2016.02.26 09:48:17 CAT J. PRINSLOO (Z4173085) Phone 0215504630
0LZC012JA - 712626796
MAINT REF NO.: E107834
OPERATION 0010 - REPLACE DEFECTIVE 220V BREAKER

F/C: CONDITION 3 - SATISFACTORY
EXPLANATION: EQUIPMENT FOUND IN A GOOD WORKING CONDITION
C/A: REPAIR
FAULT CONDITION: CERTAIN OUTGOING FEEDER BREAKERS WERE FAULTY AND WORKING INTERMITTENTLY. A DECISION WAS TAKEN TO REPLACE ALL THIRTEEN OUTGOING FEEDER BREAKERS AS ITS OF THE OLDER TYPE BREAKERS.
REPAIRS: ALL THIRTEEN OUTGOING CIRCUIT BREAKERS (2 POLE) OF 0LZC SWITCHBOARD REPLACED WITH NEW EQUIVALENT SPARES
T/R: ALL THIRTEEN OUTGOING FEEDER BREAKERS REPLACED WITH NEW EQUIVALENT CIRCUIT BREAKERS. ALL THE NEW INSTALLED BREAKERS WERE INSTALLED AND TESTED AND OPERATED SUCCESSFULLY.
R/C: SUSPECT COMPONENT DEGRADATION
M&TE: KEM301081(Y)
RI NUMBERS: 53717
RUNNING HRS: N/A
STARTS/ACTUATIONS: N/A
CROSS REF: PTW - 9/16-87555
W/O - 712626796
COMPLETED BY: I. GABRIELS
VERIFIED BY: W. SIMPSON
COMPLETION DATE: 2016/02/10
FOR MORE INFO CONTACT MAIN DOCS...

C.O.C; 0277/88Q; Q3:1E:1:0; SEE EQUIVALENCE E018/09E REV2; BREAKER, CIRCUIT; MNF: MERLIN GERIN; P/N: MG C60N-10A; WITH AUXILIARY SWITCH (OF + SD) - NO. 26929; SWITCHGEAR DESIGN: MCB; POTENTIAL: 230 V AC; CURRENT: 10 A; SHORT TIME CURRENT: 5 KA; POLE: 2; CONTROL VOLTAGE: 230 V AC; CREEPAGE: >0.5 MM; BASIC INSULATION LEVEL: 25 M OHMS; INSULATION MATERIAL: PLASTIC; OPERATING CONTROL TYPE: 230 V AC; POLLUTION CLASS: 3; APPLICATION: PROTECTION & ISOLATION; TEMPERATURE RATING: 40 DEG C; WIDTH: 36 MM; LENGTH: 70 MM; HEIGHT: 81 MM; MOUNT: DIN RAIL; M/MAN: 308,571; FUNCT.LOC: 1/2 LNA/B/C/D 001 DL; END DETAIL DESCRIPTION; JNF 2009/04/07; CLC 2013/09/12; JNF 2015/08/05; BN 2022/10/13

Eskom

TD & RM

RECORD COVER SLIP

Reference No.:	KFI-RE-001	
Revision: 1		Page: 1
Associated Procedure:	KAA-830	

ALLOC. CENTRE	DOCUMENT NUMBER		REV	FOR OFFICE USE ONLY
		1139445	0	

TITLE	COVER SLIP COMPLETED BY
EQUIVALENT: CIRCUIT BREAKER. (REV 1)	CHAMELLE TULLEY

DOCUMENT TYPE	SECURITY CLASS
RECORD	RESTRICTED

AUTHOR ORIGINATOR

MB FAHRENFORT

TRIGRAMME (STATUS COMMENTS)

1/2 LNA/B/C/D 001 DL (DJ02;DJ03, 101, 102, 103, 104, 105, AND 106 JA)
1/2 LNE 001 DL (DJ02; DJ03)

ADDRESSEE

REF. DATE (CCYYMMDD)	KIS / SHELF LOCATION	NO. OF PGS	RETENTION PERIOD	
2009/10/13	PT095	59	YEARS	40

REFERENCE NUMBERS

E018/09E
S2009/0180

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NOTES

ESKOM

KOEBERG NUCLEAR POWER STATION

DESIGN ENGINEERING GROUP

EQUIVALENCY STUDY NUMBER:	E 018/09E
EQUIVALENCY STUDY TITLE:	Circuit Breaker
ORIGINAL EQUIPMENT:	MERLIN GERIN F32 / C32H-DC series
PROPOSED REPLACEMENTS:	MERLIN GERIN C60N series

PREPARED BY:		**MB Fahrenfort**
REVIEWED BY:		**EJ Kerr**
REVIEWED BY:		**SME**
AUTHORISED BY:		**NW Boonzaier**
DATE:	2009-10-13	
DATA CAPTURED		**C Tulley**

KOEBERG NUCLEAR POWER STATION

DESIGN ENGINEERING GROUP

	AUTHORISED: AM Kotze	DATE:
REVISION	**PREPARED BY**	**REVIEWED BY**
Original	MB Fahrenfort	EJ Kerr
Rev 1	MB Fahrenfort	EJ Kerr

RECORD OF REVISIONS

Rev	Date	Description of Revision	Prep.	Rev.	Auth.
0	2009-03-25	Original	MBF	EJK	AMK
1	2009-09-30	Added auxiliary switch to C60N-32 A circuit breaker.	MBF	EJK	NWB

CONTENTS

1.0 SCOPE

1.1 Equivalency Evaluation between:

MERLIN GERIN F32 and C32H-DC series circuit breaker

and proposed replacement(s)

MERLIN GERIN C60N series circuit breaker

1.2 Equipment Trigramme

1/2 LNA/B/C/D 001 DL (DJ02; DJ03; 101, 102, 103, 104, 105, AND 106 JA)
1/2 LNE 001 DL (DJ02; DJ03)

1.3 Function of the Equipment

LNA/B/C/D 001 DL:
The circuit breakers (rated at 32 A, 10 A and 2 A) and auxiliary switch (only on the 32 A circuit breaker), are used in the dirty supply circuit (DJ03), as the outgoing feeders (101 -106 JA) and in the inverter control circuit (DJ02), respectively in the 5 kVA inverter units.

LNE 001 DL:
The circuit breakers (DJ02 and DJ03, both rated at 2 A), are used in the auxiliary power circuit on the 20 kVA inverter units.

1.4 Reason for change

The original MERLIN GERIN F32 and C32H-DC series circuit breakers are obsolete.

1.5 Classification

Classification No	:	**0277/88Q**
Safety	:	**1E**
Seismic	:	**1**
Quality	:	**Q3**
Environmental	:	**0**
Importance	:	**CSR**

2.0 REFERENCES

2.1 DSE-LNi;

2.2 DSE-LNE;

2.3 MM 308;

2.4 MM 571;

2.5 MERLIN GERIN catalogue;

2.6 Schneider Electric Catalogue (Jan 2002);

2.7 SAR II-11.2.2.2.1;

2.8 Equivalency study E 039/91E ;

2.9 Equivalency study E 061/91E;

2.10 Equivalency study E 061/93E.

3.0 EQUIPMENT REQUIREMENTS

3.1 Service Conditions

3.1.1 Normal Environment:

Temperature	:	5 to 40°C
Pressure	:	Atmospheric
Humidity	:	40 to 90%
Radiation	:	Background

3.1.2 Accident Conditions

The circuit breaker is safety related and is required to operate under seismic and nuclear accident conditions.

3.2 Functional Requirements

The following are the functional requirements for the item under evaluation:

Voltage rating (V ac)	:	220
Rated current (A) @ 40°C	:	32, 10 and 2
No. of poles	:	2
Maximum short circuit current (kA)	:	5
Frequency (Hz)	:	50
Auxiliary switch	:	1 NO

3.3 Physical Requirements

Mounting	:	DIN rail
Terminals	:	Self-clamping

3.4 Verification and Test

KWM-EP-MAC-017 (for 5 kVA inverters) and KWM-EP-MAC-018 (for 20 kVA inverters).

3.5 Quality Assurance

Final inspection and test certificates are sufficient, based on NOTE 8 of section 4.1 and the attached seismic justification report (see attachments 12.4 and 12.5).

3.6 Availability

The circuit breaker is available through Schneider Electric distributors.

4.0 TECHNICAL EVALUATION / OE

4.1 TECHNICAL EVALUATION

DESCRIPTION Attachment 12.6 lists all the criteria considered.	FUNCTIONAL REQUIREMENTS	MERLIN GERIN C32H-DC series circuit breaker see attachment 12.2	MERLIN GERIN C60N series circuit breaker see attachment 12.3	COMMENTS
FUNCTION				
Voltage rating (V ac)	220 (ref. LNi-DSE)	220	230	Acceptable **Note 1**
Rated current (A) @ 40 ºC	LNi-DSE (ref. Inverter design).	32, 10 and 2	32, 10 and 2	Same
Breaking Capacity (kA)	5 (ref. LNi-DSE)	20	10	Acceptable **Note 2**
No. of poles	2 (ref. LNi-DSE Inverter design).	2	2	Same
Mechanical life span-operations (10^3)	None. (ref. Original equipment specification)	20	20	Same
Tropicalisation	77%@40ºC (ref. LNi-DSE)	95% @ 55ºC	95% @ 55ºC	Acceptable **Note 3**
Tripping characteristics	No design basis. 5,5 to 8,8 In Based on the original F32 circuit breaker.	U-curve (5,5 to 8,8 In)	C-curve (5 to 10 In)	Acceptable **Note 4**
Auxiliary switch	1NO. (ref. Original equipment specification)	1 NO	1 NO	Same
Cable size (mm^2)	≤ 25 (ref. inverter design – MM571)	≤ 25	≤ 60	Acceptable **Note 5**
FORM/FIT				
Dimensions (LxHxD) mm	Requirement acceptance based on visual inspection.	36x80,5x66	36x81x70	Acceptable **Note 6**
Mounting	DIN rail (Visual inspection)	DIN rail	DIN rail	Same

DESCRIPTION Attachment 12.6 lists all the criteria considered.	FUNCTIONAL REQUIREMENTS	MERLIN GERIN C32H-DC series circuit breaker see attachment 12.2	MERLIN GERIN C60N series circuit breaker see attachment 12.3	COMMENTS
FORM/FIT				
Terminals	Tunnel terminals, self-clamping (Visual inspection)	Tunnel terminals, self-clamping	Tunnel terminals, self-clamping	Same
CLASSIFICATION				
Seismic	1A (ref. Classification: 0277/88Q)	1A	1A	Same Note 7

Note 1: The recommended supply voltage in accordance with IEC 60038 is 230 V ac (see attachment 12.8), which is the basis for SANS 1019 (Standard Voltages, Currents and Insulation Levels for Electricity Supply).

Note 2: The short circuit breaking capacity stipulated in DSE-LNi (document no. TS/EE-DC-0346 p8) is 5 kA. This value is applicable to the main supply busbars and sub-components e.g. circuit breakers and contactors.

Note 3: The relative humidity stipulated in the DSE-LNi (document no. TS/EE-DC-0244 p12) is 77%@40°C.

Note 4: There are no tripping characteristics stated in the DSE-LNi. The characteristic of the original circuit breaker (F32 series) is 5 to 9,5 In-see attachment 12.1. The tripping characteristic of the proposed circuit breaker envelopes the tripping characteristic of the original and is considered to be acceptable.

Note 5: The proposed circuit breaker has the same tunnel type, self clamping terminals as the original, and can accommodate a larger cable.

Note 6: There are slight height and depth dimensional differences (0,5 mm and 4 mm respectively) between the original and the proposed equivalent circuit breaker. There is sufficient space on the mounting rail (DIN type), inside the inverter unit to fit the new circuit breaker.

Note 7: EDF Directive 81 does not allow for a qualified item/component to be replaced by a non-qualified item/component. In the case of the MG 30 inverters supplied by Data Systems and Solutions, the inverters are qualified but certain individual components like the circuit breakers are not qualified. The obsolete MG F32 and MG C32H-DC series circuit breakers are replaced by the MG C60N series. Qualification by Analysis (of the inverter and circuit breaker) was performed by Data Systems and Solutions to demonstrate that the replacement of the circuit breakers does not affect negatively the seismic qualification of the inverters (see attachments 12.4 and 12.5).

4.2 OPERATING EXPERIENCE

No OE could be found.

5.0 FAILURE MODES AND EFFECTS ANALYSIS

5.1 There are no new failure modes introduced by the proposed MG C60N series circuit breakers.

6.0 OBSOLESCENCE

6.1 End of production

MERLIN GERIN has confirmed that the equipment will be available for the next 5 years (2014).

6.2 End of support

The expected end of support date is 3 years (2017).

7.0 CONCLUSIONS

7.1 Based on the technical evaluation performed in Section 4.1, the proposed MG C60N series circuit breakers has the same form and function as the original equipment, and an acceptable fit. DE Support, therefore considers the proposed circuit breaker equivalent to the original.

7.2 The outcome of the safety screening, S2009/0180 rev 1 is that neither a safety evaluation nor NNR approval is required. See attachment 12.7.

8.0 INSTALLATION

8.1 The equipment shall be installed in accordance with KWM-EP-MAC-017 (for 5 kVA inverters) and KWM-EP-MAC-018 (for 20 kVA inverters).

9.0 TRAINING

No Maintenance, Operating or Engineering training is required.

10.0 DOCUMENTATION UPDATES

The following documentation has been identified as requiring inclusion/updating.

10.1 DDR 2009/02749;

10.2 Log equivalency on EPMS-EQ number 46681.

11.0 COMMERCIAL UPDATES

11.1 The SAP material no. 0240514 be created to reflect the following description:

Manufacturer	:	MERLIN GERIN
Supplier	:	Schneider Electric
Equipment type	:	Circuit breaker
Part no.	:	MG C60N – 2 A
Classification	:	1E/1/Q3/0 in accordance with 0277/88Q
Specification	:	C.O.C. based on E 018/09E
Trigramme	:	1/2 LNA/B/C/D 001DL 1/2 LNE 001/002/003 DL
Equivalency no.	:	E 018/09E rev 1

11.2 The SAP material no. 0240515 be created to reflect the following description:

Manufacturer	:	MERLIN GERIN
Supplier	:	Schneider Electric
Equipment type	:	Circuit breaker
Part no.	:	MG C60N – 10 A
Classification	:	1E/1/Q3/0 in accordance with 0277/88Q
Specification	:	C.O.C. based on E 018/09E
Trigramme	:	1/2 LNA/B/C/D 001DL
Equivalency no.	:	E 018/09E rev 1

11.3 The SAP material no. 0240516 be created to reflect the following description:

Manufacturer	:	MERLIN GERIN
Supplier	:	Schneider Electric
Equipment type	:	Circuit breaker + Auxiliary switch
Part no.		MG C60N – 32 A and auxiliary switch (OF + SD), no. 26929
Classification	:	1E/1/Q3/0 in accordance with 0277/88Q
Specification	:	C.O.C. based on E 018/09E
Trigramme	:	1/2 LNA/B/C/D 001DL
Equivalency no.	:	E 018/09E rev 1

12.0 ATTACHMENTS

12.1 MG F32 data sheets;

12.2 MG C32H-DC data sheets;

12.3 MG C60N data sheets;

12.4 Data Systems and Solutions seismic report (translated version);

12.5 Data Systems and Solutions seismic report (original version);

12.6 Input Consideration Checklist for circuit breakers;

12.7 Safety Screening Form S2009/0180;

12.8 IEC 60038 recommended voltages.

EQUIVALENCE	REV
E 018/09E	1

ATTACHMENT 12.1

MG F32 data sheets

5 PAGES

disjoncteurs basse tension

compact F32 - F32H

32 A
C.A. 380 V
C.C. 250 V

1, 2, 3 ou 4 pôles pas 17,5 mm

marque de qualité NF USE (F 32 u)

homologation Bureau Véritas (F 32 MM) (1)

Ces disjoncteurs sont élaborés en fonction des recommandations internationales CEI 157-1, de la norme européenne CEE 19 et des normes françaises UTE NFC 63 120 (disjoncteurs industriels) et NFC 61 400 (disjoncteurs pour installations domestiques ou analogues).

Le Compact F 32 H se distingue du Compact F 32 par son haut pouvoir de coupure (10 kA).

Le Compact F 32 u est admis à la marque de qualité NF USE.
Le Compact F 32 MM est homologué par le Bureau Véritas (1).

Les caractéristiques de montage et d'encombrement sont identiques pour tous les appareils.

Utilisation
Protection des lignes et des circuits d'éclairage et de chauffage : commande et protection des moteurs de petite puissance.

Déclencheurs
Un déclencheur à maximum de courant par pôle. Ils sont de type magnétothermique, non réglables.

Pour la description générale de l'ensemble des disjoncteurs Compact consulter la fiche technique F 9,30.

caractéristiques

pouvoir de coupure

Calibres 10 à 32 A

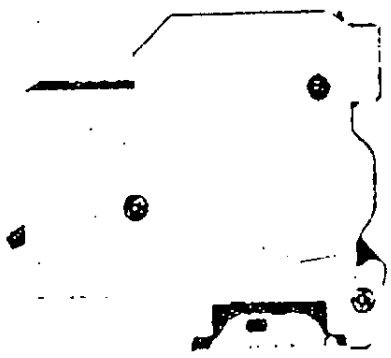
réseau 220/380 V normes de référence		F 32	F 32 H hautes performances
NFC 63 120 P1	220 V	8 000 A	12 000 A
CEI 157-1 P1	380 V	6 000 A	10 000 A
NFC 61 400 (CEE 19 révisée)		3 000 A	
Bureau Véritas	220 V	5 000 A (1)	

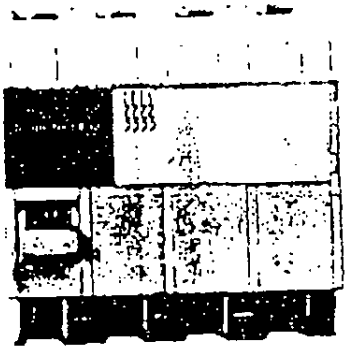
Calibres inférieurs à 10 A : un seul modèle, le Compact F 32 (réseau 220/380 V - norme NFC 63 120 - P1 et CEI 157-1 P1).

calibres	pouvoir de coupure
1 A	10 000 A (20 000 A bipolaire 220 V)
2 et 3 A	8 000 A (18 000 A bipolaire 220 V)
5 A	6 000 A (10 000 A bipolaire 220 V)
Bureau Véritas	5 000 A (1) sous 220 V

Sur les réseaux 110/220 V, pouvoirs de coupure plus élevés.
L'unipolaire sous 380 V (cas du défaut double) a un pouvoir de coupure de :
2 500 A pour le F 32,
3 000 A pour le F 32 H.

