KYN79 (i-AX)
Metalclad Removable
AC Metal-Enclosed Switchgear

Instruction for
Installation and Operation

K \textsuperscript{15} \cdot SM \cdot 01 \cdot 02

Tianshui Changcheng Switchgear Factory
January, 2007
Warning: This instruction should be read carefully before operation, otherwise, incorrect operation will cause the system faults, damage the equipments, or even cause the personal injury.

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1 General

KYN79 metalclad removable AC metal-enclosed switchgear (called i-AX switchgears, the switchgear or the product in the following) the framework of which is made of aluminum-alloy section materials is our self-developed new medium voltage switchgear. It is the AC 50 Hz 3-phase indoor power distributing switchgear assemblies. It is suitable to be use to receive and distribute 3.6~24 kV power energy, and to control, monitor and protect the circuits. It can be sued in the power system of power plants, substations, industrial and mining enterprises, as well as civil and commercial buildings.

i-AX switchgear conforms to the Chinese national standard GB3906, Chinese Electric Power Industrial Standard DL/T404, the international standard IEC62271-2003, and etc.. The product is provided with reliable mechanical and electric interlocking device, which can realize 5-prevent interlocking function, thereby, the operating safety can be provided to the operators. i-AX switchgear can be equipped with type EVH1, ZN63A and ZNM-24 vacuum circuit breakers (VCB) developed and manufactured by us, type VEP VCB made by Xiamen Huadian Switchgear Co. Ltd., as well as the imported VCB VD4.

Note: refer to Subclause 2.2.

i-AX switchgear can be used in the power system of all kinds of power plants, substations, industrial and mining enterprises, buildings and etc.

The functions of intelligent switchgear can be provided if the users select the motor operating unit and the integrated device for intelligent controlling for i-AX switchgear.

i-AX switchgear is a power distributing device with perfect performance.

2 Definitions

For the purpose of this product guide, the following definitions as well as the definitions of IEC 60050(441), IEC 60050(151), IEC 60050(60694) apply.

2.1 Truck

The removable part of the MV switchgear which is equipped with VCB or other primary components, and the secondary circuit, driving parts, framework and others.

2.2 5-prevent interlocking function

5-prevent interlocking function of the switchgear is specified as the following:
- prevent the truck from being moved while the VCB is closed;
- prevent the VCB from being opened or closed incorrectly;
- prevent entering the live compartment;
- prevent the ES from being closed while the primary circuit of the switchgear is live;
- prevent the VCB from being closed while the ES is closed.

2.3 VCB

Vacuum circuit breaker
KYN79 metalclad removable AC metal-enclosed switchgear

2.4 **Contact case**
A insulation case used to house the isolating contacts.

2.5 **PT**
Voltage transformer

2.6 **Isolating contacts**
The contacts used to connect the main circuit of the truck with the main circuit of the switchgear. The ones on the truck are called the movable isolating contacts, the ones in the switchgear are called the fixed isolating contacts.

2.7 **CT**
Current transformer

2.8 **ES**
Earthing switch

2.9 **SA**
Surge arrester

2.10 **Secondary plug**
Connecting device used to connect the secondary circuit of the truck with the secondary system of the switchgear, the one on the truck is called the secondary plug, the fixed one in the switchgear is called the secondary contactor.

2.11 **Carrier chassis**
A part in the lower of the truck used to move the truck within the switchgear.

2.12 **Carrier table**
A table with wheels used to move the truck into, or out of the switchgear.

2.13 **Charge**
A operation to elongate the closing (or the opening) springs to store the closing (or the opening) force.

2.14 **Middle position**
Positions during the truck being moved from test position to the service position or from the service position to the test position.

2.15 **Removed position**
A position of the truck when it has been moved out of the switchgear.

2.16 **discharged condition**
A condition of the VCB when it has not been charged.

2.17 **Truck operating handle**
A handle used to operate (move) the truck in the switchgear.

3 **Signification of the Type**
4 **Main parameters**

4.1 **Main technical parameters of i-AX switchgear**

The main technical parameters of i-AX switchgear is shown in Table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Unit</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rated voltage</td>
<td>kV</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Rated current</td>
<td>A</td>
<td>630, 1250, 1600, 2000, 2500, 3150, 4000</td>
</tr>
<tr>
<td>3</td>
<td>Rated frequency</td>
<td>Hz</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>Rated peak withstand current</td>
<td>kA</td>
<td>63, 80, 100, 130</td>
</tr>
<tr>
<td>5</td>
<td>Rated short time withstand current</td>
<td>kA</td>
<td>25, 31.5, 40, 50</td>
</tr>
<tr>
<td>6</td>
<td>Rated short-time duration</td>
<td>s</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Rated insulation level</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rated lightning impulse withstand voltage</td>
<td>kV</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Across opened isolating gap</td>
<td></td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>Power frequency withstand voltage within 1min</td>
<td>kV</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Across opened isolating gap</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>8</td>
<td>Auxiliary control circuits</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rated voltage</td>
<td>DC:220, AC:220</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power frequency withstand voltage within 1min</td>
<td>V</td>
<td>2000</td>
</tr>
<tr>
<td>9</td>
<td>Degree of protection of the enclosure</td>
<td></td>
<td>IP4X</td>
</tr>
<tr>
<td></td>
<td>Between the different compartment with the door of the truck compartment opened</td>
<td></td>
<td>IP2X</td>
</tr>
<tr>
<td>10</td>
<td>Overall dimension* (Width × Depth × Height)</td>
<td>mm</td>
<td>650 × (800) × 1500 × 2125</td>
</tr>
<tr>
<td></td>
<td>Rated voltage not greater than 1250A</td>
<td>1000 × 1500 × 2125</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rated voltage not greater than 2000A</td>
<td>1000 × 1500 × 2125</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rated voltage not greater than 3150A</td>
<td>1000 × 1500 × 2125</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Weight</td>
<td>kg</td>
<td>600 ～ 1200</td>
</tr>
</tbody>
</table>

