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**DEALERS & IMPORTERS OF POWER PLANTS & ALLIED MACHINERY**

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## 1 X 29.7 MVA UNUSED BRUSH make, 60 Hz, 3600 RPM, 11 kV Alternator

### GENERATOR DATA

Manufacturer .....	Brush Electrical Machines Ltd.
Type.....	BDAX 62.195ERH
Rated power @water temperature 16°C.....	29700 kVA
Rated power factor (overexcited) .....	0.8
Rated power factor (underexcited).....	0.95 as minimum
Rated voltage.....	11000 V (tolerance acc. to IEC34-1
Rated frequency.....	60 Hz (tolerance acc. to IEC34-1
Rated current .....	1558.8A
Output power versus coolant temperature curve .....	Not applicable
Number of phases.....	3
Location of line leads (facing from DE) .....	Left
Location of neutral leads (facing from DE) .....	Right
Number of poles .....	2
Rated speed.....	3600 rpm
Overspeed.....	4320 rpm
Insulation class .....	F
Winding temperature (at rated power) .....	within class B
Max. total temperature stator/rotor.....	125/130°C
Number of main terminals.....	6
Sound pressure level @ 1 m (FSNL condition) .....	85 dB(A)
Sound pressure level @ 1 m (expected at FSFL condition).....	88 dB(A)
Vibration limits at site .....	ISO10816
Vibration limits (acceptance at Manufacturer workshop).....	IEC34-14
Protection degree .....	IP55 (IP56 for J.Boxes)
Type of construction.....	IM1005

Cooling type .....ICW71  
 Neutral.....Grounded see para. 6.3  
 Rotation direction facing the generator from (main) DE .....CCW (Counterclockwise)  
 Generator phase sequence .....U-V-W  
 Bearing type.....Sleeve  
 Bearing housing type.....End shield  
 Bearing lifting provision.....Not required  
 Thrust bearing.....Required  
 Lubrication .....Forced  
 Paint requirement.....Manufacturer standard for Offshore  
 Final colour.....RAL9002  
 Certificate of conformity.....3rd party certification acc. To IEC  
 required. ATEX certification for instruments and relevant JB's.

**Excitation system**

Type.....Brushless  
 Supply.....PMG  
 Current boosting (referred to rated current).....300% lasting 10 sec

**Terminal boxes**

**5.3.1. Line side cubicle**

Position (facing from DE)..... Left  
 Material..... Stainless steel AISI 316L  
 Bus duct connection..... Not applicable  
 Cable connection ..... N°4 cables 1x 300 mm<sup>2</sup> per phase  
 Cable entry.....Bottom by MCT frames and rubbers to be  
 included in the supply.  
 Space for CTs .....Required see para. 6.1.1  
 Space for PTs..... Required see para. 6.2  
 Surge capacitors and lightning arresters.. Required  
 Cable terminations .....Not required  
 Stress relieving cones .....Not required  
 Anticonsensation heaters.....Required – 230Vac 1Ph+N 60Hz  
 Breather and Drain..... Required  
 Handles on removable plates .....Required if terminal box cover plate

dimensions exceed 300 mm x 250 mm

(length x height)

Supporting structure.....Required if necessary

Lifting lugs.....Required

Protection degree .....IP56

Provision for installation of IRIS condition monitoring system Required

### 5.3.2. Star point side cubicle

Position (facing from DE)..... Right

Material..... Stainless steel AISI 316L

Cable connection ..... N° 1x300 mm<sup>2</sup>

Cable entry.....Bottom by MCT frames and rubbers to be included in the supply.

Space for CTs .....Required see para. 6.1.1

Space for neutral grounding equipment... Required see para. 6.3

Cable terminations..... Not required

Stress relieving cones .....Not required

Anticondensation heaters.....Required – 230Vac 1Ph+N 60Hz

Breather and Drain..... Required

Handles on removable plates .....Required if terminal box cover plate

dimensions exceed 300 mm x 250 mm

(length x height)

Lifting lugs..... Required

Protection degree ..... IP56

### 5.3.3. Auxiliary junction box

Position (facing from DE)..... Left

Cable entry.....Bottom (by non-magnetic, removable undrilled gland plate)

Material..... SS AISI 316L

Drain and breather ..... Required

JB's separation ..... Control, Vibration, Power, PSD and ESD

Separate JB's for IS circuits ..... Required

Protection degree ..... IP56

### 5.3.4. Additional requirements

Line and Neutral cubicles mounted on the Generator frame

## 5.4. Cooling system

Water-cooled

Coolant type .....	Sea water
Glycol content .....	%
Inlet temperature min/max .....	4.9/16 °C
Design water temperature .....	-6/23 °C
Allowed temperature rise .....	9.5°C
Design Pressure .....	19 bar
Operating pressure .....	10 bar
Allowed water pressure drop .....	1 bar
Cooling water flow.....	14 Litres/second
Number of cooler sections .....	4 (four)
Cooler position .....	Top
Power output with one section out of service .....	70% (class B temperatures)
Fouling factor.....	m <sup>2</sup> K/Kcal
Inlet and outlet flange location (facing from DE)...	Right
Cooling water heat rejection .....	545kW @23°C

## TECHNICAL DATA

### 10.1.Electrical data

Data based on rated KVA and kV at rated temperature (29.7MVA, 11kV).

