

SECTION 6

TECHNICAL SPECIFICATIONS FOR MISCELLANEOUS MATERIALS

6.1 GENERAL

6.1.1 Scope

This Section covers the designing, manufacturing, supplying, testing before shipment, finishing, painting, packing for export, insuring, shipping, delivering to the port of Saigon, landing, customs clearance and transport from the port of Saigon to the Site and supervising for the installation work, site testing and commissioning of the following materials to be installed in the Da Nhim Power Station, the Thap Cham Substation, the Phan Ri Substation, the Phan Thiet Substation, the Cam Ranh Substation and the Dien Khanh Substation.

Da Nhim Power Station

- (1) Power cables and fittings
- (2) Control cables and fittings
- (3) Insulated wires and fittings
- (4) Bare hard drawn copper conductors and fittings
- (5) Galvanized steel wires
- (6) Bare annealed copper conductors
- (7) Insulators and fittings
- (8) Steel structures
- (9) Other materials

Thap Cham Substation

- (1) Power cables and fittings
- (2) Control cables and fittings
- (3) Insulated wires and fittings
- (4) Bare hard drawn copper conductors and fittings

- (5) Galvanized steel wires
- (6) Bare annealed cooper conductors
- (7) Insulators and fittings
- (8) Steel structures
- (9) Other materials

Cam Ranh Substation

- (1) Power cables and fittings
- (2) Control cables and fittings
- (3) Insulated wires and fittings
- (4) Bare hard drawn copper conductors and fittings
- (5) Galvanized steel wires
- (6) Bare annealed cooper conductors
- (7) Insulators and fittings
- (8) Steel structures
- (9) Other materials

Dieu Khanh Substation

- (1) Power cables and fittings
- (2) Control cables and fittings
- (3) Insulated wires and fittings
- (4) Bare hard drawn copper conductors and fittings
- (5) Galvanized steel wires
- (6) Bare annealed cooper conductors
- (7) Insulators and fittings

(8) Steel structures

(9) Other materials

Phan Ri Substation

(1) Power cables and fittings

(2) Control cables and fittings

(3) Insulated wires and fittings

(4) Bare hard drawn copper conductors and fittings

(5) Galvanized steel wires

(6) Bare annealed copper conductors

(7) Insulators and fittings

(8) Steel structures

(9) Other materials

Phan Thiet Substation

(1) Power cables and fittings

(2) Control cables and fittings

(3) Insulated wires and fittings

(4) Bare hard drawn copper conductors and fittings

(5) Galvanized steel wires

(6) Bare annealed copper conductors

(7) Insulators and fittings

(8) Steel structures

(9) Other materials

6.1.2 Tests

The test to be carried out before shipment at the manufacturer's plant are as stated in the relevant clauses. The tests as specified in Clause 1.19 of the General Specifications, as applicable shall be conducted at the Site.

6.2 ELECTRICAL CONDUCTORS AND FITTINGS

The following electrical conductors and fittings shall be supplied and installed for the respective electrical circuits according to the drawing and the requirements as hereafter specified.

- (1) Power cables.
- (2) Control cables.
- (3) Insulated wires.
- (4) Bare hard drawn copper conductors.
- (5) Bare soft annealed copper conductors.

6.2.1 Power Cables

All power cables shall be of single- or multi- core copper, crosslinked polyethylene (XLPE) insulated PVC sheathed type with suitable cable ends.

All cable trays and supporting brackets complete with fixing material, required for installation of the power cables shall be supplied by the Contractor as specified in Clause 6.3.5.

The following power cables shall be supplied by the Contractor:

- (1) 12/20 kV, 800 sq.mm, single-core for each 115/22 kV main transformer secondary circuit; connection between the main transformer and the 22 kV cubicle in each substation.
- (2) 12/20 kV, 240 sq.mm, three-core for each 22 kV distribution circuit; connection between the 22 kV cubicle and the distribution end terminal pole in each substation.
- (3) 12/20 kV, 120 sq.mm, three-core for each 200 KVA house-service transformer primary circuit; connection between the house-service transformer and the 22 kV cubicle in each substation.

- (4) 0.6/1.0 kV, 200 sq.mm, single-core, one cable per phase for line circuit of the house-service transformer; connection between the low voltage switchgear and the 200 kVA house-service transformers in each substation.
- (5) Other power cable required for the equipment to be covered under this Contract shall also be supplied and installed by the Contractor. The minimum size of the power cables shall be 6 sq.mm.

6.2.2 Control Cables

(1) Scope

The following control cable shall be supplied, by the Contractor:

- (a) All control cables for the control system for the extension of 110 kV switchgears in the Da Nhim Power Station.
- (b) All control cables for of the control system for the condensers, transformers and switchgears in the Thap Cham, Phan Ri Phan Thiet, Cam Ranh and Dien Khanh Substations.

All cable trays and supporting brackets complete with fixing materials required additionally for installation of the control cables shall be supplied by the Contractor.

(2) Type

The control cable shall be of jacket type and classified as follows:

- (a) 600 V polyvinyl chloride (PVC) insulated, PVC sheathed cables of single-core or 2, 3, 4, 5, 6, 9 and 12-cores (CVV) for general use.
- (b) 600 V polyvinyl chloride (PVC) insulated, PVC sheathed, electrostatic-induction shielded cables of 2, 3, 4, 5, 6, 9 and 12-cores (CVV-S).
- (c) 600 V special thermo-resistant polyvinyl chloride (PVC) insulated, thermo-resistant PVC sheathed single-core or 2, 3, 4, 5, and 6-cores (Thermo-resistant VV).
- (d) 600 V special thermo-resistant polyvinyl chloride (PVC) insulated, thermo-resistant PVC sheathed, electrostatic-induction shielded cable of 2, 3, 4, 5 and 6-cores (Thermo-resistant VV-S), if any.

Multi-core cables may be used by obtaining the Engineer's approval.

(3) Characteristics

(a) General characteristics;

The characteristics of control cables shall meet all the relevant requirements of Thermoplastic Control Cable.

(b) Electrostatic induction shield;

The electrostatic induction shielded cables shall be wrapped with a soft annealed copper tape with a thickness of 0.1 mm and overlapped for a fourth of the tape.

(c) Thermo-resistant characteristics;

Besides the general requirements specified the above, the thermo-resistant VV and thermo-resistant VV-S cables shall also be provided.

(4) Use

Control cable for search coils, telemetering circuits, speed signal generator circuits, current transformer and voltage transformer circuits, and other circuits liable to interference due to electrical noise shall be shielded against electrostatic and/or electromagnetic induction.

Control cable for fire alarm circuits of generator housing and for emergency stop control circuits shall be of thermo-resistant characteristics.