**Note:**

1. The rated short time withstand current and the rated peak withstand current is checked independently.
2. The Overall dimension shown in this table are the ones for the cable incoming switchgears, the depth of 12 kV overhead incoming switchgears should increase for 300mm, therefore, the depth of such switchgear should be 1800 mm; the depth of 24 kV overhead incoming switchgears should increase for 400mm, therefore, the depth of such switchgear should be 2200 mm.
3. When special requirements on the degree of protection of the enclosure is required, the degree of protection of the enclosure can be improved to IP41, IP42. When the degree of protection of the enclosure is IP42, the gaps due to arranging the switchgear should be sealed with the silica gel.
4.2 Resistance of the main circuits and the contacting resistance between the truck and the cabinet body of i-AX switchgear

The resistance of the main circuits and the contacting resistance between the truck and the cabinet body of i-AX switchgear is shown in Table 2.

<table>
<thead>
<tr>
<th>Rated current (A)</th>
<th>Main circuit</th>
<th>Primary isolating contact (Single)</th>
</tr>
</thead>
<tbody>
<tr>
<td>630</td>
<td>≤200</td>
<td>≤25</td>
</tr>
<tr>
<td>1250</td>
<td>≤150</td>
<td>≤20</td>
</tr>
<tr>
<td>1600</td>
<td>≤90</td>
<td>≤20</td>
</tr>
<tr>
<td>2000</td>
<td>≤90</td>
<td>≤20</td>
</tr>
<tr>
<td>2500</td>
<td>≤70</td>
<td>≤18</td>
</tr>
<tr>
<td>3150</td>
<td>≤65</td>
<td>≤15</td>
</tr>
</tbody>
</table>

The contacting resistance: ≤1000 μΩ

4.3 The parameters of the equipped VCB

The parameters of the equipped VCB are shown on the rating plate and the instruction of the VCB.

5 Service condition

- Ambient temperature:
  - Upper limit: +40℃;
  - The average value over 24 hours should not be greater than 35℃;
  - Lower limit: −15℃.

- Relative humidity:
  - The daily average value of the relative humidity should not be greater than 95%, the monthly average value of the one should not be greater than 90%;
  - The daily average value of the saturation vapor pressure should not be greater than 2.2×10⁻³ MPa, the monthly average vale of the one should not be greater than 1.8×10⁻³ MPa.

- Altitude: up to 3000m.

- The earthquake intensity of the place where the products will be installed should not be greater than 8 degree.

- The running site of the products should be free from flammable and explosive risk, and the chemical corrosion.

- The service site should be free from frequent severe vibration.

- The amplitude value of the electromagnetic interference of the secondary circuits should not be greater than 1.6kV.
6 Structure and Principle

6.1 Structure

6.1.1 General

i-AX switchgear comprises of the fixed cabinet body and the truck.

The cabinet body is assembled with the section-materials framework made of aluminum alloy and the parts made of metal plates. The section-materials framework made of aluminum alloy is provided with high rigidity, all holes on the framework are machined once through by the manufacturer, therefore, such holes can be machined accurately. The parts made of metal plates are machined by the NC machines. The cabinet body is assembled with perfect technologies. The assembled switchgear can provide the uniformity on key size and the exchangeability of trucks. The cabinet body is provided with high ability on corrosion proof and deformation proof.

The inner structure of the cabinet body is separated into 4 independent compartments by the metal partitions, such compartments are busbar compartment, truck compartment, cable compartment, and instrument compartment. The typical structure of the product is shown in Figure 1.

![Figure 1 The typical structure of i-AX switchgear](image)
KYN79 metalclad removable AC metal-enclosed switchgear

The truck consists of the main components of the switchgear and the carrier chassis used to move the truck in the switchgear. The truck is located in the middle position of the switchgear, the carrier chassis is in the lower of the truck. The VCB can be fixed on the carrier chassis. The different trucks with same specification are exchangeable.

The truck can be moved in or out the switchgear with a carrier table.