Short circuit ratio .....	(Ko) .....	0.68
Direct synchronous reactance (saturated) .....	(X <sub>dv</sub> ) .....	1.47 pu
Direct synchronous reactance (unsaturated) .....	(X <sub>di</sub> ).....	1.79 pu
Quadrature axis synchronous reactance (saturated) .....	(X <sub>qv</sub> ) .....	1.18 pu
Quadrature axis synchronous reactance (unsaturated) .....	(X <sub>qi</sub> ).....	1.64 pu
Direct axis transient reactance (saturated) .....	(X' <sub>dv</sub> ).....	<b>0.16</b> pu
Direct axis transient reactance (unsaturated) .....	(X' <sub>di</sub> ) .....	0.19 pu
Direct axis sub-transient reactance (saturated) .....	(X'' <sub>dv</sub> ) .....	0.112 pu
Direct axis sub-transient reactance (unsaturated) .....	(X'' <sub>di</sub> ).....	0.142 pu
Quadrature axis transient reactance (unsaturated) .....	(X' <sub>qi</sub> ) .....	0.28 pu
Quadrature axis sub-transient reactance (saturated) .....	(X'' <sub>qv</sub> ) .....	0.14 pu
Quadrature axis sub-transient reactance (unsaturated) .....	(X'' <sub>qi</sub> ).....	0.17 pu
Negative sequence reactance (saturated) .....	(X <sub>2v</sub> ) .....	0.109 pu
Negative sequence reactance (unsaturated) .....	(X <sub>2i</sub> ).....	0.138 pu
Zero sequence reactance (saturated) .....	(X <sub>0v</sub> ) .....	0.063 pu

Zero sequence reactance (unsaturated) .....	(X0i).....	0.063pu
Potier reactance .....	(Xp) .....	0.165 pu
Leakage reactance (overexcited).....	(Xlmoex) .....	0.070 pu
Leakage reactance (underexcited).....	(Xlmuex) .....	0.070 pu
Positive sequence resistance at rated current @ 75°C/125°C.....	(R1).....	0.0055/0.0064 pu
Negative sequence resistance at rated current @ 75°C/125°C ....	(R2i) .....	0.0245/0.0284 pu
Zero sequence resistance at rated current @ 75°C/125°C .....	(Roi) .....	0.0082/0.0096pu
Armature windings D.C. resistance @ 100°C.....	(Ra).....	0.0019/--- pu
Armature windings D.C. resistance @ 75°C/125°C .....	(Ra1) .....	0.0018/0.0021pu
Excitation windings D.C. resistance @ 75°C/125°C.....	(Rf) .....	0.033/0.038 pu
Rotor iron resistance .....	(Ri) .....	0.00012 pu
Direct axis short circuit transient time constant.....	(T'd) .....	0.56 sec
Direct axis three-phase short circuit transient time constant .....	(T'd3) .....	0.56 sec
Direct axis line-to-line short circuit transient time constant.....	(T'd2) .....	1.10 sec
Direct axis line to neutral short circuit transient time constant ...	(T'd1) .....	1.31 sec
Direct axis open circuit transient time constant @ 125°C.....	(T'do) .....	5.5 sec
Direct axis open circuit transient time constant @ 100°C.....	(T'do1) .....	5.9 sec
Quadrature axis short circuit transient time constant.....	(T'q) .....	0.28 sec
Quadrature axis open circuit transient time constant .....	(T'qo) .....	2.4 sec
Direct axis short circuit sub-transient time constant.....	(T''d).....	0.04 sec
Direct axis open circuit sub-transient time constant.....	(T''do).....	0.05 sec
Quadrature axis short circuit sub-transient time constant.....	(T''q).....	0.04 sec
Quadrature axis open circuit sub-transient time constant.....	(T''qo).....	0.05 sec
Armature short circuit time constant.....	(Ta) .....	0.20 sec
Armature three phase short circuit time const. @ 100°C/125°C .....	(Ta3) .....	0.15/0.14 sec
Armature line to line short circuit time const. @ 100°C/125°C.....	(Ta2) .....	0.15/0.14 sec
Armature line to neutral short circuit time const @ 100°C/125°C...	(Ta1) .....	0.13/0.12 sec
Excitation windings open circuit time constant .....	(Tfdo).....	7.8 sec
Excitation windings short circuit time constant .....	(Tfd) .....	0.56 sec
Damping equivalent circuit open circuit time constant .....	(Tkdo) .....	0.05 sec
Damping equivalent circuit short circuit time constant .....	(Tkd) .....	0.04 sec
Stator windings thermal time constant.....	(T).....	45 min
Rotor windings thermal time constant .....	(Tj) .....	30 min
Rotor short time thermal capacity .....	(I <sub>r</sub> ) <sub>2t</sub> .....	33