(5) Requirements

The sectional area of core shall be not less than 4.0 sq.mm and shall comply with the following requirements:

(a) Voltage transformer secondary circuits:

Allwable voltage drop in the cable under the total vurdien of connedted instruments and relays shall be one (1) percent.

(b) Current transformer secondary circuits:

The total burden of instruments and relays plus that of cable shall be less than the rated burden of respective current transformer, and that to be consumed in cable be less than 15 VA.

(c) AC and DC circuits:

i) Allowable AC voltage drop in the cables shall be as follows.

- 10 volt for 400 V circuit
- 5 volt for 230 V circuit
- 2.5 volt for 110 V circuit

ii) Allowable DC voltage drop in the cables shall be 5 volts.

Temperature of cable under continuous current shall be less than 60°C.

(6) Colour

Colours of core insulation shall be as follows:

One-core ----- Black.

Two-cores ----- Black and white.

Tree-cores ----- Black, white and red.

Four-cores ----- Black, white, red and green

Five-cores ----- Black, white, red, green, and yellow.

Six-cores----- Black, white, red, green, yellow and brown.

Colour of core insulation of more than six cores shall be in accordance with the Engineer's instruction.

6.2.3 Insulated Wires

600 V grade, PVC insulated wires (IV) may be used for power and space heater circuits for auxiliary equipment. The minimum size shall be 4.0 sq.mm.

6.2.4 Bare Hard Drawn Copper Conductors

Bare hard drawn copper stranded wire (HDCC) of 240 sq.mm (19/4.0 mm) for the Da Nhim Power Station and 200 sq.mm (37/2.6 mm) for other substations and necessary fittings shall

be supplied for the 110 kV system circuits of the power station and substations as follows:

Da Nhim Power Station

- One (1) transformer circuit
- One (1) single bus circuit
- Two (2) transmission line circuits

Thap Cham Substation

- One (1) single bus circuit
- One (1) transformer circuit
- Three (3) transmission line circuits

Phan Ri

- One (1) bus circuit
- One (1) transformer circuit
- Two (2) transmission line circuits

Phan Thiet Substation

- One (1) single bus circuit
- One (1) transformer circuit
- One (1) transmission line circuits

Cam Ranh Substation

- One (1) main bus circuit
- One (1) transfer bus circuit
- One (1) transformer circuit
- Three (3) transmission line circuits

Dien Khanh Substation

- One (1) main bus circuit
- One (1) transfer bus circuit
- One (1) transformer circuit
- Two (2) transmission line circuits

Fittings shall be of compression type suitable for connection to the 200 mm² HDCC conductors and of spring clamp type. all fittings; such as line terminals of suitable type for all switchgears including the high-frequency coupling devices, anchor clamps, spring type T Clamps, bolt connected jumper sleeves, jumper connectors, etc., shall be supplied for connection of the 110 kV bus and branch circuits.

6.2.5 Galvanized Steel Wire

Galvanized steel stranded wire of 50 sq.mm (7/3.0 mm) shall be supplied for the overhead ground wire system of the main steel structures in the substation.

All fittings, such as jumper clamps, P.G. clamps, grounding clamps, clips, etc., shall be supplied and used for connection of the overhead ground wire system. The clips, on the top of post for transmission line section, shall be of duplex type for easy connection and disconnection of ground wires from transmission line system.

6.2.6 Bare Annealed Copper Conductor

Bare annealed copper stranded wires of 95 and 35 sq.mm in size shall be supplied for connecting the equipment and enclosures to the grounding conductors.

6.2.7 Tests

The following test for conductors, as applicable, shall be carried out at the manufacturer's plant:

- (1) Construction test

- (2) Resistance tests
- (3) Withstand voltage test
- (4) Insulation resistance test
- (5) High temperature insulation resistance test
- (6) Tensile strength test
- (7) Coiling test
- (8) Thermal deformation test
- (9) Oil proof test
- (10) non-inflammability test
- (11) Shield conductivity test
- (12) Thermal shrinkage test
- (13) A.C. breakdown voltage test
- (14) Impulse breakdown voltage test
- (15) Tin plating test
- (16) Acid and alkaline proof test
- (17) Oxygen index measurement
- (18) Chlorine gas measurement
- (19) Burning test on vertical tray installation

The appearance and construction check and other check as required shall be carried by the Contractor at the Site under the Engineer's witness.

6.3 INSULATORS AND FITTINGS

The following items shall be supplied under this Clause:

- (1) Insulator units.
- (2) Station post insulators.
- (3) Fittings.

6.3.1 Insulator Unit

Each suspension or tension insulator string shall be of 8 units for 110 kV circuits without arcing horn. The insulator unit shall be the standard U 70 BL 255 mm porcelain disc type of arc resistant nature with ball and socket, having a spacing of 146 mm between discs, according to IEC Publication 305-1978.

The connection between units shall be such as to allow sufficient flexibility for freedom of movement and as to prevent the possibility of becoming separated accidentally either during or after the erection.

The interlocking sockets shall be designed to allow easy passage of the ball into the socket, and retaining pins or locking devices are required to keep in the socket under all service conditions.

The insulator units shall be brown glazed.

Each insulator unit shall have the following characteristics:

- (1) Minimum flashover voltage
 - (a) Power frequency:

Dry	78 kV
Wet.....	45 kV
 - (b) Impulse, 1.2 x 50 micro-seconds:

Positive	120 kV
Negative	125 kV

- (2) Withstand voltage
 - (a) Power frequency:
 - Dry 70 kV
 - Wet 40 kV
 - (b) Impulse..... 110 kV
- (3) Puncture voltage 110 kV
- (4) Electromechanical breaking load 7,000 kg
 Minimum breaking load of insulator string with fittings shall be 7,000 kg.

6.3.2 Fittings

All fittings shall be malleable iron hot-dipped galvanized.

Suspension and tension clamps shall be as light as possible and of approved types. All clamps shall be designed to avoid any possibility of deforming the stranded conductors and separating the individual strands.

Tension clamps shall be bolted type, and shall not permit slipping off or damage to conductors or any part thereof.

Suspension clamps shall be free to pivot in the vertical plane containing the conductor.

Clamps shall not exhibit excessive heating by magnetizing or other reasons.

A suitable measure shall be provided at each jumper portion between the insulator strings or between the insulator string and terminals of the equipment to prevent generation of corona noise.

6.3.3 Tests

The following tests shall be carried out before shipment:

- (1) Flashover voltage test.
- (2) Withstand voltage test.

- (3) Puncture voltage test.
- (4) Mechanical impact test.
- (5) Electromechanical breading test.
- (6) Porosity test.
- (7) Galvanizing test.
- (8) Dimension check of insulators and fittings.

