Protection Standard

Standard for Pole Transformer Fusing

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Abstract: This document describes the high voltage and low voltage standards for pole-mounted distribution transformers on the Energex network. This document shall be used for the planning, design and construction processed relating to all new, upgraded and retrofitted 11kV pole-mounted distribution transformers installations within the Energex network.

Keywords: Protection Standards, Distribution, Transformer, Fusing, Pole-mounted, 11kV

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1 Overview

1.1 Purpose

The Overhead Distribution Transformer Fusing Standard provides the high and low voltage protection requirements for 11kV/415V pole-mounted distribution transformers within ENERGEX and outlines the philosophy and rationale for the selection of fuses. It shall apply to all new, upgraded and retrofitted installations of 11kV pole-mounted transformers.

1.2 Scope

This document covers high and low voltage fuse protection standards for ENERGEX's pole-mounted distribution transformers. It does not cover 33kV/415V substation transformer, ring main unit, AFLC cells, pole-mounted capacitor bank or master drop-out (MDO) fuses. This standard shall apply to all planning, design and construction processes related to all new, upgraded and retrofitted installations of 11kV pole-mounted transformers within ENERGEX.

1.3 Application

This standard recommends the maximum fuse sizes for the distribution transformer sizes listed in the ENERGEX Standard Network Building Blocks and Overhead Construction Manual. It is expected that the fuses will be applicable to most situations.

2 References

2.1 Legislation, Regulations, Rules, and Codes

This document refers to the following: Nil

2.2 Energy Queensland Controlled Documents

Document Number or Location (If Applicable)	Document Name	Document Type
4920-A4	Overhead Construction Manual	Manual
TSD0071b	Line Constructions and Components for Use in High Bushfire Risk Areas	Technical Instruction
TSD0019i	Selection Guide for HV Expulsion Drop-Out and LV HRC Fuses	Technical Instruction
BMS 02168	Substation Design Standards	Standard Document
N/A	LV Fusing Calculator	Calculator

2.3 Other Documents

Document Number or Location (If Applicable)	Document Name	Document Type
AS1033	High voltage fuses (for rated voltages exceeding 1000V)	
IEC 60269	Low-voltage fuses	
ANSI/IEEE C57.109	Guide for Transformer Through-Fault Current Duration	

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this standard, the following definitions apply.

Term	Definition
Fuse	Fuse is a device that, by melting of one or more of its specially designed and proportioned components, opens a circuit in which it is inserted. The fuse comprises all parts that form the complete device.
Fuse-element	A part of the fuse-link designed to melt under the action of current exceeding some definite value for a definite period of time.
Fuse-link	The part of a fuse (including the fuse-element) intended to be replaced after the fuse has operated.
Fuse-base	The fixed part of a fuse provided with contacts and terminals.
Fuse-carrier	The movable part of a fuse designed to carry a fuse-link.
Fuse-holder	The combination of a fuse-base with its fuse-carrier.
Fuse-Switch	A switch in which a fuse-link or fuse-carrier with fuse-link forms the moving contact.
HRC	High Rupturing Current. A fuse that can interrupt extremely high currents.
Current-Limiting	A fuse-link that, during and by its operation in a specified current range, limits the current to a substantially lower value than the peak value of the prospective current.
“g” fuse-link	A full-range breaking, current-limiting low voltage fuse-link capable of breaking under specified conditions all currents, which cause melting of the fuse-element up to its rated breaking capacity.
Pre-arcing time; Melting time	The interval of time between the beginning of a current large enough to cause a break in the fuse-element and the instant when an arc is initiated.
Arcing time of a fuse	The interval of time between the instant of the initiation of the arc and the instant of final arc extinction in that fuse

Operating time; Total clearing time	Operating time; Total clearing time

3.2 Abbreviations

This list does not include well-known unambiguous abbreviations, or abbreviations defined at their first occurrence within the text.

FLC	Full Load Current. Transformer current at rated power and voltage.
TCC	Time-current characteristic. A curve giving the pre-arcing time or operating time as a function of the prospective current under stated conditions of operation.
EDO	Expulsion Drop Out. A fuse in which the fuse-carrier automatically drops into a position providing an isolating distance after the fuse has operated. The operation is accomplished by expulsion of gases produced by the arc.
MDO	Master Drop Out fuses are an EDO installed on radial feeder spurs to provide an economic solution to address low fault levels where protection sensitivity of upstream overcurrent protection is inadequate. MDOs are often installed to improve network reliability.

