METHOD OF STATEMENT

FOR

FACTORY ACCEPTANCE TEST PROCEDURE

OF

LOW VOLTAGE SWITCHBOARDS
## CONTENTS

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<th>DESCRIPTION</th>
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</tr>
</tbody>
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Scope of Work

1.1 Purpose

The aim of this documentation is to outline the FAT procedure of Low Voltage Main Switchboard.

A) Visual Inspection Test
B) Insulation Test
C) High Voltage Injection Test
D) Primary Current Injection Test
E) Metering Current Transformer Polarity Test
F) Secondary Current Injection Test

1.2 Working Location

Approved LV main switchboard to be used for the FAT. FAT is conducted at Sunlight factory, Singapore.

1.3 Material and Equipment to be used

<table>
<thead>
<tr>
<th>Items</th>
<th>Description Make, Model &amp; Serial Number</th>
<th>Equipment Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3.1</td>
<td>Digital insulation Continuity Tester Make: KYORITSU Model: 3007A Serial No.: 1462615</td>
<td><img src="image1.png" alt="Digital insulation Continuity Tester" /></td>
</tr>
<tr>
<td>1.3.2</td>
<td>High Voltage / Flash Tester Make: T&amp;R Model: KV 5 -100 Serial No.: 1TE0456</td>
<td><img src="image2.png" alt="High Voltage / Flash Tester" /></td>
</tr>
<tr>
<td>1.3.3</td>
<td>Primary Current Injection Test Set Make: T&amp;R Equipment Pte. Ltd. Model: PCU2 / EMK4 Serial No.: 2TE0405A / 2TE0405B</td>
<td><img src="image3.png" alt="Primary Current Injection Test Set" /></td>
</tr>
</tbody>
</table>
| 1.3.4 | Secondary Current Injection Test Set  
Make: T&R Equipment Pte. Ltd.  
Model: 100A MK2  
Serial No.: 18TE0391 |
|---|---|
| 1.3.5 | Leakage Current Clamp Tester  
Make: KYORITSU  
Model: 2414 & 2431  
Serial No.: 27911 / 34783 /& 71716 / 71717 / 71728 |
| 1.3.6 | Elcometer Thickness Gauge  
Make: Elcometer  
Model: A345FB-S1  
Serial No.: NM1550-273 |
| 1.3.7 | Torque Wrench  
Make: TOHNICHI  
Model: QL100N  
Serial No.: 024484W |
| 1.3.8 | Dial Caliper Range (0-150mm)  
Make: Mitutoyo  
Model: 515-550  
Serial No: A-19755 |
1.4 FAT procedure

(A) Visual Inspection Test

1.4.1 Visual inspection with customer will be carried out on the LV switchboard to

a. Check the layout of fitted components
b. Check the overall dimension of switchboard, size of busbars, cables and earthing conductors and location of feeder entry point.
c. Check and verify the brand, model, and circuit identification of components installed such as breakers, current transformers, fuses, ammeters, voltmeters, power meters and protection relays etc.
d. Check overall paint work, door locking device, door gasket, door hinges, door cut-out holes
e. Check the busbar and cable tightening, the marking, busbar clearance, base angle bar and plinth
f. Check the labels, name plate and phase identification

The customer comments will be recorded in “QC-03 Customer Inspection Comments”. Refer Appendix A – Form 03.

(B) Insulation Test

1.4.2 Carry out 500V meggar test for phase to earth, neutral to earth, phase to neutral and phase to phase to measure the insulation resistance with all breakers in ‘ON’ positions.

All reading will be recorded in “QC-06 Quality Assurance Test Report – Meggar”. Refer Appendix A – Form 06.
Refer Appendix B – Test Circuit of Insulation Test.
(C) **High Voltage Injection Test**

1.4.3 Carry out 500V meggar test between each stressed phase and all other phase connected to exposed conductive parts with all breakers in ‘ON’ positions.

1.4.4 Apply 2.5kV AC voltage between each stressed phase and all other phase connected to exposed conductive parts for 60 seconds and measure the leakage current.

1.4.5 To repeat the test mentioned on 1.4.3

All reading will be recorded in “QC-06 Quality Assurance Test Report – Meggar”. Refer Appendix A - Form 06.

Refer Appendix B – Test Circuit of High Voltage Injection Test.

(D) **Primary Current Injection Test**

1.4.6 Temporarily short the R, Y, B & N primary bars on one side of the protection current transformers.

1.4.7 Connect the primary injection test set on R-phase and N on primary bars on the other side of the current transformers.

1.4.8 Connect an ammeter to the R-phase of CT to monitor the secondary current.

1.4.9 Connect a milli-ammeter to the earth-fault relay current coil to monitor the spill current.

1.4.10 Inject 50% and 100% of the CT ratio through the primary bars and record spill current respectively. At the same time, record the secondary current of the R-phase respectively.

1.4.11 Repeat test mentioned from 1.4.7 to 1.4.10 with Y-phase and B-phase.

All reading will be recorded in “QC-05 Quality Assurance Test Report – PI&SI”. Refer Appendix A - Form 05.

