5. De-energizing, grounding and start-up

5.1. General

The following sections provide instructions on how to shut-down the PCS6000 for service purposes and on how to start-up again after the work is done.

5.2. Safety information

Before you begin, read and understand the material in chapter 2, **Important safety information**, page 23 and always follow the safety rules that are described in section 2.3.2, **The 7 steps that save lives**, page 26.

DANGER **High voltage!**

The PCS6000 is a medium voltage high power device.

- High voltage in the PCS6000 can result in serious injury or DEATH and damage to the equipment.
- Parts replacement and other work on the PCS6000 must only be carried out by qualified personnel in compliance with local regulations.

CAUTION **Cooling fans can start automatically!**

- The water cooling system and the cooling fans can start automatically as soon as the auxiliary voltage is switched on or when the EMERGENCY OFF button is released, even if the PCS6000 is de-energized.
- Switch off the corresponding motor protection switches (see diagrams contained in the cabinet specific documentation) to shut down the cooling system.

NOTICE **Risk of component damage.**

PCS6000 parameters are set during commissioning of the device and must not be changed afterwards.

- Running the PCS6000 with incorrect data can result in improper operation, reduction in control accuracy and damage to equipment.

5.3. Lockout/Tagout

Service MTTR 0 - 2 h

DANGER **High voltage!**

- DO NOT access the power sections of the PCS6000 before the converter is completely disconnected and grounded.
- Before the internals of the PCS6000 are accessed for service purposes, the relevant components of the converter must be de-energized safely.
- Follow the Lockout/Tagout procedure in appendix B05.
- The Logout/Tagout procedure is to be coordinated with the site manufacturer.

5.4. Start-up after maintenance or troubleshooting

Service MTTR 0 - 2 h

1. To release the over pressure from the cooling liquid circuit or to empty the cooling liquid circuit for the replacement of the faulty component, refill the cooling system to static pressure of 1.3 to 1.7 bar.

   For instructions, see the Operation and maintenance manual of the PCS6000 water cooling system, in Appendix A06 of the Data-sheets components of the user's manual.

2. Check that the water cooling system is ready for operation.

   See the user manual for the water cooling unit.

3. Remove safety grounding equipment.
4. Visually check the appearance, cleanliness inside and outside and that no tools, grounding equipment and other objects are left in any of the units.
5. Check that the grid is energized.
6. Connect all disconnected power supplies.
7. Switch on all MCBs (mini circuit breakers).
8. Make sure the “Bat.-select” switch on the uninterrupted power supply (UPS) module is set according to electrical drawings (“3.4Ah” in CCU, “7.2Ah” in POU) (see Fig. 8–2).
9. Close all unit doors properly.

   All units containing live MV equipment are equipped with door switches and solenoid coils.

   IMPORTANT! If a door is not closed, the converter start will be prevented.

10. Check that the Key Switch is in “ON” position

Figure 5–1 Key switch

IMPORTANT! The grid isolators and the grid grounding isolator are not operated by the PCS6000 control.

11. Turn the DC-link grounding isolator in position “not grounded”.

The signal lamp ISOLATOR CLOSED must be off, ISOLATOR RELEASED stays on until the GRB disconnector is closed. (Only with DC-link grounding isolator modification otherwise until DC-link is above 50VDC)

Figure 5–2 DC-link grounding isolator in position “not grounded”

12. Check the status supervision signal lamps (GRB closed, DC-link grounding isolator closed/released) located at the front of the PCS6000.

All three yellow signal lamps must be off to get the ready to start converter.(With old grounding isolator setup grounding isolator is still released)

13. If applicable, check that the grid ground switch is open and the grid isolators are closed.

14. Check that the main circuit breaker is in operating position.

15. Press the ACKNOWLEDGE ALARM or ACKNOWLEDGE TRIP function key or select the appropriate command from remote control to reset all pending alarms and trips.

