Schedule - I

Guaranteed Technical Particulars of Tuiching Micro Hyroelectric Project

(to be filled by the Tenderer)

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
1.0	**Turbine, Electronic Load Controller and Main Inlet Valve**		
1.1	**Turbine**		
1.1.1	**Guaranteed characteristics**		
1.	General	-	_____
1.1	Manufacturer	-	_____
1.2	Place of manufacture	-	_____
1.3	Type designation	-	_____
1.4	Applicable standards	-	_____
2.	Main data		
2.1	Turbine rated output at rated net design and at rated speed	kW	_____
2.2	Maximum continuous output at design net head	kW	_____
2.3	Rated speed	rpm	_____
2.4	Maximum runaway speed at following net head and at generator no-load (except friction losses)		
	• at rated net head	rpm	_____
2.5	Direction of rotation(viewed from drive end)	-	_____
2.6	Fly wheel effect of turbine rotating parts	kg m^2	_____
2.7	Fly wheel effect required from the generator	kg m^2	_____
3.	Efficiency		
3.1	Turbine efficiency at rated net head and rated speed		
	- at 115% continuous rated output	%	_____
	- at 100% continuous rated output	%	_____
	- at 80% continuous rated output	%	_____
	- at 60% continuous rated output	%	_____
	- at 40% continuous rated output	%	_____
3.2	Weighted average efficiency (according to clause 1.3.4 of specification)	%	_____
4.	Maximum noise level at a Distance of 1 m at rated operation		
	• at turbine pit	dB(A)	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	• at draft tube manhole	dB(A)	_____
5.	Weights		
5.1	Weight of finished-machined runner complete	kg	_____
5.2	Weight of shaft	kg	_____
5.3	Weight and designation of heaviest part or assembly of the turbine as prepared for shipment	kg	_____
5.4	Total weight of complete turbine delivery	kg	_____
6.	Dimensions		
6.1	Turbine shaft diameter	mm	_____
1.1.2	**Information data**		
1.	Turbine water discharge quantities		
	• under maximum overload operation at maximum net head	$m^{3/s}$	_____
	• at maximum runaway condition	$m^{3/s}$	_____
	• at no-load at rated net head	$m^{3/s}$	_____
2.	Turbine runner		
2.1	Dimensions of		
	• inner diameter	mm	_____
	• outer diameter	mm	_____
2.2	Number of blades	pcs	_____
3.	Bearing		
3.1	Maximum temperature rise above cooling medium, measured by embedded temperature detectors		
	• at continuous rated operation	^oC	_____
	• at most unfavourable operating conditions as specified	^oC	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
1.2	**Electronic Load Controller**		
1.2.1	**Guaranteed characteristic**		
1.	General		
1.1	Manufacturer	-	_____
1.2	Place of manufacture	-	_____
1.3	Type designation	-	_____
1.4	Detailed specifications		
1.4.1	Frequency	Hz	_____
1.4.2	Voltage	V	_____
1.4.3	Load switching mode	-	_____
1.4.4	Self testing/watchdog facilities provided	Yes/No	_____
1.4.5	Frequency regulation	%	_____
1.4.6	Maximum deviation in frequency at full Load trip	%	_____
1.4.7	Maximum deviation in frequency on switching on full load	%	_____
1.4.8	No. of digital input	No.	_____
1.4.9	Analogue output	No.	_____
1.4.10	Rating of ballast load	kW	_____
1.4.11	Number of heater in the ballast load	No.	_____
1.4.12	Rating of each heater	kW	_____
1.4.13	Suitable for autosynchronization	Yes/No	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
1.3	**Turbine main inlet valve**		
1.3.1	**Guaranteed characteristic**		
1.	General	-	_____
1.1	Manufacturer	-	_____
1.2	Place of manufacture	-	_____
1.3	Type designation	-	_____
1.4	Applicable standards	-	_____
2.	Main data		
2.1	Maximum leakage from main valve when Fully closed against maximum head in (with new seal)		
