**TECHNICAL DATA SHEETS**

*(to be filled up by the Tenderer)*

1. **Turbine, Governor and Main Inlet Valve**
   1. **Turbine**
      1. **Guaranteed characteristics**
2. General - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.1 Manufacturer - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.2 Place of manufacture - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.3 Type designation - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.4 Applicable standards - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Main data

2.1 Turbine rates output at rated net design kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

and at rated speed

2.2 Maximum continuous output at design kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

net head

2.3 Maximum continuous output at maximum kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

net head

2.4 Maximum continuous output at kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

minimum net head

* 1. Minimum output at the following heads

and at rated speed

* Minimum net head kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Maximum net head kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Rated speed rpm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  2. Maximum runaway speed at following

net head and at generator no-load

(except friction losses)

* at net maximum net head rpm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* at rates net head rpm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* at minimum net head rpm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Direction of rotation(viewed from drive end)

- \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.9 Fly wheel effect of turbine rotating parts kg m2 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.10 Fly wheel effect required from the kg m2 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

generator

1. 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 Turbine efficiency at maximum 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 % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.3 Turbine efficiency at minimum 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 % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.4 Weighted average efficiency (according

to clause 1.2.3 of specification) % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.5 Number of wicket gates pcs \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Maximum sound pressure level at a

Distance of 1 m at rated operation

* at turbine pit dB(A) \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* at draft tube manhole dB(A) \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. 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 Heaviest turbine assembly to be handled

by powerhouse crane during installation kg \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Dimensions

6.1 Turbine shaft diameter mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

6.2 Required transport opening for largest

turbine part

* weight mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* height mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  + 1. **Information data**

1. Turbine water discharge quantities

* under maximum overload operation

at maximum net head m3/s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* at maximum runaway condition m3/s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* at no-load at rated net head m3/s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Turbine runner
   1. Dimensions of

* inner inlet diameter mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* outer inlet diameter mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* discharge diameter mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* net height of inlet mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.2 Number of blades/bucket pcs \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Guide bearing
   1. Maximum temperature rise above

cooling medium, measured by embedded

temperature detectors

* at continuous rated operation K \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* at most unfavourable operating

conditions as specified K \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Losses in the bearing at rated operating kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

conditions

* 1. Quantity of cooling water required (if l/s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

applicable)

* 1. Capacity of bearing oil reservoir l \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Servomotors (Guide Vane/Runner Blade)

4.1 Number of servomotors pcs \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.2 Full stroke mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.3 Bore of cylinders mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.4 Active volume cm3 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.5 Maximum operating pressure bar \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.6 Minimum operating pressure bar \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.7 Max. operating energy per servomotor

kNm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.8 Min. operating energy per servomotor

1. Weights
   1. Total weight of complete turbine

delivery tons \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Dimensions
   1. Maximum diameter and designation of

turbine part to be removed through

generator stator bore mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Minimum distance between centerlines

of adjacent units mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* + 1. **Information to be supplied together with the bid**

At least the information listed hereunder shall be given by the tenderer. The tenderer may support advantages in his design of the delivery or of special technical features of his offer by additional documents/descriptions

1. Compute pressure rise at turbine inlet under the most unfavourable conditions (load acceptance and rejection) as per the specification. Conditions considered as well as governor acting times to be clearly indicated in the computations
2. Compute turbine speed rise under conditions as above and for following load rejection parameters

* From 115% rated output to zero
* From 100% rated output top zero
* From 80% rated output to zero
* From 60% rated output to zero

1. Expected flow characteristics during closing and opening of wicket gates as function of time
2. Expected performance curves for the rated/maximum/minimum net heads at different runner blade angles. The curves shall also show the overload output at maximum possible wicket gates opening extending beyond the guarantee points.
3. Provide dimensional drawing (cross section) of turbine and associated equipment showing main dimensions.
4. Describe proposed shaft seal system, preferably illustrated by schematic diagram. Figures of the required quantities of sealing water and / or compressed air to be given.
5. Provide information on model or field performance tests performed on a turbine which is hydraulically similar to the proposed turbine. Indicate at least the following:

* Place of model of field tests
* Year of model or field tests
* Designed rated turbine output
* Rates net head
* Rated speed
  1. **Governing System**
     1. **Guaranteed characteristic**

1. General
   1. Manufacturer

* Control unit - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Hydraulic unit - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Placed of manufacture
* Control unit - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Hydraulic unit - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Type designation
* Control unit - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Hydraulic unit - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.4 Applicable standards - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Main data
   1. Sensitivity of governor to respond to % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

Minimum speed change of rated speed

* 1. Maximum dynamic pressure for total

load rejection of both turbines working

in parallel on 110% load at maximum bar \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

net head

* 1. Maximum speed rise for total

load rejection of both turbines working

in parallel on 110% load at maximum % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

net head

2.4 Governor operating oil pressure

* minimum - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* maximum - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Range of adjustment of gain control
* Proportional gain - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Derivative gain s-1 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Integral gain s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  + 1. **Informative data**

1. Governor oil pumps

1.1 Number of main oil pumps - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.2 Type of oil pumps - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.3 Unit governor pump discharge 1/mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

at pressure bar \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.4 Power rating of main pump motor kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.5 Power rating of jockey pump motor kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Pressurised accumulator tank

2.1 Total oil volume 1 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.2 Design pressure bar \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.3 Minimum possible operating cycles of

wicket gates (close-open) without

recharging tank - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Sump tank

3.1 Total oil volume 1 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Hydraulic oil

4.1 Total quantity of oil required for

complete system including servomotors 1 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.2 Oil quantity - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Weight of complete governor actuator

cabinet with pump set equipment kg \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* + 1. **Information to be supplied together with the bid**

At least the information listed hereunder shall be given by the Tenderer. The Tenderer may support advantages in his design of the delivery or special technical features of his offer by additional documents/ descriptions.

1. Description of the governor, including schematic and block diagrams
2. Drawing showing overall dimensions and general arrangement of equipment
3. Description and technical data of the programmable, numerical type control unit
4. Applicable method and type of speed sensing equipment
5. Explanations of failsafe provisions according to the specification
6. Detail on the operating time adjustment for wicket gate closing and opening as per technical specification
   1. **Turbine main inlet valve**
      1. **Guaranteed characteristic**
7. General - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.1 Manufacturer - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.2 Place of manufacture - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.3 Type designation - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Applicable standards - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. 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 rates net head Nm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Specified turbine overload output at

rates net head Nm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* Specified turbine overload output at

rates net head Nm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. 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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Lowest factor of safety (referred to design

stress) for any hydraulically loaded part of

the valve - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Valve operating oil pressure
* minimum bar \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* maximum bar \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

**1.3.2 Informative data**

1. Head loss through the valve at a flow

required for rated turbine output

* at minimum net head m \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* at maximum net head m \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Servomotor

2.1 Make - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.2 Nominal design oil pressure bar \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.3 Active volume cm3 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.4 Range of opening time s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.5 Range of closing time s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Oil pressure unit

3.1 Number of main oil pumps - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.2 Type of oil pumps - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.3 Oil pump discharge capacity 1/min \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

at pressure

3.4 Power rating of main pump motor kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.5 Power rating of jockey pump motor Kw \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Pressured accumulator tank

4.1 Total oil volume 1 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.2 Design pressure bar \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Minimum possible operating cycles of

main inlet valve (close-open) without

recharging tank - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Sump tank

5.1 Total oil volume 1 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Hydraulic volume
   1. Total quantity of oil required for 1 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

Complete system including servomotor

6.2 Oil quality - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Weights

7.1 Weight of complete main inlet valve kg \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

7.2 Weight of complete oil pressure unit

with pump set equipment kg \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

7.3 Estimated shipping weight of valve kg \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

7.4 Maximum weight of valve assembly to

Be handled by powerhouse crane kg \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Dimensions
   1. Minimum floor opening required for

Valve installation/removal

* Width mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Length mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  + 1. **Information to be supplied together with the bid**

At least the information listed hereunder shall be given by the Tenderer. The Tenderer may support advantages in his design of the delivery or special technical features of his offer by additional documents/ descriptions.