If an alarm or fault cannot be reset, the original alarm or fault cause might still be present. Ensure that the cause is removed and press the ACKNOWLEDGE ALARM or ACKNOWLEDGE TRIP function key again.

Faults caused by defects cannot be reset with the ACKNOWLEDGE TRIP function key. Elimination of these faults requires troubleshooting by authorized service personnel.

For more information concerning “Acknowledge of alarms” for S2S application, see the “PCS6000 Local control panel description”, 3BHS606571 E49.

16. The PCS6000 can only be started if all faults are eliminated.

The PCS6000 is now in status OFF and ready to be started via the customer's HMI system (see application specific information in Appendix A04 Operation & Interface Documents, 01 Function Description and Control Interface). The above mentioned commands can also be given from a service PC, if it is connected to the PCS6000.

For more information, see the “PCS6000 Service software manual”, 3BHS600000 E81.

If parts have been replaced, check in the list in section 7.3, **Checking procedure**, page 81 or in section 10.3, **Overview of serialized power components**, page 135 as to whether these parts have a serialization profile, ie, these parts were serialized in production.

If such a part is replaced in the field the serialization database has to be updated, ie, the new serial number must be reported to ABB by means of a warranty and failure report.

6. Troubleshooting

6.1. General

The following sections provide instructions on how to replace control components and are intended for qualified personnel who are responsible for servicing a PCS6000 drive.

6.2. Safety information

Before you begin, read and understand the material in chapter 2, **Important safety information**, page 23 and always follow the safety rules that are described in section 2.3.2, **The 7 steps that save lives**, page 26.

⚠ DANGER High voltage!

Dangerous voltage inside the PCS6000 can lead to life-threatening situations, injury of the persons involved or damage to equipment.

- When planning and carrying out maintenance work, the operating condition of the whole system should be considered.

⚠ WARNING High temperatures, risk of burns!

Rails, reactors, resistors and fuses can be hot.

⚠ CAUTION Cooling fans can start automatically!

- The water cooling system and the cooling fans can start automatically as soon as the auxiliary voltage is switched on or when the EMERGENCY OFF button is released, even if the PCS6000 is de-energized.
- Switch off the corresponding motor protection switches (see diagrams contained in the cabinet specific documentation) to shut down the cooling system.

NOTICE **Risk of component damage.**

- ABB strongly recommended to carry out all preventive maintenance work according to the maintenance schedule on time and at the stated intervals.
- Observing the maintenance schedule can prevent system malfunctions.
- ABB is not liable for defects as a result of neglecting preventive maintenance work.
- To maintain safe and reliable operation of the PCS6000, ABB recommends taking out a service contract with the local ABB service organization.
- For more information contact your local service representative.
- During the warranty period, any repair work must be carried out exclusively by trained personnel according to the ABB service and authorization concept.
- ABB recommends periodical training for the maintenance and repair personnel.

6.3. Standard procedure for troubleshooting

IMPORTANT! After a temporary blocking of IGCTs, the PCS6000 attempts to reset the fault and to restart. If the restart is successful, ie, the device does not trip again within a pre-set time, the fault will be cleared automatically.

In case of a fault proceed as follows:

1. Select the fault and alarm display of one of the following:
   - Overriding control system
   - Optional commissioning tool

   NOTICE Do NOT clear or reset the fault buffer / display and the transient recorder data at this stage!

2. Check the alarm display for the first failure (marked with “FF” in commissioning tool) and other, possibly related error messages.

