



## Factory Acceptance Test Report

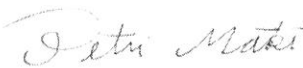
### Test report for asynchronous machine

Customer **ABB AS**  
Project **51020405 - RR, Peregrine 1**  
Order ref. **1400kW, B3, CCW**

Machine **AMI 450L6L BAMH**  
Work no. **4443HG200**  
Serial no. **4631603**

Date **9.4.2013**

Approved on behalf of the manufacturer

  
Petri Mäki

**ABB Oy  
Machines  
Final Testing**

Approved on behalf of the classification society



Digitally Signed By: Konttori, Jari  
Location: DNV Helsinki, Finland  
Signing Date: 2013-06-17

Hannu Suominen / DNV

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### ABB Oy, Machines

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## Factory Acceptance Test Report

|                                              |                                             |                              |
|----------------------------------------------|---------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>           | Page<br><b>2</b>             |
| Order ref.                                   | Work no.<br><b>4443HG200</b>                | Serial no.<br><b>4631603</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><i>Petri Mäki</i><br>Petri Mäki | Report rev<br><b>B</b>       |

### Ratings

#### Machine

|                        |                |                        |                |
|------------------------|----------------|------------------------|----------------|
| Standards              | <b>IEC</b>     |                        |                |
| Specification          | <b>NONE</b>    |                        |                |
| Classification society | <b>DNV</b>     |                        |                |
| Insulation class       | <b>F</b>       | Mounting designation   | <b>IM 1001</b> |
| Temperature class      | <b>F</b>       | Protected by enclosure | <b>IP 55</b>   |
| Ambient temp., max.    | <b>45.0 °C</b> | Method of cooling      | <b>IC 81W</b>  |

|               |                   |                      |              |              |             |                          |               |
|---------------|-------------------|----------------------|--------------|--------------|-------------|--------------------------|---------------|
| <u>f [Hz]</u> | <u>Connection</u> | <u>P [kW] / [hp]</u> | <u>U [V]</u> | <u>I [A]</u> | <u>p.f.</u> | <u>Direction n [rpm]</u> | <u>Duty</u>   |
| <b>50.0</b>   | <b>Y</b>          | <b>1400 / 1877</b>   | <b>6000</b>  | <b>170</b>   | <b>0.82</b> | <b>&lt;==</b>            | <b>991 S1</b> |

### Table of contents / Test program

- 1) *Visual inspection*
- 2) *Air gap measurement*
- 3) *Insulation resistances before tests*
- 4) *Resistance measurement of windings and elements*
- 5) *Direction of rotation, checking of phase sequence*
- 6) *Short-circuit point*
- 7) *No-load point*
- 8) *Vibration measurement*
- 9) *High voltage test*
- 10) *Insulation resistances after tests*



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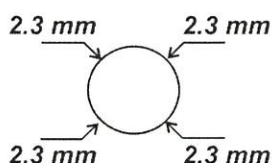
|                                              |                                             |                              |
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| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>           | Page<br><b>3</b>             |
| Order ref.                                   | Work no.<br><b>4443HG200</b>                | Serial no.<br><b>4631603</b> |
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## 1) Visual inspection

| Version | Notes |
|---------|-------|
| A       | OK    |

## 2) Air gap measurement

Viewed from ND-end



## 3) Insulation resistances before tests

$\vartheta = 22.1\text{ }^{\circ}\text{C}$

| Winding      | R [Mohm] | U [V] |
|--------------|----------|-------|
| Stator       | 43500    | 1000  |
| Auxiliaries  | R [Mohm] | U [V] |
| Space heater | 607000   | 500   |

| Temperature detectors | R [Mohm] | U [V] |
|-----------------------|----------|-------|
| Stator                | 735000   | 500   |
| Other (1)             | 1500000  | 500   |

Notes Pt100(Other1) = hot & cold air

## 4) Resistance measurement of windings and elements

$\vartheta = 20\text{ }^{\circ}\text{C}$

| Winding | R <sub>uv</sub> [ohm] | R <sub>uw</sub> [ohm] | R <sub>vw</sub> [ohm] |
|---------|-----------------------|-----------------------|-----------------------|
| Stator  | 0.30957               | 0.30972               | 0.30938               |

$\vartheta = 22.1\text{ }^{\circ}\text{C}$

| Terminals     | R [ohm] | Position        | Detector         |
|---------------|---------|-----------------|------------------|
| 1 - 2         | 114.2   | Space heater    | RER-Z 21         |
| 3,4 - 5,6     | 108.5   | Stator, U-phase | PYR PT100LG4/4EX |
| 7,8 - 9,10    | 108.6   | Stator, V-phase | PYR PT100LG4/4EX |
| 11,12 - 13,14 | 108.6   | Stator, W-phase | PYR PT100LG4/4EX |
| 15,16 - 17,18 | 108.6   | Stator, U-phase | PYR PT100LG4/4EX |
| 19,20 - 21,22 | 108.6   | Stator, V-phase | PYR PT100LG4/4EX |
| 23,24 - 25,26 | 108.5   | Stator, W-phase | PYR PT100LG4/4EX |
| 27,28 - 29,30 | 108.5   | hot air         | PYR PT100        |
| 31,32 - 33,34 | 108.5   | cold air        | PYR PT100        |



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|                                              |                                             |                              |
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## 5) Direction of rotation, checking of phase sequence

Result **U-V-W | L3-L2-L1 | <<< (CCW)**

## 6) Short-circuit point

| Connection | f [Hz]      | U1 [V]        | I1 [A]       | P1 [kW]      | p.f.         | u [°C]      | Ik [A]       | Un [V]      |
|------------|-------------|---------------|--------------|--------------|--------------|-------------|--------------|-------------|
| <b>Y</b>   | <b>50.0</b> | <b>1577.0</b> | <b>166.2</b> | <b>52.50</b> | <b>0.116</b> | <b>22.1</b> | <b>632.3</b> | <b>6000</b> |

## 7) No-load point

| Connection | f [Hz]      | U1 [V]        | I1 [A]       | P1 [kW]      | p.f.         | u [°C]      | Direction  |
|------------|-------------|---------------|--------------|--------------|--------------|-------------|------------|
| <b>Y</b>   | <b>50.0</b> | <b>5995.0</b> | <b>61.56</b> | <b>21.34</b> | <b>0.033</b> | <b>32.0</b> | <b>CCW</b> |

