



KIOSK-SUBSTATION up to 24kV

VIETSTAR CORPORATION

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I. SCOPE:

This specification is applicable to distribution prefabricated compact substation included transformer with rated primary voltage up to 22kV.

II. STANDARDS OF THE FABRICATE AND TEST :

- IEC 1330 : High voltage/low voltage prefabricated substation

III. DESCRIPTIONS :

A. SERVICE CONDITIONS :

- The substation shall be designed and fabricated, suitable for outdoor use in Vietnam under the following conditions:
 - Altitude : Not exceeding 1000m above sea level
 - Maximum ambient air temperature : 40°C
 - Mean annual ambient air temperature : 30°C
 - Maximum relative humidity : 95%
 - Climate : Tropical, salty atmosphere, industrial contamination.
 - Solar radiation : 1000W/m²
 - Maximum wind velocity : 30m/s
 - Lightning stroke expectancy : 120 thunderstorm days per year.
- The substation shall be suitable for installation at ground level as the lane, pavement ... in the crowded streets.

B. CONTRUCTION :

1. General :

- The substation comprises :
 - Enclosure.
 - Medium voltage ring main unit (MV RMU).
 - Low voltage switchboard.
 - Distribution transformer.
 - Medium voltage connections between the MV RMU and primary terminals of the transformer.
 - Low voltage connections between secondary terminals of the transformer and upstream MCCB of the LV switchboard.
 - Metering system.
 - Earthing system.
 - Lighting system.
 - Ventilated system.
 - Auxiliary cable inside the substation.
- The substation shall be designed for :
 - Fast installation, no extra concrete foundation needed for erection.
 - Maintenance free.
 - Safety for worker and public.
 - Self- contained, no external supplies needed.
 - Capable of operating with SCADA system later.
 - Capable of operating from outdoor.
 - Capable of replacement each component inside the compact substation easily on site without moving other components.

2. Enclosure :



2.1. Configuration :

- The enclosure consists of three main following compartments :
 - Medium voltage compartment.
 - Transformer compartment.
 - Low voltage compartment.
- These compartments shall be separated by partitions.

2.2. Material:

- The enclosure consists of a frame supporting all of the equipment, partitions and an outside cover.
- The materials used in the construction of the enclosure of the prefabricated compact substation shall have a minimum level of behavior against fire occurring inside or outside of the compact substation.
- In case of synthetic materials are used, they shall be tested according to ISO 1210, method A.
- The enclosure shall be made of the following materials :
 - Frame : Stainless steel, or Powder coat (outdoor type) sheet-steel. Thickness more 2mm.
 - Partitions : Stainless steel or Glass reinforced epoxy, Powder coat (outdoor type) sheet-steel. Thickness from 1.5mm to 2mm.
 - Outside cover : Thickness more 2mm.

We can produce the optimum from following reference cases:

- * Case 1 : Powder coat (outdoor type) sheet-steel panels.
- * Case 2 : Stainless sheet-steel panels.
- * Case 3 : Aluminum.
- * Case 4 : Glass reinforced epoxy.

2.1. Protection against mechanical stress:

The enclosure of compact substation shall have sufficient mechanical strength and shall withstand the following loads and impacts :

- Roof load : Minimum 2.500N/m^2 (erection loads or other loads).
- Wind loads on the enclosure : 30m/s
- External mechanical impacts on covers, doors and ventilated openings: External mechanical impacts with an impact energy of 20 J.

2.2. Water tightness :

The roof and the walls of enclosure will be watertight and the roof will have a slope at least 2% allowing the passage of the water.

2.3. Accessibility :

The accessibility of the compartments of the substation is provided with the followings :

- The enclosure has type of accessibility on its various sides according to IEC 1330: Prefabricated substation with unrestricted accessibility, including that of the general public. All doors have to be closed and correctly secured.
- Each component inside the substation will be easily replaceable directly on site without moving other components.

- Access to the operating compartments is provided by the followings :
 - Two double hinged doors located at the sides of the substation for normal operation of the MV ring main unit, LV switchboard and metering board.
 - One hinged door located at the front of the substation for normal operation of the transformer.

- Requirements of these doors :
 - The doors are equipped with door switches intended for use with lighting system, rubber seals, locking device and keys.
 - The doors shall not require tools for their opening.
 - The doors are capable of opening outwards at an angle of at least 90° and equipped with a device able to maintain them in an open position.
- The roof of the transformer compartment can be removable for installation of the transformer. This roof shall not be possible to remove before the door used for normal operation of the transformer have been opened.
- The support to receive the transformer moved through this roof will be included in the substation.
- The light weight plates below the MV RMU and LV switchboard can be removed in such a way that the cable connection room is freely accessible.



2.4. Internal fault :

- The enclosure is designed in such away that any destruction of one component in a compartment due to internal fault, the operators standing in front of the MV RMU or LV switchboard and components located in the other compartments must not be affected.
- The capable of the internal arc

withstanding of the prefabricated compact substation shall be tested according to IEC 1330-annex A.

2.5. Degree of protection (when doors of enclosure are closed):

- Degree of protection of Enclosure of MV and LV compartments, Enclosure of transformer compartment to ensure that compact substation can be operated in service condition shown in item III.A.
- Louvers will also incorporate with deflection plates to prevent an object being pushed straight into the enclosure.

2.6. Dimensions :

- The compact substation will be supplied with fabricated in minimum dimensions. The transformer compartment has sufficient space for installation of 15-22/0.4kV- up to 1000kVA.
- The Supplier has to describe overall maximal dimensions of supplied substations (Length[mm] x Width[mm] x Height[mm]) in his proposal. Maximum surface area of the substation (Length[mm] x Width[mm]) shall be not exceed 6m². The substation with minimum overall dimensions shall be prefer.

2.7. Color :

- Outside: Light gray
- Inside : Light gray

2.8. Requirements of enclosure made of non-conducting materials :

- The insulation between non-shielded live parts of the connections between the RMU and transformer and the accessible surface of the enclosure of the compact substation shall withstand the following test voltage :
 - Power frequency test voltage : 50kV/1min
 - Impulse (1.2/50 μ s) withstand voltage : 125kV
- The insulation between non-shielded live parts of the connections between the RMU and the transformer and the inner surface of insulating parts of the enclosure facing these shall be withstand at least 150% of the rated voltage of the prefabricated compact substation.

2.9. Storage of accessories :

The enclosure has adequate space for keeping of accessories as capacitive voltage indicators, operating handle for the load break switches and earthing switch, etc...

2.10. Labels on surface of prefabricated compact substation enclosure :

- VIETSTAR name.
- Type designation.
- Serial number.
- Year of manufacture.
- Character height : 100mm

3. Medium voltage ring main unit (RMU) :

The RMU is preinstalled inside the medium voltage compartment.

3.1. Construction :

- Type :
 - Non-extensible.
 - SF₆ gas-insulated.
 - Configuration : Two cable feeders and one transformer tee-off.
- The RMU consists of the followings :
 - Enclosure : Metal clad type.
 - Cable feeder : Load break switch and earthing switch.
 - Outgoing cable feeder : Load break switch and earthing switch.
 - RMU tee-off :
 - Switch-fuse combination for transformer protection. The switch - fuse combination consist of :
 - * 01 fuse chamber for housing 03 striker fuse cartridges.
 - * 01 three-phase switch equipped with a switch trip unit triggered by fuse blowing.
 - * 01 upstream three phase earthing switch
 - * 01 downstream three phase earthing switch.
 - Interlocked system :
 - * The earthing switch of cable feeder is interlocked with the load break switch.
 - * The downstream earthing switch is interlocked with the upstream earthing switch
 - * Downstream and upstream earthing switches are interlocked with the switch trip unit.
 - * The fuse chamber could only be accessed when three-phase switch is opened and the downstream and upstream earthing switches are closed
 - SF₆ gas leakage monitor.
 - Busbar :
 - * Type : Single.
 - * Material : Copper.
- All breaking units, including earthing switches, are contained in enclosure filled with SF₆ gas.