4 General Fusing Requirements

11kV/415V pole-mounted transformers shall be protected against fault currents by fuses on both the 11kV and the LV side of the transformer. On the 11kV side, Expulsion Dropout (EDO) fuses are normally used with High Rupturing Current (HRC) fuses installed in certain circumstances (e.g. in high bushfire risk areas, or areas with phase-to-phase fault currents > 8 kA). On the LV side, HRC fuses are used. The LV HRC fuses extend the protective coverage for faults beyond the network that cannot be cleared by the high voltage (HV) fuses.

The prospective bolted phase to ground fault levels at the end of an LV feeder should be greater than 3 times the LV Fuse rating to ensure adequate protection coverage and operation of the LV Fuse.

All fuses shall meet the requirements of the appropriate Australian or International Standard as listed below:

AS 1033 – High voltage fuses (for rated voltages exceeding 1000V)

IEC 60269 – Low-voltage fuses

The primary purpose of the fuse is short-circuit protection and secondly overload protection. The latter requirement shall be relaxed if compromises are needed.

The HV fuse provides protection by (1) isolating the system upstream of the transformer from faults in or beyond the transformer, and (2) protecting the transformer and conductors against bolted LV faults, such as wires twisted or firmly held together by fallen tree branches.

To be effective, fuses should not operate for magnetising inrush currents, cold-load pickup or temporary overloads. The HV fuse should also coordinate with the upstream protective devices. Where possible, the HV fuse should grade with the LV fuse for all possible types and values of fault current. A lack of discrimination between fuses across a transformer is accepted to ensure grading with upstream protection devices. Discrimination across the transformer is not considered to be a major requirement given that a site visit is required regardless of whether the HV and/or LV fuse operates.

Low voltage fusing effectiveness shall be confirmed using the Line Standards LV Fusing Calculator Tool.

5 Technical Fusing Requirements

5.1 Fuse Types

HV fuse links shall be expulsion drop-out fuse links with speed class “K” (fast operation) or “T” (slow operation) and shall comply with AS 1033. HV fuses modelled in coordination studies were S&C Positrol fuse-links.

All new sites in high bushfire risk areas are to utilise the 11 kV Fault Tamer sparkless fuse (for 200 kVA transformer or smaller). The Fault Tamer is a sophisticated fuse unit comprising a usual fuse element in series with a High Rupture Capacity (HRC) fuse unit, while fitting into the existing EDO mounting bracket. TSD0071b has been updated to include the requirement for this type of fuse. HRC Kmate fuses are intended for use on 300 – 500 kVA transformers in high fault current areas (>8 kA phase to phase). They are installed in series with the EDO fuses to provide backup to the EDO for these high fault currents. TSD0019g provides application details for both types of fuse.

LV fuses shall be current-limiting HRC fuses with class gG (full-range breaking, general application) and should comply with IEC 60269.

The type of low voltage fuse for each distribution transformer depends on the low voltage conductor and the capacity of the transformer. Bolt-in fuse links to are used on larger transformers supplying open wire LV systems, DIN standard fuses are typically used on aerial bundled LV systems and cylindrical, ferrule-ended fuses are generally used on smaller single and three phase transformers. Refer to the Overhead Construction Manual and the tables attached for preferred applications of each fuse type.

LV fuses modelled in coordination studies were Eaton-MEM bolt-in fuse-links, SIBA NH series fuses and FuseCo cylindrical service fuses.

For older transformers where an LV isolating switch was installed on the transformer LV terminals, changes shall be made to accommodate fusing on the LV side. For 100 kVA pole transformers, a single fuse-switch unit with bolt in fuse links shall be installed. For 200 kVA transformers and above, the isolating switch shall be left at the transformer pole, and separate circuit fusing using a switch fuse shall be erected on the adjacent pole in each direction from the transformer. Figure 1 depicts the described arrangements.

In limited circumstances, a single fuse-switch unit can be installed for 200 kVA transformers and above (as per 100 kVA transformers) as follows:

- Where the transformer supplies the majority of load in one direction and the 65-35% load sharing rule does not apply, or
- Where the transformer supplies a ring circuit.