6.4 STEEL STRUCTURE

6.4.1 General

The Contractor shall furnish all outdoor main steel structures, and supporting structures for 110 kV switchgear to be supplied under section 3.

The construction of supporting structures for 110 kV switchgear shall be modified as the case may be required in the course of detailed design accordig to the structural dimension and specifications of the switchgear.

6.4.2 Requirements for Design

The main steel structure, supporting structures and other frame works shall be designed according to the following requirements:

(1) Loads on structures

Following loads shall be taken into account for the design of structures:

(a) Vertical loads:

Weight of structure members, conductors, ground wires, insulator strings and equipment to be mounted on the structure.

A weight of 200 kg shall be assumed on the center of each beam.

(b) Wind loads:

- i) On single conductors..... 40 kg/m² on projected area
- ii) On insulator and all other circular section 70 kg/m² on projected area
- iii) On lattice structures 220 kg/m² on projected area
- iv) On equipment, round 80 kg/m² on projected area
- v) On equipment, square..... 120 kg/m² on projected area

(c) Working tension:

- i) 110 kV bus HDCC 220 sq.mm..... 500 kg/phase/conductor
- ii) 110 kV transmission line 200 sq.mm 500 kg/phase/conductor
- iii) Overhead ground wire GSW 50 sq.mm 300 kg/conductor

(d) Seismic coefficient:

Seismic coefficient of 0.15 G shall be taken into the design calculation for switchgear supporting structures.

(2) Strength for structures

(a) Factor of safety:

The structures shall be designed so that no failure or permanent distortion shall occur when the load equivalent to 1.5 times the maximum simultaneous working loads specified in above (1) are applied.

(b) Stress:

The ultimate design stress, obtained from the working stress times the factor of safety in tensile members shall not exceed the yield point of materials and that in compressive members shall not exceed a figure obtained from the formula, approved by the Engineer, on the yield point of materials.

(c) Ratio of slenderness:

The ratio of slenderness of compressive members shall not exceed 200 for main members, 220 for web members and 250 for nominal members, and that of tensile members shall not exceed 400 for all members.

(3) Dimension for material

(a) Member size:

No main member shall be less than 5 mm in thickness and 60 mm in width of flange, and no web and nominal members shall be less than 4 mm in thickness and 45 mm in width of flange.

(b) Bolts and nuts:

All the members shall be connected by bolts and nuts. The size of the connection bolts shall be not less than 16 mm in diameter. The suitable anchor bolts shall be provided. The size of step bolts shall be 16 mm

The Contractor shall submit full detailed design calculation sheets and drawings for the steel structures and anchor bolts to the Engineer for approval prior to commencement of fabrication.

6.4.3 Foundation

The concrete foundations will be placed on the switchyard by the civil contractor.

The Contractor shall supply installation drawing giving full erection particulars/

Safety factor of concrete for uplifting force shall not be less than 2. The allowable bearing strength of earth shall be assumed to be 20 ton/m². The weight of earth shall be assumed to be 2.0 ton/m³ and weight of concrete to be 2.4 ton/m³.

The angle of repose shall be reckoned as 35 degree.

6.4.4 Materials

All steel employed for the structures shall have high yield point and high ultimate tensile

strength of uniform characteristics, and shall be subject to the approval of the Engineer.

6.4.4 Materials

All steel employed for the structures shall have high yield point and high ultimate tensile strength of uniform characteristics, and shall be subject to the approval of the Engineer.

6.4.5 Worksmanships

The cutting, drilling, punching and bending of all fabricated steel work shall be in accordance with the best practice for the materials being used and subject to the approval of the Engineer. Diameter of bolt holes shall not more than 1.5 mm large than the diameter of the bolts.

All members shall be hot-dipped galvanized after fabrication. Bolts and nuts shall also be galvanized.

All members shall be stamped or marked in an approved manner with numbers and/or letters corresponding to number and/or letters on the drawings or material list approved by the Engineer.

The erection marks shall be stamped before galvanizing and shall be clearly legible after galvanizing.

6.4.6 Tests

The following tests shall be carried out before shipment:

- (1) Mechanical strength of materials.
- (2) Galvanizing test.
- (3) Shop assembly.

6.5 OTHER MATERIALS

All cable trays and supporting brackets required for the installation of the power cables and

control cables to provided under this Contract in the powerhouse, the cable culvert and the cable trench in the outdoor switchyard of the Renun Power Station and in the cable trench of the Sub-stations shall be supplied and installed by the Contractor.

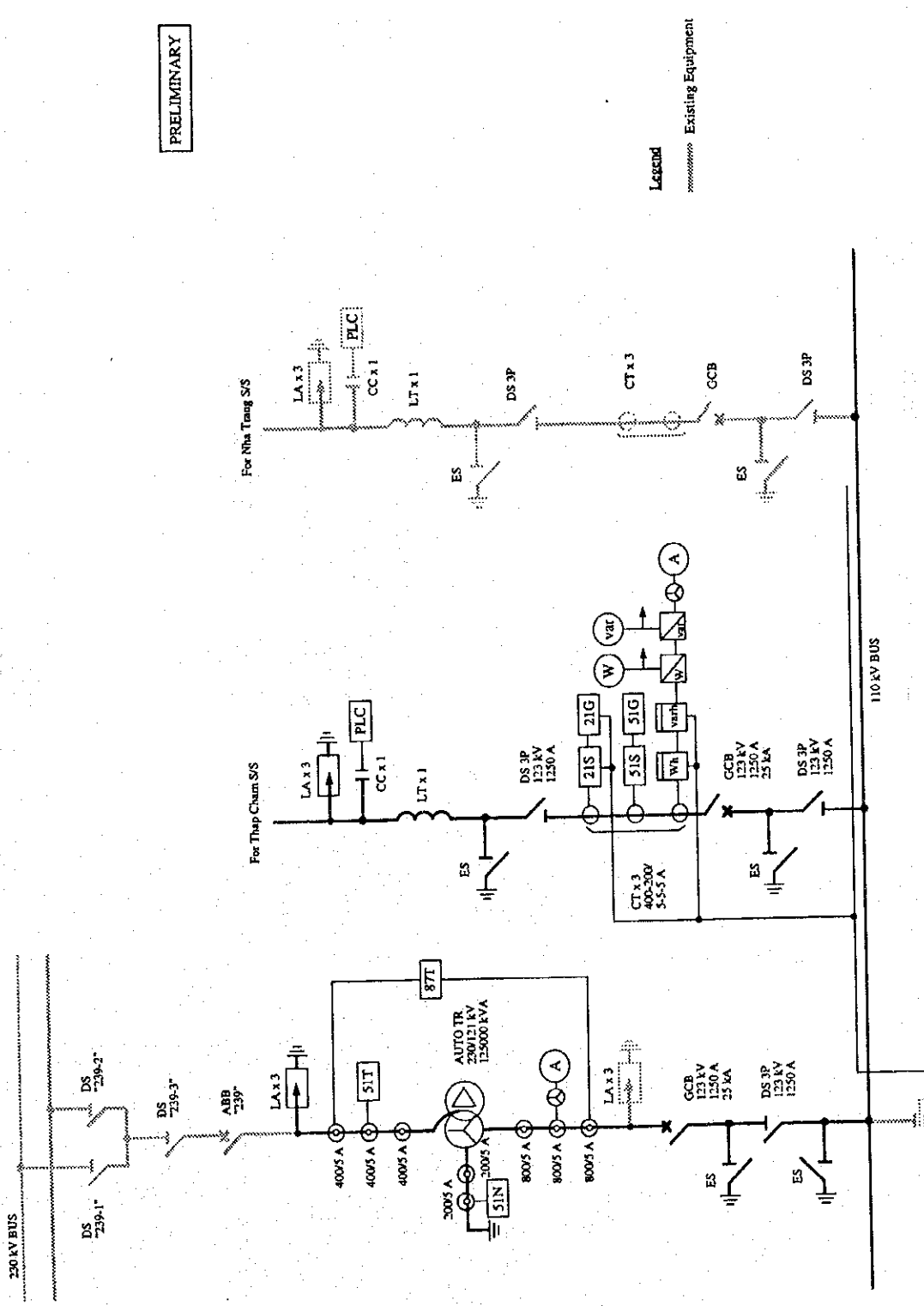
All other miscellaneous materials required for this Contract; such as conduit pipes, wooden cable cleats, angle steel, channel steel, steel plate, bolts, nuts and other items required for putting into service the main transformers, switchgear and control equipment shall be supplied and installed as required according to the Engineer's instruction. These materials shall comply with the highest grade specified in the relevant standards.