3.2. Technical data :

- Rated voltage : 24kV
- Rated frequency : 50Hz
- Rated current
 - Busbar : 630A
 - For load break switch of cable feeders : 630A
 - For switch of RMU tee-off : 200A
- Rated breaking current
 - For load break switch of cable feeders : 630A
 - For switch of RMU tee-off : 200A
- Power frequency withstand voltage : 50kV/1min
- Impulse (1.2/50 μ s) withstand voltage : 125kV
- Rated short time withstand current : 16kA /3s or 25kA/1s
- Rated peak withstand current : 40kA
- Rated short circuit making current of load break switch of cable feeders and switch of RMU tee-off : 40kA



- Number of operating cycles (C-O) cycles of load break switch of cable feeders and switch of RMU tee-off :
 - at rated current : 1000 times
 - at no load : 5000 times
- Degree of protection of the enclosure : IP3X
- The RMU is completely supplied with the followings :
 - Three 24kV striker HRC fuse cartridges for short circuit protection of the 15-22kV/0.4kV- 400kVA transformer.
 - 02 set of terminals for connection two 24kV-3x240mm² underground copper cable to RMU.
 - 01 termination kit (consist of 01 cable breakout, 3 re-jacketing sleeves, 3 copper crimp lugs and accessories corresponding to Elbow adapters for copper conductor of 50 mm²)
 - 03 elbow terminals for connection three single core 24kV-50mm² copper cable to RMU tee off.
 - Pressure relief.
 - 09 capacitive voltage indicators.
 - Short circuit indicator, 3 poles.
 - Ground fault indicator.
 - Operating position of load break switch indicator.
 - Operating position of switch of switch-fuse combination indicator.
 - Transparent earthing covers for visible cable earthing.
 - 01 operating handle for the load break switches.
 - 01 operating handle for the earthing switch.
 - Cover compartment for RMU tee-off cables.
 - 01 set of side walls.
 - Padlock for locking the load break switch in open position and the earthing switches in either open or close position.
 - 01 single line diagram on the front surface of RMU.
- The position of the pressure relief must be designed corresponding to the construction of the compact substation to ensure the capable of the internal arc withstanding of the compact substation.

4. Low voltage switchboard and metering board :

Low voltage switchboard and metering board is preinstalled on the separate wall inside the LV compartment.

4.1. Switchboard :

Low voltage switchboard consists of the followings :

- 01 single busbar system, consist of three phase busbars and one neutral busbar.
- 01 upstream three phase moulded case circuit breaker (MCCB).
- 05 downstream three phase MCCBs.
- 01 fault current indicator to detect earth-phase and phase-phase current faults.
- 01 single line diagram on the front surface of switchboard.

4.1.1. Busbar system :

- Type : Single.
- Material : Copper.
- The phase busbars consists of the followings :
 - three horizontal bars.
 - parts of connecting upstream MCCB to three busbars.
 - parts of connecting phase busbars to 05 downstream MCCBs.
- The neutral busbar consists of one horizontal bar which will be located under the downstream MCCBs.
- The neutral bar shall be equipped with two screw connector including copper lugs for copper cable of 300mm² and five screw connectors for 70-95mm² copper lugs.
- The busbar system shall be painted with yellow/red/blue for phase busbars and white for neutral busbar.
- Thickness x width of copper bar : $\geq 600 \text{ mm}^2$
- Degree of protection of busbar system : IP2X



4.1.2. Moulded case circuit breaker (MCCB) :

- Rated voltage : 220/380VAC
- Rated frequency : 50Hz
- Characteristic : B or C according to IEC 947-2
- Number of poles : 3 poles protected.
- Installation : Fixed type
- Rated current (I_n)
 - For upstream MCCB : 800A

- For downstream MCCBs : 250A
- Rated breaking current
 - For upstream MCCB : 800A
 - For downstream MCCBs : 250A
- Power frequency withstand voltage : 02kV/1min
- Impulse (1.2/50 μ s) withstand voltage: 06kV
- Rated short circuit breaking current : 25kA
- Rated short circuit making current : 52.5kA
- Degree of protection : IP3X
- The operating handle cannot indicate the "OFF" position unless the contacts are effectively open.
- Creepage distance :
 - Between live parts which are separated when the circuit breaker is in the open position : ≥ 3 mm
 - Between live parts and accessible surfaces of operating means : ≥ 3 mm
- Number of operating cycles (C-O) cycles :
 - at rated current : 10,000 times
 - at no load : 20,000 times
- Terminals :
 - Type of connection : Screw
 - Upper terminals of the upstream MCCB shall be supplied with terminal pads and lugs for connection to the secondary terminals of transformer by two copper conductors of 300 mm².
 - Under terminals of the upstream MCCB shall be supplied with terminal pads and lugs for connection to three phase busbars by copper bars or conductors of 600mm².
 - Upper terminals of each downstream MCCB shall be supplied with terminal pads and lugs for connection to three phase busbars by copper bars or conductors of 120mm².
 - Under terminals of each downstream MCCBs shall be pre-installed the terminal pads and lugs for connection to 95-120mm² copper cable.

4.2. Metering board :

- The metering system is performed at secondary side of transformer.
- The metering board consists of three low voltage current transformers, one three phase KWh, one three phase KVARh, three ammeter, three maximum ammeters.

4.2.1. Current transformers :

- Type : Ring
- Rated primary current (I_n) : 600A
- Rated secondary current : 05A
- Ratio : 600/5
- Insulation : Dry type
- Power frequency withstand voltage : 02kV/1min
- Impulse (1.2/50 μ s) withstand voltage: 06kV
- Rated short time withstand current : $80 \times I_n / 1s$
- Rated peak withstand current : $200 \times I_n$
- Burden and accuracy : 20VA, Class 1
- Current factor : 1.2

4.2.2. KWh or KVARh meter :

- Rated voltage : 220/380V
- Rated frequency : 50Hz
- Type : Electro mechanical
- Number of stator : 3
- Number of current carrying wires : 4

- Type of service : Ground wye connection
- Basic current (I_b) : 5A
- Rated maximum current :
 - KWh meter : $150\% \times I_b$
 - KVARh meter : $150\% \times I_b$
- Power frequency withstand voltage : 02kV/1min
- Impulse (1.2/50 μ s) withstand voltage: 06kV
- Accuracy
 - KWh meter : Class 2
 - KVARh meter : Class 2
- Register : Uni-directional.
- Display : 8 digits with 2 decimals.
- Reading values is multiplied with current transformer ratio
- Short time overcurrent for 0.5 s :
 - KWh meter : $30 \times I_b$
 - KVARh meter : $30 \times I_b$
- Under bearing : Magnetic type.
- Connection : Bottom
- Meter cover is made of unbreakable, non-flame burning material.
- Terminal block : for copper conductors with diameter of at least 8mm.
- Terminal block cover : Fully cover all the wires and being made of unbreakable, non-flame burning material.