## 8) Vibration measurement

| Bearing position | U [V]       | I [A]     | f [Hz]      | Mounting <b>Rigid</b> |             | Axial Unit            |
|------------------|-------------|-----------|-------------|-----------------------|-------------|-----------------------|
|                  |             |           |             | Horizontal            | Vertical    |                       |
| <b>D-END</b>     | <b>5995</b> | <b>62</b> | <b>50.0</b> | <b>0.41</b>           | <b>0.47</b> | <b>0.55 mm/s, rms</b> |
| <b>ND-END</b>    | <b>5995</b> | <b>62</b> | <b>50.0</b> | <b>0.46</b>           | <b>0.36</b> | <b>0.30 mm/s, rms</b> |

### Measuring equipment

| Id            | Type                      | Name                                | Cal Date          | Next Cal Due     |
|---------------|---------------------------|-------------------------------------|-------------------|------------------|
| <b>715777</b> | <b>Vibration analyzer</b> | <b>CSI 1910, vibration analyzer</b> | <b>13.12.2012</b> | <b>13.6.2013</b> |

## 9) High voltage test

| Winding               | U [V]        | t [s]     | f [Hz]    |
|-----------------------|--------------|-----------|-----------|
| <b>Stator</b>         | <b>15000</b> | <b>60</b> | <b>50</b> |
| <b>Auxiliaries</b>    |              |           |           |
| <b>Space heater</b>   | <b>1500</b>  | <b>60</b> | <b>50</b> |
| Temperature detectors |              |           |           |
|                       | U [V]        | t [s]     | f [Hz]    |
| <b>Stator</b>         | <b>1500</b>  | <b>60</b> | <b>50</b> |
| <b>Other (1)</b>      | <b>500</b>   | <b>60</b> | <b>50</b> |

Notes **Pt100(Other1) = hot & cold air**

## 10) Insulation resistances after tests

u = **32.0 °C**

| Winding             | R [Mohm]      | t [s]      | U [V]                 |
|---------------------|---------------|------------|-----------------------|
| <b>Stator</b>       | <b>24900</b>  | <b>60</b>  | <b>1000</b>           |
| Auxiliaries         | R [Mohm]      | U [V]      | Temperature detectors |
| <b>Space heater</b> | <b>393999</b> | <b>500</b> | <b>Stator</b>         |
|                     |               |            | <b>487000</b>         |
|                     |               |            | <b>500</b>            |
|                     |               |            | <b>Other (1)</b>      |
|                     |               |            | <b>1500000</b>        |
|                     |               |            | <b>500</b>            |

Notes **Pt100(Other1) = hot & cold air**





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|----------------------------------------------|---------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>           | Page<br><b>5</b>             |
| Order ref.                                   | Work no.<br><b>4443HG200</b>                | Serial no.<br><b>4631603</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><i>Petri Mäki</i><br>Petri Mäki | Revision<br><b>A</b>         |
|                                              |                                             | Report rev<br><b>B</b>       |

End of report

Test bay **AMA-production line**

Author **Petri Mäki, Tarmo Juntunen**

Number of pages 5

Printed: 28.5.2013

Kai Jauhiainen  
2.2



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### Test report for asynchronous machine

Customer **ABB AS**  
Project **51020405 - RR, Peregrine 1**  
Order ref. **1400kW, B3, CCW**

Machine **AMI 450L6L BAMH**  
Work no. **4443HG201**  
Serial no. **4631604**

Date **9.4.2013**

Approved on behalf of the manufacturer

*Kai Jauhainen*  
Kai Jauhainen

**ABB Oy  
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Digitally Signed By: Konttori, Jari  
Location: DNV Helsinki, Finland  
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### Ratings

#### Machine

Standards

**IEC**

Classification society

**DNV**

Insulation class

**F**

Temperature class

**F**

Ambient temp., max.

**45.0 °C**

Mounting designation

**IM 1001**

Protected by enclosure

**IP 55**

Method of cooling

**IC 81W**

| <u>f [Hz]</u> | <u>Connection</u> | <u>P [kW] / [hp]</u> | <u>U [V]</u> | <u>I [A]</u> | <u>p.f.</u> | <u>Direction n [rpm]</u> | <u>Duty</u> |
|---------------|-------------------|----------------------|--------------|--------------|-------------|--------------------------|-------------|
| 50.0          | Y                 | 1400 / 1877          | 6000         | 170          | 0.82        | <==                      | 991 S1      |

Cooling water flow 8.1 m<sup>3</sup>/h

Cooling water temp 38 °C

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- 7) Overload test
- 8) Short-circuit point
- 9) No-load point
- 10) Vibration measurement
- 11) High voltage test
- 12) Insulation resistances after tests



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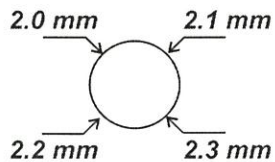
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| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>                 | Page<br><b>3</b>             |
| Order ref.                                   | Work no.<br><b>4443HG201</b>                      | Serial no.<br><b>4631604</b> |
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|                                              |                                                   | Report rev<br><b>B</b>       |

### 1) Visual inspection

| <u>Version</u> | <u>Notes</u> |
|----------------|--------------|
| A              | OK           |

### 2) Air gap measurement

Viewed from ND-end



### 3) Insulation resistances before tests

$\vartheta = 20.3\text{ }^{\circ}\text{C}$

| <u>Winding</u>     | <u>R [Mohm]</u> | <u>U [V]</u> |
|--------------------|-----------------|--------------|
| Stator             | 49400           | 1000         |
| <u>Auxiliaries</u> | <u>R [Mohm]</u> | <u>U [V]</u> |
| Space heater       | 576000          | 500          |

| <u>Temperature detectors</u> | <u>R [Mohm]</u> | <u>U [V]</u> |
|------------------------------|-----------------|--------------|
| Stator                       | 622000          | 500          |
| Other (1)                    | 1000000         | 500          |

Notes      Other (1) = Pt-100 temperature detectors in cooling air





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|                                              |                                                     |                              |
|----------------------------------------------|-----------------------------------------------------|------------------------------|
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| Order ref.                                   | Work no.<br><b>4443HG201</b>                        | Serial no.<br><b>4631604</b> |
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|                                              |                                                     | Report rev<br><b>B</b>       |

### 4) Resistance measurement of windings and elements

$\nu = 20\text{ }^{\circ}\text{C}$

| <u>Winding</u> | <u>R<sub>uv</sub> [ohm]</u> | <u>R<sub>uw</sub> [ohm]</u> | <u>R<sub>vw</sub> [ohm]</u> |
|----------------|-----------------------------|-----------------------------|-----------------------------|
| Stator         | 0.30980                     | 0.30997                     | 0.30975                     |

