Technical Data

B 2385 — NORTH BRANCH

Appendix

Capability Diagram
Steam Pressure and Temperature Limits
Feed Water Treatment
Lubricating Oil Requirements
Conservation During Storage, Erection and Stand-still

Turbine system (20)

HP Turbine

Turbine: ABB STAL, type VAX HT40

Rated economical output, turbine coupling	56 900	kW
Rated maximum output, turbine coupling	57 700	kW
Rated speed	6 317	rpm
Maximum continuous speed	6 380	rpm
Overspeed trip setting	6 950	rpm
Normal inlet steam pressure	1 450	psig
Normal inlet steam temperature	950	°F
Exhaust pressure, economical load	95	psig
Axial clearance in thrust bearing	0.5	mm

HP Turbine gear

Reduction gear: Flender-Graffenstaden, type TRL 71/68

Rated load (inkluding service factor 1.1)	62 700	kW
Speed, in	6 317	rpm
Speed, out	3 600	rpm

Turning gear

Motor rating (AC motor)	30	kW
Speed, in	1 800	rpm
Speed, out	65	rpm

Turbine system (20) (Continued)

LP Turbine

Turbine: ABB STAL, type VAX LT33

Rated output, turbine coupling	40 390	kW
Rated speed	3 600	rpm
Maximum continuous speed	3 636	rpm
Overspeed trip setting	3 960	rpm
Inlet steam pressure, economical load	94	psig
Inlet steam temperature, economical load	370	°F
Exhaust pressure	1.96	psia
Axial clearance in thrust bearing	0.6	mm

Limitation of variation from rated steam pressure and temperature according to I.E.C. publ. 45, see attached excerpt.

Regarding steam quality and feed water treatment, see attached instruction K-3787-1.

Gland Steam System (31)

Gland steam condenser

Heat exchanged	543	kW
Cooling medium flow	1 330	US gpm
Cooling medium inlet temp.	148	°F
Cooling medium outlet temp.	151	°F
Pressure drop, tube side	1.5	psi
Operating pressure, shell side	13.9	psia
Design pressure, tube side	325	psig
Design pressure, shell side	14.5	psig

Gland steam condenser fan

Motor rating	4	kW
Power consumption	3	kW
Exhaust damp air flow	310	cfm
Exhaust damp air density	0.051	lb/ft^3
Exhaust damp air temperature	167	°F
Max. allowable pressure drop in exhaust pipe	0.03	psi

Lubrication system (32)

Recommended makes of oil — see attached instruction VTI 3200-3.

General

Oil tank capacity	3 960	USG
First filling	3 960	USG
Oil grade	ISO	VG 32
Oil pressure before bearings and gear	20	psig
Oil temperature before bearings and gear	113	°F
Nominal temperature rise	36	°F
Negative pressure in oil tank	3 - 4	" w. c.

Main oil pumps (Data for one pump)

Capacity	600	US gpm
Delivery head	68	psi
Motor rating (AC motor)	60	hp
Power consumption	38	Bhp
Speed	3 500	rpm

Emergency oil pump

Capacity	500	US gpm
Delivery head	30	psi
Motor rating (DC motor)	20	hp
Power consumption	16	Bhp
Speed	3 500	rpm

Jacking oil pump

Capacity	0.37	US gpm
Motor rating (AC motor)	1.12	kW
Power consumption	≈ 1	kW
Speed	1 200	rpm

Lubrication system (32) (Continued)

Bearing squeeze film pump

Capacity	5.7	US gpm
Motor rating (AC motor)	11	kW
Power consumption	≈ 8	kW
Speed	1 800	rpm

Oil filter

Pressure drop	7	psi
Filter mesh size	10	µm nom.

Oil vapor fan

Exhaust air flow	212	cfm
Max. allowed pressure drop in exhaust pipe	0.04	psi
Motor rating	0.9	kW
Power consumption	< 0.9	kW

Oil coolers (Data for one cooler)

Number of coolers	2	
Heat exchanged	1 355	kW
Cooling water flow	514	US gpm
Cooling water inlet temperature	95	°F
Cooling water outlet temperature	113	°F
Pressure drop, tube side	7	psi
Design pressure, tube side	150	psig

Hydraulic system (33)

General

Oil tank capacity	105	USG
First filling	105	USG
Oil grade:	ISO	VG 32
Min. oil temperature at start	60	°F
Max. oil temperature	158	°F

