POWER AND WATER AUTHORITY

STANDARDS BRANCH
– Power Division

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STANDARDS BULLETIN No. :

SUBJECT: MINOR CENTRES FUSE POLICY

CONTENTS

1.0 INTRODUCTION

Minor Centres supplied by local diesel generators of relatively small capacity and some centres connected to long distribution lines where fault levels are extremely low require a separate fusing philosophy from that required in major centres with large capacity generation sources.

Minor Centres with low fault levels and large variations in load cycles where different sizes of generators are used to pick up day time and night time loads create unique problems for fault protection application.

A new fusing policy has been developed for application in low fault areas which will address the specific problems for protection discrimination.

Regional Operations staff and Technical Services staff have assisted in the development of this policy.

2.0 FAULT LEVELS

Fault level studies were carried out on various locations and Oenpellie (Gumbalanya) and Lake Evella (Gapuwiyak), were used as the basis for fault calculations both with maximum and minimum generation.

Typical 11kv fault levels at the step up transformer are as follows:

Maximum: 230 amperes 3 phase
290 amperes phase to earth
i.e. 650kva generator
500kva step up transformer

Minimum: 64 amperes 3 phase
98 amperes phase to earth
i.e. 140kva generator
300kva step up transformer.

3.0 FAULT CLEARING TIMES

Because of insufficient information available regarding the proposed H.V. earth fault protection system, the fuse co-ordination was restricted to the distribution substation area and the following criteria used:
The H.V. EDO fuse is to clear a bolted phase to ground low voltage fault at the transformer terminal, in one second. Where this cannot be achieved (generally because of minimum size EDO) low voltage transformer protection is to be used to achieve the 1 second clearing time.

4.0 MINIMUM SIZE H.V. EXPULSION DROP OUT FUSES

POLICY

The minimum size expulsion fuse element to be used in minor centres is to be 5 amperes.

This requirement is necessitated by the placement of surge diverters on step up substations and distribution substation such that lighting discharge current and 50hz follow through current passes through the fuse element. Fuse elements of less than 5 ampere rating would operate with operation of the H.V. surge diverter.

5.0 STEP UP TRANSFORMERS

5.1 FUSES

Most centes with H.V. reticulation have at least two step up transformers supplying an open H.V. ring system. Each transformer should be capable of carrying the combined feeder loading in the case of a step up transformer failure when the open point has to be closed.

In centres with more than two step up substations failure of only one step up transformer is considered in redundancy situations i.e. with three substations and one substation out of service remaining substations to carry 50% of total H.V. feeder loads (provided) load can be balanced between open points.)

In many cases step up transformers have been sized for future expansion and present loads are supplied by very much smaller generating sets. H.V. EDO feeder fuses should not necessarily be sized to transformer capacity but to total feeder loads as stated above.

This policy will provide for better H.V. feeder fuse discrimation.

POLICY

Step up transformer H.V. feeder expulsion drop out fuses shall be sized to carry the combined H.V. feeder load in the case of redundancy of one step up transformer.

5.2 L.V. FUSES

POLICY

Where low voltage fuses are fitted to protect low voltage cables to the step up transformers theses fuses are to be sized to carry the combined H.V. feeder load in the case of redundancy of one step up transformer.

6.0 DISTRIBUTION TRANSFORMERS

6.1 H.V. FUSES

In major centres distribution transformer fusing is sized to allow for parelling of L.V. feeders and for loads up to 150% of the rated transformer capacity.

In minor centres this approach requires large H.V. EDO fuses which invariably won't grade with the EDO fuses on the step up transformer.

In addition low voltage paralleling is rarely used in minor centres so it has been decided to fuse the distribution transformers to 100% of the rated transformer capacity.

POLICY

a) Distribution transformer H.V. expulsion fuse elements are to be sized to 100% transformer capacity.

b) H.V. fuse shall grade with any L.V. fuse installed according to 6.2 below.

6.2 L.V. FUSES

POLICY

Where a high voltage fuse will not clear a bolted low voltage phase to earth terminal fault within 1 second low voltage protection is to be installed as close as is practicable to the transformer.
These L.V. fuses may cause discrimination problems with any down stream protection devices and any such problems are outside the scope of this policy. The L.V. transformer fuses are to be considered essential.

7.0 MAXIMUM DEMAND INDICATORS STEP UP TRANSFORMER

To assist in managing H.V. feeder loads and determining correct step up substation fusing application all step up substations will be fitted with maximum demand indicators.

The indicators will be fitted to all three phases on the low voltage side of the transformer and will be of the thermal time delay type indicating the previous maximum current (black pointer) and the present average load (red pointer). The meter will have a scale reading up to 6 (amperes) which must be multiplied by the current transformer ratio constant (K) to obtain the actual current values:

eg. - 400/5 C.T.
K= 80
multiply meter reading by 80
Reading = 3.8
Load = 3.8 x 80
= 304 amperes.

For standard step up transformers of 433/11kv voltage and YNzn1 vector groups the low voltage line current values can be divided by 25.4 to obtain appropriate H.V. line currents for use with the fuse application chart.

Full installation instructions for the maximum demand indicators will be issued separately.

