2.1.5 ELECTRICAL INSULATION OIL

The electrical insulation oil shall have sufficient insulation strength, and shall be excellent in heat conductivity, low in viscosity and pour point and high in flash point. The oil shall not cause any corrosion to insulation materials and structural materials of electrical equipment, and shall be chemically stable for long years of use.

2.1.6 COOLER CUBICLE

The cooler cubicle shall be installed around the main transformer. A cooling control device for the main transformer, molded type air circuit breaker, control PT, fault indicator, etc., shall be attached on the cubicle.

The cooling fan and oil pump shall start automatically and simultaneously when the field circuit breaker closes.

The power source of the cooler shall consist of two (2) systems, one for normal operation and the other for emergency use. The power source shall automatically be changed over to emergency power source at the time of fault in normal power source. All faults shall be indicated by the fault indicator and by alarm from the re-annunciation system to the central control room.

2.1.6.1 TYPE

Outdoor, self standing, metal clad

2.1.6.2 CONSTRUCTION

The cooler cubicle shall have a door at its front and a panel inside the cubicle. The control switch, molded type air circuit breaker, changeover switch and signal lamp to be mounted at the front of the panel shall be of construction which enable supervision from outside. A base plate shall be set up under the cubicle. The cubicle shall be of convection ventilation construction, and care shall be taken to shut out of rain water, dust and insects.

2.1.6.3 RATING

Power voltage	AC	3φ	380 V	50 Hz
Control voltage	AC	1φ	110 V	50 Hz
	DC		220 V	

2.1.6.4 SPACE HEATER

A space heater having appropriate capacity shall be provided to prevent moisture from forming inside the cubicle.

2.1.6.5 LIGHTING AND WORKING PLUG SOCKET

Fluorescent lamps, snap switches and plug sockets shall be provided for inspection of the cubicle inside.

4-740

2.1.7 NOISE

The indicating sound level meter shall be provided to measure the noise of the transformer, and shall be in accordance with "Measurement of transformer and reactor sound level" (IEC-551). The average value shall be less than the value indicated below.

75 dB(A)

2.1.8 TRANSPORTATION

Packing shall be provided for transportion to prevent damage due to outside shock, rain and dust. If required, the electrical insulating oil shall be removed from the tank, and N_2 gas shall be filled.

In this case, an N_2 gas pressure gauge shall be attached for supervision, and the pressure value shall clearly be indicated.

The electrical insulating oil shall be put in a drum, which shall be completely sealed to shut out rain water and dust.

2.2 AUXILIARY TRANSFORMER

2.2.1 APPLICABLE STANDARDS AND CODES

Applicable standard and codes shall be in accordance with 2.1.1 in this specification.

2.2.2 SCOPE OF SUPPLY

The axulilliary transformer shall be provided and connected to the generator circuit, and shall be serve as the power source of unit auxiliary equipment.

One (1) set	Auxiliary transformer with complete accessories for Unit No.1
One (1) set	Ausiliary transformer with complete accessories for Unit No.2

2.2.3 TECHNICAL INFORMATION

2.2.3.1 TYPE

Outdoor oil immersed, self-cooled (ONAN), three-phase, two (2) windings

2.2.3.2 RATING

Capacity	* kVA (ONAN)
Class of rating	Continuous
Voltage	
High tension side	Generator voltage
Low tension side	6,900V
No load, no voltage tap	$0.950V_G$ $0.975V_G$ $1.0V_G$ $1.025V_G$ $1.050V_G$ (V_G: Generator voltage)
Frequency	50 Hz

Connection	Dyllyll
High tension side	Delta
Low tension side	Wye
"	Wye
Low tension neutral	Transformer grounding
Impedance voltage	* % (at rated kVA base)
Insulation class	A
Insulation	
High tension side	Full insulation
Low tension side	Full insulation
Insulation level	
High tension side winding	BIL 150 kV (full wave)
Low tension side winding	BIL 60 kV (full wave)

2.2.3.3 SHOP TEST

In accordance with 2.1.3.3 in this specification.

2.2.4 CONSTRUCTION

2.2.4.1 STEEL CORE MATERIAL AND CONSTRUCTION

In accordance with 2.1.4.1 in this specification.

2.2.4.2 WINDING MATERIAL AND CONSTRUCTION

In accordance with 2.1.4.2 in this specification.

2.2.4.3 INSULATION MATERIAL AND CONSTRUCION

In accordance with 2.1.4.3 this specification.

E-743

2.2.4.4 TANK

In accordance with 2.1.4.4 in this specification.

2.2.4.5 TAP CHANGER

The tap changer shall be a no-load no-voltage tap changer, and shall be changed over easily and precisely from outside and have ample mechanical and electrical strength. Consideration shall be given that there be no oil leakage not incoming of rain water. The tap changer shall have a tap position indicator and a loc device.

2.2.4.6 OIL CONSERVATOR

In accordance with 2.1.4.6 in this specification.

2.2.4.7 COOLING SYSTEM

The cooling system shall comprise a removable type radiator and a header. The removable radiator shall have welded flanges and shall be attached on the main tank through package.
An indicating type shutoff valve shall be mounted on the tank side to enable removal of each radiator.

2.2.4.8 BUSHING

(1) High tension side bushing

The high tension side bushing shall be provided and connected to the isolated phase bus duct, and shall be in accordance with item 1.2.2 of this specification.
Flanges for connection to the isolated phase bus duct shall be provided.
The bushings shall be able to withstand the voltage rising of sound phases after one phase grounding with condition

4-744

of salt contamination of 0.03 mg/cm^2 when the humidity of the air around bushings is 100%.

The CT for the high tension side shall be attached on each phase and wired to the fixing terminal cabinet.

The rating of the bushing shall be as follows.

Quantity	3 x 2	3 x 2
CT ratio	* /5A	*/5A
Burden	40 VA	40 VA
Accuracy class	1.0	1.0
Over current strength	40	40
Over current constant	>20	>20

(2) Low tension side bushing

The low tension side bushing shall be connected to 6.9 kV MCSG incoming cable.

The bushings shall be able to withstand the voltage rising of sound phases after one phase grounding with conditions of salt contamination of 0.03 mg/cm^2 when the humidity of the air around bushings is 100%.

(3) Neutral side bushing

The neutral side bushing shall be drawn out, and shall be pulled up to the side, of the transformer so as to be supported with the insulator.

2.2.4.9 ACCESSORY

(1) Oil level gauge

In accordance with 2.1.4.9(1) in this specification.

(2) Oil temperature indicator

In accordance with 2.1.4.9(2) in this specification.

(3) Winding temperature indicator

In accordance with 2.1.4.9(3) in this specification.

(4) Sudden pressure relay

In accordance with 2.1.4.9(4) in this specification.

(5) Gas detective device

In accordance with 2.1.4.9(5) in this specification.

(6) Pressure relief device

In accordance with 2.1.4.9(6) in this specification.

(7) Miscellaneous valve

In accordance with 2.1.4.9(7) in this specification.

(8) Terminal cabinet

In accordance with 2.1.4.9(8) in this specification.

(9) Ladder

In accordance with 2.1.4.9(9) in this specification.

(10) Steel plate platform with handrail

In accordance with 2.1.4.9(10) in this specification.

(11) Grounding lug

In accordance with 2.1.4.9(11) in this specification.

(12) Anchor bolts and nuts, foundation base

In accordance with 2.1.4.9(12) in this specification.

(13) Lifting lug, jack bosses, pulling hole, etc.

In accordance with 2.1.4.9(13) in this specification.

(14) Piping and wiring

In accordance with 2.1.4.9(14) in this specification.

(15) Name plate

In accordance with 2.1.4.9(15) in this specification.

4-746

2.2.5 ELECTRICAL INSULATION OIL

In accordance with 2.1.5 in this specification.

2.2.6 SECONDARY CUBICLE

The secondary cubicle shall be provided to enable low tension neutral grounding, and shall be detected for the ground over-voltage relay (64AT1).

This cubicle shall be installed beside the auxiliary tansformer.

The secondary cubicle shall consist of a transformer, grid type resister, arrester, disconnecting switch, bus duct with bushing and all pertinents required for the grounding circuit of the auxiliary transformer.

2.2.6.1 TYPE

Outdoor, self standing, metal clad

2.2.6.2 RATING

(1) Transformer

Capacity	:	50 kVA, continuous
Voltage	:	4,800 V/240 V
Type	:	Dry, self cooled

(2) Resister

Resistence value: 1 ohm, continuous

(3) Disconnecting switch

Voltage	:	24 kV
currnet	:	600 A

2.2.6.3 CONSTRUCTION

The secondary cubicle shall have a door at its front and a panel inside the cubicle.

A base plate shall be set up under the cubicle.

The cubicle shall be of convection ventilation construction, and care shall be taken to shut out rain dust and insects.

2.2.6.4 SPACE HEATER

A space heater of appropriate capacity shall be provided to prevent moisture from forming inside the cubicle.

2.2.6.5 LIGHTING AND WORKING PLUG SOCKET

Fluorescent lamps, snap switches and plug sockets shall be provided for inspection of the cubicle inside.

2.2.7 NOISE

In accordance with 2.1.7 in this specification. However, the averagevalue of noise shall be less than the value indicated below.

65 dB(A)

2.2.8 TRANSPORTATION

In accordance with 2.1.8 in this specification.

2.3 STARTING TRANSFORMER

2.3.1 APPLICABLE STANDARDS AND CODES

In accordance with 2.1.1 in this specification.

2.3.2 SCOPE OF SUPPLY

One (1) set of starting transformer with complete accessories shall be provided.

2.3.3 TECHNICAL INFORMATION

The starting transformer shall be connected to the circuit of 132 kV system bus, and shall be used as the common load for starting, stopping and normal operation of the unit.

2.3.3.1 TYPE

Outdoor, oil immersed, self cooled (ONAN) forced air cooled (ONAF), three-phase, three (3) windings

2.3.3.2 RATING

Capacity	* kVA (ONAN/ONAF)
Class of rating	Continuous
Voltage	
High tension side	132 kV
Low tension side	6,900 V
On load, voltage tap changer	+ 7.5% (6 steps) - 20% (16 steps)
Frequency	50 Hz
Connection	Ynyoyod1
High tension side	Wye
Low tension side	Wye
	Wye

4-749

Tertiary	Delta (embedded)
High tension neutral	Direct grounding
Low tension neutral	Trasnformer grounding
Impedance voltage	* % (at rated kVA base)
Imsulation class	A
Insulation	
High tension side	Grade insulation
Low tension side	Full insulation
Insulation level	
High tension side winding	BIL 650 kV (Full wave)
Low tension side winding	BIL 60 kV (Full wave)
High tension side neutral	BIL 200 kV (Full wave)

2.3.3.3 SHOP TEST

In accordance with 2.1.3.3 in this specification

2.3.4 CONSTRUCTION

2.3.4.1 STEEL CORE MATERIAL AND CONSTRUCTION

In accordance with 2.1.4.1 in this specification.

2.3.4.2 WINDING MATERIAL AND CONSTRUCTION

In accordance with 2.1.4.2 in this specification.

2.3.4.3 INSULATION MATERIAL AND CONSTRUCTION

In accordance with 2.1.4.3 in this specification.

2.3.4.4 TANK

In accordance with 2.1.4.4 in this specification.

2.3.4.5 ON LOAD TAPCHANGER

In accordance with 2.1.4.5 in this specification.

4-770

2.3.4.6 OIL CONSERVATOR

In accordance with 2.1.4.6 in this specification.

2.3.4.7 COOLING SYSTEM

The cooling system shall consist of a removable radiator which is composed of a unit radiataor, a header and a fan.

The removable radiator shall have welded flanges attached on the main tank through packings.

A totally enclosed type motor shall be used for the cooling fan. The fan shall be excellent in cooling performance and cause as little noise as possible. The rating of the fan motors shall be AC 380 V, 3ϕ. For details, refer to "Standard of Electric Motor" in Clause 9.7 in Section I.

2.3.4.8 BUSHING

(1) High tension slide busing

The high tension side bushing shall be of an elephant type with porcelain, and connected to 132 RV CV cable.

The bushing in the oil and the one in the air cable head, and each terminal at elephant parts shall not be included in the scope of estimate, but the leads between the bushing in the oil cable head and the transformer side bushing in the oil shall be included in the scope of estimate.

The elephant shall be provided for each phase independently, and the bushing oil shall be charged separately.

The bushing shall be able to withstand the voltage rising of sound phases after one phase grounding with condition of salt contamination of 0.03 mg/cm^2 when the humidity of the air around bushing is 100%.

The following accessories shall be attached on the elephant parts.

Oil conservater

Pressure relief device

Valves

N_2 pressure meter

(2) Low tension side bushing

In accordance with 2.2.4.8(2) in this specification.

(3) Neutral side bushing

In accordance with 2.2.4.8(3) in this specification.

4-754

2.3.4.9 ACCESSORY

(1) Oil level gauge

In accordance with 2.1.4.9(1) in this specification.

(2) Oil temperature indicator

In accordance with 2.1.4.9(2) in this specification.

(3) Winding temperature indicator

In accordance with 2.1.4.9(3) in this specification.

(4) Sudden pressure relay

In accordance with 2.1.4.9(4) in this specification.

(5) Gas detection device

In accordance with 2.1.4.9(5) in this specification.

(6) Pressure relief device

In accordance with 2.1.4.9(6) in this specification.

(7) Miscellaneous valve

In accordance with 2.1.4.9(7) in this specification.

(8) Terminal cabinet

In accordance with 2.1.4.9(8) in this specification.

(9) Ladder

In accordance with 2.1.4.9(9) in this specification.

(10) Platform

In accordance with 2.1.4.9(10) in this specification

(11) Grounding lugs

In accordance with 2.1.4.9(11) in this specification.

(12) Anchor bolts and nuts, foundation base

In accordance with 2.1.4.9(12) in this specification.

(13) Lifting lug, jack bosses, pulling hole, etc.

In accordance with 2.1.4.9(13) in this specification.

(14) Piping and wiring

In accordance with 2.1.4.9(14) in this specification.

(15) Name plate

In accordance with 2.1.4.9(15) in this specification.

2.3.5 ELECTRICAL INSULATION OIL

In accordance with 2.1.5 in this specification.

2.3.6 COOLER CUBICLE

The cooler cubicle shall be installed around the starting transformer.

The cooling control device for the starting teransformer shall consist of molded type circuit breaker, control PT, fault indicator, etc., and these shall be installed on the cooling cubicle.

The cooling fan shall automatically start at the time of current relay actuation.

All faults shall be alarmed by the fault indicator, and this shall be alarmed in the central control room.

2.3.6.1 TYPE

Outdoor, self standing, metal clad

4-754

2.3.6.2 CONSTRUCTION

The cooler cubicle shall have a door at its front and a panel inside the cubicle. The control switch, molded type air circuit breaker, changeover switch, and signal lamp to be mounted at the front of the panel shall be of construction which enables supervision from outside. A base plate shall be set up under the cubicle. The cubicle shall be of convection ventilation construction, and care shall be taken to shut out rain, dust and insects.

2.3.6.3 RATING

Power voltage	:	AC	3ϕ, 380 V	50 Hz
Control voltage	:	AC	1ϕ, 100 V	50 Hz
		DC	220 V	

2.3.6.4 SPACE HEATER

A space heater having the appropriate capacity shall be provided to prevent moisture from forming inside the cubicle.

2.3.6.5 LIGHTING AND WORKING PLUG SOCKET

Fluorescent lamps, snap switches and plug sockets shall be provided for inspection of the cubicle inside.

2.3.7 SECONDARY CUBICLE

The secondary cubicle shall be provided for low tension neutral grounding, and shall be detected for the ground over voltage relay (64ST1).

This cubicle shall be installed beside the starting transformer.

The secondary cubicle shall consist of a transformer, grid type resister, arrester disconnecting switch, bus duct with bushing and all pertinents required for the grounding circuit of the starting transformer.

2.3.7.1 TYPE

Outdoor, self standing, metal clad

2.3.7.2 RATING

(1) Transformer

Capacity	:	50 kVA, continuous
Voltage	:	4,800 V/240 V
Type	:	Dry, self cooled

(2) Resistance value: 1 ohm, continuous

(3) Disconnecting switch

Voltage	:	24 kV
Current	:	600 A

2.3.7.3 CONSTRUCTION

The secondary cubicle shall have a door at its front and a panel inside the cubicle.

A base plate shall be set up under the cubicle.

The cubicle shall be of convection ventilation construction, and care shall be taken to shut out rain, dust and insects.

2.3.7.4 SPACE HEATER

A space heater having the appropriate capacity shall be provided to prevent moisture from forming inside the cubicle.

2.3.7.5 LIGHTING AND WORKING PLUG SOCKET

Fluorescent lamps, snap switches and plug sockets shall be provided for inspection of the cubicle inside.

2.3.8 NOISE

In accordance with 2.1.7 in this specifiction. However, the average value of noise shall be less than the value indicated below.

65 dB(A)

2.3.9 TRANSPORTATION

In accordance with 2.1.8 in this specification

3. METAL CLAD SWITCHGEAR

3.1 6,600 V METAL CLAD SWITCHGEAR

3.1.1 APPLICABLE STANDARDS AND CODES

The following codes of latest edition shall be applied.

International Electrotechnical Commission (IEC)

IEC - 56 "High-voltage alternating current circuit breaker

Other pertinent.

The International Electrotechnical Commission (IEC) standard and/or equivalent shall be applied generally for electrical machineries and apparatuses, and more detailed specifications shall be in accordance with "Panels and Boards" in Clause 2.1 in Section II of Part I.

3.1.2 SCOPE OF SUPPLY

6,600 V metal clad switchgear and its accessories shall be provided, but not be limited to the followings. More detailed quantities shall be according to the attached drawing.

One (1) set	Indoor, 6,600 V metal clad switchgear assembly for unit No. 1
One (1) set	Indoor, 6,600 V metal clad switchgear assembly for common
One (1) set	Indoor, 6,600 V metal clad switchgear assembly for chlorination equipment.
One (1) set	Indoor, 6,600 V metal clad switchgear assembly for Unit No. 2

3.1.3 TECHNICAL INFORMATION

3.1.3.1 TYPE

Indoor, drip-proof, self standing, metal clad,

three (3) pole, single-throw vaccum circuit breaker.

