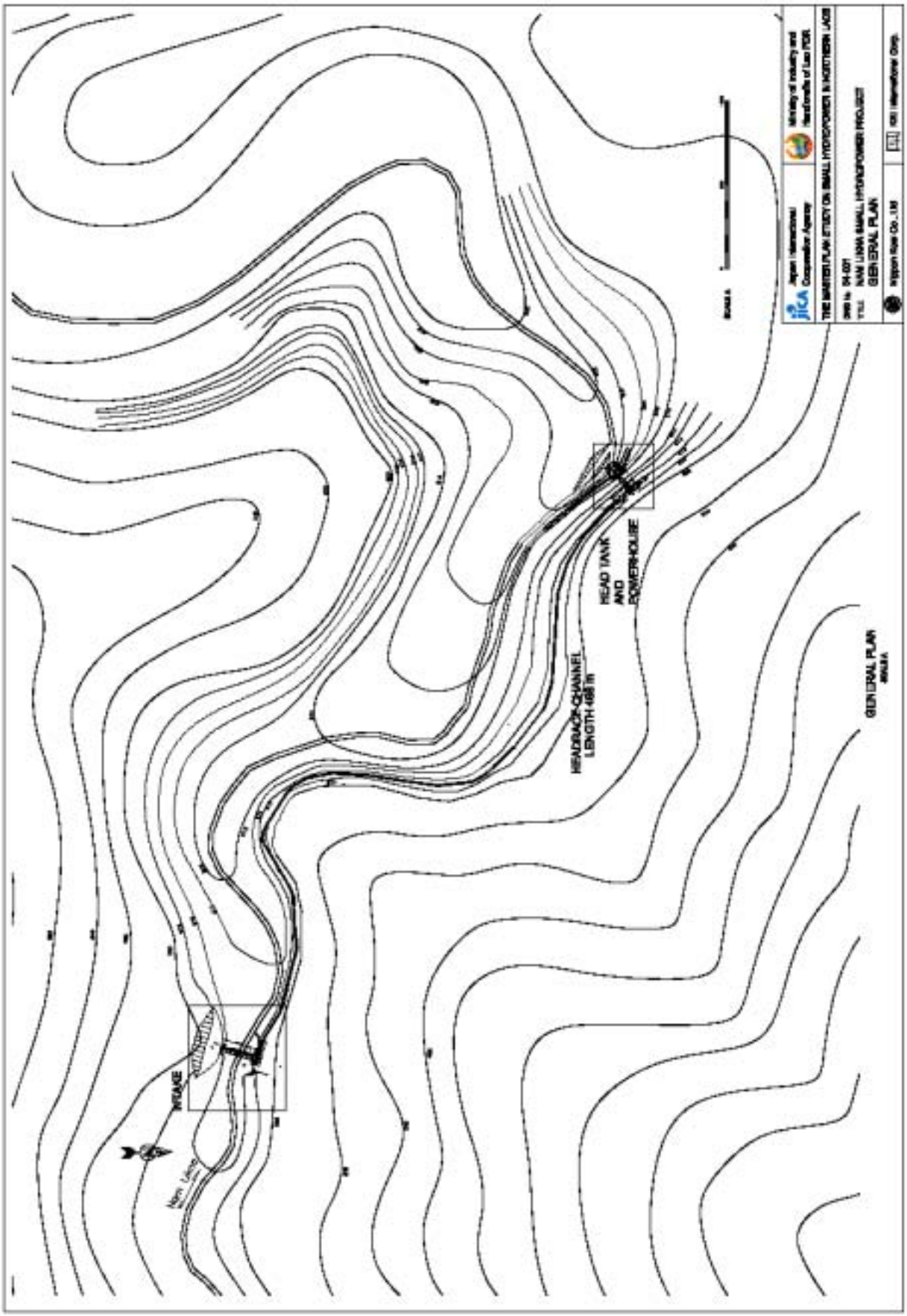
B. Construction Cost

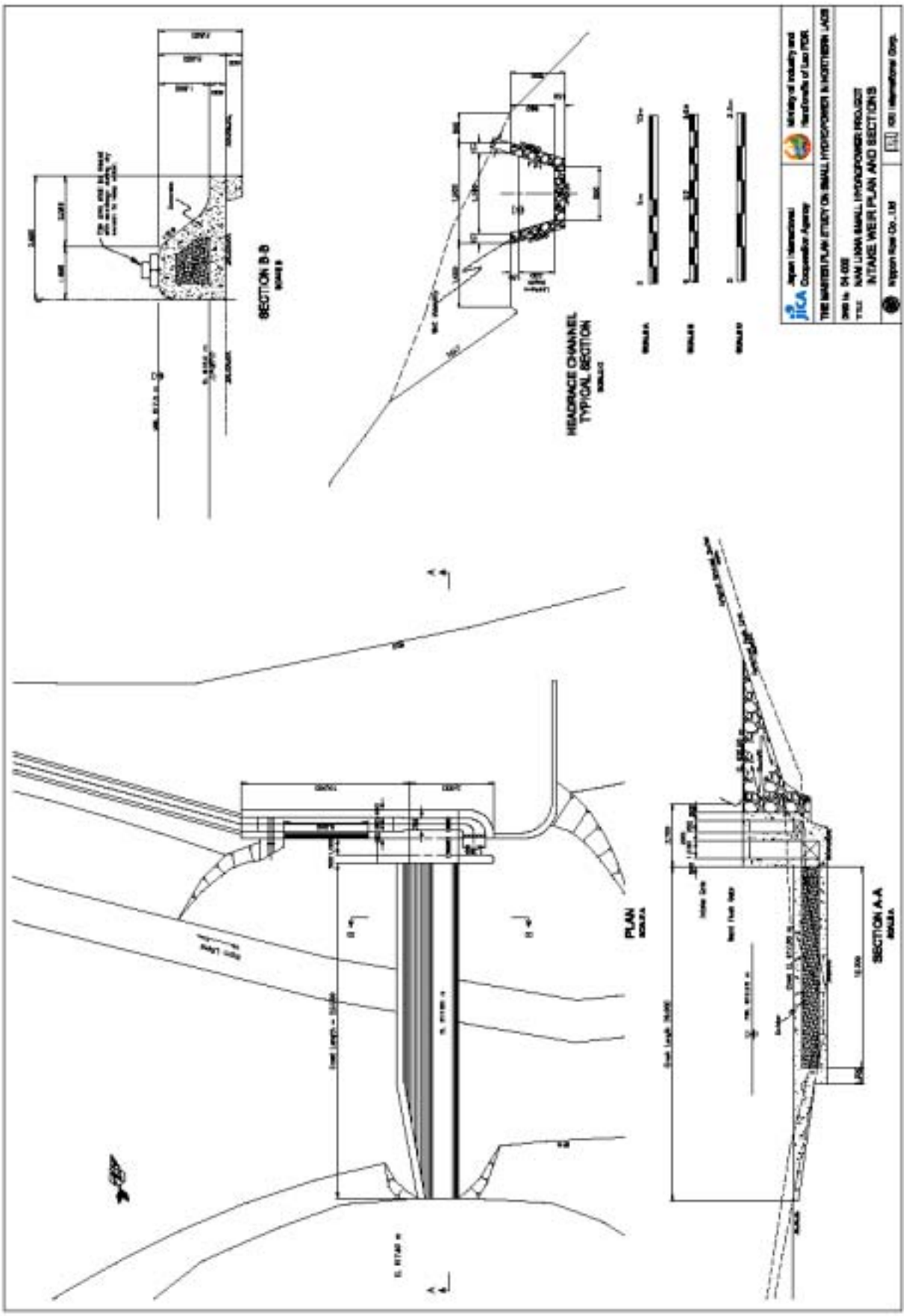
Items	Cost
1.Civil Works	
1.1 Intake	US$ 30,853
1.2 Desilting Basin	US$ 14,786
1.3 Headrace Channel	US$ 15,574
1.4 Head Tank	US$ 2,992
1.5 Penstock	US$ 789
1.6 Powerhouse	US$ 2,838
1.7 Tailrace	US$ 32
1.8 Access Road	US$ 5,000
1.9 Miscellaneous (20% of 1.1~1.11)	US$ 14,547
Total of Civil Works	***US$ 87,437***