Utilisation en courant continu voir fiche technique N 9,05.



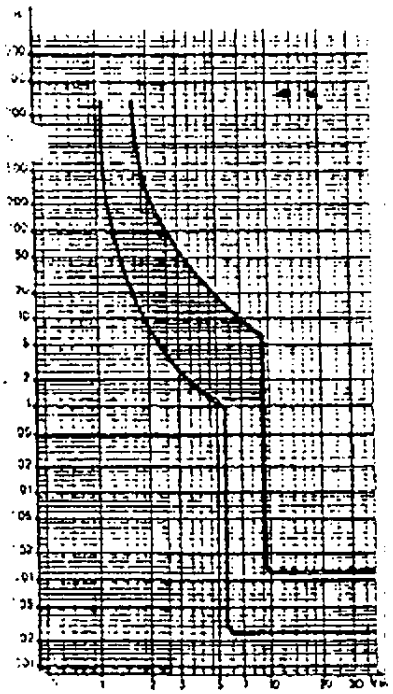


(1) Tension nominale 250 V 2 ou 3 pôles
Pouvoir de coupure
5 kA sous 220 V, cos φ ≥ 0,7

département Compact

courbes de déclenchement

La variation du temps de déclenchement est donnée en fonction du rapport I/In (I courant réel, In courant nominal).
25 °C, la courbe de déclenchement d'un appareil de calibre quelconque se trouvera dans la plage délimitée par les courbes ci-dessous.



choix des calibres

Le choix du calibre dépend du courant d'utilisation et de la température ambiante
Coefficient de réduction de l'intensité nominale de service suivant la température ambiante.

calibres (A)	20 - 25 °C	35 °C	45 °C (1)
1-2-3-5	1	0,9	0,85
10-15-20-25-32	1	0,85	0,75

(1) références vérifiées

Installation en coffret
Pour tenir compte de l'élévation de température à l'intérieur du coffret, il est d'usage de prendre un coefficient de sécurité et de multiplier par 0,8 les calibres.

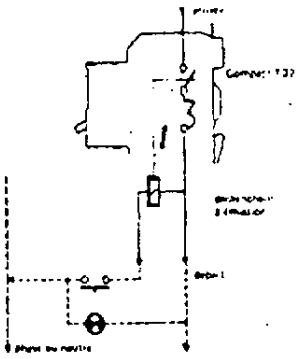
Coffrets MGA
En coffrets MGA type G, Mégo D ou D, pour des calibres supérieurs à 10 A fonctionnant simultanément et placés côte à côte, les intensités à ne pas dépasser sont:
14 A pour le calibre 15
16 A pour le calibre 20
20 A pour le calibre 25
22 A pour le calibre 32
pour une température ambiante de 25 °C à l'extérieur du coffret.

En circuit d'éclairage incandescent ces précautions suffisent largement. En circuit d'éclairage fluorescent, suivant l'efficacité de la compensation, d'autres précautions peuvent parfois s'avérer nécessaires : consulter le catalogue Merlin Gerin ou la pratique d'installation sur ce sujet.

auxiliaires

Bloc Vigi F 32
Bloc déclencheur différentiel bi ou tétra enclenchable
Sensibilité 1Δn = 30 et 300 mA
Cf. fiche technique F 8.303

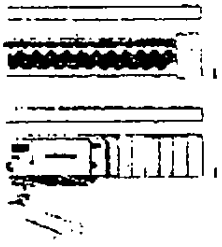
Déclencheur à émission de courant (un fil sorti)
Bloc unipolaire enclenchable
Tension :
110 à 380 V C.A., 110 à 125 V C.C.



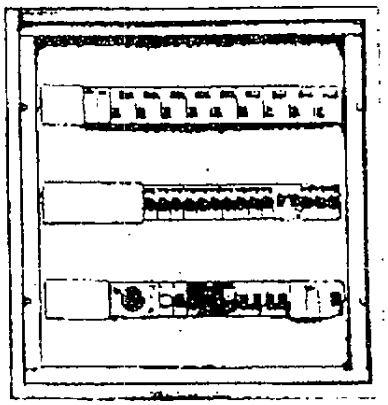
En pointillé, raccordement et fourniture non réalisés par construction.

Contact auxiliaire O + F
montage en usine. Présentation identique au déclencheur à émission.

Contact signal défaut à ouverture
montage en usine. Occupe un pôle supplémentaire indépendant électriquement des autres pôles.



coffret Mégo D 2



coffret G 2

association avec des fusibles

Dans certains cas de courants de court-circuit élevés, l'association judicieuse du Compact F32 avec des fusibles permet d'assurer la protection nécessaire tout en conservant l'économie d'exploitation. le plus grand nombre de défauts reste à éliminer par le disjoncteur, le fusible n'intervenant qu'exceptionnellement.
En général, dans le cas du tétrapolaire, ne pas mettre de fusible sur le neutre.

Dimensions des fusibles
Suivant les calibres, les fusibles sont à choisir dans les tailles 10 x 38, 14 x 51, 22 x 58 pour le type cylindrique et 00 pour le type à couteaux.

H bloc 32
Ensemble, monté câblé sur platine, livré prêt à raccorder, comprenant :
un disjoncteur F 32 équipé d'un déclencheur à émission de courant ou d'un bloc différentiel Vigi F 32,
un jeu de coupe-circuit HPC,
un voyant lumineux et des fusibles de protection du circuit de signalisation.

Le H bloc 32 :
- assure un pouvoir de coupure de 50 kA
- réalise la coordination entre le disjoncteur et les coupe-circuit HPC
- assure la coupure omnipolaire en cas de fusion d'un coupe-circuit
- visualise la fusion du coupe-circuit de neutre, pour interdire la manœuvre de réenclenchement du disjoncteur avant changement du coupe-circuit.

Gain en pouvoir de coupure
Association avec **FUSIBLES AMONT** réalise la coupure omnipolaire* pouvoir de coupure de l'association 50 kA.

calibre F 32 (A)	fusibles aM		fusible gF	
	calibre (A) maxi	mini	calibre (A) maxi	mini
1	40	2	63	6
2	40	4	63	12
3	40	6	63	16
5	80	12	100	32
10	80	20	100	50
15	80	25	100	63
20	80	32	100	80
25	80	40	100	100
32	80	50	100	100

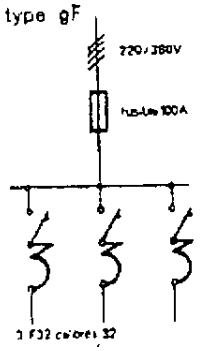
* Le courant de court-circuit provoque la fusion du fusible et le déclenchement simultané du disjoncteur (coupure omnipolaire).

Sélectivité avec FUSIBLES AVAL
Association avec fusibles aval gF avec garantie de sélectivité

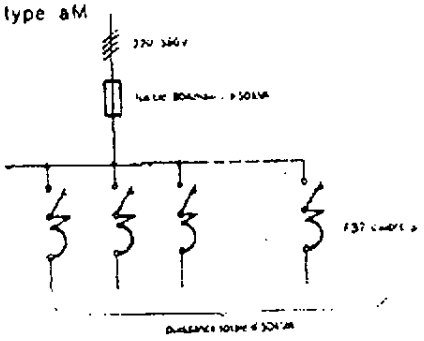
calibre F 32 (A)	calibre maxi du fusible
10	2
15	2
20	2
25	4
32	6

Exemples d'association fusibles amont
le nombre de départs dépend de la puissance admise par le fusible employ

type gF



type aM



utilisations particulières

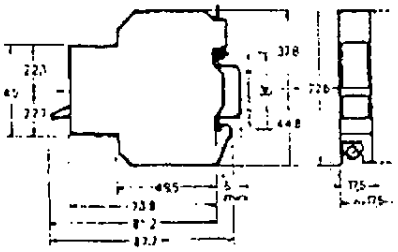
Réseau 440 V, 50 et 60 Hz.
Pouvoir de coupure cycle P1,
bi, tri, tétra
F 32 : 3 000 A
F 32 H : 5 000 A

Réseau 400 Hz.
- comportement des déclencheurs comme sur réseau 50 Hz
- déclassement des calibres en fonction de la température ambiante :

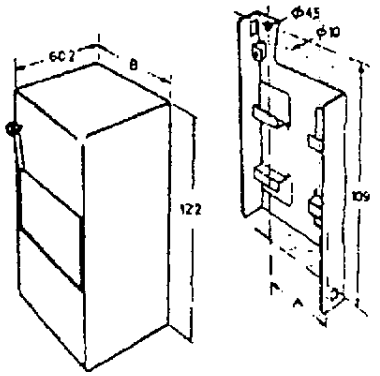
température ambiante	25°	35°	4
coefficient de déclassement	0,9	0,75	0

montage

Encombrement



Montage sur platine avec ou sans cache-bornes
L'encliquetage se fait de la même façon que sur le profilé Oméga symétrique de 35 mm. La platine se fixe sur panneau par deux vis.
Le cache-bornes se fixe sur la platine par encliquetage et se verrouille par une vis incorporée plombable.



	uni	bi	tri	tétra
A	8,8	26,3	43,8	61,3
B	23	40,5	58	75,5

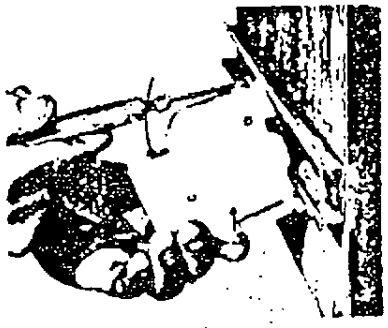
Il existe des cache-bornes pour le F 32 équipé de ses auxiliaires encliquetables.

Masse
uni : 150 g
bi : 300 g
tri : 440 g
tétra : 590 g

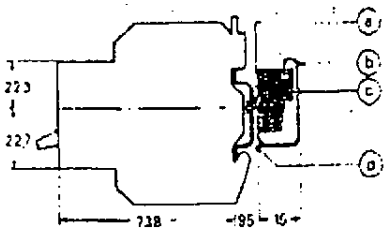
Fixation sur profilé Oméga symétrique de 35 mm (profondeur 5 mm minimum) par encliquetage

montage

démontage

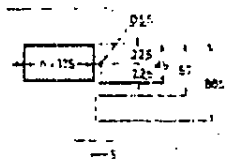


Fixation sur profilé DIN asymétrique
Une pièce intermédiaire et un Fixocap blanc permettent de monter le disjoncteur comme sur le profil Oméga symétrique.



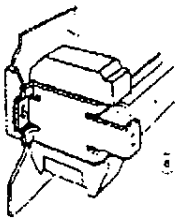
a : vis de fixation
b : rail asymétrique
c : fixocap
d : pièce intermédiaire

Montage derrière panneau
plan de découpe

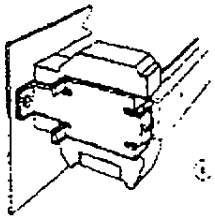


L : longueur du rail DIN
(n - 1) x 17,5 mm
n : nombre de pôles F32

étriers de fixation : la même pièce permet les 2 modes de fixation.

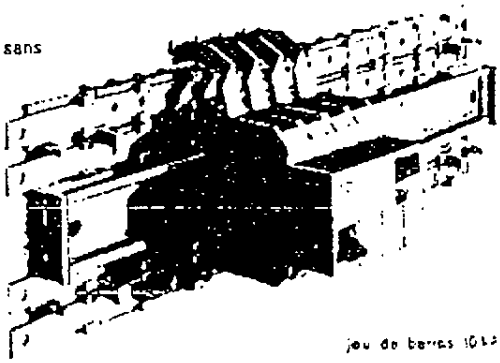


en saillie



encastré

Montage en coffrets
- métalliques MGA avec ou sans jeu de barres fonctionnel.
- isolants O, Méga O, E, F, FT.



jeu de barres 10 x 2

MERLIN GERIN
département Compact
Grenoble France
adresse postale :
38 X
38041 GRENOBLE CEDEX

EQUIVALENCE	REV
E 018/09E	1

ATTACHMENT 12.2

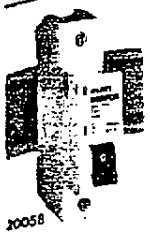
MG C32H data sheets

3 PAGES

IEC 157-1
C32H mcb

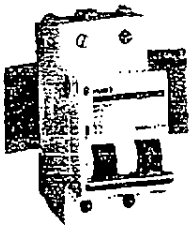
U type tripping curve : 10000 A

Selection table for Multi 9 mcbs : see page 8.


20058

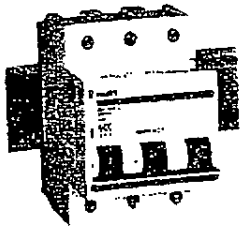
type	width in modules of 9 mm	rating (A)	cat No.
1P	2	10	20054
		15	20055
		20	20056
		25	20057
		32	20058
		40	20059

1 protected pole


20078

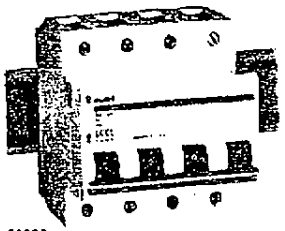
type	width in modules of 9 mm	rating (A)	cat No.
2P	4	10	20074
		15	20075
		20	20076
		25	20077
		32	20078
		40	20079

2 protected poles


20088

type	width in modules of 9 mm	rating (A)	cat No.
3P	6	10	20084
		15	20085
		20	20086
		25	20087
		32	20088
		40	20089

3 protected poles


20098

type	width in modules of 9 mm	rating (A)	cat No.
4P	8	10	20094
		15	20095
		20	20096
		25	20097
		32	20098
		40	20099

4 protected poles

Application
Control and protection of circuits in installations with high short-circuit current.

Technical data
- **current rating** : 10, 15, 20, 25, 32, 40 A at 40°C.
- **voltage rating** : 220/240/380/415 V AC.
- **breaking capacity** : to IEC 157-1, NF C 63-120 and BS 4752 (O-CO sequence).

rating (A)	type	voltage (V)	breaking capacity (A)
10 to 40	1P	220	10000
	1P	240	8000
	2, 3, 4P	220	20000
	2, 3, 4P	380	10000
	2, 3, 4P	415	8000

- **number of operating cycles** (O-C) : 20 000.
- **tripping characteristics**(1) : U curve : the magnetic releases operate between 5.5 and 6.8 In.
- **tropicalization** : treatment 2 (relative humidity 95% at 55°C).
- **overall dimensions** : see page 96.
- **weight** (g) :

type	1P	2P	3P	4P
	127	250	385	495

- **other technical data** : see pages 104 to 108.
- **connections** : tunnel terminals for cables up to 25 mm^2.
- **approvals** : Lloyds approval : 10 to 40 A, 2P, 3P, 4P : 220 V, 50/60 Hz, b.c. : 2100 A ; 440 V, 50/60 Hz, b.c. : 6100 A ; 70 V DC, b.c. : 15000 A (2 poles take part in breaking). Véritas approval.

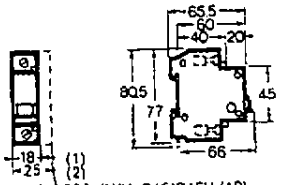
Installation
In all enclosures designed for Multi 9 equipment.

Electrical auxiliaries : page 32.
Application guide : pages 104 to 127.
Connection and installation accessories : page 33.

(1) the identification of the curve is made by the colour of the clip : red for U type.