The switchgears of the same rating shall be interchangeable.

3.1.3.2 RATING

Voltage	M/C	6,600V
	VCB	7,200V
Phase		3
Frequency		50 Hz
Continuous current		
Bus conductor		2,000 A
Incoming and bus tie unit		2,000 A
Feeder units		600 A
Interrupting current		31.5 kA
Insulation level		BIL 60 kV (full wave)
Operating duty (VCB)		CO-(15 sec)-CO

3.1.3.3 TYPICAL FRONT VIEW OF METAL CLAD SWITCHGEAR

Refer to attached drawing.

3.1.3.4 SHOP TEST

The shop tests shall be as follows, but not limited to the items belows. The test shall be carried out in the precence of the Engineer.

Switchgear

- Construction test
- Meggering
- Withstand voltage test
- Sequence test
- PT, CT circuit test

Vacuum Circuit Breaker

- Construction test
- Meggering
- Operation test

3.1.4 CONSTRUCTION

3.1.4.1 STATIONARY STRUCTURE

The stationary structure shall be of a double stage welded construction using steel plate with a thickness not less than of 3.2 mm, and shall be a completely separated compartment consisting of circuit breaker, cable and bus room.

TIPICAL FRONT VIEW OF MCSG

Note:

86	LOCK-OUT RELAY	A	AMBER LAMP
49-50-51	OVER CURRENT RELAY	W	WHITE LAMP
50-51		PB	RESET PUSH BUTTON
87	BUS DIFFERENTIAL RELAY	AUX. RY	AUXILIARY RELAY
27	UNDER VOLTAGE RELAY	NP	NAME PLATE
G	GREEN LAMP	NPL	NUMBERING PLATE
R	RED LAMP		

These shall be completely gas-tight and of a construction having no exposed parts.

In front of the stationary structure, there shall be a hinged panel with stopper and a handle with key. The hinged panel shall be of a construction on which meters, relays, control devices and other accessories can be attached.

The rear door shall be of the removable bolt type. The stationary structure shall have the following mechanisms.

(1) Potential transformer compartments

The potential transformer shall be of a draw out type compartments having construction whereby the potential transformer is automatically ground when it is drawn out. The primary and secondary connectors shall be of the silver-plated pressure type, and sufficient consideration shall be given to its mechanical and electrical strengths.

(2) Cable compartments

The cable compartment shall have a sufficient space for end treatment and connection of cables, and shall have cleats for supporting the cable.

(3) Metal shutters

The metal shutters shall completely be closed in case the circuit breaker is drawn out, and shall be of a construction where exposure of charging part can be completely prevented.

(4) Draw out mechanism of circuit breaker

The racking mechanism shall be used to fix the circuit breaker at prescribed positions (operating position, test position and disconnecting position), and shall be of such construction that the circuit breaker should, in principle, lock if the draw out mechanism functions when the circuit breaker is closed.

The circuit breaker shall have a racking mechanism which shall not be set in the operating position when circuit breaker is closed in the disconnecting position or test position.

The draw out mechanism shall be mounted at a location where respective positions of indicators can easily be seen.

The draw out mechanism shall be of the following type:

Horizontal type: Manual

The primary circuit shall be completely disconnected in the test position, but the control circuit shall be completely connected in the test position.

(5) Bus

a. Main bus

The main bus shall be an insulated bus using electric copper or aluminum flat bar.

The contact surfaces of the bus joints shall be silver-plated, and the bus shall be firmly joined mechanically and electrically and insulated. Mechanically and electrically excellent insulation materials shall be provided for the bus supports, and the supports shall firmly support the bus and sufficiently withstand the electromagnetic force at the time of bus short circuit.

b. Ground bus

The ground bus shall utilize a copper or aluminum bar, and shall be installed in the stationary structure. The ground bus shall be branched into each cubicle and connected for internal ground circuit. The ground bus shall be used for the ground of circuit breaker frame when circuit breaker is in the operating position.

(6) Cable entry

The power cable shall be drawn out from the lower part of the cubicle, and the following accessories shall be provided.

Terminals for power cable shall be appropriate for each cable condition.

Compression type for more than 125 mm^2

Crimp type for 125 mm^2 or less

Power cable connecting terminal box shall be provided for the incoming panel and bus tie panel.

(7) Auxiliary switch

Auxiliary switches of at least 10a and 10b shall be mounted for interlocking, and shall be of construction receiving no effect even when the circuit breaker is drawn out.

(8) Meter, relay, instrument

Meters, relays and instruments shall be mounted on the front panel.

(9) Space heater

The space heater shall be provided to protect the inside of the stationary structure from moisture. The space heater shall have a switch with the appropriate capacity.

(10) Receptacle for site work

One receptacle with grounding terminal shall be provided on each panel.

(11) Grounding Terminal

Two (2) grounding terminals shall be provided on each side of the stationary structure.

Size of grounding terminal: 250 mm^2

(12) Grounding terminal for cable sheath

Cramp type terminal

Incoming panel ..... 8 mm^2 in size

Bus tie panel ..... 8 mm^2 in size

Feeder Panel : The size shall be 5.5 mm^2.

(13) Grounding terminal for site work

The grounding terminal shall be provided at an appropriate location on the rear side of each panel.

(14) Meggering device

An excellent maggering device shall be provided on the bus and feeder side of the stationary structure for maintenance and inspection.

3.1.4.2 VACUUM CIRCUIT BREAKER

The vacuum circuit breaker shall be a three (3) pole, single throw, self-aligning type having secondary disconnecting devices, positive mechanical interlocks, auxiliary switches, operation counter, position indicator and control wiring. The number of auxiliary switches shall be five (5) or more per circuit breaker.

(1) Mechanical interlock

The mechanical interlock shall be of such a construction that when the breaker is inclose position, it should neither be racked in nor racked out.

A trip button shall be set up in front of the circuit breaker for manual handling, and the circuit breaker shall be tripped manually at all times.

(2) Operation mechanism

The circuit breaker shall be operated electrically via DC 220V and shall be trip free. The operation mechanism shall be of solenoid or mechanical stored-energy type, and a manual closing device shall be furnished. However, incoming and bus tie circuit breakers shall be given consideration for 6.6 kV bus transfer.

(3) Grounding

The grounding shall be of a construction that the frame can automatically be connected to the ground bus when the circuit breaker is set in the operating position.

(4) Power contactor

The power contactor shall consist of a main contactor and an auxiliary contactor, and shall have a capacity not only to break the maximum short circuit current but also sufficiently break the exciting current and leading current.

(5) Insulation

The insulation materials shall be excellent in incombustibility, and mechanical strength and moisture-proof, and shall have the capability to withstand arc and corona produced on the occasion of breaking.

3.1.4.3 INSTRUMENT TRANSFORMER

(1) Potential transformer

The potential transformers shall be of the molded type. For details of the quantity and specifications, refer to the attached drawings.

Current limiting fuses able to be easily attached and detached shall be mounted on the primary side, and enclosed fuses shall be mounted on the secondary side.

(2) Current transformer

The current transformers shall be of the molded type.

For details regarding to quantity and specifications of current transformers, refer to the attached drawings.

3.1.4.4 LIGHTNING ARRESTER

The lightning arrester shall be of the draw out type, and shall limit abnormal surge voltage to prevent insulation damage to equipment. In addition, good discharge characteristics shall be obtained under varied atmospheric conditions.

Rated voltage	8,400V
Rated current	10,000 A
Insulation level	BIL 60 kV (full wave)

3.1.4.5 NAME PLATE, NUMBER PLATE, CAUTION PLATE

Name plates, number plates and caution plates shall be attached at the prescribed positions as follows.

For details, in this specification, refer to Clause 9.6 in Section I.

(1) The name plate shall be placed at the upper side of the front door and rear surface.

(2) Cubicle and circuit breaker number plate

The incoming panel side shall be numbered 1, 2, 3, ... counting from left to right.

The upper panel side shall be numbered A, B, C, ... starting from top to bottom.

(3) Meggering caution plate

The meggering caution plates shall be placed on each feeder unit.

(4) Reverse voltage caution plate

Example

The red portion shall be kept energized even when the related circuit breakers are opened.

The background shall be white and of acrylic resin plate.

English shall be written in red lettering.

The size shall be 200 mm x 200 mm.

The PT shall be colored in red, if used.

3.1.4.6 SPARE PANEL

The spare metal clad switchgear in complete set shall be provided for both the unit metal clad switchgear (for motor feeder) and for common metal clad switchgear (for transformer feeder).

3.1.4.7 TESTING DEVICE OF CIRCUIT BREAKER

A testing device for circuit breaker performance test shall be provided.

3.1.4.8 ACCESSORY

One (1) complete set of accessories required for operation and handling, and one (1) complete set of special tools (standard) for erection, maintenance and overhaul shall be provided.

3.1.5 TRANSFER SYSTEM

Note that in this specification only changeover from the unit bus to the common bus is described. Thus, no description is made on reverse changeover.

3.1.5.1 AUTOMATIC CHANGEOVER OF BUS

(1) Changeover during normal operation (parallel operation)

o Instantaneous changeover system (power failure)

All of 6.6 kV unit auxiliary buses and 6.6 kV common buses, except those required to be kept in service for safe shutdown of auxiliary equipment in view of the capacity of starting transformer, shall be changed over.

(2) Changeover during island operation of unit

In case the boiler is extinguished, or turbine and/or generator are tripped during island operation of the unit, the power source shall be changed over to common bus after confirming that the residual bus voltage has been reduced to less than approx. 30% of the rated voltage by voltmeter.

However, when the turbine or generator is tripped due to overload or trouble in buses in the cases of the above items (1) and (2), the power source shall never be changed over from the unit bus to the common bus.

3.1.5.2 MANUAL CHANGEOVER OF BUS

(1) Changeover from unit bus to common bus (under shutdown conditions)

o Changeover during synchronized operation

The bus tie circuit breaker shall be closed by operating the control switch for the bus tie circuit breaker, and after instantaneously putting the bus into parallel synchronized operation, the power receiving circuit breaker shall be tripped by means of spring return of the control switch.

o Changeover during asynchronized operation

The power receiving circuit breaker shall be tripped by the control switch for the bus tie circuit breaker, then the incoming circuit breaker shall be tripped, and after instantaneously shutting down the unit bus, the bus tie circuit breaker shall be closed.

(2) Changeover from common bus to unit bus (under starting conditions)

Changeover from the common bus to the unit bus shall be carried out in accordance with the above items (1) in both cases of synchronized and asynchronized operation. In this case, however, changeover shall be carried out by operating the control switch for the incoming circuit breaker.

3.2 400V POWER CENTER

3.2.1 APPLICABLE STANDARDS AND CODES

The following applicable standards and codes of latest edition shall be applied.

International Electrotechnical Commission (IEC)

IEC-157 "Low voltage switchgear and controlgear"

Other pertinent International Electrotechnical Commission (IEC) standard and/or equivalent shall be applied generally for electrical machineries and apparatuses, and more detailed specifications shall be in accordance with "Panels and Boards" in Clause 2.1 in Section II of Part I.

3.2.2 SCOPE OF SUPPLY

The following 400V power center and accessories shall be provided, but not be limited to the followings.

For details of quantity, refer to the attached drawing.

One (1) set	Indoor, 400V power center assembly for unit No. 1
One (1) set	Indoor, 400V power center assembly for common
One (1) set	Indoor, 400V power center assembly for unit No. 2

3.2.3 TECHNICAL INFORMATION

3.2.3.1 TYPE

Indoor, drip-proof, self standing metal clad,

three (3) pole, single throw air circuit breaker

dry type three-phase, two (2) winding transformer

3.2.3.2 RATING

(1) Switchgear

Voltage	600V
Phase	3 ϕ
Frequency	50 Hz
Continuous current	
Bus conductor	3,000 A
Incoming and bus-tie units	3,000 A
Feeder units	600A
Short-time current	
Incoming bus tie	70 kA (symm.)
Feeder	40 kA (symm.)

(2) Transformer

Capacity	* kVA
Class of rating	Continuous
Voltage	
High tension side	6,600V
Low tension side	400V
No load no voltage taps	6,930 - 6,770 - 6,600 - 6,430 - 6,270V
Frequency	50 Hz
Connection	Dd0
High tension side	Delta
Low tension side	Delta
Impedance voltage	*% (at rated kVA base)

Insulation class	H
High tension side	Full insulation
Low tension side	Full insulation
Insulation level	
High tension side winding	BIL 60 kV (Full wave)

3.2.3.3 TYPICAL FRONT VIEW OF POWER CENTER OUTLINE DRAWING

NOTE:

27 : UNDER VOLTAGE RELAY
R : RED LAMP
G : GREEN LAMP
A : AMBER LAMP
PB : PUSH BUTTON
NP : NAME PLATE
NP1: NUMBERING PLATE

3.2.3.4 SHOP TEST

The shop tests shall be as follows, but shall not be limited to the items below. The test shall be carried out in the precence of the Engineer.

(1) Switchgear

Construction test

Meggering

Withstand voltage test

Sequence test

PT, CT circuit test

(2) Transformer

Withstand voltage test

Induced voltage test

Applied voltage test

Measurement of winding resistance

Polarity test

Angular displacement test

Temperature test

3.2.4 CONSTRUCTION

3.2.4.1 CUBICLE

The cubicle shall be of welded construction using steel plate with a thickness of 2.3 mm/3.2 mm, and shall comprise a transformer cubicle and switchgear cubicle.

(1) Transformer cubicle

The transformer cubicle shall have a built-in power center transformer.

For construction of the cubicle, sufficient consideration shall be given to heat radiation from the transformer.

The cubicle shall have a door with handle and key, and stopper at its front. The door shall be of a construction which facilitates supervision of the transformer winding temperature meter from outside, and at its rear part, removable plates shall be provided.

A guide rail with stopper lug for putting in and drawing out the transformer and a support for high tension side cable shall be mounted inside the cubicle.

(2) Switchgear cubicle

The switchgear cubicle shall be of the vertical section type, and consist of an air circuit breaker compartment, a potential transformer compartment, inside compartment and rear compartment, and each compartment shall be of a completely separate construction.

The inside compartment shall consist of a bus conductor, a power cable terminal and a cable supporter, and the rear compartment shall be composed of a control cable terminal block, a cable supporter and auxiliary relay.

The separator for the inside compartment and the rear compartment shall be of a removable type having windows for meggering.

The switchgear cubicle shall have a door with a handle and key and a stopper at the front of each compartment, and at each rear part the switchgear cubicle shall have a door with a handle and key and a stopper at each vertical

section.

(a) Potential transformer compartments

The compartment shall consist of a potential transformer, relays, meters, etc.

The potential transformer shall be of the draw out type and shall be of a construction where by the potential transformer can automatically be grounded when is drawn out.

The primary and secondary circuit connector shall be of silver-plated pressure type, and sufficient consideration shall be given to mechanical and electricl strengths.

The relays, meters and switches shall be attached on the front door the potential transformer compartment, and shall have a constructions which allow easy supervision from outside.

(b) Air circuit breaker compartments

The compartment shall consist of an air circuit breaker, signal lamps, auxiliary switches, etc.

The circuit breaker shall be of the draw out type, and the compartment shall have built-in primary and secondary circuit connectors, draw out mechanism, etc.

The contact surfaces of the primary and secondary connector shall be silver-plated and shall be strong electrically and mechanically.

The draw out mechanism shall be applied to set the circuit breaker at prescribed positions (operating

position, test position and disconnecting position).

At the operating position, the primary and secondary circuits shall be completely connected by the connector.

At the test position, the primary circuit connector shall be disconnected from the bus and load side conductor, but the secondary circuit connector shall be connected with the control circuit.

At the disconnecting position, the primary and secondary circuit connector shall be completely disconnected from the bus and load side conductor and the control circuits, respectively.

At all positions, the front door shall be kept closed.

When the draw out mechanism is moved, as in the case when the circuit breaker is kept closed, the mechanism shall have a construction enabling the circuit breaker to trip or such a construction that the position cannot be moved.

The indicators for each position shall be mounted on the draw out mechanism at positions easily visible from outside.

The draw out mechanism shall be of the manual operation type.

The auxiliary switches of at least 8a and 8b shall be provided.

(c) Inside compartment

The inside compartment shall consist of a bus conductor, a power cable terminal, cable supports, etc.

For the bus and load side conductor, insulated copper or aluminium bar shall be used.

The contact surfaces of the joint part for the bus and load side conductor shall be silver-plated, and the conductor shall be firmly jointed mechanically and electrically and insulated sufficiently.

For bus and load side conductor support, insulating material having excellent mechanical and electrical properties shall be applied in order to firmly support the bus conductor, and the support shall sufficiently withstand the electromagnetic force at the time of bus short circuit.

The power cable terminal having the following specifications shall be supplied.

Compression type	More than 125 mm^2
Crimp type	125 mm^2 or less

Sufficient space shall be provided at the supporting part for cable in the compartment for the handling of cable terminal and connection, and the supporter for cable shall be provided.

(d) Rear side compartment

The rear side compartment shall consist of a control cable terminal block, a cable supporter, auxiliary relays, etc.

(e) Space heater

The space heater with switch having an appropriate capacity for moisture-proofing shall be mounted inside the cubicle.

(f) Grounding terminal

A crimp type graounding terminal of 100 mm^2 shall be attached on both sides of the cubicle.

3.2.4.2 POWER CENTER TRANSFORMER

The power center transformer shall be connected with the 6,900V metal clad switchgear by means of cable and shall supply 400V voltage to the power center. The construction shall be as follows.

(1) Construction of steel core material

For the steel core material, cold rolled directional silicone steel plate excellent in magnetic property shall be provided. The exciting current loss shall be reduced and measures required to reduce a eddy current loss and stray load loss of the winding shall be provided.

All magnetic and mechanical connections shall be carried out, and care shall be taken for the reduction of no load current and noise.

(2) Construction of winding material

For the component wire, high purity electric copper shall be provided, and sufficient heat treatment shall be carried out.

Sufficient insulation shall be applied between the component wires, and the wires shall be transposed. Care shall be given to the insulation between layers and layers and between the ground and winding.

Regarding countermeasures against surge voltage, the internal potential distribution of the winding shall be kept at a uniform value, and consideration shall be given for the prevention of internal potential vibration.