In-line filter

Filtration, absolute	3	µm

Return filter

Filtration, absolute	10	µm

Accumulator

Number of accumulators	1	
Nominal volume	10.6	USG
Charging pressure	580	psig

Pumps (Data for one pump)

Number of pumps	2	
Capacity	9.5	US gpm
Discharge pressure	1 450	psig
Motor rating (AC motor)	7.5	kW
Power consumption	2 - 7.5	kW
Speed	1 800	rpm

TECHNICAL SPECIFICATION FOR TURBO GENERATOR OG 130-163

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Design
Approved

1.	GENERAL INFORMATTION	
1.1	Reference number	L 8861.0009
1.2	Plant	North Branch
1.3	Turbine type	ABB Stal VAX

2.	GENERAL DATA AND RATING DETAILS	
2.1	Generator type for steam turbine	GTL 1350GK
2.2	Rated output at incoming cooling water temperature of 35.0 C	110000 kVA
2.3	Power factor	0.85
2.4	Rated speed	3600 r/min
2.5	Rated frequency	60 Hz
2.6	Rated voltage and voltage range	13.80 kV + 5.0 / - 5.0 %
2.7	Standards	ANSI C50.13
2.8	Insulation class stator	F
	rotor	F
2.9	Arrangement	IM 1006
2.10	Protection form	IP 54
2.11	Cooling form	CACW

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3. PERFORMANCE CHARACTERISTICS

3.1 Permissible output in kVA at different temperatures of cooling air

PF	Cooling medium temperature 45 C	C	C	C	Temperature guarantee as below
0.85	110000				1, 3

Temperature guar. 1 Acc. to temperature class B + 5 C
Temp. in stator winding measured with ETD between coil sides. 115 C

Temperature guar. 3 Acc. to temperature class B
Temp. in rotor winding measured by rotor winding resistance. 125 C

3.2 Performance curves

3.2.1	No load and short circuit saturation	GKE 54851
3.2.2	V-curves	GKE 54852
3.2.3	Reactive capability diagram	GKE 54853
3.2.4	Efficiency curves	GKE 54854

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4. LOSSES

Losses in kW at winding temperature of 95 C. 1 p.u. load = 93500 kW

PF	Load p.u. 1.00*	0.75	0.50	0.25
0.85	1574*	1346	1179	1073

The above losses include bearing and exciter losses.
Losses guaranteed according to ANSI

5. REACTANCES

r.c.v. = rated current value (unsaturated)
r.v.v. = rated voltage value (saturated)

5.1	Direct axis synchronous	Xd	1.88 p.u.
5.2	Quadrature axis synchronous	Xq	1.70 p.u.
5.3	Transient, r.v.v.	X'd	0.18 p.u.
5.4	Subtransient, r.v.v.	X"d	0.13 p.u.
5.5	Negative sequence, r.v.v.	X2	0.13 p.u.
5.6	Zero sequence, r.c.v.	X0	0.07 p.u.
5.7	Short circuit ratio	Kc >	0.58 p.u.

6. ROTOR DATA

6.1	Moment of inertia, generator- + exciter rotor	WR^2	2067 kgm2
6.2	Overspeed during 2 min		4320 r/min
6.3	Rotation direction as seen from exciter side	clockwise	

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7. SPECIAL OPERATION CONDITIONS

7.1	Voltage regulation, rated load to no load	36 %
7.2	Unbalanced fault capability,(I2/IN)^2*t	20 secs
7.3	Maximum I2/IN for continuous operation	8.0 %
7.4	Max. short circuit current at 3-Phase shortt circuit of unloaded generator excited to rated voltage 1/2 period after occurence of short circuit	97 kA

7.5 Air gap torque at short circuit between 2 phase terminals at rated load, 13800 V and 0.85 p.f.

$$M_{d2p} = (2050e^{-2.8t} + 400e^{-31t})*\sin wt - (860 + 330e^{-29t} + 30e^{-57t})*\sin wt + 280 + 430e^{-4.8t} + 55e^{-29t} \text{ kNm}$$

This torque includes the remaining load torque calculated as half of rated load torque.

Max. value M_{d2p} = 3785 kNm after 1 / 180 sec.

