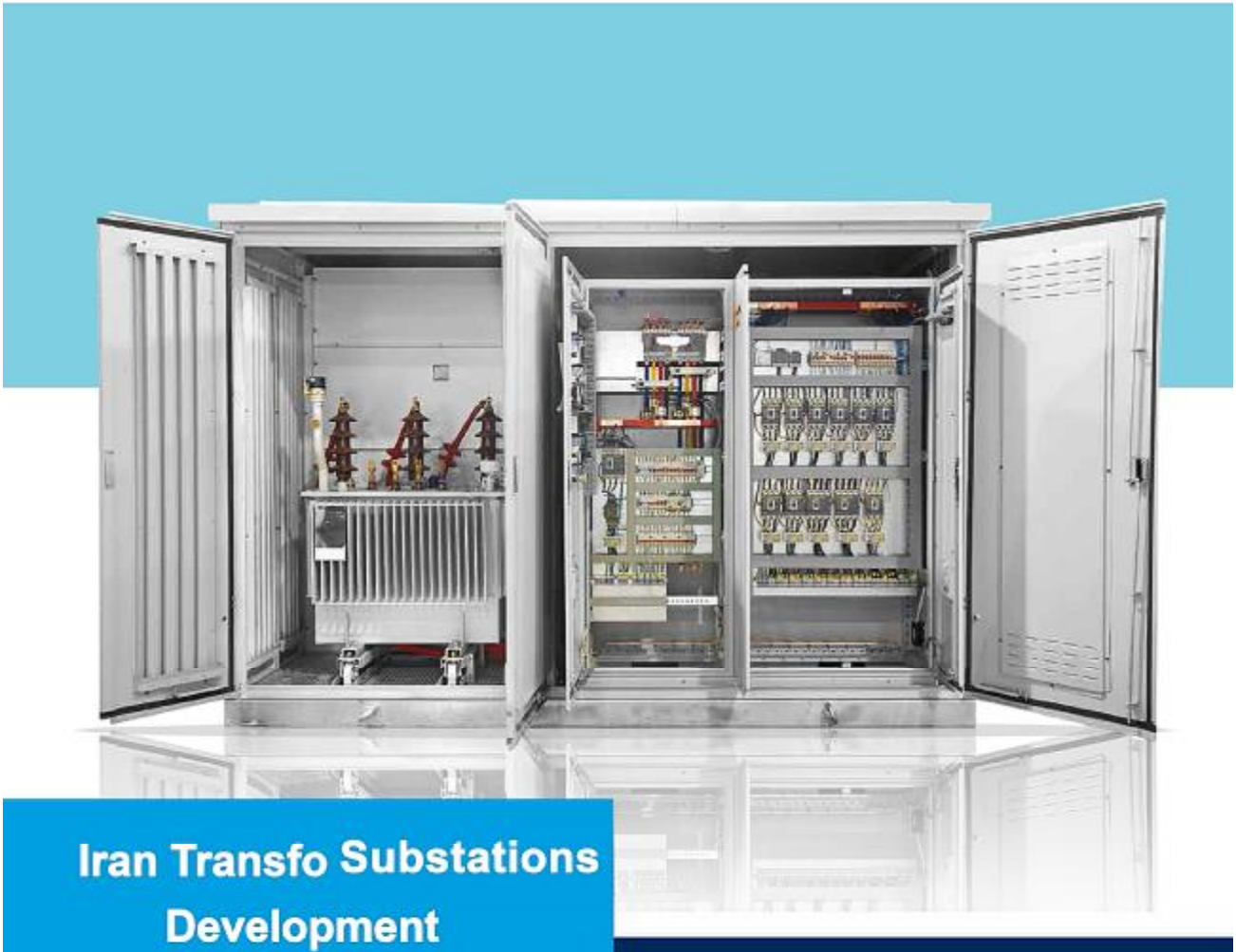
Prefabricated Substations



Iran Transfo Substations Development

IRAN TRANSFO CORPORATION

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CORPORATION

I.T.S.D

IRAN TRANSFO
SUBSTATIONS
DEVELOPMENT

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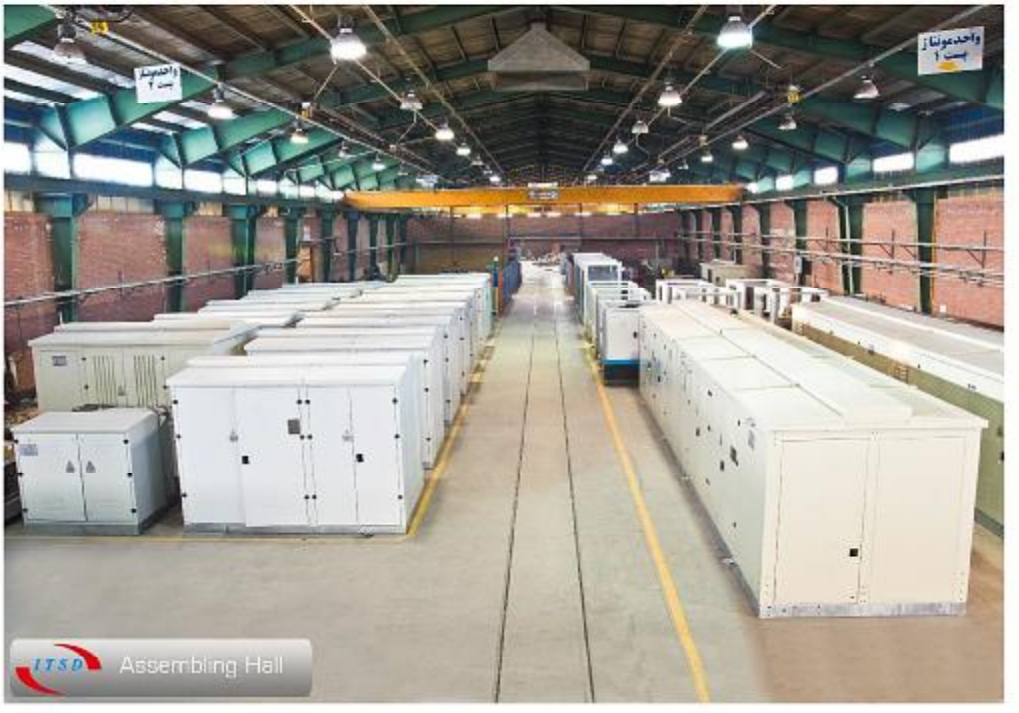
Introduction of Iran-Transfo substations Development company



Assembly Hall of Iran-Transfo substations Development company

Iran Transfo substations Development Company (ITSD) is one of Iran Transfo subsidiary companies which was established in 2003 with the purpose of producing transformer ancillary equipment.

After starting its activities, it began to study the market and identify the needs of the electricity industry and finally started designing and producing prefabricated substations. In this way company's name was changed to Iran Transfo substations Development Company.

The company has designed and manufactured all types of metal compact, double floor, mobile, unit pad mounted, semi-buried and underground concrete and semi-concrete (concrete base and metal body) substations to fulfill the following needs:

- Increasing energy consumption and the need for distribution substations and restrictions in urban spaces
- Considering the benefits such as high safety and usage, beauty and urban design
- Saving substation construction space (due to the high cost of land in metropolis)
- Minimizing the need for regular periodic surveys, with the purpose of developing and optimizing country's distribution grid.

Since prefabricated substations need different types of low and medium voltage switchgears, the necessary information and knowledge in designing and producing these switchgears was transferred to the company and by designing, producing and conducting of all routine and typical tests, the necessary experience was provided and achieved in this field. The company is one of the pioneers in exporting compact substations to various countries due to the available facilities and potentials.

Advantages of prefabricated substations

Prefabricated substations with many technical and economic advantages can easily and reliably solve the problems of the country's electricity distribution grid as follow:

- Minimum occupied space (using compact equipment)
- Speed in power supply (being prefabricated)
- High safety factor (available factory tests)
- Full Coverage of Customer Needs (Customized Production)
- Full compliance with conditions of installation place (mechanical and thermal design)
- Easy operation (no special training is required)
- No need to short-term periodic surveys
- Increased grid reliability (no need to Repair and maintenance in MV switchgear)
- Long lifetime (designed for 30 years)
- Reducing Energy Loss in Distribution grid (Reduce LV grid Length)
- Easy transportability after installation
- Lower final cost than ground substations
- Beauty and appropriateness to urban design

Compact Substations

Metal kiosk Compact substations

It is one type of prefabricated substations that have the following characteristics:

- Metal substations will require concrete foundation to be installed in accordance with the plan, map and related technical specifications, the layout and foundation specifications will be schematically presented to the customer.
- The ceiling, doors and walls are made of 2mm galvanized sheet and the main frame (columns and beams) are made of 2.5 to 3mm galvanized with electrostatic powder coating of 80 to 110 microns thickness. The kiosk base is made of 4mm thick bent sheets and is welded seamlessly integrated and then galvanized by hot-dipped method.
- Access to the foundation layer is possible through the operator entry which is provided on the base floor.
- All of the metal parts inside the substation, walls, doors and equipment used, are connected to each other and connected to the main ground terminal inside the low voltage switchgear. (The doors are grounded through copper woven belts).
- Inside the substation, the fire extinguisher, a single-phase outlet in L.V side, interior lighting in all three parts of low-voltage, medium-voltage and transformer units and first aid kits are anticipated.

- Transformer enclosures, low voltage and medium voltage switchgear are separated by a colored metal partition, which limits the heat transfer of the transformer to other equipment.
- The protection rating of the transformer and switchgears enclosures are IP33 and IP43 respectively.
- Moving the substation takes place through the hooks at the bottom of the substation marked in red.
- The kiosk is designed in a way that allows natural air circulation and ventilation which has a 10K thermal class.
- The ceiling of substation has a double-sided slope to direct rainwater.
- The kiosk doors are equipped to a pendant locking system in addition to the appropriate safety lock.
- Compact substations will be delivered after the routine tests and approval of the quality control unit.

Double floor compact substations

Due to the dimensional limitations requested by customers and with the minimum necessity of transformer protection as well as the ring system in substation, the design of the double floor substation has been done. As a result, the substation dimensions have been reduced to the minimum possible.

The structure of the enclosure, the equipment used, and the way it fits into these substations are similar to those of a metal kiosk single floor and the only difference is in the layout of the equipment.

In these substations, the transformers are on the upper floor and the medium voltage and low voltage switchgears are on the lower floor thus reducing the space required for installation of the substation. Equipment accessibility is anticipated from both sides. The medium voltage switchgear is usually in the form of antenna or ring. If an oil transformer is used, a suitable oil conduction system (in case of leakage) is provided.

Mobile compact substations

These substations are designed to be used in emergencies or temporary operation; the equipment used is as follows:

- Medium voltage switchgear (MV) with two incoming and outgoing feeders (RMU)
- Resin dry type transformer
- Low voltage switchgear (LV)

Mobile compact substations

In the mobile substations made by this company, one of the medium voltage switchgear ring feeders is considered to use for airline. For this purpose, the horn system of cable carrier rises up to a height of 6 meters above the ground and is located below the 20 kV line and easily connected to the supply line. The second feeder of MV ring is intended to feed the ground substations. Mobile substations with specific technical specifications can be designed and manufactured based on the customer request.

Benefits and Uses

- Easy to operate and carry
- temporary supply during prolonged power outages
- temporary increase of grid capacity
- power supply during repair or construction of substations
- emergency power supply to flooded or earthquake struck areas
- Temporary use in places that large projects are constructed
- Emergency substations for public ceremonies

Trailer specifications

- Two axes proportional to the weight and dimensions of the substation
- transportable by truck, crane and tractor
- equipped to a wheelchair
- equipped to a shock brake system for complete substation safety during transportation
- maximum carrying capacity of 8000 kg excluding trailer weight
- equipped to a manual jack to set four jacks in stop mode
- equipped to a park lamp and a flashlight
- equipped to an anti-impact shield

Concrete substations

Full concrete substations

The concrete room consists of a base, walls and ceiling, made of reinforced concrete with a cement grade of C30/37 and then is assembled. Ventilation doors and valves are made of galvanized or oil-coated foil with electrostatic powder color, double-walled and fixed to the concrete room by a bolt system.

The roof of the concrete room is easily removed, taking into account the safety conditions, which makes equipment replacement easy. The structure of the concrete room is such that it can be moved with all equipment and is semi-buried; depending on the environmental conditions of the installation site, it is buried 350 to 710 mm inside the ground. In fact, the base of the concrete room is a prefabricated foundation that is moved along with it and does not require foundation construction in installation site. To prevent water from penetrating into the concrete room, the outer layer of the base is covered with a waterproof layer. The tops are colored according to the customer's request and in accordance with the installation environment. Ventilation of the concrete room is done naturally through the ventilation valves on the transformer side doors, with a thermal class of 10K and its layout is only available in one model as shown below, with four access doors to the equipment. In this arrangement, the transformer seat that surrounds it, is like a pool that is covered with a protective oil layer. The low and the medium voltage equipment are installed on both sides of the transformer and the cable entry and exit area is provided at the bottom of the room.

