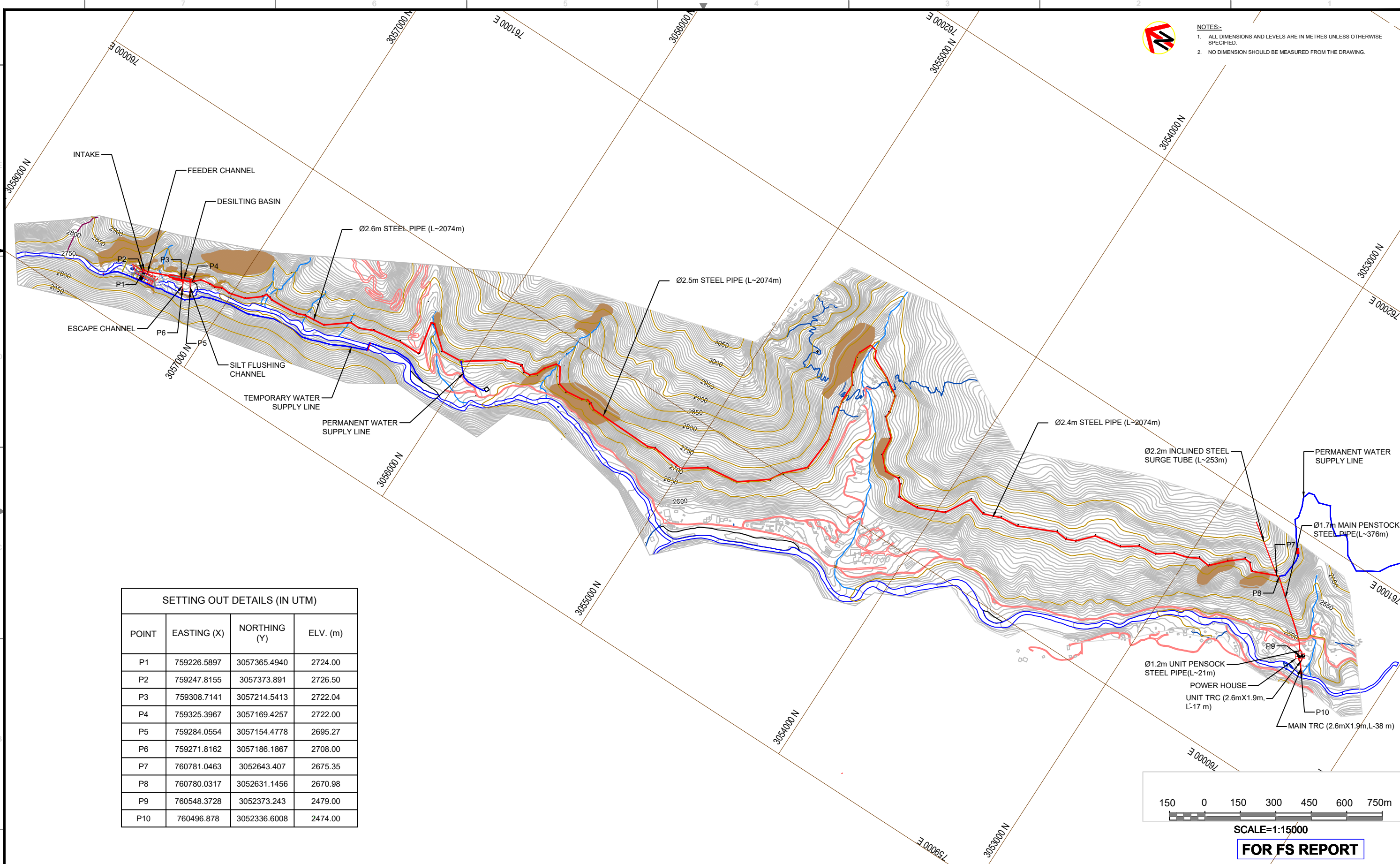
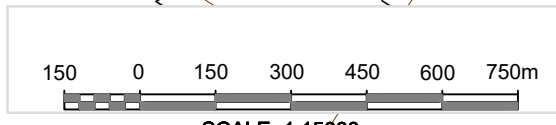




NOTES:-  
 1. ALL DIMENSIONS AND LEVELS ARE IN METRES UNLESS OTHERWISE SPECIFIED.  
 2. NO DIMENSION SHOULD BE MEASURED FROM THE DRAWING.