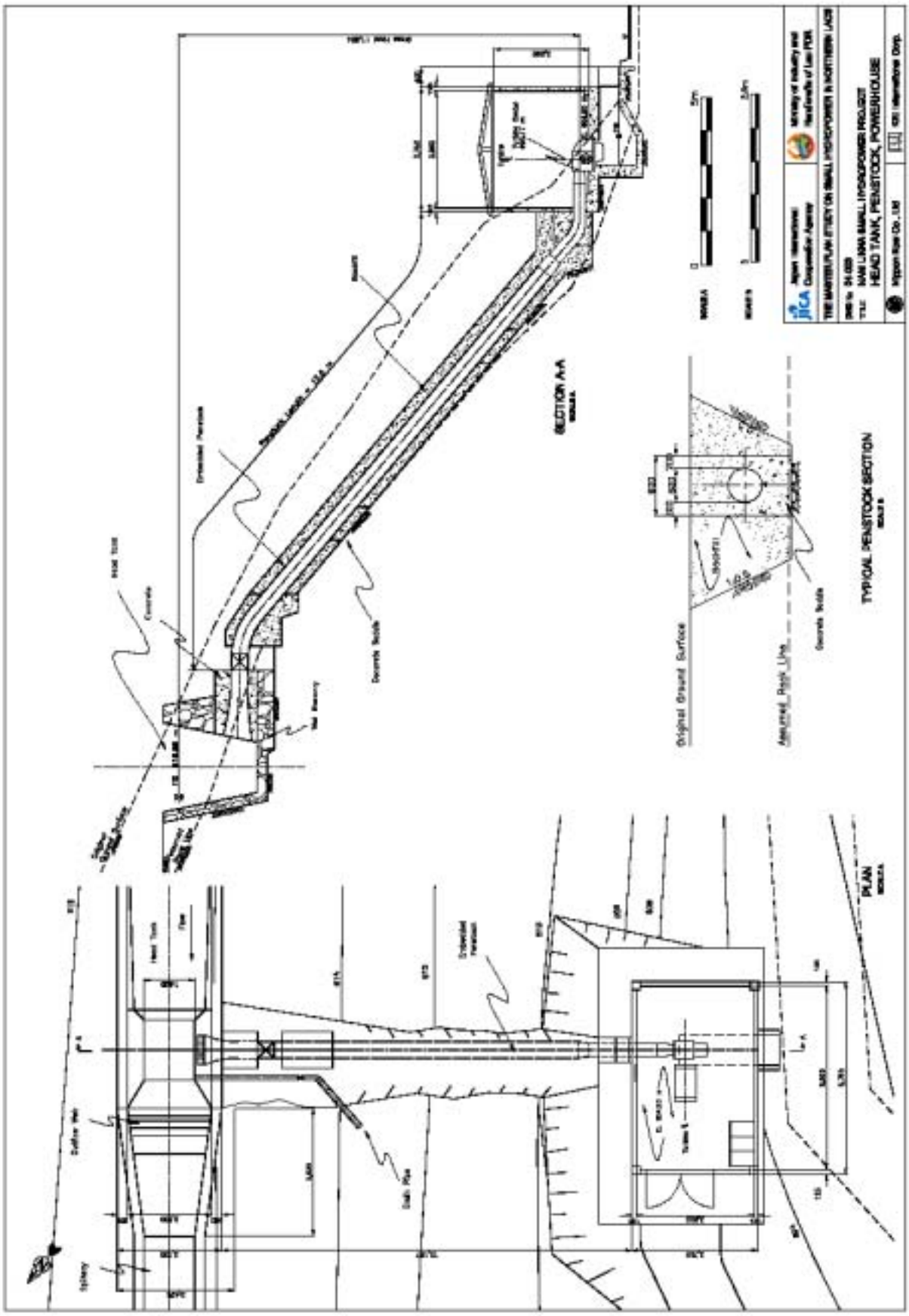
Items	Cost
2.Steel Penstock	US$ 3,461
3.Gate & Trashracks	US$ 5,850
4.Turbine & Generator	US$ 70,057
5. Transformer & Switchgear	US$ 10,483
6. Transmission Line	US$ 12,000
7.E&M Miscellaneous (10% of 2~6)	US$ 8,985
Total of E&M Works	*US$ 110,836*
GRAND TOTAL	***US$ 198,273***

C. Economic Analysis

1.Unit Construction Cost	US$ 6,609 kW				
2.Unit Generation Cost	UScent /kWh				
3.Economic Analysis	Project Life	n/a years	Discount Rate	n/a%	O&M	n/a % of construction
	Replace	n/a years			EIRR	n/a %


INTAKE
HEADRACE CHANNEL
LENGTH 488 m
HEAD TANK
AND
POWERHOUSE
GENERAL PLAN
THE MASTER PLAN STUDY ON SMALL HYDROPOWER IN NORTHERN LAOS
NAM LIKHA SMALL HYDROPOWER PROJECT
GENERAL PLAN


SECTION B-B
HEADRACE CHANNEL
TYPICAL SECTION
PLAN
SECTION A-A
Japan International Cooperation Agency
Ministry of Industry and Handicrafts of Lao PDR
THE MASTER PLAN STUDY ON SMALL HYDROPOWER IN NORTHERN LAOS
NAM LIKHA SMALL HYDROPOWER PROJECT
INTAKE WEIR PLAN AND SECTIONS
Nippon Koei Co., Ltd.
KRI International Corp.


SECTION A-A
TYPICAL PENSTOCK SECTION
PLAN
HEAD TANK, PENSTOCK, POWERHOUSE
Original Ground Surface
Concrete Solids

2. Nam Ou Neua (Sequence No. 5)

A. Salient Features

1.General	Province	Phongsaly		District	Gnod Ou	
	Electr. Status	Electrified by diesel genset				
2.Demand	Load Center	Ou Tai (District Center) and Ou Neua		H/H Number	1,239	
	Peak Load	259 kW		Peak Hours	4 hours	
3.Hydrology	River	Nam Ou		Basin	Nam Ou	CA 593 km^2
	Rainfall	1,750 mm		Q_{ave}	14.23 m^3/s	$Q_{95\%}$ 3.60 m^3/s
4.Structures						
4.1 Intake	Type	Gabion-core concrete facing		Height	4.0 m	Length 28.0 m
				FSL	753.0 m	FWL 759.26 m
4.2 Desilting Basin	Length	18.5 m	Width 2.5 m	Side Spillway Length	12 m	
4.3 Headrace Channel	Shape	Trapezoidal (1:0.5)		Lining	Wet Masonry	Length 3,102 m
	Uniform Depth	1.04 m		Base	1.3 m	
4.4 Head Tank	Regulating Capacity	(None) m^3		NWL	750.77 m	MOL 748.27 m
4.5 Penstock	Type	Exposed		Dia.	0.9 m	Length 102.3 m
4.6 Powerhouse	Type	Surface	EL 490.94 m	Turbine	Cross-Flow	Units 1 nos
5.Power and Energy	Q_{design}	1.87 m^3/s	H_{net} 20 m	Installed Capacity	259 kW	
	Energy	1,140,456 kWh/yr		P.F.	50%	
6.Access Road	Length	1.0 km				
7.Transmission Line	Capacity	22 kV		Length	40 km	
	Loss	10.0%		Energy Delivered.	1,026,410 kWh/yr	

