

APPENDIX I

Generator Operating Curves

DESCRIPTIVE MANUAL

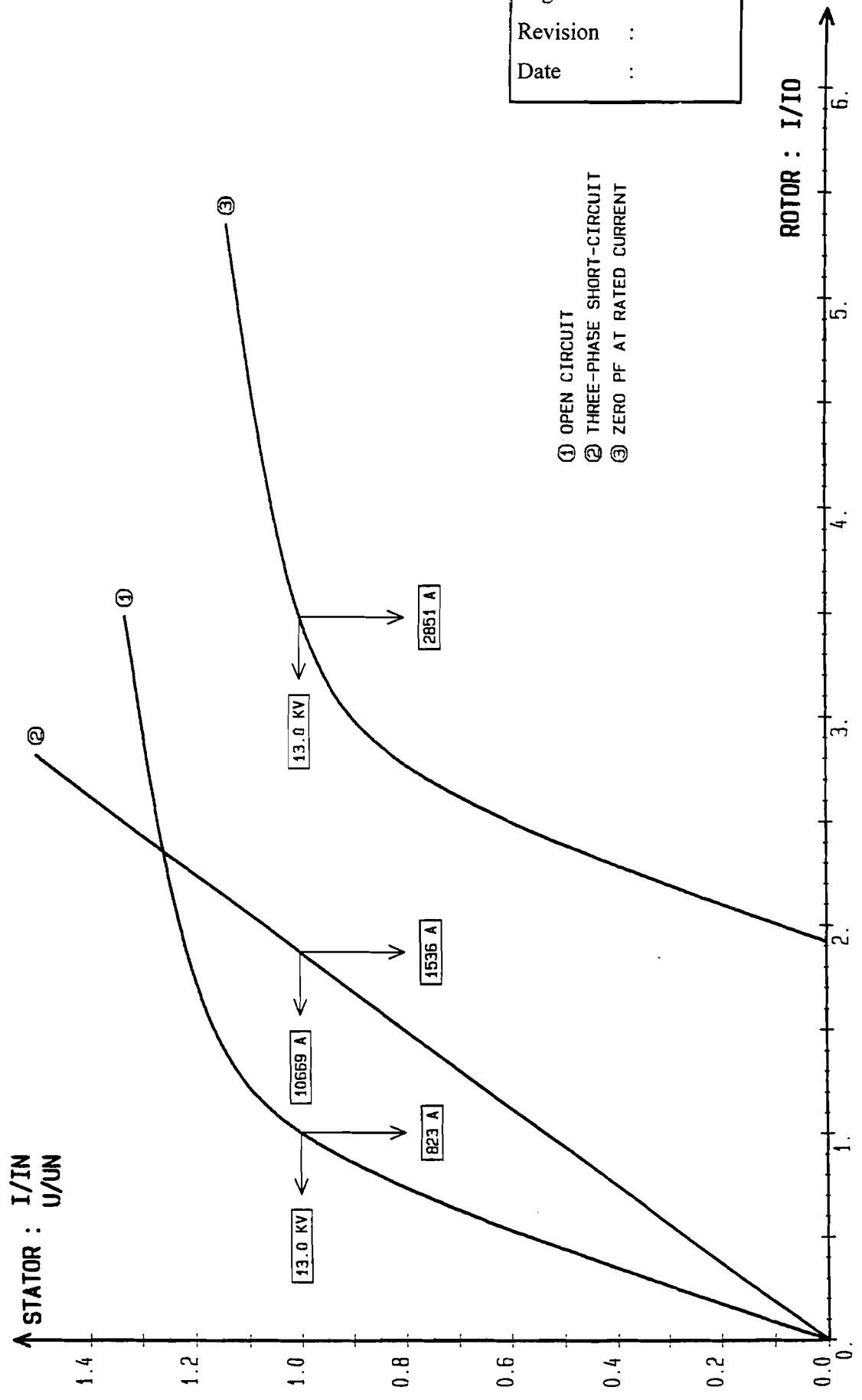
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Mod.	Chap.	Par.	
01	07		<p>OPERATING CURVES</p> <ul style="list-style-type: none"> • Saturation curves N° 33-T-5616-B • Vee curves N° 33-T-5616-C • Reactive capability curve N° 33-T-5616-D

Section : 1
 01.07
 Page : 02
 Revision :
 Date :



GTA-TC-P	LAVRION 4	GEC ALSTHOM	
13/10/94	- SATURATION CURVES -	No. 33-T-5616-B	Page 1/1
			Rev 0

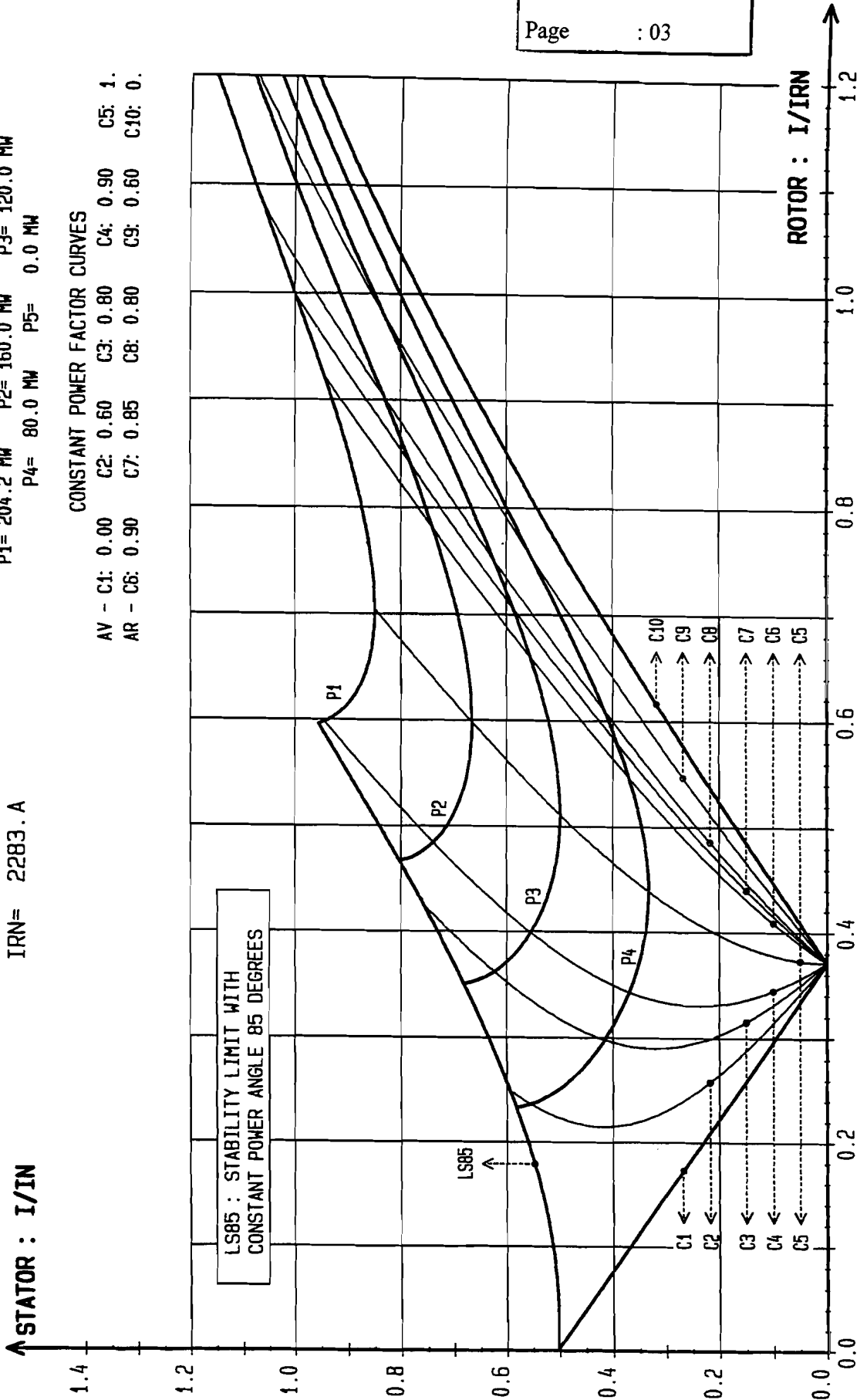
VEE CURVES AT 13.00 KV

IN = 10669. A
IRN = 2283. A

CONSTANT ACTIVE POWER CURVES
P1 = 204.2 MW P2 = 160.0 MW P3 = 120.0 MW
P4 = 80.0 MW P5 = 0.0 MW

CONSTANT POWER FACTOR CURVES
AV - C1: 0.00 C2: 0.60 C3: 0.80 C4: 0.90 C5: 1.0
AR - C6: 0.90 C7: 0.85 C8: 0.80 C9: 0.60 C10: 0.0

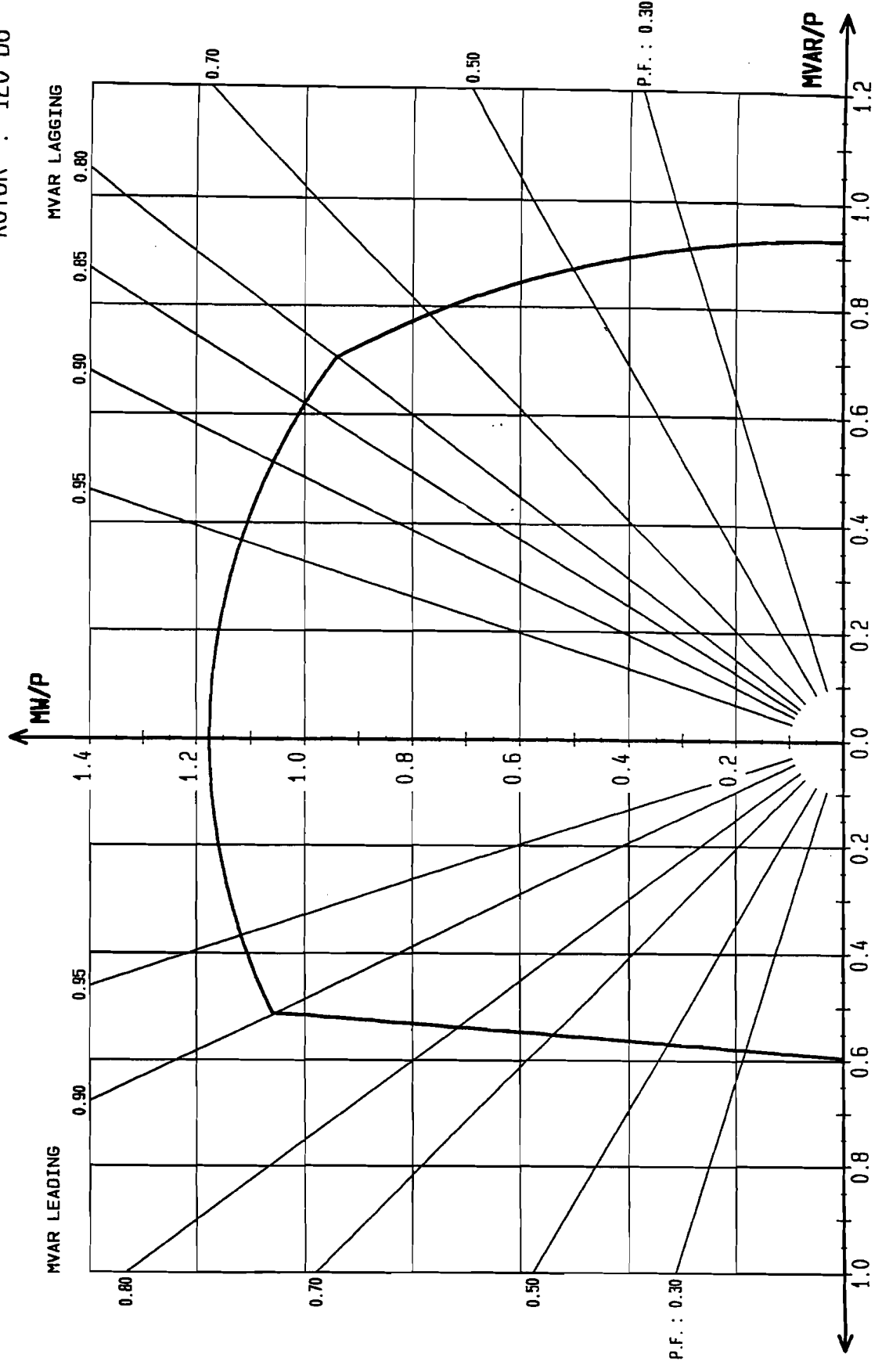
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GTA-TC-P	LAVRION 4 - VEE CURVES -	GEC ALSTHOM	
13/10/94		No. 33-T-5616-C	Page 1/1 Rev 0

POWER P= 204.200 MW
 COOLING WATER TEMPERATURE 28.0 DG - MAX. TEMPERATURES :
 STATOR : 123 DG
 ROTOR : 120 DG

CAPABILITY CURVES : ——— 13.00 KV



GTA-TC-P	LAVRION 4	GEC ALSTHOM	
13/10/94	REACTIVE CAPABILITY CURVES	No. 33-T-561.6-D	Page 1/1
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APPENDIX II

Generator main components drawings and respective parts lists

DESCRIPTIVE MANUAL

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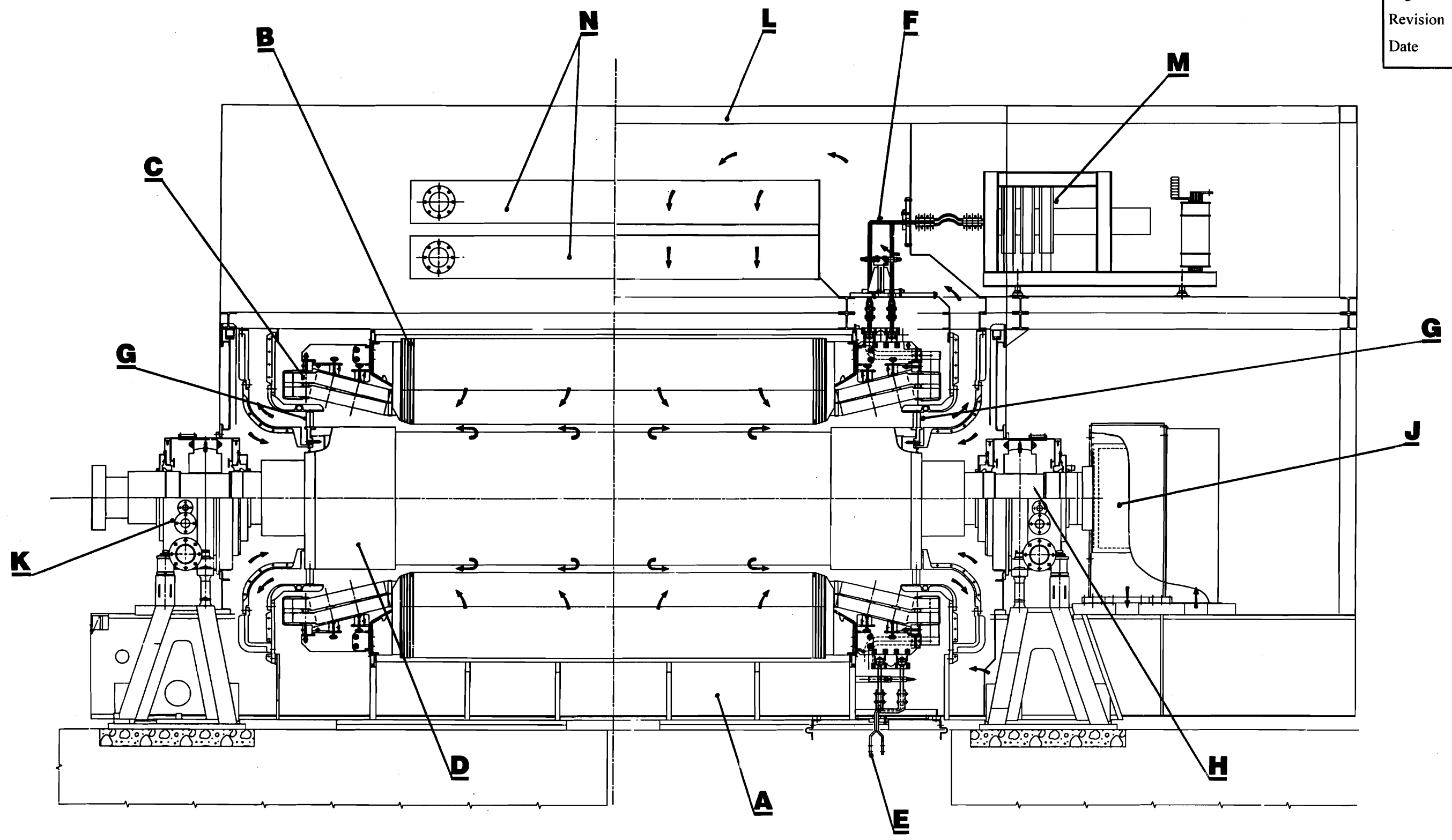
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Mod.	Chap.	Par.

01 08 LOCATION OF MAIN COMPONENTS

PART	NOMENCLATURE
A	BASE
B	MAGNETIC CORE
C	STATOR WINDING
D	ROTOR
E	PHASE OUTLET
F	NEUTRAL OUTLET
G	FANS
H	BEARING - EXCITER SIDE
J	EXCITER
K	BEARING - COUPLING SIDE
L	SOUND PROOF ENCLOSURE
M	MEDIUM VOLTAGE PLATFORM
N	COOLERS



LOCATION OF MAIN COMPONENTS

DRAWINGS

Mod.	Chap.	Par.

SUMMARY

01	DRAWING PARTS LIST
01	GENERATOR

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Mod.	Chap.	Par.

01 01 GENERATOR

DESIGNATION	PAGE
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Mod.	Chap.	Par.

01 01 SOLE PLATE ARRANGEMENT

39-603 182 (E)

ITEM	DESIGNATION	QTY
A	Sole plate	1
B	Plate	1
C	Sole plate	4
D	Sole plate	1
E	Screw H M 24 x 180	32
F	Plate	32
G	Pipe 13 x 48 L = 3 M	1
H	Dowel	64
J	Screw H M 8 x 25	64
K	Plate	22
L	Gudgeon	8
M	Gudgeon	14
N	Blocking wedge	4
P	Nut H M 56	44
Q	Nut H M 56	22
R	Nut lock	22
S	Square	22
T	Stop	4
AA	Foundation beam	2
AB	Levalator specification	1
AC	Nut lock	8
AD	Screw H M 16 x 140	8

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DRAWINGS

Mod.	Chap.	Par.

01 01 GENERATOR POSITIONING

39-407 571 (A)

ITEM	DESIGNATION	QTY
A	Resting plate for jack	4
B	Jack support	4
C	Screw H M8x60	8
D	Nut H M8	8

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DRAWINGS

Mod.	Chap.	Par.

01 01 THERMOCOUPLES IN AIR CIRCUIT

39-603 547 (B)

ITEM	DESIGNATION	QTY
A	Dual thermocouple	7
B	Extension Cable L = 100 m	1
D	Thermocouple support	2

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DRAWINGS

Mod.	Chap.	Par.
01	01	

01 01 CORE AND STATOR WINDING PROBES

39-103 300 (C)

ITEM	DESIGNATION	QTY
A	3-tube flange	36
B	Screw H M6x10	72
C	Flexible pipe 10x13 L = 18 m	1
D	Brass end	72
E	2-tube flange	9
F	Clip	200
P	Araldite glue AV 138 M	250 g
Q	Hardening compound HV 998	100 g
R	Tape 0.22x20 L = 30 m	1
S	Varnished, glass cloth sheath L = 450 m	1
T	Thermocouple	18
U	Thermocouple L = 17 m	18
AD	Araldite glue AY 103	200 g
AE	Hardening compound HY 991	100 g
AF	Sleeve	35
AG	Sheath L = 2 m	1

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DRAWINGS

Mod.	Chap.	Par.

01

01

ROTOR GROUNDING SYSTEM

39-203 768 (A)

ITEM	DESIGNATION	QTY
A	Brush	1
B	Brush-holder support	1
C	Support	1
D	Screw H M6x50	2
E	Washer ZN8B M6	6
F	Nut H M6	4
G	Screw H M6x10	1
H	Screw H M8x70	3
J	Toothed washer DEC M6	5
K	1-hole clamp	6
L	Screw H M5x10	6
M	Toothed washer DEC M5	6
N	Screw H M8x50	2
P	Washer ZN8B M8	2
Q	Toothed washer DEC M8	5
R	Nut H M8	2
S	Connecting lug	1
T	Brush-holder	1
U	Screw H M6x30	2
V	Green/yellow cable	1
W	Tubular terminal	2

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DRAWINGS

Mod.	Chap.	Par.
01	01	

01 01 BEARING ASSEMBLY (N.D.E.)

39-603 564 (A)

ITEM	DESIGNATION	QTY
A	Bearing casing	1
B	Journal bearing clamp screw	1
C	Adjusting shim	2
E	Screw H M42x260	4
F	TREP Washer	4
G	SILICOMET JS 544 blue	As req.
H	Screw H M16x120	12
J	Washer ZN8B L16	12
K	Pin for bearing cap	2
L	Screw H M8x50	2
M	Washer ZN8B L8	2
P	Diaphragm on external side	1
Q	Diaphragm on internal side	1
R	Screw H M10x35	32
S	TREP Washer	56
T	Rubber section L = 8 m	1
U	Screw H M10x40	24
V	Outer cover	1
W	Inner cover	1
X	Plug 3/4" gas thread	1
Y	Plug 1" gas thread	1
Z	Plug 1/2" gas thread	2

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DRAWINGS

Mod.	Chap.	Par.

01 01 BEARING ASSEMBLY (D.E.)

39-603 563 (A)

ITEM	DESIGNATION	QTY
A	Bearing casing	1
B	Journal bearing clamp screw	1
C	Adjusting shim	2
E	Screw H M42x260	4
F	TREP Washer	4
G	SILICOMET JS 544 blue	As req.
H	Screw H M16x120	12
J	Washer ZN8B L16	12
K	Pin for bearing cap	2
L	Screw H M8x50	2
M	Washer ZN8B L8	2
P	Diaphragm on external side	1
Q	Diaphragm on internal side	1
R	Screw H M10x35	32
S	TREP Washer	56
T	Rubber section L = 8 m	1
U	Screw H M10x40	24
V	Outer cover	1
W	Inner cover	1
X	Plug 3/4" gas thread	1
Y	Plug 1" gas thread	1
Z	Plug 1/2" gas thread	2

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Mod.	Chap.	Par.

01

01

BEARING INSTRUMENTATION (CTN'D)

39-603 609 (A)

ITEM	DESIGNATION	QTY
A	Vibration sensor	2
B	Support	2
C	Screw	8
D	Thermocouple L = 195	2
E	Thermocouple	4
F	Reducer R 13/9 M	8
G	Judodix adapter	24
H	Gland nut D 9 M	12
J	Oil pressure switch	2
K	Immersion well	2
L	Box	3
M	Screw H M 6 x 10	12
N	Starred washer	20
P	Section G 32 L = 55	2
Q	Section G 32 L = 155	2
R	BAE stop	8
S	Junction block M 4 / 6.3	24
T	Block M 4 / 6 . P	4
U	Tag	8
V	Sarel nut DIN M 5	8
W	Short length stuffing box 16 M	2
X	Gland nut D 16 M	2
Y	Perbunan joint 16	2
Z	End flange	4

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DRAWINGS

Mod.	Chap.	Par.

01 01 BEARING INSTRUMENTATION (CTN'D)

ITEM	DESIGNATION	QTY
AA	Support	2
AB	Manometer	2
AC	Screw H M 5 x 20	12
AD	Gate valve	2
AE	Thermometer	2
AF	Short length stuffing box 11 M	6
AG	Nut H M 5 x 20	12
AH	Reducer 1/2 x 3/8	2
AJ	Cable L = 50 M	1
AK	Cable 7 x 1,5 mm ² L = 12 M	1
AL	Plug 1/2"	2
AM	Screw C M 5 x 16	10
AN	Starred washer M 5	10
AP	End plate	2
AQ	Cover	2
AR	Screw H M 4 x 10	4
AS	Nut H M 4	4
AT	Starred washer M 4	4
AU	Pipe 1/4" L = 1 M	1
AV	Union 1/4"	4
AW	Conduit	2
AX	Plug 1"	2
AY	Tube	30
AZ	Support	1

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Mod.	Chap.	Par.
01	01	

BEARING INSTRUMENTATION (END)

ITEM	DESIGNATION	QTY
BA	Screw C M 6 x 16	4
BB	Screw M 6 x 30	12
BC	Cover	2
BD	Clips H 50	8
BG	Short length stuffing box 21 M	2
BH	Gland nut D 21 M	2
BJ	Perbunan joint	2
BM	Extension cable	1
BQ	Nitrile rubber tube	1
BR	Box	4
BS	Extension cable	4
BT	Proximitior	4
BU	Box	2
BV	Support extension	4
BW	Capriplast sheath	1
BX	Judodix adapter 3/4''	4
BY	Perbunan joint	4
CB	Screw H M 6 x 16	8
CD	Cable	1
CJ	Thermometer specification	1

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Mod.	Chap.	Par.

01

01

CLAMPING OF ROTOR

36-204 235 (B)

ITEM	DESIGNATION	QTY
A	Rotor clamping system	1
B	Screw H M30x90	6
C	Washer ZN8B M30	6
D	Screw H M52x300	2
E	Nut H M52	2
F	Washer ZN8B M52	2
G	Plate	1
H	Glazed cardboard sheet 100x56	4

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Mod.	Chap.	Par.

01

01

TRANSPORT - STATOR BLOCKING SYSTEM

39-103 338 (A)

ITEM	DESIGNATION	QTY
A	Guide support	4
B	Support	4
C	Nut H M48	16
D	Stainless steel square nut lock 48	4
E	Threaded rod M48 L = 800 mm	4

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DRAWINGS

Mod.	Chap.	Par.

01 01 TRANSPORT - GENERATOR SEALING SYSTEM

39-103 339 (C)

ITEM	DESIGNATION	QTY
A	Flange 05-A PN16 BF42 ND100	2
B	Screw H M16x65	16
C	Nut H M16	16
D	Toothed washer DEC M16	16
E	Flange joint PN16 4"	2
F	Flange 05-A PN16 BF42 ND200	2
G	Screw H M20x75	24
H	Nut H M20	24
J	Toothed washer DEC M20	24
K	Flange joint PN16 8"	2
L	Plug M36x2	4
M	Plate	18
N	Fastening lug	18
P	Screw H M18x55	72

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DRAWINGS

Mod.	Chap.	Par.
------	-------	------

01

01

OIL INLET AND OUTLET ASSEMBLY (CTN'D)

39-603 523 (B)

ITEM	DESIGNATION	QTY
A	Oil outlet - N. D. E.	1
B	Oil inlet - N. D. E.	1
C	Oil outlet - D. E.	1
D	Oil inlet - D. E.	1
G	Diaphragm	1
H	Measuring diaphragm	2
J	Stainless steel flange ND 150	2
K	Stainless steel flange ND 50	2
L	Stratified pipe 16.5 x 21.8 L = 55	4
M	Stratified pipe 20.5 x 26.8 L = 63	8
N	Stratified insulation 40 x 22 x 6.3	8
P	Stratified insulation 40 x 27 x 6.3	16
Q	Stratified insulation 114 x 23 x 5	1
R	Stratified insulation 212 x 168 x 5	1
S	Flange joint 6"	5
T	Supranite gasket 212 x 168 x 2	2
U	Flange joint 2" ½	5
V	Flange joint 2"	2
W	Screw H M 16 x 50	8
X	Screw H M 16 x 55	4
Y	Screw H M 16 x 60	8
Z	Screw H M 16 x 65	8

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DRAWINGS

Mod.	Chap.	Par.

01 01 OIL INLET AND OUTLET ASSEMBLY (END)

ITEM	DESIGNATION	QTY
AA	Screw H M 16 x 80	4
AB	Screw H M 20 x 70	24
AC	Screw H M 20 x 80	32
AD	Screw H M 20 x 100	8
AE	Toothed washer DEC M 16	56
AF	Toothed washer DEC M 20	128
AG	Nut H M 16	24
AH	Nut H M 20	64
AJ	Expansion joint ND 65 (std)	1
AK	Expansion joint ND 65 (special)	1
AL	Expansion joint ND 150 (special)	1
AM	Expansion joint ND 150 (std)	1
AN	Piping support (D.E.)	1
AQ	Screw H M10x20	8
AR	Stainless steel rectangular nut lock 10-75	8
AS	Stainless steel clip 73.1+ nuts	2
AT	Piping support (N.D.E.)	1
E1	Flowmeter (N.D.E.)	1
E2	Flowmeter (D.E.)	1

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DRAWINGS

Mod.	Chap.	Par.

01 01 JACKING OIL PIPING ASSEMBLY

39-603 518 (A)

ITEM	DESIGNATION	QTY
A	Jacking oil supply - opposite turbine side	1
D	Jacking oil supply - Steam Turbine side	1
H	Clip	14
K	Steel sheet 35x42	2
L	Washer DEC M6	30

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DRAWINGS

Mod.	Chap.	Par.

01 01

OIL COUNTER FLANGES FOR GENERATOR BASE

39-408 123 (A)

ITEM	DESIGNATION	QTY
A	Stainless steel flange 11-B1PN20 ND200	1
B	Stainless steel flange 11-B1PN20 ND100	1
C	Stainless steel rectangular locking plate 20-80	24
D	Stainless steel rectangular locking plate 16-85	16
E	Flange joint PN20 8"	1
F	Flange joint PN20 4"	1

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Mod.	Chap.	Par.

01 01 COOLER INSTRUMENTATION

39-603 565 (B)

ITEM	DESIGNATION	QTY
C	Cooler connection	4
D	Screw H M20x90	32
E	Washer ZN8B M20	64
F	Nut H M20	32
G	Flange joint 8"	4
H	Grommet	1
J	Clip COLSON 9/92	10
K	Conduit Type MSB7P REF 9	1
L	Channel 30x42 L = 10 m	1
M	Screw C M5x16	6
N	Toothed washer DEC ZN8B M5	6
Q	Single thermocouple L = 195	4
R	Extension cable L = 80 m	1
S	Immersion probe 1/2" 3/4"	4
T	Thermometer	4
U	Immersion probe 1/2" 3/4"	4
V	Screw H M5x10	12
W	Washer ZN8B M5	24
X	Nut H M5	12
Y	Judodix adapter	8
Z	Butt joint PERBUNAN 9	8
AA	Flow indicator	2

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DRAWINGS

Mod.	Chap.	Par.

SUMMARY

02		DRAWING LIST
	01	GENERATOR

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DRAWINGS

Mod.	Chap.	Par.
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02 01 GENERATOR

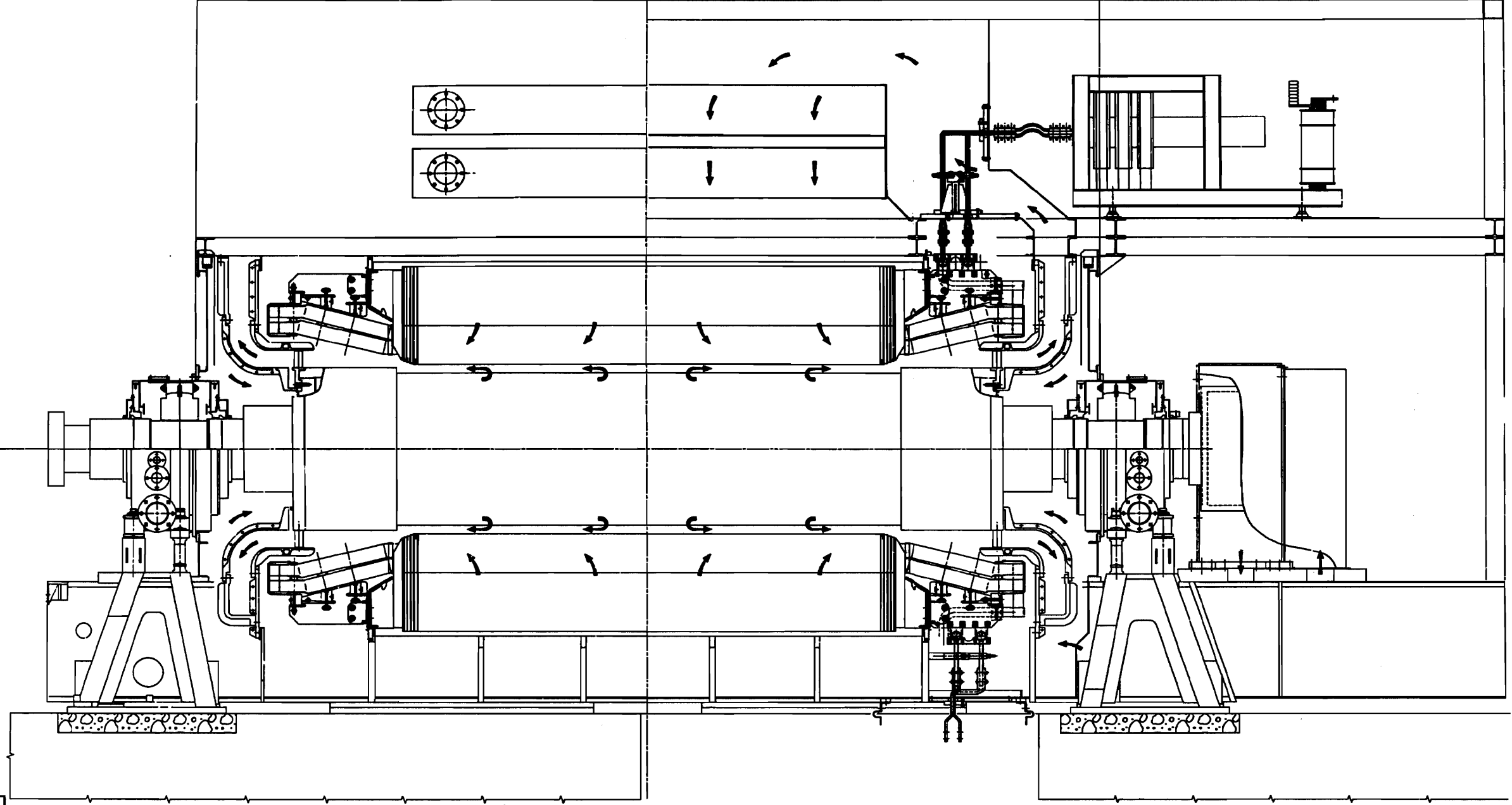
DESIGNATION	REF.	PAGE
Sectional drawing	39-603 181	02
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Sole plate arrangement	39-603 182	04
Loads on the base plates	39-305 11	05
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Generator positioning	39-407 571	07
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Thermocouples in air circuit	39-603 547	11
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Clamping of rotor	39-204 235	19
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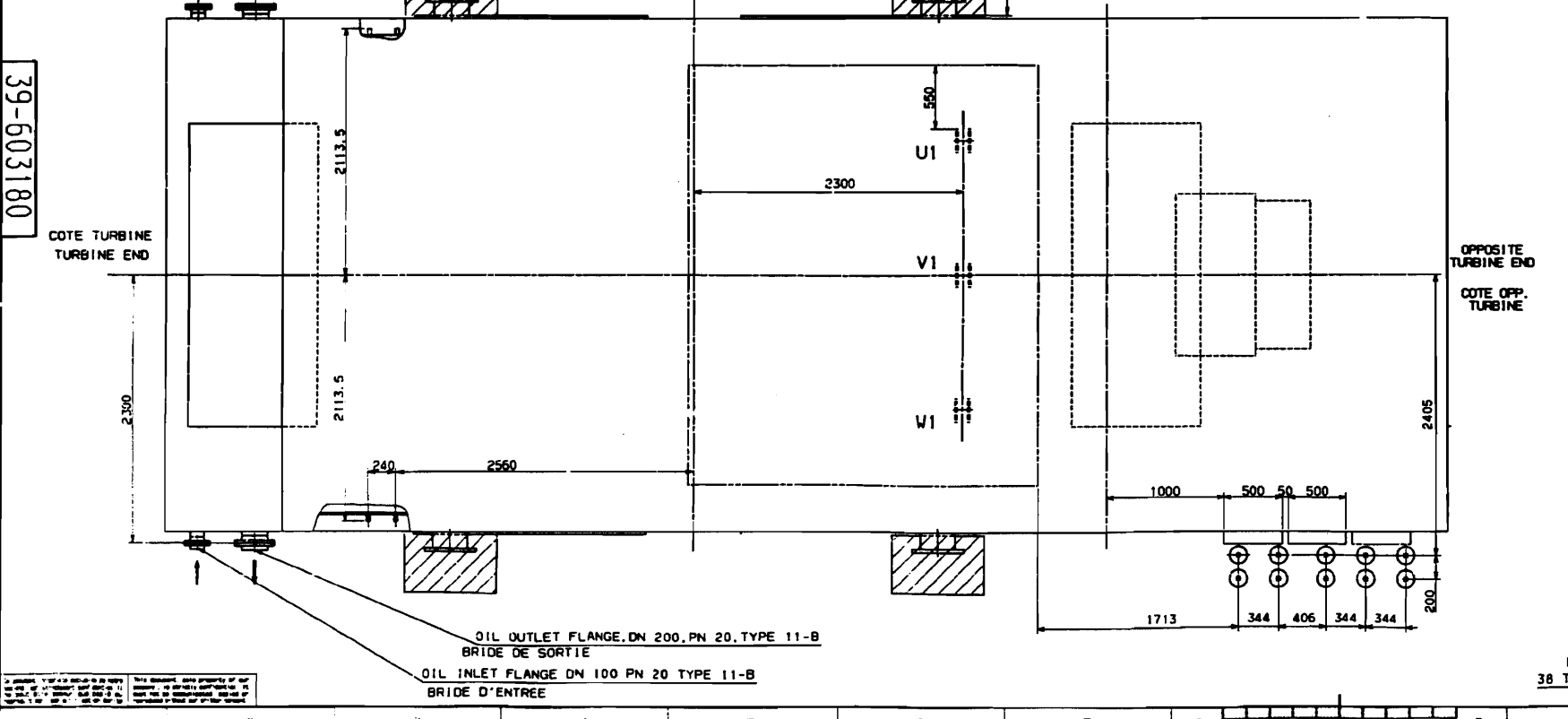
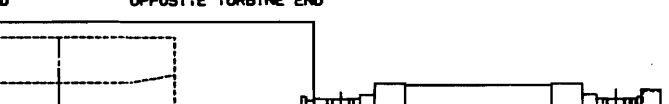
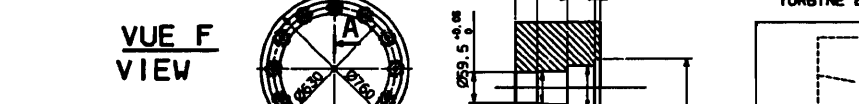
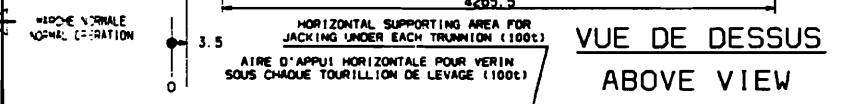
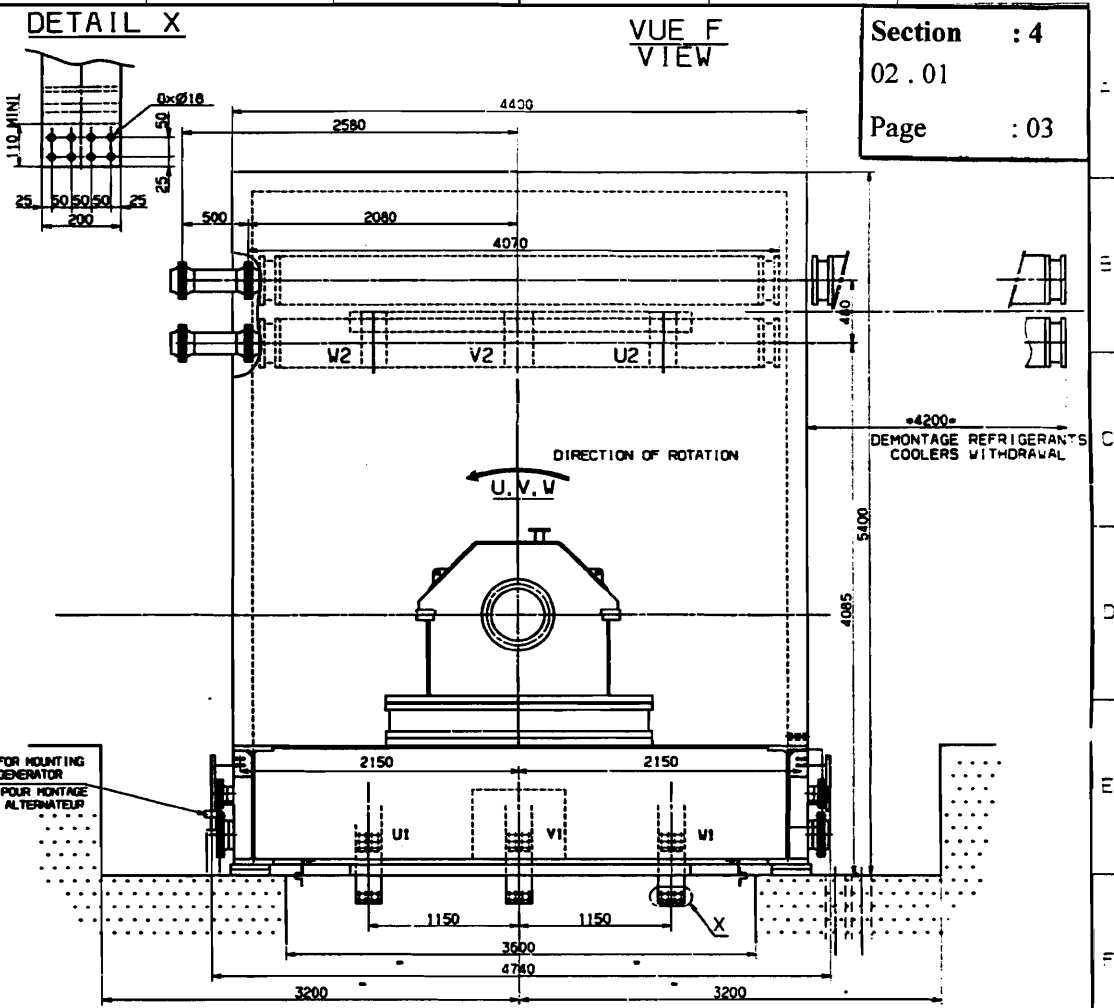
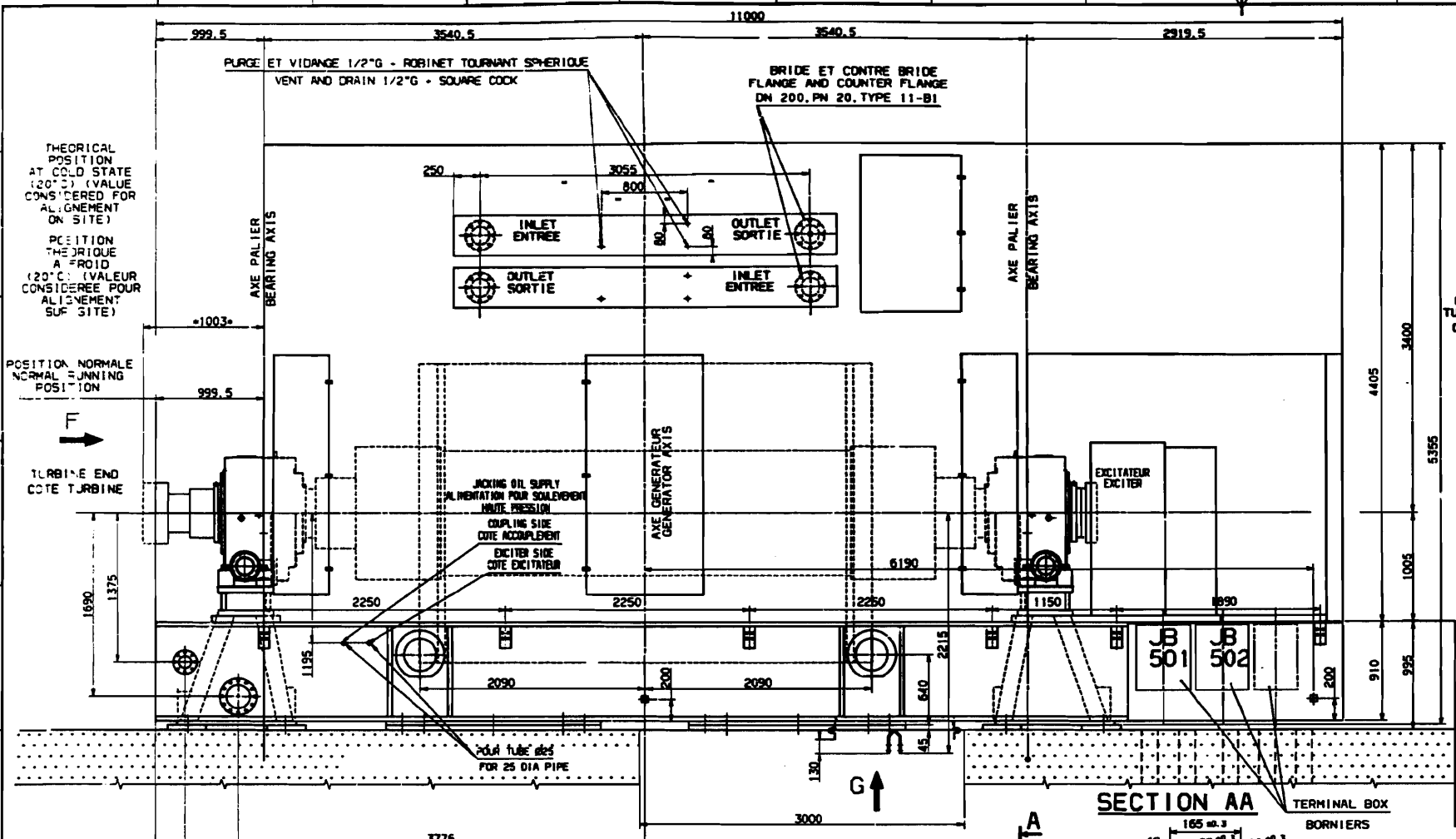
39-603181

3577

B 20/1/96 A0		AM 398690	
A 18/06/96 HD PD		FIRST ISSUE	
REV	DATE	BY	DESCRIPTION
SCALE: /		SUPPLIER NAME: BTA-RA-C	
1:1	A0	39-603181	
 PUBLIC POWER CORPORATION ATHENS GREECE LAVRION COMBINED CYCLE BLOCK - 550 MVA CONTRACT N° 02/95/003			
S. T. GENERATOR SECTIONAL DRAWING			
GECALSTROM METKA S. A.		EMG-BTA N° LAV 04 A 002 - DV GA 104 Customer number: LAV 04 A 002 - DV GA 104	
ISSUE REV: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z			
Date: 21/08/96 NOM: MOUNIER VISE: METTETAL		Date: 21/08/96 NOM: METTETAL VISE: METTETAL	
DA: 2 DESSINE/MEDIOG VERIFIE APPROUVE			
ENSEMBLE COUPE SECTIONAL DRAWING			
PRODUIT EN: 2 COEFF: 1/10 LE BLANC:		GECALSTROM 35839 A0 39-603181 0001	

55
 The drawing shall remain the property of the client. It shall not be reproduced, copied, or used in any way without the written consent of the client.

B	20/1/96	A0	AM 398690	39-603181	0001
A	18/06/96	HD PD	FIRST ISSUE		
REV	DATE	BY	DESCRIPTION		



STATOR	142000 kg
ROTOR	45000 kg
BEARINGS / PALIER	7000 kg
BASE FRAME / SOCLE	35000 kg
EXCITER / EXCITATEUR	5000 kg
HABILLAGGE CLADDING	33000 kg
DIVERSE / DIVERS	3000 kg
TOTAL	270000 kg

C	AM 39-9109	APP
B	AM 39-8690	APP
A	FIRST ISSUE	APP

3578

SCALE / REFERENCE: BTA-RA-C 39-603180

PUBLIC POWER CORPORATION
LAVRIEN COMBINED CYCLE BLOCK - 550 MW NET

**S. T. GENERATOR
GENERATOR OUTLINE**

EMCALSTROM
METKA S.A. N° LAV.04.A.GGE - GV.GA.10.1
LAV.04.A.MKA - GV.GS.10.1

28/06/95 BLINC

DATE: 28/06/95
Dessine: MOUNIER
Vérifié: METETA
Approuvé: THIOU

ENCOMBREMENT ALTERNATEUR
GENERATOR OUTLINE

EMCALSTROM
39-603180

39-603180

LAVRION

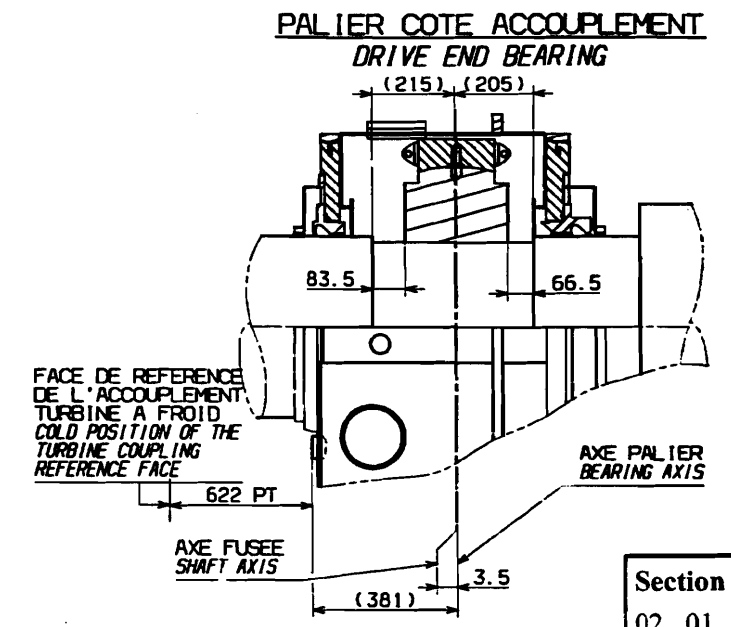
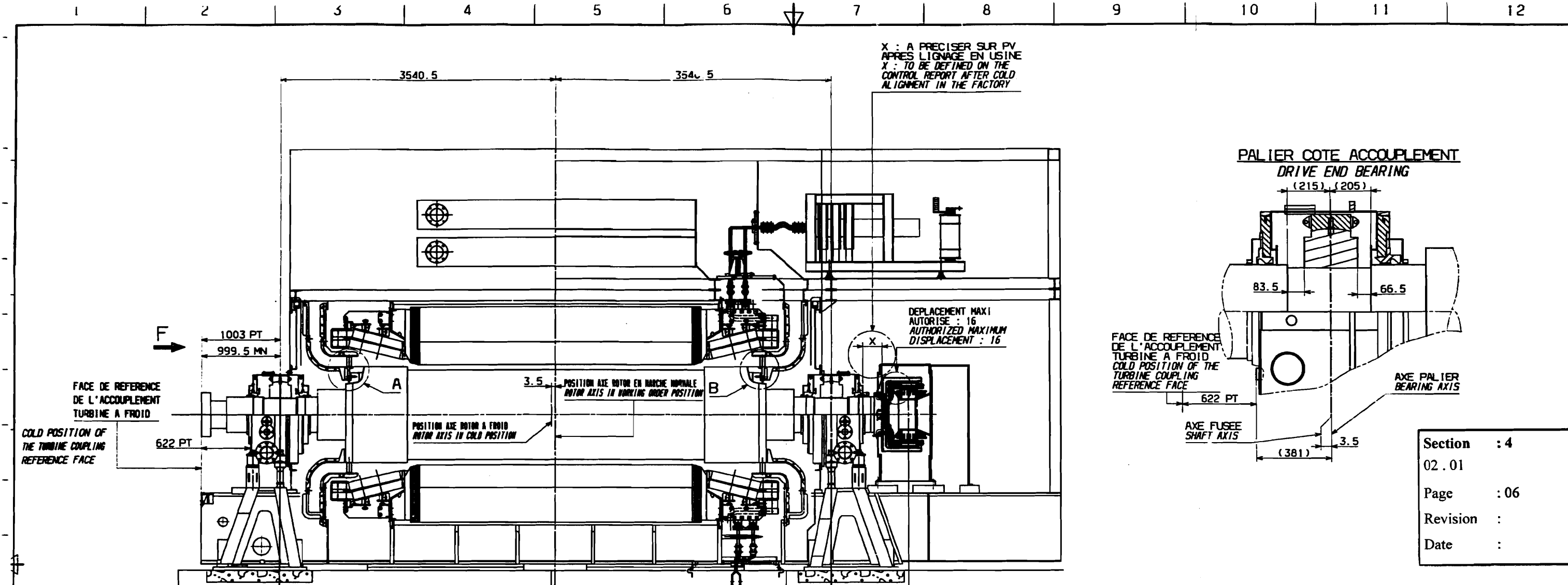
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	A1	A2	B1	B2	C1	C2	D1	D2	E1	E2	X
VERTICAL LOAD (kdaN)											
static loads	44.5	44.5	44.5	44.5	20.5	20.5	12.8	12.8	10.2	10.2	0.0
loads due to nominal torque	7.6	-7.6	7.6	-7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
loads due to gear box torque	NON APPLICABLE										
loads due to accidental torque:generator(+)	90.2	-90.2	90.2	-90.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
loads due to accidental torque:gear box(+)	NON APPLICABLE										
screwing of anchor bolts	54.8	54.8	54.8	54.8	83.7	83.7	83.7	83.7	18.3	18.3	0.0
loads due to abnormal rotor unbalance (+)	0.0	0.0	0.0	0.0	26.2	-26.2	26.2	-26.2	0.0	0.0	0.0
Static resultant in operation	106.9	91.7	106.9	91.7	104.2	104.2	96.5	96.5	28.5	28.5	0.0
HORIZONTAL LOADS (kdaN)											
loads due to thermal expansion (+-);(trans)	32.1	27.5	32.1	27.5	31.3	31.3	0.0	0.0	8.5	8.5	99.4
loads due to thermal expansion (+-);(axial)	32.1	27.5	32.1	27.5	31.3	31.3	0.0	0.0	8.5	8.5	136.3
loads due to abnormal rotor unbalance (+-); (transversal)	0.0	0.0	0.0	0.0	14.4	14.4	14.4	14.4	0.0	0.0	0.0
DYNAMIC FLEX. PLATES (microns/metric ton)											
Maximum value at nominal speed	5	5	5	5	3	3	3	3	5	5	5
Maximum value from 0 to overspeed	10	10	10	10	6	6	6	6	10	10	10
RESULTANT FORCE (vertical)											
First max	189	9	189	9	104	104	96	96	28	28	0
Second max	9	189	9	189	104	104	96	96	28	28	0

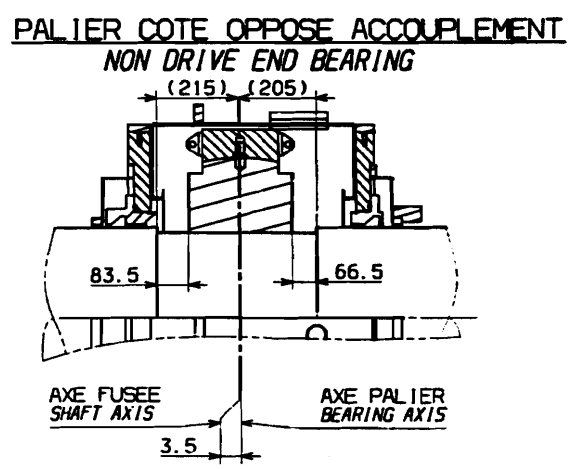
LOADS ON THE BASE PLATES

A 1ère EDITION.															
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MODIFICATIONS				MODIFIE				VERIFIE				APPROUVE			
APPROUVE				T: TRE											
VERIFIE	28-08-96	BLIND.		[Signature]				CHARGES SUR LES ASSISES							
DES./RED	28-08-96	MOUNIER.		[Signature]											
QA : 2	Dates	Noms		Visas											
INFO. INTERIE A	GIDOC	B.D.GRA	LANGUE	ECHELLE	BELFORT	GECALSTHOM									
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DOC. ORIGINE	DIFFU.	NATURE	EMETTEUR	FORIAT	SECT. DOC										
	2	P	358 39	3	39.305 111 0001 A										

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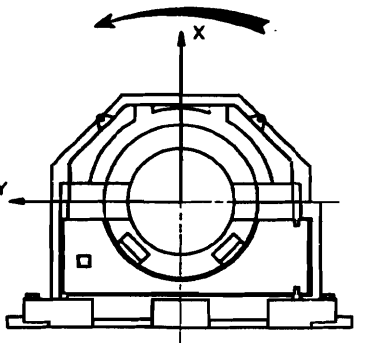
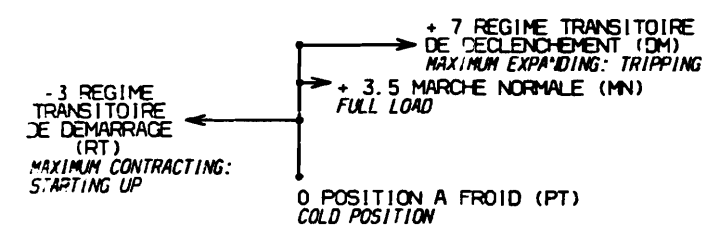


39-103326

VUE F
VIEW F

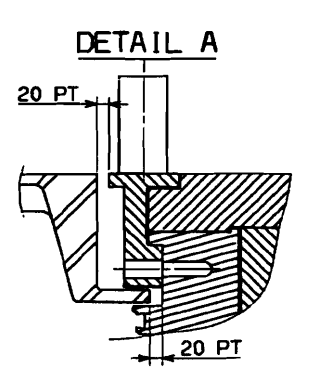
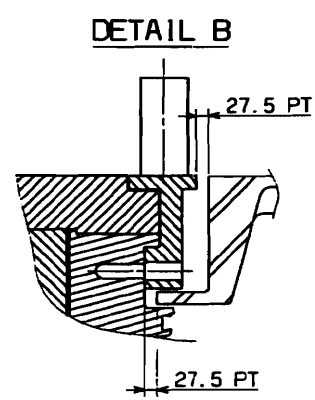
SENS DE ROTATION
DIRECTION OF ROTATION

DEPLACEMENT ACCOUPLEMENT
COUPLING DISPLACEMENT



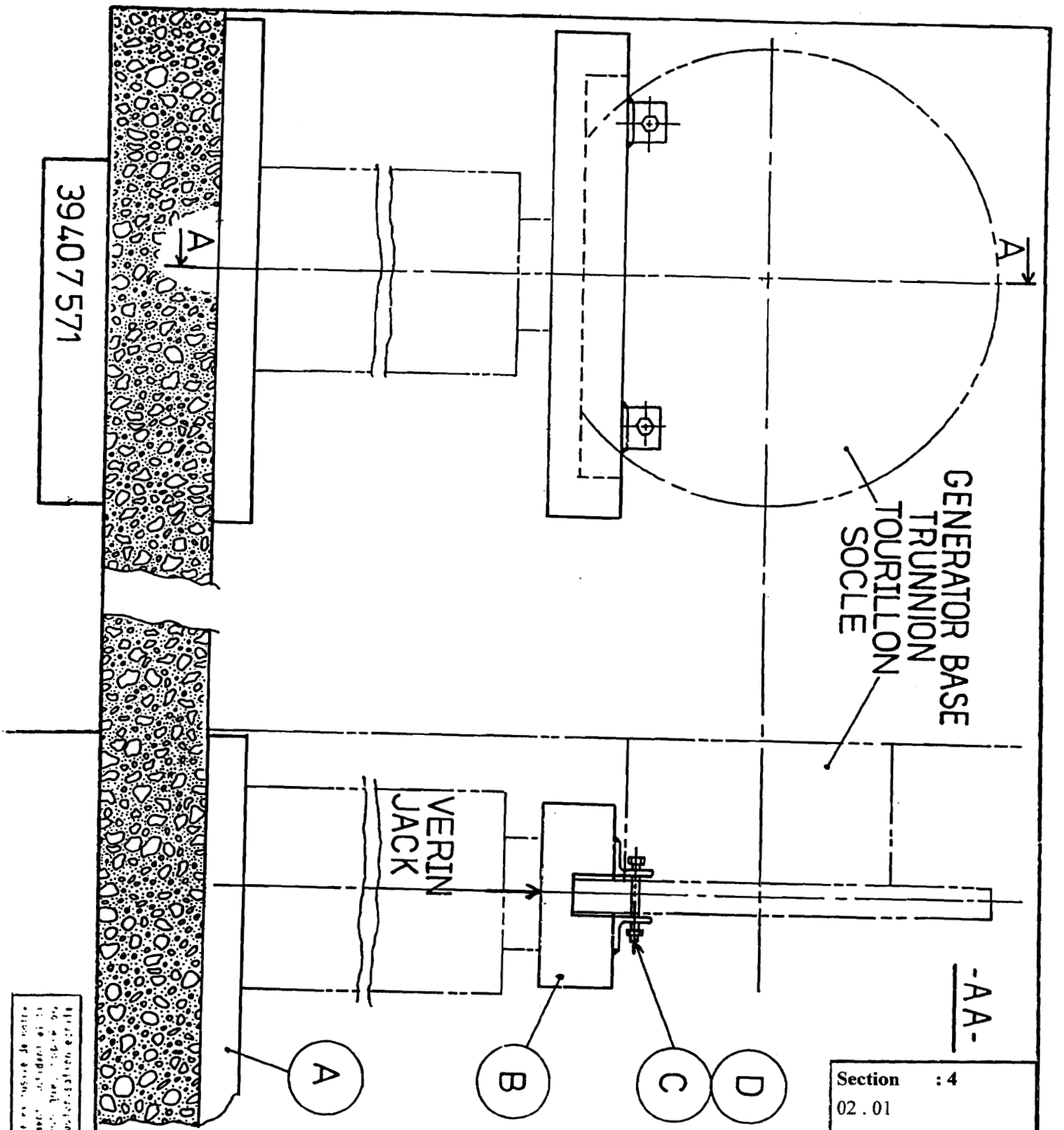
TOTAL DISPLACEMENT OF JOURNAL CENTERS BETWEEN STANDSTILL IN COLD CONDITIONS AND STABILISED RUNNING CONDITIONS

DISPLACEMENTS	X	Y
BEDPLATE-BEARING	+0.11	-0.28
OIL FILM	+0.57	-
TOTAL	+0.68	-0.28



PAGE	1	Dates	17/02/97	17/02/97
Noms	BOUDEVIN	BL IND		
SUITE PAGE	1	Visas		
DA	2	DESSINE/REDIGE	VERIFIE	APPROUVE
DOC. ORIGINE	TITRE GENERATOR ALIGNMENT DATA			
DONNEES LIGNAGE ALTERNATEUR				
ETAT	<input checked="" type="checkbox"/> DIFFL. INTRE <input checked="" type="checkbox"/> FINISSE <input type="checkbox"/> F/E			
EMETTEUR	39	FORMAT	A1	SECT. DOC. 0.0.0.1 A
ELABORATION		ECHELLE BELFORT 1/25 LE BOURGET 1/10 GECALSTHOM		

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39407571

GENERATOR BASE
TRUNNION
SOCLE

VERIN
JACK

-A-A-

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A ELABORATION		MODIFICATIONS		MODIFIE		VERIFIE		APPROUVE	
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		16/4/96		THEVENIN				REGLAGE ALTERNATEUR	
		28/03/96		CAIREY				GENERATOR POSITIONING	
		3							
GIDCC		B.D.GRA		LANGUE		ECHELLE		BELFORT	
-		-		F.E		1.5		LE BOURGET	
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39405611		2		P		39 CP		A4	
								GEC ALSTHOM	
								39407571	
								SECT 000	
								A	

SPECIFICATION D'APPROVISIONNEMENT POUR
PRECONTRAINTE SUR TIRANTS DE FONDATION
COMPRENANT =

- 1 VERIN DE TENSION TYPE ST.C 100/5 REF. 173024
AVEC FAUX-ECROU M56x5,5 ET JUPE D'APPUI.
- 1 POMPE A MAIN SA 25+10-500
AVEC RESERVOIR 1,5 L REF. 90 M 00 078
- 1 MANOMETRE REF. A 69 034 + RACCORDEMENT REF. 215 050/100
- 1 FLEXIBLE HP5 . 2m REF. A 38 053
- 1 REDUCTION MF 18x150-1/8"NPT REF. 833 198
- 1 JOINT REF. A 52 007
- 1 ACCOUPLEMENT FVR 1/8" NPT REF. 826 099
- 1 ACCOUPLEMENT MVR 1/8" NPT REF. 826 098
- 1 RACCORD D.M 1/8"NPT - G 1/4" REF. 833 253
- 1 JOINT REF. A 52 012

PROCUREMENT SPECIFICATION FOR
PRESTRESSING ON FOUNDATION TIE-RODS
INCLUDING =

- 1 TIGHTENING JACK TYPE ST.C 100/5 REF. 173024
WITH FALSE NUT M56x5,5 AND SKIRT FOR SUPPORT.
- 1 HAND PUMP SA 25+10-500
WITH OIL TANK 1,5 L REF. 90 M 00 078
- 1 PRESSURE-GAUGE REF. A 69 034 + CONNECTING REF. 215 050/100
- 1 FLEXIBLE TUBE HP5 . 2m REF. A 38 053
- 1 REDUCTION MF 18x150-1/8"NPT REF. 833 198
- 1 GASKET REF. A 52 007
- 1 CONNECTING FVR 1/8" NPT REF. 826 099
- 1 CONNECTING MVR 1/8" NPT REF. 826 098
- 1 COUPLING D.M 1/8"NPT - G 1/4" REF. 833 253
- 1 GASKET REF. A 52 012

FOURNISSEUR = QUIRI
SUPPLIER BP190 67042 STRASBOURG CEDEX
TEL 88.62.90.77.

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Revision :
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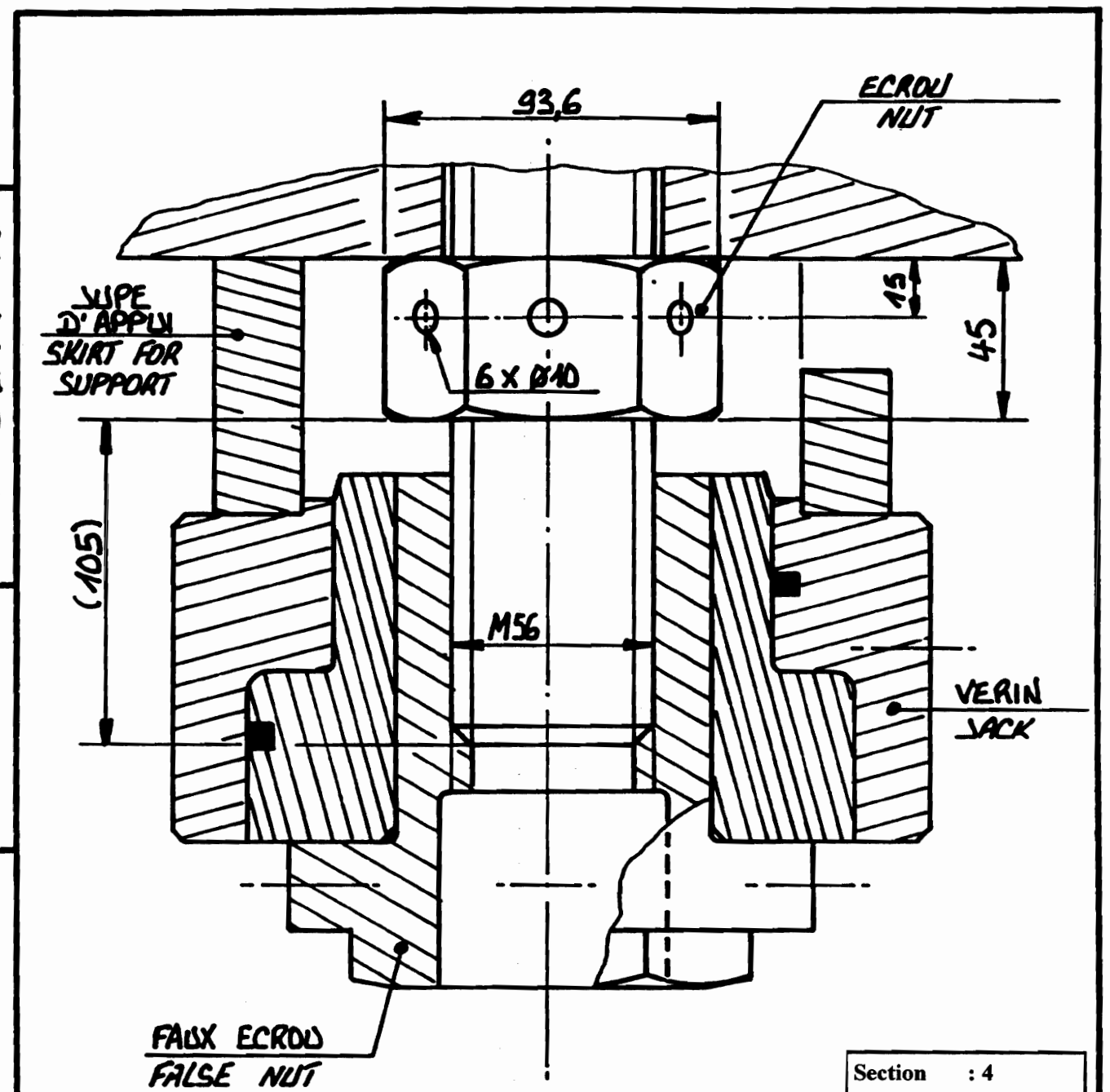
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VERIFIE				PRECONTRAINTE					
DES. / RED.	11.04.96			SUR TIRANTS DE FONDATION					
QA : 3	TEULIERE			PRESTRESSING ON FOUNDATION TIE-RODS					
DATE									
INTO. interne	G/DOC	B/D/GR	LANGUE	EHELLE	BELFORT	GECALSTHOM			
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DOC. ORIGINE	DIFFU.	NATURE	EMETTEUR	FORMAT	39 407583				
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39 407583

39 407583



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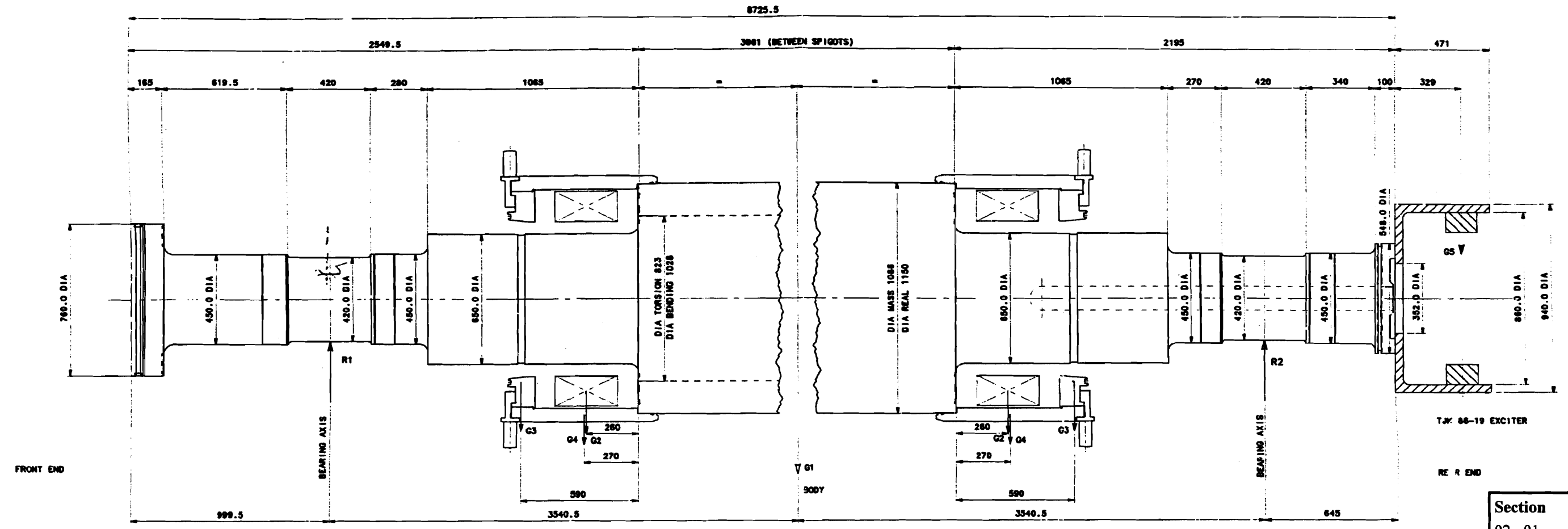
PAGE 2/2

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QA : 3							
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DOC. ORIGINE 2 DIFFU SA NATURE 39 75				FORMAT A4			
GECALSTHOM				39 407583			
16110R				SECT DOC A			

059X0015
SHEET 1 OF 1 SHEETS

REVISIONS
NO. DATE BY
A



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ADDITIONAL MASS & INERTIA.		
	MASS kg.	INERTIA MR ² kgm ²
G1	0	301
G2	838	185
G3	467	110
G4	1353	456
G5	596	75

BEARING REACTIONS N	
R1	216274
R2	220811

	MASS kg	INERTIA kgm ²
ROTOR	43404	6506
EXCITER	1166	176
TOTAL	44570	6682

SHAFT MATERIAL PROPERTIES	
Rm	900 MPa MIN
Re	772 MPa MIN
E	205 GPa
Nu	0.27
ρ	7850 kg/m ³

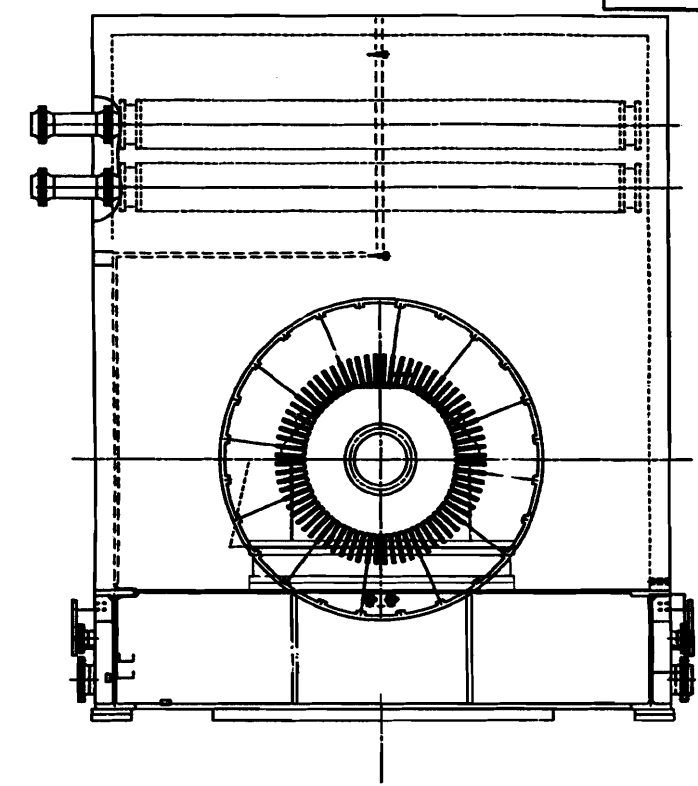
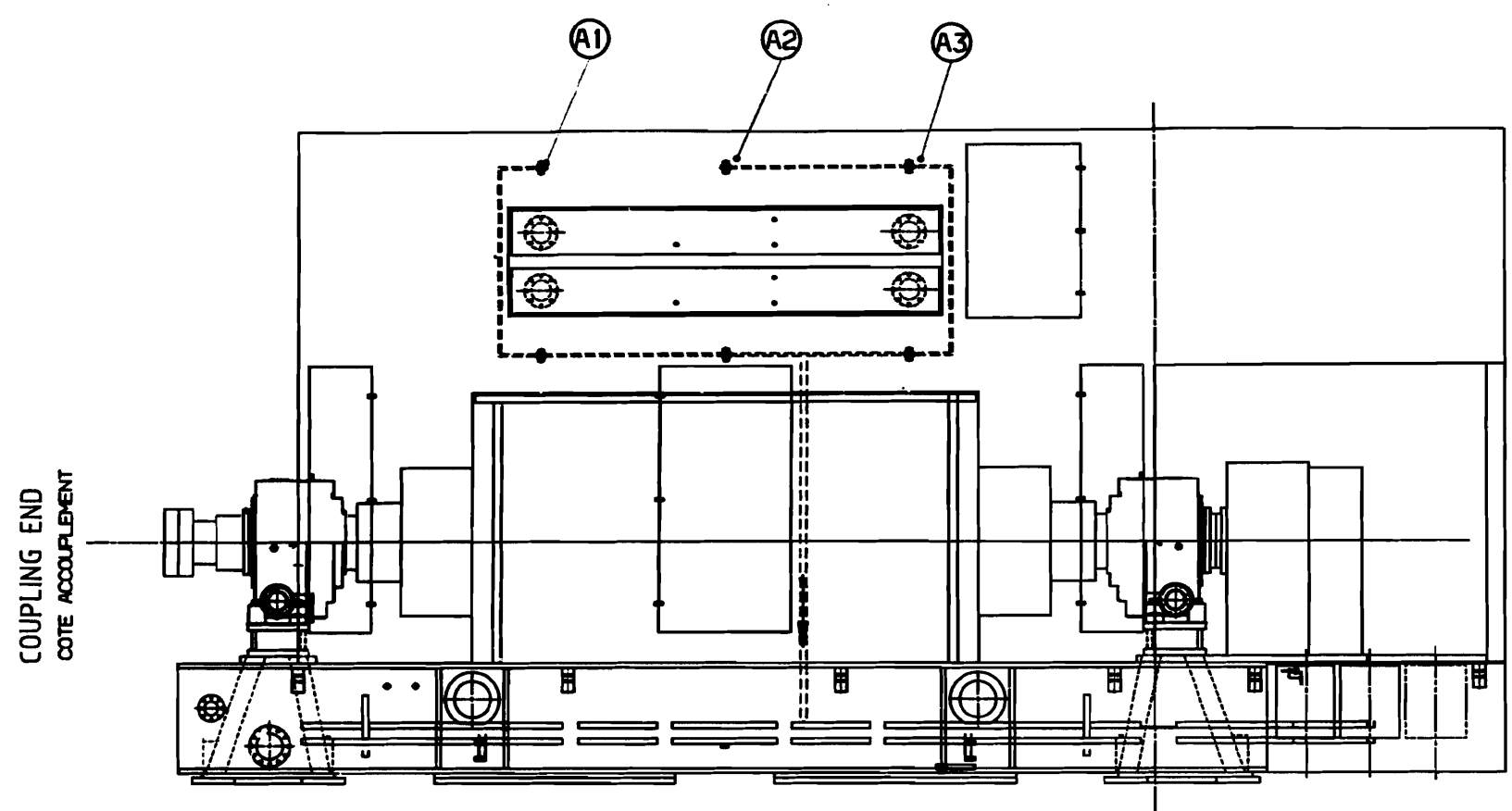
SHAFT TORSIONAL STIFFNESS. Nm/RAD	
FRONT END SHAFT TORSIONAL STIFFNESS 183.5 X 10 ⁶ Nm/RAD	
FRONT END SHAFT TORSIONAL STIFFNESS INCLUDING 50% OF ROTOR BODY TORSIONAL DIAMETER LENGTH 166.5 X 10 ⁶ Nm/RAD	

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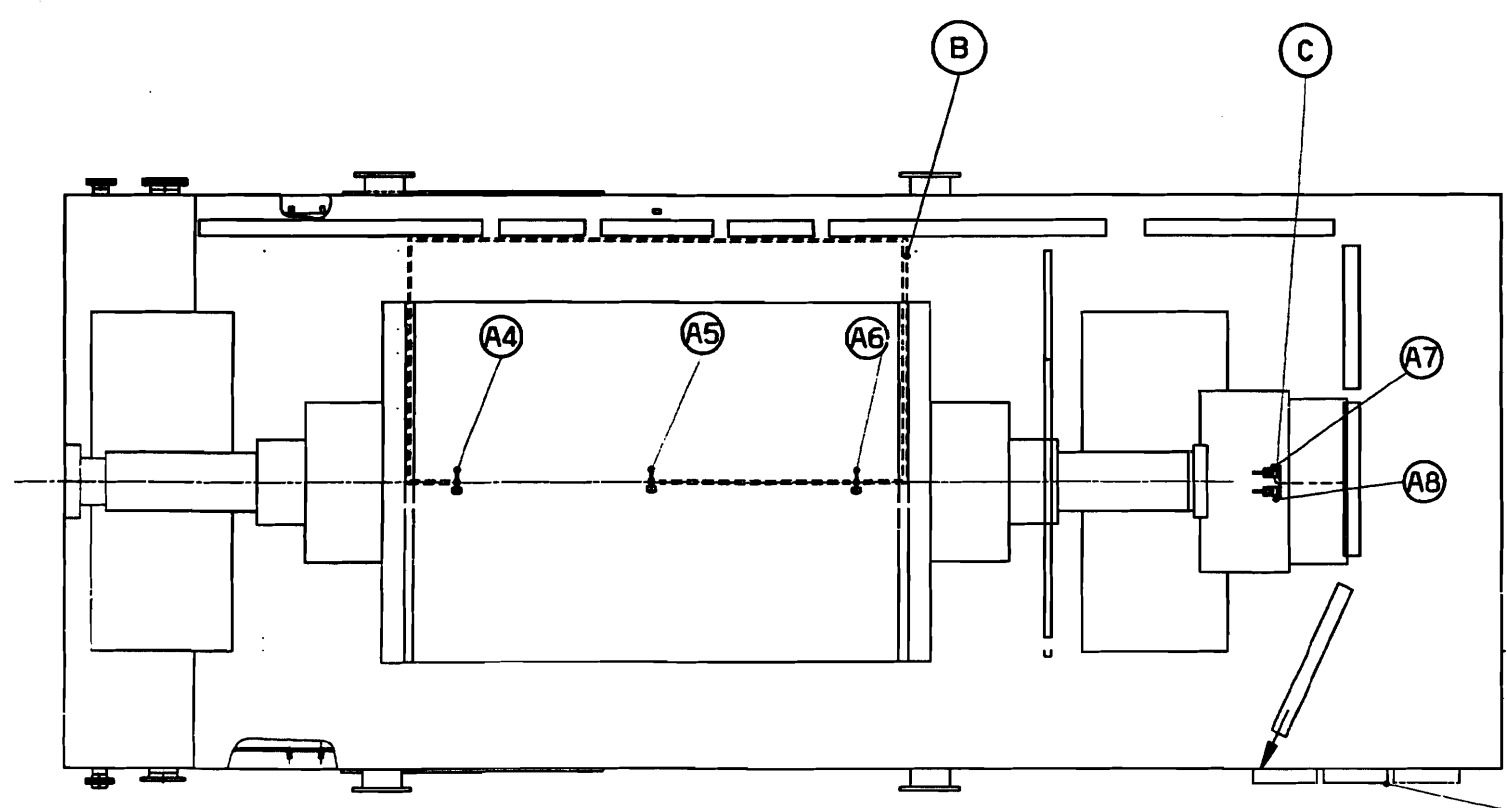
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ALL UNFINISHED DIMENSIONS AND OTHER TOLERANCE FITS TO BE IN ACCORDANCE WITH BRITISH STANDARDS SUPPORTED DRAWING TO BE SHOWN AND ANY NECESSARY REVISIONS TO BE MADE. UNLESS STATED OTHERWISE

DRAWING SPECIFICATIONS		TITLE	
LOAD DISTRIBUTION DIAGRAM T276-371		GEC ALSTHOM POWER GENERATION	
DESIGNER	DATE	PROJECT	NO.
059X0015		556671	
LARGE GENERATORS STAFFORD ENGLAND		SHEET 1 OF 1 SHEETS	



39-603547



REP.	SITUATION	DESIGNATION
A1	AIR CHAUD	GRA TE 201
A2	AIR CHAUD	GRA TE 202
A3	AIR CHAUD	GRA TE 203
A4	AIR FROID	GRA TE 101
A5	AIR FROID	GRA TE 102
A6	AIR FROID	GRA TE 103
A7	AIR CHAUD	GRA TE 204
A8	AIR CHAUD	GRA TE 205