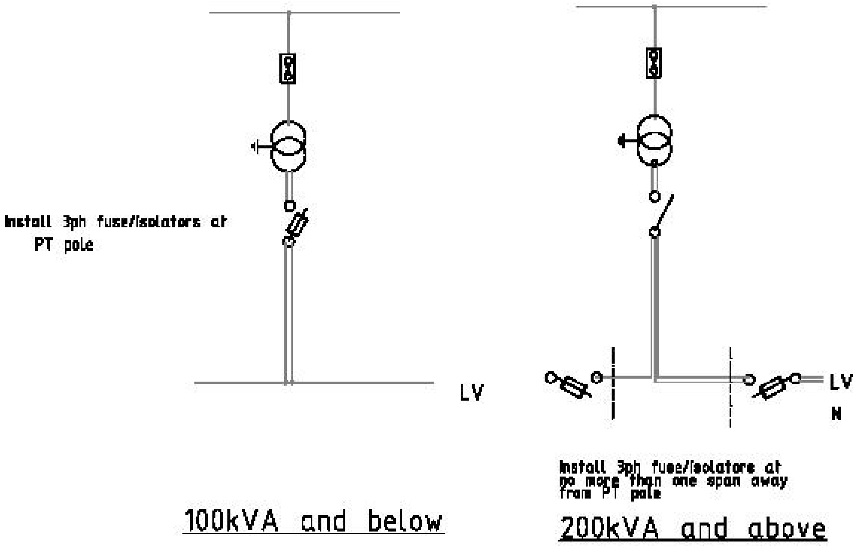

Figure 1: Low Voltage Fusing Arrangements

5.2 Voltage Rating

The voltage rating of a fuse indicates its ability to extinguish the arc that is produced when a section of the fuse element melts. The arc lengthens by burning away link-metal until the electrical resistance, or dielectric strength, of the gap is too large to sustain the arc. Therefore, the voltage rating of the fuse shall equal or exceed the maximum system line-to-line operating voltage.

5.3 Interrupting Rating

The interrupting rating of a fuse is the maximum level of fault current that can be safely interrupted. If the fault current exceeds the interrupting rating, the fuse may fail explosively resulting in damage to equipment or injury to personnel. The breaking capacity of the fuse should therefore exceed the maximum prospective fault current. For LV fuses, the maximum current condition is a phase-phase fault just downstream of the LV fuse. LV HRC fuses are capable of interrupting high currents in excess of 30 kA. HV expulsion type fuses have an interrupting rating of 8 kA. An investigation of the ENERGEX network shows very few locations where an 8 kA fault level is exceeded, but care must be taken for new installations. The Fault Tamer fuse has a rating of 12 kA and may be considered for such areas but is limited to transformer sizes 200 kVA and below. The Kmate HRC backup fuse can be installed on 300 kVA, 315 kVA or 500 kVA sized pole mounted transformers.

5.4 Current Rating

The current rating of a fuse is the continuous load it can sustain without exceeding temperature rise limits. Persistently operating a fuse-link above its current rating will accelerate its ageing, even if it does not melt. This can result in loss of coordination as the fuse may melt sooner under a genuine fault condition.

The fuses listed in the attached tables are the recommended maximum current rating for the transformer sizes listed.

The HV fuse rating was selected to handle approximately 150% of the transformer nameplate rating. This considers transformer cyclic overload and sustained emergency loads typically around 135% and 145% of transformer rating respectively. Transformers smaller than 100kVA have a recommended fuse rating significantly greater than 1.5 times their nameplate rating. The purpose of this larger fuse is to prevent nuisance operation due to lightning surges. HV fuses shall not be loaded beyond the name plate rating of the fuse.

For transformers up to 100 kVA, LV fuses were selected to handle around 120% of the transformer nameplate rating where there is a single fuse installation on the transformer LV terminals. For transformers 200 kVA and above, separate fusing is to be provided on each circuit emanating from the transformer. Circuit load is based on a maximum 65/35 split between circuits at maximum load, and LV fuse selection is to be able to handle this predicted load. In the case of LVABC, where multiple circuits are to be fused separately then the rating chosen should consider the size of the LVABC cables and not exceed their current-carrying capacity. LV fuses shall not be loaded above the rated fuse current except for short term emergency overloads.

6 Transformer Application

6.1 Time Current Characteristics

For coordination of fuses across a transformer, time-current curves shall be used since the fuses to be graded operate at different voltages and are consequently of different design with different operating characteristics. To ensure coordination, the minimum pre-arcing time of the HV fuse must be greater than the maximum clearing time of the LV fuse for all possible faults downstream of the LV fuse. That is, the minimum pre-arcing curve of the HV fuse should lie above the total clearing curve of the LV fuse with a typical margin of at least 100 msec to ensure coordination.