4.2.3. Maximum ammeter :

- Rated voltage : 220/380V
- Rated frequency : 50Hz
- The maximum ammeter is capable of recording the maximum current, used with external 600/5 current transformer.
- The maximum ammeter has one external reset current button.
- Indicator : Pointer type
- Scale arc : 90°
- Power frequency withstand voltage : 02kV/1min
- Impulse (1.2/50 μ s) withstand voltage: 06kV
- Scale : 0-1000A
- Accuracy : Class 2
- Damping time : 3 seconds

4.2.4. Ammeter :

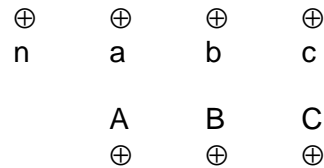
- Rated voltage : 220/380V
- Rated frequency : 50Hz
- Indicator : Pointer type
- Scale arc : 90°
- Power frequency withstand voltage : 02kV/1min
- Impulse (1.2/50 μ s) withstand voltage: 06kV
- Scale : 0-1000A
- Accuracy : Class 2
- Damping time : 3 seconds

5. Distribution Transformer :

5.1. Construction :

- The transformer shall be provided with a minimum of two closed lifting lugs. The minimum diameter of the hole or width of the slot shall be 25 mm. The two lifting lugs shall be located such that there will be a minimum of 50 mm between the lifting chain and the nearest part of the bushings.
- The transformer tank shall endure the internal pressure of 50 kPa.

- The base under transformer shall have the metal rods with pre-made holes for bolting transformer to the platform of transformer compartment.
- Color paint on the external surface : Light Gray.
- The terminals of transformer shall be brass palms with one $\Phi 13\text{mm}$ hole and arranged from left to right if the view is from the top and the viewing position is from HV bushing :



- The nominal section area of neutral terminal lug shall not be less than 50% of section area of phase terminal.
- Two earthing connections shall be provided with connection facilities for 25-35 mm² copper stranded conductor. The bolts shall be located on the lower side of the transformer and be of M12 size. Each shall be clearly indicated with an engraved 'earth symbol'.

5.2. Technical data :

- The transformer is preinstalled inside transformer compartment.
- Type : Three phase oil-immersed hermetically sealed
- Vector group : Dyn11
- Cooling system : ONAN
- Capacity : 400kVA
- Operation : Continuity
- Rated primary voltage : 15-22kV.
- The primary voltage of 15KV or 22KV can selected by voltage level changer.
- Rated secondary voltage : 0.4 KV
- Tap changer : $+5\%U_n$, $+2.5\%U_n$, $0\%U_n$, $-2.5\%U_n$, $-5\%U_n$ ($U_n = 22\text{kV}$)
- Tap changer and voltage level changer must be located at external transformer tank, adjustable easily and have a sharply sound (e.g. 'clic') for assuring in new position correctly.
- Insulation level : LI 125/AC50/AC3
- Short circuit impedance at 75°C : 4%
- No load current : 2%
- Short time withstand current : 15kA /2seconds.
- Insulation oil : according to IEC 296 or ASTM D D3487
- Maximum no load losses : 450W
- Maximum load losses at 75°C : 4200W
- Maximum total losses : 4448W
- Sound level : $\leq 56\text{dB}$
- Insulation class : A
- Maximum temperature rise :
 - For top oil : 60°C
 - For average winding : 65°C
- Creepage distance : $\geq 20 \text{ mm/kV}$
- Capability of overload operation is accordance with IEC 354.
- The transformer is completely supplied with oil level indicator, pressure relief valve, ...

6. Interconnection inside the compact substation :

- The interconnections between the RMU tee-off and the primary terminals of the transformers is preinstalled by three 24kV XLPE single core copper cable of 50mm²

- The interconnections between the secondary phase terminals of the transformer and upstream MCCB of the low voltage switchboard is preinstalled by two 1kV XLPE single core copper cable of 300mm² per phase.
- The interconnections between the secondary neutral terminal of the transformer and neutral busbar of low voltage switchboard is preinstalled by two 1kV XLPE single core copper cable of 300mm²

7. Earthing system :

- Each component inside the compartments and enclosure of the compact substation are connected to earthing circuit by an earthing copper conductor with minimum cross-section of 50mm².
- If the enclosure of the compact substation is not metallic, the metallic doors and other accessible metallic parts of the enclosure may be connected to the earthing circuit.
- For the interconnections within the prefabricated compact substation, fastening by bolting, welding or riveting is acceptable for providing electrical continuity between the frame, covers, doors or other structural parts provided that it takes into account the thermal and mechanical stresses caused by the current it may have to carry.
- The compact substation shall be provided an adequate terminal intended for connection to the earthing system of the installation.

8. Ventilated system :

- Design ventilated system in such away that any equipment inside the compact substation may be operated continuously at their ratings in service conditions shown in item III.A. of this specification.
- Ventilated openings shall be so arranged or shielded that the same degree of protection as that specified for the enclosure is obtained.

9. Lighting system :

The lighting system is preinstalled for each compartment.

- The lighting system can switch ON/OFF by door switches.
- Each compartment is pre-equipped with 40W Fluorescent lamp, miniature circuit breaker and fault current indicator.
- The lighting energy is measured via metering system.

10. Transportation :

- All the components inside the substation are arranged in such away that the centre of the substation is also the centre of gravity. This load distribution ensures a safe transport of the substation.
- The structure of the enclosure is capable of supporting the gross weight off all equipment for lifting and transportation.
- The substation can be hooked via the crane eyes on the top of substation enclosure.

11. Sound emission :

The level of sound emission from the prefabricated compact substation shall be 56 dB.

12. Instructions :

The instruction for operations, maintenance, transport, erection and storage will be enclosed each prefabricated compact substation.

IV. TESTING ITEMS :

1. Testing items :

1.1. Testing items for the prefabricated substation :

a. Routine test :

- Voltage tests on auxiliary circuits.

- Functional tests
- Verification of correct wiring.

b. Type test of equivalent compact substation (capacity of transformer must be accordance with each type) can be acceptable :

- Tests to verify the insulation level of the prefabricated substation.
- Tests to prove the temperature rise of prefabricated substation.
- Tests to verify the degree of protection.

1.2. Testing items for the RMU :

a. Routine test :

- Power frequency voltage tests on the main circuit
- Dielectric tests on auxiliary and control circuits
- Measurement of the resistance of the main circuit
- Mechanical operation tests
- Tests of auxiliary electrical, pneumatic and hydraulic devices
- Verification of the correct wiring

b. Type test :

- Dielectric tests
- Temperature rise tests
- Measurement of the resistance of the main circuit
- Short time and peak withstand current test.
- Verification of making and breaking capacities
- Mechanical operation tests
- Verification of the degree of protection
- Measurement of leakage currents
- Weatherproofing test
- Arcing due to internal fault

1.3. Testing items of the MCCB :

a. Routine test :

- Mechanical operation.
- Calibration of releases.
- Dielectric withstand.

b. Type test :

- Temperature rise.
- Tripping limits and characteristics.
- Dielectric properties
- Operational performance capability
- Overload performance.
- Short circuit breaking capacities.
- Short time withstand current.