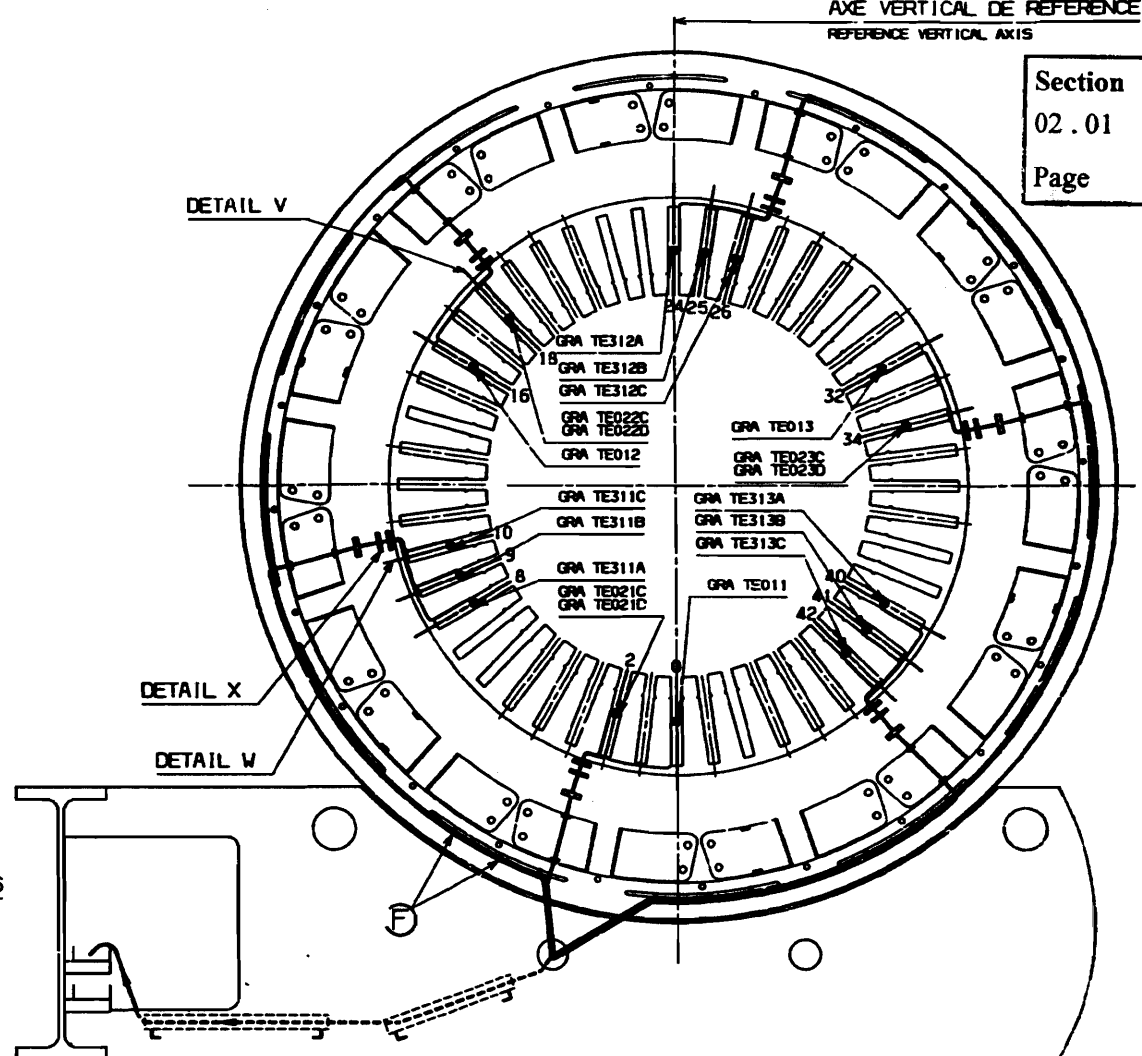
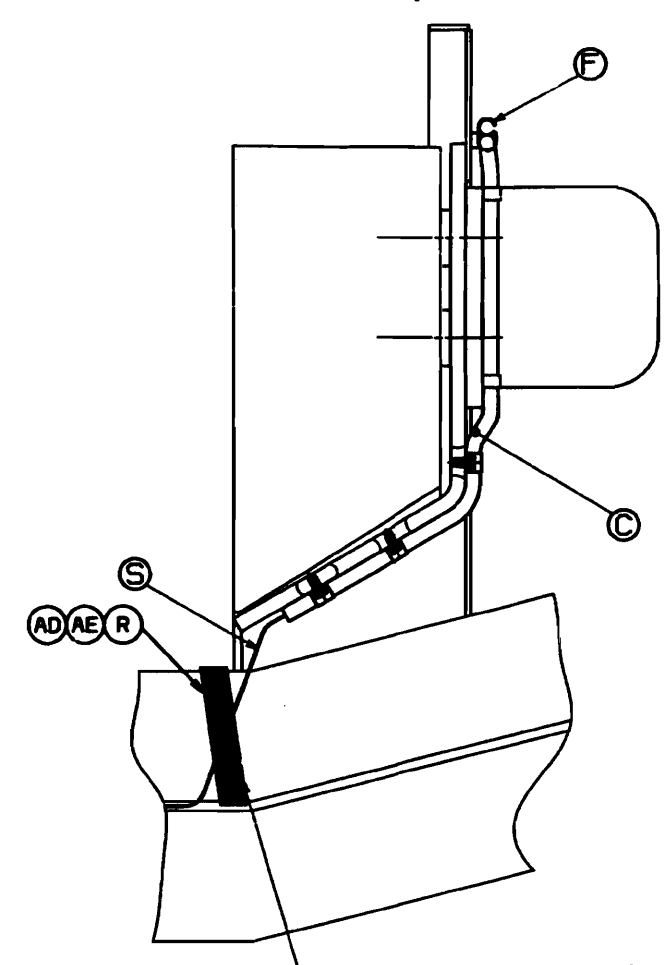
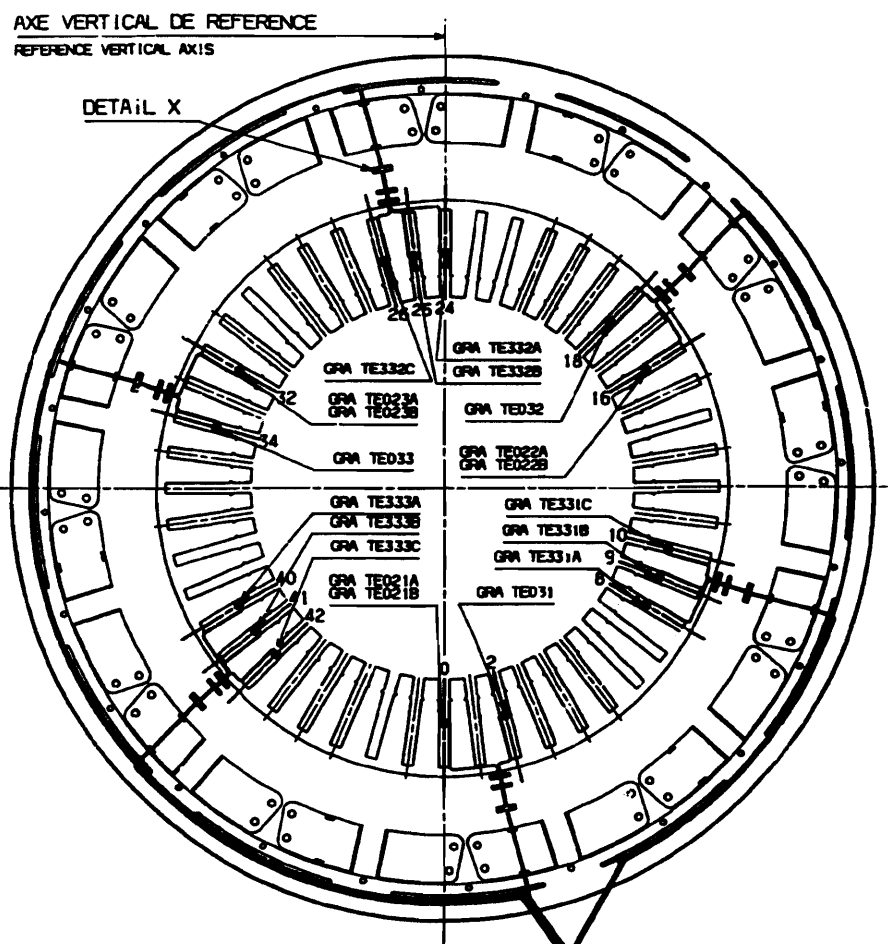
AIR CHAUD = HOT AIR
 AIR FROID = COLD AIR

THERMOCOUPLES IN AIR CIRCUIT

PROJ. N°	30/12/96	30/12/96
DATE	HEBINGER	MOUNIER
NOM		
DESIGNATEUR		
VERIFIEUR		
APPROUVEUR		
SONDES DANS L'AIR		
GECALSTHOM		
FORMAT	A0	39-603547
SECT. DOC		

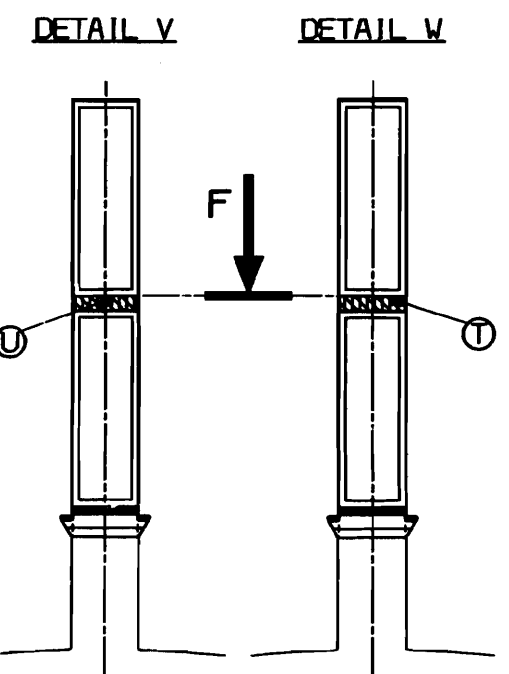
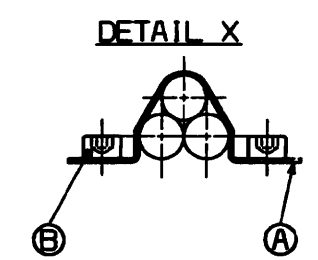
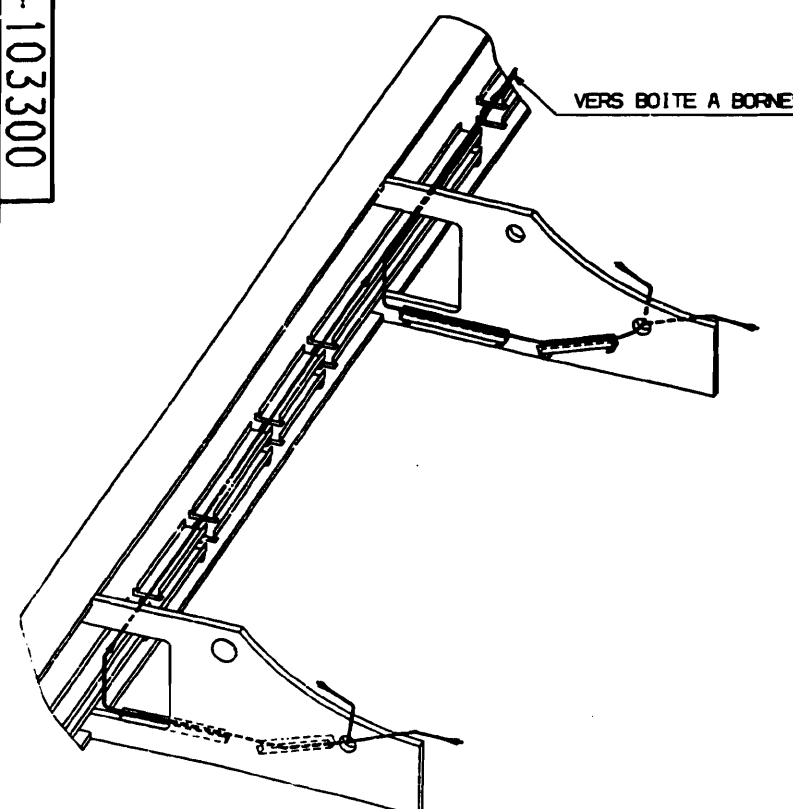
VUE COTE OPPOSE TURBINE
VIEW OPPOSITE TURBINE END

VUE COTE TURBINE
VIEW TURBINE END



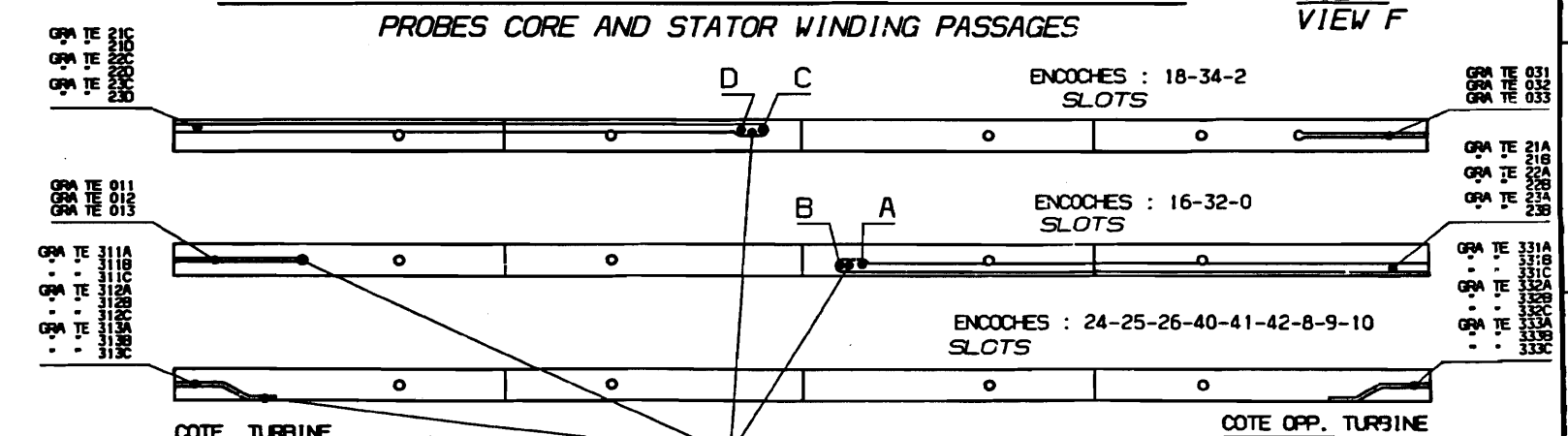
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39-103300



PASSAGES SONDES CIRCUIT MAGNETIQUE ET ENROULEMENT STATOR
PROBES CORE AND STATOR WINDING PASSAGES

VUE F
VIEW F



(AF) REPERAGE DES SONDES
(AG) PROBES MARKING

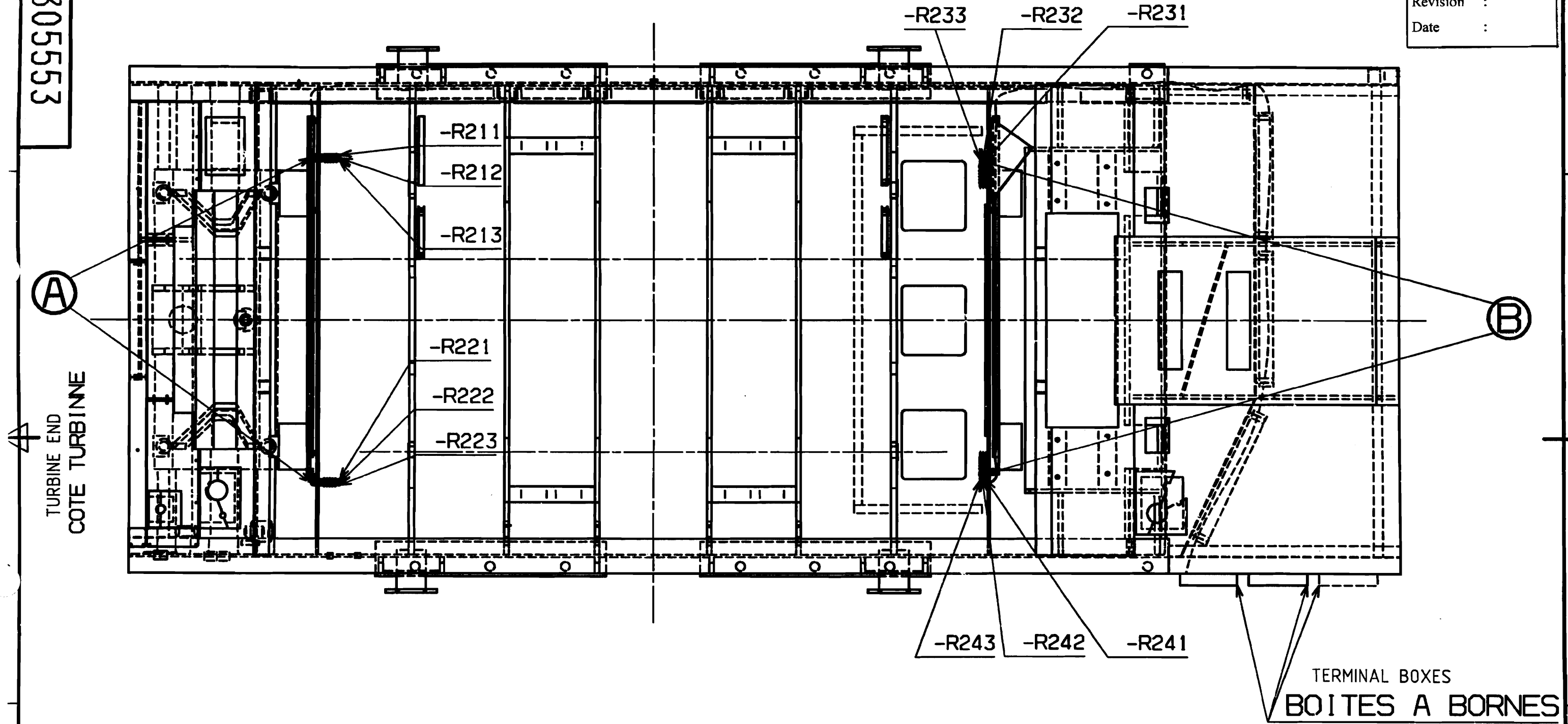
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		CORE AND STATOR WINDING PROBES		
GIDOC	R.B.G.M.			
DIFFU. NOME	EDHELLE	BELFORT		
LANGUE	F/E	LE BOURGET		
EMETTEUR	FORMAT	GEC ALSTHOM		
39	A1	39-103300		

Code	Reference	Date	Nom	Visas	Nom	Visas	Nom	Visas
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B	M3900009222	23/05/97	RICHARD		MOUNIER		THIOT	
A	ELABORATION	31/12/96	RICHARD		MOUNIER		THIOT	

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39-305553

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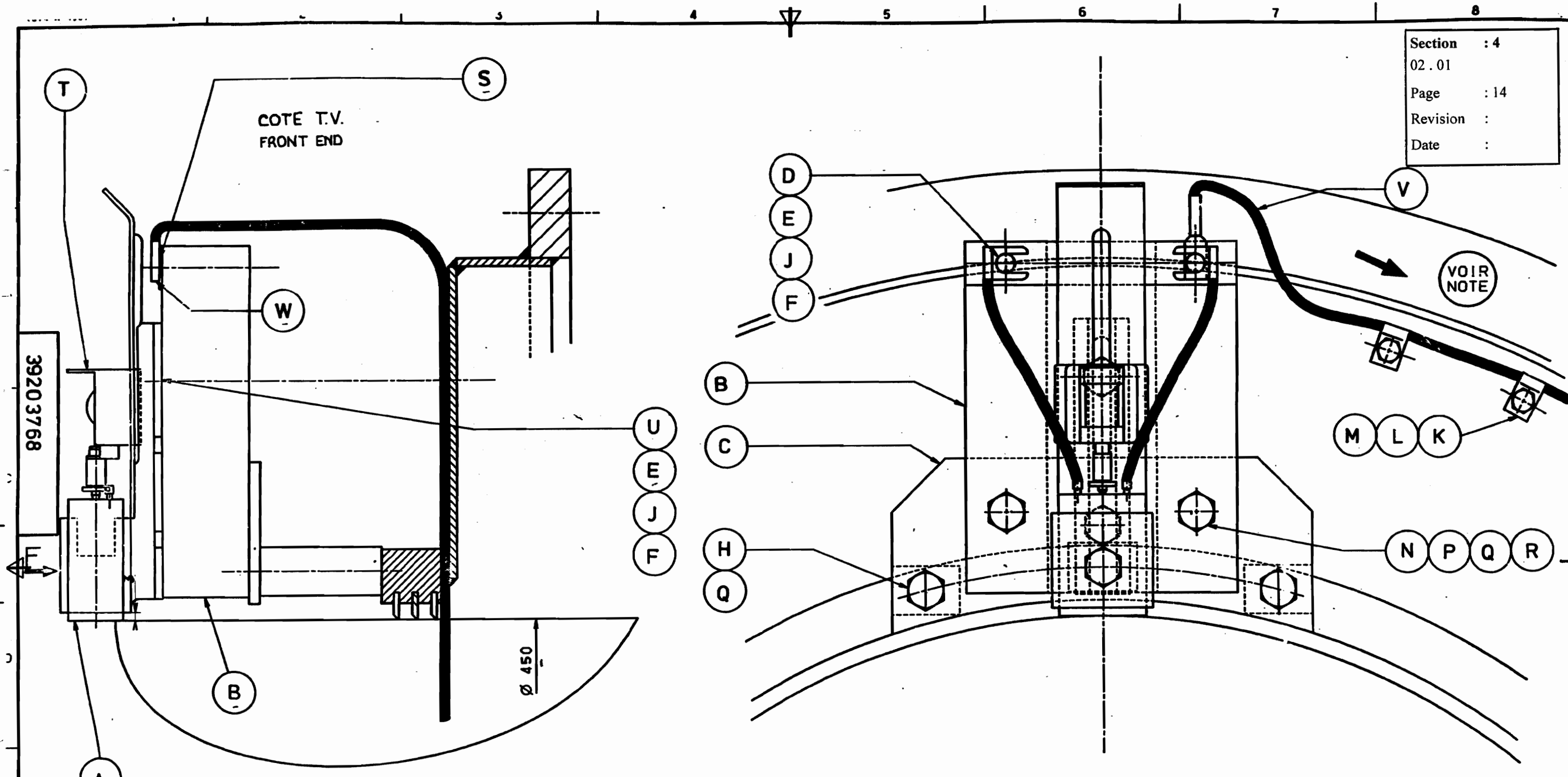
A ELABORATION									
Indice	Nature/N° Avis modif.	Dates	Noms	Vises	Noms	Vises	Noms	Vises	
MODIFICATIONS				MODIFIE		VERIFIE		APPROUVE	
APPROUVE					TITRE				
VERIFIE	16/01/97	MOUNIER			SITUATION RESISTANCES CH				
DES./RED.	16/01/97	HEBINGER			SPACE HEATERS LOCATION				
QA : 2	Dates	Noms	Vises						
INFO. INTERNE	PAGE: 1	SIDOC	B.D. GRA	LANGUE	ECHELLE	BELFORT	GEC ALSTHOM		
	SUITE PAGE: 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	F		LE BOURGET			
	DOC. ORIGINE	DIFFU.	NATURE	EMETTEUR	FORMAT	39-305553			
		2	P	39	A3	0001			

26

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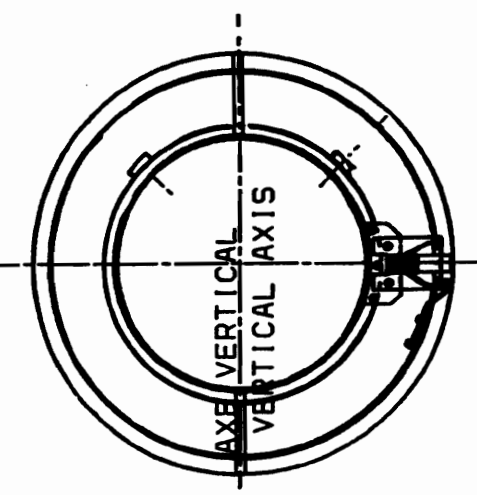
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NOTE: CABLE EN DIRECTION DU SOCLE.
 CABLE FIXER SUR LE SOCLE
 AVEC VIS (G) ; RDL (J)
 TOWARD THE BASE
 CABLE FASTENED TO BASE
 WITH SCREW HM6x10; WASHER 6

VUE F
 VIEW F



PAGE	Dates	05/01/96	11/1/96
SUITE PAGE	Noms	CAIREY	THEVENIN
	Vises	<i>[Signature]</i>	<i>[Signature]</i>
	DA : 3	DESSINE/REDIGE	VERIFIE
			APPROUVE
DOC. ORIGINE	TITRE ROTOR GROUNDING SYSTEM		
	ENSEMBLE DE MISE A LA MASSE ROTOR		
GIDOC S.D. 804	ECHELLE	BELFORT	GEC ALSTHOM
DIFFU. NATURE	1/1	LE BOURGET	
LANGUE	F.E	FORMAT	39203768
ENETTEUR	39PC	A2	
A ELABORATION		SECT. DOC.	
Indices N° Avis Modif Local. Dates Noms Vises Noms Vises Noms Vises		A	
MODIFICATIONS		APPROUVE	

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39-305176

QTY	DESIGNATION	VOLTAGE	LOADS
12	GENERATOR HEATERS	220 VAC	12 X 500W
1	FIELD GROUND DETECTION	125 VDC	
2	WATER LEAKAGE DETECTOR	220 VAC	

REV	DATE	AUTH.	CHECK BY	APPR. BY	MODIFICATIONS	STATUS
B	26/11/96	MD	MD		AM 39 8690	APP
A	25/09/96	MD	MD		FIRST ISSUE	APP

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 Date :

SCALE: / SUPPLIER NAME: **BTA-RA-C** N°: **39-305176**
 SIZE: A3 SPECIFICATION N°:

 **PUBLIC POWER CORPORATION**
 ATHENS GREECE
LAVRION COMBINED CYCLE BLOCK - 550 MW NET
 CONTRACT N°: DMKT-162/99129

S. T. GENERATOR
UTILITY LIST

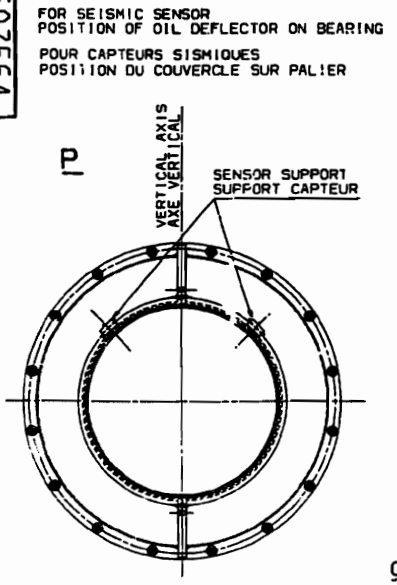
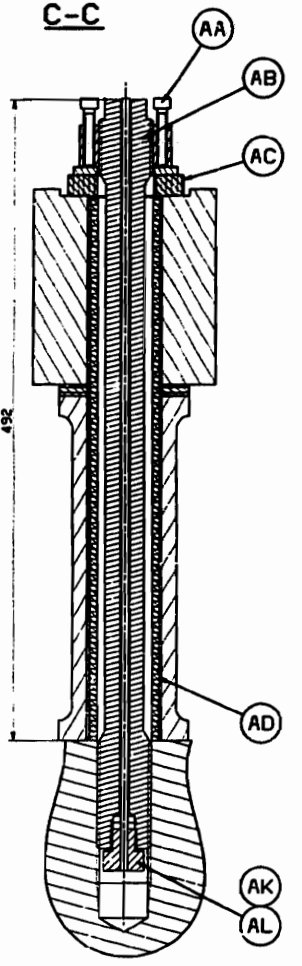
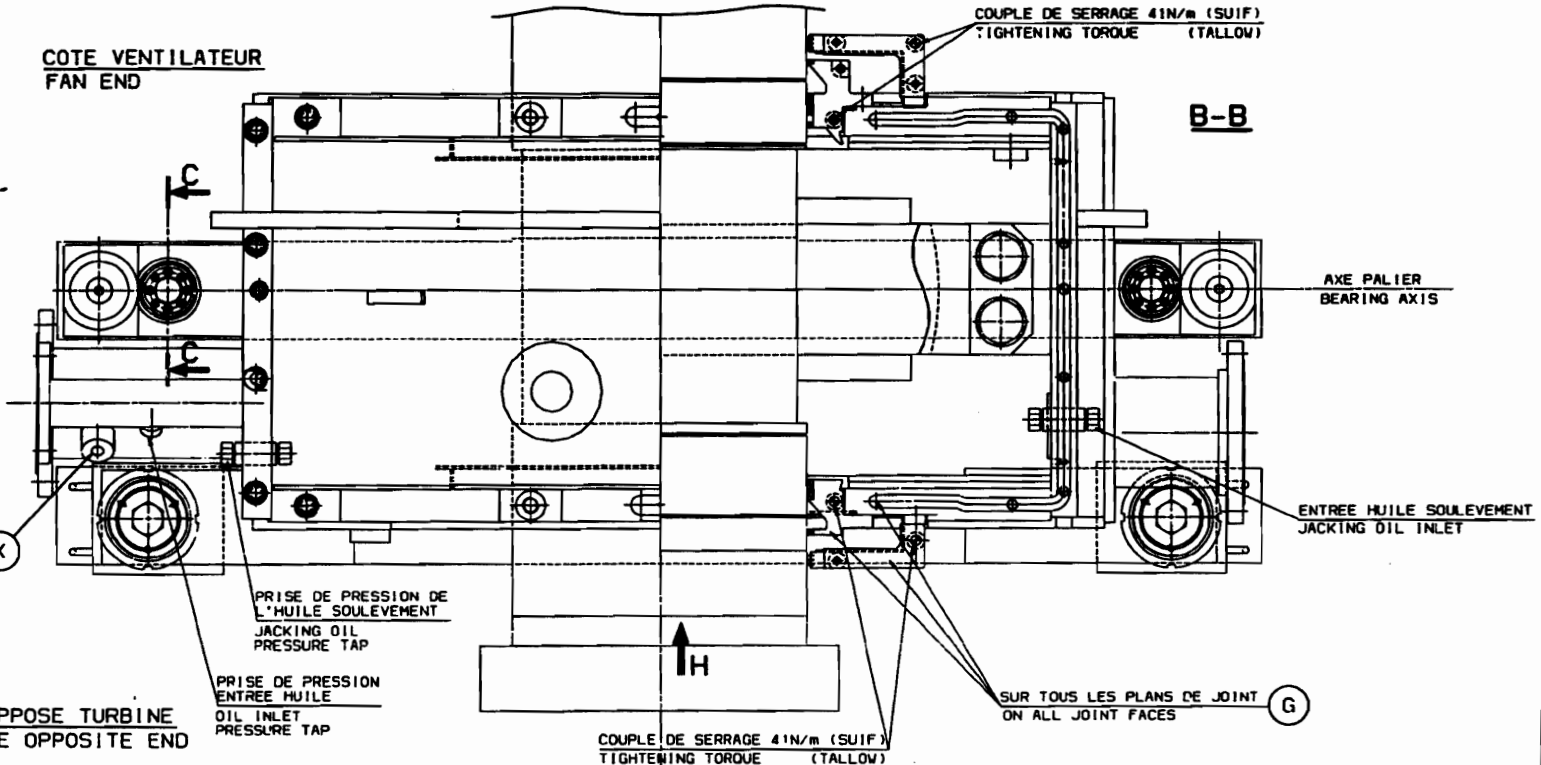
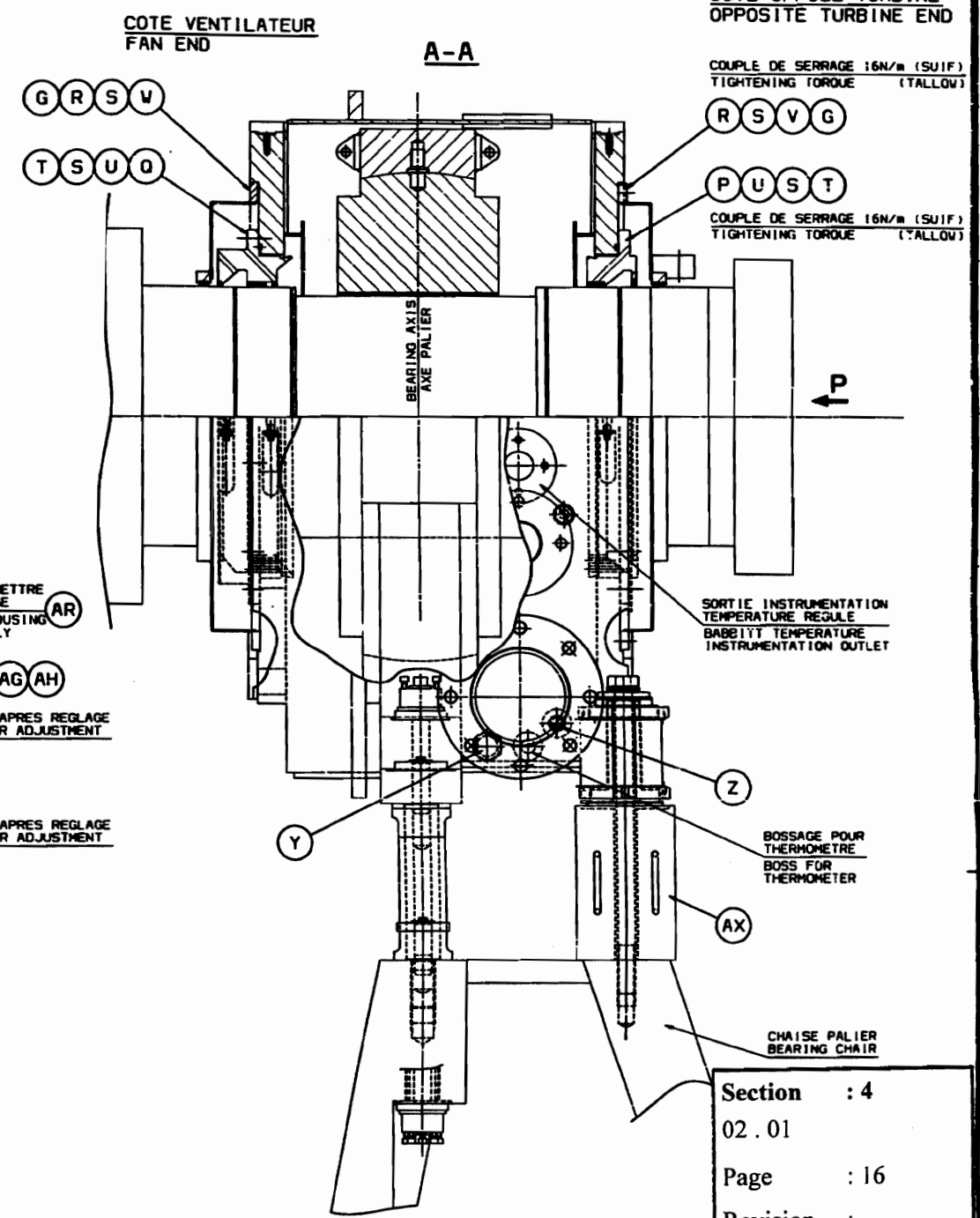
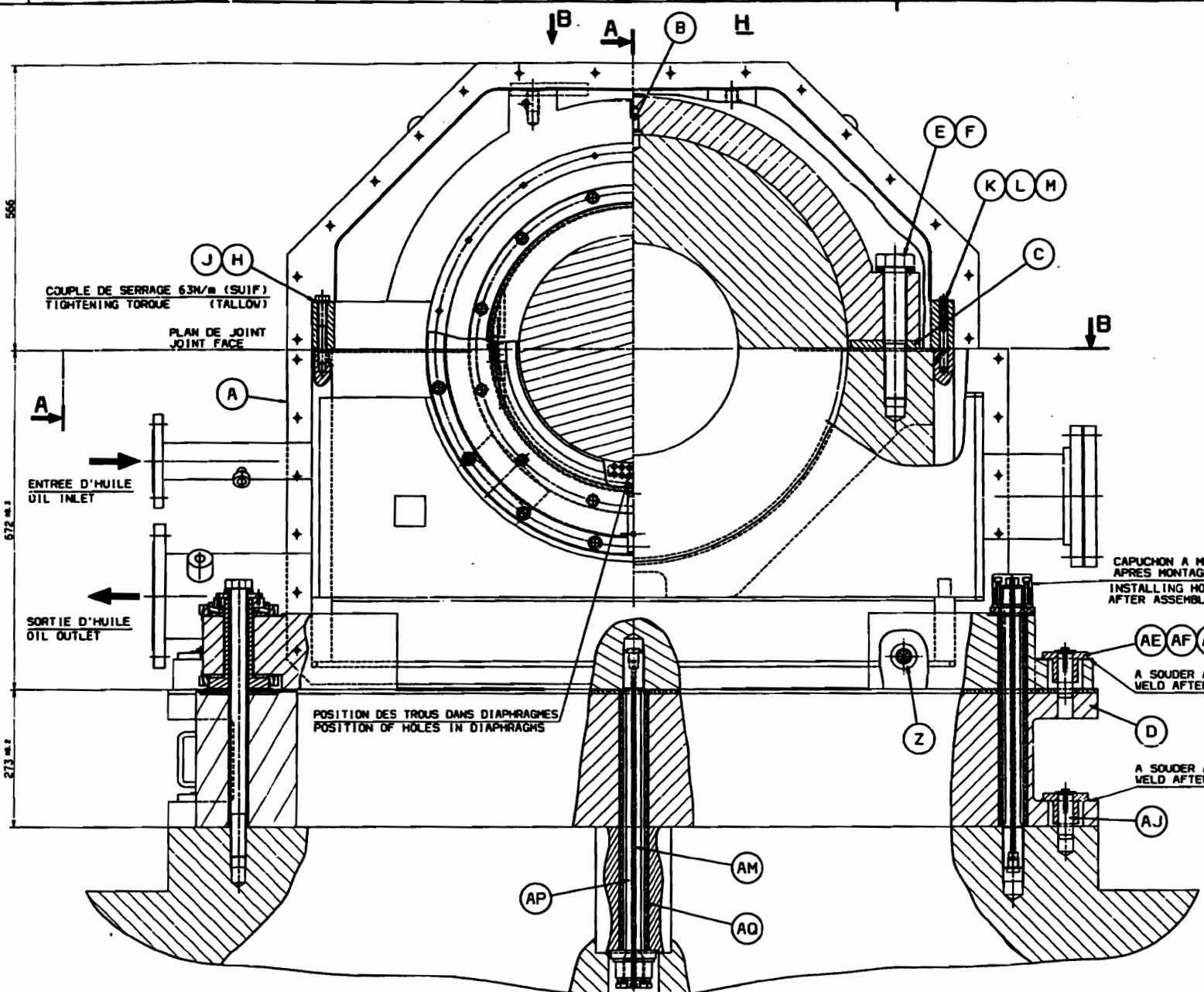
GEC ALSTHOM
 POWER GENERATION DIVISION
METKA S. A.

EMG-BTA
 N° LAV 04 A GGE - GV EL 105

Customer number **LAV 04 A MKA - GV EL 105**

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NOTA:
AVANT MONTAGE DE CHAQUE COTE DU PALIER, DESOBLSTRUER LES OUVERTURES
DES 2 CAISSONS DE VENTILATION.
PUIS EFFECTUER UN SOUFFLAGE SOIGNE, AFIN D'EN EXTRAIRE EVENTUELLEMENT
TOUS CORPS ETRANGERS(COPEAUX, SOUDURE etc)

NOTE:
BEFORE ASSEMBLY, ON EACH SIDE OF BEARING, UNBLANK OPENINGS
OF TWO VENTILATION CAISSONS THEN CAREFULLY BLOW OUT TO
REMOVE ANY POSSIBLE FOREIGN MATTER (CHIPS, WELD MATERIAL, ETC..)

39-603564

PAGE	1	Date	20/01/97	20/01/97
SUITE PAGE		NOM	BOUDEVIN	MOUNIER
NUMERO	1	DESIGNATION	39-603564	
DATE	20/01/97	DESSINE	BOUDEVIN	VERIFIE
SCALE	1/4	APPROUVE		
ENS. PALIER COTE OPP. TUR. BEARING ASS. OPP. TUR. END				
GECALSTON				
39-603564				

COTE VENTILATEUR
FAN END

COUPLE DE SERRAGE 16N/m (SUIF)
TIGHTENING TORQUE (TALLOW)

COUPLE DE SERRAGE 16N/m (SUIF)
TIGHTENING TORQUE (TALLOW)

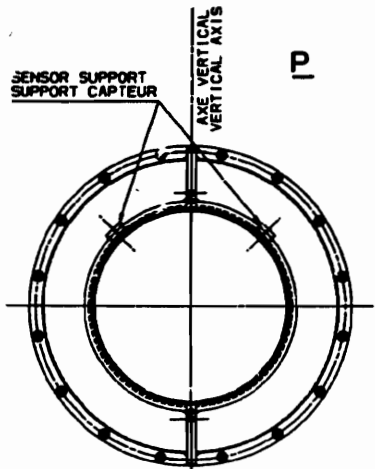
COTE TURBINE
TURBINE END

SORTIE INSTRUMENTATION
TEMPERATURE REGULE
BABBIT TEMPERATURE
INSTRUMENTATION OUTLET

BOSSAGE POUR THERMOMETRE
BOSS FOR THERMOMETER

BEARING CHAIR
CHAISE PALIER

POSITION OF OIL DEFLECTOR ON BEARING
FOR SEISMIC SENSOR
POSITION DU COUVERCLE SUR PALIER
POUR CAPTEURS SISMQUES



AXE PALIER
BEARING AXIS

ENTREE HUILE SOULEVEMENT
JACKING OIL INLET

G SUR TOUS LES PLANS DE JOINT
ON ALL JOINT FACES

COUPLE DE SERRAGE 41N/m (SUIF)
TIGHTENING TORQUE (TALLOW)

B-B

COTE VENTILATEUR
FAN END

NOTA:
AVANT MONTAGE, DE CHAQUE COTE DU PALIER, DESOBLSTRUER LES OUVERTURES
DES 2 CAISSONS DE VENTILATION.
PUIS EFFECTUER UN SOUFFLAGE SOIGNE, AFIN D'EN EXTRAIRE EVENTUELLEMENT
TOUS CORPS ETRANGERS (COPEAUX, SOUDURE etc).

NOTE:
BEFORE ASSEMBLY, ON EACH SIDE OF BEARING, UNBLANK OPENINGS
OF TWO VENTILATION CAISSONS THEN CAREFULLY BLOW OUT TO
REMOVE ANY POSSIBLE FOREIGN MATTER (CHIPS, WELD MATERIAL, ETC..)

PRISE DE PRESSION
ENTREE HUILE
OIL INLET
PRESSURE TAP

PRISE DE PRESSION DE
L'HUILE SOULEVEMENT
JACKING OIL
PRESSURE TAP

COTE TURBINE
TURBINE END

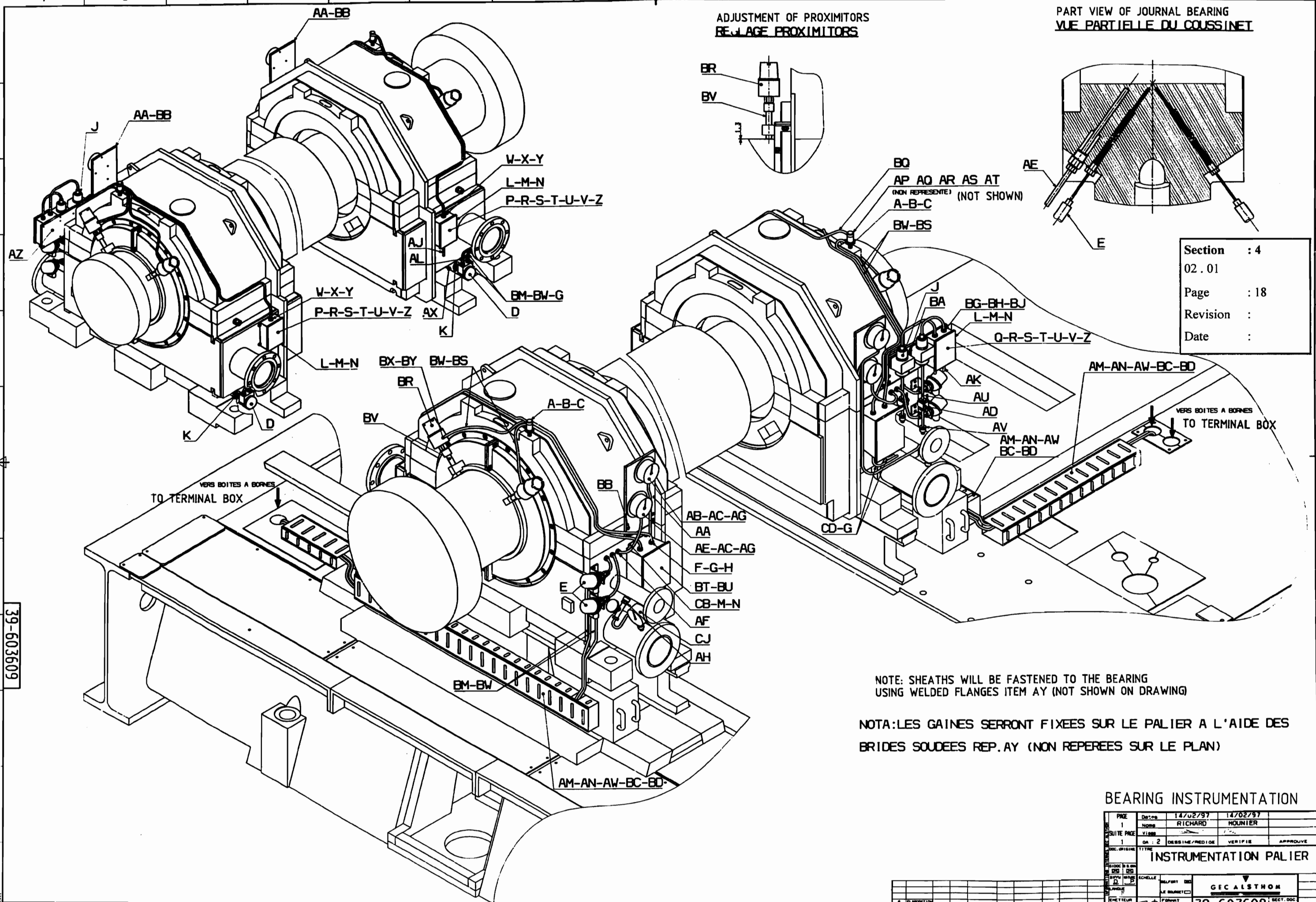
COUPLE DE SERRAGE 41N/m (SUIF)
TIGHTENING TORQUE (TALLOW)

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PRE	Date	20/01/97	20/01/97
1	Nom	BOUDEVIN	HOUJIER
SUITE PRE	Ville		
1	ca :	3	DESIGN/REVISION
			VERIFIE
			APPROUVE
39-603563 ENS. PALIER COTE TURBINE BEARING ASS. TURBINE END			
SECALSTROM			
39-603563			

ADJUSTMENT OF PROXIMITORS
REGLAGE PROXIMITORS

PART VIEW OF JOURNAL BEARING
VUE PARTIELLE DU COUSSINET



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NOTE: SHEATHS WILL BE FASTENED TO THE BEARING USING WELDED FLANGES ITEM AY (NOT SHOWN ON DRAWING)

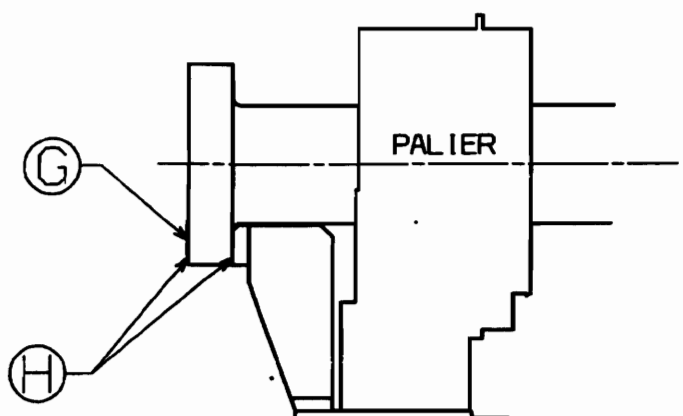
NOTA: LES GAINES SERRONT FIXEES SUR LE PALIER A L'AIDE DES BRIDES SOUDEES REP. AY (NON REPEREES SUR LE PLAN)

BEARING INSTRUMENTATION

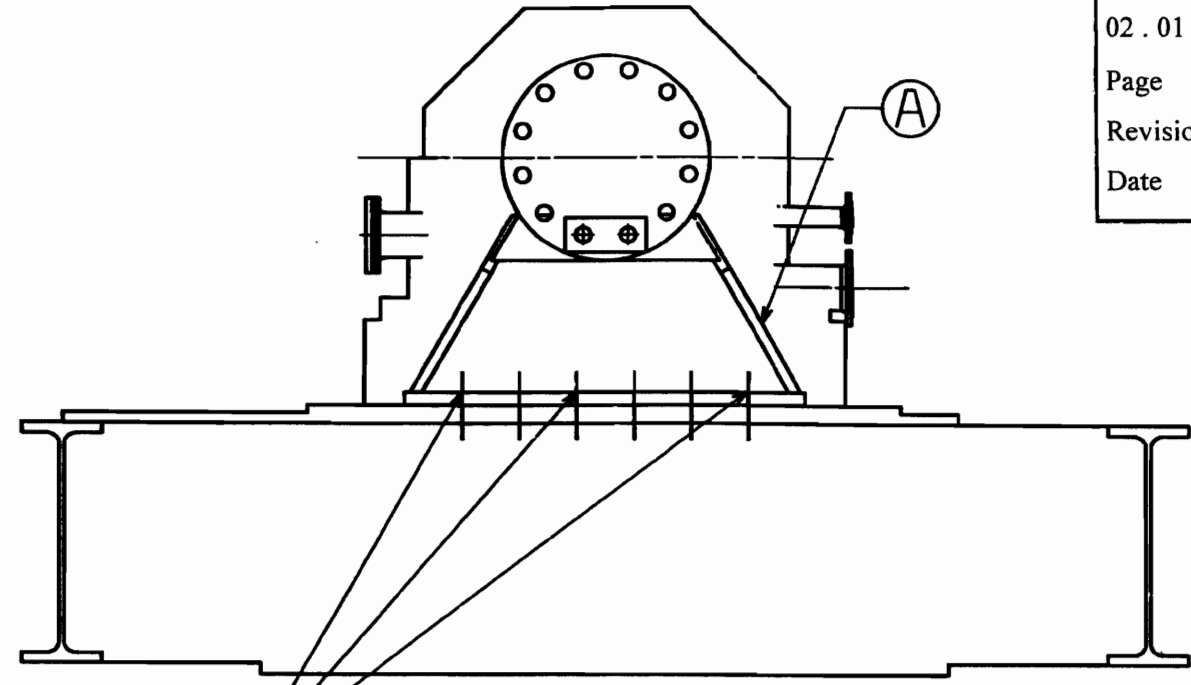
DATE	14/02/97	14/02/97
NOM	RICHARD	HOUNIER
DESIGNATEUR		
VERIFIEUR		
DATE	DA : 2	DESSINE/RED/DE
VERIFIE		APPROUVE
TITRE		
INSTRUMENTATION PALIER		
ECHELLE		
GEC ALSTHOM		
39-603609		

39-603609

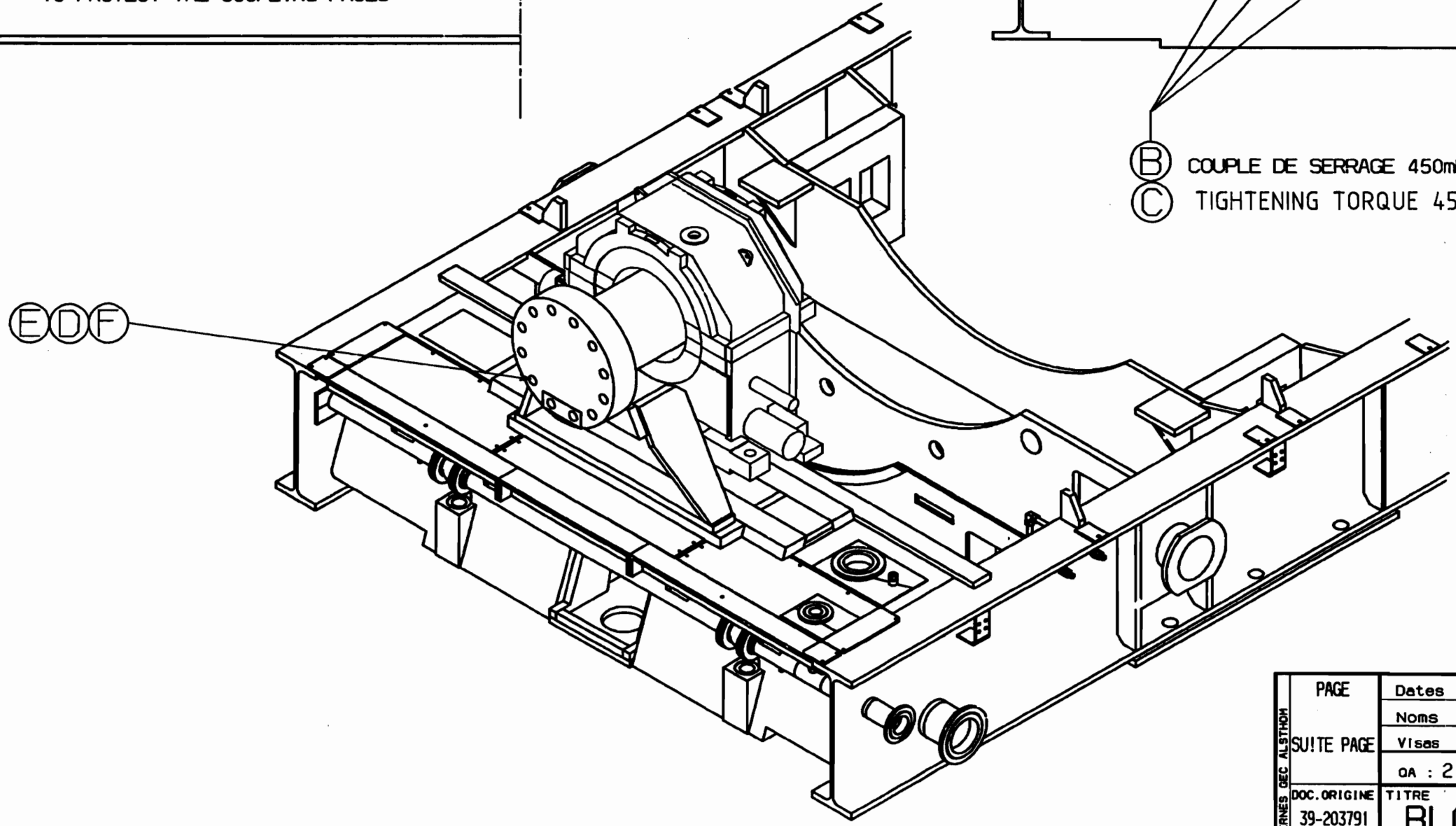
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 Date :



INTERPOSER DU CARTON
 LUSTRE EPR 1 POUR PROTECTION
 DES FACES D ACCOUPLEMENT.
 INSERT 1 MM THICK GLAZED CARDBOARD
 TO PROTECT THE COUPLING FACES



(B) COUPLE DE SERRAGE 450mN
 (C) TIGHTENING TORQUE 450 mN



39-204235

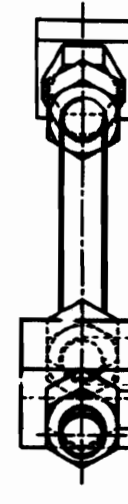
INFORMATIONS INTERNES GEC ALSTHOM	PAGE	Dates	17/02/97	17/02/97	
	SUITE PAGE	Noms	LOUVRIER	BLIND	
		Visas			
		QA : 2	DESSINE/REDIGE	VERIFIE	APPROUVE
DOC. ORIGINE	TITRE				
39-203791	BLOCAGE ROTOR TRANSPORT				
	CLAMPING OF ROTOR				
GIDOC	B.D. GRA	ECHELLE			
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	BELFORT <input checked="" type="checkbox"/>			
DIFFU. NATURE		LE BOURGET <input type="checkbox"/>			
2	P				
LANGUE					
F/E					
EMETTEUR	FORMAT				
35.8.GL	A2				

B	AM390009450	23/09/97	ACCIS AR		TRONCIN				
A	ELABORATION								
Indice	N° Avis Modif	Localisat.	Dates	Noms	Visas	Noms	Visas	Noms	Visas
	MODIFICATIONS			MODIFIE	VERIFIE	APPROUVE			

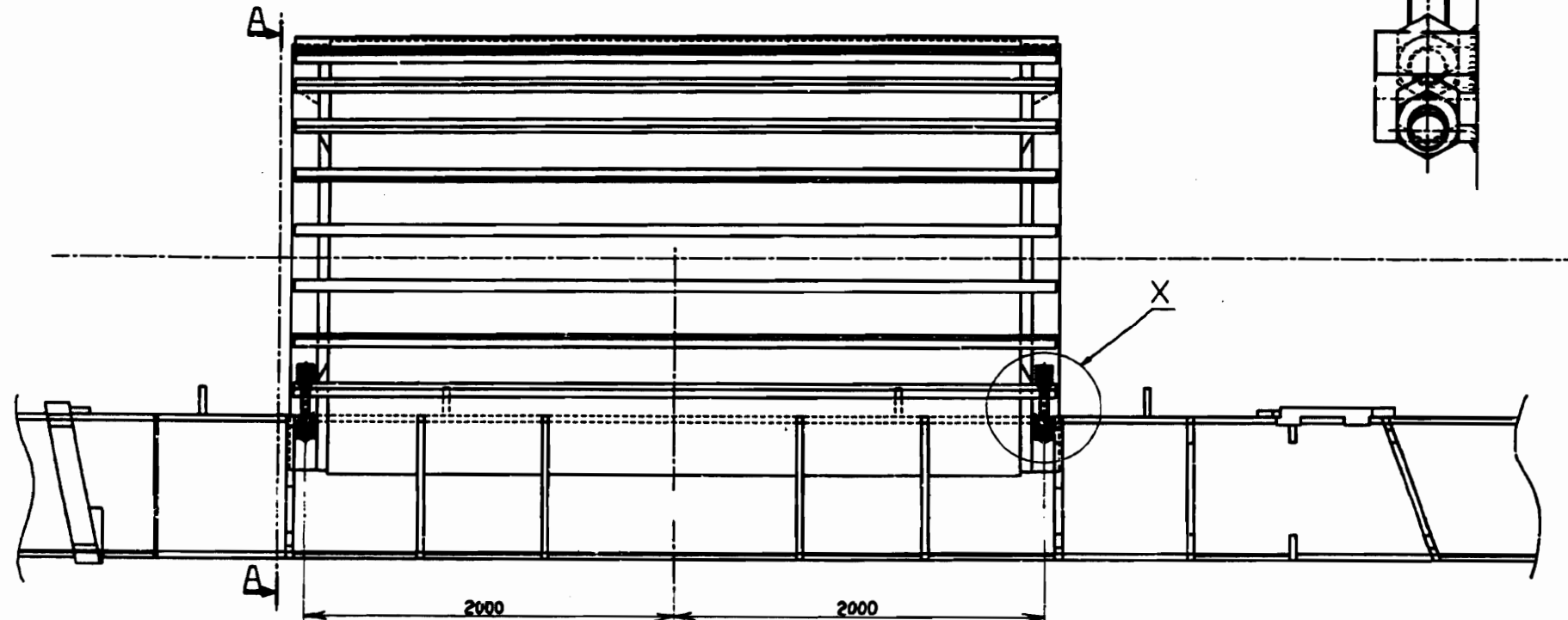
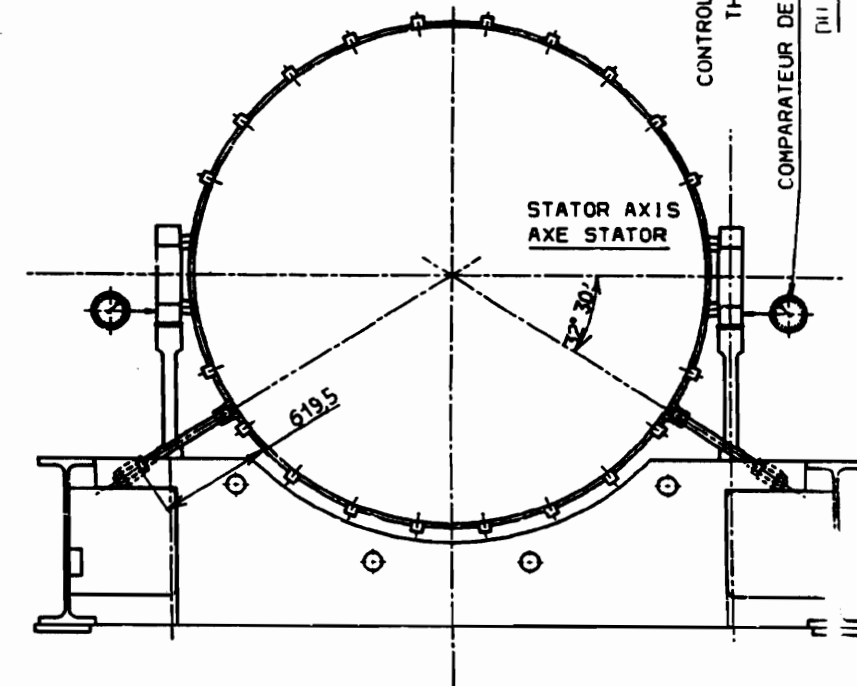
32
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GEC ALSTHOM
 39-204235 SECT. DOC. B

DETAIL X



COUPE A-A SECTION

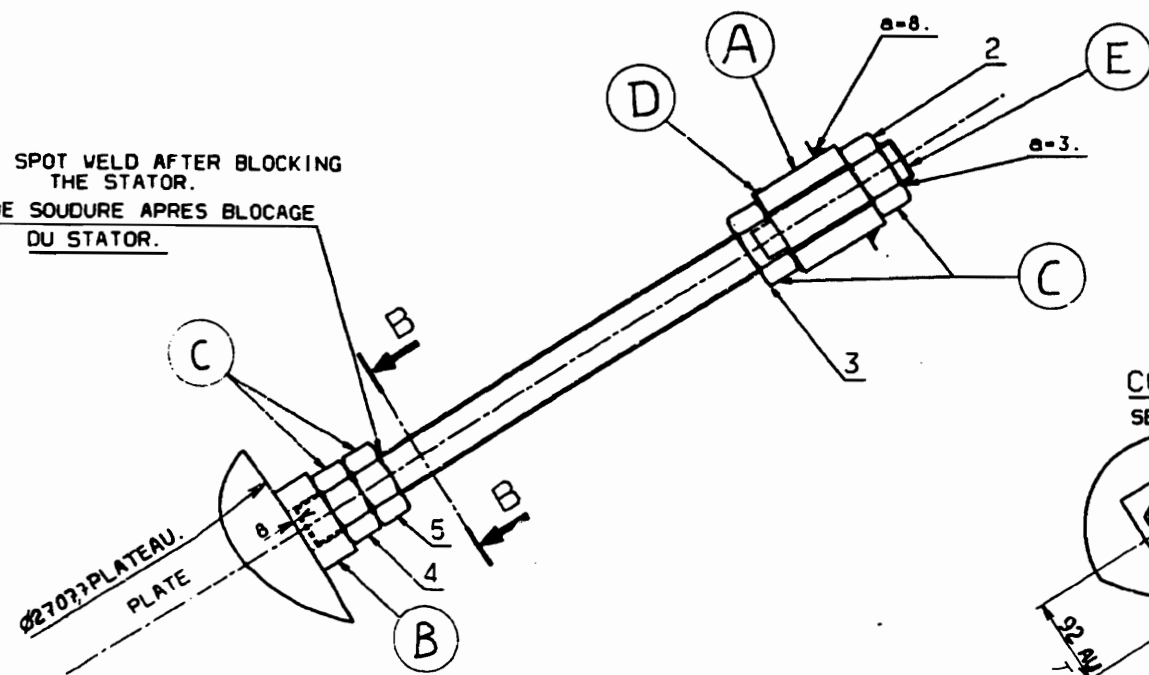


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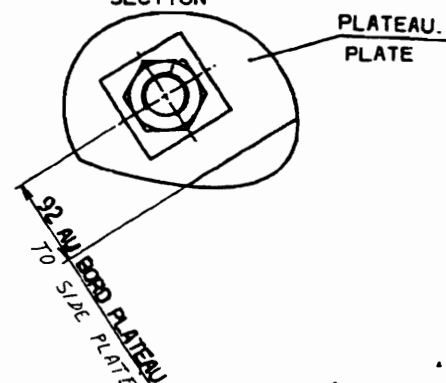
- SOUDER L'ECROU (2) SUR LA TIGE FILETEE (E)
- METTRE SUR LA TIGE FILETEE LES ECREUS (3, 4, 5) ET LE FREIN D'EQUERRE DE 48.
- METTRE L'ENSEMBLE EN PLACE ET LE BLOQUER SUR LE SUPPORT GUIDE (A) AVEC L'ECROU (3) ET LE FREIN.
- LES 4 ENSEMBLES EN PLACE VENIR EN APPUI AVEC LES ECREUS (4) SUR LE SUPPORT (B)
- BLOQUER LE STATOR EN EQUILIBRANT LES SERRAGES A L'AIDE DES COMPARATEURS.
- ARRETER L'ECROU (4) AVEC L'ECROU (5) ET UN POINT DE SOUDURE.

- WELD NUT (2) TO THREADED ROD (E)
- POSITION NUTS (3, 4, 5) AND SQUARE NUT LOCK OF 48 ON THE THREADED ROD.
- PUT THE ASSEMBLY INTO PLACE AND LOCK IT ON THE GUIDE SUPPORT (A) USING NUT (3) AND NUT LOCK.
- WITH THE FOUR ASSEMBLIES IN POSITION BRING NUTS (4) INTO CONTACT WITH SUPPORT (B)
- BLOCK THE STATOR AND BALANCE THE TIGHTENINGS USING THE COMPARATORS.
- LOCK NUT (4) WITH NUT (5) AND A SPOT WELD.

PERFORM SPOT WELD AFTER BLOCKING THE STATOR.
POINT DE SOUDURE APRES BLOCAGE DU STATOR.



COUPE B-B SECTION



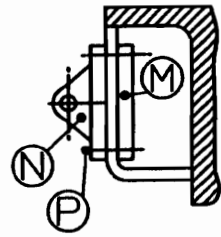
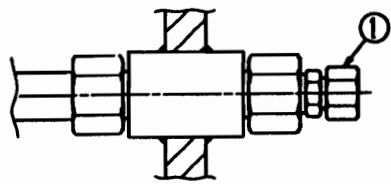
CE DISPOSITIF SERA MIS EN PLACE A BELFORT.
THIS LOCKING SYSTEM SHALL BE INSTALLED IN BELFORT.

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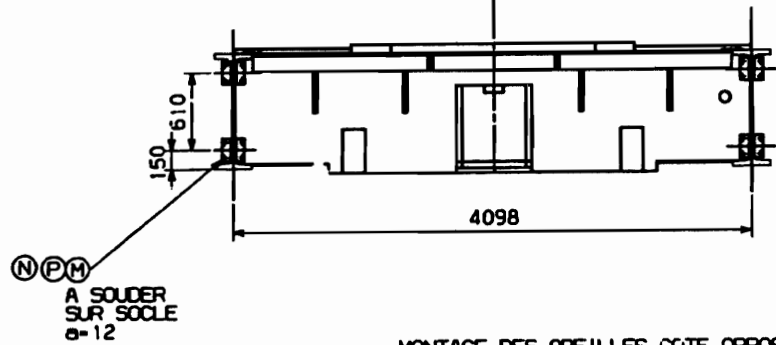
PAGE	Dates	7-2-37		
SUITE PAGE	Noms	Louvrier		
	Vises	2		
	DA	3	DESSINE/REDIGER	VERIFIE
				APPROUVE
DOC. ORIGINE	TITRE TRANSPORT-BLOCKING OF STATOR			
	TRANSPORT - BLOCAGE DU STATOR			
	TRANSPORT-BLOCKING OF STATOR			
DIPLO. NATURE	2	P	0.05	BELFORT
CLASSE	F/E	1/4	LE BOURGET	
EMETTEUR	FORMAT			39-103338
				SECT. DOC. 0.00.1

DETAIL A

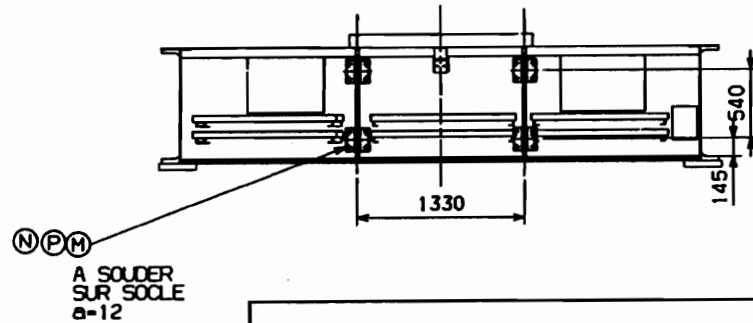
A-A



MONTAGE DES OREILLES COTE TURBINE



MONTAGE DES OREILLES COTE OPPOSE TURBINE

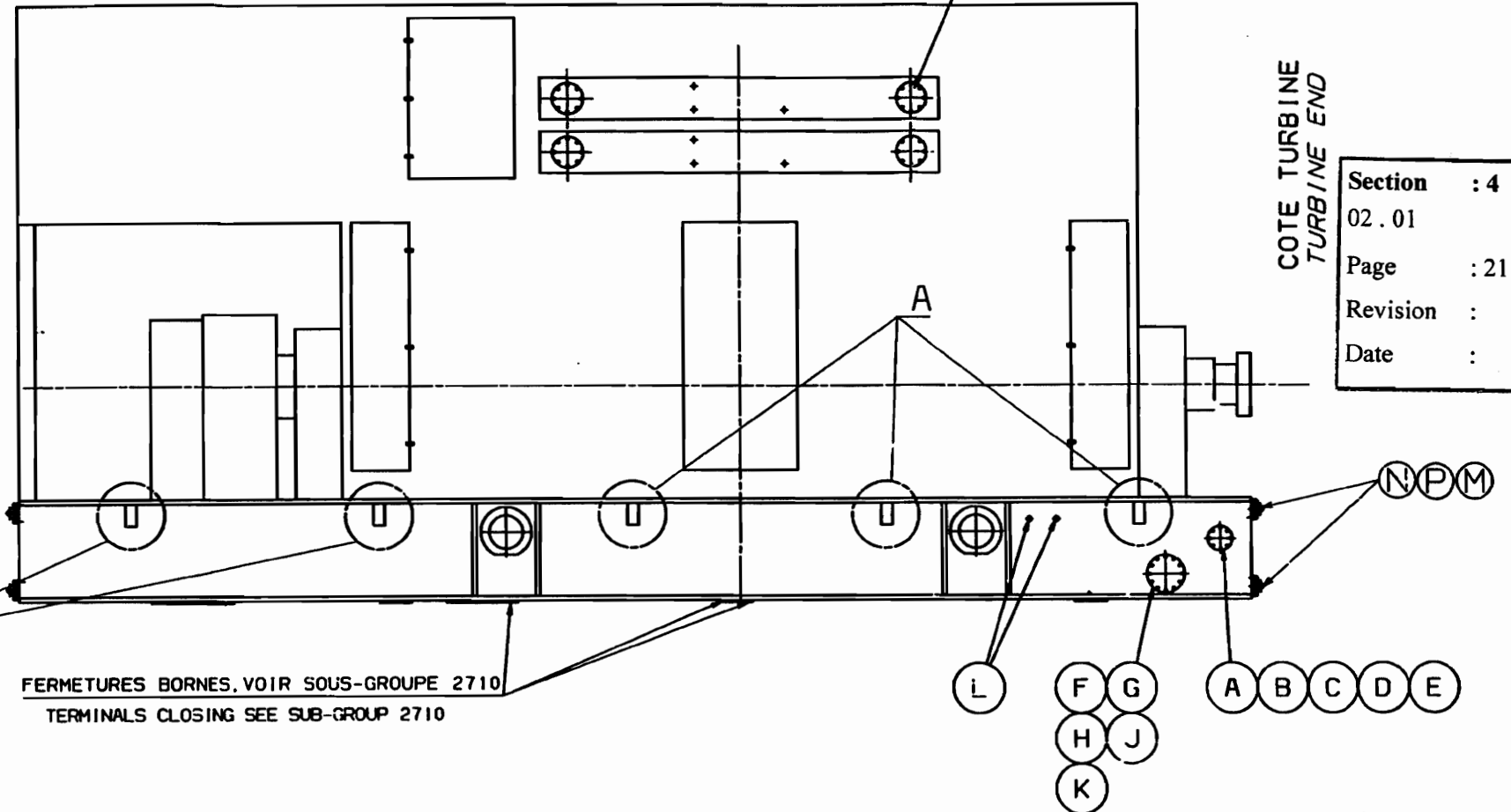


FERMETURE PAR CAPES PLASTIQUE.
FOURNIES AVEC LE REFRIGERANT
CLOSING BY PLASTIC CAPS SUPPLIED
WITH THE COOLER

COTE TURBINE
TURBINE END

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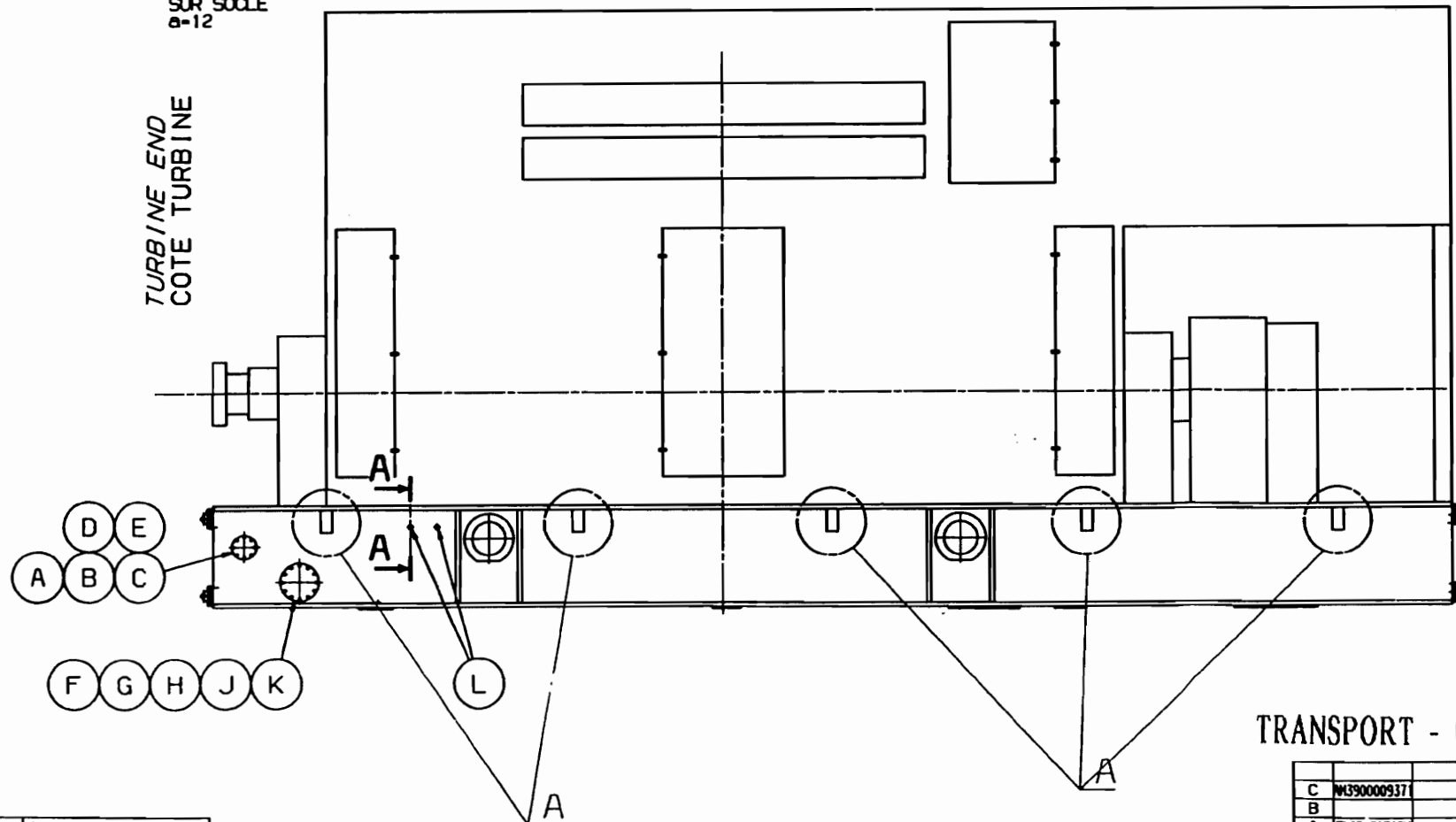
OPPOSITE TURBINE END
COTE OPPOSE TURBINE



FERMETURES BORNES. VOIR SOUS-GROUPE 2710
TERMINALS CLOSING SEE SUB-GROUP 2710

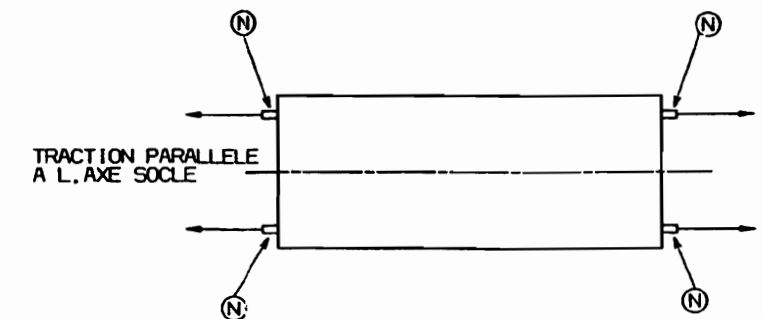
TURBINE END
COTE TURBINE

COTE OPPOSE TURBINE
OPPOSITE TURBINE END



NOTA: REMPLACER LES REDUCTIONS REP. 1.
PAR LES BOUCHONS
REP. L. ET LES EXPEDIER SUR
SITE AVEC L'ALTERNATEUR AINSI QUE
LES CONTRE-BRIDES DU SOCLE.

NOTE: REPLACE REDUCTION FITTINGS REF. 1.
BY PLUGS REF. L. AND
DISPATCH THEM TO SITE WITH GENERATOR
AND COUNTER-FLANGES OF BASE.



TRACTION PARALLELE
A L'AXE SOCLE

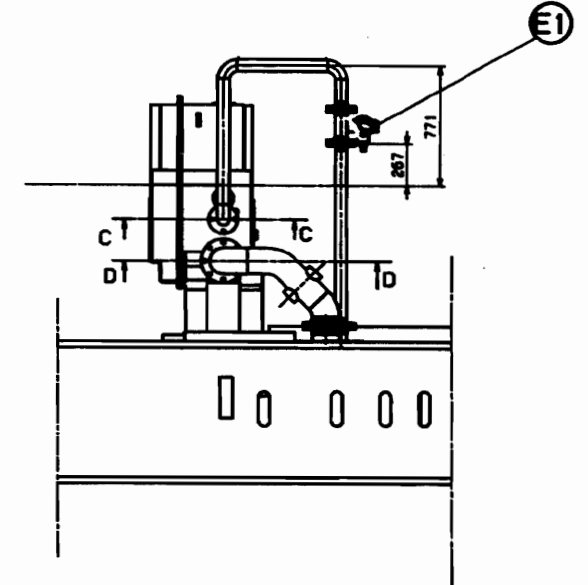
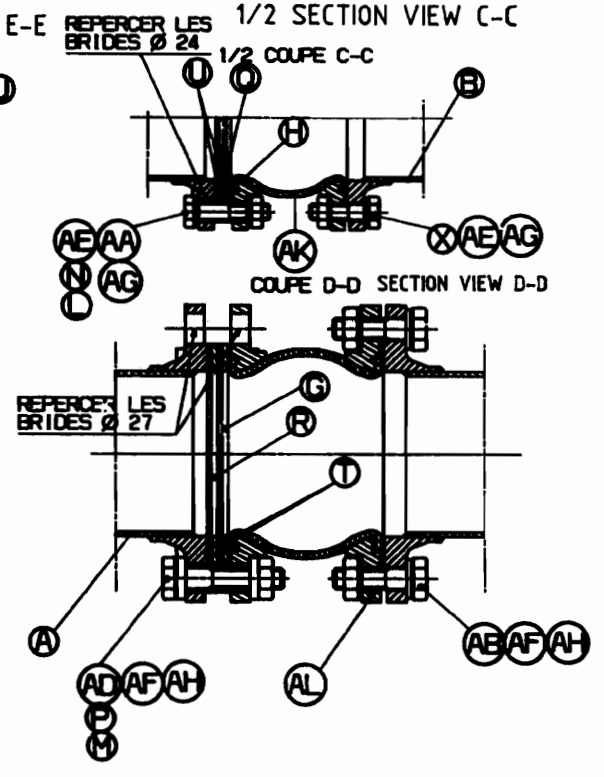
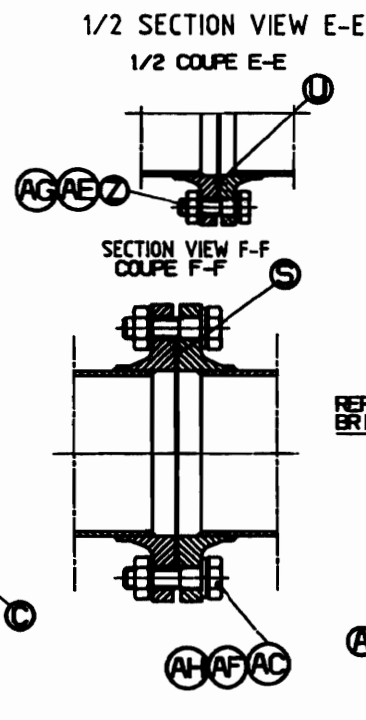
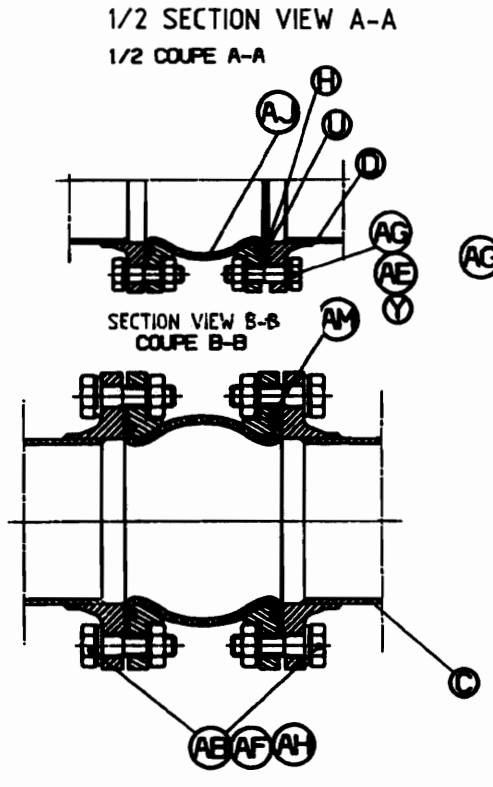
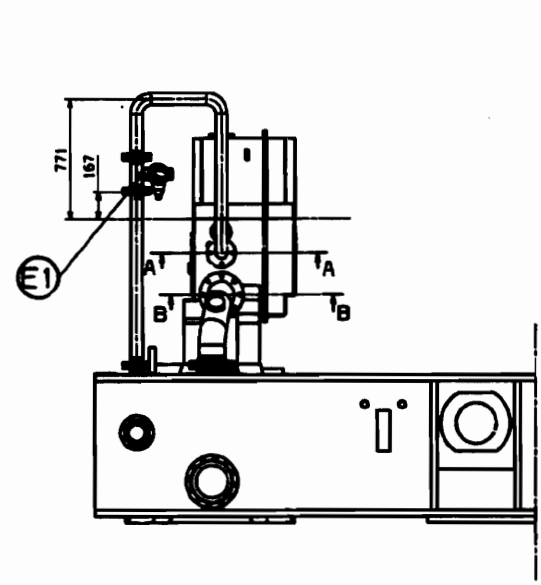
A SOUDER
SUR SOCLE
a-12

TRANSPORT - GENERATOR SEALING SYSTEM

C	3910000937	12/08/97	LOUVRIER						
B		12/08/97	LOUVRIER						
A	ELABORATION								

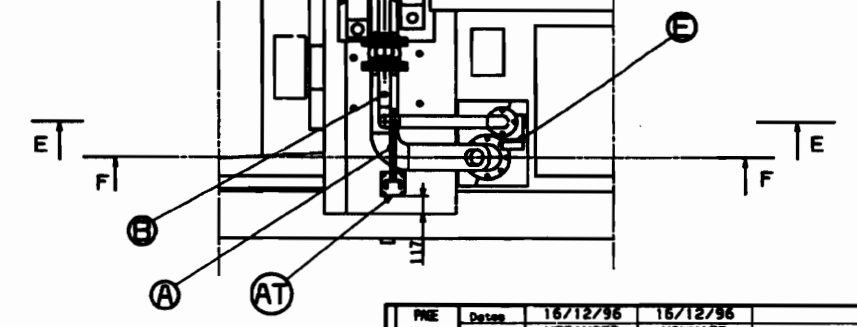
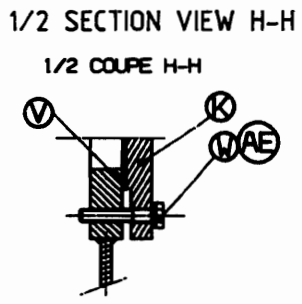
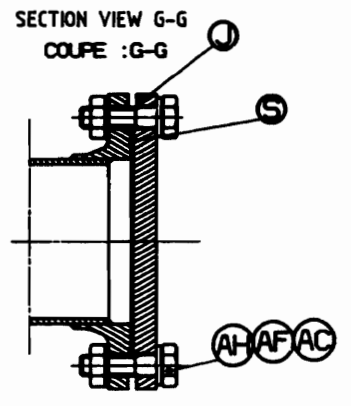
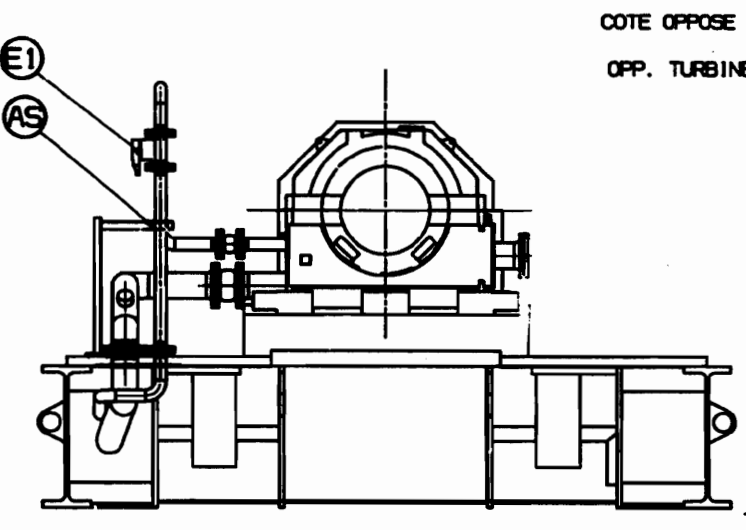
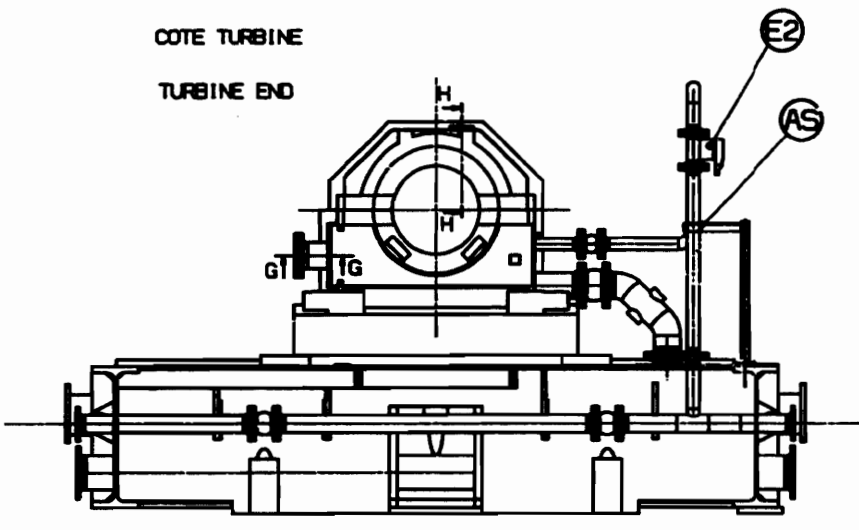
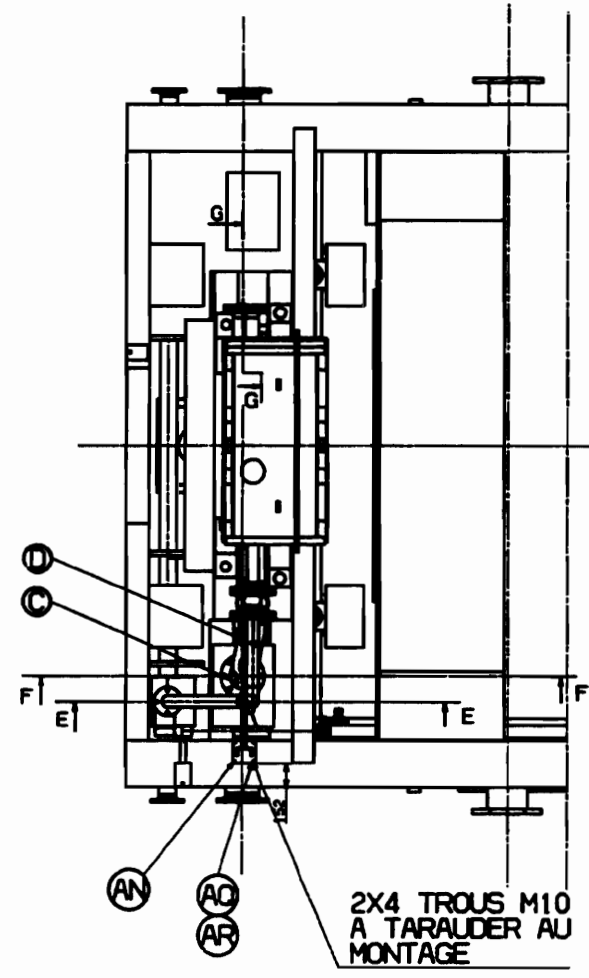
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SUITE PAGE	Noms	LOUVRIER		
	Vises			
	QA : 3	DESSINE/REDIGE	VERIFIE	APPROUVE
DOC. ORIGINE	TITRE	FERMETURE POUR TRANS		
39 102993				
EMETTEUR	ECHELLE	1/30	BELFORT	
	LE BOURGET			
		GEC ALSTHOM		
		70 102220		
		SECT. DOC.		