	• through service seal	1/min	_____
	• through maintenance seal	1/min	_____
2.2	Maximum head loss through the valve at a Flow required for rated turbine output Rated net head	m	_____
2.3	Maximum torque required to close the valve with a flow corresponding to		
	• Rated turbine output at rated net head	Nm	_____
	• Specified turbine overload output at rated net head	Nm	_____
	• Specified turbine overload output at rated net head	Nm	_____
2.4	Main dimensions of main inlet valve		
	• Inside diameter	mm	_____
	• Length of valve body (excluding Extensions)	mm	_____
	• Maximum distance from horizontal centerline of valve to lowest portion of assembly	mm	_____
2.5	Lowest factor of safety (referred to design stress) for any hydraulically loaded part of the valve	-	_____
2.6	Valve operating oil pressure		
	• minimum	bar	_____
	• maximum	bar	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
1.3.2	**Informative data**		
1.	Servomotor (if applicable)		
2.1	Make	-	_____
2.2	Nominal design oil pressure	bar	_____
2.3	Active volume	cm^3	_____
2.4	Range of opening time	s	_____
2.5	Range of closing time	s	_____
3.	Weights		
3.1	Weight of complete main inlet valve	kg	_____
3.2	Weight of complete oil pressure unit with pump set equipment	kg	_____
3.3	Estimated shipping weight of valve	kg	_____
3.4	Maximum weight of valve assembly to Be handled by powerhouse crane	kg	_____
4.	Dimensions		
4.1	Minimum floor opening required for Valve installation/removal		
	• Width	mm	_____
	• Length	mm	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
2.0	**Generator, Excitation, AVR**		
2.1	**Generator**		
2.1.1	**Guaranteed characteristic**		
1.	General		
1.1	Manufacturer	-	_____
1.2	Place of manufacture	-	_____
1.3	Type designation	-	_____
1.4	Applicable standards	-	_____
2.	Main data		
2.1	No. of phase	-	_____
2.2	Generator continuous rating at rated frequency and voltage and:		
	- 0.9 power factor (lagging)	kVA	_____
	- At unity power factor	kVA	_____ lagging
2.3	Rated power factor	-	_____
2.4	Generator rated voltage	kV	_____
	Guaranteed voltage range	%	_____
1.5	Generator losses at full load, rated Voltage and power factor:		
	- Constant losses	kW	_____
	- Load losses	kW	_____
2.6	Rated frequency	Hz	_____
2.7	Rated synchronous speed	rpm	_____
2.8	Direction of rotation (viewed D.E)		_____
2.9	Design runaway speed	rpm	_____
	Lowest factor of safety (referred to yield strength) for a generator rotating part at runaway speed)	-	_____
2.10	Maximum peripheral speed at runaway speed	m/s	_____
2.11	Flywheel effect of the generator rotating parts, excluding turbine wheel:		
	- Inertia constant (H)	s	_____
2.	Efficiency		
2.1	Generator efficiency at rated voltage, frequency and power factor		
	- at 115% continuous rated output	%	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	(MVA)		
	- at 100% continuous rated output (MVA)	%	_____
	- at 80% continuous rated output (MVA)	%	_____
	- at 60% continuous rated output (MVA)	%	_____
	- at 40% continuous rated output (MVA)	%	_____
3.2	Weighted average efficiency	%	_____
	corresponding to average generator total losses	kW	_____
3.	Temperatures		
3.1	Maximum generator temperature rise above inlet cooling air temperature (40˚C) with the generator delivering rated output continuously at rated frequency and power factor and 90%-100% rated voltage		
	- Stator winding, measured by RTD	K	_____
	- Field winding, measured by resistance	K	_____
4.2	Maximum temperature rise above inlet cooling water temperature (30˚C) with the generator delivering rated output continuously:		