8. EXCITATION

8.1	Excitation system	brushless excitation
8.2	Excitation voltage and current, generator no load, rated voltage	52 V 480 A
	rated load and power factor	175 V 1209 A
8.3	Main exciter	290 kVA * 0.85 155 V 240 Hz
8.4	Pilot exciter, PMG	5.3 kVA 3 - phase 255 V 420 Hz

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9	MECHANICAL SPECIFICATION	
9.1	Scope of delivery	
9.1.1	Generator	XO 160650-BH
9.1.2	Excitation system	XO 141024-EC
9.1.3	Spare parts	XO 106041-49 XO 106044-49 XO 106045-49 XO 106046-49
9.2	Testing: Routine test according to	4104001-94E
9.3	Cooling data	
9.3.1	Cooling water requirement	288 m^3 / h
9.3.2	Pressure drop on water side of cooler	28 kPa
9.3.3	Output with one cooler disconnected on the water side at 0.9 p.f.	81600 kVA
9.3.4	Cooler type and number	4 pcs QLKC 23-8-6-0-2-2-2-6
9.3.5	Material of tubes tube plates fins reversing chambers	CU / Ni 90/10 Munts Metal (SIS 5163-02) Aluminium Plastic coated steel
9.4	Bearings	
9.4.1	Insulated bearings, number	3 pcs
9.4.2	Insulated coupling to turbine required	yes
9.4.3	Oil flow required to generator bearings exciter bearing Total	280 l/min 40 l/min 320 l/min

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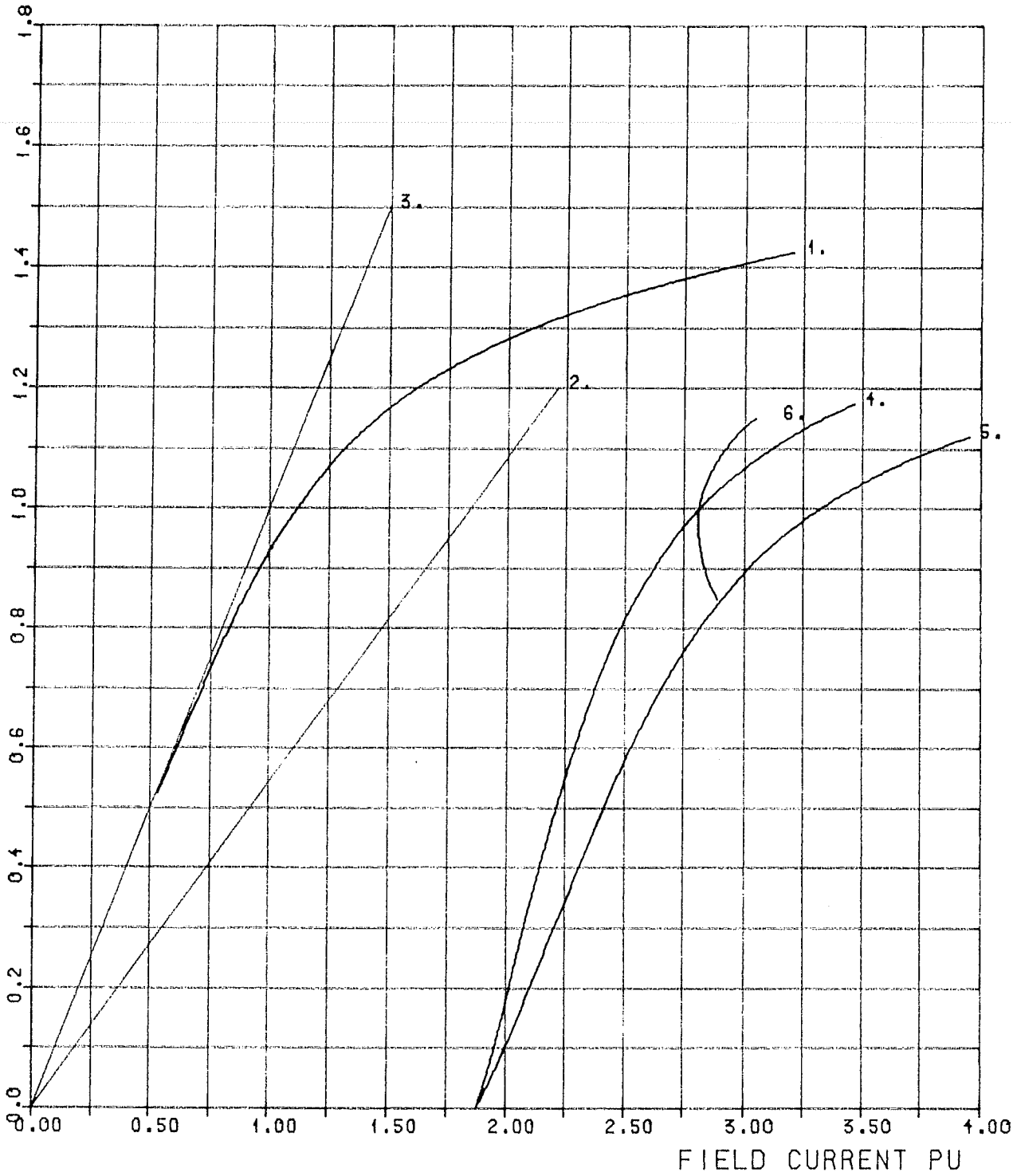
10. ACCESSORIES