6.1.2 Truck compartment

The truck compartment is the part B of the Figure 1. The truck compartment is provided with special rails which can be used to guide and position the truck when the truck is being moved. The shutters used to cover the contact cases are designed in the rear of the truck compartment, the shutters can be opened automatically when the truck is moved from the test position to the service position; the shutters can be completely closed automatically when the truck is moved from the service position to the test position, which can provide effective isolation. After the truck being moved out of the switchgear, two M10×30 bolts should be inserted into the holes on the crank used to drive the shutters. Such bolts should be removed before the truck being moved into the switchgear. The truck compartment is provided with inspection windows through which the position of the truck, opening/closing indication, charging condition, position of the movable contacts can be observed. The installing position of the heater is designed on the side wall of the truck compartment, the heater can be installed if necessary.

6.1.3 Main busbar compartment

The main busbar compartment is the part A of the Figure 1. The main busbars pass through one switchgear to another, and are supported and fixed by the busbar bushings installed on the side wall. All busbars can be enclosed with thermal-shrinkage insulation tube (when required by the users). The main busbars and the connecting busbars adopt the copper busbars with rectangular section. 2 pieces of parallelly located busbars can be used for high current condition. The branch busbars directly connect the fixed isolating contact and the main busbar, the other additional clammers and supports are not required. For special requirement, the bolts for mounting the busbars can be covered with insulation covers or the end caps. In the event when the inner fault arc appears, the side walls and the busbar bushings can effectively prevent the faults from spreading to the adjacent switchgear.

6.1.4 Cable compartment

The cable compartment is the part C of the Figure 1. The cable compartment of i-AX switchgear is provided with big space, the CTs, ES, SA and other electric components can be located inside the cable compartment. The operators can enter the cable compartment from the rear of the switchgear to carry out the checking and maintenance works (when necessary). The cable connecting conductors are designed in the cable compartment, 1~3 or even more pieces of single-core cables can be connected for each phase. The dismountable cable cover is provided in the bottom of the cable compartment, therefore, the cable is convenient to be led into the switchgear through the bottom.

6.1.5 Instrument compartment

The instrument compartment is the part D of the Figure 1. The relays, protecting devices, instruments, voltage indicating device, as well as various secondary devices can all be installed in the instruments compartment. The control wires are located in the wire channels with enough space, which are provided with metallic cover.
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To separate the control wires from the high voltage compartment. The wire channel on the left side is prepared for the control wires being leading in or out the switchgear, the wire channel on the right side is used to held the secondary wires of the switchgear. The hole for the small wires to passing through is designed on the top cover of the instrument compartment. The cover of the small wire compartment can be removed when it is necessary for the operator to connect the wires. The hole for the communication cable to pass through is designed in the lower of the rear part of the instrument compartment. The communication cable between different switchgears can conveniently pass through the switchgears.

6.1.6 ES

The ES can be selected in accordance with the requirement of the individual project. When the truck with VCB is moved to the test position and it is necessary to check the feeding main circuits, the ES should be closed for operators’ safety. When the ES is in the closed position, it can withstand the rated peak withstand current and rated short time withstand current. The ES is equipped with spring operating device which can be charged manually. The ES can be opened and closed rapidly by the force from the operating springs, thereby, the opening/closing speed of the ES is independent of the operator. The ES can be operated by the motor in the intelligent switchgear.

6.1.7 Voltage indicating

i-AX switchgear can be equipped with voltage indicating device to monitor the voltage of the primary circuit of the switchgear. The voltage indicating device can co-operate with the electromagnetic lock to forcibly lock the operating handles, buttons, net doors and other operating elements, therefore, the ability of the product to prevent the incorrect operations can be greatly improved.

6.1.8 Earthing conductor

The copper earthing busbar which passes the switchgears horizontally is located in the bottom of the cable compartment. The cross section of the copper earthing busbar is 10 x 40 mm², it passes through the neighbored switchgears and connects with the cabinet bodies correctly. The copper earthing busbar can be used to connect the direct earthing devices. Because the framework of the cabinet body of the switchgear is made of aluminum alloy, the whole cabinet body of the switchgear can be earthed reliably, and the operators’ safety can be provided. The earthing busbars of the adjacent switchgears can be connected with the connecting busbars prepared by the manufacturer. The earthing connecting busbar is provided with Φ13 holes on the both end, which can be used to connect the earthing system of the substation.

6.1.9 Secondary plug/connector

The auxiliary secondary circuits of the truck and the switchgear are connected with the secondary plug on the truck and the secondary connector in the switchgear. The secondary plug should be inserted to connect the auxiliary secondary circuits of the truck and the switchgear before the truck being moved to the test position. The secondary plug should be pulled out of the secondary connector before the truck being moved from the test position out of the switchgear. The interlocking device is provided between the connecting condition of the secondary plug and the truck. The secondary plug and connector both have 50 pins.

6.1.10 Small wires

The small wires employ Φ6 bar coppers. i-AX switchgear can be provided with 20-circuit
KYN79 metalclad removable AC metal-enclosed switchgear

small wires at most. The quantity of the small wires will be decided by the schematic diagrams from the users. The small wires will be provided by the users and will be connected by the users after the switchgears be installed.

