Phona HPP

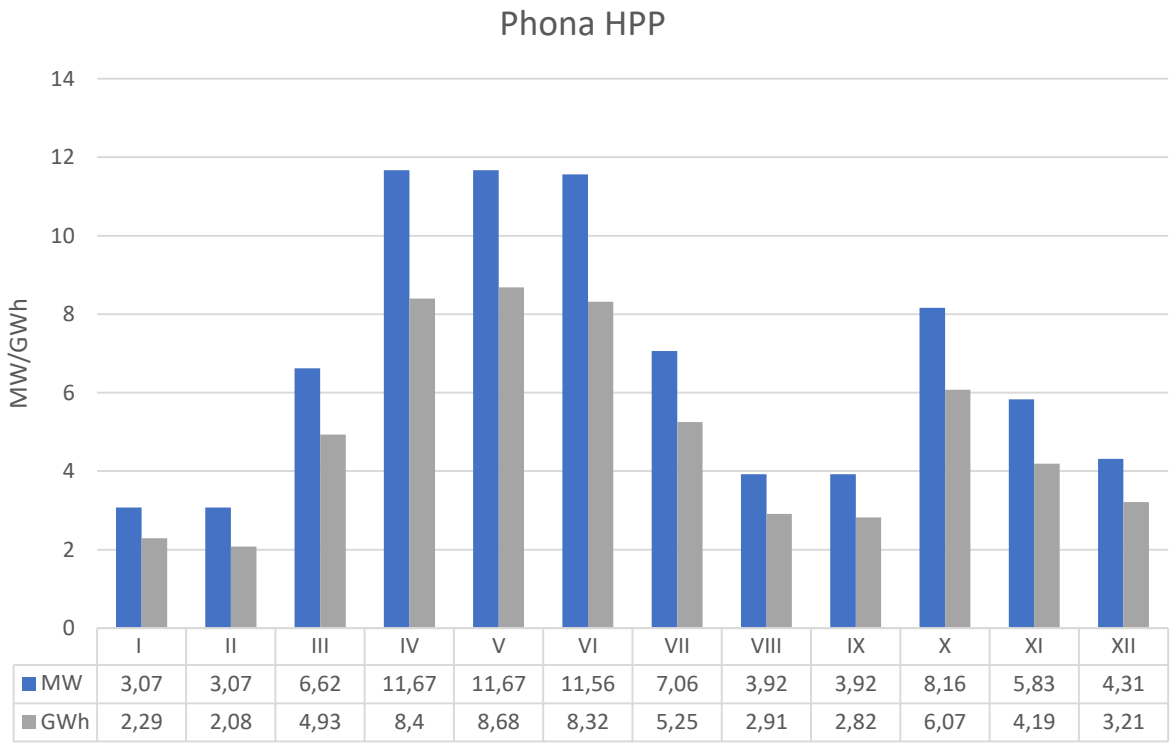
MOU Conditions

- The initial MOU has been signed between the Government of Georgia and Hereti Energy LLC in January 20, 2017. The MOU extension process is ongoing.
- Elevations defined in the MOU:
  - Phona HPP on the River Kabali – 505.0-312.0 m.a.s.l.