(3) Insulating material

The transformer is of the large capacity dry type. Therefore, the insulating material shall be excellent in dielectric strength, corona-proof property, heat-proof property, moisture-proof property and dust-proof property. In addition, the material having large heat conductivity and large mechanical strength shall be applied, and sufficient attention shall be paid to these at the time of manufacture.

(4) Tap changer

The tap changer shall be of the no load no voltage type, and shall enable easy and precise change over inside the cubicle. The tap changer shall have sufficient mechanical and electrical strength.

The tap changer shall have a tap position indicator.

(5) Connection

The high tension side of the power transformer shall have a construction facilitating easy connection of the outside cable. The low tension side of the power transformer shall be directly connected with the power center incoming breaker by means of a bus bar. The construction shall enable absorption of vibration of the transformer.

(6) Accessory

The following accessories and those considered to be necessary shall be provided.

(a) Winding temperature indicator

The winding temperature indicator with alarm shall be of the dial type, and shall be attached at a position enabling supervision from the outside of the cubicle.

(b) Grounding

As grounding lugs, two (2) sets of 150 mm^2 compression type terminals shall be mounted on the transformer structure.

(c) Lifting lug

Sufficient attention shall be given to the mounting position of the lifting lugs in order to facilitate easy transport and installation of the power transformer.

(d) Name plate and caution plate

The name plate shall be attached at a position easy to see from the floor level. For the material, SUS shall be applied.

Each item shall be clearly inscribed and shall not be erased under any atmospheric conditions.

Name

Standard

Name of manufacturer

Number of manufacture

Date of manufacture

Rated capacity

Frequency

Phase

Rated voltage

Tap voltage

(A tap indicating mark shall be provided.)

Rated current

Vector

Connection diagram

Impedance voltage

Cooling type

Insulation class

Total weight

Indoor or outdoor

Temperature rise

Noise

(7) Noise level

The indication sound level meter shall be provided to measure the noise of transformer and shall be in accordance with "Measurement of transformer and reactor sound level" (IEC-551), and the measured average value shall not exceed 75 dB(A).

3.2.4.3 AIR CIRCUIT BREAKER

The air circuit breaker shall consist of a three (3) pole, single throw, self-aligning primary and secondary disconnecting devices, positive mechanical interlocks, auxiliary switches, overcurrent device, operation counter, position indicator and control wiring.

The number of auxiliary switches shall be five (5) or more than five (5) per air circuit breaker.

(1) Mechanical interlock

The mechanical interlock shall be of such a construction that the circuit breaker should, in principle, lock if the draw out mechanism functions when the circuit breaker is closed.

At the front of the circuit breaker, a manual operating trip button shall be mounted in order to provide manual tripping at any time.

(2) Operation mechanism

The circuit breaker shall be electrically operated from the DC 220V and shall be trip free.

The operation mechanism shall be based upon the solenoid or mechanically stored-energy type, and a manual closing device shall also be furnished.

(3) Grounding

The grounding device shall have such a construction that the frame will automatically be connected with the ground bus when the circuit breaker is set-in the operating position.

(4) Power contactor

The power contactor shall consist of a main contactor and auxiliary contactors, and shall be sufficiently capable of breaking not only the maximum short circuit current but also the exciting current and the leading phase current.

(5) Insulation

For the insulation materials, materials excellent in incombustibility, moisture-proof property and mechanical property shall be applied, and shall sufficiently withstand the corona and arc produced at the time of breaking.

(6) Overcurrent protected device

The overcurrent protected device with alarm contact, shall be static type with CT, and an adjustable dial shall be applied for tripping the corresponding circuit breaker. The device shall function by means of overcurrent and short circuit current, and shall be mounted on circuit breaker.

The overcurrent protected device for feeder shall have long time and short time characteristics, and the overcurrent protected device for motor feeder shall have long time and instantaneous characteristics.

3.2.4.4 INSTRUMENT TRANSFORMER

(1) Potential transformer

The potential transformers shall be of the molded type. For details of quantity and specifications, refer to the attached drawing.

The current limiting fuses, easy to mount and dismount, shall be placed on the primary side. Enclosed fuses shall be mounted on the secondary side.

(2) Current transformer

The current transformers shall be of the molded type. For details of quantity and specifications, refer to the attached drawing.

3.2.4.5 NAME PLATE, NUMBER PLATE

The following name plates and number plates shall be provided at the prescribed positions.

(1) Name plate

The name plate shall be placed at the upper side of the front door and rear surface.

(2) Number plate for cubicle and circuit breaker

The panel shall be numbered 1, 2, 3, ..., counting from the incoming panel side, and A, B, C, ..., counting from the upper level.

3.2.4.6 SPARE PANEL AND IDLE PANEL

One (1) spare panel for feeder shall be provided in the common power center, and one (1) spare panel for motor shall be provided for each unit power center.

In case the idle panel should be mounted, the panel shall be provided with all necessary stationary compartments including air circuit breaker.

3.2.4.7 ACCESSORY

The following accessories and those considered necessary shall be supplied.

(1) Protective cover for operating switch

The protective cover of transparent synthetic resin shall be provided for the operation switch.

(2) Lift

The lift shall be provided for lifting and carrying circuit breakers.

4-799

(3) Testing device for air circuit breaker

The testing device to be applied for working test of the circuit breakers shall be provided separately.

(4) Testing kit for static overcurrent protective device

The testing kits to be applied for working test of the static overcurrent protective device for circuit breaker shall be provided separately.

3.3 400V CONTROL CENTER

3.3.1 APPLICABLE STANDARDS AND CODES

The following applicable standards and codes of latest edition shall be applied.

International Electrotechnical Commission (IEC)

IEC-157 "Low voltage switchgear and controlgear"

Other pertinent International Electrotechnical Commission (IEC) and/or equivalent shall generally be applied for electrical apparatuses, and more detailed specifications shall be in accordance with "Panels and Boards" in Clause 2.1 in Section II of Part I.

3.3.2 SCOPE OF SUPPLY

The control centers and accessories described hereunder shall be supplied, but not be limited to the followings.

Five (5) sets	Indoor type 400V control center assembly for unit No. 1
Two (2) sets	Indoor type 400V control center assembly for No. 1 common
Five (5) sets	Indoor type 400V control center assembly for Unit No.2

However, other than the power source equipment for unit auxiliary machines to be decided by the Contractors, the control center unit indicated in the attached drawing shall be estimated as the power source equipment for auxiliary machines in the main building.

3.3.3 TECHNICAL INFORMATION

3.3.3.1 TYPE

Indoor, self standing, metal clad vertical section type.

3.3.3.2 RATING

(1) 400V control center

Voltage	600V
Frequency	50 Hz
Phase and wire	3ϕ, 3W
Bus current	400 A
Interrupting current	15 kA

3.3.3.3 TYPICAL FRONT VIEW OF CONTROL CENTER

3.3.3.4 SHOP TEST

The stop tests shall be as follows, but not be limited to the items below. The tests shall be carried out in the precence of the Engineer.

(1) Control center (Motor combination starter unit)

Construction test

Meggering test

Withstand voltage test

Sequence test

(2) Air circuit breaker (Feeder unit)

Construction test

Meggering test

Withstand voltage test

Operating test

3.3.4 CONSTRUCTION

3.3.4.1 STATIONARY STRUCTURE

The stationary structure shall be of welded or frame assembled construction using steel plates with thicknesses of 1.6 mm to 3.2 mm, and shall consist of a motor combination starter unit, an air circuit breaker (ACB) unit, bus compartment and terminal compartment, etc. Each component shall be of a complete separate construction and there shall be no exposed parts. The stationary structure shall have a hinged panel with stopper and handle with key for each unit at its front, and shall be of a construction which facilitates operation of ACB and thermal reset from outside. At its back, the stationary structure shall have a door hinged with fastening bolts which shall be mounted at each vertical section.

For each power circuit, cable supporters for outside cable and inside wiring shall be provided.

The cable supporters shall be provided for the outside cable for the control circuit.

(1) Unit compartment

The unit compartment for each unit shall be of such a complete construction that shall not allow spreading of any influence to other units in case of accident, and the compartment shall have a guide with stopper for inserting and drawing out the unit.

(2) Bus

For the bus conductor, insulated copper or aluminium bar shall be applied.

The bus conductor shall consist of a horizontal bus conductor and a vertical bus conductor. The contact surfaces of the joint part shall be silver-plated, and the joint part shall be firmly jointed mechanically and electrically and insulated.

The contact surfaces of the vertical bus conductor connecting to each unit shall be silver-plated. For the bus supporter, mechanically and electrically excellent insulating materials shall be applied and sufficiently withstand the electromagnetic force at the time of short circuit of the bus.

(3) Terminal

The terminals for power and control circuit shall be attached in each vertical compartment to be provided at each vertical section.

The power circuit shall be provided at the rear side of the terminal compartment, and the control circuit, at the front side of the terminal compartment.

(4) Cable entry

Drawing the cable outside shall be made possible from the upper or lower part of the control center and the following terminals shall be supplied.

Terminals for power cable shall be applied.

Compression type for more than 125 mm^2

Crimp type for 125 mm^2 or less

However, in case the cable is drawn out from the upper part, it shall be connected to the cable tray with a vertical shaft.

(5) Auxiliary relay and wiring

All auxiliary relays for outside interlocking shall be attached at the rear side of the control center, and no relay shall be attached inside the control center.

(6) Grounding terminal

The grounding terminals, shall be provided at each side of the stationary structure. The size shall be 50 mm^2.

3.3.4.2 UNIT

(1) Motor feeder unit

The motor feeder unit shall consist of a molded type air circuit breaker with alarm contact magnetic contactor, trouble indicating lamp, thermal relay, transformer for control circuit, signal lamps, auxiliary relays, wiring, etc. For reversible type unit, electrical and mechanical interlock shall be provided.

Each unit shall be of the draw out type. The primary power circuit shall be connected to the vertical bus on the stationary structure by a grip type connector. The secondary power circuit and the control circuit shall be connected with a connector, and shall have a construction facilitating easy drawing out of the unit for maintenance and repair.

Each motor feeder unit shall be of a construction which enables operation test through other power source while the circuit breaker is open without drawing out the unit from the stationary structure.

The units such as fans and blowers from among the motor feeder units having a large GD^2 shall be coordinated by means of a saturation reactor or a time relay as required.

Each unit shall be provided with current limiting wire between buses and molded type air circuit breaker.

The current limiting wire shall be to restrain the short circuit at 15,000 A (symmetrical) in case of trouble in the short circuit of molded type air circuit breaker in side control center.

(2) Molded case air circuit breaker (MCCB) unit

The MCCB unit shall consist of a molded type air circuit breaker with alarm contact, signal lamp and wiring, and shall have the same construction as that for the motor feeder unit.

3.3.4.3 400V EMERGENCY CONTROL CENTER (1-3 C/C, 2-3 C/C)

During normal conditions, the power source of the control center shall be supplied from the 400V Unit power center. However, in the case of power fault of the 400V power center, power shall be automatically supplied from emergency diesel engine generator.

For no voltage detection, a three-phase under voltage relay shall be provided on both incoming sides.

The partial auxiliary machines from among the ones to which power is supplied in the control center shall be designed to autonatically re-start after changeover.

At the time the normal power source is recovered, the control center shall be designed to be changed over manually.

(1) Incoming breaker for normal and emergency power source

The incoming breaker for normal and emergency power source shall be an air circuit breaker of a 600 A rating.

For further details, refer to 400V Power Center in Item 3.2.

3.3.4.4 NAME PLATE, NUMBER PLATE

The name plates and number plates shall be provided at the prescribed positions.

(1) Name plate

The name plates shall be placed at the front door and rear surface of each unit.

(2) Unit number plate

The panel shall be numbered 1, 2, 3, ..., counting from the incoming panel side, and A, B, C, ..., counting from the upper level. Each panel shall be numbered 1A, 2A, etc.

3.3.4.5 SPARE UNIT

Two (2) sets of a complete spare unit shall be provided for motor feeder unit (including reversible type motor feeder) and MCCB unit corresponding to each capacity in each control center. In case an idle case among the panels constituting the control center, a motor unit shall be provided.

In regard to details, discussion shall be made separately.

3.4 MOTOR VALVE CONTROL CENTER

3.4.1 APPLICABLE STANDARDS AND CODES

The following applicable standards and codes of latest edition shall be applied.

International Electrotechnical Commission (IEC)

IEC-157 "Low voltage switchgear and controlgear"

Other pertinent International Electrotechnical Commission (IEC) shall generally be applied for electrical appratuses, and more detailed specifications shall be in accordance with "Standards of "Panels and Boards" in Clause 2.1 in Section II of Part I.

3.4.2 SCOPE OF SUPPLY

The control center with accessories described below shall be provided, but not be limited to the followings.

One (1) set	Indoor type 400V and 230V control center assembly for unit No.1
One (1) set	Indoor type 400V and 230V control center assembly for unit No.2

3.4.3 TECHNICAL INFORMATION

The motor valve control center shall be provided as the power source of motor operated valve for unit.

3.4.3.1 TYPE

(1) 400V control center

Indoor, self standing, metal clad vertical section type, drip-proof.

(2) 230V control center

Indoor, self standing, metal clad, vertical section type, drip-proof.

(3) 400V/230V Transformer

Indoor, dry type, two (2) winding transformer.

3.4.3.2 RATING

(1) 400V control center

Voltage	600V
Frequency	50 Hz
Phase and wire	3ϕ 3W
Bus current	400 A
Interrupting current	15 kA

(2) 230V control center

Voltage	600V
Frequency	50 Hz
Phase and wire	3ϕ 3W
Bus current	400 A
Interrupting current	15 kA

K-799

(3) Transformer

Type	Dry
Capacity	* kVA
Voltage	
High tension side	400V
Low tension side	230V
No load, no voltage tap	± 5%
Insulation class	H

3.4.3.3 SHOP TEST

(1) 400V control center

In accordance with 3.3.3.4 in 400 V Power Center in this specification.

(2) 230V control center

In accordance with 3.3.3.4 in 400 V Control Center in this specification.

(3) 400V/230V transformer

In accordance with 4.4.3.3 in Distribution Panel in this specification.

3.4.3.4 CONSTRUCTION

The motor valve control center shall consist of 400V control center, 230V control center, and 400V/230V transformer.

(1) 400V control center

In accordance with 3.3.4 in 400V Control Center in this specification.

(2) 230V control center

In accordance with 3.3.4 in 400V Control Center in this specification.

(3) 400V/230V transformer

In accordance with 4.4.4 in Distribution Panel in this specification.

3.4.3.5 NAME PLATE

(1) 400V control center

In accordance with 3.3.4.5 in 400V Control Center in this specification.

(2) 230V control center

In accordance with 3.3.4.4 in 400V Control Center in this specification.

(3) 400V/230V transformer

In accordance with 4.4.4.3 in Distribution Panel in this specification.

3.4.3.6 SPARE UNIT

(1) 400V control center

In accordance with 3.3.4.6 in 400V Control Center in this specification.

(2) 230V control center

In accordance with 3.3.4.5 in 400V Control Center in this specification.

108-7

3.5 WATER TREATMENT SWITCHGEAR

3.5.1 APPLICABLE STANDARDS AND CODES

The following applicable standards and codes of latest edition shall be applied.

International Electrotechnical Commission (IEC)

IEC-157 "Low voltage switchgear and controlgear"

Other pertinent International Electrotechnical Commission (IEC) shall generally be applied for electrical appratuses, and more detailed specifications shall be in accordance with "Panels and Boards" in Clause 2.1 in Section II of Part I.

3.5.2 SCOPE OF SUPPLY

The switchgears with accessories described below shall be provided, but not be limited to the followings.

One (1) set	Indoor type 400V control center assembly
One (1) set	Indoor type 380-220V distribution panel assembly

3.5.3 TECHNICAL INFORMATION

The water treatment switchgear shall be provided as the power source of auxiliary equipment and machinery for water treatment.

3.5.3.1 TYPE

(1) 400V control center

Indoor, self standing, metal clad vertical section type, drip-proof.

(2) 380-220V distribution panel

Indoor, drip-proof, self standing, metal clad, three-phase, four (4) wire, two (2) winding transformer.

3.5.3.2 RATING

(1) 400V control center

Voltage	600V
Frequency	50 Hz
Phase and wire	3ϕ 3 W
Bus current	400 A
Interrupting current	15 kA

(2) 380-220V distribution panel

(a) Panel

Voltage	380, 220V
Phase and wire	3ϕ 4W
Bus current	400 A
Molded type air cicuit breaker	
Number	10 or more
Rating	600V, 2P, 100 A x 6
	600V, 3P, 100 A x 4

(b) Transformer

Type	Dry
Capacity	* kVA
Voltage	
High tension side	400V
Low tension side	380-220V
No load, no voltage tap	$\pm$ 5%
Insulation class	H

3.5.3.3 SHOP TEST

(1) 400V control center

In accordance with 3.3.3.4 in 400 V Control Center in this specification.

(2) 380-220V distribution panel

In accordance with 4.4.3.3 in Distribution Panel in this specification.

3.5.3.4 CONSTRUCTION

The water treatment switchgear shall consist of 400V control center, 380-220V distribution panel with 400/380-220V transformer.

(1) 400V control center

In accordance with 3.3.4 in 400V Contrl Center in this specification.

(2) 380-220V distribution panel

In accordance with 4.4.4 in Distribution Panel in this specification.

3.5.3.5 NAME PLATE

(1) 400V control center

In accordance with 3.3.4.4 in 400V Control Center in this specification.

(2) 380-220V distribution panel

In accordance with 4.4.4.3 in Distribution Panel in this specification.

3.5.3.6 SPARE UNIT

(1) 400V control center

In accordance with 3.3.4.5 in 400V Control Center in this specification.

(2) 380-220V distribution panel

In accordance with 4.4.4.4 in Distribution Panel in this specification.

3.6 WASTE WATER TREATMENT SWITCHGEAR

3.6.1 APPLICABLE STANDARDS AND CODES

The following applicable standards and codes of latest edition shall be applied.

International Electrotechnical Commission (IEC)

IEC-157 "Low voltage switchgear and controlgears"

Other, pertinent International Electrotechnical commission (IEC) and/or equivalent standards shall generally be applied for electrical appratuses, and more detailed specifications shall be in accordance with "Standards of Panels and Boards" in Clause 2.1 in Section II of Part I.