$\nu = 20.3\text{ }^{\circ}\text{C}$

| <u>Terminals</u> | <u>R [ohm]</u> | <u>Position</u> | <u>Detector</u>  |
|------------------|----------------|-----------------|------------------|
| 1 - 2            | 111.8          | Space heater    | RER-Z 21         |
| 3,4 - 5,6        | 107.9          | Stator, U-phase | PYR PT100LG4/4EX |
| 7,8 - 9,10       | 107.9          | Stator, V-phase | PYR PT100LG4/4EX |
| 11,12 - 13,14    | 107.9          | Stator, W-phase | PYR PT100LG4/4EX |
| 15,16 - 17,18    | 107.9          | Stator, U-phase | PYR PT100LG4/4EX |
| 19,20 - 21,22    | 107.9          | Stator, V-phase | PYR PT100LG4/4EX |
| 23,24 - 25,26    | 107.9          | Stator, W-phase | PYR PT100LG4/4EX |
| 27,28 - 29,30    | 108.7          | Hot air         | PYR PT100PF5/4Z  |
| 31,32 - 33,34    | 108.6          | Cold air        | PYR PT100PF5/4Z  |



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|                                              |                                                   | Report rev<br><b>B</b>       |

### 5) Direction of rotation, checking of phase sequence

Result **U-V-W | L3-L2-L1 | <<< (CCW)**

### 6) Temperature rise test

Test run **A**

Loading method **Loading machine**

Loading conditions

U = **6035 V**

Direction **<==**

I = **171.2 A**

f = **50.0 Hz**

Water flow **8.10 m³/h**

n = **992 rpm**

Final temperatures

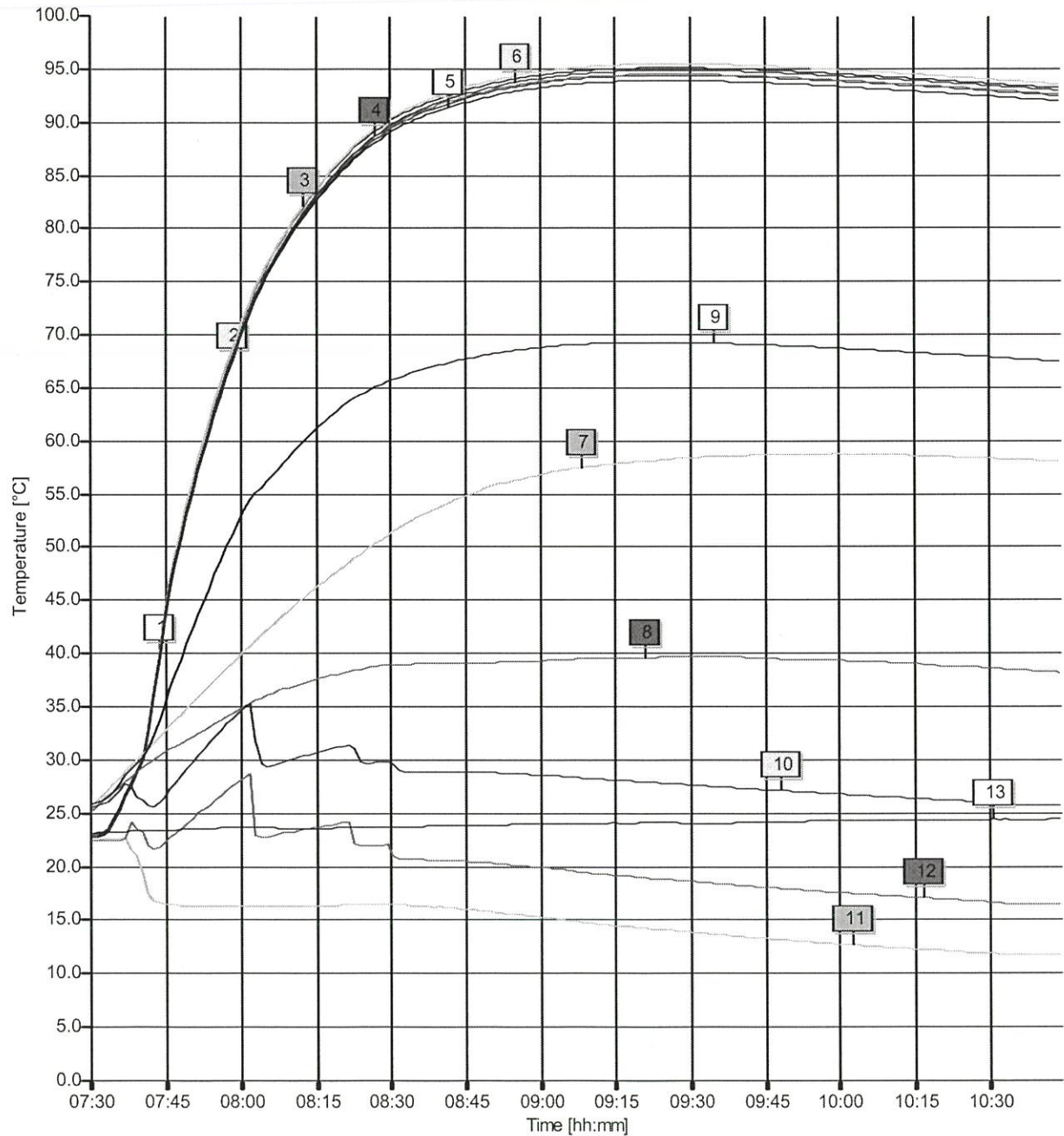
| Recorder         | Channel | Terminal      | Position                          | $\vartheta$ [°C] | Detector         |
|------------------|---------|---------------|-----------------------------------|------------------|------------------|
| Keithley<br>2700 | 1       | 3,4 - 5,6     | Stator winding, U-phase           | 93.2 °C          | PYR PT100LG4/4EX |
|                  | 2       | 7,8 - 9,10    | Stator winding, V-phase           | 92.5 °C          | PYR PT100LG4/4EX |
|                  | 3       | 11,12 - 13,14 | Stator winding, W-phase           | 93.6 °C          | PYR PT100LG4/4EX |
|                  | 4       | 15,16 - 17,18 | Stator winding, U-phase           | 92.6 °C          | PYR PT100LG4/4EX |
|                  | 5       | 19,20 - 21,22 | Stator winding, V-phase           | 92.0 °C          | PYR PT100LG4/4EX |
|                  | 6       | 23,24 - 25,26 | Stator winding, W-phase           | 93.0 °C          | PYR PT100LG4/4EX |
|                  | 7       | External      | D.E - bearing                     | 58.1 °C          | Pt100            |
|                  | 8       | External      | N.D.E - bearing                   | 38.2 °C          | Pt100            |
|                  | 9       | 27,28 - 29,30 | Outlet cooling air(inner circul.) | 67.5 °C          | PYR PT100PF5/4Z  |
|                  | 10      | 31,32 - 33,34 | Inlet cooling air(inner circul.)  | 25.8 °C          | PYR PT100PF5/4Z  |
|                  | 11      | External      | Inlet cooling water (ref.)        | 11.8 °C          | Pt100            |
|                  | 12      | External      | Outlet cooling water              | 16.5 °C          | Pt100            |
|                  | 13      | External      | Ambient temperature               | 24.5 °C          | Pt100            |