10.1	Stator winding: Resistance element with terminals at connection box ZAA1	6 pcs Pt 100
10.2	Cooling air: Resistance element with terminals at connection box ZAA1	6 pcs Pt 100
10.3	Bearing: Resistance element with terminals at connection box ZAA7 (LP-end) ZAA8 (HP-end) ZAA9 (Exciter bearing)	2 x 3 pcs Pt 100
10.4	Vibration detectors on all bearings: Velocity vibration tranducers Proximity vibration tranducers	
10.5	Anti condensation heater in generator in exciter	8 pcs each 460 V, 750 W 1 pcs 460 V, 300 W

11. ERECTION INFORMATION

11.1	Dimensions and weights according to dimensional drawing	4235 035-10
11.2	Erection instructions	2096 089-8

12. Brochure OG01 - 0007E



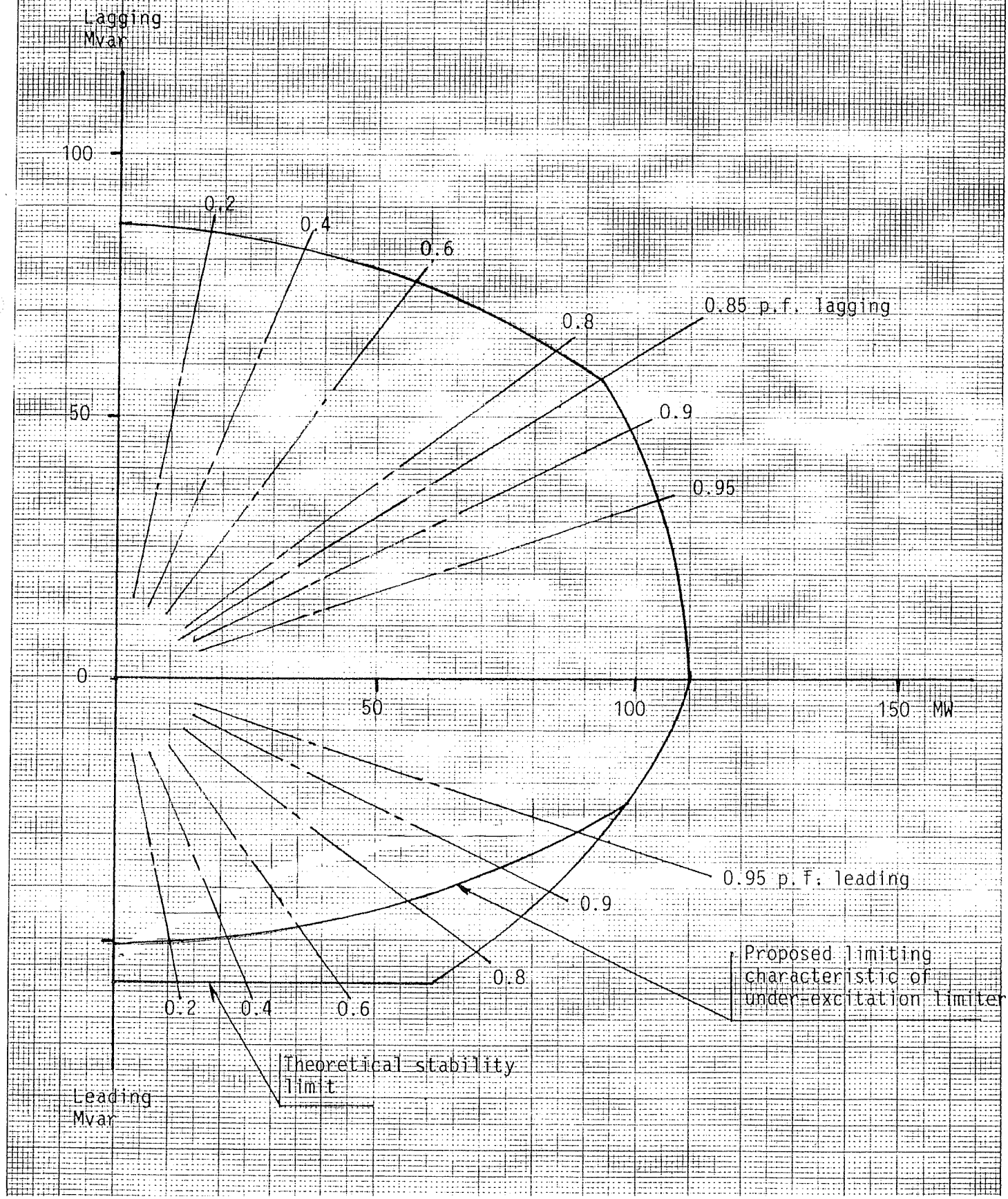
1. OPEN -CIRCUIT SATURATION
2. SHORT-CIRCUIT SATURATION
3. AIR-GAP LINE

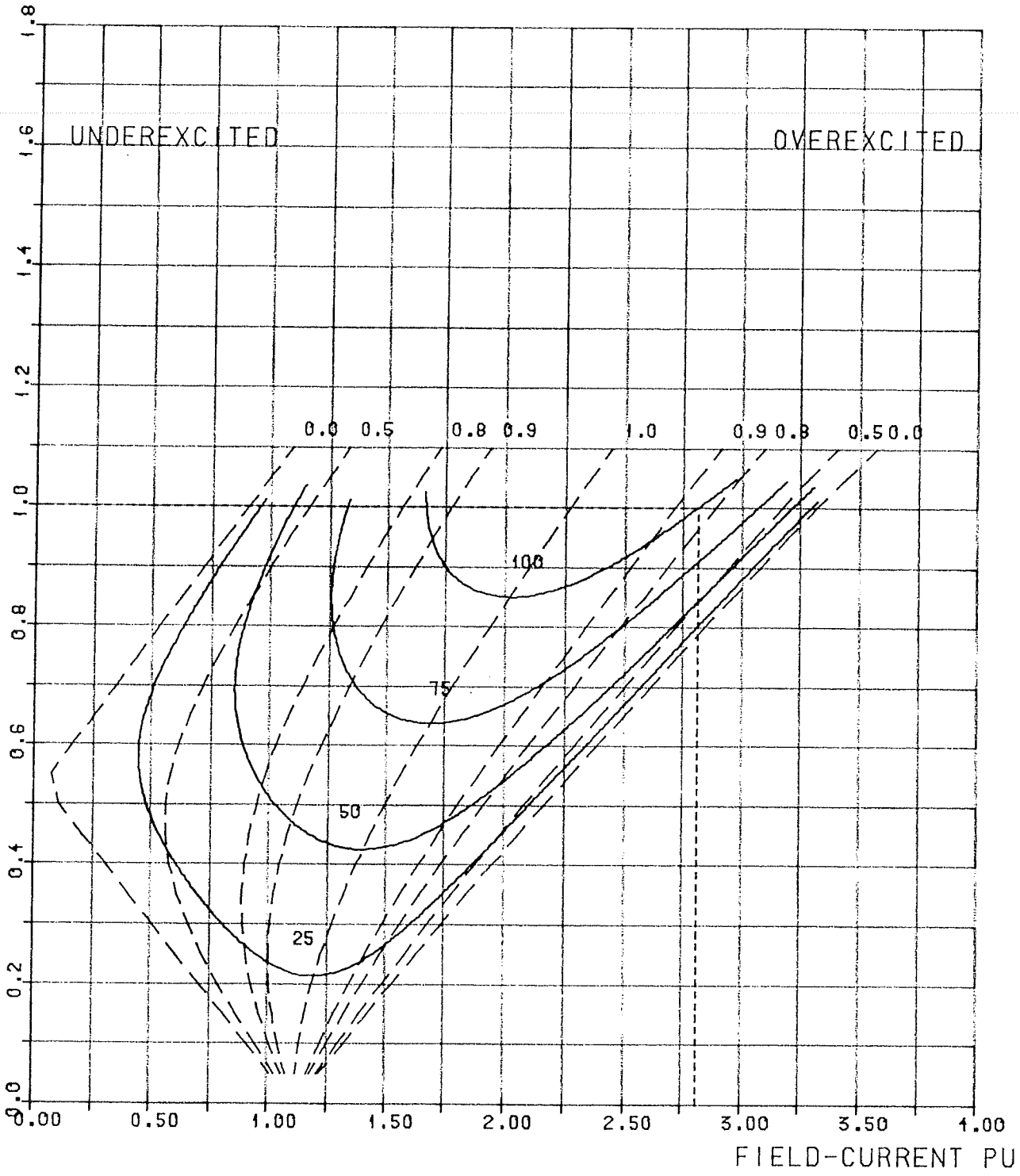
RATED-CURRENT SATURATION AT
4. PF = 0.85
5. PF = 0.00 LAGGING
6. RATED-OUTPUT SATURATION
   ARMATURE VOLTAGE IPU = 13800 V
   ARMATURE CURRENT IPU = 1602 A
   FIELD CURRENT IPU = 430 A

