



**ICE**  
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& CONTRÔLE  
COMMANDE



***FIRST HANDLING GUIDE***

***DIGITAL AUTOMATIC  
SYNCHRONIZER***

***NPRG 870 – NPRG 860***

**TECHNIREL**

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# FOREWORD

This aim of this handbook is to provide to the User useful information for the commissioning and the tests of NPRG 860 and NPRG 870 Automatic Synchronizer.

We advise you to read it attentively, in order to take note of the available functionalities and to proceed to connection and power of the product in accordance with the provided recommendations.

Before any use, we recommend you to read the safety instructions of this guide.

This guide is an add-on to the other documents of the NP800 range:

- ◆ « General presentation of the NP800 range », which shows the respective functions of each product of the range, the physical characteristics and the environment ratings.
- ◆ « NPRG 860 – NPRG 870 user’s guide », introducing each function and the using of local MMI.
- ◆ « SMARTSoft setting software user’s guide », which introduces its using with a computer (*including installation procedure*) and the communication protocol with a SCADA.
- ◆ Diagrams of the various products.

These functions described in the following chapters are partially programmable locally or fully by the dedicated SMARTSoft setting software used on a computer.

- ◆ Regulation of speed "NPRG 860 - NPRG 870" - ANSI 90.
- ◆ Regulation of voltage "NPRG 870" - ANSI 90 + management of 4 generators.
- ◆ Synchrocheck "NPRG860 - NPRG 870" - ANSI 25 + management of 4 generators.

The operation functions of the Automatic Synchronizer are configurable from the menu « **OPERATION** », or from the sub-menu "Parameters" available with the setting software.

Locally, setting, commissioning (Communication & Disturbance only) and real time or event readings are accessible from keyboard located on the front plate and displayed on the display screen.

To be fully exploited, the available functions must be programmed and consulted with the setting software PC – SMARTSoft, provided with the product

# CONTENTS

<b>1.</b>	<b>SAFETY INSTRUCTIONS</b>	<b>3</b>
1.1	DOCUMENTATION .....	3
1.2	CONNECTION OF NP800 DEVICES .....	3
1.3	ON LOAD WITHDRAWAL.....	3
1.4	REMOVAL AND DESTRUCTION.....	3
<b>2.</b>	<b>AUTOMATIC SYNCHRONISER CHECKING AND COMMISSIONING</b>	<b>4</b>
2.1	RECOMMENDATIONS.....	4
2.2	PRELIMINARY INFORMATION .....	4
2.3	CHECKING'S PRIOR TO THE COMMISSIONING.....	4
2.4	CONNECTION DIAGRAMS.....	4
<b>3.</b>	<b>MEASURE OF THE CLOSING TIME OF THE PARALLELING CHAIN</b>	<b>5</b>
<b>4.</b>	<b>CHOICE OF THE AUTHORIZED SLIP (<math>\Delta F</math>)</b>	<b>8</b>
<b>5.</b>	<b>CHOICE OF THE PHASE DISPLACEMENT OF GE MEASUREMENT</b>	<b>8</b>
<b>6.</b>	<b>CALIBRATION OF THE VOLTAGE MEASUREMENTS</b>	<b>8</b>
<b>7.</b>	<b>ADJUSTMENT OF THE NPRG 860 – NPRG 870 AUTOMATICS SYNCHRONISER</b>	<b>9</b>
7.1	VOLTAGE REGULATION ( <i>NPRG 870 ONLY</i> ) .....	9
7.2	SPEED REGULATION .....	10
7.3	DEAD BUSBAR PARALLELING .....	12
7.4	"SYNCHROCHECK MODE" OPERATION .....	14
7.5	OPERATION OF THE BOOST PULSING.....	15
<b>8.</b>	<b>COMMISSIONING</b>	<b>15</b>

# 1. Safety instructions

For your safety, we recommend you to read the following information carefully. They have the aim of specifying the precautions essential to the good installation and the correct operation of the devices.