1.4. Routine testing items of the current transformer :

- Verification of terminal markings
- Power frequency tests on primary windings and measurement of partial discharges
- Power frequency tests between sections and on secondary windings
- Test of interterm insulation
- Accuracy routine test

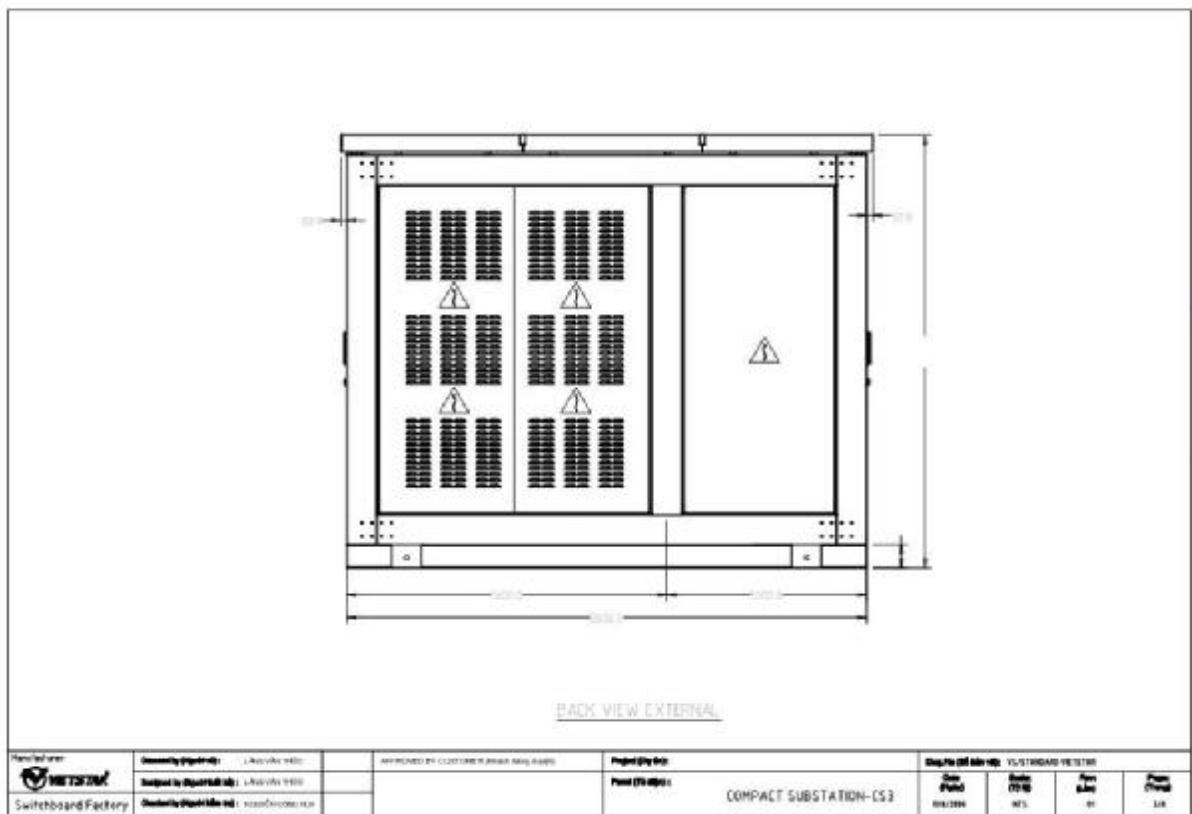
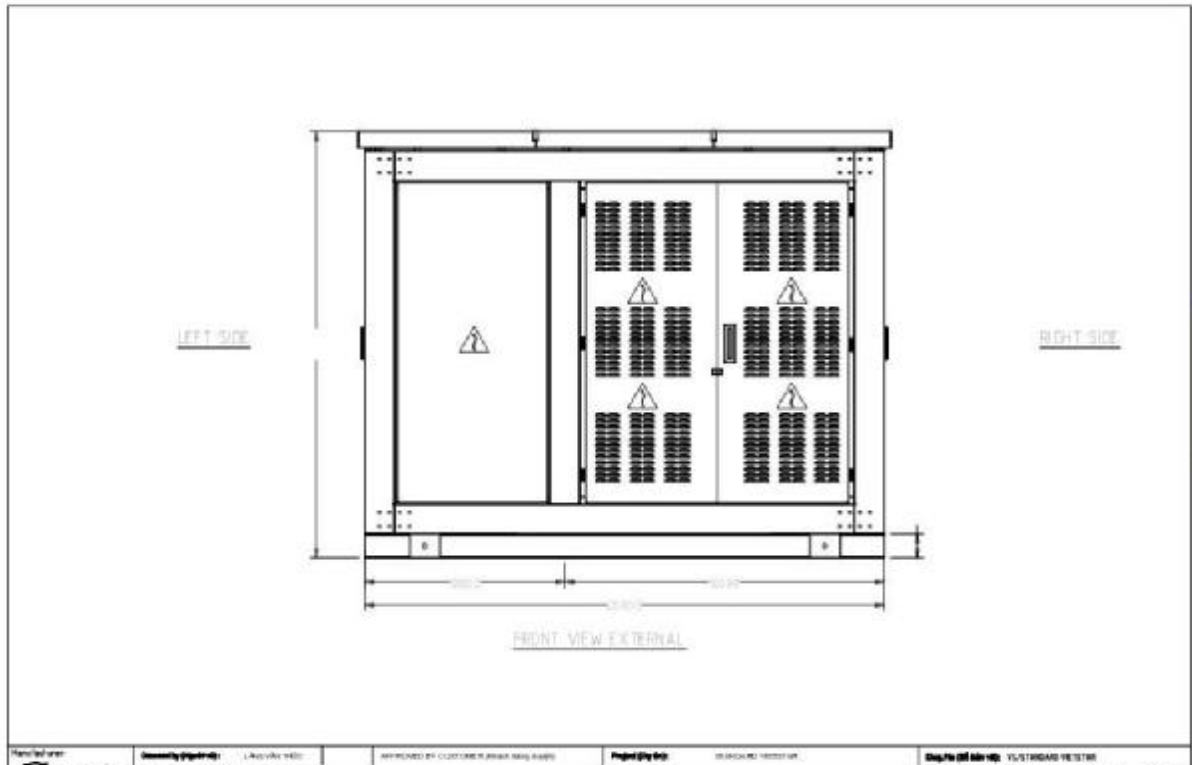
1.5. Routine testing items of the KWh and KVARh meter :

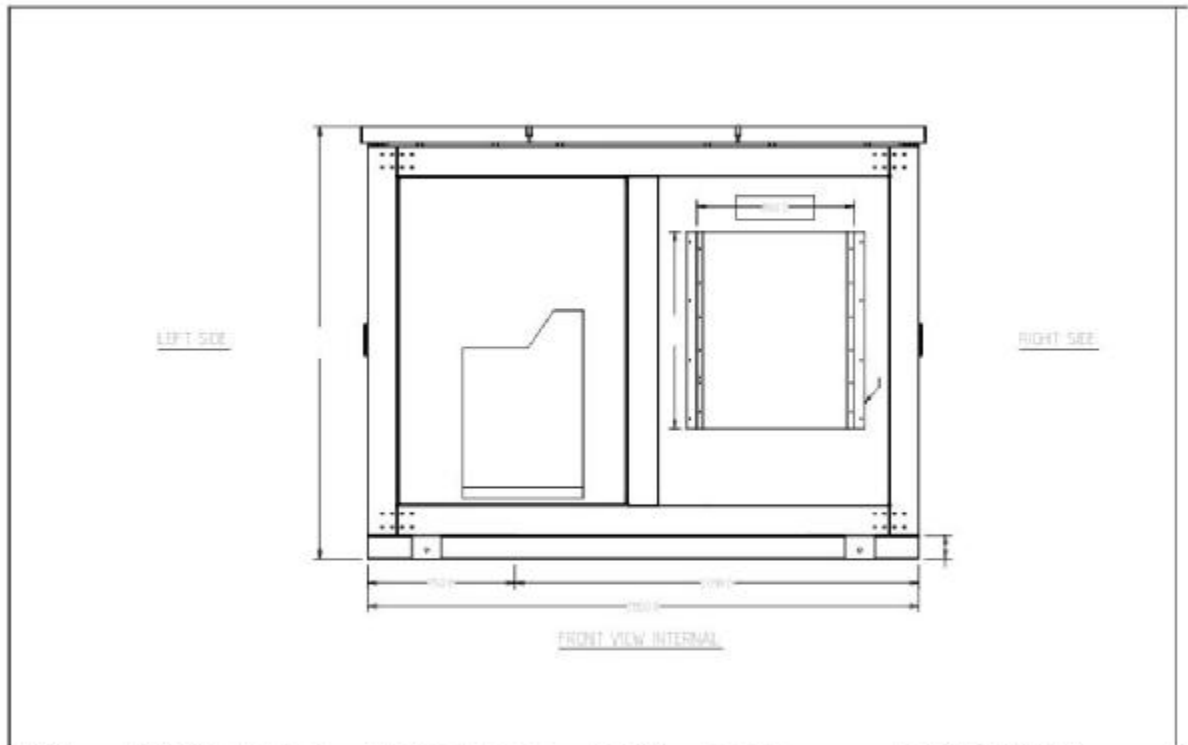
- Inspection for conformity with the specification.
- Checking mechanical function and releases.
- Dielectric tests.