Generator phase capacitance to ground .....	0.11 $\mu$ F
Three phase short circuit current at full load (peak value) .....	13.6 pu
Three phase short circuit current at full load (max rms value) .....	9.6 pu
Three phase short circuit current at full load (steady state rms value) .....	3.0 pu

### Mechanical data

Constant of inertia (H) (based on Generator only shaft inertia) .....	0.89 kWsec/KVA
Generator inertia (J=WR <sup>2</sup> ) .....	370 Kgm <sup>2</sup>
Shaft end torsional stiffness (coupling side).....	2.3E7 Nm/rad
Shaft material yield strength .....	510 Mpa
(Shall be $\geq$ 460 Mpa)	
Thrust load during operation.....	-- kN
First/Second critical speed .....	_____ rpm
Allowable axial displacement (internal/external) from magn. center.....	+/- _____mm
Shaft elongation (from cold to operating conditions) .....	3 mm
Generator rated torque .....	63 kNm
Breakaway start-up torque (if Jacking oil is not provided).....	2.4 kNm
Vibration at full load (rms value).....	2.8 mm/sec
Bearing type .....	Sleeve
Bearing diameter DE/NDE.....	200 mm
Bearing length DE/NDE.....	148 mm
Bearing static load DE/NDE .....	40,000 N
Bearing journal displacement (from cold to operating conditions) .....	0.5 mm
Bearing maximum allowable load.....	_____N
Bearing pressure.....	13.8 Kg/cm <sup>2</sup>
Bearing oil supply pressure.....	1.5 bar
Bearing oil inlet/outlet temperature .....	54 °C
Bearing max. temperature .....	95 °C
Bearing stiffness and damping coefficients Vs rotating speed (from 800 up to 1.5 times operating speed) .....	To be provided (see relevant document, item 21 required on para. 13)
Air gap.....	29 mm

### 10.3.Dimensions

Length.....	6079 mm
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Width..... 2200 mm  
 Height..... 3000 mm  
 Rotor withdrawal distance from generator centerline..... 8000 mm

**Weights**

Stator ..... 29500 Kg  
 Rotor..... 8170 Kg  
 Total ..... 46050 Kg  
 Max weight for lifting (Generator less cooler) ..... 46100 Kg  
 Max weight for transportation (Generator less cooler)..... 46100 Kg

**10.5. Excitation equipment**

**10.5.1. Generator field**

Field excitation current at full load ..... 802 A  
 Field excitation voltage at full load ..... 127 V

**10.5.2. Exciter**

Manufacturer and model..... Brush / BX 10.13-3S  
 Rated power..... 123 kW  
 Exciter current at full load ..... 882 A  
 Exciter voltage at full load..... 140 V  
 Rated frequency..... 180 Hz

**10.5.3. PMG**

Manufacturer and model..... Brush/MXI 44.07-A1  
 Rated power..... 3.6 KW  
 Rated current..... 15 A  
 Rated voltage ..... 240 V  
 Rated frequency..... 480 Hz

**10.5.4. Excitation system performances (with A.V.R. in operation)**

Excitation system response speed..... 2.9 sec-1  
 Ceiling value at full load..... 228 V  
 Max transient over voltage at 25 % step load increase..... \_\_\_\_\_  
 Max transient over voltage at 100% load rejection..... 14 %  
 Max voltage drop at \_\_\_\_\_ kW motor starting..... \_\_\_\_\_ %  
 Recovery time at \_\_\_\_\_ kW motor starting..... \_\_\_\_\_ sec

**Efficiency**

Load..... 100 % 75 % 50 % 25 %

Efficiency @ rated p.f.(0.8) ..... 97.89% 97.75% 97.26% 95.39%  
Efficiency @ 1.0 p.f. .... 98.37% 98.14% 97.55% 95.60%  
Guarantee on efficiency .....Required

**PHOTOGRAPH :**



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