CMS-17
SWITCHING AND BREAKING SUBSTATION

LIB
11.08.2011
CAUTION!

When MV equipment is operating, certain components are live, other parts may be in movement and some may reach high temperatures. Therefore, the use of this equipment poses electrical, mechanical and thermal risks.

In order to ensure an acceptable level of protection for people and property, and in compliance with applicable environmental recommendations, Ormazabal designs and manufactures its products according to the principle of integrated safety, based on the following criteria:

- Elimination of hazards wherever possible.
- Where elimination of hazards is neither technically nor economically feasible, appropriate protection functions are incorporated in the equipment.
- Communication about remaining risks to facilitate the design of operating procedures which prevent such risks, training for the personnel in charge of the equipment, and the use of suitable personal protection equipment.
- Use of recyclable materials and establishment of procedures for the disposal of equipment and components so that once the end of their useful lives is reached, they are duly processed in accordance, as far as possible, with the environmental restrictions established by the competent authorities.

Consequently, the equipment to which the present manual refers complies with the requirements of section 11.2 of the forthcoming IEC standard 62271-1. It must therefore only be operated by appropriately qualified and supervised personnel, in accordance with the requirements of standard EN 50110-1 on the safety of electrical installations and standard EN 50110-2 on activities in or near electrical installations. Personnel must be fully familiar with the instructions and warnings contained in this manual and in other recommendations of a more general nature which are applicable to the situation according to current legislation.

The above must be carefully observed, as the correct and safe operation of this equipment depends not only on its design but also on general circumstances which are in general beyond the control and responsibility of the manufacturer. More specifically:

- The equipment must be handled and transported appropriately from the factory to the place of installation.
- All intermediate storage should occur in conditions which do not alter or damage the characteristics of the equipment or its essential components.
- Service conditions must be compatible with the equipment rating.
- The equipment must be operated strictly in accordance with the instructions given in the manual, and the applicable operating and safety principles must be clearly understood.
- Maintenance should be performed properly, taking into account the actual service and environmental conditions in the place of installation.

The manufacturer declines all liability for any significant indirect damages resulting from violation of the guarantee, under any jurisdiction, including loss of income, stoppages and costs resulting from repair or replacement of parts.

Guarantee

The manufacturer guarantees this product against any defect in materials and operation during the contractual period. In the event that defects are detected, the manufacturer may opt either to repair or replace the equipment. Improper handling of this equipment and its repair by the user shall constitute a violation of the guarantee.

Registered Trademarks and Copyrights

All registered trademarks cited in this document are the property of their respective owners. The intellectual property of this manual belongs to the manufacturer.

In view of the constant evolution in standards and design, the characteristics of the elements contained in this manual are subject to change without prior notification.

These characteristics, as well as the availability of components, are subject to confirmation by Ormazabal’s Technical - Commercial Department.
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1. DESCRIPTION AND MAIN CHARACTERISTICS

Ormazabal's CMS-17 externally operated Switching and Breaking Substation has been designed in accordance with standard EN 62271-202, to be used in public electrical distribution networks of up to 24 kV.

**Figure 1.1: Main components of CMS-17**

1. Interior switchgear
   1.1. MV switchgear (CGMCOSMOS system)

2. Prefabricated Concrete Enclosure
   2.1. Concrete monoblock enclosure
   2.2. Removable cover
   2.3. Access door to the MV switchgear
   2.4. Bottom entry and exit of MV cables
   2.5. Side exit of MV cables
1.1. INTERIOR SWITCHGEAR

The electrical equipment of the CMS-17 Switching and Breaking Substation is located inside and anchored to the enclosure and has the following types of configuration:

a) **Switching and Breaking Substation**, made up of the following components:
   - Switchgear unit formed by up to 4 MV feeder functions completely insulated in SF₆, with an insulation voltage of 24 kV.

b) **Switching and Breaking Substation with Protection units**, made up of the following components:
   - Switchgear unit formed by 2 MV feeder functions completely insulated in SF₆, with up to two fuse protection units.

