Engineering System Integrity
Electrical Network Safety Rules

Engineering Procedure
Electrical Distribution Unit

Electrical Distribution Network Management

PR D 78304

Work on 1500 Volt Negative Equipment Inside Substations

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Transport Sydney Trains

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Document control

Version	Date	Author/ Prin. Eng.	Summary of change
1.0	28 April 2015	Chris Leung	First issue as a Sydney Trains document, rebranded from previous RailCorp SMS-06-EN-0569 V1.2
2.0	3 May 2018	Chris Leung	Amended 2.1.1 and 2.3
2.1	19 February 2019	Nick Loveday	Updated roles and position names to reflect the current organisation
2.2	11 December 2020	Nick Loveday	Updated to include Auto REC
2.3	1 February 2022	ENSR Project Team	Reviewed as part of the ENSR Project.

Summary of changes from previous version

Summary of change	Section
Minor grammatical updates	All
Updated reference documents	All

Table of Contents

1 Purpose and scope

To describe the procedures required for carrying out work on 1500 Volt negative equipment inside substations.

2 Definitions

Refer to the **Electrical Safety Definitions** page available on the **RailSafe** site.

3 Instruction

When work is to be carried out on 1500 Volt negative equipment inside substations, the negative busbar shall be earthed by closing the Rail Earth Contactor (REC) or Auto-Rail Earth Contactor (Auto-REC) unless:

- The substation negative busbar is disconnected from rail. In this case, refer to Section 3.1.
- A special written procedure is approved by the Associate Director Electrical Distribution Unit for the work (e.g. use of insulated platforms).

Mains powered tools used in substations shall be double insulated. Battery powered tools may be used.

The times for which the negative equipment is earthed shall be recorded in the substation logbook.

In general, a Substation Access Permit (refer to *PR D 78502 Substation Access Permit*) is not required for the work other than when stipulated for the situations described below.

WARNING

A total loss of connection between the main negative busbar and the rails may result in a dangerous potential between the negative busbars and earth.

3.1 Work requiring the substation negative to be disconnected from the rail

1. For work on negative equipment inside substations and when the substation main negative busbar is disconnected from the rail.

   When breaking, making or working on the connection to rail:

   a. All 1500 Volt positive feeders shall be isolated from the substation.

   b. All Positive and Negative outputs of the rectifiers shall be isolated.

   c. Except for Harmonic Filters which are integrated with the Rectifier, all Harmonic Filters shall be isolated.

WARNING

Prior to working on the harmonic filter, ensure that capacitors are isolated, completely discharged (for at least 5 minutes) and 'Tested Dead before Touched'.

   d. The REC/Auto-REC shall be open and made inoperative in accordance with the Local Instruction. Depending upon the type of REC/Auto-REC, this is normally achieved by isolating and DANGER Tagging (refer to *PR D 78104 Securing Systems for Electrical Equipment*) the control supply.

e. Persons shall not bridge themselves between the connection to rail and the substation earth and should work from an insulated platform.

WARNING

The REC/Auto-REC must remain open to prevent persons being exposed to high touch potentials between rail and earth at the worksite.

