SECTION 17

EXTERIOR

17.1 SCOPE OF WORK:

Scope of work

The scope of work specified in this section is the entire exterior work and its relevant work required for completing the works shown in drawings and specified in the specification.

17.2 GENERAL:

17.2.1 All the working drawings and shop drawings shall be submitted to the supervisor for approval.

17.2.2 Samples of materials to be used shall be submitted as specified in the section for brick laying work.

17.2.3 Reinforcing bars shall be suitably arranged for drain ditches in accordance with drawings.

17.2.4 The crushed stone to be used for berms shall be of the size of around 25 mm. Samples shall be submitted to the supervisor for approval before use.

17.2.5 Brick laying work shall be executed in accordance with the provisions of the section for brick laying work.

SECTION 18

ELECTRICAL INSTALLATION WORK

18.1 GENERAL

18.1.1 Extent to be Covered

This specification shall be applied to the electrical installation work for the Construction of "National Broadcasting House of Radio Bangladesh".

18.1.2 Working Standard

The installation shall be effected according to this specification, design drawings and instruction of the supervisor, and also to the section relating to this installation in the "Common specification for electrical installation work". (laid down by Government Buildings Department, Minister's Secretariat, Ministry of Construction of Japan.)

18.1.3 Doubts

If there are any doubts in the drawings and the specification and on fabrication of the equipments, they shall be settled in the instruction of the supervisor.

18.1.4 Slight Alternations

Slight alternations of installation method and position of equipment, appratus and materials in view of the settlement, fitting, etc., in the site shall be performed according to the instruction of the supervisor. In this case, the contract amount shall not be adjusted.

18.1.5 Selection of a Superintendent

The superintendent of the contractor engaged in this installation work shall be a Japanese engineer who has sufficient experience of installation work and be excellent in personality and technique.

18.1.6 Act and Cooperation for Procedures

Procedures in the government and the other public office necessary for this installation work shall be made for work and work together by the contractor without delay.

18.1.7 Selection of Equipment, Apparatus and Materials

The equipment, the apperatus and the materials shall be principally selected in the manufacturers specified in the special specification and shall be approved by the supervisor.

18.1.8 Approval and Inspection of Equipment, Appraturs and Materials

The equipment, the apparatus and the materials for this installation work shall be inspected and approved by the supervisor when carried in the site. Manufacturing drawings and samples shall be submitted to the supervisor for approval.

