Client: ABB SACE S.p.A. BAU ATAP
Address of the Client: Via Italia, 50-58
23846 Garbagnate Monastero (LC)
ITALY
Manufacturer: ABB SACE S.p.A. BAU ATAP
Tested samples/items: n.2 ABB SACE IS2 Automation Boards
Tests carried out: SEISMIC QUALIFICATION TESTS – Levels: 0.50g and 0.75g

Standards/Specifications:

Tests date: from June 15th, 2010 to June 17th, 2010

The results reported in this document relate only to the tested samples/items.
Partial reproduction of this document is permitted only with the written permission from CESI.

No. of pages: 46
No. of pages annexed
Issue date: July 23rd, 2010

Prepared: PPR - Bontempi Paolo
Verified: QED - Vidori Mauro, PPR - Pucci Gino
Approved: LAP - The Manager - Nicolini Roberto
1 GENERAL DATA

1.1 Customer

ABB SACE S.p.A. BAU ATAP
Via Italia, 50-58
23846 Garbagnate Monastero (LC)
ITALY

1.2 Unit under test

Tests have been performed on:

- Unit 1: ABB SACE IS2 Automation Board (photo 3), without electrical components;
- Unit 2: ABB SACE IS2 Automation Board with seismic kit (photo 4) without electrical components.

Unit 1 and 2 are shown in photos 1 and 2 with the general views of the units. Drawings about Unit 1 and Unit 2 are reported in photos 3 and 4.

During all tests each Unit has been charged up with a total weight of 435 kg (dummy load): weights distribution are detailed in photos 3 and 4.

1.3 Manufacturer

ABB SACE S.p.A. BAU ATAP

1.4 Reference documents

1.4.1 Contract documents

- CESI offer B0005306 dated 25/02/2010.

1.4.2 Technical documents and standards


1.5 Test objective

The purpose of the tests was to demonstrate that the unit behaves in compliance with the requirements stated in technical documents and standards.

1.6 Testing laboratory

CESI - LPS Laboratory
DIVEN Division
via Pastrengo, 9
24068 SERIATE BG
ITALY

The CESI quality management system for performing laboratory investigations and tests in structural field is conforming with standard UNI EN ISO 9001:2000, as certified in SQS N.24295-01.

CESI LPS laboratory (P610) is qualified for testing railway items by R.I.N.A. (Registro Navale Italiano Div. Ferroviaria).

1.7 Test date

Tests have been performed from the 15th to the 17th of June, 2010.
4 TEST RESULTS

4.1 Resonance frequency search tests

Response curves and transfer functions relevant to the resonance frequency searches are illustrated in the following figures:

<table>
<thead>
<tr>
<th>Direction</th>
<th>Control position 5</th>
<th>Measuring positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tests n. 1, 9, 13</td>
<td>X</td>
<td>Fig. 6</td>
</tr>
<tr>
<td>Test n. 2, 10, 14</td>
<td>Y</td>
<td>Fig. 9</td>
</tr>
<tr>
<td>Test n. 3, 11, 15</td>
<td>Z</td>
<td>Fig. 12</td>
</tr>
<tr>
<td>Tests n. 1, 9, 13</td>
<td>X</td>
<td>Fig. 6</td>
</tr>
<tr>
<td>Test n. 2, 10, 14</td>
<td>Y</td>
<td>Fig. 9</td>
</tr>
<tr>
<td>Test n. 3, 11, 15</td>
<td>Z</td>
<td>Fig. 12</td>
</tr>
</tbody>
</table>

4.2 Seismic tests

Response curves during the seismic test are illustrated in the following figures:

<table>
<thead>
<tr>
<th>Directions</th>
<th>Control positions</th>
<th>Measuring positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test n. 8</td>
<td>X, Y, Z</td>
<td>Figs. 15, 16</td>
</tr>
<tr>
<td>Test n. 12</td>
<td>X, Y, Z</td>
<td>Figs. 21, 22</td>
</tr>
<tr>
<td>Test n. 8</td>
<td>X, Y, Z</td>
<td>Figs. 15, 16</td>
</tr>
<tr>
<td>Test n. 12</td>
<td>X, Y, Z</td>
<td>Figs. 21, 22</td>
</tr>
</tbody>
</table>

4.3 Functional checks

At the end of each test the tightening torque of the screws connecting the unit to shaking table have been verified.

Visual inspections have been performed after each test on the Unit 1 and Unit 2:

- Unit 1: no visible damages have been detected on IS2 Automation Board after seismic tests at 0.5 g level (test n 8: 0 dB – 100 %).
- Unit 1: damages have been detected on IS2 Automation Board after seismic tests at 0.75 g level (test n 12: +3.5 dB – 150 %), as reported in photo 14.
- Unit 2: no visible damages have been detected on IS2 Automation Board with seismic kit.

5 Spurious motion measured at the distance of: yaw 1879 mm, pitch 1540 mm and roll 1340 mm.