GEN/GKE gm	SATURATION CURVES	North Branch
ABB GENERATION	GTL 1350GK 110000 KVA 0.85 PF 13800V	89-02-03

ASEA BROWN BOVERI	891031	110 000 kVA, 0.85 p.f., 13 800 V 60 Hz, 3600 r/min	GKE 54853 L8861.0009

CAPABILITY DIAGRAM AT 13800 V

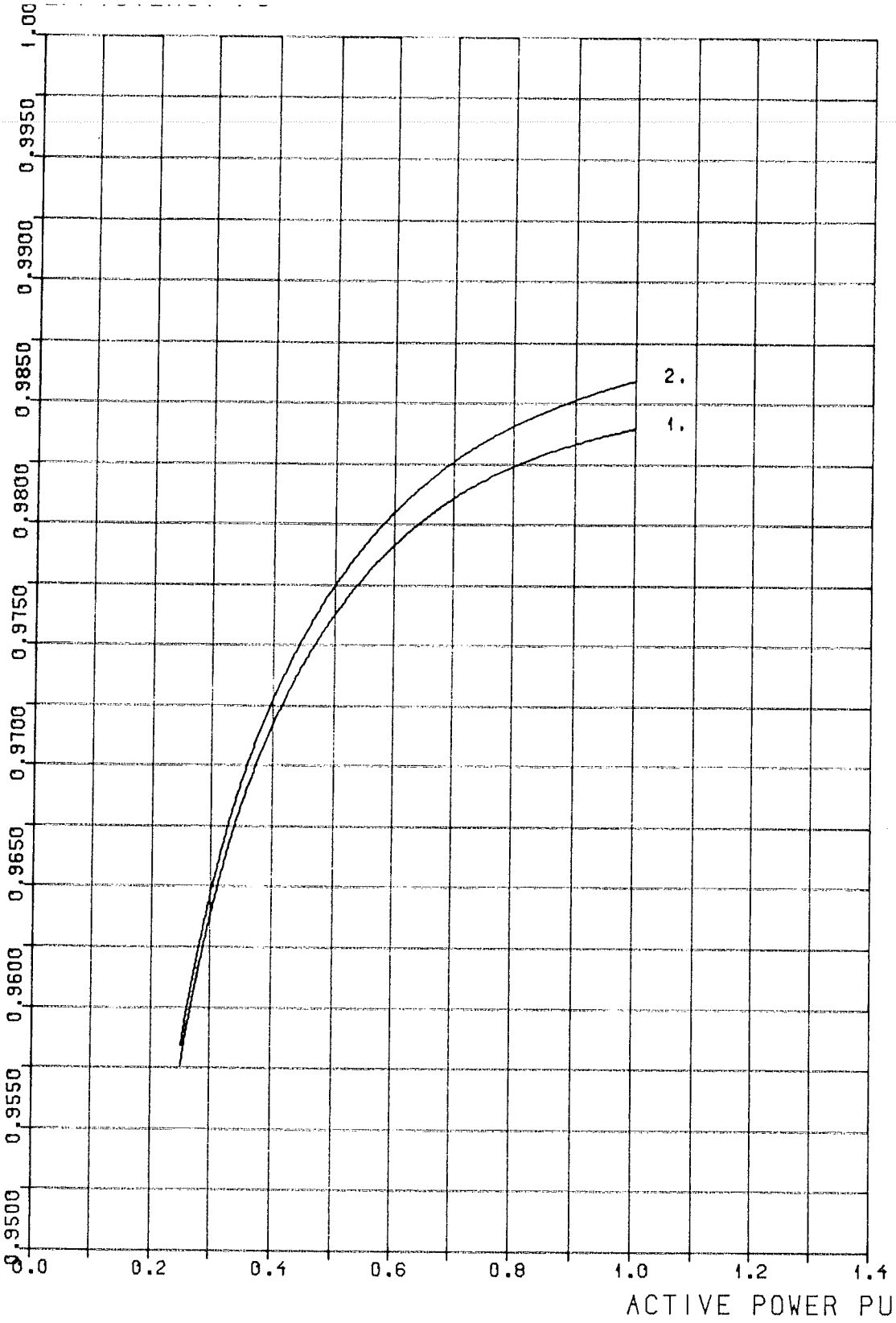




ACTIVE POWER CURVES:
25/50/75/100% OF RATED ACTIVE POWER

ARMATURE CURRENT 1PU = 4602 A
FIELD CURRENT 1PU = 430 A

GEN/GKE	V-CURVES	North Branch
ABB GENERATION	GTL 1350GK 110000 KVA 0.85 PF 13800V	89-02-03



1. PF = 0.85
2. PF = 1.00

ACTIVE POWER 1PU = 93500 KW

GEN/GKE	EFFICIENCY CURVES	North Branch
ABB	GTL 1350GK 110000 KVA 0.85 PF 13800V	89-02-03

DATA SHEET AND TUBE CONNECTIONS

OUTLINE DRAWING 4205 035-10
EXCITER TYPE GDL 520 C
PILOT EXCITER TYPE GU 250 RT

WEIGHTS (maintenence weights)		(KG)	(LBS)
STATOR EXCL. COOLERS AND COOLER HOUSING		99400	219139
ROTOR EXCL. EXCITER ROTOR		21920	48325
EXCITER ROTOR		1620	3571
BEARING BRACKETS	(2)	4700	10362
BEARINGS COMPLETE	(2)	520	1146
SCREEN PLATES	(2)	280	617
OIL GRAVITY TANKS	(2)	210	463
FAN COUVERS	(2)(incl.in stator)	300	661