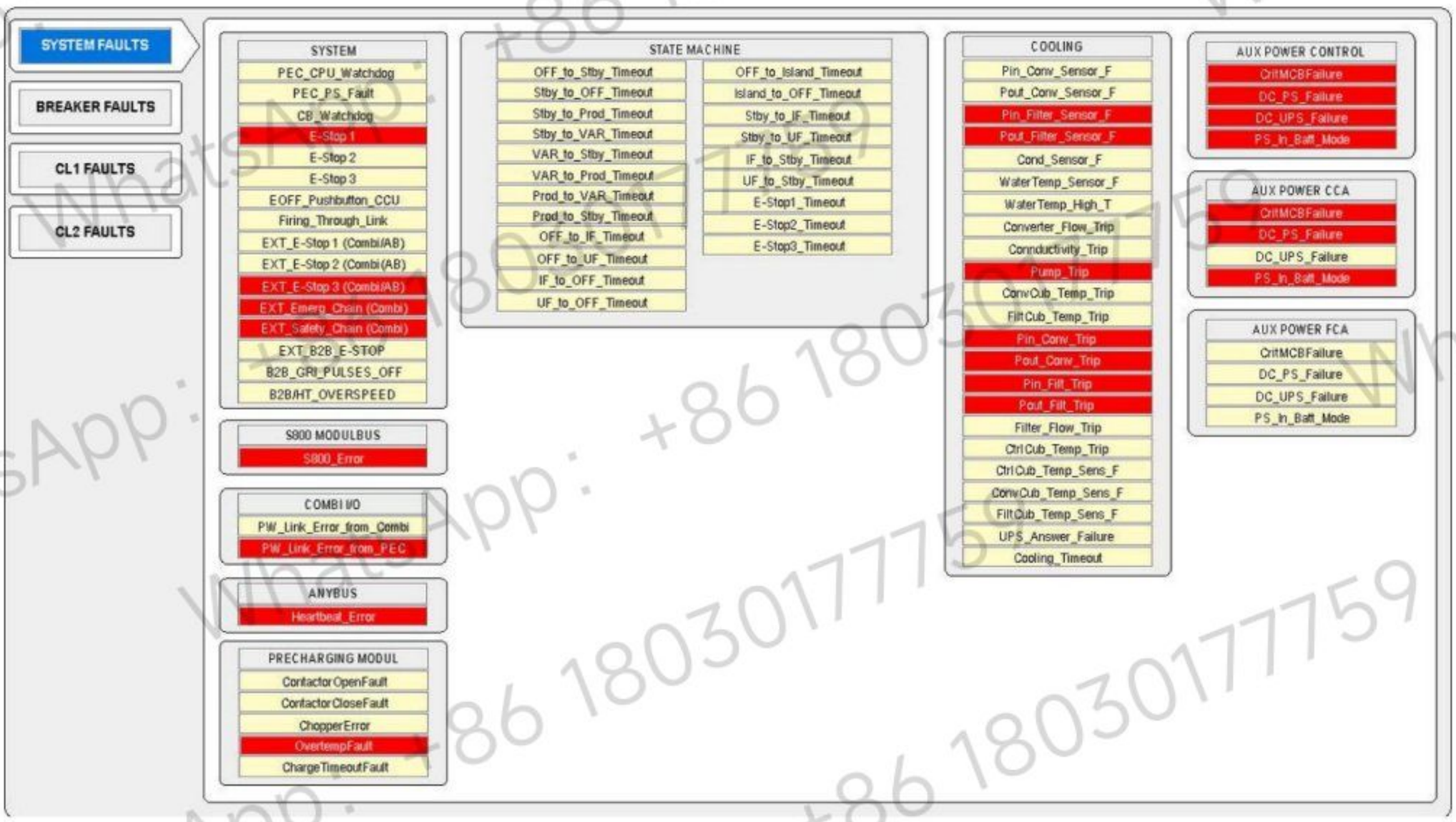

Figure 6–1 Commissioning tool (optional), error messages window

Read error messages on remote terminal

1) Try to find and rectify using Fault Handbook.
2) Check states of control equipment, power supplies, fiber-optic and communication links.
3) Check states of power equipment (converter, cooling system, switchgear, etc.)
4) Try to eliminate fault.

Fault eliminated?