Key Technical Parameters

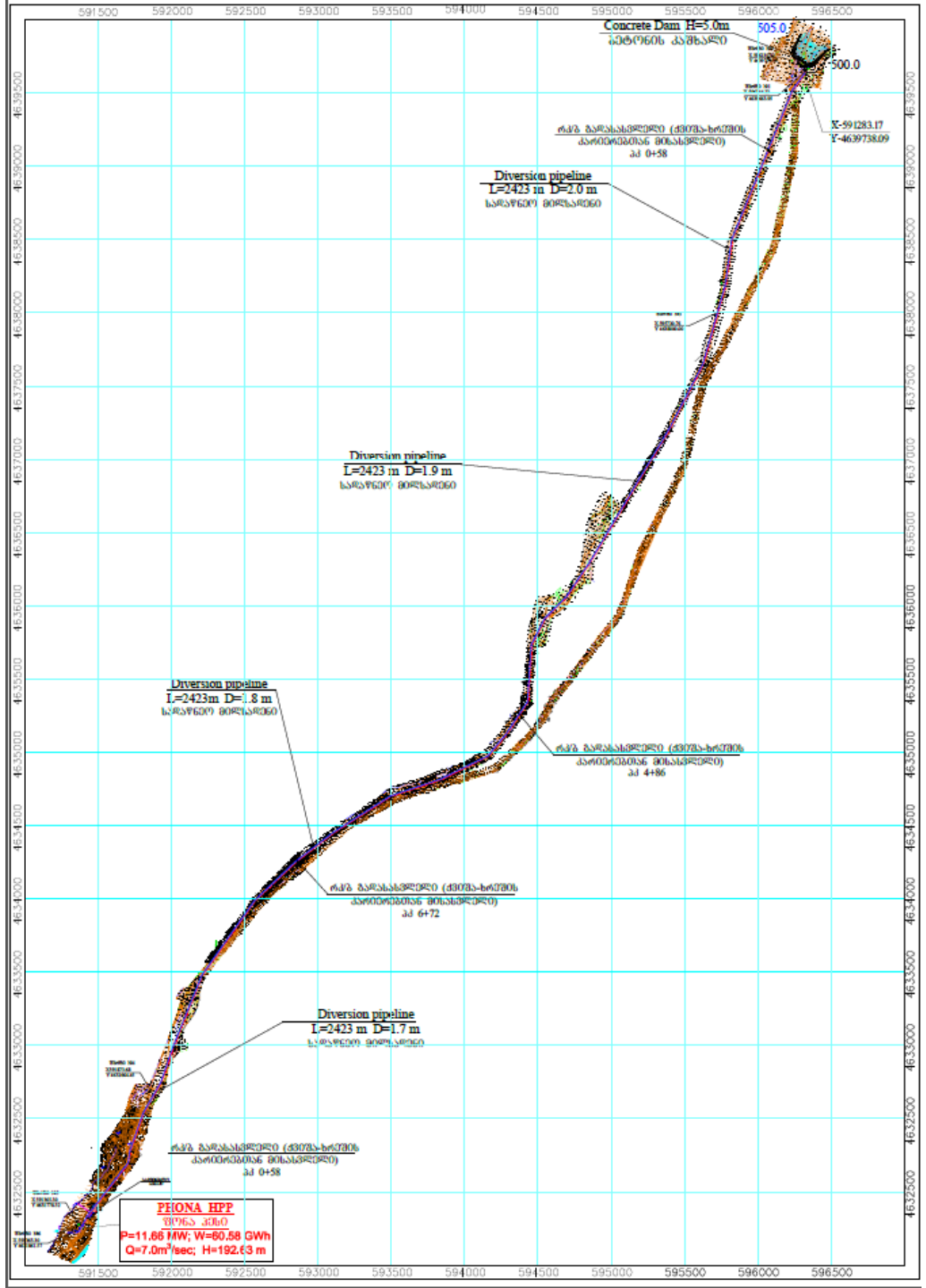
- Installed Capacity – 11.66 MW
- Average annual generation – 60.58 GWh
- Regulation Type – Run-off-the-river
- Average water discharge – 7.0 m^3/sec
- Head - 192.63 m
- Dam Height – 5.0 m
- Diversion Type - Pipeline
- Diversion details – Pipeline – D=1.7m; 1.8m; 1.9m; 2.2m; L=9692.0 (2423; 2423; 2423, 2423) m

Generation at 50% provision



	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
MW	3,07	3,07	6,62	11,67	11,67	11,56	7,06	3,92	3,92	8,16	5,83	4,31
GWh	2,29	2,08	4,93	8,4	8,68	8,32	5,25	2,91	2,82	6,07	4,19	3,21