1. Indicate type of construction for valve body and rotor
2. Describe method of operation on closure of the valve
3. Specify proposed type of by-pass valve
4. Describe method of operation of the automatic air inlet and vacuum release valve
5. Specify proposed type of service deal control valve
6. Provide dimensional drawing with cross section showing the type of trunnion seal, bearing, general arrangement of major valve parts and main dimensions
7. Provide schematic and block diagram of complete main inlet valve system
8. Indicate expected maximum dynamic and static loads on foundation for the most unfavourable conditions (opening/closure)
9. Provide information on field performance tests performed on a main inlet valve which is similar to the proposed valve. Indicate at least the following:

* Place of field test
* Year of field test
* Size of valve
* Design pressure

1. **Generator, Excitation, AVR**
   1. **Generator**
      1. **Guaranteed characteristic**
2. General

1.1 Manufacturer - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.2 Place of manufacture - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Type designation - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  2. Applicable standards - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Main data

2.1 No. of phase - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Generator continuous rating at rated

frequency and voltage and:

* 0.9 power factor (lagging) MVA \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* At unity power factor MVA \_\_\_\_\_\_\_\_\_ lagging

2.3 Rated power factor - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.4 Generator rated voltage kV \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

Guaranteed voltage range % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. 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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Efficiency
   1. Generator efficiency at rated voltage,

frequency and power factor

* at 115% continuous rated output % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

(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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Temperatures
   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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Electrical characteristics

5.1 Generator short-circuit ratio p.u \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

5.2 Generator synchronous reactance

* Direct axis p.u \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* 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 p.u \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

reactance

5.6 Generator zero phase sequence p.u \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

reactance

5.7 Ratio of X”q to X”d - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

5.8 Telephone harmonic factor as specified

in IEC-34 % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Excitation conditions
   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 MVAr \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. 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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Weight
   1. Weight of generator rotating parts

Including shafts kg \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Weight of heaviest assembly or part of

the generator to be lifted by the

powerhouse crane kg \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Weight and name of heaviest part or

assembly of the generator, as prepared

for shipment kg \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Dimensions
   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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Overall dimension of largest generator

part or assembly, as prepared for

shipment

* Length mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Height mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Width mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Segregated losses at nominal operating

conditions

* 1. Constant losses
* Core losses kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Ventilation losses kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Friction losses in top guide bearing kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Load losses
* I2R losses in armature winding

Including additional losses (corrected

For 75˚C) kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* I2R Losses in field winding (corrected

for 75˚C) kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* Excited system kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. 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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

**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 s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

(Tn)

1. 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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Maximum expected current density

(nominal operation)

* Stator winding A/mm2 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Field winding A/mm2 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. 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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Air-water heat-exchangers (stator air

Coolers)

* No of units pcs \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. 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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Thrust bearing

Total load on thrust bearing, including

rotating turbine parts and hydraulic

thrust kN \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* Number of thrust bearing pads pcs \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Specific load on thrust bearing at

nominal operation N/mm2 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* Total oil content of bearing housing l \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Generator space heaters

* Number of units pcs \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Total rating of all units kW \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Number of sections into which the

generator stator is divided (for

transportation) pcs \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. 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 Um kV \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.3 Rated frequency Hz \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Rated short duration power frequency

withstand voltage, 1 min kVrms \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Rated lightning impulse withstand

Voltage kVpeak \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.6 Applicable standards - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Current transformers

2.1 Make - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.2 Type - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. 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 kArms \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Rated dynamic current kApeak \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Line-end current transformers
* Rated primary current kApeak \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Rated secondary current A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Accuracy class/burden of CT5 -/VA \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Accuracy class burden of CT6 -/VA \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* 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 kArms \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Rated dynamic current kApeak \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. 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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Accuracy class/rated burden