18.1.9 Submission of drawings

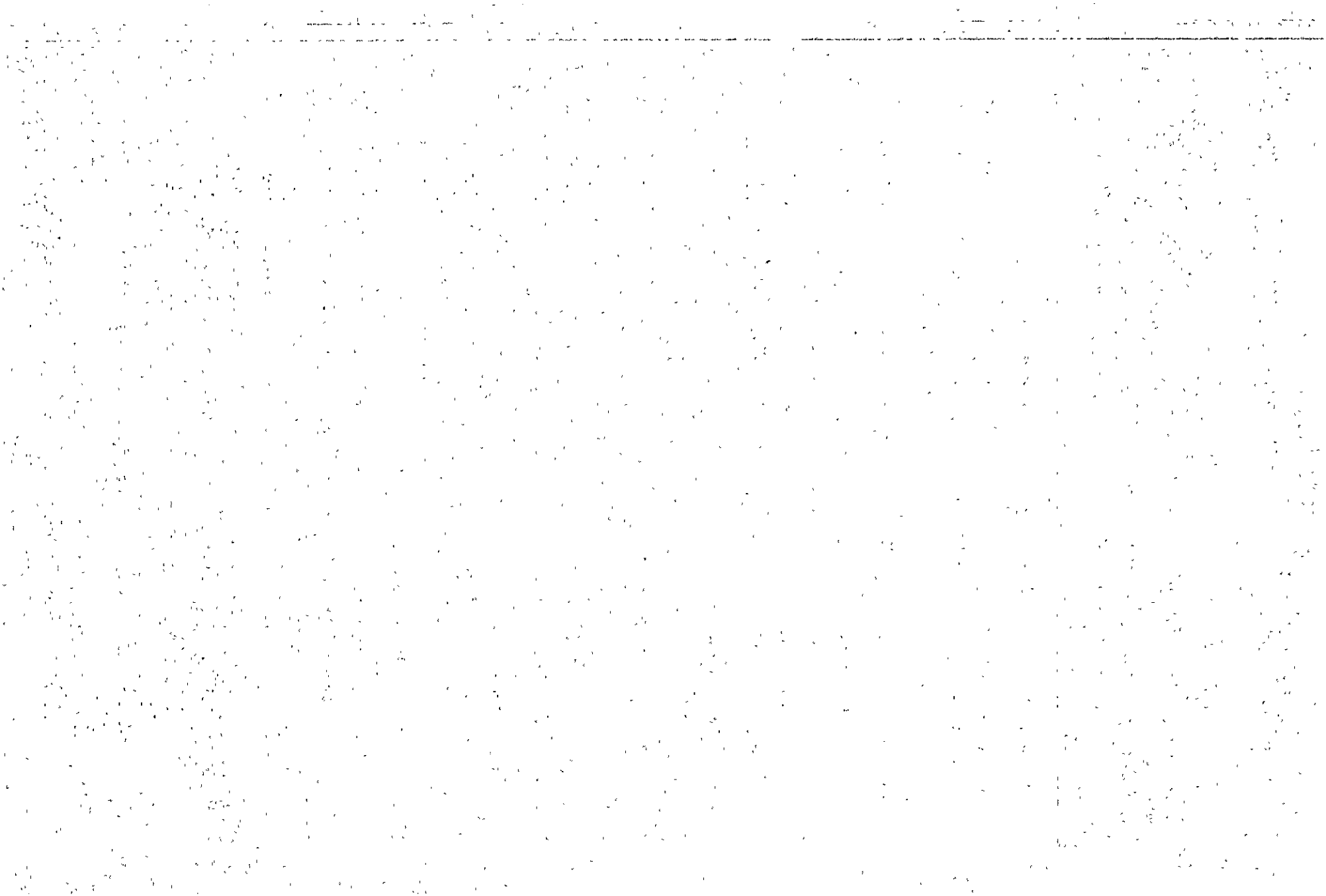
The drawings of working, fitting positions, manufacturing, etc., necessary for work and manufacture shall be made without delay before working and manufacturing, and submitted to the supervisor for approval.

18.1.10 Inspection and Presence for Installation Work

The installation work items on which any inspection can not be made or is difficult after completion shall be inspected or checked by the supervisor in the process of works.

18.1.11 Test and Inspection

(a) The equipments, the appratus and the materials which the supervisor will recognize that it is necessary shall be inspected or tested on the site or manufacture's factory concerned, in the presence of the supervisor, and only those accepted shall be used. The report of test results shall be submitted to the supervisor without fail.



(b) The inspection during installation work or after complete installation work, in the presence of the Government and other public officials shall be conducted under the responsibility of the contractor before the completion insepction.

(c) Before delivery of the facilities, the test, adjustment and trial run of the respective equipment and apparatus shall be executed. The records shall be submitted to the supervisor.

(d) After completion of installation work, an inspection shall be conducted in the presence of the supervisor.

18.1.12 Completion Drawings and Maintenance Handbooks

When the installation work is completed, completion drawings and instruction manuals or handbooks of equipments and apparatus for maintenance shall be submitted to the supervisor.

18.2 COMMON PROVISION OF INSTALLATION WORK

18.2.1 Receiving and Distribution of Electricity

a) Receiving and distribution method

They shall be shown in the drawings and the special specification.

b) Protective device

Unless the protection device is stated in the drawings, the protection device shall be provided for the equipments and for the smallest conductor.

18.2.2 Equipment and Apparatus

a) Equipment and appratus

They shall be manufactured with complete work and a good run in accordance with the use.

b) Mounting of equipment

Mounting location for the equipment shall be shown in the drawings. The detail of installation work shall be decided according to the instruction of supervisor.

c) Location of apparatus

The location of appratus shall be shown in the drawings. The detail for actual installation work shall be decided with the study in the site according to the instruction of supervisor.

18.2.3 Conductor (Cable and Wire)

a) Kind and size

The kind and size of conductor for this installation work shall be shown in the drawings.

b) Connection

The conductor shall be connected in a few points, the connection points shall be completed not to increase the resistance and not reduce the tension in more than 20%. The insulator of the connection point shall keep the effect more than the conductor. In the connection of conductor to the terminal of switch and apparatus, the connection shall be completely made and shall be firmly tightened at the end without becoming loose.