8.0 FUSE TABLES

8.1 STEP UP TRANSFORMER FUSE TABLE

MINOR CENTRES EDO FUSE TABLE

11 KV STEP-UP TRANSFORMERS

H.V. FEEDER LOAD —AMPS—	H.V. FUSE		COMPATIBLE L.V. FUSE
	AMPS	STOCK CODE	
< 5·0	5	10290	125
5 – 8	8	10173	200
8 – 10	10	10181	250
10 – 15	15	10199	400
15 – 20	20	10215	500
20 – 25	25	10223	630

NOTES: 1. H.V. FUSES TO BE SIZED TO FEEDER LOADS AND NOT TRANSFORMER CAPACITY
2. H.V. FUSES ARE (E.D.O. FAST TYPE 'K')

8.2 DISTRIBUTION TRANSFORMER FUSE TABLE

MINOR CENTRES EDO FUSE TABLE

11 KV DISTRIBUTION TRANSFORMERS

TRANSFORMER CAPACITY (KVA)	THREE PHASE		SINGLE PHASE	
	H.V.	L.V.	H.V.	L.V.
15	–	–	5	63
25	5	45	–	–
50	5	63	5	200
100	5	160	–	–
* 150	8	–	–	–
200	10	–	–	–
300	15	–	–	–

NOTES: 1. FUSES SIZED TO 100% TRANSFORMER CAPACITY
* 2. NON STANDARD SIZE

NOTE:

The above tables have been produced on a pocket sized water proof card and are available from the Standards Branch.

9.0 FUSE TABLE APPLICATION

9.1 STEP UP TRANSFORMERS

EXAMPLE:

MINOF CENTRES EDO FUSE TABLE

11 K.V STEP-UP TRANSFORMERS

H.V. FEEDER LOAD — AMPS —	H.V. FUSE		COMPATIBLE L.V. FUSE
	AMPS	STOCK CODE	
< 5·0	5	10280	125
5 – 8	8	10173	200
8 – 10	10	10181	250
10 – 15	15	10199	400
15 – 20	20	10215	500
20 – 25	25	10223	630

NOTES: 1. H.V. FUSES TO BE SIZED TO FEEDER LOADS AND NOT TRANSFORMER CAPACITY
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H.V. Feeders = 2
Feeder Load No. 1 = 8 amperes
Feeder Load No. 2 = 7.7 amperes
Total feeder load = 15.7 amperes
Column 1 : 15-20 amperer line

Column 2 : EDO fuse size 20 amperes

Column 3 : Stock Code 10215

Column 4 : L.V. fuse if fitted 500 amperes

9.2 DISTRIBUTION TRANSFORMER

EXAMPLE:

MINOR CENTRES EDO FUSE TABLE

11 KV DISTRIBUTION TRANSFORMERS

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	H.V.	L.V.	H.V.	L.V.
15	–	–	5	63
25	5	45	–	–
50	5	63	5	200
100	5	160	–	–
* 150	8	–	–	–
200	10	–	–	–
300	15	–	–	–

NOTES: 1. FUSES SIZED TO 100% TRANSFORMER CAPACITY
* 2. NON STANDARD SIZE

Transformer rated capacity = 50kva
No. of phases = 3

H.V. fuse size (column 2) = 5 amperes

L.V. fuse size (column 3) = 63 amperes

* **NOTE:**

That an L.V. fuse is required to be fitted in order that an L.V. phase to ground fault is cleared within 1 second (see para 3.0 above.)

10.0 FUSE INSTALLATION CHART

A fuse installation chart (attachment 1) has been prepared to enable each centres/communities fuse application requirements to be documented. It is anticipated that this chart will be used for reference both on and off site.

If required Standards Branch will print and laminate copies of charts prepared by Regional Staff for placement in power station control rooms.

MINOR CENTRES EDO FUSE TABLE

11 KV DISTRIBUTION TRANSFORMERS

TRANSFORMER CAPACITY (KVA)	THREE PHASE		SINGLE PHASE	
	H.V.	L.V.	H.V.	L.V.
15	–	–	5	63
25	5	45	–	–
50	5	63	5	200
100	5	160	–	–
* 150	8	–	–	–
200	10	–	–	–
300	15	–	–	–

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MINOR CENTRES EDO FUSE TABLE

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	AMPS	STOCK CODE	
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5 – 8	8	10173	200
8 – 10	10	10181	250
10 – 15	15	10199	400
15 – 20	20	10215	500
20 – 25	25	10223	630

NOTES: 1. H.V. FUSES TO BE SIZED TO FEEDER LOADS AND NOT TRANSFORMER CAPACITY
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POWER AND WATER AUTHORITY

FUSE INSTALLATION CHART
- MINOR COMMUNITIES -

COMMUNITY: _____

STEP-UP TRANSFORMERS-

SUBSTATION		FEEDER				FUSE SIZE	
No.	Rating(kVA)	Name	Load(amps) R	W	B	H.V.	L.V.

COMMENTS: ----------

DISTRIBUTION TRANSFORMERS-

SUBSTATION			FUSE SIZE	
No.	Rating(kVA)	Name/Location	H.V.	L.V.

COMMENTS: ----------

PAWA REPRESENTATIVE: _____

SIGNED: _____

DATED: _____

FILE REF. No.: _____