Yes

No

Go to site

1) Try to find and rectify fault using Fault Handbook.
2) Check states of control equipment, power supplies, fiber-optic and communication links.
3) Check states of power equipment (converter, cooling system, switchgear, etc).
4) Repair or replace faulty component.

Fault eliminated?

Yes

No

Call ABB service

Restart

Figure 6–2 Standard procedure for troubleshooting (overview)

Proceeding from remote terminal:

1. Make sure that the transient recorder data are saved (The IPC automatically saves any new TR-Files every 10 minutes).
2. Try to find the reason for the fault: after having checked the alarm display, refer to the customer documentation, Appendix A09 - Fault handbook which provides a list of all alarm and fault messages and information on possible causes and suggestions to rectify the fault condition.
3. If necessary, analyze the transient recorder data.
   For more information, see the “PCS6000 Service software manual”, 3BHS600000 E81.
4. In the overriding control system or commissioning tool go to the window of the affected sub-system (eg, cooling system, S800).

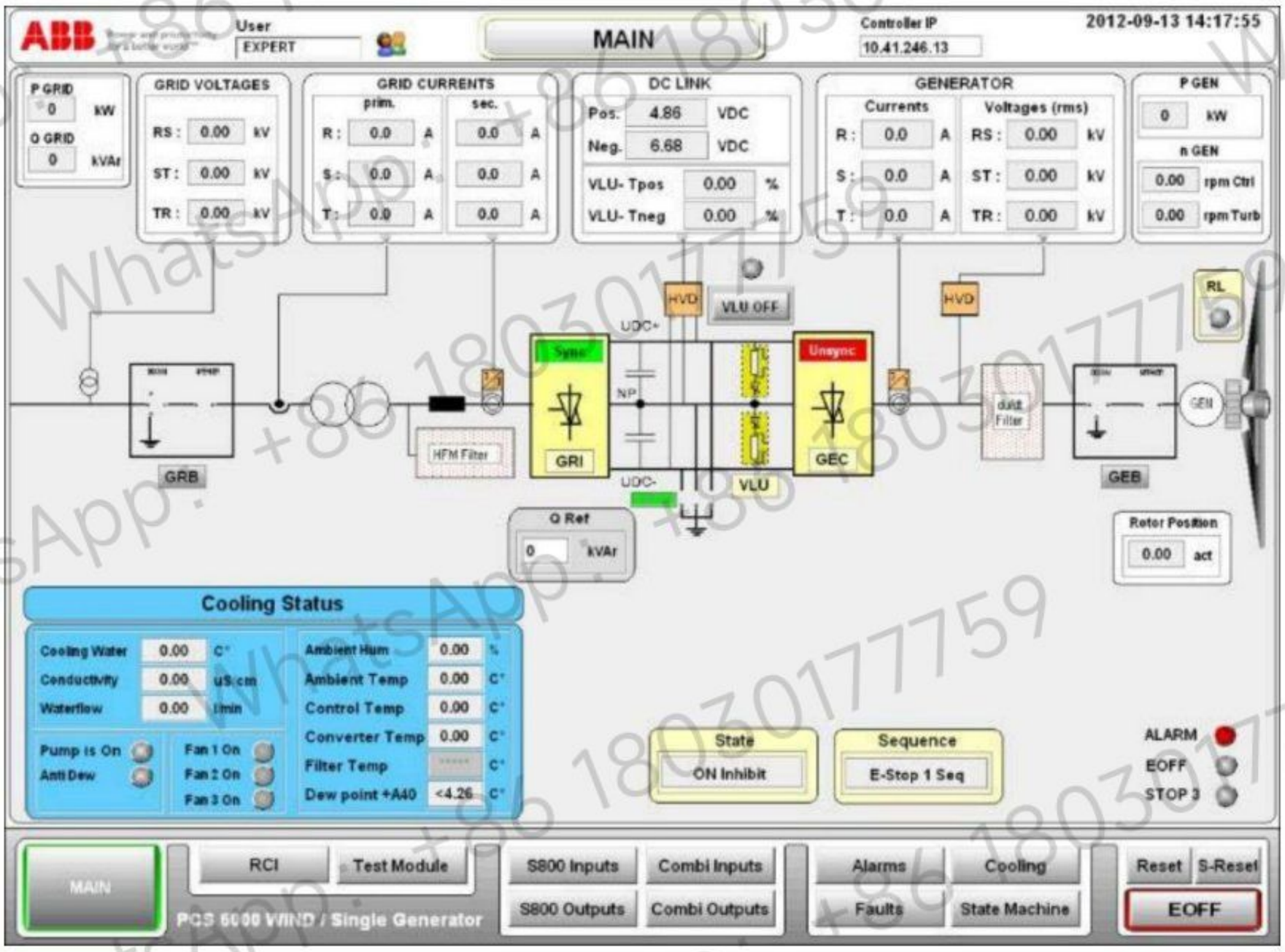

Figure 6–3 Commissioning tool (optional), typical window

5. Depending on the suggestions in the fault handbook, check the following:
   - Component states of control
   - Power equipment
   - Measured quantities, such as voltage, current, temperature, pressure and quality, statuses of switchgear.
6. If appropriate, try to restart the PCS6000 (in case of over temperature wait for cooling down first) and check if the fault occurs again.

   NOTICE DO NOT try to restart if the fault is related to converter hardware (eg, short circuits in the converter)!

Proceeding on site:

DANGER High voltage!

PCS6000 components are precision devices. Incorrect handling can result in serious injuries or DEATH and damage to the equipment.

- DO NOT access the power sections of the PCS6000 before the converter is completely de-energized and grounded.
- All repair work inside the PCS6000 must be carried out exclusively by service personnel authorized by ABB.
- Work accurately and follow exactly the instructions in this manual
- Always use the proper tools
- Recheck carefully all your actions