3.6.2 SCOPE OF SUPPLY

The switchgears and accessories described hereunder shall be supplied, but not be limited to the followings.

One (1) set Indoor type 400V control center assembly

3.6.3 TECHNICAL INFORMATION

The waste water treatment switchgear shall be installed as the power source of auxiliary equipment and machinaries of waste water treatment and related facilities.

3.6.3.1 TYPE

(a) 400V control center

Indoor, self standing, metal clad, vertical section type, drip-proof.

3.6.3.2 RATING

(1) 400V control center

Voltage	600V
Frequency	50 Hz
Phase and wire	3 ϕ 3 W
Bus current	400 A
Interrupting current	15 KA

3.6.3.3 SHOP TEST

(1) 400V control center

In accordance with 3.3.3.4 in 460V Control Center in this specification.

3.6.3.4 CONSTRUCTION

(1) 400V control center

In accordance with 3.3.4 in 400V Control Center in this specification.

3.6.3.5 NAME PLATE

(1) 400V control center

In accordance with 3.3.4.4 in 460V Control Center in this specification.

3.6.3.6 SPARE UNIT

(1) 400V control center

In accordance with 3.3.4.5 in 400V Control Center in this specification.

K-067

3.7 DC 220V CONTROL CENTER

3.7.1 APPLICABLE STANDARDS AND CODES

The following applicable standards and codes of latest edition shall be applied.

International Electrotechnical Commission (IEC)

IEC-157 "Low voltage switchgear and controlgear"

Also, other pertinent International Electrotechnical Commission (IEC) standards shall generally be applied for electrical apparatuses, and more detailed specifications shall be in accordance with "Standards of Panels and Boards" in Clause 2.1 in Section II of Part I.

3.7.2 SCOPE OF SUPPLY

The following control center and accessories shall be supplied, but not be limited to the followings.

One (1) set of DC 220V control center assembly for Unit No. 1

One (1) set of DC 220V control center assembly for Unit No. 2

3.7.3 TECHNICAL INFORMATION

The control center shall be provided as the power source for emergency auxiliary machines.

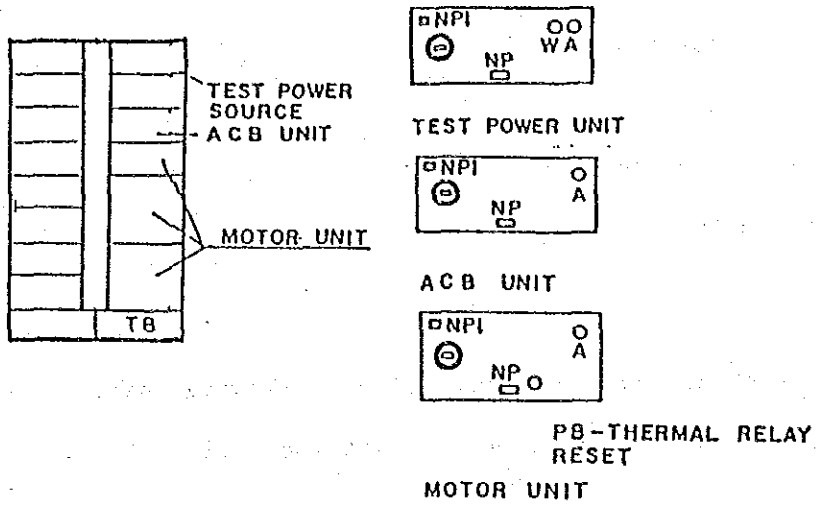
3.7.3.1 TYPE

Indoor, self standing, metal clad, vertical section type.

3.7.3.2 RATING

Voltage	220V
Main circuit	DC two (2) wire
Bus current	400 A
Interrupting current	10 kA (at 220V)

3.7.3.3 TYPICAL FRONT VIEW OF CONTROL CENTER



N O T E

A : AMBER LAMP

W : WHITE LAMP

NP : NAME PLATE

PB : THERMAL RELAY RESET PUSH-BUTTON

TB : TERMINAL BOARD

NP1 : NUMERING PLATE

3.7.3.4 SHOP TEST

The tests shall be as follows, but shall not be limited to the items below. The tests shall be carried out in the presence of the Engineer.

Construction test

Meggering

Withstand voltage test

Sequence test

3.7.4 CONSTRUCTION

The items which are not described in the following shall be the same as those described in Item 3.3 "400V Control Center".

3.7.4.1 STATIONARY STRUCTURE

The stationary structure shall be installed between the battery charger panel and DC 220V No.1 or No.2 distribution panel in accordance with the attached drawing.

(1) Unit compartment

(2) Bus

The bus conductor shall be of a construction connected with the DC 220V No.1 or No.2 distribution panel bus conductor.

(3) Terminal

(4) Cable entry

4-8/10

(5) Motor starting and field rheostat

The motor starting rheostat shall be of a grid type, and shall have a sufficient capacity for motor starting current. The grid resistance value shall be controlled to the value close to that of the motor rated current to the extent possible.

The field rheostat for motor speed adjustment shall be of the bobbin type.

(6) Auxiliary time and under-voltage relay and wiring

The auxiliary relay for interlock shall be attached on the rear side of the panel, and the time and under-voltage relay shall be attached inside the unit compartment.

3.7.4.2 UNIT

Motor feeder unit

The thermal relay for the motor feeder unit shall be used only for alarming, and shall not be tripped.

3.7.4.3 NAME PLATE

Same as item 3.3.4.4 " 400V Control Center".

3.7.4.4 SPARE UNIT

One complete spare unit shall be provided for motor feeder unit.

3.8 CVCF (Constant Voltage, Constant Frequency Equipment)

3.8.1 APPLICABLE STANDARDS AND CODES

The following applicable standards and codes of the latest edition shall be applied.

International Electrotechnical Commission (IEC)

JEC-188 "Thyristor Converter"

JEC-204 "Transformer"

Other pertinent JIS and/or International Electrotechnical Commission (IEC) standards shall be applied generally for electrical apparatuses, and more detailed specifications for panels shall be in accordance with "Standards of Panels and Boards" in Clause 2.1 in Section II of Part I.

3.8.2 SCOPE OF SUPPLY

The CVCF equipment and accessories shall be provided, but not be limited to the followings.

One (1) set CVCF equipment and accessories for Unit No. 1

One (1) set CVCF equipment and accessories for Unit No. 2

3.8.3 TECHNICAL INFORMATION

One (1) CVCF equipment shall be installed as the power source equipment for the computer, electro hydorolic governer, automatic burner control, automatic boiler control system, etc.

The CVCF equipment shall consist of power source panel, DC filter panel, inverter panel and load distribution panel.

The CVCF equipment having two (2) lines of power source (AC and DC) shall be designed so that AC power shall be stably supplied through an inverter at constant voltage and constant frequency.

The CVCF equipment shall be installed in the control equipment room in main powerhouse. This room shall be furnished with air conditioning.

3.8.4 TYPE OF CVCF EQUIPMENT

Indoor, self standing and metal clad

Height: 2,350 mm (including channel base of 50 mm)

3.8.5 RATING

Capacity	* kVA (100% constant)
Voltage	
DC input	220V
AC input	400V, three-phase 3 W, 50 Hz
AC output	220V
Frequency	
Output	50 Hz
Output voltage regulation	±1.5 %
Output frequency regulation	±1 %
Harmonic distortion	5 %
Cooling system	*

3.8.6 SHOP TEST

The tests shall be as follows, but shall not be limited to the items below. The tests shall be carried out in the presence of the Engineer.

(1) Visual inspection of the construction

(2) Temperature rising test

(3) Measurement of insulation resistance

(4) Dielectric strength test

(5) Steady state characteristics test

(a) Precision of output voltage

(b) Precision of output frequency

(c) Measurement of efficiency

(d) Measurement of harmonical distortion factor

(e) Measurement of noise level

(6) Meggering

3.8.7 CONSTRUCTION

3.8.7.1 STATIONARY STRUCTURE

The stationary structure shall be of a welded or frame assembled construction using steel plates with thicknesses of 1.6 mm to 2.3 mm, and shall consist of an input panel, a DC filter panel, inverter panel, power distribution panel and all other necessary pertinents.

Each component shall be of complete and separate construction, and there shall be no exposed parts.

The stationary structure shall have a hinged panel with stopper and handle with key for each panel at its front. At its back, the stationary structure shall have a hinged door.

For each power circuit, cable supporters for the outside cable and inside wiring shall be provided.

Cable supporters shall be provided for the outside cables for the control circuit.

The perforated metal plates shall be used at places of the panel which require ventilation.

3.8.7.2 PANEL COMPONENTS

Each panel shall be constructed so as to permit separate transportation. The construction shall enable components assembly after delivery to the site.

(1) Input power source panel

The input power source panel shall consist of molded type circuit breakers, transformers, buses and meters, and shall be used as a panel for the DC input and AC input power source. The transformer shall be installed on the bottom of the panel.

The incoming cable shall be drawn in from the bottom of the panel, and cable supports shall be provided in the panel.

The molded type circuit breakers shall be attached to the internal panel front surface and set so as to be operated while the front door is kept open.

The name plate indicating the purpose of use shall be attached to each molded type circuit breaker.

(2) DC filter panel

The DC filter panel shall be equipped with DC filters.

The DC filters shall be of a unit type and constructed as so to be drawn out.

(3) Inverter panel

The inverter panel shall be equipped with inverters.

The inverters shall be of a unit type and constructed as so to be drawn out.

Two (2) sets of inverters, each with a 100% rate capacity, shall be supplied.

(4) Filter panel

The filter panel shall be equipped with an AC filter.

The AC filter shall be of a unit type and constructed as to be drawn out.

(5) Load distribution panel

The load distribution panel shall consist of molded type air circuit breakers. The molded type air circuit breaker shall be attached to the front surface of the panel and set so as to be kept in operation while the front door is open.

The name plate indicating the purpose of use shall be attached to each molded type air circuit breaker.

9/8-7

3.8.7.3 TERMINAL

Power and control terminals shall be supplied.

Drawing the cable outside shall be carried out from the upper or lower part of the CVCF.

The terminals for power cable shall have the following characteristics.

Compression type for more than 125 mm^2

Crimp type for 125 mm^2 or less

Location of input/output terminals shall be as follows.

DC input terminal	:	Lower front surface in the panel

AC input/output terminal for standby power source

AC input terminal	:	Upper back surface in the panel
Control terminal	:	Lower back surface in the panel

3.8.7.4 GROUNDING TERMINAL

One grounding terminal shall be provided on each side of the stationary structure. The terminal size shall be 50 mm^2.

3.8.7.5 The following items shall be attached on the front side of the panel.

(1) Indicator lamp

1) Inverter running indicator lamps

(2) Annunciator (ANN)

1) Overload ANN

2) MCCB trip ANN

3) Inverter trouble ANN

(3) Meter

1) Output current meter

2) Output voltage meter with alarm contact

3) Output frequency meter with alarm contact

(4) Switch

1) Changeover switch for current

2) Changeover switch for voltage (input)

3) Changeover switch for voltage (inverter)

4) ANN reset button switch

5) ANN lamp test switch

6) ANN bell stop switch

3.8.7.6 OPERATION METHOD

(1) Normal operation

The CVCF equipment shall be designed and manufactured so as to constantly receive DC 220V power source and supply stable AC power at constant voltage and constant frequency by means of the inverter.

Two (2) sets of inverters each with 100% rated capacity shall be designed and constructed so as to constantly permit synchronous operation.

(2) Emergency measures against trouble of inverter

The inverters shall be designed and constructed so that in the event where any one inverter should be in trouble while two (2) inverters are in synchronous operation, the inverter in trouble can be automatically separated, and the load can be changed over to another inverter.

In the event where both of the two (2) inverters should be in trouble, the power source of the load shall be changed over to the backup power source through automatic operation after confirming that the voltage and frequency of the backup power source is normal by the relay.

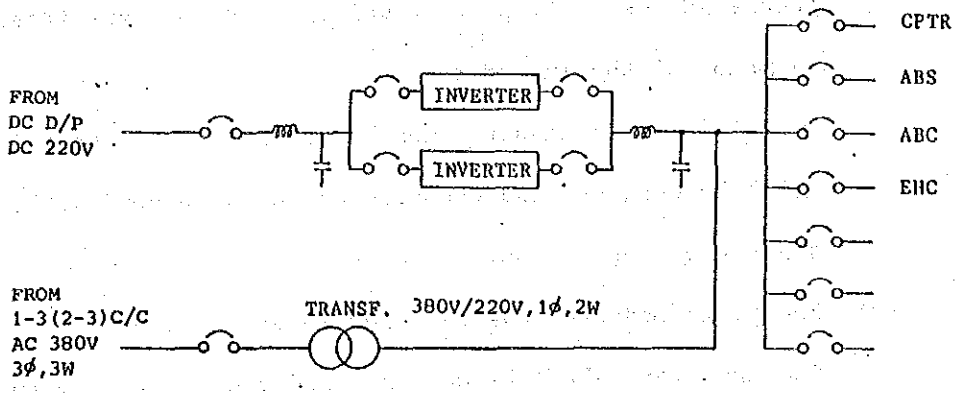
(3) Restoration of power source to inverter

Restoration from backup power source to inverter power source shall be carried out through manual operation after confirming that the inverters are under normal conditions.

K-8/9

3.8.7.7 CIRCUIT FOR CVCF EQUIPMENT

The circuit for the CVCF equipment shall be as illustrated in the following diagram.



Two (2) sets of inverters, each with a 100% rated capacity, shall be installed.

4. PANEL AND BOARD

4.1 BOILER-TURBINE-GENERATOR BOARD (BTG BOARD)

4.1.1 APPLICABLE STANDARDS AND CODES

The International Electrotechnical Commission (IEC), and/or equivalent standards shall be applied generally for electrical apparatuses, and more detailed specifications shall be in accordance with "Panels and Boards" in Clause 2.1 in Section II of Part I.

4.1.2 SCOPE OF SUPPLY

The following boiler-turbine-generator board and accessories shall be supplied, but not be limited to the followings.

One (1) set of boiler-turbine-generator board for Unit No. 1

One (1) set of boiler-turbine-generator board for Unit No. 2

4.1.3 TECHNICAL INFORMATION

The board shall be installed inside the central control room on the operating floor.

The boiler-turbine-generator board shall be designed to facilitate easy and precise operation, control and supervision of the boiler, turbine, generator and common during the normal and starting up operation as well as to provide countermeasures in case of emergency.

The air conditioning equipment shall be installed in the central control room in order to control the temperature and humidity at uniform values.

4.1.3.1 TYPE

Indoor, drip-proof, self standing, metal clad, bench board, bent.

4.1.3.2 FRONT AND REAR VIEW OF BOILER-TURBINE-GENERATOR BOARD

For detailed arrangement of Unit No. 1 BTG board,

4.1.3.3 SHOP TEST

The shop tests shall be as follows, but shall not be limited to the items below. The tests shall be carried out in the presence of the Owner and the Engineer.

Construction test

Meggering

Withstand voltage test

Sequence test

Accuracy test

Characteristic test

Synthesis operation test

4.1.4 CONSTRUCTION

The board shall be of a welded construction using 2.3mm/3.2mm /4.5 mm thick steel plate. The front part shall be of a bench board bent type, and the board shall have on both sides a hinged door with a stopper and a handle with key.

At the front of the board, an operation and supervising panel having a mimic bus, meters, control switches, changeover switches, signal lamps, instruments, annunciator, etc., shall be provided.

At its rear part, protective relays, recorders, watt-hour meters, auxiliary relays, etc., shall be attached.

4.1.4.1 DUCT

As a considerably large number of control cables have to be inserted upward vertically in the board, a duct with sufficient capacity shall be installed, and sufficient space for cnnecting the cables and terminal tretment shall be provided.

4.1.4.2 CABLE ENTRY

Drawing out of the cables and tubing for control and instrumentation shall be carried out at the bottom part of the board.

4.1.4.3 GROUNDING TERMINAL

Two (2) sets of the grounding terminals of 38 mm^2 crimp type shall be provided on both sides of the board.

4.1.4.4 SEALING PLATE

The sealing plate shall be set up at the cable draw out hole at the bottom part of the board so as to maintain airtightness of the central control room.

4.1.5 OTHERS

Annunciator

The annunciators shall consist of five (5) units for each block of the boiler, turbine, generator, common and computer unit and all of annunciators shall be provided in reannunciation circuit of the annunciators are used for alarming the loss in DC power source, an alarm of AC power source type shall be supplied.

4.1.6 ACCESSORT ON BTG BOARD

4.1.6.1 INSTRUMENT LIST FOR ELECTRICAL PARTS

One (1) set	Watt meter for generator
One (1) set	Var meter for generator
Three (3) sets	Current meter for generator
One (1) set	Voltage meter for generator
One (1) set	Frequency meter for generator
Two (2) sets	Synchronizing voltage meter
Two (2) sets	Synchronizing frequency meter
One (1) set	Power factor meter for generator
One (1) set	Synchroscope
One (1) set	Field current meter for generator
One (1) set	Field voltage meter for generator
One (1) set	AVR balance meter for generator
One (1) set	Position indicator for on load tap changer of starting transformer
Two (2) sets	Current meter for 6.9 kV unit bus and common bus
Two (2) sets	Voltage meter for 6.9 kV unit bus and common bus
Two (2) sets	Current meter for 400V unit power center and common power center
Two (2) sets	Voltage meter for 400V unit and common power center bus
Three (3) sets	Current meter for BFP motor
Two (2) sets	Current meter for FDF motor
Two (2) sets	Current meter for GRF motor

Three (3) sets	Current meter for CWP motor
Three (3) sets	Current meter for CP motor
Three (3) sets	Current meter for residual oil pump
One (1) set	Purity meter for generator H_2 gas

4.1.6.2 INTEGRAL INSTRUMENT LIST

One (1) set	Watt hour meter for generator
Four (4) sets	Watt hour meter for 6.9 kV unit aux. bus, common aux. bus, No. 1 and No. 2 bus tie circuits

4.1.6.3 RECORDER LIST

One (1) set	Watt with var recorder for generator
One (1) set	Temperature recorder for generator stator and gas
One (1) set	Temperature recorder for generator rotor
One (1) set	Operation recorder 60 points

The operation recorder shall be provided for analyzing the causes of accidents.