Round and coloured phase mark plates of 300 mm in diameter shall be fitted on each beam of 110 kV steel structures.

DRAWINGS FOR CHAPTER 5

110 KV SUBSTATIONS

PRELIMINARY



Legend
 Existing Equipment

Figure 5.1
 Single Line Diagram of 110 kV Upgrading
 Facilities for Da Nhim Power Station

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FEASIBILITY STUDY ON
 REHABILITATION OF DA NHIM
 POWER SYSTEM

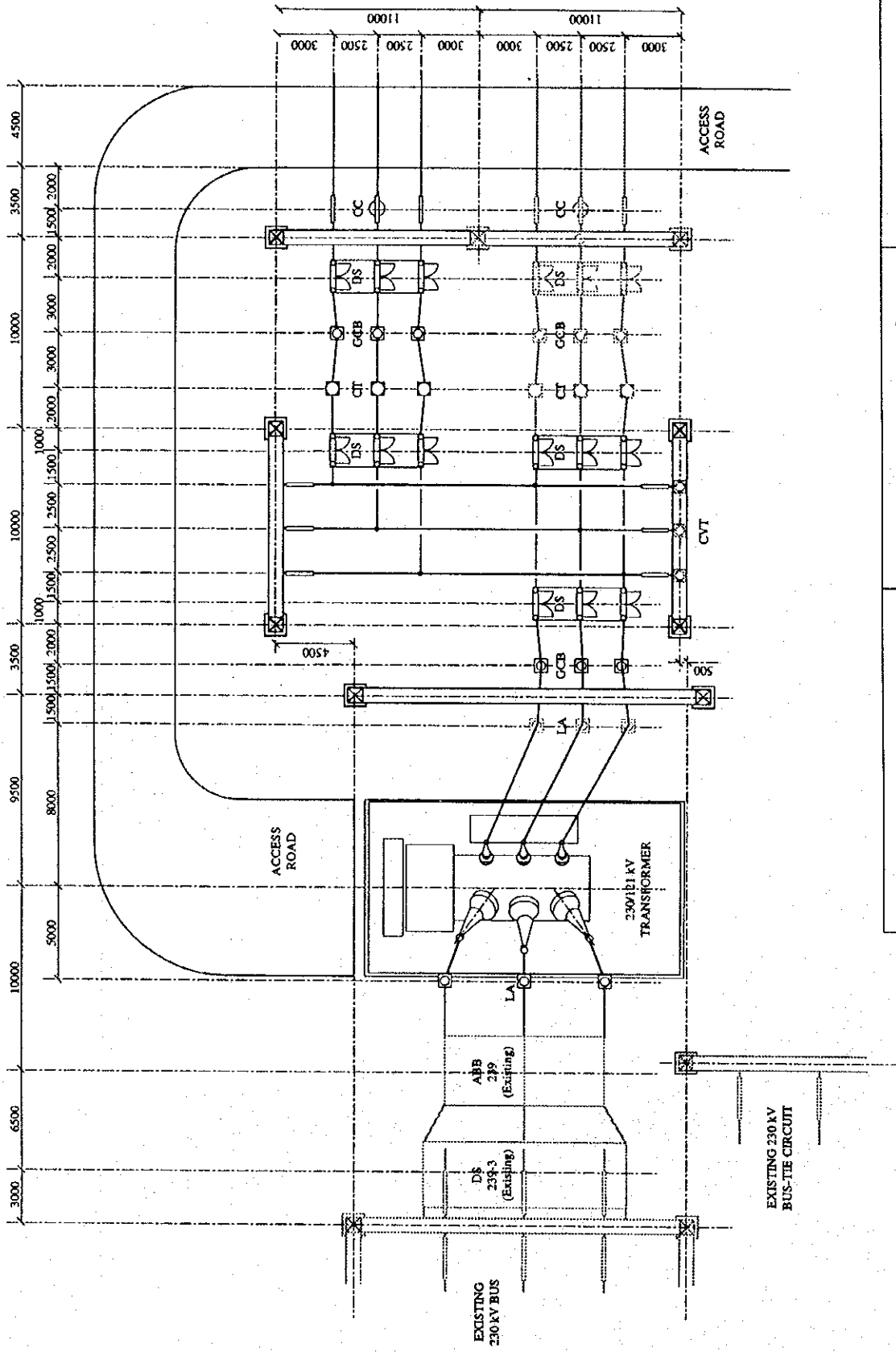
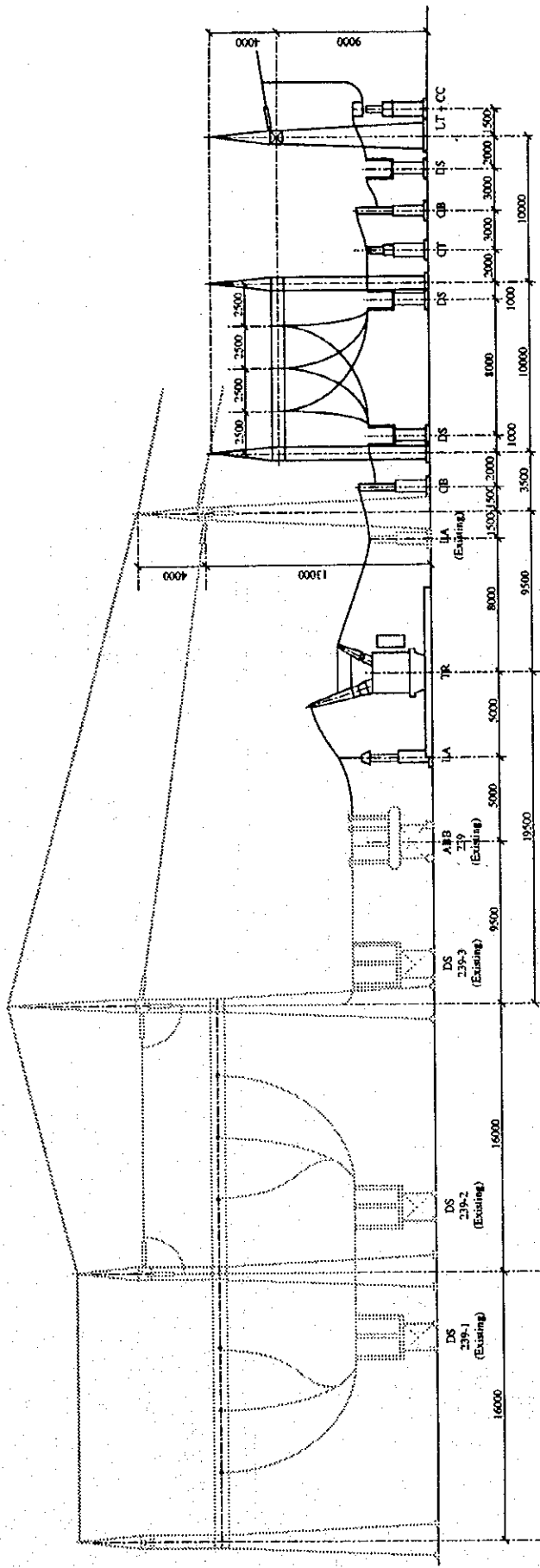