1. If necessary to enter the converter site for further fault finding: take an adequate set of spare parts.
2. Shut down the PCS6000 according to the “PCS6000 Lockout/tagout procedure”, 3BHS600000 E22.

   NOTE – Depending on the suggestions in the fault handbook, proceed as follows.
3. Check the power and electronic components visually for the following:
   - LED indications (see chapter 7, **Checking control components**, page 81) that may indicate a component failure
   - Signs for overheated components, wires, cables or busbars
   - Equipment with traces of discoloring or sooting
   - Correct polarity of power diodes
   - Leaks
   - Proper functioning of fans, pumps etc.
   - Soiling of heat exchangers
   - Try if the fault can be located
4. Check all auxiliary power supplies.
   - If the fault is related to converter hardware check consecutively all power components (diodes, IGCTs and IPS) of each stack in the upstream and downstream converters.
   - Compare the results with neighboring stacks to find irregularities.

   For more information, see chapter 9, **Checking diodes, IGCTs and IPS**, page 115.
5. Replace the faulty component according to the instructions in chapter 10, **Replacing power and cooling components**, page 133 or according to the instructions in the specific component documentation (see customer documentation, Appendix A06 Data sheets for components).

6. If the fault could not be located, check the electronic equipment using the electrical drawings:
   - Power supplies
   - Control modules
   - Measurement devices
   - Hardwired connections
   - Fiber-optic connections
7. Replace the faulty electronic component according to the instructions in chapter 8, **Replacing control components**, page 85.
8. Restart the PCS6000 according to section 5.4, **Start-up after maintenance or troubleshooting**, page 70 (in case of over-temperature wait for cooling down).
9. Reset the PCS6000:
   - Faults that are related to converter hardware failures (eg, overcurrent) require a service reset after correction of the problem.
   - Faults that are related to other than converter hardware failures (eg, cooling system problems) require a normal reset after correction of the problem.