EXCITER HOUSING COMPLETE		2025	4464
SUPPORT BEARING COMPLETE		575	1268
COOLER HOUSING INCL. COOLERS		9400	20723
AIRDUCTS	(2)	100	220
GENERATOR COMPLETE		140750	310300
MAX. WEIGHT HOIST		133660	294669

ROTOR DIMENSION PRINT L8861.0009-1/XO 103 042-50
CONTROL WIRING DIAGRAM 4270 221-14
LIST OF APPARATUS 5660 006-4

GENERATOR STATOR HEATERS 460 V; 8x 750 W
EXCITER HEATER 460 V; 1x 300 W

THE TWO GENERATOR BEARINGS AND THE SUPPORT BEARING ARE INSULATED FROM EARTH.

Generator bearing at exciter end includs a squeeze film damper.

Anti-clockwise rotation seen from LP-end.

Available axial allowance in the bearings +/-19/32"(+/- 15 mm.)

Before moving the rotor axial the earth fault indication brushes should be lifted.

Painting outside according to 2065 4232-C.
Cover paint: blue

Oil gravity tank sized for 25 min. to stand still.
Jacking oil at start and low speed is required for the two generator bearings.

The exciter housing has closed air cooling integrated with the generator.
Air leakage filter is located on one of the airducts.

GENERATOR COOLER.