The chart shall have such a function that the chart paper should be advanced by another 24 hours length by rotating at a high speed when the generator lockout relay or the master fuel oil trip is in operation.

All necessary protective relays, breakers, shutoff valves, etc., shall be provided.

K-227

4.1.6.4 CONTROL SWITCH AND CHANGEOVER SWITCH LIST

(1) Control switch with lamp

Control switches with spring return to normal position marked "trip-close" or "open-close" having, green and red lamps shall be provided.

One (1) set	o	generator breaker
One (1) set	o	6.9 kV unit incoming breaker
One (1) set	o	6.9 kV common incoming breaker
One (1) set	o	6.9 kV bus tie No.1
One (1) set	o	6.9 kV bus tie No.2
One (1) set	o	6.9 kV unit P/C transformer breaker
One (1) set	o	6.9 kV common P/C transformer breaker
One (1) set		400V unit P/C incoming
One (1) set		400V common P/C incoming
One (1) set		400V bus tie No.1
One (1) set	o	No.1 starting transformer breaker
One (1) set		Generator field breaker
Three (3) sets		BFP suction valve
Three (3) sets		BFP discharge value
One (1) set		Seal air booster fan
Two (2) sets		Air heater
Two (2) sets		Heavy oil pump
One (1) set		Inlet valve for feed water control valve
One (1) set		Bypass valve for feed water control valve
Two (2) sets		Gland steam condenser blower
One (1) set		Heavy oil recirculation valve
Three (3) sets		BFP auxiliary oil pump
Two (2) sets		FDF motor

Two (2) sets GRF motor

two (2) sets CWP motor

One (1) set SSR inlet valve

One (1) set SSR bypass valve

One (1) set Other pertinents required for plant operation

Note: o mark indicates that control switch shall be pulled locked at trip or open position.

(2) Control switches with spring return to normal position and pull lock at stop.

Position marked "Trip-Auto-Close" having green, red and white lamps shall be provided.

Three (3) sets BFP motor

Two (2) sets CP motor

One (1) set Other pertinents required for plant operation

(3) Control switches with spring return to normal position and pulled locked at stop position. The switch shall be marked "start-auto-stop", and shall be provided with green and red lamps.

Two (2) sets	Drain pump for feedwater heater
One (1) set	Condenser water box vacuum pump
Two (2) sets	Flame detector and TV cooling fan.
Two (2) sets	Auxiliary oil pumps
One (1) set	Emergency oil pump
One (1) set	Turning system
One (1) set	Other pertinents required for plant operation

(4) Maintained switch (Synchro switch)

Maintained switches with removable handle and two (2) positions marked "Off-On" with handle removable in the "Off" position only shall be provided.

One (1) set	Generator breaker
One (1) set	6.6 kV unit incoming breaker
One (1) set	6.6 kV common incoming breaker
One (1) set	6.6 kV bus tie No.1 breaker
One (1) set	6.6 kV bus tie No.2 breaker
One (1) set	Starting transformer breaker
One (1) set	Other pertinents required for plant operation

(5) Control switch

Control switches with spring return to normal position marked "Lower-Rise" having green and red lamps shall be provided.

One (1) set	Generator field rheostat
One (1) set	AVR manual regulator
One (1) set	Governor control
One (1) set	Load limiter control
One (1) set	Other pertinents required for plant operation

(6) Control switch

Control switch with setter and scale shall be provided.

One (1) set	AVQR setter
One (1) set	PSS setter

(7) Changeover switch

Changeover switches having four (4) positions marked "UV-UW-WV-OFF" or "RS-RT-TS-OFF" shall be provided.

One (1) set	Generator voltmeter
One (1) set	6.9 kV unit aux. bus voltmeter
One (1) set	6.9 kV common aux. bus voltmeter
One (1) set	400V unit power center voltmeter
One (1) set	400V common power center voltmeter
One (1) set	Other pertinents required for plant operation

R-83/

(8) Changeover switch

Changeover switches having four (4) positions marked "U-V-W-OFF" or "R-S-T-OFF" shall be provided.

One (1) set	6.9 kV unit aux. bus ammeter
One (1) set	6.9 kV common aux. bus ammeter
One (1) set	6.9 kV unit power center ammeter
One (1) set	6.9 kV common power center ammeter
One (1) set	Other pertinents required for plant operation

(9) Changeover switch

Changeover switches having four (4) positions marked "Out of Service-Test-In Service shall be provided.

One (1) set	AVR transfer switch

(10) Changeover switch

Changeover switch having two (2) position "USE-DO NOT USE" shall be provided.

One (1) set	AVQR Transfer switch
One (1) set	PSS Transfer switch

(11) Changeover switch

Changeover switches having three (3) positions marked "Close-Auto-Open" with red and green lamps shall be provided.

Three (3) sets	BFP minimum flow valve
One (1) set	Bypass valve for feedwater valve
One (1) set	Boiler PCV
One (1) set	Other pertinents required for plant operation

4.1.6.5 PUSH BUTTON LIST

Push buttons shall be provided.

One (1) set	Turbine reset (master) with red lamp
One (1) set	Turbine trip with green lamp
One (1) set	Power load unbalance protection with red and green lamp
One (1) set	Annunciator test
One (1) set	Annunciator reset
One (1) set	Annunciator flicker stop
One (1) set	Annunciator bell stop
One (1) set	Other pertinents required for plant operation

4.1.6.6 LAMP AND RESISTANCE LIST

(1) Green and red lamps shall be provided.

One (1) set	Disconnecting switch for starting transf. of 220 kV/grid station
Two (2) sets	CWP discharge valve
Three (3) sets	BFP discharge valve
Two (2) sets	CP discharge valve
Two (2) sets	MSV
Two (2) sets	CRV
One (1) set	SH spray valve
One (1) set	RH spray valve
One (1) set	Other pertinents required for plant operation

4.1.6.7 RELAY LIST

The following relays shall be provided.

Three (3) sets Generator differential relay (87G1)

The differential relay shall be of the high speed variable percentage increase type for operation at approximately 10% unbalance current.

Three (3) sets Generator backup relay (44G1)

The relays shall be for main circuit backup (between the generator and the generator breaker), and shall consist of an impedance unit.

One (1) set Negative phase sequence relay (46G1)

Negative phase sequence time overcurrent relay shall be provided for generator unbalanced fault protection, and shall consist of an induction overcurrent unit controlled by voltage unit.

One (1) set Loss of excitation relay (40G1)

Loss of excitation relay shall consist of a directional unit and an offset impedance unit.

One (1) set Ground over-voltage relay (64G1)

The ground over-voltage relay shall be of low pick up over-voltage induction type.

One (1) set Voltage balance relay (60G1)

The voltage balance relay shall be provided to prevent incorrect operation of the voltage regulator and protective relay when a potential transformer fuse burns out.

Three (3) sets Generator transformer differential relay (87GT1)

The differential relay shall be of the high speed, single phase variable percentage ratio type with harmonic restraint. The relays shall be inoperative on transformer magnetizing inrush currents and operative on differential zone faults.

One (1) set V/F relay

V/F relay shall be provided for the generator and the main transformer to prevent over-excitation.

One (1) set Frequency relay (91L1, 91H1)

Frequency relay shall be provided for turbine-generator high-low speed during operation.

Two (2) sets Main transformer neutral overcurrent relay (51N-MT1), and starting transformer neutral overcurrent relay (51N-ST1)

The transformer neutral overcurrent relay shall be provided for backup protection, and shall be of the induction type and single phase.

One (1) set — Lock-out relay for generator (86G)

This relay shall be a hand-reset lock-out relay with twelve (12) normal open contacts and six (6) normal close contacts to enable tripping required to shutdown the generator, isolate the auxiliary buses and perform such alarm functions and other trip functions to take the turbine generator out of service as may be required.

Six (6) sets — Auxiliary transformer differential relay (87AT1) and starting transformer differential relay (87ST1)

The relay shall be of the high speed, single phase variable percentage ratio type with harmonic restraint. The relays shall be inoperative on transformer magnetizing inrush current and operative on differential zone faults.

Six (6) sets — Backup overcurrent relay for auxiliary transformer (51AT1) and starting transformer (51ST1)

This relay is for backup protection and shall be of the induction type and single phase.

Two (2) sets — Ground over-voltage relay for auxiliary transformer low tension circuit (64AT1) and starting transformer low tension circuit (64ST1).

This relay shall be of the low pickup over-voltage induction type.

One (1) set Lock-out relay for starting transformer (86ST1)

This relay shall be a hand-reset lock-out relay with twelve (12) normal open contacts and six (6) normal close contacts to enable tripping required to shutdown the starting transformer, isolate the common auxiliary bus, 220 kV grid station and perform such alarm functions and trip functions to take the starting transformer out of service as may be required.

One (1) set Synchronizing check relay (25)

This relay is for synchronizing check of 6.9 kV incoming and bus tie circuit and generator synchronizing, and shall be of the static and voltage comparison type.

One (1) set Other pertinents required for plant operation

4.1.6.8 ANNUNCIATOR LIST

Annunciator windows shall have at least the following numbers.

Boiler section	112
Turbine section	112
Generator section	60
Common section	60
Computer section	8

4.1.6.9 OTHER INSTRUMENT AND CONTROL DEVICE LIST

The following instruments and devices shall be provided in order to control and supervise the boiler, turbine and common equipment, but shall not be limited to the items below.

(1) Indicator

One (1) set	N gas pressure
One (1) set	N gas pressure (after FV)
One (1) set	N gas flow
One (1) set	Heavy oil service tank level
One (1) set	Heavy oil temperature
One (1) set	Heavy oil pressure
One (1) set	Heavy oil pressure (after FV)
One (1) set	Atomizing steam pressure
One (1) set	Heavy oil flow
Two (2) sets	FDF outlet draft
Two (2) sets	GRF outlet draft
Two (2) sets	GRF inlet draft
One (1) set	Ignition oil pressure
Two (2) sets	AH outlet air draft
Two (2) sets	Windbox - furnace differential draft
One (1) set	Furnace draft
One (1) set	Economizer outlet draft
One (1) set	Economizer inlet feedwater pressure
One (1) set	Economizer inlet feedwater temperature
Two (2) sets	AH differential gas draft
One (1) set	Drum level
One (1) set	Drum pressure
One (1) set	Main steam master pressure

One (1) set	Main steam master temperature
One (1) set	Bearing oil pressure
One (1) set	Hydraulic oil pressure
One (1) set	Gland steam pressure
One (1) set	Turbine and generator vibration (Digital)
One (1) set	Condenser vacuum
One (1) set	Hot-well level
One (1) set	Reheat steam master temperature
One (1) set	Boiler outlet steam pressure
One (1) set	Deaerator pressure
One (1) set	Deaerator level
Three (3) sets	BFP speed (Digital)
One (1) set	Feedwater flow
One (1) set	Cooling tower water basin level
One (1) set	Feedwater pressure
One (1) set	Superheater spray water flow
One (1) set	Turbine bowl pressure
One (1) set	Steam CV chest pressure
One (1) set	Turbine first stage pressure
One (1) set	Reheater spray water flow
One (1) set	Hot reheat pressure
One (1) set	Cooled reheat pressure
One (1) set	Turbine speed
One (1) set	Other pertinents required for plant operation

(2) Recorder

One (1) set	Heavy oil and air flow
One (1) set	Flue gas O_2 and CO
One (1) set	Steam pressure/temperature (SH and RH)
One (1) set	Feedwater flow/drum level/main steam flow
One (1) set	Wind direction and speed
Two (2) sets	Trend recorder
One (1) set	Other pertinents required for plant operation

(3) Control device

One (1) set	Selector stations and manual loader for automatic boiler control
One (1) set	Control panel (insertion type) for automatic burner control
One (1) set	Control panel (insertion type) for EHC governer control
One (1) set	Test panel (insertion type) for turbine valve
One (1) set	Unit master control

(4) CRT

One (1) set	CRT (Cathode Ray Tube)

4.2 DISTRIBUTION PANEL

4.2.1 APPLICABLE STANDARDS AND CODES

The International Electrotechnical Commission (IEC) standards shall be applied generally for electrical apparatuses, and more detailed specifications shall be in accordance with "Panels and Boards" in Clause 2.1 in Section II of Part I.

4.2.2 SCOPE OF SUPPLY

The following distribution panel and accessories shall be provided, but not be limited to the followings.

(1) For Unit No. 1

One (1) set	AC 220V No.1 normal and emergency lighting distribution panel
One (1) set	AC 220V No.1 instrument power distribution panel
One (1) set	DC 220V No.1 distribution panel
One (1) set	AC 380 and 220V No.1 miscellaneous distribution panel
One (1) set	AC 220V No.1 lighting distribution panel
One (1) set	AC 380V and 220V administration building distribution panel
One (1) set	Laboratry distribution panel

(2) One (1) set — AC 220V No.2 normal and emergency lighting distribution panel

One (1) set — AC 220V No.2 instrument power distribution panel

One (1) set — DC 220V No.1 distribution panel

One (1) set — AC 220V No.2 lighting distribution panel

4.2.3 TECHNICAL INFORMATION

The distribution panel shall be provided to supply the power source to instruments, control equipment, site work, etc., of the power station.

4.2.3.1 TYPE

Indoor, drip-proof, self standing, metal clad.

4.2.3.2 RATING

(1) Unit No. 1

(a) No.1 normal and emergency lighting distribution panel

Panel

Voltage	220V
Phase and wire	3φ 4 W
Bus current	400 A
Molded type air circuit breaker	
Number	20
Rating	600V, 2P, 50AF

Transformer

Type	Dry
Capacity	30 kVA
High tension side	400V

Low tension side	220V
No load, no voltage tap	± 5%
Insulation class	H

(b) No.1 instrument power distribution panel

Panel

Voltage	220V
Phase	1φ, 3W
Bus current	400 A
Molded type air circuit breaker	
Number	30
Rating	600V, 2P, 100AF

Transformer

Type	Dry
Capacity	* kVA
Voltage	
High tension side	400V
Low tension side	220V
No load, no voltage tap	± 5%
Insulation class	H

(c) DC 220V No.1 distribution panel

Panel

Voltage	220V
Bus current	400 A
Molded type air circuit breaker	
Number	30
Rating	600V, 2P, 100AF, x 25
	600V, 2P, 225AF, x 5

(2) Common

(a) AC 380 and 220V No. 1 miscellaneous distribution panel

Panel

Voltage	380-220V
Phase and wire	3φ, 4 W
Bus current	800 A
Molded type air circuit breaker	
Number	100A x 40
	225A x 20
Rating	600V, 2P, 100A
	600V, 3P, 100A
	600V, 3P, 225A

Transformer

Type	Dry
Capacity	300 kVA
Voltage	
High tension side	400V
Low tension side	380-220V
No load, no voltage tap	± 5%
Insulation class	H

(b) No.1 lighting distribution panel

Panel

Voltage	220V
Phase and wire	3φ, 4 W
Bus current	400 A
Molded type air circuit breaker	
Number	16 or more
Rating	600V, 3P, 100AF

Transformer

Type	Dry
Capacity	100 kVA
High tension side	400V
Low tension side	220 V
No load, no voltage tap	± 5%
Insulation class	H

(c) Administration duilding distribution panel

Panel

Voltage		380-220V	
Phase and wire		3φ,4W	
Bus current		400 A	
Molded type air circuit breaker			
Number	5	10	15
Rating	600V,2P,100AF	600V,2P,50AF	600V,2P,30AF

Transformer

Type	Dry
Capacity	150 kVA

Voltage

High tension side	400V
Low tension side	380-220V
No load, no voltage tap	± 5%
Insulation class	H

(d) Laboratry distribution panel

Panel

Voltage	220-110V
Phase and wire	3φ, 4W
Bus current	400 A

Molded type air circuit breaker

Number	5	10	15
Rating	600V,2P,100AF	600V,2P,50AF	600V,2P,30AF

Transformer

Type	Dry
Capacity	50 kVA

Voltage

High tension side	400V
Low tension side	220-110V
No load, no voltage tap	± 5%
Insulation class	H

4.2.3.3 SHOP TEST

The shop tests shall be as follows, but not be limited to the items below.

(1) Panel

Construction test

Meggering

Withstand voltage test

Circuit test

(2) Transformer

Withstand voltage test

Measurement of winding resistance

Measurement of transformer ratio

Polarity test

Angular displacement test

Impedance test

Temperature test

4.2.4 CONSTRUCTION

4.2.4.1 AC DISTRIBUTION PANEL

The AC distribution panel shall be provided, and shall consist of a distribution panel with a built-in molded type air circuit breaker and a cubicle with a built-in transformer.

(1) Distribution panel

The distribution panel shall be of an assembled construction of 1.6 - 3.2 mm thick steel plate and frame, and shall have built-in bus conductor and molded type air circuit breaker with alarm contact. The distribution panel shall have a hinged door with stopper and handle with key at its front, and the rear part shall be of the removable bolt type.

A protective plate shall be attached inside the panel so as to separate the bus conductors, and the distribution panel shall be of a construction which facilitates easy operation of the molded type air circuit breakers.

For the bus conductors, insulated copper or aluminum bar shall applied, and the contact surfaces of the joined parts for the bus conductor shall be silver-plated. The conductor shall firmly be joined mechanically and electrically.

Insulation materials excellent in mechanical and electrical properties shall be applied for the bus conductor supports, and the supports shall firmly hold and sufficiently withstand the electromagnetic force produced at the time of bus short circuit.

The terminal board shall be mounted inside the rear side of the panel, and insulated wire shall be applied between the terminals and the molded type air circuit breakers. The cable shall be drawn out from the upper part and shall be connected with the cable tray by means of a vertical shaft.

For the terminal for the cable, a compression type terminal of more than 125 mm^2 and a crimp type terminal of 125 mm^2 or less shall be provided. In addition, a set of grounding terminals of 50 mm^2 shall be provided on both sides.

(2) Transformer cubicle

The transformer cubicle shall have a built-in transformer for the distribution panel.

The cubicle shall have a construction in consideration of heat radiation.

The cubicle shall have at its front door a handle with key and stoppers. The door shall be of a construction facilitating supervision from outside of the transformer winding temperature meter, and the cubicle shall have a removable plate at its rear part.

Inside the cubicle, a guide rail with stopper lug for drawing in and drawing out the transformer, and a supporter for the high tension side cable shall be provided.