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|                                              |                                                     |                              |
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| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>                   | Page<br><b>6</b>             |
| Order ref.                                   | Work no.<br><b>4443HG201</b>                        | Serial no.<br><b>4631604</b> |
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|                                              |                                                     | Report rev<br><b>B</b>       |

Graph of the temperatures





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|                                              |                                                   |                              |
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|                                              |                                                   | Report rev<br><b>B</b>       |

## Temperature rise test - Continued

Stator: 1

### Determination of temperature rise from cooling curve

Winding cold resistance

$R1 = 0.31016 \text{ ohm}$

$\nu1 = 20.3 \text{ }^{\circ}\text{C}$

Temperature of the coolant

$\nu0 = 11.8 \text{ }^{\circ}\text{C}$

Resistance after shutdown

$R2 = 0.39899 \text{ ohm} / 0 \text{ s}$

$\nu2 = 93.4 \text{ }^{\circ}\text{C}$

Temperature rise

$\Theta = \nu2 - \nu0 = 81.6 \text{ K}$

Resistances of other phases

$R_{uw} = 0.39133 \text{ ohm} / 240 \text{ s}$

$R_{vw} = 0.39065 \text{ ohm} / 270 \text{ s}$

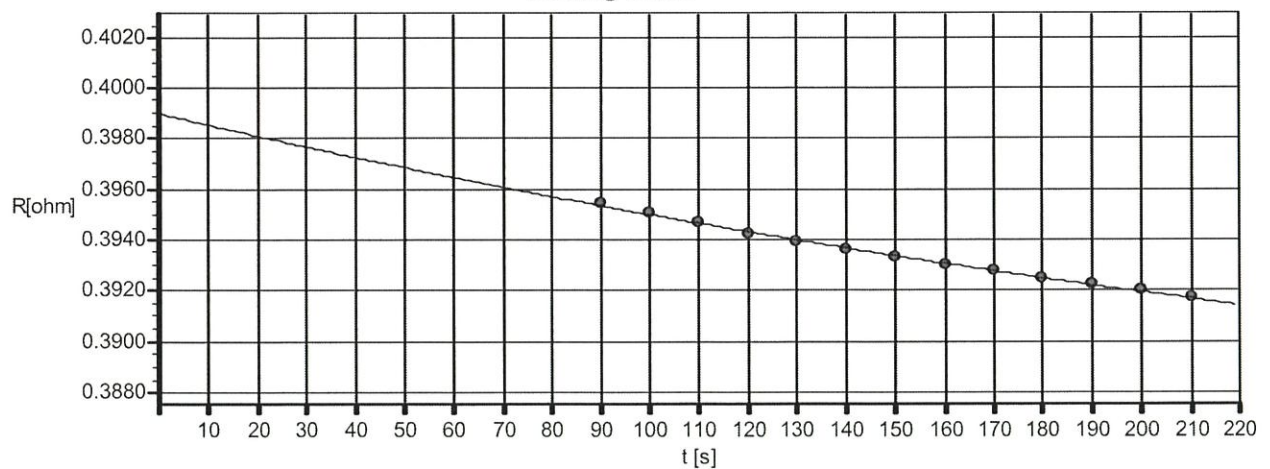
Reference coolant:

*Inlet cooling water (ref.)*

$$\nu2 - \nu0 = \frac{R2 - R1}{R1} \times (k + \nu1) + \nu1 - \nu0$$

k is the temperature coefficient, for copper k = 235

Cooling curve







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|                                              |                                                   |                              |
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### Temperature rise test - Continued

#### Voltage and current balances

$U_{uv} = 6035 \text{ V}$      $U_{uw} = 6034 \text{ V}$      $U_{vw} = 6035 \text{ V}$

$I_u = 171.3 \text{ A}$      $I_v = 171.2 \text{ A}$      $I_w = 171.1 \text{ A}$

#### Machine loading values:

| Time  | $U_1$ [V] | $I_1$ [A] | $P_{el}$ [kW] | p.f. | f [Hz] | n [rpm] | s [%] |
|-------|-----------|-----------|---------------|------|--------|---------|-------|
| 07:41 | 6035      | 170.8     | 1454.4        | 0.82 | 50.0   | 993.0   | 0.70  |
| 08:12 | 6034      | 171.2     | 1454.9        | 0.81 | 50.0   | 992.2   | 0.78  |
| 08:42 | 6034      | 171.4     | 1454.2        | 0.81 | 50.0   | 992.1   | 0.79  |
| 09:12 | 6036      | 171.3     | 1453.2        | 0.81 | 50.0   | 992.1   | 0.79  |
| 09:42 | 6035      | 171.3     | 1452.5        | 0.81 | 50.0   | 992.1   | 0.78  |
| 10:12 | 6035      | 171.2     | 1452.2        | 0.81 | 50.0   | 992.1   | 0.78  |
| 10:42 | 6035      | 171.2     | 1451.8        | 0.81 | 50.0   | 992.2   | 0.78  |

### 7) Overload test

#### Loading conditions

$t = 15 \text{ s}$      $U = 6034 \text{ V}$      $I = 273.1 \text{ A}$      $P = 2301.3 \text{ kW}$

$f = 50.0 \text{ Hz}$     p.f. = 0.806



## Factory Acceptance Test Report

|                                              |                                                   |                              |
|----------------------------------------------|---------------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>                 | Page<br><b>9</b>             |
| Order ref.                                   | Work no.<br><b>4443HG201</b>                      | Serial no.<br><b>4631604</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><i>Kai Jauhainen</i><br>Kai Jauhainen | Revision<br><b>A</b>         |
|                                              |                                                   | Report rev<br><b>B</b>       |

