

Substation Design Instruction

Arc inhibiting membranes

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Substation Design Instruction

ASSET STANDARDS & DESIGN

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SDI 109 ARC INHIBITING MEMBRANE

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1.0 PURPOSE

This standard provides technical and reference information to indicate when an arc inhibiting membrane is required, and the processes to be followed when low voltage busbars and connections are to be coated.

2.0 SCOPE

This instruction provides information and reference documentation to assist in the safe application of arc inhibiting membrane.

This instruction relates generally to low voltage distribution substation equipment, but may be applied to other low voltage equipment, where relevant.

The scope of this document provides reference to the various lifecycle stages of the switchgear and therefore shall be read in conjunction with the references of section 3.0 and:

- Mounting and construction requirements: refer Mains Construction Instruction MCI 0006 – Underground distribution: Construction standards manual;
- Earthing design, construction and testing: refer Earthing Design Instruction EDI 100 – Distribution earthing design, construction and test;
- Specification of new equipment: refer Equipment Technical Specification ETS 0069 – Distribution indoor and padmount substation low voltage switchgear;
- General details and minimum design requirements: refer Substation Design Instruction SDI 101 – Distribution substation general details and minimum requirements and Mains Design Instruction MDI 0028 Underground distribution network design;
- Testing and commissioning: refer Substation Design Instruction SDI 120 – Testing and commissioning for distribution systems;
- Ongoing maintenance requirements: refer Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment; and
- Standard drawing requirements: Standard Asset Data SAD 0001 – Project drawing standards.

Note: This product and process is no longer required or installed on new LV switchgear but is present on older equipment and may be used on existing LV equipment or where arcing may be considered a risk.

3.0 REFERENCES

Company Policy (Network) 9.1.7 – Commissioning Network Electrical Assets

Company Policy (Network) 9.2.5 – Network Asset Design

Company Policy (Network) 9.7.1 – Network Asset Construction

Company Policy (Network) 9.8.3 – Network Operations

Company Policy (Network) 9.9.1 – Network Asset Maintenance

Engineering Technical Specification ETS 0069 – Distribution indoor and padmount substation low voltage switchgear

Mains Construction Instruction MCI 0006 – Underground distribution: Construction standards manual

Mains Design Instruction MDI 0028 – Underground distribution network design

Substation Design Instruction SDI 101 – Distribution substation general details and minimum requirements

Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment

Company Network Management Plan December - 2013 Review

Work Health and Safety Act 2011 (NSW)

Work Health and Safety Regulation 2011

Australian Standards AS 2650 - HV AC switchgear and control gear – common requirements

ENA National Electricity Network Safety Code (Doc. 01-2008)

4.0 DEFINITIONS AND ABBREVIATIONS

A full list of definitions is contained in SDI 101

LV Low voltage

5.0 ACTIONS

5.1 LV arcing currents

5.1.1 Magnitude of LV arcing currents

It is important to understand that low voltage arcing damage does not result from high fault currents. The presence of the arc adds appreciable resistance to the faulted circuit so the current is much less than the calculated maximum fault current.

This calculated maximum fault current is the current usually referred to in the fault level of the system at the particular point of fault. The maximum fault current flows only with a bolted or welded (fused together) short circuit.

The resistance of the arc varies considerably from fault to fault. The spacing between bars and the ability of the arc to blow out (lengthen) all markedly affect the value of the arc resistance. The fault current with a low voltage arc can be in the range of 30% to 70% of the bolted short circuit current.

5.1.2 Effect on protection

If no low voltage protection exists upstream of the arcing fault, the first point of protection is on the high voltage side of the distribution transformer. To cater for distribution transformer magnetic inrush, and normally encountered transformer overloads (peak periods or emergency switching periods), the current protection is relatively insensitive to the HV currents flowing as a result of LV arcing faults.

Typically, HV current protection will not operate until the current is two or three (2 or 3) times the continuously rated current of the distribution transformer and even then the time for the protection to operate is long, several minutes.

It is therefore quite feasible that LV arcing faults will not cause the HV protection to operate for a long time. As a consequence, considerable damage can be caused to the LV distribution board in the event of a LV arcing fault.

5.1.3 The remedy

Clearly, if there is to be protection against low voltage damage, ALL of the LV connections in the distribution transformer terminal zone (see accompanying diagram) must be either:

- fully insulated, or provided with barriers that achieve the same result as full insulation; or,
- coated with a membrane that resists momentary contact and inhibits arc travel and consequent restriking.

