Procurement
New Generation Activities
Procurement Department

CALL FOR TENDERS NGAPD-2006
ADDENDUM N°5

Call for Tenders: **NGAPD-2006**

Scope: **"Kardia Mine Pumped Hydro Storage Plant: Early Technology Provider Involvement for Design, Supply, Erection and Commissioning of Pump, Turbine, Generator and Auxiliary Systems"**

By means of the present Addendum N°5, the following modifications and clarifications are hereby introduced and incorporated into the Call for Tenders NGAPD-2006:

a. **Article 2.3 ("Scope of Supply and Services") of ANNEX II ("Technical Part") of the Call for Tenders NGAPD-2006 is amended as follows:**

1. In Table 2-1: Division of work per lot, under Item 8.2 "Earthing and lightning systems design", the responsibility (R) is reallocated to Lot 2, and the input (In) is reassigned to Lot 1. Also, the relevant note under the column "Remarks/key interface", is modified as follows: *"Lot 1 shall be responsible for providing inputs and checking the basic design"*

2. In Table 2-1: Division of work per lot, under Item 8.3 "Embedded and buried earthing system installation, including interconnection to surface switchyard and at remote sites (e.g. intakes)", the relevant note under the column "Remarks/key interface", is deleted in its entirety.

b. **Article 3.7 ("Pump-Turbine Input Data") of ANNEX II ("Technical Part") of the Call for Tenders NGAPD-2006 is amended as follows:**

The following phrase is added at the beginning of the article:
"Offering four (4) pump-turbines is mandatory and alternative offers with a different number of units are not accepted."

c. **ANNEX III ("Schedule of Guarantees") of the Call for Tenders NGAPD-2006 is amended as follows:**

A new spreadsheet titled "Table of Performances to be filled by Tenderers" is hereby added to Annex III. Tenderers must mandatorily fill in the spreadsheet, which includes both expected and guaranteed values. The relevant guaranteed values must then be transferred to the "SCHEDULE OF GUARANTEES" at the corresponding item number (#1, #2 etc.), under the column "Guaranteed Value", (which currently includes the minimum or maximum value). The native (editable) .doc file of "SCHEDULE OF GUARANTEES" is also hereby provided to Tenderers for convenience.

All other terms and conditions of the Call for Tenders No NGAPD 2006 and Addenda N°1, N°2, N°3 and N°4 remain unchanged and in full force.

Call for Tenders **No. NGAPD-2006**

Scope: **«Kardia Mine Pumped Hydro Storage: Early Technology Provider Involvement for Design, Supply, Erection and Commissioning of Pump, Turbine, Generator and Auxiliary Systems»**

ANNEX III

SCHEDULE OF GUARANTEES

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SCHEDULE OF GUARANTEES

No	Name	Guaranteed Value	Measured at	Rejection Limit	Performance LD	Performance LD rate	Comment
1	Turbine Weighted Average Efficiency (WAE) on turbine shaft	Min 90.50%	Model Test and Tests on completion	1 percentage point lower than the guaranteed value	Yes	1,5% of Lot 1 Contract Value per each 0,1% of efficiency shortfall	If during Model Test the Turbine WAE falls short of the rejection limit, the Lot 1 Contractor will have to improve the design and repeat the Model Test. If during Model Test the Turbine WAE, is higher than the rejection limit, but falls short of the guaranteed value, Performance LD's will be calculated and paid, unless the Contractor decides to improve the design and repeat the Model Test. If LD's are paid at this stage, the Model Test Turbine WAE will become the new Turbine WAE guarantee. During Tests On Completion a combined turbine and generator efficiency test will be performed. The actual WAE of turbine and generator will be compared against the Turbine WAE guarantee (as it may have been modified after Model Test) after applying the Generator's Guaranteed Performance curve). In case of shortfall additional Performance LD's will be calculated and paid.
2	Pump Weighted Average Efficiency (WAE) on turbine shaft	Min 93.80%	Model Test and Tests on completion	1 percentage point lower than the guaranteed value	Yes	1,5% of Lot 1 Contract Value per each 0,1% of efficiency shortfall	If during Model Test the Pump WAE falls short of the rejection limit, the Lot 1 Contractor will have to improve the design and repeat the Model Test. If during Model Test the Pump WAE, is higher than the rejection limit, but falls short of the guaranteed value, Performance LD's will be calculated and paid, unless the Contractor decides to improve the design and repeat the Model Test. If LD's are paid at this stage, the Model Test Pump WAE will become the new Pump WAE guarantee. During Tests On Completion a combined pump and motors efficiency test will be performed. The actual WAE of pump and motor will be compared against the Pump WAE guarantee (as it may have been modified after Model Test) after applying the Motor's Guaranteed Performance curve. In case of shortfall additional Performance LD's will be calculated and paid.
3	Turbine mechanical output under max head	Min 82.5 MW	Model Test and Tests on completion	N/A	No LD, Taking Over and Make Good during DNP	Not Applicable	