B. Construction Cost

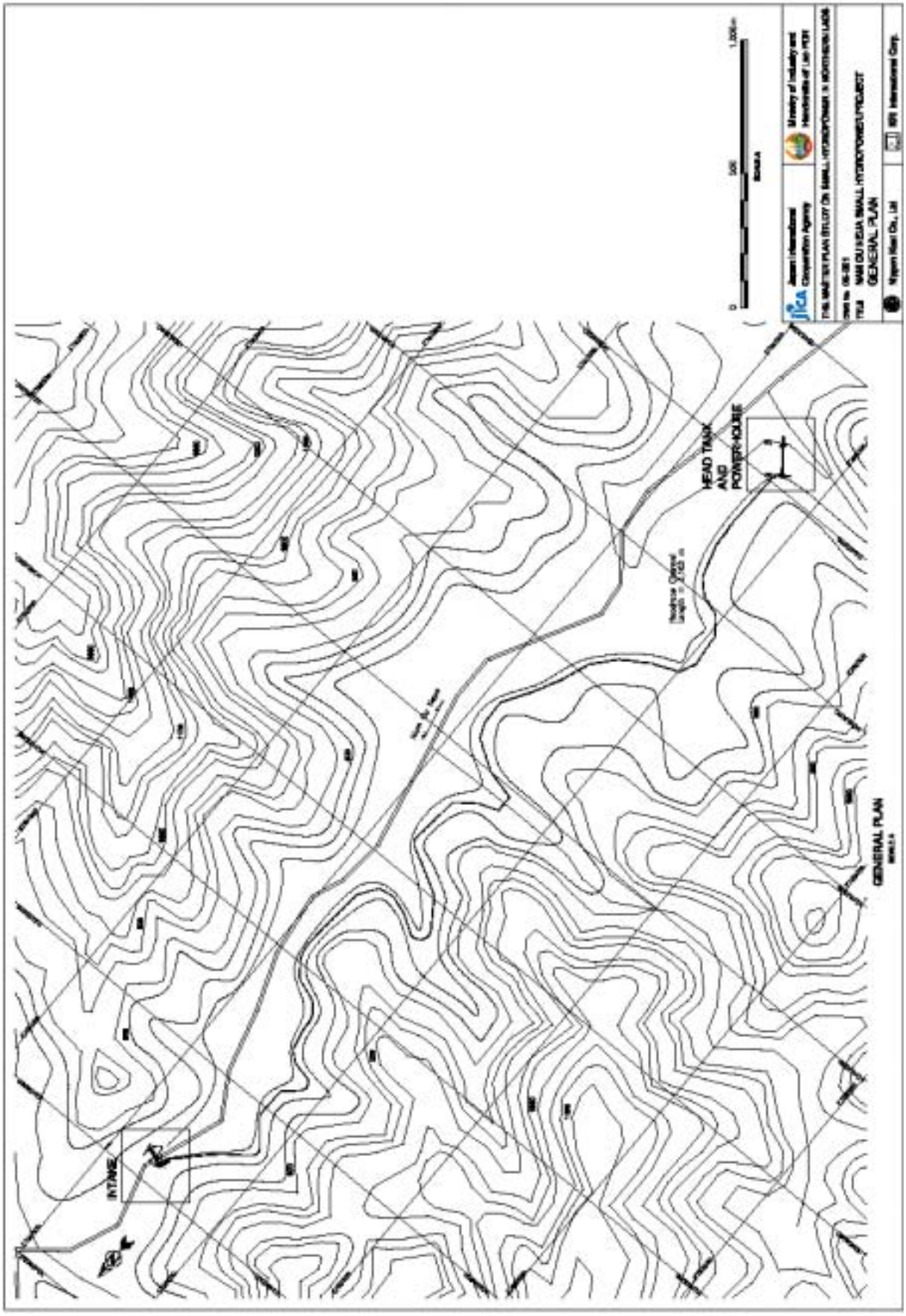
Items	Cost
1.Civil Works	
1.1 Intake	US$ 168,329
1.2 Desilting Basin	US$ 109,825
1.3 Headrace Channel	US$ 364,930
1.4 Head Tank	US$ 37,016
1.5 Spillway Channel	US$ 2,277
1.6 Penstock	US$ 8,038
1.7 Powerhouse	US$ 19,897
1.8 Tailrace	US$2,015
1.9 Access Road	US$ 10,000
1.10 Miscellaneous (20% of 1.1~1.9)	US$ 144,465
Total of Civil Works	***US$ 866,792***
2.Steel Penstock	US$ 47,984

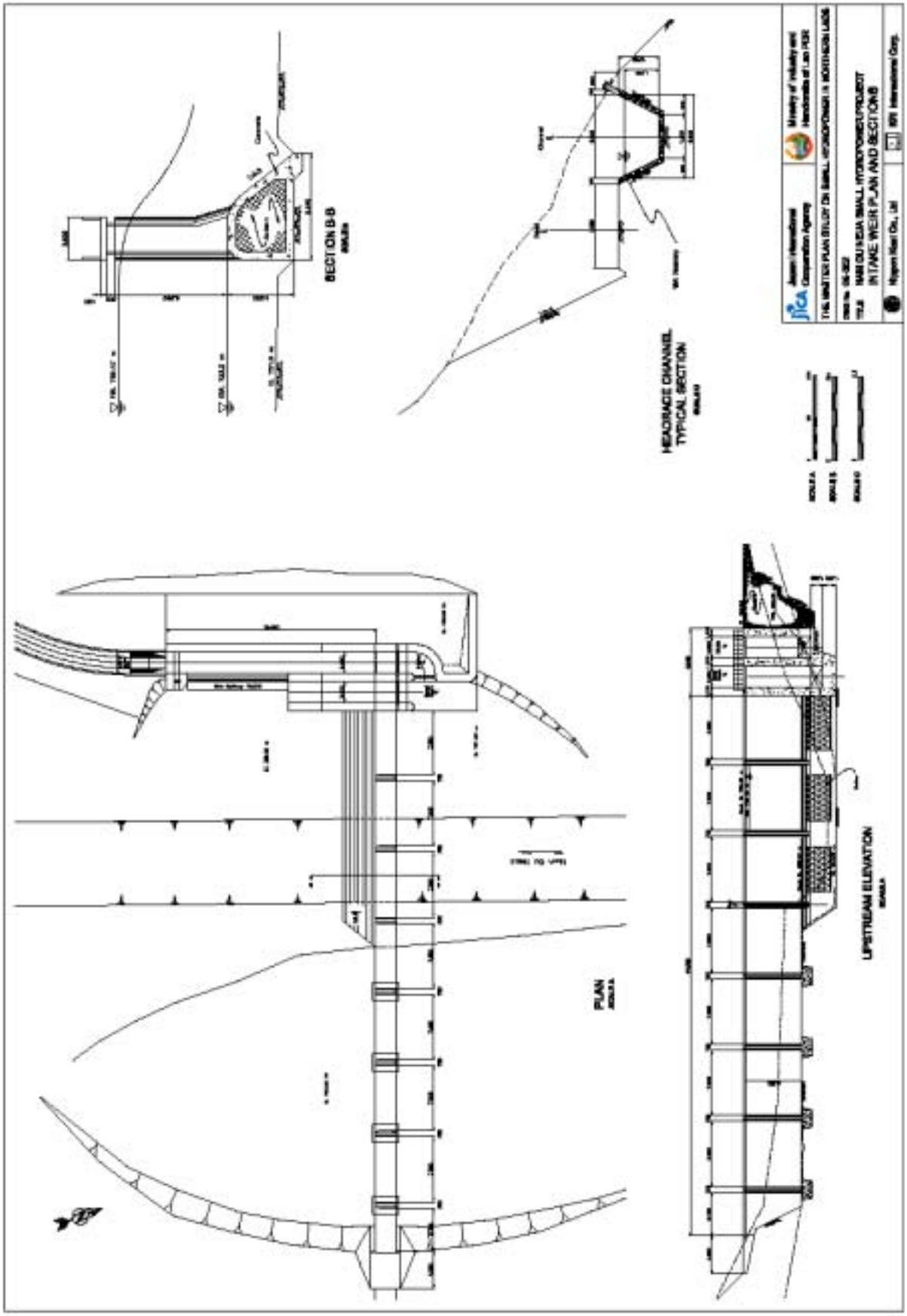
Items	Cost
3.Gate & Trashracks	US$ 9,999
4.Turbine & Generator	US$ 123,016
5.Transformer& Switchgear	US$ 18,408
6.Transmission Line	US$ 501,727
7.E&M Miscellaneous (10% of 2~5)	US$ 19,941
Total of E&M Works	***US$ 721,075***
GRAND TOTAL	***US$ 1,587,867***