Phona HPP Scheme



Key Technical Parameters

NAME OF THE HPP – PHONA HPP	UNIT	DIMENSION
INSTALLED CAPACITY	11.66	MW
AVERAGE ANNUAL GENERATION	60.58	GW/h
CAPACITY USAGE RATIO	59.29	%
DESIGN WATER DISCHARGE	7	m^3/sec
MAXIMUM HEAD	209.28	m
MINIMUM HEAD	205.35	m
TRANSMISSION LINE TYPE (220,110,35)	35	kV
TRANSMISSION LINE LENGTH	5	km
HYDROLOGICAL DATA		
WATER CATCHMENT AREA	119.31	km^2
AVERAGE FLOW	5.68	m^3/sec
FLOOD ONCE IN 10 YEARS (FLOW)	974	m^3/sec
FLOOD ONCE IN 100 YEARS (FLOW)	285.5	m^3/sec
FLOOD ONCE IN 1000 YEARS (FLOW)	405.9	m^3/sec
SEISMICITY		
PEAK GROUND ACCELERATION (5%)	0.3-04	PGA
PEAK GROUND ACCELERATION (2%)	0.4-05	PGA
PEAK GROUND ACCELERATION (1%)	0.5-06	PGA

Key Technical Parameters

RESERVOIR		
NORMAL SUPPLY LEVEL (NSL)	505.00	NSL
SPILLWAY		
TYPE	-	
SPILLWAY CREST ELEVATION	505.00	m.a.s.l
FLOOD (FLOW) 5%	132	m^3/sec
RESERVOIR ELEVATION IN RELATIONS WITH 5% PROVISION	806.21	m.a.s.l
SPILLWAY LEVEL AT PMF, M.A.S.L.	107.3	m^3/sec
WATER INTAKE		
CREST ELEVATION	505.00	m.a.s.l
TYPE AND NUMBER OF INTAKE GATES	1	
GATE DIMENSIONS (W X H)	2.4x1.65	m
DE-SANDER DIMENSIONS (W X H)	4.0x5.15	m
SLUICE		
TYPE AND NUMBER	1	
DIMENSIONS (W X H)	4x3	m
HEADRACE PIPELINE		
PIPELINE DIAMETER D	2.0-1.7	m
TOTAL PIPELINE LENGTH	9800	m

Key Technical Parameters

POWERHOUSE		
HPP TYPE	Above-ground	
POWERHOUSE DIMENSIONS	43.0x19.0x16.6	m
AGGREGATE HALL ELEVATION	291.01	m.a.s.l
PENSTOCK CROSS SECTION D=0.54	0.38	m^2
TURBINE AXIS ELEVATION	295.11	m.a.s.l
OUTLET CHANNEL		
CHANNEL DIMENSIONS	2.0x1.6	m^2
LENGTH OF THE CHANNEL FROM DIFFUSER TO THE RIVER	20	m
DIFFUSER GATE DIMENSIONS	2x1.6	m
CREST ELEVATION OF THE OUTLET CHANNEL	293	m.a.s.l
TURBINE/GENERATORS		
TURBINE TYPE	Pelton	

Key Technical Parameters

DESIGN DISCHARGE FOR EACH	3.5	M^3/SEC
RATED CAPACITY ON THE DESIGN LOAD	5.83	MW
MAXIMUM CAPACITY	5.97	MW
NOMINAL ROTATION NUMBER	1000	R/h
NOMINAL ACTIVE CAPACITY OF THE GENERATOR	5.91	MW
NOMINAL SIMULATED CAPACITY OF THE GENERATOR FOR EACH (COS = 0.85)	6.86	MWA
SYNCHRONIC SPEED	428.6	r/min
TRANSFORMERS		
NUMBER AND TYPE		
MAXIMUM VOLTAGE	6.5/10.5	kV
NOMINAL CAPACITY	3.54	kVA