5.2 Where arc inhibiting covering is required

Where it is not possible to fully insulate or provide suitable phase/phase or phase/earth barriers on low voltage busbars and connections in the transformer LV terminal zone (see Figure 1), an arc inhibiting covering is required on the bars and connections in all such locations.

It must be remembered that the LV busbars and connections, in some instances, can be some distance from the distribution transformer LV terminals, so inhibiting covering will have to be applied at the distribution transformer, LV board and any exposed busbar along the route.

The inhibiting covering need be applied only to the point of first protection. This means covering the incoming terminals of LV fuses and LV circuit breakers of sub-circuits. If an LV isolator is used (that has no protection), the covering will be required on both sides (incoming and outgoing) of the isolator.

Wherever possible, bars and connections must be removed from the switchboard before applying the coating: the coating is not easy to apply and it will generally be found that considerable experience is required to apply the coating in confined areas with difficult access. If coating is applied to removed bars, the coating must not be applied over the jointing areas.

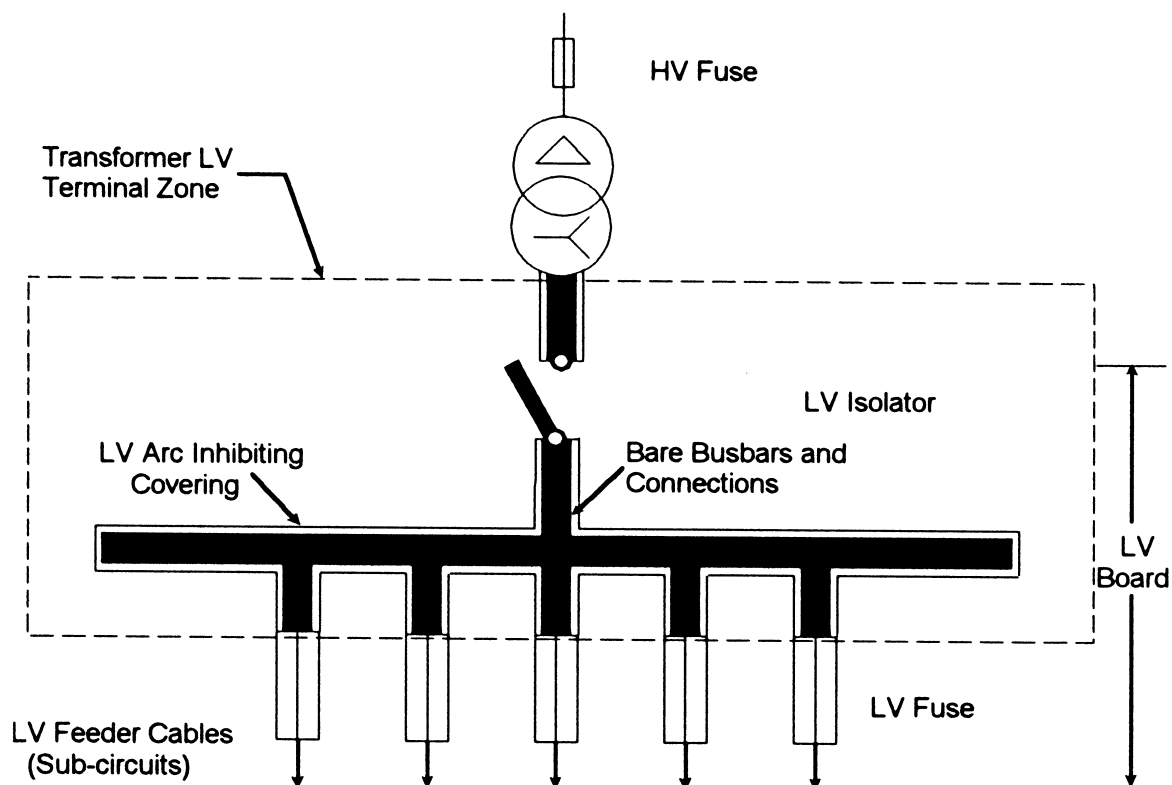


Figure 1 – Typical LV arc inhibiting membrane

5.2.1 Example arc inhibiting covering applications



Figure 2 - Cover over connections at busbar + fuse strip



Figure 3 - Cover on bushing to LV busbar connection 1



Figure 4 - Cover on bushing to LV busbar connection 2



Figure 5 - Cover on top connected LV bushings



Figure 6 - Cover on busbar to CB connections

5.3 Content of membrane

The coating material can best be described as paste-like when in the container before application, and before it cures (dries out) to become the membrane.