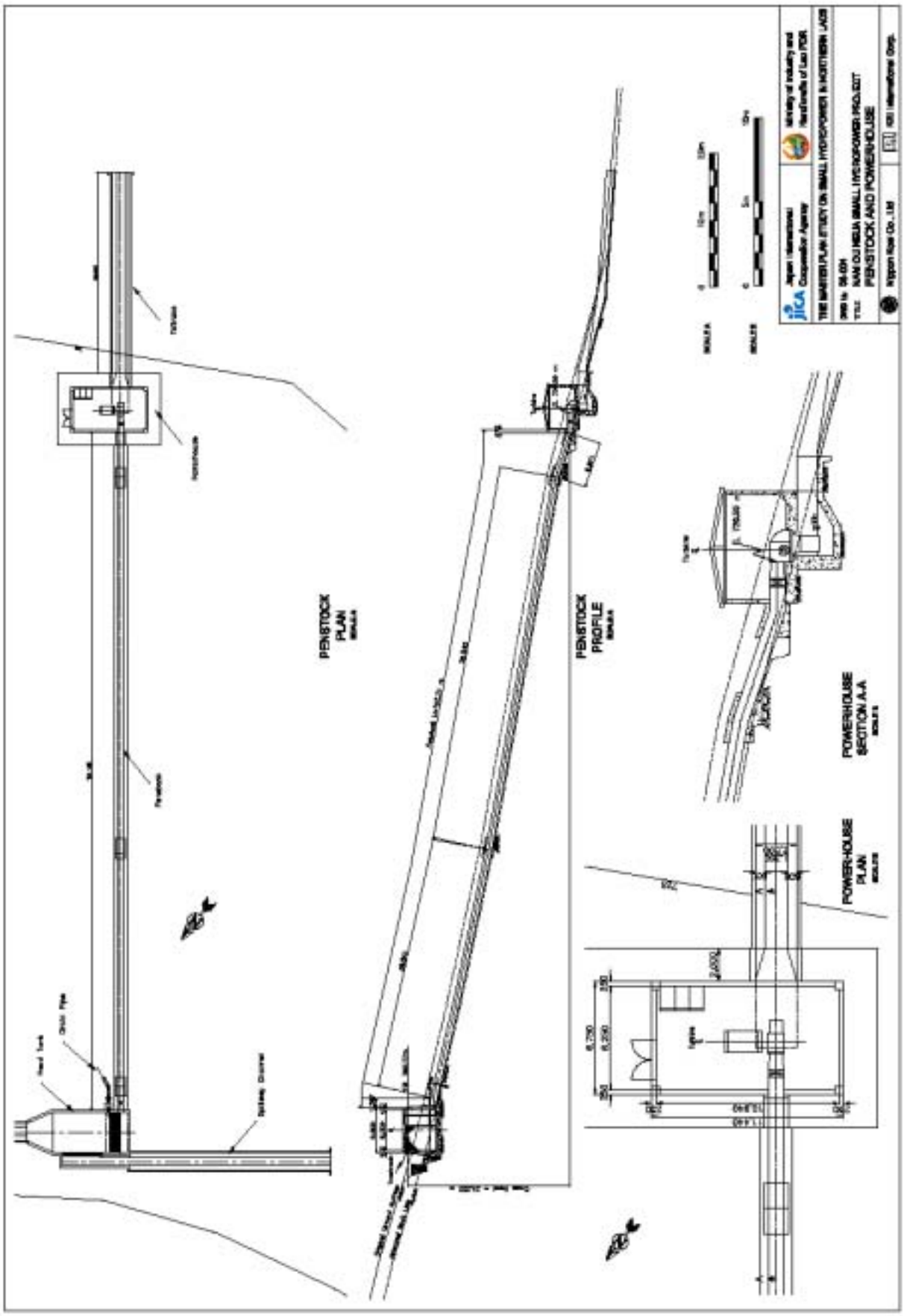
C. Economic Analysis

1.Unit Construction Cost	US$ 6,107 / kW				
2.Unit Generation Cost	UScent / kWh				
3.Economic Analysis	Project Life	n/a years	Discount Rate n/a%	O&M	n/a % of construction
	Replace	n/a years		EIRR	n/a %

D. Remarks


HEAD TANK
AND
POWERHOUSE
INTAKE
GENERAL PLAN


SECTION B-B
HEADRACE CHANNEL
TYPICAL SECTION
PLAN
UPSTREAM ELEVATION
INTAKE WEIR PLAN AND SECTION


PENSTOCK PLAN
PENSTOCK PROFILE
POWERHOUSE SECTION A-A
POWER-HOUSE PLAN

3. Nam Long (Sequence No. 7)

A. Salient Features

1.General	Province	Luangnamtha			District	Long	
	Electr. Status	Diesel Power Generator (30kW) operated by District					
2.Demand	Load Center	Grid 22kV(to be extended by 2008)			H/H Number	-	
	Peak Load	-			Peak Hours	-	
3.Hydrology	River	N. Long		Basin	Nam Long	CA	156 km^2
	Rainfall	1,730 mm		Q_{ave}	2.80 m^3/s	$Q_{95\%}$	0.43 m^3/s
4.Structures							
4.1 Intake	Type	Concrete weir		Height	3.7 m	Length	50 m
				FSL	1014.70 m	FWL	1019.36 m
4.2 Desilting Basin	Length	26.4 m	Width 2.50 m	Side Spillway Length		12.0 m	
4.3 Headrace Channel	Shape	Rectangle		Lining	Concrete	Length	4,220 m
	Uniform Depth	0.77 m		Base	1.60 m		
4.4 Head Tank	Regulating Capacity	162.0 m^3		NWL	1,010.178m	MOL	1,009.27m
4.5 Penstock	Type	Exposed		Dia.	0.80 m	Length	420.60 m
4.6 Powerhouse	Type	Surface	EL 765.70 m	Turbine	Francis (H)	Units	2 nos
5.Power and Energy	Q_{design}	1.35 m^3/s	H_{net} 238 m	Installed Capacity		2,500 kW	
	Energy	16,782,480 kWh/yr		P.F.	76.4 %		
6.Access Road	Length	7 km					
7.Transmission Line	Capacity	22 kV	Length 15 km	Loss	9.0%	Energy Delivered	15,269,367 kWh