Total-clearing curves for the LV HRC fuses could not be obtained, however given that HRC fuses generally operate in less than ½ cycle, the margin between melting and clearing curves is negligible. Therefore, the minimum-melting curve was used for coordination studies.

Where it is possible to separately fuse two or more LV circuits emanating from the transformer, coordination between the low and high voltage fuse is generally achieved, since the LV fuses can be rated below the full transformer load. The HV fuse rating can be decreased which improves the coordination with upstream protection devices and provides increased transformer protection. This is the case for all new constructions using aerial bundled conductor for the LV circuits.

For older open-wire transformer constructions of 100 kVA and below, a single fuse installation is required to deliver full transformer load as a result of cost efficiencies into the retrofit of existing installations. In this situation, coordination between the LV and HV fuse can generally be achieved for single phase-to-neutral faults but is not guaranteed for all three-phase and phase-to-phase LV faults.

6.2 Grading with Delta-Wye Transformers

ENERGEX distribution transformers have an electrical vector configuration of Dyn11. Delta-wye transformers have the unique characteristic that the ratio of per-unit primary fuse current to secondary winding current varies depending on the type of fault on the system.

Grading fuses on either side of a delta-wye transformer should be carried out for an LV phase-phase fault as the HV fuse melts faster than would be expected for a three-phase fault. This is the worst case for coordination. A phase-to-neutral fault, however, causes the slowest operating time for the HV fuse. The HV fuse must therefore be carefully chosen in order to operate quickly enough to avoid damage to the transformer windings in this situation.

6.3 Transformer Inrush Currents

HV Fuses shall be able to withstand, without damage, the magnetising inrush currents that flow just after an unloaded distribution transformer is energised. The transient magnetising currents are produced on the energising side only and therefore appear as an internal fault. The currents can be very large depending on any residual magnetism of the transformer core as well as the instantaneous voltage when the transformer is energised. The minimum-melting curve of the fuse shall lie above the following industry standard inrush points:

25 x rated current for 0.01 second

12 x rated current for 0.1 second

The HV and LV fuses shall also be able to withstand cold-load pickup, a long-duration overcurrent, which can arise due to lack of load diversity when power is restored after an extended outage. Transformers are typically sized based on the After Diversity Maximum Demand (ADMD) rather than the maximum possible load since customer load curves do not usually coincide precisely. However, if controlled loads such as air-conditioners have been without power for an extended time, many will be outside the thermostat’s set point and will simultaneously require power on re-energisation. To withstand cold-load pickup, the HV and LV fuse curves shall lie above the following industry standard points on a time-current curve:

6 x rated current for 1 second

3 x rated current for 10 seconds

2 x rated current for 100 seconds

The standard inrush time-current curve is a conservative estimate of the magnetising-inrush current. The actual rms equivalent of the inrush current is lower than the values stated above.

6.4 Transformer Damage Limit

The HV fuse should protect the transformer from damage resulting from thermal and mechanical stresses imposed by faults in and beyond the transformer. The ANSI/IEEE C57.109 “Guide for Transformer Through-Fault Current Duration” recommends that the following fault magnitude and duration limits should not be exceeded:

25 x rated current for 2 seconds

11.3 x rated current for 10 seconds

6.3 x rated current for 30 seconds

4.75 x rated current for 60 seconds

3 x rated current for 300 seconds

2 x rated current for 1800 seconds

Where possible, the fuses should be faster than this transformer damage curve.

The fuse total clearing time curve should only intersect the transformer damage limit curve at the lowest possible fault current. However the compromise, if any, should be with the transformer damage curve not the inrush curve, since the primary purpose of the fuse is short-circuit protection, not overload protection.

7 Operational Requirements

To enhance the benefits for fuse protection of transformers the following operational practices need to be applied:

- When a single fuse is found blown at a transformer, all fuses of that voltage shall be changed at the same time (excluding 11 kV Fault Tamer and Kmate fuses).
- HV fuses may operate before LV fuses for close-in faults on the LV network. Blown HV fuses are not necessarily an indication of a transformer fault.
- Fuses used in overhead construction are not to be paralleled in order to achieve the current carrying capacity requirement of supply.