6.1.11 Heater

When the switchgears are used in the heavily humid areas or the areas where the humidity changes greatly, water condensation will appears. Therefore, i-AX switchgear is provided with heater, the relative humidity can be reduced by increasing the temperature in the switchgear, for the purpose to prevent the vapor in the switchgear from condensing.
The power of the heater used in the switchgear is 150 W, The heater can be installed on the side wall of the truck compartment, and the side wall of the cable compartment. The heater can be started by the switch located on the door or other position. The heater can be equipped in accordance with the users’ requirements.

6.1.12 The control cable channel of the auxiliary circuit

The control cable channel of the auxiliary circuit of the switchgear is designed in the left side of the switchgear. It is made up of upper shielding channel, lower shielding channel, left side wall and the small wire compartment at the top of the switchgear. The control cables can be led into the control cable channel through the bottom of the switchgear from the cable trench. The control cable channel pass through all switchgears, therefore, the control cables can be connected to all switchgears if they have been led into any one switchgear.
The control cables can be checked by opened the cover of the channel.

6.1.13 Pressure-relief device

The pressure-relief devices are designed on the top of the truck compartment, busbar compartment and cable compartment. When inner fault arc appears on the busbar or the VCB, the pressure in the switchgear will rise, the pressure-relief device on the top of the switchgear will be opened automatically to release the high pressure, and the safety of the operators and the switchgears can be provided.

6.1.14 Positions of the truck within the switchgear

The truck can be locked in 2 positions (test position and service position) in the switchgear. When the truck is in the test position, a proper insulation distance can be provided between the movable and fixed isolating contacts, and the movable and fixed isolating contacts are separated by a shutter.

6.2 Moving the truck

The operator can move in (or out ) the truck by rotating the operating handle in clockwise (or counter clockwise) direction (shown in Figure 2). The truck can be locked in the test position or the service position by the interlocking device. The truck in the intelligent switchgear can be moved by the intelligent integrated controlling device and motor operating device.

6.3 Moving the truck into or out of the switchgear with the carrier table

The truck of i-AX switchgear is located in the middle position of the switchgear, it can not be directly moved into or out of the switchgear. The specified quantity of carrier tables will be provided as the accessories to i-AX switchgears for convenient, laborsaving and safe operation. The carrier table and its operating method is shown in Figure 3. The door of the switchgear should be opened for at least 90 degrees when the truck is necessary to be moved into the switchgear. First, move the carrier table with the truck to the front of the
switchgear, and aim the locking pin on the carrier table at the locking hole on the switchgear; then move the carrier cable onto the switchgear and adjust the adjusting nut on the carrier table to set the rail on the carrier table and the rail in the switchgear in a same horizontal plane. After then, pull the hooks on the carrier table to hook with the special set pins in the switchgear. Finally, push the truck into the switchgear.

Great attention should be paid to the following: when the locking plates on the both side of carrier chassis of the truck are close to the rectangular slots on the bed block at the end of the rail of the switchgear, the 2 handgrips on the carrier chassis should be drawn towards the central direction, thereby, the truck can be pushed into the switchgear slowly, and the locking plates can be inserted into the rectangular slots automatically and exactly. At this time, the truck is locked in the test position.

6.4 Interlocking device

i-AX switchgear is provided with perfect interlocking device which can provide correct operation and safety.

6.4.1 Interlocking between the VCB and the position of the truck

- The interlocking device on the carrier chassis of the truck which can prevent the truck from being moved (shown in Figure 2) can be unlocked and the truck can be moved from the test or service position only when the VCB is in the opened position.
- The interlocking device on the carrier chassis of the truck which prevents the VCB
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from being closed (shown in Figure 2) can be unlocked and the VCB can be closed only when the truck is in the test or service position.

- When the truck is in the middle position, the electric closing circuits and the mechanical closing system of the VCB are locked, the VCB can not be opened.

6.4.2 Mechanical interlocking device between the VCB truck and the ES

The mechanical interlocking device between the VCB truck and the ES is shown in Figure 4. The operating shaft of the ES can be uncovered and the ES can be closed only when the truck is in the test position or has been moved out of the switchgear. When the truck is in the service position, the truck can drive the blocking plate to cover the operating shaft of the ES, and the ES can not be closed.

When the ES has been closed, the interlocking device can drive the interlocking plate to raise towards the rail, the truck can not be moved to the service position.

![Image](Figure_4.jpg)

**Figure 4** Mechanical interlocking device between the VCB truck and the ES

6.4.3 Indication of the status of the VCB

The indicating device which gives the opening and closing condition of the VCB is designed on the front plate of the truck.

6.4.4 Interlocking between the position of the truck and the secondary plug

- The interlocking between the position of the truck and the secondary plug is shown in Figure 5.
- The secondary plug can be removed only when the truck is in the test position (shown in the left part of Figure 5).
- The secondary plug can not be removed when the truck is being moved to the service position or has reached the service position (shown in the right part of Figure 5).

![Image](Figure_5.jpg)

**Figure 5** Interlocking between the position of the truck and the secondary plug

6.4.5 Interlocking between the ES and the cover of the cable compartment

The interlocking between the ES and the cover of the cable compartment is shown in Figure 6. The cover of the cable compartment can be removed only when the ES is closed; on the
6.4.6 Additional locking

The electromagnetic lock can be equipped in the operating device of the ES of I-AX switchgear to improve the reliability of the product.