## 1.1 Documentation

Following documentations are available for the products of the range NP800:

- ◆ General Presentation of the NP800 range
- ◆ Application guide of the NP800 series
- ◆ User's Guide of SMARTSoft Setting Software
- ◆ User's Guide (for each kind of device)
- ◆ First Handling Guide (for each kind of device)
- ◆ Diagram of each device.

We advise you to read them before any handling.

## 1.2 Connection of NP800 devices

The terminal blocks of the NP800 devices are studied to ensure the safety of the people during the operation of the devices.

During installation, commissioning or maintenance, they can however present high voltages and possibly a thermal heating. Consequently, the following precautions must be respected:

- ◆ Connection of the terminal blocks at installation must be carried out after having ensured of the absence of any voltage
- ◆ Their access during operation must be carried out through adequate means ensuring as well electric as thermal insulation
- ◆ The connection of the earth at the back of the devices must imperatively be done with mean of a 2.5 mm<sup>2</sup> wire.

Before powering the devices, it will be necessary to check in particular:

- ◆ The value of the voltage rating of the auxiliary supply and its polarization
- ◆ Integrity of the connection to the earth.

## 1.3 On load withdrawal

It is formally misadvised to withdraw the connectors under voltage or on load.

## 1.4 Removal and destruction

The devices should in no case be opened by the User. During their removal, they must be completely isolated from any external polarity and condensers must be discharged by connecting their external terminals to the earth.

Destruction of the devices will have to be carried out in accordance with legislation in force, in particular in compliance with the environment and safety requirements.

## 2. Automatic Synchroniser checking and commissioning

### 2.1 Recommendations

All the Automatic Synchronisers are delivered after a final inspection in factory.

It is important before any test to make sure that the device did not suffer any mechanical damage.

### 2.2 Preliminary information

All the Automatic Synchronisers of the NP800 range of devices, technology used is digital.

Due to their design, they comprise a significant number of self-controls, as well as powering as under operation. Any material or software failure is automatically detected and announced by an alarm.

During the first use, it is thus not necessary to test all the functions. It is on the other hand recommended to look after and check the good wiring of the device, and the specifications of this handbook have the aim of allowing a fast setting in order of the device.

The User will be able then to define the setting values necessary to its installation, and to adjust the device using the Setting software, common to the whole of the range. The saving of the configuration and its loading will be carried out with a laptop.

The functions of recording of events and disturbance recording, available through the setting software, will also largely contribute to the commissioning of the installation.

### 2.3 Checking's prior to the commissioning

They are intended to check that the hardware did not suffer damage during its transport or its storage and constitute a proof of right operation at the set values.

The tests are carried out directly on site during the commissioning, or starting from a three-phase test set with a module of synchroniser type allowing of the U and F variations

In order to be freed from the interaction between the functions of the Automatic Synchroniser, the tests must be sometimes carried out by deactivation certain functions..

### **CAUTION:**

**Keep to cut off the injections before any intervention on the Automatic synchroniser.**

### 2.4 Connection diagrams

Connection diagrams for each version are available as follow:

Automatic Synchroniser Version	Drawing reference
NPRG 860	S 38894
NPRG 870	S 38895

### 3. Measure of the closing time of the paralleling chain

After having suitably connected the NPRG 860 according the S38894 diagram or the NPRG 870 according to the S38895 diagram, it is appropriate of carry out several checks.

Above all thing, two cases can arise:

- ◆ The Busbars is free of voltage and in this case, the test can be carry out without particular action. **(case 1)**
- ◆ The Busbars is supplied and cannot be put free of voltage. In this specific case, the solution is to reverse the Busbars and generators measurements by a secure software order thanks to the PC setting software. **(case 2)**

#### Description of the various cases:

**CASE 1:** To be free from a possible electrical fault, **it was required to disconnect the generator**, for example by opening the connection of the star point of the machine. It needs to make sure that the measurement input of voltage of the generator is correctly connected (A1-A2 terminals).