For protection kV/V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* For measuring kV/V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* For AVR kV/V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Surge arrestors

4.1 Rated voltage (Ur) kV \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.2 Maximum continuous operating voltage

(Uc) kV \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.3 Nominal discharge current (8/20 μs) kA \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.4 Pressure relief rated current kArms \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

4.5 Line discharge class - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

**2.1.4 Informative data**

1. Grounding transformer

1.1 Rated continuous power (both winding) kVA \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Rated voltages (no-load)
* HV winding kV \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* LV winding V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Grounding resistor

2.1 Resistance ohm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.2 Rated voltage V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.3 Maximum continuous current A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.4 Maximum current for one minute A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Dimensions

3.1 Dimensions of complete 3-phase PT and

Surge protection cubicle

* Length mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Depth mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Height mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Dimensions of the neutral grounding

Cubicle

* Length mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Depth mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Height mm \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

**2.1.5 Information to be supplied together with the bid**

At least the information listed hereunder shall be given by the Tenderer. The Tenderer may support advantages in his design of the delivery or special technical features of his offer by additional documents/descriptions

1. Description of proposed construction and procedure for erection at site for the generator stator and rotor with view to transport limitations
2. Description of applicable stator winding insulation (material, insulation, method etc)
3. Cross section through a slot with winding
4. Description of rotor pole fitting including type of rotor rim construction
5. Description of proposed bearing insulation to prevent shaft current
6. Description of bearing seal system including measures to prevent discharge of oil from bearing
7. Description of high pressure lubrication system for the thrust bearing
8. Description and schematic diagram of the combined braking and jacking system
9. Dimensional drawing of the generator with major dimensions
10. Diagrams with electrical characteristics

* No load
* Short circuit curve
* Capacity curves (power chart) for rated output to normal factor and 0.9/1.0/1.1xnormal voltage
* Load curves (V-curves)
* Inverse current I2=f(t)

1. Calculated no load harmonics in the voltage wave form
2. Supporting documents for the guarantor output and efficiencies (reference)

**2.2 Excitation and AVR system**

**2.2.1 Guaranteed characteristics**

1. General

1.1 Manufacturer - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.2 Place of manufacture - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Type designation - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  2. Applicable standards - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. 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 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Field current at rated ceiling voltage A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.4 Excitation system voltage repose

Ratio l/s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Response time to reach 95% of the

difference between rated ceiling

voltage and full load field voltage s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Time to each +0.5% of ceiling s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

Voltage from rated field voltage

* 1. Maximum time period for operation at s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

Ceiling voltage without damage

* 1. Date of excitation system at 110%

rated generator terminal voltage,

power factor 0.9 and maximum

generator power

* Field voltage V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Field current A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Maximum continuous output

Capability of one 100% excitation

* Maximum field current A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* Maximum field voltage V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. maximum duration of over excitation

period s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Time to reach 5% limit of generator

terminal voltage in case of load

rejection s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. maximum overshot of generator

terminal voltage in case of load

rejection % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. 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 % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Voltage Regulating System

3.1 Voltage regulator, make - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.2 Voltage regulator, type - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. 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 s \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

current

**2.2.2 Information to be supplied together with the bid**

At least the information listed hereunder shall be given by the Tenderer. The tenderer may support advantages in his design of the delivery or special technical features of his offer by additional documents / description

1. Description and schematic diagram of the proposed excitation system including field flashing equipment.
2. Description of the voltage regulating system giving technical characteristics and all necessary information on automatic and manual control, change over from automatic to manual control and vice versa, as well as on the protective and limiting devices
3. Describe method of equal load sharing between rectifier elements
4. Describe method used to prevent damage due to reverse field current during pull-out conditions
5. Information on field winding monitoring system
6. Describe method used to provide a signal to annunciate failure of diode and/or fuse