Medium voltage switchgear

Medium voltage switchgear GIS (SF6 Insulation) includes:

- One transformer feeder: With three-position on load break switchgear with HV-HRC fuse protection or circuit breaker and ground Load Break Switch (LBS) with self-power protection
- Two or three input - output feeder: With three-position on load LBS (if using antenna or ring panel, MV switchgear metering can be used).

Transformer

Conservator oil type transformer
Hermetically sealed oil type transformer
Cast-resin type transformer
The type of transformer is selected according to the environmental conditions and customer's request.

Low voltage switchgear

It is selected as Board type according to transformer power and customer's request

concrete substations with metal body

Concrete base substations are a new sample of compact substations that were made and offered for the first time in Iran by this company. This substation has a concrete base and an all-metal body which leads to increase in strength and efficiency of the substation. The base of this substation is similar to the base of full-concrete half-buried substation and just the room is designed in metal form to give it more flexibility.

Specifications of substation:

Up to 800KVA power, conservatory oil type transformer
Overall dimensions: L*W*H (3800*2200*3100) mm
(The height of the substation is reduced to 2345mm after installation)
Maximum weight of 9600Kg (with 800KVA transformer)

Advantages in comparison to full metal compact substations:

- No need to complicated foundation and 20 to 30 percent savings of cost
- Proper operation height about 2070 mm
- High base corrosion resistance in comparison to full metal substations
- Increase in generation speed and decrease in waiting time of customers
- Cheaper finished price (in comparison to metal substations that need construction of concrete foundation)

Advantages in comparison to full concrete compact substations:

- Using transformers up to 800 KVA which is 630 KVA in full concrete substations
- Lower enclosure weight in comparison to similar full concrete substations

Advantages of the UESA Design Concrete Semi-Submersible Substation

- Natural ventilation
- no need to foundation
- suitable for urban design
- shock and corrosion resistant
- low height (about 170 cm)
- easy transportation and fast operation
- easy and safe access to equipment
- Small dimensions K*W*H (2950*2050*2390) mm
- easy entry and exit of low and medium voltage cables

Underground substations

Underground substations have a concrete chamber, which is completely buried in the ground and houses the substation equipment like a pond. This does not take up any space from the surface. The chamber is made of reinforced concrete with a grade of cement C30/37 and the outer part is covered with a waterproof layer and the walls have only cable entry and exit valves, which are fully sealed after passing the cables. Operating valves, access valves and air intake valves at the top of the

ceiling, the sides are forecasted as V shaped ventilation valves and all necessary measures are taken to prevent surface water from penetrating into the substation. However, for emergencies such as flooding and ... special arrangements are made:

- Water level sensors (at different levels),
- Thermometer & Humidity Meter,
- Motorized Damper (Inlet and Outlet Valves),
- Water Drain Engines

Benefits:

- no occupation of passages,
- high safety due to low accessibility of people and no collision of vehicles,
- no need for foundation,
- suitable for highly-polluted conditions (such as heavy dust)

Medium voltage switchgear panel:

GIS Three-cubical Medium voltage switchgear which Includes:

- One Transformer Feeder with Three-position LBS and HV-HRC Fuse or one circuit breaker and earth load break switch with secondary relay.
- Two incoming – outgoing feeders with three-position LBS.

Transformer:

Hermetically oil type transformer with plug-in bushings

Low voltage switchgear panels:

With a main motorized automatic breaker (to enable connection and disconnection without having to enter the substation)

Connection of Equipment:

- Connection between Medium voltage switchgear and the Transformer is through Medium voltage XLPE Cable and XLPE plug-in cable head.
- Connection between Low voltage switchgear and transformer is through low voltage cable and cable lug.

Economic comparison

According to the announcement of Tehran Electricity Distribution Company, the cost of prefabricated substations (with no maintenance and repayment required) would be a 10-15% reduction without considering land price. Also, when using prefabricated substations, at least 60% of the substation space will be reduced compared to public substations. So, in terms of land price, we can see that in addition to using high quality equipment, safety and longevity, we will have a 25 to 45 percent cost saving. Moreover, the aforementioned comparison does not take into account the time saved on the use of prefabricated substations.