39 10337



ALL COMMENTS NOT TRANSLATED ARE ONLY MOUNTING INSTRUCTIONS USED IN THE WORKSHOP

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NOTA : DETAIL CC ET AA :ENTREE D'HUILE :
DIAPHRAGME H L'IVRE AU MONTAGE AVEC TROU Ø8
A RETOUCHER AUX ESSAIS.
APRES ESSAIS GRAVER SUR LA LANGUETTE
LE DIAMETRE DE PASSAGE
LE DECAPAGE DE CES TUYAUTERIE SERA EFFECTUE
UNE FOIS L'ASSEMBLAGE ET LES SOUDURES TERMINEES

MASSE : 260 kg

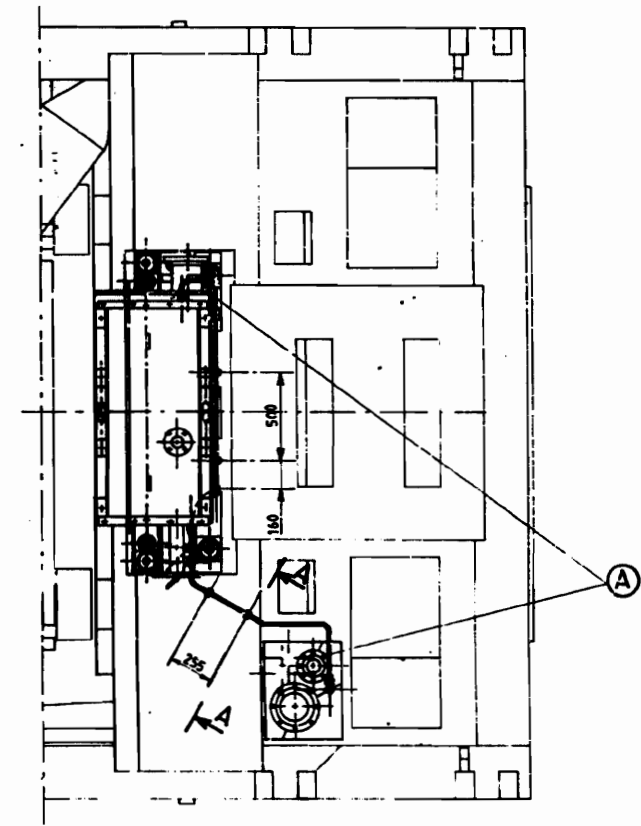
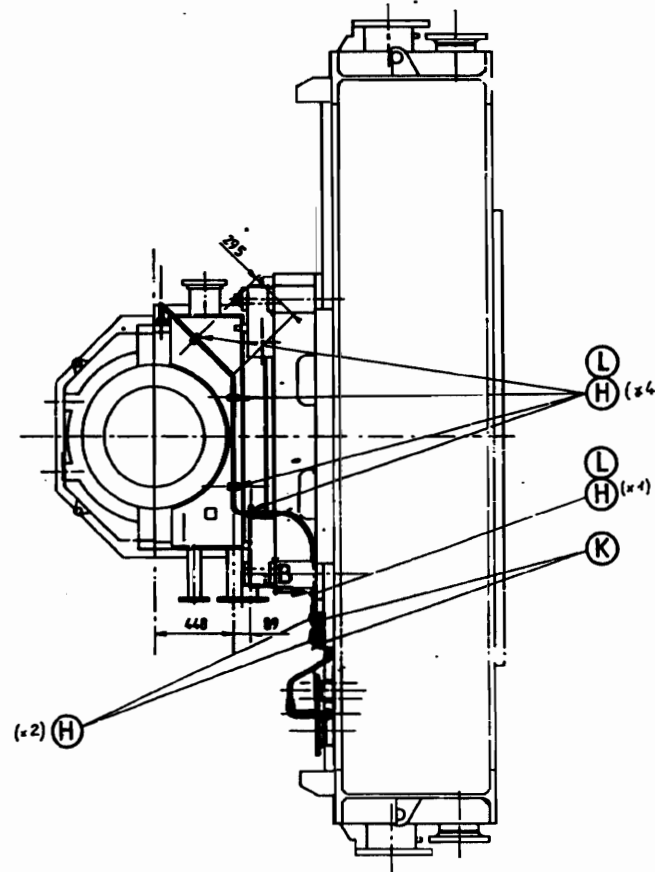
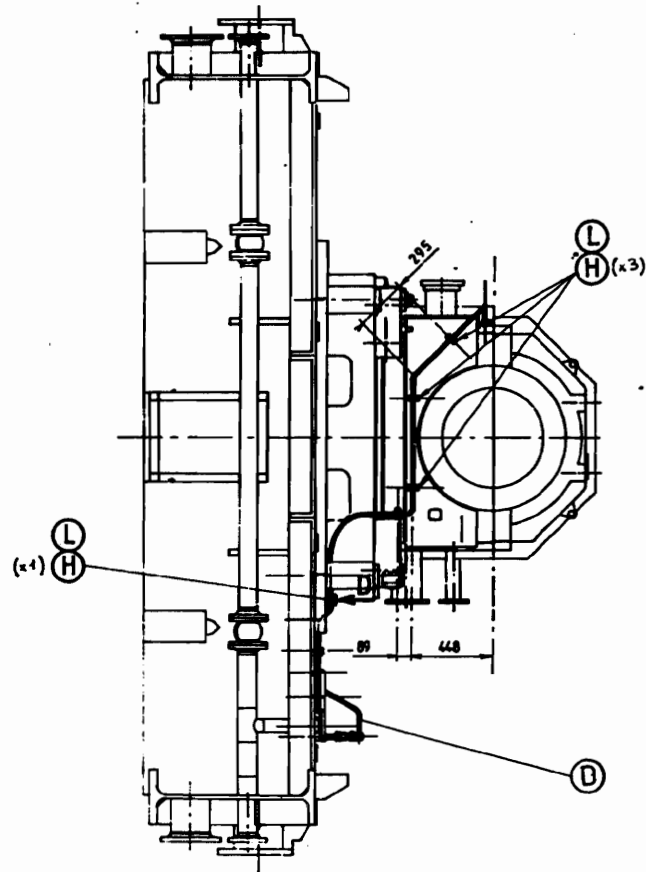
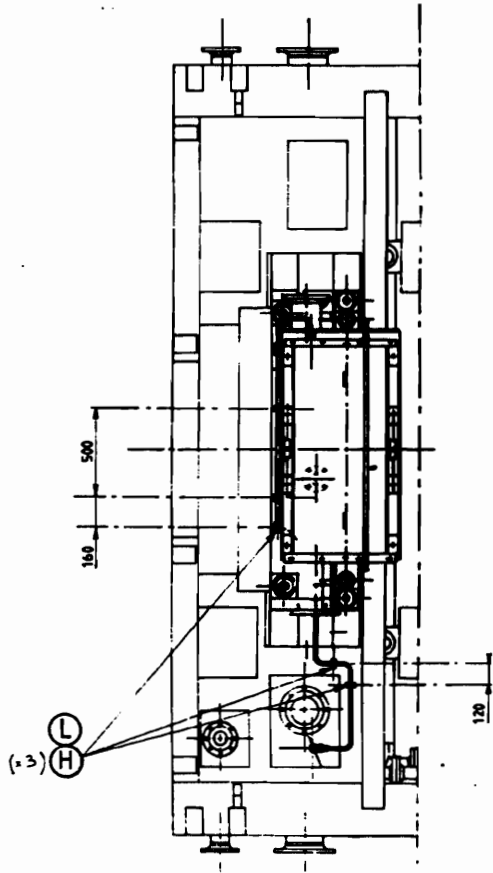
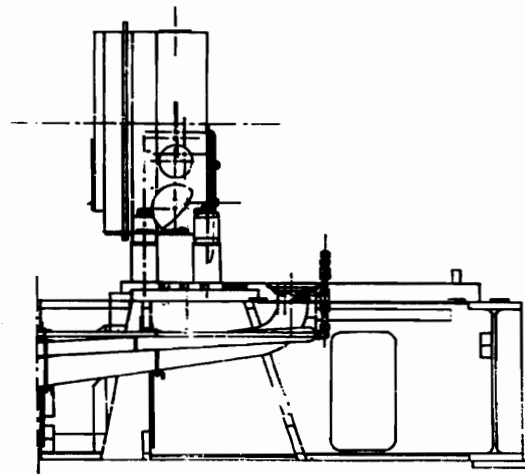
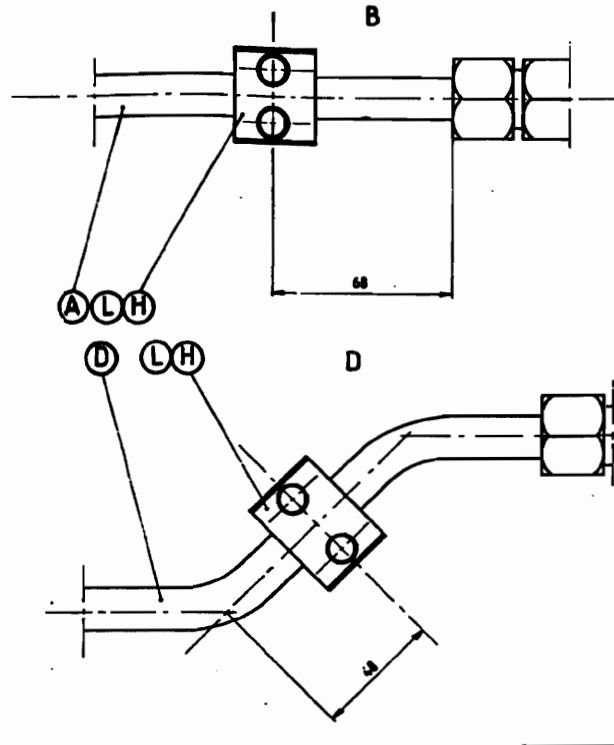
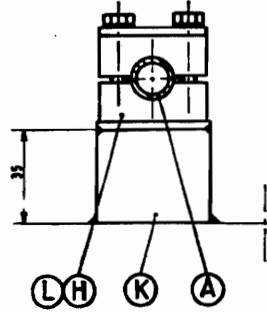
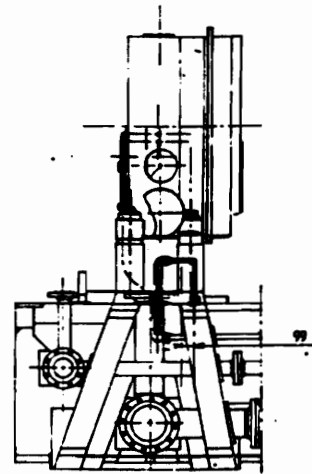
OIL INLET AND OUTLET ASSY

PRE	16/12/96	16/12/96
DESIGN	HEBINGER	MOUNIER
DATE PRE		
VERIF		
CA : 2	DESIGN/REVISE	VERIF/IE
TITRE		
ENTREE ET SORTIE HUILE		
SECALSTRON		
AD 39-603523 0001 B		

39-603523

SCALE 1:1
ECH:1:1

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Revision :
Date :



NOTE: C1-C1 SYMMETRIC TO C-C
NOTA: C1-C1 symétrique à C-C

TURBINE END
CÔTÉ TURBINE

OPP. TURBINE END
CÔTÉ OPPOSÉ TURBINE

MASSE: 20 Kg
WEIGHT:

DATE	04/12/96	12/12/96	
NOM	HEBINGER	MOUNTIER	
STAT			
no 2	DESIGN	REVISION	APPROUVE
TITRE		SOULEV. HUILE	
ENS. TUYAUT.		OIL JACKING PIPE ASSEMBL	
SCALE	1/15	REVISION	0001
FORMAT	A0	39 603518	

815E09 6E

36

AXE ALTERNATEUR
GENERATOR AXIS

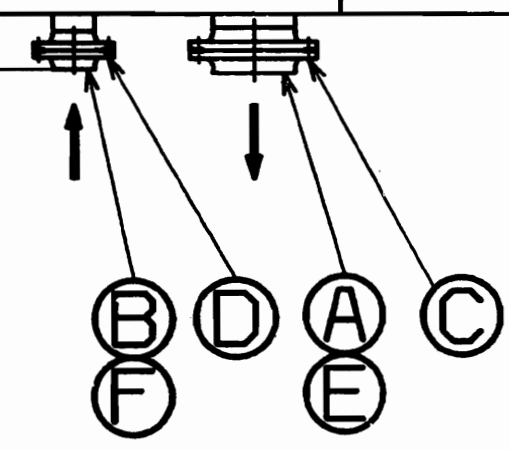
39-408123

LIMITE DE FOURNITURE
MATERIAL END SOURCE

COTE TURBINE
TURBINE END

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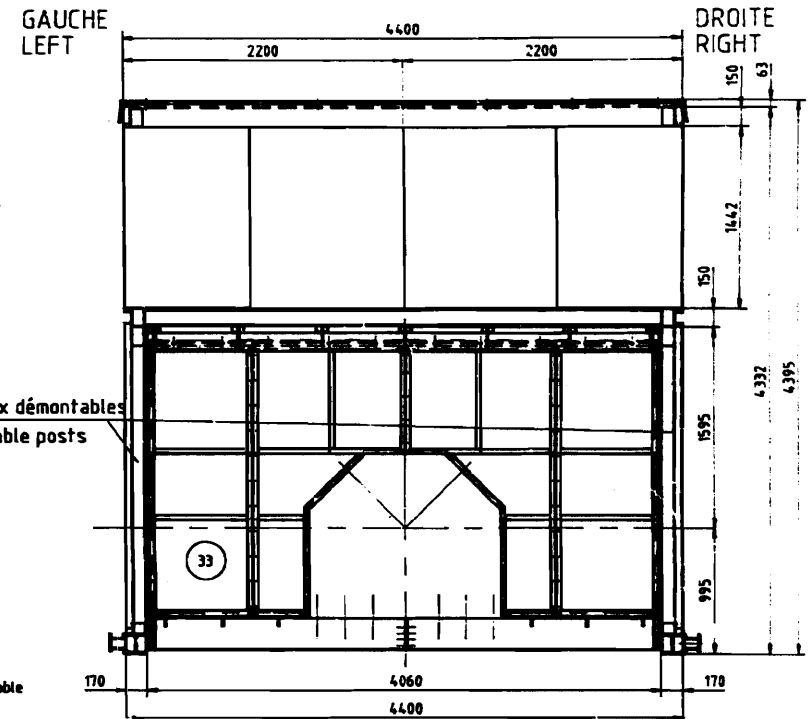
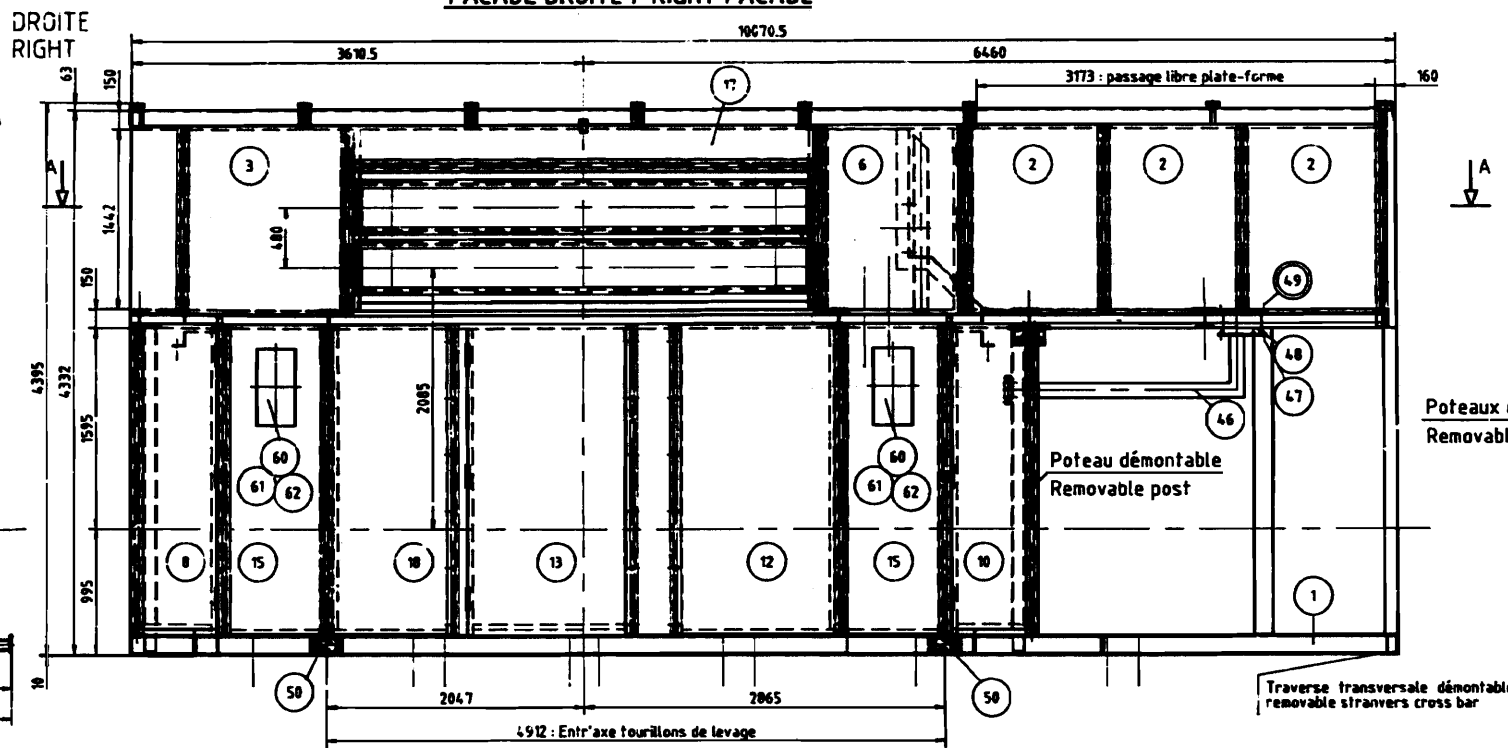
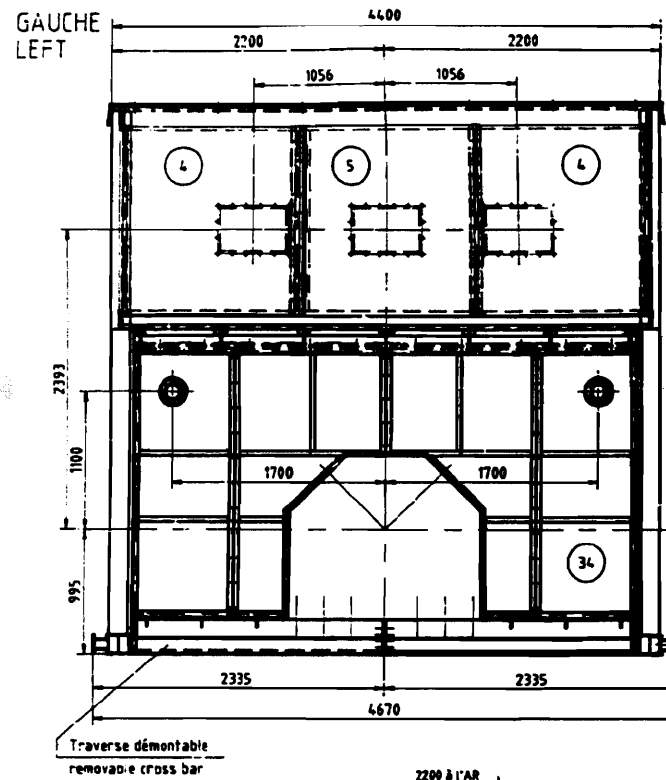


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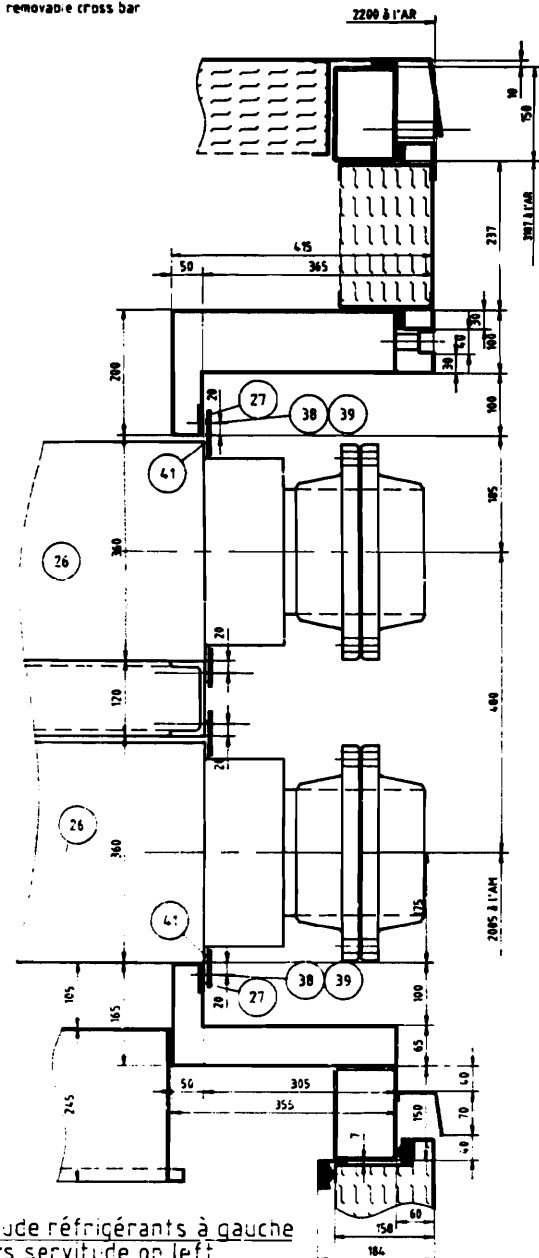
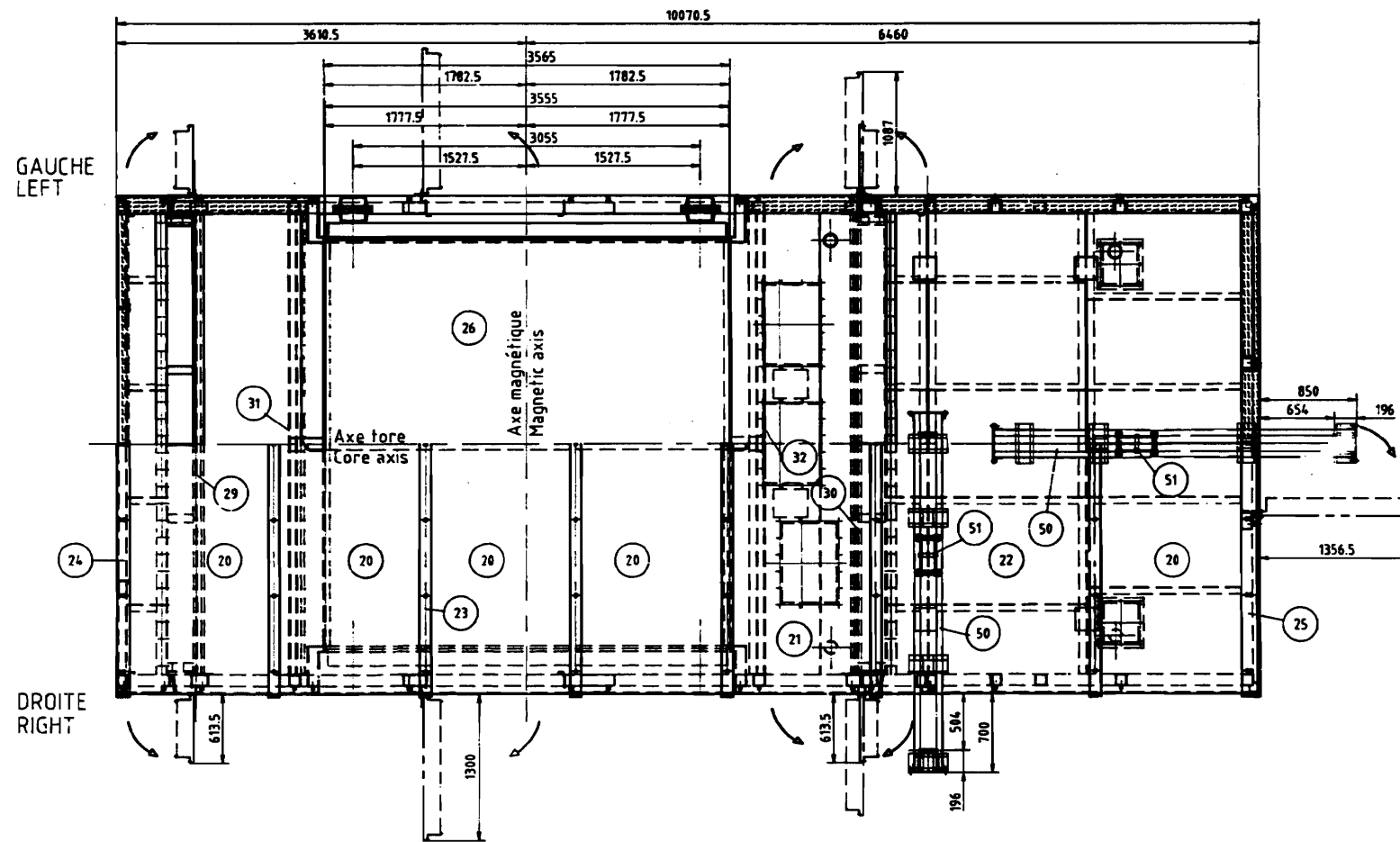
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Indices	Nature/N°	Avis modif.	Dates	Noms	Vises	Noms	Vises	Noms	Vises	
MODIFICATIONS					MODIFIE	VERIFIE	APPROUVE			
APPROUVE					TITRE OIL COUNTER FLANGES FOR GENERATOR BASE					
VERIFIE					CONTRE-BRIDES					
DES./RED.					21/01/97	BOUDEVIN	25	D'HUILE SOCLE		
CA : 3					Dates	Noms	Vises			
INFO. INTERNE	PAGE: 1	GIDOC	B.D.GRA	LANGUE	ECHELLE	BELFORT <input checked="" type="checkbox"/>	GEC ALSTHOM			
	SUITE PAGE: 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	F	/	LE BOURGET <input type="checkbox"/>				
	DOC. ORIGINE	DIFFU.	NATURE	EMETTEUR	FORMAT	39-408123				
	39-407585	2	P	39	A4	0001		A		

NEV 291406

FACADE DROITE / RIGHT FACADE



1/2 Vue 1/2 Coupe AA
1/2 View 1/2 Section AA



Service réfrigérants à gauche
coolers service on left

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Revision :
Date :

ÉCHELLE: 1/30	CLIENT: GEC ALSTHOM	 Z.I. du Douvresnil 76550 OFFRANVILLE Tél. 02 35 04 28 78 Fax : 02 35 05 38 62
FORMAT: A1	TITRE: CAPOT ABSORBANT LAVRION TV ENSEMBLE POUR MACHINE SUR REFRIGÉRANTS Planche 1/2	
N° PLAN: 97547 PC01 1/2 a	N° AR: 97547	

Index	N°	Avis	Modif	Date	Préparé	Approuvé	Index	N°	Avis	Modif	Date	Préparé	Approuvé
A	Diffusion			09.06.97	FIZET Patrice								
Date		09.06.1997		24.06.1997		24.06.1997							
Nom		FIZET Patrice		GAUCHE Reynald		OBERLI José							
Fonction		325		325		325							
N°		3		3		3							
NATURE		P		P		P							
ÉCHELLE		1/30		1/30		1/30							
LARGEUR		F		F		F							
ÉMETTEUR		A1		A1		A1							
N°		39		39		39							
N°		A1		A1		A1							
N°		39-103 528		39-103 528		39-103 528							

CAPOT ABSORBANT LAVRION TV
ENSEMBLE POUR MACHINE SUR REFRIGÉRANTS Planche 1/2
ABSORBING HOUSING LAVRION TV
GENERAL ARRANGEMENT FOR MACHINE ON COOLERS Plate 1/2

GEC ALSTHOM

39-103 528

POIDS DE LA CHARPENTE : 9036 Kg
POIDS PANNEAUX ET ACCESSOIRES : 11782 Kg
POIDS REFRIGERANTS PLEINS : 5218 Kg
POIDS REFRIGERANTS VIDES : 4560 Kg

WEIGHT OF THE SUPPORTING STRUCTURE : 9036 Kg
WEIGHT OF PANELS AND ACCESSORIES : 11782 Kg
WEIGHT OF FULL COOLERS : 5218 Kg
WEIGHT OF EMPTY COOLERS : 4560 Kg

POIDS DE L'ENSEMBLE PLEIN : 26036 Kg
POIDS DE L'ENSEMBLE VIDE : 25378 Kg

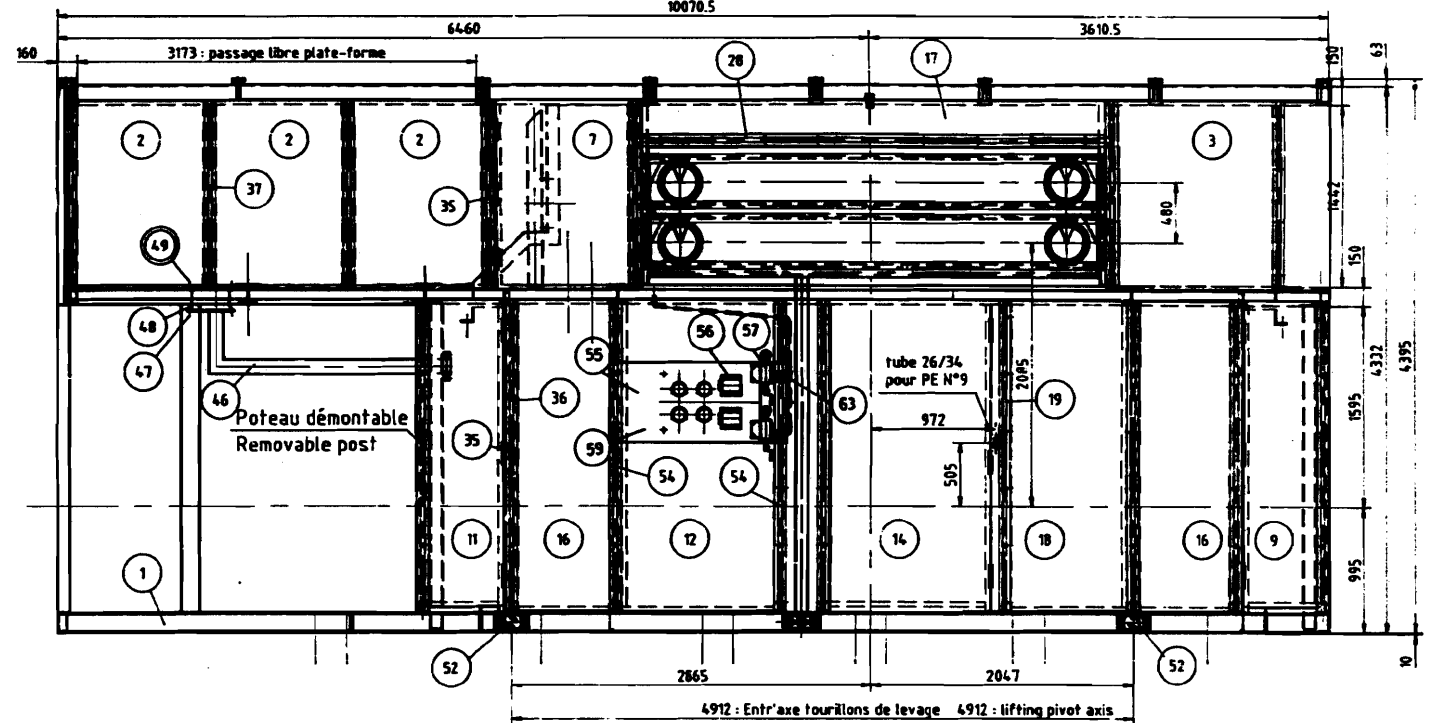
WEIGHT OF THE FULL SET : 26036 Kg
WEIGHT OF THE EMPTY SET : 25378 Kg

Note:
 (1) PREPARATION DES SURFACES :
 Tôles et fers commerciaux E24-2 : sablage SA 2.5
 Tôles galvanisées : voir spécification HEPPPEL
 (2) SPECIFICATION PEINTURE :
 • Parties extérieures :
 Type P1 soit 1 couche HEMPADUR VINYLE F508 rouge 5870
 Type P1 soit 1 couche HEMPADUR VINYLE F508 jaune 2178
 • Parties intérieures :
 Type P1 soit 1 couche HEMPADUR VINYLE F508 rouge 5870 sur l'ensemble
 Type P1 soit 1 couche HEMPADUR VINYLE F508 gris 4648 dans tous les compartiments
 Sur la tranche des panneaux, sur les parties recouvertes par les omégas et couvres joints
 des tôles, appliquer 2 couches de peinture II afin d'obtenir un film de 150 microns.
 Dernière des omégas, finition en F509 gris 4648
 Ensemble de l'assauture intérieure et extérieure à peindre en : P1 + P1.

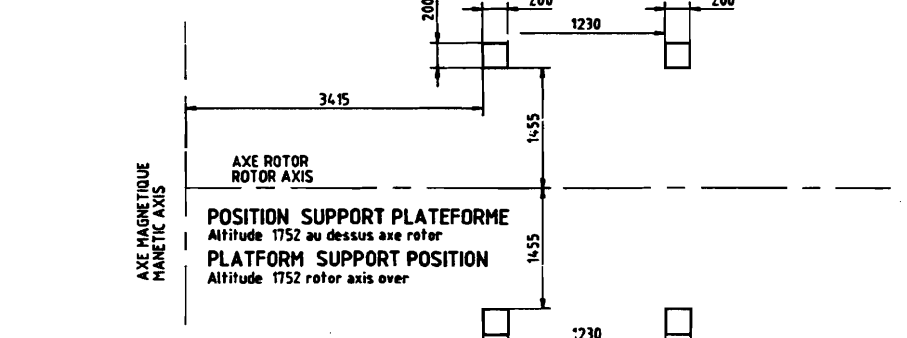
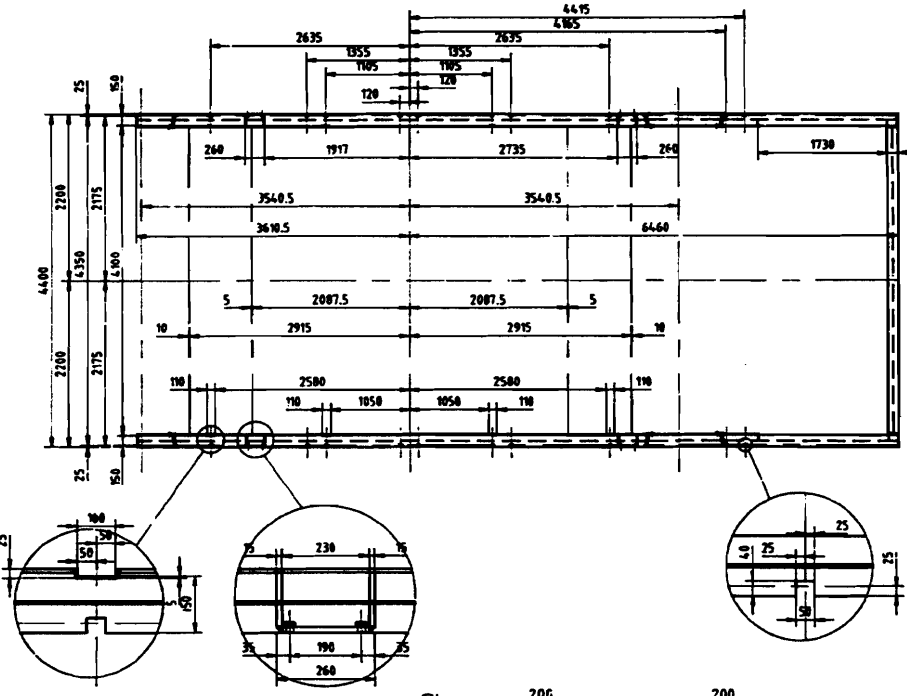
LA PEINTURE DOIT ETRE APPLIQUEE APRES UN DELAI MINIMUM DE
 SECHAGE DE 24 H A 20°C SUR LES JOINTS GUTTATERNA
ATTENTION : IL EST INTERDIT DE PENDRE LA TOILE PERFOREE
 (3) Pour positionnement de l'emplacement du
 constructeur et du contrôleur voir plan N° 39-103 168
 (4) ATTENTION :
 Pour levage voir plans N° 39-103 558 et 39-103 559
 (5) Etrancher le montage des toits rep 20 et rep 22 voir p : 4

Note:
 (1) PREPARATION OF THE SURFACES :
 Sheets and profiles E24-2 : sandblasting SA 2.5
 Galvanized sheet : refer to HEPPPEL specification
 (2) SPECIFICATION FOR PAINTING :
 • Outer parts :
 P1 type - La. 1 coat of HEMPADUR VINYL of F508 type - red 5870
 P1 type - La. 1 coat of HEMPADUR VINYL F508 type - yellow 2178
 • Inner parts :
 P1 type - La. 1 coat of HEMPADUR VINYL F508 type - red 5870 on the complete set
 P1 type - La. 1 coat of HEMPADUR VINYL F508 type - grey 4648 in all the compartments
 The edges of the panels and the surfaces recovered by the omega profiles and joint covers
 of the roofs must receive 2 layers of paint II in a way to obtain 150 µ thick.
 Behind the omegas, finish of F509 type - grey 4648
 The whole internal and external structure to be painted with P1 + P1.
 THE PAINT MUST BE APPLIED ON THE GUTTATERNA GASKET ONLY AFTER
 A MINIMUM DRYING PERIOD OF 24 H AT 20°C
CAUTION : IT IS NOT ALLOWED TO PAINT THE PERFORATED SHEET
 (3) Refer to drawing Nr 39-103 168 for the position
 of the manufacturer identification
 (4) ATTENTION :
 For lifting refer to drawing Nr 39-103 558 and 39-103 559
 (5) Tightness of the roofs erection non-20 and item-22 to see drawing N°

FACADE GAUCHE / LEFT FACADE



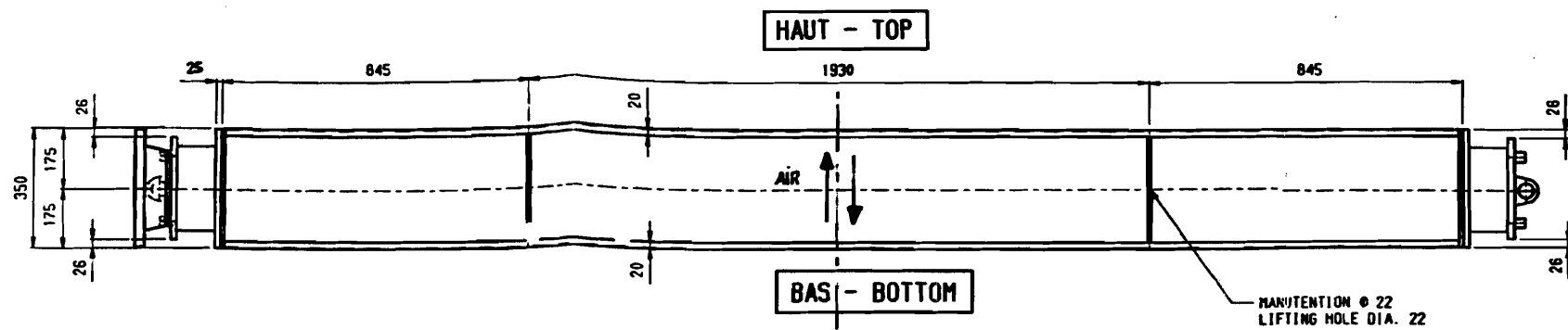
Rep	Nbr	Nr	Designations	Designations	Mat/Mat	Surf/Area	Poids/Weight	N°Plan/Drawing	Fournisseur/Supplier
63	4		Vis HM10x70 - rondelle plate	Screw HM10x70 - Flat washer			0,27		EUROSILENCE
62	2		filtré VARICEL VV6 10-12-24-12	filter VARICEL VV6 10-12-24-12			8		EUROSILENCE
61	2		Préfiltre AMERKLEEN cadre métallique taille 12x24	Præfilter AMERKLEEN metallic frame size 12x24			1,40		EUROSILENCE
60	2		Cadre M203 taille 12x24	Frame M203 size 12x24			0,50		EUROSILENCE
59	1		Support instrumentation	Instrumentation support			36,60	39-103 558	EUROSILENCE
58	1		Support sondes	Air sounding support			16	39-103 557	EUROSILENCE
57	2		Pot de purge	Lining lug			7,60		GEC-ALSTHOM
56	2		Relai redox	Redox relay			0,80		GEC-ALSTHOM
55	4		Thermomètre	Thermometer			2		GEC-ALSTHOM
54	2		Oméga tôle ep 15/10 30x25x35x25x30 L=2458	Omega shaped section sheet thk 15/10 30x25x35x25x30 Lth=2458	Galva Z275				EUROSILENCE
53	16		Vis HM20-70 - rondelle plate	Screw HM18-60 - Flat washer	Zingé Aluminium		3,71		EUROSILENCE
52	4		Tourillon de levage	Lifting pivot			4,2		EUROSILENCE
51	1		Chariot support palan	Trolley carriage for lifting gear			11		EUROSILENCE
50	1		Ensemble monorail côté palier et excitateur	Monorail exciter side and bearing side			122		EUROSILENCE
49	16		Vis HMB-30 - rondelle plate	Screw HMB-30 - Flat washer	Zingé Aluminium		0,26		EUROSILENCE
48	2		Registre ERO 300x345x185	Damper ERO 300x345x185			17,8		EUROSILENCE
47	16		Boulon HMB-35 - rondelle plate et grower	Bolt HMB-35 - Flat and grower washer	Zingé Aluminium		0,4		EUROSILENCE
46	2		Tuyauterie Ø114,3 ép 3,18 L=2463	Piping Ø114,3 thk 3,18 Lth=2463	Inox 304		42,91		EUROSILENCE
45	24,5m		Joint 180x15 comprimé à 10 entre capot et socle	Gasket 180x15 compressed to 10 between housing and base					GEC ALSTHOM
44	4,5m		Joint PVC NBR ref C151 30x5	PVC NBR gasket ref C151 30x5			0,82		EUROSILENCE
43	9,5m		Joint PVC NBR ref C151 40x15	PVC NBR gasket ref C151 40x15			5,23		EUROSILENCE
42	2,5m		Joint PVC NBR ref C151 30x15	PVC NBR gasket ref C151 30x15			10,31		EUROSILENCE
41	3,3m		Joint PVC NBR ref C151 60x10	PVC NBR gasket ref C151 60x10			1,88		EUROSILENCE
40	70		Rondelle étanche M10	Sealing washer M10			0,83		EUROSILENCE
39	316		Rondelle plate M10	Flat washer M10	Zingé Aluminium		0,15		EUROSILENCE
38	386		Vis HM10-30	Screw HM10-30	Zingé Aluminium		10,42		EUROSILENCE
37	18		Oméga tôle ep 15/10 30x25x35x25x30 L=1512	Omega shaped section sheet thk 15/10 30x25x35x25x30 Lth=1512	Galva Z275		3,62	4,64	EUROSILENCE
36	17		Oméga tôle ep 15/10 30x25x35x25x30 L=2458	Omega shaped section sheet thk 15/10 30x25x35x25x30 Lth=2458	Galva Z275		4,61	58,84	EUROSILENCE
35	18		Paumelle maroc 180 à axe démontable	Removable axis door hinges maroc 180	E24-2		8,86		EUROSILENCE
34	1		Cloison démontable côté Excitateur	Removable dividing panel EXCITER side	E24-2		687		EUROSILENCE
33	1		Cloison démontable côté TV	Removable dividing panel TV side	E24-2		675		EUROSILENCE
32	1		Cloison fixe vue P2	Dividing panel P2 view	E24-2		24,6	39-103 533	EUROSILENCE
31	1		Cloison fixe vue P1	Dividing panel P1 view	E24-2		228,88	39-103 534	EUROSILENCE
30	1		Cloison fixe vue O2	Dividing panel O2 view	E24-2		144,5	39-103 537	EUROSILENCE
29	1		Cloison fixe vue O1	Dividing panel O1 view	E24-2		109,2	39-103 535	EUROSILENCE
28	2		Oméga tôle ep 15/10 30x25x35x25x30 L=3665	Omega shaped section sheet thk 15/10 30x25x35x25x30 Lth=3665	Galva Z275		0,97	11,7	EUROSILENCE
27	4		Cadre é-anchéité réfrigérant en 2 parties	Two parts cooler tightness frame	E24-2		88,12		EUROSILENCE
26	2		Réfrigérant	Cooler			4560		GEC ALSTHOM
25	1		Couvre joint d'extrémité côté excitateur	Extremity covering gasket EXCITER side	Galva Z275		37,62		EUROSILENCE
24	1		Couvre joint d'extrémité côté TV	Extremity covering gasket TV side	Galva Z275		34,32		EUROSILENCE
23	6		Couvre joint	Covering gasket	Galva Z275		95,7		EUROSILENCE
22	1		Panneau de toit 4420x1976x200	Roof panel 1976x4420x200	Galva Z275		503		EUROSILENCE
21	1		Panneau de toit 4420x1283x200	Roof panel 4420x1283x200	Galva Z275		314		EUROSILENCE
20	5		Panneau de toit 4420x1296x200	Roof panel 4420x1296x200	Galva Z275		1584		EUROSILENCE
19	1		Oméga tôle ep 15/10 30x25x35x25x30 L=2458	Omega shaped section sheet thk 15/10 30x25x35x25x30 Lth=2458	Galva Z275		3,93		EUROSILENCE
18	2		Panneau 965x2450x150	Panel 965x2450x150	Galva Z275		334		EUROSILENCE
17	2		Panneau 297x3725x150	Panel 297x3725x150	Galva Z275		179		EUROSILENCE
16	2		Panneau 778x2450x150	Panel 778x2450x150	Galva Z275		275		EUROSILENCE
15	2		Silencieux entrée d'air 778x2450x645	Air inlet silencer 778x2450x645	Galva Z275		682		EUROSILENCE
14	1		Panneau ouvrant 1292x2418x170	Opening panel 1292x2418x170	Galva Z275		234		EUROSILENCE
13	1		Panneau ouvrant 1292x2418x170	Opening panel 1292x2418x170	Galva Z275		234		EUROSILENCE
12	2		Panneau 1280x2450x150	Panel 1280x2450x150	Galva Z275		434		EUROSILENCE
11	1		Panneau ouvrant 612x2418x170	Opening panel 612x2418x170	Galva Z275		124		EUROSILENCE
10	1		Panneau ouvrant 612x2418x170	Opening panel 612x2418x170	Galva Z275		124		EUROSILENCE
9	1		Panneau ouvrant 612x2418x170	Opening panel 612x2418x170	Galva Z275		124		EUROSILENCE
8	1		Panneau ouvrant 612x2418x170	Opening panel 612x2418x170	Galva Z275		124		EUROSILENCE
7	1		Panneau ouvrant 1075,5x1512x158	Opening panel 1075,5x1512x158	Galva Z275		123		EUROSILENCE
6	1		Panneau ouvrant 1075,5x1512x158	Opening panel 1075,5x1512x158	Galva Z275		123		EUROSILENCE
5	1		Panneau ouvrant 1345x1512x158	Opening panel 1345x1512x158	Galva Z275		137		EUROSILENCE
4	2		Panneau 1336x1502x150	Panel 1336x1502x150	Galva Z275		227		EUROSILENCE
3	2		Panneau 1280x1502x150	Panel 1280x1502x150	Galva Z275		232		EUROSILENCE
2	6		Panneau 1063x1502x150	Panel 1063x1502x150	Galva Z275		584		EUROSILENCE
1	1		Charpente	Supporting structure	E24-2		9036		EUROSILENCE



EUROSILENCE
 ZI de Douvresnil
 76550 OFFRANVILLE
 TEL: 02 35 04 28 70 -
 Fax: 02 35 05 38 62
 N° PLAN : 97547 PC01 2/f a N° AR : 97547

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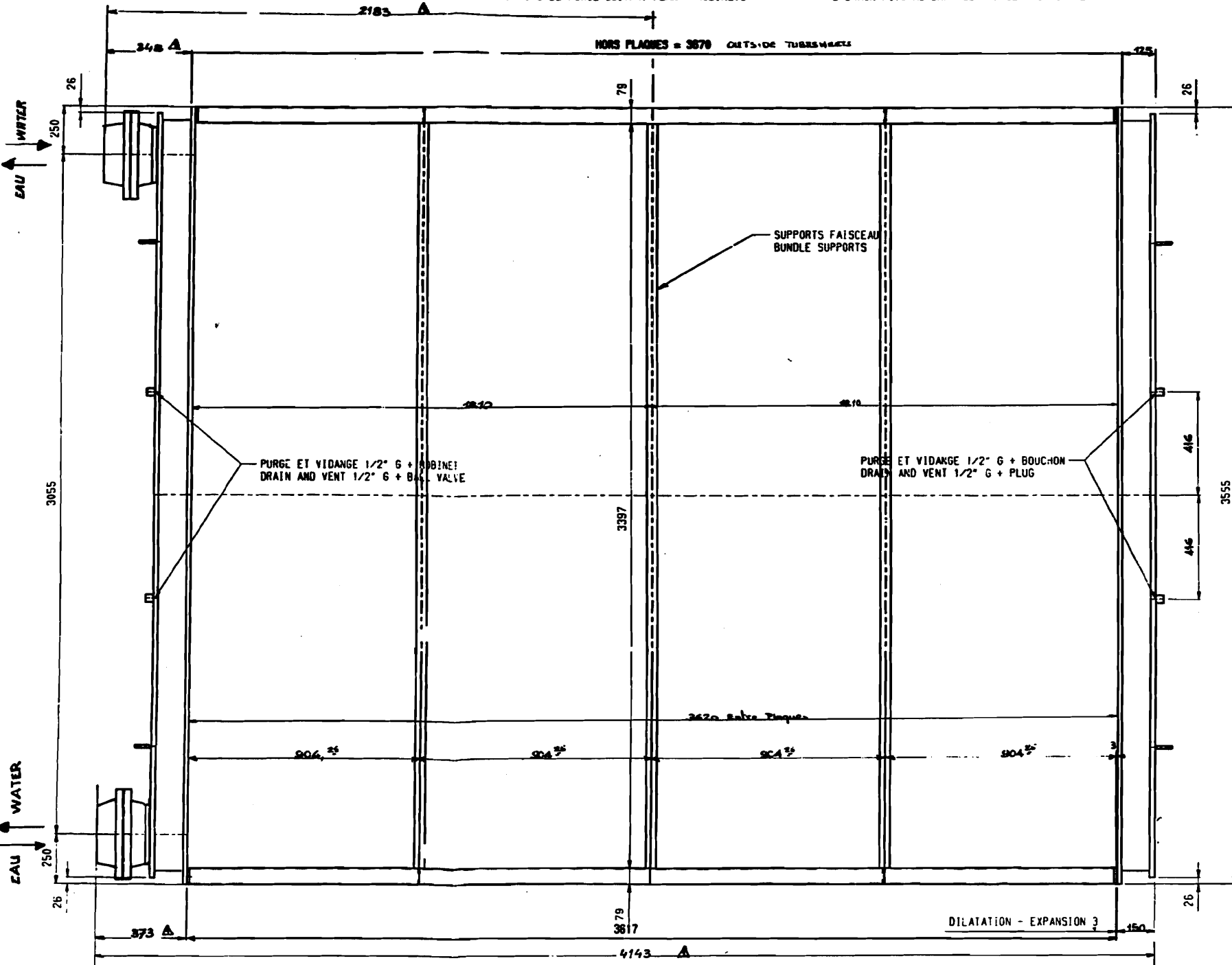
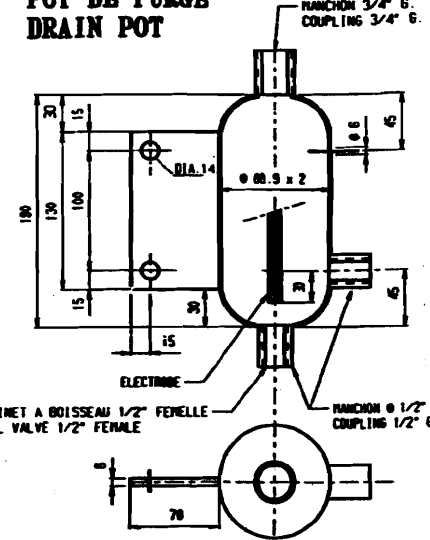
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 09.06.1997
 24.06.1997
 24.06.1997
 CAPOT ABSORBANT LAVRION TV
 ENSEMBLE POUR MACHINE SUR REFRIGÉRANTS Planche 2/2
 ABSORBING HOUSING LAVRION TV
 GENERAL ARRANGEMENT FOR MACHINE ON COOLERS Plate 2/2
GEC ALSTHOM
 39 A1 39-103 529 1 A



POUR LA CDE IL SERA FOURNI NON MONTE :
 2 RELAIS REDOX 69 SOUS COFFRET ETANCHE
 ALIMENTATION 220-380V - 50Hz
 2 BOUGIES TV INOX 3/4" G
 2 POTS DE PURGE SUIVANT PLAN + ROBINETS

FOR THE ORDER IT WILL BE SUPPLIED NO CONNECTED :
 2 REDOXES RELAY IN A WATER TIGHT BOX
 ALIMENTATION 220-380V - 50 Hz
 2 STAINLESS TV DETECTORS 3/4" G FIXATION
 2 DRAIN POTS AS DRAWED + BALL VALVES 1/2" G.

POT DE PURGE
 DRAIN POT



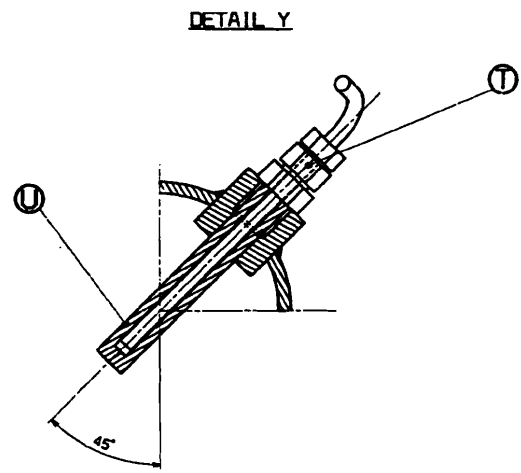
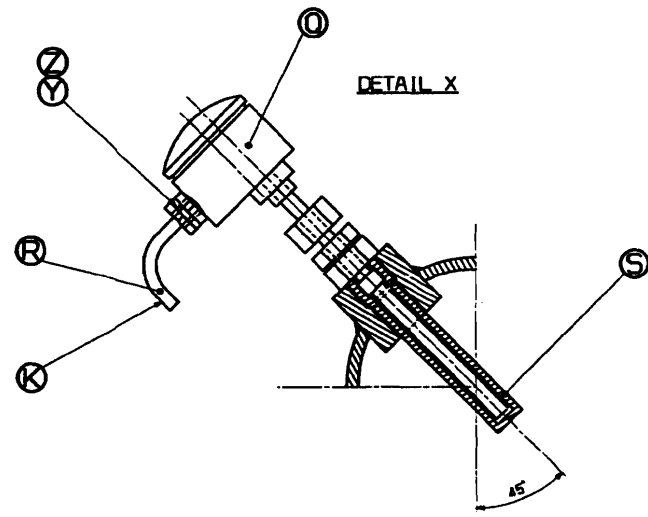
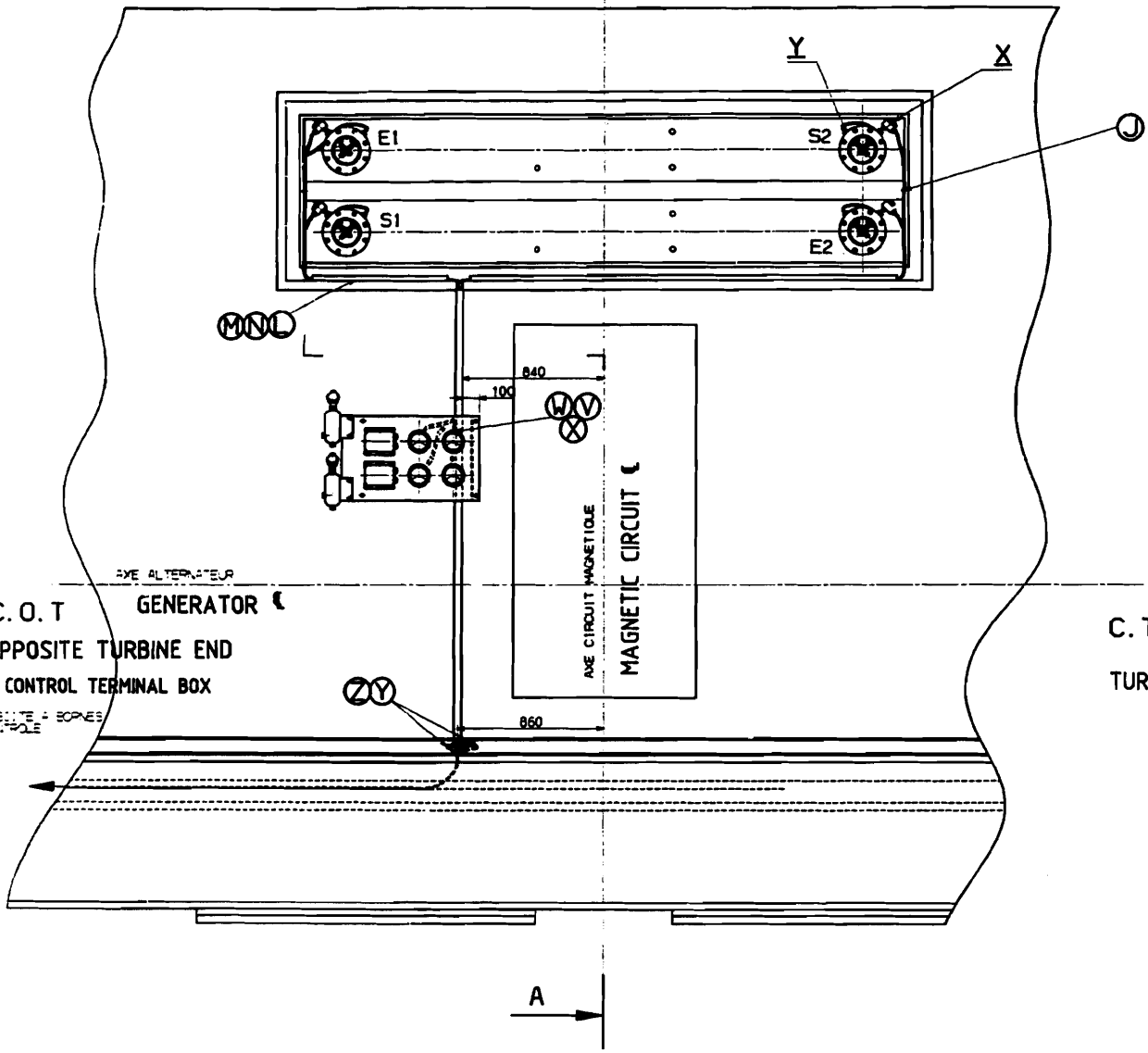
IDENTIFICATION		380/3307-0-ER-2-332002 05		2 PASSES	
FLUIDE - FLUID		EAU - WATER	AIR		
Cote de calcul - Calculation code		COP 85 O. C (0,7)			
Pression de service - Service pressure		bar	40		
Pression de calcul - Design pressure		bar			
Pression d'essai - Test pressure		bar	55		
Masse totale a vide - Total empty weight		kg	2,230		
Volume Capacité		dm ³	223		
MATERIEUX - MATERIALS					
Tubes de faisceaux		Interieur - Internal	Alu - Aluminium	NF A 50-123	
Tubes de faisceaux		Extérieur - External	Alu - Aluminium	NF A 50-123	
Alésages - Flats			Aluminium	NF A 50-104	
Plaque tubulaire		Cote eau - Water side	A2 DP	NF A 30-205	
Tubulature		Cote air - Air side			
Bouton a vis - Water tap					
Cote de bolton - Water tap frame					
Fond plat - Flat end					
Coudes - Flange					
Tubulures - Brazing					
Joints de bolton - Water tap gasket					
Joints de chambre - Chamber gasket					
Isolamento - Insul					
PROTECTION					
Coque int. - Water side inside		Selvant specif. BFA/CEM 81/81-80/81 5-10mm G			
Cote air - Air side		Selvant specif. BFA/CEM 81/81-80/81 5-10mm G			
Joint Gris 1640 / Color Gris 1640		Selvant specif. BFA/CEM 81/81-80/81			
Reception finale - Final receipt		EPEE SPIRILE -			
1 Plan mis à jour pour suite de fabrication de stock		02/05/06	LOMEZ		
6 EDITION ORIGINALE - ORIGINAL ISSUE		08/12/06	LOMEZ		
CLIENT - CUSTOMER		COMMANDE E.S. - E.S. ORDER		321-30403	
CSC ALSTROM		OBJET CLIENT - CUSTOMER ORDER		53/L 30964/AC41	
AFFAIRE - CONTRACT		PLAN DE REF - REF. DRAWING		380/3307-0-ER-2-332002 05	
APPAREIL - EQUIPMENT		HYDROREFRIGERANT - AIR COOLER		BOULE - SCALE	
TITRE - TITLE		PLAN D'ENSEMBLE - GENERAL DRAWING		380/30403-0100	

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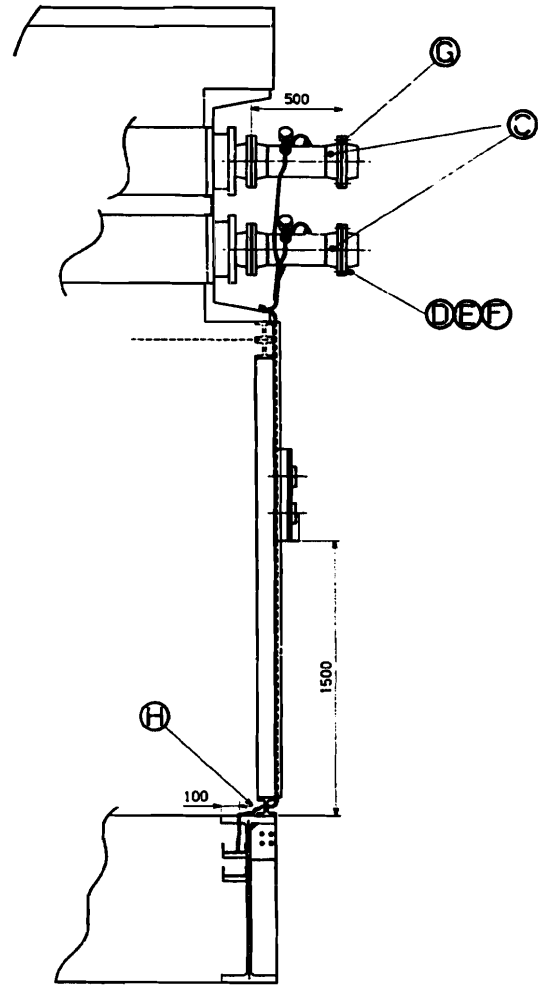
CSC ALSTROM PORT
 C.A. - I.A. - C
 BON POUR CIRCULATION
 Nom: HOUWERZ Date: 21/01/07
 Signature:

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 Date :

A →



SECTION A
 COUPE A



(AA) DEBITMETRES MONTES PAR PPG SUR SORTIES EAU

39-603565

COOLER INSTRUMENTATION


INSTRUMENTATION REFRIGE.

DATE	27/02/97	27/02/97
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APPENDIX III

OEM exciter regulation cubicle test report 54-651247 and TOGT
protection relay technical guide

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Reference Name :					QA :	DATE	NAME	VISA		
LAVRION IV TV					Commande usine					
Title :					 N° 54-651247 GEC ALSTHOM Folios 1 /40					
TEST REPORT INSPECTION REPORT										
EXCITATION REGULATION CUBICLE					Revision	A	B			

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1. OBJECT

This document, completed by EGT PEES, becomes the **LAVRION IV TV** excitation regulation cubicle factory test inspection report.

2. REFERENCE DOCUMENTS

Schematic diagram : 54-101410

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3. TEST MEANS

- Multi-meter : 20.000 points
- Oscilloscope
- Multi-meter : class 2
- Dielectrometer
- Ammeter : class 2
- Functions generator
- Frequency analyser

Tests executed from _____ to _____

Test realized by :

Name :

Date :

Visa :

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4. PRELIMINARY TESTS

4.1. MECHANICAL CHECKING AFTER MANUFACTURE

In accordance with IC74-41075

4.2. MEASUREMENT OF MECHANICAL EARTHING CONTINUITY

In accordance with IC74-41116

REMARKS

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4.3. DIELECTRIQUE TESTS INSULATION RESISTANCE MEASUREMENT

Following IEC 439-1.

During this tests, electronic circuits are disconnected. Other components are disconnected or short-circuited.

4.3.1. DIELECTRIC TESTS

The dielectric test consists in applying an alternative voltage of 50 Hz between terminals of one sub-assembly and all other earthed connections of the circuit during one minute. Neither effluvia nor flashover must appear.

There are the following assemblies:

- Power circuit : test voltage 2000 Volts
- 220 V - 50 Hz auxiliaries supply : test voltage 2000 Volts
- 125 Vdc supply : test voltage 2000 Volts
- Voltage and current measurement circuits : test voltage 2000 Volts
- Electronic power supply circuits : test voltage 500 Volts
- 48V circuit : test voltage 500 Volts
- 4-20mA circuit : test voltage 500 Volts

4.3.2. INSULATION RESISTANCE MEASUREMENT

The insulation resistance measurement is realized by applying 500 V dc between terminals of one sub-assembly and all other earthed connections of the circuit.

During this test, the sub-assembly is disconnected from external circuits and not supplied with power, except the circuit providing testing voltage.

The insulation resistance is measured when the normal working is reached, and not less than 5 seconds after having applied a 500 V dc voltage. The value of this resistance must be better than 1000 Ω/V .

This test is realized on :

- The sub-assemblies with regard to earth
- The totality of the sub-assemblies wired together with regard to earth

4.3.3. MECHANICAL EARTHING CONTINUITY MEASUREMENT

The value of the resistance must always be less than 0.1 Ω when the elements are supplied with a 2 Amperes current.

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INSULATION MEASUREMENT AND DIELECTRIC TEST

Circuits tested	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Power circuit		2000Vac > 2MΩ					
220Vac - 50 Hz supply		2000Vac > 2MΩ					
125 Vdc control supply		2000Vac > 2MΩ					
Voltage and current measurement circuits		2000Vac > 2MΩ					
Electronique power supply circuits		500Vac > 0.5MΩ					
Global insulation resistance		> 0.5MΩ					
48V circuit		500Vac > 0.5MΩ					
4-20mA circuit		500Vac > 0.5MΩ					

PANEL NUMBER
N°

CARD NUMBER
N°

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5. EXCITATION SYSTEM RESPONSE TIME

- Short-circuit of RS1 card integrator.
- Set the output bridge voltage at the nominal excitation voltage $U_n = 58V$.
- Simul a stator voltage drop.
- Measure of the time the excitation voltage reaches its ceiling value $U_p = 200V$. (see annexe B)
The time must be $\leq 0.03s$ from 0 to 10% ($U_p - U_n$) and
 $\leq 0.1s$ from 0 to 95% ($U_p - U_n$)
- Simul a fast rise stator voltage.
Measure of the time the excitation voltage breakdown from its ceiling value $U_p = 200V$ from its nominal $U_n = 58V$. (see annexe C)
This time must be $\leq 0.15s$.

6. RISE TEMPERATURE TEST

This test has to be done for only one equipment and at the end of the tests procedure.
The temperature is measured at different points inside the cubicle and on the enclosure.

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7. CONTROL / SETTING SPECIFICATION

7.1. STANDARD TESTS

Verify that the regulation cards used have been controlled :

- Insulation
- Dielectric
- Presetting

7.2. CONTROL / SETTING

See following board.

See annexe A

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CONTROL SUPPLY

Element tested	Values controlled				Measure	Remarks
	Characteristics	Measure point	Theoretical value	Delta max		
Single phased voltage transformer -T11	300V/20,20V 70VA 50Hz	1.1-1.2 2.1-2.2 3.1-3.2	300V 20V 20V	+/- 5% +/- 5%		Automatic channel supply
Single phased voltage transformer -T13	300V/20,20V 70VA 50Hz	1.1-1.2 2.1-2.2 3.1-3.2	300V 20V 20V	+/- 5% +/- 5%		Manual channel supply
Three-phased voltage transformer -T05	(100,110) $\sqrt{3}$ / 6x35V 30VA 50Hz	A2-B2-C2 a1-n a2-n b1-n b2-n c1-n c2-n	100V 35V 35V 35V 35V 35V 35V	 +/- 5% +/- 5% +/- 5% +/- 5% +/- 5% +/- 5%		Automatic channel stator voltage reference
Three-phased voltage transformer -T14	110 ...100/ 60V6 10VA	A2-B2 B2-C2 C2-A2 a1-n b1-n c1-n	100V 100V 100V 35V 35V 35V	 \pm 5% \pm 5% \pm 5%		Phase reference voltage transformer for automatic channel
Three-phased voltage transformer -T16	110 ...100/ 60V6 10VA	A2-B2 B2-C2 C2-A2 a1-n b1-n c1-n	100V 100V 100V 35V 35V 35V	 \pm 5% \pm 5% \pm 5%		Phase reference voltage transformer for manual channel

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RELAYS SETTING/TRANSDUCER

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Value measured	Setting range	Measure point	Theoretical value to be obtained		
Overexcitation relay -F31	RMPU 1020	U Time	25% to 100 % Un		46% +/-5% 12s +/-5%		Current fault = 138A (1,3 Ifn) Shunt = 150A/100mV Un = 200mV
Time delayed relay -K90	CST-ET	Time	0,2 to 45s		2s +/- 2%		2nd stage overexcitation fault
Time delayed relay -K92	CST-MT	Time	0,2 to 45s		5s +/- 2%		This temporisation includes the TOG 2nd stage temporisation
Excitation voltage -U04	ISTAT300	Voltage			4mA 20mA		for 0V for 150V
Excitation current -U05	ISTAT300	Voltage			4mA 20mA		for 0V for 200mV Shunt 150A/100mV
Time delayed relay -K95	SRL	Time			T1=10s T2=24H		
-K80	EUIC	U Time			50V 0.1s		
Time delayed relay -K94	CST-MT	Time	0,2 to 45s		1s +/- 2%		
Time delayed relay -K91	CST-ET	Time	0,2 to 45s		10s +/- 2%		
Time delayed relay -K93	CST-ET	Time	0,2 to 45s		5s +/- 2%		This temporisation includes the TOG 2nd stage temporisation
Time delayed relay -K96	CACTA-MT	Time	0,2 to 3s		0.2s +/- 2%		
Rotor earth fault -K32	TOGT + PG2	Resistor	1KΩ to 5KΩ		2KΩ +/- 20% 1KΩ +/- 20%		Rotor earth fault 1st stage Rotor earth fault 2nd stage

Remarks : All the auxiliary contact microswitches (-Q15) to (-Q18) must be in CA-CA position.

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8. FUNCTIONAL TEST

- The preliminary tests are made (see chapter 4)
- The standard tests are made (see chapter 5)

8.1. AUTOMATIC CHANNEL SELECTION

Select the channel :

- Control of signalisation
- Control of acknowledge
- Control of inhibitions

8.2. MANUAL CHANNEL SELECTION

Select the channel :

- Control of signalisation
- Control of acknowledge
- Control of inhibitions

8.3. ORDERS +Ex

Give orders so as to increase the set point to the maximum step.

- Control the maximum step signal.

8.4. ORDERS -Ex

Give orders so as to decrease the set point to the minimum step.

- Control the minimum step signal.

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8.5. EXCITATION CLOSING

On external order, if unit speed > 90% of the rated value, and there is not inverter forcing, then the excitation breaker -Q01 closes

-Q01 actived

In the same time, the field flashing contactor -Q03 closes, supply the exciter, and stop when the stator voltage reach 50% of nominal stator voltage.

8.6. EXCITATION TRIPPING

On external order (unit fault or tripping) or internal order (2nd step excitation fault) and when unit breaker is opened,

-Q01 opened

8.7. FOLLOW-UP TEST BY SIMULATION

Set automatic mode

Check the equality of the stator voltage with auto reference

Check the equality of the manual reference with excitation current image

Check the equality of the manual control voltage with automatic control voltage

Set manual mode

Check the equality of the excitation current image with manual reference

Check the equality of the auto reference with stator voltage

Check the equality of the automatic control voltage with manual control voltage

8.8. EXCITATION BOOSTER

The excitation booster is prepared to start when the regulation is in automatic mode and when the unit breaker is closed.

The excitation booster operates when stator voltage decrease under 70% of nominal stator voltage and stop when stator voltage increase over 80% of nominal stator voltage.

Check the sequence

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9. PERFORMANCE ON FAULT

The equipment runs on normal conditions

9.1. PERFORMANCE ON NORMAL RUN UNDER 1ST STAGE FAULT

9.1.1. ROTOR EARTH FAULT

- -F32 relay detects the rotor earth fault.
 - Control of signalisation
 - Control the terminal board contacts

9.1.2. OVER EXCITATION FAULT

- -F31 relay detects the over excitation.

When the excitation current exceeds the -F31 setted threshold, this validation involves a change over from the automatic channel to the manual channel.

- Control of signalisation
- Control the regulation change in manual channel
- Control the terminal board contacts

9.1.3. AUTO CHANNEL NORMAL POWER SUPPLY FAULT

When the auto channel power supply is faulty, this validation involves a change over from the automatic channel to the manual channel (fuses -F11 or ALS1 +A67 card in fault).

- Control of signalisation
- Control the terminal board contacts
- Control the regulation change in manual channel

9.1.4. STAND-BY POWER SUPPLY FAULT

When the stand-by power supply is faulty.

- Control of signalisation
- Control the terminal board contacts

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9.2. TRIPPING ON FAULT

9.2.1. FIELD FLASHING FAULT

Too long field flashing.

- Control of signalisation
- Control of field breaker tripping
- Control the terminal board contacts

9.2.2. OVER EXCITATION FAULT

The 2nd stage beeing present (2s after the 1st stage)..

- Control the terminal board contacts
- Control of field breaker tripping

9.2.3. THYRISTOR FUSES FUSION

If the fuses of the two bridges are faulty.

- Control of signalisation
- Control the terminal board contacts
- Control of field breaker tripping

9.2.4. ROTATING DIODES FAULT

The relay -F30 detects a exciter diode fault :

- Control of signalisation
- Control the terminal board contacts
- Control of field breaker tripping

9.2.5. 2ND STAGE EXCITATION TRANSFORMER OVERHEATING

If the second stage excitation transformer overheating is detects.

- Control of field breaker tripping

9.2.6. MANUAL POWER SUPPLY FAULT

When manual channel is ON and the manual channel power supply is faulty.