B. Construction Cost

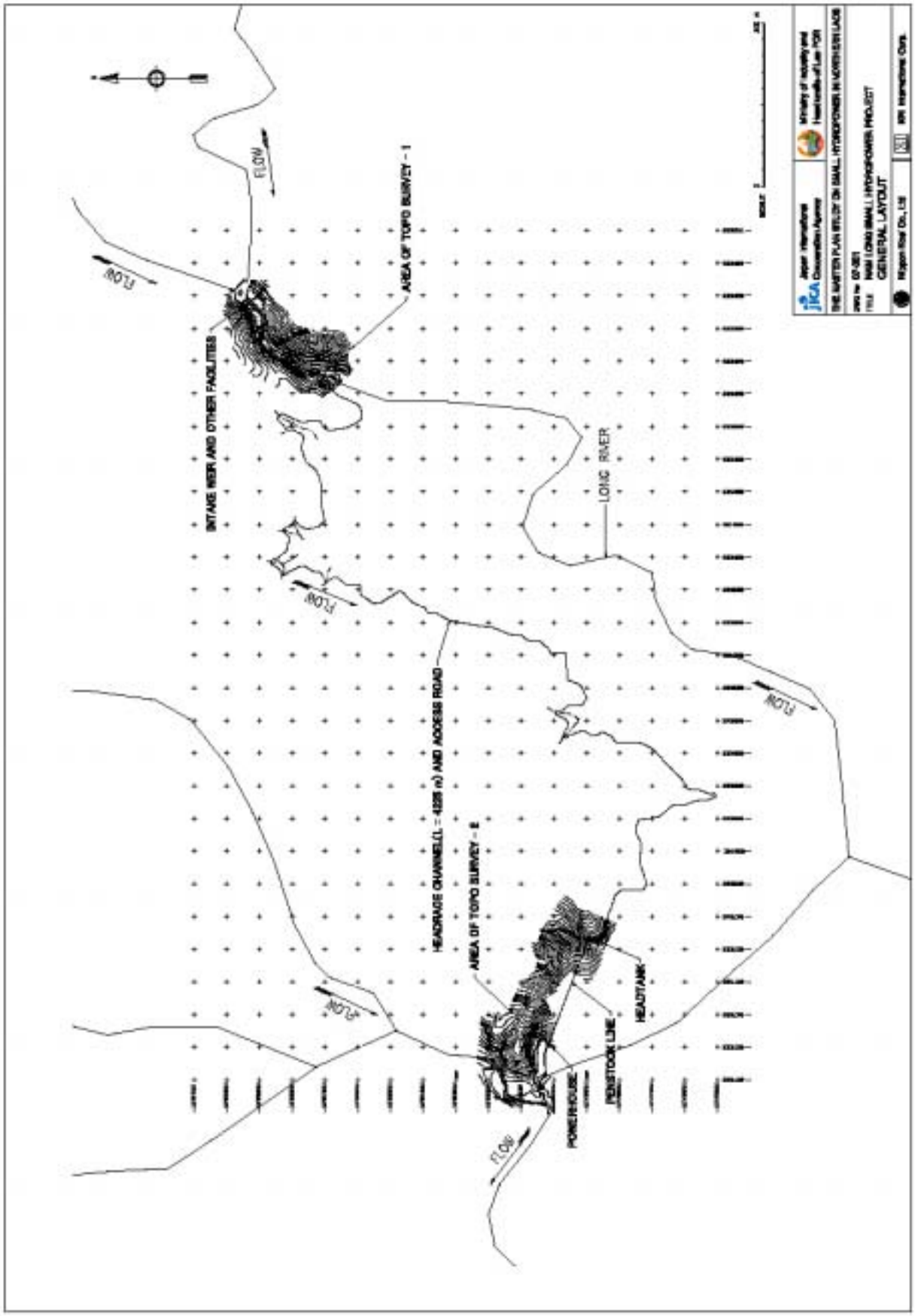
Items	Cost
1.Civil Works	
1.1 Intake	US$ 392,385
1.2 Desilting Basin	US$ 48,400
1.3 Headrace Channel	US$ 1,190,200
1.4 Head Tank	US$ 33,950
1.5 Spillway Channel	US$ 6,600
1.6 Penstock	US$ 108,140
1.7 Powerhouse	US$ 91,960
1.8 Tailrace	US$ 13,340
1.9 Access Road	US$ 70,000
1.10 Miscellaneous (20% of 1.1~1.9)	US$ 390,995
Total of Civil Works	***US$ 2,345,970***
2.Steel Penstock	US$ 270,000

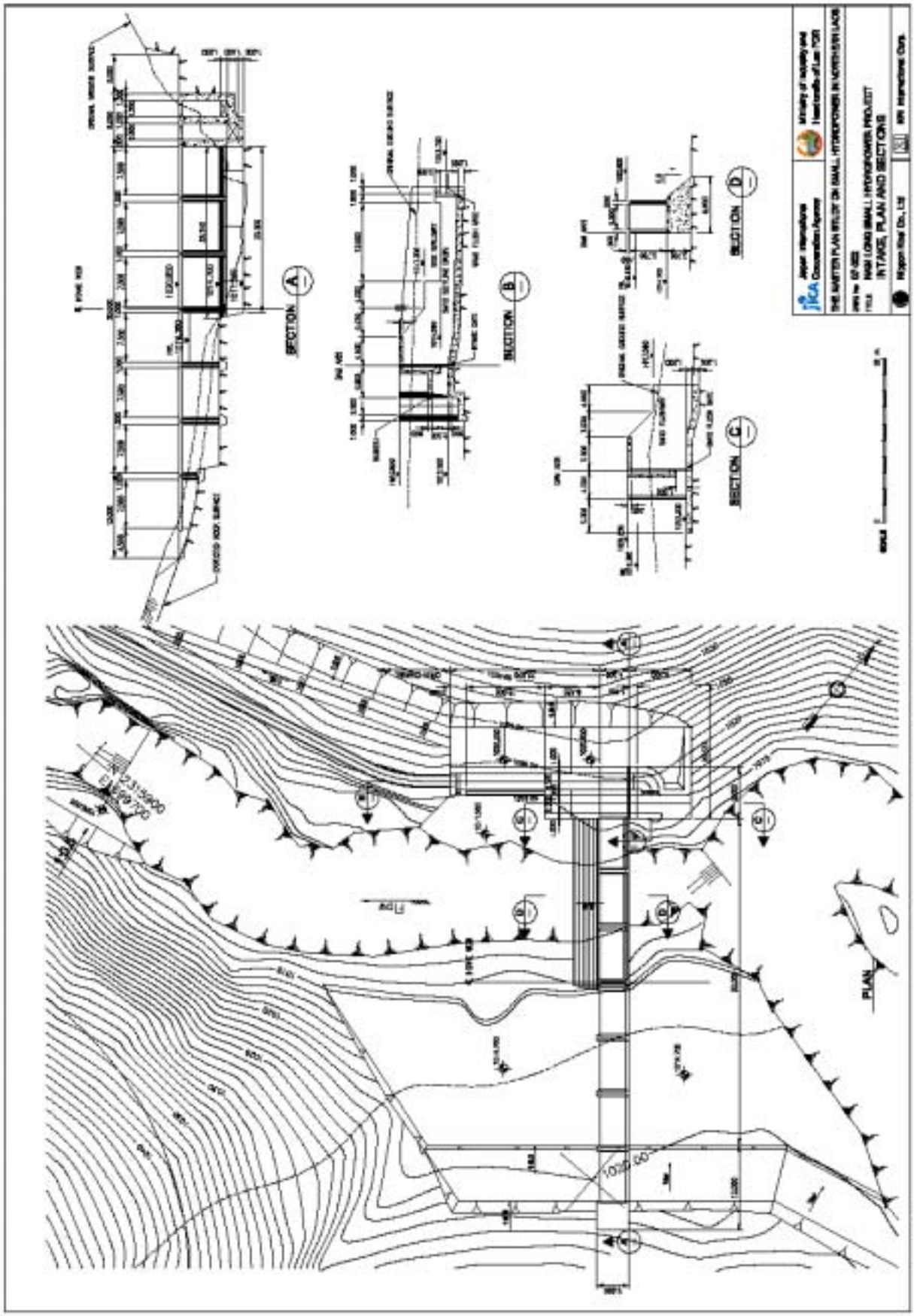
Items	Cost
3.Gate & Trashracks	US$ 10,500
4.Turbine & Generator	US$ 273,769
5.Transformer & Switchgear	US$ 169,397
6.Transmission Line	US$ 373,000
7.E&M Miscellaneous (10% of 2~5)	US$ 72,367
Total of E&M Works	***US$ 1,169,033***
GRAND TOTAL	***US$ 3,515,003***