18.2.4 Conduit Tube

a) Kind and size

The kind and size of conduit tube for this installation work shall be shown in the drawings.

b) Laying method

The conduit tube shall be embeded and shall be penetrated in the structure, in case of the installation point without adverse influence. The tube end shall be made smooth in such a manner as the conductor coverings shall not be damaged.

c) Connection

The connection between conduit tubes or between conduit tube and box or the like shall be firmly tightened for the using a coupling of the screw type.

The connection between conduit tubes or between conduit tube and boxes or the like shall be made perfectly in a series with using a bounding materials in the case where the connection is electrically separated.

d) Fixing of exposed conduit tube

The exposed conduit tube shall be installed in the proper positions to support in good order with the use of pipe hanger of the like.

e) Boxes

The boxes shall be made of steel plate, the size shall be confirmed in the quantity of conductor and the volume of conduit tubes.

18.2.5 Underground Feeder

a) Laying method

Laying method for the underground feeder shall not make adverse influence of pressure from the ground. The connection of conductor shall not be made in the underground.

b) Depth

The underground feeder shall be installed at the depth of more than -1200 mm, where vehicles pass over the installation area. At the other installation area, they shall be set at a depth of more than -600 mm from the ground surface.

c) Mark block

The underground feeder line shall have concrete mark blocks above the ground at the points with the instruction of the supervisor.

18.2.6 Earthing

a) Kind of earthing

The kind of earthing shall be shown in the drawings.

b) Installation of earthing

The installation work shall be checked and inspected in the presence of the supervisor. The earthing electrode position shall be selected in the incorrodible place at the depth more than -700 mm from the ground surface. The connection of earthing cable to the necessary thing shall be firmly made electrically and mechanically.

18.3 SPECIAL SPECIFICATION

18.3.1 General Provision

This installation work shall be carried out in sufficient cooperation with the other parts of this construction, in accordance with the specified installation work period and with care of site, for establishment of the safe and convenient plant.

18.3.2 Installation Items

This installation work shall be formative as follows.

a) Sub-station equipment
b) Main line and power control system
c) Lighting fixture and socket outlet system
d) Telephone, clock and broadcasting system
e) Lightning conductor and earthing

18.3.3 Separate Work to be Provided by the Client

a) Electric power supply work to the site from outside the site
b) Telephone trunk work to the studio house on the site from outside the site
c) Supply and installation of private automatic branch exchange of thlephone and materials on the site

18.3.4 Outline of Installation Work

a) Sub-station equipment

Supply and installation of indoor type incoming transformer, generator and D.C. power source equipment. Laying 11 Kv lead-in cable and receiving pole
(See specification of equipment and drawings)

b) Main line and power control system

Supply and laying of main line cable from low-voltage distribution panel in the sub-station to power control board and distribution board. Supply and fixing of power countrol board, distribution board and switch. Piping and wiring from board to board, machine, apparatus or the like

c) Lighting fixture and socket outlet system

Supply and fixing of lighting fixture, ceiling fan, socket outlet, switch or the like. Piping and wiring from distribution board to fixture

d) Telephone, clock and broadcasting system

Supply and fixing of terminal board, piping and boxes required for telephone, clock and broadcasting system. Supply, fixing and wiring of clock and broadcasting equipment, appratus or the like to be provided in the broadcasting installation work

e) Lightning conductor and earthing

Supply and fixing of lightning protection materials for buildings and earthing for sub-station, broadcasting, telephone and lightning conductor

18.3.5 Manufacturer for Electrical Equipment, Apparatus and Materials

They shall be principally made by the manufacturer in Japan or Bangladesh and the list of manufacturer shall be submitted to the supervisor for approval.