- Control of signalisation
- Control the terminal board contacts
- Control of field breaker tripping

PART LIST

PANEL:				
Mark	Material	Serial number	Description	Code
+ A01	SP1		Power stabilizer	L54E1411AY00
+ A08	LCS1		Current limitation card	L54E1454AG00
+ A15	CMS1		Automatic set point	L54E1425AY00
+ A25	LSES		Under-excitation limitation	L54E1407AY00
+ A32	RS1		Regulator	L54E1420AY00
+ A39	ADA1		Temperature adaptation	L54E8000DK00
+ A46	GITS		Three-phased pulses generator	L54E1416AY00
+ A53	FITS1		Filtered phase references	L54E1423AY00
+ A58	ACS3		Standby power supply 125 VDC	L54E1414AY00
+ A67	ALS2		+/- 15 VDC - 1A supply	L54E1421AY00
+ A76	CMG4		Measurement circuit	L54E2900JJG4
+ B08	ASEX1		Booster	L54E1417AY00
+ B15	CMS1		Manual set point	L54E1425AY00
+ B32	RIEX		Current loop	L54E1409AY00
+ B46	GITS		Three-phased pulses generator	L54E1416AY00
+ B53	FITS1		Filtered phase references	L54E1423AY00
+ B58	ACS3		Standby power supply 125 VDC	L54E1414AY00
+ B67	ALS2		+/- 15 VDC - 1A supply	L54E1421AY00

SP1 CARD

+ A01 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Active power calibration	Pot. P4,P1 Rési.	R45 = 3,32K R46 = 20K		M1	5V +/- 2%		For the rated active power : Sn = 240,0MVA
Derivation gain	Rési.	R3 = 100K			G = 1 +/- 2%		R3 = 200 x G - 100 (in K)
Stops calibration	Pot. P2 Rési.	R15 = 2K		M2	+ 250 mV - 250 mV +/- 20 mV		Signal delta P

PANEL NUMBER

N°

LCS1 CARD NOT USED
+ A08 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Limitation set-point	P1			M2	5,5 V		Limitation to 110% of rated stator current
Idwo calibration	Rési.	R33 = 150U			0,55V +/- 20mV		R33 = $\frac{23166,72U-11005,8}{143,208-234,8672U}$ (in Ohms) (0,48V < U < 0,81V)
Offset setting	Rési.	R37 = 100K		PT1	-8V +/- 2%		(in K) R37 $\frac{22,1(U_{lim} \text{ for } \phi = 0 - U_{lim} \text{ for } \phi = 0)}{Idwo \text{ cal.}}$
Stator current calibration	P3			M3	5 V +/- 2%		For rated stator current I _{stn} = 10659 A
Limitation time constant to be on	Rési.	R39 = 82,5K R41 = 680K			100s +/- 10s		R39 = $\frac{582,98T-2,74 \cdot R41}{2,74 + R41}$ (in K) T in s
Limitation time constant to be out	Rési.	R42 = 100K R44 = 100K			5s +/- 1s		R42 = $\frac{10000T-4,7R44}{47 + 4,7R44}$ (in K) T in s

PANEL NUMBER
N°

CMS1 CARD (automatic channel)
+ A15 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Cut-off frequency of the stabilizer filter	Rési.	R21 = 4,75K			$F_c = 490\text{Hz}$ +/-10%		$R21 = \frac{10\,000}{2\pi \cdot F_c \cdot 0,001-1}$ (U)
Minimum automatic set-point	Pot. P1 Rési. Rési.	R7 + R8 = 24,83K R9 = 2,21K		M1	Umin 4,5V +/-0,02V		Minimum setting of 90% for Un. $R7 + R8 = \frac{100R9 \cdot Umin}{500 - (100 + R9) \cdot Umin}$ (K)
Maximum automatic set-point	Pot. P2 Rési.	R39 + R40 = 1,39K		M1	Umax 5,5V +/-0,02V		Maximum setting of 110% for Un. $R39 + R40 = \frac{1235(Umax-Umin)}{1000 - 112,35(Umax-Umin)}$ (K)
Minimum set-point sign	Straps	V-W = 1 X-W = 0					Minimum set-point positive
Input set-up direction	Straps	A-B = 1 B-C = 0					With reversing
Output set-up direction	Straps	E-F = 0 F-G = 1					Negative signal in Z8
Auto-manu selection validation	Straps	R-S = 1 T-U = 1					Auto-manu selection used
Preset input validation	Strap	P-Q = 1					Preset input used
Use of an external supply	Straps	L-K = 1 M-N = 1					External supply used
Preset mode before starting	Strap	I-J = 0 J-Z = 0					Preset not used
Nominal stator voltage	Straps	2^7 = 1 2^6 = 0 2^5 = 0 2^4 = 0 2^3 = 0 2^2 = 0 2^1 = 0 2^0 = 0			5,0V		Preset to this value at the end of the flashing
Selection of following	Straps	B1-B2 = 0 B2-B3 = 1 F1-F2 = 0 F2-F3 = 1					

PANEL NUMBER
N°

CMS1 CARD (Automatic channel)
+ A15 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
External following	Strap	A1-A2 = 0					
Input polarisation	Rési.	R68 = 22,1K R69 = 22,1K					
Internal/External control switch inhibition	Strap	E1-E2 = 0					

PANEL NUMBER
N°

LSES CARD

+ A25 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Reactive current calibration	Pot.	P2		Point M1	-5V +/-0,1V		Reactive power absorbed and phi = 90°.
Reactive current calibration	Pot.	P2		Point M1	+5V +/-0,1V		Reactive power furnished and phi = 90°.
Active current calibration	Pot.	P1		Point M2	+5V +/-0,1V		For phi = 0°.
Limitation line setting ldw = $K1x lw - K2xU$	Rési.	R67 = 249K R25 = 4,61K			K1 = 0,180 K2 = 0,41		R67 = Xd if Xd is in %. Slope setting at 80°. $R25 = \frac{23702 K1}{1000 - 525 K1}$ (K)
Limitation line point			P = 0 MW Q = -97,0 MVAR				Reactive power absorbed and phi = 90°.
Limitation line point			P = 127,5 MW Q = -74 MVAR				Reactive power absorbed and phi = 30°.
Proportionnal gain setting	Rési.	R2 = 0U R73 = 10K			G = 0,1 +/- 10%		R2 = $22,1x(11G - 1)$ in K
Droop sign	Straps	A - B = 0 B - C = 0					Adjusted on site
Droop value	Rési.	R39 = 4,71K			4,5% +/- 1%		$R39 = \frac{100\ 000 \times \text{Droop in \%}}{100 - \text{Droop in \%}}$ (in K)
Time constant	Rési.	R44 = 333,33K			0,55s +/- 10%		$R44 = \frac{1000 \times T}{2,2 - T}$ T in s, R44 in K

PANEL NUMBER
N°

N°

RS1 CARD

+ A32 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Ceiling release on dv/dt	Strap	X9 = 1					Ceiling release on dv/dt used
Ceiling release on threshold	Strap	X10 = 1					Ceiling release on threshold used
Current loop	Strap	X12 = 0					Current loop unused
Field current limitation	Strap	X13 = 1					Field current limitation used
LUF2 card using	Strap	X14 = 1					Without LUF2 card .
Connection between the adder and the PI limitation current loop	Strap	X17 = 1					Connection made
Connection between voltage measurement and voltage regulation adder	Strap	X18 = 1					Connection made
Time constant of phase leading filter	Rési.	R95 = 8,51K			T1 = 40ms +/-10%		$R95 = \frac{R96T1}{0,0047R96-T1}$ T1 in s
Time constant of phase leading filter (efficacy)	Rési.	R96 = 190,48K			a = 6.25 T2 = 250 ms +/-10%		$a = \frac{T2}{T1}$ $R96 = \frac{1000}{a-1}$ (K)
Voltage loop : gain	Rési.	R97 = 475K			G = 10 +/-2%		R97 = 47,5G (K)
Voltage loop : constant	Rési.	R92 = 22,0K			T3 = 1s +/-10%		$R92 = \frac{11,7}{T3 - 0,469}$ T3 in s
Current loop time constant	Rési.	R71 = 270,3K			T4 = 1s +/-10%		$R71 = \frac{1000T4}{4,7 - T4}$ T4 in s

PANEL NUMBER
N°

RS1 CARD

+ A32 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Stator voltage calibration	P.R60	R62 = 12.1K		VT	5,0V +/-2%		For U rated stator voltage USN = = 13KV + L(50)C
Field current calibration	Rési.	R68 = 0U R69 = 0U R65 = infinite R66 = infinite		IF	3,5V +/-2%		For rated Iex Iexn = 106 A.
Current limitation loop gain	Rési.	R53 = 199,60K			G = 4 +/-2%		R53 = 49,9G (K)
Current limitation loop time constant	Rési.	R45 = 22,0K			T5 = 1s +/-10%		R45 = $\frac{11,7}{T5 - 0,469}$ (K) T5 in s
Permanent field current limitation	Rési.	R18//R19 5,78K		X15	-3.85V +/-2%		Limitation to 1,1 times the rated current
Ceiling field current limitation	Rési.	R52//R122 = 11,20K			-4.55V +/-5%		Limitation to 2,4 times the rated current
Ceiling release on dv/dt	Rési.	R17 = = 825U			25,0 V/s +/-10%		Voltage variation of 500 % in 1 seconde
Ceiling release on threshold	Rési.	R7 = 15,00K		X8	4,15V +/-5%		Ceiling release at 83% rated U
Ceiling time setting	Rési.	R5 = 162,4K			T = 10s +/-0,3s		R5 = $\frac{T - 0,58}{0,058}$ (K) T in s

PANEL NUMBER

N°

ADA1 CARD

+ A39 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
	Wrapping to add	E21-E9 E14-D22 G14-D18 H20-G23					
Temperature calibration	Resi.	R24 = 499U R25 = 499U		G8	-1V -5V +/-2%		For 4..20mA input temperature 4..20mA for 0..50°C Generator cold air
Rotor current correction	Straps	W61 = 0 W60 = 1					
Rotor current correction	Resi.	R21 = R22 = 0U		G24	V +/-2%		
Gain I rotor correction	Resi.	R26 = 33,2K					
Field current calibration	Resi.	R33 = 68,1U 1W R32 = 475U R34 = 100K			3,5V G = 1 +/-2%		

PANEL NUMBER
N°

GITS CARD

+ A46 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Rectifier stop	Rési.	R114 = 49,9K R214 = 49,9K R314 = 49,9K		X12 X22 X32	10° +/- 2°		
Inverter stop	Rési.	R102 = 20K R202 = 20K R302 = 20K		X12 X22 X32	32° +/- 4°		
Pulse width	Rési.	R130 = 4,75K R230 = 4,75K R330 = 4,75K		X11 X21 X31	50µs +/- 6 µs		

PANEL NUMBER

N°

N°

FITS1 CARD

+ A53 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Input filter setting	Rési. Straps	R24 = R25 = R51 = R52 = R76 = R77 = 681U X10=1 X11=1 X12=1				0° +/- 2°	
Input filter gain	Rési.	R21 = R48 = R73 = 0U R22 = R49 = R74 = infinite				G = 1 +/- 2%	
Adder gain	Rési.	R12 = 100K				G = 1 +/- 2%	R12 = 100 x G (in K)
Inverter gain	Rési.	R62 = 100K				G = 1 +/- 2%	R62 = 100 x G (in K)
Close pulses width	Rési.	R63 = 39,2K		X8		40µs +/- 5µs	R63 = T (in K) T in µs
Close pulses frequency	Rési.	R32 = 249K		X8		630Hz +/- 80Hz	$R32 = \frac{1}{6,3 \cdot 10 \exp - 6 \cdot F_n}$ R in Kohms
Pulses release gain	Rési.	R84 = infinie R67 = 274K		X7		G = 3,6	Threshold at 7.5%
Close pulses presence	Strap	X8 = 0					Close pulses unused

PANEL NUMBER

N°

ACS3 CARD

+ A58 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Short-circuit current	Rési.	R10=475U			< 3,2A		One output short-circuited
Output voltage				B14-B16 B6-B4	2 x 28V +/-2V		At no load

PANEL NUMBER

N°

ALS2 CARD

+ A67 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Output voltage	P. R22 P. R11			X2 X3	+15V -15V +/- 0,3V		
Short-circuit current	Rési.	R5 = 5,62K R16 = 5,62K			1,24 A +/- 0,1 A		

PANEL NUMBER

N°

CM(G4) CARD

+ A76 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Stator current	Rési.	R7 // R11 = 586 U		B30 Z30	5V +/-5%		For ISTN = 10 659 A
		R4 // R8 = 586 U		Z18 B18	5V +/-5%		
Stator voltage adaptation	Straps	A-B=0 C-D=0 E-F=0 G-H=0 I-J=0 K-L=0					Not used

PANEL NUMBER
N°

ASEX1 CARD

+ B08 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Voltage calibration				X4	5V +/- 0,1V		Nominal stator voltage calibration
Voltage threshold to bring the booster into service	Pot. R5			X3	3,5V +/- 0,1V		Threshold setting : 70%
Voltage threshold to bring the booster out of service	Pot. R6			X3	4V +/- 0,1V		Threshold setting : 80%

PANEL NUMBER

N°

CMS1 CARD (Manual channel)
+ B15 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Cut-off frequency of the stabilizer filter	Rési.	R21 = 4,75K			Fc = 490Hz +/-10Hz		$R21 = \frac{10\,000}{2\pi \cdot Fc \cdot 0,001}$ (U)
Minimum manuel set-point	Pot. P1 Rési. Rési.	R7 + R8 = 3,73K R9 = 22,10K		M1	0,70V +/-0,02V		Minimum setting 20% Ifn $R7 + R8 = \frac{100R9 \cdot U_{min}}{500 - (100 + R9) \cdot U_{min}}$ (K)
Maximum manuel set-point	Pot. P2 Rési.	R39 + R40 = 6,021K		M1	3,85V +/-0,02V		Maximum setting 110% for Ifn. $R39 + R40 = \frac{1235(U_{max} - U_{min})}{1000 - 112,35(U_{max} - U_{min})}$ (K)
Minimum set-point sign	Straps	V-W = 1 W-X = 0					Minimum set-point positive
Input set-up direction	Straps	A-B = 1 B-C = 0					With reversing
Output set-point direction	Straps	E-F = 0 F-G = 1					Negative signal in Z8
Auto-manu selection validation	Straps	R-S = 1 T-U = 1					Auto-manu selection used
Preset input validation	Strap	P-Q = 1					Preset input used
Use of an external supply	Straps	L-K = 1 M-N = 1					External supply used
Preset mode before starting	Strap	I-J = 0 J-Z = 0					Preset used
Field current at no load	Straps	2^7 = 0 2^6 = 0 2^5 = 0 2^4 = 1 2^3 = 1 2^2 = 0 2^1 = 0 2^0 = 0			0,99V +/-0,05V		Preset to this value on unit breaker opening. If0 = 30 A
Selection of following	Straps	B1-B2 = 1 B2-B3 = 0 F1-F2 = 0 F2-F3 = 1					

PANEL NUMBER

N°

CMS1 CARD (manual channel)
+ B15 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Internal following	Strap	A1-A2 = 1					
Input polarisation	Rési.	R68 = 2,21K R69 = 2,21K					
Internal/external control switch inhibition	Strap	E1-E2 = 0					

PANEL NUMBER

N°

RIEX CARD

+ B32 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Clock period	P1			Output Z12	117 ms +/- 3 ms		Frequency 8,6 Hz
Field current calibration	P2 Rési.	R49 = 82,5K R52 = 66U		M1	-3,5V +/- 0,1 V		For the rated field current Ifn = 108A
Regulation loop gain	Rési.	R10 = 100K			G = 1 +/- 2 %		R10 = 100 x G (in K)
Regulation loop time constant	Rési. Strap	R7 = 45K A - B = 0			T = 0.25s +/- 10 %		T = (149,9 + (4990/(R7 + 4,99))) * C T in s R7 in K C = 0,001 avec A-B=0 C = 0,0057 avec A-B=1
Follow up gain	Rési.	R24 = 100K			G1 = 1 +/- 2 %		R24 = 100 x G1 (in K)
Follow up input level adaptation	Rési.	R39 = 0U					Input level: 15V
Integral term short-circuiting input level adaptation	Rési.	R53 = 332U					Input level: 15V

PANEL NUMBER

N°

GITS CARD

+ B46 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Rectifier stop	Rési.	R114 = 49,9K R214 = 49,9K R314 = 49,9K		X12 X22 X32	10° +/- 2°		
Inverter stop	Rési.	R102 = 20K R202 = 20K R302 = 20K		X12 X22 X32	32° +/- 4°		
Pulse width	Rési.	R130 = 4,75K R230 = 4,75K R330 = 4,75K		X11 X21 X31	50µs +/- 6 µs		

PANEL NUMBER

N°

N°

FITS1 CARD

+ B53 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Input filter setting	Rési.	R24 = R25 = R51 = R52 = R76 = R77 = 681U			0° +/- 2°		
	Straps	X10=1 X11=1 X12=1					
Input filter gain	Rési.	R21 = R48 = R73 = 0U R22 = R49 = R74 = infinite			G = 1 +/- 2%		
Adder gain	Rési.	R12 = 100K			G = 1 +/- 2%		R12 = 100 x G (in K)
Inverter gain	Rési.	R62 = 100K			G = 1 +/- 2%		R62 = 100 x G (in K)
Close pulses width	Rési.	R63 = 39,2K		X8	40µs +/- 5µs		R63 = T (in K) T in µs
Close pulses frequency	Rési.	R32 = 249K		X8	630Hz +/- 80Hz		R32 = $\frac{1}{6,3 \cdot 10 \exp - 6 \cdot F_n}$ R in Kohms
Pulses release gain	Rési.	R84 = infinie R67 = 274K		X7	G = 3,6		Threshold at 7.5%
Close pulses presence	Strap	X8 = 0					Close pulses unused

PANEL NUMBER
N°

ACS3 CARD

+ B58 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Short-circuit current	Rési.	R10 = 475U			< 3,2A		One output short-circuited
Output voltage				B14-B16 B6-B4	2 x 28V +/-2V		At no load

PANEL NUMBER
N°

ALS2 CARD

+ B67 Mark

Parameter	Adjusting components			Test		Measure	Remarks
	Type	Theoretical value	Real value	Measure point	Theoretical value to be obtained		
Output voltage	P. R22 P. R11			X2 X3	+15V -15V +/- 0,3V		
Short-circuit current	Rési.	R5 = 5,62K R16 = 5,62K			1,24 A +/- 0,1 A		

PANEL NUMBER
N°

TOG

Rotor earth fault protection

Operation-Commissioning instructions
Trouble-shooting

D97 1

A

C O N T E N T S

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I - FUNCTION - APPLICATION	3
II - DESCRIPTION - SPACE REQUIREMENTS	3
III - PRINCIPLE	6
IV - CHARACTERISTICS	8
V - RECEPTION TESTS	9
VI - COMMISSIONING TESTS	11
VII - REPAIRS	12

I - FUNCTION - APPLICATION

Alternators and, more generally, synchronous machines, have a field system supplied with direct current and insulated from the machine frame.

A single insulation fault between the field system and the frame is not dangerous for the machine but it must be detected and eliminated before a second fault can appear which second fault would have catastrophic results for the machine.

The TOG relay, in association with an equipment support plate, ensures the supervision of the insulation between the field winding of a synchronous machine and the frame.

It operates by the injection of a low frequency voltage which makes the measurement independent of the position of the fault on the winding. Moreover, the use of low frequency avoids any need for compensating adjustment of the capacitance between the field winding and earth.

The TOG relay contact allows of :

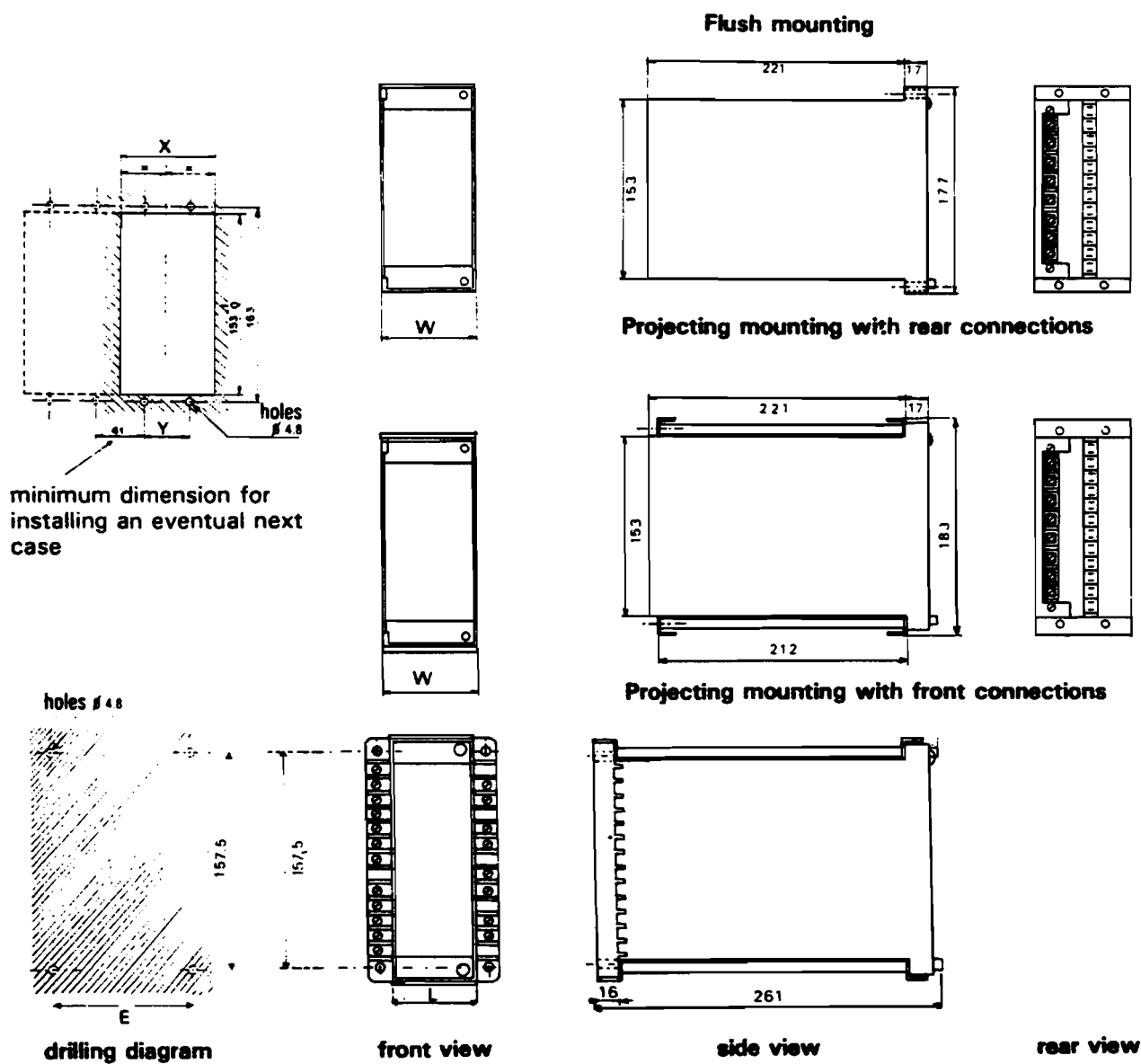
- either the de-energizing of the machine,
- or the starting of an alarm.

II - DESCRIPTION - SPACE REQUIREMENTS

The plug-in TOG relay is housed in a TROPIC case four modules wide.

The connections are made by means of 6.35mm clips and screw terminals.

SPACE REQUIREMENTS FOR THE TOG RELAY



		CASE (NUMBER OF MODULES)							
		2	3	4	5	6	7	8	
DIMENSIONS (mm)	Flush and projecting mounting with rear connections	W	40.4	60.7	81	101.1	121.4	141.7	162
		X	41	61	81.5	101.5	122	142	162.5
		Y	0	20.5	41	61	81	102	122
	Projecting mounting with front connections	E	X	77.5	98.5	118.5	138.5	159.5	179.5
L		X	94	115	135	155	176	196	

SPACE REQUIREMENTS FOR SUPPORT PLATES PG2 AND PG5

plate PG2

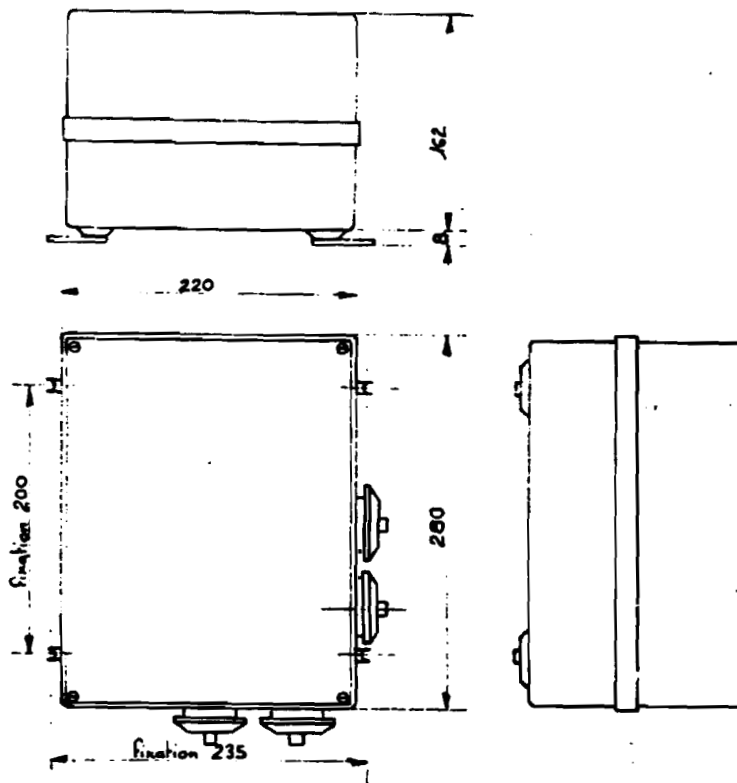
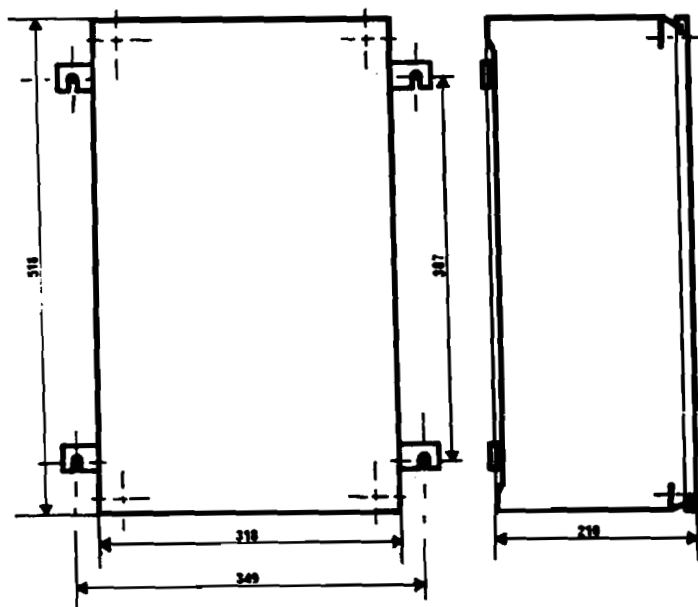


plate PG5



III - PRINCIPLE

1 - The TOG relay

The TOG relay applies a low frequency voltage to the field winding of the machine under supervision through the intermediary of a PG support plate.

The measurement of the insulation resistance is achieved by measurement of the current flowing in the TOG relay.

The TOG relay includes a low frequency voltage generator (4.75Hz - 24V peak to peak), and a shunt used for measuring the current.

The voltage appearing at the terminals of the shunt is filtered by a low-pass filter, rectified, filtered and compared with a fixed comparator setting which activates a time lag (optionally 5s, 10s, 20s or 40s). On expiry of the time delay, an amplifier controls the output relay and the indicator (LED).

There is a push button for resetting to zero the memory associated with the indicator (LED) when the fault has been cleared.

The resistance setting can be selected from the values 1k Ω , 2k Ω , 3k Ω or 5k Ω by means of a flying lead accessible on the front face (adjustment by shunt).

A test push button (optional) simulates a fault. During the test the output relay is locked out.

2 - The support plate

The support plate PG carries a reactor and a capacitor.

The purpose of the capacitor is to block the direct voltage from the field winding. The reactor and the capacitor form a series oscillating circuit presenting a minimum impedance at 4.75Hz (an adjustable series resistor enables that value of impedance to be adjusted to 1.5k Ω).

This circuit allows the passage of 4.75Hz and blocks other frequencies.

There are two versions of the support plate :

- the PG2 plate for cases where the field winding is supplied at direct voltages up to 200V,
- the PG5 plate for cases where the field winding is supplied at direct voltages up to 600V.

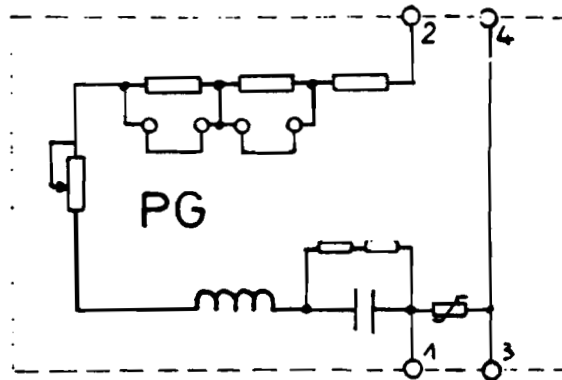
NOTES

- either plate can be used with any TOG relay, the equipments are not matched,
- the capacitor may retain a charge. It is advised that, before any further action after having de-energized the field circuit, the plate assembly be short circuited.
However that assembly is equipped with a discharge circuit (time constant about 7mn).

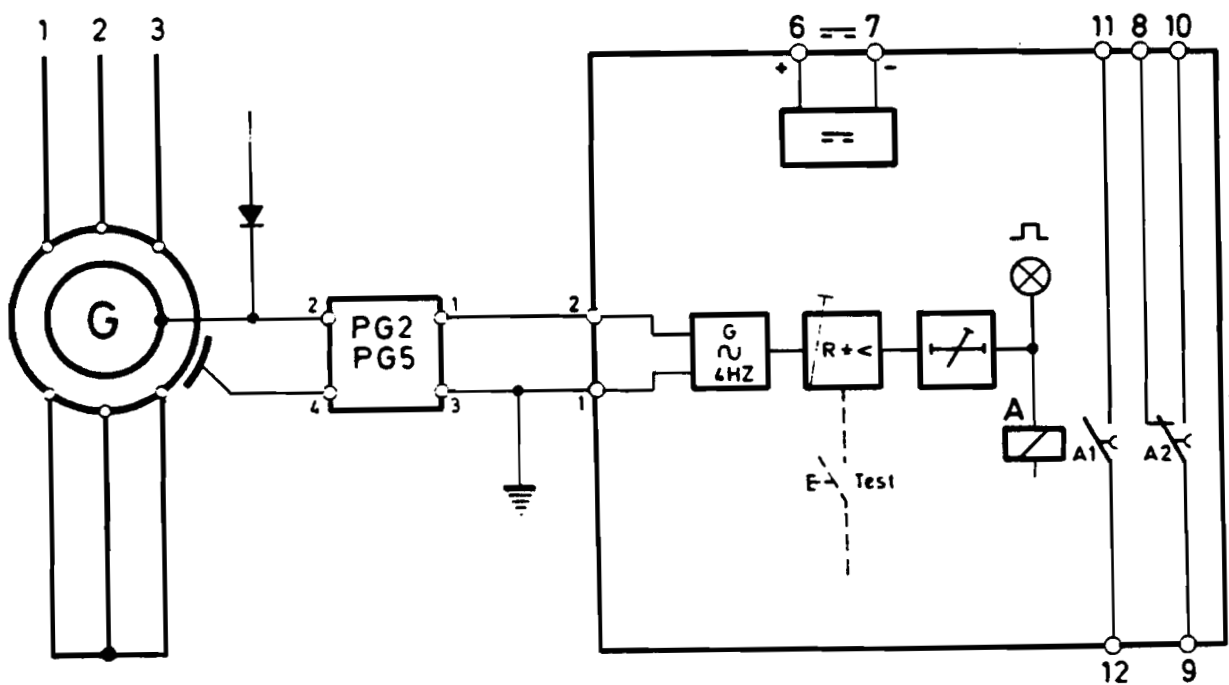
Since the measuring circuits are in direct connection (dc voltage) with the field circuits, the TOG supply circuit must include electrical isolation from the supply battery. That isolation is provided by a converter.

SIMPLIFIED DIAGRAM SHOWING THE PRINCIPLE AND EXAMPLE OF CONNECTIONS

plate PG.



relay T06 and plate PG.



IV - CHARACTERISTICS

1 - Input quantities

a) resistances

. values : 1 - 2 - 3 - 5k Ω ,

. accuracy : \pm 20%

b) reset percentage

113% of operating setting \pm 10% absolu

2 - Outputs

By energization of relay.

For each output there is one normally open contact and one changeover contact.

Switching capacity for 10 ⁴ operations	break	make
220V - 50/60Hz - $\cos \varphi = 0.6$	5A	5A
135Vdc - L/R = 30ms	0.3A	5A

3 - Indicators

flashing LED with memory or LED with permanent memory even on loss of supply.

4 - Times

. response time : $< 2s + T$ (T = set time delay)

. reset time : $< 2s$

. time of non-operation : T - 2s

. time lagging

5 - 10 - 20 - 40s

accuracy : \pm 5%

5 - Supply

. dc : 48V - 60V - 110V - 125V - 220V - 250V

. range of variation : 0.8 to 1.1 Un

. consumption

DC SUPPLY	48V	60V	110V	125V	220V	250V
under quiescent condition	3.5W	3.5W	3.5W	3.5W	6.5W	6.5W
per energized relay	2W	2W	2W	2W	3W	3W

6 - Withstand values

. temperature :

in service : - 10°C, + 55°C

in store : - 25°C to + 70°C

. dielectric : 2000V - 50Hz - 1mm in accordance with IEC standard 255-5

. impulse : 5000V - 1.2/50 μ s in accordance with IEC standard 255-4 class 3

. HF interference : 2500V - 1MHz in accordance with IEC standard 255-4 class 3

. vibration : in accordance with standard NF C20-616 severity 2000/10

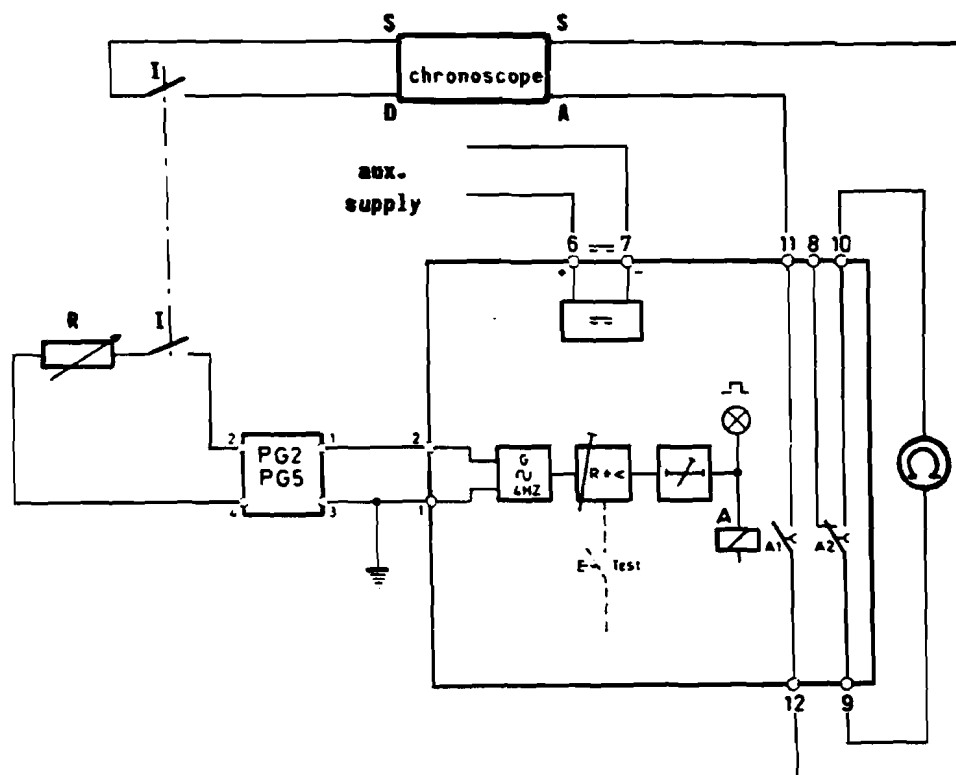
or with IEC standard 68-2-6 : 10 at 2000Hz - 1.5mm peak to peak - 10g.

V - RECEPTION TESTS

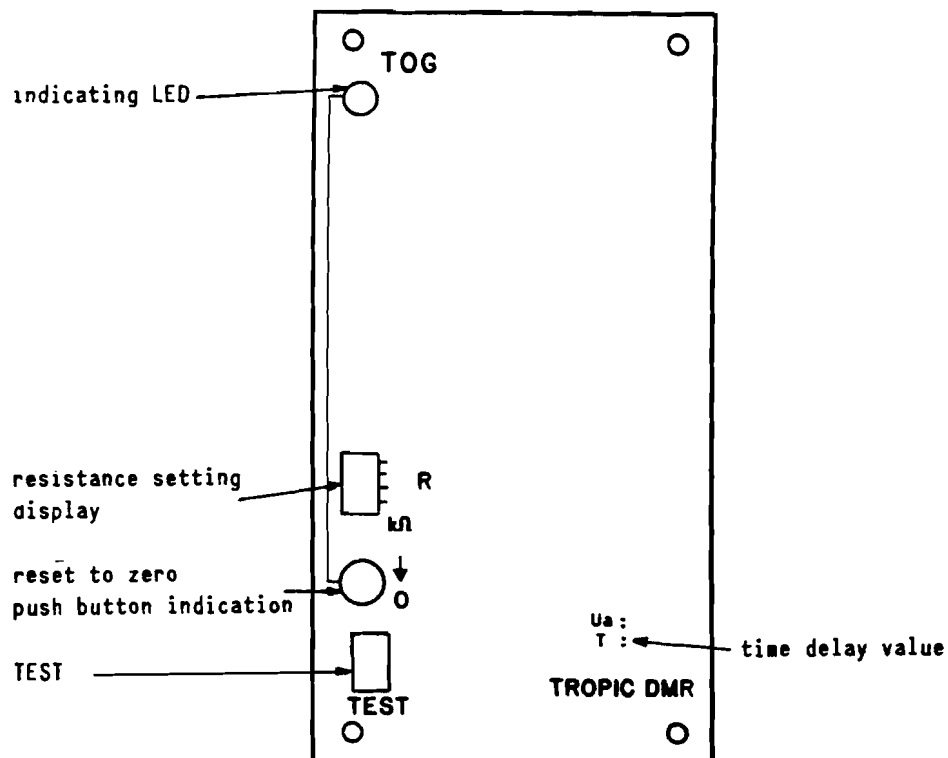
This specification applies to TOG relay + PG support plate for checking the insulation level between rotor and frame.

As soon as the relay are received on site and before they are put to work, it is advised that the following checks described hereafter be performed. If a relay proves defective, it is recommended that the ALSTHOM Mesure et relay, After Sales Service be approached.

1 - Test arrangement

a) diagramb) equipment required for the tests

- dc auxiliary supply
- decade resistance box,
- ohmmeter,
- chronoscope,
- switch I with two synchronized contacts.

c) description of the indicator plate**2 - General test conditions**

The relay is supplied at the rated auxiliary voltage corresponding to the option chosen.

The flying lead for setting the resistance range is positioned on the point corresponding to the desired utilization.

3 - Checking the setting R and the operation of the time lagged output relay

- without any resistance on the measuring input, by means of the ohmmeter, check the continuity of the time lagged output relay contacts (contact 8-9 closed, contacts 11-12 and 9-10 open),
- close the switch I,
- connect to terminals 2 and 4 of plate PG. a resistance of greater ohmic value than the value set on the relay,
- gradually reduce the value of the resistance until the output relay contacts operate,
- check the operation of the contacts for a value of resistance corresponding to the set value R ,
- on passing the setting, check the continuity of contacts 9-10, 11-12 and the discontinuity of contact 8-9,

NOTE

the contact operate on expiry of the time shown on the information plate of the relay tested.

4 - Checking the timing

- pre-adjust the value of the resistance to zero,
- open switch I and then reset the chronoscope to zero,
- close switch I,
- check that the time shown by the chronoscope agrees with that set on the relay,

5 - Checking the indication and the reset to zero

- gradually reduce the resistance connected to the measuring input until the output relay contacts operate,
- check the time lagged indicator : it lights (permanent memory) or flashes (plain memory) on expiry of the set time delay,
- increase the value of the resistance to a value exceeding that set on the relay, the indication is memorized and the indicator remains lit (permanent memory) or continues to flash (plain memory),
- press the reset to zero button on the front face of the relay and observe that the indication ceases.

6 - Checking the TEST function

When the TEST push button is pressed :

- on expiry of the set time, the indicator of the time lagged output lights (permanent memory) or flashes (plain memory) and the output contacts do not operate.

VI - COMMISSIONING TESTS

1 - The RECEPTION TESTS covered by section V will have shown that the protection functions properly

2 - With the protective equipment unplugged

- check the value and polarity of the voltage of the auxiliary supply to the switchboard,
- check the interconnection between plate PG and the TOG relay,
- set the selected values of resistance and time on the front face.

3 - Plug in the protective equipment on the switchboard, it is now ready for service.

4 - Testing the protection

The tests described in section V are again performed but with the resistance connected between one pole in the field cubicle or of the rotor of the machine and earth.

VII - REPAIRS

In case of doubt as to proper functioning of the protective equipment, undertake the following tests :

1 - auxiliary supply voltage

- check the value of the supply voltage at the TOG relays terminals, it must be between 0.8 and 1.1 Un ;
- in the case of a dc supply, check the polarity (the TOG relay is protected against reversal of the polarity) ;
- make the necessary corrections.

2 - connections

- check the agreement of the connections with the connection diagram ;
- make the necessary corrections.

3 - circuit continuity

- check the continuity, up to the relay terminals, of the logic information arriving at or leaving the contacts.
Watch for badly crimped lugs or screws not properly tightened ;
- make the necessary corrections.

4 - test

- press the TEST push button, if the relay includes this feature, with the protective equipment still plugged in and in the absence of a fault on the protected system ;
- check that the indicators (LED) light on expiry of the protection timing.

5 - resetting the indicators

- check that the push button RAZ extinguishes the indicators when the protective relay is not seeing a fault on the protected system.

6 - reception tests - test before setting to work

- unplug the working part,
- undertake the tests set out in the sections RECEPTION TESTS and TESTS BEFORE SETTING TO WORK.

In the event that the results of the checks under paragraphs 1, 2 and 3 are satisfactory but one of the points mentioned in paragraphs 4, 5 or 6 is not correct, contact the ALSTHOM Mesure et relais, After Sales Service at Villeurbanne with a view to return if necessary of the defective protection module.

APPENDIX IV


Rotor Operation Manual 39-701738 & Required consumable parts list
A for order

39 701 738

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ROTOR OPERATION MANUAL LAVRION 4TV

A	First issue	25.03.97	BOUDEVIN		MOUNIER			
Indice	Nature/N° Avis modif.	Dates	Noms	Visas	Noms	Visas	Noms	Visas
MODIFICATIONS			MODIFIE		VERIFIE		APPROUVE	
APPROUVE				TITRE				
VERIFIE	25.03.97	MOUNIER	<i>[Signature]</i>	ROTOR OPERATION MANUAL LAVRION TV				
DES./RED.	25.03.97	BOUDEVIN	<i>[Signature]</i>					
QA : 2	Dates	Noms	Visas					
INFO. INTERNE A	1/32	GIDOC <input checked="" type="checkbox"/>	BD.GRA <input type="checkbox"/>	LANGUE E	ECHELLE /	BELFORT <input checked="" type="checkbox"/> LE BOURGET <input type="checkbox"/>	GEC ALSTHOM	
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
1. GENERAL

As a general rule, a part must not be disassembled without having first marked it. As well, make sure that the part is not linked to neighbouring parts by any screws or bolts, and that it does not drag along with it any cable or conductor that has not been freed.

- specific handling toolings and equipment (referenced on phase drawings) are supplied by GEC ALSTHOM with the machine.
- the torques given are applicable after having lubricated the threads and bearing faces of the screws and nuts.

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A ²⁴	First issue	25.03.97	BOUDEVIN		MOUNIER				
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2. ROTOR DISASSEMBLY

PRELIMINARY

To disassemble the rotor (3A), the following parts are removed:

- the generator closing plates and enclosure.
- the removable cross arms of the door.
- the exciter cover and stator.
- the removable partitions between bearings and cover.
- the oil pipings supplying the bearings.
- the baffles and air nozzles on exciter side and coupling side.
- the fan blades.
- the air guides also on each side.
- the end-winding covers on each side.
- the bearing caps and collars.
- the two complete bearings (instrumentation, raising blocks, lower and higher half bearing journals).
- the rotor earthing system on coupling side.
- the rotor short-circuit RTD (accessed by a removable hatch in the cover).

The rotor (3A), with the exciter bell housing (3C), is supported in the stator (3B) by the two shimmings used for removing the bearings.


The rotor axis (3V) is located at a certain distance (3AA) above the stator axis (3U).

The rotor vertical axis (3Y) is at a distance of (3AB) from the magnetic axis (3X) (or stator axis).

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The two shimmings, or raising devices, rest on the pedestal (3D) and are made up of:

TURBINE SIDE (3E)

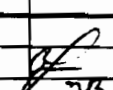
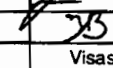
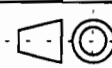
- The wooden wedge (300) on which rests the shaft (3A).
- The I profile (301) supporting the wedge.
- Four threaded rods (304) that maintain, using the nuts (305) and washers (306), the clamp (302) on the wooden wedge.
- In order to protect the rotor, a cardboard plate (303) is inserted between the rotor shaft and the clamp (302).
- The height of the rotor, on coupling side, is a function of the height of adjustment plates (314), (315) and (316) arranged between the profile (301) and the wooden wedges (313).

SIDE OPPOSITE FROM THE TURBINE (3F)

- The wooden wedge (307) on which rests the shaft (3A).
- The I profile (301) supporting the wedge.
- Two threaded rods (310) that maintain, using the nuts (311) and washers (312), the clamp (308) on the wooden wedge.
- In order to protect the rotor, a cardboard plate (309) is inserted between the rotor shaft and the clamp (308).
- As for the other raising device, the height of the rotor, on exciter side, is a function of the height of adjustment plates (314), (315) and (316) arranged on the wooden wedges (313).

To carry out the raising operations of the rotor in the bore, a system (317) made up of two jacks and of a manual pump is used.

The jacks (317) are placed on a stack of adjustment plates (318), (319) and (320) under the support of one of the raising devices and enable the height of the wedges (314), (315) and (316) to be modified.

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PHASE 1:

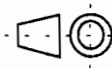
CENTRE OF THE ROTOR

- Position the two articulated pads (321) while securing them by two lengths of string (322) as indicated on the drawing.
- Arrange in the stator, under the two pads, the wedging plates (323).

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PHASE 2:

- Lower the rotor in the bore, the articulated pads (321) resting on the wedging plates (323). To do this, the following operations will have to be carried out on coupling side and then on exciter side:
 1. Position the two jacks (317), symmetrically, under the raising device.
 2. Wedge them using the adjustment plates (318), (319) and (320) in order to obtain a jack-I profile clearance of about 13 mm.
 3. Activate the manual pump until the jacks come to a stop and raise the rotor.
 4. At this time remove some of the plates (314), (315) and (316) located on the wooden wedges (313) in order to reduce the shimming by approximately 13 mm.
 5. Lower the jacks completely.
 6. Start from step 2 again until the pads rest on the wedging plates (namely five iterations).

ATTENTION: The shimming heights under the two jacks must be identical. The same applies to the two shimmings located under one of the raising devices.


CENTRE OF THE ROTOR

- Check the contacts between pads and plates.

SIDE OPPOSITE FROM THE TURBINE

- Disassemble and remove the raising device with its wedges.
- Fit the materials handling car to the rotor (3A). To do this:
 1. Fit the lower materials handling car (331) to the bearing pedestal (3G).
 2. Fit the six threaded rods (332) to the lower materials handling car.
 3. Raise the assembly until it comes in contact with the bottom part of the rotor.
 4. Fit the clamp (333) to the rotor shaft.
 5. Fit the washers (329) and tighten the nuts (330) to the torque of 303 Nm.

NOTE: Handle the lower materials handling car (331) using two steel bars inserted through holes (3J).

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PHASE 3:

SIDE OPPOSITE FROM THE TURBINE


- Position the two wedges (334) on the pedestal (3G) while observing the positioning dimensions (3AC) and (3AD) in relation to the bearing axis (3W).

FIRST DISASSEMBLY

- Set the self-drilling dowels (335) into the floor (3K) while observing the positioning dimensions (3AC), (3AF), (3AG).
- Place, on the front of the pedestal (3H) and on the floor (3K), the stacks of adjustment plates (336), (337), (338) and (382), by means of which the levelling of the rail systems fitted in PHASE 4 can be carried out.
- Observe the radial positioning dimension (3AH) of the wedges in relation to the rotor axis as well as dimensions (3AF) and (3AG).

FOLLOWING DISASSEMBLIES

- Loosen the plug screws (33) that prevent the dowels (335) located in the concrete floor (3K) from being obstructed.

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PHASE 4:

SIDE OPPOSITE FROM THE TURBINE

- Bring and position the inner rail system (340) on the pedestal (3D) so as to centre it in relation to the rotor axis.
- Fit the outer rail system (241) to the end of the pedestal (3H) and to the floor (3K). Check its positioning so as to equally centre it in relation to the rotor axis and to align it with the inner rail system (340).

FIRST DISASSEMBLY

- Check the alignment of the rail systems and level the rail system (341). If necessary, adjust using the adjustment plates (336), (337), (338) and (382).
- Join the two rail systems using the fish plates (342) and screws and bolts (343), (344) and (345). Tighten to the torque of 155 Nm.
- Secure the inner rail system (340) to the pedestal (3D) using screws and bolts (346)+(376) and at the wedges (334) with (347)+(376). Tighten to the torque of 62 Nm.
- Screw, to the torque of 62 Nm, the outer rail system (341) to the pedestal profile (3H) using screws and bolts (347)+(376).
- Secure the rail system (341) to the floor (3K) using clamps (348) and screws and bolts (349)+(306) tightened in the dowels (335) to the torque of 62 Nm.
- Position the 2 levelators (383) under the pedestal using the 2 wedges (384).

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PHASE 5:

- Clean the sliding plate (350) and coat the internal surface slightly with paraffin (351).

SIDE OPPOSITE FROM THE TURBINE

- Position the raising jacks (317) and the wooden blocks (313) on the rail system (340), under the materials handling car (331). Make sure that the spacing dimension (3AJ) is observed.
- Raise the rotor in such a way as to position the rotor axis (3V) to a certain distance (3AK) above the stator axis (3U). To do this, carry out the following operations twice:
 1. Insert a set of wedges (318), (319) and (320) under the jacks (317) to minimize the clearance between the jack and the materials handling car.
 2. Activate the manual pump until the jacks come to a stop.
 3. Add plates (314), (315) and (316) on the wooden wedges (313) to increase the shimming under the rotor.
 4. Lower the jacks again.

TURBINE SIDE

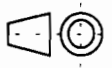
- Place the two jacks (317) with their wedges under the raising device on coupling side.
- Then raise the rotor in the same way and to the same height as on the exciter side.

CENTRE OF THE ROTOR

- Remove the wedging plates (323).
- Position the cardboard plate (352) inside the stator being careful to centre it in relation to the stator.

SIDE OPPOSITE FROM THE TURBINE

- Fit the sliding plate (350) to the rail system (340) and make it slide in the direction of the stator while making it go under the materials handling car.
- Raise the plate slightly before inserting it into the bore and position it on the glazed cardboard while centring it in relation to the stator.
- Lash down the sliding plate using cables (353) and cable clamps (354) to avoid dragging it along when moving the rotor.

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PHASE 6:

TURBINE SIDE

- Lay back down the rotor so that the articulated pad (321), on coupling side, can rest on the sliding plate (350). Perform the raising operations described in PHASE 5 in reverse sequence.
- Disassemble the raising device made up of the parts (300) to (306) and withdraw the shimming (313) to (316).

SIDE OPPOSITE FROM THE TURBINE

- Place the wooden wedge (355) on the bearing pedestal (3G), under the lower materials handling car (331). Respect the positioning dimension (3AL).
- On the wedge, place a stack of adjustment plates (314), (315) and (316) with a height of (3AM).
- Position the raising jacks (317) with their adjustment plates under the materials handling car, then slightly raise the rotor.
- Remove the stack of plates located on the rail system.
- Lower the jacks again, the materials handling car resting on the shimming made up by the wooden wedge (355) and the stack of adjustment plates.

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PHASE 7:

SIDE OPPOSITE FROM THE TURBINE

- On the materials handling car (331), fit the four guides (356), the washers (357) then tighten the nuts (358).
- Place the handling lug (359) on the materials handling car, fit the washers (329) and tighten the screws (360).
- Fit onto the materials handling car as well the two trolley jacks (361), the washers (357) and the tightened screws (362).

CENTRE OF THE ROTOR


- Pivot the articulated pad (321), exciter side, using the binding strings (322) and bring it above the shaft (3A).

SIDE OPPOSITE FROM THE TURBINE

- Raise the rotor, exciter side, using the jacks (317) that are still in position, until the shimming, made up of the adjustment plates and of the wooden wedge (355), can be taken off.
- Lower the jacks again. The trolley jacks then rest on the rail system (340) and support the rotor.
- Take off the two jacks (317) and all the wedges found on the rail system (340).

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PHASE 8:

SIDE OPPOSITE FROM THE TURBINE

- Position the cable (363), the turnbuckle (364) and the pulley (365). Connect them to the spreader beam (366) using shackles (367). Then, secure the spreader beam to the anchoring point (3L).
- Fit an end of the disassembly sling (368) to the lug (359) of the materials handling car by means of the axle (369) going through the tube (370) and maintained by the pin (371).
- Link the other end of the sling (368) to the pulley (365).
- Activate the turnbuckle until a stroke of 100 mm has been achieved.

TURBINE SIDE

Position the tooling shaft (326):

- Secure it to the rotor coupling using the screws (328), washers (379) (380) and nuts (381).
- Fit the plywood pad (327) and the 2 plates (325) to the shaft. Secure the assembly with the screws (324), washers (329) and nuts (330). Tighten to the torque of 300 Nm.
- Activate the turnbuckle again to start taking out the rotor.

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PHASE 9:

During this phase, consisting of pulling out the rotor using the turnbuckle, the following operations will have to be carried out successively:

SIDE OPPOSITE FROM THE TURBINE

- Remove the articulated pad (321), exciter side, when it has been pulled all the way out of the bore.

TURBINE SIDE

- Check that the coupling pad (327) goes above the sliding plate (350).

SIDE OPPOSITE FROM THE TURBINE


- Stop the operation of the turnbuckle (364) when the total stroke of the rotor reaches (3AN), ie, before the articulated pad (321) remaining comes into contact with the parts of the stator plate that are damaged.
- Place the two jacks (317) with their wedges (318), (319) and (320) under the materials handling car (331) and raise the shaft until the articulated pad can be moved. The coupling pad (327) then rests on the sliding plate and supports the rotor shaft.
- Pivot the released pad (321) around the rotor (3A) in order to bring it above the shaft.
- Put back down the rotor and take off the jacks with their wedges.
- Activate the turnbuckle (364) again and take off the articulated pad located on the shaft when this one is completely free.

ATTENTION: The coupling pad and the articulated pads must never support any load above the damaged plates.

- Pull the rotor until its total stroke is (3AP).

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PHASE 10:

CENTRE OF THE ROTOR

- Protect the shaft with both parties of the two glazed cardboard (372).
- Fit the two slings (373) while effecting a round turn.
- The dimension (3AQ) indicates the axial position of the assembly centre of gravity (3M). Respect the spacing dimension (3AR) of the slings.
- Raise the rotor slightly using the crane so as to check its horizontality. Put back down the shaft and adjust the positioning of the sling consequently.
- Remove the rotor (3A) while being careful not to hit any of the stator (3B) parts.

PHASE 11:

- Put back down the rotor on its shimmings (375) while observing the dimensions (3N).
- Take off the sliding plate (350), the glazed cardboard (352), the cables (353).
- Disassemble the lower materials handling car (331) and the upper one (333), side opposite from the turbine.
- Disassemble the tooling shaft (326).

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3. ROTOR ASSEMBLY

PRELIMINARY

CENTRE OF THE ROTOR

- Clean the sliding plate (350) and coat the internal surface slightly with paraffin (351).
- Install the cardboard plate (352) inside the stator, being careful to centre the cardboard plate in relation to the stator.
- Install the sliding plate (350) on the cardboard plate (352) and position it by centring in relation to the stator.
- Lash down the sliding plate using cables (353) and cable clamps (354) so that it is not dragged along when the rotor is inserted (3A).


SIDE OPPOSITE FROM THE TURBINE

Fit the inner (340) and outer rail systems (341) (See phase 3 and 4):

- Position the two wedges (334) on the channel (3G).
- Bring the inner rail system (340) and position it on the pedestal (3D) in such a way as to centre it in relation with the rotor axis.
- Lay the outer rail system (341) on the end of the pedestal (3H) and on the floor (3K). Check that it is positioned in such a way as to centre it equally in relation to the rotor axis and align it with the inner rail system (340).
- Check the level of the rail systems (340) (341).
- Join the two rail systems with fish plates (342) and screws and bolts (343), (344) and (345). Tighten to a torque of 155 Nm.
- Hold the inner rail system (340) on the pedestal (3D) using the screws and bolts (346) (376) at the wedges (334) with (347) (376), torque to 62 Nm.
- Using screws and bolts (347) (376), tighten the outer rail system (341) onto the pedestal profile (3H) to a torque of 62 Nm.
- Hold the rail system (341) on the floor (3K) using clamps (348) and screws and bolts (349) (385) tightened in the dowels (335) to a torque of 62 Nm.

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PHASE 11:

Remove the rotor near the generator.

- Remove the rotor (3A), observing the dimension (3N) and by positioning the rotor at an angle on the coupling positioned.


CENTRE OF THE ROTOR

- Protect the shaft with both parties of the glazed cardboard (372).
- Fit the two slings (373) by effecting a round turn.
- The dimension (3AQ) indicates the axial position of the centre of gravity (3M) of the assembly. Observe the dimension (3AR) of the sling spacing.
- Raise the rotor slightly with the crane, in such a way that it remains horizontal. Lay the shaft back down and adjust the positioning of the sling accordingly.

TURBINE SIDE

Position the tooling shaft (326) (see phase 8) :

- Secure it onto the rotor coupling using screws (328), washers (379) (380) and nuts (381).
- Fit the plywood pad (327) and the 2 plates (325) onto the shaft. Secure the entire assembly with screws (324), washers (329) and nuts (330). Tighten to a torque of 300 Nm.

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SIDE OPPOSITE FROM THE TURBINE


- Position the lower materials handling car (331) (see phase 2).
- Fit the six threaded rods (332) onto the lower materials handling car (331).
- Lift the assembly to bring it into contact with the rotor.
- Position the clamp (333) onto the rotor (3A):
- Fit the washers (329) and the nuts (330) without tightening them.

NOTE: Handle the lower materials handling car (331) using two steel bars inserted through holes (3J).

- Fit the four guides (356) and the washers (357) on the materials handling car (331), then tighten the nuts (358) (see phase 7).
- Fit the handling lug (359) and the washers (329) onto the lower materials handling car (331), and tighten the screws (360).
- Fit the two trolley jacks (361), washers (357) and the tightened screws (362) also onto the materials handling car.

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PHASE 10:

Fit the rotor (3A) onto the rail system (341) and the plate (350).

- Start engaging the rotor (3A) into the stator (3B), being careful not to strike the various components with the coupling plate or the pad (327).

TURBINE SIDE

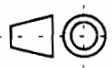
- Fit the coupling pad onto the sliding plate (350)

SIDE OPPOSITE FROM THE TURBINE

- Fit the trolley jacks (361) of the lower materials handling car (331) onto the outer rail system (341).
- Tighten the nuts (330) of the materials handling car (331) (333) to a torque of 300 Nm.
- Take off the slinging (373) and the glazed cardboard (372).

Fit the handling cable

- Position the cable (363), the tumbuckle (364) and the pulley (365). Attach the assembly to the spreader beam (366) using the shackles (367). Then, secure the spreader beam to the anchoring point (3L) (see reassembly phase).
- Secure one end of the reassembly sling (374) to the lug (359) of the materials handling car by threading an axle (369) through a tube (370) and holding it into place with a pin (371).
- Connect the other end of the sling (374) to the pulley (365).

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PHASE 9

TURBINE SIDE

- Position the articulated pad (321) by holding it into place with the string (322), as indicated on the drawing.

SIDE OPPOSITE FROM THE TURBINE

- Using the turnbuckle (364), insert the rotor (3A) into the stator until it is in the position indicated on the drawing.
- When inserting the rotor, make sure that the coupling pad (327) and the trolley jacks of the lower materials handling car (331) are pulled along correctly and that the sliding plate (350) remains in place.
- Place the two jacks (317) with the wedges (318), (319) and (320) under the materials handling car (331) and raise the shaft slightly. The coupling pad (327) shall then lie on the sliding plate.

TURBINE SIDE

- Pivot the pad that has been freed (321) around the rotor (31) in order to bring it to the lower end of the shaft.

SIDE OPPOSITE FROM THE TURBINE

- Lay the rotor back down and remove the jacks (317) with the wedges (318), (319) and (320).

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PHASE 8:

SIDE OPPOSITE FROM THE TURBINE

- Position the articulated pad (321) above the rotor (3A) as shown on the drawing.
- Activate the turnbuckle again (364) until the interlocking of the coupling plate is at a distance of approximately 100 mm from the turbine plate.

TURBINE SIDE

- Lay down the tooling shaft (326).

SIDE OPPOSITE FROM THE TURBINE

- Activate the turnbuckle (364) until the coupling plate interlocking is 5 to 10 mm from the turbine plate.
- When inserting the rotor, make sure that the articulated pad (327) and the trolley jacks of the lower materials handling car (331) are pulled along correctly and that the sliding plate (350) remains in place.

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PHASE 7 and 6:

SIDE OPPOSITE FROM THE TURBINE

- Take away the pin (371) and remove the axle (369), tube (370), sling (374), pulley (365) and the turnbuckle (364).
- Place the wooden wedge (355) on the pedestal bearing (3G), under the lower materials handling car (331). Observe the dimension of the positioning (3AL).
- Place the raising jacks (317) with the adjustment plates under the materials handling car, then raise the rotor slightly.
- Stack adjustment plates (314), (315) and (316) with a height of (3AM) on top of the wedge.
- Lower the jacks back down. The materials handling car will have to rest on the shimming made up of the wooden wedge (355) and the stack of adjustment plates.
- Remove the nuts (358), the washers (357) from the materials handling car (331) and take off the four guides (356).
- Remove the screws (360), the washers (329) and take off the handling lug (359).
- Remove the screws (362), the washers (357) and take off the trolley jacks (361).

CENTRE OF THE ROTOR

- Pivot the articulated pad (321), exciter side, using the binding strings (322) and bring it to the lower end of the shaft (3A).

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PHASE 5:

TURBINE SIDE

- The wooden wedge (300) on which lies the shaft (3A).
- The I profile (301) supporting the wedge.
- Four threaded rods (304) holding the clamp (302) onto the wooden wedge, with the help of nuts (305) and washers (306).
- In order to protect the rotor, a cardboard plate (303) is inserted between the shaft and the clamp (302).
- The height of the rotor, coupling side, is a function of the height of the adjustment plates (314), (315) and (316) stacked between the profile (301) and the wooden wedges (313).

SIDE OPPOSITE FROM THE TURBINE

- Place the raising jacks (317) as well as the wooden wedges (313) on the rail system (340) under the materials handling car (331). Be careful that the spacing dimension (3AJ) is respected.
- Raise the rotor until the rotor axis (3V) is at a certain distance (3AK) above the stator axis (3U). To do this, perform the following operations twice:
 1. Insert a set of wedges (318), (319) and (320) under the jacks (317) so as to reduce the play between the jack and the materials handling car.
 2. Raise the rotor until the jacks come to a stop.
 3. Add the plates (314), (315) and (316) on wooden wedges (313) in order to increase the shimming under the rotor.
 4. Lower the jacks back down (317).

TURBINE SIDE

- Remove the two jacks (317) with the wedges under the raising device on the coupling side.
- Raise the rotor in the same way and to the same height as on the exciter side.

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CENTRE OF THE ROTOR

- Take off the cables (353), the cable clamps (354), the sliding plate (350) and the glazed cardboard (352).
- Position the wedging plates (323) inside the stator as shown on the drawing in phase 2.
- Lower the rotor into the bore; the articulated pads (321) will lie on the wedging plates (323).

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PHASE 4 AND 3:

SIDE OPPOSITE FROM THE TURBINE

- Take off the screws (349), the washers (385) and remove the clamps (348).
- Take off the screws (343), the washers (344), the nuts (345) and remove the fish plates (342), the outer rail system (341), and the adjusting wedges (336) (337) (338) and (382).
- Take off the screws (346), the washers (376) and remove the inner rail system (340).
- Take off the screws (347), the washers (376) and remove the wedges (334).
- Position the plug screws (339) that prevent the dowels from being obstructed (335).

PHASE 2:

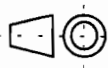
SIDE OPPOSITE FROM THE TURBINE

- Take off the nuts (330) and the washers (329) and clear away the materials handling cars (331) (333) and the rods (332).

NOTE: Handle the materials handling car (331) using two steel bars inserted through holes (3J).

CENTRE OF THE ROTOR

- Check the pad (331) - Plates (323) contacts

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PHASE 1:

SIDE OPPOSITE FROM THE TURBINE

- The wooden wedge (307) on which lies the shaft (3A).
- The I profile (301) supporting the wedge.
- Two threaded rods (310) holding the clamp (308) on the wooden wedge, using the nuts (311) and washers (312).
- Two threaded rods (304) stabilizing the wooden wedge (307) on the support (301), using the nuts (305) and the washers (306).
- In order to protect the rotor, a cardboard plate (309) is inserted between the rotor shaft and the clamp (308).
- In the same way as for the other raising device, the height of the rotor, exciter side, is a function of the height of the adjustment plates (314), (315) and (316) stacked under the wooden wedges (313).

In order to perform the raising operations of the rotor in the bore, a system made up of two jacks and a manual pump is used. Placed on top of a stack of adjustment plates (318), (319) and (320) under the support of one of the raising devices, the jacks (317) enable the height of the wedges (314), (315) and (316) to be modified.

- Using jacks, raise the rotor all the way, being careful that the binding band does not come into contact with the magnetic circuit or the winding.
- Remove the pads (321) and the wedging plates (323).
- The rotor (3A) is thus in preliminary phases.
- The two complete bearings (instrumentation, raising blocks, lower and upper half bearing journal.)

CENTRE OF THE ROTOR

- Lower the jacks back down and lay the rotor (3A) onto the bearing brasses.

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TURBINE SIDE

- Remove the jacks (317), and the adjustment plates (318) (319) and (320).
- Remove the nuts (305) and take out the clamp (302) and the cardboard (303).
- Take off the wooden wedges (300), (313) and the support (301).

SIDE OPPOSITE FROM THE TURBINE

- Remove the jacks (317), and the adjustment plates (318) (319) and (320).
- Remove the nuts (311) (305) and take off the clamp (308) and the cardboard (309).
- Take off the wooden wedges (307), (313) and the support (301).
- The end-winding covers on each side.
- The air guides on each side.
- The blades of the fans.
- The baffles and air nozzles on the exciter side and the coupling side.
- The oil pipings supplying the bearings.
- The removable partitions between the bearings and the cover.
- The rotor short-circuit RTD.
- The rotor earthing system on the coupling side.
- The cover and the stator of the exciter.
- The removable cross arm of the doors.
- The closing plates of the generator enclosure.

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PRELIMINARY - PHASES 1 TO 11 - REASSEMBLY

Refer to drawings 39-305 208 from 1/13 to 13/13.

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NOMENCLATURE OF THE DRAWINGS 39-305 208

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REF	DESCRIPTION	QTY PER ASS'Y	OBSERVATION
3A	Rotor	1	m = 45 910 kg
3B	Stator	1	
3C	Exciter bell housing	1	
3D	Pedestal	1	
3E	Turbine side (coupling)		
3F	Side opposite from the turbine (exciter)		
3G	Bearing pedestal COT		
3H	IPE of the pedestal COT		
3J	Handling hole of the lower materials handling car	2	
3K	Floor COT		
3L	Anchoring point		
3M	Centre of gravity of the assembly		
3U	Stator axis		
3V	Rotor axis		
3W	Bearing axis COT		
3X	Stator magnetic axis		
3Y	Rotor vertical axis		
3AA	Raising dimension of the rotor / stator		3AA = 50
3AB	Axial dimension of the rotor / stator		see drawing 39-103926
3AC	Radial dimension of the wedges (335)		3AC = 340
3AD	Axial dimension of the wedges (332) / bearing axis COT		3AD = 35
3AE	Radial dimension of the dowels (335)		3AE = 400
3AF	Positioning dimension of the dowels (335)		3AF = 2765
3AG	Spacing of the dowels (335)		3AG = 680

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REF	DESCRIPTION	QTY PER ASS'Y	OBSERVATION
3AH	Radial dimensions of the wedges (336), (337) and (338)		
3AJ	Spacing of jacks (317)		3AJ = 520
3AK	Dimension of raising of the rotor / stator		3AK ≈ 10
3AL	Positioning of the wedge (355) under the materials handling car		3AL ≈ 155
3AM	Height of the adjustment plate on the wooden wedge		3AM = 29
3AN	Rotor stroke for disassembling articulated pad CT		3AN = 3300
3AP	Total stroke of the rotor to the stop		3AP = 6973
3AQ	Position of the centre of gravity (3M) of the assembly		3AQ = 1685
3AR	Dimension of the sling positioning		3AR = 700

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REF	DESCRIPTION	QTY PER ASS'Y	OBSERVATION
300	Wooden wedge for raising CT	1	m = 30 kg
301	Raising support (IPE 270)	2	m = 40 kg
302	Clamp CT	1	m = 7 kg
303	Cardboard plate CT thickness 2	1	
304	M12 Threaded rod; L = 510	6	
305	H M12 Nut	12	
306	M12 Washer	16	
307	Wooden wedge for COT raising	1	m = 31 kg
308	Clamp COT	1	m = 4.5 kg
309	Cardboard plate COT thickness 2	1	
310	M16 Threaded rod; L = 500	2	
311	H M 16 Nut	4	
312	M16 Washer	4	
313	Wooden wedge 280 x 140 x 80	4	
314	Adjustment plate 280 x 140 Thickn. 10	24	
315	Adjustment plate 280 x 140 Thickness 3	12	
316	Adjustment plate 280 x 140 Thickness 1	20	
317	Raising system: 2 jacks + manual pump	1	
318	Adjustment plate 100 x 100 Thickn. 10	10	
319	Adjustment plate 100 x 100 Thickness 3	6	
320	Adjustment plate 100 x 100 Thickness 1	10	

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REF	DESCRIPTION	QTY PER ASS'Y	OBSERVATION
321	Assembled articulated pad	2	m = 10 kg
322	String of ECR hemp B 4; L = 15 m	3	
323	Wedging plate	2	
324	Threaded rod M20 with flat surfaces; L = 200	4	
325	Tapped plate	1	m = 23
326	Seal	2	
327	Coupling pad	1	m = 12 kg
328	Clamping plate	1	m = 23 kg
329	M20 Washer	10	
330	M20 Nut	10	
331	Upper materials handling car	1	m = 156 kg
332	M20 threaded rod ; L = 945	6	m = 14 kg
333	Upper materials handling car	1	m = 76 kg
334	Drilled wedge 170 x 100 x 35	2	
335	M12 Self-drilling dowel	20	m = 4.5 kg
336	Adjustment plate 170 x 100 Thickness 3	40	
337	Adjustment plate 170 x 100 Thickness 2	40	
338	Adjustment plate 170 x 100 Thickness 1	40	
339	M12 - 40 Hc Screw	12	
340	Inner rail system	1	m = 307 kg
341	Outer rail system	1	m = 950 kg
342	Fish plate	4	m = 4.5 kg
343	H M16 - 55 screw	8	
344	M16 washer	8	
345	M16 nut	8	
346	H M12 - 40 Screw	8	
347	H M12 - 60 Screw	4	
348	Clamp	20	
349	H M12 - 100 Screw	20	

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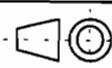
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REF	DESCRIPTION	QTY PER ASS'Y	OBSERVATION
350	Sliding plate	1	m = 65 kg
351	Paraffin	2 kg	
352	Glazed cardboard	1	
353	Cable Dn 4.5 ; L = 1.7 m	4	
354	Cable clamp	8	
355	Wooden wedge 400 x 400 x 280	1	m = 36 kg
356	Materials handling car guide	4	
357	M10 Washer	12	
358	H M10 Nut	8	
359	Handling lug	1	m = 12 kg
360	H M20 - 40 screw	4	
361	Trolley jack	2	m = 9.8 kg
362	H M10 - 35 screw	4	
363	Cable DN 16.5; L = 15 m	1	m = 21 kg
364	Turnbuckle T532	1	m = 24 kg
365	Pulley	1	m = 14 kg
366	Spreader beam	1	m = 24 kg
367	Harp shackle	2	m = 3.6 kg
368	Sling for disassembly Dn 20; L - 2.5 m	1	
369	Handling lug axle	1	m = 1 kg
370	Tube	1	m = 16 kg
371	Pin 6.3 - 63	1	
372	Glazed cardboard 2 x 1500 x 3800	2	m = 20 kg
373	Sling Dn 60; L = 14 m	2	
374	Sling for reassembly Dn 20; L = 7.5 m	1	
375	Wooden wedge	2	m = 139 kg
376	M12 Washer	12	
379	Washer	6	m = 2.2 kg
380	M36 Washer	6	
381	H M36 Nut	6	
382	Wedge	20	m = 4.8 kg
383	Levalator	2	m = 50 kg
384	Adjustment plate 360 x 275 Thickn. 45	2	m 35 kg
385	DEC M12 Washer	20	

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PART LIST A

Item n°	Part Description	Part Number	Qty
	S.T GENERATOR SPARE PARTS		
	HOT WEDGING	740	
1	WINDING SEMI CONDUCTIVE PAINT	18512050	10
2	SLOT WEDGING INSTALLATION GLUE	18564342	10
3	SLOT WEDGING INSTALLATION GLUE	18564343	10
4	ENDWINDING COATING RESIN	18564001	2
5	ENDWINDING COATING RESIN	18564866	0,5
6	GLUE	18181132	2
	ASSEMBLY OF HOUSING	1013	
7	SCREW	21437337	4
8	WASHER	21255718	4
	SHAFT HEARTING DEVICE	2013	
9	CARBON BRUSH	26273116	2
10	BRUSH HOLDER INSTALLATION SCREW	21437200	4
11	BRUSH HOLDER INSTALLATION WASHER	22112650	4
12	BRUSH HOLDER INSTALLATION NUT	21321016	4
13	BRUSH HOLDER INSTALLATION WASHER	21255712	4
14	BRUSH HOLDER INSTALLATION SCREW	21437260	6
15	BRUSH HOLDER INSTALLATION WASHER	21255714	6
16	BRUSH HOLDER INSTALLATION WASHER	21255710	12
17	BRUSH HOLDER INSTALLATION SCREW	21437132	12
	END BELLS ASSEMBLY	2110	
18	GASKET	D39408141000	16
19	END BELL INSTALLATION WASHER	21253118	136
20	END BELL INSTALLATION NUT	21371411	68
21	END BELL ASSEMBLY SCEW	21440357	32
22	END BELL ASSEMBLY NUT	21327515	32
23	END BELL ASSEMBLY LOCKING	21275532	64
	AIR GUIDE ASSEMBLY	2112	
24	SCREW	D39406929P10	12
25	LOCK	21275532	40
26	NUT	21373409	20
27	WASHER	22113102	40
28	SCREW	D39406929P10	12
29	LOCK	21275532	40
30	NUT	21373409	20
31	WASHER	22113102	40
	BAFFLE ASSEMBLY	2112	
32	GASKET	D39408092000	8
33	GASKET	D39408093000	8
34	GASKET	D39408094000	8
35	GASKET	D39408095000	8
36	NUT	21371411	28
37	WASHER	21253118	120
38	SCREW	21440353	100
39	LOCK	21275532	116
40	SCREW	21440340	16
41	NUT	21327515	30
42	LOCK	21275532	60
43	SCREW	21440357	30
44	SCREW	21440353	72
45	WASHER	22113102	72
46	LOCK	21275532	72
47	NUT	21327515	20
	TURBINE END BEARING	2410	
48	WASHER	21253342	4
49	WASHER	22112698	12

PART LIST A

Item n°	Part Description	Part Number	Qty
50	SCREW	21437475	12
51	SCREW	21437252	2
52	WASHER	22112666	2
53	WASHER	21253316	2
54	NUT	21321019	2
55	SCREW	21437300	2
56	WASHER	21253316	4
57	NUT	21321019	4
58	SCREW	21437300	4
59	SCREW	21432285	32
60	WASHER	21253316	56
61	GASKET Ø 7	17111360	1
62	SCREW	21432288	24
63	BAFFLE	D39407464000	3
64	SCREW	21432288	12
65	NUT	21321001	12
66	WASHER	21253316	12
67	BAFFLE	D39407463000	3
68	SCREW	21432288	4
69	NUT	21321001	4
70	WASHER	21253316	4
	OPPOSITE TURBINE END BEARING	2415	
71	WASHER	21253342	4
72	WASHER	22112698	12
73	SCREW	21437475	12
74	SCREW	21437252	2
75	WASHER	22112666	2
76	WASHER	21253316	2
77	NUT	21321019	2
78	SCREW	21437300	2
79	WASHER	21253316	4
80	NUT	21321019	4
81	SCREW	21437300	4
82	SCREW	21432285	32
83	WASHER	21253316	56
84	GASKET Ø 7	17111360	1
85	SCREW	21432288	24
86	BAFFLE	D39407464000	3
87	SCREW	21432288	12
88	NUT	21321001	12
89	WASHER	21253316	12
90	BAFFLE	D39407463000	3
91	SCREW	21432288	4
92	NUT	21321001	4
93	WASHER	21253316	4
	SUPPORT PILLAR	2510	
94	INSULATING WASHER	RDL.EPGM203#040	3
95	VINYL CAP	24412150	2
96	WASHER	21253334	2
97	INSULATING WASHER	D39407330000	2
98	DAMPER	23613000	2
99	INSULATING WASHER	D39407350000	1
100	INSULATING WASHER	RDL.EPGM203#041	3
101	INSULATING PIPE	TB.EPGC22#090	2
102	INSULATING PIPE	TB.EPGC22#091	1
103	VINYL CAP	24412150	2
104	WASHER	21253334	2

PART LIST A

Item n°	Part Description	Part Number	Qty
105	SCREW	21532860	2
106	INSULATING WASHER	D39407330000	2
107	SKF NUT	D39305039000	4
108	DAMPER	23613000	2
109	INSULATING WASHER	D39407350000	1
110	INSULATING PIPE	TB.EPGC22#093	2
111	SKF NUT LOCKING	D39407651000	8
112	WASHER	21253110	4
113	SCREW	21411255	4
	JOURNAL BEARING	2610	
114	BAFFLE	D3940691900A	4
115	SCREW	21437236	28
116	CENTERING BUSH	D38155460P30	2
117	WASHER	21256114	28
	GENERAL OIL PIPING	3010	
118	FLANGE INSTALLATION WASHER	21255722	56
119	FLANGE INSTALLATION WASHER	21255730	128
120	FLANGE INSULATING PIPE	TB.EPGC22/126	4
121	FLANGE INSULATING PIPE	TB.EPGC22/127	8
122	FLANGE INSULATING WASHER	RDL.EPGM203/004	8
123	FLANGE INSULATING WASHER	RDL.EPGM203/053	16
124	FLANGE INSULATING WASHER	RDL.EPGM203/054	1
125	FLANGE INSULATING WASHER	RDL.EPGM203/055	1
126	FLANGE SEAL	16856812	5
127	FLANGE INSULATING WASHER	JT.PGAC#038	2
128	FLANGE SEAL	168568AH	5
129	FLANGE SEAL	168568AG	2
	CAPOTAGE FOURNISSEUR EUROSILENCE	3120	
130	SEALING	D38R46571P10	1
131	SCREW INSTALLATION COOLER	21437284	386
132	WASHER INSTALLATION COOLER	22112672	316
133	SEALING	D38R46571P20	1
134	SEALING	D38R46571P30	1
135	SEALING	D38R46571P40	1
136	PRE-FILTER	D38R46571P60	1
137	FILTER	D38R46571P70	1
138	BONDING JUMPER	D39406521P20	1
139	BONDING JUMPER	D39406521P30	1
	MONTAGE CLOISON CAPOT-PALIER	3135	
140	BEARING CLOSING ASSEMBLY SCREW	21432290	112
141	BEARING CLOSING ASSEMBLY NUT	21321001	68
142	BEARING CLOSING ASSEMBLY WASHER	21253316	104
143	SEALING	JT.CTCHNIT1F#014	1
144	SEALING	JT.CTCHNCN50#002	1
145	SEALING	18183310	8
146	SQUARE LOCK	21275307	56
147	SEALING	JT.CTCHNIT1F#015	1
148	BEARING CLOSING ASSEMBLY SCREW	21432284	48
149	BEARING CLOSING ASSEMBLY WASHER	22112672	68
150	BONDING JUMPER	D39407482000	3
151	BONDING JUMPER INSTALLATION SCREW	21432278	32
152	BONDING JUMPER INSTALLATION WASHER	22112672	32
	COOLERS	3721	
153	SEAL WATER BOX FRONT	D38R46556P20	2
154	SEAL WATER BOX REAR	D38R46556P30	2
155	NUTS AND BOLTS KIT	D38R46556P40	1
	COOLERS INSTRUMENTATION	3740	

PART LIST A

Item n°	Part Description	Part Number	Qty
156	EQUIPMENT INSTALLATION WASHER	22112709	64
157	FLANGE SEAL	D39405365R40	4
158	EQUIPMENT INSTALLATION COLLAR	25274174	10
	CONSOMMABLES	9240	
159	GLUE	18564375	1
160	SEALING PATE	18463206	2
161	INSULATING VARNISH	18545100	1
162	GLUE	18181131	2
163	SOLVENT	18243376	1
164	SOLVENT	17714113	10
165	ANTI FLASH VARNISH	18547405	2
166	CONDUCTIVE PAINT	18512049	3
167	SOLVENT	18581415	3
168	FINISHING VARNISH	18512070	3
169	CLEANING SOLVENT	18581629	20
170	SERALING AGENT	D38R44962000	2
171	SEALING PLATE	JT.PGX30/140	1
172	SEALING PLATE	JT.PGX30/141	2
173	PRIMER PAINT	18654025	1
174	FINISHING PAINT	18639311	1
175	SEALING	18183310	50
176	BAR OVERHANG WEDGING FELT	16342635	50
177	TERGAL TAPE	16544A04	100
178	FINISHING PAINT	18639071	2
179	PRIMER PAINT	18654025	2
180	SOLVENT	18243376	1
181	FINISHING PAINT	18683001	2
182	PRIMER PAINT	18650202	2
183	SOLVENT	18243376	1
184	TEFLON TAPE	18464003	2
	TKJ 86-19		
	ACCESSORIES FRAME	110	
185	STARRED WASHER	21255122	11
	COUPLING	1120	
186	COUPLING LOCK	D36401250000	6
	ACCESORIES AND DIODES	1810	
187	SCREW	21437337	14
188	SQUARE LOCK	21275308	14
	CONNEXION ASSEMBLY	1910	
189	SCREW	21437286	4
190	WASHER	21255828	4
	COVER N°1	2510	
191	GASKET	D36402905000	1
192	GASKET	JT.CTCHNEPEN#032	2
193	GASKET	JT.CTCHNEPEN/035	1
194	COVER INSTALLATION,SCREW	21437278	30
195	COVER INSTALLATION,WASHER	21255116	30
196	COLLAR	22248160	2
197	ELECTRICAL VARNISH	18547405	1
198	GLUE	18181132	1
	ASSEMBLY DMR	4010	
199	WASHER	22112666	4
200	NUT	21371408	4
201	BRUSH	D38145378000	1
202	SCREW	21437240	4

APPENDIX V

Generator (Stator and Rotor) OEM descriptive drawings and main design features description

DESCRIPTIVE MANUAL

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In the area of the core teeth, and within the yoke itself for the first packets, the spacer ribs on the vent ducts are non-magnetic.

In addition to the radial field flux, the core ends are also subject to a front fringing flux, whose axial component increases with a low excitation current, particularly when operating with reactive load absorption.

The additional losses caused by this fringing flux have necessitated specific design features at the core ends in order to prevent unacceptable temperature rises:

- the outermost laminations (3) are stepped (i.e. with progressive reduction in radial core height) in order to provide a better trap for the fringing flux, and to facilitate entry of air into the air gap.
- these laminations are glued together in their packets
- the teeth of the end laminations are slit down to the level of the bottom of the slot in order to minimise circulating currents in the teeth.

The outer edge of each lamination is provided with rectangular slots which serve to fasten the core to the core-bars (4), evenly spaced around the outer core diameter.

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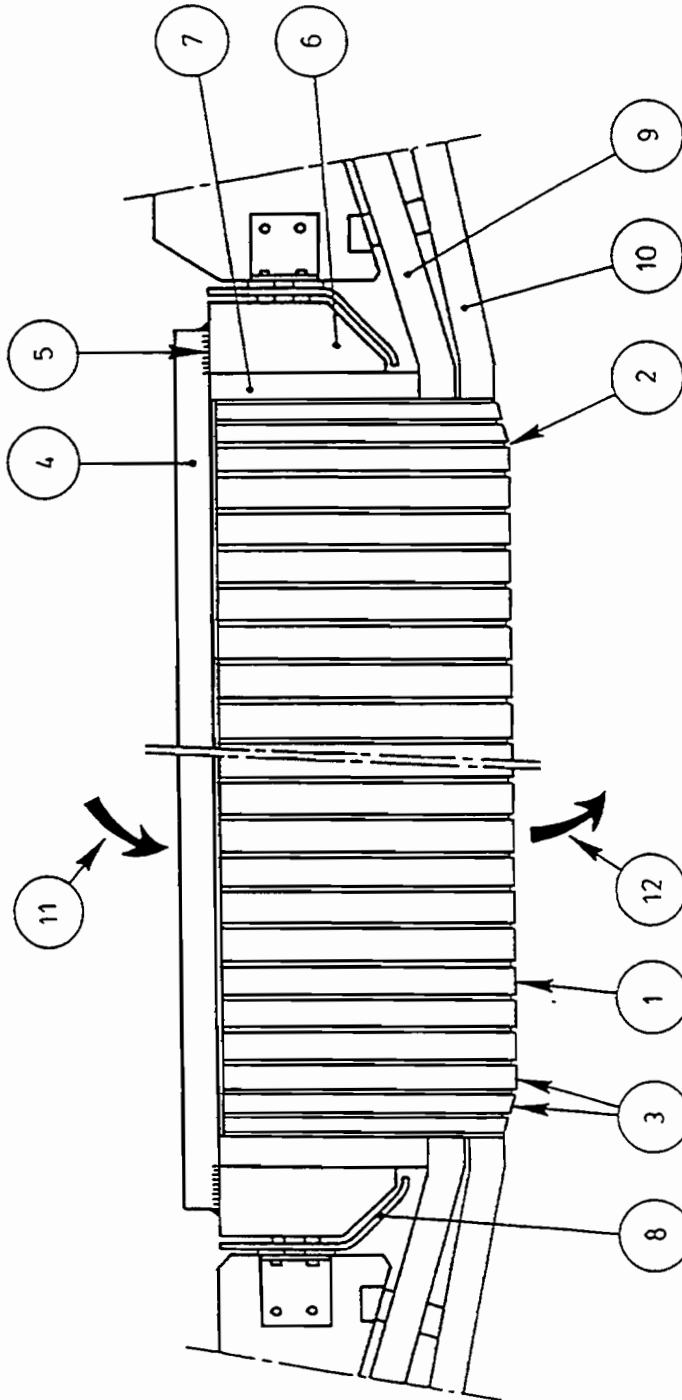
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03 02



GBT-W 2586

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03 02

KEY TO DRAWING GBT-W 2586

1. Standard lamination packets
2. Vent ducts
3. Stepped lamination packets
4. Core bars
5. Clamping plate locking nuts
6. Clamping plates
7. Clamping fingers
8. End flux screen
9. Slot-bottom bar
10. Air gap bar
11. Cold air intake
12. Warm air outlet

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03 03 FLEXIBLE SUPPORT SYSTEM

See drawing GBT-W 3350

In operation, the magnetic core of a two-pole generator is subjected to an elliptical deformation which rotates at the same speed as the rotor and produces a 4-node vibrational mode.

In order to minimise the transmission of radial vibrations to the frame components and foundations, the magnetic core (4) is connected to the base (1) by means of vertical (2) springs. This system is called « flexible support system ».

The vertical springs (2) are welded to intermediate support pieces (6) welded to the key bars (7). The springs are also fixed to the base (1), thereby ensuring direct transmission of forces to the foundations.

They are steel strips dimensioned so as to withstand the forces without damage in normal and abnormal operation.

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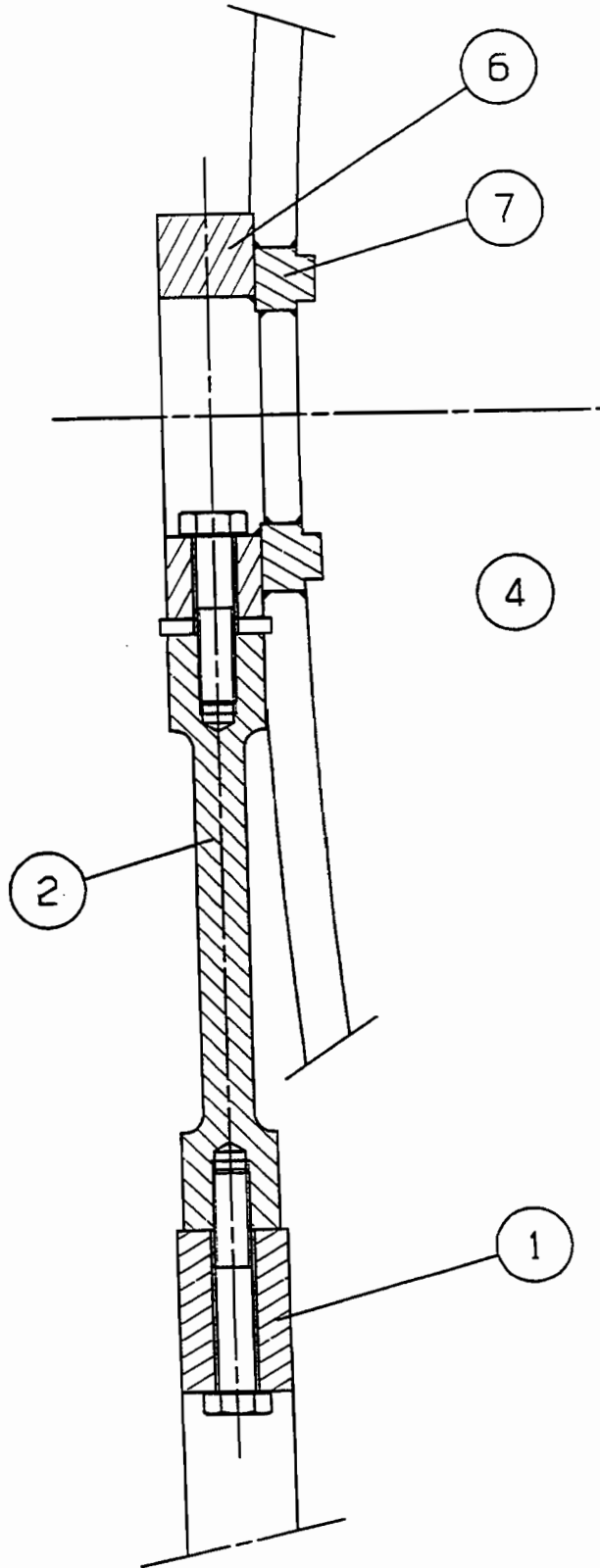
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03 03



GBT-W 3350

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03 03

KEY TO DRAWING GBT-W 3350

1. Base
2. Vertical springs
3. Not applicable
4. Magnetic core
5. Not applicable
6. Vertical spring support piece
7. Key bars

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03

04

CORE CLAMPING PLATES - FLUX SHIELDS

See drawing GBT-W 2586

1. Core Clamping Plates

Two single-piece plates (6), one at each end of the stator, provide firm axial clamping of the magnetic core assembly.

