ABB SOLAR INVERTERS
PVS980-CS compact skid
Hardware manual
# Table of contents

1 *Safety instructions*

Contents of this chapter ........................................................................................................ 9
Use of warnings .................................................................................................................. 9
Allowed usage .................................................................................................................. 10
Safe installation, start-up and maintenance ..................................................................... 10
  General safety instructions ................................................................................. 10
  Working areas ................................................................................................. 11
  Personal protective equipment (PPE) ............................................................. 11
    PPE safety equipment ............................................................................... 11
  Safety instructions for MV switchgear and MV transformer area ................... 11
    Disconnecting the MV switchgear from power supply ............................ 12
    Earthing the MV switchgear and AC cabinet ........................................... 12
  Safety instructions for the Inverter area ......................................................... 12
    Disconnecting the inverter from all possible sources .............................. 13
    Disconnecting the MV switchgear (V-module) ........................................ 14
  Safety instructions for the auxiliary service board ......................................... 14
Safe operation .............................................................................................................. 14

2 *Introduction to this manual*

Contents of this chapter ........................................................................................................ 17
Applicability .................................................................................................................... 17
Target audience ............................................................................................................. 17
Related documents ........................................................................................................ 17
Terms and abbreviations .................................................................................................. 18

3 *Hardware description*

Contents of this chapter ........................................................................................................ 19
Product overview ............................................................................................................ 19
External dimensions ....................................................................................................... 19
Layout drawing ................................................................................................................ 20
Working areas and main components ............................................................................. 20
  Main components .............................................................................................. 21
  AC cabinet components .................................................................................. 21
  Auxiliary service board .................................................................................. 21
  MV switchgear ................................................................................................. 23
    MV switchgear circuit .............................................................................. 23
  MV transformer .............................................................................................. 24
  Inverter ............................................................................................................ 24
Main circuit diagram ...................................................................................................... 24
Type designation label .................................................................................................. 25
Type designation key ...................................................................................................... 26

4 *Storing, lifting and transporting*

Contents of this chapter ....................................................................................................... 27
11 Maintenance of external hinges and locks

Tools ................................................................. 59
  Lubricating the external hinges and locks ........................................ 59
Procedure ...................................................................... 59

12 Technical data

Contents of this chapter ................................................................. 61
Technical data and types: PVS980-CS ............................................... 62

13 Drawings

Contents of this chapter ................................................................. 65
List of technical drawings .............................................................. 65

Further information
Safety instructions

Contents of this chapter

This chapter presents the use of warnings in the manual and gives instructions for safe installation, start-up, use and maintenance of the PVS980-CS compact skid.

Use of warnings

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment, and advise on how to avoid the danger. The following warning symbols are used in this manual:

**WARNING!**
Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.

**WARNING!**
General warning warns about conditions, other than those caused by electricity which can result in physical injury and/or damage to the equipment.

**WARNING!**
General warning warns about weather conditions, prohibited maintenance operations during a typhoon, thunderstorm, snow, rain and electrical storm. Maintenance in such conditions can result in physical injury and/or damage to the equipment.

**WARNING!**
General warning warns about maintenance work on the roof which should always be done from the outer perimeter, considering the local safety regulations.
**Allowed usage**

- The PVS980-CS is a compact skid containing: two outdoor 1500 VDC ABB central inverters, an ABB oil immersed MV transformer, MV switchgear, a monitoring system and DC connections. The skid connects a PV power plant to a medium voltage grid. Use the skid only at its permissible input/output ratings and ambient conditions. Make sure this compliance is satisfied before commissioning.
- The operation and maintenance of the compact skid must be carried out by certified technicians that fulfill all local skill set and safety requirements. Any unqualified personnel must maintain a safe distance from the compact skid. All activities must be in accordance with the criteria described in the ABB technical documents and local regulations.
- Make changes to the compact skid only with the direct authorization of ABB. Any alterations done outside ABB approval will invalid the warranty for the product. ABB is not liable for any damages caused by these changes.

**Safe installation, start-up and maintenance**

This section contains the safety instructions which you must follow when installing, commissioning and maintaining the compact skid. If ignored, physical injury or death may follow, or damage may occur to the equipment.

- Only authorized electricians are allowed to install, start-up and maintain the compact skid. Working methods, tools, components etc. must follow the IEC regulations.
- Obey all local safety regulations concerning electrical stations.
- The compact skid should be energized and de-energized only by an authorized person who has the task-specific instructions for the operation of an MV substation and permission from the on-site foreperson in charge of electrical work.

**General safety instructions**

**WARNING!**
Before you perform any work in the compact skid, obey the following safety precautions.

1. Clearly identify the work location.
2. Read the safety instructions of the work area and the component you are working on. See the subsections below and the component-specific manuals.
3. Disconnect and secure against reconnection.
4. Disconnect all possible power supplies (external, auxiliary and inverters) and open all base fuse switches. Lock the disconnectors in the open position and attach a warning notice to them. After disconnecting power to the inverters, always wait until the stored energy of the inverters is discharged. See also, inverters manual.
5. Use protection against any live parts.
6. Take special precautions when you work close to exposed conductors.
7. Measure to ensure that there is no voltage connected.
8. Carry out earthing (grounding) and short circuiting.
9. Issue a permit to work.
Working areas
- MV Transformer Area
- MV Switchgear Area
- Inverter Area
- Auxiliary Service Area

Each work area has separate safety instructions.

Personal protective equipment (PPE)
- Perform any operation on the equipment with suitable work clothes and instruments. See PPE safety equipment (page 11).
- When choosing a personnel protective equipment, consider environmental conditions such as humidity, noise, etc. and local regulations.
- Make sure the work clothes and accessories are not prone to generate electrostatic charges, fires or any other condition that compromises personnel safety.

PPE safety equipment
The minimum required safety equipment is as follows:
- Safety shoes
- Safety gloves
- Safety glasses
- Head protection
- Hearing protection
- Work clothes

Safety instructions for MV switchgear and MV transformer area

WARNING!
Perform the below instructions before you start working inside the MV switchgear and/or MV transformer area. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Identify the MV switchgear and read its safety instructions.
2. Check the operation of the capacitive voltage indicators in all MV switchgear bays (all phase LEDs are switched on when a voltage is connected).
3. Disconnect the MV switchgear from all possible power supplies (external, auxiliary, and inverters as well as any parallel connection stations), and secure by locking and tagging. See instructions in section, Disconnecting the MV switchgear from power supply (page 12).
4. Check that all shrouds/screens are in place.
5. Check that you are not near to any live parts while working. All live circuits must be protected with shrouds/screens.
6. Make sure that the MV switchgear is dead.
   - Check the status of voltage indicators in all MV switchgear bays. Note that all phase LEDs which were switched on AC cabinet at are now switched off).
7. Earth the MV switchgear and the AC cabinet. See instructions in section, Earthing the MV switchgear and AC cabinet (page 12).
8. Check that the MV transformer is dead (high voltage terminals, low voltage terminals, any auxiliary power, and instrumentation). Use an appropriate high voltage tester only for the high voltage side, and a voltage detector with suitable testing heads for the low voltage side.

9. Issue a work permit.

**Disconnecting the MV switchgear from power supply**

To disconnect the MV switchgear from all possible power supplies (external, auxiliary, and inverters as well as any parallel connection stations), follow the below steps:

1. Stop the string inverters outside the compact skid.
2. Open the DC disconnecting switches in each inverter unit and add warning notices. If applicable, open the AC disconnecting switches in each inverter unit, lock and add warning notices (applicable only when inverter includes the options +F296 and +F253).
3. Open all fuse base switches of the inverter inputs, lock and add warning notices.
4. Open all auxiliary breakers, switches and fuses in the auxiliary service board, lock and add warning notices.
5. Open the main circuit breaker in the auxiliary service transformer, lock and add warning notices.
6. Set the inverter auxiliary power off (if applicable).
7. Turn the vacuum circuit breaker of the MV switchgear to open position. Lock and add warning notice.
8. Turn the disconnecting switch of the MV transformer side of the MV switchgear to open position. Lock and add a warning notice.
9. Disconnect the MV switchgear from the MV network (all possible external power supplies, grid and parallel stations). See the User's manual of the MV switchgear. Lock and add warning notices.

**Earthing the MV switchgear and AC cabinet**

1. Turn the earthing switches of the MV switchgear to “earthed” position, lock (remove the MV switchgear Ronnis key of the V module) and add warning notices.
2. If the compact skid is connected to parallel skids, make sure that you also turn the appropriate earthing switches of the parallel skids to “earthed” position.
3. Temporarily, ground the MV switchgear terminals at all possible external power supplies (grid and parallel skids). See the User's manual of the MV switchgear. Lock and add warning notices.
4. Ground the inverter AC sides with appropriate temporary grounding set.