The maximum single-wire diagrams available for the CMS-17 Switching and Breaking Substation are shown below:

![Figure 1.2: CMS-17 substation 4L single-wire diagram](image1)

![Figure 1.3: CMS-17 substation 2LP+P single-wire diagram](image2)
### 1.1.1. Technical Characteristics: CGMCOSMOS system

<table>
<thead>
<tr>
<th>MV Switchgear Unit</th>
<th>CGMCOSMOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation</td>
<td>SF₆</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>kV 24</td>
</tr>
<tr>
<td>Insulation level</td>
<td>kV Power freq.: 50/60</td>
</tr>
<tr>
<td></td>
<td>kV Lightning impulse: 125/145</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Busbar (IEC 62271-200):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
</tr>
<tr>
<td>Peak value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Switch-disconnector (IEC 60265-1):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Rated current</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
</tr>
<tr>
<td>Peak value</td>
</tr>
<tr>
<td>Short-circuit making capacity</td>
</tr>
<tr>
<td>Nº of short-circuit closing operations CO/CO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Earthing Switch (IEC 62271-102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated short-time withstand current</td>
</tr>
<tr>
<td>Peak value</td>
</tr>
<tr>
<td>Short-circuit making capacity</td>
</tr>
<tr>
<td>Nº of short-circuit closing operations CO/CO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuse Protection Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current</td>
</tr>
<tr>
<td>Short-time current (main circuit)</td>
</tr>
<tr>
<td>Main switch making capacity</td>
</tr>
<tr>
<td>Opening capacity Co/Co</td>
</tr>
<tr>
<td>Nº of short-circuit closing operations CO/CO</td>
</tr>
</tbody>
</table>
1.2. PREFABRICATED ENCLOSURE

Made up of:

- Concrete monoblock prefabricated construction with a door opening measuring 1420 mm high and 1720 mm wide.
- Prefabricated removable concrete cover.
- Double door measuring 1420 x 900 mm each, with a system enabling it to be fixed in place at 90° and 180°. It has a document holder with documentation relating to the Switching and Breaking Substation.
- Cable entry and exit holes, four at the bottom of the enclosure, with a diameter of 174 mm. Additionally, the substation also has 400 x 132 mm cable exit holes on both sides of the enclosure that allow servitude access to adjoining plots.
- Connection point for the protective earth of the electrical equipment as well as for the enclosure, located on the inside of the enclosure’s left side wall.
- Concrete floor and fixing rails for assembling the cubicle layout.
- Frontal ventilation through the doors in compliance with IP23D protection rating, according to IEC 60529.
1.3. MECHANICAL CHARACTERISTICS

The dimensions and weights of the CMS-17 Switching and Breaking Substation are given below.

1.3.1. Concrete Enclosure

- **Dimensions**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Total</th>
<th>Visible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>2080</td>
<td>1600</td>
</tr>
<tr>
<td>Width</td>
<td>2170</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>1310</td>
<td></td>
</tr>
</tbody>
</table>

![Enclosure dimensions diagram](image)

- **Weight**

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>2180 kg</td>
</tr>
<tr>
<td>Cover</td>
<td>515 kg</td>
</tr>
<tr>
<td>Floor</td>
<td>440 kg</td>
</tr>
<tr>
<td>Total weight</td>
<td>3135 kg</td>
</tr>
</tbody>
</table>

(*) Electrical equipment not included.
1.3.2. Electrical equipment

- **Dimensions**

<table>
<thead>
<tr>
<th></th>
<th>4L</th>
<th>2L2P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Height</strong></td>
<td>mm</td>
<td>1300</td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>mm</td>
<td>1460 (4 x 365 mm)</td>
</tr>
<tr>
<td><strong>Depth</strong></td>
<td>mm</td>
<td>735</td>
</tr>
</tbody>
</table>

- **Weight**

<table>
<thead>
<tr>
<th></th>
<th>4L</th>
<th>2L2P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight</strong></td>
<td>kg</td>
<td>344 (4 x 86 kg)</td>
</tr>
</tbody>
</table>

1.3.3. Concrete Enclosure and Electrical Equipment

<table>
<thead>
<tr>
<th></th>
<th>4L</th>
<th>2L2P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum weight</strong></td>
<td>kg</td>
<td>3500</td>
</tr>
</tbody>
</table>
2. TRANSPORT

2.1. LIFTING METHODS

The CMS-17 Switching and Breaking Substation has 4 DEHA-type inserts (6000-2-0170) which enable it to be handled using the proper lifting beam, slings and hooks in order to guarantee a hoisting as balanced as possible.