The clamping force exerted by these plates is transmitted to the core via clamping fingers (7), welded onto the end laminations opposite each tooth; this arrangement ensures adequate distribution of pressure from the plate of the core. This clamping force corresponds to an elastic deformation of the two clamping plates, which is maintained by welding to them the ends of the bars (4) which tie the two plates together.

2. Flux shields

In view of the considerable alternating magnetic fields in the immediate vicinity of the clamping plates, special precautions are taken to minimise stray load loss in these areas.

Both ends of the core are protected by an annular copper damper screen, or flux shield (8), which is shaped to fit the core clamping plate.

These damper screens shield the core assemblies from the front leakage flux flowing between rotor and stator.

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COOLING OF MAGNETIC CORE AND CORE END STRUCTURES

1. Magnetic core

Heat generated in the magnetic core (1) is removed by cold air flowing through the radial vent ducts (2) under the action of the fans. These vent ducts are formed by splitting up the core, along its whole length, into packets separated from each other by radial spacer ribs. Core cooling is thus of the "radial" type.

2. Core end structures

Cold air flowing between the clamping fingers (7), and in the space between the flux screen (8) and the clamping plate (6), removes the heat lost in these end structures.

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03 06

STATOR WINDING

See drawing GBT-W 2039 and GBT-W 1637.

The stator winding is the noble part of the generator. It is composed of conductors wedged into the magnetic core. It is in the winding that the electrical energy is generated, and it is from the winding that this energy must be channelled outside.

There are two distinct parts of the winding:

- The straight part which is within the magnetic core,
- The end windings which are outside the core and which serve to connect bars of different slots together, thereby completing the winding.

Straight part:

Drawing GBT-W 2039 represents the cross section of a stator slot containing the slot bottom bar (1) and air gap bar (2), separated by an insulating inter-bar spacer (8). These are held in place by the slot closing wedge (9).

End windings:

Drawing GBT-W 1637 shows the support system (6) of bars (1) and (2), and their bracing components (8), (9) and (10).

The description of the stator winding deals with the following points:

- Design of conductor bars
- Radial wedging of bars in the core
- End winding bracing system
- Circular phase connections
- Connections between winding and terminals
- Cooling of the stator winding
- Identification of phases

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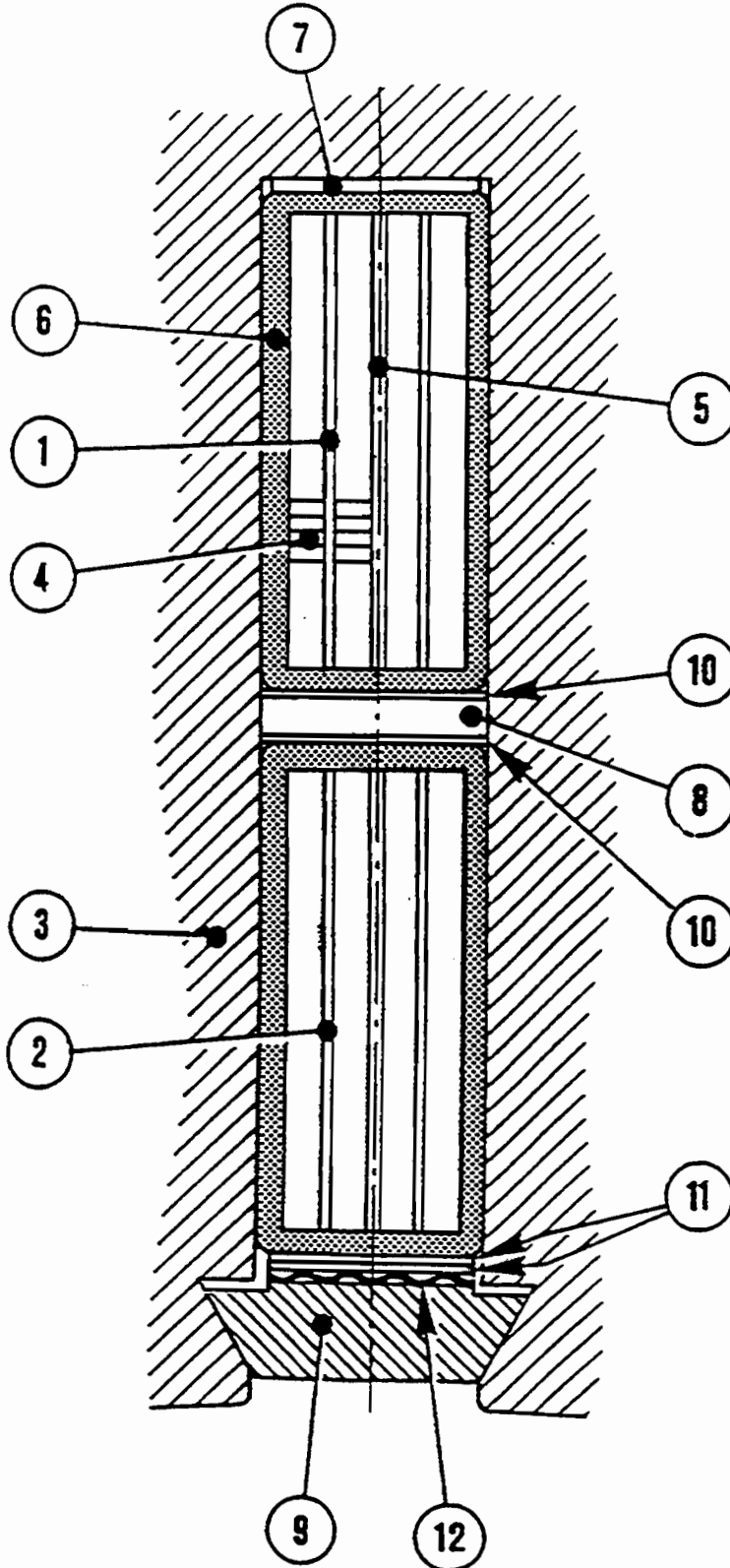
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06

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GBT-W 2039

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03 06

KEY TO DRAWING GBT-W 2039

1. Slot bottom bar
2. Air gap bar
3. Magnetic core
4. Solid strand
5. Insulating strip
6. Insulating wrapping
7. Slot bottom pad
8. Inter-bar spacer
9. Slot closing wedge
10. Levelling strip/Tapered wedge
11. Wedge/Rubber packing strip
12. Spring/Side wedging strip

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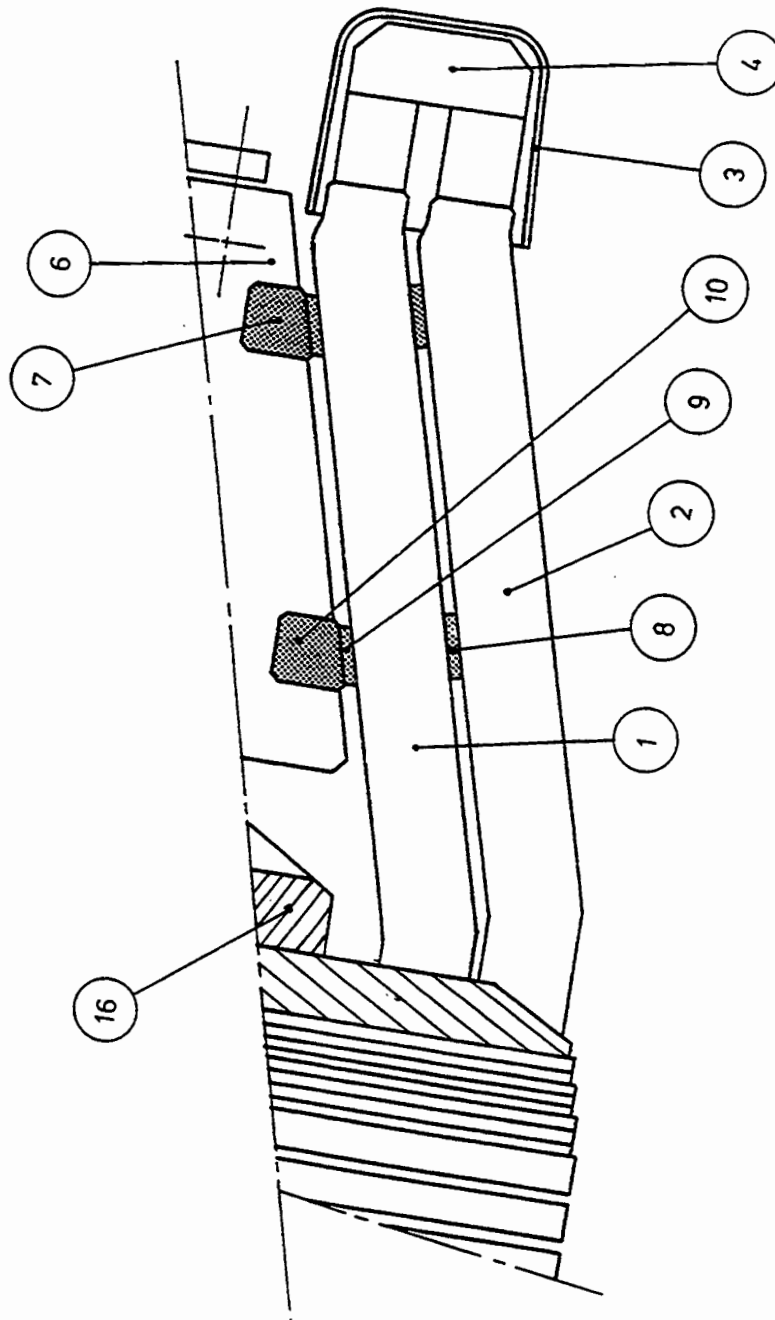
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03 06



GBT-W 1637

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03 06

KEY TO DRAWING GBT-W 1637

1. Slot bottom bar
2. Air gap bar
3. Insulating hood
4. Connection between bars
5. Insulating support brackets
6. Outer support ring
7. Spacer between involutes
8. Packing between slot bottom bars and outer support rings
9. Outer support ring
16. Clamping plate

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03 06 01 Conductor design

See drawing GBT-W 2039

The stator conductor bars are made up of a bundle of elementary copper strands (4).

These insulated strands are transposed according to the Roebel method along the entire length of the magnetic core. In this way the additional loss caused by transverse leakage flux is minimised.

The electrical conductor is a composite assembly of elementary copper strands. It is insulated from the core (3) by an insulating wrapping (6).

This insulation is obtained by wrapping the bar with an ISOTENAX tape, made up of glass cloth and mica paper impregnated with an epoxy bonding resin, which is then hot polymerised.

To avoid the formation of corona or sparkings, the slot portion of the bars is covered with a conductive paint, and the end windings are coated with resistive paint.

At the end of bar (see drawing GBT-W 1637) all the strands are electrically connected by means of copper plates (4), which provide the electrical connection between the two bars (1) and (2). This connection is made after the bars are wedged in their slots.

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Radial wedging in the core

The high current levels in the conductors requires wedging which is particularly resistant to mechanical forces and vibrations. Bars are therefore equipped with radial and tangential wedging in the stator slots.

1. Radial wedging

See drawing GBT-W 2039

The slot bottom bar (1) pushes radially against the core (3) via the slot bottom pad (7). This pad is made of thermo-setting resin which molds the shape of the bar so as to ensure uniform contact pressure between the bar and the core. The slot bottom bars (1) and air gap bars (2) are separated by an insulating wedge (8) and levelling strips (10).

The bars are held radially by the combined effort exerted by wedge (9) and ripple spring (12) pushing against air gap bar (2) via slide shims (11).

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03 06 03

End winding bracing

See drawing GBT-W 1637.

The end windings of the stator bars must be anchored by means of a special support system built on to the active part of the machine.

Insulating support brackets (6) are attached to the magnetic core clamping plate (16). On these brackets are mounted support rings (7) and (10), against which rest the slot bottom bars (1), via intermediate hot-polymerised packing blocks (9).

The bracing between the air gap bars (2) and the slot bottom bars (1) is obtained by inserting hot-polymerised spacing blocks (8). Radial clamping is achieved by the winding head tie -rods in the brackets (6).

The tangential wedging of the slot bottom bars (1) and air gap bars (2) is obtained by means of tapered wedges, the whole being held by strapping which is hot-polymerised.

The wedge/stator bar assembly thus forms a rigid cone capable of withstanding normal and accidental electromagnetic forces.

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03	06	04	Cooling of stator winding
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The current flowing through the stator bars creates heat losses which are evacuated by:

- the magnetic core for the straight portion of bars: due to the close contact between winding and core, the heat generated in each bar may escape towards the core, which is itself cooled by air flowing through the radial vent ducts
- cold air circulation in the end-winding area.

This cooling system is called "indirect cooling".

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ROTOR

See drawing GBT-W 03335

The two-pole rotor, driven directly by the turbine, is designed to run with the minimum of vibration at all speeds, with any critical speeds occurring well away from the running speed. It operates with winding mean and hot spot temperatures well within the capabilities of the insulation. The rotor is well balanced using the most modern techniques and is tested at 20% above normal running speed.

At the turbine end, the rotor is directly flange coupled (5) to the turbine end coupling. At the opposite turbine end, the rotating exciter unit is both mechanically and electrically directly coupled to the generator rotor.

The field winding is installed in longitudinal slots milled into the shaft body (1). The field end windings, which extend beyond the body, are held against centrifugal force by the retaining rings (2). Axial flow fans (3) mounted on the retaining ring endcovers circulate the air which is used to cool the rotor windings. The rotor turns on two journals (4).

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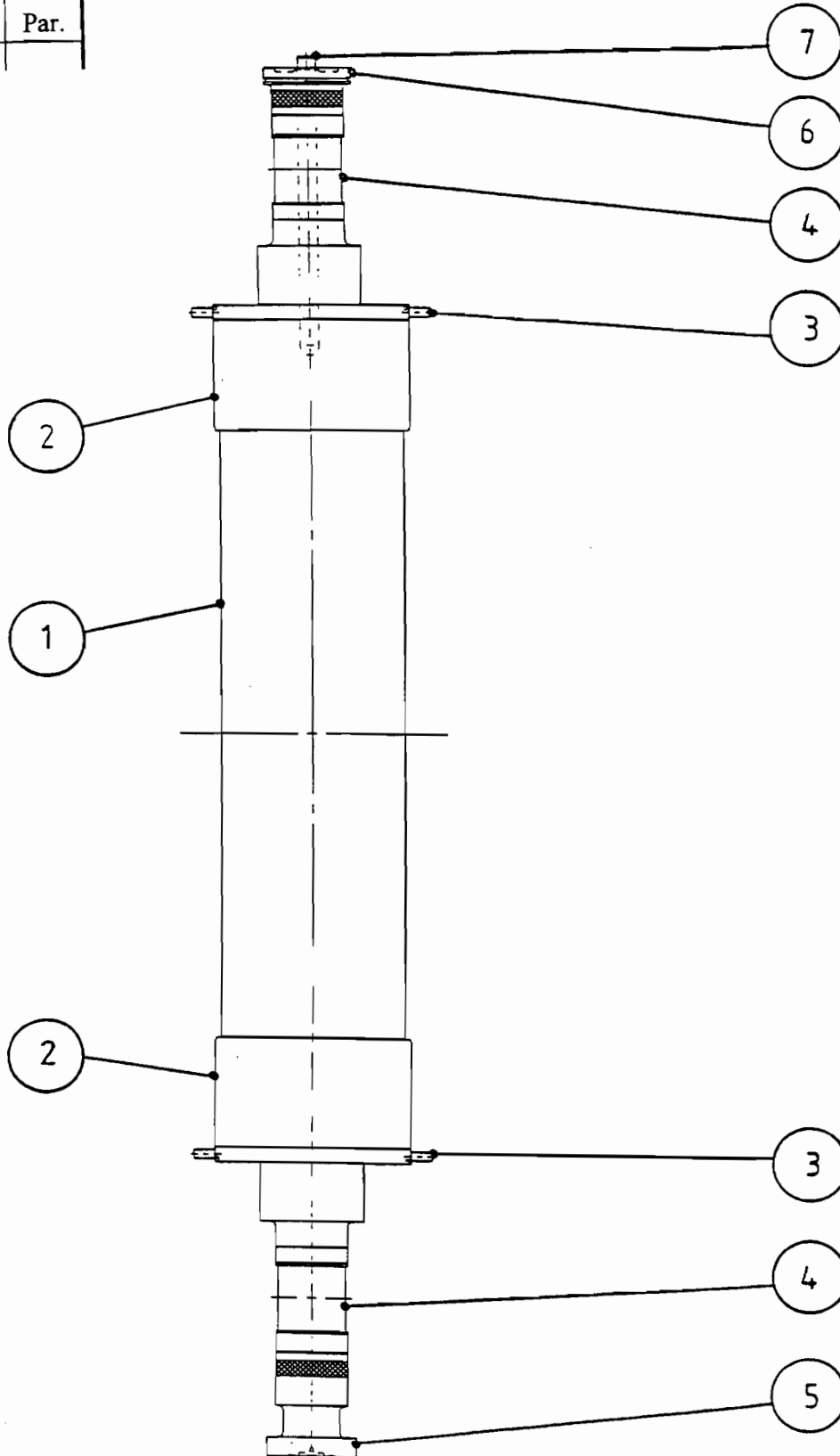
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04 01

GBT-W O3335 ROTOR OUTLINE

1. Shaft
2. Rotor winding retaining rings
3. Axial fans
4. Journals
5. Coupling - turbine end
6. Coupling - non turbine end
7. Exciter unit electrical connection

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04 05 01 Slot portion of the winding

See drawing GBT-W 2962

The rotor winding consists of a number of formed turns (3) stacked inside the rotor slots, and which when joined together at the ends form the field coils which make up the poles of the rotor.

Each turn (3) is made up of two straps of drawn copper strip both of which have longitudinal grooves in their mating faces. Joined together, these grooves form two ventilation channels (8) longitudinally down each turn.

With interturn insulation strips (4) laid between the turns, the coils are assembled into two separate, club footed, moulded slot cells (5) which fit closely into the shaft body slots. Along the length of the body, these copper turns are provided with radial slots (7), so arranged to provide inlet and outlet radial ducts through the finished coil stack.

The top of each slot is packed with insulation packing strips (2) between the field winding and the aluminium slot wedges (1).

A damper winding is made by the full length aluminium wedges which enclose the winding slots and which are in intimate contact with the endwinding retaining rings.

A separate damper winding is also provided in the pole body and comprises two full length copper straps in each of the six longitudinal shallow pole slots. The damper windings are retained in position by means of short aluminium wedges, of the same cross section as the main slot wedges, suitably packed in position by means of insulation packers fitted under the copper.

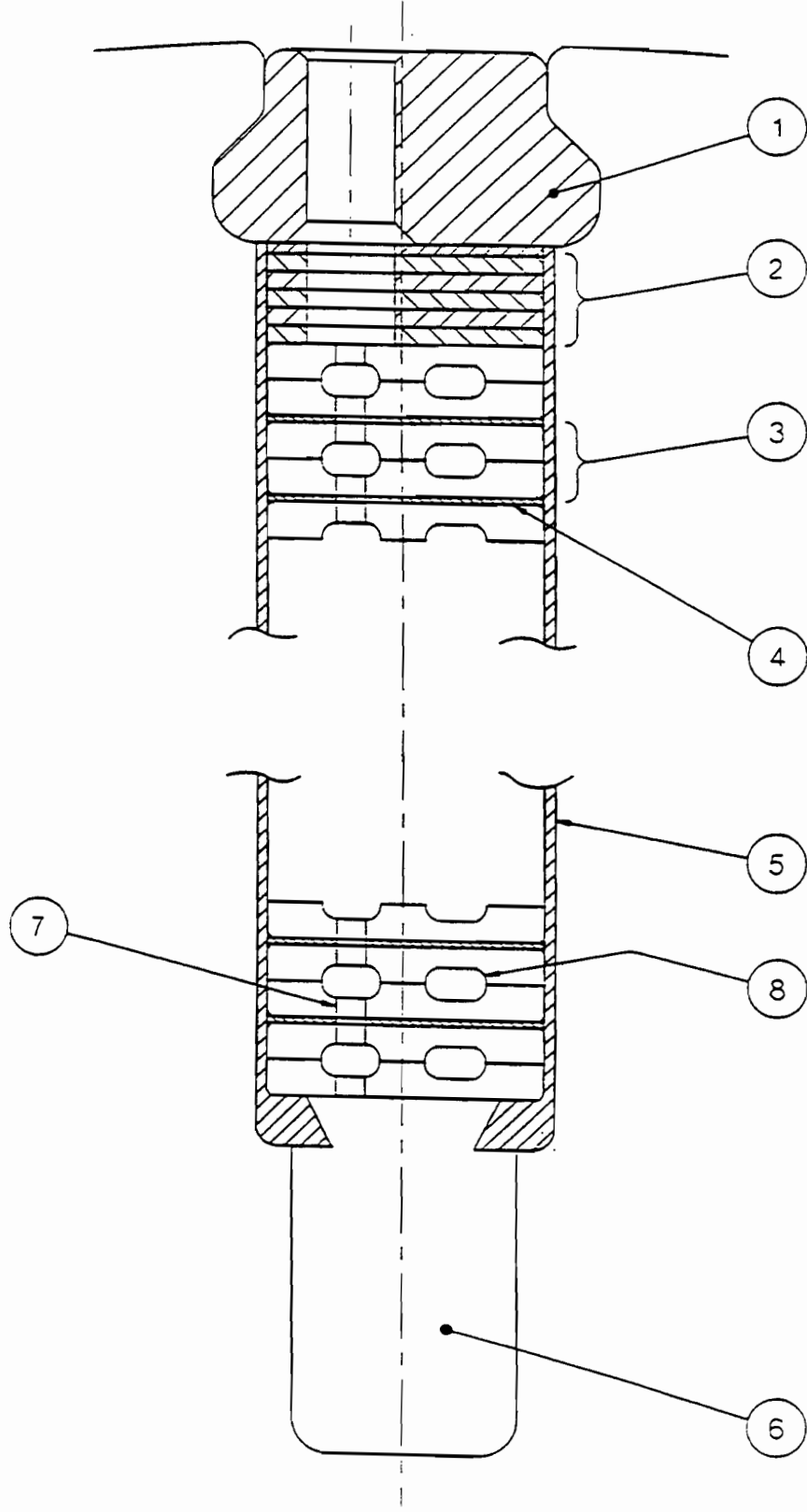
An axial channel, or subslot (6) is machined along the whole length of the shaft body under the field winding slots. This hollow subslot is used to duct air for cooling the rotor winding.

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GBT-W 2962

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GBT-W 2962 ROTOR SLOT CONTENT

1. Slot wedge
2. Top insulation packing strips
3. Double strap copper coil turn
4. Interturn insulation strips
5. Slot cell
6. Subslot cooling channel
7. Radial ventilation duct
8. Axial ventilation duct

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04 05 02 Wedging of the slot portion of the winding

See drawing GBT-W 2962

The rotor winding coils are held tangentially in the shaft body by the rotor teeth.

The two separate, club footed, moulded slot cells (5) which fit closely into the shaft body slots are bonded to the winding in such a way as to allow the air to flow into the radial inlet air ducts from the subslot channel (6).

The entire slot assembly is held against centrifugal force by the aluminium dovetailed slot wedge (1). In the wedge are holes which enable the air to discharge from the outlet radial ducts into the air gap.

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Cooling of the slot portion of the winding

See drawing GBT-W O3336

The winding is cooled by circulating air. A system of axial-radial passages circulates the air through the rotor and windings in two identical circuits, each cooling half of the rotor length.

The two axial flow fans circulate the air within the generator. Part of the air supply (1) flows between the shaft (2) and the endwinding (3). It then flows axially in the sub slots (4) underneath the wound slots (5) before entering the winding through radial inlet ducts at intervals along the half length of the rotor.

From the radial ducts (6) in the coils, inside the hollow conductors (7), the air is forced to flow axially in the ducts in order to reach the next radial outlet duct before escaping into the airgap (8) through drilled holes in the slot wedges.

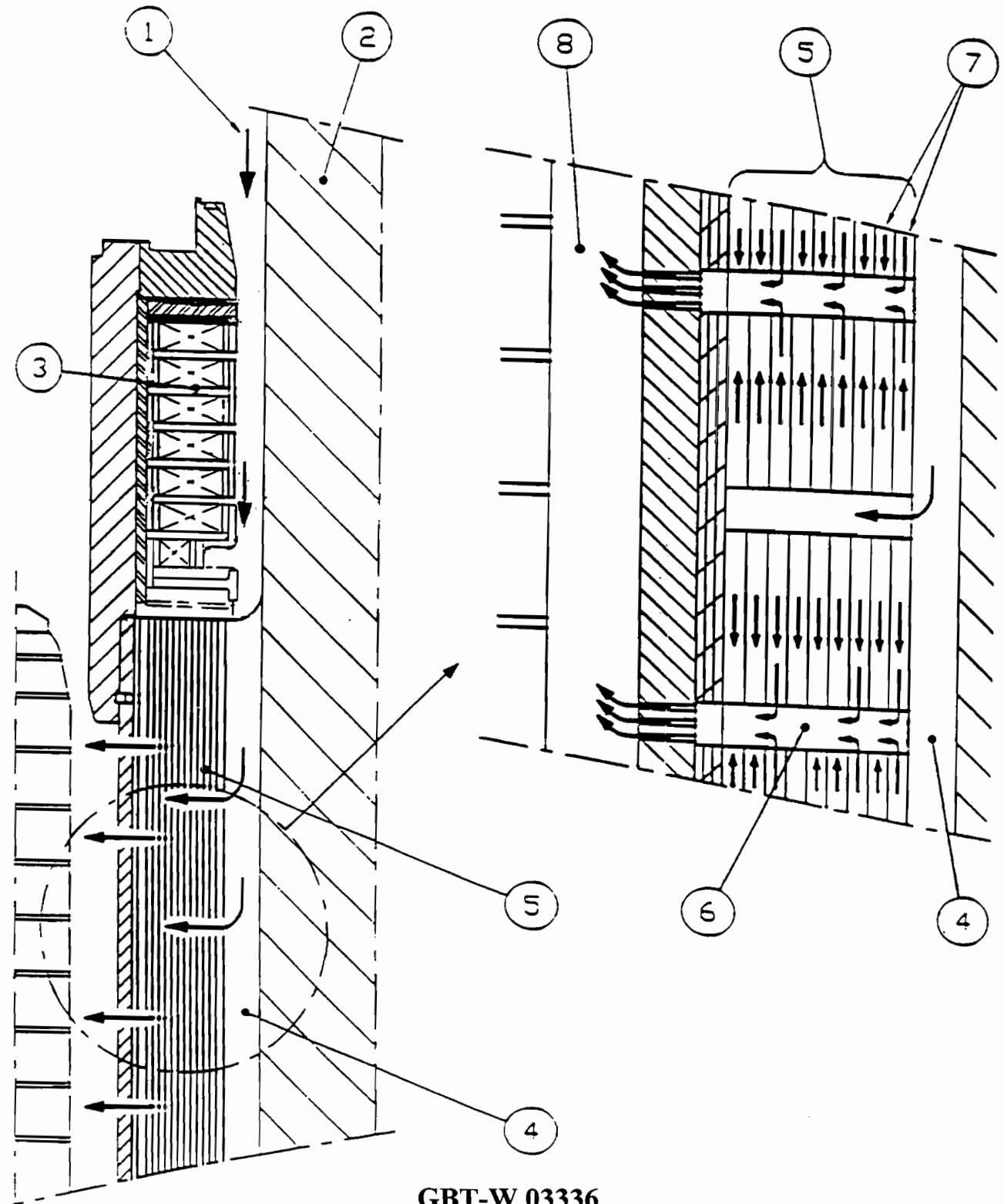
The air flowing through the hollow conductors (7) is heated by contact with the copper. After leaving the rotor, the heated air in the air gap is mixed with cool air entering the air gap from the end and passes through the stator core ducts. The air is then directed towards the generator coolers where the heat is transferred to the coolant passing through the coolers before being recirculated around the machine.

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04 05 03

GBT-W O3336 COOLING OF THE SLOT PORTION OF THE WINDING

1. Air flow
2. Shaft
3. Endwinding
4. Sub slot
5. Wound slot
6. Air duct
7. Hollow conductor
8. Air gap

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Mod.	Chap.	Par.
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04 05 04 Endwinding

See drawings GBT-W 03337

The endwindings (2) are those parts of the rotor winding which extend beyond the shaft body (1). The endwindings at each end of the rotor body are concentric with the shaft ends, but an annulus for the passage of cooling air under the endwindings remains.

During winding each single turn of the coils formed from two half coils have the half turns joined at the turbine end by straight jointing. This ensures the continuity of the turns. At the non turbine end the turns are progressively connected using step-up joint blocks. Crossover inter coil connections are used on top and bottom turns as required to connect adjacent coils. The electrical connection between the two poles is made by a circumferential copper strap which is brazed to the bottom turn of the outermost coil of each pole in the non turbine end winding. This creates a continuous winding in series around the two poles.

The turns are insulated from each other in a similar manner to that used in the slot portion.

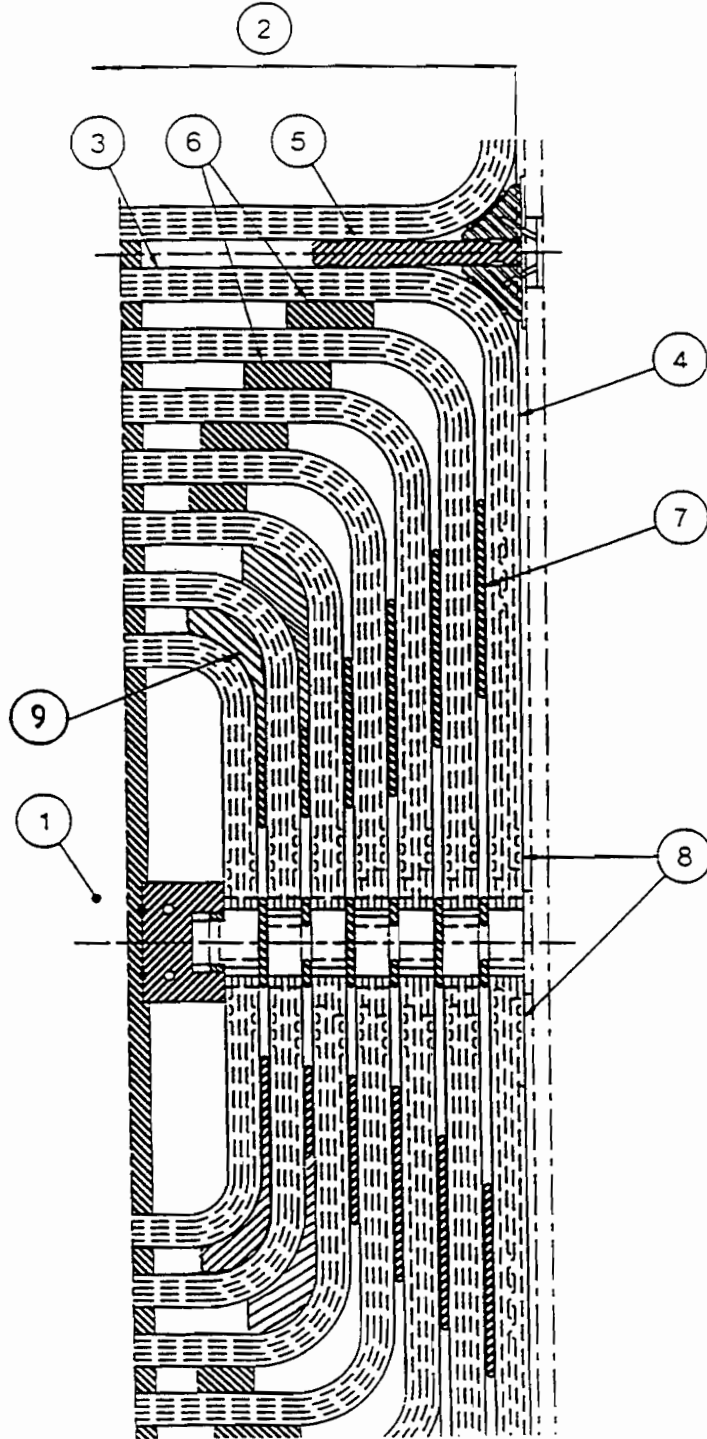
Each of the conductor straps has two longitudinal grooves machined in their mating faces. In addition the lower strap has a series of transverse grooves in its surface linking with the longitudinal grooves to form air inlet ducts. When these conductors are superimposed to form the endwinding coils, each turn thus has longitudinal cooling ducts.

A cylindrical insulation liner, made up from two half cylinders and fitted around the winding overhang inside the retaining ring, prevents grounding to bare metal.

Where the straight part of the coil emerges from the rotor body, the slot cells insulating the coil from the body are supported by a series of shaped finger blocks, each individually secured to the end face of the rotor body.

DESCRIPTIVE MANUAL

Mod.	Chap.	Par.
04	05	04



GBT-W 03337

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Mod.	Chap.	Par.
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04 05 04

GBT-W O3337 ENDWINDING (REAR END)

1. Shaft body
2. Endwinding
3. Axial portion of endwinding
4. Circumferential portion of endwinding
5. Axial packers
6. Axial packers
7. Circumferential packers
8. Transverse or lateral ducts
9. Axial/circumferential packers

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Mod.	Chap.	Par.
------	-------	------

04 05 05 Endwinding packing

See drawing GBT-W O3337

The endwindings (2) are mutually located and supported axially and circumferentially by insulation packers (6), (7) and (9) arranged between the axial and circumferential parts (3) and (4) of the coils.

Together the coils and packers form a continuous structure.

The endwindings are located and supported axially by insulation packers (5) between the coil circumferential portions. There are also insulation packers between the endwinding and the shaft body side and the retaining ring endcovers.

The endwindings and packers are held radially against the effects of centrifugal force by the rotor endwinding retaining rings.

The overall packing system allows the winding to expand axially and thereby eliminates distortion in the endwindings.

DESCRIPTIVE MANUAL

Mod.	Chap.	Par.
04	05	06

Cooling of endwindings

See drawing GBT-W O3339

The endwinding portion (3) of the winding is cooled by circulating air. An axial-radial system of passages allows the air to circulate through the rotor and windings. The endwinding cooling circuit is independent of the slot portion cooling circuit.

Part of the cold air supply (1) passing underneath the endwindings (3) flows through the space between the coil stacks (4). It enters the longitudinal ducts in each conductor (8) via lateral openings (10) and flows around the circumferential and axial parts of the endwinding. The air flowing through the hollow conductors (8) is heated by contact with the copper before finally flowing through radial ducts (7) into the airgap (9).

The pressure required for the air circulation is self-generated by the fan action of the winding assisted by the axial flow fans mounted on the shaft.

Endwinding cooling is thus assured by cold gas flowing through multiple parallel circuits.

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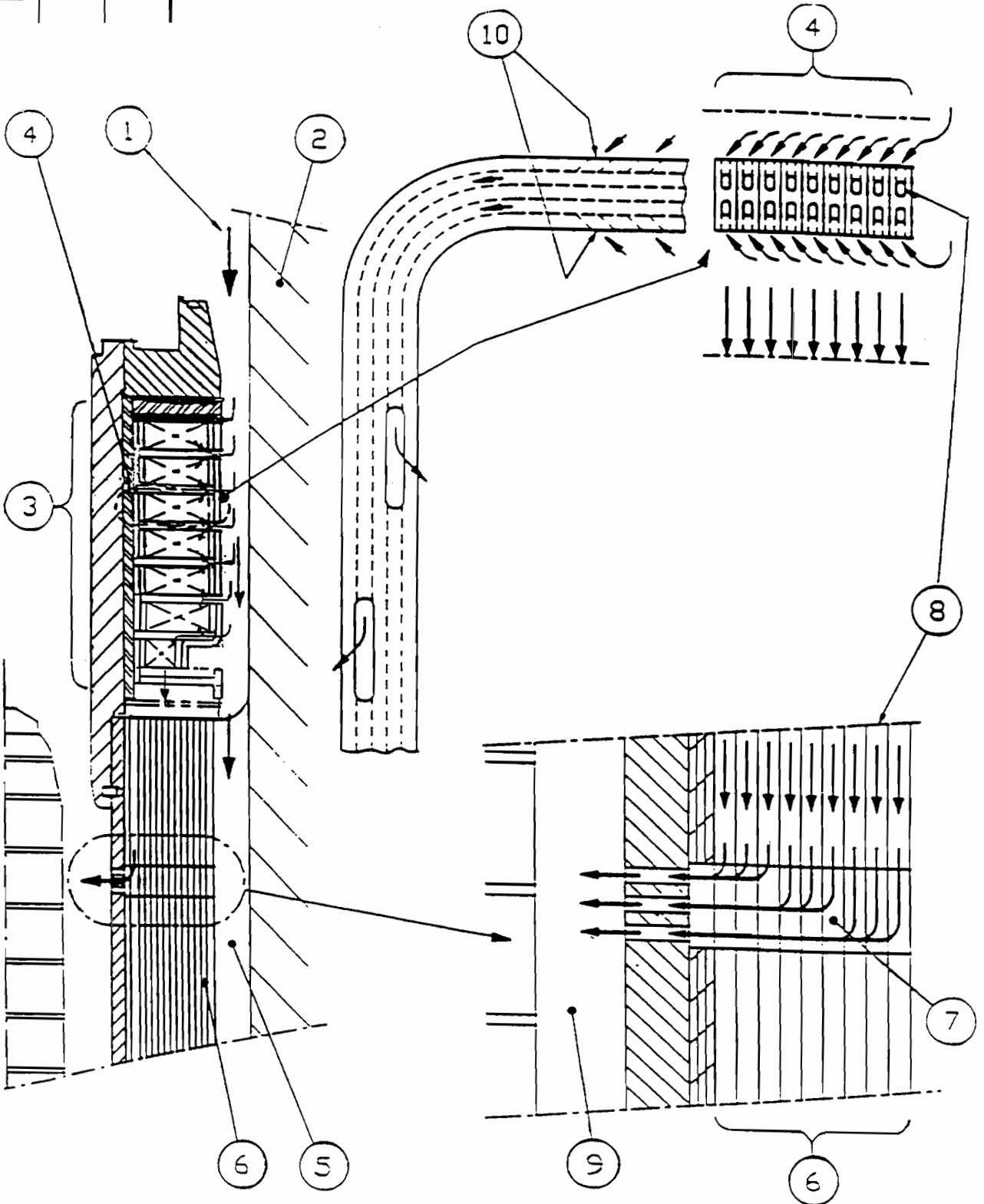
DESCRIPTIVE MANUAL

Mod.	Chap.	Par.

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GBT-W 03339

Mod.	Chap.	Par.
04	05	06

GBT-W O3339 COOLING THE ENDWINDING

1. Air flow
2. Shaft
3. Endwinding
4. Endwinding coil stack
5. Sub slot
6. Wound slot
7. Radial ventilation duct
8. Hollow conductor
9. Air gap
10. Lateral ventilation opening

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DESCRIPTIVE MANUAL

Mod.	Chap.	Par.
04	06	

ROTOR WINDING RETAINING RINGS AND ENDCOVERS

See drawing GBT-W O3340

The endwindings (7), which extend beyond the shaft body, are held against centrifugal force by the rotor winding retaining rings (2) and retaining ring endcover (3) assembly.

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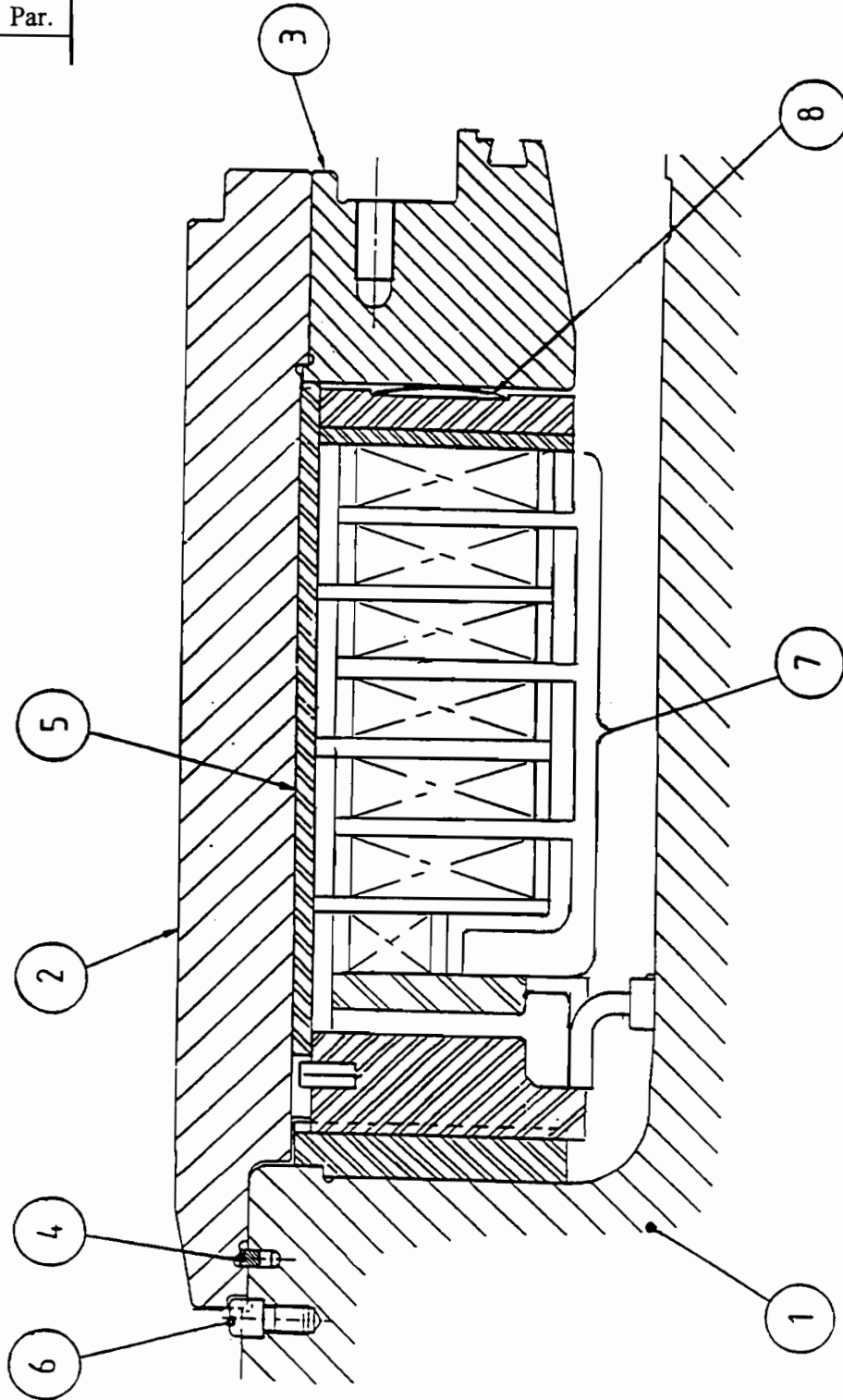
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DESCRIPTIVE MANUAL

Mod.	Chap.	Par.
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04 06



GBT-W 03340

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DESCRIPTIVE MANUAL

Mod.	Chap.	Par.	
04	06		

GBT-W O3340 ROTOR WINDING RETAINING RINGS AND ENDCOVERS

1. Shaft body
2. Retaining ring
3. Endcover
4. Spring ring
5. Insulation liner
6. Stop pin
7. Endwinding assembly
8. Spring packer

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Mod.	Chap.	Par.	
04	06	01	<p>Retaining rings</p> <p>See drawing GBT-W O3340</p> <p>The endwinding retaining rings (2) which are machined from forgings of non-magnetic alloy steel, support the coil endwindings against the effect of centrifugal force. The characteristics of the steel are tested using specimen pieces taken from the forging during manufacture.</p> <p>Each retaining ring is shrunk on to a stepped seating at the end of the shaft body and locked against axial movement by a spring ring (4) which is assembled into a groove machined radially in the shaft body and the retaining ring.</p> <p>The retaining ring is locked circumferentially by a stop pin (6) screwed into the shaft body and whose head is partially recessed into the inboard edge of the ring.</p> <p>The retaining rings are supported only at their inboard ends and have no contact with the shaft at their outboard ends, thereby avoiding any transmission of shaft deflection to the rings.</p> <p>Each retaining ring is insulated from the endwinding by a lining (5) of resin glass laminate. The lining (split into two halves) is faced on its inner diameter with a layer of epoxy polyester glass laminate and a coating of P.T.F.E. compound.</p>

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Mod.	Chap.	Par.
04	06	02

Retaining ring endcovers

See drawing GBT-W O3340

The outboard end of the retaining ring (2) is fitted with an annular endcover (3) on to which the retaining ring is shrunk. The endcover minimizes the deformation that the retaining ring would undergo if it was mounted only on the shaft body. The shrink fit is sufficient to maintain contact against the effects of centrifugal forces. The endcover also acts as an axial restraint on the endwinding and endwinding packers.

Axial movement of the endcover is prevented by a ridge machined in its periphery which engages with a shoulder machined in the retaining ring bore. The endcover has a dovetail groove machined in its outer face for the attachment of balance weights and a machined bevel on its inner diameter which facilitates the flow of cooling air under the end windings.

The outboard face of the endcover is also machined and drilled to accept the axial flow fans.

APPENDIX VI

OEM technical report off-line end winding bump test presentation

PROCES VERBAL / FICHE DE COMMUNICATION

PV

CUSTOMER **PPC** PLANT **LAVRION** UNIT **GT 4-2**
 CUSTOMER CONTRACT or ORDER Nb SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Distributed to : Operational manager On : 01/06/2015 Name B. LEFEVRE Fax : + 33 3 84551938	Contract : <input type="checkbox"/> New <input checked="" type="checkbox"/> Maintenance <input type="checkbox"/> Guarantee (Tick the appropriate boxes) Material / Activities : <input checked="" type="checkbox"/> Generator <input type="checkbox"/> Turbine <input type="checkbox"/> Commissioning <input type="checkbox"/> Auxiliaries <input type="checkbox"/> Other
Answer required : YES	Concerned item : STATOR Identification / Marking T 2 4 0 / 3 7 0 N° 5 0 0 0 3 7

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

Natural frequencies measurement on endwindings, has been performed after rotor removal.

1. Conditions :

- Test Date: 27/05/2015
- Localisation: LAVRION
- Machine state : After rotor removal
- Ambient conditions : Temperature = 21°C
- Test Procedure : DP38R0001B

2. Measurement equipment :

- Acquisition : Microlog SKF n° 22115
- Process : for global measurement : Matlab STMCSV
 for local measurement : Matlab PLFTCSV
- Measurement in the range 0 - 200 Hz with accuracy 0.25Hz.

3. Results :

3.1. Local measurements


The local natural frequencies on caps have several response levels above the criteria.
 The local natural frequencies on leads have low response levels within the criteria.

Responsible name : **A. BANCELIN** Tel : Fax : E-mail :

<input type="checkbox"/> In accordance <input type="checkbox"/> Not in accordance <input checked="" type="checkbox"/> To be determined with specification Nb : DP38R0001B	DSI Nb : Lign Nb :
---	---------------------------

Customer :

Statement agreement Name : Date : Visa :

By	M. CLAUDE	A. BANCELIN			
On	01/06/2015	01/06/2015			
Visa					
	Issued	Verified	PV	LVR BX15 1902 004	Page 1/26 File

PROCES VERBAL / FICHE DE COMMUNICATION

PV

CUSTOMER **PPC** PLANT **LAVRION** UNIT **GT 4-2**
 CUSTOMER CONTRACT or ORDER Nb SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

3.2. Global Measurements

The first 4 nodes mode is at 45.3 Hz on the turbine side.
 The first 4 nodes mode is at 42.5 Hz on the opposite turbine side.

4. Local measurements :

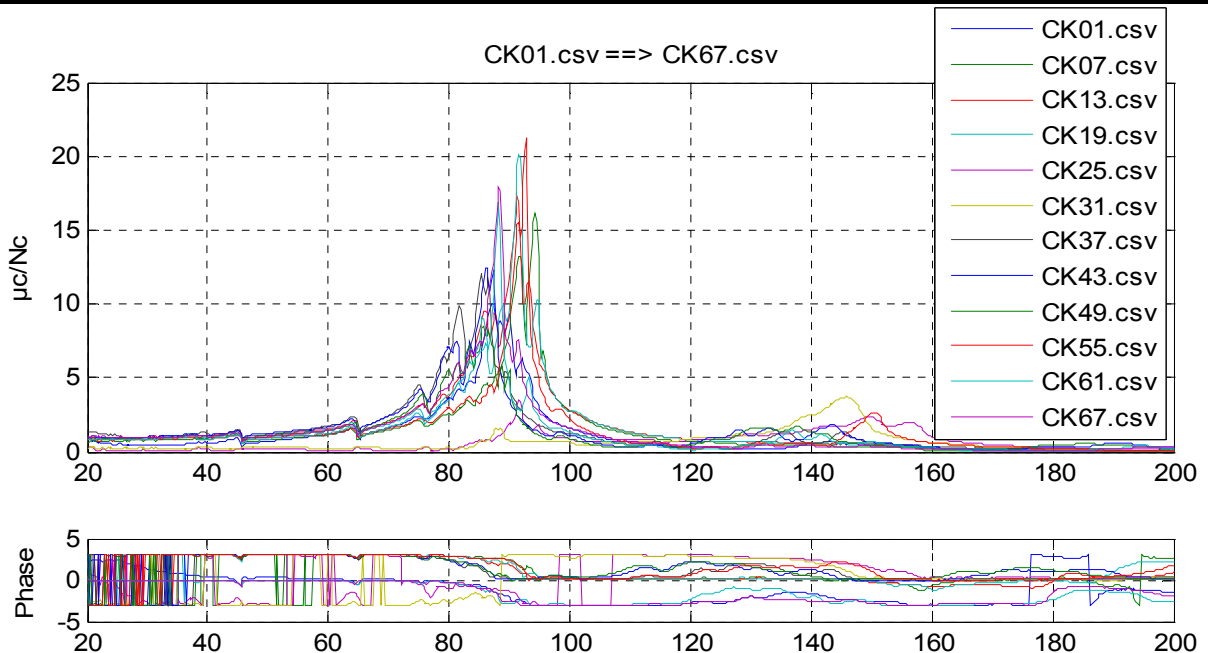
4.1. Caps

Measurements on 12 caps in tangential direction, on [0 - 200 Hz].
 Some levels are not in criteria : several peaks are superior to 5µm in the frequency band [95 – 115 Hz], mainly opposite turbine side.

On turbine side, the peaks are located under 95Hz. A refurbishment is not necessary on this outage (no signs detected during visual inspection).

Turbine side :

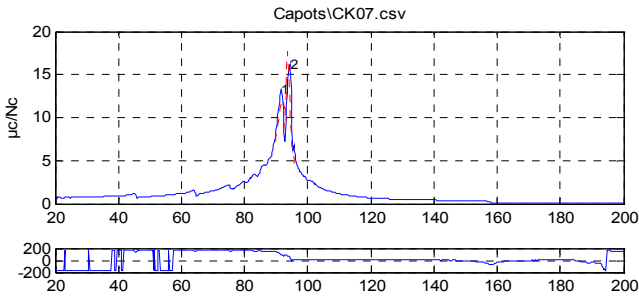
Cap of top bar	Files	f0 (Hz)	µc/Nc (f0)	Phi (f0) en °	fmax1 between 95-115 (Hz)	µc/Nc (fmax1)	Phi (fmax1) en °	fmax2 between 0-200 (Hz)	µc/Nc (fmax2)	Phi (fmax2) en °
1	CK01.csv	100	1.56	-171.8	95.25	2.75	-174.8	87.25	10.03	-78.2
7	CK07.csv	100	2.73	16.6	95.50	6.77	16.4	94.25	16.11	48.3
13	CK13.csv	100	2.80	9.2	95.25	5.77	13.4	91.25	17.39	71.2
19	CK19.csv	100	2.73	14.0	95.25	6.87	6.4	91.50	20.08	73.0
25	CK25.csv	100	0.88	173.4	95.25	1.48	-177.8	91.50	3.46	-118.0
31	CK31.csv	100	0.64	153.8	112.75	0.72	166.2	145.75	3.70	64.7
37	CK37.csv	100	1.19	11.4	95.25	1.73	4.8	85.25	12.04	78.7
43	CK43.csv	100	1.09	19.1	98.50	1.37	26.4	86.25	12.49	66.2
49	CK49.csv	100	0.88	20.5	98.50	1.07	30.3	85.75	8.44	78.0
55	CK55.csv	100	2.19	7.7	95.25	4.15	11.1	92.75	21.18	42.9
61	CK61.csv	100	1.32	-172.2	95.25	2.13	-174.5	88.25	16.91	-124.7
67	CK67.csv	100	1.59	-171.8	95.25	2.55	-174.0	88.25	17.89	-112.1



CUSTOMER **PPC** PLANT **LAVRION** UNIT **GT 4-2**
 CUSTOMER CONTRACT or ORDER Nb SAP PROJECT Nb **IE0-001902**

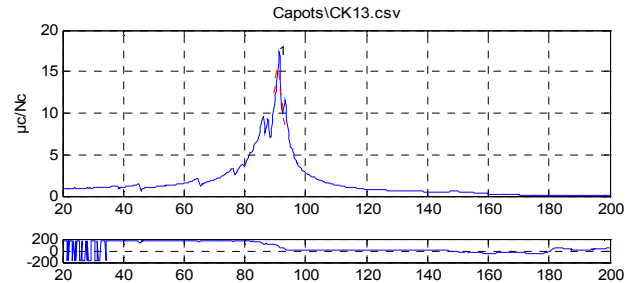
INTERVENTION DESIGNATION :
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**



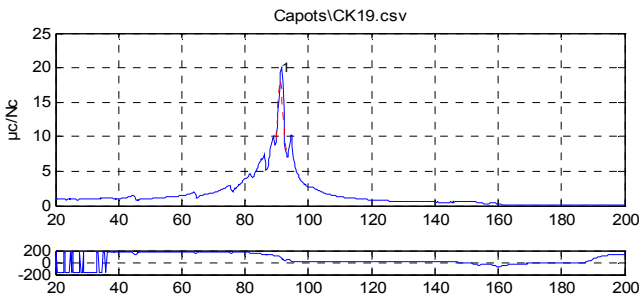
ALSTOM ENERGY TGP/IFT (Ver 1.0)

Valeurs mesurées		Valeurs calculées					
#	F(Hz)	µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	91.5	13.177	104.1	92.0	1.7687	12.134	6.97
2	94.3	16.112	48.3	93.6	0.6213	17.988	12.9



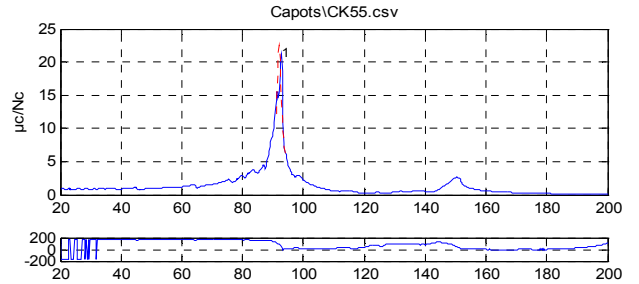
ALSTOM ENERGY TGP/IFT (Ver 1.0)

Valeurs mesurées		Valeurs calculées					
#	F(Hz)	µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	91.3	17.392	71.2	90.7	1.7194	15.434	5.8



ALSTOM ENERGY TGP/IFT (Ver 1.0)

Valeurs mesurées		Valeurs calculées					
#	F(Hz)	µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	91.5	20.075	73.0	91.2	0.9423	18.4	8.79



ALSTOM ENERGY TGP/IFT (Ver 1.0)

Valeurs mesurées		Valeurs calculées					
#	F(Hz)	µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	92.8	21.184	42.9	92.0	0.6682	22.481	9.97

Opposite turbine side :

On opposite turbine side, several peaks are located around 100Hz with high level. A strengthening of caps is necessary.

Cap of top bar	Files	f0 (Hz)	µc/Nc (f0)	Phi (f0) en °	fmax1 between 95-115 (Hz)	µc/Nc (fmax1)	Phi (fmax1) en °	fmax2 between 0-200 (Hz)	µc/Nc (fmax2)	Phi (fmax2) en °
1	OK01.csv	100	13.75	69.9	100.00	13.75	69.9	100.00	13.75	69.9
7	OK07.csv	100	3.79	111.4	101.50	5.80	47.2	101.50	5.80	47.2
13	OK13.csv	100	0.27	13.0	95.25	2.59	49.6	94.00	3.24	89.0
19	OK19.csv	100	2.64	11.2	96.50	7.01	85.0	96.50	7.01	85.0
25	OK25.csv	100	0.52	161.1	115.00	0.71	149.1	140.75	1.25	76.6
31	OK31.csv	100	2.48	19.3	98.00	9.77	59.4	98.00	9.77	59.4
37	OK37.csv	100	0.68	166.4	115.00	1.16	164.5	128.75	3.27	97.5
43	OK43.csv	100	0.44	28.3	95.75	3.81	66.8	95.75	3.81	66.8
49	OK49.csv	100	0.26	63.3	111.50	0.49	125.3	82.00	5.00	97.1
55	OK55.csv	100	0.72	36.7	95.25	2.03	28.3	94.00	4.79	63.3
61	OK61.csv	100	2.37	10.9	96.25	9.43	51.2	96.25	9.43	51.2
67	OK67.csv	100	1.60	9.8	95.25	2.85	9.7	90.50	9.87	61.9

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

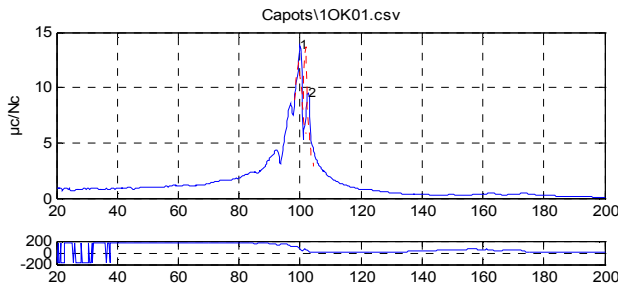
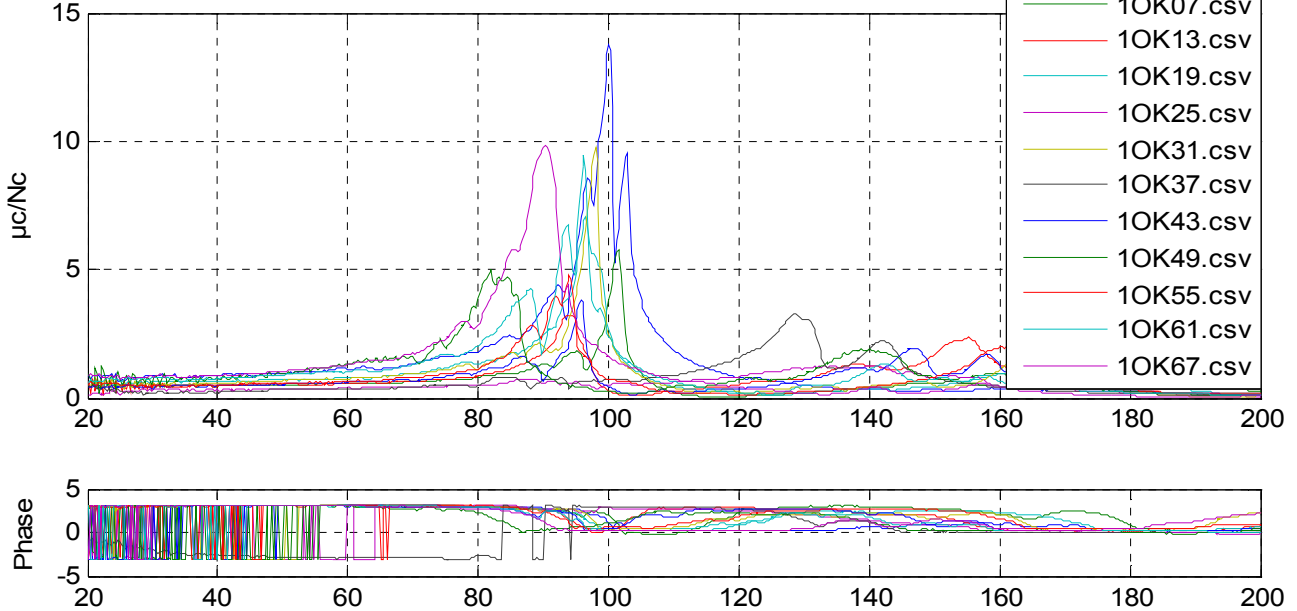
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

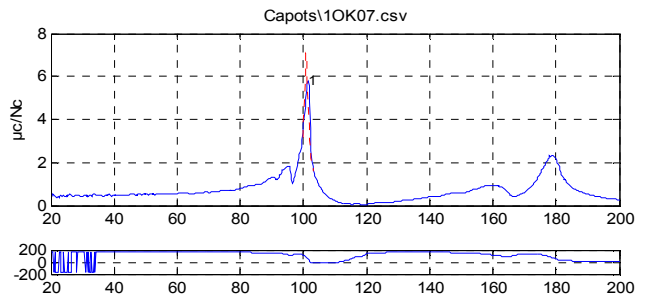
Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

1OK01.csv ==> 1OK67.csv



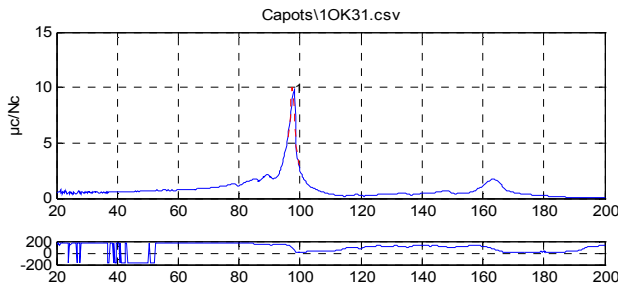
ALSTOM ENERGY TGPIIFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	100.0	13.747	69.9	99.5	1.2514	12.236	8.36
2	102.8	9.4994	33.0	101.7	0.5909	13.77	15



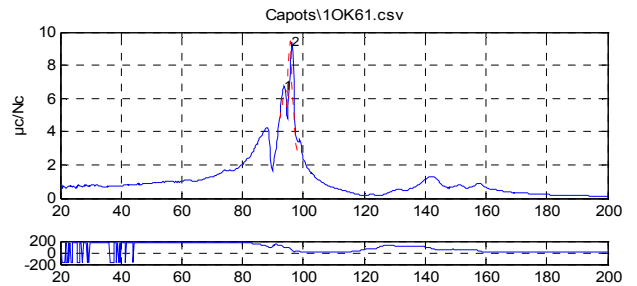
ALSTOM ENERGY TGPIIFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	101.5	5.7956	47.2	100.9	0.5352	7.1974	32.3



ALSTOM ENERGY TGPIIFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	98.0	9.7742	59.4	97.4	0.7544	10.117	17.5



ALSTOM ENERGY TGPIIFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	93.8	6.7624	96.5	94.4	2.5837	6.4544	8.53
2	96.3	9.4318	51.2	95.6	0.7794	9.477	18.8

PROCES VERBAL / FICHE DE COMMUNICATION

PV

CUSTOMER **PPC** PLANT **LAVRION** UNIT **GT 4-2**
 CUSTOMER CONTRACT or ORDER Nb SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

Comments :

On opposite turbine side, a lacing (or additionnal wedging) between caps has to be installed in order to reduce the levels and to modify the local natural frequencies.

4.2. Leads

Measurements on the leads between bars and circular phase connections in radial and tangential directions, on [0 - 200 Hz].

All the levels are in criteria : no peak superior to 5µm in the frequency band [95 – 115 Hz]. A refurbishment is not necessary (no signs detected during visual inspection).

Leads	Files	f0 (Hz)	µc/Nc (f0)	Phi (f0) en °	fmax1 between 95-115 (Hz)	µc/Nc (fmax1)	Phi (fmax1) en °	fmax2 between 0-200 (Hz)	µc/Nc (fmax2)	Phi (fmax2) en °
TB08R	TB08R.csv	100	0.15	-125.6	104.25	0.18	-130.0	33.75	0.69	-43.8
TB08T	TB08T.csv	100	0.02	-97.9	112.25	0.05	-42.7	36.25	0.64	-81.2
BB52R	BB52R.csv	100	0.09	-68.8	114.75	0.24	-46.3	45.00	2.85	-86.4
BB52T	BB52T.csv	100	0.18	-158.6	95.50	0.24	-162.8	45.25	4.29	-101.7
TB20R	TB20R.csv	100	0.06	-155.6	115.00	0.12	-26.4	38.50	17.19	-125.6
TB20T	TB20T.csv	100	0.06	-27.3	115.00	0.56	-37.7	44.25	15.35	-115.2
BB64R	BB64R.csv	100	0.38	-50.9	109.00	0.88	-103.1	52.75	2.36	-62.8
BB64T	BB64T.csv	100	0.64	119.5	109.00	1.34	69.5	52.75	1.35	107.4
TB32R	TB32R.csv	100	2.35	-80.8	100.25	2.38	-86.5	100.25	2.38	-86.5
TB32T	TB32T.csv	100	0.35	149	102.50	0.39	133.2	51.00	2.00	91.2
BB04R	BB04R.csv	100	0.62	-101.8	100.50	0.65	-114.0	100.50	0.65	-114.0
BB04T	BB04T.csv	100	0.07	-39	104.75	0.08	-71.4	24.50	0.44	-58.4
TB44R	TB44R.csv	100	0.12	-19.9	115.00	0.27	-21.2	68.75	1.59	-95.7
TB44T	TB44T.csv	100	0.14	162.9	115.00	0.19	168.3	68.75	0.84	80.6
BB16R	BB16R.csv	100	0.37	-148.7	95.25	0.41	-152.4	43.75	9.16	-138.2
BB16T	BB16T.csv	100	0.11	-176.2	95.25	0.23	-175.1	44.50	7.69	-132.1
TB56R	TB56R.csv	100	0.37	-177.2	95.25	0.47	-176.4	45.25	11.47	-124.1
TB56T	TB56T.csv	100	0.41	-17.1	111.25	1.15	-61.9	45.25	7.18	-126.8
BB28R	BB28R.csv	100	0.15	-21.9	115.00	0.48	-37.3	59.75	3.07	-90.9
BB28T	BB28T.csv	100	0.23	-22.9	115.00	0.41	-35.8	123.50	1.17	-103.9
TB68R	TB68R.csv	100	0.47	-9.7	113.50	1.67	-72.0	116.50	1.80	-105.2
TB68T	TB68T.csv	100	0.33	-16.1	112.50	0.63	-40.6	57.25	2.32	-76.1
BB40R	BB40R.csv	100	0.15	-162.9	95.25	0.27	-170.0	74.75	2.22	-74.1
BB40T	BB40T.csv	100	0.20	150.7	102.25	0.22	138.9	34.75	0.65	77.1

TB : top bar BB : bottom bar R : radial direction T : tangential direction

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

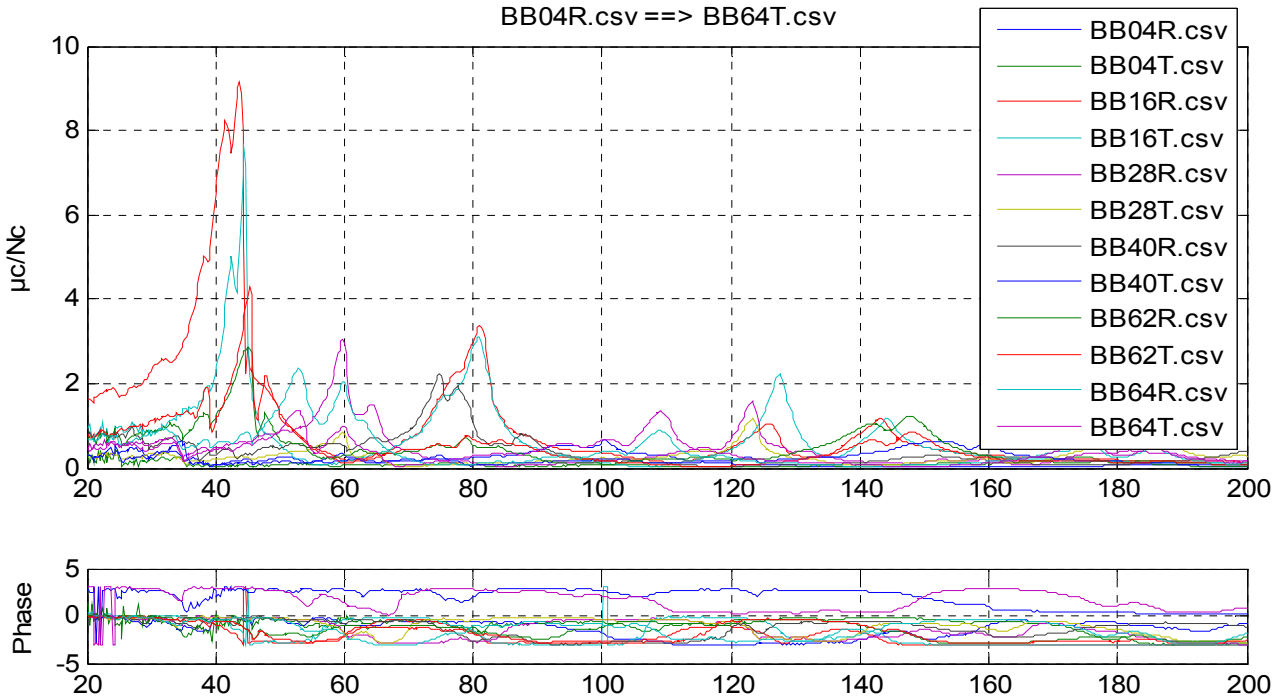
INTERVENTION DESIGNATION :

GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

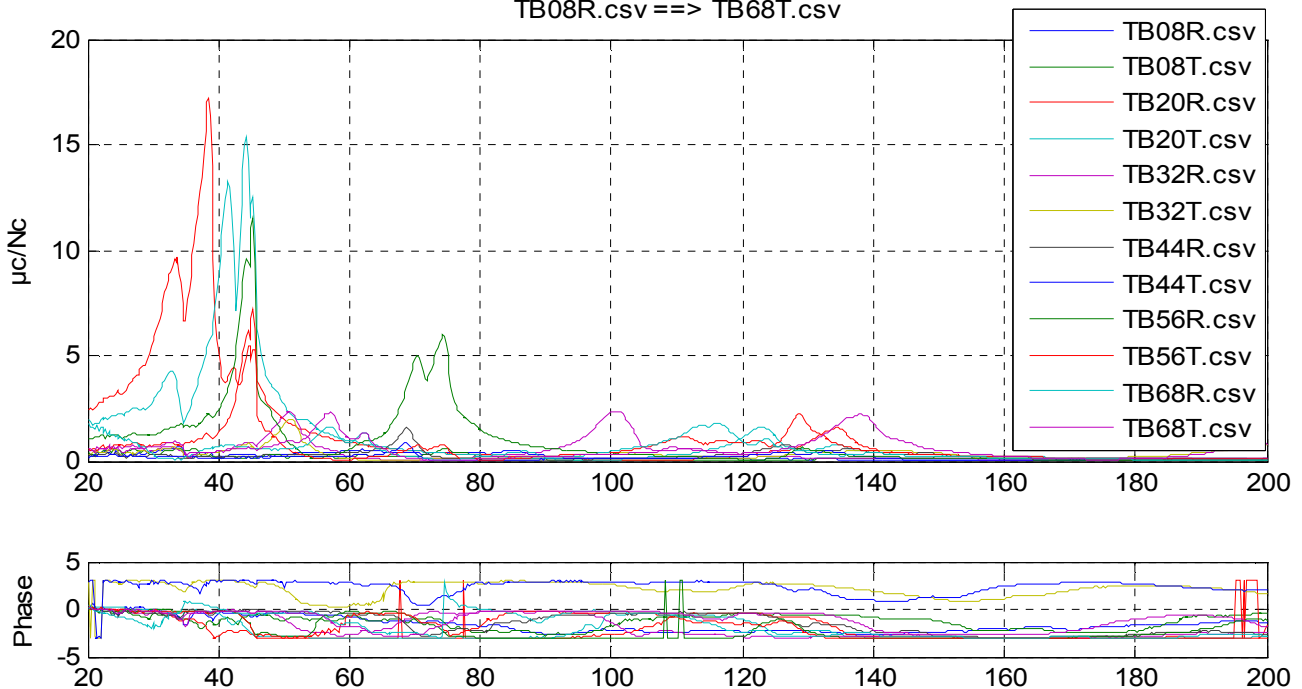
Leads of bottom bars :

BB04R.csv ==> BB64T.csv



Leads of top bars :

TB08R.csv ==> TB68T.csv



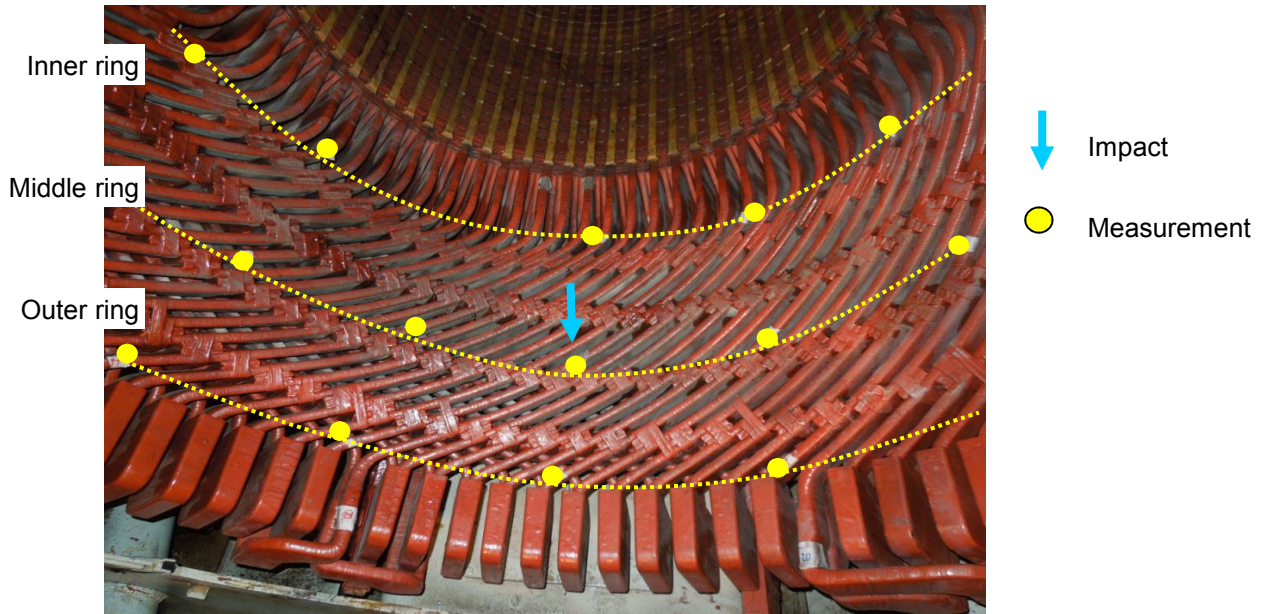
CUSTOMER **PPC** PLANT **LAVRION** UNIT **GT 4-2**
 CUSTOMER CONTRACT or ORDER Nb SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

5. Global measurements :

Measurements : 3 rings (inner, middle and outer) of 12 points in radial direction.
 Impact : on middle ring, at 6h00.