18.3.6. Spare Apparatus and Materials

The followings shall be provided.

a) Lighting fixture

A type: NOS 20
G type: NOS 20
I_2 type: NOS 20
J type: NOS 5
L^2 type: NOS 5

b) Ballast

FL 40^W x 1 type: NOS 20
FL 40^W x 2 type: NOS 20

c) Lamp

FL 40^W : NOS 100
IL 200^W: NOS 30
IL 100^W: NOS 50
IL 60^W: NOS 50
IL 20^W : NOS 20
IL 5^W : NOS 10

d) Ceiling fan (with regulator)

1400 mm Sweep: NOS 5
400 mm Sweep: NOS 3

e) Cable and wire

Cabtyre cable 600v 3.5 mm^2-4C : 200 m
Polyvinyl chloride insulated and sheathed cable
600 V VVF 2.0-3C : 200 m

f) Socket outlet

2P-15A E with plug: NOS 30
3P-15A E with plug: NOS 5

h) Molded case circuit breaker

MCB 4P 225 AF: NOS 2
MCB 4P 50 AF: NOS 5
MCB 3P 225 AF: NOS 2
MCB 3P 50 AF: NOS 10
MCB 2P 50 AF: NOS 20

i) Magnetic Contactor

MGS 3P 50A: NOS 5
MGS 2P 50A; NOS 5

18.4 SPECIFICATION OF EQUIPMENT AND APPARATUS

18.4.1 Sub-station Equipment

a) Lead-in section panel (11KV 50Hz 3ϕ 3W)

Quantity : one set
Type : Outdoor type sheet steel, enclosed switchboard
Comprising: : 1 - 3 pole load breake switch 12KV, 800A, manual operated

b) Incoming panel (11KV 50Hz 3ϕ 3W)

Quantity : one set
Type : Indoor type sheet steel, enclosed switchboard
Comprising : 1 - Vaccum type circuit breaker 12KV, 600A, 25KA (at 12KV) motor charged spring operated

1 - 3 pole disconnecting switch 12KV, 600A, manual operated with mechanical interlock

3 - single phase current transformers mold type,11.5KV, 20/5A

3 - single phase lightning arrester station type, 14KV, 10KA

1 - Rectifier for closing circuit breaker input AC 105V

1 - Capacity type tripping device for circuit breaker input AC 105V

1 - Relay, meter, lamp, contral switch, standard accessaries and spare parts

c) MOF panel (11KV 50Hz 3ϕ 3W)

Quantity : one set

Type : Indoor type sheet steel, enclosed switchboard

Comprising : 2 - Single phase potential transformer mold type 11000/110V

1 - Transformer 1ϕ, 50Hz, 10KVA 11000/210-105V, oil-immersed, self-cooled

1 - Metering out-fit (MOF) oil-immersed 0.5W class PT Ratio 11000/110V 2 x 25 VA CT Ratio 20/5A 2 x 25 VA

1 - Demand meter (including watt-hour meter)

1 - Standard accessories and spare parts

d) G-distribution panel (415/240V 50Hz 3ϕ 4W)

Quantity : one set

Type : Indoor type sheet steel, enclosed switchboard

Comprising : 3 - Single phase potential transformer mold type $440/\sqrt{3}/110/\sqrt{3}$ V

3 - Single phase current transformer mold type 1150V 500/5A

1 - Single phase current transformer mold type 11.5KV 100/1A

1 - Molded case circuit breaker and earth leakage circuit breaker
600AF, 4P, 3P, 2P

1 - Relay, meter, control switch, standard accessories and spare parts

e) AVR panel (415/240V 50Hz 3ϕ -4W)

Quantity : one set

Type : Indoor type sheet steel, enclosed switchboard

Comprising : 1 - Automatic voltage regulator, oil-immersed, self-cooled
Three phase 150 KVA ± 20% 50Hz
Primary voltage 415V ± 1.5%
Secondary voltage 415V ± 1.5%

6 - Single phase potential transformer
mold type $440/\sqrt{3}/110/\sqrt{3}$ V

2 - Electromagnetic contactor,
4PDT, 600V, 400A

1 - Meter, control switch, standard accessories and spare parts

f) E-distribution panel (415/240V, 50Hz, 3ϕ 4W)

Quantity : one set

Type : Indoor type sheet steel, enclosed switchboard

Comprising : 3 - Single phase potencial transformer
mold type $440/\sqrt{3}/110/\sqrt{3}$ V

3 - Single phase current transformer
mold type 1150V 250/5A

1 - Electromagnetic contactor,
4PDT, 600V, 250A

1 - Molded case circuit breaker and earth leakage circuit breaker, 600AF, 4P.3P.2P

1 - Meter, control switch, standard accesories and spare parts

g) CVCF distribution panel (240V 50Hz 1ϕ 2W)