### Safety instructions for the Inverter area

**WARNING!**

Perform the below instructions before you start working on the inverters. Ignoring the instructions can cause physical injury or death, or damage to the equipment. You must be a qualified electrician to do installation and service work.

1. Identify the inverter and read its safety instructions. See *PVS980 central inverters hardware manual* (3AXD50000026013 [EN]).
2. Clearly identify the work location. Make sure that there is an escape route in case of an emergency.
3. Disconnect and isolate. (Not all disconnectors provide sufficient isolation against voltage surges.). See instructions in section, *Disconnecting the inverter from all possible sources (page 13)*.

4. Protect any other energized parts in the work location against contact.

5. Open the breaker and switches of the auxiliary service board.

6. Open the main circuit breaker of the auxiliary service transformer, lock and add warning notices.

7. Disconnect the MV switchgear (V-module). See instructions in section *Disconnecting the MV switchgear (V-module) (page 14)*.

8. Check that the inverter is dead. Make sure the voltage between the following terminals and the grounding (PE) busbar is close to 0 V.
   - inverter AC output terminals (L1, L2, L3)
   - inverter power module UDC+ and UDC- terminals
   - DC input terminals DC+ and DC-

9. After you disconnect the inverter, wait for at least five minutes to let the intermediate circuit capacitors discharge before you continue.

10. Check that all shrouds/screens are in place except the one that prevents access to the parts that you must work on currently.

11. Make sure you are not near to any live parts while working. Disconnect the live circuits or protect with shrouds/screens.

12. Temporarily ground inverter 1 or inverter 2, AC and DC sides. Connect the AC and DC busbars (in both DC sections) to PE with a temporary grounding tool.

13. Issue a work permit.

**Disconnecting the inverter from all possible sources**

To disconnect the inverter from all possible sources, such as AC & DC supply, external auxiliary power, etc., follow below steps:

1. Disconnect the inverter from the AC supply (normally a disconnector or a breaker on the HV side of the main transformer), because the optional AC disconnectors or breakers of the inverter do not remove the voltage from the AC outside busbars of the inverter.

2. Disconnect the inverter from the DC power supply (usually the DC circuit breakers of the solar array junction boxes or the DC combiner box), because the optional DC disconnectors do not remove the voltage from the inverter input busbars or fuses.

3. Disconnect the following optional devices:

<table>
<thead>
<tr>
<th>Devices</th>
<th>Option code</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC main disconnection devices (AC breakers or AC switch disconnectors) of all power units</td>
<td>1Q4, 2Q4</td>
</tr>
<tr>
<td>DC disconnectors of all the power sections</td>
<td>1Q1, 2Q1</td>
</tr>
<tr>
<td>Auxiliary power disconnectors of all the power sections</td>
<td>1Q10, 2Q10</td>
</tr>
<tr>
<td>3-phase output disconnector</td>
<td>0Q12</td>
</tr>
<tr>
<td>1-phase output circuit breakers</td>
<td>0F11, 0F13</td>
</tr>
</tbody>
</table>

If the inverter is supplied from external auxiliary power, disconnect also that.

4. Make sure that reconnection is not possible. Lock all disconnectors in the open position and attach warning notices. Lock and tag.
5. After disconnecting the inverter, wait for at least five minutes to let the capacitors discharge.

**Disconnecting the MV switchgear (V-module)**

To disconnect the MV switchgear (V-module), follow the below steps:

1. Open the V-module breaker, lock and add warning notices.
2. Set the disconnecting switch on the V-module to open position, lock and add warning notices. See MV switchgear user's manual.
3. Make sure that the V-module is dead: check that the voltage indicators in all V-module bays (all phase LEDs) are switched off.
4. Measure to confirm that the installation is not energized. Also, test the performance of the voltage measurement device by measuring a live voltage.
5. Make sure that the V-module is earthed. Turn the earthing switches to “earthed” position, lock (remove the V-module key) and add warning notices. If the station is connected to parallel stations, turn the applicable earthing switches to “earthed” position.

**Safety instructions for the auxiliary service board**

1. Open the main circuit breaker or main switch of the auxiliary service transformer. Lock and tag.
2. Open the secondary circuit breaker of the auxiliary service transformer. Lock and tag.
3. Open all switches, breakers and connectors of the auxiliary service board. Lock and tag.
4. Make sure you are not near to any live parts while working. Disconnect the live circuits or protect them with shrouds/screens.
5. Check the status of the voltage indicators in the auxiliary service board.
6. Check that the auxiliary service board is dead.
7. Issue a work permit.

**Safe operation**

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**WARNING!**
Obey these instructions to prevent injury, death, or damage to the equipment.

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**WARNING!**
Keep all doors locked while the compact skid is operating. Allow access to only authorized personnel.

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1. Keep all doors of the compact skid closed during operation. Give the keys only to authorized personnel.
2. Before you start the inverter, close the following devices:
   - two AC and two DC main switches
   - auxiliary measurement unit switch 1F3.4
   - internal auxiliary MV transformer fuse switches
   - overload protection switches 1Q10, 1Q11, 2Q10 and 2Q11.
3. Do not open the AC base fuse switches when the compact skid is operating.
4. Before you adjust the group of inverters and set them into service, make sure that all of them are suitable for operation.
5. Do not use the inverters in a manner not specified in the manual.

6. The maximum allowed number of power-ups by applying power is five in ten minutes.

**Note:**
- Spend as little time as possible near the inverters or the compact skid.
- Use a personal computer and the Drive composer PC tool with a communication cable of sufficient length when you monitor or adjust inverter parameters during operation.
- If the Start switch is in ON position, and the Start command is active, the inverter starts immediately after a fault reset. For more information, see PVS980 central inverters firmware manual (3AXD50000026271 [EN]).
- Use the start delay when you start the PVS980-CS for the first time to let you move away.
Introduction to this manual

Contents of this chapter
This chapter provides information about the manual such as applicability, target audience and contents. It also lists the related documents.

Applicability
This manual is applicable to PVS980-CS (compact skid).

Target audience
This manual is intended for persons who transport, store, plan the installation, install, commission and maintain the compact skid.

Read this manual before working on the compact skid. You are expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

Related documents

<table>
<thead>
<tr>
<th>Document</th>
<th>Code (English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware manuals and guides</td>
<td></td>
</tr>
<tr>
<td>PVS980 central inverter hardware manual</td>
<td>3AXD50000026013</td>
</tr>
<tr>
<td>PVS980 central inverters commissioning and maintenance manual</td>
<td>3AXD50000046782</td>
</tr>
<tr>
<td>Firmware manuals and guides</td>
<td></td>
</tr>
<tr>
<td>PVS980 central inverters firmware manual</td>
<td>3AXD50000026271</td>
</tr>
<tr>
<td>Option manuals and guides</td>
<td></td>
</tr>
<tr>
<td>ACS-AP-x Assistant control panels user’s manual</td>
<td>3AUA00000085685</td>
</tr>
<tr>
<td>Start-up and maintenance PC tool Drive composer user’s manual</td>
<td>3AUA0000094606</td>
</tr>
</tbody>
</table>
18 Introduction to this manual

<table>
<thead>
<tr>
<th>Document</th>
<th>Code (English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FENA-01/-11/-21 Ethernet adapter module user’s manual</td>
<td>3AUA0000093568</td>
</tr>
<tr>
<td>FSCA-01 RS-485 adapter module user’s manual</td>
<td>3AUA0000109533</td>
</tr>
<tr>
<td>NETA-21 Remote monitoring tool user’s manual</td>
<td>3AUA0000096939</td>
</tr>
<tr>
<td>SafeRing/SafePlus 12–24 kV installation and operating instructions</td>
<td>1VDD005976</td>
</tr>
<tr>
<td>SafeRing/SafePlus 36 kV installation and operating instructions</td>
<td>1VDD006116</td>
</tr>
<tr>
<td>Oil-type MV transformer: Operation and maintenance manual of distribution MV transformers</td>
<td>1LTR954400-1</td>
</tr>
</tbody>
</table>

Terms and abbreviations

<table>
<thead>
<tr>
<th>Term/Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Alternating current</td>
</tr>
<tr>
<td>CCV</td>
<td>Construction of ABB SafeRing MV switchgear</td>
</tr>
<tr>
<td>CS</td>
<td>Compact skid</td>
</tr>
<tr>
<td>CV</td>
<td>Construction of MV switchgear</td>
</tr>
<tr>
<td>DC</td>
<td>Direct current</td>
</tr>
<tr>
<td>LV</td>
<td>Low voltage (50…1000 V AC)</td>
</tr>
<tr>
<td>LVRT</td>
<td>Low voltage ride-through</td>
</tr>
<tr>
<td>MV</td>
<td>Medium voltage (1…35 kV)</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
</tr>
<tr>
<td>SF6</td>
<td>Sulfur hexafluoride (this gas type is used in MV switchgear).</td>
</tr>
<tr>
<td>SWG</td>
<td>Switchgear</td>
</tr>
<tr>
<td>THD</td>
<td>Total harmonic distortion</td>
</tr>
<tr>
<td>TN-S</td>
<td>Earthed network</td>
</tr>
</tbody>
</table>
Hardware description

Contents of this chapter

This chapter provides an overview of the PVS980-CS (compact skid). It also includes layout, type designation label and type designation information.