	- Thrust bearing pad, measured by embedded temperature detector	K	_____
	- Guide bearing segments, measured by embedded temperature detector	K	_____
4.3	Temperature limit assigned by the Bidder to the generator:		
	- Stator winding, measured	K	_____
	- Field winding resistance	K	_____
4.	Electrical characteristics		
5.1	Generator short-circuit ratio	p.u	_____
5.2	Generator synchronous reactance		
	- Direct axis	p.u	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	- Quadrature axis	p.u	_____
5.3	Generator transient reactance		
	- Direct axis	p.u	_____
	- Quadrature axis	p.u	_____
5.4	Generator subtransient reactance		
	- Direct axis	p.u	_____
	- Quadrature axis	p.u	_____
5.5	Generator negative phase sequence reactance	p.u	_____
5.6	Generator zero phase sequence reactance	p.u	_____
5.7	Ratio of X''_q to X''_d	-	_____
5.8	Telephone harmonic factor as specified in IEC-34	%	_____
5.	Excitation conditions		
5.1	Maximum admissible continuous generator output when charging a transmission line under-excited without the generator becoming unstable or self-excited, at rated frequency and rated voltage	kVAR	_____
5.2	Ratings of field winding at nominal operating conditions of generator (corrected for 75˚C winding temperature)		
	- Field current	A	_____
	- Field voltage	V	_____
6.3	Maximum permissible continuous field Current	A	_____
6.	Weight		
6.1	Weight of generator rotating parts Including shafts	kg	_____
6.2	Weight of heaviest assembly or part of the generator to be lifted by the powerhouse crane	kg	_____
6.3	Weight and name of heaviest part or assembly of the generator, as prepared		

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	for shipment	kg	_____
7.	Dimensions		
7.1	Minimum required crane hook clearance above service bay floor elevation, for erection, dismantling or maintenance of the generator by means of the powerhouse crane	mm	_____
7.2	Overall dimension of largest generator part or assembly, as prepared for shipment		
	- Length	mm	_____
	- Height	mm	_____
	- Width	mm	_____
8.	Segregated losses at nominal operating conditions		
8.1	Constant losses		
	- Core losses	kW	_____
	- Ventilation losses	kW	_____
	- Friction losses in top guide bearing	kW	_____
8.2	Load losses		
	- I^2R losses in armature winding Including additional losses (corrected For 75˚C)	kW	_____
	- I^2R Losses in field winding (corrected for 75˚C)	kW	_____
	- Excited system	kW	_____
8.3	Friction losses in combined thrust and Guide bearing		
	- Total losses caused by generator rotor, turbine runner and hydraulic thrust	kW	_____
	- Losses caused by generator rotor only	kW	_____
9.4	Total losses	kW	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
2.1.2	**Informative data**		
1.	Generator time constant		
	- Direct axis, open circuit transient time constant (T'_{do})	s	_____
	- Direct axis, short-circuit transient time constant (T'a)	s	_____
	- Armature short-circuit time constant (T_n)	s	_____
2.	Dimensions		
2.1	Diameter of stator frame	mm	_____
2.2	Generator stator bore, diameter	mm	_____
2.3	Generator effective core length	mm	_____
2.4	Diameter of rator	mm	_____
2.5	Diameter of shaft	mm	_____
3.	Maximum expected current density (nominal operation)		
	- Stator winding	A/mm^2	_____
	- Field winding	A/mm^2	_____
4.	Generator braking jacking system (if provided)		
	- No of braking cylinders	pcs	_____
	- Speed at which brakes may be applied for routine operation	rpm	_____
	- Braking time for conditions as above	s	_____
5.	Air-water heat-exchangers (stator air Coolers)		
	- No of units	pcs	_____