**3.0 48V DC system**

**3.1 Guaranteed characteristics**

1.1 Make - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.2 Type designation - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.3 Applicable standards - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.4 Number of batteries - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.5 Battery cells

* type of cells - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* number of cells per battery - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
  1. Battery data
* rated voltage UN V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* floating charging voltage V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* maximum variation of voltage under

all conditions of service % UN \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* normal charging current A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* maximum permissible charging

current A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* battery capacity at 25˚C

1. at 10 hours Ah \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
2. at 1 hour Ah \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1.7 Maximum permissible ambient

temperature ˚C \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. 48 V DC main distribution board

2.1 Manufacturer - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.2 Type designation - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.3 Number of boards - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.4 Number of outgoing feeders - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.5 Rated voltage - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* 1. Power frequency withstand voltage,

1 min kV \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.7 Rated current of incoming and busbar A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

2.8 Short-circuit withstand current (1 s) kA \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

1. Static inverter

3.1 Manufacturer - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.2 Type designation - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.3 Applicable standards - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.4 Number of inverters - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.5 DC supply

* input voltage V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* maximum admissible variation of

input voltage % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* input current at rated output A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.6 AC output

* rated voltage UN V \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* number of phases - \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* rated frequency fN Hz \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* rated output kVA \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

at power factor cosphi \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

* rated current IN A \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.7 Voltage stability of load variation from

no-load to full load %UN \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.8 Frequency stability (island operation) % fN \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.9 Range of load power factor

* inductive cosphi \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* capacitive cosphi \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.10 Short time overload capability

* for 1 second % IN \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
* for 1 minute % IN \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

3.11 Maximum distortion factor of voltage

wave form % \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

**4.0 Protection System**

**4.1 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 \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

c) current setting:

• differential elements - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• differential current % \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• bias % \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

d) high set overcurrent elements:

operating time:

• less than 3 x IN ms \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

e) harmonic restraint:

• based on second harmonic,

content included yes/no \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

f) relay stability:

• through-fault xIN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

2. Underimpedance relay

a) type/designation - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

b) setting ranges:

• current xIN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• ratio R/X - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• time stage t1 s \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

t2 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

a) type/designation - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

b) setting ranges of the pick-up values:

• delayed trip xUN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• instantaneous trip xUN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

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 % UN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• start element reset at % UN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• 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 % IN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• second stage % IN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

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 xd % IN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

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 % fN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• level 2 % fN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• level 3 % fN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• level 4 % fN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

b) continuous/steps - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

c) time setting s \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

d) number of steps - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

13. High-speed distance relay

a) type/designation - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

b) setting ranges:

• current xIN \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• distance measurement - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• ratio R/X - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

• time stage t1 s \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

t2 s \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

t3 s \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

t4 s \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

c) distance error % \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

d) time error % \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

14. Line earth fault relay

a) type/designation - \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

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 \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

**4.2 Information to be supplied together with the bid**

At least the information listed hereunder shall be given by the Tenderer. The Tenderer may support advantages in his design of the delivery or of special technical features of his offer by additional documents/descriptions.

1. Pamphlets of each type of the proposed protection relays as well as of cubicles assemblies for complete systems.

2. Description of the proposed power supply concept as well as of the trip function arrangement for the protection system to receive an adequate safety and some kind of redundancy or back-up protection.

3. Describe processing and indication of trip signals coming from protective devices or actuators outside of this section (e.g. transformer Buchholz relays etc.)

4. Indicate deviations from the specification.

**5.0 Grounding & lighting protection system**

**5.1 Guaranteed characteristics**

1. Design short-circuit and ground fault

Current, l s

* 415 V low voltage system kArms \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_

1. Type of earthing conductor

* buried in ground - \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_
* embedded in concrete - \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_
* installed above ground/floor - \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_

1. Material of earthing conductors

* buried in ground - \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_
* embedded in concrete - \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_
* installed above ground/floor - \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_

1. Method (type) of connection of

conductors laid in ground - \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_

1. Expected total earthing impedance

of earthing system (informative) ohm \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_