- Check of dimensions and quality of workmanship.
- Acceptance tests 1 to 11 listed in IEC 514.

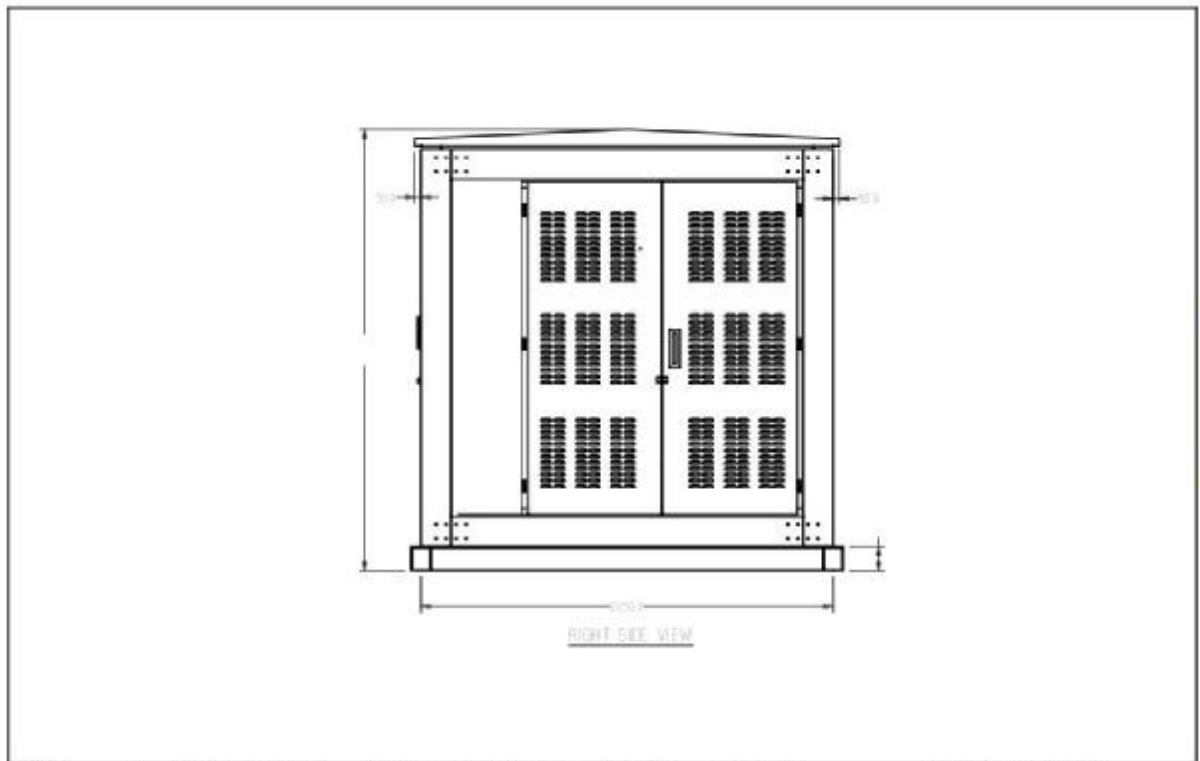
V. DRAWING :

1. Kiosk-Substation up to Transformer 560KVA :

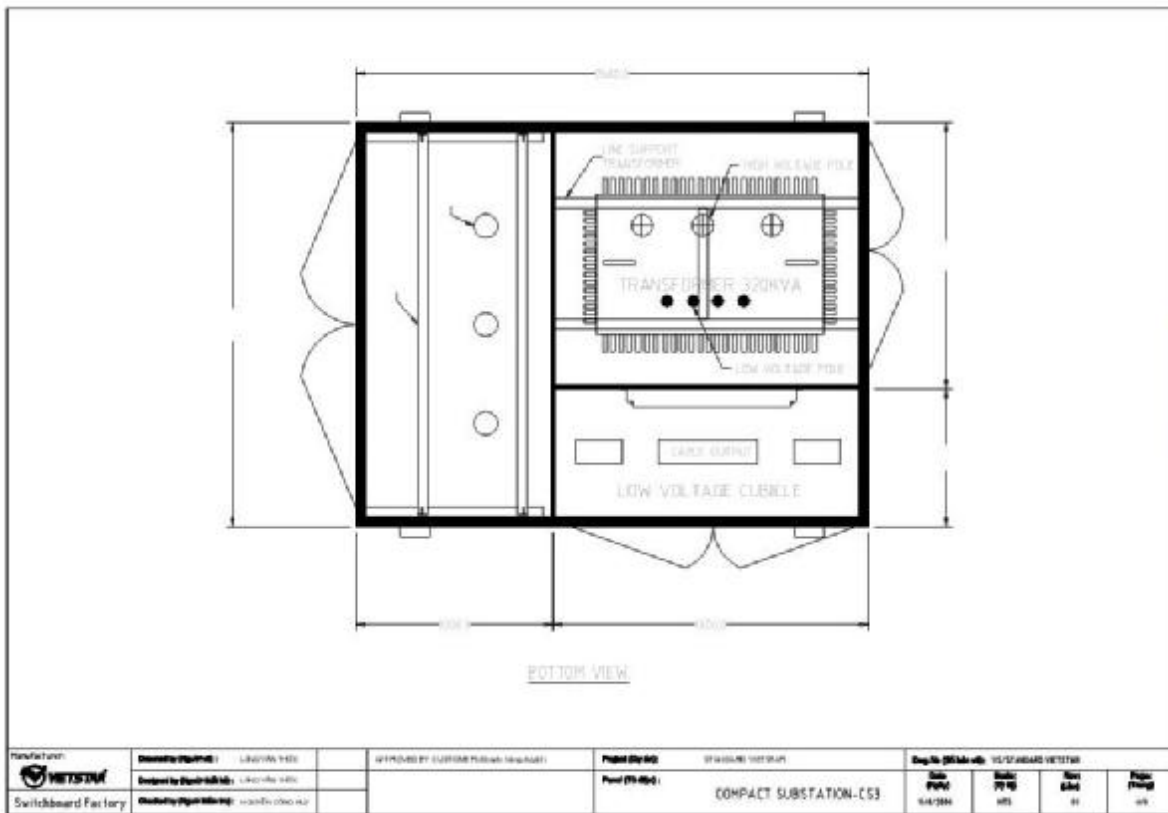
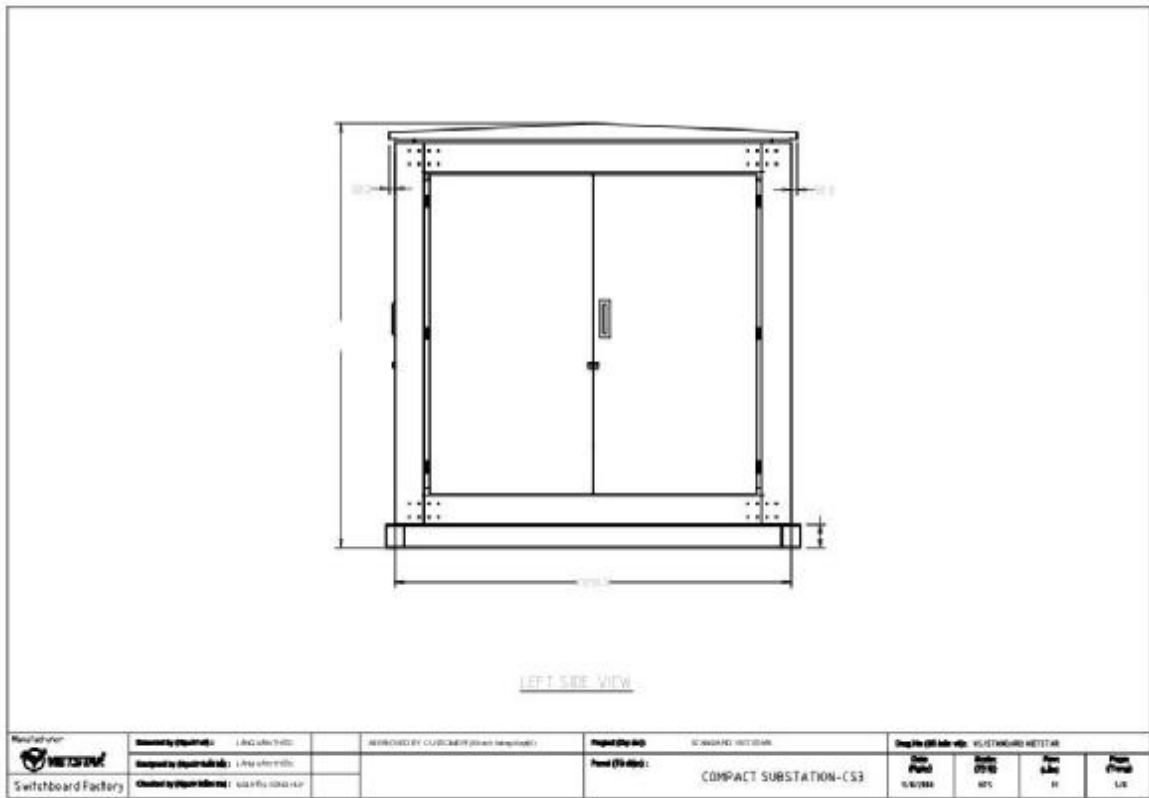