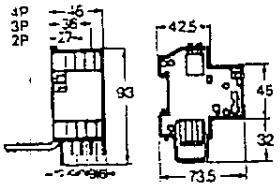
C32/C45/C63 (Fixing on symmetrical DIN rail)

Circuit-breaker

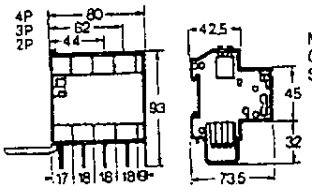


(1) for C32a/N/H, C45/C45N (1P)
(2) for C32L/LH, C63L/LH (1P)

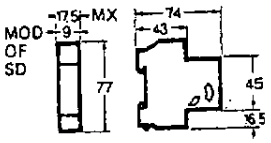
Vigi module C32/C45



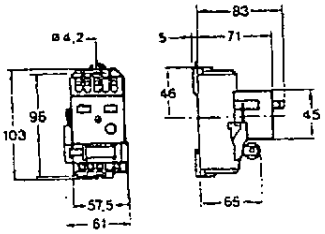
Vigi module C63



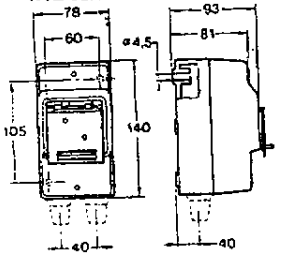
Auxiliaries



P25M

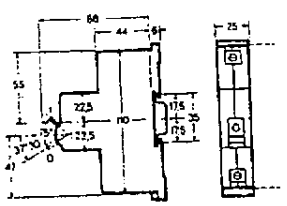


installation accessories

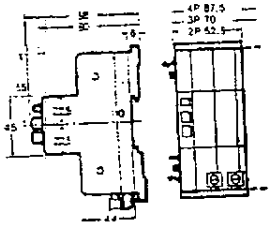


C100 (Fixing on symmetrical DIN rail)

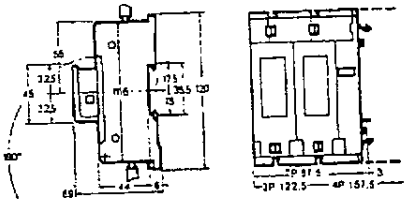
Circuit-breaker



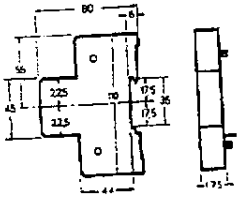
Vigi module



Codis block

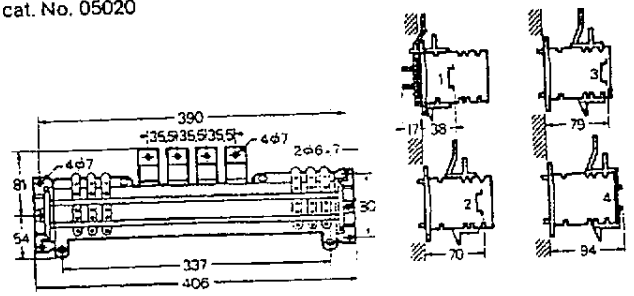


Other auxiliaries

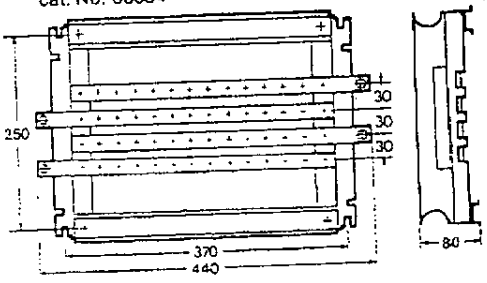


connection accessories

4-pole busbar assembly C32/C45
cat. No. 05020

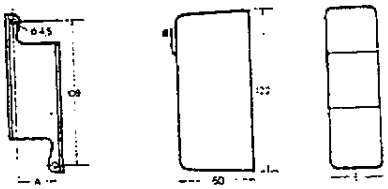


4-pole busbar assembly C100
cat. No. 05034

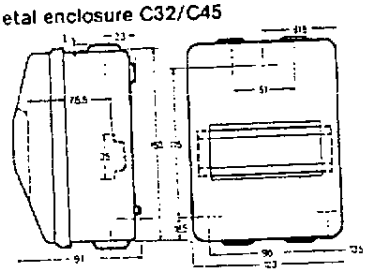


installation accessories

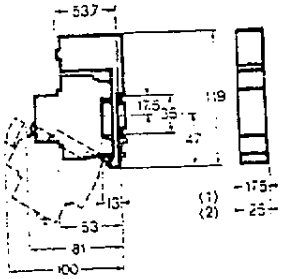
Back plate and terminal shields C32/C45



Metal enclosure C32/C45



Isolatable back plate C32/C45/C63



	1P	2P	3P	4P
A	8.8	26.3	43.8	61.3
B	23	40.5	58	75.5

(1) Use clip-spacer cat. No. 14880 (2 mod.)

(1) for C32a/N/H, C45/C45N
(2) for C32L, C63L

EQUIVALENCE	REV
E 018/09E	1

ATTACHMENT 12.3

MG C60N data sheets

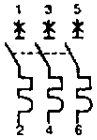
6 PAGES

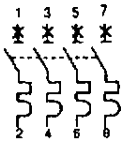
C60N (1-63A)
C120N (80-100A)
C curve

10kA
VC8036
IEC 947-2

1

	Pole	Width in mod of 9mm	Type	In (A)	Ref.	Price
1 protected pole	1P	2	C60	1	60862	153.49
				2	60863	153.46
				3	60864	153.46
				6	60866	101.38
				10	60867	101.38
				16	60868	101.38
				20	60869	101.38
				25	60870	117.71
				32	60871	117.71
				40	60872	117.71
				50	60873	127.71
				63	60874	127.71
		3	C120	80	60729	144.32
				100	60730	167.20
2 protected poles	2P	4	C60	1	60875	397.06
				2	60876	397.05
				3	60877	397.05
				6	60879	278.77
				10	60880	278.77
				16	60881	278.77
				20	60882	278.77
				25	60883	305.53
				32	60884	305.53
				40	60885	305.53
				50	60886	312.57
				63	60887	312.57
		6	C120	80	60733	382.00
				100	60734	397.87
3 protected poles	3P	6	C60	1	60888	505.88
				2	60889	505.88
				3	60890	505.88
				6	60892	382.97
				10	60893	382.97
				16	60894	382.97
				20	60895	382.97
				25	60896	382.97
				32	60897	443.51
				40	60898	443.51
				50	60899	457.59
				63	60900	457.59
		9	C120	80	60737	598.40
				100	60738	649.00
4 protected poles	4P	8	C60	1	60901	802.53
				2	60902	802.53
				3	60903	802.53
				6	60905	594.17
				10	60906	594.17
				16	60907	594.17
				20	60908	594.17
				25	60909	594.17
				32	60910	718.05
				40	60911	718.05
				50	60912	957.41
				63	60913	957041
		12	C120	80	60741	1222.10
				100	60742	1299.10





Application
- Control and protection of circuits against overloads and short circuits
- In commercial and industrial electrical distribution systems

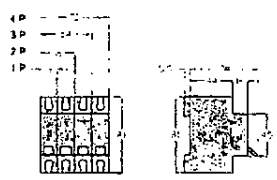
Technical data
- **Current rating**: 1 to 100A at 40° C
- **Voltage rating**: 230 / 400 V AC
- **Breaking capacity**:

IEC 947.2

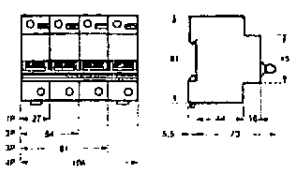
Rat. (A) (A)	Type	Volt. (V)	Breaking capacity (A)
1 to 63	1P	230	10000
	2, 3, 4P	400	10000

- **positive contact indication**
- **fast closing**
- **Number of operating cycles (O-C)**: 20000
- **Tripping characteristics**: C curve: the magnetic releases operate between 5 and 10 In
- **Tropicalisation**: treatment 2 (relative humidity 95% at 55°C).
- **Connections**: tunnel terminals for rigid cables up to: 25mm for rating < 25A, 50mm for rating < 63A
- **Installation**: in all enclosures designed for Multi 9 equipment.

C60 Dimensions



C120 Dimensions



Auxiliaries: page 19
Accessories: page 20
Vigi module: page 24
DC characteristics: page 4
Temperature derating: page 4
Tripping curves: page 7

Merlin Gerin Multi 9 System – Miniature Circuit Breakers

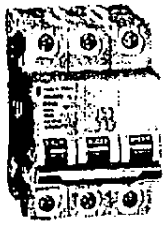
C60N – 1 to 63A

10kA at 230/415V, C & D Curves

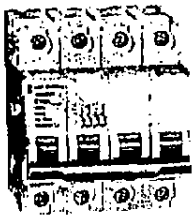
IEC60947-2

60867

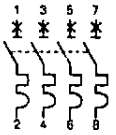
60880



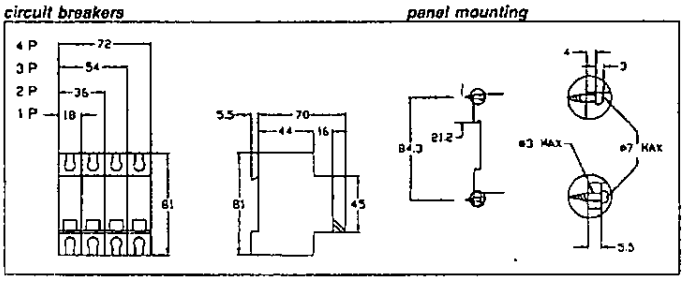
60893



60906

Type C60N	Rating (A)	C Curve	D Curve
1P	1	60862	60506
	2	60863	60507
	3	60864	60508
	6	60866	60509
	10	60867	60510
	16	60868	60511
	20	60869	60512
	25	60870	60513
	32	60871	60514
Width in mod of 9mm - 2	40	60872	60515
	50	60873	60516
	63	60874	60517
2P	1	60875	60518
	2	60876	60519
	3	60877	60520
	6	60879	60521
	10	60880	60522
	16	60881	60523
	20	60882	60524
	25	60883	60525
	32	60884	60526
Width in mod of 9mm - 4	40	60885	60527
	50	60886	60528
	63	60887	60529
3P	1	60888	60530
	2	60889	60531
	3	60890	60532
	6	60892	60534
	10	60893	60535
	16	60894	60536
	20	60895	60537
	25	60896	60538
	32	60897	60539
Width in mod of 9mm - 6	40	60898	60540
	50	60899	60541
	63	60900	60542
4P	1	60901	60543
	2	60902	60544
	3	60903	60545
	6	60905	60547
	10	60906	60548
	16	60907	60549
	20	60908	60550
	25	60909	60551
	32	60910	60552
Width in mod of 9mm - 8	40	60911	60553
	50	60912	60554
	63	60913	60555

circuit breakers *panel mounting*



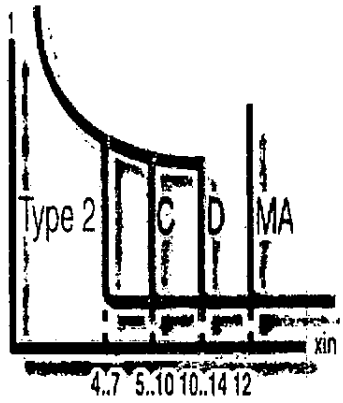
Connection: Tunnel terminals for the following cables
- up to 25A : 25mm² stranded
- 32 to 63A : 35mm² stranded

Merlin Gerin Multi 9 System - Miniature Circuit Breakers
Tripping Curves
Markings & limitation Capability

Trip Unit Variations

Circuit Protection

A choice of several curves
Whatever circuit has to be protected, a C60 or C120 circuit breaker provides the perfect solution with a suitable curve.



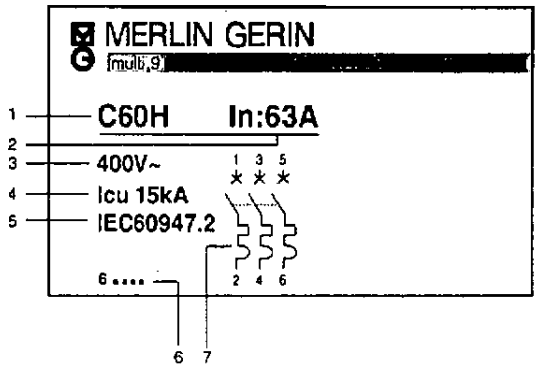
Type 2 Curve
tripping:
4 to 7 In;
protection of circuits, general applications.

Curve C
tripping:
5 to 10 In;
protection of circuits, general applications.

Curve D
tripping:
10 to 14 In;
protection of high surge circuits, welders, transformers, motors.

Curve MA
(magnetic only)
tripping: 12 In;
protection of motor starters (+ thermal protection when combined with contactor).

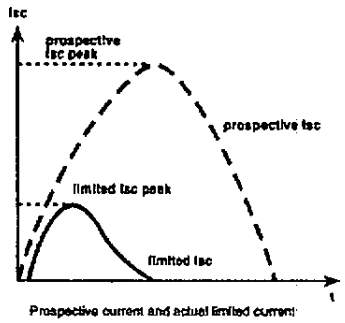
Circuit Breaker Marking



1. Circuit Breaker Model Number
2. Circuit Breaker Current Rating
3. Operating Voltage
4. Rated Breaking Capacity
5. Specification
6. Circuit Breaker Part Number
7. Electrical Diagram - No. of Poles

Circuit Breaker Limitation Capability

The limitation capability of a circuit breaker is that characteristic whereby only a current less than the prospective fault current is allowed to flow under short-circuit conditions.



Prospective current and actual limited current

This is illustrated by limitation curves which give:

- The limited peak current in relation to the RMS value of the prospective short-circuit current (the short-circuit current being that current which would flow continuously in the absence of protection equipment).
- The limited current stress in relation to the RMS value of the prospective short-circuit current.
- Current limiting capability. The advanced design of the Multi-9 range provides current limitation with far better protection than conventional circuit breakers. For example, on a 6A rating with a prospective short circuit of 5000A, the current will be limited at 350A or 7%.

Installation of current limiting circuit breakers offers several advantages:

- **Better network protection**
  Current limiting circuit breakers considerably reduce the undesirable effects of short-circuit currents in an installation.
- **Reduced thermal effects**
  Cable heating is reduced, hence longer cable life.
- **Reduced mechanical effects**
  Electrodynamic forces reduced, thus electrical contacts are less likely to be deformed or broken.
- **Reduced electromagnetic effects**
  Measuring equipment situated near an electrical circuit less affected.

Adaptable electrical auxiliaries for

Multi 9

C60, C120, DPN Vigi, ID

Combined with the Multi 9, C120 circuit-breakers, ID residual current and DPN Vigi circuit-breakers.
They ensure remote tripping or indication.

Auxiliary contacts: "OF" and "OF.S"
Indication of the "open" or "closed" position of the circuit-breaker (OF) or the residual current circuit-breaker (OF.S) with which they are combined.

Fault indicating switch: "SD"
Indication of the "fault trip" position of the circuit-breaker or residual current circuit-breaker with which it is combined. Visualisation of the fault (circuit-breaker) or earth fault indication (ID) on the front face by means of a mechanical indicator.

Changeover contact: "OF+SD/OF"
- Upper circuit: OF, lower circuit: OF or SD.
- OF: remote indication of the "open" or "closed" position of the circuit-breaker or residual current circuit-breaker with which it is associated.
- SD: remote indication of the "tripped" on fault position of the circuit-breaker or residual current circuit-breaker with which it is associated.
- Function choice using the selector switch on the right side.
- The selected function is indicated on the front face.

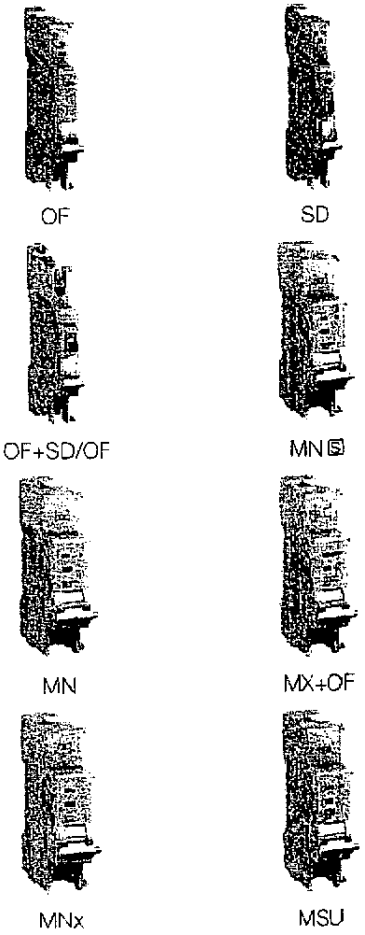
Undervoltage selective release: "MN S"
Undervoltage release that controls the opening of the circuit-breaker or residual current circuit-breaker with which it is combined; it allows a 0.5 second time delay on a brownout or voltage drop.

Undervoltage instant release: "MN"
When its supply voltage drops (between 70 and 35%), it controls the tripping and opening of the circuit-breaker or residual current circuit-breaker with which it is combined. Furthermore, it prevents the circuit-breaker or the residual current circuit-breaker from reclosing as long as its supply voltage is not restored.
- Utilisation:
  - emergency stop using a pushbutton,
  - safety on the circuits supplying several machines by preventing "uncontrolled" restart of all motors.

Shunt release: "MX + OF"
When energised, it controls the tripping and opening of the circuit-breaker or residual current circuit-breaker with which it is combined. Equipped with an O +C contact to indicate the "open" or "closed" position of the circuit-breaker or the residual current circuit-breaker.

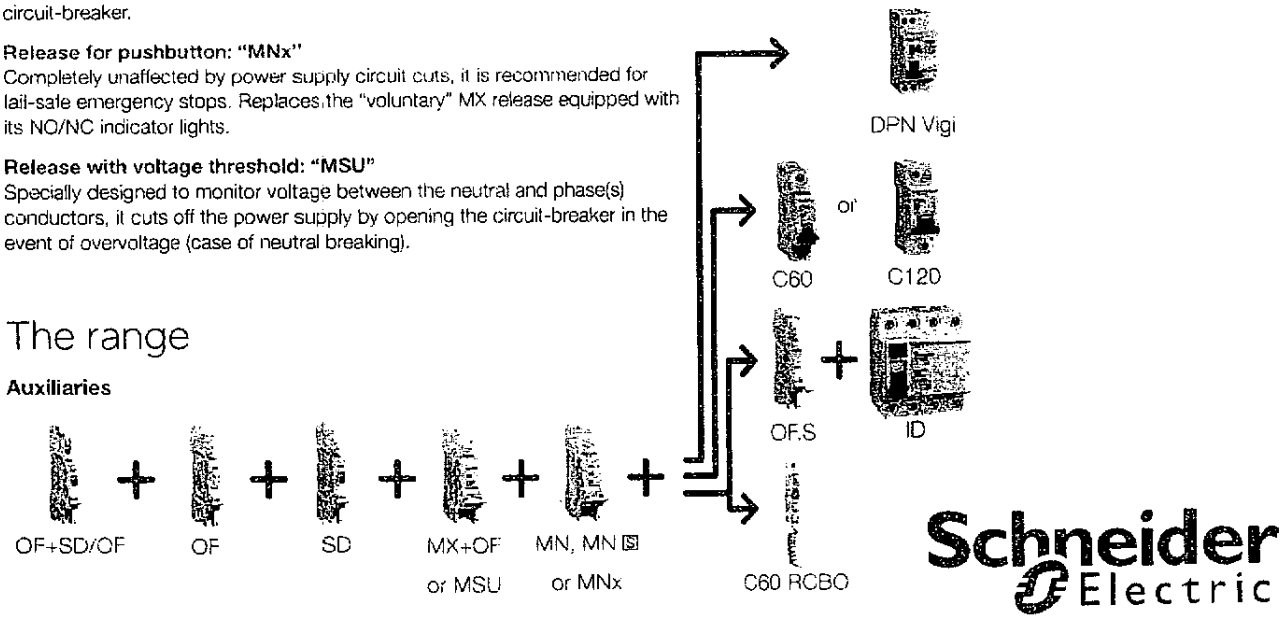
Release for pushbutton: "MNx"
Completely unaffected by power supply circuit cuts, it is recommended for fail-safe emergency stops. Replaces the "voluntary" MX release equipped with its NO/NC indicator lights.