Product overview

The PVS980-CS is a skid-based solution that connects a PV power plant to a medium voltage power grid. The solution is constructed around a skid house that contains:

- **Central inverters**—converts direct current (DC) and voltage from the solar generator into alternating current (AC) and voltage for the power grid. The inverters also control the power flow, monitor, and protect the power generator.
- **Oil immersed MV transformer**—transforms low voltage from the inverters into a medium voltage for the power grid.
- **MV switchgear**—is the connection point to the power grid. It is also the main protection, switching, breaking and disconnecting equipment on the medium voltage side of the solar power plant.
- **Auxiliary service board**—contains auxiliary services for the autonomous operation of the compact skid as well as space for optional UPS and communication bard.

External dimensions

The compact skid is constructed over a skid suitable for transportation inside a 40 HC container with,

- External dimension (length, width, height) = 11850 x 2150 x 2340 mm
- Total weight = < 22 ton.
This section describes the working areas and main components of the PVS980-CS. For more information, see drawing 3AES-PVS980-CS-30-DW01.

### Working areas and main components

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>MV switchgear area. For more information, see section MV switchgear (page 23).</td>
</tr>
<tr>
<td>B</td>
<td>AC auxiliary area. For more information, see section Auxiliary service board (page 21).</td>
</tr>
<tr>
<td>C</td>
<td>Inverter area. For more information, see section Working areas and main components (page 20).</td>
</tr>
<tr>
<td>D</td>
<td>MV transformer area. For more information, see section MV transformer (page 24).</td>
</tr>
</tbody>
</table>
### Main components

- **A** Lead-through holes for power grid cabling and terminal for external earthing electrode (in base plate, at the end of MV switchgear area)
- **B** Cooling air inlet
- **C** Cooling air outlet
- **D** Lead-through holes for DC cabling from solar generator. Terminal for the external DC earthing.
- **E** Lead-through holes for AC cabling from inverters to MV transformer.
- **F** Lead-through holes for cabling from MV transformer to MV switchgear

### AC cabinet components

- **A** Inverter inputs.
- **B** Auxiliary service board. For more information, see section Auxiliary service board (page 21).

### Auxiliary service board

The figure below describes the components of a standard auxiliary service board. Additional components and customization are included in the project specific documentation.
22 Hardware description

**Note:** Technical drawings are delivered with the unit, only if you requested.

<table>
<thead>
<tr>
<th></th>
<th>Hardware Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Auxiliary service transformer</td>
</tr>
<tr>
<td>2</td>
<td>Surge arrester protection for the auxiliary service board</td>
</tr>
<tr>
<td>3</td>
<td>Upstream on-load fuse switch for auxiliary service transformer protection</td>
</tr>
<tr>
<td>4</td>
<td>Downstream circuit breaker for auxiliary service transformer protection</td>
</tr>
<tr>
<td>5</td>
<td>Torch light and charger</td>
</tr>
<tr>
<td>6</td>
<td>Auxiliary service board circuit breakers and differential protections</td>
</tr>
<tr>
<td>7</td>
<td>Grounding busbar</td>
</tr>
<tr>
<td>8</td>
<td>Terminals block</td>
</tr>
</tbody>
</table>
**MV switchgear**

The station is always equipped with ABB SafeRing MV switchgear. Type CV is used as the standard and consists of two modules:

- C uses a double cable bushing configuration to connect to:
  1. The grid-side module with grid cable terminals and a disconnecting and earthing switch. See figure below.
  2. The connection of other parallel-connected substations.

- V is the Vacuum circuit breaker module equipped with the Self power relay (REJ 603) as a standard.

**MV switchgear circuit**

The diagrams below show the standard CV MV switchgear and optional CCV MV switchgear. Both the switchgears can be upgraded to V-module motorized and REF615 protection relay by adding combisensors for metering purpose.

For more information, see MV switchgear manuals ([1VDD005976](#) and [1VDD00614](#)).
24 Hardware description

- **MV transformer**
  See MV transformer manual (1LTR954400-1).

- **Inverter**
  For information on the inverter, see:
  - *PVS980 central inverter hardware manual* ([3AXD50000026013](#) [EN])
  - *PVS980 central inverters commissioning and maintenance manual* ([3AXD50000046782](#) [EN])
  - *PVS980 central inverters firmware manual* ([3AXD50000026271](#) [EN]).

**Main circuit diagram**

The general single-line diagram depends on the configuration and options of the unit as well as the configuration of the inverter group. The table below describes the baseline configuration.

See also, single line diagram 3AES-PVS980-CS-01-DW01 ([List of technical drawings (page 65)](#)).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inverters</td>
</tr>
<tr>
<td>2</td>
<td>MV transformer</td>
</tr>
<tr>
<td>3</td>
<td>MV switchgear</td>
</tr>
<tr>
<td>4</td>
<td>Auxiliary power supply</td>
</tr>
<tr>
<td>5</td>
<td>AC cabinet fan</td>
</tr>
<tr>
<td>6</td>
<td>AC cabinet heating</td>
</tr>
<tr>
<td>7</td>
<td>Power socket</td>
</tr>
<tr>
<td>8</td>
<td>Lighting</td>
</tr>
<tr>
<td>9</td>
<td>AC Cabinet control system</td>
</tr>
<tr>
<td>10</td>
<td>Inverter 1 power supply</td>
</tr>
<tr>
<td>11</td>
<td>Inverter 2 power supply</td>
</tr>
<tr>
<td>12</td>
<td>CS Control equipment</td>
</tr>
<tr>
<td>13</td>
<td>Spare 1</td>
</tr>
<tr>
<td>14</td>
<td>Spare 2</td>
</tr>
</tbody>
</table>
Type designation label

The figure below shows an example of the type designation label. The label contains the basic data of the unit. It is located inside the AC cabinet in the door to access the Auxiliary service board.

![Type designation label example](image)

<table>
<thead>
<tr>
<th>A</th>
<th>Serial number. Each unit has a unique serial number.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Description of the unit: Medium Voltage Compact Skid</td>
</tr>
<tr>
<td>C</td>
<td>Type designation key. For more information, see <a href="#">Type designation key (page 26)</a>.</td>
</tr>
<tr>
<td>D...H</td>
<td>See item description in <a href="#">Type designation key (page 26)</a>.</td>
</tr>
<tr>
<td>I</td>
<td>Manufacturing country name</td>
</tr>
<tr>
<td>J</td>
<td>Manufacturing year</td>
</tr>
</tbody>
</table>
Type designation key

The type designation describes the composition of the unit. The type designation is visible on the type designation label which is attached to the unit. The complete type designation is divided into sub codes:

- The first 1…18 digits form the basic code which describes the basic construction of the unit. The fields in the basic code are separated by hyphens.
- The option codes follow the basic code. Each option code starts with an identifying letter (common for the whole Product Series), followed by descriptive digits. The option codes are separated by plus signs.

The following table describes the fields of the basic code and the option code. Refer to the items of figure in Type designation label.

Example: PVS980-CS - XXXX - Y - + Options

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>PVS980 = Inverter mode</td>
</tr>
<tr>
<td>E</td>
<td>CS (Compact skid) = Station type</td>
</tr>
</tbody>
</table>
| F    | Power rating XXXXkVA  
See chapter Technical data (page 61). |
| G    | LV voltage  
I = 600 V, J = 630 V, K = 660 V, L = 690 V |
| H    | Option (plus) codes for additional upgrades |
Storing, lifting and transporting

Contents of this chapter
This chapter provides instructions for storing, lifting and transporting the PVS980-CS (compact skid).

⚠️ WARNING!
Inspect carefully the container before performing any activity. Verify that the compact skid has no protuberance, lack of rings, or any general poor condition.