SETTING OUT DETAILS (IN UTM)			
POINT	EASTING (X)	NORTHING (Y)	ELV. (m)
P1	759226.5897	3057365.4940	2724.00
P2	759247.8155	3057373.891	2726.50
P3	759308.7141	3057214.5413	2722.04
P4	759325.3967	3057169.4257	2722.00
P5	759284.0554	3057154.4778	2695.27
P6	759271.8162	3057186.1867	2708.00
P7	760781.0463	3052643.407	2675.35
P8	760780.0317	3052631.1456	2670.98
P9	760548.3728	3052373.243	2479.00
P10	760496.878	3052336.6008	2474.00



**FOR FS REPORT**

Consultant: DRUK GREEN CONSULTANCY		Owner: DRUK GREEN POWER CORPORATION Ltd.	
Date	JUNE, 2023	Revised date	
Designed	G.Gajmer	Verified	T.Dorjee
Reviewed	D.Singer	Approved	C.Tenzin
Drawn	J.Wangmo	Scale	AS SHOWN
THIS DRAWING IS MEANT FOR FSR NOT TO BE USED FOR CONSTRUCTION.		Project: 25 MW BEGANA HYDROPOWER PROJECT THIMPHU, BHUTAN Title: GENERAL PROJECT LAYOUT Drawing No. BHP-CD-GEN-2023-01	
		Rev.	0

## Annexure- 3

## Salient Features of 25 MW Begana Integrated Multipurpose Small Hydropower Project

<b>A. GENERAL</b>	
<b>Location</b>	
Country	Bhutan
District/Dzongkhag	Thimphu
River	Thimchhu
Nearest Village (Weir site)	Tango
Nearest Village (Power House Site)	Begana
Nearest Airport	Paro International Airport
Nearest Railhead (Broad gauge)	Hasimara (India)
<b>Location of Dam/Weir Site (UTM)</b>	
Easting	759229.8101
Northing	3057344.5575
<b>Location of Powerhouse (Centre of Building in UTM)</b>	
Easting	759545.7100
Northing	3052371.7600
<b>B. HYDROLOGY</b>	
Catchment area	300 km <sup>2</sup>
Design flood (1 in 100 year)	418 m <sup>3</sup> /s
Diversion Flood (non-monsoon, 1 in 25 year)	42 m <sup>3</sup> /s
Design Discharge	12.09 m <sup>3</sup> /s
Average Annual Flow	9.90 m <sup>3</sup> /s
Average minimum flow	1.65 m <sup>3</sup> /s
Discharge for Water supply	0.21 m <sup>3</sup> /s
E-Flow	0.24 m <sup>3</sup> /s
Firm Flow for power generation	1.20 m <sup>3</sup> /s
Gross head	248.2 m
Design head	233.0 m
<b>C. CIVIL WORKS</b>	
Full Supply level (FSL)	El. 2,728.50 m
Minimum Draw Down Level (MDDL)	El. 2,726.94 m
Gross head	248.2 m
Net head	233.0 m
<b>Diversion Dyke</b>	
<b>First stage</b>	
Type	Diversion Dyke, RRM
Size (LxWXH)	146 m x 2 m x 5 m
<b>Second stage</b>	
Type	Diversion Dyke, RRM

Size (LxWXH)	133 m x 2 m x 5 m
<b>Raised Weir</b>	
Type	Raised Weir
Weir top	El. 2,728.50 m
River bed level at weir site	El. 2,724.00 m
Weir height (above river bed level)	4.5 m
Weir crest length	32.0 m
<b>Under sluice</b>	
Under sluice opening (WxH)	4.0 m x 2.2 m
Under sluice gate size (WxH)	4.0 m x 2.2 m
Crest elevation of under sluice	El. 2,732.00 m
Energy Dissipater	Stilling Basin
Type of Hoist	Hydraulic Hoist
Operating Conditions	6 t capacity
<b>Power Intake and Feeder Channel</b>	
Number of Feeder channels	1
Shape & Size of channel (WxH)	Rectangular, 3.0 m x 2.6 m
Trash rack sill level	El. 2,726.50 m
Length of Feeder channel	111.0 m
Intake invert elevation	El. 2,726.50 m
Discharge Capacity for Power Intake	14.15 m <sup>3</sup> /s
Number of Intake trash rack	1 set
Size of Intake trash rack (WxH)	6.5 m x 2.0 m
Number of Intake gate	1
Size of Intake gate (WxH)	3.0 m x 2.6 m
<b>Desilting Basin</b>	
Type and Number	Surface, 2 nos
Size (LxWxH)	96.0 m x 5.5 m x 5.3 to 6.3 m
Desilting Inlet Gate number	2 nos
Desilting Inlet Gate size (WxH)	4.1 m x 2.6 m
Desilting Outlet gate number	2 nos
Desilting Outlet Gate size (WxH)	3.75 m x 2.6 m
<b>Silt Flushing Channel</b>	
Total flushing discharge (15%)	1.85 m <sup>3</sup> /s
Sediment size to be removed	>0.2 mm
Unit Channel – Number	2 nos
Unit channel – Size (WxH)	2.0 m x 1.2 m
Unit Channel– Length	8.2/6 m
Main Channel– Size (WxH)	2.0 m x 1.2 m
Main channel – Length	42.0 m
Number of SFC gates	2 nos
SFC Gate size (WxH)	2.0 m x 1.2 m