   For more information concerning “Acknowledge of alarms” for S2S application, see the “PCS6000 Local control panel description”, 3BHS606571 E49.
10. Check if the fault occurs again.

    If the reason for the failure is unclear or the problem cannot be solved, contact the ABB service representative!

    For efficient troubleshooting, have the following data available when calling the ABB service representative:
    - Serial number of converter and installation data
    - Type and serial number of each affected part
    - Date and time of occurrence
    - Grid condition (switching action, fault etc.)
    - Load conditions (steady or changing load etc.)
    - Cooling water data (temperature, pressure)
    - Any other irregular situation or operating condition (ambient temperature etc.)

7. Checking control components

7.1. General

The following sections provide instructions on checking the electronic devices of the PCS6000 and an overview on the meaning of LEDs of the main circuit boards and I/O devices.

7.2. Safety information

DANGER High voltage!

Dangerous voltage inside the PCS6000 can lead to life-threatening situations, injury of the persons involved or damage to equipment.

Before you begin, read and understand the material in chapter 2, **Important safety information**, page 23 and always follow the safety rules that are described in section 2.3.2, **The 7 steps that save lives**, page 26.

7.3. Checking procedure

1. Use the electrical drawings to locate the devices to be checked.
2. If you need to enter the power sections for additional fault finding, Shut down the PCS6000 according to the “PCS6000 Lockout/tagout procedure”, 3BHS600000 E22.
3. Check the electronic components visually for the following:
   - LED indications (see section 7.4, **LED status indications**, page 81) that may indicate a component failure
   - Missing LED indications
   - Signs for overheated components, wires, cables or busbars
   - Equipment with traces of discoloring or sooting
4. Check all auxiliary power supplies.
5. Check all hardwired and fiber-optic connections.
6. If necessary replace a faulty component according to chapter 8, **Replacing control components**, page 85.

7.4. LED status indications

The LEDs presented in the following section can be checked easily with the auxiliary voltage switched on and without having to remove covers first. The LEDs provide information on the status of the devices and can be used for diagnostic purposes.

7.4.1. LEDs on AC 800PEC

Table 7–1 LEDs on AC 800PEC

LED number	Color	Marking	Description
LED 1	Red	F(ault)	LED off: normal state LED on: severe system fault
LED 2	Green	R(un)	LED off: FPGA not configured LED on: FPGA configured
LED 3	Green	P(ower)	LED off: power supply out of range LED on: power is on
LED 4	Green	S(upervisor)	LED off: operating condition out of range LED on: normal state
LED 5	Yellow	T(ransmission)	LED off: PowerLink not available LED flashing: PowerLink available
LED 6	Yellow	A(ctivity)	LED off: watchdog error LED flashing: normal state

7.4.2. LEDs on Combi IO

Table 7–2 LEDs on Combi IO UA D155

LED number	Color	Marking	Description
LED 1	Red	F(ault)	LED off: normal state LED on: severe system fault
LED 2	Green	R(un)	LED off: FPGA not configured LED on: FPGA configured
LED 3	Green	P(ower)	LED off: power supply out of range LED on: power is on
LED 4	Green	S(upervisor)	LED off: hardware disturbance LED on: normal state
LED 5	Yellow	T(ransmission)	LED off: PowerLink not available LED flashing: PowerLink available
LED 6	Yellow	A(ctivity)	LED off: watchdog error LED flashing: normal state

7.4.3. LEDs on PECINTM

Table 7–3 LEDs on PECINTM PC D237

LED number	Color	Marking	Description
LED 1	Red	F(ault)	LED off: normal state LED on: severe system fault
LED 2	Green	R(un)	LED off: FPGA not configured LED on: FPGA configured
LED 3	Green	P(ower)	LED off: power supply out of range LED on: power is on
LED 4	Yellow	A(ctivityr)	LED off: watchdog error LED flashing: normal state