NB: If during the tests, the Busbar was supplied by a source former than the generator, the paralleling contact will not be able to be closed when the request will be carried out. *(Safety related to the automatic synchroniser).*

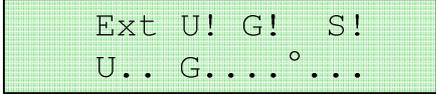
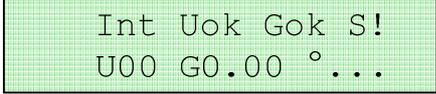
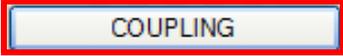
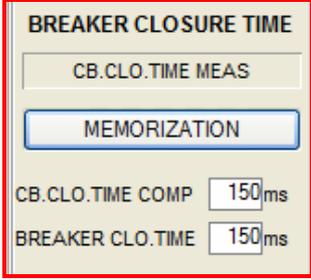
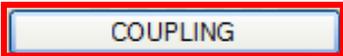
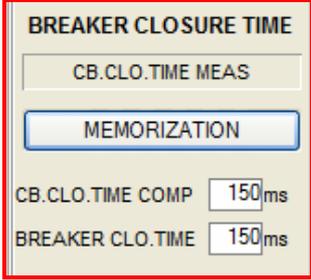
**CASE 2:** It is **imperative to disconnect the generator** because in the opposite case or the machine would be excited; the paralleling contact will not be able to be closed when the request will be carried. *(Safety related to the automatic synchroniser).* On the other hand, when the machine is not excited, thus without voltage stator, the automatic synchroniser will estimate a dead Busbar. The paralleling will be in that case possible.

 Do not forget to repeat several times the operation in order to check the veracity of the recorded values. In the case or several machines are managed by the same automatic synchroniser (NPRG 870), it is necessary after shifting the settings tables to carry out the measurements for each circuit breaker.

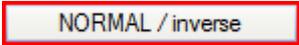
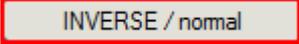
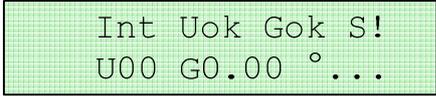
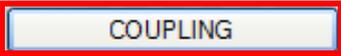
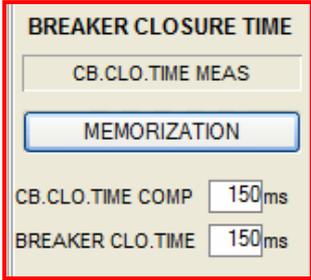
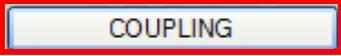
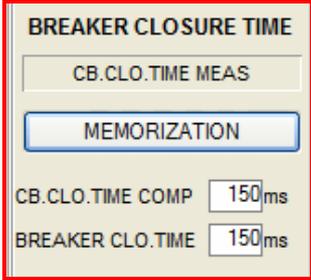
For the commissioning of an automatic synchroniser of NPRG870 type, the tests are carried out on the machine which is connected to the automatic synchroniser by selection of the corresponding settings table. For example, it is necessary to polarize the input n<sup>5</sup> (G-1/g-2) for selection of GE n<sup>1</sup>. If not, the below indicati on will appear on the automatic synchroniser display.

```
INVALID SELECT A
11/01 15:06:42 R
```

**CASE N°1:**

Carried out the steps sequence as follows	Results after each step
Apply the auxiliary supply.	<p><u>Display indication:</u></p> 
Check that the connection of the voltages inputs is correctly carried out. (A-1/A-2 → UGE) & (A-3/A-4 → UBb)	
Check that the Busbar is not supplied. The reference must go from "Ext." to "Int".	<p><u>Display indication:</u></p> 
<p>Polarize the input n°3 (B-1/B-4)"Order function enable".</p> <p>From the setting software, in the "SYNCHRO" menu, click on the "COUPLING" button.</p>  <p>Carry out several tests in order to check the veracity of the measured values.</p>	<p><u>Indication on the setting software :</u></p>  <p><u>Display indication:</u></p>  <p>The circuit breaker must be closed.</p> <p>Acknowledge the event with the <b>CLEAR</b> key then ENTER.</p>
<p>If the reading time delay "CB.CLO.TIME COMP" is suitable, click on the button "MEMORIZATION" in order to allow the memorizing of the time delay of anticipation [MT] in the automatic synchroniser.</p> 	<p><u>Indication on the setting software:</u></p>  <p><u>Indication in the « MEASUREMENTS » menu :</u></p>  <p>(example)</p>