Figure 2.1: Correct coupling method using DEHA hooks

Figure 2.2: Placement of the lifting beam used for hoisting the CMS-17

Dimensions in millimetres
2.2. ACCESS

The site must be visited in advance to check if vehicles can have access and if there is sufficient space for the unloading and assembly operations, taking into account the distances to overhead lines, slopes, etc.

2.3. OVERLAND TRANSPORT

Transportation should be carried out using a truck. The CMS-17 Switching and Breaking Substation electrical equipment is supplied screwed onto the rails located on the floor of the concrete enclosure for transportation.

The concrete enclosure is lashed using ropes. These are hooked into the DEHA hooks in the building, thereby ensuring stability during transportation. To avoid any movement of the roof in respect to the body, slings should be attached above the cover.

![Figure 2.3: Land transport of CMS-17](image-url)
2.4. SEA TRANSPORT

The transportation should be carried out using "open top" or "flat-rack" containers.

To eliminate the risk of water intake, protect the front ventilation outlets located in the doors with an elastic plastic band rolled around the perimeter several times.

Attach 2 planks of 1500 x 150 x 20 mm to support the CMS-17 in the container.

Once positioned inside the container, attach a 100 x 100 x 10 mm and 100 mm long square to each corner of the building. They must be welded to the floor of the container, in order to avoid any movement during transportation. Lastly, place two slings transversally over the enclosure, after having placed corner pieces below the slings in order to protect the enclosure from possibly rubbing against the slings.

![Figure 2.4: Sea transport of CMS-17](image)

2.5. DELIVERY CONDITIONS

The CMS-17 Switching and Breaking Substation is supplied fully assembled and ready for connection to the MV supply.

Upon receipt of the CMS-17 substation, carefully check the following:

- That the characteristics of the different components that make up the electrical equipment that are listed in the corresponding name plates coincide with the order.
- The general condition of the assembly.

⚠️ CAUTION:

In the event that any anomaly is found, please contact Ormazabal's Technical-Commercial Department immediately.
3. INSTALLATION

3.1. LOCATION

The site location should be precisely defined, indicating the levels of alignment and height of the possible reference points, such as: roads, kerbs, milestones, fences, pavilions, pylons, etc.

3.2. PLANNING

The coordination of the transport and the crane must be scheduled or, if this is not possible, a tow-truck suitable for the weight of the CMS-17 Switching and Breaking Substation[^1].

The existence of any circumstance or object that could impede or obstruct the smooth operation of the installation must be indicated (posts, cables, ditches, walls, pipelines, etc.), marking their positions on the drawing with the corresponding measurements.

Due to technical reasons concerning the protection and safety of people and property, the conditions of the installation site and its design must be in accordance with the applicable regulations on High Voltage.

Similarly, please take into account the assembly instructions provided by the Electric Utility, which is aware of the regulations and also takes into account any particularities in the electrical network to which the Switching and Breaking Substation is to be connected.

[^1]: See sections 1.3 Mechanical Characteristics and 2.1.Lifting Methods.
3.3. EXCAVATION DIMENSIONS

For the installation of the CMS-17 Switching and Breaking Substation, an excavation including an earthing loop is necessary.

In order to carry this out, it is recommended that the minimum construction worksite safety and health Regulations be observed. Among others:

- Before beginning to open, carry out a preliminary study of the ground for the purpose of knowing its stability and the possible existence of conduits.
- Avoid accumulating excavated material and equipment next to the edge of the excavation, taking the necessary precautions to prevent the walls from caving in and materials falling inside.
- As a general rule, maintain a 3000 mm area around the excavation free of materials and vehicle traffic.
- In the case of rain and puddles, carefully inspect the excavation using qualified technicians before resuming the work. Carry out immediate pumping out of water that may be present inside the excavation in order to prevent the stability of the slope from being altered.
- The operators that work inside the excavation must be properly trained and informed and must use a safety hat as well as the appropriate protective clothing for each specific hazard.

Ensure that the building is not buried over the reference line marked on the walls of the concrete enclosure. The maximum burying height is 480 mm measured from the base.

The measurements below must be adapted in each case, depending on the solution adopted for the earthing network according to the earthing diagram.