### 8) Short-circuit point

| Connection | f [Hz] | U1 [V] | I1 [A] | P1 [kW] | p.f.  | $\vartheta$ [°C] | I <sub>k</sub> [A] | U <sub>n</sub> [V] |
|------------|--------|--------|--------|---------|-------|------------------|--------------------|--------------------|
| Y          | 50.0   | 1620.8 | 170.1  | 58.08   | 0.122 | 68.7             | 629.9              | 6000               |

### 9) No-load point

| Connection | f [Hz] | U1 [V] | I1 [A] | P1 [kW] | p.f.  | $\vartheta$ [°C] | Direction |
|------------|--------|--------|--------|---------|-------|------------------|-----------|
| Y          | 50.0   | 6036.0 | 63.58  | 19.83   | 0.030 | 69.5             | CCW       |

### 10) Vibration measurement

| Bearing position | U [V] | I [A] | f [Hz] | Mounting <i>Rigid</i> |          |       | Unit                   |
|------------------|-------|-------|--------|-----------------------|----------|-------|------------------------|
|                  |       |       |        | Horizontal            | Vertical | Axial |                        |
| D-END            | 6036  | 64    | 50.0   | 0.37                  | 0.26     | 0.59  | mm/s, rms              |
| D-END            | 6036  | 64    | 50.0   | 0.35                  | 0.30     | 0.61  | m/s <sup>2</sup> , rms |
| D-END            | 6036  | 64    | 50.0   | 0.96                  | 0.77     | 1.00  | μm, rms                |
| ND-END           | 6036  | 64    | 50.0   | 0.60                  | 0.29     | 0.63  | mm/s, rms              |
| ND-END           | 6036  | 64    | 50.0   | 0.99                  | 0.37     | 0.97  | m/s <sup>2</sup> , rms |
| ND-END           | 6036  | 64    | 50.0   | 1.41                  | 0.83     | 0.94  | μm, rms                |

#### Measuring equipment

| Id     | Type               | Name                             | Cal Date   | Next Cal Due |
|--------|--------------------|----------------------------------|------------|--------------|
| 715955 | Vibration analyzer | CSI 1910, vibration analyzer (2) | 12.12.2012 | 12.6.2013    |



## Factory Acceptance Test Report

|                                              |                                                   |                              |
|----------------------------------------------|---------------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>                 | Page<br><b>10</b>            |
| Order ref.                                   | Work no.<br><b>4443HG201</b>                      | Serial no.<br><b>4631604</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><i>Kai Jauhainen</i><br>Kai Jauhainen | Revision<br><b>A</b>         |
|                                              |                                                   | Report rev<br><b>B</b>       |

### 11) High voltage test

|                    |              |              |               |
|--------------------|--------------|--------------|---------------|
| <u>Winding</u>     | <u>U [V]</u> | <u>t [s]</u> | <u>f [Hz]</u> |
| Stator             | <b>15000</b> | <b>60</b>    | <b>50</b>     |
| <u>Auxiliaries</u> |              |              |               |
| Space heater       | <b>1500</b>  | <b>60</b>    | <b>50</b>     |

|                              |              |              |               |
|------------------------------|--------------|--------------|---------------|
| <u>Temperature detectors</u> | <u>U [V]</u> | <u>t [s]</u> | <u>f [Hz]</u> |
| Stator                       | <b>1500</b>  | <b>60</b>    | <b>50</b>     |
| Other (1)                    | <b>500</b>   | <b>60</b>    | <b>50</b>     |

Notes      Other (1) = Pt-100 temperature detectors in cooling air

### 12) Insulation resistances after tests

$\vartheta = 63.2\text{ }^{\circ}\text{C}$

|                    |                 |              |              |
|--------------------|-----------------|--------------|--------------|
| <u>Winding</u>     | <u>R [Mohm]</u> | <u>t [s]</u> | <u>U [V]</u> |
| Stator             | <b>10050</b>    | <b>60</b>    | <b>1000</b>  |
| <u>Auxiliaries</u> | <u>R [Mohm]</u> | <u>U [V]</u> |              |
| Space heater       | <b>49300</b>    | <b>500</b>   |              |

|                              |                 |              |
|------------------------------|-----------------|--------------|
| <u>Temperature detectors</u> | <u>R [Mohm]</u> | <u>U [V]</u> |
| Stator                       | <b>247000</b>   | <b>500</b>   |
| Other (1)                    | <b>1000000</b>  | <b>500</b>   |

Notes      Other (1) = Pt-100 temperature detectors in cooling air



## Factory Acceptance Test Report

|                                              |                                                     |                              |
|----------------------------------------------|-----------------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>                   | Page<br><b>11</b>            |
| Order ref.                                   | Work no.<br><b>4443HG201</b>                        | Serial no.<br><b>4631604</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><i>Kai Jauhiainen</i><br>Kai Jauhiainen | Revision<br><b>A</b>         |
|                                              |                                                     | Report rev<br><b>B</b>       |

### End of report

Test bay **AS4 (Asynchronous, test bench no. 4)**

Author **T.Kotilainen, M.Viljanen**

Number of pages 11

Printed:28.5.2013

Kai Jauhiainen  
2.2





## Factory Acceptance Test Report

### Test report for asynchronous machine

Customer **ABB AS**  
Project **51020405 - RR, Peregrine 1**  
Order ref. **1400kW, B3, CW**

Machine **AMI 450L6L BAMH**  
Work no. **4443HG202**  
Serial no. **4631605**

Date **8.4.2013**

Approved on behalf of the manufacturer

  
Petri Mäki

**ABB Oy  
Machines  
Final Testing**

Approved on behalf of the classification society



Digitally Signed By: Konttori, Jari  
Location: DNV Helsinki, Finland  
Signing Date: 2013-06-17

Jari Konttori / DNV

HEL13-6335

### ABB Oy, Machines

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## Factory Acceptance Test Report

|                                              |                                             |                              |
|----------------------------------------------|---------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>           | Page<br><b>2</b>             |
| Order ref.                                   | Work no.<br><b>4443HG202</b>                | Serial no.<br><b>4631605</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><i>Petri Mäki</i><br>Petri Mäki | Report rev<br><b>A</b>       |