Release with voltage threshold: "MSU"
Specially designed to monitor voltage between the neutral and phase(s) conductors, it cuts off the power supply by opening the circuit-breaker in the event of overvoltage (case of neutral breaking).



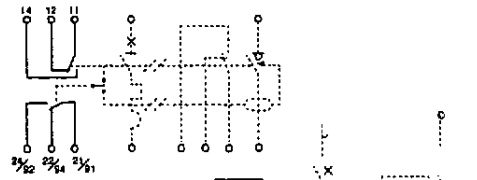
The range

Auxiliaries

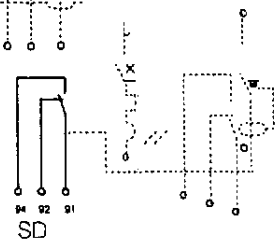


Schneider Electric

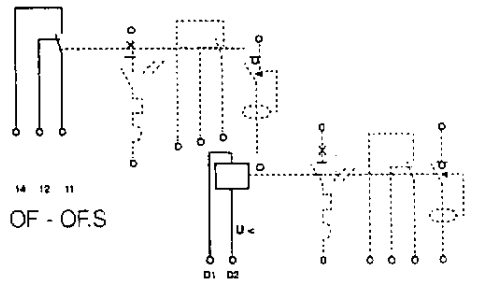
Wiring schemes



OF+SD/OF

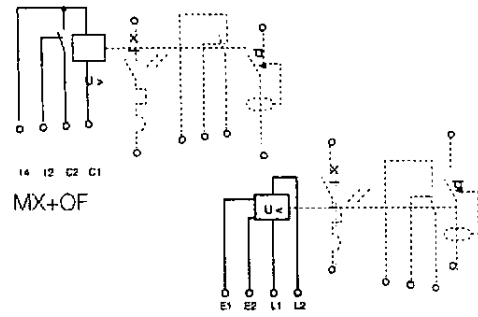


SD



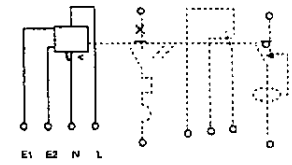
OF - OF.S

MN - MN S

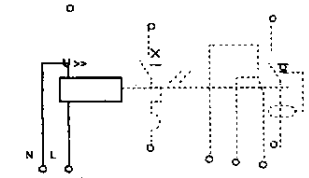


MX+OF

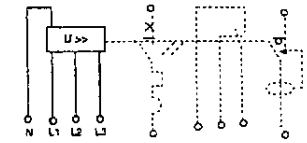
MNx



MNx



1Ph + N
MSU



3Ph + N
MSU

Owing to changes in standards and equipment, the characteristics given in the text and images in this document are not binding until they have been confirmed with us.

Implementation

- Designed for installation in modular electrical enclosures and cubicles.
- Easy connection and reliability ensured by the serrated tunnel terminals with guard.
- Captive screws with mixed ± imprint.
- Simplified combination with C60, C120, DPN Vigi circuit-breakers and ID residual current circuit-breakers using clip-ons. The electrical auxiliaries allow remote tripping or indication of the circuit-breakers with or without Vigi module.They are mounted on the left-hand side of the circuit-breaker (max. width: 54 mm). Use of the OF.S auxiliary contact is compulsory for adding the MN, MX, SD, OF, MNx, MSU functions to the ID residual current circuit-breaker switch.

Operation simulation

- On the front face of the auxiliary contacts (26924 26927), a test button allows for the OF and SD functions to be simulated without generating the circuit-breaker or the residual current circuit-breaker.

Technical data

Type	Voltage (V)	Width in mod. of 9mm	Cat. no.
Auxiliary contacts			
OF		1	26924
OF.S		1	26923
Fault indicating switch			
SD		1	26927
Changeover contact			
OF+SD/OF		1	26929
Undervoltage release			
MN	220 to 240 V AC	2	26960
	48 V AC	2	26961
	48 V AC	2	26962
MN S	220 to 240 V AC	4	26963
0.2 sec delay			
Release for PB pushbutton with opening			
MNx	230 V AC	4	26969
	400 V AC	4	26971
Shunt release			
MX+OF	220 to 415 V AC	2	26946
	110 to 130 V DC		
	48 to 130 V AC	2	26947
	48 V DC		
	24 V AC - DC	2	26948
	12 V AC - DC	2	26949
Voltage increase release			
MSU	230 V AC	4	26979
	400 V AC	4	26980

Release consumption

Type	Voltage (V)	(W or VA)
MX	415 V AC	120
	220 to 240 V AC	50
	110 to 130 V AC	200
	110 to 130 V DC	10
	48 V AC - DC	22
	24 V AC - DC	120
	12 V AC - DC	120
	MN 220 240 V AC	4.1
	48 V AC	4.3
	48 V DC	2.0
MN S	220 to 240 V AC	4.1
MNx	230 V AC	50
	400 V AC	120

Contact auxiliary breaking capacity

	Voltage (V)	(A)
	415 V AC	3
	≤ 240 V AC	6
	130 V DC	1
	≤ 24 V DC	6

Schneider Electric New Zealand Ltd

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EQUIVALENCE	REV
E 018/09E	1

ATTACHMENT 12.4

Data Systems and Solutions seismic report (translated version)

15 PAGES

Seismic Qualification Justification For Breakers C60 and C32

INVERTER MG30

Paul ROSIER – 2009/03/10

UPDATING BOARD

Issued Date / Written By	Modified Pages	Origin and Designation of the Modification
A – 2006 / 03 / 27		Original issue
B – 2006 / 07 / 04	All	Adding of Breaker C32 for Inverters MG30 5kVA Type FRA-BEV 21200-00. Cancellation of Standard CEI 68-3-3 extract

TABLE OF CONTENTS

1. AIM OF THE DOCUMENT

To prove that the replacement of the breakers F32 with breakers C60 and C32 does not invalidate the seismic qualification of the inverters MG30.

2. REFERENCE DOCUMENT

Ref . N°	Document N°	Designation
1	LV 12573	SOPEMEA Report "Seismic Resistance Tests" on inverter MG-30-CS 5kVA FRA Type
2	LV 12041 / 1	SOPEMEA Report " Seismic Vibration Tests" on Merlin Gerin inverter 5kVA
3	LV 12041 / 2	SOPEMEA Report " Seismic Vibration Tests" on Merlin Gerin inverter 20kVA
4	CEI 68-3-3	Applicable Seismic Test's Methodology to equipment
5	3000430 B	Seismic Testing Procedure for all Project – SPINLINE 3
6	3000439 C	Seismic Test report for all Project – SPINLINE 3

3. ANALYSIS

3.1 Approach

To be sure that the seismic qualification of the inverters is not invalidated, we will demonstrate the following:

- The modification does not challenge seismic qualification of the cabinet,
- The new circuit breakers have a satisfactory seismic resistance response as determined by the original testing of the inverters MG30.

3.2. Seismic Resistance of the Cabinet

The aim is to demonstrate that the installation of the new breaker does not challenge the seismic qualification of the inverters MG30.

➢ **Breaker of the Power Supply Board for inverters 5kVA – FRAMATOME Type**

Mass	Breaker Type	Element taken into account	Weight
Previous	Breaker F32	Both contacts for remote's display and support	500g
New	Breaker C60N Bipolar	Both contacts for remote's display SD and support	350g
Previous		Breaker F32	450g
New		Breaker C32H-DC Bipolare	300g

➢ **Breaker DJ02 or DJ03 for the inverters 5kVA – EDF Type or 20kVA**

Mass	Breaker Type	Element taken into account	Weight
Previous		Breaker F32	450g
New		Breaker C60N Bipolare	300g

Consequently, the difference of mass between the original and the new circuit breakers are negligeable related to the total mass of the inverter's cabinet MG30:

➢ **MG30 5kVA – FRAMATOME Type**

- Mass of the Cabinet = 650kg,
- Mass of the Breakers F32 = 2 x 0,45 + 6 x 0,5 + 1 x 0,45 = 4,35 kg,
- Mass of the Breakers C60 and C32 = 2 x 0,3 + 6 x 0,35 + 1 x 0,3 = 3,00 kg,
- Δ Mass = 1,35 kg

➢ **MG30 5kVA – EDF Type**

- Mass of the Cabinet = 550kg,
- Mass of the Breakers F32 = 2 x 0,45 = 0,9 kg,
- Mass of the Breakers C60 = 2 x 0,3 = 0,6 kg,
- Δ Mass = 0,3 kg

➢ **MG30 20kVA**

- Mass of the Cabinet = 770kg,
- Mass of the Breakers F32 = 2 x 0,45 = 0,9 kg,
- Mass of the Breakers C60 = 2 x 0,3 = 0,6 kg,
- Δ Mass = 0,3 kg

That difference in mass is not able to significantly impact on the resonance frequencies of the inverter.
The replacement of the breakers results in a reduction of the total mass of the inverter. Consquently, this will increase the frequencies of the cabinet. The first resonance's frequency being 9,5 Hz (Case of the inverter 5kVA – FRAMATOME Type), the undergone constraints by the cabinets will be lower.

- *Case of inverter 5kVA – FRAMATOME Type*

$$Fr_f = \sqrt{\frac{Mi}{M_f}} x\ Fr_i = \sqrt{\frac{650}{648,65}} x\ 9,5 = 9,5099Hz$$

With
$Fr_f =$ Resonance frequency After Modification
$Fr_i =$ Resonance frequency Before Modification
$M_f =$ Mass After Modification
$M_i =$ Mass Before Modification

The influence of that modication is obviously quite favourable regarding the cabinet behavior.

Consquently, the mechanical behavior and the functionality of the cabinet are not challenged.

3.3. Seismic Resistance of the New Breakers

The references of the used new breakers are the following:

- **HUA 10128** : Bipolar C60N 10A / Curve D for :
  - Distribution MG30 5kVA – FRAMATOME Type
- **HUA 12728** : Bipolar C32H-DC 10A / Curve C for :
  - Auxiliary Power Supply LN* 110JA MG30 5kVA – FRAMATOME Type
- **1PRE 013097** : Bipolar C60N 2A / Curve C for :
  - DJ02 MG30 5kVA, DJ02 and DJ03 MG30 20kVA
- **012485** : Bipolar C60N 32A / Curve D for : DJ03 MG30 5Kva.

According to numerous and earlier seismic qualifications of the equipment, the C60 breaker family has widely been used as to equip for example the RPN equipment of Qinshan (*China*) and CP0 (*1st French Program*).

To demonstrate the acceptable seismic response of the new equipment, we will consider the latest qualification, which means, the seismic qualification of the « SPINLINE 3 product ».

In this case, the circuit breakers which have been used are bipolar C60N 20A / Curve D and bipolar C32H-DC 32A / Curve C type. Afterwards, we will consider that these breakers are representative of the bipolar C60N and C32H-DC breaker's family (Same arc chute and same volume).

3.3.1 Resolution of the acceleration at the level of the inverter's breakers

The SOPEMEA reports Ref. 1, 2 and 3 describe the accelarations taken on different area of the cabinet.
The considered data are the N°1 and 2 which are measure on the top of the cabinet.
Therefore, to take into account of the accelerations of the circuit breakers is obviously conservative, regarding that they are breakers are located lower down in the cabinet.

➢ **Inverters MG30 5kVA – FRAMATOME Type**

Data N°	Axis	Maximum Acceleration (g)	Acceleration of nill period (g)	Curve N°
1	OX	7,5	3,2	14
	OY	7,2	2,8	38
	OZ	2,1	2,1	62
2	OX	7,5	4	16
	OY	7,5	3,9	40
	OZ	1,6	1,6	64

- Test perform with accelerogram

➢ **Inverters MG30 5kVA – EDF Type**

Data N°	Axis	Maximum Acceleration (g)	Frequency (Hz)	Curve N°
1	OX	6,2 (1)	12 (1)	70
	OY	3,1	11,5	77
	OZ	Not recorded (2)	Not recorded (2)	
2	OX	6,5	12	71
	OY	6,5	11,5	78
	OZ	Not recorded (2)	Not recorded (2)	

- (1) Measurement performed with noise
- (2) Resonance frequency > 30 Hz
- 5 tests performed at different frequencies.

➢ **Inverters MG30 20kVA – EDF Type**

Data N°	Axis	Maximum Acceleration (g)	Frequency (Hz)	Curve N°
1	OX	1,5 (1)	11,5	65
	OY	2,8	12	75
	OZ	Not recorded	Not recorded	
2	OX	4,5 (1)	11,5	67
	OY	5	12	78
	OZ	Not recorded	Not recorded	

- ([1]) Measurement performed with noise
- 5 tests performed at different frequencies.

Severity taken into account for all the breakers of the inverter MG30

To still be conservative and to standardize the severities for all the breakers which have been installed on the different inverters MG30, we will consider only the most restrictive data of the 3 in the tables below. Moreover, the highest severity will be kept for the horizontal axis as described here under for the inverter MG30 5kVA – FRAMATOME Type.

Data N°	Axis	Maximum Acceleration (g)	Acceleration of nill period (g)	Curve N°
1	Vertical	2,1	2,1	62
2	Horzontal	7,5	4	16

Refer to Annex 2 and 3

3.3.2. Seismic Qualification Tests already performed

The qualification « SPINLINE 3 product », indicates some information relative to the behavior of the bipolar breakers C60N.

The Annex 1 describes the extreme Spectrum's responses applied to the sub-equipment where was installed in the area of the C60 circuit breaker.

The figure 3 is representing the SDD spectrum (sizing spectrum) on the vertical axis and the figure 4 is representing the SDD on horzontal axis.

These tests applied to the sub-equipment are in accordance with RCC-E 2002 version which means 5 DSD (1/2 sizing seismic spectrum) followed with one SDD (sizing spectrum) on each of the axis. Therefore, they are more restrictive than the seismic tests performed in 1976 and 1977 on the inverters MG30.

We can notice on the curves figure 3 and 4 the following and remarkable data :

Axis	Maximum Acceleration (g)	Acceleration of nill period (g)	Annex 1 Figure N°
Vertical	36	3,6	3
Horzontal	50	5	4

The circuit breakers did not fail functionally before, during or after the seismic tests.

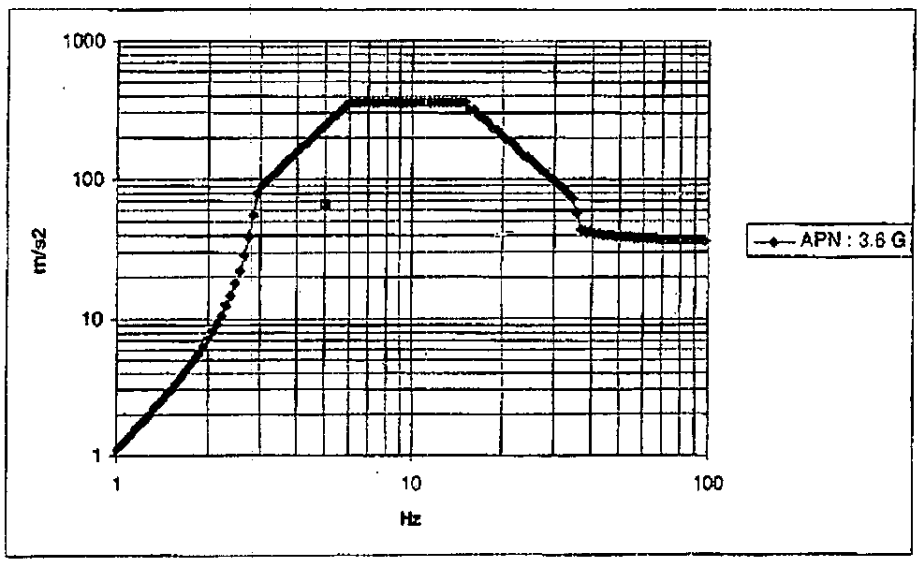
4. CONCLUSIONS

The breakers C60 have been qualified for some severity levels widely greater than the levels that they would be undergone inside the inverters.

Moreover, the testing conditions are definitely more severe.

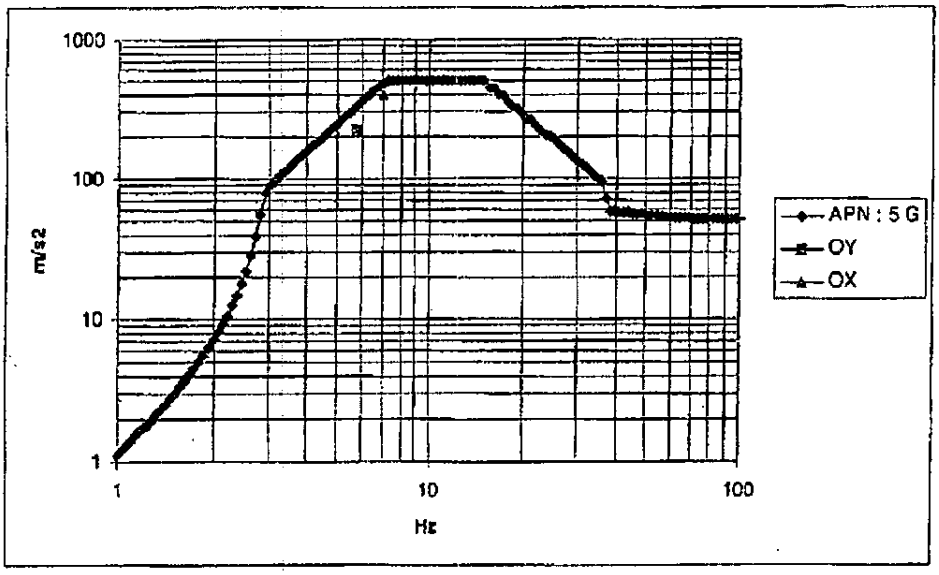
Furthermore, that study entitles to demonstrate that the replacement of the breakers F32 with breakers C60N and C32H-DC does not challenge the sesmic qualification of the inverters MG30.