Unit substations

Unit substations are mainly designed for very hot and humid areas.

The base of substation is made of standard profiles, proportional to its weight by welded and heated galvanized.
Outdoor designed substation equipment is usually connected to the transformer by direct coupling.
These substations are mounted outdoor with IP54 on a concrete foundation without need to compartments or canopies with zero heat class.

Medium voltage switchgear
Outdoor Medium voltage switchgear with Oil or SF6 Gas Insulation including a Transformer feeder;

with Three-Position LBS and HV-HRC Fuse Protection or with circuit breaker and earth load break switch with self-power protection and usually two incoming-outgoing feeders with on load three position LBS.

Low voltage switchgear
Designed for outdoor in the form of Box Type or Free Standing according to transformer power and customer's request

Transformer
Hermetically oil or gas cushion transformer with special design, according to temperature and environmental conditions

Pad mounted substations

Semi-oily Pad-mounted substations

Pad mounted substations are selected to be used in distribution and installation systems on concrete foundation with modern design, high flexibility and easy installation. The impenetrable structure of these substations has made installation in publicly accessible places without the need for fencing. Design of these substations are based on IEEE & NEMA & ANSI & IEC standards. The transformer and the chamber of substation have an enclosure consisting of medium voltage switchgear and low voltage switchgears separated by a metal plate. Container doors are pendant lockable. Low voltage and medium voltage switchgears are located on one side of the transformer and it is possible to remove this equipment from the transformer easily. The transformer used is a hermetic gas type and the carrier hooks are mounted to move the substations on the transformer walls. Similarly, the Transformer Protection section is accessible by a separate box.

Medium voltage switchgear:

GIS three-cubicle with two incoming-outgoing feeder and transformer feeder include HV-HRC fuse protection or circuit breaker whit 50/51,50N/51N protection.

Low voltage switchgear:

It can be equipped with automatic compact break, vertical fuse breaker and energy management system according to dimensions of LV part and customer request.

Benefits of a pad-mounted substations:

- Suitable for very hot and humid areas
- base structure with hot galvanized coating
- one-way access
- low weight and easy portability
- no need to maintenance and repairment
- installing on a concrete platform
- Zero heat class
- portability from above
- High safety
- Low losses
- very low space occupancy

Users:

- Shopping centers
- Schools
- industrial buildings and factories
- apartment complexes
- commercial buildings
- hospitals

they can also be installed in parking lots, rooftops and underground due to their small size and low weight.

Oily pad mounted substations

Pad mounted substations with oily (full oily) medium voltage breakers and fuses with hermetic design

The main component of these substations, like other distribution substations, is transformer, which can be designed with either hermitically oily type with congress wall or an hermetically oil design with a neutral gas pad and radiator cooling system. Most of the components of substation are in the transformer oil, which are known as Pad Mounted Transformer and can only be manufactured and designed by transformer manufacturers.

Switches:

The LBS used in these substations are of a rotary oil type which are installed inside the transformer oil. These switches are designed to be disconnected and connected on load.

Fuse (Bay-O-Net):

Thees type of fuses are used to protect the transformer against normal overload and short circuit current.

Other specifications are as follows:

- Suitable for ambient temperature of 45° C and 1000 meters above the sea level as normal or customer request,
- with thermometer, compressor, oil and gas voltage gauge
- with fuse protection using Bay-O-Net fuses
- Along with back-up fuse protection using current limiting fuses,
- Equipped with two, three -position mode LBS for M.V incoming and outgoing feeders,
- Equipped with a dual-mode LBS for Transformer feeder,
- Equipped with Plug in type 630A Resin Medium voltage Bushing for M.V incoming and outgoing feeders
- Equipped with low-voltage resin bushing for L.V output feeder,
- Equipped with capacitive voltage indicator for incoming and outgoing feeders (by these indicators which are similar to the voltage indicator of medium voltage switchgears, there is no longer need to indicator lights on the cable head)
- Equipped with mechanical interlock between Bay-O-Net fuses and LBS of transformer feeder
- with three-layer robust color system (respectively: Zinc rich, Epoxy, Polyurethane), thickness of each layer is at least 40 microns (totally 120 microns) for transformer and electrostatic powder coating color for MV and LV chambers with at least 80–100 microns thickness.
- With IP54 protection rate
- Equipped with a locking system to prevent unauthorized access
- all doors have a microswitch to provide light when the door is opened,
- With two doors to access the substation from one side (one door for access to LV and one access to M.V)