### Ratings

#### Machine

|                        |                |                        |                |
|------------------------|----------------|------------------------|----------------|
| Standards              | <b>IEC</b>     |                        |                |
| Specification          | <b>NONE</b>    |                        |                |
| Classification society | <b>DNV</b>     |                        |                |
| Insulation class       | <b>F</b>       | Mounting designation   | <b>IM 1001</b> |
| Temperature class      | <b>F</b>       | Protected by enclosure | <b>IP 55</b>   |
| Ambient temp., max.    | <b>45.0 °C</b> | Method of cooling      | <b>IC 81W</b>  |

|               |                   |                      |              |              |             |                          |               |
|---------------|-------------------|----------------------|--------------|--------------|-------------|--------------------------|---------------|
| <u>f [Hz]</u> | <u>Connection</u> | <u>P [kW] / [hp]</u> | <u>U [V]</u> | <u>I [A]</u> | <u>p.f.</u> | <u>Direction n [rpm]</u> | <u>Duty</u>   |
| <b>50.0</b>   | <b>Y</b>          | <b>1400 / 1877</b>   | <b>6000</b>  | <b>170</b>   | <b>0.82</b> | <b>==&gt;</b>            | <b>991 S1</b> |

### Table of contents / Test program

- 1) *Visual inspection*
- 2) *Air gap measurement*
- 3) *Insulation resistances before tests*
- 4) *Resistance measurement of windings and elements*
- 5) *Direction of rotation, checking of phase sequence*
- 6) *Short-circuit point*
- 7) *No-load point*
- 8) *Vibration measurement*
- 9) *High voltage test*
- 10) *Insulation resistances after tests*



# Factory Acceptance Test Report

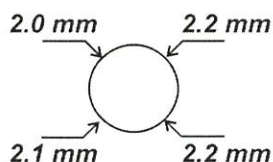
|                                              |                                             |                              |
|----------------------------------------------|---------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>           | Page<br><b>3</b>             |
| Order ref.                                   | Work no.<br><b>4443HG202</b>                | Serial no.<br><b>4631605</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><i>Petri Mäki</i><br>Petri Mäki | Revision<br><b>A</b>         |
|                                              |                                             | Report rev<br><b>A</b>       |

## 1) Visual inspection

| <u>Version</u> | <u>Notes</u> |
|----------------|--------------|
| A              | OK           |

## 2) Air gap measurement

Viewed from ND-end



## 3) Insulation resistances before tests

$\nu = 20.6\text{ }^{\circ}\text{C}$

| <u>Winding</u>     | <u>R [Mohm]</u> | <u>U [V]</u> |
|--------------------|-----------------|--------------|
| Stator             | 48700           | 1000         |
| <u>Auxiliaries</u> | <u>R [Mohm]</u> | <u>U [V]</u> |
| Space heater       | 680000          | 500          |

| <u>Temperature detectors</u> | <u>R [Mohm]</u> | <u>U [V]</u> |
|------------------------------|-----------------|--------------|
| Stator                       | 476000          | 500          |
| Other (1)                    | 1500000         | 500          |

Notes Pt100(Other1) = hot & cold air

## 4) Resistance measurement of windings and elements

$\nu = 20\text{ }^{\circ}\text{C}$

| <u>Winding</u> | <u>R<sub>uv</sub> [ohm]</u> | <u>R<sub>uw</sub> [ohm]</u> | <u>R<sub>vw</sub> [ohm]</u> |
|----------------|-----------------------------|-----------------------------|-----------------------------|
| Stator         | 0.30958                     | 0.30963                     | 0.30934                     |

$\nu = 20.6\text{ }^{\circ}\text{C}$

| <u>Terminals</u> | <u>R [ohm]</u> | <u>Position</u> | <u>Detector</u>  |
|------------------|----------------|-----------------|------------------|
| 1 - 2            | 114.0          | Space heater    | RER-Z 21         |
| 3,4 - 5,6        | 108.1          | Stator, U-phase | PYR PT100LG4/4EX |
| 7,8 - 9,10       | 108.0          | Stator, V-phase | PYR PT100LG4/4EX |
| 11,12 - 13,14    | 108.0          | Stator, W-phase | PYR PT100LG4/4EX |
| 15,16 - 17,18    | 107.9          | Stator, U-phase | PYR PT100LG4/4EX |
| 19,20 - 21,22    | 108.1          | Stator, V-phase | PYR PT100LG4/4EX |
| 23,24 - 25,26    | 108.0          | Stator, W-phase | PYR PT100LG4/4EX |
| 27,28 - 29,30    | 108.6          | hot air         | PYR PT100        |
| 31,32 - 33,34    | 108.6          | cold air        | PYR PT100        |



# Factory Acceptance Test Report

|                                              |                                             |                              |
|----------------------------------------------|---------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>           | Page<br><b>4</b>             |
| Order ref.                                   | Work no.<br><b>4443HG202</b>                | Serial no.<br><b>4631605</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><i>Petri Mäki</i><br>Petri Mäki | Report rev<br><b>A</b>       |

## 5) Direction of rotation, checking of phase sequence

Result **U-V-W | L1-L2-L3 | >>> (CW)**

## 6) Short-circuit point

| Connection | f [Hz]      | U1 [V]        | I1 [A]       | P1 [kW]      | p.f.         | u [°C]      | Ik [A]       | Un [V]      |
|------------|-------------|---------------|--------------|--------------|--------------|-------------|--------------|-------------|
| <b>Y</b>   | <b>50.0</b> | <b>1566.0</b> | <b>164.8</b> | <b>52.00</b> | <b>0.116</b> | <b>22.8</b> | <b>631.4</b> | <b>6000</b> |

## 7) No-load point

| Connection | f [Hz]      | U1 [V]        | I1 [A]       | P1 [kW]      | p.f.         | u [°C]      | Direction |
|------------|-------------|---------------|--------------|--------------|--------------|-------------|-----------|
| <b>Y</b>   | <b>50.0</b> | <b>5996.0</b> | <b>61.54</b> | <b>21.31</b> | <b>0.033</b> | <b>42.4</b> | <b>CW</b> |