ANNEX 1 : Utmost Spectrum's responses (Testing Procedure for all Project « SPINLINE 3 »



SDD 0Z

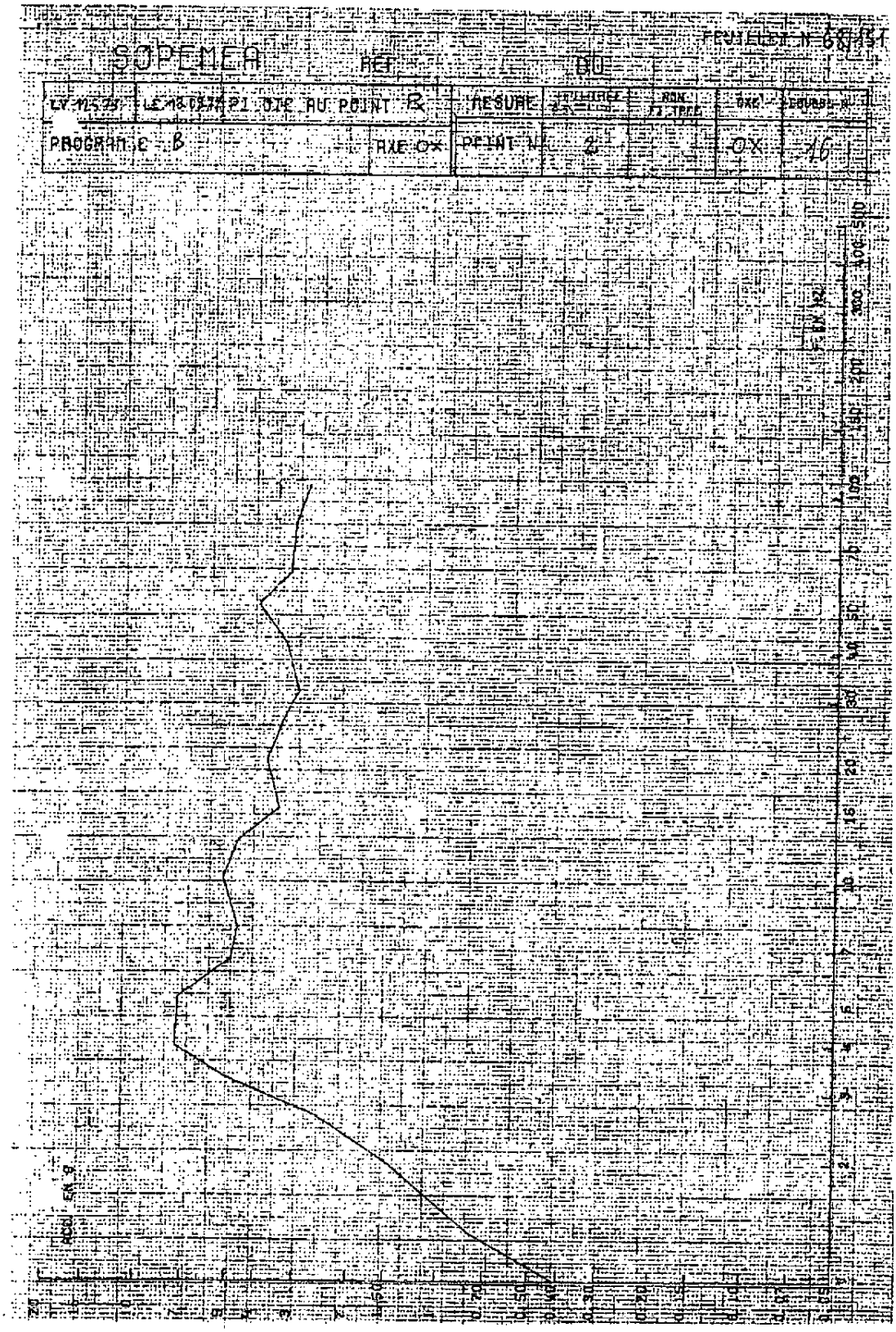
Figure 3 – Vertical Excitation (Severity target level)



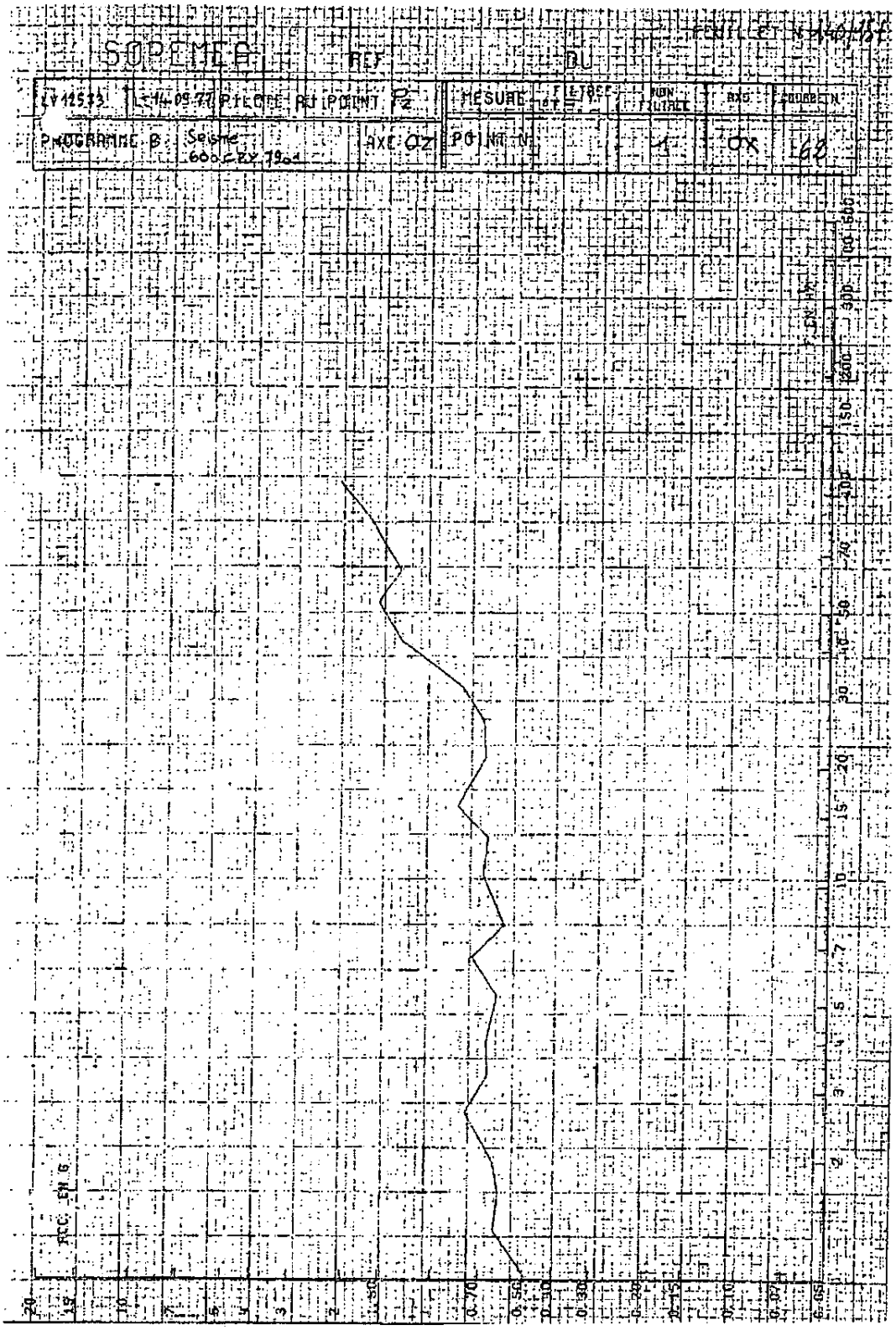
SDD
OX and OY

Figure 4 – Horizontal Excitation (Severity target level)

ANNEX 2 : Extract of SOPEMEA Report « LV 12573 – axis 0X »



ANNEX 3 : Extract of SOPEMEA Report « LV 12573 – axis 0Z »



Translater's NOTE about SOPEMEA:

SOPEMEA is a French laboratory located in Villacoublay (near Paris) in charge of about 150 official and different tests

SOPEMEA, a company for the Improvement of Aerospace Materials and Equipment, is born in January 1948

In 1965, **CNES** entrusts to **SOPEMEA** the creation, then the development of its space environment tests laboratory located in Brétigny-sur-Orge, which will be transferred to Toulouse in 1972 and will become **INTESPACE**, a common subsidiary both to **CNES** and to **SOPEMEA** in 1984

In 1969, **SOPEMEA** extends and establishes a site in Vélizy-Villacoublay.

In 1987, **SOREAS** sells 51 % of the company capital to **MESSIER-BUGATTI**, a subsidiary of the **SNECMA** group that becomes its principal shareholder.

In 2000, **SOPEMEA** assigns its whole shareholding in **INTESPACE**.

In 2001, **SOPEMEA** joins the **APAVE** group, an expert in commanding the industrial risk of installation controlling and products compliance.

SOPAVIB is created in Vaulx-en-Velin in 1997 on **SOPEMEA** (50 %), **APAVE** (40 %) and **VIBRATEC** (10 %) initiative to offer a better service to its customers of the South-Eastern part of France.

Located in Valenciennes, in the heart of the European pole of rail and car transportation, **SOPAVAL** is inaugurated in 2002 by its shareholders: **SOPEMEA** (50 %) and **APAVE** (50 %).

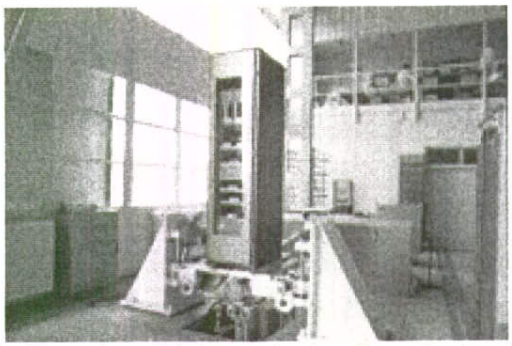
The earthquake risk is important enough, even in our country, to be taken into account from the design of an industrial development.

The regulation texts that have been applied for many years to nuclear installations are and will be more and more widely spread to all types of industrial and strategic installations.

SOPEMEA qualifies assemblies and sub-assemblies of small or huge dimensions :

Either by the test that consists in reproducing an earthquake with given specifications, in a laboratory, on biaxial vibrations tables

- Or by computation,
- Or while associating both possibilities to validate the models of computations via experimental methods.



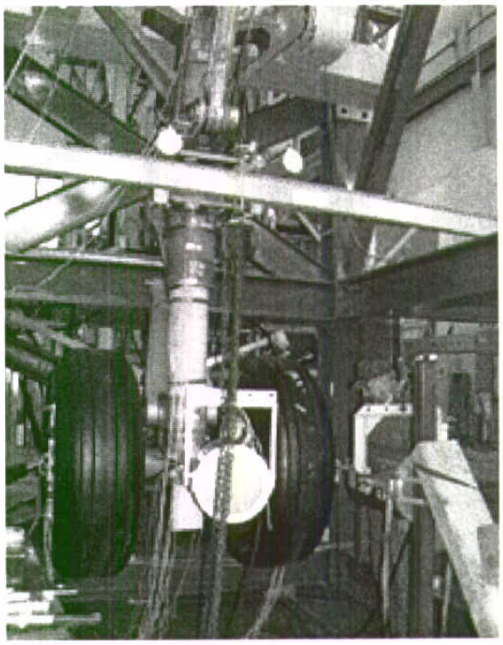
Earthquake resistance tests of an electronic rack on a 4000 daN biaxial table

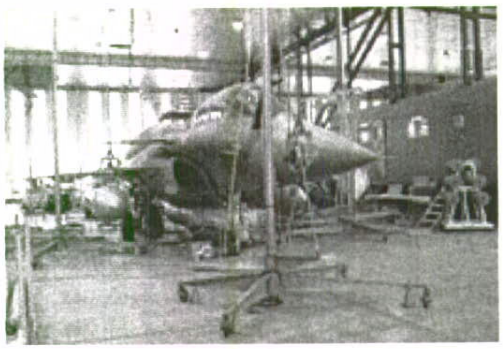
SOPEMEA is the **leading centre** of the Group. With fifty years experience in the tests field and a 125 people team, our laboratory can offer every day all its available services to its customers all over the world : **tests engineering, tests, facility tests maintenance, training** for laboratories personnels, according to of international standards

SOPEMEA itself combines nearly **150 tests installations**.

Discover *SOPEMEA Group tests facility means* unique in Europe.

From qualification to research and development tests, as well as tuning and « halt and hass » tests, **SOPEMEA** and ist Lyons and Valenciennes subsidiaries are present at your side at any moment during the marketing implementation of new products.





EQUIVALENCE	REV
E 018/09E	1

ATTACHMENT 12.5

Data Systems and Solutions seismic report (original version)

11 PAGES

Désignation du document *Designation of the document*	**Justificatif de la qualification sismique des disjoncteurs C60 et C32**

Affaire *Product*	☐	**ONDULEURS MG30**
Equipement *Equipment*	☒	
Sous-ensemble *Subassembly*	☐	
Autres *Others*	☐	

Document contractuel (pour le client) *Contractual document (for customer)* oui *yes* ☐ non *no* ☒ **Nbre de pages** *Nr pages* 10

	Niv1	Niv 2
Code projet *Project code*		

Diffusion interne: *Internal dispatching*

Diffusion externe: *External dispatching*

Tampon archivage MF

Version française

Rédigé par *Written by*	Vérifié par *Checked by*	Approuvé par *Approved by*
Nom: P. OLMOS *Name :*	**Nom: G. JALIER** *Name :*	**Nom: P. VIALA** *Name :*
Visa: *Signature:*	**Visa:** *Signature:*	**Visa:** *Signature:*
Date: *Date:* 03/10/06	**Date:** *Date:* 03/10/2006	**Date:** *Date:*

Version étrangère

Rédigé ou traduit par *Written by*	Vérifié par *Checked by*	Approuvé par *Approved by*
Nom: *Name:*	**Nom:** *Name:*	**Nom:** *Name:*
Visa: *Signature:*	**Visa:** *Signature:*	**Visa:** *Signature:*
Date: *Date:*	**Date:** *Date:*	**Date:** *Date:*

TABLEAU DE MISE A JOUR
Updating board

Indice /date **Rédigé par** *Issue/date* *Written by*	**Pages modifiées** *Modified pages*	**Origine et désignation de la modification** *Origin and designation of the modification*
A / 27/03/2006 P. OLMOS		Edition originale
B / 04/07/2006 P. OLMOS	Toutes	Ajout du disjoncteur C32 pour l'onduleur MG30 5kVA de type FRA – BEV 21200-00 Suppression de l'extrait de la norme CEI 68-3-3

Identification des moyens de production de ce document
Identification of ways of production of this document

Outils : Microsoft Word 2003 **Fichier :** 3003743B Qualif Sismique C60 C32 (remplac F32) MG30.doc

Tools : *File:*

TABLE DES MATIERES

Table of contents

1. BUT DU DOCUMENT

Montrer que le remplacement des disjoncteurs F32 par des disjoncteurs C60 et C32 ne remet pas en cause la qualification sismique des onduleurs MG30.

2. DOCUMENTS DE REFERENCE

Réf. N°	N° du document	Désignation
1	LV12573	Rapport SOPEMEA "Essais de tenue aux séismes sur un onduleur MG-30-CS" Type 5KVA FRA
2	LV12041/1	Rapport SOPEMEA "Essais de vibrations de tenue aux séismes sur un onduleur Merlin Gerin 5KVA"
3	LV12041/2	Rapport SOPEMEA "Essais de vibrations de tenue aux séismes sur un onduleur Merlin Gerin 20KVA"
4	CEI 68-3-3	Méthodes d'essais sismiques applicables aux matériels
5	3000430 B	Procédure d'essais sismique Toutes affaires - Spinline3
6	3000439 C	Rapport d'essais sismiques Toutes affaires - Spinline3

3. ANALYSE

3.1. Démarche

Pour s'assurer que la qualification sismique des onduleurs MG30 n'est pas remis en cause, nous démontrerons:

- que la modification ne remet pas en cause la bonne tenue de l'armoire
- que les nouveaux constituants ont un comportement satisfaisant au même niveau sismique qu'ils auraient subis lors de l'essai sur les onduleurs MG30.

3.2. Tenue de l'armoire

Il s'agit de démontrer que le chargement du nouveau disjoncteur ne remet pas en cause l'onduleur MG30.

- **Disjoncteurs de la platine de distribution** pour l'onduleur 5kVA de type FRA:
  Masse avant, disjoncteur F32, contact de report à distance et son support: 500g.
  Masse après, disjoncteur C60N bipolaire, son contact de report à distance SD et son support: *350g*.
  Masse avant, disjoncteur F32: 450g.
  Masse après, disjoncteur C32H-DC bipolaire: *300g*.

- **Disjoncteurs DJ02 ou DJ03** pour l'onduleur 5kVA de type EDF ou 20kVA:
  Masse avant, disjoncteur F32: *450g*.
  Masse après, disjoncteur C60N bipolaire: *300g*.

Par conséquent, la différence de masse entre les anciens disjoncteurs et les nouveaux sont négligeables vis à vis de la masse totale de l'armoire onduleur MG30:

- MG30 5kVA de type FRA
  Masse de l'armoire = 650kg
  Masse des disjoncteurs F32 = 2 x 0,45 + 6 x 0,5 + 1 x 0,45 = 4,35kg
  Masse des disjoncteurs C60 et C32 = 2 x 0,3 + 6 x 0,35 + 1 x 0,3 = 3kg
  ΔMasse = 1,35kg
- MG30 5kVA de type EDF
  Masse de l'armoire = 550kg
  Masse des disjoncteurs F32 = 2 x 0,45 = 0,9kg
  Masse des disjoncteurs C60 = 2 x 0,3 = 0,6kg
  ΔMasse = 0,3kg
- MG30 20kVA
  Masse de l'armoire = 770kg
  Masse des disjoncteurs F32 = 2 x 0,45 = 0,9kg
  Masse des disjoncteurs C60 = 2 x 0,3 = 0,6kg
  ΔMasse = 0,3kg

Cette modification de masse n'est pas en mesure de modifier significativement les fréquences de résonance de l'onduleur.
Le remplacement des disjoncteurs se traduit par une diminution de la masse totale de l'onduleur. Cela a pour conséquence de relever les fréquences de résonance de l'armoire. La première fréquence de résonance étant de 9,5 Hz (cas de l'onduleur 5kVA de type FRA), les contraintes subies par l'armoire seront donc plus faibles.