**CASE N°2:**

Carried out the steps sequence as follows	Results after each step
Apply the auxiliary supply.	<p><u>Display indication:</u></p> 
Check that the connection of the voltages inputs is correctly carried out. (A-1/A-2 → UGE) & (A-3/A-4 → UBb)	
<p>The Automatic synchroniser must be commutated in "Reverse" mode starting from the setting software to allow the measurement of the time delay of the closing chain with a supplied Busbar.</p> 	<p><u>Indication on the setting software:</u></p> 
Check that the automatic synchroniser is in "INT" reference and that the Busbar is supplied.	<p><u>Display indication:</u></p> 
<p>Polarize the input n°3 (B-1/B-4)"Order function enable".</p> <p>From the setting software, in the "SYNCHRO" menu, click on the "COUPLING" button.</p> 	<p><u>Indication on the setting software:</u></p>  <p><u>Display screen indication:</u></p>  <p>The circuit breaker must be closed. Acknowledge the event with the <b>CLEAR</b> key then ENTER.</p>
<p>If the reading time delay "CB.CLO.TIME COMP" is suitable, click on the button "MEMORIZATION" in order to allow the memorizing of the time delay of anticipation [MT] in the automatic synchroniser.</p> 	<p><u>Indication on the setting software:</u></p> 

## 4. Choice of the authorized slip ( $\Delta f$ )

From measurements of preceding times of paralleling and variation of phase accurate by the manufacturer(s) of generator(s), it is possible to determine the authorized slip starting from the formula below:

$$\text{Ex : } \Delta F = \frac{\varphi}{TA \times 360}$$

NOTA: For more explanations, refer to the NP800 application guide.

## 5. Choice of the phase displacement of GE measurement

For the groups generator-transformer call "Block", a phase displacement of the voltages reference, generator and network, is imposed by the power transformer.

In order to correct this phase displacement, which is generally 11 hours (330°), the NPRG 860 – 870 automatic synchroniser allow a phase shift by software programming of the measurement.

NOTA: For more explanations, refer to the NP800 application guide.

## 6. Calibration of the voltage measurements

The calibration of the voltage measurements is carried out directly by configuration of the «Primary / Secondary Voltage of GE and BUS" parameters from the PC setting software.

NOTA: For more explanations, refer to the user guide of the PC setting software of NP800 range.

## 7. Adjustment of the NPRG 860 – NPRG 870 Automatics Synchroniser

### 7.1 Voltage regulation (*NPRG 870 only*)

Carried out the steps sequence as follows	Results after each step
Set the "Minimum pulse duration +U/-U" to a value appreciably higher than the minimum time of pulse required by the external voltage regulator. The modes "AUTO" and "Order function enable" of the NPRG 870 should not be enabled.	
In order to not to be disturbed by the speed regulation, set "the Interval between Frequency pulses " at 0 s	
With the setting software, set the parameters "Proportional gain for $\pm U$ " to 100 and "Interval between Voltage pulse" to 1 s	
With the synchronising equipment, set the generator at a speed close to the rated value.	
Control the excitation of the generator.	
With the synchronising equipment, set the generator at a voltage close to 1.1 the rated voltage.	
Move in mode « AUTO ».	<p style="text-align: center;"><u>Indication on the display:</u></p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px; width: fit-content; margin: 0 auto;"> <p style="margin: 0;">AUTO MODE            A</p> <p style="margin: 0;">11/01 15:06:42 R</p> </div> <p>Acknowledge the event with the key <i>CLEAR</i> then <i>ENTER</i>.</p> <p>The voltage adjusted by "-U" control order must be stabilized quickly without excess. In the case of excess, it will be necessary to readjust the gain proportional for -U.</p>
A second test may be carried out by observation of the voltage stabilization from 0.9 the rated voltage.	<p>The voltage adjusted by "+U" control order must be stabilized quickly without excess. In the case of excess, it will be necessary to readjust the gain proportional for +U.</p>