7 Storage and Transportation

Before installation, i-AX switchgear should be stored with original packing case. The storage ambient should be as dry and clean as possible, i-AX switchgears should be prevent from long period of getting wet in the rain.

When transporting, i-AX switchgear should be lifted by the lifting equipment and removed from packing chassis. For lifting, the users can use the hoisting rings on the switchgears. The included angle of the wire ropes should not be greater than 60 degree.

The i-AX switchgear should be moved by the means of laying the rolling bars under the switchgear and prying the rolling bars slowly without vibration and shocking. The switchgear should be in erect position and the tilt angle should be less than 10 degrees during transportation. It is not permitted to lay down the switchgears and transport the switchgears with the side, rear or front facing downward.

The trucks should be moved out before the switchgear being lifted and transported.

Precautions:

- The truck should be moved out before the switchgear being lifted and transported.
- The switchgear should be in erect position and the tilt angle should be less than 10 degrees during transportation. It is not permitted to lay down the switchgears and transport the switchgears with the side, rear or front facing downward.
- When it is necessary to lift the truck, the operator can use the special hook and the special lifting holes on the truck. After adjusting the truck to the balanced condition, the operator can lift the truck.
8 Installation

The environmental condition of the installing site of I-AX switchgears should meet the requirements specified in Chapter 3 of this instruction.

During the installation of the products, special measure should be done to prevent the products being damaged by the architectural and other projects, and to prevent the water, dirt, metal filings and others from entering the switchgear.

8.1 Installing foundation

The installing drawing for the cable trench and the embed channel section steels of the foundation of the i-AX cable incoming/outgoing switchgears are shown in Figure 7.

Table 2 The value of the items A~G of the Figure 7

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 kV</td>
<td>650</td>
<td>768</td>
<td>682</td>
<td>1290</td>
<td>245</td>
<td>360</td>
<td>1500</td>
</tr>
<tr>
<td>24kV</td>
<td>1000</td>
<td>768</td>
<td>682</td>
<td>1290</td>
<td>415</td>
<td>710</td>
<td>1500</td>
</tr>
</tbody>
</table>

The installing foundation for the i-AX switchgears should conform with the related requirements of *Construction and the inspection Specification for Electrical Power Projects*.

The laying of the foundation channel section steels should meets the requirements specified in Figure 7, and the linearity and level of the laying of the foundation channel section steel...
8.2 Installing and arranging the Switchgear

For the purpose of arranging the switchgears and mounting the main busbar, the following should be carried out on the i-AX switchgears to be arranged:

- Remove the lifting plates of the switchgears;
- Loosen the bolts at the rear of the switchgear, remove the rear cover, first remove the lower cover, then the upper cover.
- Remove the upper left protective plate and lower left protective plate from the left side of the switchgears, the left holes for arranging the switchgears will be exposed.
- Remove the upper right protective plate and lower right protective plate from the right side of the switchgears, the right holes for arranging the switchgears will be exposed.

After finishing above operation, the switchgears should be transferred to special position of the installing rail in accordance with the project requirements and the drawing,. If the quantity of the switchgears in a single row is greater than 10, it is best to start arranging the switchgears from the middle parts.

When the switchgear having been placed in the specified position, great attention should be paid to the following:

The nonperpendicularity of all switchgears should not exceed 1.5/1000 mm. When the switchgears have been completely combined and connected, they should be connected to the foundation frame with M12 bolts, or by welding.

8.3 Installation of the main busbars

The installation, connection and fastening of the main busbars should conform to the requirements of “The Installation of the Electric Assemblies-----Installation and acceptance specification for Busbar”. All of the busbars used in the switchgear are provided with rectangular cross section, which can be prepared by the manufacturer. The followed should be followed during fixing the busbars:

1) Wipe and clean the busbars with clean and dry soft cloth, check whether the insulation bushings have been damaged, and apply some conducting ointment or neutral Vaseline on the connected position of the busbars.

2) Install the busbars from one switchgear to next, connect the busbar to the corresponding branch busbar, and insert the suitable pad when connecting and fixing them with bolts.
8.4 Earthing of the switchgear

1) Use the provided connecting bar to connect the earthing busbar of each switchgear together.

2) Connect all earthing wires which are required to be earthed in the switchgear.

3) Connect the foundation frame to the earthing bar. If the quantity of the switchgears arranged in a row are over 10, the quantity of the earthing rows should be more than 2.

4) Connect the earthing wire of the ES with the main earthing busbar of the switchgears.

9 Check before the products being put into use

9.1 Check on completeness

Check whether the primary components, secondary components in the switchgears, as well as the accessories and the spare parts are complete.

9.2 Check the rated value

Check the name plate of all the primary and secondary components to check whether the rated values of the components conform with the ones shown in the relative drawings.

9.3 Check the Fasteners

Check the fasteners, especially the ones for the driving devices and the main circuits, those that have been found to have loosened should be screwed up.