Quantity : one set

Type : Indoor type sheet steel, enlosed switchboard

Comprising : 1 - Molded case circuit breaker, 600AF, 2P

1 - Standard accessaries and spare parts

h) Bus duct

Main bus 11KV, 600A, bus 440V 600A with supporting insulators

i) Transformer

Quantity : oue set

Type and Form: Oil-immersed, self-cooled, core type complete with accessaries and spare parts

Capacity : 300KVA

Frequency : 50 Hz

Rated primary voltage: 11000V

Rated secondary voltage:415 - 240V

Taps, high voltage windings: F12000/F11500/R11000/10500/10000V

Connection : Primary Delta

Secondary Star with neutral brought out

j) D.C. power source equipment

Quantity : one set

Type and Form: Full automatic D.C. power source Indoor type, complete with accessories and spare parts

Input voltage: 3 phase 415V ± 10% 50Hz

Output voltage: DC 240V

Capacity at 5-hour discharge rate: 80 amp-hours

Number of cells: 200 cell, alkaline storage batteries of the nickel-cadmium type

k) Stand-by generator

The engine generator shall be 150 KVA, indoor use, and consist of a three phase A.C. generator, four (4) cycle spark ignition, turbocharged after cooled natural gas engine. The engine generator shall be coupled directly with each other on a common frame, and include control panel, a starting battery and neccessary other parts. Spare parts shall also be provided.

Quantity : one set

Engine type : Water cooled, spark ignition type, turbocharged after cooled natural gas engine

Operation cycle : four (4) cycle

Rated power : Engine 175 BHP (with fan)
Generator 120KW (150KVA)
415-240V 3ϕ-4W 50Hz

Speed : 1,500 r.p.m.

Cylinder number : In-line type, 6 cylinders

Starting system : Electric starting

Fuel : Dry natural gas

Gas pressure regulator : Diaphram type, require min.0.84 kg/cm $0.84\ kg/cm^2G$ to max.1.4 kg/cm^2G

18.4.2 Distribution Board and Power Control Board

Indoor type board shall be covered with steel sheet, installing neccessary devices such as a circuit breaker, magnetic contactor, relay, meter, control switch, and line to terminals.

Standard spare parts shall also be provided.
(See drawings)

18.4.3 Ceiling Fan

1,400 mm sweep ceiling fan shall consist of motor, brade, speed regulator, canopy and down rod and 400 mm sweep cycle ceiling fan shall consist of motor, blade and regulator. (See drawings)

18.4.4 Lighting Fixture

Ceiling and wall fixing type of lighting fixture shall consist of lamp, steel body, lamp base, ballast and neccessary other parts. (See drawings)

The lamp base shall be usable for both lamp made in Japan and Bangladesh.

SECTION 19
PLUMBING

19.1 GENERAL

19.1.1 Scope of work:

(1) Water supply equipment work
(2) Drainage, sewage and vent piping work
(3) Gas supply and gas equipment work
(4) Sanitary fixture work
(5) Septic tank equipment work

19.1.2 Separate Works:

(1) Electrical work
(2) Outdoor drainage equipment work
(3) Water and gas lead-in work
(4) Manhole for piping inspection
(5) Rainwater draining work
(6) Fire extinguisher
(7) Embedded washstand
(8) Full-length mirror

19.1.3 Spare Parts:

Consumable material, such as lubrication oil for all rotating machines, etc., necessary for continuous one year operation, shall be supplied.

19.1.4 Inspection:

During installation work and after completion of work, apparatus, piping and accessories shall be hydraulically tested to ensure no leakage and functional operation. Also running test of pumps shall be performed.

19.2 WATER SUPPLY EQUIPMENT WORK:

The piping shall be provided up to the water meter indicated in the design drawing, and the piping shall be plugged. The lead-in work to the water meter from the water supply main shall be a separate work.

19.2.1 Piping Material:

19.2.1.1 Pipes and joints

Steel pipes lined with polyvinyl chloride shall be used. The pipe joints to be used shall be those of screw type made of malleable cast iron with resin coating. Lead pipes for waterworks shall be used in the sections for connection with equipment and other sections at which use of lead pipes in unavoidable for execution of work.

19.2.1.2 Valves

(1) Sluice valves

Valves with a diameter less than 50 mm shall be made of bronze and be of the screw-in type. Those over 65 mm in diameter shall be, with their valve bodies being made of cast iron and spindle and valve seat being bronze. They must be of the flange type and withstand pressures up to 10 kg/cm^2.