6.	Quantity of cooling water required		
	- Air coolers, total	l/s	_____
	- Combined thrust/guide bearing oil cooler	l/s	_____
	- Upper guide bearing oil-cooler	l/s	_____
7.	Generator space heaters		

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	- Number of units	pcs	_____
	- Total rating of all units	kW	_____
8.	Number of sections into which the generator stator is divided (for transportation)	pcs	_____
9.	Net weight of complete generator, incl. Cooler, racks, platform etc. as offered	tons	_____
2.1.3	**Current/voltage transformer, surge arrester and neutral grounding cubicle**		
1.	General		
1.1	Rated voltage of equipment	kV	_____
1.2	Highest voltage for equipment U_m	kV	_____
1.3	Rated frequency	Hz	_____
1.4	Rated short duration power frequency withstand voltage, 1 min	kV_{rms}	_____
1.5	Rated lightning impulse withstand Voltage	kV_{peak}	_____
1.6	Applicable standards	-	_____
2.	Current transformers		
2.1	Make	-	_____
2.2	Type	-	_____
2.3	Neutral-end current transformers		
	• Rated primary current	A	_____
	• Rated secondary current	A	_____
	• Accuracy class/burden of CT1	-/VA	_____
	• Accuracy class/burden of CT2	-/VA	_____
	• Accuracy class/burden of CT3	-/VA	_____
	• Accuracy class/burden of CT4	-/VA	_____
	• Rated short-time thermal current, 1 s	kA_{rms}	_____
	• Rated dynamic current	kA_{peak}	_____
2.4	Line-end current transformers		
	• Rated primary current	kA_{peak}	_____
	• Rated secondary current	A	_____
	• Accuracy class/burden of CT5	-/VA	_____
	• Accuracy class burden of CT6	-/VA	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	• Accuracy class burden of CT7	-/VA	_____
	• Accuracy class burden of CT10	-/VA	_____
	• Accuracy class burden of CT11	-/VA	_____
	• Rated short-time thermal current, 1 s	kA_{rms}	_____
	• Rated dynamic current	kA_{peak}	_____
3.	Potential transformers		
3.1	Make	-	_____
3.2	Type	-	_____
3.3	Rated transformation ratio		
	• For protection	kV/V	_____
	• For measuring	kV/V	_____
	• For AVR	kV/V	_____
3.4	Accuracy class/rated burden		
	For protection	kV/V	_____
	• For measuring	kV/V	_____
	• For AVR	kV/V	_____
4.	Surge arrestors		
4.1	Rated voltage (U_r)	kV	_____
4.2	Maximum continuous operating voltage (U_c)	kV	_____
4.3	Nominal discharge current (8/20 µs)	kA	_____
4.4	Pressure relief rated current	kA_{rms}	_____
4.5	Line discharge class	-	_____
2.1.4	**Informative data**		
1.	Grounding transformer (if applicable)		
1.1	Rated continuous power (both winding)	kVA	_____
1.2	Rated voltages (no-load)		
	• HV winding	kV	_____
	• LV winding	V	_____
2.	Grounding resistor (if applicable)		
2.1	Resistance	ohm	_____
2.2	Rated voltage	V	_____
2.3	Maximum continuous current	A	_____
2.4	Maximum current for one minute	A	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
3.	Dimensions		
3.1	Dimensions of complete 3-phase PT and Surge protection cubicle		
	• Length	mm	_____
	• Depth	mm	_____
	• Height	mm	_____
3.2	Dimensions of the neutral grounding Cubicle		
	• Length	mm	_____
	• Depth	mm	_____
	• Height	mm	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
2.2	**Excitation and AVR system**		
2.2.1	**Guaranteed characteristics**		
1.	General		
1.1	Manufacturer	-	_____
1.2	Place of manufacture	-	_____
1.3	Type designation	-	_____
1.4	Applicable standards	-	_____
2.	Main data		
2.1	Ratings of excitation system at rated generator output and power factor (hot rotor winding)		
	- Field voltage	V	_____
	- Field current	A	_____
	- Field power	kW	_____
2.2	Ceiling voltage in per units of rated Field voltage		
	- Ceiling voltage at no load	p.u	_____