Figure 5.2
 General Layout of 110 kV Upgrading
 Facilities for Da Nhim Power Station

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FEASIBILITY STUDY ON
 REHABILITATION OF DA NHIM
 POWER SYSTEM



Legend
 Existing Equipment

Figure 5.3
 Sectional Layout of 110 kV Upgrading
 Facilities for Da Nhim Power Station

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 REHABILITATION OF DA NHIM
 POWER SYSTEM

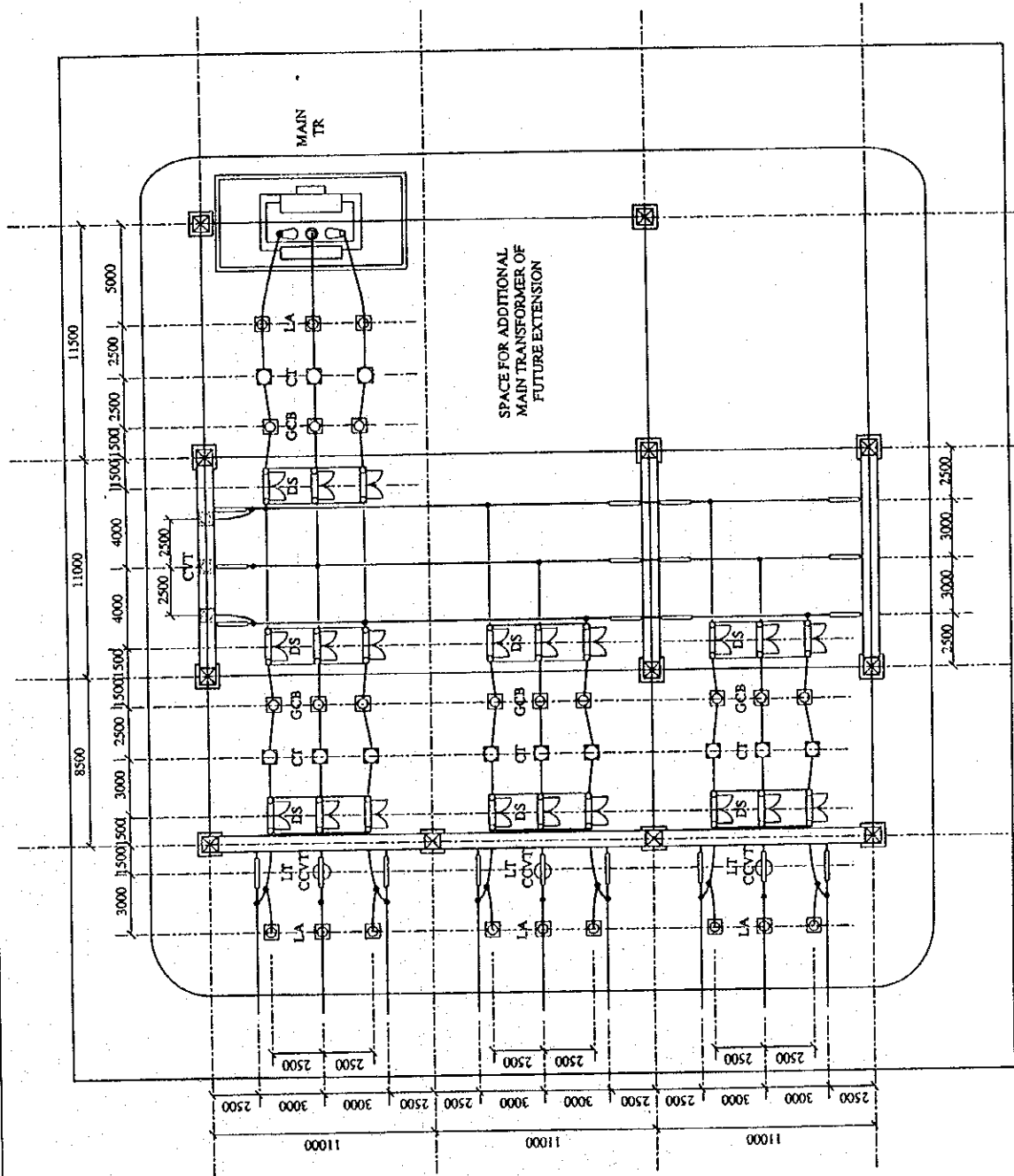


Figure 5.5
General Layout for 110 kV
Thap Cham Substation

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FEASIBILITY STUDY ON
REHABILITATION OF DA NHIM
POWER SYSTEM

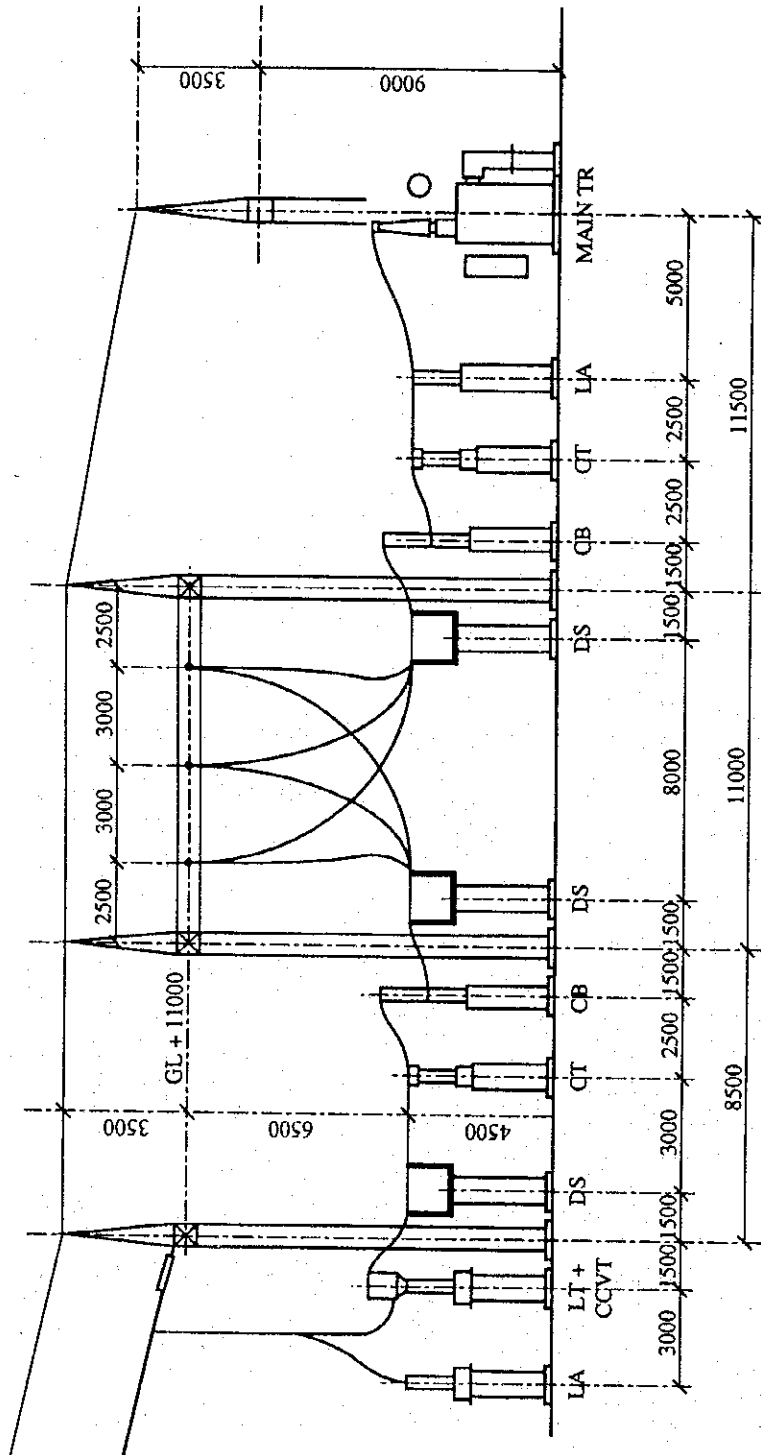


Figure 5.6
Sectional Layout for 110 kV
Thap Cham Substation

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REHABILITATION OF DA NHIM
POWER SYSTEM