Heat exchanges	1470 kW
Waterflow: (95 degree F inlett temperature)	10172 cu.ft/h(288 M3/hour)
Cooling water temperature rise:	39.92 degreeF(4,4 degree C)
Cooling water pressure drop:	4 lbf/sq.in(27,6 kPa)
Design pressure	87 lbf/sq.in.(600 kPa)
Test pressure	130 lbf/in.(900 kPa)
Design tempererature (water side)	149 degree F (65 degree C)

LUBE OIL DATA.
Oil quality: ABB Generation designation 7 1201-302 (ISO VG 46)
Inlet oil pressure min. 11.6 lbf/sq.in.(80 kPa), max. 21.75 lbf/sq.in. (150 kPa)
Inlet oil temperatur: 55 degree C (min. 15, max. 70 degree C)
Outlet oil pressure 0.073 lbf/sq.in. (0,5 kPa)
Required oil quantity at 3600 rpm:

Oil flow in generator bearing (2 units)	593.3 cu.ft/h(16,8 M3/hour)
Oil flow in exiter bearing	84.7 cu.ft/h(2,4 M3/hour)
Bearing losses (total)	91,7 kW
Oil temperature rise	51,8 degree F(11 degree C)
Gravity oil tank volume (total 2x0,2 M3)	14.1 cu.ft.(0,4 M3)

JACKING OIL DATA.
One connection on each generator bearing (total 2)

Pressure	min.4350 lbf.(min.30 MPa)
Flow(per bearing)	0.0127 cu.ft/min.(0,36 l/min.)

BEARING HOUSING.

Subatmospheric pressure	-0.073 lbf/sq.in.(-500 Pa)

SQUEEZE FILM DAMPER.

Pressure	3625 lbf/sq.in.(25MPa)
Flow	0.71 cu.ft./min.(20 l/min.)

PIPE CONNECTIONS

PC	SIZE	PN	FLANGE	FUNCTION
1	40	16 bar	DIN 2633	Oil inlet, gen.bearing LP-end
2	40	16 bar	DIN 2633	Oil inlet, gen.bearing HP-end
3	25	16 bar	DIN 2633	Oil inlet, support bearing
4	125	16 bar	DIN 2633	Oil outlet, gen.bearing LP-end
5	125	16 bar	DIN 2633	Oil outlet, gen.bearing HP-end
6	65	16 bar	DIN 2633	Oil outlet, support bearing
7	40	16 bar	DIN 2633	Oil mist evakuation LP-end
8	40	16 bar	DIN 2633	Oil mist evakuation HP-end
9	25	16 bar	DIN 2633	Oil mist evakuation supp. bearing
10	D8/5mm	300 bar	Temeto	Jacking oil inlet LP-end
11	D8/5mm	300 bar	Temeto	Jacking oil inlet HP-end
12	D10/7mm	250 bar	Temeto	Jacking squeez film damper,HP-end
13	R1"	Internal threads		Drain for event. oil leakage
17	3"	150 lbs	ANSI B 16.5	Cooling water inlet
18	3"	150 lbs	ANSI B 16.5	Cooling water inlet
19	3"	150 lbs	ANSI B 16.5	Cooling water inlet
20	3"	150 Lbs	ANSI B 16.5	Cooling water inlet
21	3"	150 Lbs	ANSI B 16.5	Cooling water inlet
22	3"	150 Lbs	ANSI B 16.5	Cooling water inlet
23	3"	150 Lbs	ANSI B 16.5	Cooling water outlet
24	3"	150 Lbs	ANSI B 16.5	Cooling water outlet
25	3"	150 Lbs	ANSI B 16.5	Cooling water outlet
26	3"	150 Lbs	ANSI B 16.5	Cooling water outlet
27	3"	150 Lbs	ANSI B 16.5	Cooling water outlet
28	3"	150 lbs	ANSI B 16.5	Cooling water outlet
29	R 1/4"			Cooler draining
30	R 1/4"			Cooler draining
31	R 1/4"			Cooler draining
32	R 1/4"			Cooler draining
33	R 1/4"			Cooler draining
34	R 1/4"			Cooler draining
35	R 1/4"			Cooler venting
36	R 1/4"			Cooler venting
37	R 1/4"			Cooler venting

PIPE CONNECTIONS

PC	SIZE	PN	FLANGE	FUNCTION
38	OD8 mm			Cooler venting
39	OD8 mm			Cooler venting
40	OD8 mm			Cooler venting
41	R1/4"			Cooler,drain conn.,leakage detect.
42	R1/4"			Cooler,drain conn.,leakage detect.
43	3/4"-NPT			Connecting point for customers RTD.
44	3/4"-NPT			Connecting point for costomers RTD.