Appendix A

Informative

Document History

A.1 Revision History

Revision Date	Version Number	Author	Description of Change/Revision
19/12/2024	1.0	Paul Hohenhaus	• ECM document alignment • Updates to contact details for application support. • Updates to correct units. • Update to reflect the deprecation of the Australian Standard and inclusion of the IEC equivalent (IEC 60269).

Appendix B

Normative

Maximum Fuse Size for 3 Phase Pole-Mounted Transformers

Table 1: Overhead LVABC Construction

TX Rating	HV Fuse[1]		LV Fuse[1]			Fuseholder	
[kVA]	[A]	Stock Code	[A]	Description	Stock Code	[A]	Stock Code
10/15[2]	8T	14228	50/80[3]	Ferrule Ended 57mm x 22.2mm Diameter HRC	4442 / 4451[3]	100	19910
25	8T	14228	80	Ferrule Ended 57mm x 22.2mm Diameter HRC	4451	100	19910
50[2]/63	8T	14228	100	Bolt-in Type HRC, 111mm	4458	630	2622
100	16K	14231	160	Bolt-in Type HRC, 111mm	4465	630	2622
200	20K	13405	200	DIN Size 2 HRC (per circuit)	13898	400	20146
300/315	25K[6]	13730	200	DIN Size 2 HRC (per circuit)	13898	400	20146
500	40K[6]	13731	315	DIN Size 2 HRC (per circuit)	15118	400	20146

Table 2: Overhead Open-Wire Construction

TX Rating	HV Fuse[1]		LV Fuse[1]			Fuseholder	
[kVA]	[A]	Stock Code	[A]	Description	Stock Code	[A]	Stock Code
50[2]/63	8T	14228	100	Ferrule Ended 57mm x 22.2mm Diameter HRC	12454	100	19910
100	16K	14231	160	Bolt-in Type HRC, 111mm	4465	630	2622
200	20K	13405	200[4] / 315[5]	Bolt-in Type HRC, 111mm	4471[4] / 477[5]	630	2622
300/315	25K[6]	13730	315[4] / 500[5]	Bolt-in Type HRC, 111mm[4] / 133mm[5]	4477[4] / 485[5]	630	2622
500	40K[6]	13731	500[4] / TBA[7]	Bolt-in Type HRC, 133/184mm	4485[4] / TBA[7]	630[4] / BA[7]	2622[4] / TBA[7]

NOTES:

1. The fuse sizes listed are the recommended maximum.
2. 15 and 50kVA are no longer ENERGEX standard pole mounted transformer sizes but are included here as there are units still in service.
3. The choice of LV fuse depends on the LV conductor/service cable size. If used as a combination LV and service fuse, the smaller rating should be used.
4. Dual Fusing - fuse size based on 2 separately fused LV circuits supplied from the transformer. Where practical, fuses are to be sited on the adjacent pole to the transformer in each direction.
5. Single Fusing - fuse size based on a single LV fuse per transformer protecting all LV circuits. For use in limited circumstances.
6. If required, the Kmate HRC backup fuse can be installed in series with the EDO in high fault current areas (>8 kA Phase to Phase)

   300/315kVA – 25K (SC23387)

   500kVA – 40K (SC23388)
7. For existing 500 kVA transformers with single fusing, replacement fuses should be a like for like replacement. For new single fuse installations on 500 kVA transformers, please contact Protection Engineering Support using ServiceNow for advice on the correct fuse size.
8. At the time of approval, the fusing requirements for 10kVA Transformer was unable to be included into the Overhead Distribution Transformer Overcurrent Protection table shown in Appendix E. Until an update can be undertaken, Table 1 is to be used to identify the fusing requirements for 10kVA Transformer.

Appendix C

Normative

Maximum Fuse Sizes for 1 Phase Pole-Mounted Transformers

Table 3: Overhead LVABC Construction

TX Rating	HV Fuse[1]		LV Fuse[1]			Fuseholder	
[kVA]	[A]	Stock Code	[A]	Description	Stock Code	[A]	Stock Code
10/15[2]	8T	14228	50/80[3]	Ferrule Ended 57mm x 22.2mm Diameter HRC	4442 / 4451	100	19910
25	8T	14228	80[4]	Ferrule Ended 57mm x 22.2mm Diameter HRC	4451	100	19910