(3) Transformer

The transformer shall be connected with the V power center and control center, respectively. The transformer shall supply power to the respective distribution panels. Construction of the main components of the transformer shall be in accordance with the following.

(a) Construction of steel core material

For the steel core materials, cold rolled directional silicone steel plate excellent in magnetic property shall be applied. The exciting current loss shall be reduced as much as possible, and measures shall be taken to reduce the winding eddy current loss and the stray load loss.

Magnetic and mechanical connections shall be completely provided, and no load current and noise shall be reduced as much as possible.

(b) Construction of winding material

For the component wires, high purity electric copper sufficiently heat treated shall be provided.

Sufficient insulation between the component wires and transposition shall be provided, and sufficient consideration to insulation between layers and layers, winding and grounding shall be given.

As a measure against surge voltage, the internal potential distribution of the winding shall be kept at a uniform level, and consideration shall be given to the prevention of internal potential vibration.

(c) Insulation material

The insulation material shall be excellent in dielectric strength, corona-proof property, heat-proof property, moisture-proof property and dust-proof property. In addition, the material having large heat conductivity and large mechanical strength shall be applied, and sufficient attention shall be taken at the time of manufacture.

(d) Tap changer

The tap changer shall be of the no load, no voltage type, and applied for easy and precise changeover of taps inside the cubicle.

It shall have sufficient mechanical and electrical strength.

The tap changer shall have a tap position indicator.

(e) Connection

The high tension side of the transformer shall have a construction facilitating easy connection of the outside cable. The low tension side of the transformer shall directly be connected with the distribution panel by means of a bus bar, and it shall have a construction enabling absorption of vibration of the transformer.

(f) Accessory

The following accessories and the ones required shall be supplied.

a. Winding temperature indicator

The winding temperature indicator shall be of the dial type and shall be attached at a position enabling supervision from outside of the cubicle.

b. Over-current ground relay

The over-current ground relay shall be attached on the front door of the transformer cubicle.

c. Current transformer

The current transformer shall be of the through-type, and shall be installed on the transformer low tension circuit which shall detect ground fault current on the over-current relay at the time ground occurs in the circuit.

d. Grounding lug

For grounding lug, one (1) set of 50 mm^2 clamp type terminals shall be mounted on the transformer structure.

e. Lifting lug

Sufficient attention shall be paid to the mounting position of the lifting lugs so as to facilities easy transport and installation of the transformer.

4.2.4.2 DC DISTRIBUTION PANEL

The DC distribution panel shall have built-in molded type air circuit breakers with alarm contact, and shall be directly connected with the DC control center bus.

The construction of the distribution panel shall be the same as that of the AC distribution panel.

4.2.4.3 NAME PLATE, NUMBER PLATE

(1) Name plate, number plate

The following name plates and number plates shall be placed at the prescribed positions.

(1) Name plate

The name plate shall be placed on the upper side of the front and rear surfaces of the doors for distribution panel and molded type circuit breakers.

(2) Number plate for molded type air circuit breaker

The circuit breakers shall be numbered 1, 2, 3, ..., continuous from the left side, and A, B, C, ..., continuous from the upper side.

4.2.4.4 SPARE CIRCUIT BREAKER

Five (5) sets of spare circuit breakers shall be provided.

K-4-53

4.3 AUXILIARY CONTROL PANEL

4.3.1 APPLICABLE STANDARDS AND CODES

The International Electrotechnical Commission (IEC) standards of Latest edition shall be applied generally for electrical apparatuses, and more detailed specifications shall be in accordance with "Panels and Boards" in Clause 2.1 in Section II of Part I.

4.3.2 SCOPE OF SUPPLY

The following auxiliary control panel and accessories shall be supplied, but not be limited to the followings.

One (1) set	Auxiliary control panel for Unit No.1
One (1) set	Auxiliary control panel for Unit No.2

4.3.3 *TECHNICAL INFORMATION*

The panel shall be installed inside the central control room on the operating floor.

The auxiliary control panel shall be designed to facilitate easy and precise operation, control and supervision of the boiler and turbine and common equipment during normal and starting up operation and to provide countermeasures in case of emergency.

The air conditioning system shall be provided in the central control room to control the temperature and humidity at uniform values.

4.3.3.1 TYPE

Indoor, drip-proof, self standing, metal clad.

4.3.3.2 FRONT AND REAR VIEW OF AUXILIARY CONTROL PANEL

For detail arrangement of Unit No.1 auxiliary control panel,

4.3.3.3 SHOP TEST

The shop tests shall be as follows, but shall not be limited to the items below. The tests shall be carried out in the presence of the Engineer.

Construction test

Meggering

Withstand voltage test

Sequence test

Characteristic test

Accuracy test

Synthesis operation test

4.3.4 CONSTRUCTION

The panel shall be of a welded construction using 3.2 mm thick steel plate, and the panel shall have on both sides a hinged door with a stopper and a handle with key.

At the front of the panel, an operation and supervising panel having a meters, control switches, changeover switches, signal lamps, instruments, recorder, etc., shall be provided.

At the side, manometer and barometer shall be attached.

4.3.4.1 DUCT

As a considerably large number of control cables have to be inserted upward vertically in the board, a duct with sufficient capacity shall be installed, and sufficient space for connecting the cables as well as for terminal treatment shall be provided.

4.3.4.2 CABLE ENTRY

Drawing out of the cables shall be carried out at the bottom part of the panel.

4.3.4.3 GROUNDING TERMINAL

One (1) set of grounding terminals of the 38 mm^2 clamp type shall be provided on each side of the panel.

4.3.4.4 SEALING PLATE

The sealing plate shall be set at the cable draw out hole at the bottom part of the panel so as to maintain airtightness of the central control room.

4.3.5 ACCESSORIES ON AUXILIARY CONTROL PANEL

4.3.5.1 INDICATING LAMP (RED AND GREEN)

Two (2) sets	Service air compressor operation
Two (2) sets	Instrument air compressor operation
One (1) set	Water treatment equipment operation
One (1) set	Waste water plant operation
One (1) set	Chrolination equipment operation
One (1) set	Tube cleaning system operation
One (1) set	Other pertinents required for plant operation

4.3.5.2 INSTRUMENTS AND CONTROL DEVICE

The following instruments and devices shall be provided for the boiler, turbine and common equipment, but shall not be limited to the items below.

(1) Indicator

One (1) set	Instrument air pressure
One (1) set	Service air pressure
One (1) set	Soot blowing steam pressure
One (1) set	Condenser vacuum guage (manometer)
Two (2) sets	Auxiliary steam pressure
Two (2) sets	Make up water storage tank level for No.1 and No.2
Two (2) sets	Service water storage tank level
One (1) set	Thermoprobe temperature
One (1) set	Drum continuous blowdown valve
Two (2) sets	Boiler drain valve
One (1) set	Other pertinents required for plant operation

(2) Recorder

One (1) set	Boiler water quality (conductivity)
One (1) set	Boiler water quality (PH)
One (1) set	Boiler water quality (Dissolved O_2, residual hydrazine)
One (1) set	Turbine casing metal temperature
One (1) set	Turbine vibration and speed
One (1) set	Turbine eccentricity, CV position and expansion
One (1) set	Turbine-generator bearing temperature

One (1) set	Other pertinents required for plant operation

(3) Control device

One (1) set	Soot blowing control panel (insertion type)
One (1) set	Other pertinents required for plant operation

(4) Control switch

Control switch with spring return to normal position marked "OPEN-CLOSE" or "TRIP-CLOSE" having red and green lamps shall be provided.

Six (6) sets	Cooling tower fan
One (1) set	Drum vent valve
One (1) set	Auxiliary steam (from boiler) shutoff valve
One (1) set	Auxiliary steam (for SAH) shutoff valve
One (1) set	Auxiliary steam (for ejector and SSR)
One (1) set	Auxiliary steam (from dearerator)
One (1) set	Auxiliary steam (for cooled reheat)
One (1) set	MSV seat drain valve
One (1) set	Condenser vacuum braker valve
One (1) set	Deaerator blow valve
One (1) set	Upstream deaerator level control valve
Two (2) sets	Make up water transfer pump
One (1) set	Thermoprobe
One (1) set	Drum continuous blow down valve
One (1) set	Final SH outlet drain valve
One (1) set	Main steam pipe drain valve

Three (3) sets	HP heater extraction steam inlet valve
One (1) set	HP heater feedwater outlet valve
Two (2) sets	SH header inlet drain valve
One (1) set	SH header outlet drain valve
Three (3) sets	HP heater drain valve for extraction steam inlet valve
One (1) set	HP heater feedwater bypass valve
One (1) set	Soot blowing steam shutoff valve
One (1) set	Burner atomizing steam shutoff valve
One (1) set	Other pertinents required for plant operation

(5) Control switch

Control switch with spring return to normal position marked "OPEN-CLOSE" and having lamps shall be provided.

One (1) set	MSV drain valve with four lamps, two (2) red and two (2) green
One (1) set	Combined reheat valve seat drain valve with two (2) lamps, one (1) red and one (1) green
One (1) set	HP and IP turbine casing drain valve with two (2) lamps, one (1) red and one (1) green
One (1) set	Other pertinents required for plant operation

4.4 AUXILIARY RELAY PANEL

4.4.1 APPLICABLE STANDARDS AND CODES

The International Electrotechnical Commission (IEC) of latest edition standards shall be applied generally for electrical apparatuses, and more detailed specifications shall be in accordance with "Panels and Boards" in Clause 2.1 in Section II of Part I.

4.4.2 SCOPE OF SUPPLY

The following auxiliary relay panel and accessories shall be supplied, but not be limited to the followings.

One (1) set	Auxiliary relay panel
One (1) set	Auxiliary relay panel

4.4.3 TECHNICAL INFORMATION

The auxiliary relay panel shall consist of the auxiliary relays, timers, terminal blocks and other pertinents required for the control circuit for the auxiliary equipment.

The auxiliary relay panel shall be installed in the control equipment room for Unit No.1 and No.2. This room shall be furnished with air conditioning.

4.4.4 TYPE OF AUXILIARY RELAY PANEL

Indoor, self standing and metal clad.

Height: 2,350 mm (including channel base of 50 m)

4.4.5 CONSTRUCTION

The stationary structure shall be of welded construction using steel plate with a thickness of 3.2 mm.

The panel shall be completely gas-tight and of a construction having no exposed parts.

In front of the stationary structure, there shall be a hinged panel with stopper and a handle with key.

The auxiliary relays and timers shall be attached on the surface of the panel, in principle. All wiring inside the panel shall be carried out by using ducts.

(1) Ducts

As a considerable large number of control cables have to be inserted upward vertically and horizontally in the panel, ducts with sufficient capacity shall be installed, and sufficient space for connecting the cables and for terminal treatment shall be provided.

(2) The cables shall be drawn out from the lower part of the cubicle, and the cable supports shall be provided wherever necessary.

(3) Grounding terminal

Two (2) grounding terminals shall be provided at the stationary structure.

Size of grounding terminal: 38 mm^2

4.5 SUBSTATION MONITORING PANEL

4.5.1 APPLICABLE STANDARDS AND CODES

The following codes of newest edition shall be applied:

International Electrotechnical Commisssion (IEC)

Also, other pertinent International standards shall be applied generally for Electrical Apparatuses, and more detailed specification shall be in accordance with "Panel and Board" in Clause 2.1 in Section II of Part I.

4.5.2 SCOPE OF SUPPLY

The following supervising panel for 220 kV and 132 kV switchyard and accessories shall be supplied.

One (1) set Substation monitoring panel

4.5.3 TECHNICAL INFORMATION

The monitoring panel for substation which indicates the conditions of the circuit breakers and disconnecting switches for the 220 kV and 132 kV switchyard, along with buscs voltage and frequency shall be supplied and installed in the central control room.

Since circuit breakers are operated after confirming the conditions of the 220 kV switchyard at the time of synchronizing the generators for Units No.1 and No.2, it shall be made possible to ensure precise operation and readily detect the conditions of the system at the same time.

The control panel of the 220 kV and 132 kV switchyard bus and transmission for Baldia has been installed in the substation control room.

The air conditioning equipment shall be installed in the central

control room in order to control the temperature and humidity at uniform values.

4.5.3.1 TYPE

Indoor use drip-proof, self-standing and metal clad.

4.5.3.2 ARRANGEMENT OF PANEL

In regard to the external shape of the panel, refer to the attached drawing.

4.5.3.3 MANUFACTORY TEST

The items of manufactory test shall be as follows, but not be limited and the tests shall be in the presence of the Owner and/or the Engineer.

Construction test

Meggering

Withstand voltage test

Sequence test

4.5.4 CONSTRUCTION

The panel shall be of a welded construction using 3.2 mm thick steel palte, and the panel shall have on both sides a hinged door with a stopper and a handle with key.

The supervising panel with, signal lamps, mimic buses, volt meters, volt and frequency recorders name plates and necessary pertinents, shall be provided.

4.5.4.1 DUCTS

As a considerably large number of control cables have to be inserted vertically and horizontally in the board, ducts with

sufficient capacity shall be installed, and sufficient space for connecting the cables as well as for terminal treatment shall be provided.

4.5.4.2 CABLE ENTRY

Drawing out of the cables shall be carried out at the bottom part of the panel.

4.5.4.3 GROUNDING TERMINAL

Two sets of grounding terminals of 38 mm^2 crimp type shall be provided.

4.5.4.4 SEALING PLANT

A sealing plate shall be set up at the cable draw-out hole at the bottom part of the panel in order to maintain airtightness of the central control room.

4.5.5 SCOPE OF SUPPLY AND ERECTION

The Contractor of Lot-1 shall be responsible for supply, installation, and wiring and terminal connection of the supervising panel between the substation monitoring panel and the substation control panel.

5. EMERGENCY DIESEL ENGINE GENERATOR

5.1 EMERGENCY DIESEL ENGINE GENERATOR

5.1.1 APPLICABLE STANDARDS AND CODES

The following applicable standards and codes of latest edition shall be applied.

International Electrotechnical Commission (IEC)

IEC-34 "Rotating electric machine"

Other pertinent International Electrotechnical Commission (IEC) standard and/or equivalent shall be applied generally for electrical machinaries and apparatuses, and more detailed specifications shall be in accordance with "Panels and Boards" in Clause 2.1 Section II of Part I.

5.1.2 SCOPE OF SUPPLY

The following diesel engine driven generator with accessories shall be provided, but not be limited to the followings.

One (1) set	Diesel engine and generator with accessories

5.1.3 TECHNICAL INFORMATION

The diesel engine generator shall be provided for supplying emergency power for Units No.1 and No. 2 and shall supply safety shutdown and preservation power in case of shutdown of all of the units.

The following emergency auxiliary load shall be applied so as to determaine the capacity of diesel engine genenrator but not be limited to the followings

Seal oil pump

Seal oil recirculation pump

Turning gear oil pump

Seal oil vacuum pump

Vapor extractor

Flame detector cooling fan

Batt. room exh. fan

D/G aux. equipment

Unit battery charger

Switchyard battery charger

Paging equip.

Normal emergency lighting

Obstruction lighting

Instrument power source

Turning gear

Elevator

The control system for the diesel engine generator shall be designed to provide automatic and manual start and stop. The automatic start control system shall be provided to start the engine by receiving the signal from each control center when in case of power failure in 400V 1-3 control center or 400V 2-3 control center . However, engine stop shall be provided manually.

The main circuit breaker for the generator shall be automatically closed after confirming the rated speed of the engine and rated voltage of the generator.

The power source for auxiliary machines shall be supplied from the 400V 1-3 control center or the 400V 2-3 control center with

changeover switch .

5.1.3.1 TYPE

(1) Generator

Indoor, horizontal, diesel engine driven, air cooled, three-phase, three (3) wire synchronous generator.

(2) Diesel engine

Indoor, horizontal, radiator-cooled, direct fired, four (4) cycle diesel engine.

5.1.3.2 RATING

(1) Generator

Class of rating	Continuous
Capacity	* kVA
Power factor	0.85 (lagging)
Voltage	400V
Frequency	50 Hz
Phase and wire	3ϕ 3 W
Pole	4 or 6
Connection	Wye
Speed	1,000 RPM or 1,500 RPM
Excitation system	Static self-excited
Automatic voltage regulator	Static
Voltage adjustment	$\pm$10%
Insulation class	B or F (Temp. Brize)
Overload capacity	110% one (1) hour

(2) Diesel engine

Combustion system	Direct fired system
Noise level	90 dB (A)
Starting system	Automatic starting by compressed air
Starting time from starting signal to full speed	Less than 40 second
Fuel	

5.1.3.3 SHOP TEST

The shop tests shall be as follows, but shall not be limited to the items the tests shall be in the carried out of the Engineer.