7.4.4. LEDs on ASE2 board

Table 7–4 ASE2 board UD C920

LED number	Color	Marking	Description
LED 1	Red	F(ault)	LED off: normal state LED on: in test mode and channel 0 full scale test fault and channel 0 test offset fault – In test mode and channel 1 full scale test fault and channel 1 test offset fault – In test mode and communication test fault
LED 2	Green	R(un)	LED off: FPGA not configured LED on: FPGA configured
LED 3	Green	P(ower)	LED off: power supply out of range LED on: power on
LED 4	Green	TOF (test offset)	LED off: normal state LED flashing: in test mode and only one channel in offset test range LED on: in test mode and both channels in offset test range

Table 7–4 ASE2 board UD C920 (continued)

LED number	Color	Marking	Description
LED 5	Green	TFS (test full scale)	LED off: normal state LED flashing: in test mode and only one channel in full scale test range LED on: in test mode and both channels in full scale test range
LED 6	Green	COM(munication)	LED off: communication faulty LED on: communication OK

7.4.5. LEDs on UPS

Table 7–5 UPS/24DC/40

LED number	Color	Marking	Description
LED 1	Red	Alarm	LED off: normal state LED on: alarm state
LED 2	Yellow	Bat.-Mode Bat.-Charge	LED off: output fed from input LED on: output fed from battery LED flashing: battery charging
LED 3	Green	Power In	LED off: power supply out of range LED on: power is on

8. Replacing control components

8.1. General

The following sections provide instructions on how to replace control components and are intended for qualified personnel who are responsible for servicing a PCS6000 drive.

8.2. Safety information

Before you begin, read and understand the material in chapter 2, **Important safety information**, page 23 and always follow the safety rules that are described in section 2.3.2, **The 7 steps that save lives**, page 26.

DANGER **High voltage!**

Dangerous voltage inside the PCS6000 can lead to life-threatening situations, injury of the persons involved or damage to equipment.

- When planning and carrying out maintenance work, the operating condition of the whole system should be considered.

WARNING **High temperatures, risk of burns!**

Rails, reactors, resistors and fuses can be hot.

CAUTION **Cooling fans can start automatically!**

The water cooling system and the cooling fans may start automatically as soon as the auxiliary voltage is switched on or when the EMERGENCY OFF button is released, even if the PCS6000 is de-energized.

- Switch off the corresponding motor protection switches (see diagrams contained in the cabinet specific documentation, tab 2) to shut down the cooling system.

NOTICE **Electrostatic discharge (ESD) can damage electronic boards and components!**

- DO NOT touch printed circuit boards or other sensitive components without applying static-sensitive handling precautions!
- While working with components containing printed circuit boards, use a wrist strap which is earthed at the unit's frame.
- Whenever components need to be replaced use an antistatic mat on a table near the unit and connect the mat to the same point as the wrist strap.
- Hold a board only at the edge.
- Handle a faulty board as carefully as a new one.

IMPORTANT! It is strongly recommended to install some cover (plastic, cardboard, etc.) below the components to be removed before starting replacement work. This cover will catch dropped parts as screws, washers, screw nuts, etc.

8.3. Overview of replaceable control components

Tables 8–1, 8–2, 8–3, 8–4 and 8–5 contain electrical control components in the different units replaceable by the customer. Beside the component name, the product number and the SAP number there are 2 additional columns:

- Serialized: An “x” in this column indicates that this component was serialized in production.

  If the component was replaced in the field the serialization database should be updated, ie, the new serial number has to be reported to ABB by means of a warranty and failure report.

  For a complete list of serialized parts refer to the list of serialized assemblies and components (3BHE600000 E70).

- Special tasks in case of replacement: Indicates what must be done after replacement of the component.