Cas du MG30 5kVA de type FRA => $Fr_f = \sqrt{\frac{M_i}{M_f}} x Fr_i = \sqrt{\frac{650}{648,65}} x 9,5 = 9,5099 Hz$

Avec Fr_f = Fréquence de résonance après modification M_f = Masse après modification

Fr_i = Fréquence de résonance avant modification M_i = Masse avant modification

L'influence de cette modification est donc plutôt favorable sur le comportement de l'armoire.

Par conséquent, la tenue mécanique et fonctionnelle des armoires n'est pas remise en cause.

3.3. Tenue des nouveaux disjoncteurs

Les nouveaux disjoncteurs utilisés ont les références:

- HUA10128: C60N bipolaire 10A courbe D Distribution MG30 5kVA type FRA
- HUA12728: C32H-DC bipolaire 10A courbe C Alim. auxiliaire LN*110JA MG30 5kVA type FRA
- 1PRE013097: C60N bipolaire 2A courbe C DJ02 MG30 5kVA; DJ02 et DJ03 MG30 20kVA
- 0120485: C60N bipolaire 32A courbe D DJ03 MG30 5kVA

Dans le cadre de nombreuses qualifications sismiques antérieures d'équipements, la famille des disjoncteurs C60 a largement été utilisée comme par exemple, les équipements RPN Qinshan et RPN CP0.
Pour cette démonstration de bonne tenue sismique, nous considèrerons la dernière qualification en date, c'est à dire celle de la qualification sismique "produit SPINLINE3".
Dans ce cas, les disjoncteurs utilisés sont le C60N bipolaire 20A courbe D et le C32H-DC bipolaire 32A courbe C. Nous considèrerons par la suite que ces disjoncteurs sont représentatifs de la famille des disjoncteurs C60N et C32H-DC bipolaire (même chambre de coupure et même encombrement).

3.3.1. Détermination de l'accélération au niveau des disjoncteurs de l'onduleur

Les rapports SOPEMEA *Réf. 1, 2 et 3* nous donnent les accélérations relevées en différents points de l'armoire.
Les points considérés sont les points n°1 et 2. Ceux sont les mesures effectuées tout en haut de l'armoire. Prendre ces accélérations est donc conservateur vis à vis des disjoncteurs placés en dessous

MG30 5kVA de type FRA

Point n°	Axe	Accélération maximale (g)	Accélération de Période Nulle (g)	Courbe n°
1	OX	7,5	3,2	14
	OY	7,2	2,8	38
	OZ	2,1	2,1	62
2	OX	7,5	4	16
	OY	7,5	3,9	40
	OZ	1,6	1,6	64

Essais par accélérogramme

MG30 5kVA de type EDF

Point n°	Axe	Accélération maximale (g)	Fréquence (Hz)	Courbe n°
1	OX	6,2[1]	12[1]	70
	OY	3,1	11,5	77
	OZ	Non relevée[2]	Non relevée[2]	
2	OX	6,5	12	71
	OY	6,5	11,5	78
	OZ	Non relevée[2]	Non relevée[2]	

[1] = mesure bruitée
[2] = Fréquence de résonance > 30Hz

Essais par 5 battements à différentes fréquences

MG30 20kVA de type EDF

Point n°	Axe	Accélération maximale (g)	Fréquence (Hz)	Courbe n°
1	OX	1,5[1]	11,5	65
	OY	2,8	12	75
	OZ	Non relevée	Non relevée	
2	OX	4,5[1]	11,5	67
	OY	5	12	78
	OZ	Non relevée	Non relevée	

[1] = mesure bruitée

Essais par 5 battements à différentes fréquences

Sévérité retenue pour l'ensemble des disjoncteurs du MG30

Pour rester encore conservateur et uniformiser les sévérités sur l'ensemble des disjoncteurs présents sur les différents onduleurs MG30, nous considèrerons les relevés les plus contraignants des 3 tableaux ci dessus. De même, la sévérité la plus élevée sera conservée pour les axes horizontaux. C'est à dire, les relevés ci dessous de l'onduleur 5kVA de type FRA:

Point n°	Axe	Accélération maximale (g)	Accélération de Période Nulle (g)	Courbe n°
1	Vertical	2,1	2,1	62
2	Horizontal	7,5	4	16

Voir ANNEXE 2 et ANNEXE 3

3.3.2. Essais de qualification sismique déjà réalisés

La qualification produit Spinline3 nous donne des informations quand à la tenue des disjoncteurs C60N bipolaire.

L'ANNEXE 1 nous donne les Spectres de Réponses Extrêmes appliqués au sous ensemble sur lequel était présent le disjoncteur C60. La figure 3 représente le spectre SDD (Spectre De Dimensionnement) sur l'axe vertical et la figure 4 représente le SDD sur les axes horizontaux.

Ces essais appliqués au sous-ensemble répondent aux contraintes du RCCE version 2002, c'est à dire 5 DSD (Demi Séisme de Dimensionnement) suivi d'un SDD (Spectre De Dimensionnement) sur chaque axe. Ils sont donc plus contraignants que les essais sismiques réalisés en 1976 et 1977 sur les onduleurs MG30.

On peut relever sur la courbe figure 3 et 4 les points singuliers suivant:

Axe	Accélération maximale (g)	Accélération de Période Nulle (g)	Annexe 1 Figure n°
Vertical	36	3,6	3
Horizontal	50	5	4

Les disjoncteurs n'ont pas eu de problèmes fonctionnels avant, pendant et après les essais sismiques.

4. CONCLUSIONS

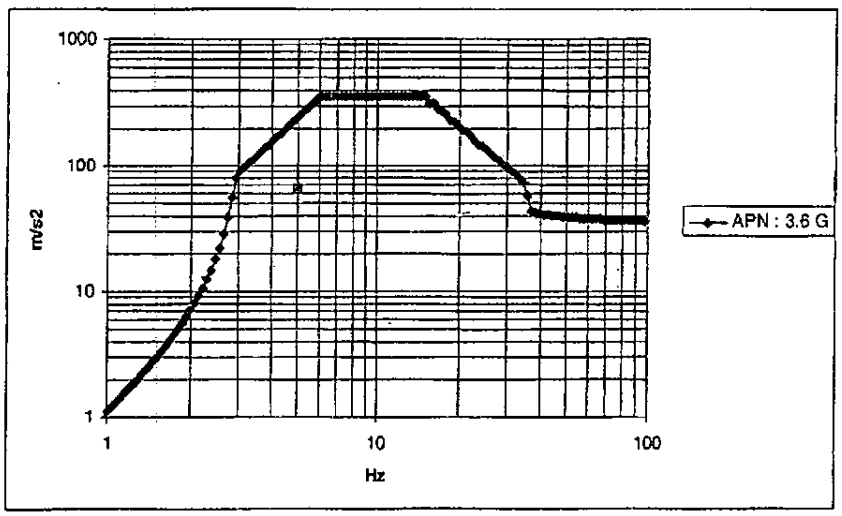
Les disjoncteurs C60 ont été qualifiés pour des niveaux de sévérités largement supérieurs aux niveaux qu'ils auraient subis dans les onduleurs.

De plus, les conditions d'essais sont nettement plus sévères.

Cette étude permet donc bien de montrer que le remplacement des disjoncteurs F32 par des disjoncteurs C60N et C32H-DC ne remet pas en cause la qualification sismique des onduleurs MG30.

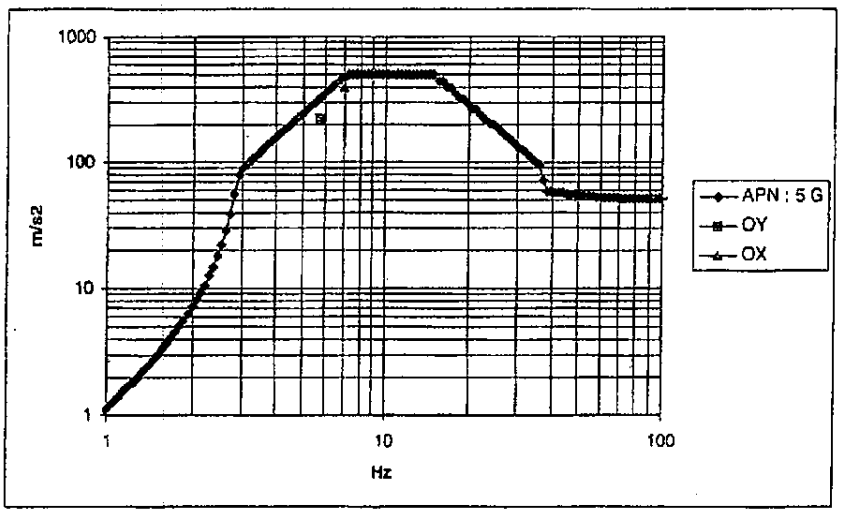
ANNEXE 1 – Spectres de Réponses Extrêmes de la PE sismique Toutes affaires Spinline3

Schneider Electric



SDD 0Z

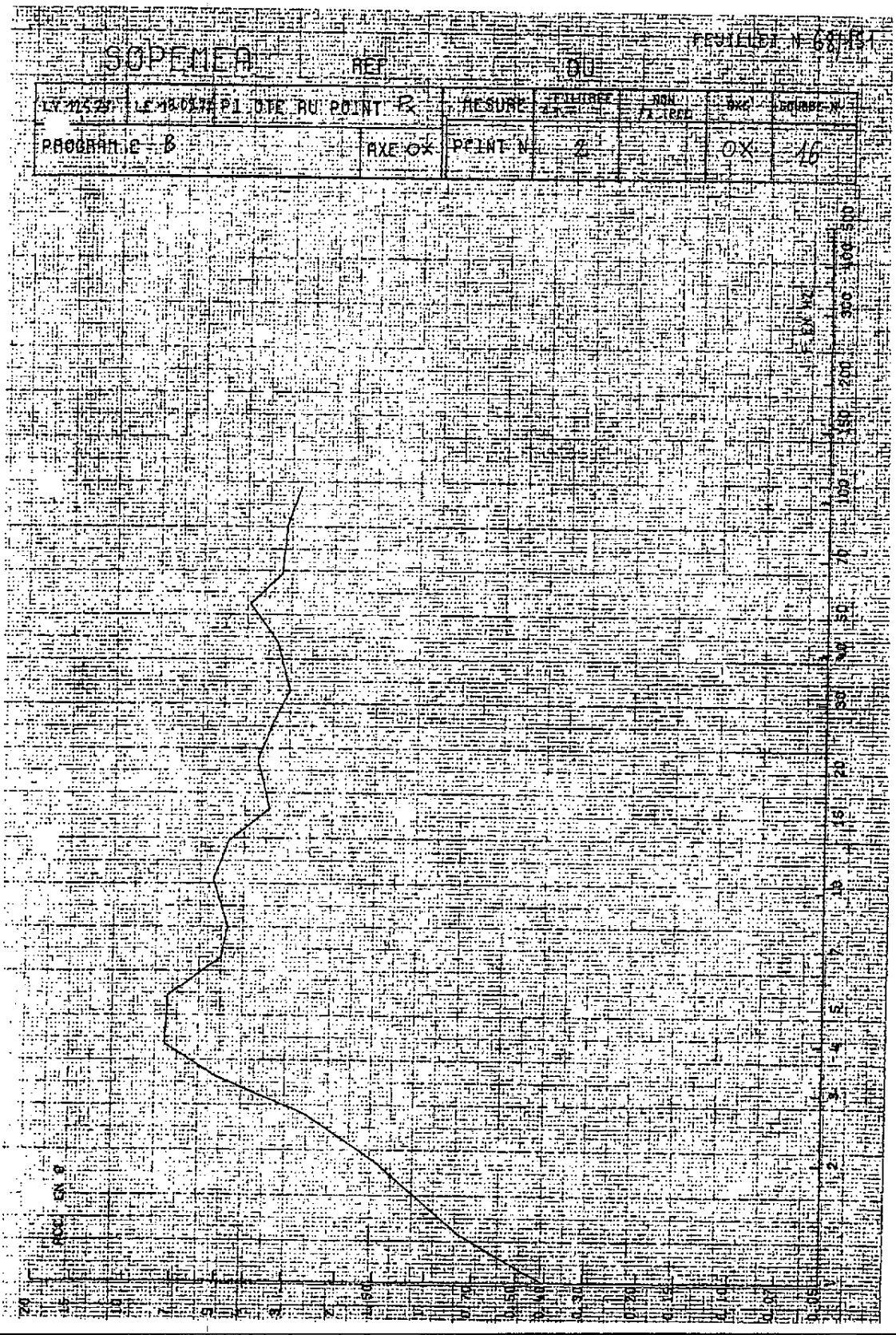
- Figure 3 – Excitation verticale (sévérité niveau objectif)



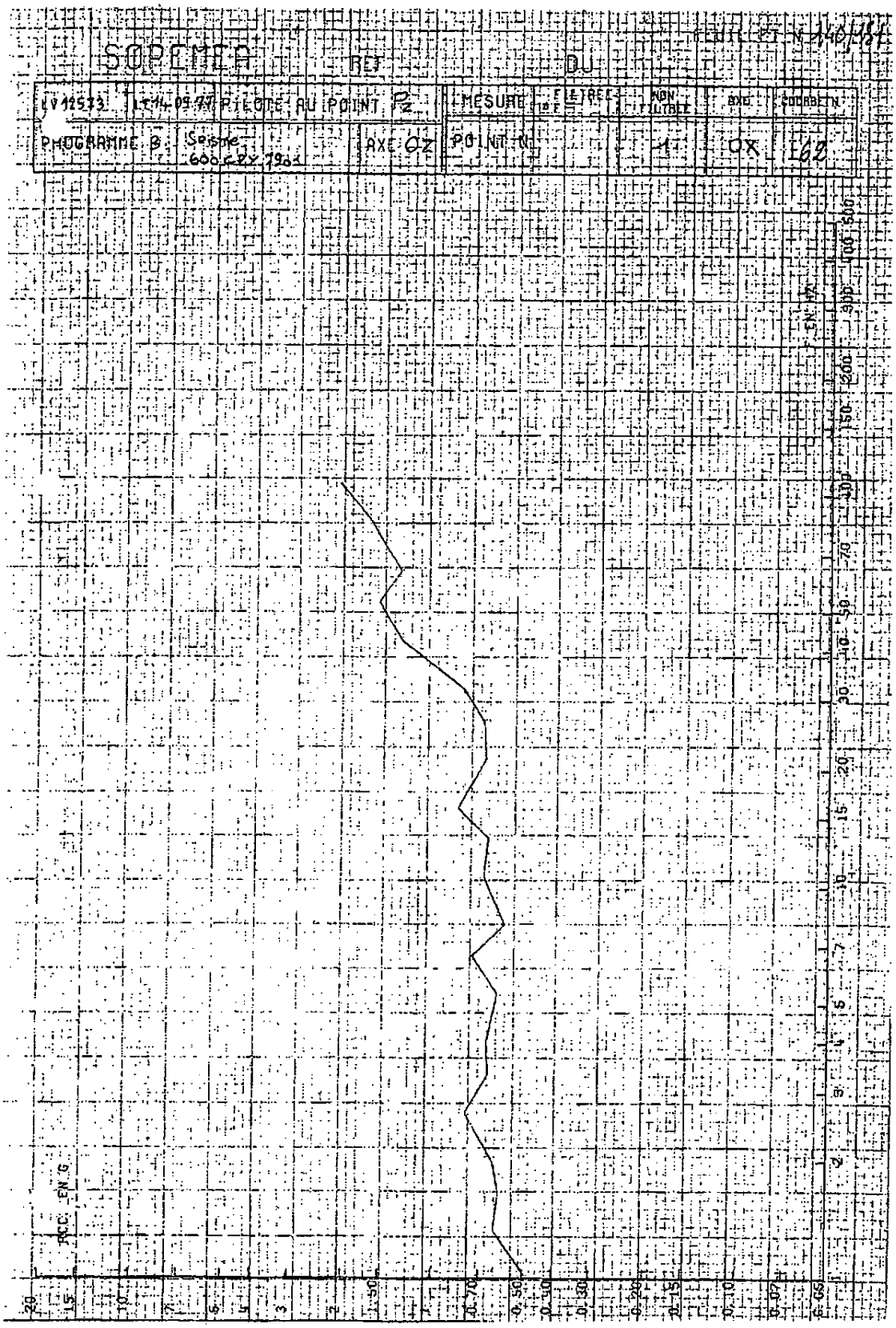
SDD
OX et OY

- Figure 4 – Excitation horizontale (sévérité niveau objectif)

ANNEXE 2 – Extrait du Rapport Sopéméa LV 12573 - axe 0X



ANNEXE 3 - Extrait du Rapport Sopéméa LV 12573 - axe 0Z



EQUIVALENCE	REV
E 018/09E	1

ATTACHMENT 12.6

Input Consideration Checklist for circuit breakers

2 PAGES

EQUIVALENCE	REV
E 018/09E	1

Eskom Generation Rev 0	EQUIVALENCY CHECK SHEET ELECTRICAL CIRCUIT BREAKERS	EQUIVALENCY NUMBER: E 018/09E

DESCRIPTION	Applicable	Not Applicable	COMMENTS (if not applicable)
SYSTEM DATA			
Circuit breaker voltage rating	☒	☐	
Current rating	☒	☐	
Rated power	☒	☐	
COMPONENT DATA			
Operational voltage	☒	☐	
Rated current	☒	☐	
Contacts configuration	☒	☐	
Short circuit capacity	☒	☐	
Enviromental conditions e.g. temperature	☒	☐	
Derating required??	☒	☐	
No of poles	☒	☐	
COMPONENT MATERIALS	☒	☐	
INSTALLATION DATA			
Mounting	☒	☐	
Dimensions	☒	☐	
Terminal connections (cable, busbars)	☒	☐	
Mass	☒	☐	
GENERAL			
Has the obsolescence database been checked for a possible resolution?	☒	☐	
Has the SAP database been checked for links to other plant systems?	☒	☐	

Compiler: MB Fahrenfort
Name

Reviewer: E.J KERR
Name

Signature

Date: 2009-10-08

EQUIVALENCE	REV
E 018/09E	1

ATTACHMENT 12.7

Safety Screening Form S2009/0180

4 PAGES

Eskom Generation

TITLE

SAFETY SCREENING FORM

ALL. CENTRE	FORM REF. NUMBER	REV	TO BE USED IN CONJUNCTION WITH – (ASSOCIATED DOCUMENTS / PROCEDURES)
38F	KFA-047	0	KAA-709

No: S2009/0180 **Rev. 1**

CONCLUSION

Safety Evaluation Required (in accordance with section 4.0 or 5.0)? YES☐ NO☒ Safety Evaluation Number: E

NNR approval required (in accordance with Section 6.0 or 7.0)? YES ☐ NO ☒

PREPARED BY:

NAME: *MB Fahrenfort* **SIGNATURE:** _____ **DATE:** 2009-10-01

(Preparer to be qualified in accordance with KTA-001)

INDEPENDENTLY REVIEWED BY:

NAME: *EJ Kerr* **SIGNATURE:** _____ **DATE:** 2009-10-08

(Reviewer to be qualified as an Evaluator if a Safety Evaluation is NOT required)

APPROVED BY:

NAME: *R Goldstein* **SIGNATURE:** _____ **DATE:** 2009-10-13

(Approver cannot be the reviewer and does need to be a qualified Screener / Evaluator)

1.0 DESCRIPTION

1.1 This screening is for:

☐Procedure ☐Temporary Alteration ☐Modification (30% phase ☐) ☐Test ☒Other

Revision/Activity/Condition No.: *Equivalency no. E 018/09E rev 1*

Title: *Circuit breaker for LNA/B/C/D 001 DL and LNE 001/002/003 DL*

Brief Description of Activity or Plant Condition:
The circuit breakers MG F32 and MG C32H series are obsolete. The equivalency study evaluates the proposed equivalent circuit breaker MG C60N against the original and the system functional requirements for interchangeability.