![Dimensions in millimetres](image)

3.1: Excavation dimensions
3.4. LEVELLING PROCESS

For the correct assembly of the enclosure, the ground levelling is important. The following equipment is recommended for correct levelling:

- A spirit level
- A square-end spade
- Levelling tools

**CAUTION:**
Consult Ormazabal’s Technical-Commercial Department in the event of installation on a slope.

A 100 mm thick compacted and levelled layer of sand is required at the bottom of the excavation in order to prevent differential settlements.

The installation operation consists of positioning the CMS-17 in the excavation made for this purpose and of connecting the MV cables, along with the external earthing network.

3.5. EARTH CONNECTION

The CMS-17 Switching and Breaking Substation has an internal earthing circuit to facilitate the connection of the different elements to the earthing network external to the Switching and Breaking Substation.

3.5.1. Protective Earth Connection

For the correct connection of the protective earth (metallic parts), the enclosure of the CMS-17 Switching and Breaking Substation has a switching box located on the inside of the left side wall, which is accessible from the outside through the doors.

The MV switchgear unit earthing is routed to this connection point, which connects all the earth connections of all the concrete enclosure's electrical equipment.
3.5.2. External Earthing Circuit

The installation project must include a section corresponding to the earthing installation (check the Utility’s standard project), as well as the justification of its size. The requirements for this type of installation are established in the regulations governing Earth Connection Installations.

Below is a recommended method for the installation of the earthing network from the operator safety perspective:

- Create an equipotential surface for both the switchgear and the operation area.
- Each project should include the study of the most suitable earthing diagram.
  - The copper braid cross-section, the terminations' contact surface and the tightening torques must be suitable for a fault current delimited by network protections. It is recommended an external protective earthing network of bare copper wire with a minimum cross-section of 50 mm².
  - It is recommended that the external earthing circuit is installed simultaneously. To this end, it is recommended to check the Switching and Breaking Substation installation standard project available at the Electric Utility that provides the service and is responsible for maintaining safety in the worksite earthing installation.
- Adequate earthing measures around the Transformer Substation must be provided to prevent dangerous touch and step voltages.
- The recommended tightening torque for electrical connections in the earthing network is shown in the following table:

<table>
<thead>
<tr>
<th>Metric</th>
<th>Tightening Torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.8 Steel</td>
<td>A2 Stainless</td>
</tr>
<tr>
<td>M8</td>
<td>21</td>
</tr>
<tr>
<td>M10</td>
<td>38</td>
</tr>
<tr>
<td>M12</td>
<td>60</td>
</tr>
</tbody>
</table>
3.6. MV CABLE ACCESS

The CMS-17 Switching and Breaking Substation has 4 holes of 174 mm in diameter at the bottom part. Additionally it has 2 exits, one on either side, which allow access to adjoining plots.

![Figure 3.2: Side access to CMS-17](image)

The bottom holes allow to lay cables at distances of less than 900 mm from level 0, even underneath the enclosure itself.

To open a hole, simply knock it inwards with a hammer. Then clean the pieces of concrete from inside the enclosure.

The MV cables must meet the minimum radius of curvature indicated by the cable manufacturer, with the aim of having a sufficient length of cable inside the enclosure so as to enable a comfortable arrangement and handling of terminals[2].

![Figure 3.3: Bottom access to CMS-17](image)

Once the MV connections have been performed, proceed with the sealing of the cable holes.

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3.7. MV CABLE CONNECTIONS
MV incomings are made with cables. The connection of these cables with the MV switchgear bushings is carried out using type C 400 series elbow connectors.

The cables are subsequently fixed onto their respective clamp supports and the earth connectors of both the terminals and the cable shields are connected to the earthing bars of the MV switchgear unit.

4. SEQUENCE OF OPERATIONS OF THE SWITCHGEAR
Once the CMS-17 Switching and Breaking Substation is installed, the MV switchgear commissioning operations must be carried out.

4.1. OPERATING THE MV SWITCHGEAR

CAUTION:
Before carrying out any operation when voltage is present, we recommend checking the SF₆ gas pressure, using the manometer.

The operating sequences for starting up as well as shutting down the CGMCOSMOS cubicles used in the electrical equipment are specified in Ormaazabal's IG-078 General Instructions document, which is supplied with the CMS-17.

5. MAINTENANCE
The requirements set out in the applicable legislation on Transformer Substations to protect people and property which may be affected by the installations must be met.