Phona HPP BoQ & Cost Estimate

#	Structure	Works to be performed	Unit	Quantity	Unit Price, USD	Total Cost, USD
1	Reinforced concrete dam with spillway and stilling basin; Length - 50m. Height 5m.	Earth Works	m^3	2,450.00	$ 4.00	$ 9,800.00
		Back fill	m^3	8,500.00	$ 4.00	$ 34,000.00
		Concrete and Reinforced Concrete B7.5	m^3	2,285.00	$ 80.00	$ 182,800.00
		Concrete and Reinforced Concrete B40	m^3	1,500.00	$ 170.00	$ 255,000.00
		Reinforcement	t	151.00	$ 670.00	$ 101,170.00
		Metal Structures	t	16.00	$ 2,500.00	$ 40,000.00
2	Reinforced concrete water intake, B=4.0m, with racks and lock gates	Earth Works	m^3	120.00	$ 5.00	$ 600.00
		Back fill	m^3	120.00	$ 4.00	$ 480.00
		Concrete and Reinforced Concrete B22.5	m^3	243.00	$ 130.00	$ 31,590.00
		Reinforcement	t	9.70	$ 670.00	$ 6,499.00
		Metal Structures	t	10.00	$ 2,500.00	$ 25,000.00
3	Horizontal silt basin, B=5.2m, L=40.0m and intake basin (forebay) B=5.2m, H=5.0m, L=3.0m	Earth Works	m^3	420.00	$ 4.00	$ 1,680.00
		Back fill	m^3	420.00	$ 4.00	$ 1,680.00
		Concrete and Reinforced Concrete B7.5	m^3	360.00	$ 80.00	$ 28,800.00
		Reinforcement	t	14.40	$ 670.00	$ 9,648.00
		Metal Structures	t	3.00	$ 2,500.00	$ 7,500.00
4	Fish way	Earth Works	m^3	50.00	$ 4.00	$ 200.00
		Back fill	m^3	-	$ 4.00	$ -
		Concrete and Reinforced Concrete B7.5	m^3	20.00	$ 80.00	$ 1,600.00
		Reinforcement	t	0.80	$ 670.00	$ 536.00

Phona HPP BoQ & Cost Estimate

5	Head Unit: Sluice	Earth Works	m^3	84.00	$	4.00	$	336.00
		Back fill	m^3	84.00	$	4.00	$	336.00
		Concrete and Reinforced Concrete B22.5	m^3	172.00	$	130.00	$	22,360.00
		Reinforcement	t	6.90	$	670.00	$	4,623.00
		Metal Structures	t	3.00	$	2,500.00	$	7,500.00
6	Diversion Pipeline, GRP D=2.0-1.7m; L=9692m	Earth Works	m^3	61,740.00	$	4.00	$	246,960.00
		Back fill	m^3	39,496.00	$	4.00	$	157,984.00
7	Reinforced Concrete Bridges for crossing the pipeline, 3 pieces	Earth Works	m^3	150.00	$	4.00	$	600.00
		Back fill	m^3	150.00	$	4.00	$	600.00
		Concrete and Reinforced Concrete B40	m^3	60.00	$	170.00	$	10,200.00
		Reinforcement	t	2.40	$	670.00	$	1,608.00
8	Reinforced Concrete support for diversion pipeline bending sections	Earth Works		200.00	$	4.00	$	800.00
		Concrete and Reinforced Concrete B40	m^3	5.00	$	170.00	$	850.00
9	Diversion Pipeline, GRP D=2.0, 1.9, 1.8, 1.7, 1.0m; L=9692m			9,862.00	$	295.00	$	2,909,290.00
10	Pipeline crossing the motorway with the length of 50.0m, opening width 4.0m, concrete well with locking valve	Concrete and Reinforced Concrete B40	m^3	5.00	$	80.00	$	400.00
		Reinforcement	t	0.20	$	670.00	$	134.00
		Metal Structures	t	-	$	2,500.00	$	-
11	Powerhouse, W=43.2m, B=18.9m, H=16.6m	Earth Works	m^3	1,129.00	$	4.00	$	4,516.00
		Back fill	m^3	600.00	$	4.00	$	2,400.00
		Concrete and Reinforced Concrete B40	m^3	1,100.00	$	170.00	$	187,000.00
		Reinforcement	t	44.00	$	670.00	$	29,480.00
		Metal Structures	t	15.00	$	2,500.00	$	37,500.00
		E&M	MW	11.66	$	350,000.00	$	4,081,000.00