(2) Check valves

The check valve at the pump outlet shall be of the anti-shock type or equivalent. Others, smaller than 50 mm in diameter, shall be bronze, screw-in swing type valves. Those over 65 mm in diameter shall have their valve bodies being made of cast iron, and spindle and valve seat being bronze.

They must be of the flange type and withstand pressures up to 10 kg/cm^2.

(3) Faucets

The faucet shall be provided with the totally chrome-plated handle and shall have been accepted by the hydraulic pressure test at 17.5 kg per cm^2. The faucet to be used for the booth in the toilet shall be set at FL +300.

19.2.2 Plumbing:

(1) For indoor plumbing, galvanized steel gas pipes shall mainly be used. Lead pipes may be used only in portions where they will be connected to various apparatus or where their use will be unavoidable.

(2) Cut pipes perpendicularly to their center lines using a pipe cutting saw or other tools which shall allow the work to be done without affecting the diameter of the pipes. File off burrs at the cut portions and clean the cut pipes before connecting them to others. Pipe cutters shall never be used.

(3) Steel pipes shall be screwed together or connected with flanges. They shall have tapered threads.

(4) To connect lead pipes, the joint wiping method shall be employed. In connecting a galvanized steel gas pipe and a lead pipe, soldering nipples made of bronze shall be used.

(5) Use flange couplings for portions which need removal. As a rule, union joints should not be used. In flange joints and union joints, use good quality rubber packings.

(6) Valves should be installed in such a manner that they can be easily operated as per drawings.

(7) Sluice valves are to be provided in take-outs for branch pipes for various floors, at lavatories and at other branching spots.

(8) Floor slabs must not have embedded in them any pipe whose diameter exceeds one-third of the floor slab thickness.

(9) Piping to be buried in concrete should at least partially be completed before being buried, and the completed portions

should undergo a water pressure test. Never dig the concrete for piping work after concrete placement has been completed. No piping may be embedded in the slabs of the floors, ceilings or walls of the studios and subcontrol room.

(10) Give an upward gradient to upfeed water supply piping and a downward gradient to downfeed supply systems. Provide air vents at portions in the piping where dead air space exists. Also provide mud discharge plugs at spots where sediment accumulates.

(11) Piping support brackets are to be made of round steel or angle steel. Concrete ceilings should have inserts embedded in advance. Portions where many pipes are to run in parallel need to be supported with an angle steel. Piping supporting fixtures should be provided at intervals as shown below:

Horizontal pipe	Pipe dia. under 50 mm	Within 1,800 mm
	Over 65 mm	3,600 mm
Rising pipe	More than one spot on each floor	

Branching points must always be supported.

(12) Pipes to be supported by ceilings or floors of the studios and sub-control room shall be so designed as to be able to perform the vibration-proof supporting function at their supported portions. 'Vibration and sound proof work' in 19.7 shall apply to vibration protection work.

(13) Walls and floors through which piping runs must have sleeves built in beforehand. After concrete has been placed, remove these sleeves and wind a fiberglass lagging material around the pipes. Then, wind a ribbed steel plate around its outside and fill in sufficient cement mortar from both sides. In the case of embedded piping, asphalt jute should be wound, instead of a ribbed steel plate. Pipes passing through the expansions of a structure are to employ flexible joints, even though it may not be so specified in the drawing. Pipes running through a wall or a floor should be supported

before or after their penetration. They should not be supported by the wall or the floor slab itself.

(14) Upon completion of piping, plug all openings and close the ends of lead pipes by soldering, so as to prevent the entry of any foreign matter.

(15) All pipes should undergo in the presence of the Supervisor one hour of 10 kg/cm^2 water pressure tests, using pressures given below, at an appropriate time; during piping work, at the time before concealing, or backfilling, or before application of anti-sweat covering after all piping work has been completed. Should any water leakage be found, the necessary replacement or repair must be made immediately, and must

(16) The material for sealing plates, decorated cover and bands shall be stainless steel or chrome plated brass. Concealed piping should as a rule be adopted. However, for penetrating portions at exposed spots in rooms, that is, in ceilings, floors and in walls, use sealing plates. Use decorated cover at the end of anti-sweat covering of the piping. Wind bands, 2 cm in width, at 2 meter intervals on straight portions and also at branching and bent sections.