## 8) Vibration measurement

| Mounting <b>Rigid</b> |                           |                                     |                   |                  |             |             |                  |
|-----------------------|---------------------------|-------------------------------------|-------------------|------------------|-------------|-------------|------------------|
| Bearing position      | U [V]                     | I [A]                               | f [Hz]            | Horizontal       | Vertical    | Axial       | Unit             |
| <b>D-END</b>          | <b>5996</b>               | <b>62</b>                           | <b>50.0</b>       | <b>0.43</b>      | <b>0.40</b> | <b>0.46</b> | <b>mm/s, rms</b> |
| <b>ND-END</b>         | <b>5996</b>               | <b>62</b>                           | <b>50.0</b>       | <b>0.36</b>      | <b>0.38</b> | <b>0.49</b> | <b>mm/s, rms</b> |
| Measuring equipment   |                           |                                     |                   |                  |             |             |                  |
| Id                    | Type                      | Name                                | Cal Date          | Next Cal Due     |             |             |                  |
| <b>715777</b>         | <b>Vibration analyzer</b> | <b>CSI 1910, vibration analyzer</b> | <b>13.12.2012</b> | <b>13.6.2013</b> |             |             |                  |

## 9) High voltage test

| Winding               | U [V]        | t [s]     | f [Hz]    |
|-----------------------|--------------|-----------|-----------|
| <b>Stator</b>         | <b>15000</b> | <b>60</b> | <b>50</b> |
| <b>Auxiliaries</b>    |              |           |           |
| <b>Space heater</b>   | <b>1500</b>  | <b>60</b> | <b>50</b> |
| Temperature detectors | U [V]        | t [s]     | f [Hz]    |
| <b>Stator</b>         | <b>1500</b>  | <b>60</b> | <b>50</b> |
| <b>Other (1)</b>      | <b>500</b>   | <b>60</b> | <b>50</b> |

Notes **Pt100(Other1) = hot & cold air**

## 10) Insulation resistances after tests

u = **42.4 °C**

| Winding             | R [Mohm]      | t [s]      | U [V]                 |
|---------------------|---------------|------------|-----------------------|
| <b>Stator</b>       | <b>18600</b>  | <b>60</b>  | <b>1000</b>           |
| Auxiliaries         | R [Mohm]      | U [V]      | Temperature detectors |
| <b>Space heater</b> | <b>250000</b> | <b>500</b> | <b>Stator</b>         |
|                     |               |            | <b>240000</b>         |
|                     |               |            | <b>500</b>            |
|                     |               |            | <b>Other (1)</b>      |
|                     |               |            | <b>1500000</b>        |
|                     |               |            | <b>500</b>            |

Notes **Pt100(Other1) = hot & cold air**





## Factory Acceptance Test Report

|                                              |                                             |                              |
|----------------------------------------------|---------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>           | Page<br><b>5</b>             |
| Order ref.                                   | Work no.<br><b>4443HG202</b>                | Serial no.<br><b>4631605</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><i>Petri Mäki</i><br>Petri Mäki | Revision<br><b>A</b>         |
|                                              |                                             | Report rev<br><b>A</b>       |

End of report

Test bay **AMA-production line**

Author **Petri Mäki, Tarmo Juntunen**

Number of pages 5

Printed: 10.4.2013  
Petri Mäki  
2.2



## Factory Acceptance Test Report

### Test report for asynchronous machine

Customer **ABB AS**  
Project **51020405 - RR, Peregrine 1**  
Order ref. **1400kW, B3, CW**

Machine **AMI 450L6L BAMH**  
Work no. **4443HG203**  
Serial no. **4631606**

Date **8.4.2013**

Approved on behalf of the manufacturer

Tarmo Juntunen

**ABB Oy  
Machines  
Final Testing**

Approved on behalf of the classification society



Digitally Signed By: Konttori, Jari  
Location: DNV Helsinki, Finland  
Signing Date: 2013-06-17

Jari Konttori / DNV

HEL 13-6335

### ABB Oy, Machines

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## Factory Acceptance Test Report

|                                              |                                                                                                                   |                              |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>                                                                                 | Page<br><b>2</b>             |
| Order ref.                                   | Work no.<br><b>4443HG203</b>                                                                                      | Serial no.<br><b>4631606</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><br>Tarmo Juntunen | Revision<br><b>A</b>         |
|                                              |                                                                                                                   | Report rev<br><b>B</b>       |

### Ratings

#### Machine

|                        |                |                        |                |
|------------------------|----------------|------------------------|----------------|
| Standards              | <b>IEC</b>     |                        |                |
| Specification          | <b>NONE</b>    |                        |                |
| Classification society | <b>DNV</b>     |                        |                |
| Insulation class       | <b>F</b>       | Mounting designation   | <b>IM 1001</b> |
| Temperature class      | <b>F</b>       | Protected by enclosure | <b>IP 55</b>   |
| Ambient temp., max.    | <b>45.0 °C</b> | Method of cooling      | <b>IC 81W</b>  |

|               |                   |                      |              |              |             |                  |                |             |
|---------------|-------------------|----------------------|--------------|--------------|-------------|------------------|----------------|-------------|
| <u>f [Hz]</u> | <u>Connection</u> | <u>P [kW] / [hp]</u> | <u>U [V]</u> | <u>I [A]</u> | <u>p.f.</u> | <u>Direction</u> | <u>n [rpm]</u> | <u>Duty</u> |
| <b>50.0</b>   | <b>Y</b>          | <b>1400 / 1877</b>   | <b>6000</b>  | <b>170</b>   | <b>0.82</b> | <b>==&gt;</b>    | <b>991</b>     | <b>S1</b>   |

Cooling water flow 8.1 m<sup>3</sup>/h

Cooling water temp 38 °C

### Table of contents / Test program

- 1) Visual inspection
- 2) Air gap measurement
- 3) Insulation resistances before tests
- 4) Resistance measurement of windings and elements
- 5) Direction of rotation, checking of phase sequence
- 6) Short-circuit point
- 7) No-load point
- 8) Vibration measurement
- 9) High voltage test
- 10) Insulation resistances after tests



# Factory Acceptance Test Report

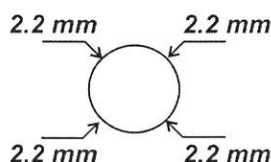
|                                              |                                                                                                                   |                              |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>                                                                                 | Page<br><b>3</b>             |
| Order ref.                                   | Work no.<br><b>4443HG203</b>                                                                                      | Serial no.<br><b>4631606</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><br>Tarmo Juntunen | Report rev<br><b>B</b>       |

## 1) Visual inspection

| Version | Notes |
|---------|-------|
| A       | OK    |

## 2) Air gap measurement

Viewed from ND-end



## 3) Insulation resistances before tests

$\vartheta = 23.6\text{ }^{\circ}\text{C}$

| Winding      | R [Mohm] | U [V] |
|--------------|----------|-------|
| Stator       | 41100    | 1000  |
| Auxiliaries  | R [Mohm] | U [V] |
| Space heater | 699000   | 500   |

| Temperature detectors | R [Mohm] | U [V] |
|-----------------------|----------|-------|
| Stator                | 673000   | 500   |
| Other (1)             | 1500000  | 500   |