Phona HPP BoQ & Cost Estimate

12	Support wall, L=150.0m	Earth Works	m^3	150.00	$ 4.00	$ 600.00
		Back fill	m^3	150.00	$ 4.00	$ 600.00
		Concrete and Reinforced Concrete B7.5	m^3	300.00	$ 55.00	$ 16,500.00
		Reinforcement	t	12.00	$ 670.00	$ 8,040.00
		Metal Structures	t	0.80	$ 2,500.00	$ 2,000.00
13	Tailrace channel at 293.0m elevation, L=150m	Earth Works	m^3	-	$ 4.00	$ -
		Back fill	m^3	-	$ 4.00	$ -
		Concrete and Reinforced Concrete B7.5	m^3	130.50	$ 55.00	$ 7,177.50
		Reinforcement	t	6.75	$ 670.00	$ 4,522.50
		Metal Structures	t	0.75	$ 2,500.00	$ 1,875.00
14	Emergency pipeline GRP D=1.0m, L=160.0m, with valve	Earth Works	m^3	360.00	$ 4.00	$ 1,440.00
		Back fill	m^3	200.00	$ 4.00	$ 800.00
		Concrete and Reinforced Concrete B7.5	m^3	4.80	$ 55.00	$ 264.00
		Reinforcement	t	0.20	$ 670.00	$ 134.00
		Metal Structures	t	0.80	$ 2,500.00	$ 2,000.00
15	Arrangement of New roads	Earth Works	km	1.50	$ 100,000.00	$ 150,000.00
16	35 kV transmission Line, 3.8km		km	3.80	$ 70,000.00	$ 266,000.00
17	Substation, 35/10 kV		piece	1.00	$ 60,000.00	$ 60,000.00
18	Total Construction Cost					$ 8,967,013.00
19	Contingencies (15%)					$ 1,345,051.95
20	Design Works, Management and Supervision (7%)					$ 627,690.91
Total Cost						**$ 10,939,755.86**

Phona HPP Financial Analysis

Investment (USD Mln. Excluding VAT)	10.90	
Duration of construction (years)	3	
Annual Generation	GWh	MWh
Capacity	60.6	60,580.0
Financial data in USD "000000"	1,000,000.0	
Currency	USD	
Project year	2018	
Taxes		
Profit tax	15%	
Property tax	1%	
VAT	18%	
Prices USD/kWh		
4 month (Summer price)	0.03	
Average annual Price growth rate	0.000	
8 month (Winter price)	0.06	
Average annual Price growth rate	0.0%	
Carbon credit	0.0399	
Carbon credit price	0.000	
Operating cost site		
Administration and Office other exp	2.50%	
O&M	2.50%	
Salary	3.00%	
Technical losses and own consumption	3.00%	
Sales distribution		
4 month (Summer generation)	43%	
8 month (Winter generation)	57%	
Capital structure		USD "000000"
Total investment	100%	10.90
Debt	70%	7.63
Equity	30%	3.27
Debt		
Amount	9.59	
Interest rate	6%	
Maturity (years)	10	
Discount rate		
Cost of equity	15%	
Cost of debt	6%	
WACC	8.07%	

Phona HPP Financial Analysis

Results	
Project NPV	11.90
Equity NPV	3.36
Project IRR	17.5%
Equity IRR	27.3%
Payback (years)	8