The paste has a high percentage of solids (a large content of titanium dioxide) and a minimum of binder (acrylic resin). The paste is made more applicable by the addition of water. The water dries out (the curing process) after application, leaving the high content of solids held in position with the minimum of resin; the combination of the solids and the resin provides the membrane.

The preferred membrane is Paint Latex Light Blue Emerclad (Stock code: SP15295) or its equivalent.

Black and red oxide coloured membranes are not permitted.

5.4 Areas not to be coated

The areas to be left uncoated can be masked. However, it is reasonably easy to remove the coating from these areas provided this is done within four (4) hours of application. The coating is touch dry in about one (1) hour and it is desirable that any areas that require removal of the coating must be attended to shortly after this one (1) hour period, instead of being left for the limit of four (4) hours.

5.5 Method of application

5.5.1 General

The coating (membrane) can be applied by brush or spray. Generally, for small quantity production, the brush method will be found to be more convenient. Switchboard manufacturers may nominate to use the spray method, but for on-site work, the brush method will be found preferable, and this instruction is confined to brush application.

If the operator has had no previous experience, it is recommended that a few sample pieces be tried on scrap metal to establish the technique. It is important that the coating is applied in single brush strokes. Any attempt to go back over a previous application will tend to lift the coating. The result gets increasingly worse the more the coating is brushed.

Immerse the brush into the paste to approximately two-thirds of its bristle length, shake off any excess and apply to the bars with one stroke.

Care must be taken to see that corners of bars are effectively coated.

The bars can be left to dry horizontally or vertically as the paste will not flow.

5.5.2 Coating of jointed areas

It is intended that all joints be coated after re-assembly of the bars and connections into the switchboard. It is important that joints be coated where these form a large percentage of the total conductor surface area. The effectiveness of the coating is at its best if the complete conductor surface area is coated.

In difficult situations where the joints are inaccessible, portions of the joint area may be left uncoated, provided there is a length of coating in excess of 75mm in all conductor directions from the uncoated area. This is to be adopted only when absolutely necessary.

5.5.3 *Insulation supports and barriers*

It is important that the coating is not applied over any insulation supports or barriers. The coating is not an insulator in the true sense of the word and tracking between phases or phase to earth can result if coating is left on such barriers and supports.

5.5.4 *Drying times*

At normal temperature, 18°C to 20°C, Emer-Clad will dry and can be recoated within 2 hours after application, full drying/curing takes approximately 7 days. In very cold or humid weather, allow overnight drying between applications. Do not apply at temperatures below 10°C, or when temperature may fall below 10°C during the drying period.

5.5.5 *Application of voltage*

The switchboard can be re-energised immediately after application of the coating, provided that there is no tracking path through the coating on the insulation parts, as mentioned above.

The coating is not effective as an arc inhibitor until it is fully dried/cured. As a consequence, no other work can be done in the vicinity of the coated bars within the seven (7) day period, but there is no problem in the board being energised and supply being maintained.

5.5.6 *General clean-up*

Brushes must be regularly washed out in water during large applications. This will avoid a build-up of coating on the bristles, which makes the coating very difficult to apply.

Any areas where the coating has been accidentally spilt or dropped can be immediately wiped off with a water-dampened cloth.

5.5.7 *Storage*

Shelf life is approximately 24 months in a dry, cool storage area.

6.0 AUTHORITIES AND RESPONSIBILITIES

General Manager Asset Management has the authority and responsibility for:

- approving this instruction; and
- approving variations to the requirements of this instruction.

Manager Asset Standards & Design has the authority and responsibility for:

- endorsing this instruction; and
- recommending changes and revisions to this instruction.

Manager Network Connections has the authority and responsibility for checking that all applications carried out by Level 3 Accredited Service Providers (ASP) conform to the requirements of this instruction.

Network Substations Manager has the authority and responsibility for revising and updating this instruction in accordance with Endeavour Energy's Policies and Procedures.

Regional managers have the authority and responsibility for checking that all applications carried out by regional employees conform to the requirements of this instruction.

Level 3 Accredited Service Providers have the authority and responsibility checking that the latest issue of any instruction or drawing relevant to or listed in this manual is available and used during the design of any project and application of this standard.

7.0 DOCUMENT CONTROL

Documentation Content Coordinator : Network Substations Manager

Documentation Distribution Coordinator : Branch Process Coordinator