9.4 Check on Operation

9.4.1 Check on the door of the switchgear

Check whether the upper, middle and lower doors of the switchgears can be opened, closed and locked smoothly and accurately.

Check whether the components, inspection windows, the locks of the door and others on the door of the switchgears are complete and correct.

Check whether the marks and labels on the door of the switchgears are correct.

9.4.2 Check on the pressure-relief cover

Check whether the fixing plates of the pressure-relief covers of each compartment at the topside of the switchgears have been removed.

9.4.3 Check on the interlock of the ES

1) Check whether the mechanical interlocking between the ES and the rear cover of the cable compartment are correct and reliable.

When the ES is in the open position, the rear cover of the cable compartment of the
2) Check whether the mechanical interlocking between the ES and the VCB truck is correct and reliable.

- When the ES is in closed position, the VCB truck (or truck with other components) should not be able to be moved from the test position to the service position.
- When the VCB truck (or truck with other components) is in the service position, the ES should not be able to be operated normally.
- When the VCB truck (or truck with other components) is in the test position or removed position, the ES should be able to be operated normally.

9.4.4.1 Check on the position of the truck

The VCB truck (or the truck with other components) has 3 positions in the switchgear: the test position, the service position and the middle position.

It should be ensured that the VCB is in the opened position, in the discharged condition, and the ES has been opened, before the VCB truck being moved from the test position to the service position.

Before moving the truck from the test position to the service position, insert the truck operating handle into the truck operating hole with your right hand, and rotate in clockwise direction. When the truck has been moved to the specified position, the operating handle can not be rotated further. Then, pull out the operating handle and finish the operation.

9.4.4.2 Check on inserting the primary isolating contacts

Because the primary isolating contacts of the switchgear is covered by the contact case, the users cannot directly observe the inserting condition of the primary contacts. Therefore, the following measures can be employed to indirectly check the inserting condition of the primary contacts: When the primary movable isolating contacts start to contact with the fixed isolating contacts during moving in the truck, the operating moment will increased suddenly, at this time, continue to rotate the operating handle for about two turns, then, the truck can be moved to the service position.

9.4.4.3 Check on the interlocking when the truck is in the test position

When the truck is locked in the test position, if the VCB is in closed condition, the interlocking between the VCB and the carrier chassis can prevent the truck from being moved from the test position to the service position. The truck can be moved from the test position to the service position only when the VCB has been opened.

9.4.4.4 Check on the interlocking during the truck being moved in or out

When the ES is in the closed position, the leading screw in the carrier chassis for operating
the truck is locked. At this time, the truck cannot be moved in.

When the VCB is in the closed position, the interlocking between the VCB and the carrier chassis can prevent the truck from being moved from the test position to the service position.

The closing circuit of the VCB should be broken during the truck being moved in or out.

During the truck being moved in or out, the VCB should not be able to be closed manually or by closing electromagnet.

During the truck being moved in or out, the bent plate used to cover the hole for operating the ES is locked, the bent plate can not be pressed down to uncover the hole. Therefore, the ES can not be closed.

During the truck being moved in or out, the secondary plug is locked and cannot be pulled out.

9.4.4.5 Check on the interlocking when the truck is in the service position

When the truck is locked in the service position, and the VCB is in the closed position, the interlocking between the VCB and the carrier chassis can prevent the truck from being moved from the service position to the test position. Only when the VCB is in the open position can the truck be moved from the service position to the test position.

When the truck is in service position, the secondary plug should be locked and cannot be pulled out.

When the truck is in service position, the bent plate used to cover the operating hole of the ES is locked, the bent plate can not be pressed down to uncover the hole.

9.4.4.6 Check on the position of the truck and the correctness of the position switch

When the truck is in the test position or service position, the position switch of the truck, which is mounted in carrier chassis, should correctly give out the position signal of the truck and close the electric operating circuit of the VCB.

When the truck is in the middle position, the position switch should open the electric operating circuit of the VCB.

9.4.5 Check on the interlock of the secondary plug

When the truck is in the test position, the secondary plug can be inserted or pulled out. When the truck is in the middle position or the service position, the secondary plug is locked and can not be pulled out.

9.4.6 Check on the correctness of the operation of the VCB

The VCB should be able to be normally opened or closed through the buttons or switches on the switchgear, as well as the protective relays, the remote control switches and manual buttons.
9.4.7 Check on the operating, controlling and protecting functions

The condition of the relays and instruments in the switchgears, and the secondary operating, controlling and protecting functions of the switchgears should be checked in accordance with the relevant drawings, so as to ensure their correctness.

After finishing the check, it is necessary to lock the truck in the test position, close and lock the door of the switchgear and hand the keys of the door of the switchgear to the keeper.

9.5 Check and test on the VCB and other electric components

Read the operation manuals of the VCB, ES and other main electric components carefully, check and test the characteristic and parameters of each component according to their operation manuals, and record the result.

9.6 Check on contact resistance between the framework of the truck and the switchgear

The contact resistance should be less than 1000 $\mu\Omega$.