2.0 EDITORIAL CHANGES / RE-REVIEWS

EDITORIAL CHANGES YES☐ NO☒ (KAA-709, Appendix 2)

RE-REVIEWS YES☐ NO☒ (For Re-Reviews Sections 3-5 may be skipped)

2.1 If editorial change is "YES"(in accordance to Appendix 2), provide a short explanation why sections 3-5 can be skipped. YES☐ NO☒

2.2 If a screening/evaluation has been compiled previously for this change provide a short explanation why the previous screening remains valid for the additional process, both in terms of impact and applicability. (Reference original screening/evaluation)

3.0 KLA-001 CLASSIFICATION

3.1 What parameters or SSCs are affected, by this activity/condition? *LNA/B/C/D 001 DL and LNE 001/002/003 DL*

3.2 KLA-001 classification of SSCs identified in 3.1 above: *CSR/SR (LNE)*

4.0 IMPACT ON DESIGN / LICENSING BASIS

		YES	NO
4.1	Is the activity/condition a change to or does it impact on one of the following:		
4.1.1	Operating Technical Specifications	☐	☒
4.1.2	Radiation Protection Licencing Requirements	☐	☒
4.1.3	Emergency Operating Procedures/SAMGs	☐	☒
4.1.4	Emergency Plan	☐	☒
4.1.5	Any other document referenced in Appendix 6 (KAA-709)	☐	☒
4.2	Does the proposed activity/condition involve a change to an SSC that **affects** the **design** as described in the SAR?	☐	☒

TITLE

SAFETY SCREENING FORM – Continued

ALL CENTRE	FORM REFERENCE NUMBER	REV	TO BE USED IN CONJUNCTION WITH – (ASSOCIATED DOCUMENTS/PROCEDURES)
38F	KFA-047	0	KAA-709

No: S2009/0180 Rev. 1

		YES	NO
4.3	Does this proposed activity involve a change to a procedure that **affects** how design base (SAR and DSE) described SSC **design functions are performed or controlled**?	☐	☒
4.4	Does this proposed activity involve **revising or replacing** an SAR desribed **evaluation methodology** that is used in establishing the design bases or used in the safety analysis?	☐	☒
4.5	Does this proposed activity involve a **test or experiment not described in the SAR** where a SSC is utilised or controlled in a manner that is outside the reference bounds of the design for that SSC or is inconsistent with analyses or descriptions in the SAR?	☐	☒

Conclusion and supporting arguments:
The technical evaluation performed in equivalency study E 018/09E rev 1 proves that the proposed circuit breaker meets the functional requirements and is an acceptable replacement to the original. The design base is not affected by this change.

TITLE

SAFETY SCREENING FORM – Continued

ALL. CENTRE	FORM REFERENCE NUMBER	REV	TO BE USED IN CONJUNCTION WITH – (ASSOCIATED DOCUMENTS/PROCEDURES)
38F	KFA-047	0	KAA-709

No: S2009/0180 Rev. 1

5.0 GENERAL

Will/could the activity/condition:		YES	NO
5.1	adversely affect the ability of the operator to assess, or control, the nuclear safety status of the plant?	☐	☒
5.2	adversely affect the nuclear safety reponse of the plant to normal evolutions, anticipated operational occurrences, or accidents?	☐	☒
5.3	adversely affect the qualification or operational characteristics of installed important to safety components classified?	☐	☒
5.4	increase the potential for the release of radioactive material to the environment, or have an impact on the activity migration model?	☐	☒
5.5	increase the potential for an initiating event (list in Appendix 5)?	☐	☒
5.6	introduce a new common mode failure?	☐	☒

Comments:

If ANY answer in Section 4.0 or 5.0 is "YES" a safety evaluation is required

6.0 SAR IMPACT

SAR Sections Reviewed: II-11.2.2.2.1

SAR Update Request raised? Yes☐ No☒ No.:

Note: NNR approval is required for SAR updates

7.0 NNR APPROVAL

Does this activity/condition:		YES	NO
7.1	require a change to a NL-1 Licence Condition, LD or subsequent LCRs?	☐	☒
7.2	require a change to a document which needs NNR approval as listed in Appendix 6 ?	☐	☒
7.3	require approval according to the requirements of LD-1012?	☐	☒

Use the Licence Impact Form to assist in answering the above. Copies of NL-1, LDs and LCRs can be found on g\\userg\nuclear engineering\design engineering\safeval\

EQUIVALENCE	REV
E 018/09E	1

ATTACHMENT 12.8

IEC 60038 recommended voltages

2 PAGES

2 Rules and statutory regulations

Low-voltage installations are governed by a number of regulatory and advisory texts, which may be classified as follows:
- Statutory regulations (decrees, factory acts,etc.)
- Codes of practice, regulations issued by professional institutions, job specifications
- National and international standards for installations
- National and international standards for products

2.1 Definition of voltage ranges

IEC voltage standards and recommendations

Three-phase four-wire or three-wire systems Nominal voltage (V)		Single-phase three-wire systems Nominal voltage (V)
50 Hz	60 Hz	60 Hz
–	120/208	120/240
–	240	–
230/400(1)	277/480	–
400/690(1)	480	–
–	347/600	–
1000	600	–

(1) The nominal voltage of existing 220/380 V and 240/415 V systems shall evolve toward the recommended value of 230/400 V. The transition period should be as short as possible and should not exceed the year 2003. During this period, as a first step, the electricity supply authorities of countries having 220/380 V systems should bring the voltage within the range 230/400 V +6 %, -10 % and those of countries having 240/415 V systems should bring the voltage within the range 230/400 V +10 %, -6 %. At the end of this transition period, the tolerance of 230/400 V ± 10 % should have been achieved; after this the reduction of this range will be considered. All the above considerations apply also to the present 380/660 V value with respect to the recommended value 400/690 V.

Fig. A1 : Standard voltages between 100 V and 1000 V (IEC 60038 Edition 6.2 2002-07)

Series I Highest voltage for equipment (kV)	Nominal system voltage (kV)		Series II Highest voltage for equipment (kV)	Nominal system voltage (kV)
3.6(1)	3.3(1)	3(1)	4.40(1)	4.16(1)
7.2(1)	6.6(1)	6(1)	–	–
12	11	10	–	–
–	–	–	13.2(2)	12.47(2)
–	–	–	13.97(2)	13.2(2)
–	–	–	14.52(1)	13.8(1)
(17.5)	–	(15)	–	–
24	22	20	–	–
–	–	–	26.4(2)	24.94(2)
36(3)	33(3)	–	–	–
–	–	–	36.5	34.5
40.5(3)	–	35(3)	–	–

These systems are generally three-wire systems unless otherwise indicated.
The values indicated are voltages between phases.
The values indicated in parentheses should be considered as non-preferred values. It is recommended that these values should not be used for new systems to be constructed in future.
Note 1: It is recommended that in any one country the ratio between two adjacent nominal voltages should be not less than two.
Note 2: In a normal system of Series I, the highest voltage and the lowest voltage do not differ by more than approximately ±10 % from the nominal voltage of the system. In a normal system of Series II, the highest voltage does not differ by more than +5 % and the lowest voltage by more than -10 % from the nominal voltage of the system.
(1) These values should not be used for public distribution systems.
(2) These systems are generally four-wire systems.
(3) The unification of these values is under consideration.

Fig. A2 ; Standard voltages above 1 kV and not exceeding 35 kV (IEC 60038 Edition 6.2 2002-07)

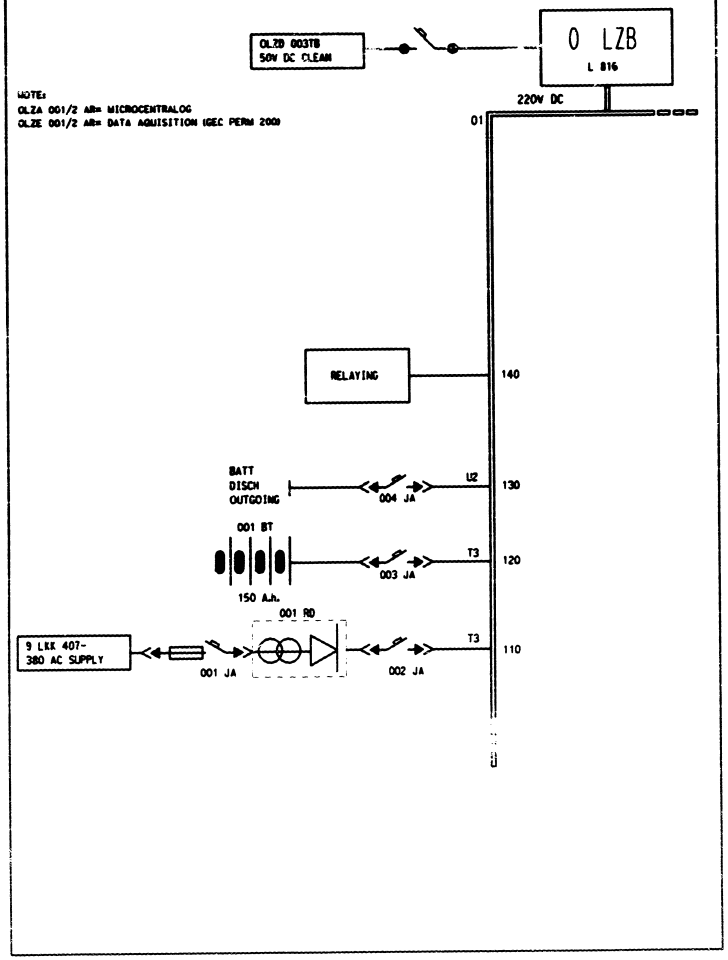
REV	DATE	DRAWN	CHECKED	APPROVED	MODIFICATION	SHEET
Z12	06.12.96	CAW	FC-A	BT	RECADDED AS PER DDR 1053/96	
A	20.8.96	Y.B.	GMP	BD	ESKOM No. ALLOCATED REF DCR 61/86	

TITLE: 0 LZB

DWG No. 31.46 / 1003

MICRO FEBBG:.5

16 BEFORE 17



Z12	09.12.96	CAW	FGA	IT	RECADDED AS PER DDR 1053/96
A	20.8.86	Y.B.	TO	BD	ESKOM No. ALLOCATED - REF DCR 61/86
REV	DATE	DRAWN	CHECKED	APPROVED	MODIFICATION

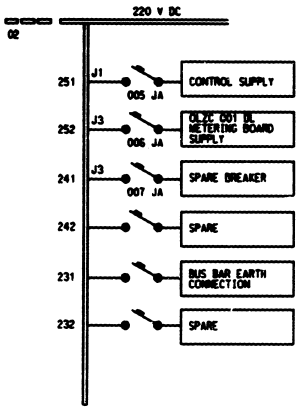
SHEET

TITLE 0 LZB

DWG No. 31.46 / 1003 MICRO FEB96116

17 BEFORE 18

0 LZB

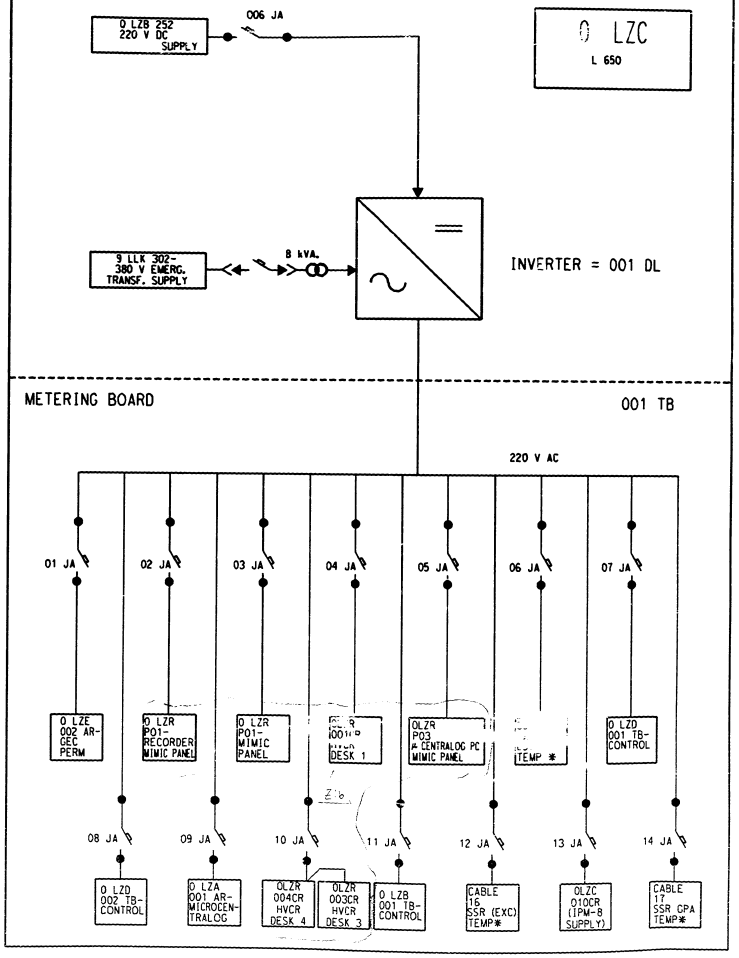


REV	DATE	DRAWN	CHECKED	APPROVED	MODIFICATION
Z16	21.08.01	PSW	MJA	PB	MOD 91011 ; DDR 2001/01958
Z15	13.09.00	PSW			AS PER DDR 2000/0196
Z12	09.12.96	CAW	FGA	BT	RECADDED AS PER DDR 1053/96
A	15.8.86	Y.W.	TO	BD	ESKOM No. ALLOCATED - REF DCR 61/86

TITLE: 0 LZC

DWG No. 31.46 / 1003 MICRO FEB96117

SHEET 18 BEFORE 19



Eskom

TITLE

TD & RM
EHR COVER SLIP

Reference No KFI-RE-002

Revision: 1 | Page: 1

Associated Procedure: KAA-830

ALLOC CENTRE	DOCUMENT NUMBER	REV	FOR OFFICE USE ONLY
	1464326	0	

TITLE

ELECTRICAL MAINTENANCE
DEFECT INVESTIGATION
AND REPAIR

REPLACE DEFECTIVE
220V BREAKERS

REPLACE ALL 13X 10A
BREAKERS ON 0LZC001TR

COVER SLIP COMPLETED BY

I. Gabriels

DOCUMENT TYPE	SECURITY CLASS
RECORD	R

AUTHOR ORIGINATOR

TRIGRAMME (STATUS COMMENTS)

38 - 0 LZC 001 TB
38 - 0 LZC
38 - 0 LZC 012 JTA

25 trigrammes may be entered

REF. DATE (CCYYMMDD)	KIS / SHELF LOCATION	NO OF PGS	RETENTION PERIOD
20160210	PT773	0010	YEARS 005

REFERENCE NUMBERS

MAINT REF NO.
E107834

WO 71308586 4
71262679 6

25 work order numbers may be entered

DISTRIBUTION / COPIES	FOR OFFICE USE ONLY		RECORD FORMAT	
	SCANNED		HARDCOPY (PAPER)	
	REGISTERED		DISC	
			RADIOGRAPH	
			TAPE	
			OTHER	

NOTES

Order Header

Order	713085864	INVETIGATE AND REPAIR BREAKERS AND INVER
Notification	22971028	

* 2014 11.11 11 45:59 CPS-BATCH CPS-BATCH (CPS-BATCH)
*Supply to HV control room plugs and unit 2 control room
*electronic LCO screen lost. Initially found 0LZC010JA
*tripped. After resetting 010JA power was still absent. Line
*up verified as per KWB-S-0-LZC
* 2014.11.12 14 53:44 CHANTAL MOLPUS (D97095) Phone 0215505013
* Operating restored breaker 010JA. EMS verified the load on the 10A breaket to be 4A. Notification kept open for a day to see if any variation in the current, no deviation noted. Due to recurring event, EMS will replace the breaker when breaker spare available as current breaker on plant is fairly old and dont latch first time when closing For more information contact Chantal Molpus at 5912

Reported by	PHILIP JOHN IRELAND		*Telno.*	0215504917
Main Work center	EM9	EMS UNIT 9		
Maint plan group	004	EMS UNIT 0 2 & 6	*Telno.*	
Order type	M300	Elective Maintenance		
Maint Act Type	135	Normal Maint		
Priority	4	Priority 4		

Start date 2015.02.04 *End date* 2015.02.06

INVETIGATE AND REPAIR BREAKERS AND INVERTER OLZC001DL

Acceptance of work to be performed, and understanding thereof

Eskom
Craig McClusky
2016 -02- 09
Sign

Supervisor _____ *Signature*

Reference Object

Functional Location	38-0LZC	220 V AC GENERATION AND DISTRIBUTION	
Room	L650	*Location*	Unit Nine Electrical Building 15.5M
ABC Indicator	3 Availability Related		

Operations

Operation	0010	(1071826300)REPLACE ALL 13X 10A BREAKERS PM01			
System Cond.					
Work Centre	EM0	EMS UNIT 0			
Work	12.0 H	*Duration*	6.0 H	*People*	2
Start Date	2015 02.04	*End Date*	2015.02.05		

Materials

Material Number	0240515	*Quantity*	15.000 EA
Material Description	BKR,CIRC.MG C60N-10A ,10 A ;230 VAC ;2		
Reservation	0089431945	0001	

Field Key	KBG0001	KOEBERG USER DATA
PROCEDURE No.	KWM-EM-DEF-001	
JOB TYPE	ELECTIVE	
RADIATION CERT.	N/A	
PERMIT TO WORK	ISOLATION	

Additional text

(1071826300)REPLACE ALL 13X 10A BREAKERS ON 0LZC001TB BOARD

COMPILED BY	REVIEWED BY	QUALITY CONTROL	DOUBLE VERIFY
Jean Paul De La Cruz			
2016 -02- 03			10/02/2016
Sign			

Feedback

Start Date 10/02/2016 *Time* ✓ *End Date* 10/02/2016 *Time* ✓

Time worked 8 Hrs *Completed* Yes / No *Time remaining* NONE

Confirmation Text REPLACE ALL 13 10A BREAKERS ON OLZC001TB BOARD COMPLETED.