Refer Appendix B – Test Circuit of Primary Current Injection Test
(E) Secondary Current Injection Test

1.4.12 Select the current plug setting of IDMTL relay to the rated current of 5A and TMS of 0.1 for 3/10 characteristic.

1.4.13 Inject secondary current of 5A to R-phase and adjust pickup current to 5A.

1.4.14 Inject 10A, 15A and 25A to R-phase and record the tripping time respectively. The time should fall with +30% and -10% of the standard timing.

1.4.15 Select the proposed current setting and adjust the pickup current accordingly.

1.4.16 Repeat the test from 1.4.13 to 1.4.15 with Y-phase and B-phase.

All reading will be recorded in “QC-05 Quality Assurance Test Report – PI&SI”. Refer Appendix A - Form 05. Refer Appendix B – Test Circuit of Secondary Current Injection Test

(F) Metering Current Transformer Polarity Test

1.4.17 Temporarily short the R, Y, B & N primary bars on one side of the protection current transformers.

1.4.18 Connect the primary injection test set on R-phase and Y-phase on primary bars on the other side of the metering current transformers.

1.4.19 Connect an ammeter to the R-phase of CT to monitor the secondary current.

1.4.20 Connect a milli-ammeter to earth cable to monitor the spill current.

1.4.21 Inject 50% and 100% of the CT ratio through the primary bars and record the spill current respectively. Same time to record the secondary current of the R-phase.

1.4.22 Repeat test mentioned from 1.4.18 to 1.4.21 with Y-phase by connecting the primary injection test set on Y-phase and B-phase.

1.4.23 Repeat test mentioned from 1.4.18 to 1.4.21 with B-phase by connecting the primary injection test set on B-phase and R-phase

All reading will be recorded in “QC-17 Quality Assurance Test Report – MCT Polarity Test”. Refer Appendix A - Form 17. Refer Appendix B – Test Circuit of Metering Current Transformer Polarity Test
2. Safety & Risk Control

2.1 Safety Arrangement

To control the risks during the FAT, the following arrangement will be done

(A) Safety barriers will be installed surrounding the area where the FAT is going to be carried out.

(B) Danger signs will be hanged to warn the people who approach the FAT area.

(C) RED colour warning lamp will be made to be flashing during supplying power to the board for testing.

(D) Fire extinguisher will be placed for emergency usage at FAT area.

(E) A First aid box will be placed at FAT area for emergency purpose.
3. Appendix A: Typical Test Forms

(A) QC-03 Customer Inspection Comments (Form 03)

<table>
<thead>
<tr>
<th>Delivery Date:</th>
<th>FORM 03</th>
</tr>
</thead>
</table>

### Customer Inspection Comments

<table>
<thead>
<tr>
<th>Client</th>
<th>Sales Order No.:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Project</th>
<th>Job Order No.:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Panel Name</th>
<th>Date (DD/MM/YY)</th>
</tr>
</thead>
</table>

#### Panel Type

- Floor-Mount
- Wall-Mount
- Apply For
- Indoor
- Outdoor
- Project In-Charge

#### IP Type

- Cable Access
- Front
- Back

<table>
<thead>
<tr>
<th>S/No</th>
<th>Feeder No</th>
<th>Comments</th>
<th>Action By</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

#### Tested By

- Sunlight
- Myint Lwin / Tan H S
- QC

#### Witnessed By

- Sunlight
- K.V.Kumar / Vase / TJ
- QC

Form No.: QC-03  Version: 05  Date: 17 Feb 2008

Sunlight Electrical Pte Ltd 150 Ubi Ave 1 Singapore 408825 Tel (65) 6741 9055 Fax (65) 6741 1558
Email info@sunlightlightgroup.com Website www.sunlightgroup.com
### Quality Assurance Test Report – Meggar

#### Title of Test
- 1. Busbar Insulation Test
- 2. High Voltage Injection Test

<table>
<thead>
<tr>
<th>Client</th>
<th>Sales Order No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Name:</td>
<td>Job Order No.:</td>
</tr>
<tr>
<td>Panel Name:</td>
<td>Date: (DD/MM/YYYY)</td>
</tr>
<tr>
<td>Panel Type</td>
<td></td>
</tr>
<tr>
<td>Floor-Mount</td>
<td>Apply For</td>
</tr>
<tr>
<td>Wall-Mount</td>
<td>Indoor</td>
</tr>
</tbody>
</table>

#### 1. Busbar Insulation Test

<table>
<thead>
<tr>
<th>Test Connection</th>
<th>Insulation Reading (MΩ)</th>
<th>Remarks</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red / Earth</td>
<td></td>
<td></td>
<td>≥ 20MΩ</td>
</tr>
<tr>
<td>Yellow / Earth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue / Earth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral / Earth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red / Neutral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow / Neutral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue / Neutral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red / Yellow</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Yellow / Blue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue / Red</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 2. High Voltage Injection Test