5.1. Summary of the global natural frequencies :

Turbine side :

	Frequency (Hz)	45.3	97.5	65	121.8	171.8	114.5	149
Ring	Mode	4 nodes	4 nodes	6 nodes	6 nodes	6 nodes	8 nodes	8 nodes
Inner	Ampl μ c/Nc An. AR	0.023	0.006	0.004	0.006	0.003	-	-
Middle	Ampl μ c/Nc An. BR	0.122	0.016	0.015	0.009	0.011	-	-
Outer	Ampl μ c/Nc An. CR	0.264	0.011	0.049	0.009	0.006	0.010	0.006

Opposite turbine side :

	Frequency (Hz)	42.5	74.3	102.5	61.8	117.5	158	75.5	107.3
Ring	Mode	4 nodes	4 nodes	4 nodes	6 nodes	6 nodes	6 nodes	8 nodes	8 nodes
Inner	Ampl μ c/Nc An. AR	-	0.002	-	-	-	0.002	-	-
Middle	Ampl μ c/Nc An. BR	0.012	0.009	0.008	0.007	0.008	0.009	-	-
Outer	Ampl μ c/Nc An. CR	0.019	-	0.007	0.010	-	0.005	0.009	0.005

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

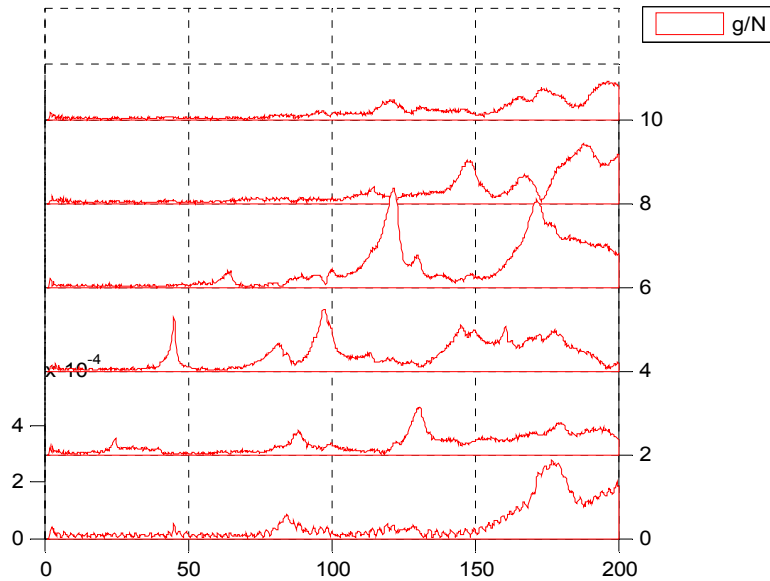
Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

4.2. Modal analysis measurements :

4.2.1. Turbine side :

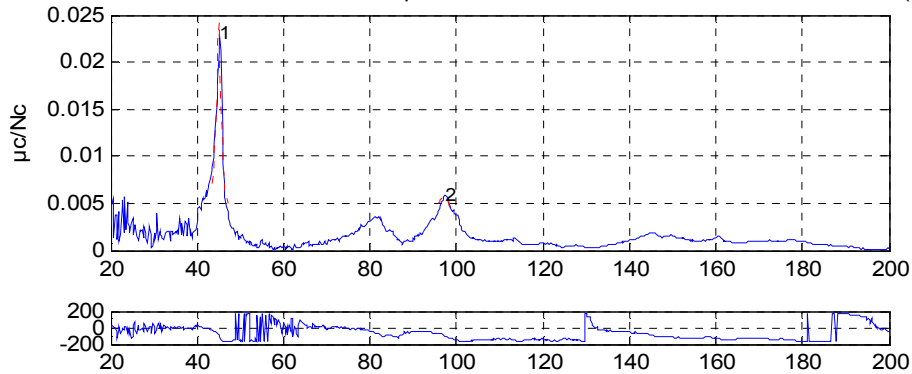
Inner ring :

D:\Data\FP LAVRION GT42\CT\ points 1CA01.csv -> 1CA12.csv



4 nodes :

D:\Data\FP LAVRION GT42\CT\ points 1CA01.csv -> 1CA12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	45.3	0.023014	-110.4	45.0	0.9674	0.024315	2.66e+004
2	97.5	0.0057827	-104.9	97.0	2.0900	0.0056886	1.13e+004

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

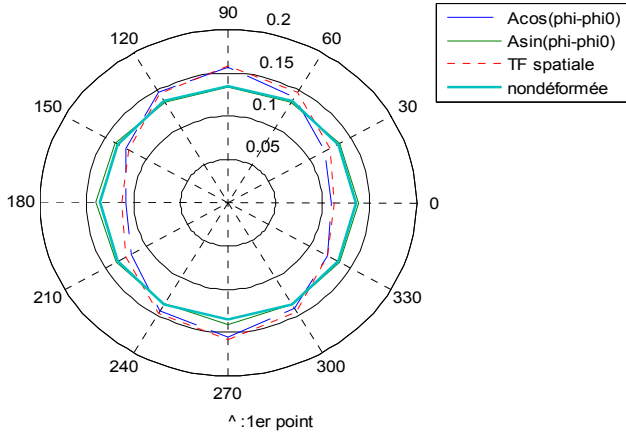
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

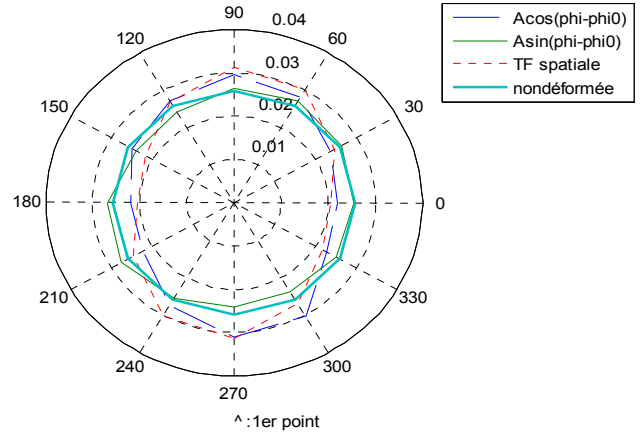
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

D:\Data\FP LAVRION GT42\CT\ points 1CA01.csv -> 1CA12.csv
Fréquence: 45.3 Hz

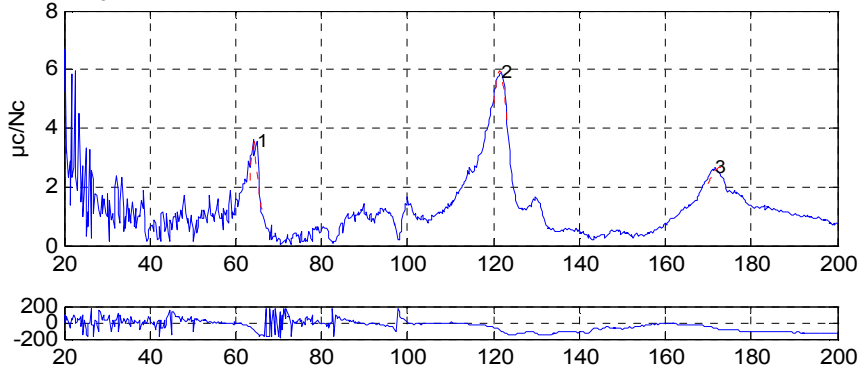


D:\Data\FP LAVRION GT42\CT\ points 1CA01.csv -> 1CA12.csv
Fréquence: 97.5 Hz



6 nodes :

D:\Data\FP LAVRION GT42\CT\ points 1CA01.csv -> 1CA12.csv Courbe 6 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	65.0	0.0035257	-132.1	64.2	1.1049	0.003668	7.58e+004
2	121.8	0.0059255	-94.6	121.4	1.6032	0.0059774	8.96e+003
3	171.8	0.0026351	-70.4	173.0	2.1964	0.0026746	7.2e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

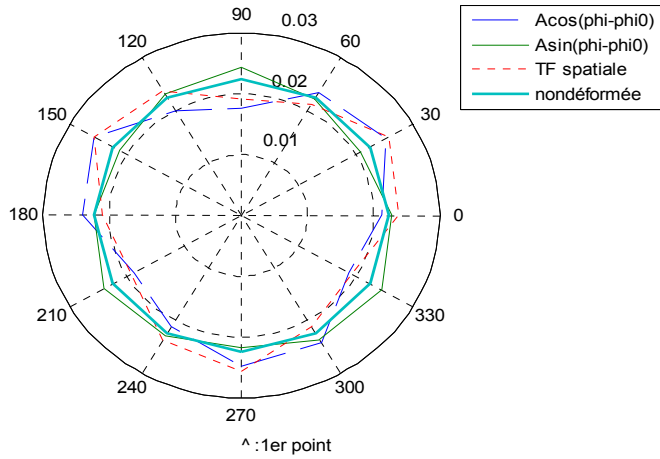
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

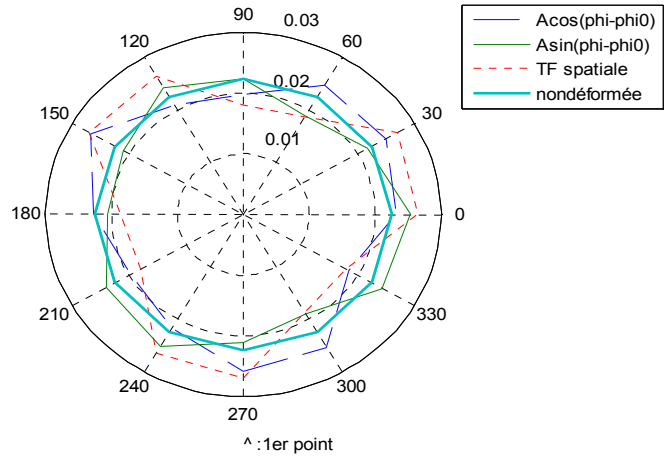
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

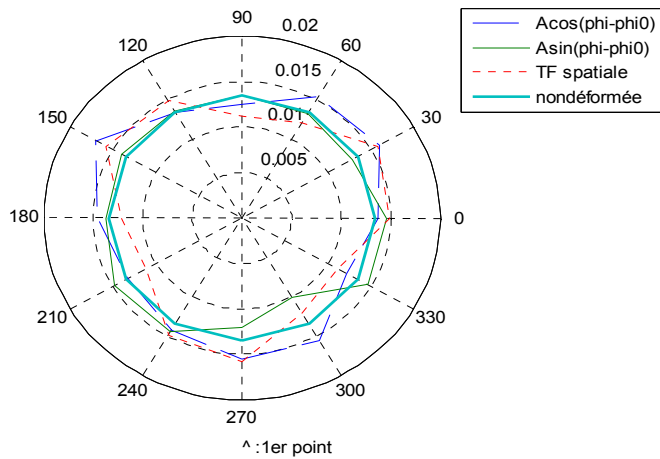
\\Data\FP LAVRION GT42\CT\ points 1CA01.csv -> 1CA12.csv
Fréquence: 65.0 Hz



\\Data\FP LAVRION GT42\CT\ points 1CA01.csv -> 1CA12.csv
Fréquence: 121.8 Hz



\\Data\FP LAVRION GT42\CT\ points 1CA01.csv -> 1CA12.csv
Fréquence: 171.8 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

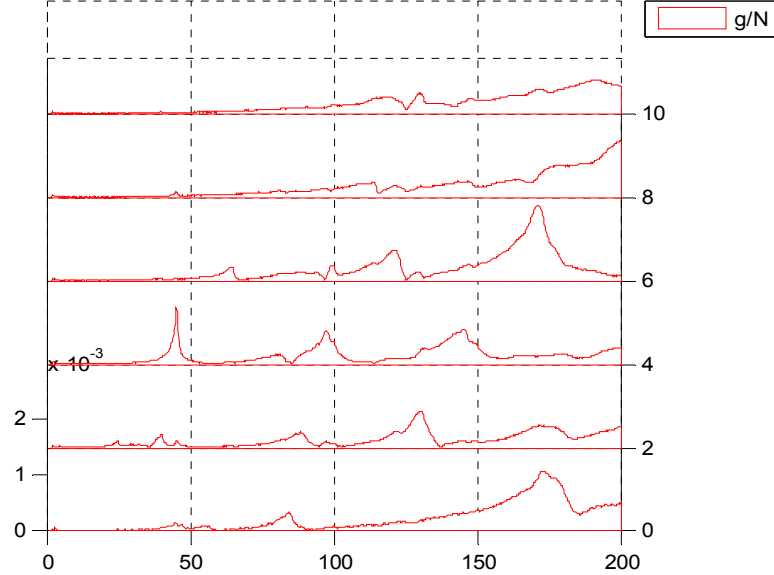
INTERVENTION DESIGNATION :

GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

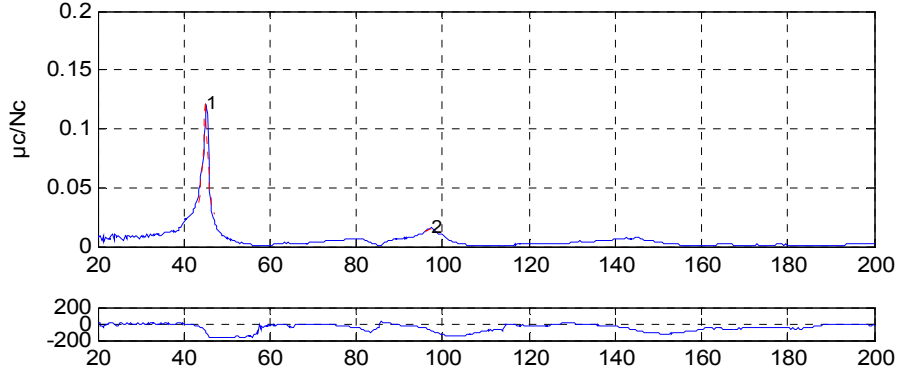
Middle ring :

D:\Data\FP LAVRION GT42\CT\ points 1CB01.csv -> 1CB12.csv



4 nodes :

D:\Data\FP LAVRION GT42\CT\ points 1CB01.csv -> 1CB12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	45.3	0.12158	-107.7	45.0	1.0224	0.12343	4.96e+003
2	97.3	0.015714	-79.6	97.6	2.1273	0.015034	4.16e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

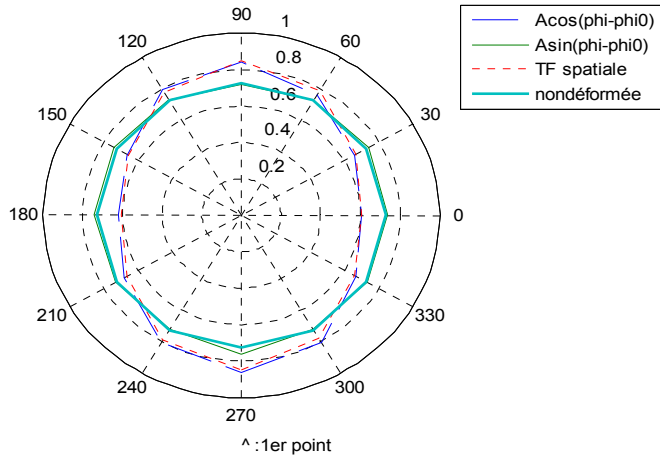
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

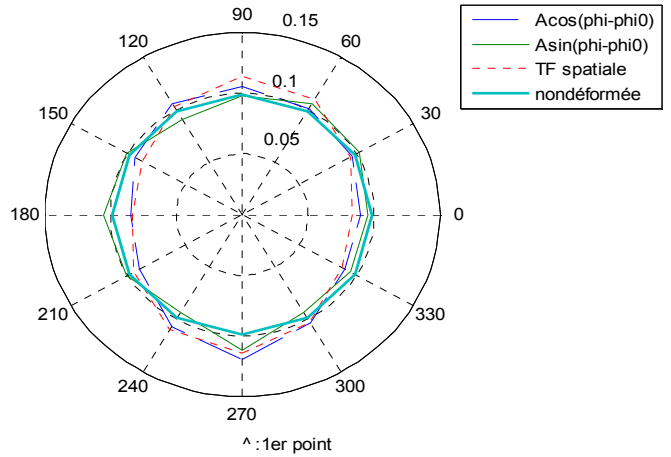
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

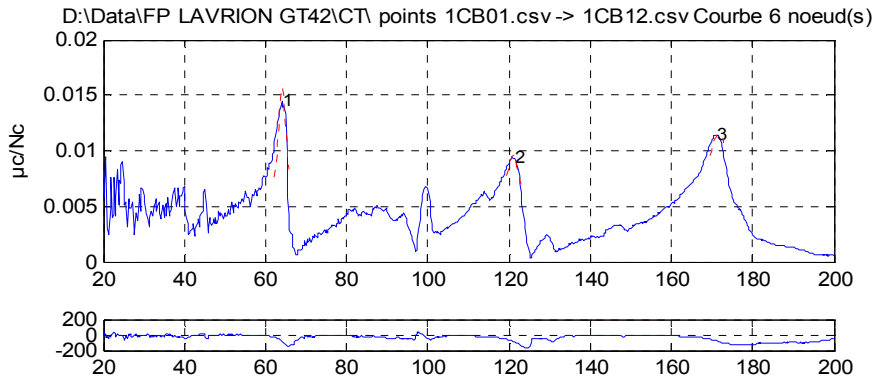
\Data\FP LAVRION GT42\CT\ points 1CB01.csv -> 1CB12.csv
Fréquence: 45.3 Hz



\Data\FP LAVRION GT42\CT\ points 1CB01.csv -> 1CB12.csv
Fréquence: 97.3 Hz



6 nodes :



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	64.0	0.014512	-72.7	64.1	1.5838	0.015848	1.23e+004
2	121.3	0.0092991	-90.2	121.1	1.7260	0.0095827	5.23e+003
3	171.3	0.011468	-79.7	171.8	1.9349	0.011514	1.93e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

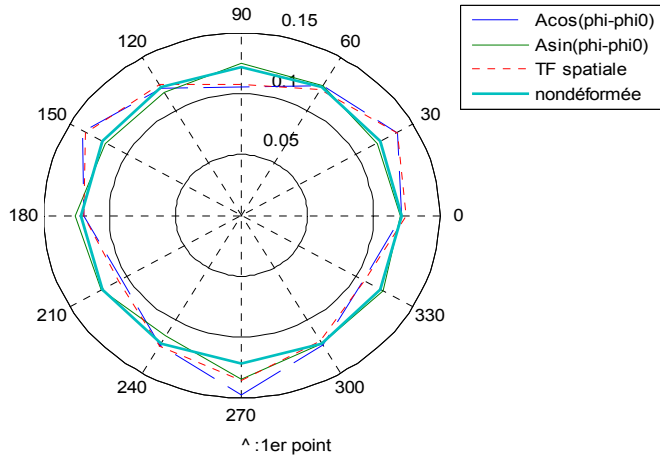
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

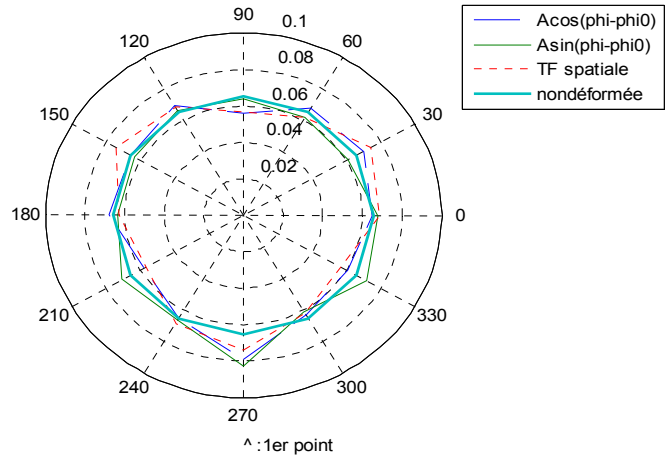
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

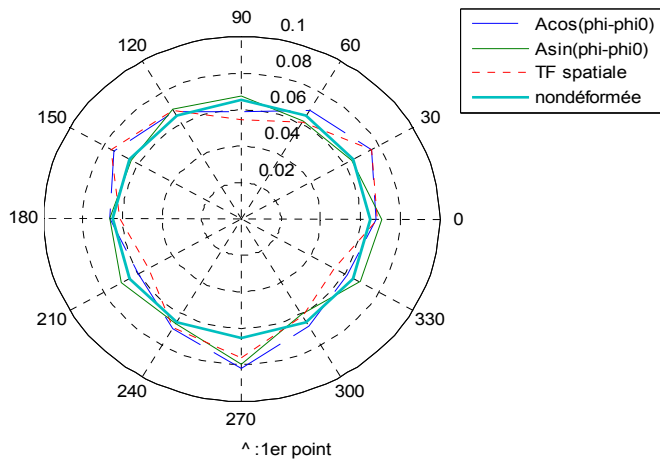
\\Data\FP LAVRION GT42\CT\ points 1CB01.csv -> 1CB12.csv
Fréquence: 64.0 Hz



\\Data\FP LAVRION GT42\CT\ points 1CB01.csv -> 1CB12.csv
Fréquence: 121.3 Hz



\\Data\FP LAVRION GT42\CT\ points 1CB01.csv -> 1CB12.csv
Fréquence: 171.3 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

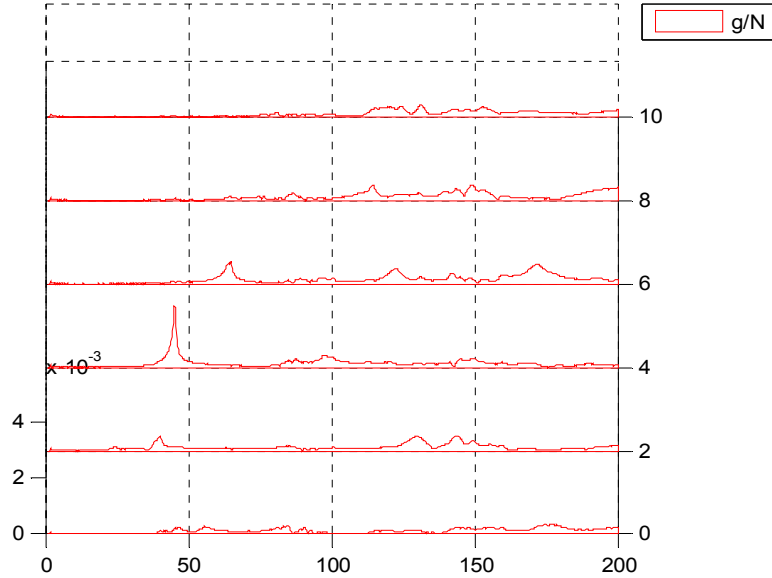
INTERVENTION DESIGNATION :

GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

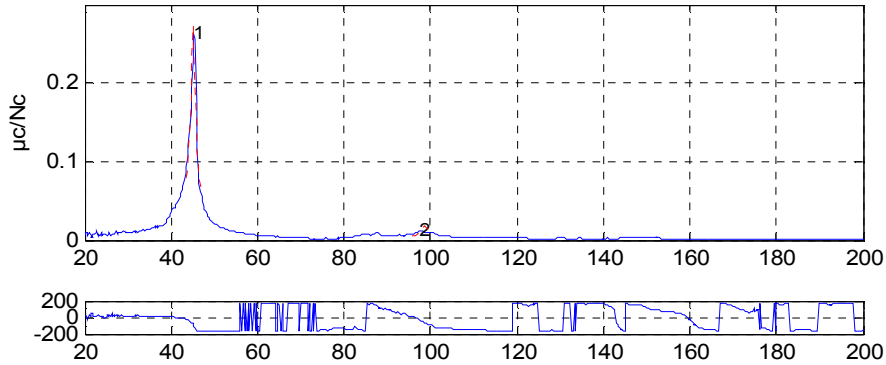
Outer ring :

D:\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv



4 nodes :

D:\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	45.3	0.26433	-102.5	45.0	1.0045	0.27517	2.26e+003
2	97.5	0.011196	-34.4	98.6	0.7437	0.018404	9.51e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

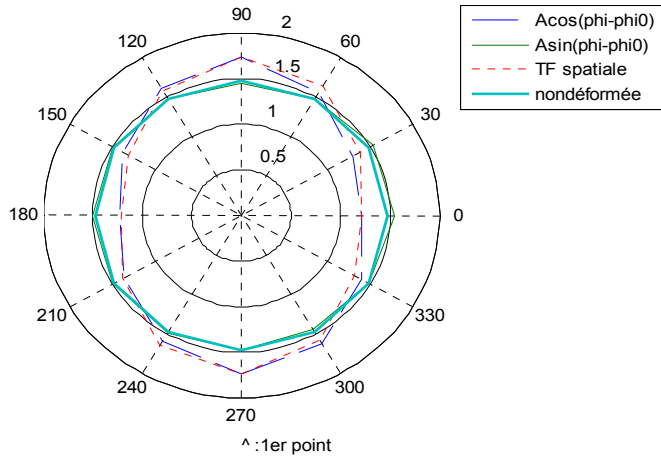
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

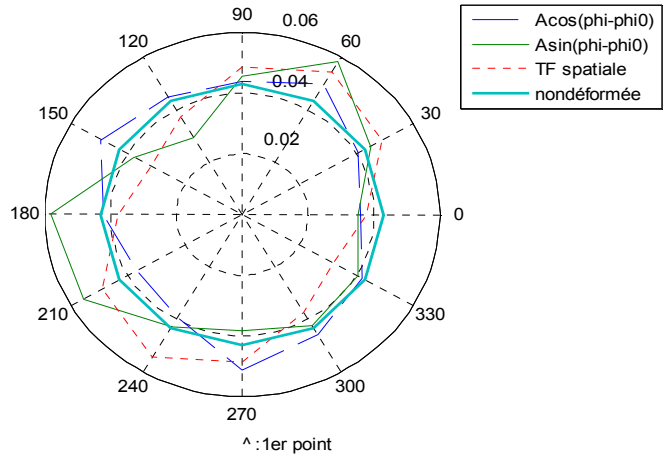
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv
Fréquence: 45.3 Hz

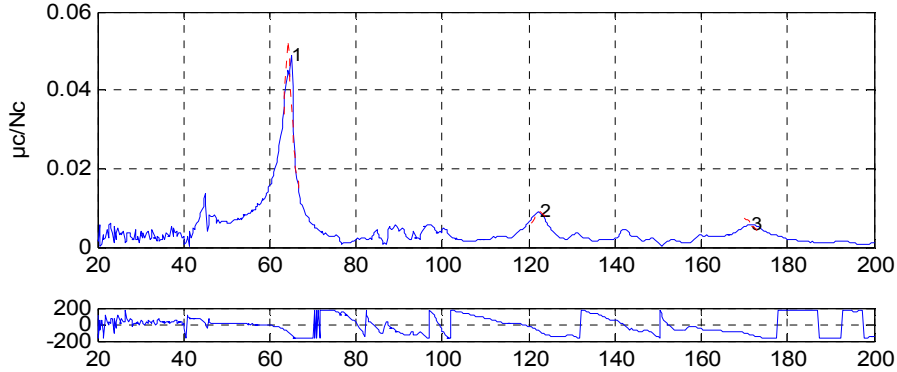


\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv
Fréquence: 97.5 Hz



6 nodes :

D:\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv Courbe 6 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		$\mu c/Nc$	Phi(°)	Fp(Hz)	a(%)	$\mu c/Nc$	M(kg)
1	65.0	0.048831	-130.0	64.2	1.2000	0.052768	4.85e+003
2	122.5	0.0088289	-83.3	122.7	1.4439	0.0090775	6.42e+003
3	171.5	0.0057813	-126.9	169.9	1.2344	0.0072398	4.91e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

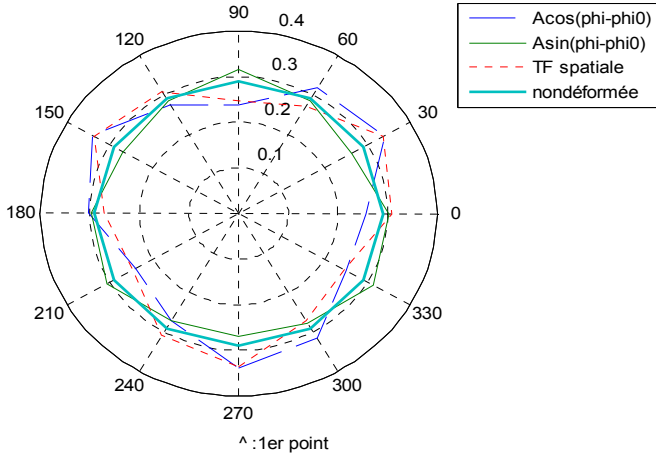
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

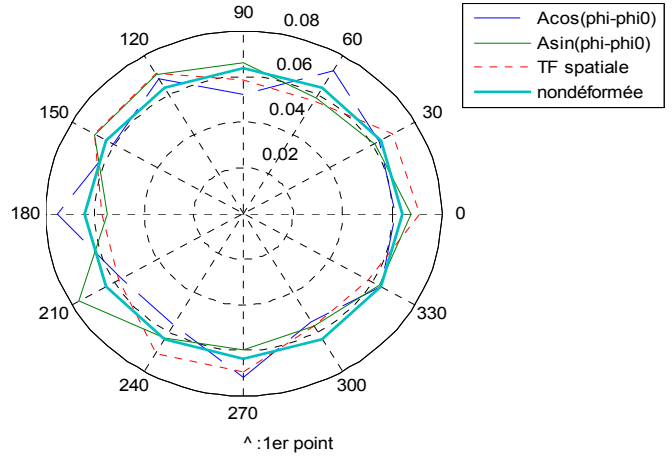
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

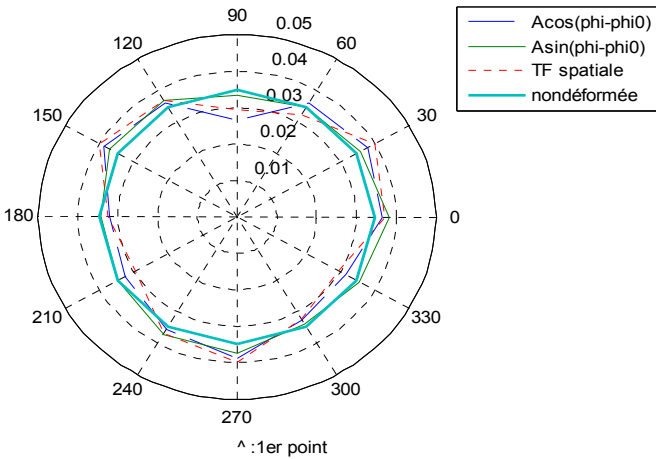
\\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv
Fréquence: 65.0 Hz



\\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv
Fréquence: 122.5 Hz



\\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv
Fréquence: 171.5 Hz



PROCES VERBAL / FICHE DE COMMUNICATION

PV

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

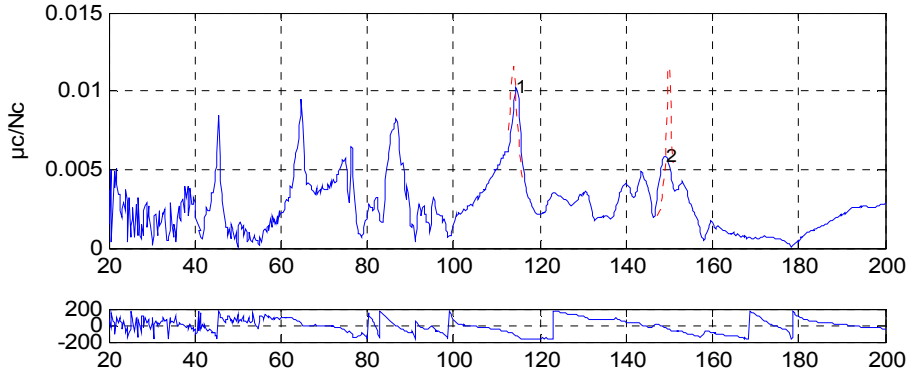
INTERVENTION DESIGNATION :

GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

8 nodes :

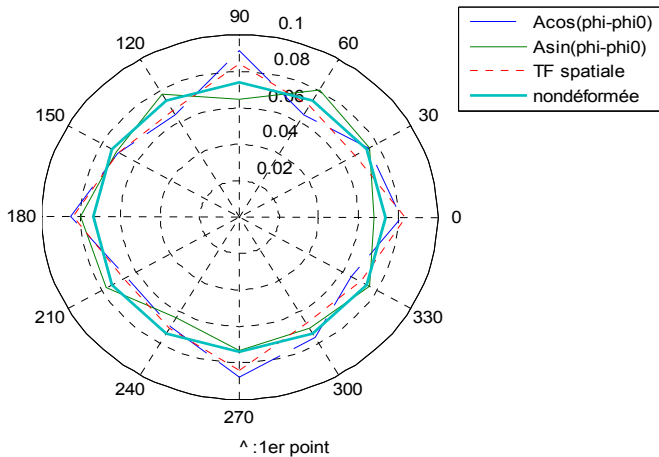
D:\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv Courbe 8 noeud(s)



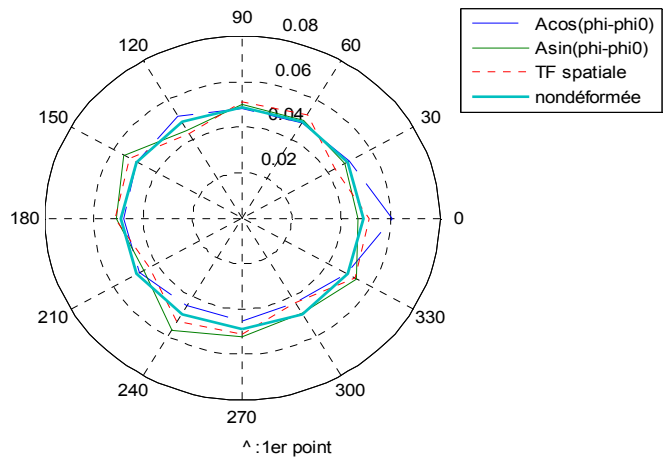
ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	114.5	0.01023	-122.0	113.8	0.7921	0.011617	1.06e+004
2	149.0	0.0058445	-27.4	149.9	0.2992	0.011905	1.58e+004

\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv
Fréquence: 114.5 Hz



\Data\FP LAVRION GT42\CT\ points 1CC01.csv -> 1CC12.csv
Fréquence: 149.0 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

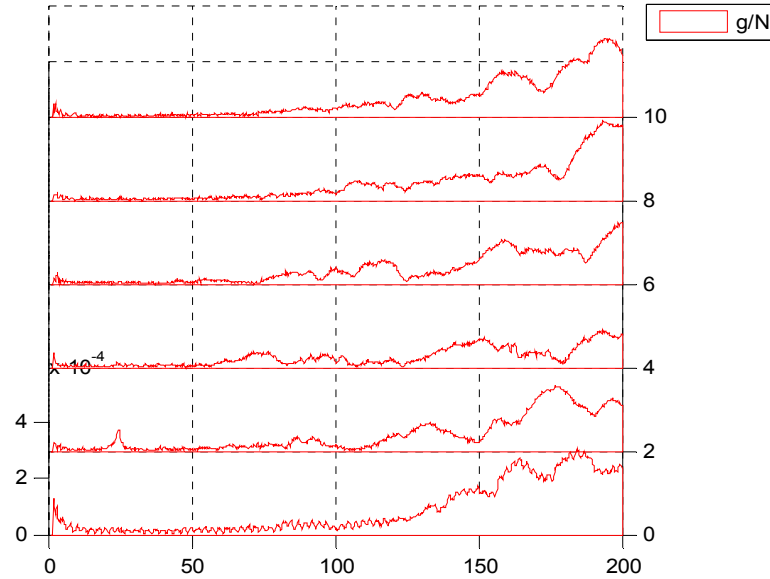
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

5.2.2. Opposite turbine side :

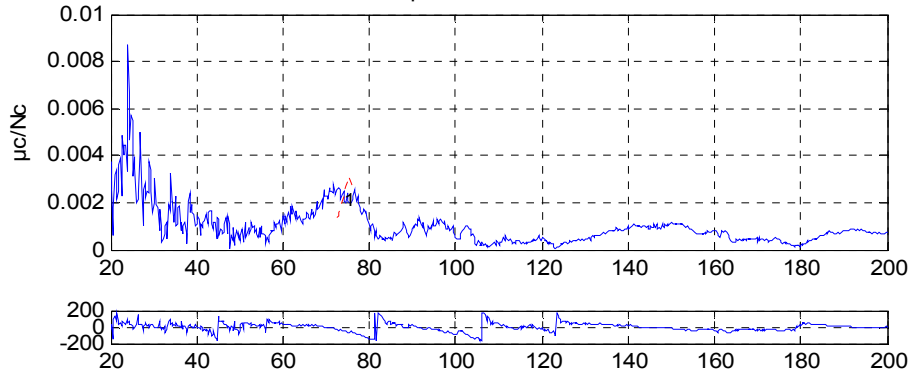
Inner ring :

D:\Data\FP LAVRION GT42\COT\ points 00A01.csv -> 00A12.csv



4 nodes :

D:\Data\FP LAVRION GT42\COT\ points 00A01.csv -> 00A12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	74.3	0.0020384	-48.4	75.2	1.6846	0.0030996	4.29e+004

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

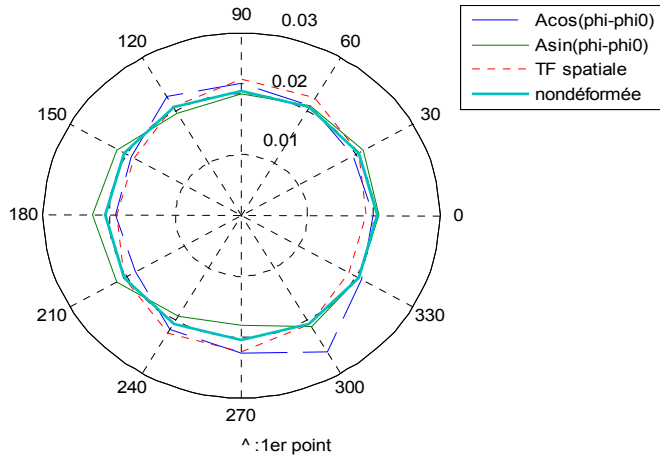
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

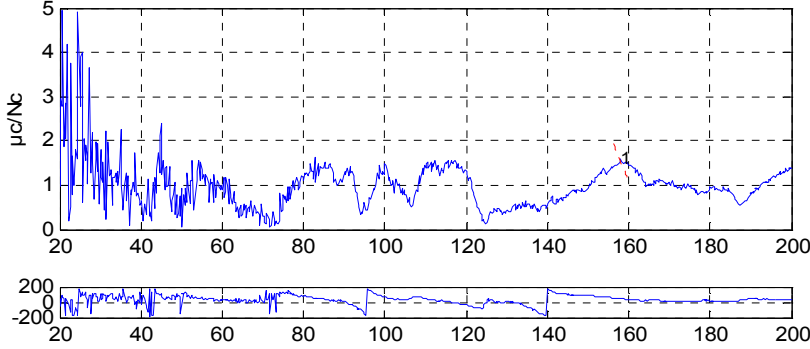
Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

Data\FP LAVRION GT42\COT\ points 00A01.csv -> 00A12.csv
Fréquence: 74.3 Hz

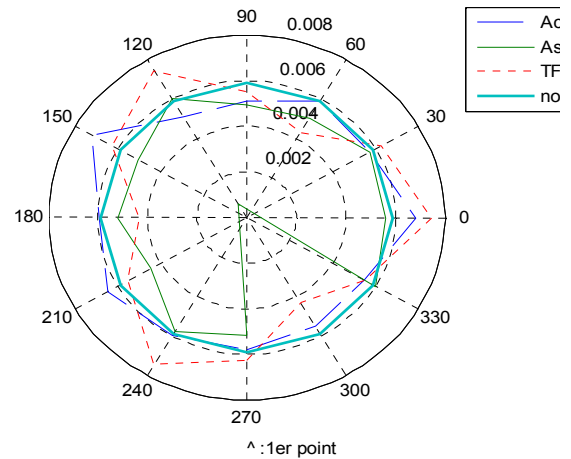


6 nodes :

D:\Data\FP LAVRION GT42\COT\ points 00A01.csv -> 00A12.csv Courbe 6 noeud(s)



Data\FP LAVRION GT42\COT\ points 00A01.csv -> 00A12.csv
Fréquence: 158.0 Hz



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	158.0	0.0016024	45.2	154.8	2.1582	0.0021151	1.16e+004

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

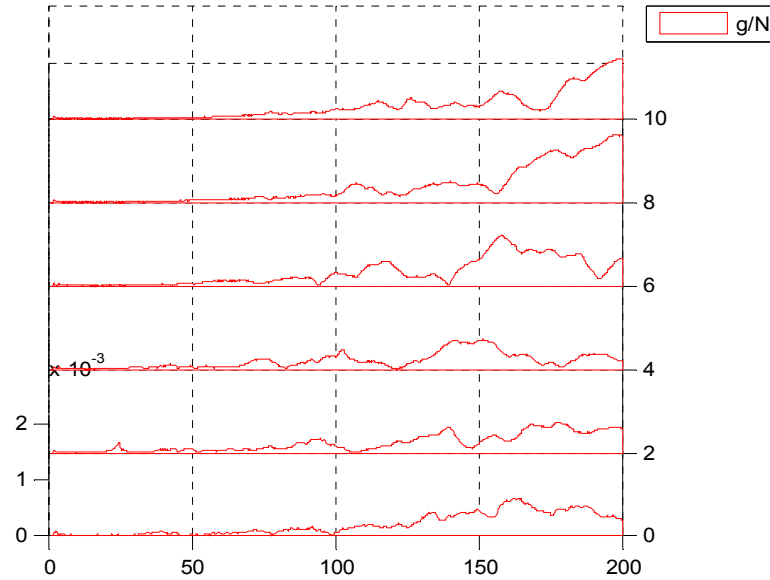
INTERVENTION DESIGNATION :

GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

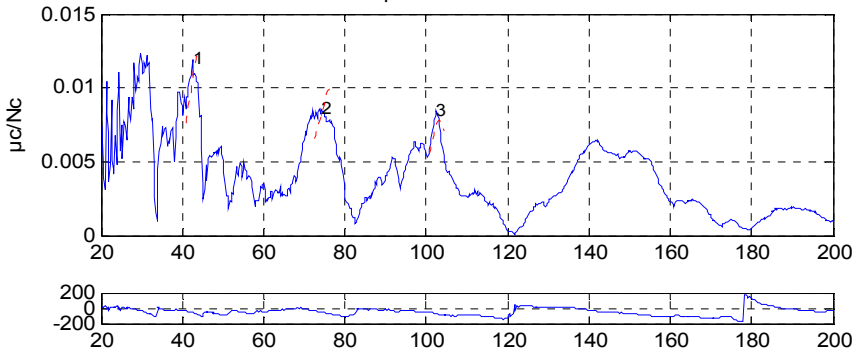
Middle ring :

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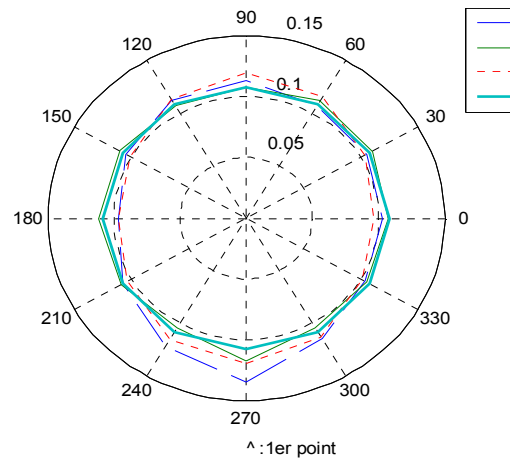


4 nodes :

D:\Data\FP LAVRION GT42\COT\ points 0OB01.csv -> 0OB12.csv Courbe 4 noeud(s)



Data\FP LAVRION GT42\COT\ points 0OB01.csv -> 0OB12.csv
Fréquence: 42.5 Hz



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	42.5	0.011856	-51.3	44.0	5.3593	0.012269	9.95e+003
2	74.3	0.0085533	-51.5	77.0	4.5793	0.010167	4.59e+003
3	102.5	0.008412	-71.7	103.2	2.2902	0.0078097	6.65e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

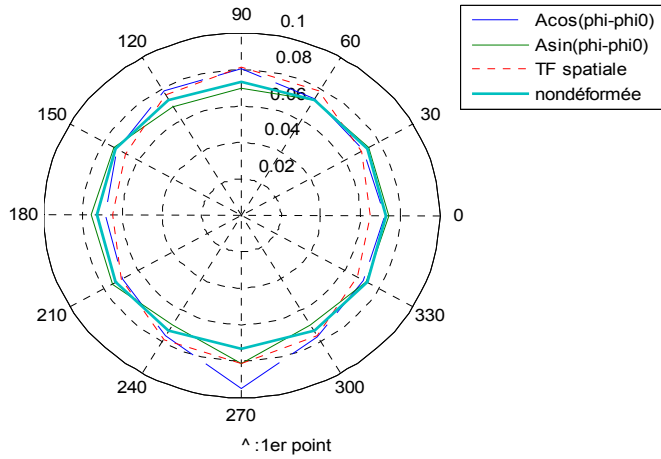
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

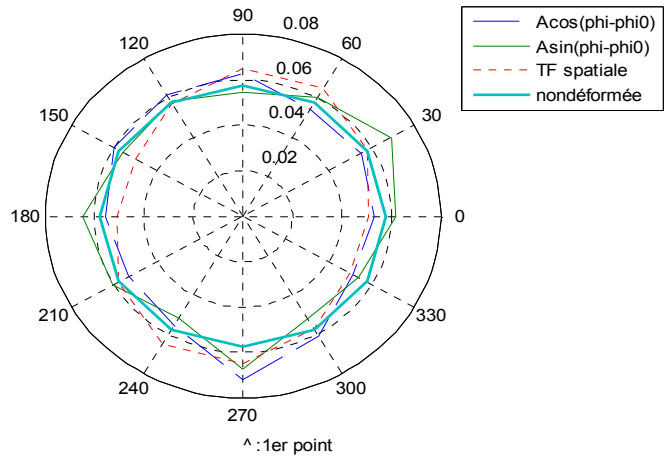
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

Data\FP LAVRION GT42\COT\ points 0OB01.csv -> 0OB12.csv
Fréquence: 74.3 Hz

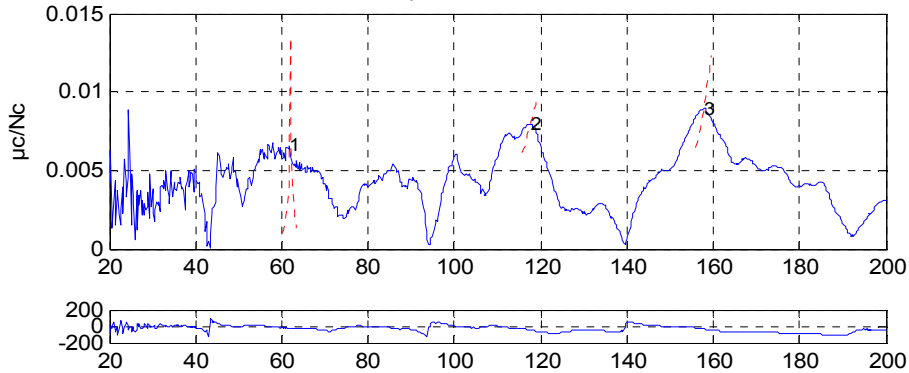


Data\FP LAVRION GT42\COT\ points 0OB01.csv -> 0OB12.csv
Fréquence: 102.5 Hz



6 nodes :

D:\Data\FP LAVRION GT42\COT\ points 0OB01.csv -> 0OB12.csv Courbe 6 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	61.8	0.0065186	-26.3	62.0	0.2403	0.013524	1.01e+005
2	117.5	0.0079032	-48.5	120.5	2.8901	0.010097	2.99e+003
3	157.8	0.0089086	-37.2	161.0	1.5390	0.014277	2.22e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

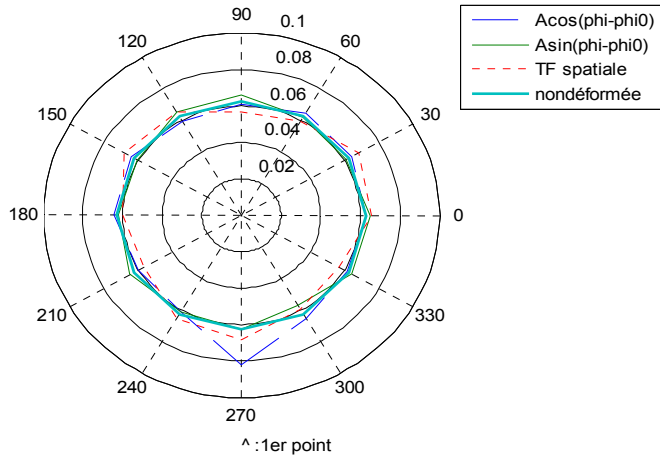
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

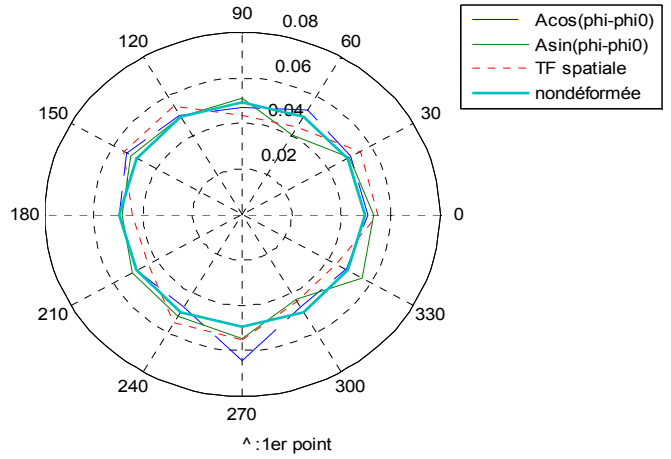
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

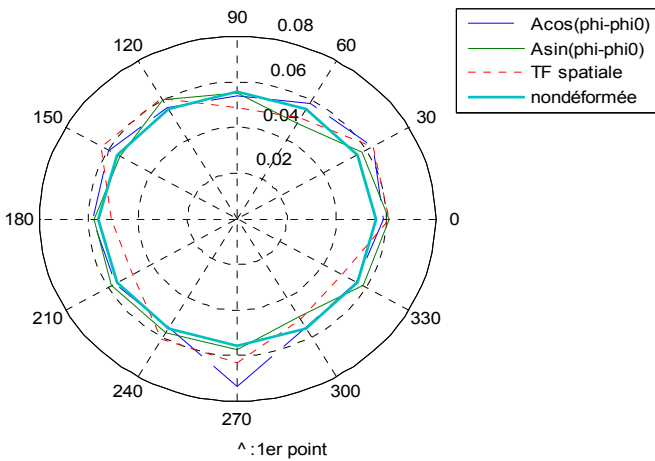
Data\FP LAVRION GT42\COT\ points 00B01.csv -> 00B12.csv
Fréquence: 61.8 Hz



Data\FP LAVRION GT42\COT\ points 00B01.csv -> 00B12.csv
Fréquence: 117.5 Hz



Data\FP LAVRION GT42\COT\ points 00B01.csv -> 00B12.csv
Fréquence: 157.8 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

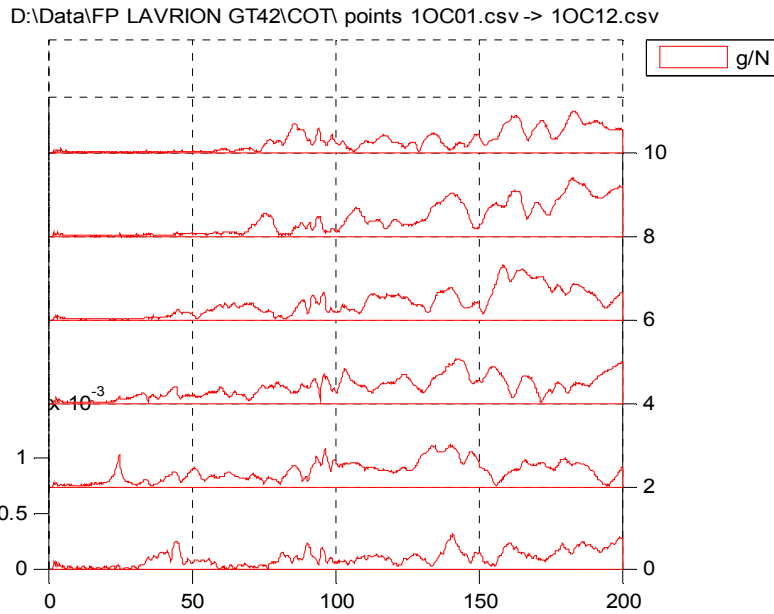
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

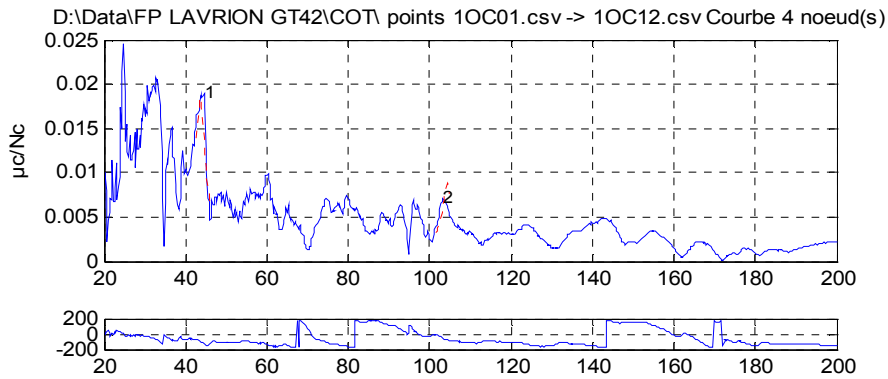
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

Outer ring :



4 nodes :



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	44.5	0.019006	-116.6	43.7	2.2244	0.018568	1.61e+004
2	103.3	0.0071428	-44.9	104.4	1.0422	0.008829	1.26e+004

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

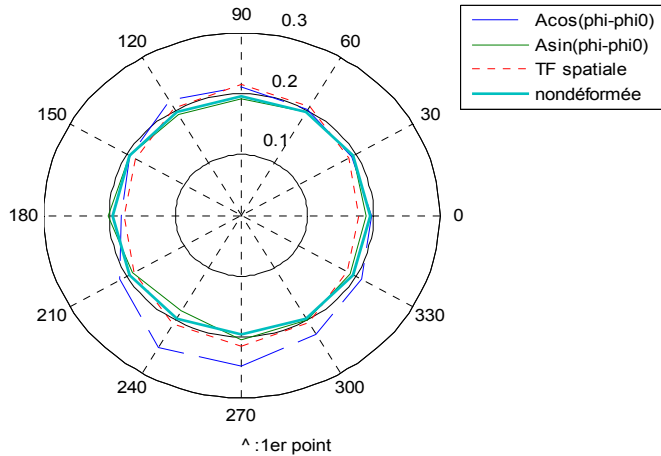
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

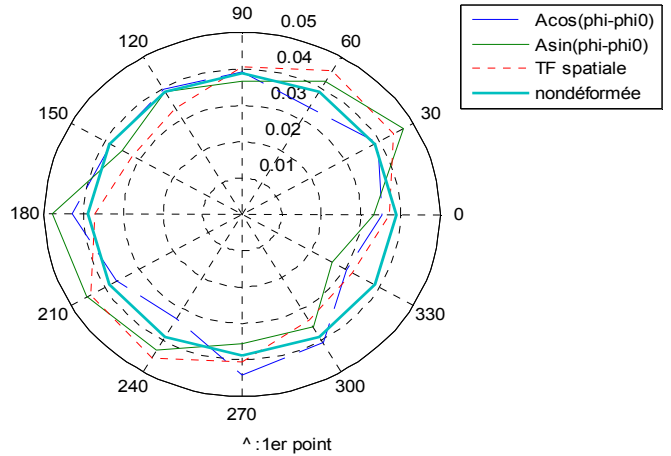
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

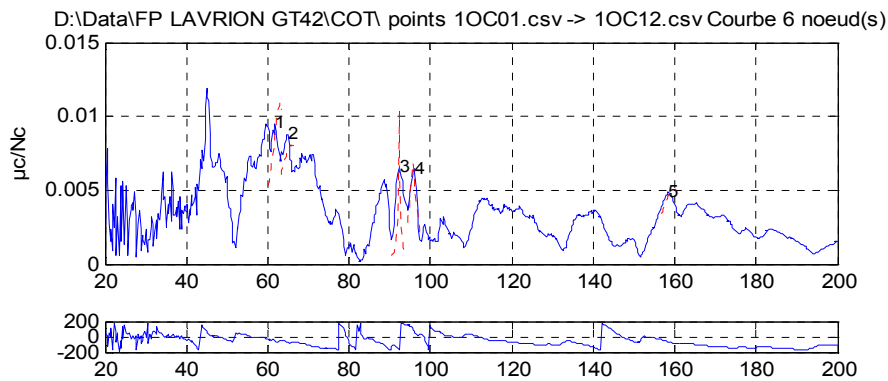
Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 44.5 Hz



Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 103.3 Hz



6 nodes :



ALSTOM ENERGY TGP/IFT (Ver 1.0)

Valeurs mesurées				Valeurs calculées			
#	F(Hz)	µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	61.8	0.0095023	-46.2	63.0	2.5758	0.010918	1.13e+004
2	65.0	0.008756	-74.1	66.0	4.4185	0.0080589	8.16e+003
3	92.3	0.0065129	-159.1	92.3	0.0441	0.024739	1.36e+005
4	96.0	0.0064697	74.9	95.7	0.6241	0.0069803	3.18e+004
5	158.5	0.0048395	-65.3	159.8	1.6736	0.0050726	5.84e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

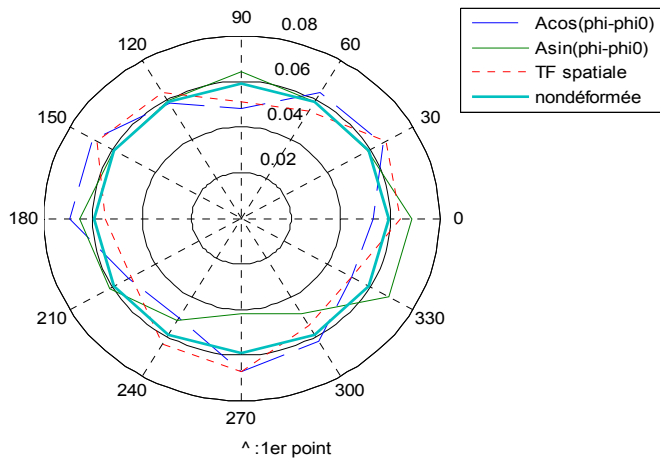
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

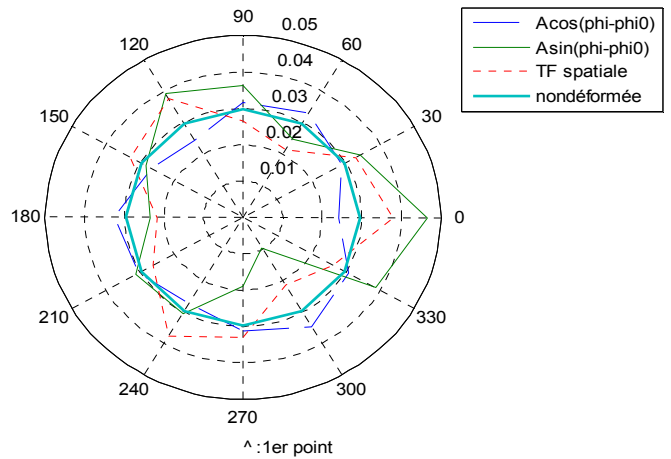
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

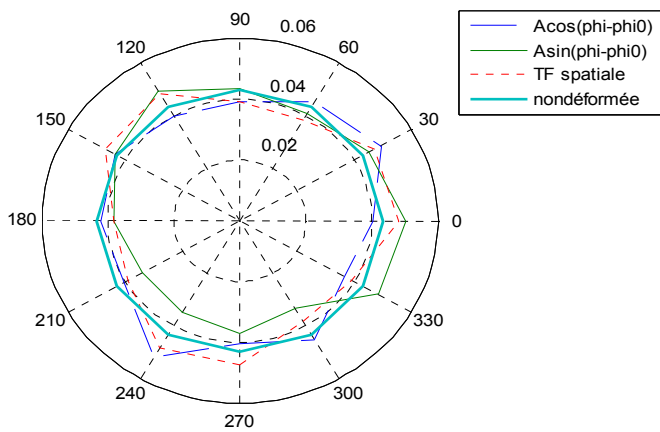
Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 61.8 Hz



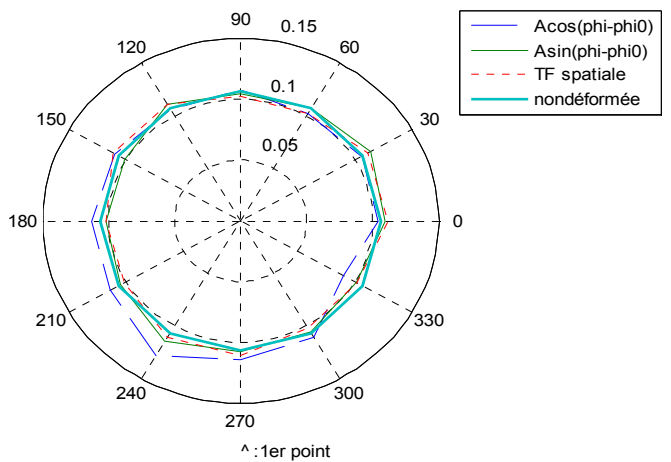
Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 65.0 Hz



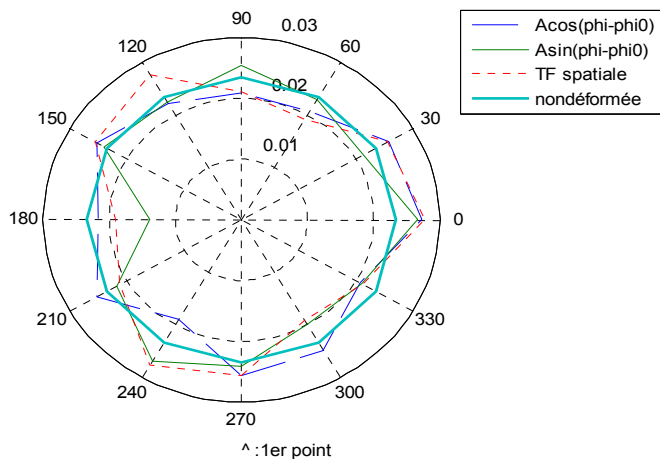
Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 92.3 Hz



Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 96.0 Hz



Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 158.5 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **GT 4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

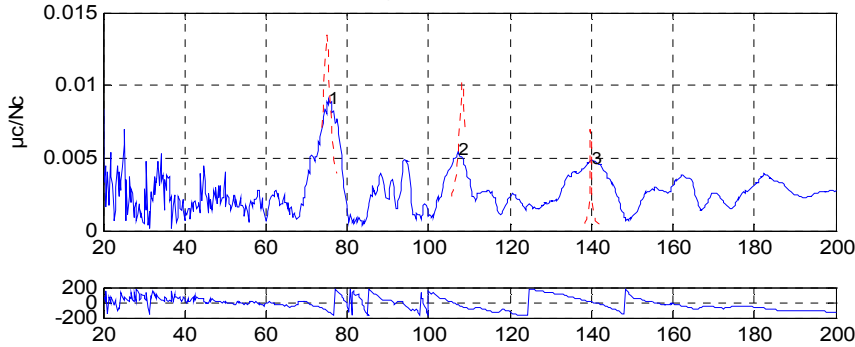
GENERATOR DIAGNOSTIC DURING MAJOR OVERHAUL

Subject (only one) - Title :

NATURAL FREQUENCIES MEASUREMENT

D:\Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv Courbe 8 noeud(s)

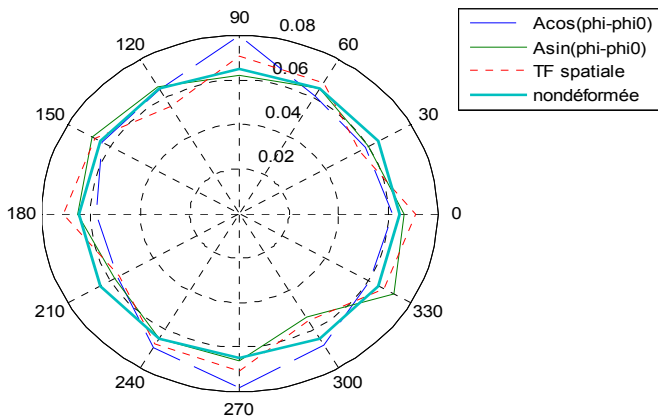
8 nodes :



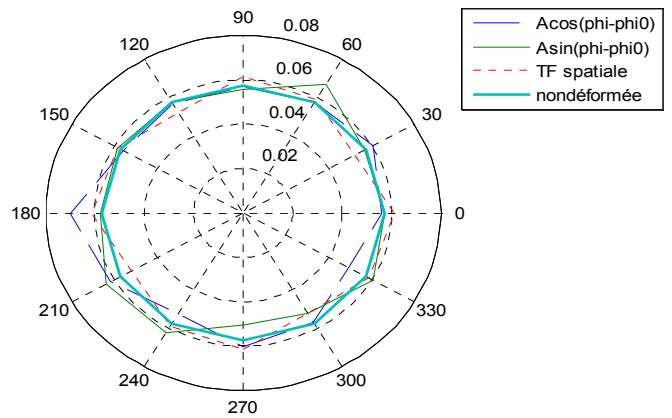
ALSTOMENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées			Valeurs calculées		
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	75.5	0.0091189	-127.5	74.9	0.9571	0.013563	1.74e+004
2	107.3	0.005486	-29.8	108.3	0.5958	0.010236	1.77e+004
3	140.0	0.0048261	5.3	139.9	0.0117	0.050852	1.09e+005

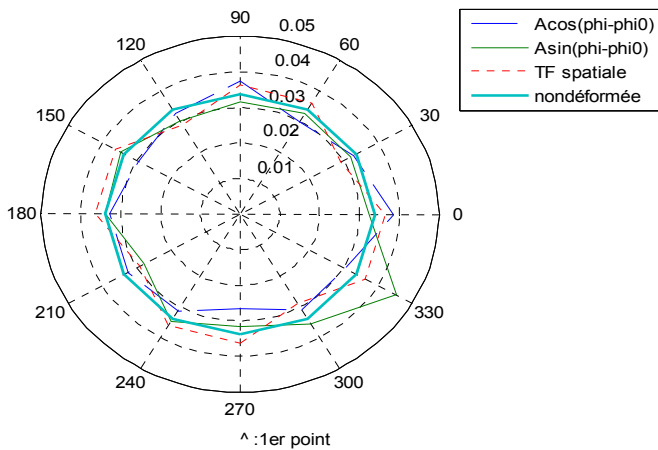
Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 75.5 Hz



Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 107.3 Hz



Data\FP LAVRION GT42\COT\ points 1OC01.csv -> 1OC12.csv
Fréquence: 140.0 Hz



PROCES VERBAL / FICHE DE COMMUNICATION

PV

CUSTOMER **PPC** PLANT **LAVRION** UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :
STATOR WINDING REINFORCEMENT

Distributed to :
Operational manager
On : **28/06/2015**
Name **B. LEFEVRE**
Fax : **+ 33 3 84551938**

Contract : New Maintenance Guarantee (Tick the appropriate boxes)
Material / Activities : Generator Turbine Commissioning Auxiliaries Other

Answer required : **NO**
Concerned item : **STATOR**
Identification / Marking **T 2 4 0 / 3 7 0 N° 5 0 0 0 3 7**

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

Natural frequencies measurement on endwindings, performed after reinforcement (see report PV LVR BX15 1902 003 and PV LVR BX15 1902 004).

Stator winding reinforcement :

- Reinforcement between supports and the internal ring on the both sides (TE and OTE)
- Lacing between caps on OTE

1. Conditions :

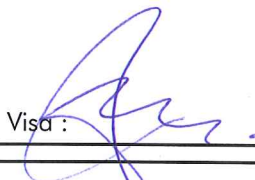
- Test Date : 28/06/2015
- Localisation : LAVRION
- Machine state : After rotor removal and after reinforcement between supports and the internal ring on TE and OTE, and add a lacing between caps on OTE.
- Test Procedure : DP38R0001B




2. Measurement equipment :

- Acquisition : Microlog SKF n° 22115
- Process : for global measurement : Matlab STMCSV
for local measurement : Matlab PLFTCSV
- Measurement in the range 0 - 200 Hz with accuracy 0.25Hz.

Responsible name : **J-Y. GABLE** Tel : Fax : E-mail :

In accordance Not in accordance To be determined
with specification Nb : **DP38R0001B** DSI Nb : **P38R55681**
Lign Nb : **80**

Customer :
Statement agreement Name : **A. Martinis** Date : **29.06.2015** Visa : 

By	M. CLAUDE	J-Y. GABLE	
On	28/06/2015	28/06/2015	
Visa			
	Issued	Verified	PV LVR B15 058 001
			A Page 1/23 Page File

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

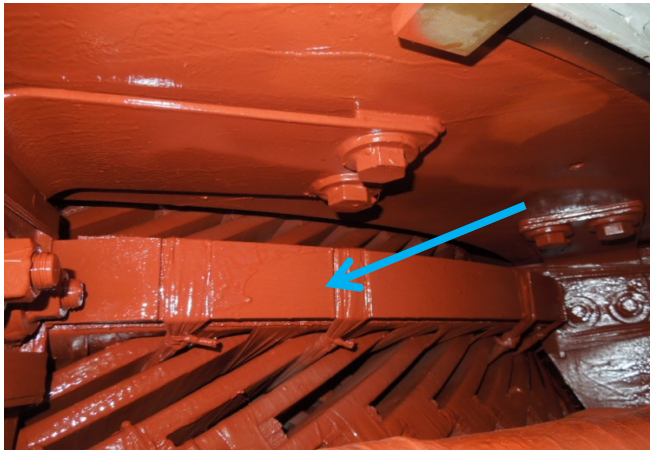
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

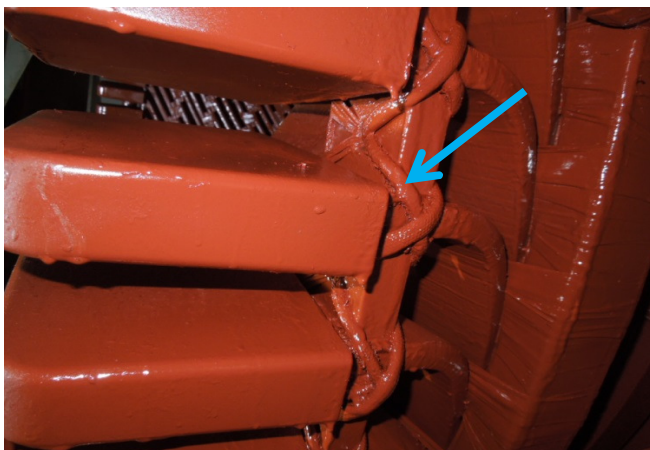
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

Photos of the winding OTE, after the reinforcement between supports and the internal ring, and lacing between caps :



Reinforcement between supports and the internal ring OTE



The lacing between caps OTE

CUSTOMER **PPC** PLANT **LAVRION** UNIT **TG4-2**
 CUSTOMER CONTRACT or ORDER Nb SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

3. Results :

3.1. Local measurements

The local natural frequencies on OTE caps have low response levels within the criteria.

3.2. Global Measurements

The first 4 nodes mode is at 48 Hz on the turbine side.
 The first 4 nodes mode is at 38.3 Hz on the opposite turbine side.

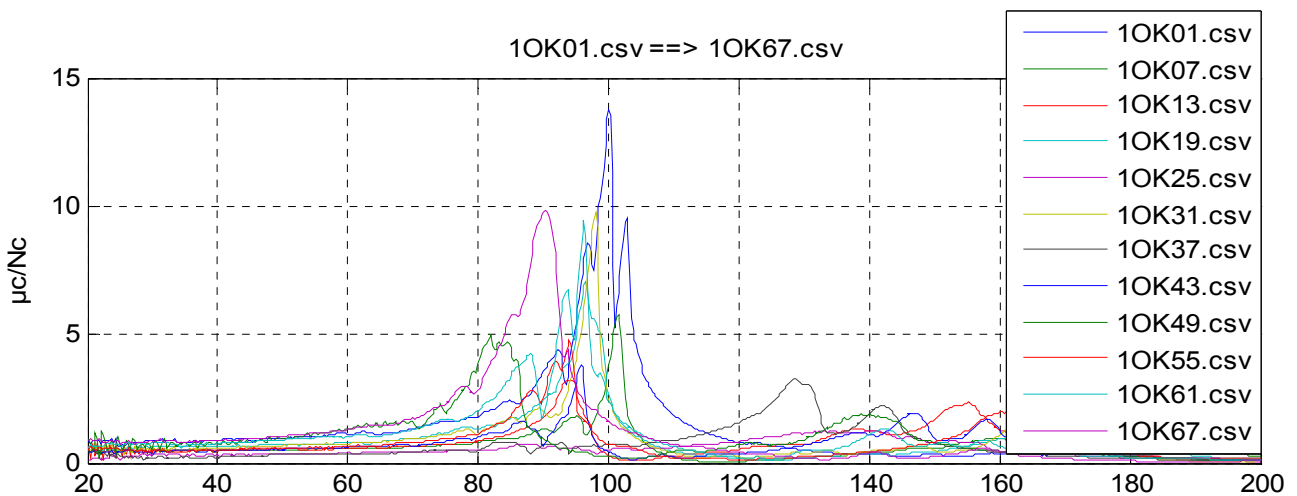
4. Local measurements :

4.1. Caps OTE

Measurements on 12 caps in tangential direction, on [0 - 200 Hz].
 All levels are in criteria : no peaks are superior to 5µm in the frequency band [95 – 115 Hz].

Measurement **before** the lacing between caps on OTE :

Cap of top bar	Files	f0 (Hz)	µc/Nc (f0)	Phi (f0) en °	fmax1 between 95-115 (Hz)	µc/Nc (fmax1)	Phi (fmax1) en °	fmax2 between 0-200 (Hz)	µc/Nc (fmax2)	Phi (fmax2) en °
1	OK01.csv	100	13.75	69.9	100.00	13.75	69.9	100.00	13.75	69.9
7	OK07.csv	100	3.79	111.4	101.50	5.80	47.2	101.50	5.80	47.2
13	OK13.csv	100	0.27	13.0	95.25	2.59	49.6	94.00	3.24	89.0
19	OK19.csv	100	2.64	11.2	96.50	7.01	85.0	96.50	7.01	85.0
25	OK25.csv	100	0.52	161.1	115.00	0.71	149.1	140.75	1.25	76.6
31	OK31.csv	100	2.48	19.3	98.00	9.77	59.4	98.00	9.77	59.4
37	OK37.csv	100	0.68	166.4	115.00	1.16	164.5	128.75	3.27	97.5
43	OK43.csv	100	0.44	28.3	95.75	3.81	66.8	95.75	3.81	66.8
49	OK49.csv	100	0.26	63.3	111.50	0.49	125.3	82.00	5.00	97.1
55	OK55.csv	100	0.72	36.7	95.25	2.03	28.3	94.00	4.79	63.3
61	OK61.csv	100	2.37	10.9	96.25	9.43	51.2	96.25	9.43	51.2
67	OK67.csv	100	1.60	9.8	95.25	2.85	9.7	90.50	9.87	61.9



PROCES VERBAL / FICHE DE COMMUNICATION

PV

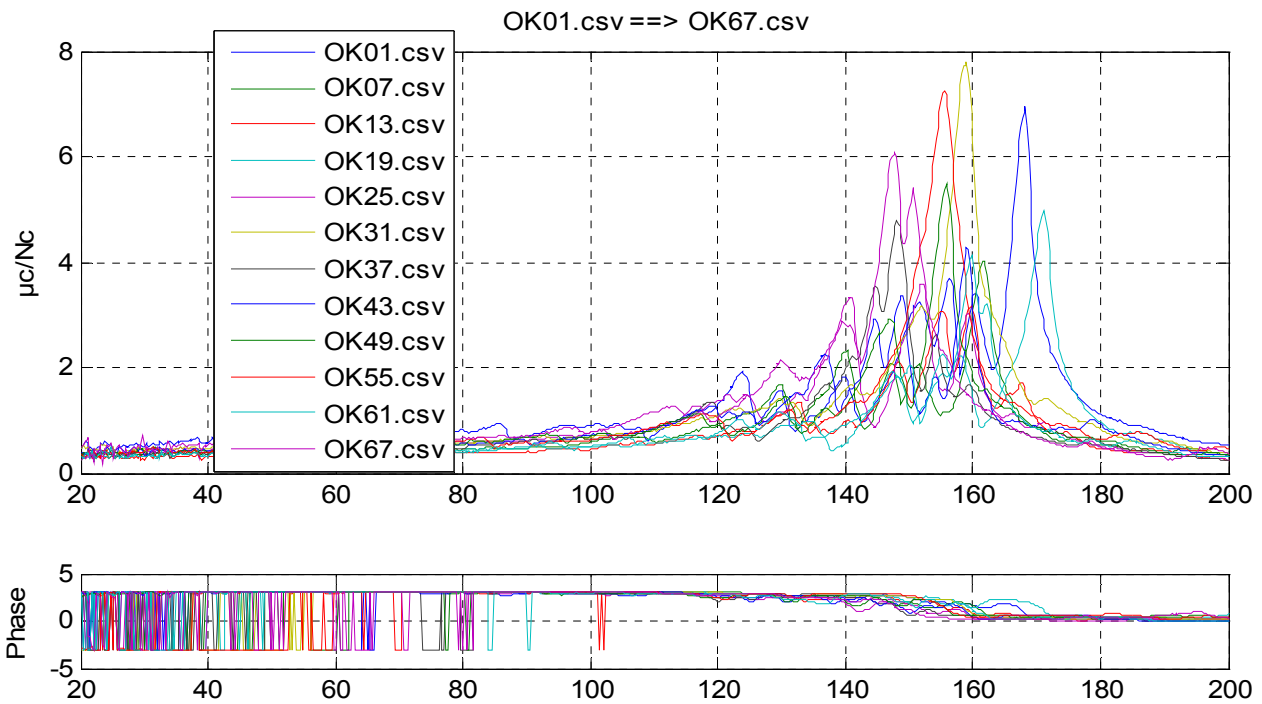
CUSTOMER **PPC** PLANT **LAVRION** UNIT **TG4-2**
 CUSTOMER CONTRACT or ORDER Nb SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

Measurement after the lacing between caps on OTE :

Cap of top bar	Files	f0 (Hz)	μc/Nc (f0)	Phi (f0) en °	fmax1 between 95-115	μc/Nc (fmax1)	Phi (fmax1) en °	fmax2 between 0-200 (Hz)	μc/Nc (fmax2)	Phi (fmax2) en °
1	OK01.csv	100	0.89	163.7	115.00	1.06	171.6	168.25	6.94	46.5
7	OK07.csv	100	0.57	176.5	115.00	0.74	171.9	161.50	4.02	59.2
13	OK13.csv	100	0.44	179.0	115.00	0.65	170.4	159.75	3.18	57.4
19	OK19.csv	100	0.50	173.6	115.00	0.62	172.7	171.25	4.98	60.6
25	OK25.csv	100	0.76	168.6	115.00	1.04	166.1	152.00	3.58	72.8
31	OK31.csv	100	0.68	175.1	113.75	0.93	173.6	159.00	7.80	72.1
37	OK37.csv	100	0.65	168.3	115.00	1.06	162.3	148.00	4.79	82.0
43	OK43.csv	100	0.72	172.0	115.00	1.08	168.3	159.00	4.26	58.2
49	OK49.csv	100	0.70	171.1	115.00	1.05	158.0	155.75	5.47	73.9
55	OK55.csv	100	0.63	175.3	115.00	0.98	164.7	155.50	7.23	83.8
61	OK61.csv	100	0.49	169.1	115.00	0.71	161.5	159.75	4.12	71.1
67	OK67.csv	100	0.77	175.4	112.75	1.28	164.4	147.75	6.07	87.4



Comments :

On opposite turbine side, with the additional lacing between caps, all the levels are in criteria.

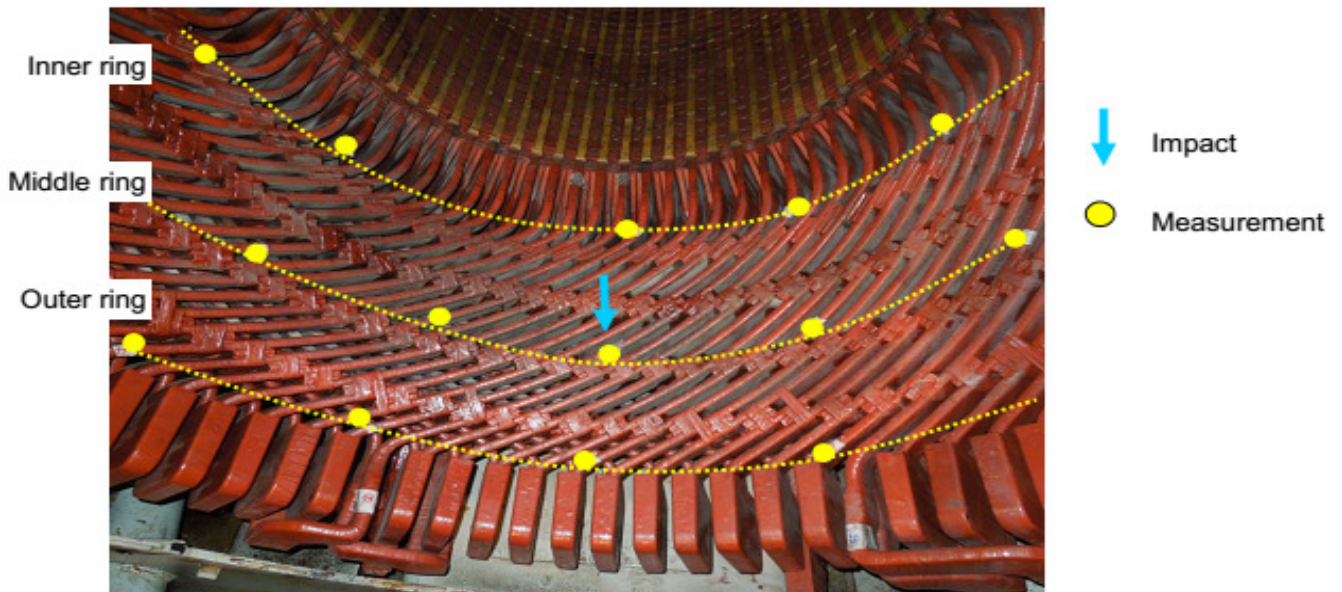
CUSTOMER **PPC** PLANT **LAVRION** UNIT **TG4-2**
 CUSTOMER CONTRACT or ORDER Nb SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

5. Global measurements :

Measurements : 3 rings (inner, middle and outer) of 12 points in radial direction.
 Impact : on middle ring, at 6h00.



5.1. Summary of the global natural frequencies :

Turbine side :

	Frequency (Hz)	48	92	104.3	67	106.5	137	181.5	77.3	120.5
Ring	Mode	4 nodes	4 nodes	4 nodes	6 nodes	6 nodes	6 nodes	6 nodes	8 nodes	8 nodes
Inner	Ampl μ /Nc An.AR	0.026	0.003	0.006	0.007	-	0.004	0.003	-	-
Middle	Ampl μ /Nc An.BR	0.109	-	0.011	0.025	0.010	0.005	0.012	-	-
Outer	Ampl μ /Nc An.CR	0.243	-	-	0.086	0.018	0.005	0.006	0.020	0.010

Opposite turbine side :

	Frequency (Hz)	38.3	86.3	117.3	123.3	74	146	161.8
Ring	Mode	4 nodes	4 nodes	4 nodes	4 nodes	6 nodes	6 nodes	6 nodes
Inner	Ampl μ /Nc An.AR	0.008	0.004	0.003	0.004	-	0.003	0.002
Middle	Ampl μ /Nc An.BR	0.033	0.006	0.008	0.009	-	0.006	-
Outer	Ampl μ /Nc An.CR	0.071	-	-	0.006	0.012	-	-

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

IE0-001902

INTERVENTION DESIGNATION :

STATOR WINDING REINFORCEMENT

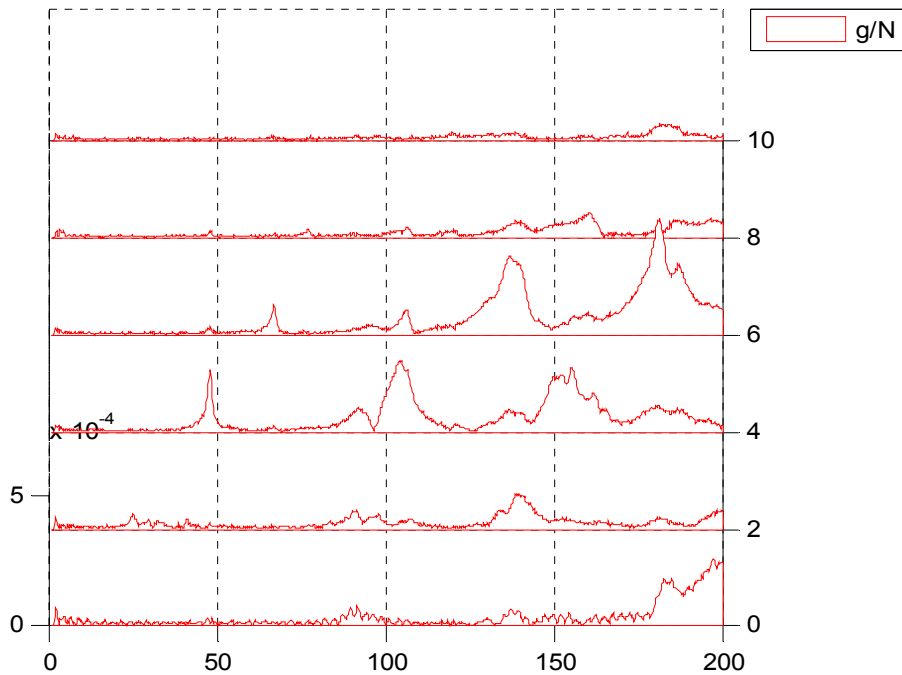
Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

5.2. Modal analysis measurements :

5.2.1. Turbine side :

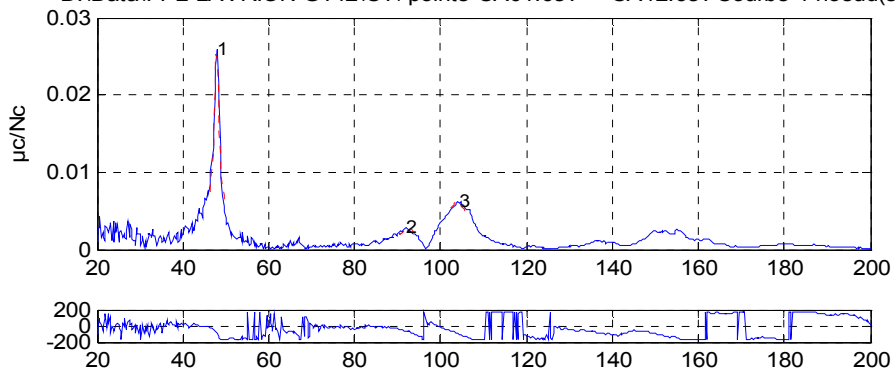
Inner ring :

D:\Data\FP2 LAVRION GT42\CT\ points CA01.csv -> CA12.csv



4 nodes :

D:\Data\FP2 LAVRION GT42\CT\ points CA01.csv -> CA12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	48.0	0.025829	-99.3	47.9	1.0049	0.025766	2.14e+004
2	92.0	0.0028375	-69.4	92.9	2.5230	0.0027058	2.15e+004
3	104.3	0.0062557	-97.1	103.9	2.2570	0.0062627	8.29e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

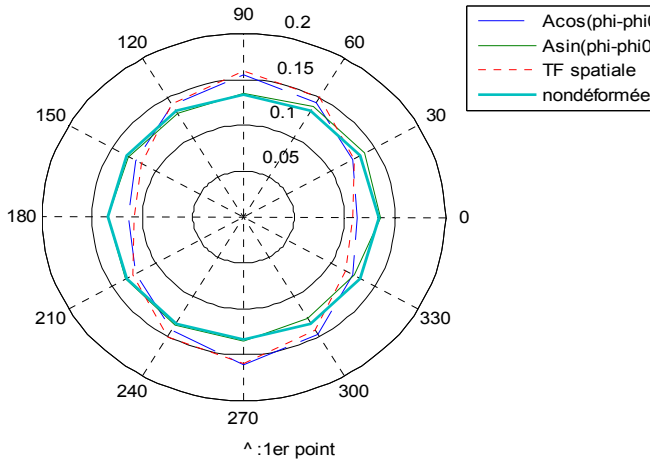
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

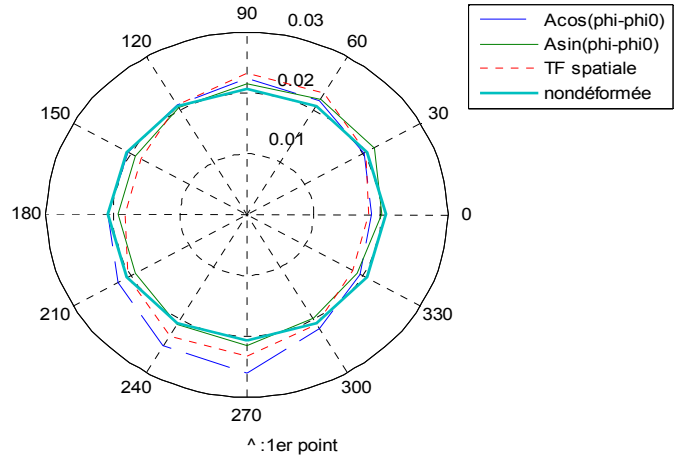
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

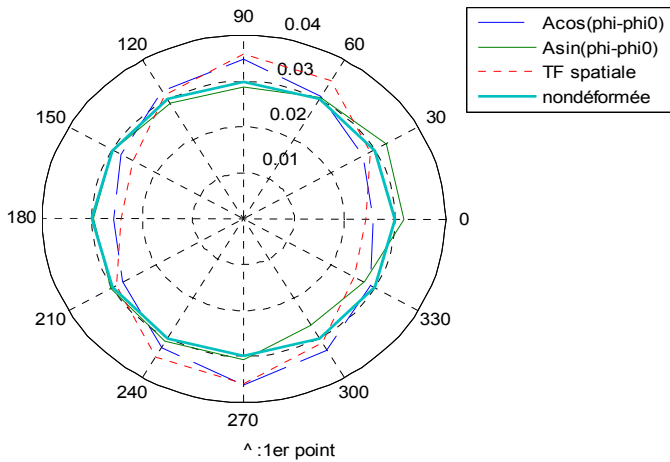
D:\Data\FP2 LAVRION GT42\CT\ points CA01.csv -> CA12.csv
Fréquence: 48.0 Hz



D:\Data\FP2 LAVRION GT42\CT\ points CA01.csv -> CA12.csv
Fréquence: 92.0 Hz



D:\Data\FP2 LAVRION GT42\CT\ points CA01.csv -> CA12.csv
Fréquence: 104.3 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

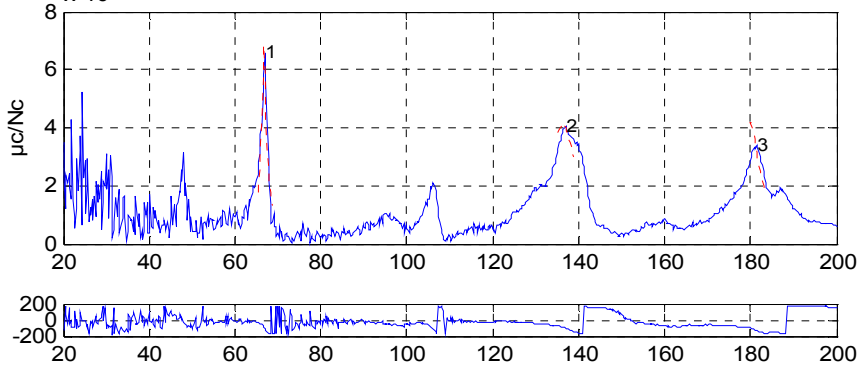
STATOR WINDING REINFORCEMENT

Subject (only one) - Title :

NATURAL FREQUENCIES MEASUREMENT

D:\Data\FP2 LAVRION GT42\CT\ points CA01.csv -> CA12.csv Courbe 6 noeud(s)

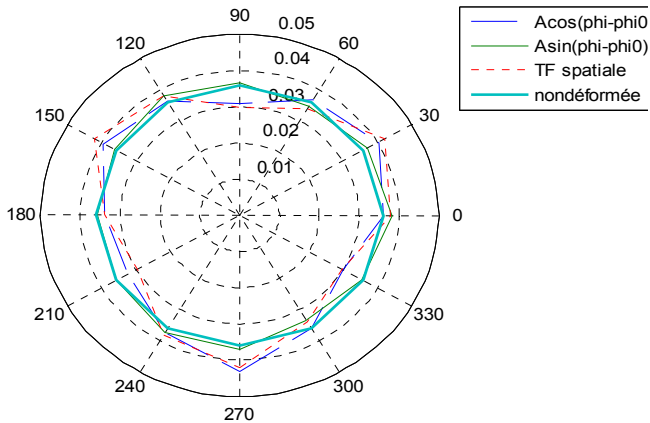
6 nodes :



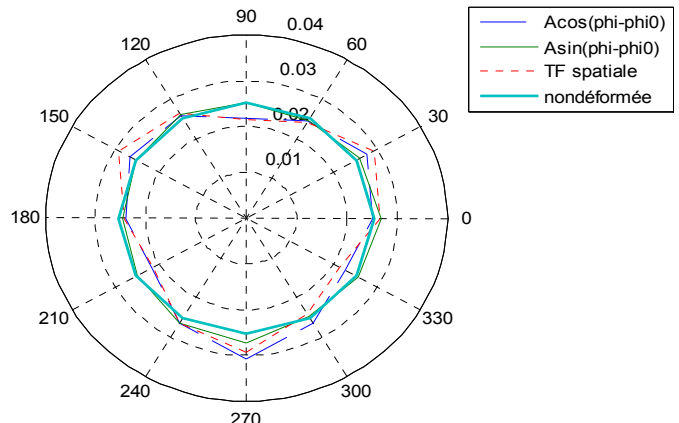
ALSTOM ENERGY TGP/IFT (Ver 1.0)

Valeurs mesurées				Valeurs calculées			
#	F(Hz)	µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	67.0	0.0065504	-100.6	66.8	0.6049	0.006836	6.87e+004
2	137.0	0.0040392	-105.5	136.3	1.9358	0.0041378	8.5e+003
3	181.5	0.0033666	-131.0	180.1	0.8991	0.004194	1.04e+004

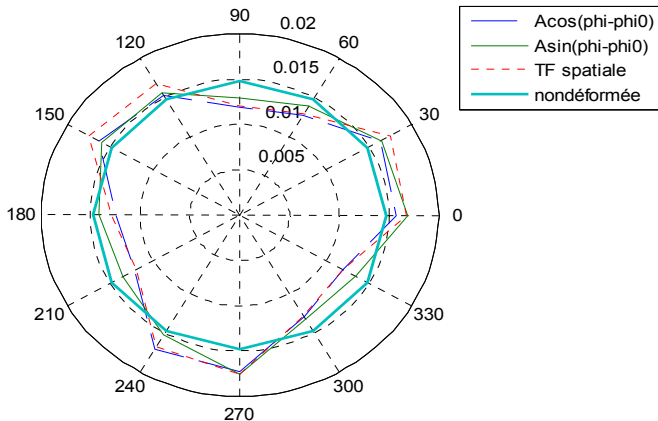
D:\Data\FP2 LAVRION GT42\CT\ points CA01.csv -> CA12.csv
Fréquence: 67.0 Hz