8.3.1. Replaceable control components in CCU

Table 8–1 CCU control components replaceable by customer

Component name	Product number	SAP number	Serialized	Special tasks in case of replacement
AC 800PEC	PP D113 B03-20-110110	3BHE023584R204Z	x	-
AC 800PEC Combi IO	UA D155 A0111	3BHE029110R0111	x	-
S800 Bus Modem	TB820V2	3BSE013208R0001	-	Set correct address
S800 Compact MTU Connection Base	TU810V1	3BSE013230R0001	-	Set correct address
S800 Compact Connection Base	TU811	3BSE013231R0001	-	Set correct address
S800 Digital Input 48VDC	DI811	3BSE008552R0001	-	Set correct address
S800 Analog Input	AI810	3BSE008516R0001	-	Set correct address
S800 Digital Output 8 NO	DO820	3BSE008514R0001	-	Set correct address
AC/DC Converter	QUINT-PS/3AC/24DC/40	3BHE031065R0001	x	Set voltage according to electrical drawings
DC/DC Converter	QUINT-PS-24DC/24DC/10	3BHB057230P2424	x	Set voltage according to electrical drawings
UPS	QUINT-DC-UPS/24DC/40	3BHB056371P0040	x	Set time and battery dial according to electrical drawings
Battery	QUINT-BAT/24DC/3.4Ah	3BHB056372R0003	x	-
Voltage Transducer	UUD148AE01	3BHE014185R0001	x	Set jumpers according to electrical drawings

Table 8–1 CCU control components replaceable by customer (continued)

Component name	Product number	SAP number	Serialized	Special tasks in case of replacement
Current Transducer	UUD148AE02	3BHE014185R0002	x	Set jumpers according to electrical drawings
Industry PC	Compact 7M2	3BHE035578R0001	x	-

8.3.2. Replaceable control components in POU

Table 8–2 POU control components replaceable by customer

Component name	Product number	SAP number	Serialized	Special tasks in case of replacement
PECINTM	PC D237 A101	3BHE028915R0101	x	-
IPS	IPS21-24V	3BHE032593R0001	x	-
HVD	XV C770 BE102	3BHE021083R0102	x	-
VLSCD	XV C724 BE	3BHE009017R0102	x	-
ASE2B	UD C920 BE102	3BHE034863R0002	x	-
AC/DC Converter	QUINT-PS/3AC/ 24DC/40	3BHE031065R0001	x	Set voltage according to electrical drawings
DC/DC Converter	QUINT-PS-24DC/ 24DC/10	3BHB057230P2424	x	Set voltage according to electrical drawings
UPS	QUINT-DC-UPS/ 24DC/40	3BHB056371P0040	x	Set time and battery dial according to electrical drawings
Battery	QUINT-BAT/24DC/ 7.2Ah	3BHB056372R0002	x	-

8.3.3. Replaceable control components in FIU

Table 8–3 FIU control components replaceable by customer

Component name	Product number	SAP number	Serialized	Special tasks in case of replacement
AC/DC Converter	QUINT-PS/1AC/ 24DC/10	3BHE016113R0110	x	Set voltage according to electrical drawings

Table 8–3 FIU control components replaceable by customer (continued)

Component name	Product number	SAP number	Serialized	Special tasks in case of replacement
UPS	QUINT-DC-UPS/ 24DC/10	3BHB056371P0010	x	Set time dial according to electrical drawings

8.3.4. Replaceable control components in DLU

Table 8–4 DLU control components replaceable by customer

Component name	Product number	SAP number	Serialized	Special tasks in case of replacement
IPS	IPS21-24V	3BHE032593R0001	x	-
VLSCD	XV C724 BE	3BHE009017R0102	x	-

8.3.5. Replaceable control components in DRU

Table 8–5 DRU control components replaceable by customer

Component name	Product number	SAP number	Serialized	Special tasks in case of replacement
12-Pulse Firing Board	DDC779BE02	3BHE037945R0001	-	-
EAF	UF C765 AE102	3BHE003604R0102	x	-