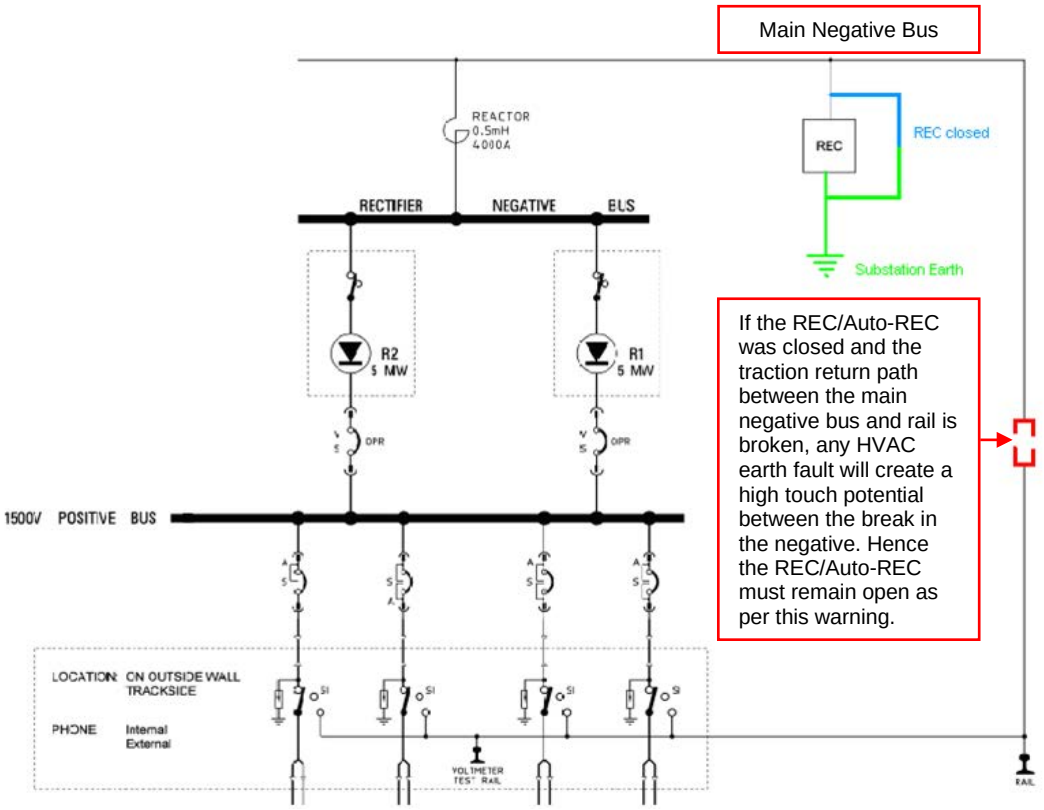

Figure 1: REC/Auto-REC

f. The work shall be done under a Substation Access Permit (refer to PR D 78502).

2. When work is completely clear of the break in the connection to rail:

   a. All 1500 Volt positive feeders shall be isolated from the substation.

   b. The REC shall be closed (tripped) and the bridging link closed. At locations equipped with Auto-REC, the Auto-REC shall be closed (tripped) and the by-pass link installed (closed).

   c. The work shall be done under a Substation Access Permit (refer to PR D 78502).

3.2 Work that requires equipment negatives to be disconnected

Before the negative connection between equipment and the substation negative busbar is removed, any 1500 Volt positive supply to the equipment shall be isolated, proved dead, DANGER tagged and a Substation Access Permit (refer to PR D 78502) issued.

NOTE

This may also require the discharging of capacitors if the equipment concerned is a Rectifier with an integral Harmonic Filter re: Warning of Section 3.1 Point number 1)

3.3 Work on substation negative equipment on the rectifier side of the substation negative reactor

When working on substation negative equipment located on the rectifier side of the substation negative reactor (e.g. Rectifier Negative Link, Substation Rectifier Negative Busbar or Negative Reactor – refer to hazardous areas in Figure 2, Figure 3 and Figure 4) and when more than one rectifier is connected to the same common negative reactor, the following procedure shall be followed:

- The REC shall be closed (tripped) and the bridging link closed.
- All rectifiers connected to the same negative reactor shall be isolated and a Substation Access Permit (refer to PR D 78502) issued.
- When working on a rectifier unit, the reactor side of the rectifier negative link shall be excluded from the Electrically Safe Work Area of the Permit unless all rectifiers connected to the same reactor are isolated, proved dead and their associated transformers earthed under the issued Substation Access Permit (refer to PR D 78502).