⚠️ WARNING!
Ignoring the following instructions can cause physical injury or death, or damage to the equipment:
- Use only authorized lifting equipment and personnel.
- Prevent anybody getting under the load.
- Do not stand on the roof while fastening the lifting slings or while lifting.
- Do not throw slings or hooks onto the roof.

⚠️ WARNING!
Use original silica gel bags only during transport. Install new silica gel bags for storage.
**Storing**

**WARNING!**
To prevent damage to the compact skid, keep the delivery packaging and protection canvas on until you install it.

- Always store the compact skid in upright position.
- If removing the compact skid from protective packaging and if condensation is possible in the storage area, follow the below conditions:
  - Supply power to the internal heaters to maintain the inside temperature of the unit more than the outside temperature.
  - If power supply is not available, add humidity desiccant bags inside the station.
  - If the compact skid is stored for more than two weeks without using electric heaters, use desiccant bags. See also, *Conditions for using desiccant bags (page 28).*
- Make sure the ground underneath the compact skid is solid, flat, dry and vegetation-free. The ground must support the station evenly from below and there should not be any twisting or stress. Do not place the compact skid directly onto the bare ground because this could damage the paint and cause corrosion.
- Place the compact skid on wooden support beams. Locate the beams under the four corners and the middle points.

### Conditions for using desiccant bags

- Hang the desiccant bags approximately 1 m from the floor.
- Use 500 grams of desiccant per week. For example, for four weeks of storage, use 2 kg of desiccant bags.
- Replace the bags with fresh bags every four weeks.
- Do not open the doors unnecessarily during the storage period.
- Examples of suitable container desiccants: Xdry desiccants “H model” or Clariant “Container Dri®II- Pole”.

**Note:** The compact skid is delivered with desiccant bags from factory as standard.

The below figure shows the locations of desiccant bags, marked in red.
Lifting

**WARNING!**
Inspect the container before any activity. Make sure that the container has no protuberance, enough rings and is in good condition. Ignorance of this message can cause physical injury, death or damage to the equipment.

Before lifting the compact skid, follow these instructions.
- Protect the corners of the compact skid against shock.
- The minimum length of each sling or chains with shorteners is five meters.
- Adjust the length of lifting sling or chains so that the compact skid does not tilt during lifting.
- Do not allow the lifting slings to scratch the walls or roof. Damaged paint can lead to corrosion.
- Use a guide wire attached to a lower corner of the compact skid to prevent rotation.

**Tools used for lifting**
- Two 30 tons cranes
- Two spreaders 17 tons of 2,10 meters / 6.89 ft //to do: should this be 2.10 meters?
- Eight sling or chains 8 tons
- Loading/unloading area of approximately 32 m x 8 m (considering 40 ft HC container, auxiliary platform and crane space).
Lifting instructions

1. Place the two spreaders across the compact skid. See locations marked in below figure.
2. Attach the sling or chains to the base structure fastening point.
3. Connect the slings to the spreaders as shown in the below figures.
4. Use the two cranes.
Transporting

**WARNING!**
Keep the transportation height as low as possible. Make sure the total height of the transportation is not more than the maximum allowed height.

**WARNING!**
Transport the compact skid on an open heavy-duty chassis. Do not use an enclosed trailer because the stations surface could easily be damaged.

**WARNING!**
Do not throw the hooks over the roof. This can damage the paint and cause corrosion or operation problems.

Obey the following instructions:
- Protect the compact skid with wooden corners, plastic film, etc. The compact skid is delivered unpacked from the factory as standard.
- The compact skid is built to fit inside an ISO 40 HC (1AAA according to ISO 3874) type shipping container. It can be transported on a dedicated sea container trailer using the standard container attachment system.

**Incoming inspection at arrival**
- Visually check for any potential transportation damage(s). If any damages found, mark and record them and immediately inform your local ABB representative or your ABB sales contact.
- Repair any damaged paint. See section, *Maintenance of painted surfaces (page 55).*
- Check that the compact skid corresponds to the delivery list and order. Record the deviations (if any) and immediately inform your local ABB representative or ABB sales contact.
Unloading

**WARNING!**
To prevent damage to the compact skid, keep the delivery packaging and protection canvas on until you install it.

**WARNING!**
Inspect the compact skid carefully before performing any activity. Check that there is no protuberance or any general poor condition.

- **Tools used for unloading**
  - Eight tons forklift
  - Two guide platforms with length eight meters and width 500 mm (not provided)
  - Two belly chains of 9.5 tons
  - Two slings of eight tons. Minimum five meters.

- **Pre-requisite**
  Follow the below instructions before you start unloading the PVS980-CS received in a 40 ft HC container:
  1. Protect the corners of the compact skid against shock.
  2. Make sure that the terrain is level and sturdy. Consider that the compact skid has an approximate weight of 15 tons.
  3. Unload the standard container carrying the compact skid inside. Follow local regulations and applicable standards such as ISO 3874.
  4. Remove all stops, and transportation sling or chains at both ends and laterals.
- **Unloading instructions**
  1. Align the guide platforms to the wheels trajectory.
  2. Make sure that the guide platforms are leveled to the container floor.
  3. Connect the belly chains to the fastening points in the skid profile.
  4. Connect the slings to the belly chains and to the forklift.
5. **Slowly and carefully** pull the compact skid out of the container using the forklift. The forklift must be perfectly aligned to the compact skid, so that the station does not touch the container walls.

Optional: Pull the compact skid until connection with spreader and crane is possible. Then follow the lifting procedure to place the compact skid.
Mechanical installation

Contents of this chapter
This chapter describes the mechanical installation of the PVS980-CS (compact skid) and gives general instructions on how to select the location and guidelines to build the foundation for the compact skid. Obey all local regulations.

Safety
See Safety instructions (page 9).
Before you move the compact skid, see instructions in chapter Storing, lifting and transporting (page 27).

Tools
Use the following tools to move the compact skid, to fasten the compact skid foundation, and to tighten the connections:
- Crane, forklift, or pallet truck (with sufficient load capacity)
- Pozidriv and Torx (2.5...6 mm) screwdrivers with short and long heads or bits
- Torque wrench
- Set of wrenches and sockets.
Foundation guidelines

**WARNING!**
The pit for the foundation and the foundation must be designed by an experienced civil work engineer. Obey all local rules and regulations. ABB is not responsible for the design of the foundation.

For information on the MVS dimensions and footprint, see drawing 3AES-PVS980-CS-30-DW02.

Always follow the local rules and laws when designing and constructing the foundation. Pay attention to the proper planning and constructing of the foundation. For example, an improper foundation can cause settling of the compact skid or difficulty opening the door.

Follow the below guidelines:

- To prevent any risk of corrosion, install the compact skid higher than its surroundings so that surface water will not collect around its perimeter.
- Tilt the surface of the surrounding ground at least 50 mm per meter (two inches per 40 in). This ensures that surface water flows away from the compact skid.
- Consider local conditions, such as soil type, frost protection, rain amounts, etc. An improper foundation can cause setting of the compact skid or difficulty opening the door.
- Consider the required cable bending radius and installation room.
- The built-on site user platform around the compact skid must be at least one meter (40 in) wide. If it is narrower, service work can be difficult.
- The entire perimeter of the compact skid must rest on the foundation.
- The compact skid must be above ground level. To support the station, use concrete or steel columns of at least 450 mm of height anchored to the attachment points marked in the drawing 3AES-PVS980-CS-4600-30-DW02.
  
  **Note:** The columns or concrete pad foundations are not part of the delivery.
- Check the load carrying capacity of the ground and potential local special requirements (for example, earthquake or typhoon anchoring) of the construction area. Use materials suitable for the local conditions and requirements.

**Placing the compact skid on the foundation**

**WARNING!**
Before laying the compact skid onto the foundation, make sure the foundation is aligned well, hardened and stable.

1. Measure the level of the foundation and the tilting of the surface of the surrounding ground around the foundation. Obey the *Foundation guidelines (page 36).*
2. Make sure the foundation below the compact skid is leveled. Inclination up to 0.1 degrees is permitted.
3. Move the compact skid onto the foundation. Obey the instructions in section *Lifting (page 29).* Make sure that the foundation does not move. Also make sure that the station is stable and in direct contact with the foundation.
4. When the compact skid is placed on the foundation, measure the height and inclination of the compact skid. Check the slope of the surface of the surrounding ground around the compact skid.
Fastening the compact skid

WARNING!
Do not fasten the compact skid by electric welding, because the welding circuit can damage electronic circuits and integrity of the station. ABB does not assume any liability for damages caused by electric welding.