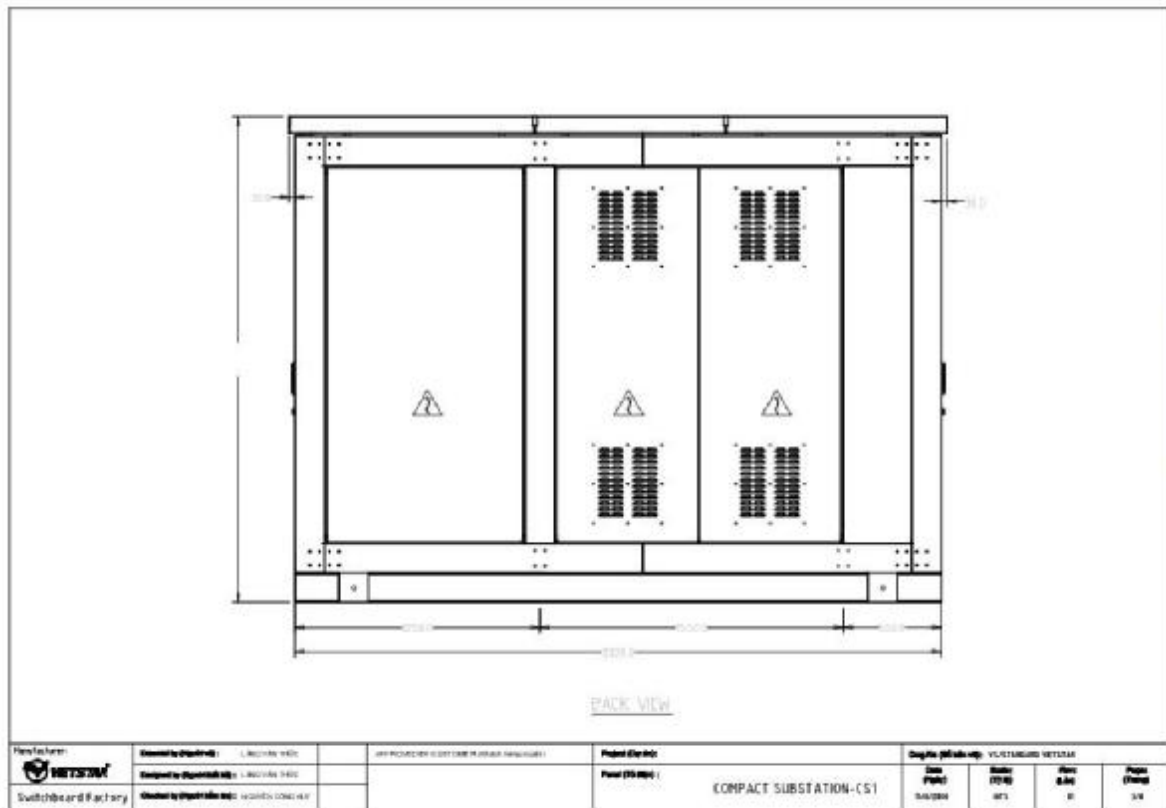
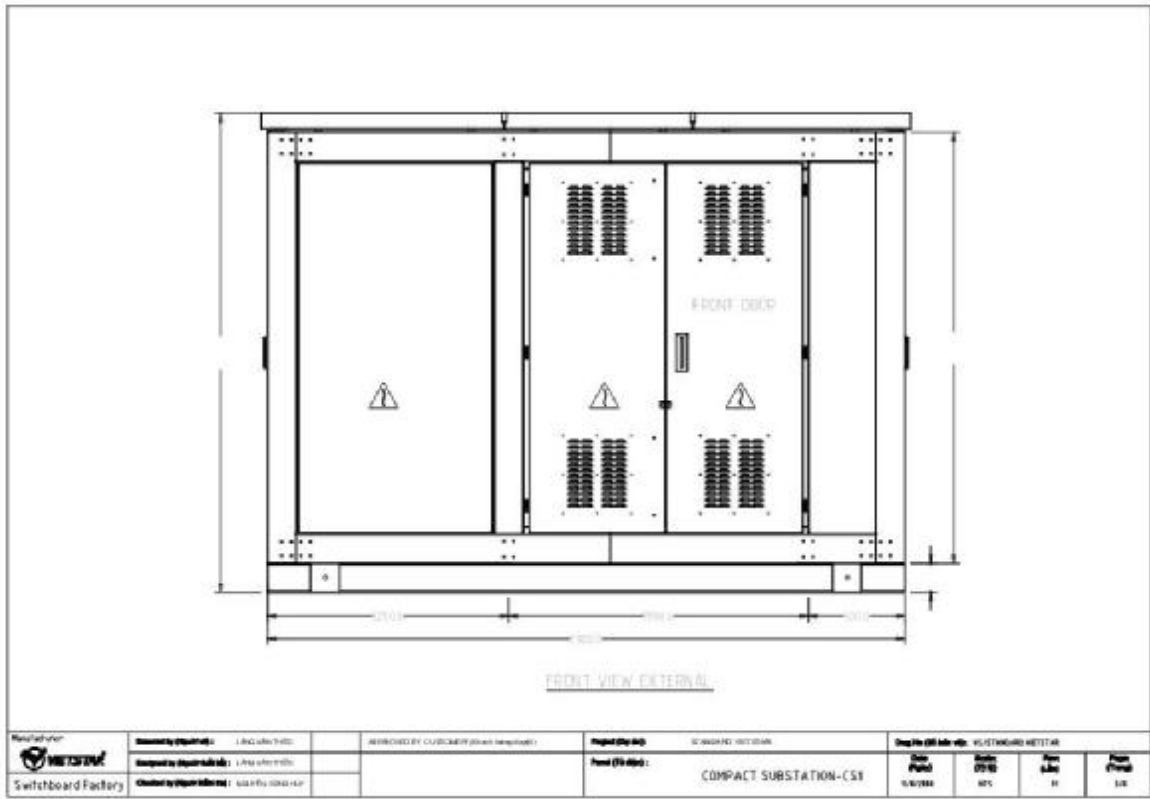
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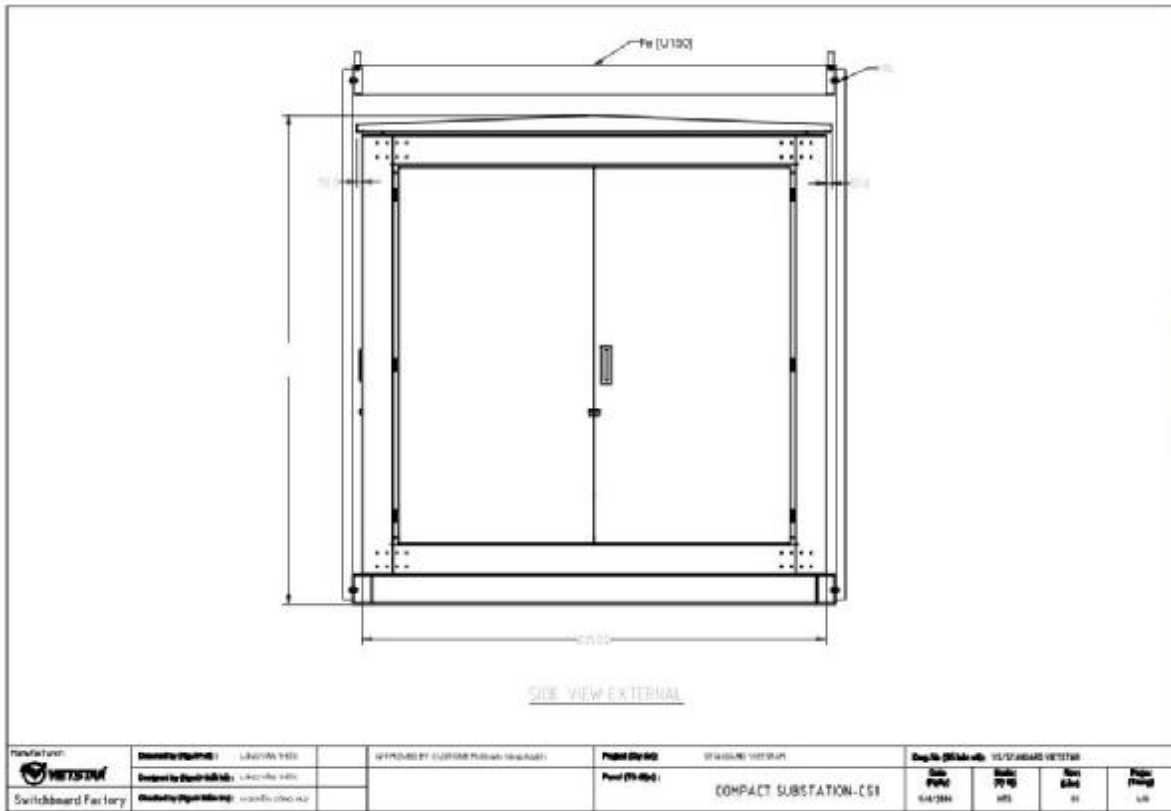
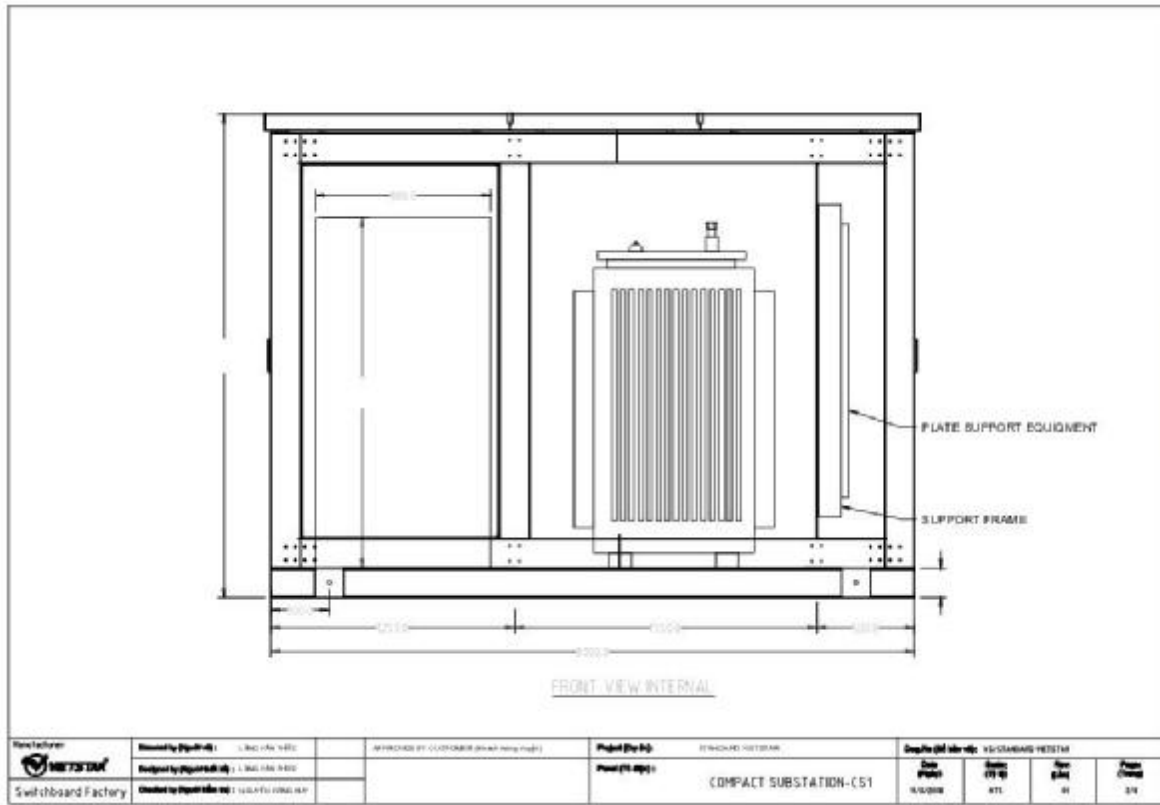