The driving mechanism of the MV cubicle does not require any type of maintenance to operate correctly during its estimated service life, under the conditions set out in IEC-62271-1.

The live parts of the main circuit and switching equipment of the MV cubicle do not require inspection or maintenance, as they are completely insulated in SF₆, and therefore unaffected by the external environment. Class E3 electrical endurance tests mean that the breaking components are maintenance free.

The prefabricated building does not require any maintenance. Depending on the circumstances, the lock may need looking at and greasing.
5.1. REPLACING THE ELECTRICAL EQUIPMENT

The electrical equipment in the CMS-17 Switching and Breaking Substation is replaced using the following procedures:

a) Open the doors to access the electrical equipment. The doors incorporate a system for locking them at 90° and 180°. To unlock the system, pull upward on the rod (a) and open the corresponding door.

b) Disconnect the power to the Electrical Equipment, switching the MV switchgear unit to the earthing position[3].

c) Disconnect the inner earth cable (a) that connects the cover and body of the CMS-17.

[3] Refer to the IG-078 General Instructions document for the CGMCOSMOS cubicle system, located in the CMS-17 Switching and Breaking Substation document holder.
d) Remove the 4 protective caps (a) from the threaded inserts of the cover.

![Figure 5.3: Caps for the threaded inserts of the cover](image)

**Figure 5.3: Caps for the threaded inserts of the cover**

e) Attach and screw in the 4 M20 eyebolts provided inside the Transformer Substation to the cover; remove the cover and place it on top of wooden planks (a).

![Figure 5.4: Hoisting Eyebolts](image)

![Figure 5.5: Positioning on the planks](image)

**Figure 5.4: Hoisting Eyebolts**

**Figure 5.5: Positioning on the planks**

f) Open the MV switchgear cable compartment lid[^4]. Disconnect the power cables and their earth connectors.

![Figure 5.6: Cable compartment opening](image)

**Figure 5.6: Cable compartment opening**

[^4]: Refer to the IG-078 General Instructions document for the CGMCOSMOS cubicle system, located in the CMS-17 Switching and Breaking Substation document holder.
g) Disconnect the earth connection of the electrical equipment from the earthing bar of the Medium Voltage switchgear, both on the left side of the left cubicle and the right side of the right cubicle.

![Figure 5.7: Disconnection of the earth connection of the MV switchgear](image)

h) Unscrew the MV switchgear fixing points (a) on the rails that are arranged over the base of the Switching and Breaking Substation.

![Figure 5.8: MV switchgear fixing screw](image)

i) Extract the electrical equipment. To do this, the use of hoisting chains is required. Hook the hoisting chains into the ring (a) located at the ends of each hoisting tool for subsequent crane handling.

![Figure 5.9: Lifting chain hooking](image)
j) Insert the new compact electrical equipment using the elevation means mentioned in the previous section.

![Electrical equipment installation](image)

**Figure 5.10: Electrical equipment installation**

k) Unhook the hoisting chains.

l) With the MV switchgear connected to earth[^5^], remove the cable compartment covers and screw the MV switchgear to the fixing rails located on the base of the Switching and Breaking Substation.

![Fixing rails](image)

**Figure 5.11: Fixing rails**

m) Connect the electrical equipment's earth connection to the MV switchgear earthing bar.

n) Re-connect the MV cables that supply power to the MV switchgear.

o) Re-attach the removable cover.

p) Once the cover has been attached and connected to its earth connector between the body and the cover, remove the lifting eyebolts from the cover and seal their housing holes.

q) Re-apply power to the CMS-17 Switching and Breaking Substation.

[^5^]: Refer to the IG-078 General Instructions document for the CGMCOSMOS cubicle system, located in the CMS-17 Switching and Breaking Substation document holder.
6. ADDITIONAL INFORMATION

6.1. SPARES AND ACCESSORIES

The following accessories are sent with the concrete enclosure:

- First aid sign.
- Electrical warning sign.
- Lever for actuating the MV switchgear.
- CMS-17 Switching and Breaking Substation General Instructions, IG-178.
- CGMCOSMOS Cubicle System General Instructions, IG-078.

**NOTE:**

Some of these spares and accessories must be installed in the equipment by specialist personnel. Please contact Ormazabal's Technical - Commercial Department.