No	Name	Guaranteed Value	Measured at	Rejection Limit	Performance LD	Performance LD rate	Comment
4	Turbine mechanical output under 130 head	Min 72.5 MW	Model Test and Tests on completion	N/A	No LD, Taking Over and Make Good during DNP	Not Applicable	
5	Pump mechanical input under max head (on shaft*)	Min 76,3 MW	Model Test and Tests on completion	N/A	No LD, Taking Over and Make Good during DNP	Not Applicable	**Pump-Turbine guide bearing losses included. Net head including the MIV losses.*
6	Turbine mode minimum stable operation output ratio	Min 50%	Model Test and Tests on completion	N/A	No LD, Taking Over and Make Good during DNP	Not Applicable	
7	Motor efficiency, pump mode, under min head (mechanical losses included*)	Min 98.55%	Shop Test and Tests on completion	1 percentage point lower than the guaranteed value	Yes	1,5% of Lot 1 Contract Value per each 0,1% of efficiency shortfall (combined with pump)	Shop Test will have to achieve rejection limit. This guarantee will be replaced by the pump performance curve During Tests on Completion the combined pump and motor test will be performed and the stipulations of line 2 above will apply. **Motor-Generator guide and thrust bearings losses included (for thrust bearing, the whole shaft line weight and hydraulic thrust are to be considered in motor-generator efficiency)*
8	Generator efficiency, turbine mode at 100% max output (mechanical losses included*)	Min 98.45%	Shop Test and Tests on completion	1 percentage point lower than the guaranteed value	Yes	1,5% of Lot 1 Contract Value per each 0,1% of efficiency shortfall (combined with turbine)	Shop Test will have to achieve rejection limit. This guarantee will be replaced by the pump performance curve During Tests on Completion the combined turbine and generator test will be performed and the stipulations of line 1 above will apply. **Motor-Generator guide and thrust bearings losses included (for thrust bearing, the whole shaft line weight and hydraulic thrust are to be considered in motor-generator efficiency)*
9	Generator efficiency, turbine mode at 50% max output (mechanical losses included*)	Min 97.5%	Shop Test and Tests on completion	1 percentage point lower than the guaranteed value	NO	Not Applicable	Same as above

No	Name	Guaranteed Value	Measured at	Rejection Limit	Performance LD	Performance LD rate	Comment
10	Main power transformer (Tier-2) efficiency	Min 99.7%	Shop Test Tests on completion	N/A	No LD, Taking Over and Make Good during DNP	Not Applicable	If transformer is not under Lot 1, this guarantee will be moved to Lot 2
11	Cavitation Pitting depth per runner (function of runner low pressure diameter D)	Max $2.5*D^{0.4}$ mm	Tests After Completion after each 3000 hours of operation in pumping mode	N/A	No LD, Make Good, during DNP	Not Applicable	Lot 1 Contractor will have to repair the pitting by grinding and welding. In addition, Lot 1 Contractor will have to make good the underlying problem of the cavitation pitting This will trigger an extension of DNP, up to the maximum aggregate of 4 years.
12	Cavitation Pitting volume per runner (function of runner low pressure diameter D)	Max $5*D^2$ cm^3	Tests After Completion after each 3000 hours of operation in pumping mode	N/A	No LD, Make Good, during DNP	Not Applicable	Lot 1 Contractor will have to repair the pitting by grinding and welding. In addition, Lot 1 Contractor will have to make good the underlying problem of the cavitation pitting. This will trigger an extension of DNP, up to the maximum aggregate of 4 years. If cavitation still occurs after 3 repairs / 4 years, then the Lot 1 Contractor must provide a new hydraulic at his own cost (new hydraulic design, new model test, new runners)
13	Standstill to Generating (100%) transition time	Max 100 sec	Tests on completion	N/A	No LD, Taking Over and Make Good during DNP	Not Applicable	
14	Standstill to Pumping transition time	Max 350 sec	Tests on completion	N/A	No LD, Taking Over and Make Good during DNP	Not Applicable	
15	Noise guarantees	TBD	Tests on completion	No, to the extent that the plant can safely operate according to applicable legislation	No LD, Make Good, either before Taking Over or during DNP	Not Applicable	
16	Vibration guarantees	TBD	Tests on completion	No, to the extent that	No LD,	Not Applicable	