(1) Generator

Construction test

Rotation test

Measurement of coil resistance

No load saturation test

Short circuit test

Measurement of each loss

Measurement of each reactance

Temperature test

Withstand voltage test

Overload test

Overspeed test

(2) Diesel engine

Construction test

Rotation test

Firing test

Automatic starting test

Governor test

(3) Control panel

Construction test

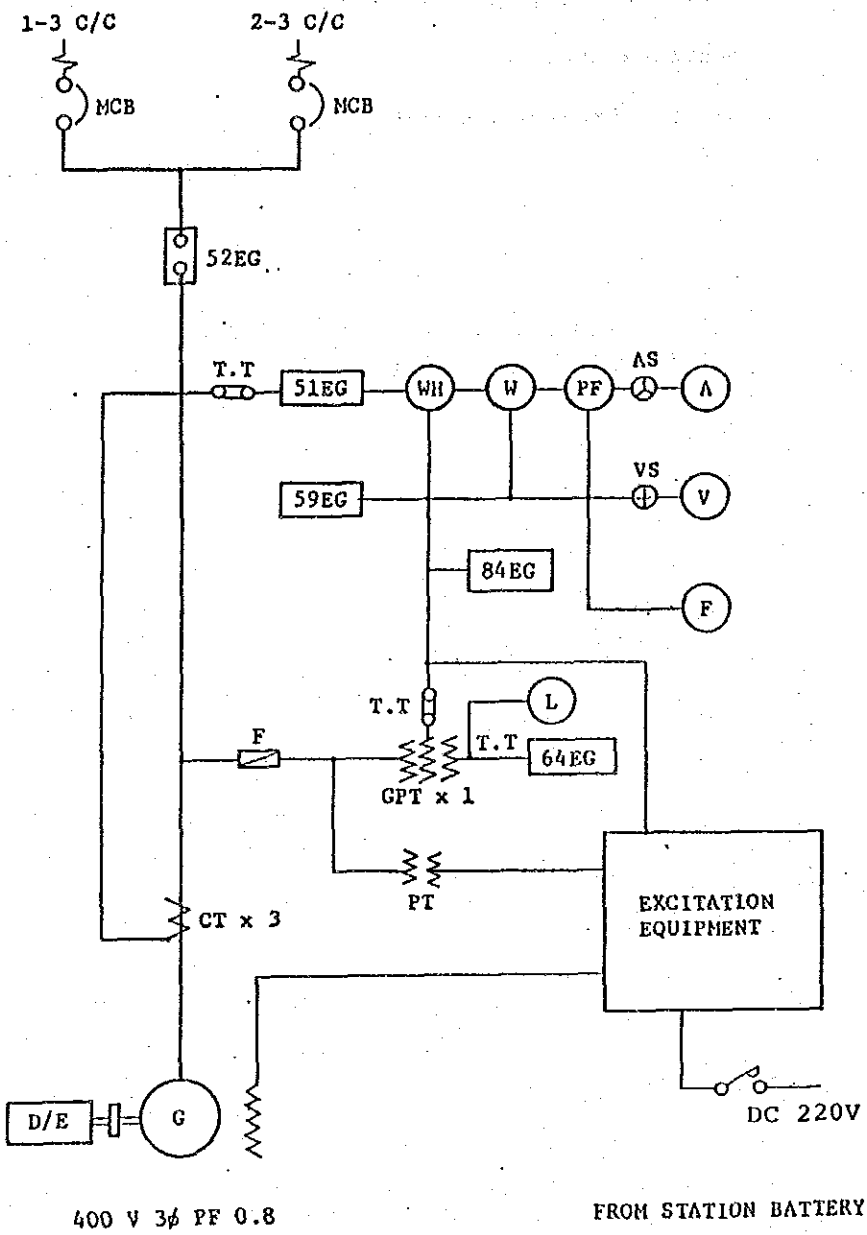
Meggering

Withstand voltage test

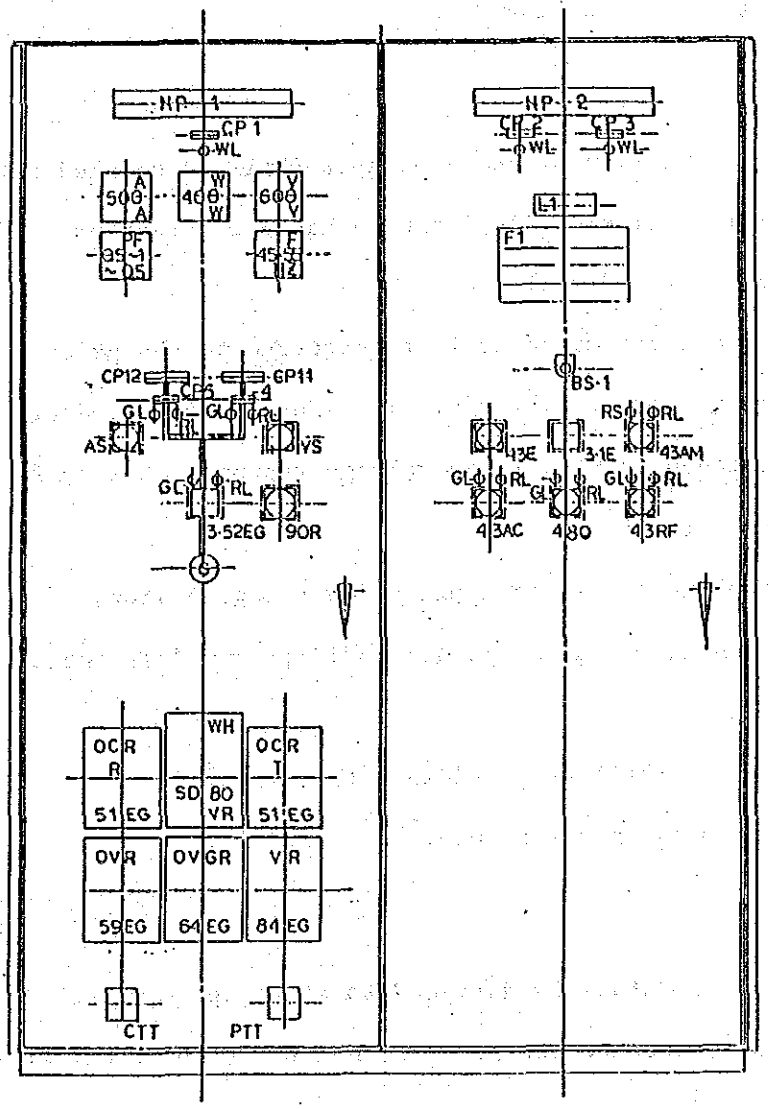
Sequence test

Circuit breaker operation test

5.1.3.4 ONE LINE DIAGRAM



5.1.3.5 TYPICAL FRONT VIEW OF CONTROL PANEL



NP1 NAME PLATE (EMERGENCY DG PANEL)
NP2 NAME PLATE (AUTO. START PANEL)
F1 ANNOUNCIATOR
BS ANNOUNCIATOR RESET BUTTON
VS CHANGEOVER SWITCH (VOLTAGE)
90R CONTROL DIAL (AVR SET)
AS CHANGEOVER SWITCH (CURRENT)
43ET CHANGEOVER SWITCH (AUTOMATIC MANUAL FOR ENGINE START)
3-1EG CONTROL SWITCH (ENGINE)
43AC CONTROL SWITCH (AIR COMPRESSOR)
RL LOCK OUT RELAY
43FM CONTROL SWITCH (COOLING FAN)
TT TEST TERMINAL
CTT13 TEST TERMINAL
PTT14 TEST TERMINAL
YS NAME PLATE
16 ACB
3-52EG CONTROL SWITCH (52EG)
43O PRIMING PUMP CONTROL SWITCH
43AM AUX. MACHINE POWER SOURCE CHANGE

5.1.4 CONSTRUCTION

As the diesel engine produces large vibration, sufficient countermeasures shall be taken.

In addition, as very heavy loads are momentarily transferred to the generator, sufficient consideration shall be paid to the flywheel effect of the engine.

5.1.4.1 GENERATOR

Design and fabrication of the generator shall be carried out in consideration of electrical and mechanical strengths of the stator coil and field coil.

When heavy loads are momentarily transferred to the generator, voltage drop becomes very large. Therefore, the generator shall be designed to have large voltage response ability for the exciting circuit.

As an air cooling system is applied for the generator, sufficient countermeasures against humidity and dust shall be provided.

The space heater shall be provided with sufficient countermeasures against moisture.

5.1.4.2 DIESEL ENGINE

The diesel engine shall be designed to start up by means of compressed air, and the engine shall not be troubled due to instant heavy load.

The cooling of the engine shall be provided by a closed system, and that of the radiator, by means of forced air.

(1) Engine control device

The engine control device shall be attached near the engine and shall consist of manual and magnetic valves for start and stop, governor, instrument gauges, pressure gauges, pressure switches, etc.

(2) Lubrication oil system

The lubrication oil system shall be provided to supply oil to the engine and generator through the oil cooler and filter by means of the oil pump directly coupled to the engine.

(3) Air compressor equipment

The air compressor equipment shall consist of an air compressor, an air tank, pipe, etc., and shall be provided for the air source of diesel engine starting.

(a) Air compressor

The air compressor shall be designed to automatically start and stop at a pre-set air pressure.

The driving motor shall be three-phase, 380V, 50 Hz. For further details, refer to "Standard of Electric Motor" in Clause 2.2 Section II of Part I.

(b) Air tank

The air tank shall be of the vertical cylinder type and manufactured by welded steel plate. Two (2) tanks, one for normal use and one for emergency use, shall be provided.

The air tank shall have a sufficient strength against the applied maximum pressure, and shall have a drain valve at its bottom.

The air tank shall have the capacity required for providing three (3) times the amount of air for automatic start and seven (7) times for manual start.

(4) Fuel oil tank and structure

The fuel oil tank shall be of an outdoor type and shall have sufficient storage capacity required for three (3) hours of operation of the diesel engine generator.

The fuel oil tank shall be installed on the supporting structure and shall have a hand operating pump, pipes, valves, level gauges, etc., for oil make up.

(5) Exhaust System

The exhaust system shall be provided to exhaust the engine gas outside through a pipe, and the exhaust outlet shall be located by 20 m above the ground.

The silencer shall be provided and shall have a capacity to control the noice level within 90 db (A).

(6) Radiator

The radiator shall be of the outdoor type and applied for cooling the diesel engine cooling water.

As the cooling water is obtained from the cooling water line inside the power station, necessary valves, pipes, etc., shall be provided.

The motor of the cooling fan shall be three-phase, 380V, 50 Hz, Refer to "Standard of Electric Motor" in Clause 2.2 Section II of Part I.

5.1.4.3 CONTROL PANEL

The control panel shall be of the indoor, drip-proof, self standing and metal clad type, and shall be used for control and supervision of the diesel engine, generator, circuit breaker and auxiliary machines.

The control panel shall consist of a diesel engine generator control panel and an air circuit breaker panel.

(1) Control panel for emergency diesel engine generator

Front panel of this control panel shall be provided with meters, control switches, changeover switches, relays, a lockout relay, signal lamps, annunciators, etc.

The panel inside shall contain the excitation equipment, relays, etc. A door shall be attached on each side of the panel.

(2) Control panel for auxiliary

The control panel for auto start shall have an air circuit breaker for the generator at the lower part and molded case air circuit breakers for each unit feeder at its upper part.

For further details regarding air circuit breaker for the generator, refer to Item 3.2.

The molded case air circuit breaker with alarm contact shall be designed for front panel operation.

The outside cables shall be able to be drawn out in an upward direction.

(3) Annunciator

The following annunciators, but not limited to those below, provided to indicate each fault on the engine control panel. However, group faults shall be indicated on the BTG board.

Cooling water high temperature

Lubrication oil low pressure

Overspeed

Engine running

Engine start failure

Low air pressure

Fuel oil tank low level

Generator ground

Generator over-current

Generator over-voltage

Note: The following indication (annunciator) shall be mounted on the BTG board.

. Engine running

. Changeover switch for engine start is in manual position

6. BATTERY AND BATTERY CHARGER

6.1 STATION BATTERY AND BATTERY CHARGER

6.1.1 APPLICABLE STANDARDS AND CODES

The following applicable standards and codes of latest edition shall be applied.

International Electrotechnical Commission (IEC)

IEC - 86 "Primary batteries"

IEC-335-2-29 "Particular requirement for battery changer"

Other pertinent International Electrotechnical Commission standard (IEC) and/or equivalent shall be applied generally for electrical apparatuses, and more detailed specifications shall be in accordance with "Standards of Panels and Boards" in Clause 2.1 Section II of Part I.

6.1.2 SCOPE OF SUPPLY

The following battery, battery charger and accessories shall be provided, but not be limited to the followings.

One (1) set	DC 220V station battery and battery charger with accessories for Unit No.1
One (1) set	DC 24V station battery and battery charger with accessories for Unit No.1
One (1) set	DC 48V station battery and battery charger with accessories for PABX
One (1) set	DC 220V station battery and battery charger with accessories for Unit No.2
One (1) set	DC 24V station battery and battery charger with accessories for Unit No.2

6.1.3 TECHNICAL INFORMATION

As the station battery is used as a power source for the control of major plant equipment as well as power source for emergency equipment and emergency lighting, and is one of the most important items of equipment in the power plant, sufficient attention shall be paid to design and fabrication of the station battery.

6.1.3.1 TYPE

(1) Battery

Indoor, stationary nickel-cadmium type.

(2) Battery charger

Indoor, three- phase full wave silicone rectifier, drip-proof, self -standing, metal clad.

6.1.3.2 RATING

(1) DC 220V station battery for No.1 and No.2 Unit

(a) Battery

Voltage	220V
Number of unit cell capacity	160 - 172 * Ah (at 5 hour rate)
Nominal voltage of cell	1.4V $\pm$ 1%
Minimum voltage of cell	1.2V
Self-discharge capacity	Less than 0.5%/day
Maximum temperature of electrolyte	45°C
Specific gravity of electrolyte when fully charged	1,200 - 1,230 (at 20°C)

(b) Battery charger

Rectification system	Three-phase full wave
Class of rating	Continuous
Cooling system	Self-air cooled
Input (AC side)	
Phase	3φ
Frequency	50 Hz
Voltage	380V
Output (DC side)	
Voltage	220V
Current	* A
Voltage adjustment range	
Automatic floating charge	210 - 240 V
Automatic equalizing charge	240 - 270 V
Manual	195 - 320 V
Current adjustment range	0 - 100%

(c) Counter cell

Current	* A

(2) DC 24V station battery for No.1 and No.2 Unit

(a) Battery

Voltage	24V
Number of unit cell	17 - 19
capacity	* Ah (at 5 hour rate)
Nominal voltage of cell	1.4V + 1% −
Minimum voltage of cell	1.2V
Self-discharge capacity	Less than 0.5%/day
Maximum temperature of electrolyte	45°C

Specific gravity of electrolyte when fully charged	1,200 - 1,230 (at 20°C)

(b) Battery charger

Rectification system	Three-phase full wave
Class of rating	Continuous
Cooling system	Self-air cooled
Input (AC side)	
Phase	3φ
Frequency	50 Hz
Voltage	380V
Output (DC side)	
Voltage	24V
Current	* A
Voltage adjustment range	
Automatic floating charge	23 - 27 V
Automatic equalizing charge	27 - 30 V
Manual	22 - 35 V
Current adjustment range	0 - 100%

(c) Counter cell

Current	* A

(2) DC 48V station battery for PABX

(a) Battery

Voltage	48V
Number of unit cell capacity	34 - 32 * Ah (at 5 hour rate)
Nominal voltage of cell	1.4V ± 1%
Minimum voltage of cell	1.2V

Self-discharge capacity	Less than 0.5%/day
Maximum temperature of electrolyte	45°C
Specific gravity of electrolyte when fully charged	1,200 - 1,230 (at 20°C)

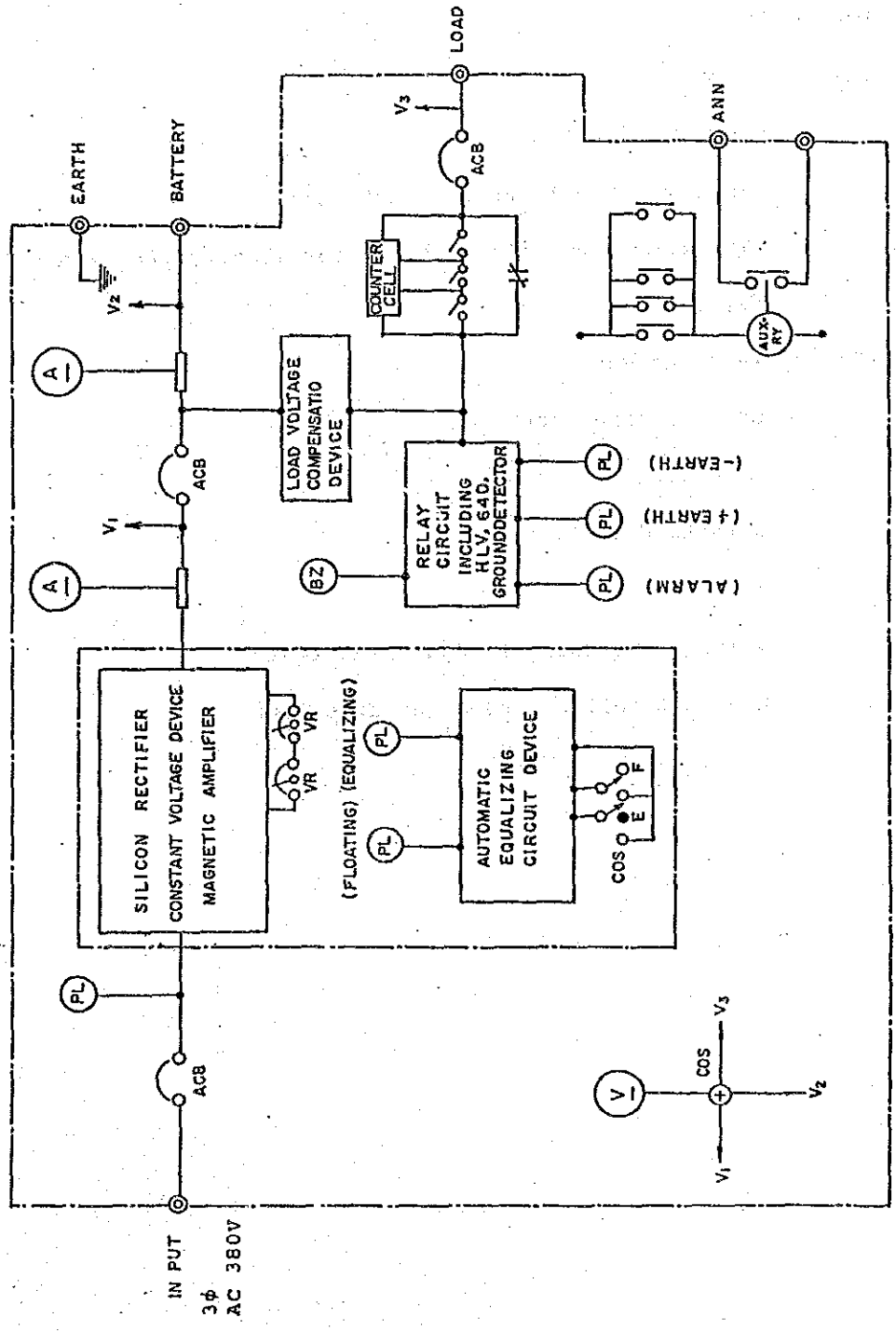
(b) Battery charger

Rectification system	Three-phase full wave
Class of rating	Continuous
Cooling system	Self-air cooled
Input (AC side)	
Phase	3φ
Frequency	50 Hz
Voltage	380V
Output (DC side)	
Voltage	48V
Current	* A
Voltage adjustment range	
Automatic floating charge	46 - 54 V
Automatic equalizing charge	54 - 60 V
Manual	44 - 70 V
Current adjustment range	0 - 100%

(c) Counter cell

Current	* A

6.1.3.3 BASIC CIRCUIT



6.1.3.4 SHOP TEST

The shop tests shall be as follows, but not be limited to the items below. The tests shall be carried out in the presence of the Engineer.