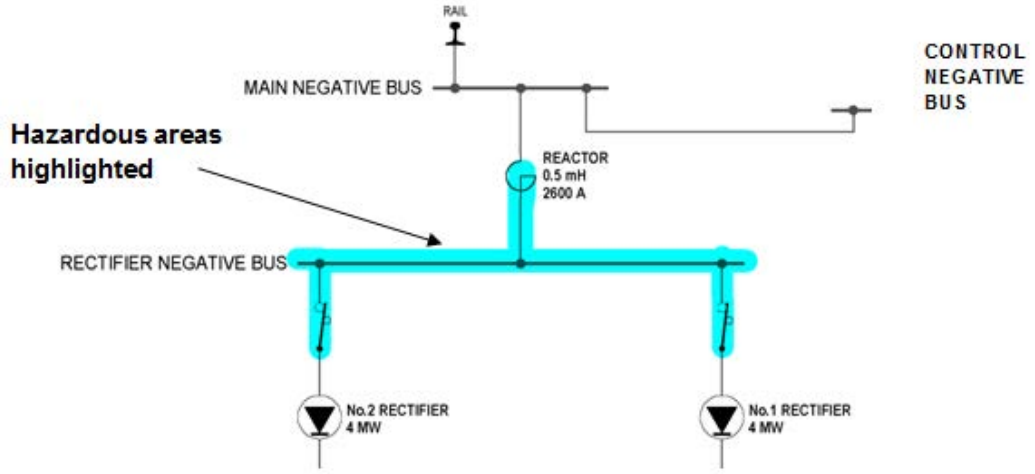

Figure 2: Common Substation negative equipment arrangement

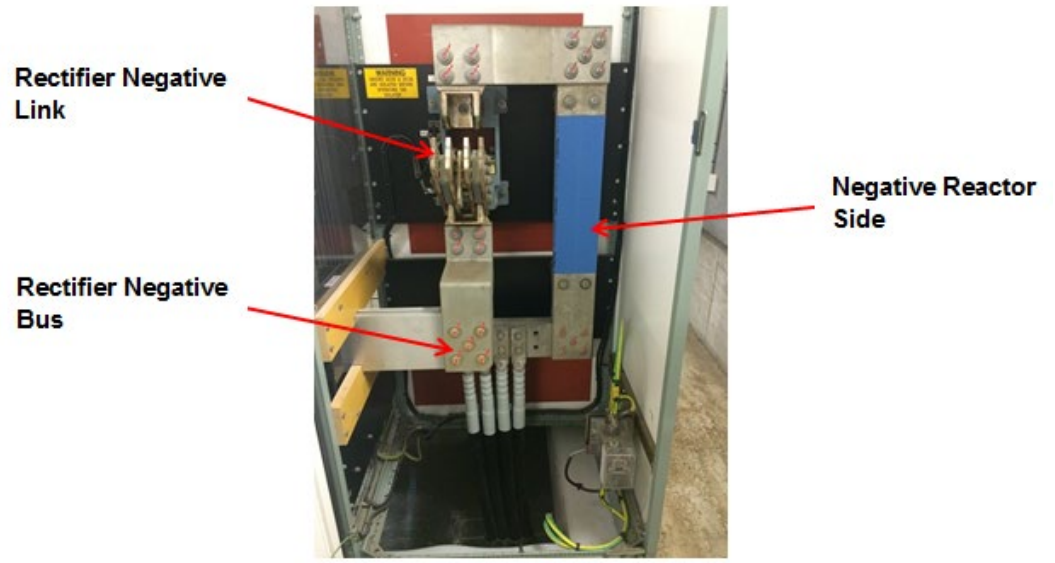

Figure 3: Rectifier negative link

NOTE

Everything within the Rectifier Negative Link cabinet is considered to be within the SADs of the Rectifier Bus and Rectifier Negative Link.

WARNING

Transient voltages may be present on the rectifier negative busbar equipment if a rectifier is left in service that is connected to the same negative reactor, even when the REC/Auto-REC is closed.