To fasten the compact skid to the foundation, use the supplied attachment brackets (see figure below). Use bolts and washers in each connection point (not provided).

Follow the local regulations and applicable standards to calculate the mechanical and structural properties of the connector. Always consider the site conditions and terrain characteristics.

For more information, see drawing 3AES-PVS980-CS-30-DW02.

Constructing earthing electrode and earthing

Construct an earthing electrode for the compact skid according to local regulations. For more information, see drawing 3AES-PVS980-CS-02-DW02.
Filling the pit and finalizing the surroundings

1. If required for local frost conditions, add insulation around the column foundation.
2. To minimize the growth of grass, use geotextile below the foundation and below the service platform around the compact skid. Put the geotextile 20 cm (8 in) below and about 100 cm (40 in) around the foundation.
3. The compact skid is a non walking station, designed to be operated from the outside. Provide a permanent or portable platform for comfortable operation of the compact skid switching devices as the foundation can be higher than the surrounding ground. For platform design and construction, follow local rules and standards.
4. Do not plant trees near the compact skid. If bushes are planted, make sure that the planting compost base is at least one meter (40 in) away from the station housing and that the fully-grown bushes do not prevent maintenance access to the compact skid. Make sure that anything planted near the inverter does not discharge dust or seeds that can affect the cooling air flow.

Unpacking

To prevent any damage to the compact skid, perform the unpacking as late as possible before the installation. For the permitted operating conditions, see PVS980-CS datasheet.
Electrical installation

Contents of this chapter

This chapter contains general instructions for earthing and cabling the PVS980-CS (compact skid). Obey all instructions contained in the applicable documentation (such as other hardware manuals) and local regulations.

**WARNING!**
Only an authorized electrician is allowed to install the cabling to the compact skid. Obey the *Safety instructions (page 9)* and the local safety regulations. If ignored, physical injury or death may follow, or damage to the equipment may occur.

**WARNING!**
Do not do any electrical installation work during a thunderstorm.

**WARNING!**
Make sure that all external cable entries are fully sealed to prevent entry of foreign elements, such as animals and insects.
Routing the cables

When you route the cables:
- Install the DC medium voltage and control cables on separate routes.
- Use separate cable entries for different cable types.
- Make sure that the cable trays are electrically bonded to each other and to the ground.
- Make sure that the power cables and the control cables are separated by at least 500 mm (20 in).
- If control cables cross the power cables, set them at an angle as close to 90 degrees as possible.
- Do not put extra cables through the compact skid without permission.

For more information, see drawing 3AES-PVS980-CS-01-DW02

Earthing

 Construct an earthing electrode for the compact skid. Follow local regulations. Connect the earthing electrode to the terminal located at the base of the compact skid. See drawing 3AES-PVS980-CS-02-DW02. Use joint lubricant to protect the connection point against corrosion.

Follow the minimum requirements for the earthing electrode:
- Minimum cross-sectional area = 95 mm². The plates are prepared for 95 mm² cables
- Installation depth = 500...800 mm from the surface of the soil
- Installation route round the compact skid = one meter from the outer wall
- Connect the compact skid earthing busbar and the skid frame protective earthing to the earthing electrode.

For more information, see drawing 3AES-PVS980-CS-02-DW02
Protective earthing (grounding) inside the compact skid

The protective earth (PE) terminals or frames of the main components in the compact skid are connected to two main PE terminals located at the corner of the building.

At the installation site:
- measure the continuity of all internal PE connections by measuring the conductivity between each protective earth terminal and the main PE busbars
- earth the shields, armors and protective conductors of all incoming cables to the appropriate earthing terminals of the station.

For more information, see drawing 3AES-PVS980-CS-02-DW02

Measuring the insulation resistance of the cabling

Make sure that the insulation resistance of the external power cables are measured according to manufacturer recommendations and local regulations.

Connecting DC cable from solar generator to inverters

**WARNING!**
Make sure that the cable entry is sealed to maintain the IP classification of the inverter.

See also, *PVS980 hardware manual (3AXD5000026013 [EN])* and the wiring diagrams delivered with the compact skid.

To connect the DC cable from solar generator to inverters:
1. Remove the covers of the cable entries.
2. Lead the cables into the compact skid and seal the entry with the gland plates that is delivered with the inverter.
3. Connect the cables to correct terminals of the inverters. Tighten the connections to the torque values given in the *PVS980 commissioning and maintenance manual (3AXD50000046782 [EN])*.
4. Fill the cable trenches and seal the cable entries. See Finalizing the installation. to do: link to correct section.

Connecting the communication and auxiliary cabling (Optional)

See the following drawings:
- Auxiliary service board drawing—3AES-PVS980-CS-14-SP01
- Communication cabinet drawing—3AES-PVS980-CS-15-SL01
- UPS connection drawing—3AES-PVS980-CS-16-SP01.

To connect the cabling for auxiliary cabinet, communication and UPS:
1. Remove the cable entry covers.
2. Lead the cables into the station and seal the cable entries.
3. Connect the cables to the correct terminal in the AC cabinet (communication cabinet and AC distribution cabinet). Tighten the connections.
4. Fill the cable trenches and seal the cable entries. See chapter *Finalizing the installation (page 43)*.

**Connecting the power grid cabling to the MV switchgear**

See the MV switchgear manual and the wiring diagrams that are delivered with the compact skid.

To connect the power grid cable to the MV switchgear:
1. Remove the cable entry covers.
2. Lead the cables into the compact skid and seal the cable entries.
3. Terminate the cables according to the cable manufacturer instructions. Connect the cables to the MV switchgear. The standard cable termination (see figure below) installed in MV switchgear is of interface type C with bolted type 400 series.

![Interface C diagram](image-url)

Interface C with M16 x 2 metric threads 400 series, \( I_n = 630 \text{ A} \)

This termination is standard on all modules and for side connections.

4. Fill the cable trenches and seal the cable entries. For more information, see chapter *Finalizing the installation (page 43)*.

5. Connect the cables to correct terminals.

**Note:** Maximum MV cable sizes depend on the connector dimensions. See MV switchgear manual to determine the maximum cable size and configuration (see 1YVA000024 and 1YVA000026).
Finalizing the installation

Contents of this chapter

This chapter contains the general instructions on how to finalize and check the installation of the PVS980-CS (compact skid). Obey all local regulations.

WARNING!
Only an authorized electrician is permitted to install the cabling to the compact skid. Obey the Safety instructions (page 9), and the local safety regulations. If ignored, physical injury or death may occur, or cause damage to the equipment.

WARNING!
Do not do electrical installation work during a thunderstorm.

WARNING!
Make sure that all external cable entries are fully sealed to prevent entry of foreign elements, such as animals and insects.

Finalizing the installation

1. Clean the compact skid of all dirt.
2. Repair any damages to the paint surface. See section, Maintenance of painted surfaces (page 55).
3. Install the external hood for the fan (if apply). See Mechanical installation (page 35).
4. If not yet done, seal the cable entries, cover the cable entries with sand and sprinkle a handful of cement over the sand. The cement hardens in a few days and it forms a barrier against small animals and plant growth.
Landscaping the station

You can plant suitable bushes around the compact skid to landscape it.
Do not plant trees near the station. If bushes are planted, make sure that the planting compost base is at least two meters away from the compact skid, and that the fully-grown bushes will not prevent maintenance access. Make sure that the plantation does not discharge dust or seeds that could hinder the cooling air flow.

Checking the installation of compact skid

<table>
<thead>
<tr>
<th>Item</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Check all mechanical operating functions by operating them at least twice.</td>
<td>✓</td>
</tr>
<tr>
<td>Make sure that the compact skid clearance space is maintained.</td>
<td>✓</td>
</tr>
<tr>
<td>For more information on the required clearance space, see footprint layout 3AES-PVS980-CS-30-DW02.</td>
<td></td>
</tr>
<tr>
<td>Examine the paint surface and repair if any damages found. See instructions in section <em>Maintenance of painted surfaces (page 55)</em>.</td>
<td></td>
</tr>
<tr>
<td>Make sure that all cable glands at each cable inlet is installed correctly and all the unused cable openings have protection caps.</td>
<td></td>
</tr>
<tr>
<td>Examine the earthing (grounding) of the compact skid and its components and make sure that it obeys the earthing (grounding) schematic. Pull the earthing wires at the terminals to ensure that the connections are tight.</td>
<td></td>
</tr>
<tr>
<td>Remove any foreign objects such as loose fastenings and tools from the compact skid. This can cause short-circuit faults or other damages.</td>
<td></td>
</tr>
<tr>
<td>Make sure that the compact skid is clean. Contaminated surfaces can increase the risk of corrosion. For more information, see chapter <em>Maintenance (page 51)</em>.</td>
<td></td>
</tr>
<tr>
<td>Examine the clearance distances, cable terminations and connections and make sure that all connections are according to the main circuit diagram.</td>
<td></td>
</tr>
<tr>
<td>Examine that all cable connections are correctly tightened.</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Tighten the cable connections of the Switchgear to the MV transformer's bushings. These are delivered loose to prevent damages when transporting the unit.

| Make sure that the required warning labels are attached to the compact skid. |   |
| Make sure that the insulation resistance of the external power cables are measured. |   |
| Do the installation checks detailed in the device-specific manuals.       |   |
| Do the inspection procedures required by the respective authorities.      |   |
Start-up and operation

Contents of this chapter
This chapter describes the start-up procedure and general operation criteria of the PVS980-CS (compact skid).