	- Ceiling voltage at rated load	p.u	_____
2.3	Field current at rated ceiling voltage	A	_____
2.4	Excitation system voltage repose Ratio	l/s	_____
2.5	Response time to reach 95% of the difference between rated ceiling voltage and full load field voltage	s	_____
2.6	Time to each +0.5% of ceiling Voltage from rated field voltage	s	_____
2.7	Maximum time period for operation at Ceiling voltage without damage	s	_____
2.8	Date of excitation system at 110% rated generator terminal voltage, power factor 0.9 and maximum generator power		
	- Field voltage	V	_____
	- Field current	A	_____
2.9	Maximum continuous output Capability of one 100% excitation		
	- Maximum field current	A	_____
	- Maximum field voltage	V	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
2.10	maximum duration of over excitation period	s	_____
2.11	Time to reach 5% limit of generator terminal voltage in case of load rejection	s	_____
2.12	maximum overshot of generator terminal voltage in case of load rejection	%	_____
2.13	Settling time to reach 0.5% limit of generator terminal voltage after overspread conditions	s	_____
2.14	Range of voltage level setting	%	_____
2.15	Range of manual control of excitation	%	_____
3.	Voltage Regulating System		
3.1	Voltage regulator, make	-	_____
3.2	Voltage regulator, type	-	_____
4.	Rectifier		
4.1	Type of diodess	-	_____
4.2	Ratings of diodes	-	_____
4.3	Rated current of rectifier	A	_____
4.4	rated voltage of rectifier	V	_____
4.5	Maximum safe operating temperature	˚C	_____
4.6	Maximum surge current rating	A	_____
4.7	Max. permissible duration of surge current	s	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
3.0	**Protection System**		
3.1	**Guaranteed characteristics**		
1.	General features		
1.1	Protective devices		
	a) manufacturer	-	_____
	b) entire system for same manufacturer	yes/no	_____
	c) numeric type	yes/no	_____
	d) year of commissioning of first plant with identical equipment	-	_____
	e) D.C. infeed:		
	• supply voltage	V	_____
	• D.C/D.C converter included	yes/no	_____
	• tolerance of supply voltage	%	_____
	a) overload protection	yes/no	_____
	b) short-circuit protection	yes/no	_____
	c) power consumption per cubicle	W	_____
	d) insulation acc. To IEC 255-4	yes/no	_____
	e) indication:		
	• hand reset flag	yes/no	_____
	• light emitting dioded	yes/no	_____
	a) accuracy:		
	• time error of calibration/repeatability	yes/no	_____
1.2	Protection cubicles		
	a) Type	-	_____
	b) protection class	IP	_____
	c) dimension (L/W/H)	mm	_____
	d) maximum weight	kg	_____
1.3	Trip circuit supervision		
	a) type/designation	-	_____
	b) continuous/on command	-	_____
	c) time delay:		
	• fixed setting approx.	s	_____
	d) auxiliary elements:		
	• hand reset	yes/no	_____
	e) supervision current:		
	• max. trip circuit supervision current	mA	_____
1.4	Test device		
	a) type/designation	-	_____
	b) current rating	A	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	c) current setting:		
	• differential elements	-	_____
	• differential current	%	_____
	• bias	%	_____
	d) high set overcurrent elements: operating time:		
	• less than 3 x I_N	ms	_____
	e) harmonic restraint:		
	• based on second harmonic, content included	yes/no	_____
	f) relay stability:		
	• through-fault	xI_N	_____
2.	Underimpedance relay		
	a) type/designation	-	_____
	b) setting ranges:		
	• current	xI_N	_____
	• ratio R/X	-	_____
	• time stage t_1	s	_____
	t_2	s	_____
3.	Stator 100% earth fault relay		
	a) type/designation	-	_____
	b) voltage setting	%	_____
	c) time setting	s	_____
4.	Generator bus ground fault relay		