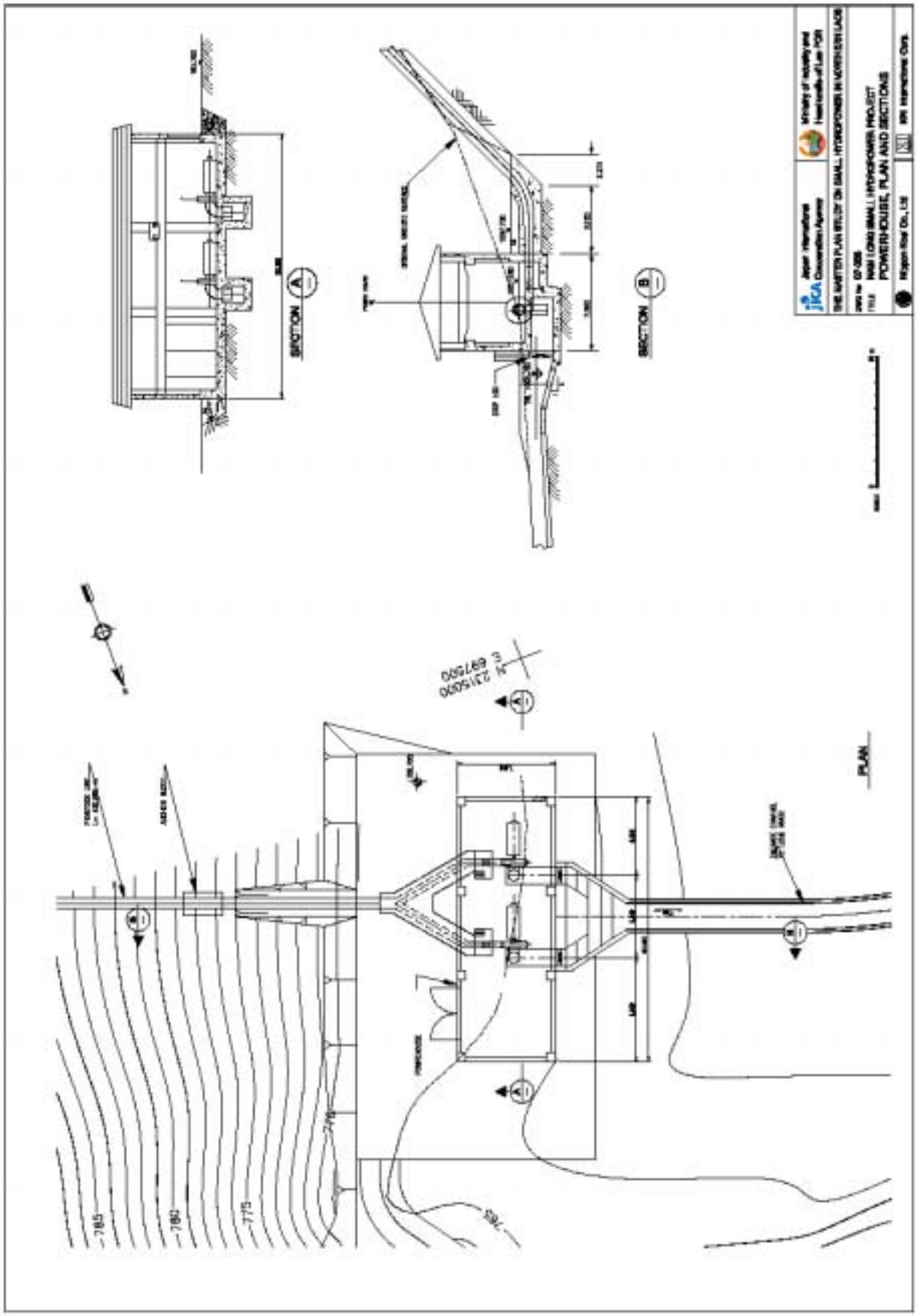
C. Economic Analysis

1.Unit Construction Cost	US$ 1,406 /kW			
2.Unit Generation Cost	UScent /kWh			
3.Economic Analysis	Project Life n/a years	Discount Rate n/a%	O&M	n/a % of construction
	Replace n/a years		EIRR	n/a %

D. Remarks


FLOW
AREA OF TOPO SURVEY - I
INTAKE WEIR AND OTHER FACILITIES
LONG RIVER
HEADRACE CHANNEL(L = 4235 m) AND ACCESS ROAD
AREA OF TOPO SURVEY - II
HEADTANK
PENSTOCK LINE
POWERHOUSE
GENERAL LAYOUT


SECTION A
SECTION B
SECTION C
SECTION D
PLAN


SECTION A
SECTION B
PLAN
POWERHOUSE, PLAN AND SECTIONS

4. Nam Ham 2 (Sequence No. 31)

A. Salient Features

1.General	Province	Xayabury			District	Boten
	Electr. Status	Imported power from Thailand				
2.Demand	Load Center	Grid			H/H Number	-
	Peak Load	-			Peak Hours	13 hours
2.Hydrology	River	Nam Ham		Basin	Nam Ham	CA 97 km^2
	Rainfall	1,350 mm		Q_{ave}	1.36 m^3/s	$Q_{95\%}$ 0.21 m^3/s
3.Structures						
3.1 Intake	Type	Gabion-core Concrete-facing		Height	5.0 m	Length 40.0 m
				FSL	541.00 m	FWL 545.48 m
3.2 Desilting Basin	Length	17 m	Width 2.4 m	Side Spillway Length		12.0 m
3.3 Headrace Channel	Shape	Trapezoidal (1:0.2)		Lining	Wet Masonry	Length 2,840 m
	Uniform Depth	0.74 m		Base	1.2 m	
3.4 Head Tank	Regulating Capacity	90 m^3		NWL	538.82 m	MOL 537.37 m
3.5 Penstock	Type	Exposed		Dia.	0.6 m	Length 649 m
3.6 Powerhouse	Type	Surface	EL 361.3m	Turbine		Units 2 nos
4.Power and Energy	Q_{design}	0.78 m^3/s	H_{net} 170 m	Installed Capacity		1,000 kW
	Energy	6,299,304 kWh/yr		P.F.	72.6%	
5.Access Road	Length	5 km				
6.Transmission Line	Capacity	22 kV	Length 6 km	Loss	8%	Energy Delivered 5,793,564 kWh/yr