<table>
<thead>
<tr>
<th>Test Connection</th>
<th>Insulation Reading (MΩ)</th>
<th>High Voltage Injection (1 min)</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stressed Phase</td>
<td>Earthed Phases</td>
<td>Before HV Injection</td>
<td>After HV Injection</td>
</tr>
<tr>
<td>Red</td>
<td>Y, B &amp; N</td>
<td></td>
<td>≥ 20MΩ</td>
</tr>
<tr>
<td>Yellow</td>
<td>R, B &amp; N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>R, Y &amp; N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>R, Y &amp; B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Equipment Used**
- Insulation Tester Used: KYORITSU 1462615 500 / 1000 Vdc
- A/C Pressure Set Used: ITES-0456 2500 Vac

**Company**
- Sunlight

**Name**
- Myint Lwin / Tan H S
- K.V. Kumar / Vass / TJ

**Designation**
- QC
- QC

**Signature**

Form No.: QC-06  Version: 08  Date: 25 Dec 2008

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(B) QC-06 Quality Assurance Test Report – Meggar” (Form 06)
# Quality Assurance Test Report - PI&SI

**Title of Test:**
1. Current Transformer Ratio & Polarity Test
2. Pri / Sec Injection Test for Overcurrent & Earth Fault Relay

**Circuit Breaker's Detail**

<table>
<thead>
<tr>
<th>Type</th>
<th>Brand</th>
<th>Model</th>
<th>Rated Volt</th>
<th>Nominal Rated Current</th>
<th>Breaking Cap</th>
<th>Trip Coil Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>A66M65A</td>
<td>V</td>
<td>A</td>
<td>KA</td>
<td>AG/DC</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

**Primary Injection Test**

- **Description:** PCT
- **Main Type:** /
- **CT Ratio:** 19N
- **Class/VA:** /

**Secondary Injection Test for Overcurrent & Earth Fault Relay**

<table>
<thead>
<tr>
<th>QC Relay</th>
<th>Brand</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>IDMTL</th>
<th>PSM (%)</th>
<th>IMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E.L. Results (Operating)</th>
<th>I (Current)</th>
<th>Operational Time (Sec)</th>
<th>Std Time (Sec)</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>R - N</td>
<td>1 x</td>
<td></td>
<td></td>
<td>+10% Tolerance</td>
</tr>
<tr>
<td>Y - N</td>
<td>1 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B - N</td>
<td>1 x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Equipment Test**

- **Make:** E.L.
- **Serial Number:** Test Set 73-121

**Company**

- **Name:** Sunlight
- **Designation:** Myint Lwin / Tan H S
- **Signature:** QC

- **Witnessed By:** Sunlight / Kumar / Vasu / TJ
- **Signature:** QC

**Date:** 12 Feb 2009
(D) QC-17 Quality Assurance Test Report – MCT Polarity Test (Form 17)

<table>
<thead>
<tr>
<th>Circuit No.</th>
<th>Description</th>
<th>MCT</th>
<th>Test Connection</th>
<th>Primary CT Current (A)</th>
<th>Secondary CT Current (A)</th>
<th>Spill Current (A)</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Primary CT current (A)</td>
<td>50% 100%</td>
<td>50% 100%</td>
<td>50% 100%</td>
<td>&lt; 50 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Secondary CT current (A)</td>
<td>50% 100%</td>
<td>50% 100%</td>
<td>50% 100%</td>
<td>&lt; 50 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Spill current (A)</td>
<td>50% 100%</td>
<td>50% 100%</td>
<td>50% 100%</td>
<td>&lt; 50 mA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment Used</th>
<th>Make</th>
<th>Serial Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Injection Test Set</td>
<td>TAC EQUIPMENT CO LTD</td>
<td>2710050 U310114</td>
</tr>
<tr>
<td>Secondary Injection Test Set</td>
<td>TAC EQUIPMENT CO LTD</td>
<td>2710050 U310114</td>
</tr>
<tr>
<td>Leakage Current Tester</td>
<td>KYOTO SHI</td>
<td>370777 09/17/11/07/28</td>
</tr>
</tbody>
</table>

Company: Sunlight

 Tested By: Sunlight Myint Lwin / Tan H S QC

 Tested By: Sunlight Kumar / Vasu / TJ QC

Form No.: QC-17 Version: 01 Date: 17 Feb 2008
4. Appendix B: Test Circuits
(A) Test Circuit of Insulation Test (Meggar)

Meggar Test On Low-Voltage System without Grounding
(B) Test Circuit of High Voltage Injection Test

High Voltage Injection Test
(2.5 KVAC for 1min)

Leakage Current

IR - Ie

Shorting Link

High Voltage Injection Test On Low-Voltage System without Grounding

Leakage Current

Earth

mA

Ie

OUTPUT

Incoming

Outgoing

R Y B N E
(C) Test Circuit of Primary Current Injection Test

Primary Injection Test On Over-Current Relay & CTs Polarities & Ratio Test
(D) Test Circuit of Secondary Current Injection Test

Secondary Injection Test On IDMTL Relay
(E) Test Circuit of Metering Current Transformer Polarity & Ratio Test

Incoming

R Y B N

IR

Ir

Iy

Ir - Iy

Ir

IY

OC

OC

OC

mA

Spill – Current Leakage Meter

Shorting Bar

Outgoing

PRIMARY INJECTION TEST SET

Metering Current Transformer Polarities & Ratio Test