9.7 Check on the resistance of the main circuit

The contacting resistance of each pair of isolating contacts and the resistance of the main circuit should conform with the values shown in Table 3.

<table>
<thead>
<tr>
<th>Rated current (A)</th>
<th>Measured position</th>
<th>Main circuit</th>
<th>Primary isolating contact (single)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value of the resistance ($\mu\Omega$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>630</td>
<td>$\leq 200$</td>
<td>$\leq 25$</td>
<td></td>
</tr>
<tr>
<td>1250</td>
<td>$\leq 150$</td>
<td>$\leq 20$</td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td>$\leq 90$</td>
<td>$\leq 20$</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>$\leq 90$</td>
<td>$\leq 20$</td>
<td></td>
</tr>
<tr>
<td>2500</td>
<td>$\leq 70$</td>
<td>$\leq 18$</td>
<td></td>
</tr>
<tr>
<td>3150</td>
<td>$\leq 65$</td>
<td>$\leq 15$</td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td>$\leq 40$</td>
<td>$\leq 15$</td>
<td></td>
</tr>
</tbody>
</table>

Note: The resistance of the main circuit is measured between the upper fixed isolating contacts and the outgoing terminal of current transformers.

9.8 Check on the insulation Level

Check the power frequency withstand voltage and the insulation resistance of the related position of the switchgears according to the relevant stipulations, so as to confirm the insulation level of the switchgear.

After finishing the check, it necessary to lock the truck in the test position, close and lock
the door of the switchgear and hand the keys of the door of the switchgear to the keeper.

10 Operation and Maintenance

**Warning:** The switchgears should be operated by the specially trained operators, the operators should know the operation techniques and essentials of the switchgear, and operate the switchgears strictly according to the stipulations of relevant operating rules. Though the switchgear has been designed with the perfect interlocking device to ensure the various operation procedures to be correct, the operator should not operate the switchgears at will, especially should not enforcedly operate without analysis. Otherwise it would cause accident, damage the equipment and even danger the operators’ safety.

10.1 Operation

10.1.1 Open the door of the truck compartment

Before opening the door of the truck compartment, the operators should carefully observe the various indications on the door, and ensure that this switchgear is the operated object, and the components in it are in the normal service condition.

10.1.2 Moving in truck

Special carrier table should be used to move the truck into the switchgear from outside. The door should be opened over 90 degrees when the truck is moved in. Before moving in the truck, the operators should ensure that the VCB has already opened. When moving in the truck, the operators should push the truck to the test position manually in accordance with the operation mentioned in Subclause 6.3.

It is necessary to ensure that the VCB is in the opened position before the truck is moved from the test position to the service position. If the VCB has not been opened, it should be opened, then the operators should ensure that the ES is in the opened position before the truck being moved to the service position.

Insert the truck operating handle into the truck operating hole with your right hand, and rotate in clockwise direction. When the movable isolating contacts start to contact with the fixed isolating contacts during moving in the truck, the operating moment will increased suddenly, at this time, continue to rotate the operating handle for about two turns, then, the truck can be moved to the service position.

10.1.3 Move the truck away from the service position

Before the truck being moved the away from the service position, it is necessary to ensure that the VCB is in the opened position. If the VCB has not been opened yet, it must be opened before being moved.

When the truck is provided with the common carrier chassis, before moving the truck away from the service position, the operators should insert the operating handle of the truck into the operating hole and rotate in counter clockwise direction, until the truck is moved to the test position. Finally, remove the operating handle and finish the operation.
10.1.4 Draw the truck out of the switchgear

It is necessary to use the special carrier table to draw the truck out of the switchgear. The door of the switchgear should be opened over 90 degrees when the truck is drawn out of the switchgear. Move the carrier table near to the switchgear and prepare for drawing the truck out of the switchgear according to Subclause 6.3. Before drawing truck, it is also necessary for the operators to ensure that the shutter has already completely been closed, the ES is in the opened position, and that the secondary plug has been removed. The truck should be removed out of the switchgear manually.

10.1.5 Close/open the VCB

Generally, it is not necessary to close or open the VCB manually.

There are manual push buttons on the front plate of the truck, which is provided for the operators to adjust and test the VCB.

10.1.6 Open/close the ES

The terminal of the operating shaft of the ES is in the right front side of the switchgear. The special operating handle provided by the manufacturer should be used to operate the ES.

Before closing the ES, the operators should ensure that the truck has already been moved back to test position or moved out of the switchgear, that the cable is dead through observing the voltage indicating device, that the rear cover of cable compartment is not removed and that the ES is in the opened position. Insert the special operating handle of the ES into the terminal of the operating shaft of the ES, and rotate the handle in clockwise direction for about 90 degrees, thereby, the operators can close the ES. After the ES being closed, the bent plate used to cover the operating hole will be locked and cannot reset.

Before opening the ES, the operators should first ensure that the rear cover of the cable compartment has already been fixed completely, that the ES is in the closed position. Insert the special operating handle into the terminal of the operating shaft of the ES, and rotate the handle in counter-clockwise direction for about 90 degrees, thereby, the operators can open the ES. At this time, the bent plate used to cover the operating hole covers the operating hole.