B. Construction Cost

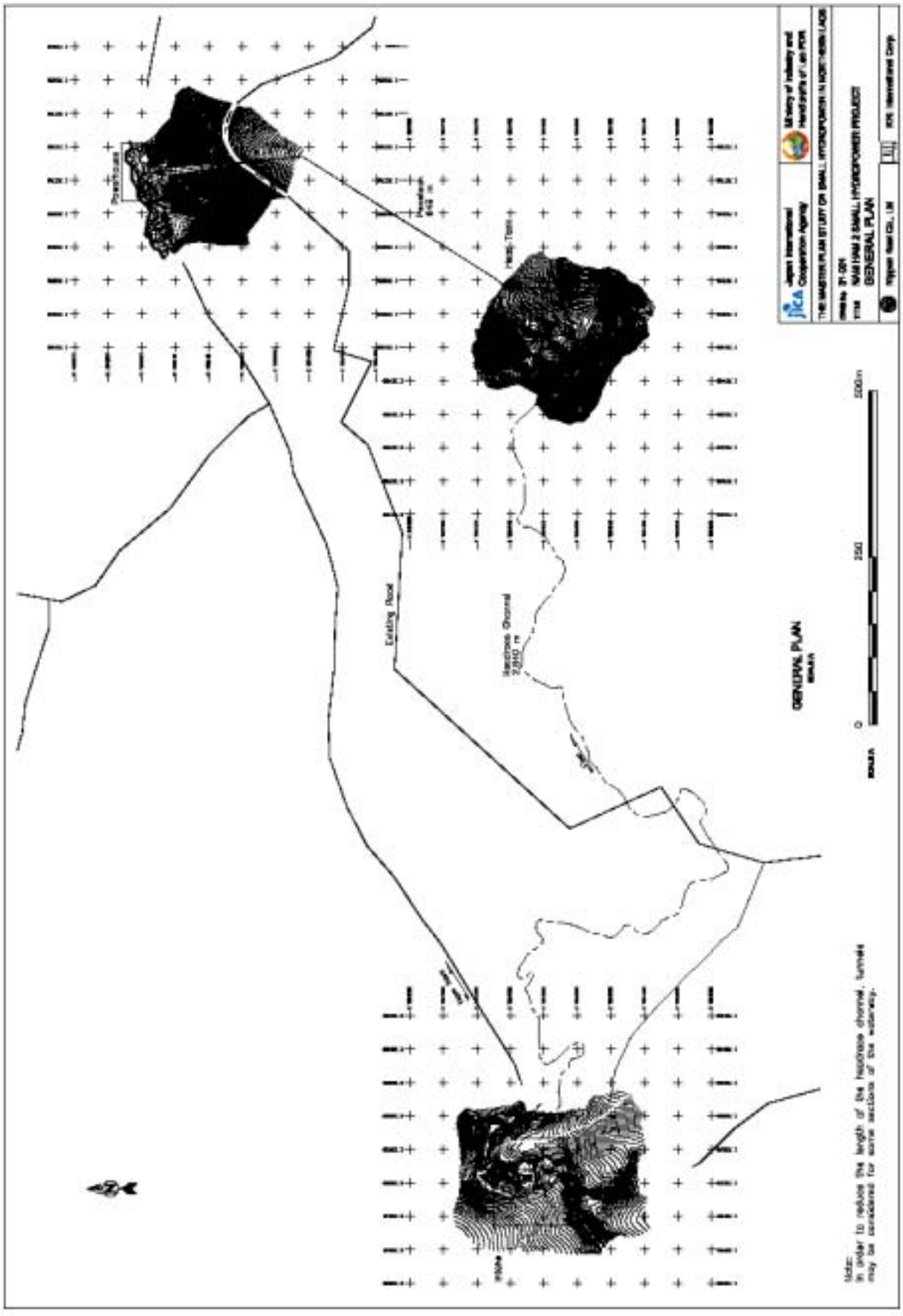
Items	Cost
1.Civil Works	
1.1 Intake	US$ 422,470
1.2 Desilting Basin	US$ 8,303
1.3 Headrace Channel	US$ 439,920
1.4 Head Tank	US$ 24,249
1.5 Spillway Channel	US$ 0
1.6 Penstock	US$ 31,715
1.7 Powerhouse	US$ 47,553
1.8 Tailrace	US$ 563
1.9 Access Road	US$ 50,000
1.10 Miscellaneous (20% of 1.1~1.9)	US$ 204,955
Total of Civil Works	***US$ 1,229,729***
2.Steel Penstock	US$ 234,947