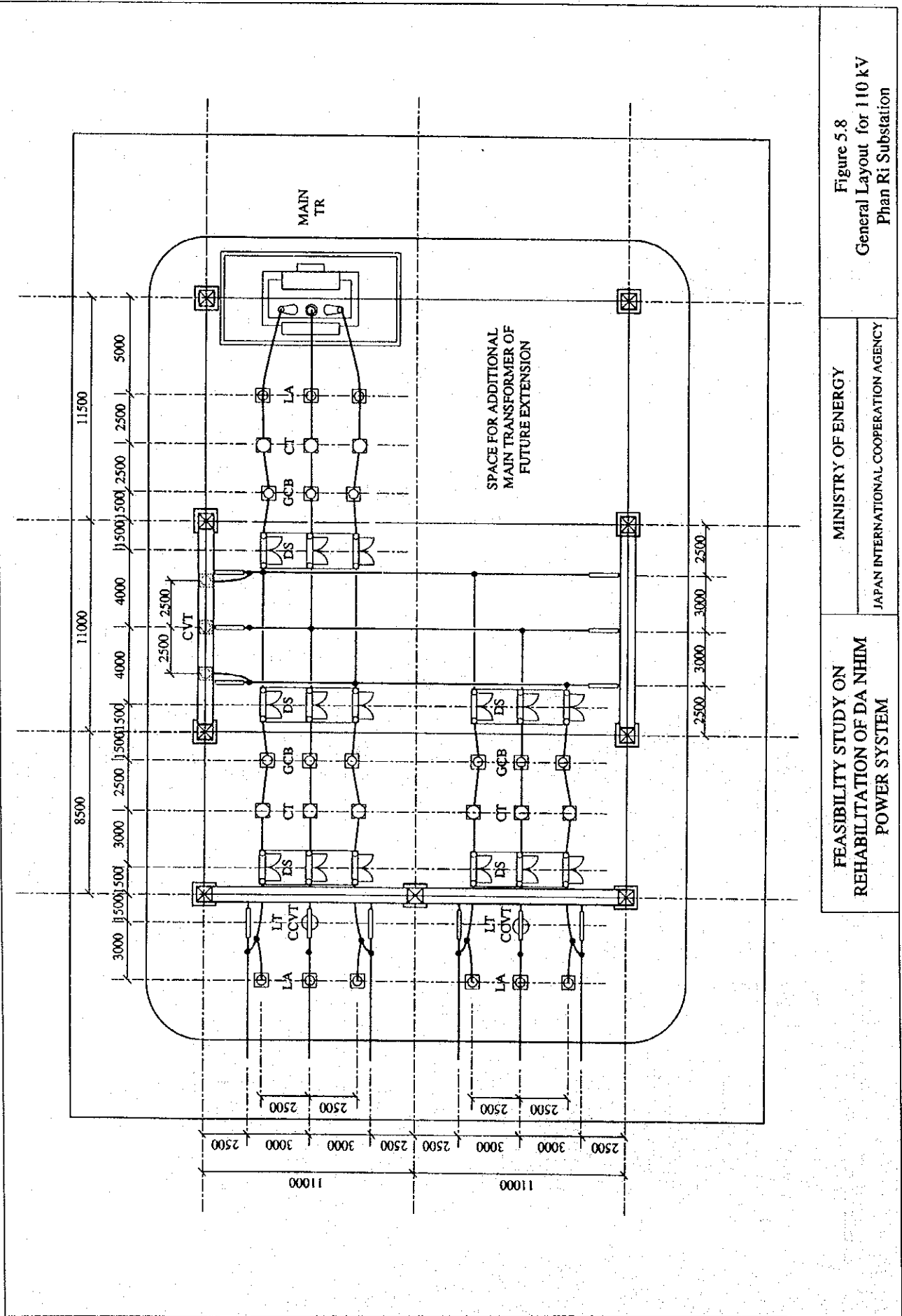


Figure 5.8
 General Layout for 110 kV
 Phan Ri Substation

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 REHABILITATION OF DA NHIM
 POWER SYSTEM