Low voltage switchgear (LV):

In the form of pad mounted

- Available from the front
- with a compact automatic main breaker (MCCB) equipped to relay and other equipment from reputable brands

Advantages of Pad Mounted Substations

Price

These types of substations are about 20 percent cheaper than compact and kiosk package substations. This reduction is due to lower cost of used materials and the procedure of kiosks production, MV-LV switchgears, and more importantly the time of manufacturing.

Simplicity of installation and operation

The simplicity and ease of operation of these substations is due to their modularity. In ground distribution substations, the use of such substations reduces the need for maintenance.

Ease of transportation

It is easily transportable due to transportability from the above and low weight.

Appearance

This type of substation is more proper for urban design due to its small size and low height.

Safety

These substations are highly secure because all equipment are dead front and there is no hypaethral part with current, so no risk to public areas which can be installed in the customers' backyard either. This degree of confidence can make these substations safer for public and wildlife.

Backup Fuse

Backup current fuse is used to protect the transformer against high short-circuit currents. In all-oily pad mounted substations, transformer's active part, the oily LBS of the incoming and outgoing feeders, as well as the oily LBS of the transformer feeder that contain fuse are generally housed inside a common oil tank, which this tank can be sealed as a gas hermetic or oil hermetic. This feature reduces the size of the substation significantly, making it fast and easy to operate.

Table below shows the approximate dimensions:

Dimensional profile table of all oil pad mounted posts

Power / Dimension mm	200 KVA 20/0.4KV	250 KVA 20/0.4KV	315 KVA 20/0.4KV	400 KVA 20/0.4KV	500 KVA 20/0.4KV	630 KVA 20/0.4KV	800 KVA 20/0.4KV	1000 KVA 20/0.4KV
Length	1848	1848	1848	1848	1848	1848	1848	1950
Width	1560	1620	1620	1620	1740	1740	1920	1980
Height	1480	1620	1770	1770	1770	1780	1850	1880

Medium voltage switchgears

Medium voltage switchgears are in two types:

I. Compact AIS (Air Insulated System)
II. GIS (Gas Insulated System)

- Regarding AIS switchgear, ITSD has signed a cooperation agreement with European Siemens as an OEM partner.
- In case of GIS switchgear, this company is an exclusive representative of Ormazabal switchgears, former F&G.

AIS Medium voltage switchgear Manufactured by Iran Transfo Substation Development Company has the following specifications:

- Each 630A SF6 LBS cell can be disconnected on load with earth LBS and can be motorized.
- Each 200A SF6 fuse equipped LBS cell can be disconnected on load with earth LBS and 20KV fuses, which the switch can be motorized and equipped with Coil Shunt Trip system (used fuses are of HV type -HRC with 442mm long).
- Each SF6 LBS cell with motorized vacuum circuit breaker (CB) has separate power supply secondary relay (with earth fault, high current and short-circuit protections) and three protective current transformers.
- Each SF6 LBS cell with motorized SF6 CB has separate power supply secondary relay (with earth fault, high current and short-circuit protections) and three protective current transformers.
- All cells have a capacitive divider and a three-phase voltage indicator (neon indicator).
- All cells are expandable on both sides and the LBS and CB can be changed separately.
- The short circuit level of the medium voltage cells is at least 16KA/1S.
- All cells have a cable holder and a galvanized gland plate.
- The protection degree of the switchgear is in accordance with the standard of medium voltage switchgears.
- Separate and self-power supply secondary relays with approved brands of power distribution companies and Tavanir Co. can be installed on CBs.
- The mechanical interlock on LBS, simple LBS and fused LBS does not allow the cell door to be opened in connected and disconnected modes, and only in the earth state is possible to open the door of LBS cell.
- A earth fault indicator (with protection transformer, flashing light and monitor) is installed on the input LBS (a cell of the set) for earth fault and over current protection.