(1) Battery

Construction test

Measurement voltage for each cell

Measurement specific gravity for electrolyte each cell

Capacity test

(2) Battery charger

Construction test

Meggering

Withstand voltage test

Sequence test

Voltage and current adjustment test

Constant voltage characteristic test

6.1.4 CONSTRUCTION

6.1.4.1 BATTERY

The battery shall consist of positive plate, negative plate, separator, cell, and exhauster, and each component shall have corrosion-proof and mechanical properties. All materials shall have excellent characteristics in every respect. An exhauster capable of preventing explosion and foaming of the gas generated inside the battery shall be provided, and the battery shall be sealed completely with the compound, packing, etc., so that no gas shall be discharged through parts other than the exhauster. Each part shall have a construction enabling stable performance for a long period of time, causing no damage or dropping of reacting agents even in case of short circuit current, and shall be made easy to provide maintenance and inspection.

(1) Plate

(a) Plate

The positive plate and negative plate shall have excellent properties and uniform surfaces. The plates shall not contain any harmful foreign matter. The plates shall have a construction causing no dropping of reacting agents, and shall endure long periods of use.

(b) Terminal

The terminal shall be made of lead alloy, and shall be completely and uniformly welded to the plates. Moreover, the terminal shall have such a construction that the terminals can be easily mounted.

(2) Cell

The transparent cell made of alkali-proof synthetic resin shall be applied for the cell. The cell shall be uniform in thickness, shall have sufficient strength with no cracks or cuts, and shall not deteriorate after long years of use.

An electrolyte level indicating line shall be attached to the cell at a position easy to supervise.

For the cell, a cover of material having sufficient strength with no cuts or cracks shall be provided.

The cell shall be of a construction facilitatin easy injection of electrolytes and measurement of gravity.

(3) Separator

For the separator, the materials made of alkali-proof synthetic resin shall be applied.

(4) Electrolyte

The electrolytes corresponding to potassium hydroxide shall be applied, and the specific gravity shall be, as a standard, 1,200 - 1,230 (tolcrance 1,160 - 1,250) at 20°C when the battery is completely under a charging condition.

(5) Exhauster

The exhauster shall have an explosion-proof and spray-proof function so that any battery outside fire shall not cause ignition and explosion inside the battery, and the exhauster shall have a construction so that the acidic mist generated inside the battery shall not be dispersed into the atmosphere.

(6) Packing and compound for sealing

Various kinds of packings to be used at the places requiring sealing shall be made of synthetic rubber, etc., of excellent quality, and the packings shall not be dissolved or expanded due to the electrolytes for long periods of use, and shall ensure complete sealing.

(7) Pilot cell

The pilot cell shall be of a construction enabling permanent enclosure of the gravity meter and thermometer, and shall be made easy to measure from outside. In regard to quantity, at least two (2) units of the pilot cells shall be provided for one set of batteries.

(8) Connectin method and conductor

The battery shall be connected, in principle, with the connecting bolts and nuts by tightening the conductor having sufficient sectional area against discharge current with the positive termainal and negative terminal. The conductors and the connecting bolts and nuts shall be conformity with the following.

(a) Conductor

The copper to be applied for the conductor and the terminal shall be lead-plated and for insulation sheathing, synthetic rubber or other alkali-proof synthetic resins shall be used.

(b) Connecting bolts and nuts

The connecting bolts and nuts shall be made of copper and lead-coating or lead-sheathing shall be provided on the surfaces.

(9) Polarity mark

For the polarity marks, "+" and "-" shall be indicated clearly and firmly at the corresponding positions of the battery, and the marks shall not be erased.

(10) Mounting structure

The mounting structure shall be made of steel, and complete acid-proof painting shall be provided. The structure shall be capable of accommodating a complete set of batteries, and all batteries shall be mounted in a one stage arrangement.

The insulators shall be made of porcelain of excellent quality, and shall have sufficient strength.

(11) Spare battery

At least two (2) sets spare battery shall be provided on the mounting structure.

6.1.4.2 BATTERY CHARGER

The battery charger shall consist of a rectifier, a transformer for the rectifier, an automatic constant voltage device, accessories and a cubicle for housing the above, and it shall have a construction easy to handle for maintenance and inspection. In regard to the layout of the battery charger, control center and distribution panel, refer to item 3.6.3.3.

(1) Rectifier

The rectifier shall consist of silicone devices and other required accessories.

The silicone devices shall be uniform in quality, of a construction causing no loosening at the tightened places of accessories, and shall facilitate easy replacement of rectifier parts when required. The devices shall be constructed so as to provide required heat radiation.

(2) Transformer for rectifier

The transformer for the rectifier shall be a two-winding transformer, and shall have 400V, 380V and 360V no-load, no voltage tap chargers on the primary side.

(3) Voltage regulator

The automatic voltage regulator shall be of a static type, and it shall be highly sensitive, quick in response and highly stable. The regulator shall be in conformity with the following.

(a) It shall be possible to be changed over to either manual or automatic operation.

(b) Incase of automatic operation, the regulator shall be capable of continuously regulating the DC side voltage within the regulating range prescribed in Item 6.1.3.2 (2)(a).

The setting voltage regulator for the floating and equalizing charge shall be mounted on the panel.

The change-over switch to enable selection of floating charge or equalizing charge shall be mounted on the panel.

(c) Incase of manual operation, the regulator shall be capable of regulating the DC side voltage to the step vltage of less than 2V in accordance with the regulating range prescribed in Item 6.1.3.2(2)(a).

(4) Counter cell

The counter cell shall be provided for compensating the load voltage when equalizing charge is used.

The counter cell shall be designed to be operated both automatically and manually.

(5) Cubicle

The cubicle shall be made of 3.2 mm thickness steel plate and shall be of the self standing type. The cubbicle shall have at its front, meters, changeover switches, adjustment dials, signal lamps, etc.

The cubicle shall have a construction enabling manual operation of the molded type air circuit breaker with an alarm contact.

The cubicle shall also have a construction giving consideration to heat radiation of the transformer rectifier, etc.

The rear part shall be composed of a removable type plate, and the power and control terminal for the outside cable shall be provided inside the cubicle.

6.1.4.3 MAINTENANCE ACCESSORIE

(1)	Syringe hydrometer	Four (4) sets
(2)	Hand type DC voltmeter with lead wire	Four (4) sets
(3)	Jug	Four (4) sets
(4)	Filling syringe	Four (4) sets
(5)	Funnel	Four (4) sets
(6)	Eye dropper with temperature meter and gravity meter	Four (4) sets
(7)	Box for attachment	One (1) set
(8)	Other necessory materials	One (1) set

168-11

7. COMMUNICATION

7.1 PAGING SYSTEM

7.1.1 APPLICABLE STANDARDS AND CODES

Applicable standards and codes shall be in accordance with "Panels and Boards" in Clause 2.1 in Section II of Part I.

7.1.2 SCOPE OF SUPPLY

(1) The following paging equipment with accessories shall be supplied, but not be limited to the followings.

One (1) set	Amplifier panel
One (1) set	Power source panel
One (1) set	Handset
	Indoor
	Outdoor, waterproof type
One (1) set	Speaker
	Indoor
	Outdoor, waterproof type
One (1) set	Desk type, hand set with speaker
One (1) set	Control console desk with chair

(2) The handset and speaker shall be installed in the following locations, but shall not be limited to those below.

One (1) set	For Unit No. 1 and No. 2 main powerhouse
One (1) set	Unit No. 1 and No. 2 boiler
One (1) set	For plant water equipment control room
One (1) set	For screen control room
One (1) set	For CWP area
One (1) set	For screen area

ode-11

One (1) set	For FDF area
One (1) set	For guard house
One (1) set	For unit neutraization pit area
One (1) set	For waste water treatment area
One (1) set	For plant water treatment area
One (1) set	For heavy oil tank and transfer pump station area
One (1) set	For main and auxiliary transformer area
One (1) set	For heavy oil service tank/heater/pump area
One (1) set	For H_2 gas generating room area
One (1) set	For house boiler area
One (1) set	For make up water tank, service water storage tank area
One (1) set	For substation area
One (1) set	For substation building
One (1) set	For administration building

Quantity of hand set and speaker, refer to the drawing (WET-1101) "SKELETON OF PAGING SYSTEM".

7.1.3 TECHNICAL INFORMATION

The paging shall be provided to enable easy operation of the thermal power plant.

The paging system shall be designed so that complete and satisfactory function is provided even at the place where noise level inside the power plant is high.

The panels for the paging system shall be installed inside the Unit No.1 control equipment room.

7.1.3.1 SPEAKING SYSTEM

The paging system shall have two circuits, namely, a calling circuit and a speaking circuit, and the calling circuit shall be of a one-way speaking type facilitating paging by all of the speaker systems.

The speaking circuit shall be of a two-way speaking type which enables communication with all handsets installed throughout the plant.

The calling circuit and the speaking circuit shall be made independent of each other, and any command shall be able to be communicated irrespective of whether there is speaking or not.

7.1.3.2 CIRCUIT SYSTEM

The circuit system shall consist of amplifier equipment, handset stations and speaker systems.

The handset stations shall have an amplifying function in order to amplify the output of the microphones. The circuit system shall have sufficient capacity to transmit at a high level.

7.1.3.3 AMPLIFIER PANEL

The amplifier panel shall be made of steel plate thickness 1.6 mm to 3.2 mm, and shall be of the self standing type. The panel shall have at its front a hinged door with a stopper and a handle with key.

The panel shall be of a solid state type, and shall be applied to protect opening of the output circuit, protection of surges, etc.

(1) Performance

Output	* W
Distortion ratio at maximum output	Less than 10% (at 1,000 Hz)
Frequency characteristics	* - * Hz
	(Deviation: Within 3 dB)
S/N ratio	More than 40 dB
Input impedance	* ohm
Input level	-50 dB
	(Voltage amplifier)
	-10 dB
	(Power amplifier)
Output impedance	* ohm

A device to give alarm when the protective device operates shall be provided, and the device shall be designed to be indicated on the BTG board and control console desk in the central control room.

K-8/5

(2) Remote control

The calling and speaking circuits shall be independent from each unit during normal operation, but the circuits shall be designed to be freely put together or separated by means of the control console desk installed in the central control room.

7.1.3.4 POWER SOURCE PANEL

The Construction of power source panel shall be of steel plate having a thickness of 1.6 mm to 3.2 mm, and shall be of the self standing type. The panel shall have at its front a hinged door with a stopper and a handle with key.

The power source for the panel shall be AC 380V, three-phase, but on the occasion of failure in the AC power source, the panel shall be designed to automatically changeover to the DC 220V power source from the station battery.

7.1.3.5 HANDSET

The wall hanging, self standing, or desk type handsets having built-in small amplifiers shall be provided.

Among the wall hanging and self standing type handsets, the outdoor type shall be of the water, dust-proof type and shall have galvanized outside case.

The handsets shall be mounted inside the elevators.

The outside cables shall be pulled into the handsets through steel conduits.

The handset shall be of sound-proof type, and shall have a construction enabling an immediate speaking circuit by picking up the handsets.

Calling shall be made possible by pushing the switch, but the switch shall be designed to automatically return when the switch is released.

In case the handset and speaker are mounted close together, the output control circuit and the speaker howling preventing circuit shall be interlocked with opening and closing for the call circuit.

7.1.3.6 SPEAKER

The speaker shall be of the horn type or cone type, and it shall consist of a speaker body, a matching transformer, a volume adjuster, a terminal stand and a supporter.

The speaker to be used outdoors shall be of a water, dust-proof type.

The speaker supporter shall be of construction enabling attachment of the speaker on the steel structure under the ceiling, on the wall or column, etc.

The speaker supporter shall have a construction enabling it to be freely fixed on both sides, or front or rear part.

The entire speaker shall be of a permanent magnet type and shall have the following characteristics.

	Horn type	Cone type
Diameter	Approx. 380 mm	Approx. 200 mm
Nominal output	15 W	3 W
Voice coil impedance	* ohm	* ohm

Frequency response shall be the same as frequency characteristics of amplifier.

7.1.3.7 CONTROL CONSOLE DESK

The control console desk shall be installed in the central control room and shall serve for controlling the paging system, public and station telephone system, and interphone system.
The load dispatch telephone shall be provided.
The desk shall be of the bench board type, and the following devices shall be provided.

Public telephone	Two (2) sets
Station telephone	Two (2) sets
Paging handset	Two (2) sets
Monitor speaker	Two (2) sets
Monitor volume control	Two (2) sets
Circuit combining switch	One (1) set
Load dispatch telephone	Two (2) sets
Interphone	One (1) set
Alarm	One (1) set

(1) Public telephone set

The public telephone set shall be of the dial-in type, and provided for emergency use at the time of a failure in the PABX in the power plant.

(2) Station telephone set

The station telephone shall be connected with the PABX.

(3) Paging handset

The paging handsets shall be provided as dispatching devices. One (1) set of the paging handset shall be provided for Unit No.1. The handsets between Unit No.1 and Unit No. 2 shall be designed to be connected or separated by switch. In case of calling with this handset, the monitor speaker on the control console desk shall be in the "off" position.

(4) Minotor speaker and volume knob

The monitor speakers shall be used for the paging system and the volume shall be adjustable by means of the volume knob.

(5) Circuit combining switch

The circuit combining switch shall be provided for connecting and separating the paging systems for Unit No.1 and Unit No.2.

(6) Load dispatch telephone

Two (2) sets of load dispatch telephone with related accessories shall be provided on the control console desk.

(7) Interphone

One (1) set of interphone and five (5) sets selector buttons with lamps shall be provided on the control console desk.

This interphone shall be for the boiler elevator and administration building elevator.

7.1.3.8 TERMINAL BOX AND BRANCHING BOX

The terminal box and the branching box shall be applied for branching and cutting off the cables for the paging equipment.

(1) Construction

Indoor type terminal box shall be of drip-proof, steel material wall hanging type, and the outdoor type terminal box shall be of water-proof, dust-proof and salt-contamination-proof type steel materials and wall hanging type.

The terminal box shall have at its front a hinged door with key. However, if the width of the door is more than 50 cm, the door shall be of the side opening type.

In case of paging, the inside terminals shall be separated on both sides for the speaker circuit and other circuits in order to prevent induction interference of input and outptut.

The door shall have at its rear side a holding case capable of accommodating the wiring diagrams, etc. The number plate shall be attached at the front.

All terminal boards shall be of the molded separation type, and the required quantity of crimp terminals shall be provided.

The quantity of spare terminals to be provided shall be about 20% of the required terminals.

In the case of paging equipment, the terminal board shall be designed to open and close by means of a U-plug.

Consideration shall be given so as to enable use of the test-use handsets with the terminals box.

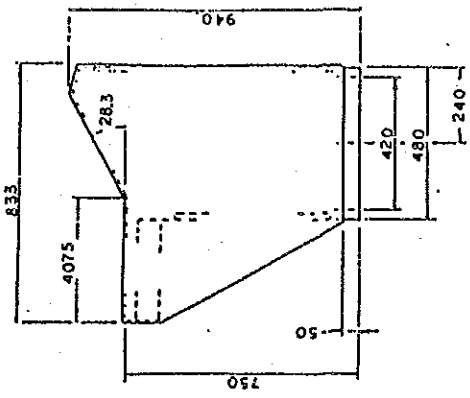
E07-9

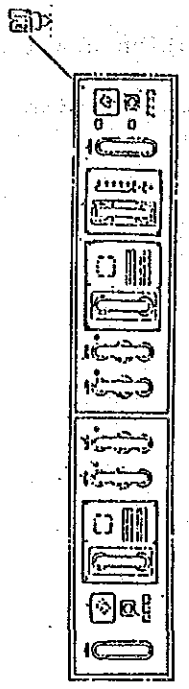
When the speaker circuit is opened by means of the cutting-off terminals, protection circuit for the main equipment shall be provided.

Consideration shall be given so as not to cause short circuit due to misoperation.

106-4

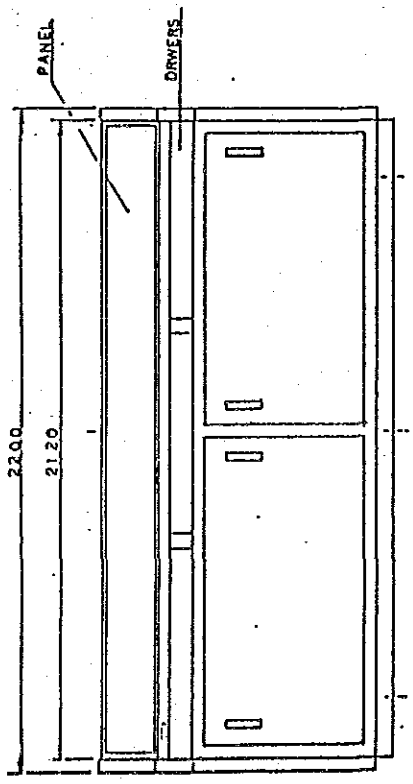
TIPICAL VIEW CONTROL CONSOLE DESK



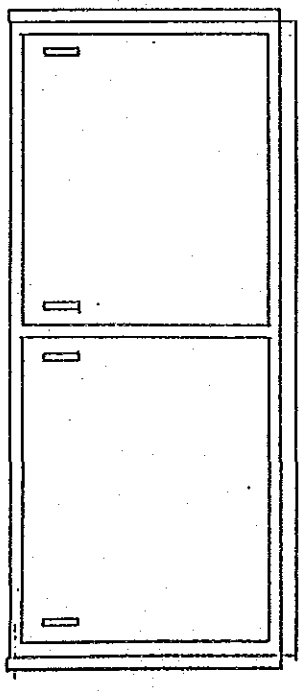


PANEL

NOTE
1. MATERIAL: COLD ROLLED STEEL PLATE



FRONT VIEW



RIER VIEW

4-903