D:\Data\FP2 LAVRION GT42\CT\ points CA01.csv -> CA12.csv
Fréquence: 137.0 Hz



D:\Data\FP2 LAVRION GT42\CT\ points CA01.csv -> CA12.csv
Fréquence: 181.5 Hz



^ : 1er point

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

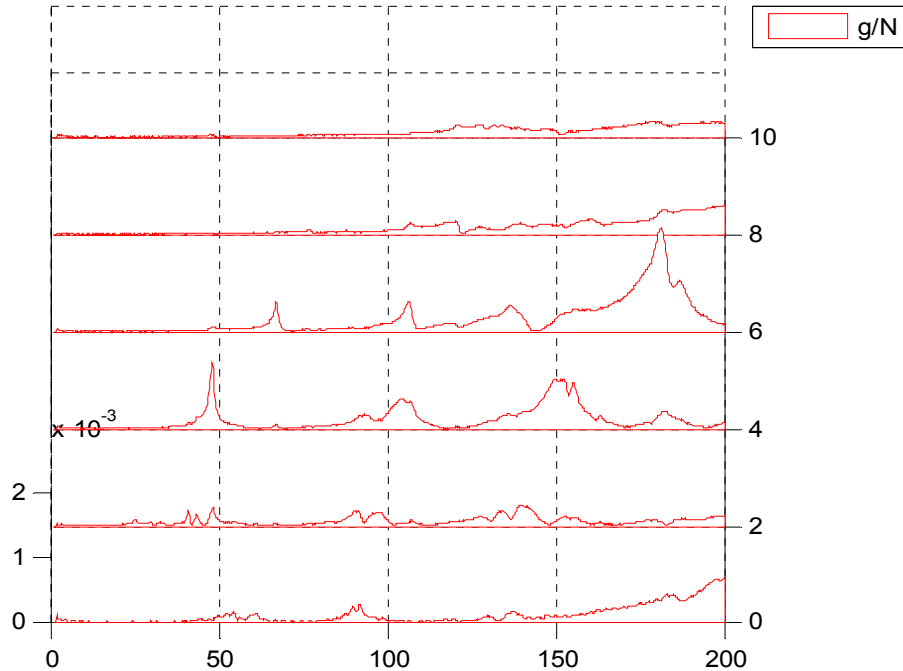
STATOR WINDING REINFORCEMENT

Subject (only one) - Title :

NATURAL FREQUENCIES MEASUREMENT

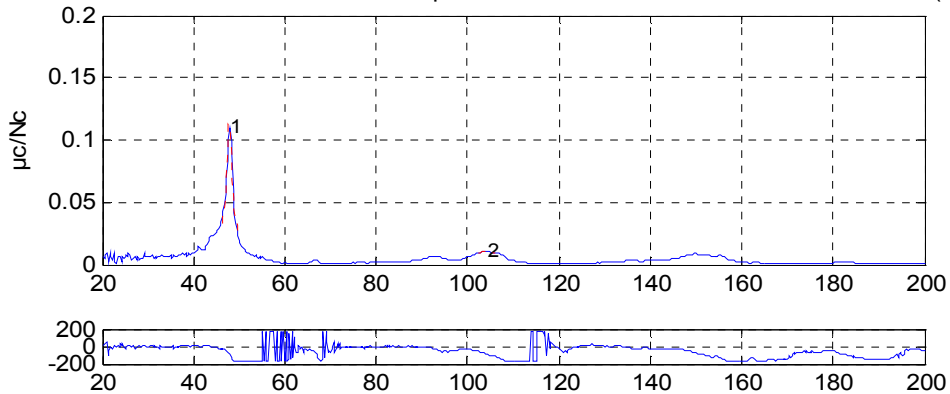
Middle ring :

D:\Data\FP2 LAVRION GT42\CT\ points CB01.csv -> CB12.csv



4 nodes :

D:\Data\FP2 LAVRION GT42\CT\ points CB01.csv -> CB12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		$\mu\text{c/Nc}$	Phi(°)	Fp(Hz)	a(%)	$\mu\text{c/Nc}$	M(kg)
1	48.0	0.10919	-99.6	47.9	0.9820	0.11512	4.89e+003
2	104.3	0.010701	-89.5	104.3	2.8688	0.010415	3.9e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

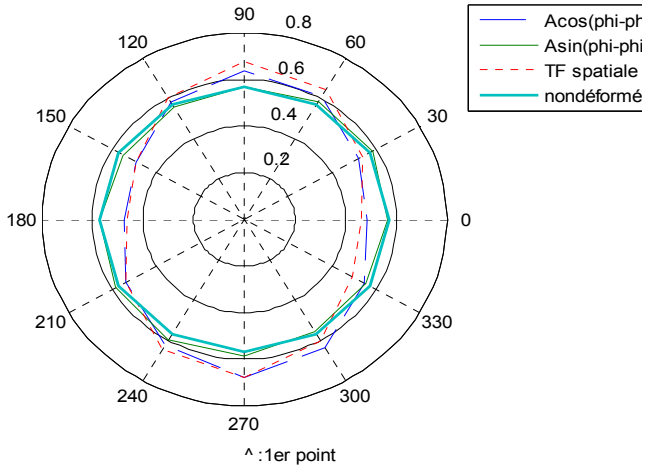
IE0-001902

INTERVENTION DESIGNATION :

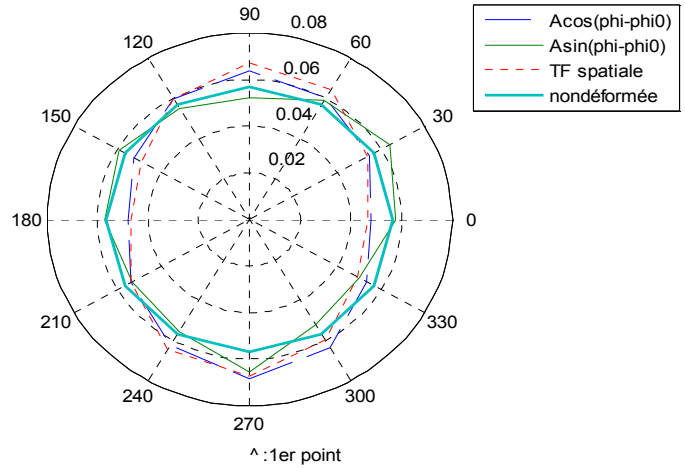
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

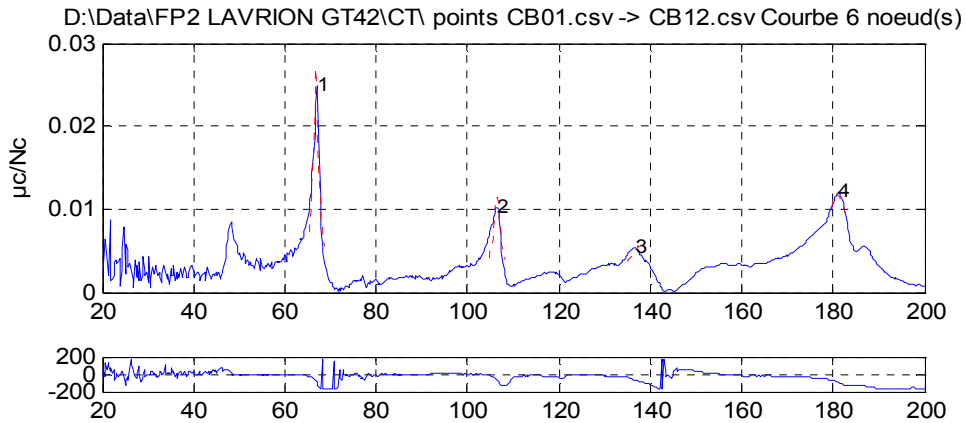
D:\Data\FP2 LAVRION GT42\CT\ points CB01.csv -> CB12.csv
Fréquence: 48.0 Hz



D:\Data\FP2 LAVRION GT42\CT\ points CB01.csv -> CB12.csv
Fréquence: 104.3 Hz



6 nodes :



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		$\mu\text{c/Nc}$	Phi(°)	Fp(Hz)	a(%)	$\mu\text{c/Nc}$	M(kg)
1	67.0	0.024954	-98.7	66.8	0.6361	0.027044	1.65e+004
2	106.5	0.01027	-73.4	106.5	0.6016	0.011522	1.61e+004
3	136.8	0.0053507	-67.0	137.7	1.6119	0.0056574	7.32e+003
4	181.3	0.011982	-94.6	181.0	1.3366	0.011814	2.45e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

IE0-001902

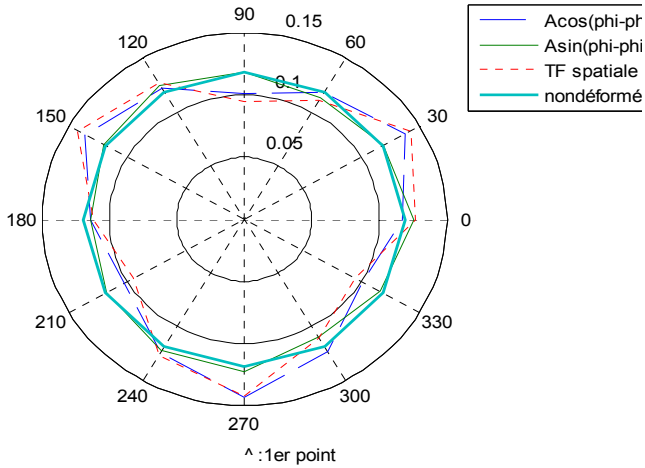
INTERVENTION DESIGNATION :

STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

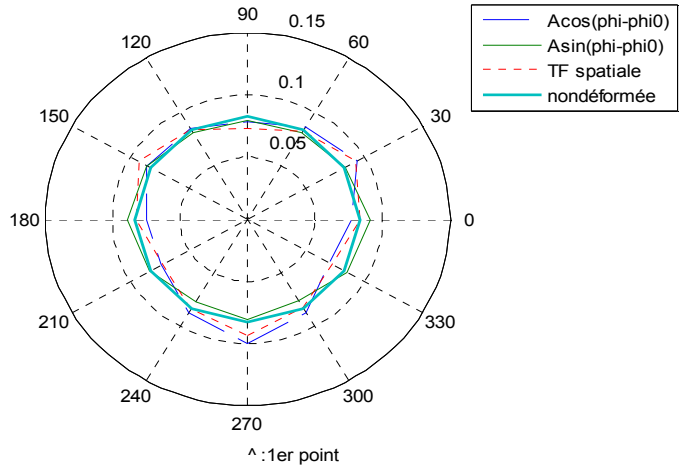
D:\Data\FP2 LAVRION GT42\CT\ points CB01.csv -> CB12.csv

Fréquence: 67.0 Hz



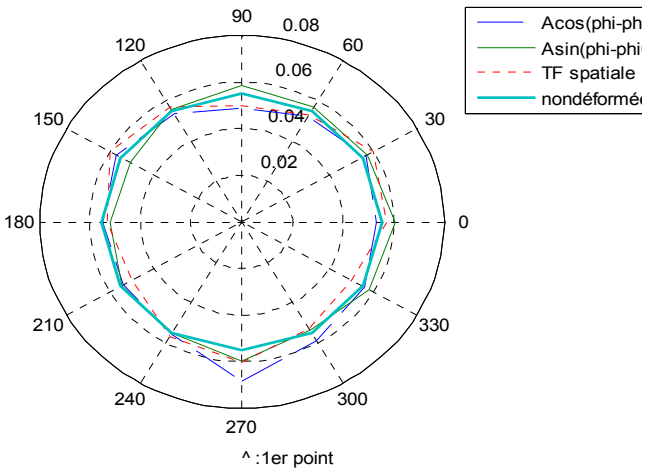
D:\Data\FP2 LAVRION GT42\CT\ points CB01.csv -> CB12.csv

Fréquence: 106.5 Hz



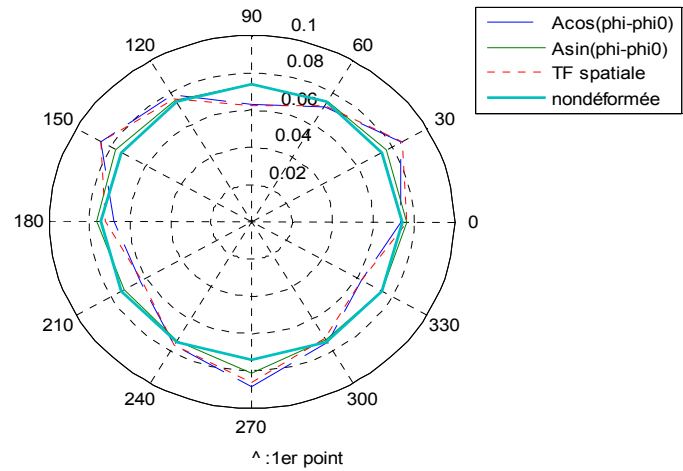
D:\Data\FP2 LAVRION GT42\CT\ points CB01.csv -> CB12.csv

Fréquence: 136.8 Hz



D:\Data\FP2 LAVRION GT42\CT\ points CB01.csv -> CB12.csv

Fréquence: 181.3 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

IE0-001902

INTERVENTION DESIGNATION :

STATOR WINDING REINFORCEMENT

Subject (only one) - Title :

NATURAL FREQUENCIES MEASUREMENT

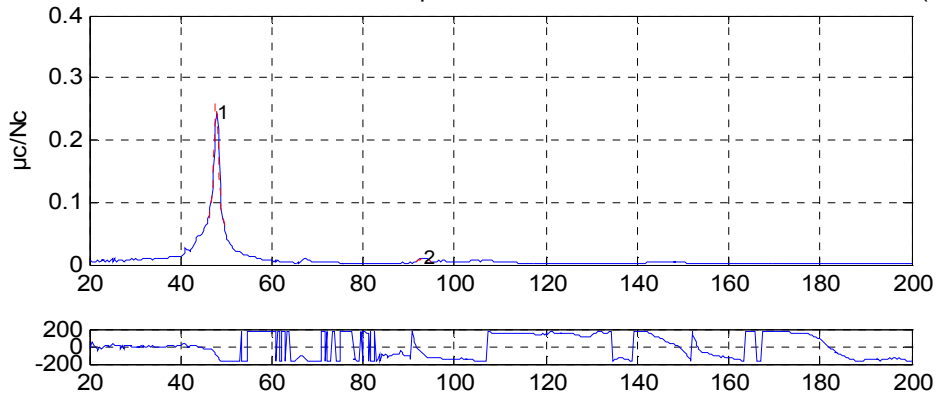
Outer ring :

D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv



4 nodes :

D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	48.0	0.24278	-107.8	47.8	0.9354	0.26005	2.28e+003
2	93.3	0.011158	-90.3	93.3	0.9406	0.011176	1.38e+004

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

IE0-001902

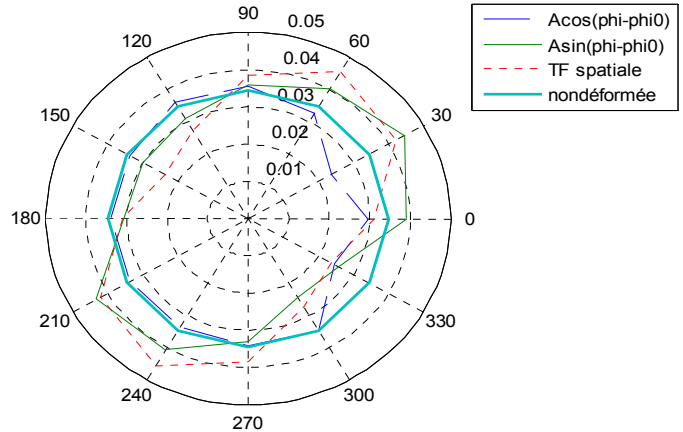
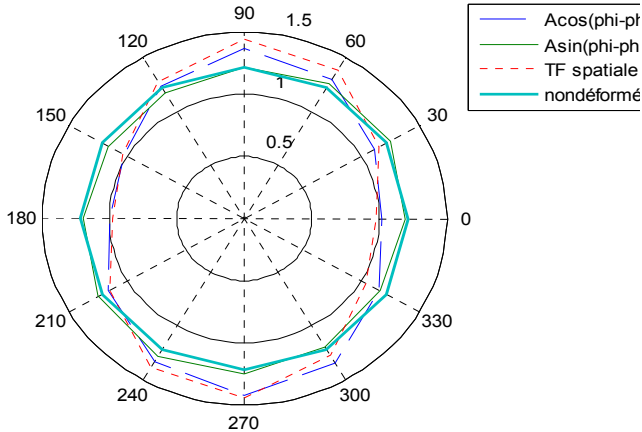
INTERVENTION DESIGNATION :

STATOR WINDING REINFORCEMENT

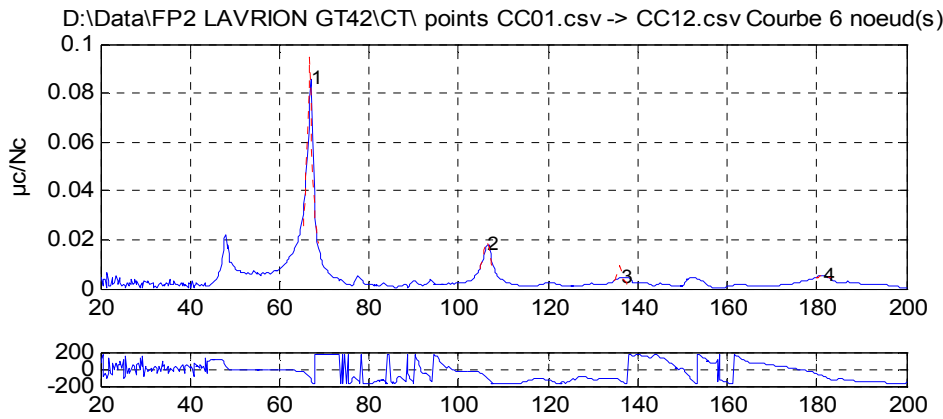
Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv
Fréquence: 48.0 Hz

D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv
Fréquence: 93.3 Hz



6 nodes :



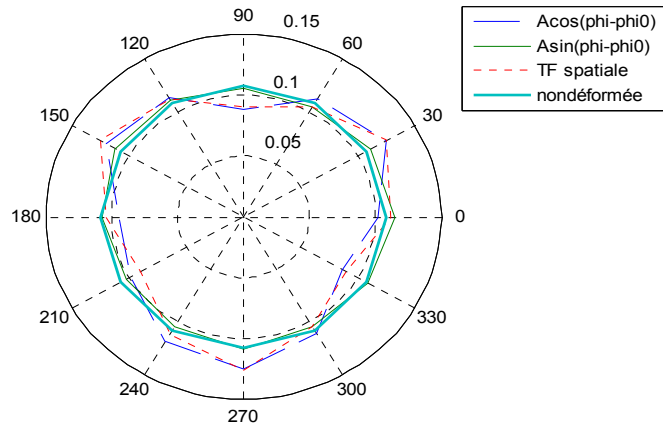
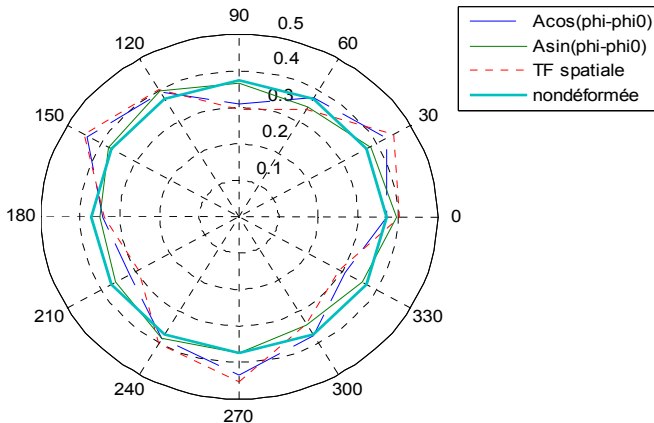
D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv Courbe 6 noeud(s)

ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	Valeurs mesurées			Valeurs calculées		
	F(Hz)	$\mu\text{c/Nc}$	Phi(°)	Fp(Hz)	a(%)	$\mu\text{c/Nc}$ M(kg)
1	67.0	0.085879	-113.1	66.7	0.6078	0.094772 4.94e+003
2	106.5	0.018057	-101.4	106.3	0.6852	0.019346 8.46e+003
3	136.5	0.0048898	-149.4	135.9	0.2970	0.0094223 2.45e+004
4	181.5	0.0055018	-84.8	181.6	1.1499	0.0054789 6.09e+003

D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv
Fréquence: 67.0 Hz

D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv
Fréquence: 106.5 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

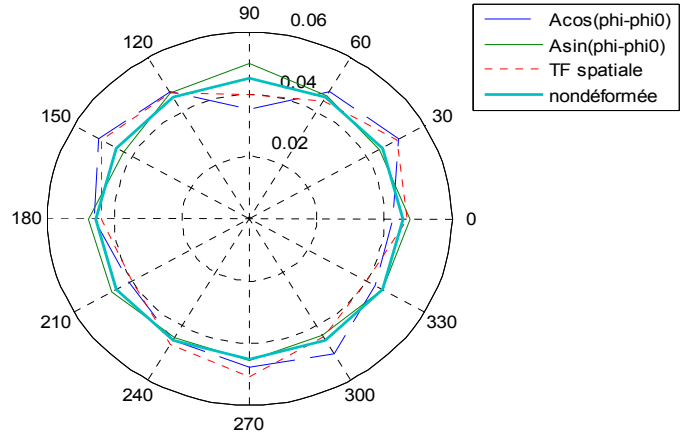
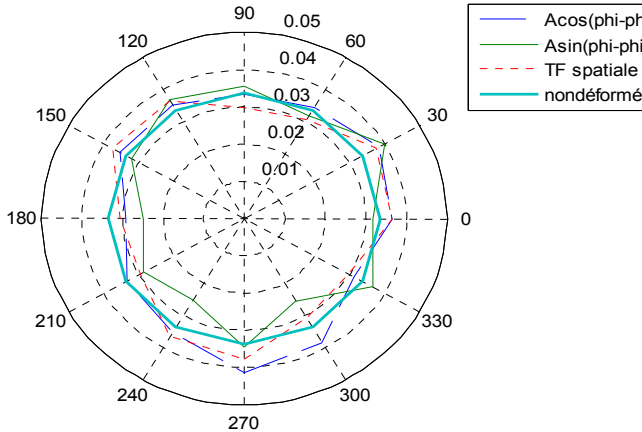
INTERVENTION DESIGNATION :

STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

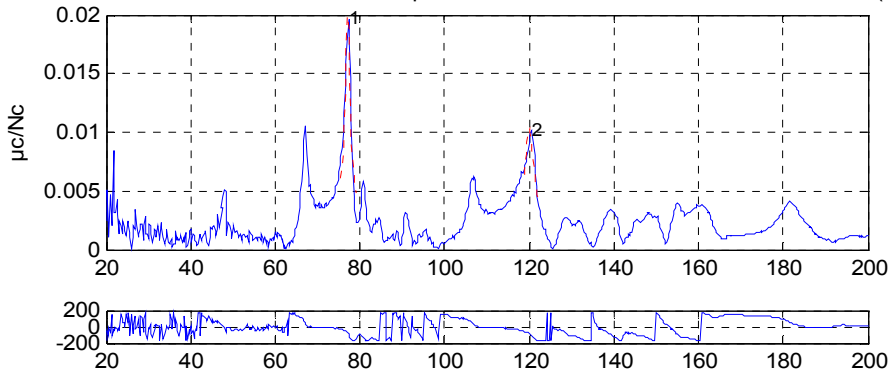
D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv
Fréquence: 136.5 Hz

D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv
Fréquence: 181.5 Hz



8 nodes :

Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv Courbe 8 noeud(s)

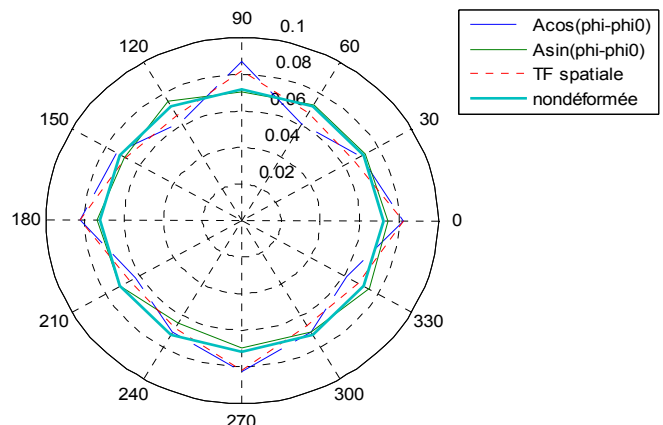
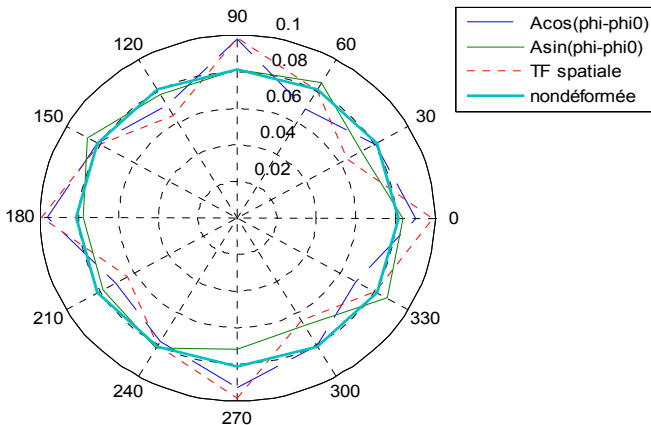


ALSTOM ENERGY TGP/IFT (Ver 1.0)

Valeurs mesurées				Valeurs calculées			
#	F(Hz)	μ/Nc	Phi(°)	Fp(Hz)	a(%)	μ/Nc	M(kg)
1	77.3	0.019651	-99.9	77.1	0.6305	0.020097	1.68e+004
2	120.5	0.010166	-105.5	120.0	0.8526	0.010287	1e+004

D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv
Fréquence: 77.3 Hz

D:\Data\FP2 LAVRION GT42\CT\ points CC01.csv -> CC12.csv
Fréquence: 120.5 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

IE0-001902

INTERVENTION DESIGNATION :

STATOR WINDING REINFORCEMENT

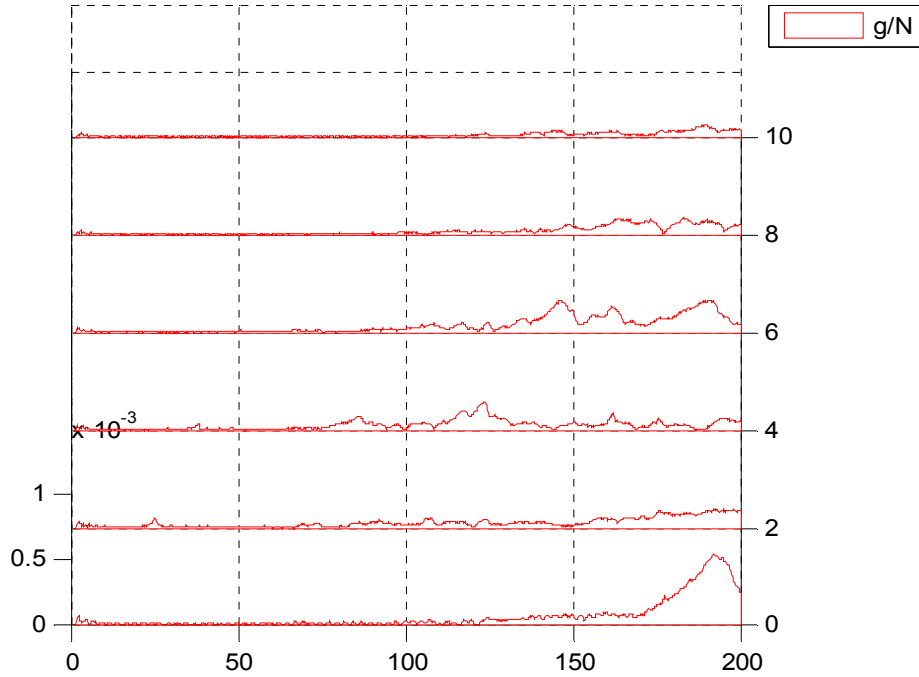
Subject (only one) - Title :

NATURAL FREQUENCIES MEASUREMENT

5.2.2. Opposite turbine side :

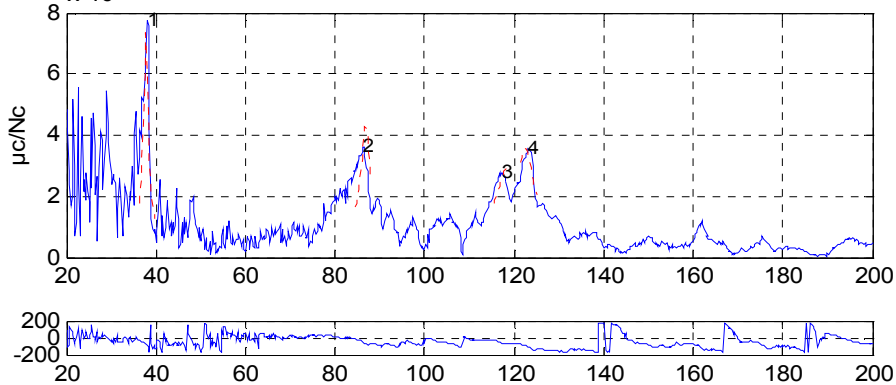
Inner ring :

D:\Data\FP2 LAVRION GT42\COT\ points OA01.csv -> OA12.csv



4 nodes :

D:\Data\FP2 LAVRION GT42\COT\ points OA01.csv -> OA12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		μc/Nc	Phi(°)	Fp(Hz)	a(%)	μc/Nc	M(kg)
1	38.0	0.007745	-92.4	37.7	0.9683	0.0073561	1.25e+005
2	86.3	0.00361	-46.8	86.8	1.0928	0.004283	3.59e+004
3	117.3	0.0027508	-62.0	118.5	1.8695	0.0029599	1.63e+004
4	123.3	0.0035771	-107.3	122.5	1.4223	0.0035792	1.66e+004

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

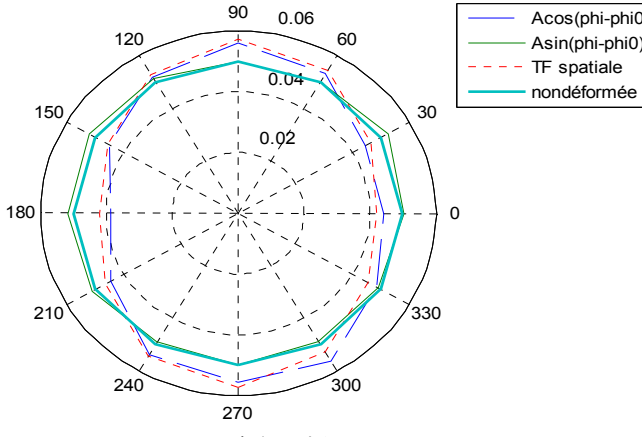
SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

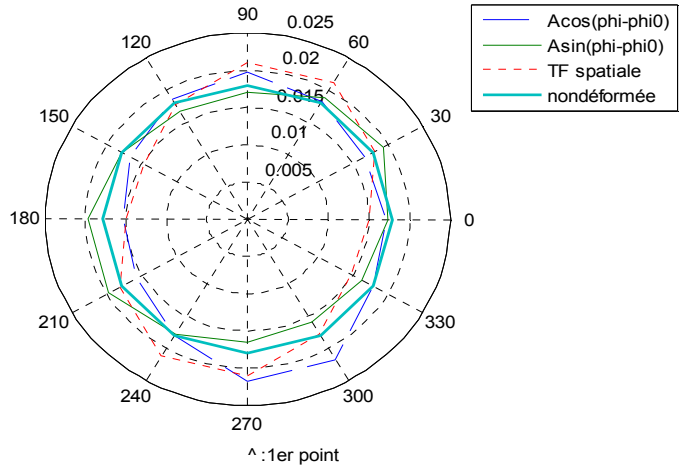
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

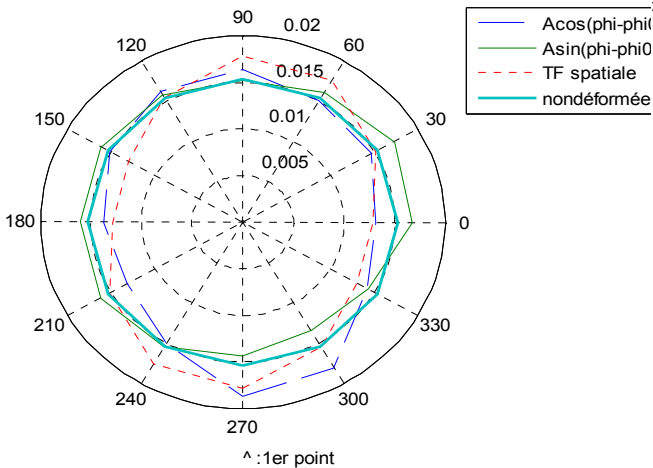
\\Data\FP2 LAVRION GT42\COT\ points OA01.csv -> OA12.csv
Fréquence: 38.0 Hz



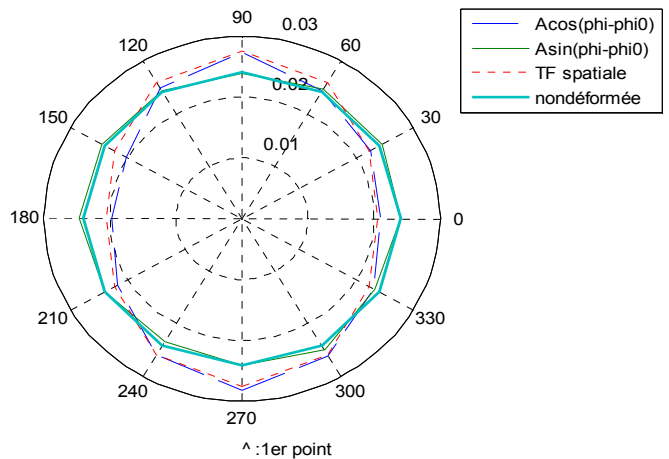
\\Data\FP2 LAVRION GT42\COT\ points OA01.csv -> OA12.csv
Fréquence: 86.3 Hz



^ :1er point
Fréquence: 117.3 Hz



\\Data\FP2 LAVRION GT42\COT\ points OA01.csv -> OA12.csv
Fréquence: 123.3 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

INTERVENTION DESIGNATION :

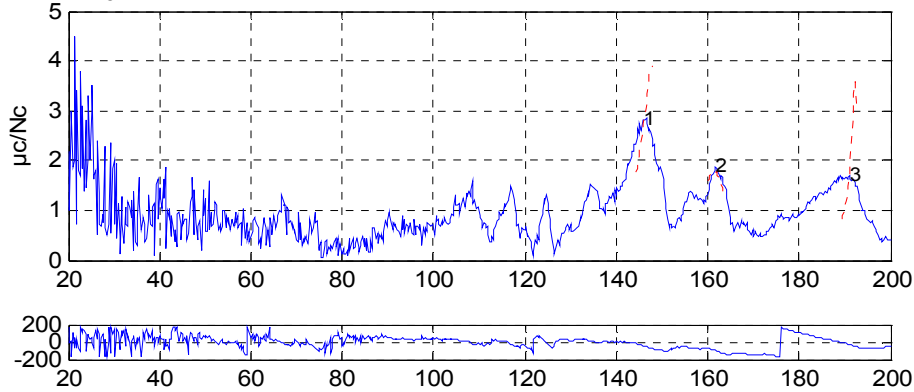
STATOR WINDING REINFORCEMENT

Subject (only one) - Title :

NATURAL FREQUENCIES MEASUREMENT

6 nodes :

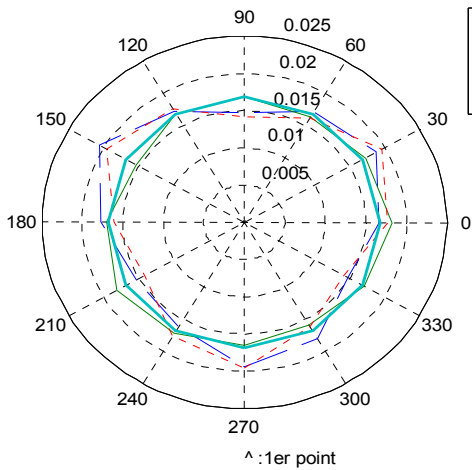
D:\Data\FP2 LAVRION GT42\COT\ points OA01.csv -> OA12.csv Courbe 6 noeud(s)



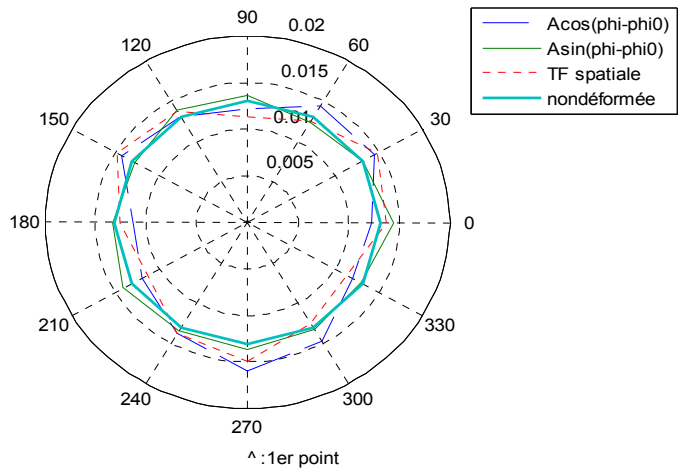
ALSTOM ENERGY TGP/IFT (Ver 1.0)

Valeurs mesurées				Valeurs calculées			
#	F(Hz)	µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	146.0	0.0027976	-42.9	147.8	1.1907	0.0038818	1.25e+004
2	161.8	0.001877	-97.4	161.5	1.6102	0.0017942	1.68e+004
3	191.0	0.0016917	-27.1	192.3	0.3616	0.0035929	2.64e+004

:\Data\FP2 LAVRION GT42\COT\ points OA01.csv -> OA12.csv
Fréquence: 146.0 Hz



:\Data\FP2 LAVRION GT42\COT\ points OA01.csv -> OA12.csv
Fréquence: 161.8 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

IE0-001902

INTERVENTION DESIGNATION :

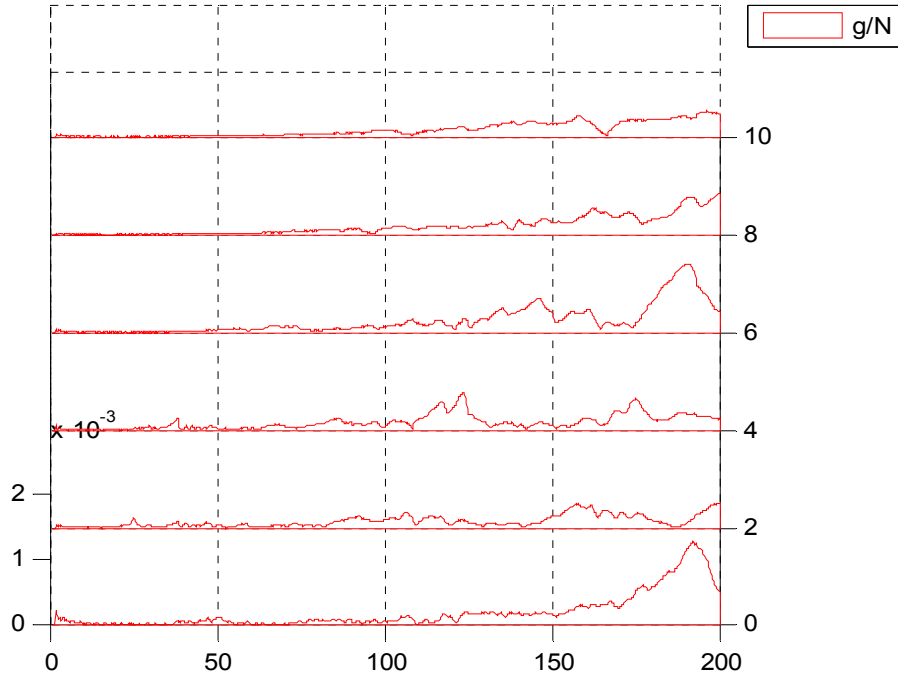
STATOR WINDING REINFORCEMENT

Subject (only one) - Title :

NATURAL FREQUENCIES MEASUREMENT

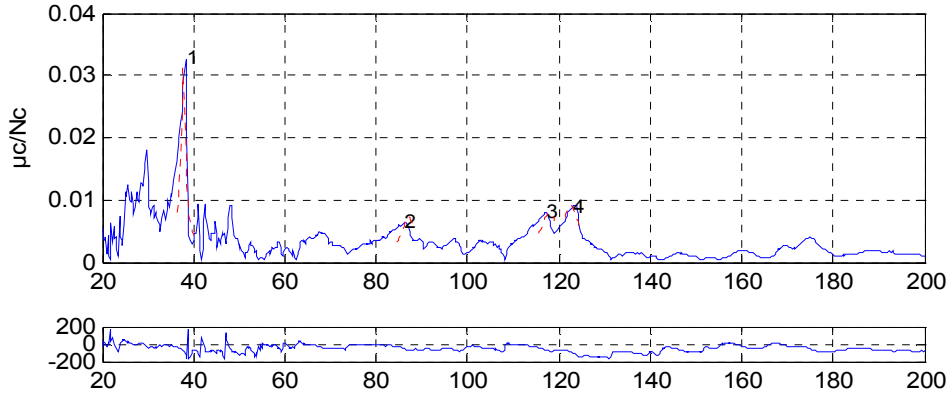
Middle ring :

D:\Data\FP2 LAVRION GT42\COT\ points OB01.csv -> OB12.csv



4 nodes :

D:\Data\FP2 LAVRION GT42\COT\ points OB01.csv -> OB12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	38.3	0.032519	-124.1	37.8	0.8523	0.03125	3.33e+004
2	86.3	0.006333	-49.0	87.0	1.3663	0.0073866	1.66e+004
3	117.3	0.0079142	-63.9	117.9	1.3504	0.0080784	8.35e+003
4	123.0	0.0088962	-98.8	122.6	1.3640	0.0092024	6.71e+003

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

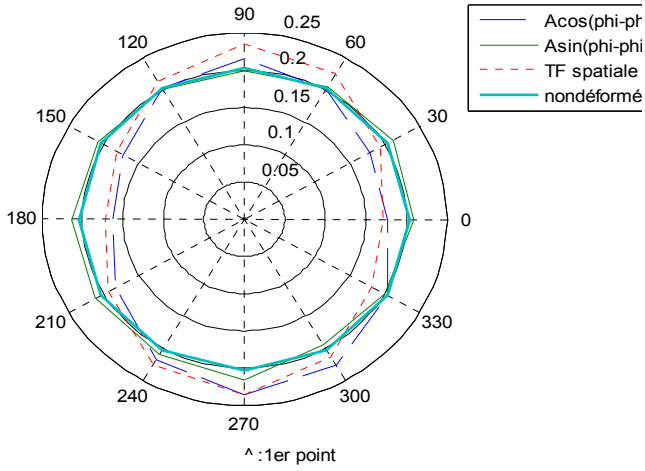
IE0-001902

INTERVENTION DESIGNATION :

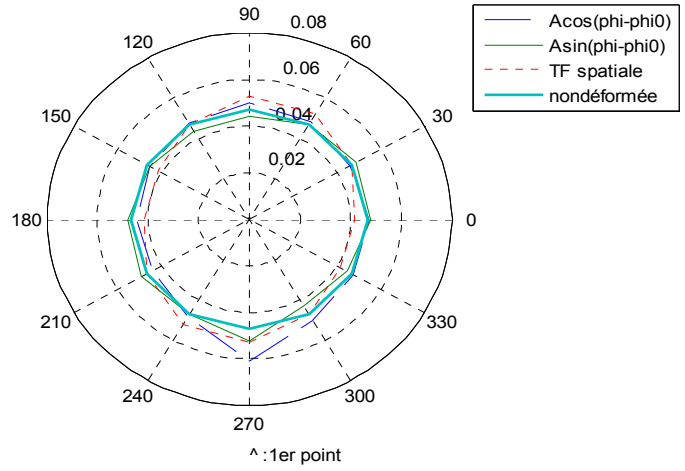
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

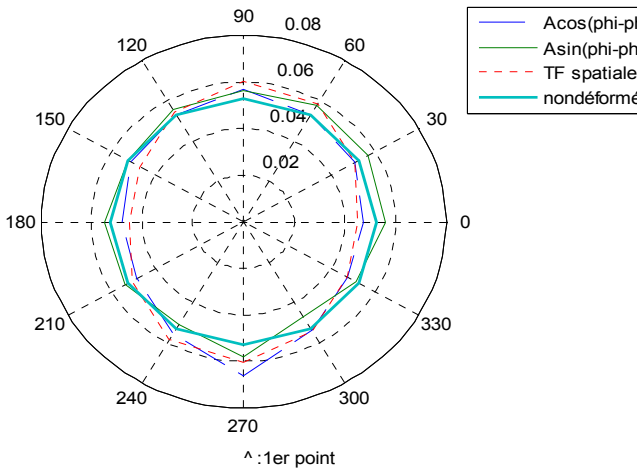
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Fréquence: 38.3 Hz



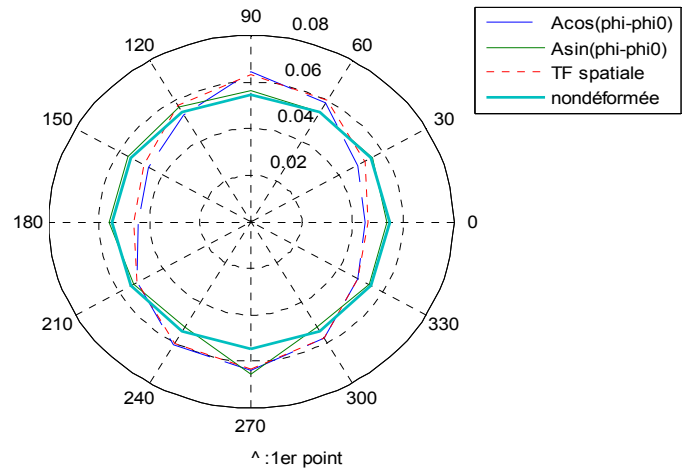
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Fréquence: 86.3 Hz



J:\Data\FP2 LAVRION GT42\COT\ points OB01.csv -> OB12.csv
Fréquence: 117.3 Hz



J:\Data\FP2 LAVRION GT42\COT\ points OB01.csv -> OB12.csv
Fréquence: 123.0 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb **IE0-001902**

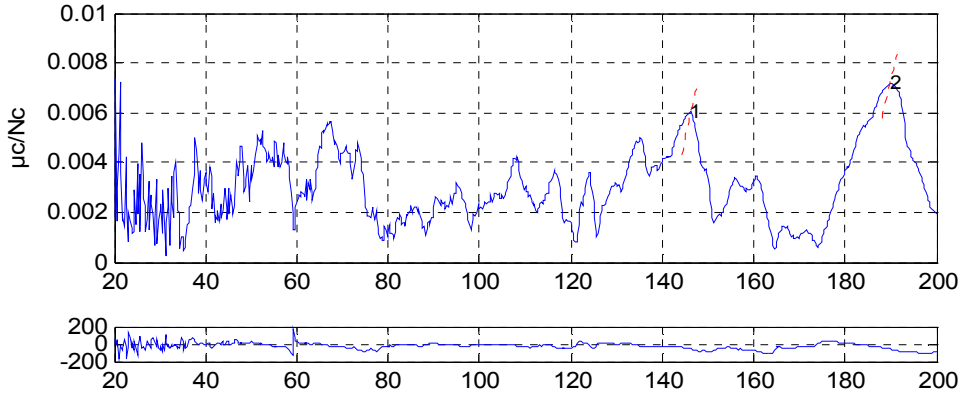
INTERVENTION DESIGNATION :

STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

6 nodes :

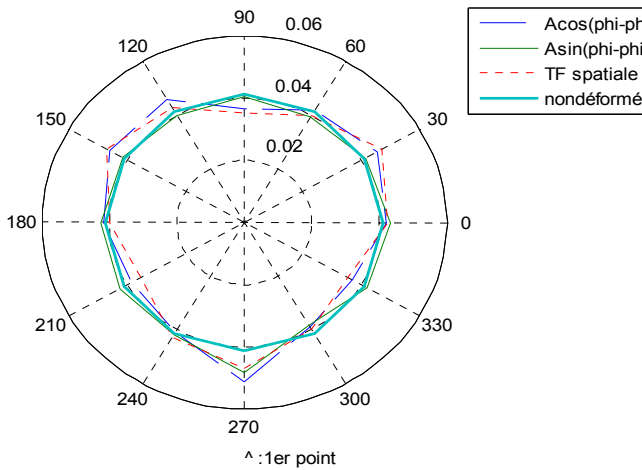
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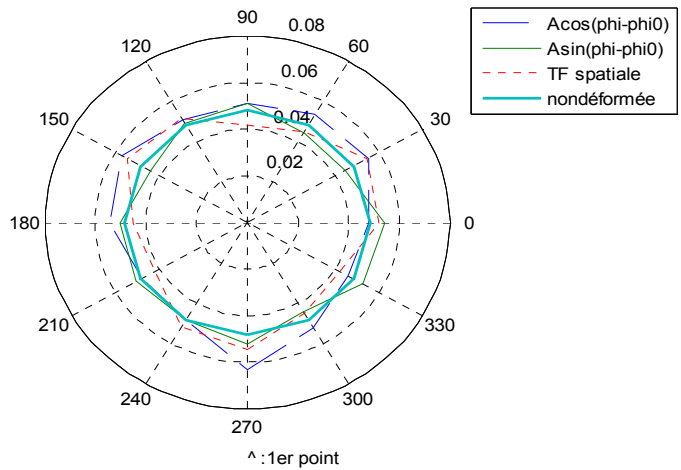
ALSTOM ENERGY TGP/IFT (Ver 1.0)

Valeurs mesurées				Valeurs calculées			
#	F(Hz)	µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	146.0	0.0059677	-53.9	147.9	1.8860	0.0069805	4.4e+003
2	189.8	0.007192	-54.5	192.5	2.0613	0.0085812	1.93e+003

:\Data\FP2 LAVRION GT42\COT\ points OB01.csv -> OB12.csv
Fréquence: 146.0 Hz



:\Data\FP2 LAVRION GT42\COT\ points OB01.csv -> OB12.csv
Fréquence: 189.8 Hz



CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

IE0-001902

INTERVENTION DESIGNATION :

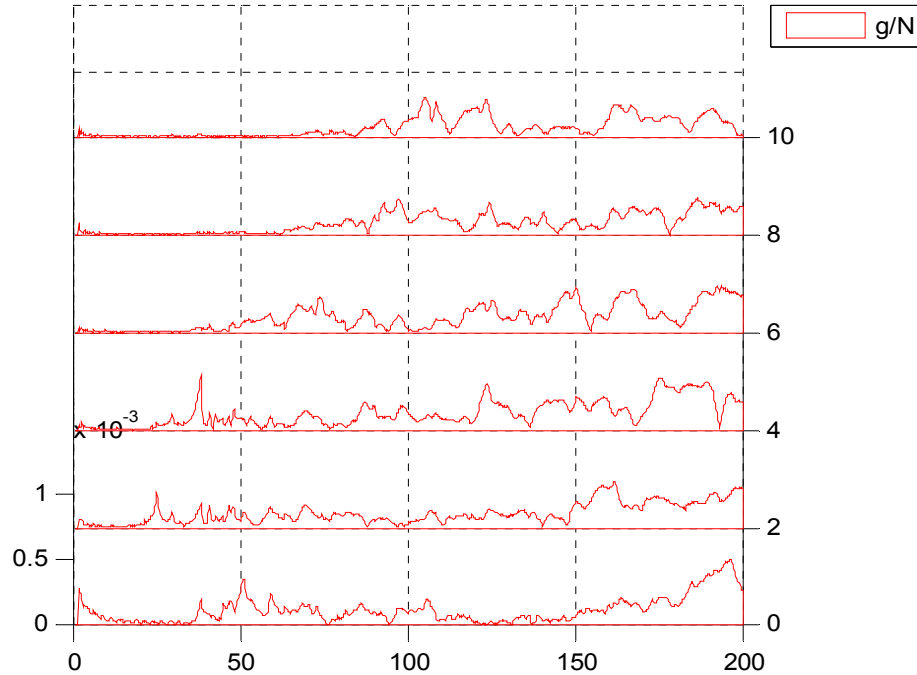
STATOR WINDING REINFORCEMENT

Subject (only one) - Title :

NATURAL FREQUENCIES MEASUREMENT

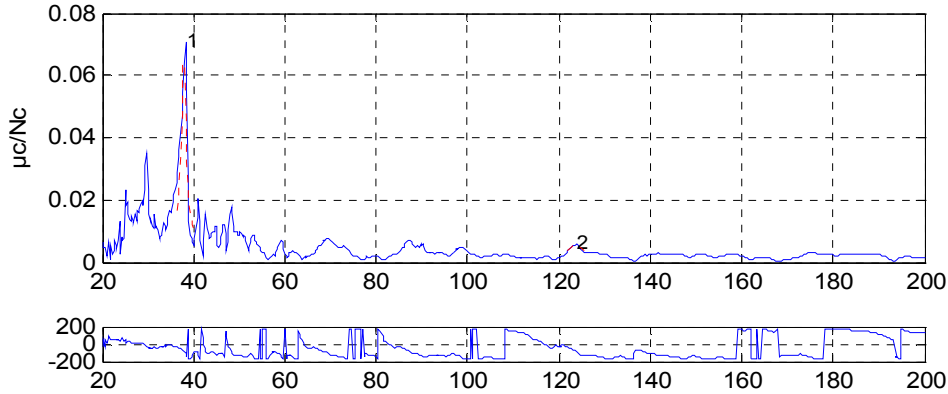
Outer ring :

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4 nodes :

D:\Data\FP2 LAVRION GT42\COT\ points OC01.csv -> OC12.csv Courbe 4 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	38.3	0.070761	-117.5	37.9	0.9043	0.067997	1.44e+004
2	123.8	0.0056952	-90.1	123.8	1.2728	0.0054849	1.18e+004

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

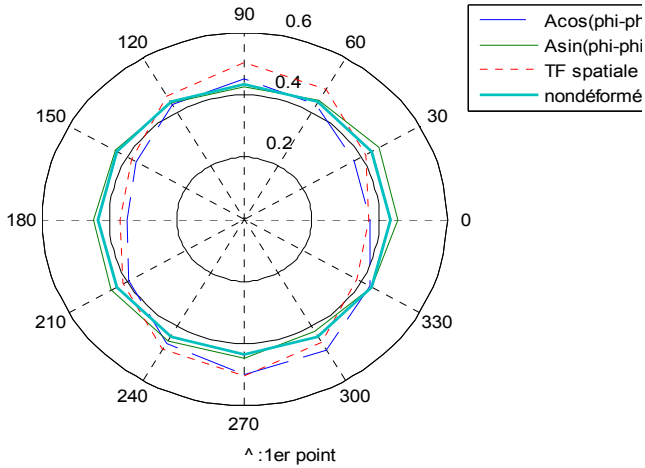
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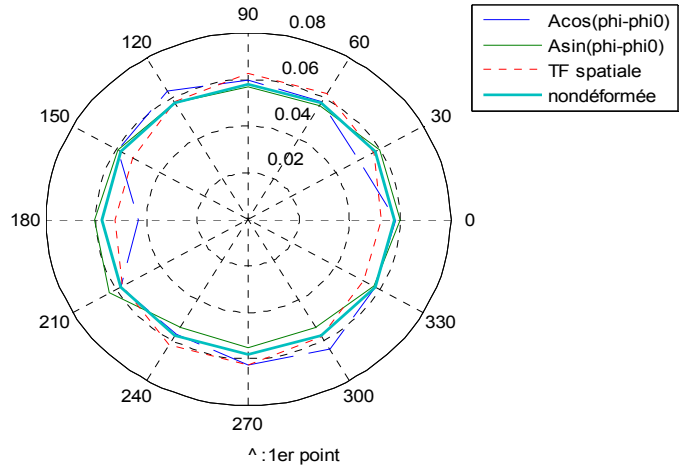
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

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Fréquence: 38.3 Hz

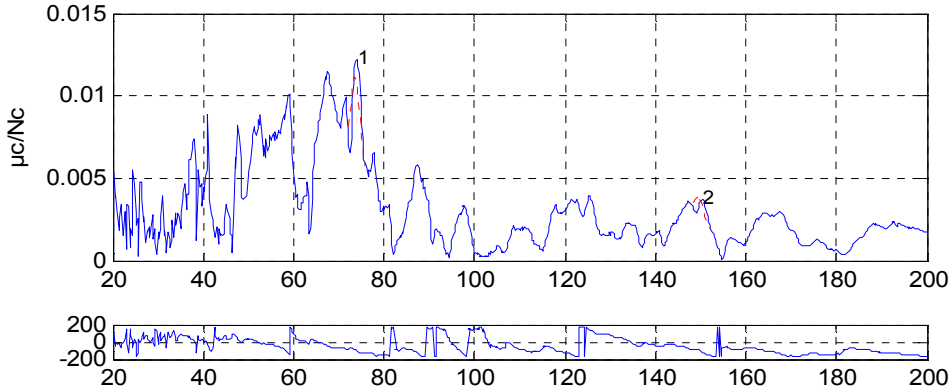


:\Data\FP2 LAVRION GT42\COT\ points OC01.csv -> OC12.csv
Fréquence: 123.8 Hz



6 nodes :

D:\Data\FP2 LAVRION GT42\COT\ points OC01.csv -> OC12.csv Courbe 6 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	74.0	0.012211	-106.0	73.6	1.8403	0.011192	1.14e+004
2	150.3	0.0037217	-114.1	149.3	1.0548	0.0039336	1.37e+004

CUSTOMER **PPC**

PLANT **LAVRION**

UNIT **TG4-2**

CUSTOMER CONTRACT or ORDER Nb

SAP PROJECT Nb

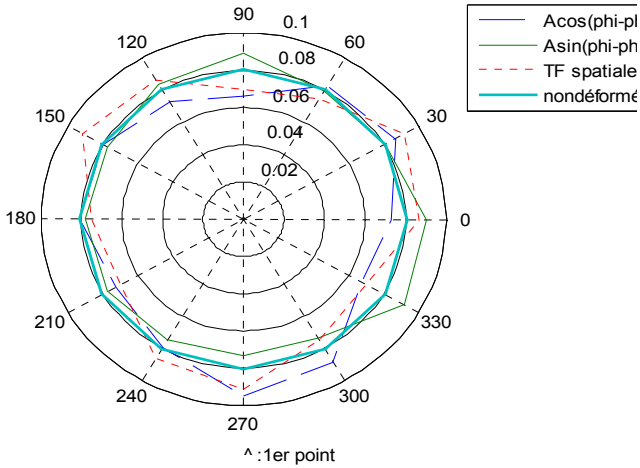
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INTERVENTION DESIGNATION :

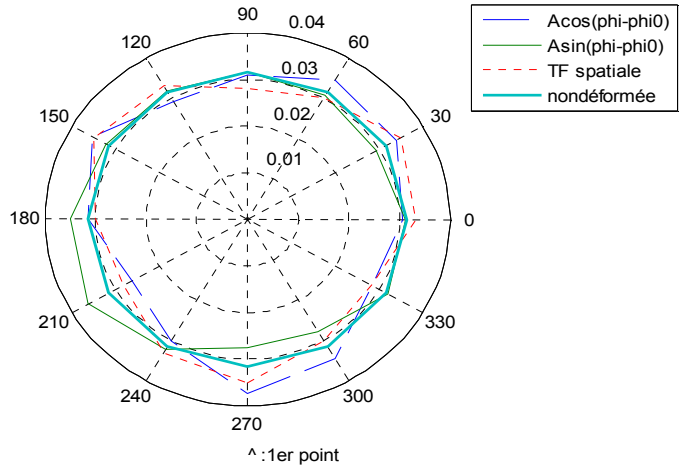
STATOR WINDING REINFORCEMENT

Subject (only one) - Title : **NATURAL FREQUENCIES MEASUREMENT**

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Fréquence: 74.0 Hz

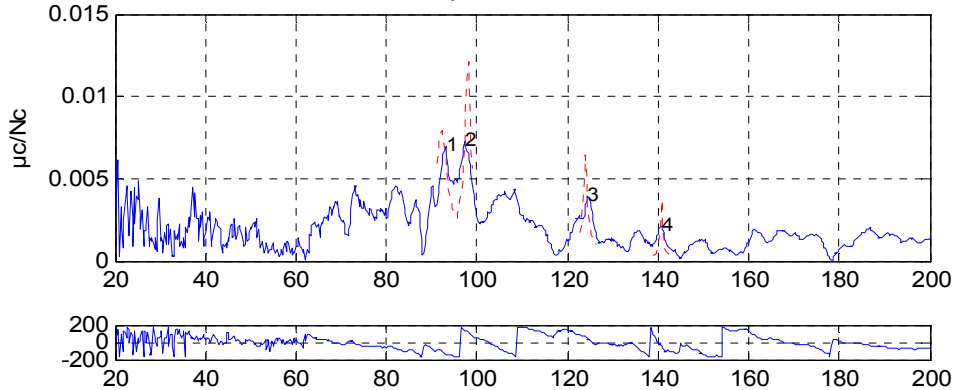


D:\Data\FP2 LAVRION GT42\COT\ points OC01.csv -> OC12.csv
Fréquence: 150.3 Hz



8 nodes :

D:\Data\FP2 LAVRION GT42\COT\ points OC01.csv -> OC12.csv Courbe 8 noeud(s)



ALSTOM ENERGY TGP/IFT (Ver 1.0)

#	F(Hz)	Valeurs mesurées		Valeurs calculées			
		µc/Nc	Phi(°)	Fp(Hz)	a(%)	µc/Nc	M(kg)
1	93.0	0.006925	-133.0	92.2	1.1267	0.0079381	1.67e+004
2	97.3	0.0072677	146.6	98.0	0.5420	0.01213	2.01e+004
3	124.5	0.0038846	37.6	124.0	0.2752	0.0065193	4.59e+004
4	140.8	0.0021329	-53.4	140.8	0.1193	0.0037179	1.44e+005

APPENDIX VII

Exciter OEM descriptive drawings and main design features description

APPENDIX VIII

Generator terminals OEM descriptive drawings

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SUMMARY

06		EXCITER (TKJ 86/19)
	01	GENERAL
	01	Electrical operating principle
	02	Exciter description
	02	CHARACTERISTICS
	01	General electrical characteristics
	02	Field
	03	Armature
	04	Tests
	04	Exciter weights
	03	STATOR
	01	General
	02	Frame
	03	Field support
	04	Laminated yoke
	05	Stator winding
	06	Wiring
	07	Exciter cooling
	08	Fastening to base
	09	Stator miscellaneous
	04	ROTOR
	01	Exciter rotor - general
	02	Armature support
	03	Magnetic core
	04	Armature winding
	05	Rectifier bridge
	06	Collector rings - diodes
	07	Coupling
	08	Rotor miscellaneous

DESCRIPTIVE MANUAL

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06

01

GENERAL

The exciter mainly consists of the following parts:

- * STATOR
 - Field support
 - Stator winding
- * ROTOR
 - Armature winding
 - Rectifier bridge

For each part mentioned above maintenance will essentially cover the following:

- Tooling required for disassembly, reassembly or handling operations
- Special precautions if necessary
- Disassembly
- Reassembly
- Wear parts to be replaced if need be
- Scheduled overhauling or emergency servicing
- Storage or preservation where applicable

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06 01 01 Electrical operating principle

The excitation system and the voltage regulator generate current whose value is determined by the operating conditions of the generator at a precise moment; the current is supplied to the field circuit (stationary part) of the exciter.

The magnetic field produced by this stationary field provides the exciter rotating winding with alternating polyphase electromotive forces that induce alternating polyphase currents under a 250 Hz frequency.

These currents pass through the rotating diodes bridge that changes all the alternating polyphase currents into a direct current which is conducted via connections to the generator rotor winding to fulfill the operating conditions set by the voltage regulator.

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06 01 02 Exciter description

The exciter consists of three main parts:

- The stationary part including the frame, the stator
- The rotating part comprising the armature winding, the diodes bridge and the collector rings
- The safety instrumentation

The exciter description can be itemized as follows:

- general
- stationary part or stator
- rotating part or rotor
- Instrumentation - Protections

Drawing GBP-W-1-AE-01 shows the longitudinal view of the exciter

Drawing GBP-W-1-AE-02 is the electrical diagram of the rotor winding

Drawing GBP-W-1-AE-03 is the electrical diagram of the stator winding

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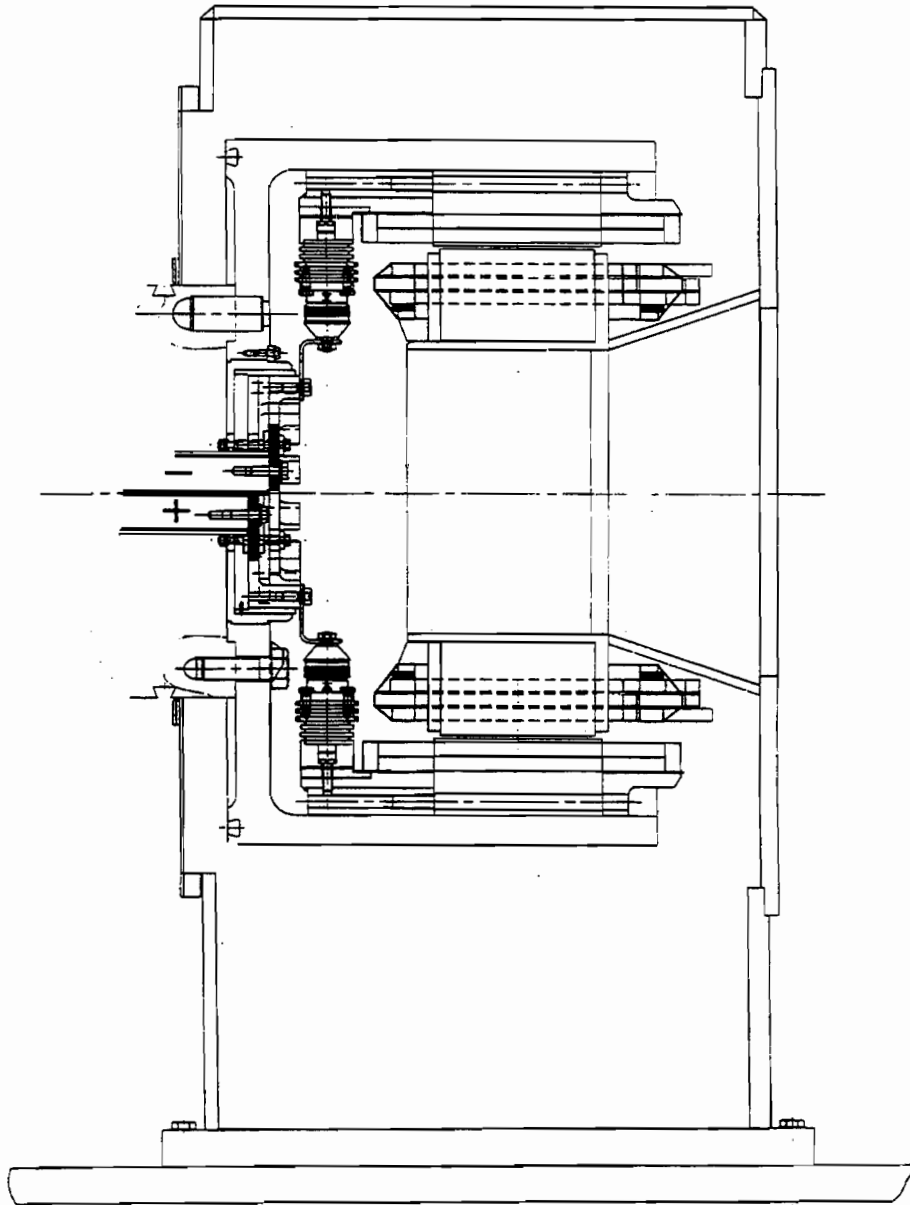
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06	01	02

06 01 02

DRAWING GBP-W-1-AE-01



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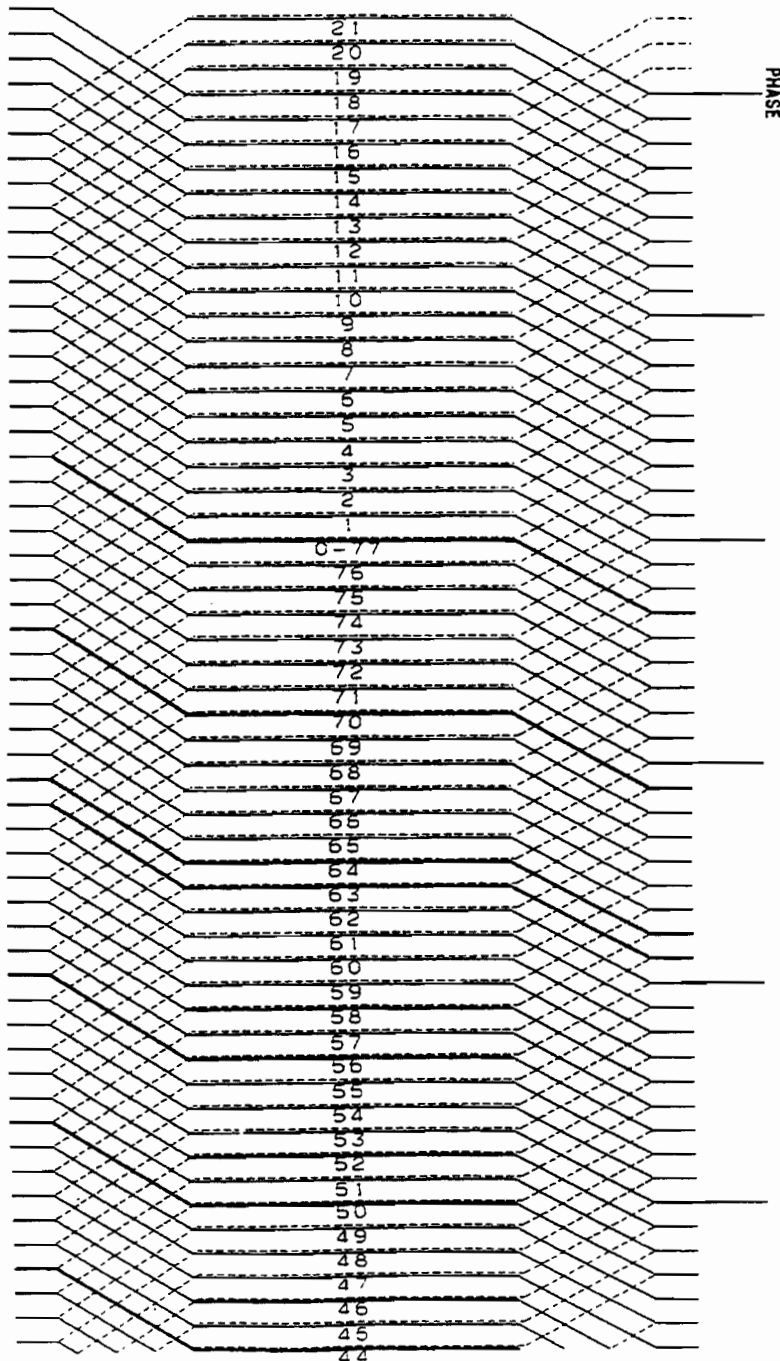
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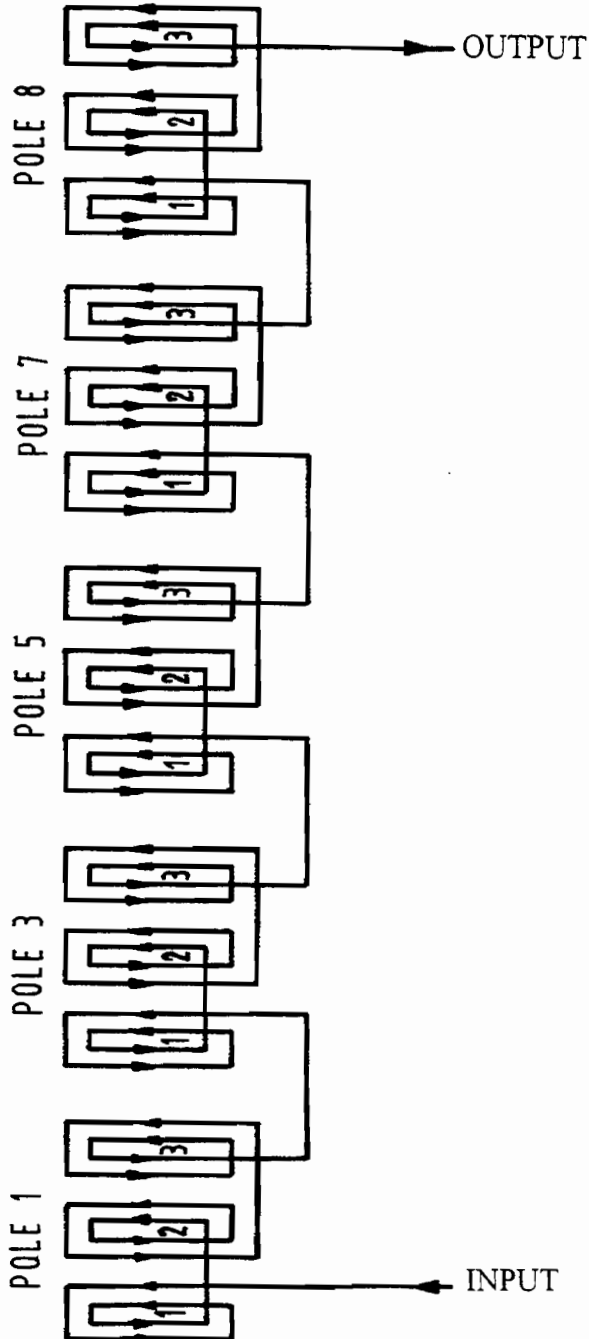
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06 01 02

DRAWING GBP-W-1-AE-03



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06

02

CHARACTERISTICS

01 General electrical characteristics

- Cooling air
- Active power 543 kW
- Voltage 238 V
- Current 2 283 A
- Frequency 250 Hz
- Speed 3 000 rpm
- Air flow rate 1.5 m³/s
- Number of diodes 14
- Number of phases 7

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06	02	02		Field	
				- Number of poles.....	10
				- Voltage.....	58 V
				- Current.....	106 A
				- Insulation class.....	F

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06	02	03	Armature	
			- Number of slots	77
			- Number of conductors per slot	2
			- Voltage	238 V
			- Current	2 283 A
			- Insulation class	F
			- Phase connection	in polygon

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06 02 04 Tests

Dielectric tests

For dielectric tests, it is necessary to short circuit the 5 phases and the polarity rings.

- Armature 2 380 V/1 min
- Field 1 500 V/1 min

Mechanical tests

- Overspeed..... 3 600 rpm for 2 min

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06	02	05	Exciter weights	
			- Complete rotor	1 260 kg
			- Rotor with disassembly and handling tooling.....	2 036 kg
			- Complete stator	1 320 kg

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06 03 STATOR

01 General

(Refer to drawing GBP-W-2-AE-01)

The stator is the stationary part of the exciter.

It mainly consists of the two following parts:

- The frame (1) is the structure which houses and centres the field support (2) bearing the active parts. It serves as an enclosure and guide for ventilation, supports the wiring and provides attachment to the base (3).
- The field support (2) is a welded steel part which bears the active parts consisting of: the laminated yoke (4), the stator winding made up of coils (5) and two power terminals (6) for direct current supply.

The stator will be described in the following chapters:

- frame
- field support
- laminated yoke
- stator winding
- wiring
- fastening to base
- stator miscellaneous

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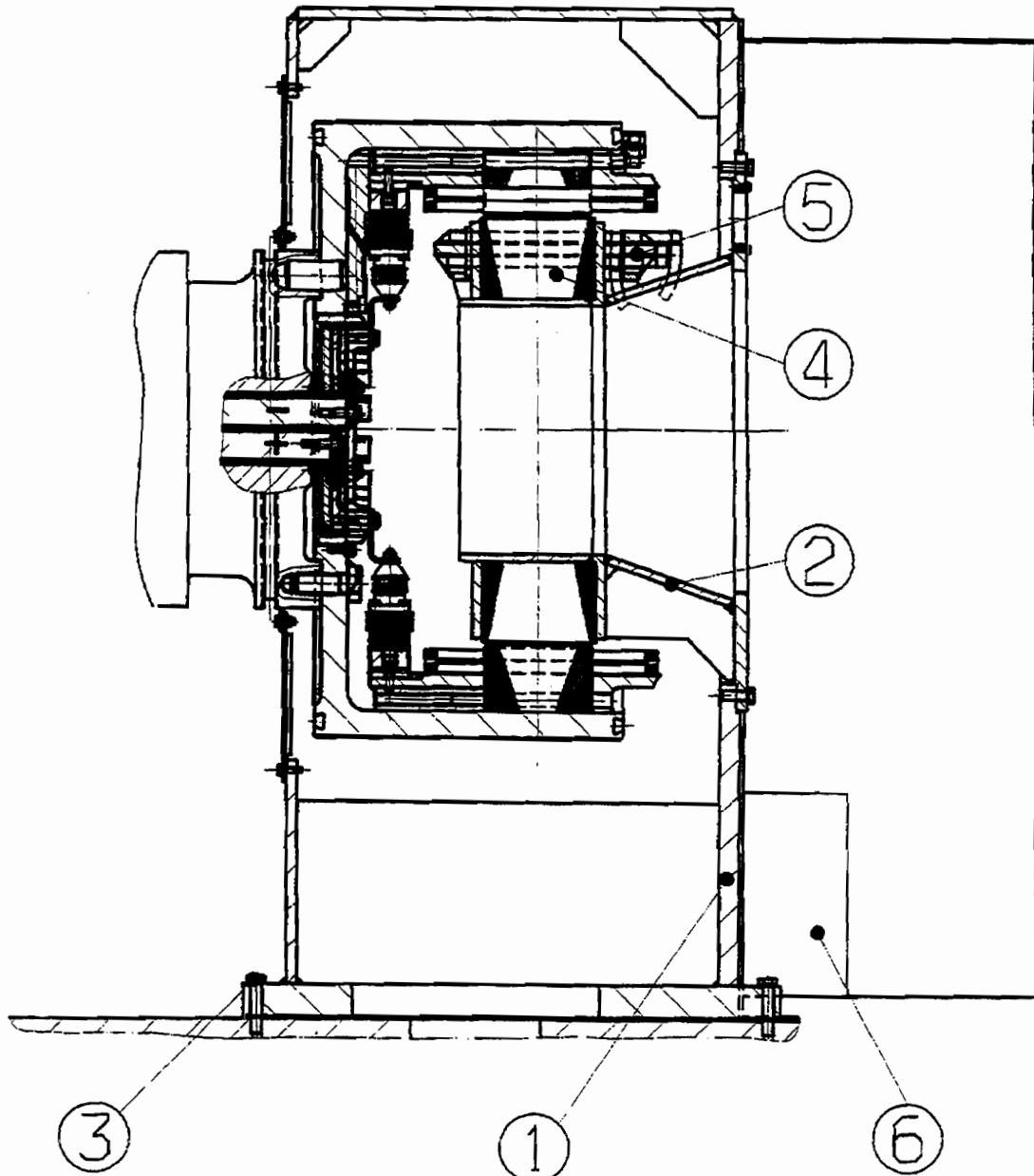
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06 03 01

DRAWING GBP-W-2-AE-01



▼
GEC ALSTHOM
ELECTROMECHANIQUE

OPERATION AND MAINTENANCE MANUAL

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Revision :

Date :

DESCRIPTIVE MANUAL

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KEY TO DRAWING GBP-W-2-AE-01

1. Frame
2. Field support, mechanical part
3. Fastening to base
4. Laminated yoke
5. Stator winding
6. Power terminals

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06 03 02 Frame

(Refer to drawing GBP-W-2-AE-02)

The frame is made up of steel sheets electrically welded to each other.

Four lifting lugs welded to the frame are provided for fitting shackles used for handling operations.

The frame consists of two heavy steel sheet flanges.

A circular opening (2) situated on the front part is used for assembling the stator inside the frame. Appropriate machining provides for the centering and fastening of the stator.

On the frame circumference a series of tapped holes (3) are used for fixing the cover.

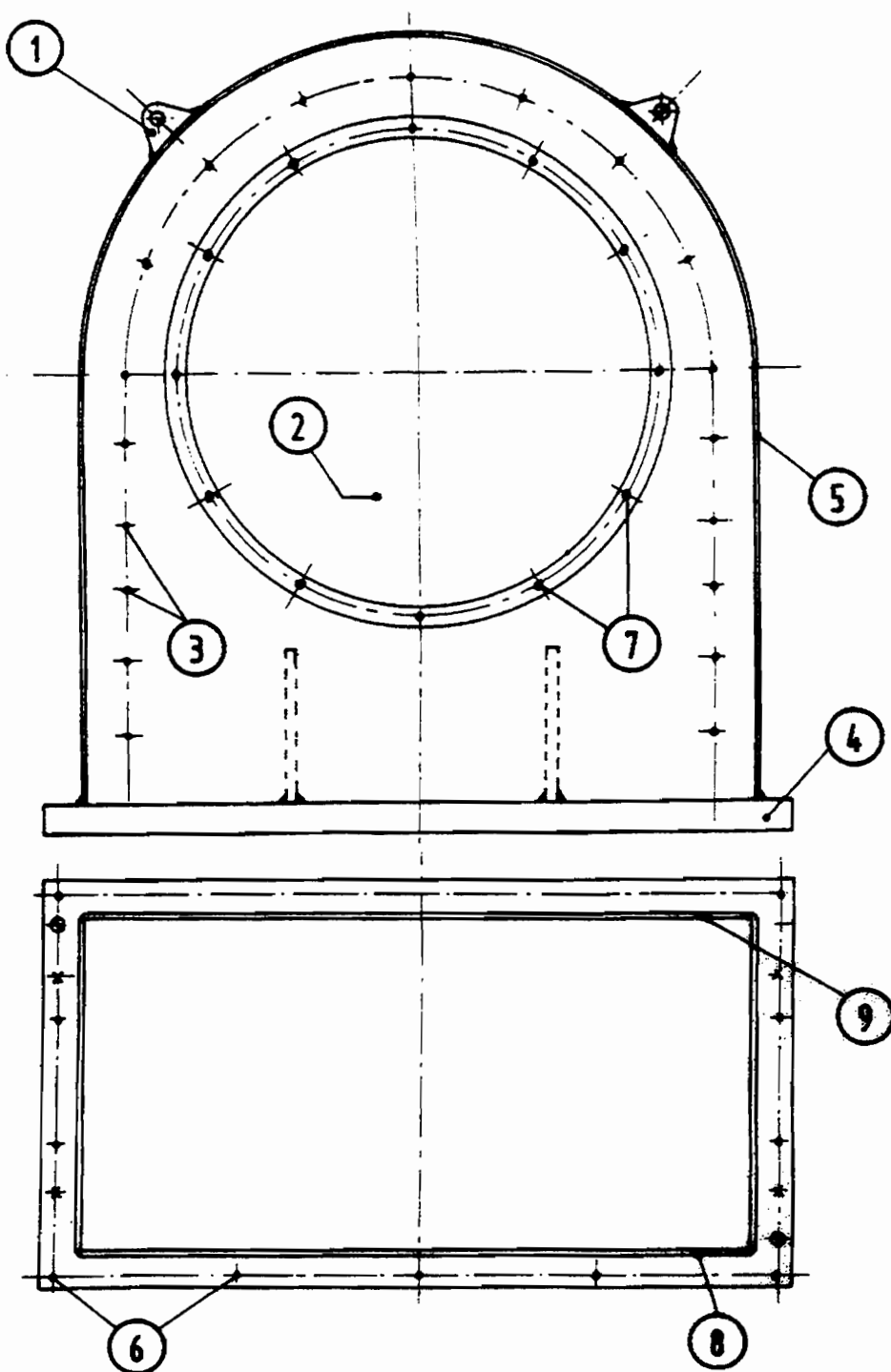
A two-part closing plate (9) is mounted on the opposite side as well as an insulated aluminium diaphragm which prevents any passage of air onto the generator sleeve.

This design rigidly fixes the frame.

A flat base plate (4) which forms an integral part with the frame provides for attachment to the generator base

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DRAWING GBP-W-2-AE-02



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DESCRIPTIVE MANUAL

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06 03 02

KEY TO DRAWING GBP-W-2-AE-02

1. Lifting lug
2. Opening for stator positioning
3. Cover fixing holes
4. Frame base plate
5. Frame
6. Fixing holes
7. Fixed fixing holes
8. Field inspection panel
9. Front panel

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06 03 03

Field support

(Refer to drawing GBP-W-2-AE-03)

The field support consists of electrically welded heavy steel plates. It is composed of:

- A shell (1) whose thickness is calculated to withstand both electrical and mechanical requirements.

The shell is welded onto the circular plate.

The outer diameter (2) is machined carefully to be fitted with the magnetic punchings of the laminated yoke.

- A clamping plate (7) for the positioning of the magnetic punchings.

The shell (1) is firmly attached to the flange plate (3) by means of a truncated cone (8).

- A circular plate (3) with a central opening enables the cooling air to pass through.

Around the plate (3) holes (4) are provided for fixing in the frame.