WARNING!
Only an authorized electrician is permitted to start-up and operate the compact skid. Obey the Safety instructions (page 9) and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

WARNING!
Do not do electrical installation work during a thunderstorm.

Tools needed
- PC with Drive composer PC tool and applicable communication cables (for the inverter diagnostics and settings).
- Voltage detector
- Insulation resistance meter. For more information, see section Measuring the insulation resistance of the cabling (page 41).
- Personal protective equipment
Prerequisite

**WARNING!**
Use original silica gel bags only during transport. Install new silica gel bags for storage.

1. Remove the transportation covers.
2. Remove silica gels.
   See below figure. The locations of silica gels are marked in red.

![Silica Gel Locations](image_url)

Start-up procedure

This section describes the procedure to start-up the PVS980-CS (compact skid).

**WARNING!**
Only an authorized electrician is permitted to install and perform the start-up procedure. Obey the *Safety instructions (page 9)* and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

**WARNING!**
Read the manuals and start-up procedures of all other components (inverters, UPS, etc.). Note that the guidelines specified in this section does not replace the instructions given by the product manuals of each component.

<table>
<thead>
<tr>
<th>Task</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-check the MV switchgear.</td>
<td>Check that there is no voltage.</td>
</tr>
<tr>
<td>Visually examine the gas level of the SF6 tank from the gauge.</td>
<td></td>
</tr>
<tr>
<td>Operate all mechanical devices twice.</td>
<td>See <em>SF6 Insulated Main Unit and Compact MV Switchgear Installation and Operating Instructions</em>.</td>
</tr>
<tr>
<td>Pre-check the MV transformer.</td>
<td>Check that there is no voltage. See instructions in the MV transformer manual. to do: manual link.</td>
</tr>
<tr>
<td>Pre-check the inverter.</td>
<td>Check that there is no voltage.</td>
</tr>
<tr>
<td>Do the inverter cold commissioning before switching on the power.</td>
<td>See <em>PVS980 commissioning and maintenance manual</em> (3AXD50000046782 [EN]).</td>
</tr>
<tr>
<td>Pre-check the auxiliary service board.</td>
<td>Check that there is no voltage.</td>
</tr>
<tr>
<td>Close the disconnecting devices between the solar generator and DC input terminals of the inverter.</td>
<td></td>
</tr>
<tr>
<td>Task</td>
<td>Additional information</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Make sure that the inverters operate correctly.</td>
<td>Check that there is sufficient light for the inverters to be able to feed power to the AC power system (grid).</td>
</tr>
<tr>
<td>Measure the DC supply voltage at each input terminal of the inverter to verify that the polarity and voltage range conforms to the specifications of the inverter.</td>
<td>See PVS980 hardware manual (3AXD50000026013 [EN]).</td>
</tr>
<tr>
<td>Close the DC disconnectors of the first inverter [PVS1].</td>
<td>See PVS980 hardware manual (3AXD50000026013 [EN]).</td>
</tr>
<tr>
<td>Repeat the above commissioning tasks for the second inverter [PVS2].</td>
<td>Make sure that the inverters detect the fault indications and trip accordingly. See the project specific circuit diagrams that came with the PVS980-CS.</td>
</tr>
<tr>
<td>Simulate MV transformer faults (unpowered).</td>
<td>Make sure that the inverters and/or the SCADA system detects the signals. See the project specific circuit diagrams that came with the PVS980-CS.</td>
</tr>
</tbody>
</table>

**Connecting the PVS980-CS to the power grid**

| Make sure that AC disconnectors of both inverters are open.         | See PVS980 hardware manual (3AXD50000026013 [EN]).                                       |
| Make sure that all the local regulations, applicable laws, and standards required by the local power grid are met. | Contact your local grid and MV authority.                                                 |
| Turn the earthing switch on the grid side of the MV switchgear to the “not earthed” position. | Applicable for C module MV switchgear                                                   |
| Ask the power grid owner to connect the station to the power grid. | Contact your local grid and MV authority. Only authorized personnel are permitted to make the connections. |
| Turn the disconnecting switch on the grid side of the MV switchgear to Closed position. | Applicable for C module MV switchgear.                                                    |
| Turn the earthing switch on the MV transformer side of the MV switchgear to the “not earthed” position. | Applicable for V module MV switchgear.                                                    |
| Turn the disconnecting switch on the MV transformer side of the MV switchgear to the closed position. | Applicable for V module MV Switchgear.                                                    |
| Close the main breaker of the MV transformer.                      | Applicable for V module MV switchgear.                                                    |
| Make sure that the voltage level on the low voltage side of the MV transformer is correct. Adjust the MV transformer tap settings if needed. | Check that MV transformer is de-energized before adjusting the tap settings.             |
| Run the MV transformer without load for several hours.             | See MV transformer documentation.                                                         |
| Check the MV transformer for any malfunctions. Observe the temperature, listen to audible changes, etc. | See MV transformer documentation.                                                         |

**Connecting the inverters to AC supply**

| Close the AC disconnectors [-1Q4 and -2Q4] of both inverters.       | See PVS980 commissioning and maintenance manual (3AXD500000048782 [EN]). |
| Follow the inverter commissioning procedure.                       |                                                                         |
If any other optional equipment is integrated into the compact skid such as UPS, communication equipment and others, then check the applicable documentation of the equipment before executing the start-up procedure.
Auxiliary service board start-up (Optional)

This section describes the procedure to start-up the auxiliary service board. See also, electrical diagrams of the AC cabinet 3AES-PVS980-CS-4600-14-SP01 delivered with the unit.

<table>
<thead>
<tr>
<th>Task</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the position of the 98A1 switch to ON position (AC</td>
<td>Voltage level depends on the inverter type: 600 / 630 / 660 / 690 V</td>
</tr>
<tr>
<td>distribution cubicle).</td>
<td></td>
</tr>
<tr>
<td>Connect the Auxiliary service board.</td>
<td>Check that the MV transformer is de-energized (open).</td>
</tr>
<tr>
<td>Close the main switch of the Auxiliary service transformer.</td>
<td>Check that all switches, disconnectors and breakers of the Auxiliary service board are open.</td>
</tr>
<tr>
<td>Energize the MV transformer.</td>
<td></td>
</tr>
<tr>
<td>Check that the incoming voltage level is equal to inverter voltage AC output.</td>
<td></td>
</tr>
<tr>
<td>Close Auxiliary service transformer primary breaker.</td>
<td></td>
</tr>
<tr>
<td>Check that the Auxiliary service transformer secondary winding voltage level is 400 / 230 V.</td>
<td>Check that voltage is 400 / 230 V +/-10%.</td>
</tr>
<tr>
<td>Close Auxiliary service transformer secondary breaker.</td>
<td></td>
</tr>
<tr>
<td>Close the auxiliary breakers one at a time. and check the voltage of each breaker.</td>
<td>Check that there is no voltage before opening the next auxiliary breaker. Also check that the auxiliary service lines with load are closed. Only switches/breaker with load should be open.</td>
</tr>
</tbody>
</table>
50 Auxiliary service board start-up (Optional)

<table>
<thead>
<tr>
<th>Task</th>
<th>Additional information</th>
<th>□</th>
</tr>
</thead>
</table>
| Close the fuse base switches of the inverter input one at a time. | Check that there is no voltage before opening the next fuse base.  
Also check that the inverters are de-energized.  
See the inverter manual. to do: correct manual link. |   |
| Follow the inverter commissioning procedure.   | See *PVS980 commissioning and maintenance manual* (3AXD50000046782 [EN]).             |   |

If any other optional equipment is integrated into the compact skid such as UPS, communication equipment and others, then check applicable documentation of the equipment before executing the start-up procedure.
Maintenance

Contents of this chapter
This chapter contains general instructions for the preventive maintenance of compact skid). These instructions are intended for personnel certified by ABB to perform such maintenance tasks. Obey all the local regulations.