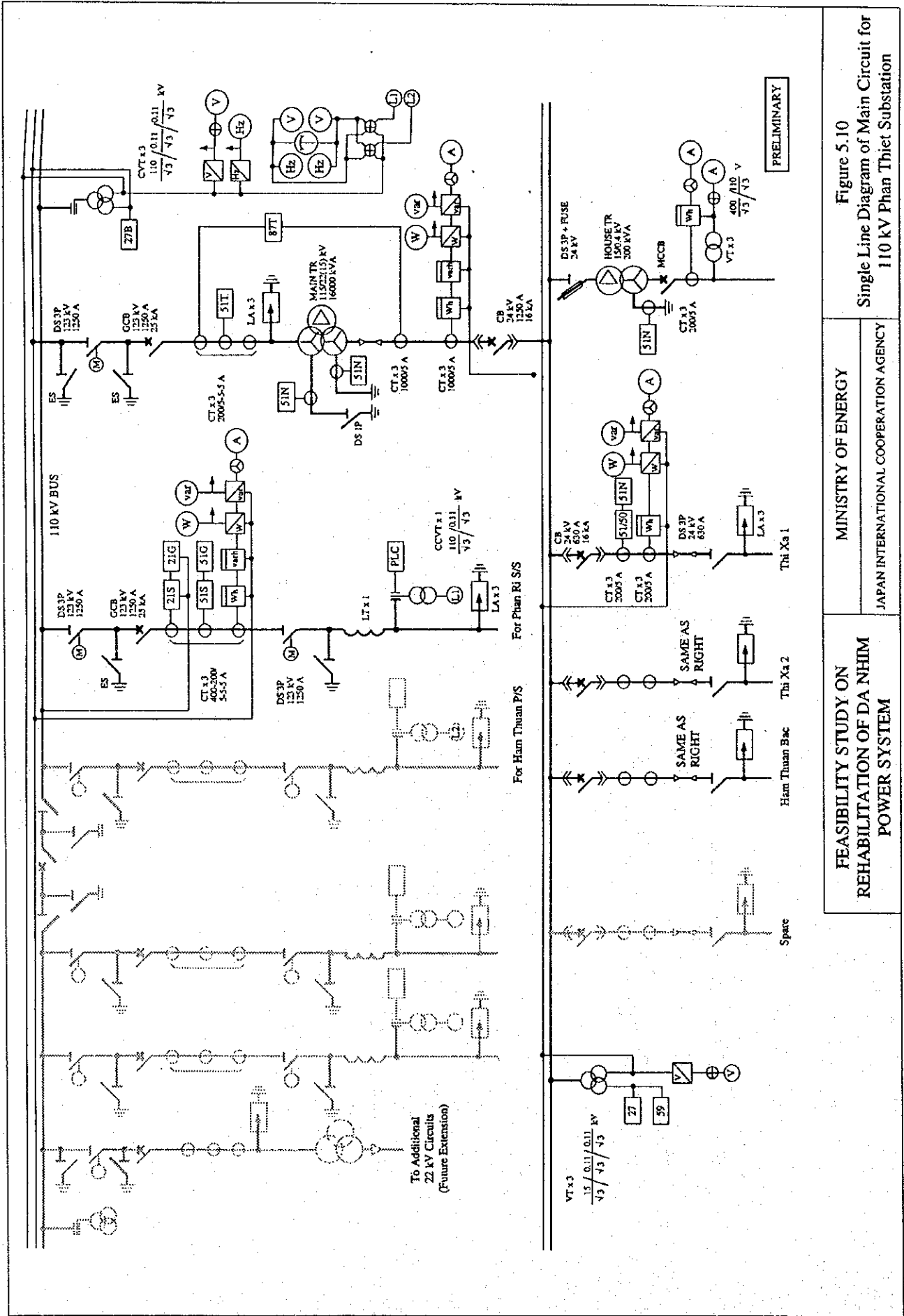


Figure 5.10
Single Line Diagram of Main Circuit for
110 kV Phan Thiet Substation

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FEASIBILITY STUDY ON
REHABILITATION OF DA NHIM
POWER SYSTEM

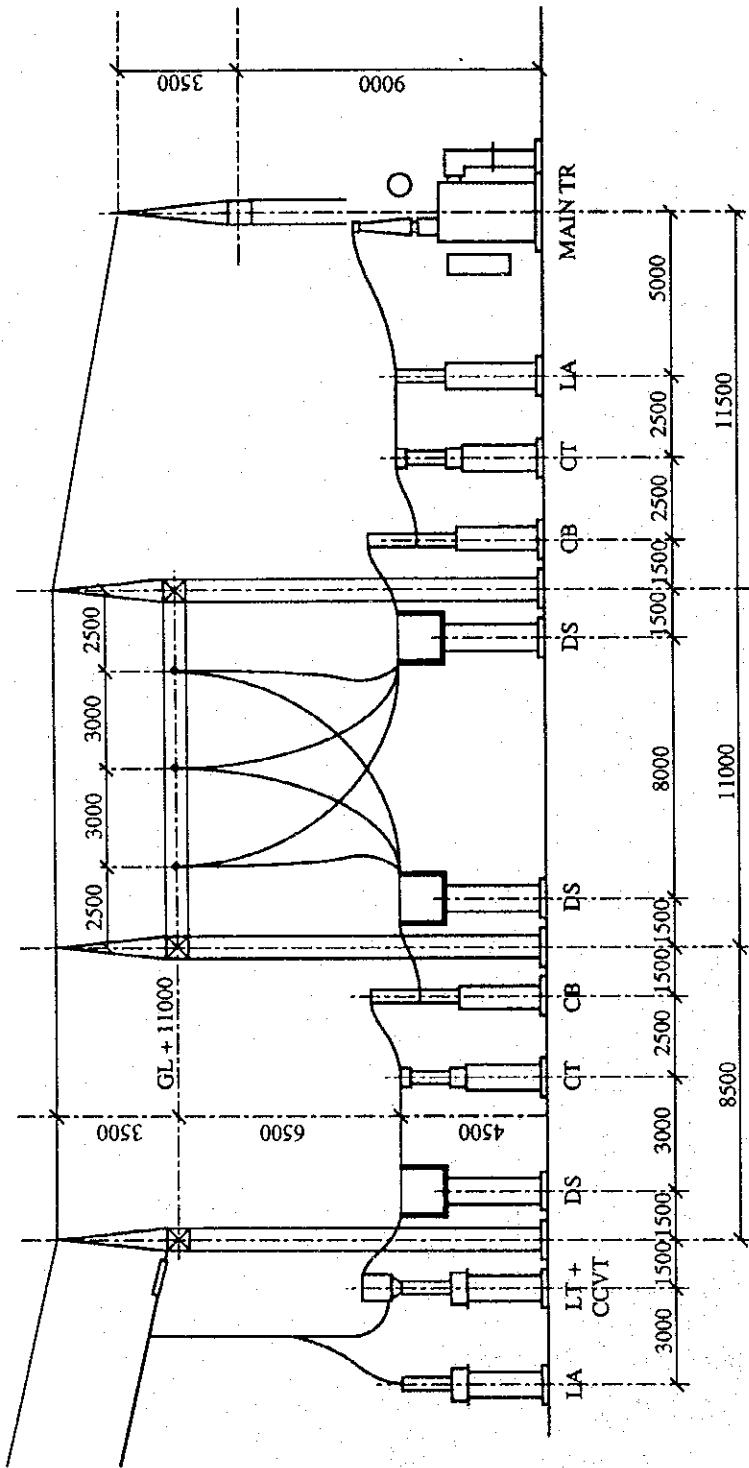


Figure 5.12
Sectional Layout for 110 kV
Phan Thiet Substation