No	Name	Guaranteed Value	Measured at	Rejection Limit	Performance LD	Performance LD rate	Comment
				the plant can safely operate according to applicable legislation	Make Good, either before Taking Over or during DNP		

Turbine Mode

For information

	Head (1) [m]	120,8	130	140	148
	Output (2) [MW]	**63,8***	**72,5**	**82,5**	**82,5**
Turbine Efficiency (for info only) for fractions of output	100%				
	90%				
	80%				
	70%				
	60%				
	50%				

(* max output under min head to be confirmed by Technology Provider)

(1) Net head is to be measured from MIV high pressure side to draft tube outlet

(2) Output is to be considered on Pump-turbine shaft, turbine bearing losses included

	Head (1) [m]	120,8	130	140	148
	Output (3) [MW]				
Generator Efficiency (for info only) for fractions of output	100%				
	90%				
	80%				
	70%				
	60%				
	50%				

(3) Output to be considered at Generator Terminal, guide and thrust bearings losses included

	Head (1) [m]	120,8	130	140	148
	Output (4) [MW]				
Transformer Efficiency (for info only) for fractions of output	100%				
	90%				
	80%				
	70%				
	60%				
	50%				

(4) Output at Transformer Terminal

	Head (1) [m]	120,8	130	140	148
	Output (4) [MW]	**0,0**	**0,0**	**0,0**	**0,0**
Overall Efficiency (for info only) for fractions of output	100%	0,00%	0,00%	0,00%	0,00%
	90%	0,00%	0,00%	0,00%	0,00%
	80%	0,00%	0,00%	0,00%	0,00%
	70%	0,00%	0,00%	0,00%	0,00%
	60%	0,00%	0,00%	0,00%	0,00%
	50%	0,00%	0,00%	0,00%	0,00%

(4) Output at Transformer Terminal

Guarantees

	Head (1) [m]	120,8	130	140	148
	Output (2) [MW]	**63,8***	**0**	**82,5**	**0**
Turbine Efficiency Weights for WAE formula	100%	3,00%	12,00%	12,00%	3,00%
	90%	3,00%	12,00%	12,00%	3,00%
	80%	2,00%	8,00%	8,00%	2,00%
	70%	1,50%	6,00%	6,00%	1,50%
	60%	0,50%	2,00%	2,00%	0,50%
	50%	0,00%	0,00%	0,00%	0,00%

Guaranteed Turbine Weighted Average Efficiency (WAE) on turbine shaft (#1 of Annex III)	**0,00%**

Efficiency will be measured on the model test as per IEC 600193-2019 standard

Efficiency will be measured at site as per IEC 60041 standard (pump-turbine)

Guaranteed Turbine Mechanical Output under Max Head [MW] (#3 of Annex III)	
Guaranteed Turbine Mechanical Output under 130m Head [MW] (#4 of Annex III)	

On Pump-turbine shaft, bearing losses included

Guaranteed Generator Efficiency at 100% Max Output (#8 of Annex III)	
Guaranteed Generator Efficiency at 50% Max Output (#9 of Annex III)	

Generator efficiency will be measured at the workshop are per IEC 60034-33 standard

Guaranteed Turbine Mode Minimum Stable Operation Output ratio (#6 of Annex III)	

Guaranteed Transformer efficiency at 100% max output (#10 of Annex III)	

Transformer efficiency will be measured as per IEC 60076 standard

	Expected value (manual input)
	Expected value (calculated)
	Guaranteed value (manual input)
	Guaranteed value (calculated)