Work done by 3958191 (Unique No.) 10/02/2016 (Date) I. GABRIELS (Name & Signature)

Work done by (Unique No.) 10/02/2016 (Date) (Name & Signature)

General Feedback

Malfunction Start ___/___/___ *Time* ___:___ *Malfunction End* ___/___/___ *Time* ___:___

Equipment Dismantling Feedback
Equipment Dismantled? Yes / No
If Yes:

	Item Dismantled	Item Installed
Equipment Number:		
Material Number:		
Serial Number:		

N/A

Certificate: Work tested and accepted

Responsible person I. GABRIELS *Signature*

Eskom Koeberg Power Station PM Order 712626796
L150 Copy 3 Page 1 of 2

Order Header

Order	712626796	REPLACE DEFECTIVE 220V BREAKER		
Notification	22829757			
* 2014.07.14 16:20:28 CHANTAL MOLPUS (D97095) Phone 0215505013				
* REPLACE DEFECTIVE 220V BREAKER.				
* BREAKER DETAILS:MERLIN GERIN, 10A, 2POLE, NO;63120 P1, COMPACT F32.				
* FOR MORE INFORMATION CONTACT CHANTAL MOLPUS AT 5912				
Reported by	D97095	*Telno*		
Main Work center	EM9	EMS UNIT 9		
Maint plan group	004	EMS UNIT 0 2 & 6	*Telno.*	
Order type	M300	Elective Maintenance		
Maint Act Type	135	Normal Maint		
Priority	3	Priority 3		
Start date	2016 02.03	*End date*	2016 02.04	

Eskom
Craig McClusky
2016 -02- 08
Sign

Acceptance of work to be performed, and understanding thereof

Supervisor _____ *Signature* _____

Reference Object

Functional Location	38-0LZC012JA	CIRCUIT BREAKER SUPL CABLE 16 SSR (EXC)	
	CIRCUIT BREAKER - SUPPLY CABLE 16 SSR (EXC) TEMPERATURE		
Room	L650	*Location*	Unit Nine Electrical Building 15.5M
ABC Indicator	3 Availability Related		

Operations

Operation	0010	REPLACE DEFECTIVE 220V BREAKER		PM01	
System Cond.					
Work Centre	EM0	EMS UNIT 0			
Work	6.0 H	*Duration*	3.0 H	*People*	2
Start Date	2016 02.03	*End Date*	2016 02 04		

Materials

Material Number	0240515	*Quantity*	1 000 EA
Material Description	BKR,CIRC:MG C60N-10A ,10 A ;230 VAC ,2		
Reservation	0088769382	0001	

Field Key	KBG0001	KOEBERG USER DATA
PROCEDURE No.	KWM-EM-DEF-001	
JOB TYPE	ELECTIVE	
RADIATION CERT.	N/A	
PERMIT TO WORK	ISOLATION	

Additional text

REPLACE DEFECTIVE 220V BREAKER

~COMPILED BY~~	~REVIEWED BY~~	QUALITY CONTROL	DOUBLE VERIFY
Jean Paul De La Cruz			
2016 -02- 03	N/A	N/A	
Sign			2016. 02. 10

Feedback

Start Date 10/02/2016 *Time* ___ *End Date* 10/02/2016 *Time* ___

Time worked 8 Hours *Completed* (Yes) / No *Time remaining* None

Confirmation Text REPLACE DEFECTIVE 220V BREAKERS COMPLETED.

Work done by 4124656 Unique No. 10/02/2016 Date L. Dolo Name & Signature

Work done by 3958191 Unique No. 10/02/2016 Date I. GABRIELS Name & Signature

General Feedback

Malfunction Start ___/___/___ *Time* ___:___ *Malfunction End* ___/___/___ *Time* ___:___

Equipment Dismantling Feedback
Equipment Dismantled? Yes / No
If Yes:

	Item Dismantled	Item Installed
Equipment Number		
Material Number:		
Serial Number:		

Certificate: Work tested and accepted

Responsible person I. GABRIELS *Signature*

HISTORY SUMMARY

NO HISTORY CAPTURE HOURS ONLY (✓) ☐

WORK CONTROL CHECKLIST (✓ or mark N/A as applicable)

- COMPONENT SWOPPED? ASSET CHANGE FORM COMPLETED — N/A
- DEFECT RAISED TO REPAIR OLD ASSET — N/A
- M & TE NUMBERS LISTED — ✓
- TEST RESULTS LISTED — ✓
- PTW CLEARED — ✓
- POST MAINT REQUAL DONE — ✓
- JOB SITE CLEANED — ✓
- H OR W POINTS ADHERED TO — ✓
- TOOLS REMOVED AND RETURNED — ✓
- SPARES RETURNED — ✓
- SCAFFOLDING INFORMED — N/A
- CORRECTIVE ACTIONS LISTED - NCR / PN — N/A

F/C AS FOUND CONDITION OF EQUIPMENT/COMPONENTS

CONDITION 1 COMPONENT DEGRADED ☐ | CONDITION 2 OUT OF TOLERANCE ☐ | CONDITION 3 SATISFACTORY ☑ | CONDITION 4 SUPERIOR ☐ | N/A ☐

EXPLANATION: Equipment found in a good working condition.

C/A CORRECTIVE ACTIONS

REPAIR ☑ | SERVICE ☐ | OVERHAUL ☐ | TEST ☐

FAULT CONDITION: Certain outgoing feeders breakers were faulty and working intermittently. A decision was taken to replace all thirteen outgoing feeder breakers as it's of the older type breakers

REPAIRS: All thirteen outgoing circuit breakers (2 pole) of 0L2C switchboard replaced with new equivalent spares.

T/R TEST RESULTS

All thirteen outgoing feeder breakers replaced with new equivalent circuit breakers. All the new installed breakers were installed and tested and operated successfully.

R/C ROOT CAUSE AND CONSEQUENCE OF FAILURE

Suspect Component degradation

M & TE USED / RI NUMBERS	RUNNING HOURS	STARTS / ACTUATIONS	CROSS REF: NCRs, W/Os, MODS, PTWs, ETC
RI: 53717 ICEM 301081 (Y)	N/A	N/A	9/16-87555 Xref: 7126796

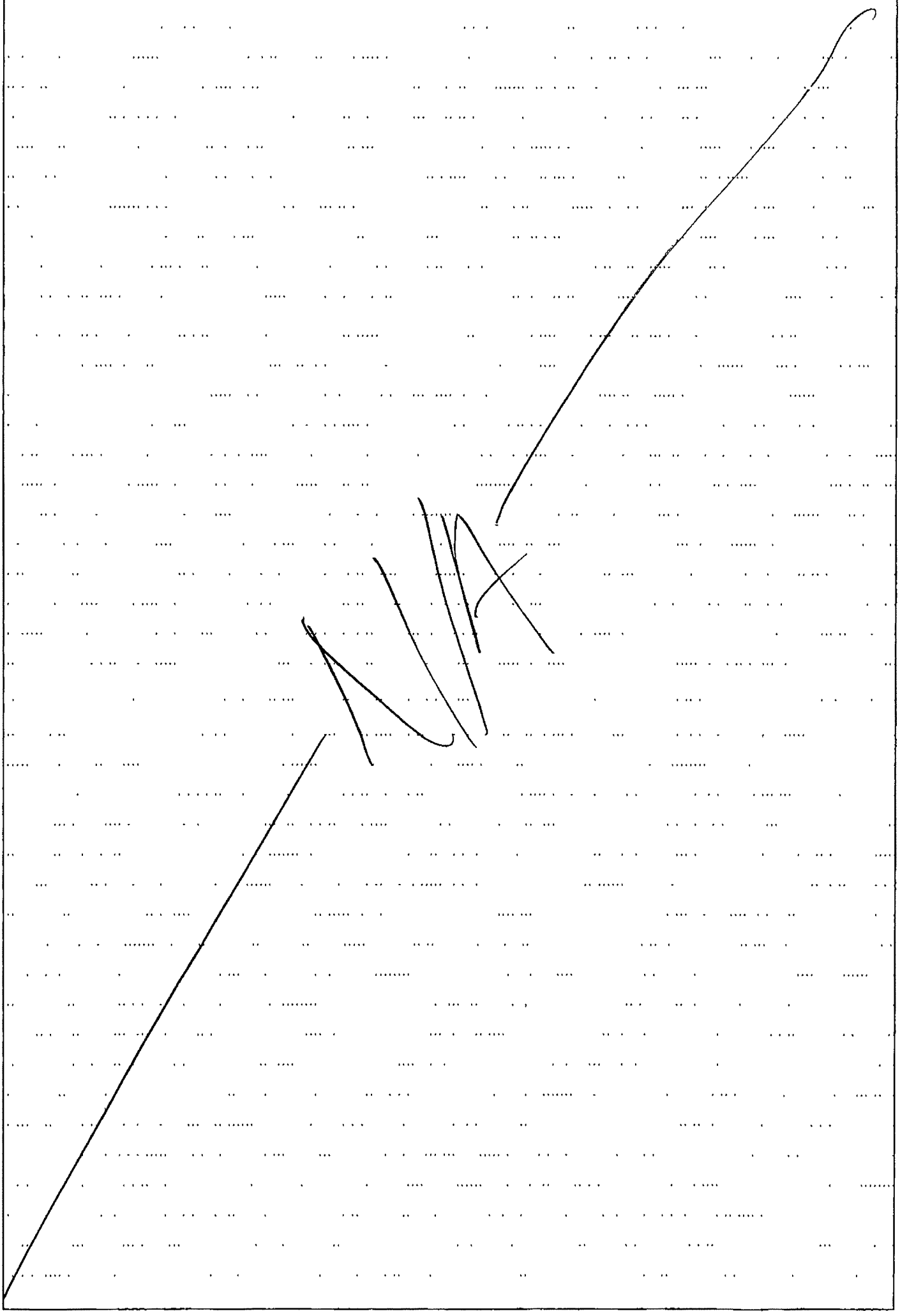
VERIFICATION OF COMPLETED WORK AND HISTORY

* CRAFTSMAN	** SUPERVISOR	QUALITY CONTROL
NAME: I. GABRIELS	NAME: W. SIMPSON	Eskom D. DITCHAM Q34
DATE: 2016-02-25	DATE: 2016-02-25	2016-03-31
SIGN:	SIGN:	SIGNATURE:

* I declare that the work has been done in a quality manner, the check off requirements have been met and the history summary is accurate and comprehensive.

** I declare that the above history is accurate, work is complete and quality requirements of the job have been met and root cause established

TEST RESULTS



APPENDIX 6 (continued) **Page 2 of 9**

5.0 Have all prerequisites been met? YES ✓ NO

I. GABRIELS — Responsible Person | Signature | 2016-02-10 — Date

PLANT REFERENCE NUMBER:	0LEC / 0L2C012JA

AS FOUND CONDITION
Certain outgoing feeder breakers working intermittently and decision was made to replace all 13 circuit breakers (2 pole type)

WORK PERFORMED:
All 13 circuit breakers of the older type replaced with new equivalent type spares

RI No. 53717	PTW. 9/16-87555

COC REQUIRED (Y/N)? N	COC No: N/A

EQUIPMENT REQUALIFICATION DETAILS:
All new circuit breakers were tested and operated successfully.

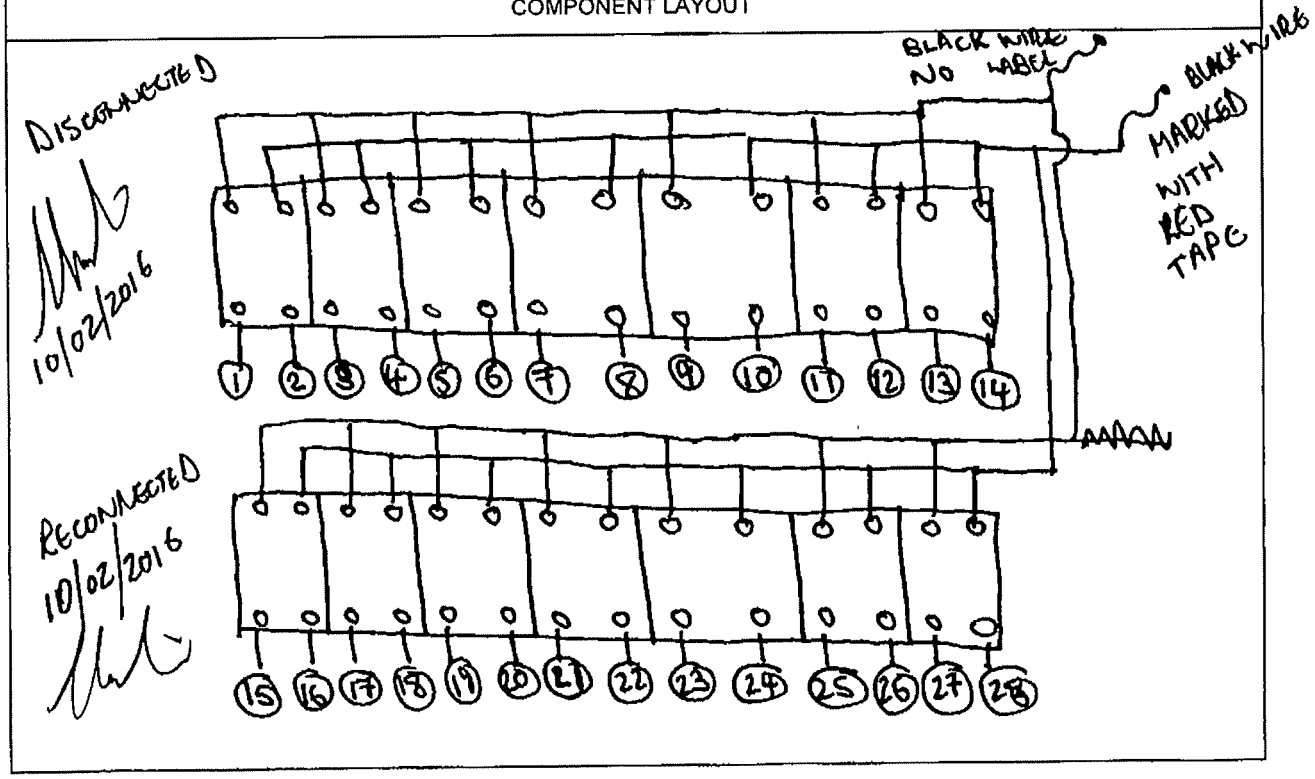
EQUIPMENT USED	M & TE No.	CALIBRATION EXPIRY DATE
Fluke Multimeter	KEM 301081	2016-11-11

APPENDIX 6 (continued) **Page 5 of 9**

RECORD OF ALTERATIONS / DISCONNECTIONS / RECONNECTIONS

Terminal Location	Wire Number Identification	Alteration Jumper Disconnect	Signature and Date	Restored to Original State Signature	Date	Verified By	Date
							2016/02/11

COMPONENT LAYOUT



APPENDIX 6 (continued) **Page 6 of 9**

TOOL INVENTORY CHECKLIST

Trigramme: O LZC 001 TB

W/O. 713085864 Date: 10/02/2016

Quantity	Description	Removed from Site (✓)
ONE	SIDE CUTTER	✓
ONE	WIRE STRIPPER (BLUE)	✓
ONE	FLAT MEDIUM SCREWDRIVER	✓
ONE	STAR MEDIUM SCREWDRIVER	✓
ONE	10 mm RING SPANNER	✓
ONE	JUNIOR HACKSAW.	✓

DECLARATION All equipment shown ticked off above has been removed from the plant site

Name C. North Signed:

Verified. L. Dolo Signed

APPENDIX 6 (continued) **Page 9 of 9**

POINT	QC H-OR-W	~~qc~~ VERIFIER			DATE
		NAME	SIGNATURE	INSPECTION No	
Trace of polarity unit short circuit or overload by disconnection					
8.9.9	H				
8 9 14	H				
Cable defects and new cable installation					
8.12 15	H				
8 12.2.6	H				
Wiring or re-wiring of faulty supply or control panels					
8 14 8	H				
Replacement of faulty cabinet components					
8 15 6	H	C. MCCLUSKY			2016/02/11
Trace heating removal and replacement					
8.19 2.3	H				
Soldering on non-1E components					
8.22.14	H				
DISTRIBUTION BOARD WORK					
8.23.6	H				
CABINET, CUBICLE, BOX OR ENCLOSURE REPLACEMENT					
8.26.11	H				
SSC affected by water damage (Flooding)					
8.27 11 (e)	H				
SSC affected by moisture, or dirt build-up					
8 27 12 (d)	H				