Notes Other (1) = Pt-100 temperature detectors in cooling air

## 4) Resistance measurement of windings and elements

$\vartheta = 20\text{ }^{\circ}\text{C}$

| Winding | R <sub>uv</sub> [ohm] | R <sub>uw</sub> [ohm] | R <sub>vw</sub> [ohm] |
|---------|-----------------------|-----------------------|-----------------------|
| Stator  | 0.30938               | 0.30939               | 0.30915               |

$\vartheta = 23.6\text{ }^{\circ}\text{C}$

| Terminals     | R [ohm] | Position        | Detector         |
|---------------|---------|-----------------|------------------|
| 1 - 2         | 112.6   | Space heater    | RER-Z 21         |
| 3,4 - 5,6     | 109.2   | Stator, U-phase | PYR PT100LG4/4EX |
| 7,8 - 9,10    | 109.2   | Stator, V-phase | PYR PT100LG4/4EX |
| 11,12 - 13,14 | 109.2   | Stator, W-phase | PYR PT100LG4/4EX |
| 15,16 - 17,18 | 109.2   | Stator, U-phase | PYR PT100LG4/4EX |
| 19,20 - 21,22 | 109.3   | Stator, V-phase | PYR PT100LG4/4EX |
| 23,24 - 25,26 | 109.1   | Stator, W-phase | PYR PT100LG4/4EX |
| 27,28 - 29,30 | 109.1   | Hot air         | PYR PT100PF5/4Z  |
| 31,32 - 33,34 | 109.2   | Cold air        | PYR PT100PF5/4Z  |





# Factory Acceptance Test Report

|                                              |                                                                                                                   |                              |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>                                                                                 | Page<br><b>4</b>             |
| Order ref.                                   | Work no.<br><b>4443HG203</b>                                                                                      | Serial no.<br><b>4631606</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><br>Tarmo Juntunen | Report rev<br><b>B</b>       |

## 5) Direction of rotation, checking of phase sequence

Result **U-V-W | L1-L2-L3 | >>> (CW)**

## 6) Short-circuit point

| Connection | f [Hz]      | U1 [V]        | I1 [A]       | P1 [kW]      | p.f.         | u [°C]      | Ik [A]       | Un [V]      |
|------------|-------------|---------------|--------------|--------------|--------------|-------------|--------------|-------------|
| <b>Y</b>   | <b>50.0</b> | <b>1581.0</b> | <b>166.2</b> | <b>52.10</b> | <b>0.114</b> | <b>23.6</b> | <b>630.7</b> | <b>6000</b> |

## 7) No-load point

| Connection | f [Hz]      | U1 [V]        | I1 [A]       | P1 [kW]      | p.f.         | u [°C]      | Direction |
|------------|-------------|---------------|--------------|--------------|--------------|-------------|-----------|
| <b>Y</b>   | <b>50.0</b> | <b>5994.0</b> | <b>61.49</b> | <b>21.17</b> | <b>0.033</b> | <b>36.1</b> | <b>CW</b> |

## 8) Vibration measurement

| Bearing position | U [V]       | I [A]     | f [Hz]      | Mounting <b>Rigid</b> |             | Axial Unit            |
|------------------|-------------|-----------|-------------|-----------------------|-------------|-----------------------|
|                  |             |           |             | Horizontal            | Vertical    |                       |
| <b>D-END</b>     | <b>5994</b> | <b>61</b> | <b>50.0</b> | <b>0.47</b>           | <b>0.59</b> | <b>0.40 mm/s, rms</b> |
| <b>ND-END</b>    | <b>5994</b> | <b>61</b> | <b>50.0</b> | <b>0.39</b>           | <b>0.34</b> | <b>0.47 mm/s, rms</b> |

### Measuring equipment

| Id            | Type                      | Name                                | Cal Date          | Next Cal Due     |
|---------------|---------------------------|-------------------------------------|-------------------|------------------|
| <b>715777</b> | <b>Vibration analyzer</b> | <b>CSI 1910, vibration analyzer</b> | <b>13.12.2012</b> | <b>13.6.2013</b> |

## 9) High voltage test

| Winding               | U [V]        | t [s]     | f [Hz]    |
|-----------------------|--------------|-----------|-----------|
| <b>Stator</b>         | <b>15000</b> | <b>60</b> | <b>50</b> |
| <b>Auxiliaries</b>    |              |           |           |
| <b>Space heater</b>   | <b>1500</b>  | <b>60</b> | <b>50</b> |
| Temperature detectors |              |           |           |
|                       | U [V]        | t [s]     | f [Hz]    |
| <b>Stator</b>         | <b>1500</b>  | <b>60</b> | <b>50</b> |
| <b>Other (1)</b>      | <b>500</b>   | <b>60</b> | <b>50</b> |

Notes **Other (1) = Pt-100 temperature detectors in cooling air**

## 10) Insulation resistances after tests

u = **36.1 °C**

| Winding             | R [Mohm]      | t [s]      | U [V]                 |
|---------------------|---------------|------------|-----------------------|
| <b>Stator</b>       | <b>20600</b>  | <b>60</b>  | <b>1000</b>           |
| Auxiliaries         | R [Mohm]      | U [V]      | Temperature detectors |
| <b>Space heater</b> | <b>388000</b> | <b>500</b> | <b>Stator</b>         |
|                     |               |            | <b>421000</b>         |
|                     |               |            | <b>Other (1)</b>      |
|                     |               |            | <b>1500000</b>        |

Notes **Other (1) = Pt-100 temperature detectors in cooling air**



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|                                              |                                                                                                                   |                              |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------|
| Customer<br><b>ABB AS</b>                    | Machine<br><b>AMI 450L6L BAMH</b>                                                                                 | Page<br><b>5</b>             |
| Order ref.                                   | Work no.<br><b>4443HG203</b>                                                                                      | Serial no.<br><b>4631606</b> |
| Project<br><b>51020405 - RR, Peregrine 1</b> | Approved<br><br>Tarmo Juntunen | Revision<br><b>A</b>         |
|                                              |                                                                                                                   | Report rev<br><b>B</b>       |

End of report

Test bay **AMA-production line**

Author **Tarmo Juntunen, Petri Mäki**

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2.2