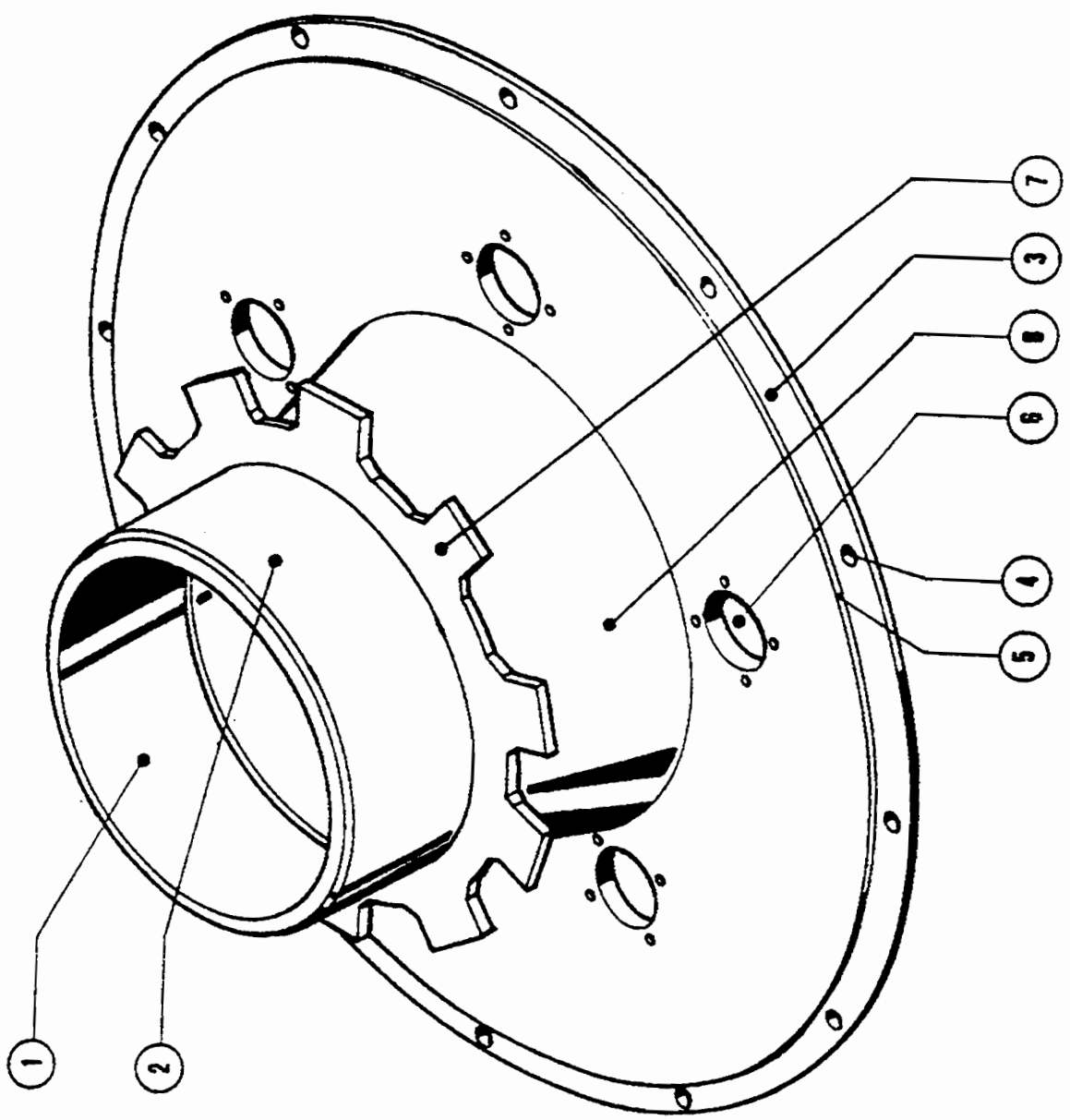
A machining on the circular plate provides for the positioning of the field assembly on the frame.

Five openings are used for air gap adjustment.

DESCRIPTIVE MANUAL

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DRAWING GBP-W-2-AE-03



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KEY TO DRAWING GBP-W-2-AE-03

1. Shell
2. Bearing surface machined for stacking
3. Flange plate
4. Fixing holes
5. Machining
6. Opening for air gap adjustment
7. Clamping plate
8. Truncated cone

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06 03 04 Laminated yoke

Magnetic punchings

The laminations are punched out from single, thin, non-oriented grain magnetic steel sheets.

The magnetic lamination is provided with:

- a central punched part and a key slot for the stacking on the field support shell.
- slots forming the poles, the pole shoes and the yoke for the fitting of the coils on the outer diameter.

The lamination is enamelled on both sides.

These cold-rolled laminations are characterized by low losses and high permeability and subjected to a surface treatment.

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Stacking of the yoke

(Refer to drawing GBP-W-2-AE-04)

The laminated yoke consists of a magnetic circuit, two clamping plates, a locking system preventing any translation motion and coil supports.

- The core is made up of stacked magnetic punchings (1). At either end, the laminations are stuck together with varnish over a thickness of 30 mm and then strongly secured between two clamping plates with special tools.
- The two clamping plates (2) are not cut flush with the top of the poles but are recessed. The contact surface is machined slightly sloping for efficient fastening of the upper part of the poles. Tack welds (3) prevent any movement of the magnetic punchings.
- Supports (4) welded around the shell in front of every other pole on both sides of the core provide for the fastening of the coils.

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ELECTROMECHANIQUE

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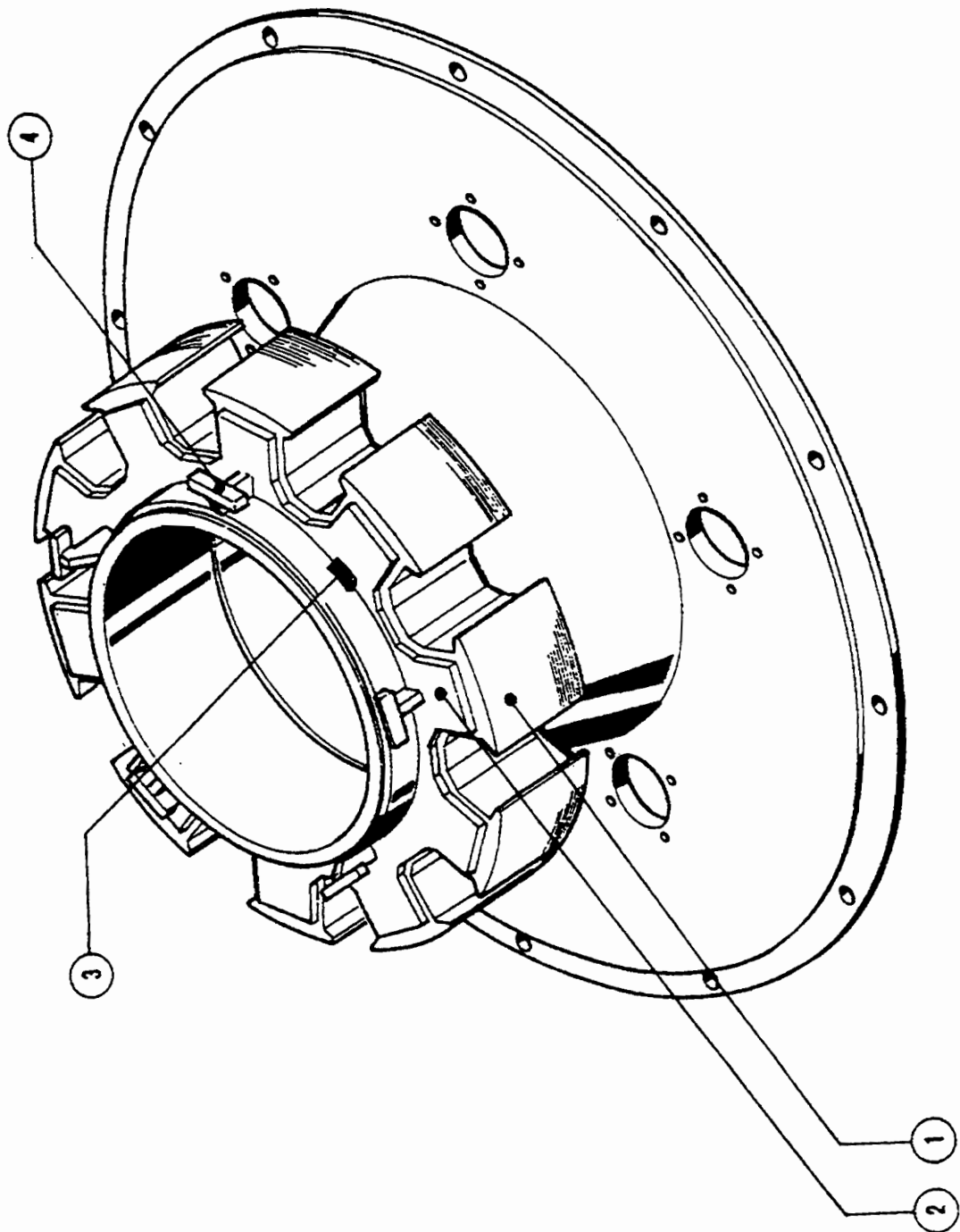
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DRAWING GBP-W-2-AE-04



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KEY TO DRAWING GBP-W-2-AE-04

1. Magnetic punchings
2. Clamping plates
3. Tack welds
4. Coil supports

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06 03 05 Stator winding

Field coils

Making

The stator winding is made up of field coils fitted on every other pole. Each coil consists of three pan-cake coils connected together.

The pan-cake coils are composed of annealed rectangular copper conductors that are rolled flatwise.

To each pan-cake coil corresponds a number of winding turns determined by the electrical calculation and by the coil fitting on the pole.

Insulation

The insulating material between the winding turns of each coil is of the epoxy glass fibre type.

The complete coil insulation is followed by polymerization by curing in a mould for six hours at 160°C.

Finishing consists of a red varnish layer.

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Wedging

(Refer to drawing GBP-W-2-AE-05)

The stator winding wedging is provided for insulation:

- between the pan-cake coils (1) (2) (3)
- between the pan-cake coils (3) and the supports (4)
- between the wound poles

This insulation is made at both ends of each pole.

- of the bindings (5): located on either side of the pole axes, consisting of several layers of a large polyester fibre tape and providing effective attachment of the pan-cake coils.

All the wedges have a rectangular shape and are made of epoxy glass fibre laminate.

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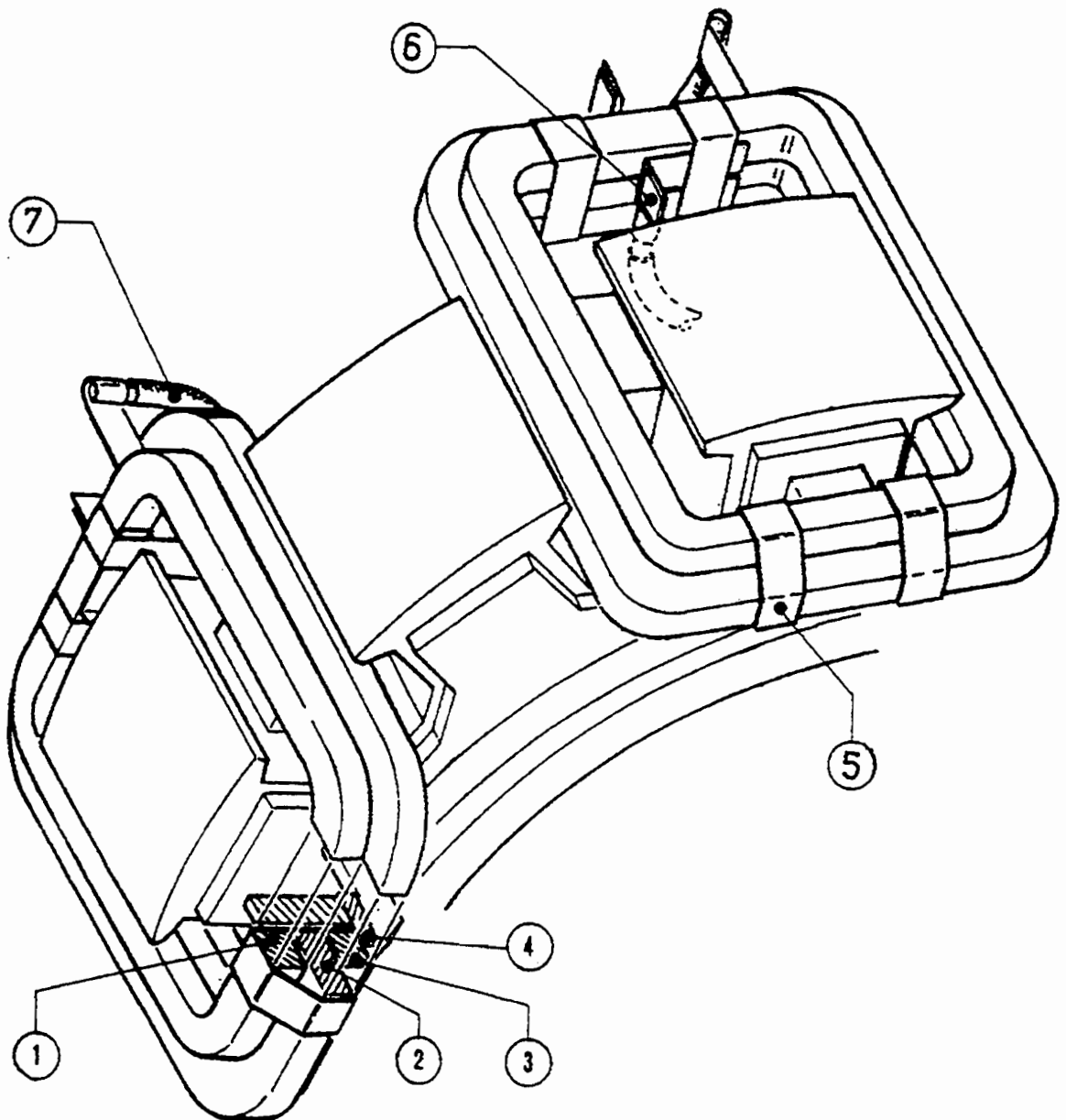
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KEY TO DRAWING GBP-W-2-AE-05

1. Pan-cake coil n°1
2. Pan-cake coil n°2
3. Pan-cake coil n°3
4. Support
5. Binding
6. Small bars
7. Flexible cable

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Connections between coils and pan-cake coils

(Refer to drawing GBP-W-2-AE-05)

Once the three pan-cake coils have been connected together by small bars (6), cables (7) are brazed to terminals formed with the copper of the pan-cake coils to connect the coils of one pole to those of another pole.

Input and output is made on two pan-cake coils, one upper pan-cake coil (1) and one lower pan-cake coil (3), through a large section cable tin-brazed in a terminal formed with the copper of the pan-cake coil.

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06 03 06

Wiring

General

A terminal box is provided for the wiring of the exciter.

This box (1) is fastened to the exciter frame.

Drawing GBP-W-2-AE-6.

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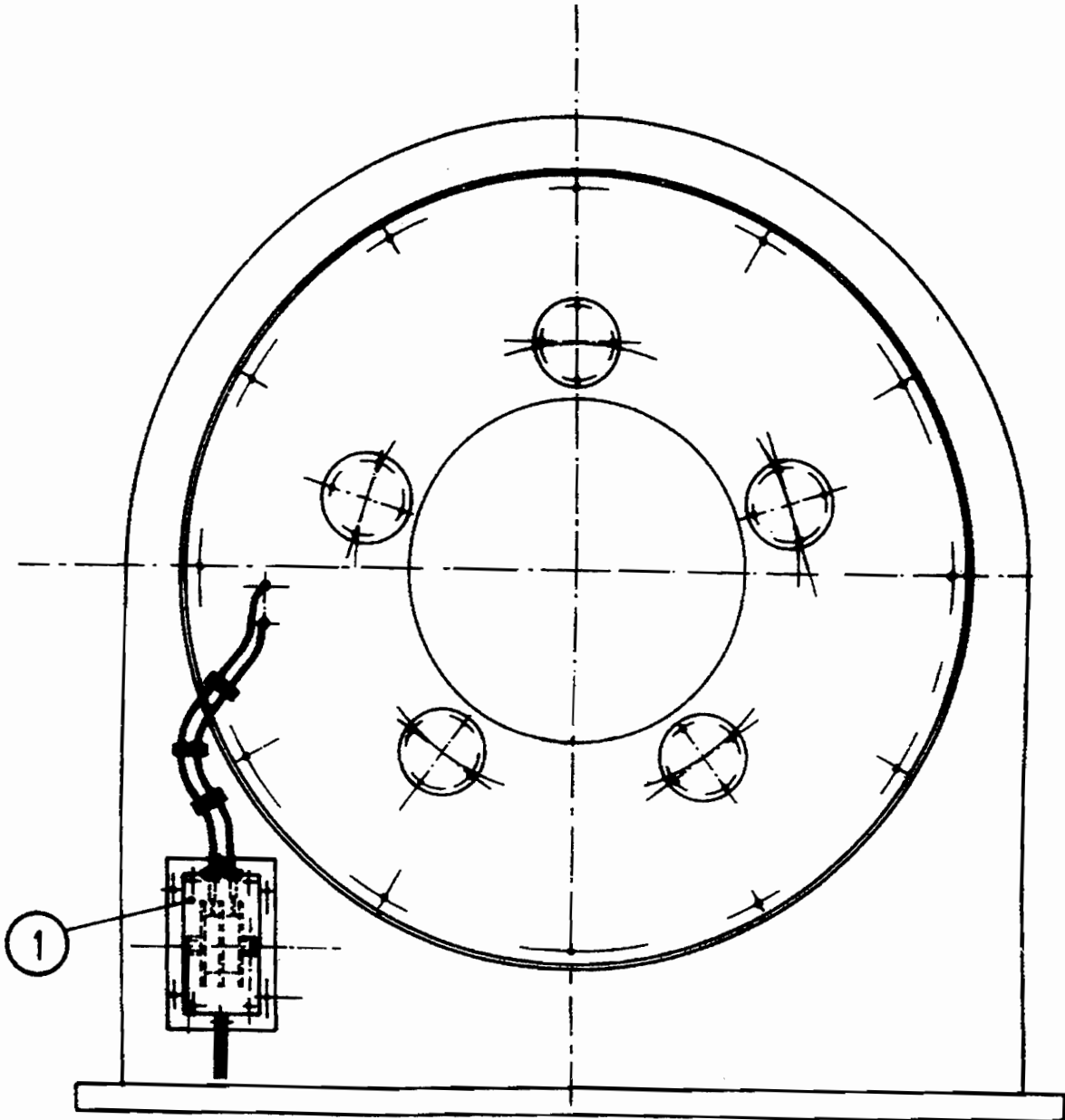
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06 03 06

DRAWING GBP-W-2-AE-06



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Power terminals

(Refer to drawing GBP-W-2-AE-18, section 3)

The two large section cables, input E1 and output E2 of the stator winding, are connected to two junction terminals fixed on an asymmetrical sectional iron.

This assembly is screwed to the frame under the field support and is protected by a thin plate cover fastened to the frame.

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06	03	07	Exciter cooling
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(Refer to drawing GBP-W-2-AE-07)

Cool air is drawn into the centre of the field and channelled to the inside of the rotating armature through the intermediary or the rectifier blocks which are mounted radially and which produce a ventilation effect for air circulation.

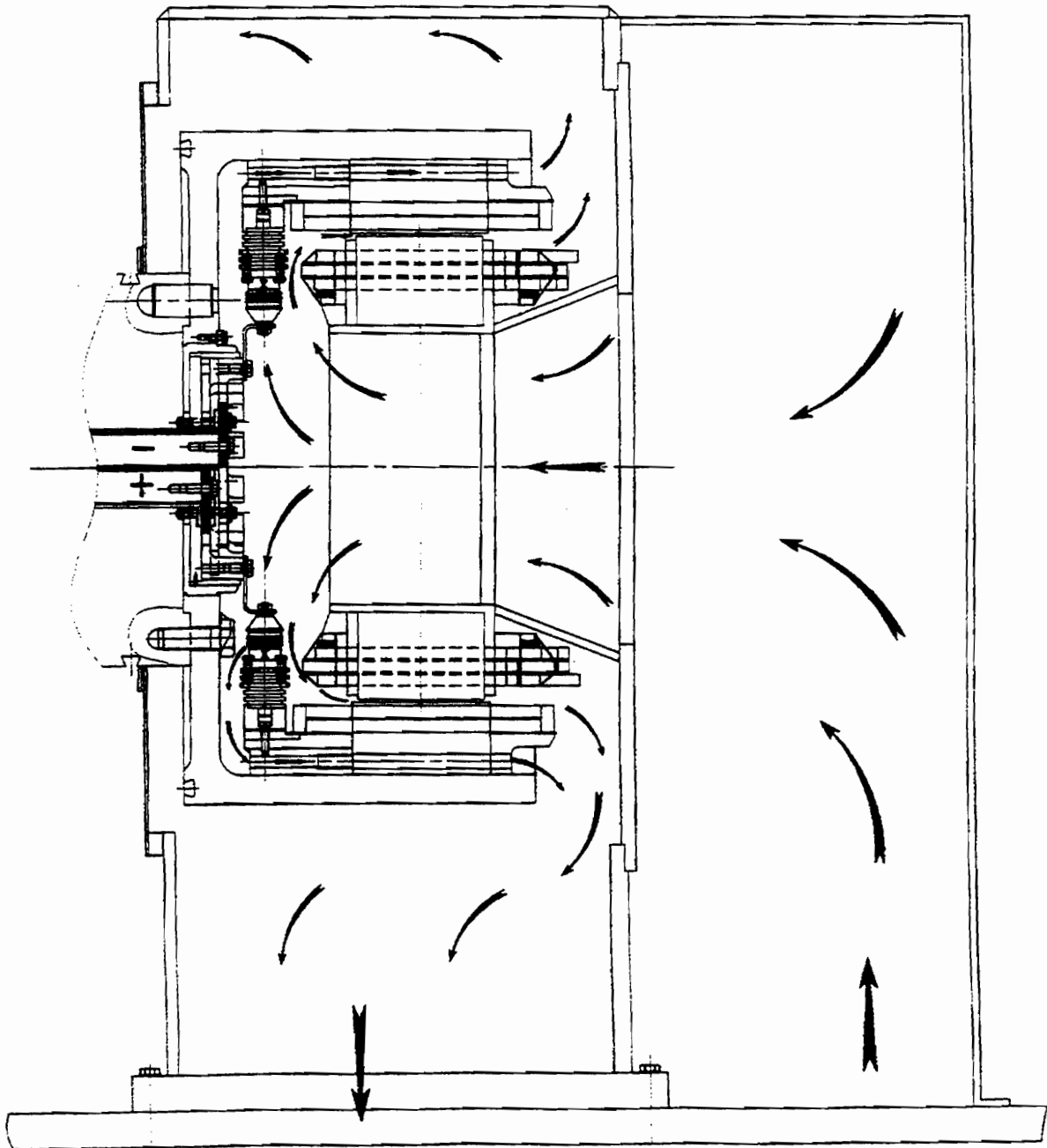
Then the air circulates through two main parallel circuits:

- the air gap, the magnetic core groove tooth dove tail and the interpolar areas of the stator wound magnetic core.
- between the rectifier blocks, in the grooves of the heat sinks and in the holes drilled through the magnetic punchings.

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06 03 08 Fastening to base

(Refer to drawing GBP-W-2-AE-08)

The exciter is fastened to the base by means of screws and washers.

Positioning is achieved using two pins.

Adjusting screws and shims of various thicknesses are used for adjustment of the exciter.

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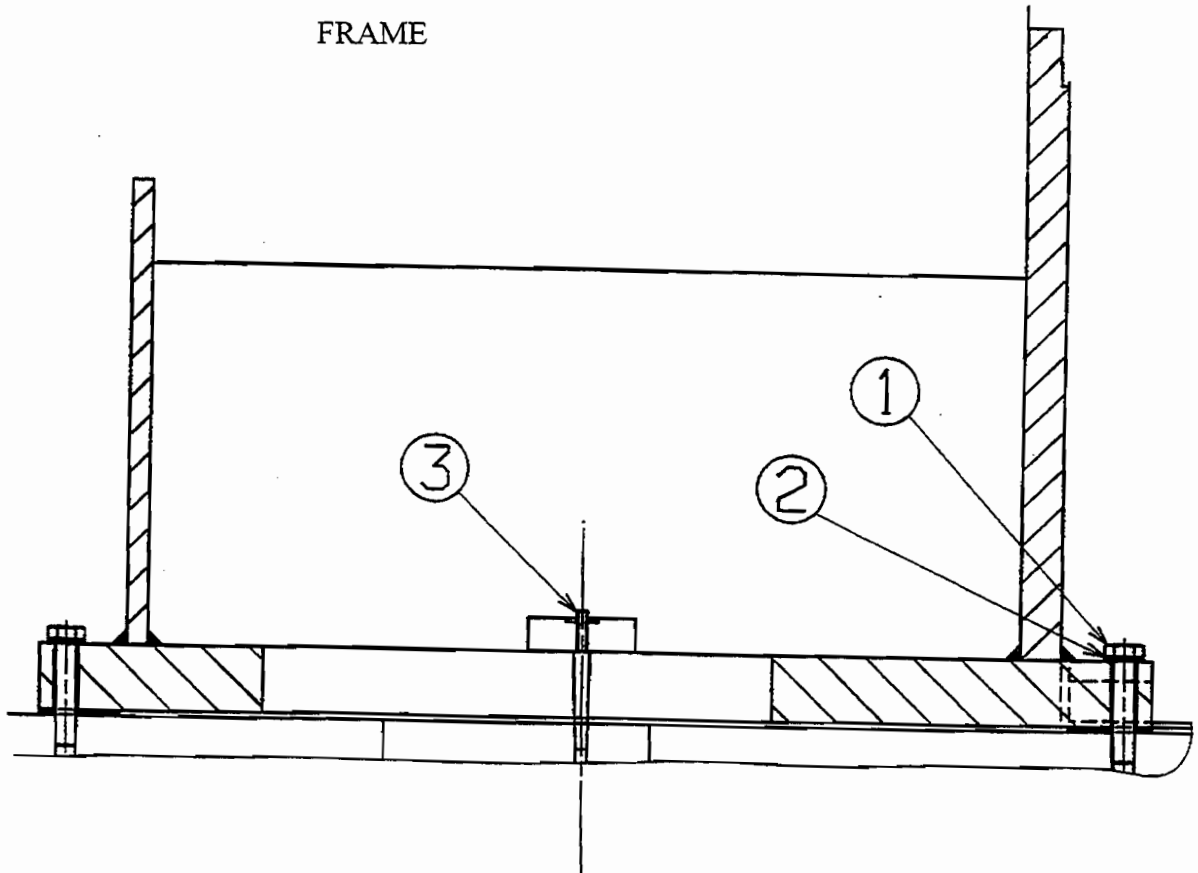
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DRAWING GBP-W-2-AE-08

FRAME



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06 03 08

KEY TO DRAWING GBP-W-2-AE-08

1. Screw H M 16x80
2. Washer M16
3. Taper pin

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06 03 09 Stator miscellaneous

Ventilation cover

The cover acts as a cooling duct for the distribution and circulation of air inside the exciter.

It is made up of electrically welded steel sheets.

It is fixed to the front part of the frame and to the base by means of welded angle irons.

Seals fixed between the cover and the frame are used for air tightness.

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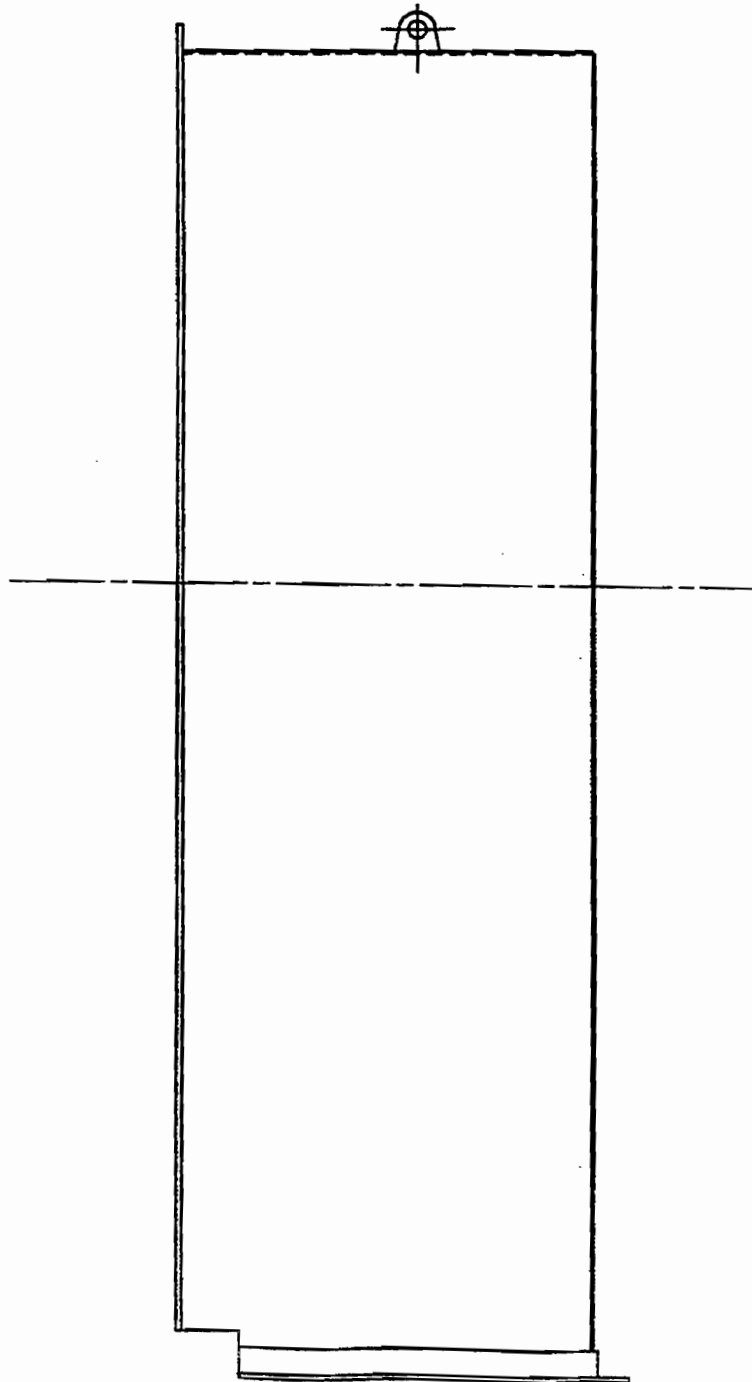
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Handling tooling

This tooling is used for any handling, of the field support, assembly or disassembly.

The tooling consists of two rail systems secured to the base and used for the shifting and guiding of the field handling trolley along the turbogenerator set centreline.

The trolley includes:

- A frame consisting of two beams attached together by two welded pins. A ball bearing is mounted at the end of each pin at the four corners of the frame.
- Two supports enabling the fixation of the field assembly. They are fastened to the frame by means of a joint. Each support is equipped with two bosses for adjusting screws. The air gap value can be maintained throughout the operation by actuating the adjusting screws.
- Two tie rod supports which connect the two supports to the frame. The tie rods are jointed at their two fastening points. Two threaded rods allow the assembly to be adjusted perpendicular to the rail system.

A two loop strap used as a sliding knot as well as a rope fasten the field assembly to its tooling in a horizontal position.

This system enables the field support to be handled and hooked to the travelling crane. Two fir wedges are used to support the field assembly.

Disassembly operations of the stator using this tooling are described in section 3.

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06 04 ROTOR

01 Exciter rotor - General

(Refer to drawing GBP-W-3-AE-01)

The rotor is the rotating part of the exciter.

It is mounted overhanging the shaft of the generator rotor.

The alternating voltage is induced and rectified through a rotating diodes bridge to feed the generator rotor.

The rotor mainly consists of a forged steel support (1), of a magnetic core with the armature winding (2), of a rectifier bridge with rotating diodes (3) and collector rings (4).

The rotor or rotating armature description will be as follows:

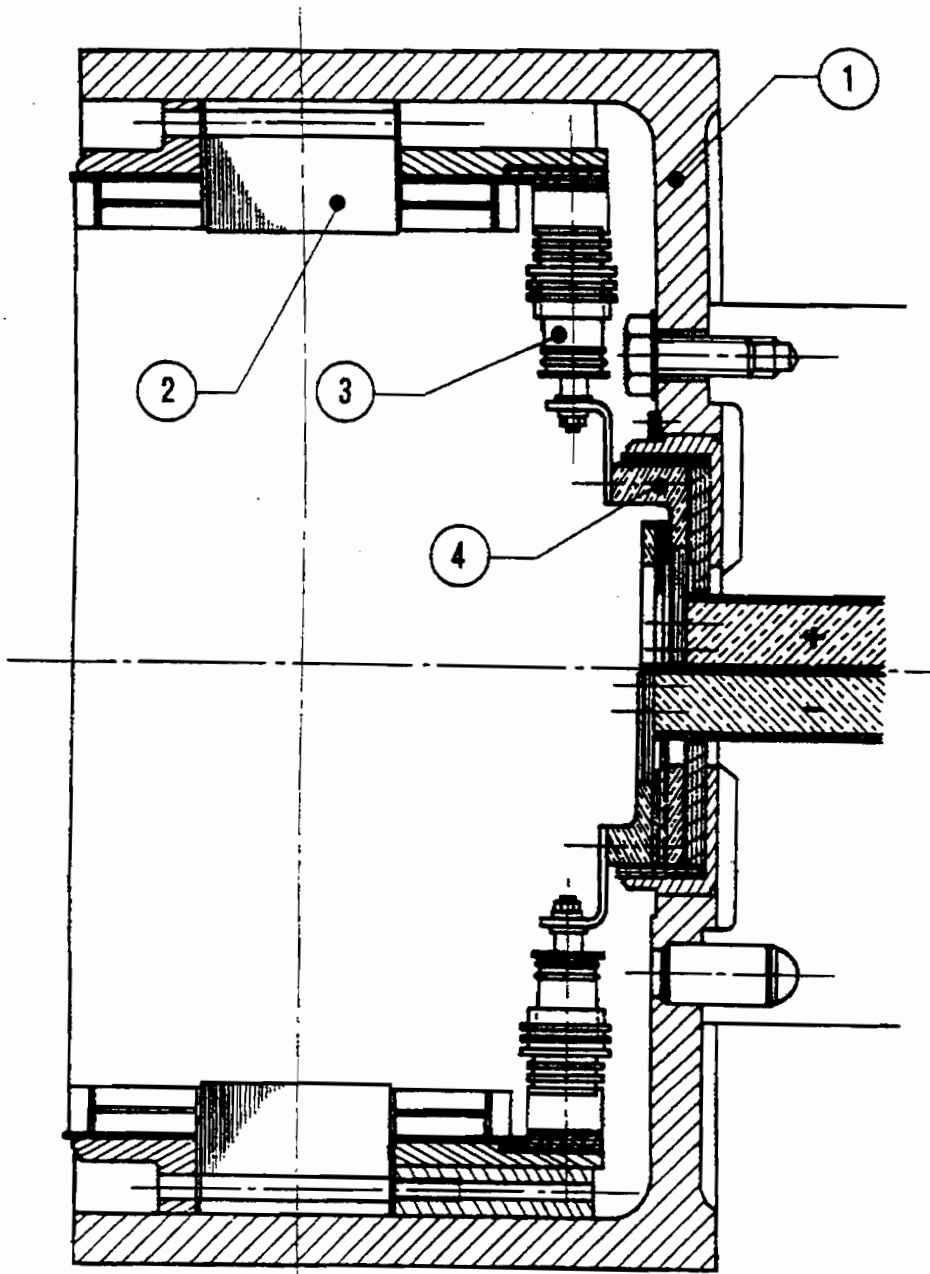
- armature support
- magnetic core
- armature winding
- rectifier bridge
- collector rings
- coupling

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06 04 01

KEY TO DRAWING GBP-W-3-AE-01

1. Armature support
2. Magnetic core - Armature winding
3. Rectifier bridge
4. Collector rings

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06 04 02 Armature support

(Refer to drawing GBP-W-3-AE-02)

The armature support is fabricated from a single alloy steel forging with high mechanical properties.

The ingot is elaborated in an electric furnace and cast under vacuum.

The steel characteristics are checked on test samples taken from the forging at the coupling level and at the end of the retaining ring - moreover, ultrasonic examinations are made to check the mass homogeneity and the absence of any inclusion.

The armature support is composed of two main parts:

- the retaining ring (1) whose thickness has been designed to hold the magnetic core firmly fitted in the bore (3). At its end, two trapezoidal grooves (4) are provided for the fitting of the balancing weights.
- the plate (2) is a solid disk whose external face is provided with a mating recess (5) for centering with the generator shaft. A central hole (6) provides for the passage of the excitation connectors.

The internal face of the plate has been machined (7) so as to be fitted with the collector rings.

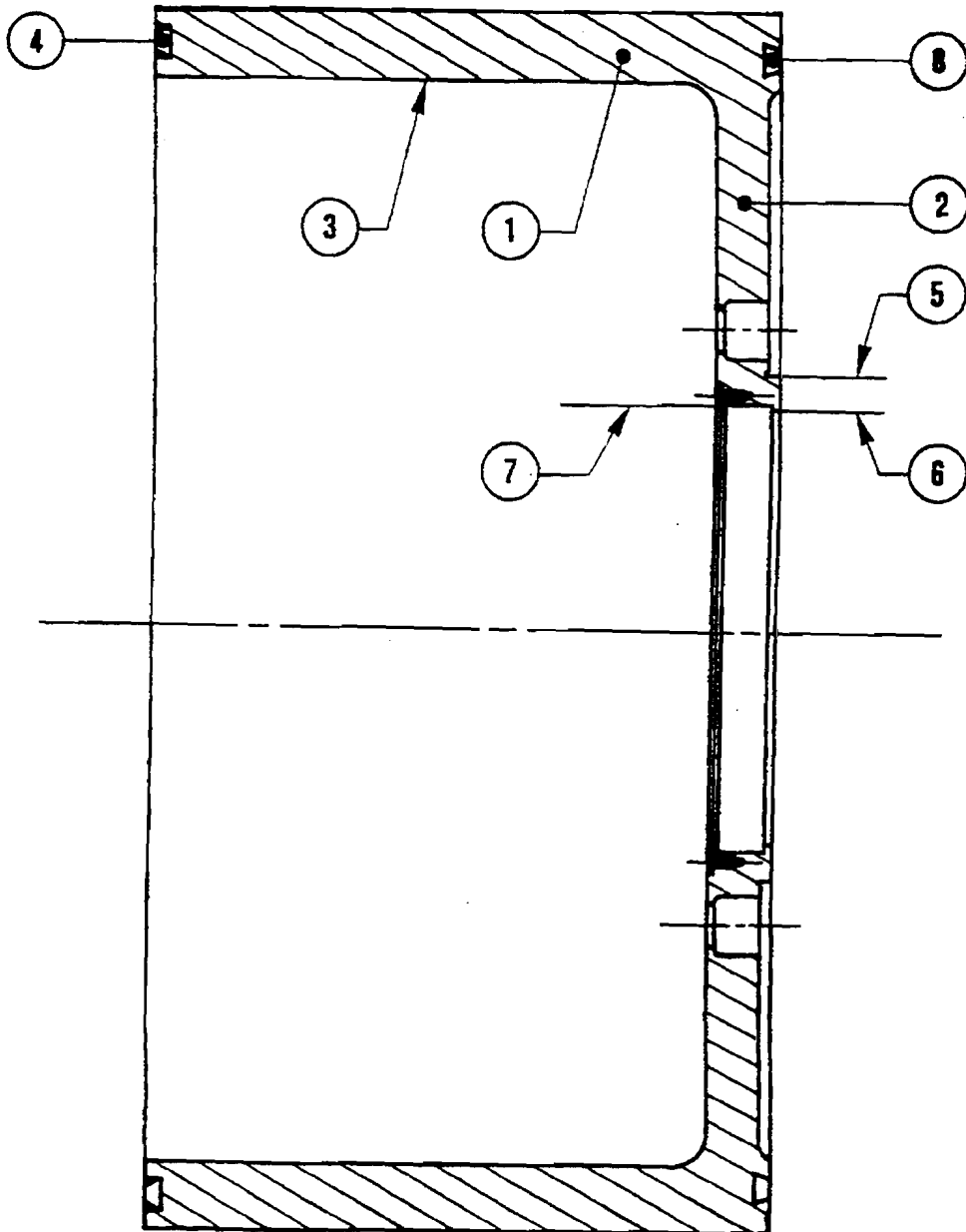
The external face is provided with a trapezoidal groove (8) for the fitting of the balancing weights.

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KEY TO DRAWING GBP-W-3-AE-02

1. Retaining ring
2. Plate
3. Bore for magnetic core
4. Groove at the end of the retaining ring
5. Mating recess
6. Central hole
7. Machining for collector rings
8. Groove on external face of plate

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06 04 03 Magnetic core

Magnetic punchings of the armature

(Refer to drawing GBP-W-3-AE-03)

The magnetic core is composed of one-piece stacked laminations (1). These laminations are punched out from thin, non-oriented grain, magnetic sheets.

The cold-rolled laminations are characterized by low losses and high permeability. They are subjected to a surface treatment and enamelled on both sides.

The inside of the lamination is provided with slots (2) that will be fitted with the armature winding.

At either end, the magnetic laminations are stuck together with varnish over a thickness of 30 mm.

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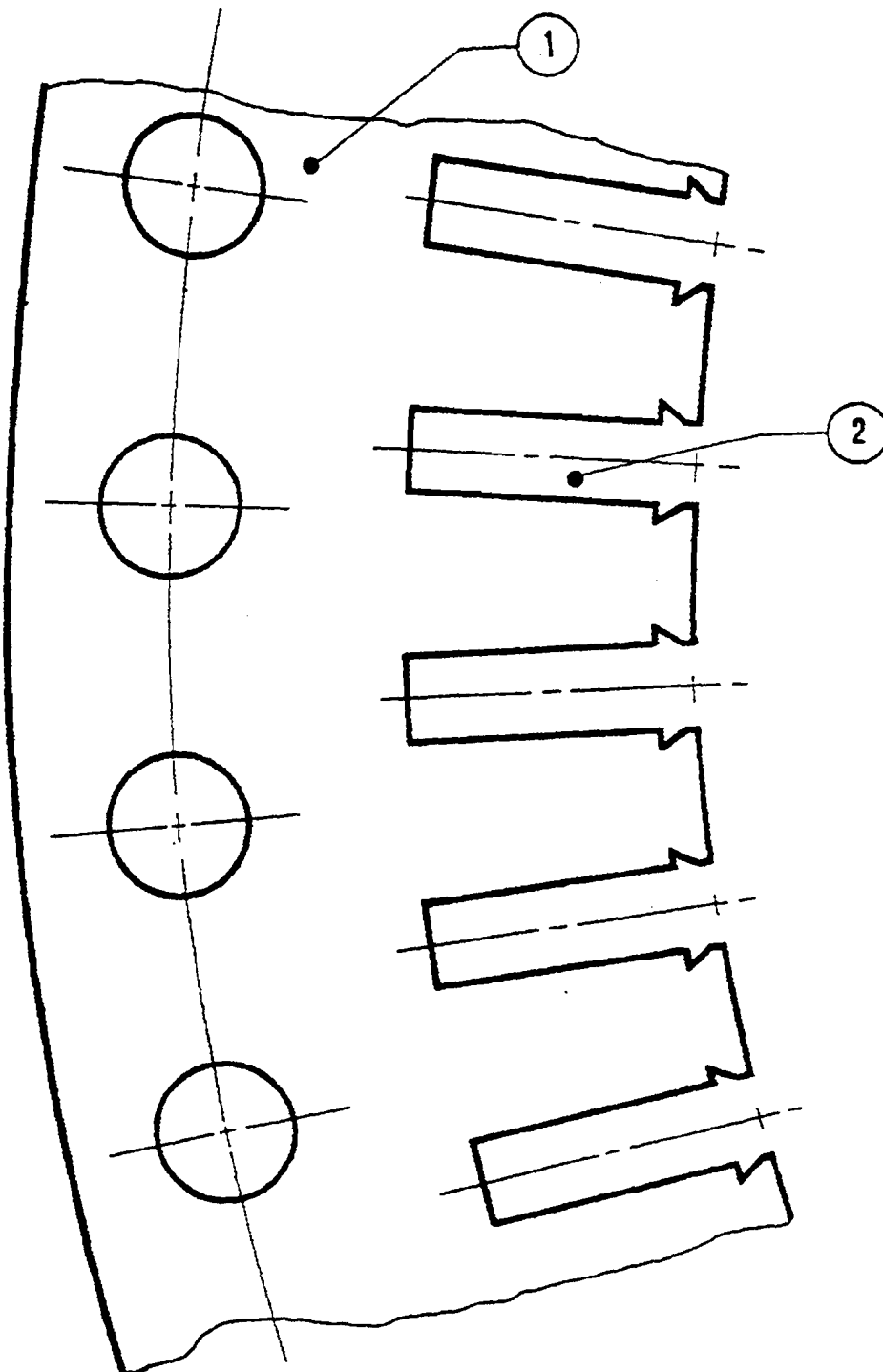
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DRAWING GBP-W-3-AE-03



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06 04 03

KEY TO DRAWING GBP-W-3-AE-03

1. Armature lamination
2. Slots

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Clamping plates - end-plates

(Refer to drawing GBP-W-3-AE-04)

The whole magnetic core includes:

- two clamping plates (1) and (2) made of forged steel.

The two clamping plates have together two main functions:

1. Holding the stacked magnetic laminations (3) strongly clamped.
 2. Supporting the endwindings and the wedges of the armature winding.
- end-plates (4) composed of packets of several staggered and cambered sheets are placed at both ends of the stacked punchings to secure the teeth of the magnetic core.

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OPERATION AND MAINTENANCE MANUAL

DESCRIPTIVE MANUAL

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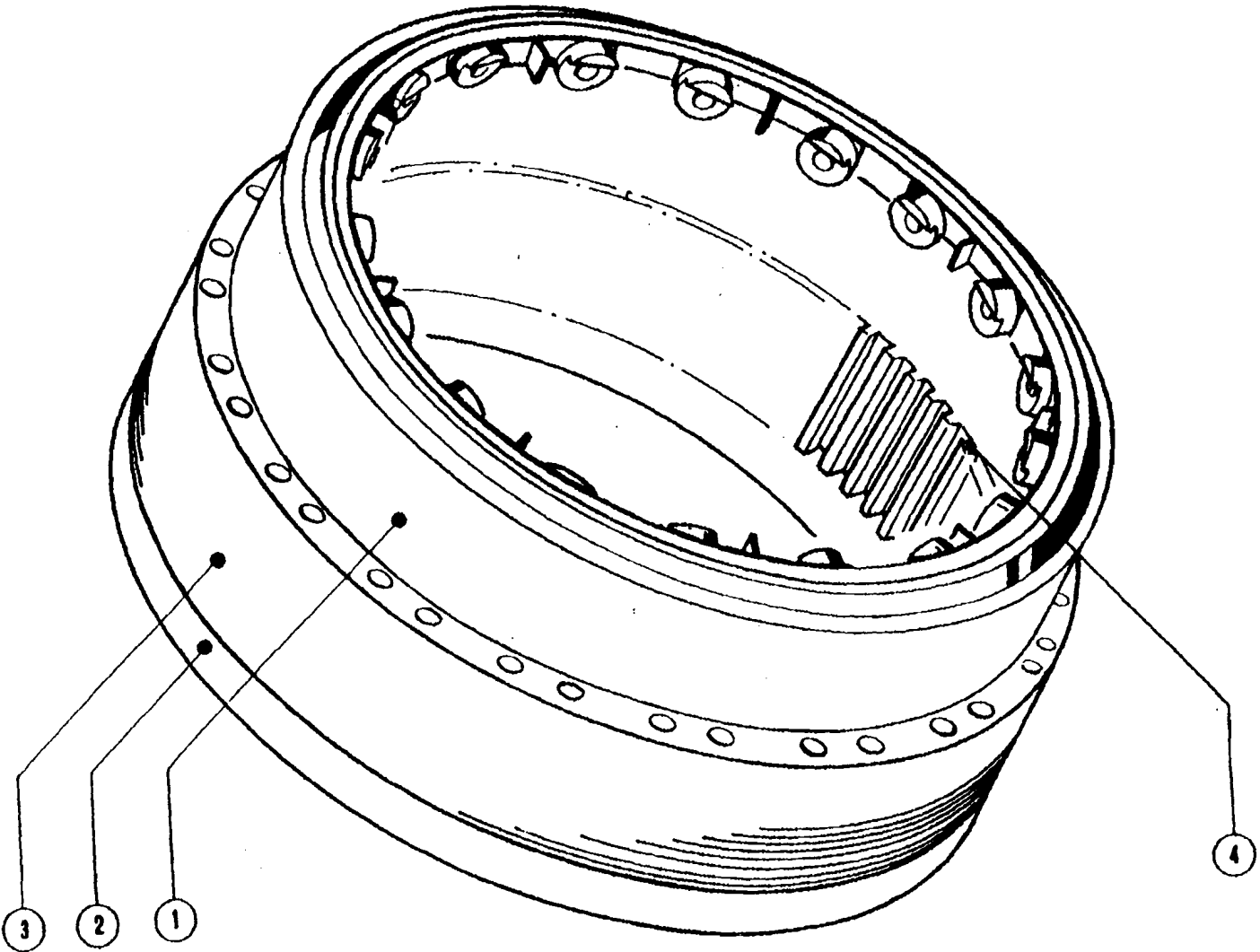
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06 04 03

DRAWING GBP-W-3-AE-04



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KEY TO DRAWING GBP-W-3-AE-04

1. Clamping plate 1
2. Clamping plate 2
3. Magnetic punchings
4. End-plates

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06 04 04 Armature winding

General

(Refer to drawings GBP-W-3-AE-03 and GBP-W-3-AE-04)

The winding of the rotating armature is the major part of the exciter. It is composed of conductors set in the magnetic core.

The electrical diagram of the rotor winding is shown on drawing GBP-W-1-AE-2.

The rotor winding consists of two main parts:

- the straight part located in the magnetic core
- the endwindings outside the magnetic core enabling the bars of the different slots to be connected together, thus forming the winding.

For the straight part, drawing GBP-W-3-AE-05 shows the sectional view of a rotor slot fitted with the slot bottom bar (1) and the air gap bar (2) separated with a polyester glass fibre spacer (3).

For the endwindings drawing GBP-W-3-AE-06 shows wedging (1) and (2) made up of several insulating tapes stuck together.

The rotor winding description will concern the following:

- design of rotor bars
- wedging in the core
- wedging of endwindings

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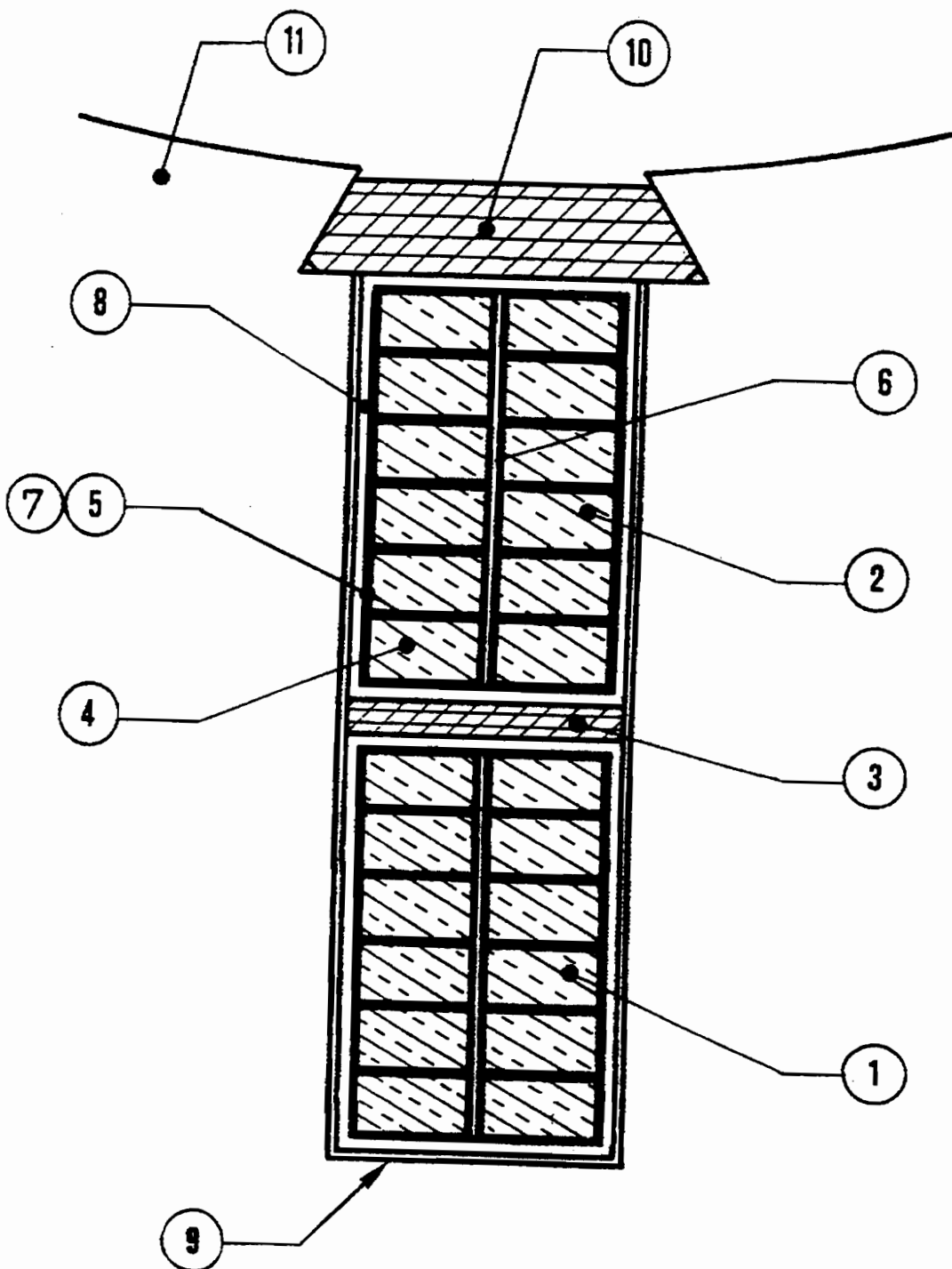
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DRAWING GBP-W-3-AE-05



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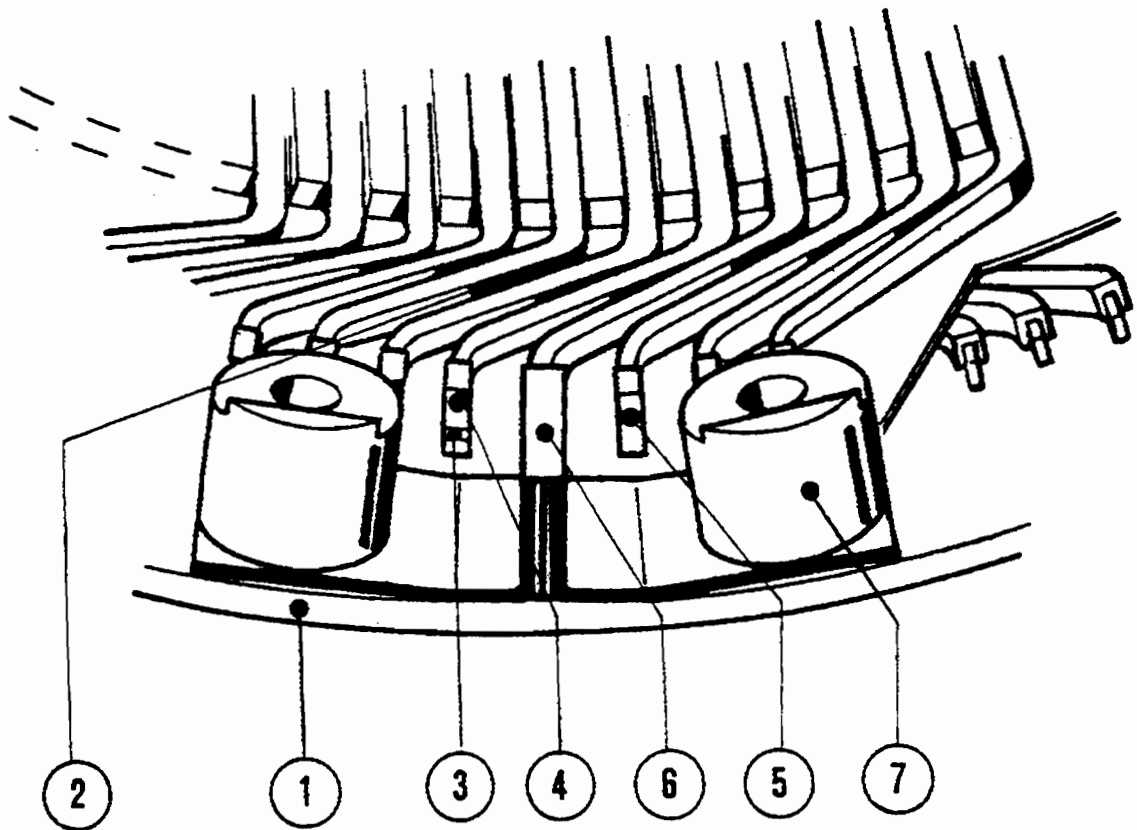
KEY TO DRAWING GBP-W-3-AE-05

1. Slot bottom bar
2. Air gap bar
3. Spacer between bars
4. Copper strand
5. Strand taping
6. Separator between copper strands
7. Compensating putty
8. Conductor insulation
9. Insulating wrapper
10. Trapezoidal wedge
11. Magnetic core

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DRAWING GBP-W-3-AE-06



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KEY TO DRAWING GBP-W-3-AE-06

1. Wedging beneath the clamping plate
2. Wedging between endwindings
3. Slot bottom bars
4. Air gap bars
5. Connection sockets
6. Outlets
7. Phase terminals

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Design of the rotor bars

(Refer to drawing GBP-W-3-AE-05)

The rotor bars are composed of annealed copper strands (4) of rectangular section transposed according to the ROEBEL system over the whole length of the magnetic core to limit the losses from the cross-slot field to a minimum.

The copper strands are insulated from one another by glass polyester glass taping (5).

A separator (6) made of epoxy preimpregnated mixed glass cloth is placed between the copper strands, in the width of the bar.

A thermosetting compensating putty (7) fills up the gaps resulting from the ROEBEL transposition.

All the copper strands form the electric conductor which is insulated from the magnetic core by an insulating material (8) composed of:

- 6 continuous half-lapped coats of 0.025 mm thick Kapton tape on the straight part and the endwindings,
- 1 half-lapped coat of 0.08 mm thick Nomex tape on the straight part,
- 1 half-lapped coat of 0.13 mm thick glass tape on the endwindings.

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Wedging

Wedging in the core

(Refer to drawing GBP-W-3-AE-05)

In each slot, the slot bottom bar (1) and air gap bar (2) are protected from the magnetic core (11) and wedged tangentially with Nomex material (9).

Tapered wedges (10) made of epoxy glass laminate are placed into each slot at both ends of the magnetic core. These wedges allow the correct positioning of the bars during the winding varnishing that must fill up the side gap and fix the bars in the rotor slots. After finishing, these wedges are removed.

Wedging beneath the clamping plate

(Refer to drawing GBP-W-3-AE-06)

This wedging consists of a strip (1) alternating several thin epoxy glass and Nomex strands stuck on the inner diameter of each clamping plate and then stuck together. This wedging is to fill up the space between the inner diameter of the plate and the various insulation layers on the endwindings, on the slot bottom bars (3), on the tapes around the connection sockets (5) and on the outlets (6).

Wedging of the endwindings

(Refer to drawing GBP-W-3-AE-06)

It consists of a strip (2) alternating several thin epoxy glass and Nomex strands stuck together.

This wedging is to fill up the space between the endwindings of the slot bottom bars (3) and of air gap bars (4).

All these wedges are designed and fitted carefully, for the rotor winding is highly stressed by centrifugal force.

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Electrical connections

Outlets - Connection sockets

(Refer to drawing GBP-W-3-AE-06)

Connection of the slot bottom bars (3) to the air gap bars (4) is through welded copper sockets (5).

An outlet (6) is welded onto each phase terminal (7). The copper outlets allow connection to the rectifier blocks.

Insulation of all sockets on the diodes side and on the opposite side and of a part of the outlets is composed of:

- two coats of a thermosetting polyester tape plus one coat of a glass tape.

Finally, the winding is varnished and subjected to an insulation test.

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06 04 05 Rectifier bridge

General

Basic diagram - Drawing GBP-W-3-AE-07

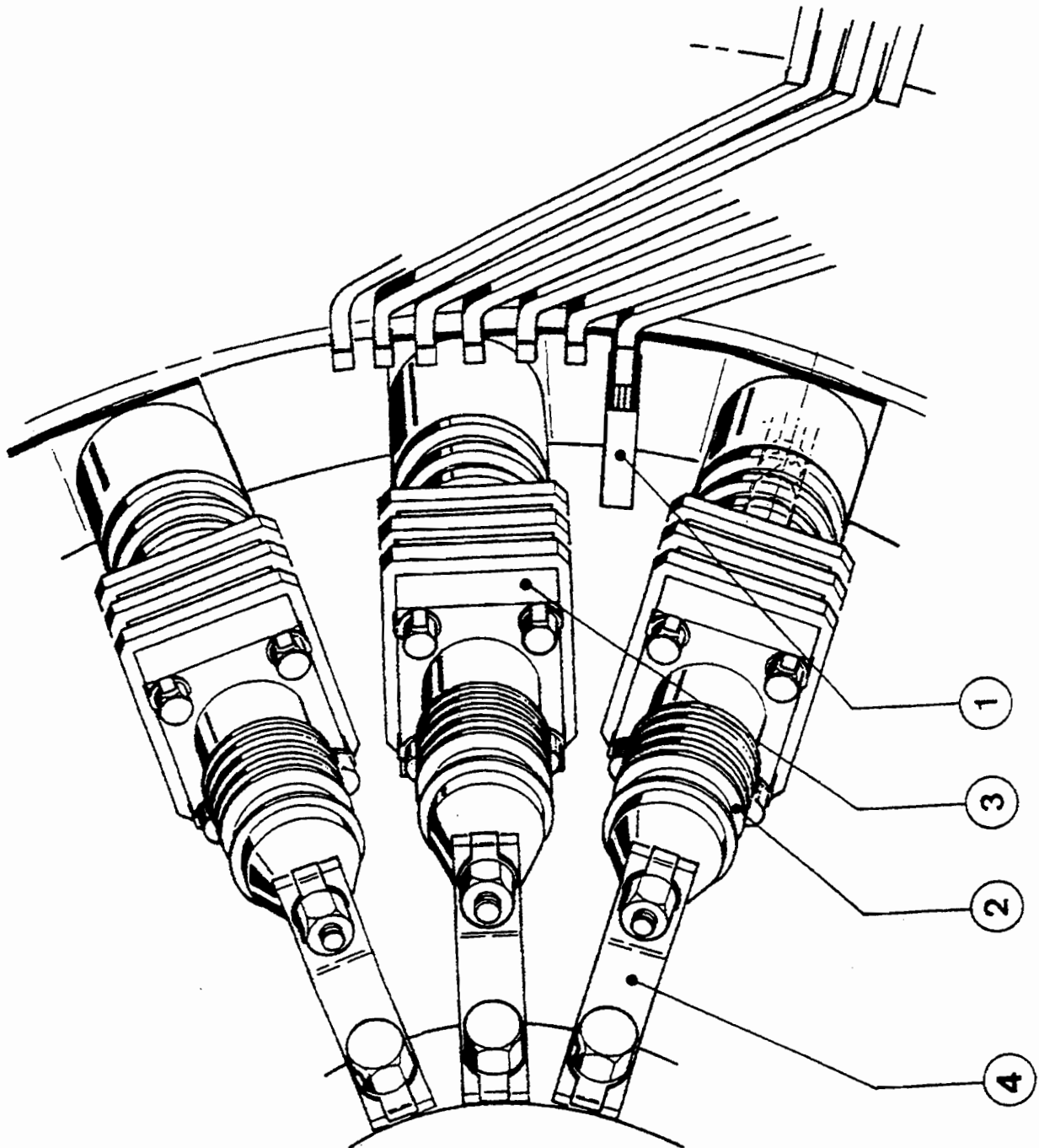
The rectifier bridge is used to transform the exciter alternating current into direct current for supply to the generator shaft bore leads.

In the machine each phase terminal is connected to two diodes, one anode based diode (+) and one cathode based diode (-).

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DRAWING GBP-W-3-AE-07



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KEY TO DRAWING GBP-W-3-AE-07

1. Phase
2. Anode based diode
3. Cathode based diode
4. To generator shaft bore leads

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Description of a complete rectifier bridge

(Refer to drawing GBP-W-3-AE-08)

A rectifier block is composed of three separate elements assembled at the bottom of the armature support.

- The first element includes:
 - A machined heat sink (1) which provides electrical connection between the diodes and evacuates the heat produced by their operation. This heat sink is made out of aluminium. Grooves machined on the four lateral sides of the heat sink ensure sufficient cooling.
- The second element includes:
 - An anode based diode (2) fixed to one end of the heat sink by four screws.
 - A laminated connection (5) made of tinned copper and fixed by a nut (7) on the upper part of the diode is for connection to the collector ring of the same polarity.
- The third element fulfills the same functions as the second element. It includes:
 - A heat sink
 - A cathode based diode (3)
 - A laminated tinned copper connection (6)

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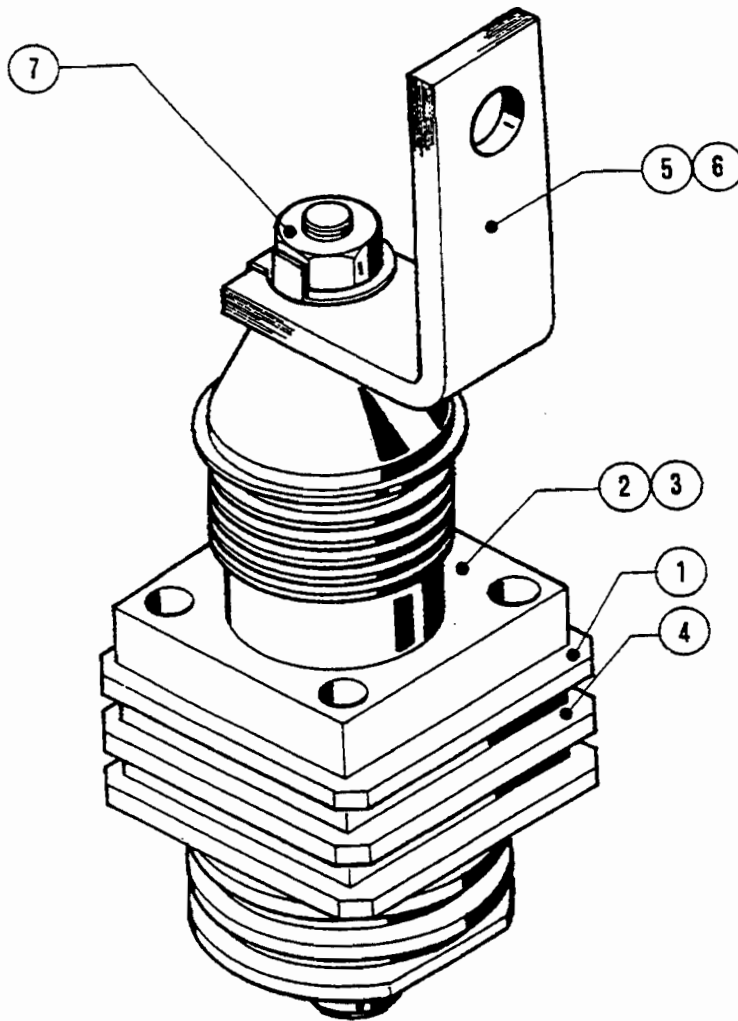
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DRAWING GBP-W-3-AE-08



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KEY TO DRAWING GBP-W-3-AE-08

1. Heat sink
2. Anode based diode (+)
3. Cathode based diode (-)
4. Diode connection (+) to the collector ring
5. Diode connection (-) to collector ring
6. Nut on the diode head

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Fitting of the rectifier blocks in the rotor

The rectifier blocks are fitted through the intermediary of their contact plate in each countersinking of the connector already in place.

This assembly provides efficient mechanical behaviour and effective electrical contact through centrifugal force action as well as quick and easy disassembly.

Each connector integral with each diode head is then connected to the collector ring of the same polarity and fixed with a lock screw.

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Collector rings - Diodes

General

(Refer to drawing GBP-W-3-AE-09)

The collector rings form a monoblock part whose various components can be dismantled.

This assembly receives on two copper rings insulated from one another the rectified diode current for supply to the generator shaft bore leads.

The collector ring assembly is composed as follows:

- The ring (1) made of cupro-chromium is forged, treated and machined on all sides. Studs (2) are machined in the outer diameter of the front face of the ring. Their middle is tapped (3). They allow the diode connectors to be connected. A central connector (4) is inserted and tin-welded in the ring.
- The insulating disk (5) made of epoxy glass is punched out from a plate. It is fitted between the two rings.
- The ring (6) made of cupro-chromium is forged, treated and machined on all sides. Studs (7) are machined in the outer diameter of the front face of the ring. Their middle is tapped. They allow the diode connectors to be connected.

A central connector (9) diametrically opposite to that of ring (1) is inserted and tin-welded in the ring.

- An insulating retaining ring (10) receives the rings and the insulating plate (5).
- The plate (11) made of low alloy forged steel, holds all the insulated rings and the insulating retaining ring and ensures an efficient mechanical behaviour while the unit is running. Smooth holes (12) are drilled through all the parts. They allow the fixing of the collector rings in the plate by means of insulated screws.

The two diametrically opposite central connectors allow connection to the generator connectors.

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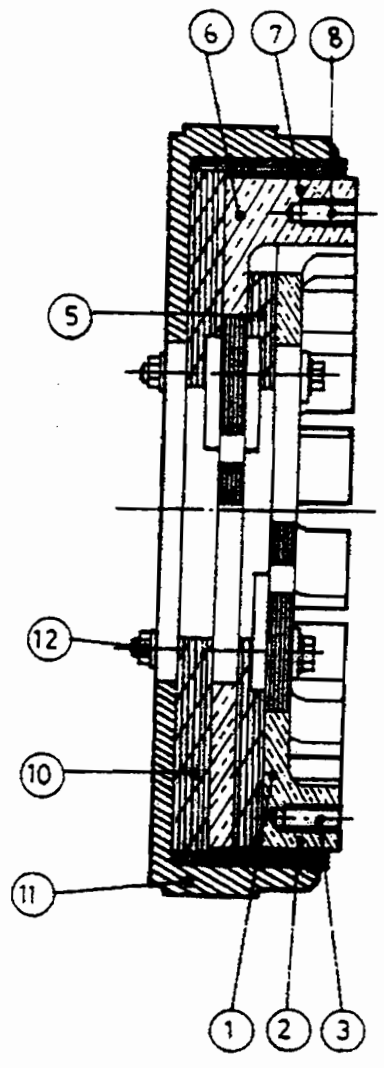
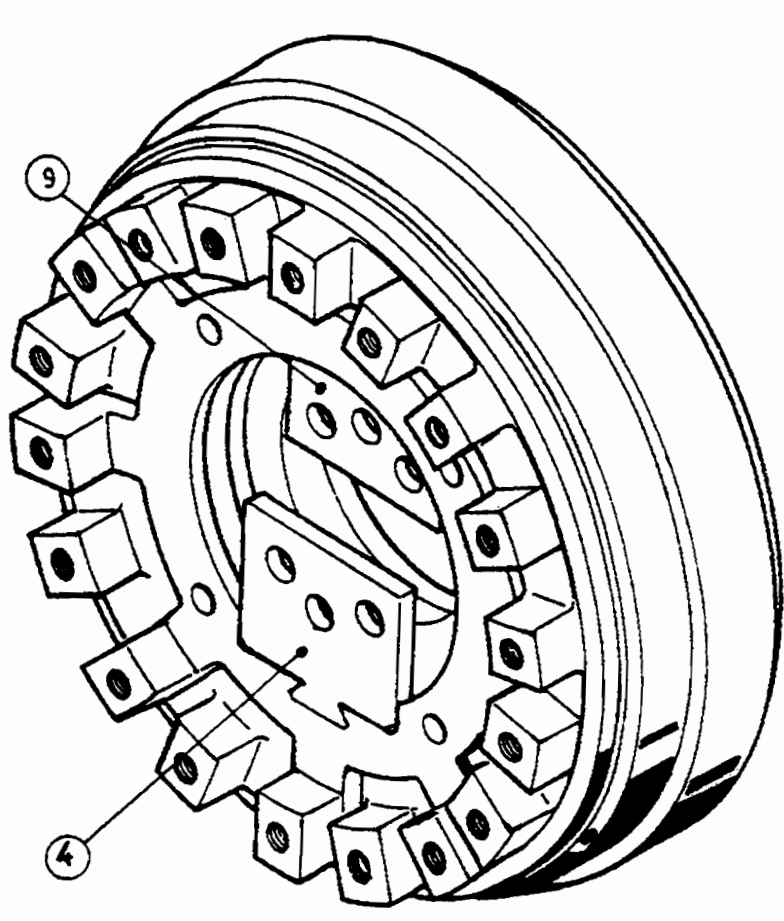
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DRAWING GBP-W-3-AE-09

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KEY TO DRAWING GBP-W-3-AE-09

1. Lower ring
2. Studs
3. Tapped holes for fixation of diode connectors
4. Lower central connector
5. Insulating disk
6. Upper ring
7. Studs
8. Tapped holes for fixation of diode connectors
9. Upper central connector
10. Insulating retaining ring
11. Plate
12. Fixing system

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Fixing in the armature support

The collector ring assembly is fitted in the part machined for this purpose at the bottom of the armature support.

Correct connection of the diode connectors is ensured by a positioning key.

Three screwed lugs prevent any translation movement.

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Electrical connection

The electrical connection is through the two opposite laminated connectors.

Contact is provided by a tinned surface at the end of the two connectors of the collector assembly.

The laminated connectors are fixed to the end of the turbogenerator shaft bore leads.

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06 04 07 Coupling

Coupling is made with screws, pins and fitting between the turbogenerator rotor and exciter rotor.

The screws and pins are made out of low alloy steel with high mechanical properties.

The tightening torque applied to the screws and the pin sections are calculated to withstand short circuit torques.

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06 04 08 Rotor miscellaneous

Rotor tooling

The tooling required for rotor assembly and disassembly operations includes:

- A two-part clamp to be mounted around the rotor centre of gravity. Two round bars are welded to the upper half-clamp. They are fitted with lifting rings. Two lugs are welded to the lower half-clamp. They provide for the attachment of the assembly to a roller support.
- The support is made up of thick, electrically welded steel sheets. It includes four rollers enabling the rotor to be shifted.

The assembly -clamp mounted on the rotor and then fastened to support- is handled by means of the travelling crane.

The disassembly operations requiring this tooling are described in section 3-Maintenance.

APPENDIX VIII

Generator terminals OEM descriptive drawings

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03	06	05	Connection to HV terminals
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See drawing GBT-W 3348

The ends of each phase are attached to the circular phase connections (1) which lead from the winding ends to the top and bottom of the generator (4).

All copper connections, including the circular phase connections, are carefully insulated along their entire length.

The conductor ends (1) are kept in position with respect to the generator (4) by means of a clamping device (2) composed of insulating wedges (3) assembled by screws and nuts.

An insulating plate (5) closes the generator, while allowing passage for bushing leads (6).

Like the rest of the winding, these connections to the HV terminals are cooled by air flow around the conductors.

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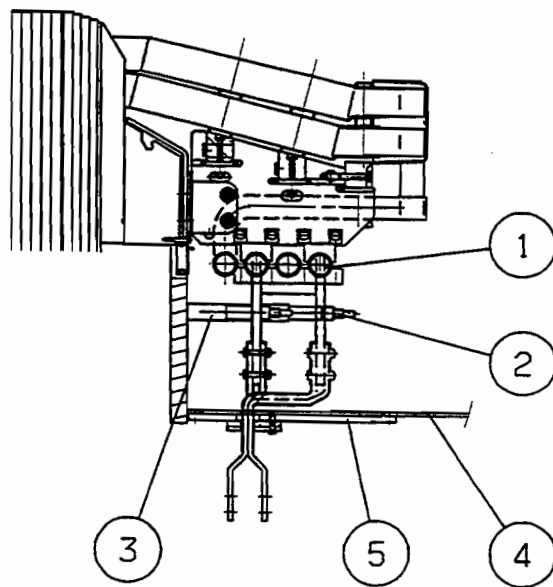
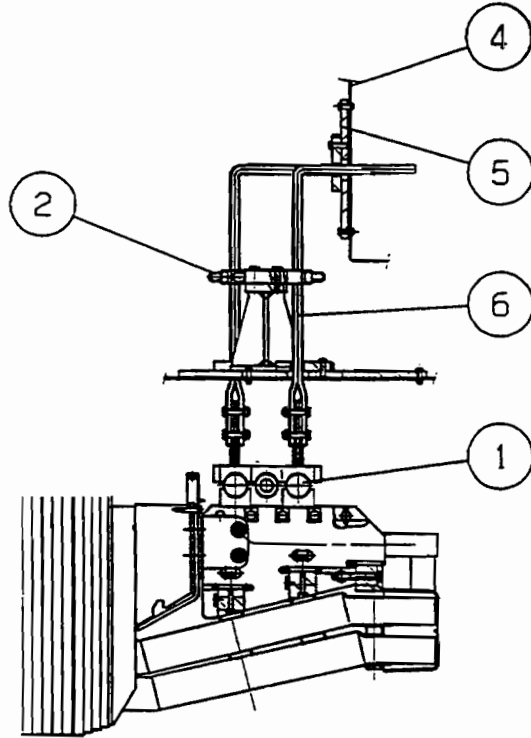
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KEY TO DRAWING GBT-W 3348

1. Circular phase connections
2. Clamping device
3. Insulating wedges
4. Generator
5. Plate
6. Bushing leads

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Referencing of the terminals

See drawing GBT-W 3349

The above drawing sets out the location of the bushing leads and their references.

The generator (1), viewed from below, is shown on figure 1.

The generator (2), viewed from above, is shown on figure 2.

The identification of the following terminals is:

- Phase terminals: U1 (7), V1 (8) and W1 (9),
- Neutral terminals: W2 (4), V2 (5) and U2 (6).

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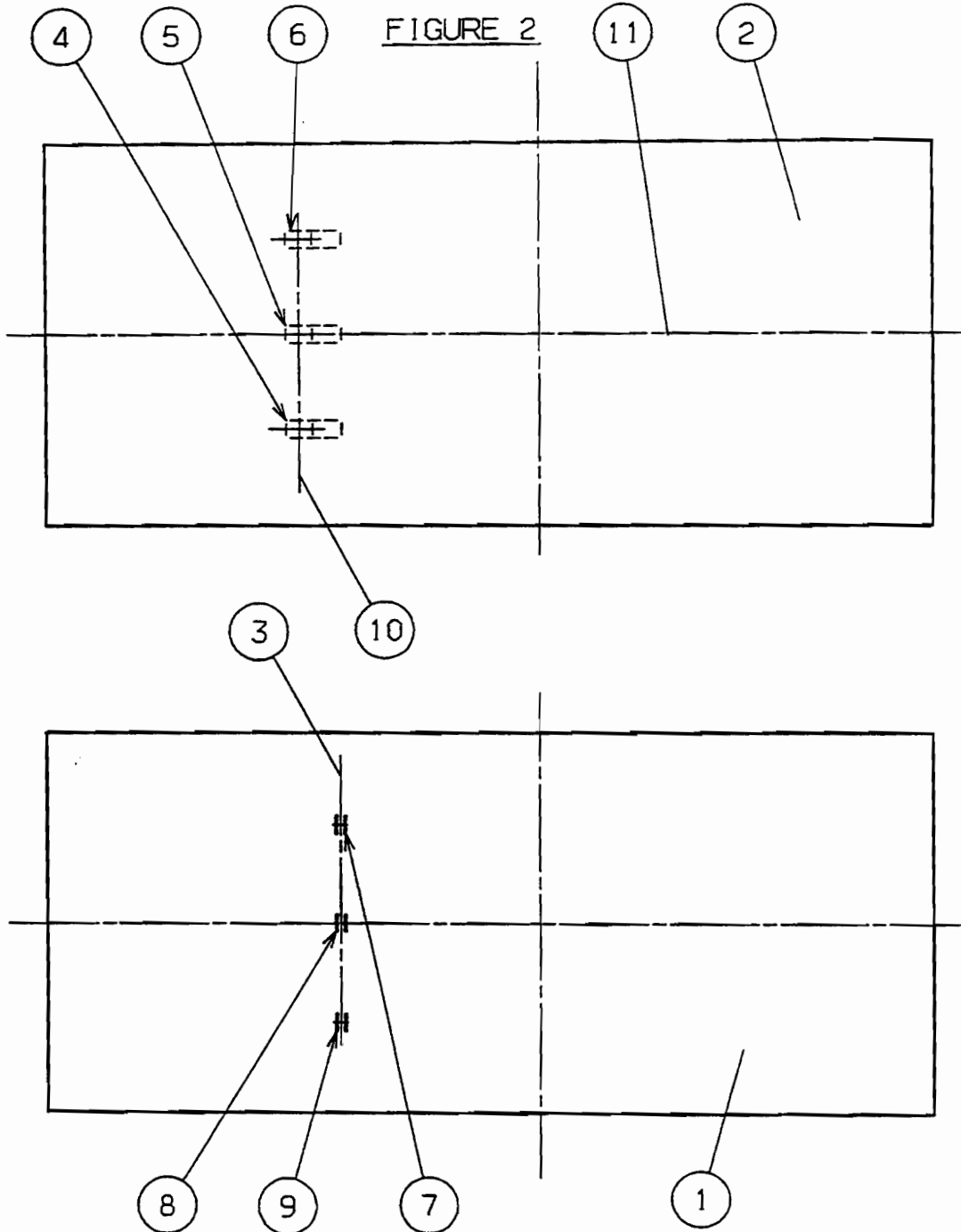


FIGURE 2

FIGURE 1

DESCRIPTIVE MANUAL

Mod.	Chap.	Par.
03	06	06

KEY TO DRAWING GBT-W 3349

1. Generator viewed from below
2. Generator viewed from above
3. Row of phase terminals
4. Neutral terminal W2
5. Neutral terminal V2
6. Neutral terminal U2
7. Phase terminal U1
8. Phase terminal V1
9. Phase terminal W1
10. Row of neutral terminals
11. Generator axis

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Mod.	Chap.	Par.
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03 06 07 Circular phase connections

See drawing GBT-W 1674

The circular phase connections (1) are parts of the copper ring of ring-shaped section made up of a ground insulation (2).

According to the end-winding diagram, one or two of each of the circular phase connection parts has a connection to the stator end-winding.

The circular phase connections (1) are held by the insulating supports (3) and radially clamped by the clamping flanges (5) and the screws (6).

The screws (6) rest on the insulating supports by means of the nuts (7) and possess a braking system (8).

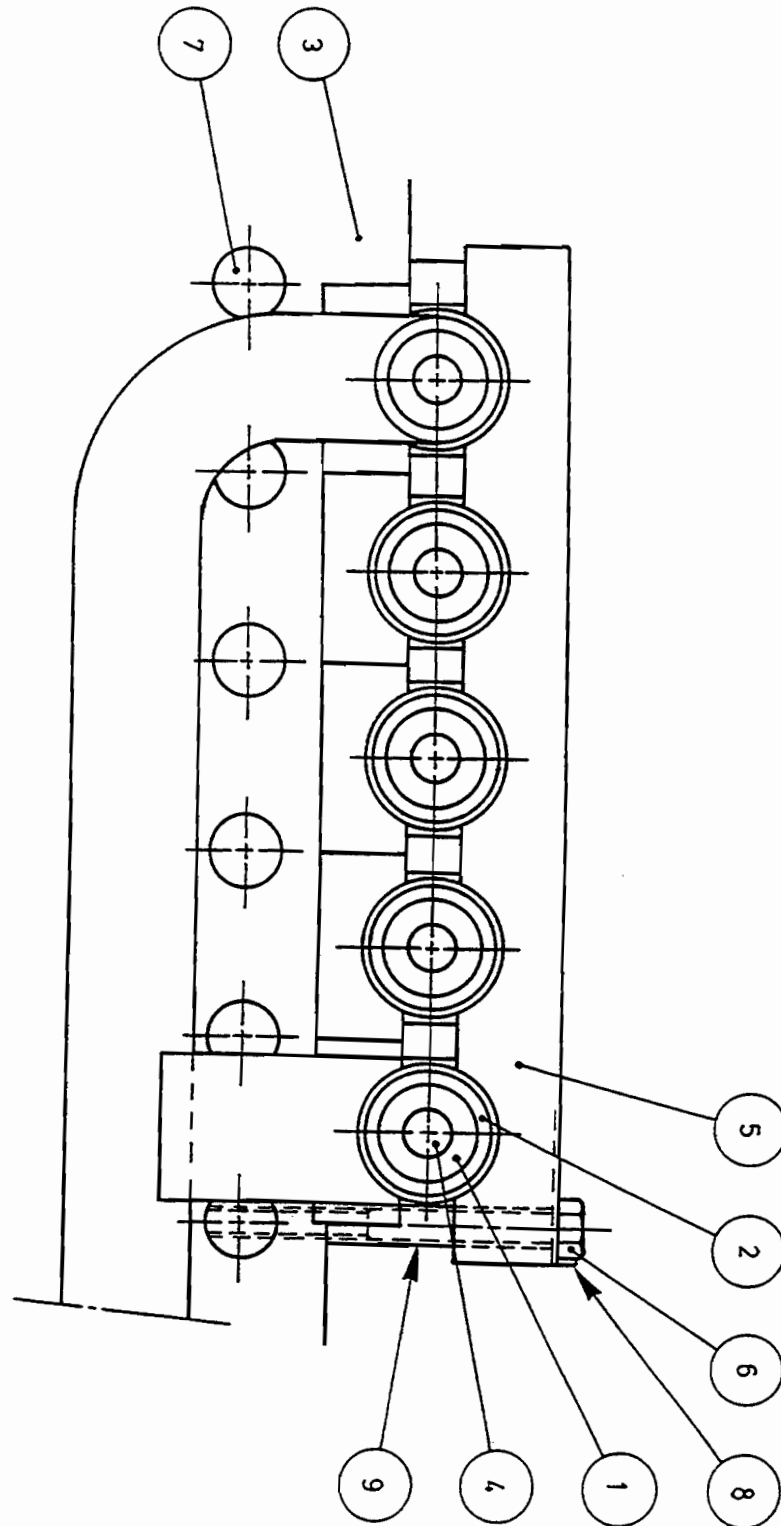
The screws (6) are equipped with an insulating tube (9).

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Mod.	Chap.	Par.
03	06	07



GBT-W 1674

Mod.	Chap.	Par.
03	06	07

KEY TO DRAWING GBT-W 1674

1. Circular phase connection
2. Ground insulation
3. Insulating support
4. Not applicable
5. Clamping flange
6. Screws
7. Nut
8. Braking system
9. Insulating tube

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