WARNING!
Only an authorized electrician is permitted to do maintenance work on the compact skid. Obey the Safety instructions (page 9) and follow the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

WARNING!
Do not do electrical work during a thunderstorm.

Tools list
• Torx drivers
• Philips screwdrivers (PoziDriv)
• Torque wrench
• Set of wrenches and sockets
• Cable and wire strippers
• Crimping tool and cable lugs
• Voltage detector
• Personal protective equipment
Tightening torque

Use the torque values given in the below table, unless otherwise specified.

<table>
<thead>
<tr>
<th>Bolt and nuts</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel: A2-70/A4-70/8.8 (N.m)</td>
</tr>
<tr>
<td>M3</td>
<td>0.9</td>
</tr>
<tr>
<td>M4</td>
<td>2.3</td>
</tr>
<tr>
<td>M5</td>
<td>4.5</td>
</tr>
<tr>
<td>M6</td>
<td>8.0</td>
</tr>
<tr>
<td>M8</td>
<td>20</td>
</tr>
<tr>
<td>M10</td>
<td>40</td>
</tr>
<tr>
<td>M12</td>
<td>70</td>
</tr>
<tr>
<td>M14</td>
<td>110</td>
</tr>
<tr>
<td>M16</td>
<td>170</td>
</tr>
<tr>
<td>M18</td>
<td>240</td>
</tr>
</tbody>
</table>

1) Not applicable to threaded inserts
### Threaded inserts

<table>
<thead>
<tr>
<th>Bolt and nuts</th>
<th>Torque in N.m (steel/ stainless steel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>7.9</td>
</tr>
<tr>
<td>M6</td>
<td>12</td>
</tr>
<tr>
<td>M8</td>
<td>20</td>
</tr>
<tr>
<td>M10</td>
<td>34</td>
</tr>
</tbody>
</table>

### Maintenance intervals

The maintenance and component replacement intervals are based on the specified operational and environmental conditions.

ABB establishes the following as a minimum maintenance schedule. The compact skid final maintenance schedule must be adapted and defined by the maintenance responsible of the plant according to the site conditions, operations and others.

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Visually inspect and perform maintenance if it is necessary</td>
</tr>
<tr>
<td>P</td>
<td>On-site/off-site performance work (commissioning, tests, measurements, etc.)</td>
</tr>
<tr>
<td>R</td>
<td>Replace the component</td>
</tr>
</tbody>
</table>

For more information on maintenance, contact your local ABB service representative.

### Maintenance activities

Perform the following inspections at least once in every six months.

<table>
<thead>
<tr>
<th>Action</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Check the operating environment, surroundings and conditions.</td>
</tr>
<tr>
<td>I</td>
<td>Check the availability of spare parts.</td>
</tr>
<tr>
<td>I</td>
<td>Check for any dust, corrosion, etc. inside and outside the compact skid.</td>
</tr>
<tr>
<td>I</td>
<td>Check and clean the inlet and outlet grills &amp; filters.</td>
</tr>
<tr>
<td>I</td>
<td>Check the sealing of all cable entries to ensure that the IP protection level is maintained.</td>
</tr>
<tr>
<td>I</td>
<td>Clean the filters of the air inlet and outlet.</td>
</tr>
<tr>
<td>I</td>
<td>Examine the tightness and cleanliness of the main circuit terminals and earth connections.</td>
</tr>
<tr>
<td>I</td>
<td>Inspect the general conditions of the compact skid (door sealing, cooling fan operation, etc.)</td>
</tr>
<tr>
<td>I</td>
<td>Inspect the operation of locks, hinges, and gaskets.</td>
</tr>
<tr>
<td>I</td>
<td>Check that all labels are readable and in proper conditions.</td>
</tr>
<tr>
<td>I</td>
<td>Examine the condition of the foundation.</td>
</tr>
</tbody>
</table>
Component maintenance intervals

<table>
<thead>
<tr>
<th>Component</th>
<th>Years from start-up or interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>MV Switchgear Area air filters</td>
<td>R(every six months)</td>
</tr>
<tr>
<td>Auxiliary service board (if applicable)</td>
<td></td>
</tr>
<tr>
<td>Cooling fans</td>
<td>R</td>
</tr>
<tr>
<td>Air filters</td>
<td>R (every six months)</td>
</tr>
<tr>
<td>UPS</td>
<td>Obey manufacturer instructions</td>
</tr>
</tbody>
</table>

For information on the maintenance of MV transformer and MV switchgear, see the applicable documentation.

Removing the technical floor

If the maintenance prefers to remove the technical floor, follow the below instructions:

1. Remove the screws.
2. Lift and remove the technical floor.

Inverter maintenance

For information on the maintenance of inverters, see PVS980 central inverters commissioning and maintenance manual (3AXD50000046782 [EN]).

Cleaning procedure

This section contains the minimum requirements for cleaning the PVS980-CS. Perform the inspections at least twice a year. Make sure that a sufficient high frequency according to specific site conditions or as recommended by ABB is used.

**WARNING!**

Obey the Safety instructions (page 9) and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

**WARNING!**

Read the manuals of other components (inverters, UPS, etc.). The guideline specified in this section does not replace the instructions given by the product manuals of each component.

<table>
<thead>
<tr>
<th>Task</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-check that there are safe conditions before starting any cleaning procedure.</td>
<td>☑</td>
</tr>
<tr>
<td>Cleaning the compact skid</td>
<td>☐</td>
</tr>
<tr>
<td>Use pressurized air to clean the external enclosure, floors and gutters.</td>
<td>☐</td>
</tr>
<tr>
<td>Use pressurized air to clean all air inlets and outlets, including grills.</td>
<td>☐</td>
</tr>
<tr>
<td>Cleaning the AC Cabinet</td>
<td></td>
</tr>
</tbody>
</table>
### Task
Use a vacuum cleaner to clean the floor, doors and interior beams.

### Additional information
If necessary, use a duster or pressurized air to clean locations you cannot reach with the vacuum cleaner.

Remove dust from the air inlets and outlets.

Use pressurized air to clean locations with excessive dust, including busbar connections.

### Cleaning the inverters
Follow the instructions in the inverters manual.

### Cleaning the MV transformer area
Use a pressurized air to clean the general dust in the MV transformer surface and locations with excessive dust.

See MV transformer manual.

### Cleaning the air filters
Clean the air filters by blowing compressed air from the inside to the outside through the filter until the dust comes off.

Loosen and remove the screws on the filter frame.

Clean the grill interior with a vacuum cleaner.

Install the filter support frames and tighten the screws.

### Cleaning the fans
Turn OFF/OPEN the circuit breaker for fan.

Avoid the circuit breaker from turning on accidentally.

Disconnect the supply and signal cabling.

Measure to make sure that it is not energized.

Use compressed air to clean the fans.

### Cleaning the MV switchgear area
Use a vacuum cleaner to clean the floor, doors and interior metal beams.

If necessary, use a duster or pressurized air to clean locations you cannot reach with the vacuum cleaner.

### Maintenance of painted surfaces

**WARNING!**
Obey the Safety instructions (page 9) and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

**WARNING!**
Obey the Safety instructions (page 9), requirements and specifications of the primer and paint manufacture.

- **Repainting the scratched areas**

**Tools and materials**

- Sand paper
- Cleaning towels and liquids: Würth Pro-Clean 0893 140 or equivalent
- Primer below paint on rusted or deeply scratched surfaces: Hempadur Mastic 45880 12170 of 280 microns when wet
• Finishing paint: 55210 RAL 7035 of 100 microns when wet

Painting the damaged surface (no visible rust)
If there is damage(s) to the paint surface, but no damages to the metal surface (i.e. no visible rust), then follow these instructions:
1. Clean the damaged area first with a suitable detergent and clean water.
2. Let the surface dry completely and keep it clean.
3. Apply the first layer of paint to the damaged area. Let it dry thoroughly for at least 12 hours.
4. Apply the second layer of paint to the damaged area.

Painting the damaged surface (visible rust)
If the damage extends to the metal surface or there is visible rust:
1. Remove the rust with sandpaper/polishing disk.
2. Clean the damaged area and its surroundings using a cloth or blower.
3. If necessary, apply putty to even out the surface.
4. Coat the damaged area with an epoxy primer. Let it dry thoroughly (for at least 24 hours).
5. Apply first layer of paint to the damaged area. Let it dry thoroughly (for at least 12 hours).
6. Apply second layer of paint to the damaged area.
7. Apply final layer (e.g. Aliphatic Polyurethane coating).