## 7.2 Speed regulation

Carried out the steps sequence as follows	Results after each step
"AUTO" and "Order function enable" Modes of the NPRG 870 do not have to be enabled.	
The generators being at rated frequency, with the synchronising equipment, carry out a speed variation lower than 5%.	Measure consecutive time until stabilization at a new speed when the mode "AUTO" is enabled. Carry out several tests in the two directions.
Adjust "Interval between Frequency pulse" at an equal time to the largest of those measured previously.	
With the setting software, set the parameters "Derivative gain for $\pm F$ " at 0.	
With the synchronising equipment, set the generator at 95% of the rated speed. The "Auto" mode should not be enabled.	
Enable the "AUTO" mode.	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px; text-align: center;">           AUTO MODE            A            11/01 15:06:42 R         </div> <p>Acknowledge the event with the <i>CLEAR</i> key then <i>ENTER</i>.</p>
Set the "Minimum pulse duration $\pm F$ " in order that after only one pulse, at the end of the interval, that the speed will be close to its rated value.	If under these conditions, the tendency of the machine is to exceed rated speed, then slow down, and again exceed the rated speed and so on, by a succession of " $\pm$ speed" orders and thus make this test difficult, even impossible. Start again the test by bringing of the <b>derived action +F and -F</b> by increasing this action gradually in order to obtain a correct stabilization of the speed.
Disable the "AUTO" mode	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px; text-align: center;">           AUTO MODE            D            11/01 15:06:42 R         </div> <p>Acknowledge the event with the <i>CLEAR</i> key then <i>ENTER</i>.</p>
Carry out the same test on the basis of a speed with 110% Fn.	

<p>Enable the "AUTO" mode.</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px;"> <p>AUTO MODE            A 11/01 15:06:42 R</p> </div> <p>Acknowledge the event with the <i>CLEAR</i> key then <i>ENTER</i>.</p>
<p>Adjust, if need, the "Minimum pulse duration <math>\pm F</math>" in order that the pulses have of sufficient length for act on the order of the speed.</p>	<p>The conditions of paralleling must quickly be obtained.</p>
<p>The settings being correctly carried out, enable the "Order function enable"</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px;"> <p>PARALL.MODE        A 11/01 15:06:42 R</p> </div> <p>At this stage, the paralleling CB must be closed</p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px;"> <p>PARALL. DONE      D 11/01 15:06:42 R</p> </div>

### 7.3 Dead Busbar paralleling

The checking of this operation must be carried out with the following conditions:

Carried out the steps sequence as follows	Results after each step
<p>The bus bar should not be supplied.</p> <p>The generator is off.</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <pre>Ext U!  G!  S! U.. G.... °...</pre> </div>
<p>From the setting software, carry out the following settings:</p> <ul style="list-style-type: none"> <li>- Usv : Presence voltage Threshold for paralleling on dead Bus = 0.1 Un</li> <li>- Fmax/Fmin generator for paralleling on Dead Bus = 0.1 Hz</li> <li>- Umax/Umin generator for paralleling on Dead Bus = 0.1 UnMax / 0.05 UnMin</li> <li>- TDB : Paralleling time for Dead Bus = 5 s</li> </ul>	
<p>Start the driving engine.</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <pre>Int U!  Gok S! U-- G-.01 °...</pre> </div>
<p>The "AUTO" &amp; "Order function enabled" modes must be put in service.</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <pre>PARALL.MODE    A 11/01 15:06:42 R</pre> </div> <p>The machine must be fixed on the internal references of the Automatic synchroniser.</p>
<p>Press on "CLEAR" key to acknowledge the events.</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <pre>Int Uok Gok S! U00 G-.01 °...</pre> </div>
<p>Enable the "Paralleling of dead bus line" input.</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <pre>DED BB CONTR.  A 11/01 15:06:42 R</pre> </div> <p>After a fixed time delay of 1s, the information output is active. (NPRG 870 only)</p>
<p>When the display indicates voltage and slip OK, the paralleling must be carried out.</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <pre>PARALL. DONE  D 11/01 15:06:42 R</pre> </div>