19.2.3 Anti-sweat and Anti-corrosion:

19.2.3.1 Materials

Use materials designated below:

(1) Rock wool and fiberglass lagging pipes
JIS-marked (No. 2)

(2) Cotton tape
115 g and above per 1 m^2

(3) Asphalt jute
385 g and above per 1 m^2 with asphalt permeated over both surfaces of linen cloth.

(4) Galvanized steel sheet
No. 28 (0.397 mm thick) as per JIS G3302.

(5) Galvanized steel wire

0.9 mm

(6) Thick paper

More than 370 g per square meter

19.2.3.2 Thickness of anti-sweat covering

Pipe Diameter	Under 20 mm	25 ~ 40	Over 50
Thickness	15 mm	20	25

19.2.3.3 Installation of anti-sweat covering

Apply an anti-sweat covering material of the specified thickness around a pipe, and bind it with galvanized steel wires of over 0.9 mm. And then wind a thick paper on it. After that, wind cotton cloth on top of it and then apply two coats of filling paint on it.

19.2.3.4 Surface finishing for pipes used in various places

a. Pipes embedded in internal walls, or concrete, etc. are to be wound with asphalt jute.

b. No anti-sweat covering shall be provided for pipes exposed outdoors.

c. Pipes buried underground must be wound with asphalt jute, whose overlapping portions should be stuck close by heating using a trowel.

d. For piping running above ceilings or through shafts, use linen cloth instead of cotton.

19.2.4 Painting:

19.2.4.1 Surfaces of steel exposed portions of piping

Carefully remove rust and apply two coats of rust preventive paint. Then, apply two coats of oil paint of designated colors.

19.2.4.2 Anti-sweat finished portions

After filling of the cotton cloth wound, apply two coats of oil paint of designated colors.

19.2.4.3 Piping marks

Pipes should be provided with appropriate marks in accordance with instructions given by the Supervisor.

19.2.4.4 Others

Valves, handles, etc. should also be given two coats of paint of designated colors.

19.3 DRAINAGE, SEWAGE AND VENT PIPING WORK:

The specific gravity drainage system shall apply to the whole drainage. The drainage system shall be divided into the sewage pipeline and the other waste water pipeline. The sewage shall be left to the septic tank through a drain catch basin, and shall then be connected to the drain ditch. The other waste water shall be connected to the outdoor drain ditch either directly or through the waste water catch basin.

19.3.1 Submarine Drain Pump:

(1)	Capacity	50ϕ x 100 ℓ/min x 5 m
(2)	Motor	0.75 kW x 415 V x 50 Hz x 3ϕ
(3)	Type	Submarine pump
(4)	Accessories	Waterproof cable 6 m
		Suspension rope 5 m
(5)	Quantity	4 units
(6)	Construction	As per design drawing.
(7)	Test	Trial run of the pumps shall be conducted at the manufacturing shop, and the test records shall be submitted.

19.3.2 Piping Materials:

19.3.2.1 Pipes

a. Lead pipes shall be made for drainage use.

b. Rigid polyvinyl chloride pipe shall be of ordinary standard.

Rigid polyvinyl chloride pipe diameter (unit: mm)

Pipe dia.	Up to 20	Up to 30	Up to 40	Up to 65	Up to 75	Up to 100	Up to 125	Up to 150	Up to 250
Thickness	Over 2.7	Over 3.1	Over 3.6	Over 4.1	Over 5.5	Over 6.6	Over 7.0	Over 8.9	Over 9.2

19.3.2.2 Joints

Vinyl fittings used on polyvinyl chloride pipes must be the products of the same manufacturer of pipes for draining. Adhesives specified by the manufacturer must be used. Private collar joint shall be used for connection between lead pipes and vinyl chloride pipes.

19.3.2.3 Valves

Valves defined in "Water supply facilities construction work" shall be used.

19.3.2.4 Waste water fittings

a. Floor drain fittings
These shall be made of cast iron, and the strainer shall be made of chrome-plated brass.

b. Floor drain traps
Floor drain traps shall be made of cast iron. The strainer shall be made of brass and its minimum water seal depth shall be 50 mm.

c. Clean-out fittings
Cast iron clean-out fittings shall be attached with flange bolts, or else be made of bronze and screwed on. Clean-outs for steel and lead pipes shall be made of bronze and be of the screw-on type. The exposed portions are to be chrome-plated. In case of a floor with a waterproof layer, a waterpoof type shall be used.

d. Sink drainage fittings and sink traps

These including strainers and plugs shall be made of brass and be chrome-plated. The plug shall be provided with a chain. The sink trap shall be made of cast iron, and the strainer shall be chrome-plated brass.