Table 4: Overhead Open-Wire Construction

TX Rating	HV Fuse[1]		LV Fuse[1]			Fuseholder	
[kVA]	[A]	Stock Code	[A]	Description	Stock Code	[A]	Stock Code
25	8T	14228	100	Ferrule Ended 57mm x 22.2mm Diameter HRC	12454	100	19910
63	16K	14231	250	Fuse Link, Enclosed Element; 250A,500V	13899	630A	2622

NOTES:

1. The fuse sizes listed are the recommended maximum.
2. 10 kVA is no longer an ENERGEX standard transformer size but is included as there are units still in service.
3. The choice of LV fuse depends on the LV conductor/service cable size. If used as a combination LV and service fuse, the smaller rating should be used.
4. The LV fuse is rated below the transformer full load capacity due to the current-carrying capacity limitations of the low voltage bundled conductor (see the Overhead Construction Manual for details).
5. At the time of approval, the fusing requirements for the single phase 63kVA Transformer was unable to be included into the Overhead Distribution Transformer Overcurrent Protection table shown in Appendix E. Until an update can be undertaken, Table 4 is to be used to identify the fusing requirements for a single phase 63kVA Transformer.

Appendix D

Normative

Maximum Fuse Sizes for SWER Transformers

Table 5: Overhead Open-Wire Construction

TX Rating	HV Fuse[1]	
[kVA]	[A]	Stock Code
25	100	19910

D.1 12.7kV SWER Distribution Transformers

Table 6: Overhead LVABC Construction

TX Rating	HV Fuse[1]		LV Fuse[1]			Fuseholder	
[kVA]	[A]	Stock Code	[A]	Description	Stock Code	[A]	Stock Code
10[2]	8T	14228	50/80[3]	Ferrule Ended 57mm x 22.2mm Diameter HRC	4442 / 4451	100	19910
25	8T	14228	80[4]	Ferrule Ended 57mm x 22.2mm Diameter HRC	4451	100	19910

Table 7: Overhead Open-Wire Construction

TX Rating	HV Fuse[1]		LV Fuse[1]			Fuseholder	
[kVA]	[A]	Stock Code	[A]	Description	Stock Code	[A]	Stock Code
25	8T	14228	100	Ferrule Ended 57mm x 22.2mm Diameter HRC	12454	100	19910

NOTES:

1. The fuse sizes listed are the recommended maximum.
2. 10 kVA is no longer an ENERGEX standard transformer size but is included as there are units still in service.
3. The choice of LV fuse depends on the LV conductor/service cable size. If used as a combination LV and service fuse, the smaller rating should be used.

4. The LV fuse is rated below the transformer full load capacity due to the current-carrying capacity limitations of the low voltage bundled conductor (see the Overhead Construction Manual for details).

Appendix E

Normative

Overhead Distribution Transformer Overcurrent Protection

OVERHEAD DISTRIBUTION TRANSFORMER OVERCURRENT PROTECTION

11kV HIGH VOLTAGE

3 Phase Transformer HV Protection – Expulsion Dropout Fuses

Transformer Rating [kVA]		LV Circuit	HV Current	with TRX LV fuse		without LV fuse	
		Open wire/ LVABC	Full Load [A]	HV Fuse Link	Stock Code	HV Fuse Link	Stock Code
3 ph	15[3]	LVABC	0.8	8T	14228	-	-
3 ph	25	LVABC	1.3	8T	14228	-	-
3 ph	50[3]/63	Open	2.6/3.3	8T	14228	-	-
		LVABC		8T	14228	-	-
3 ph	100	Open	5.2	16K	14231	8T	14228
		LVABC		16K	14231	-	-
3 ph	200	Open	10.5	20K	13405	20K	13405
		LVABC		20K	13405	-	-
3 ph	315	Open	16.5	25K	13730	25K	13730
		LVABC		25K	13730	-	-
3 ph	500	Open	26.2	40K	13731	40K	13731
		LVABC		40K	13731	-	-

1 Phase Transformer HV Protection – Expulsion Dropout Fuses

Transformer Rating [kVA]		LV Circuit	HV Current	with TRX LV fuse		without LV fuse	
		Open wire/ LVABC	Full Load [A]	HV Fuse Link	Stock Code	HV Fuse Link	Stock Code
1 ph	10[3]	LVABC	0.9	8T	14228	-	-
1ph	25	Open	2.3	8T	14228	-	-
		LVABC				-	-