<p>Acknowledge the event with the <i>CLEAR</i> key then <i>ENTER</i>.</p> <p>Disable the “Paralleling of dead bus line” input and open the Paralleling Circuit Breaker.</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px; text-align: center;"> DED BB CONTR. D  11/01 15:06:42 R </div> <p>Acknowledge the event with the <i>CLEAR</i> key then <i>ENTER</i>.</p>
<p>The paralleling conditions must be correct (Uok &amp; Gok)</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px; text-align: center;"> Int Uok Gok S!  U00 G-.01 °... </div>
<p>Enable the “Paralleling of dead bus line” input</p>	<p>The paralleling must be carried out after a time delay of 5s as previously set.</p> <p><u>Indication on the display:</u></p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px; text-align: center;"> PARALL. DONE D  11/01 15:06:42 R </div> <p>Acknowledge the event with the <i>CLEAR</i> key then <i>ENTER</i> key.</p>
	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px; text-align: center;"> Ext Uok Gok St  U00 G0.00 °-42 </div>

## 7.4 "Synchrocheck Mode" operation

The activation of the «Synchrocheck Mode » allows the opening of the parameter setting of positive and negative Angle difference, initially fixed at  $\pm 2^\circ$ , of 1 to 20°.

In this operating mode, the "Boost pulsing" becomes inactive.

Carried out the steps sequence as follows	Results after each step
<p>The modes "Order function enabled" and "Synchrocheck Mode" must be in service. The "AUTO Mode" must be put out service.</p>	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; padding: 5px; text-align: center;">           CHECKSYNC MODE A            11/01 15:06:42 R         </div> <p>Acknowledge the event with the <i>CLEAR</i> key then <i>ENTER</i> key.</p>
	<p><u>Indication on the display:</u></p> <div style="border: 1px solid black; padding: 5px; text-align: center;">           Ext U! G! S!            U.. G.... °...         </div> <p>The L2 led must be lit.</p>
<p>With the setting software, modify the values of " Positive / Negative angle difference permits in checksynchro mode ". As example, set 5°</p>	
<p>With the synchronising equipment, set the generator with a voltage and a frequency close to the rated value.</p>	<p>When the paralleling conditions are correct, i.e., correct voltage and slip with a stable speed, check that the paralleling is authorized for a variation of phase of <math>\pm 5^\circ</math>.</p> <p><u>Indication on the display:</u></p> <div style="border: 1px solid black; padding: 5px; text-align: center;">           PARALL. DONE D            11/01 15:06:42 R         </div> <p>Acknowledge the event with the <i>CLEAR</i> key then <i>ENTER</i> key.</p>

## 7.5 Operation of the boost pulsing.

The boost pulsing allows, when the beating is too weak (i.e. a weak slip and a remaining variation of phase), for carrying out an order +Speed (+f) after a monitoring time delay user programmable.

This mode is configurable with the setting software PC by adjustments of the following characteristics:

- Monitoring time delay for boost pulsing
- Duration of pulse +Speed (+f) for boost pulsing. (linked to the speed control of the machine)

## 8. Commissioning

Before the commissioning of the device, it is necessary to check that:

- the voltage transformers have a rated voltage in conformity with the scales of voltages available on the Automatic synchroniser
- Frequency of the device label is the same as the frequency of the network
- the rotation order of the phases and the direction of connection of the VT's must be followed for an optimal operation
- Wiring is in conformity with the connection diagram
- Auxiliary supply match the auxiliary supply range of the device label