	a) type/designation	-	_____
	b) voltage setting	%	_____
	c) time setting	s	_____
5.	Overcurrent relay		
	a) type/designation	-	_____
	b) setting range of time relay	s	_____
	c) setting range of instantaneous element	ms	_____
	d) setting range of overcurrent	%	_____
	e) setting range of instantaneous element	%	_____
6.	Overvoltage relay		

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	a) type/designation	-	_____
	b) setting ranges of the pick-up values:		
	• delayed trip	xU_N	_____
	• instantaneous trip	xU_N	_____
	c) time setting range	s	_____
	d) reset ratio	s	_____
7.	Under voltage relay		
	a) type/designation	-	_____
	b) definite time	yes/no	_____
	c) inverse time	yes/no	_____
	d) two setting levels	yes/no	_____
	e) voltage setting:		
	• setting range	% U_N	_____
	• start element reset at	% U_N	_____
	• continuously variable	yes/no	_____
	• steps	yes/no	_____
	f) operating time:		
	• continuously variable	yes/no	_____
	• steps	yes/no	_____
	• setting range	s	_____
8.	Rotor earth fault relay		
	a) type/designation	-	_____
	b) impedance setting	kOhm	_____
	c) time setting	s	_____
	d) harmonic filter	yes/no	_____
9.	Negative phase sequence relay (46)		
	a) type/designation	-	_____
	b) adjustable pick-up value:		
	• first stage	% I_N	_____
	• second stage	% I_N	_____
	c) tripping time-lag adjustable:		
	• first stage	s	_____
	• second stage	s	_____
10.	Loss of excitation and out of step relay		
	a) type/designation	-	_____
	b) setting range of pick-up generator x_d	% I_N	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	c) time setting:		
	• first stage	s	_____
	• second stage	s	_____
	d) time integrator setting:		
	• first stage	s	_____
	• second stage	s	_____
11.	Rotor excitation circuit overcurrent relay		
	a) type/designation	-	_____
	b) setting range of time relay	s	_____
	c) setting range of instantaneous element	ms	_____
	d) setting range of overcurrent	%	_____
	e) setting range of instantaneous element	%	_____
12.	Under/Over frequency relay		
	a) settings:		
	• level 1	% f_N	_____
	• level 2	% f_N	_____
	• level 3	% f_N	_____
	• level 4	% f_N	_____
	b) continuous/steps	-	_____
	c) time setting	s	_____
	d) number of steps	-	_____
13.	High-speed distance relay		
	a) type/designation	-	_____
	b) setting ranges:		
	• current	xI_N	_____
	• distance measurement	-	_____
	• ratio R/X	-	_____
	• time stage t_1	s	_____
	t_2	s	_____
	t_3	s	_____
	t_4	s	_____
	c) distance error	%	_____
	d) time error	%	_____
14.	Line earth fault relay		
	a) type/designation	-	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
	b) voltage setting	%	_____
	c) time setting	s	_____
15.	Synchro-check relay (25)		
	a) type/designation	-	_____
	b) 2 channel device	yes/no	_____
	c) independent check on criteria (3)	yes/no	_____
16.	Auto reclosing relay		
	a) type/designation	-	_____
	b) single phase AR	yes/no	_____
	c) three-phase AR	yes/no	_____
	d) dead time setting	ms	_____

ITEM	DESIGNATION	UNITS	VALUE/DESCRIPTION
4.0	**Grounding & lighting protection system**		
4.1	**Guaranteed characteristics**		
1.	Design short-circuit and ground fault Current, I s		
	- 415 V low voltage system	kA_{rms}	_____
2.	Type of earthing conductor		
	- buried in ground	-	_____
	- embedded in concrete	-	_____
	- installed above ground/floor	-	_____
3.	Material of earthing conductors		
	- buried in ground	-	_____
	- embedded in concrete	-	_____
	- installed above ground/floor	-	_____
4.	Method (type) of connection of conductors laid in ground	-	_____
5.	Expected total earthing impedance of earthing system (informative)	ohm	_____