Figure 4: Examples of air and enclosed negative reactors

3.4 Work on substation negative equipment on the rectifier side of the rectifier negative link

When working on the substation negative equipment located on the rectifier side of the rectifier negative link on a rectifier which incorporates a harmonic filter, the following procedure shall be followed:

- The Rectifier must be isolated.
- The Harmonic Filter capacitors must be discharged.
- The REC shall be closed (tripped) and the bridging link closed. At locations equipped with Auto-REC, the Auto-REC shall be closed (tripped) and the by-pass link installed (closed).
- The work shall be done under a Substation Access Permit (refer to PR D 78502).

3.5 Work on a REC

1. Work on a REC

   When work is to be carried out on the REC, the contactor shall be closed (tripped) and the bridging link closed for the duration of the work.

   On completion of the work, the bridging link should be opened with the REC in the closed (tripped) position to prevent a person bridging from rail to earth. The REC may then be opened (reset).

2. Disconnection, removal, installation of a Rail Earth Contactor (REC)

   When disconnecting the negative connections to a REC, it is necessary to ensure that no current is flowing in the connection(s) to be disconnected. This is because if a negative connection is disconnected whilst still carrying current, line voltage potential will occur across the break.

   Prior to disconnecting a negative connection(s):

   – The 1500V portion of the substation/section hut (and by default the REC) shall be taken ‘off-line’.

   and

   – The negative cables to be disconnected shall be positively identified.

   and

   – A tong tester (DC) shall be used to prove that no current is flowing in the circuit.

NOTE

If the negative cables cannot be tong tested, the negative cables SHALL be 'bridged out'. In this case insulated bridging equipment suitable for the task, current rating, environment and a safe working instruction shall be utilised.

3. Resetting a Rail Earth Contactor (REC)

   After an automatic operation of an REC, all equipment including the negative connections to rail shall be inspected for damage before the contactor is reset to the open position.

   Any damage shall be repaired before the contactor is reset. Any such repairs shall be carried out in accordance with Section 3.5 Point number 1).

3.6 Work on an Auto-REC

1. Work on an Auto-REC

   When work is to be carried out on the Auto-REC, the contactor shall be closed (tripped) and the by-pass link installed (closed) for the duration of the work.

   On completion of the work, the by-pass link should be opened (in park position) with the Auto-REC in the closed (tripped) position to prevent a person bridging from rail to earth. The Auto-REC may then be opened (reset).

2. Disconnection, removal, installation of an Auto-Rail Earth Contactor (Auto-REC)

   When disconnecting the negative connections to an Auto-REC, it is necessary to ensure that no current is flowing in the connection(s) to be disconnected. This is because if a negative connection is disconnected while still carrying current, line voltage potential will occur across the break.

   Prior to disconnecting a negative connection(s):

   - The 1500 Volt portion of the substation/section hut (and by default the Auto-REC) shall be taken ‘off-line’.
   - The negative cables to be disconnected shall be positively identified.
   - A tong tester (DC) shall be used to prove that no current is flowing in the circuit.

NOTE

If the negative cables cannot be tong tested, the negative cables SHALL be 'bridged out'. In this case insulated bridging equipment suitable for the task, current rating, environment and a safe working instruction shall be utilised.

3. Resetting an Auto-Rail Earth Contactor (Auto-REC)

   Auto-REC operates (trips and re-opens) automatically, ensuring the rail to earth voltage and current are at an acceptable level. Auto-REC will initiate a “blocked” mode if impermissible voltage/current exists in the system for an extended time.

   After the Auto-REC has initiated a ‘lock-out’ mode and sent an ‘Auto-REC lock-out’ alarm, all equipment including the negative connections to rail shall be inspected for damage before issuing the ‘lock-out reset’ command to reset the Auto-REC to the open position.

   Any damage shall be repaired before the contactor is reset. Any such repairs shall be carried out in accordance with Section 3.6 Point number 1).

4 Reference documents

PR D 78104 Securing Systems for Electrical Equipment

PR D 78502 Substation Access Permit