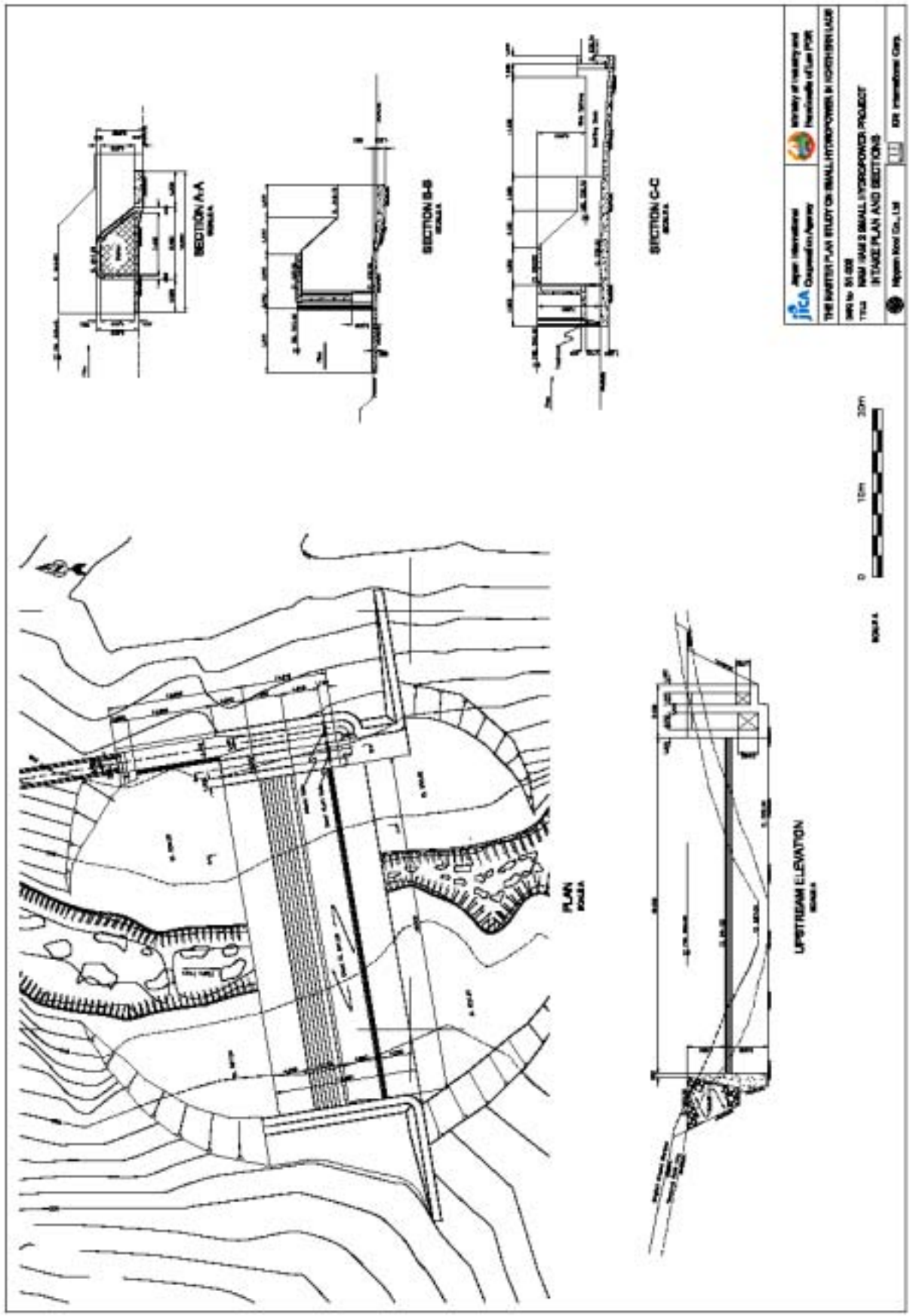
Items	Cost
3.Gate & Trashracks	US$ 2,891
4.Turbine & Generator	US$ 177,546
5.Transformer & Switchgear	US$ 142,319
6.Transmission Line	US$ 45,622
7.E&M Miscellaneous (10% of 2~6)	US$ 55,770
Total of E&M Works	***US$ 659,095***
GRAND TOTAL	***US$ 1,888,824***

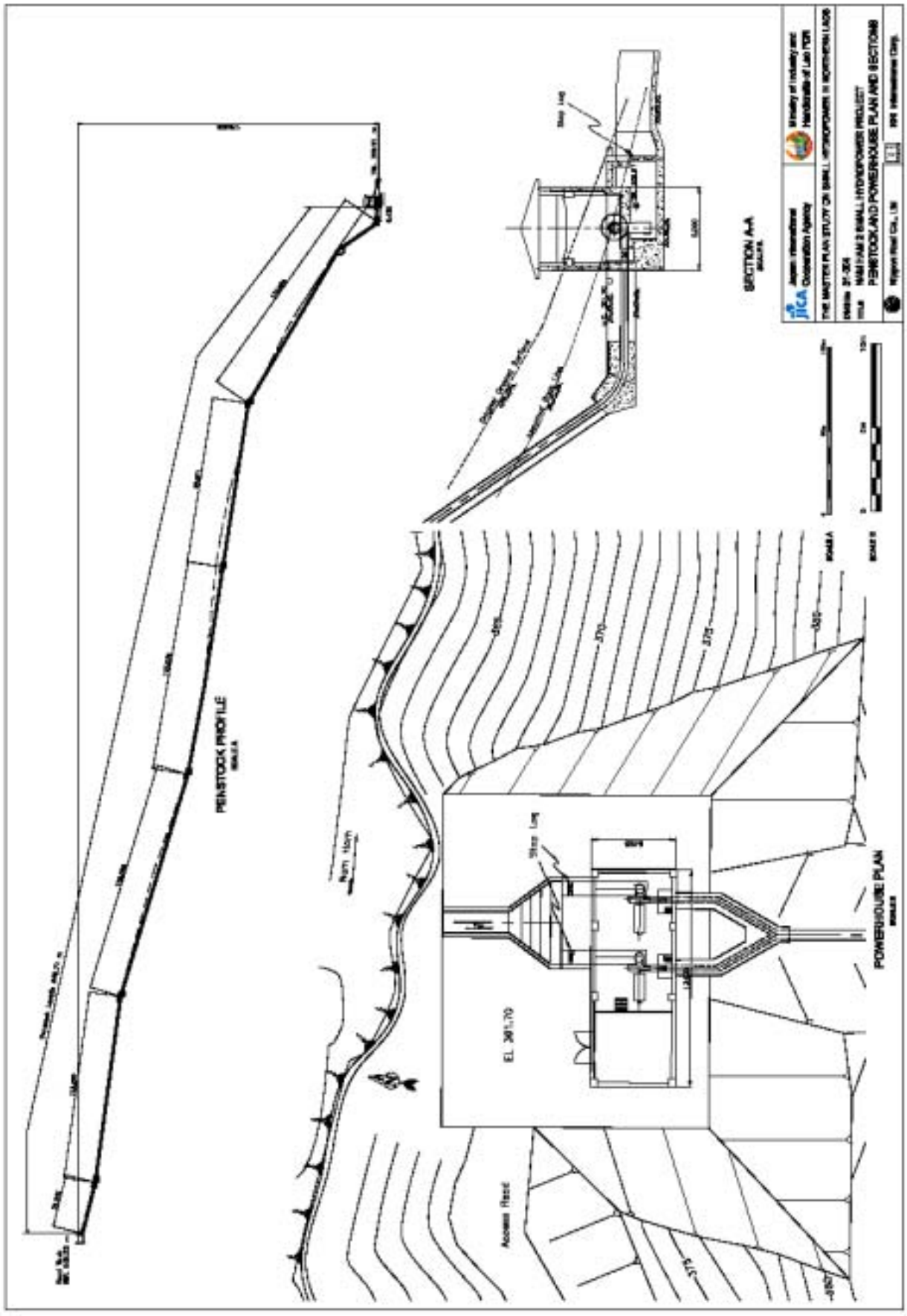
C. Economic Analysis

1.Unit Construction Cost	US$ 1,889 /kW			
2.Unit Generation Cost	UScent/kWh			
3.Economic Analysis	Project Life n/a years	Discount Rate n/a%	O&M	n/a % of construction
	Replace n/a years		EIRR	n/a %

D. Remarks


Powerhouse
Head Tank
Existing Road
Headrace Channel
3,810 m
GENERAL PLAN
0
250
500m
Japan International Cooperation Agency
Ministry of Industry and Handicrafts of Lao PDR
THE MASTER PLAN STUDY ON SMALL HYDROPOWER IN NORTHERN LAOS
IWAFUNA 2 SMALL HYDROPOWER PROJECT
GENERAL PLAN
Nippon Koei Co., Ltd.
KRI International Corp.
Note:
In order to reduce the length of the headrace channel, tunnels may be considered for some sections of the waterway.


SECTION A-A
SECTION B-B
SECTION C-C
PLAN
UPSTREAM ELEVATION
JICA
Japan International Cooperation Agency
Ministry of Industry and Handicrafts of Lao PDR
THE MASTER PLAN STUDY ON SMALL HYDROPOWER IN NORTHERN LAOS
NAM HAM 3 SMALL HYDROPOWER PROJECT
INTAKE PLAN AND SECTIONS
Nippon Koei Co., Ltd
KRI International Corp.
0
10m
20m


PENSTOCK PROFILE
SECTION A-A
POWERHOUSE PLAN
Access Road