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POWER SYSTEM

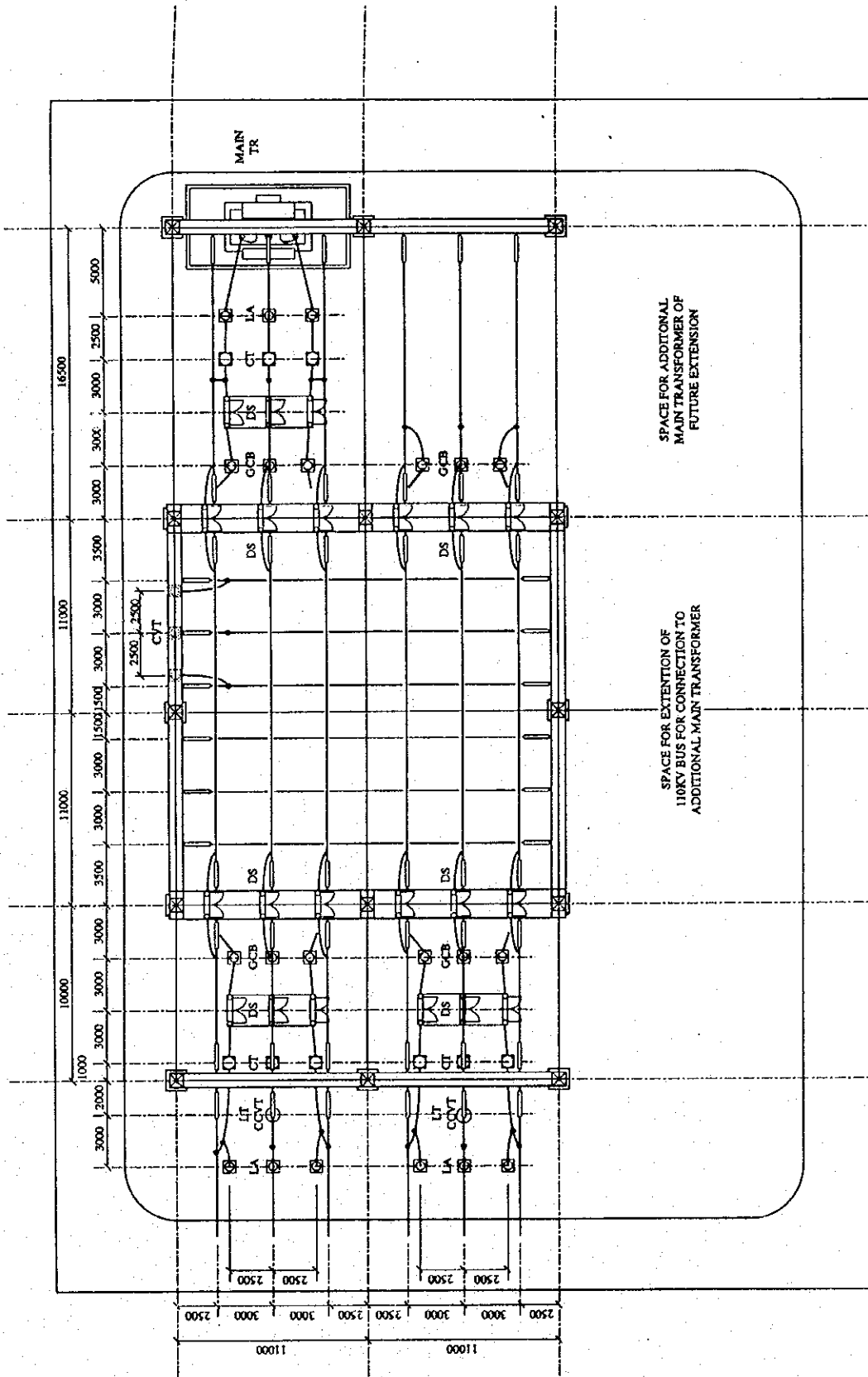


Figure 5.17
 General Layout for 110 kV
 Dien Kanh Substation

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FEASIBILITY STUDY ON
 REHABILITATION OF DA NHIM
 POWER SYSTEM

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