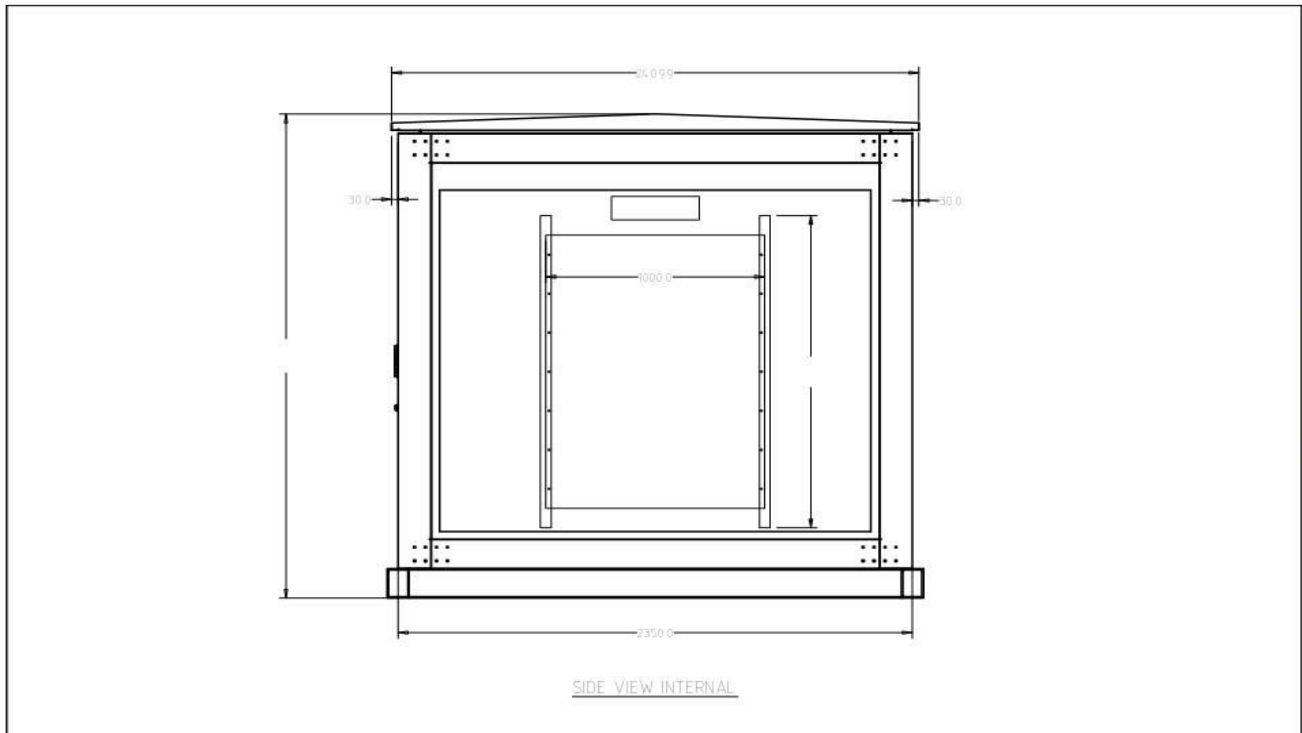
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2. Kiosk-Substation up to Transformer 1000KVA :