10.1.7 Remove the cover of the cable compartment

Before the cover of the cable compartment being removed, the ES should be closed.

The cover of the cable compartment can be removed by loosening the fixing bolts on the cover of the cable compartment.

10.1.8 Installing the cover of the cable compartment

Before the cover of the cable compartment being installed, the ES should be in the closed position, otherwise the installation cannot be carried out. Special attention should be paid that whether the impurities in the cable compartment has completely been cleared before installing the cover of the cable compartment.
10.1.9 Remove the cover of the busbar compartment

Only when it can be ensured that all of the main busbars are dead can the cover of the busbar compartment be removed.

10.1.10 Install the cover of the cable compartment

Special attention should be paid that whether the impurities in the busbar compartment has completely been cleared before installing the cover of the busbar compartment.

10.2 Maintenance

10.2.1 Clearing

The switchgear should be cleaned periodically to keep the surface of the insulation parts and conductive parts clean. The cleaning work should be carried out with the primary and secondary circuit being dead.

10.2.2 Lubrication

It is necessary to periodically lubricate the relevant parts of the switchgear. The lubrication should be carried out with the primary and secondary circuits being dead.

10.2.2.1 Main positions necessary to be lubricated

The main positions necessary to be lubricated are shown in the following:

- All driving parts of the VCB, including the operating device.
- All driving parts on the truck and in the switchgear, which are associated with the operation of the truck.
- The driving parts associated with the operation of the ES.
- The driving parts of interlocking between the truck and the switchgear.
- The moving parts of the shutters.

10.2.2.2 The contacting parts of the primary isolating contacts should be periodically cleared and applied with new Vaseline (or conductive paste).

10.2.3 Check for Maintenance

Besides Check mentioned in chapter 9, the following checking items should also be included:

10.2.3.1 The mechanical parameters of the VCB should be checked. If the results do not conform with the mechanical parameters specified in the technical specifications of the VCB, or are too much different from the ones received before the VCB being put into use, it is necessary for the operators to properly adjust the VCB according to the manual of the VCB, for the purpose to set the mechanical parameters of the VCB to the normal condition.

10.2.3.2 Check the fasteners, especially the ones associated with the driving parts and the
main circuit connection. It is necessary to re-fasten the loosening fasteners if any.

10.2.4 Attention for Maintenance

Special attention should be paid to the following for maintenance:

The cabinet bodies of the switchgears and the trucks are assembled with the special positioners in the manufacture. All of the co-ordinations are received by the means of special positioners. Therefore, the user should better avoid excessively dismantling and remounting the parts of the cabinet bodies and the truck as far as possible when maintaining the cabinet and truck. Before dismantling the parts, it is necessary to plan well the remounting method, procedure and positioning method to guarantee the remounting correctness. If the bodies of cabinets or trucks cannot be rebuilt during maintenance, ask the manufacturer for help, so as to prevent the products from being damaged or the property of the products from dropping down owing to error remounting.

11 Documents attached with the Products

a) Quality certificate of the products
b) Packing list.
c) Routine test reports of the products.
d) Instructions for operation and installation, including this instruction and the ones of the VCB and other primary components equipped. Two sets of instructions will be provided for each contract.
e) List of the equipped components.
f) Primary and secondary wiring diagrams, two copies for each contract.
g) List of the drawings of the products and the list of the components equipped.

12 Accessories attached with the products

1) Truck operating handles: Drawing No. Z07F4804, one for every 5 switchgears (one truck operating handle will also be provided when the quantity of the switchgears is less than five, At most, 5 truck operating handle can be provided for each contract).

2) Carrier tables: one for every 5 switchgears (one carrier tables will also be provided when the quantity of the switchgears is less than 5. At most, 5 carrier tables can be provided for each contract). 3 kinds of carrier tables can be provided: Drawing No. K15F2201 carrier table can be used for the switchgear the rated current of which is 630～1250A and the width of which is 650 mm; Drawing No. K15F2202 carrier table can be used for the switchgear the rated current of which is 630～1600A and the width of which is 800 mm; Drawing No. K15F2203 carrier table can be used for the switchgear the rated current of which is 2000～3150 A and the width of which is 1000 mm. Drawing No. K24F2260 carrier table can be used for the switchgear the rated voltage of which is 24 kV.
3) Operating handle of the ES: Drawing No. K01F4021, one for every 5 switchgears (one operating handle of the ES will also be provided when the quantity of the switchgears is less than 5. At most, 5 Operating handles of the ES can be provided for each contract).

4) Keys of the door of the switchgear, one for every three switchgears (three Keys of the door of the switchgear can be provided when the quantity of the switchgears is less than 10).

5) M12×30 bolts for connecting the switchgears, 6 sets for every connecting surface (including the nuts, washers).

6) GB5783 M12 × 35 bolts for connecting the earthing busbars. 2 sets for each switchgear (including the nuts, washers).

7) T-shaped bolts for connecting the earthing busbars. 2 sets for each switchgear (including the M8 nuts and φ8 washers).

Note: The above mentioned accessories can be provided when their quantity is clearly specified in the Contacts.