Maintenance of Zinc coated surfaces

WARNING!
Obey the Safety instructions (page 9) and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

WARNING!
Obey the Safety instructions (page 9), requirements and specifications of the primer and paint manufacture.

• Coating the scratched areas

Tools and materials
• Sand paper
• Cleaning towels and liquids: Würth Pro-Clean 0893 140 or equivalent)
• Primer below paint on rusted or deeply scratched surfaces: Hempadur Mastic 45880 12170 of 280 microns when wet
• Finishing paint: 55210 RAL 7035 of 100 microns when wet

Coating the damaged surface
Pay attention to doors and lower parts of the walls. These areas have potentially corrosive elements such as dust and humidity.
If there is damage to the zinc-coating:
1. Carefully remove any rust with sandpaper.
2. Clean the damaged area and its surroundings.
3. Coat the damaged area with the zinc coating. Use Würth Zinc 300 for a thicker coat. On large areas, you can use Würth Zinc Spray Perfect to ease the work and to get an even surface.

**Maintenance of grounding bars and points**

**WARNING!**
Obey the *Safety instructions (page 9)* and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

- **Tools**
  - Steel wool
  - Ensto SR1 joint compound or equivalent
  - 42839 Würth protective wax or equivalent

- **Procedure**
  1. Examine the condition of the grounding bar and grounding cables in the MV switchgear area. If there is any visible corrosion, remove the cables and remove the corrosion with steel wool. Apply joint compound between the grounding bar and the joint surfaces of the cable terminal.
  2. Change the spring lock washers. Tighten the cables to the nominal torque values.
  3. If corrosion is more, apply protective wax spray on the grounding bar and the cable terminals.
Maintenance of external hinges and locks

WARNING!
Obey the Safety instructions (page 9) and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.

Tools
- Cleaning materials
- Hinge lubricant: Würth HHS20000 0893 106 (or equivalent)
- Lock lubricant: Würth Maintenance Spray 0893 051 (or equivalent)

Note: Do not use lubricants with Silicone.

- Lubricating the external hinges and locks
  1. Lubricate the external hinges and locks.
  2. Wipe off the excess lubricant.

Procedure
1. Examine the condition of the grounding bar and grounding cables in the MV switchgear area. If there is any visible corrosion, remove the cables and remove the corrosion with steel wool. Apply joint compound between the grounding bar and the joint surfaces of the cable terminal.
2. Change the spring lock washers. Tighten the cables to the nominal torque values.
3. If corrosion is more, apply protective wax spray on the grounding bar and the cable terminals.
Technical data

Contents of this chapter
This chapter contains the technical data of the PVS980-CS (compact skid).
# Technical data and types: PVS980-CS

## Data

<table>
<thead>
<tr>
<th>Data</th>
<th>Type code (PVS980-CS-...)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>Maximum rating in kVA</td>
<td>2000</td>
</tr>
</tbody>
</table>

**Inverter**

<table>
<thead>
<tr>
<th>Inverter</th>
<th>PVS980</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum operating DC input voltage</td>
<td>1500 V</td>
</tr>
<tr>
<td>Number of inverters</td>
<td>1</td>
</tr>
<tr>
<td>Number of independent mppt</td>
<td>1</td>
</tr>
<tr>
<td>mppt range @ 35 °C in V</td>
<td>850-1500</td>
</tr>
<tr>
<td>mppt range @ 50 °C in V</td>
<td>850-1100</td>
</tr>
<tr>
<td>AC output voltage</td>
<td>600 V</td>
</tr>
</tbody>
</table>

**MV transformer**

<table>
<thead>
<tr>
<th>Transformer type</th>
<th>Oil immersed (ONAN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC power at 35 °C in kVA</td>
<td>2000</td>
</tr>
<tr>
<td>AC power at 50 °C in kVA</td>
<td>1818</td>
</tr>
<tr>
<td>Number of secondary windings</td>
<td>1</td>
</tr>
<tr>
<td>Low voltage level</td>
<td>600 V</td>
</tr>
<tr>
<td>Medium voltage level range</td>
<td>≤ 36 kV</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50 Hz or 60 Hz</td>
</tr>
<tr>
<td>Oil type</td>
<td>Mineral (vegetable optional)</td>
</tr>
<tr>
<td>Tap changer</td>
<td>± 2 x 2.5%</td>
</tr>
<tr>
<td>Winding material (primary / secondary)</td>
<td>Al / Al</td>
</tr>
<tr>
<td>Eco efficiency optional</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**MV switchgear**

<table>
<thead>
<tr>
<th>Switchgear type</th>
<th>ABB SafePlus (SF₆-insulated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current</td>
<td>630 A</td>
</tr>
<tr>
<td>Configuration</td>
<td>Single (CV) or double feeder (CCV)</td>
</tr>
<tr>
<td>Protection (up to 24 kV / 36 kV)</td>
<td>Circuit breaker (16 kA or 20 kA / 20 kA or 25 kA)</td>
</tr>
<tr>
<td>Protection relay type</td>
<td>ABB REJ603 (others on request)</td>
</tr>
<tr>
<td>Motorized optional</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Auxiliary supply**

<table>
<thead>
<tr>
<th>Auxiliary transformer power</th>
<th>10 kVA (20 kVA, 39 kVA optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary transformer primary voltage level</td>
<td>600 V</td>
</tr>
<tr>
<td>Auxiliary transformer secondary voltage level</td>
<td>400-230 V</td>
</tr>
<tr>
<td>Low voltage distribution panel for auxiliary functions</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Mechanical characteristics**
### Technical data 63

<table>
<thead>
<tr>
<th>Data</th>
<th>Type code (PVS980-CS-...)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (length × width × height) in mm</td>
<td>11850 x 2150 x 2570 (40ft HC container dimensions)</td>
</tr>
<tr>
<td>Weight approx. in ton</td>
<td>17  17  17  17  24  24  24  24</td>
</tr>
</tbody>
</table>

#### Environmental

| Operating temperature range               | -20 °C ... +50 °C |
| Operating altitude range                 | ≤ 2000 m |
| Relative humidity (non-condensing)       | ≤ 95 % |
| Environmental protection rating          | IP 54 (IP 66 for inverter) |
| Painting corrosion protection            | C4 (C5M optimal) |

#### Product compliance

| Conformity                                | IEC 60364, IEC 61936-1, IEC 60502-1 |
| Grid support                              | Reactive power compensation (also at night), power reduction, LVRT, HVRT, FqRT |
Contents of this chapter
This chapter contains the technical drawings of PVS980-CS (compact skid).

List of technical drawings
The list includes two types of drawings:
- Product Series—Standard product series drawings that can be consulted prior to the purchase of the unit.
- Project Specific—Drawings specific to a project that are delivered with the unit, only on request.

<table>
<thead>
<tr>
<th>Drawing code</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>3AES-PVS980-CS-01-DW01</td>
<td>Single Line Diagram</td>
<td>Product Series</td>
</tr>
<tr>
<td>3AES-PVS980-CS-02-DW01</td>
<td>Electrical Layout</td>
<td>Product Series</td>
</tr>
<tr>
<td>3AES-PVS980-CS-02-DW02</td>
<td>Grounding Layout</td>
<td>Product Series</td>
</tr>
<tr>
<td>3AES-PVS980-CS-14-DW03</td>
<td>Auxiliary Cabinet</td>
<td>Project Specific</td>
</tr>
<tr>
<td>3AES-PVS980-CS-30-DW01</td>
<td>Dimensional Layout</td>
<td>Product Series</td>
</tr>
<tr>
<td>3AES-PVS980-CS-30-DW02</td>
<td>Footprint</td>
<td>Product Series</td>
</tr>
<tr>
<td>3AES-PVS980-CS-14-SP01</td>
<td>Auxiliary Service Board</td>
<td>Project Specific (if applicable)</td>
</tr>
<tr>
<td>3AES-PVS980-CS-15-SP01</td>
<td>Communication Board</td>
<td>Project Specific (if applicable)</td>
</tr>
<tr>
<td>3AES-PVS980-CS-16-SP01</td>
<td>UPS Connection</td>
<td>Project Specific (if applicable)</td>
</tr>
</tbody>
</table>
Further information

Product and service inquiries
Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

Product training
For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB manuals
Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

Document library on the Internet
You can find manuals and other product documents in PDF format on the Internet at www.abb.com/drives/documents.