<b>Transition Chamber</b>	
Number of Chamber	1
Size (LxWxH)	6.05 m x 8.50 m x 8.0 m
<b>Head Race Pipe</b>	
Size & Type	2.4 to 2.6 m diameter, Steel pipe
Discharging capacity	12.3 m <sup>3</sup> /s
Length	6,223.0 m
Slope	1(V):122(H)
Inlet Invert Level	El. 2,722.00 m
Type of Steel & Thickness	ASTM 517, 10 mm
<b>Surge Tube</b>	
Number	1 no
Type	Inclined Surge Tube
Top level	El. 2765.74 m
Bottom level	El. 2676.00 m
Surge Tube- Diameter	2.80 m
Surge Tube - Length	194.00 m
Orifice Diameter	0.6 m
Orifice Length	5.00 m
Total height of surge Tube	89.74 m
Type of Steel & Thickness	ASTM 517, 10 mm
<b>Penstock</b>	
Type	Steel Pipe
Main Penstock- Diameter	1.7 m
Main Penstock – Length(m)	376.0 m
Unit Penstock – Diameter	1.2 m
Unit Penstock – Length	21.0 m
Type of Steel & Thickness	Grade E450 BR, 10-14 mm
<b>Surface Power House</b>	
Machine centre line	El. 2,479.00 m
PH size (LxWxH)	39.0 m x 20.0 m x 26.0 m
<b>Main Inlet Valve</b>	
Type	Spherical
Number	2 nos.
<b>Tail Race channel</b>	
Size (WxH) and Shape	2.0 m x 1.9 m, Rectangular
Length of Main TRC	38.0 m
Outfall invert elevation	El. 2,474.00 m
Number and Size of TRC outlet gate (WxH)	2 nos, 2.0 m x 1.9 m
<b>D. ELECTRO-MECHANICAL EQUIPMENT</b>	
<b>Turbine</b>	

Type of Turbine	Pelton
Number of turbines	2 nos
Rated net head	233
Rated Output	25 MW
Rated Speed	428 rpm
Efficiency	92%
<b>Generator</b>	
Type of Generator	Synchronous, Vertical Shaft
Rated power	14 MVA
Power Factor	0.85
Generation Voltage	11 kV
Number of Phases	3 phases
Frequency	50 Hz
Efficiency	98%
<b>Power Transmission and Distribution</b>	
Transmission Line Voltage	66 kV LILO arrangement
Total line length	5.00 km
Conductor type	ACSR Wolf conductor
<b>Power Generation</b>	
Annual Energy in 75% dependable year (100% PA)	106.99 GWh
Design Energy in 75% dependable year (95%PA)	104.23 GWh
Annual Plant Load Factor	48.86 %
Lean season Plant Load Factor	14.0 %
Probability of Exceedance	30 %
Firm Power	2.49 MW
<b>E. CONSTRUCTION PERIOD</b>	
Construction Duration	34 months including preconstruction of 2 months
<b>F. COST AND FINANCIALS</b>	
<b>June 2023 PL (Upfront Equity)</b>	
Total Hard Cost including transmission	Nu. 2,694.48 million
Total Project Cost including IDC	Nu. 2900.77 million
First-year tariff	Nu. 4.74 per unit
Levelized tariff	Nu. 4.27 per unit
Specific cost per MW	Nu. 107.03 million
<b>Cost to Completion- August 2026 PL (Upfront Equity)</b>	
Total Hard Cost including transmission	Nu. 2,759.00 million
Total Project Cost including IDC	Nu. 2,970.23million
First-year tariff	Nu. 4.85 per unit
Levelized tariff	Nu. 4.37 per unit