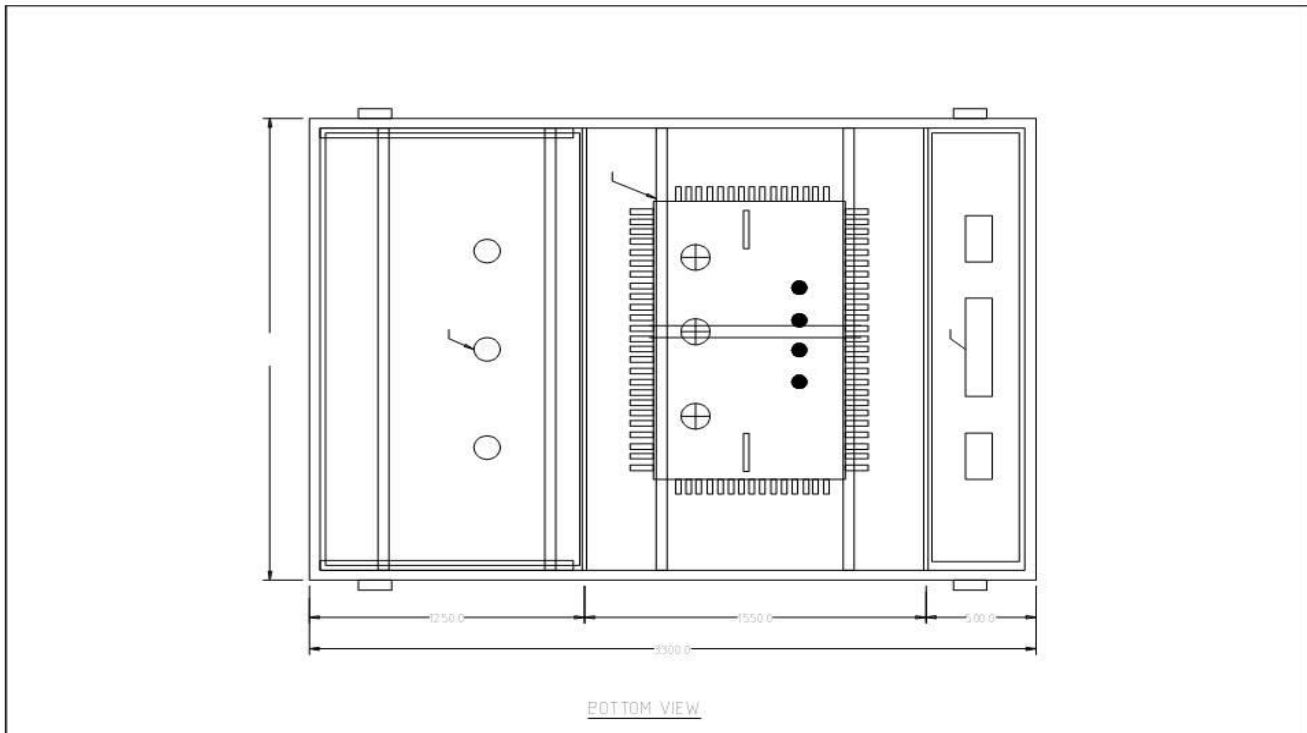






SIDE VIEW INTERNAL

Manufacturer: VIETSTAR Switchboard Factory	Designed by (Người vẽ): LƯƠNG VĂN THỨC	APPROVED BY CUSTOMER (Khách hàng duyệt):	Project (Dự án): STANDARD VIETSTAR	Design (Thiết kế vẽ): VS/STANDARD VIETSTAR	Date (Ngày): 11/8/2016	Scale (Tỷ lệ): NTS	Page (Số trang): 01	Page (Tổng): 5/8
	Designed by (Người kiểm tra): LƯƠNG VĂN THỨC		Panel (Tủ điện): COMPACT SUBSTATION-CS1					
	Checked by (Người kiểm tra): NGUYỄN CÔNG HUY							



BOTTOM VIEW

Manufacturer: VIETSTAR Switchboard Factory	Designed by (Người vẽ): LƯƠNG VĂN THỨC	APPROVED BY CUSTOMER (Khách hàng duyệt):	Project (Dự án): STANDARD VIETSTAR	Design (Thiết kế vẽ): VS/STANDARD VIETSTAR	Date (Ngày): 11/8/2016	Scale (Tỷ lệ): NTS	Page (Số trang): 01	Page (Tổng): 4/8
	Designed by (Người kiểm tra): LƯƠNG VĂN THỨC		Panel (Tủ điện): COMPACT SUBSTATION-CS1					
	Checked by (Người kiểm tra): NGUYỄN CÔNG HUY							



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Major customer:

- ❖ Lotte CM, Lotte E&C
- ❖ Posco
- ❖ Daewoo Engineering
- ❖ Samjin Vina
- ❖ Kumho
- ❖ Delta
- ❖ Young Dong
- ❖



Major customer:

- ❖ Kawasaki heavy Industry
- ❖ JFE
- ❖ Fuji Engineering
- ❖ Daneili Automation
- ❖ Coteccon
- ❖ Ree
- ❖ Archetype
- ❖ Arup
- ❖ Arucon
- ❖