SIMOSEC Switchgear AIS

ORMAZABAL Switchgear GIS

Siemens Aktiengesellschaft,
Energy Management Division,
Medium Voltage & Systems Business Unit

Hereby certifies that

Iran Transfo substation Development Company (ITSD)

Dayn-Jamdi Street, Industrial Zone No 1,
Zanjan, Iran

is an official OEM partner of Siemens Medium Voltage & Systems and is authorized to label its products, besides his own branding, as follows:

„With Siemens Medium Voltage components"

Erlangen, 31st July 2017

This certificate is valid until 31st July 2019

Getting the most out of electrical energy

TO WHOM MAY CONCERN.

WE ORMAZABAL INTERNATIONAL BUSINESS SLU, HEREBY CERTIFY THAT **IRANTRANSFO SUBSTATION DEVELOPMENT COMPANY** IS OUR EXCLUSIVE DISTRIBUTOR FOR THE ISLAMIC REPUBLIC OF IRAN ACCORDING TO CONTRACT SIGNED ON THE 16TH OF SEPTEMBER 2016.

IN ZAMUDIO, SPAIN ON THE 16TH OF SEPTEMBER 2016

Ormazabal
International Business, S.L.U.
C.I.F.: B-95288330
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48160 DERIO (Vizcaya)

ENRIQUE LOPEZ

Low Voltage Switchgears

The low voltage equipment is manufactured in the form of standard plans announced by Tavanir Co. For each substation, a list of equipment is provided in the tables according to the capacity of them. It should be noted that the low-voltage switchgears include a full board (with passages lighting circuit or low-voltage switchgear without a passage lighting feeder) and design of a low-voltage automatic switch is specifically for exclusive substations. The equipment used for low voltage switchgear are as follows:

- adjustable automatic compact switch,
- Low-voltage current transformer for main circuit current measurement and current transformer for passage lighting feeder,
- switches of three-phase vertical fuses with single phase and three-phase cut-off capability for output feeder,
- contactor,
- astronomical watch,
- digital data logger,
- knife fuses and other switchgear belongings.

It is important to note that for installation of an indirect digital meter in the lighting feeder, the necessary facilities are provided, but supply and installation of the meter is the responsibility of the customer or the electricity distribution company.

Additionally, this company is capable of designing and generating low voltage distribution switchgears, switchboards and AVR.

Equipment

Iran Transfo Substation Development Company is equipped with modern CNC cutting machines and laboratory equipment for routine testing.

Laboratory

CNC cutting, punching and bending machine

Color line system

The company is equipped with an electrostatic powder system that features a 6-step wash line including removing grease (steel and galvanized), hot water wash, accelerator, cation zinc phosphate, sealer and cold-water wash and coloring is done by spray guns. Also, quality control tests including Salt Spray (salt mist), cross cut test, impact and bending test are performed to control its substructure.

Ventilation

Special ventilation system embedded in the roof structure, side walls and doors guarantee rapid heat transfer of transformer according to real-class calculations. This natural flow of air is due to the thermosiphon phenomenon. The warm air is light and will move upwards and then slowly drift off the substation, thereby limiting the increase in heat inside the substation. For more ventilation, the level of ventilation valves for the transformer room increases.

Equipment connections

Connection of Medium voltage switchgear and Transformers:
Using XLPE Medium voltage switchgear Cable, Internal Heat head Cables and Plug-in head Cables
Connection of Low voltage switchgear and transformer:
Using low-voltage NYY cable and tin-plated copper cables with non-metallic cables or using flat or flexible copper or aluminum busbars

Layout

Substation layout is the most important determinant of its dimensions depending on location conditions, number of access sides and customer request (as we increase the number of access sides dimensions will be smaller), the following notes should be taken into account in substation layout:

- Compliance with standard conditions,
- easy access to equipment,
- high safety,
- ease of transportation,
- convenient fixing of equipment,
- ease and safety of connections,
- customer request

Grounding

In the presence of low voltage switchgear, the main earth busbar is placed in it; otherwise it is installed in the main structure of the substation, which the earth of all main equipment is connected to it directly. During operation, the earth electrode or earth well system should be installed outside the substation and connected to the main earthing bus with the appropriate copper wire.

Maintenance and repair

MV switchgear and transformers have usually no need to maintenance and repairment, but the LV switchgear should be subjected to periodic surveys depending on the operating conditions. Additionally, metal or concrete room should be considered for door regulation.

Certificates obtained by Iran Transfo Substation Development Company