LOW VOLTAGE

3 Phase Transformer LV Protection – HRC Fuses

Transformer Rating [kVA]		LV Circuit	LV Current		LV Fuse Link			LV Fuse Holder	
		Open wire/ LVABC	Full Load [A]	Circuit Load [A]	LV Fuse [A]	Description	Stock Code	Max Rating [A]	Stock Code
3 ph	15[3]	LVABC	20	13.5	50/80[4]	Ferrule Ended 57mm x 22.2mm HRC	4442 / 4451[4]	100	19910
3 ph	25	LVABC	33	21.5	80	Ferrule Ended 57mm x 22.2mm HRC	4451	100	19910
3 ph	50[3]/63	Open	67/84	44/55	100	Ferrule Ended 57mm x 22.2mm HRC	12454	100	19910
		LVABC			100	Bolt in Type HRC, 111mm	4458	630	2622
3 ph	100	Open	133	86	160	Bolt in Type HRC, 111mm	4465	630	2622
		LVABC			160	Bolt in Type HRC, 111mm	4465	630	2622
3 ph	200	Open	267	174	200[5] / 315[6]	Bolt in Type HRC, 111mm	4471[5] / 4477[6]	630	2622
		LVABC			200[5]	DIN Size 2 HRC (per circuit)	13898	400	20146
3 ph	315	Open	420	273	315[5] / 500[6]	Bolt in Type HRC, 111mm[5] / 133mm[6]	4477[5] / 4485[6]	630	2622
		LVABC			200[5]	DIN Size 2 HRC (per circuit)	13898	400	20146
3 ph	500	Open	667	434	500[5] / TBA[7]	Bolt in Type HRC, 133/184mm (per cct)	4485[5] / TBA[7]	630[5] / TBA[7]	2622[5] / TBA[7]
		LVABC			315[5]	DIN Size 2 HRC (per circuit)	15118	400	20146

1 Phase Transformer LV Protection – HRC Fuses

Transformer Rating [kVA]		LV Circuit	LV Current	LV Fuse Link			LV Fuse Holder	
		Open wire/ LVABC	Full Load [A]	LV Fuse [A]	Description	Stock Code	Max Rating [A]	Stock Code
1 ph	10[3]	LVABC	40	50/80[4]	Ferrule Ended 57mm x 22.2mm HRC	4442 / 4451[4]	100	19910
1 ph	25	Open	100	100	Ferrule Ended 57mm x 22.2mm HRC	12454	100	19910
		LVABC		80	Ferrule Ended 57mm x 22.2mm HRC	4451	100	19910

11/12.7kV SWER

SWER Isolating Transformer

Voltage	Transformer Rating [kVA]		Full Load [A]	HV Fuse Link	Stock Code
11kV	100		9.1	25K	13730

SWER Distribution Transformer

Voltage	Transformer Rating [kVA]		Full Load [A]	HV Fuse Link	Stock Code
12.7kV	1ph	10[3]	0.8	3K	13401
12.7kV	1ph	25	2.0	3K	13401

LOW VOLTAGE (SWER)

Transformer Rating [kVA]		LV Circuit	LV Current	LV Fuse Link			LV Fuse Holder	
		Open wire/ LVABC	Full Load [A]	LV Fuse [A]	Description	Stock Code	Max Rating [A]	Stock Code
1 ph	10[3]	LVABC	40	50/80[4]	Ferrule Ended 57mm x 22.2mm HRC	4442 / 4451[4]	100	19910
1 ph	25	Open	100	100	Ferrule Ended 57mm x 22.2mm HRC	12454	100	19910
		LVABC		80	Ferrule Ended 57mm x 22.2mm HRC	4451	100	19910

NOTES:

1. The fuse sizes listed are the recommended maximum.
2. Coordination between the HV and the LV fuses listed above is not guaranteed for all fault levels.
3. 10 kVA, 15kVA and 50kVA are no longer ENERGEX standard transformer sizes, but are included as there are still some in service.
4. Depends on low voltage conductor/service cable size. If used as a combination LV and service fuse, the smaller rating should be used.
5. Dual fusing - Where 2 LV circuits are fused separately, sizing is based on max 65/35 split between 2 circuits (This is assumed max circuit load). Refer to the OH Construction Manual, Section 7 for details.
6. Single fusing - Where a single set of LV fuses protect all LV circuits from the transformer, for use in limited circumstances.
7. For existing 500 kV.A transformers with single fusing, replacement fuses should be a like for like replacement. For new single fuse installations on 500 kVA transformers, please contact Engineering Standards & Technology for advice on the correct fuse size.