19.3.3 Piping:

(1) Pipes and couplings used for different purposes shall be as follows:

Pipe connected with appratus	:	Lead pipe (at minimum length)
Drain pipe	:	Rigid polyvinyl chloride pipe and joint for drainage use
Sewer pipe	:	Rigid polyvinyl chlorise pipe and joint for drainage use
Ventilation pipe:		Rigid polyvinyl chloride pipe and joint for drainage use

(2) Pipe gradient

The gradient of indoor horizontal pipes shall be over 1/50. If impossible, the gradient of the main pipe only may be more than 1/100. Ventilation pipes shall be given a gradient of more than 1/100.

(3) Use piping support fixtures defined below, which must be firmly fixed in place.

a. Horizontal lead piping for drainage

When a lead pipe horizontally runs more than one meter, it must be placed in a semi-circular trough made of a steel plate with a thickness of more than 1.6 mm, and be supported at intervals of 2 meters.

b. Polyvinyl chloride pipes for drainage

Under 40 mmϕ	Within 1 m
50ϕ ~ 100ϕ	Within 2 m
Over 125ϕ	Within 2.5 m

c. Hangers for horizontally running main pipes shall be provided with cast iron inserts or embedded bolts before concrete is placed.

d. For portions which connect to a horizontal pipe under a falling pipe, a brick or concrete base should be provided, and the bent section should be wound with concrete. In other cases, the pipe should be firmly supported with hangers.

(4) Drainage pipes, which are supported by the walls, ceilings and floors of studios, sub-control room or master control room shall be given vibration protection supporting as defined in 19.7 "Vibration and sound proof work".

(5) For splicing of both rigid polyvinyl chloride pipe and lead pipe, the lead pipe soldered to the outer diameter of the union socket and, on the other hand, the hard vinyl chloride pipe inserted with the vinyl-made socket shall be jointed together and tightened up with cap nuts.

(6) Protection of lead pipes
In burying a lead pipe underground or concrete, or in concealed piping work, pipe shall be wound with asphalt jute. After laying pipe underground, fill the groove with sand.

(7) The wiping solder used in joining lead pipes shall be a good quality lead and tin alloy of the following ratio:

Lead 60%
Tin 40% (weight ratio)

(8) Standards for rigid polyvinyl chloride pipe processing

a. Straight pipe shall be cut perpendicularly to the pipe axis. Cutting at an angle should be avoided because it will cause bend in joining section.

b. Straight pipes may be bent into bend pipes with large radius, without using elbows.

(9) Refer to instructions given in "Water supply facilities construction work" with regard to wall penetrating and embedded pipes.

(10) Unless otherwise specified, ventilation pipes shall be provided at the top with ventilation louvers made of copper or strainers made of chrome-plated bronze.

(11) Vertical drainage pipes and vertical ventilation pipes shall be connected on the highest floor. And then vertical drainage pipes shall themselves be vertical ventilation pipes. Vertical ventilation pipes shall be connected to drainage pipes on the lowest floor.

(12) Vertical ventilation pipes and ventilation pipes on various floors shall be connected above the overflow level of various fixtures.

(13) Clean-outs should be provided at the ends of drainage pipes specified in drawings and other places instructed by the engineer.

(14) When raising a ventilation pipe from a horizontal drainage pipe, the angle from the axial line of the horizontal pipe to that of the ventilation pipe at the connection section shall be more than 45 degrees, and an angle of 45 to 90 degrees upward must be maintained from the gradient line of the horizontal pipe to the axial line of the ventilation pipe.

(15) Lead pipes must be bent in a circle. When connecting a branch pipe, it should be connected to the straight portion of the main pipe. The end of the branch pipe connected to the main pipe shall not protrude from the interior surface of the main pipe.

(16) When making a trap out of a lead pipe, its water seal depth shall be more than 50 mm.

19.3.4 Tests:

(1) Water filling test

Upon completion of piping work, close all connections between branch pipes and various plumbing fixtures and all other openings, and fill the whole system to the highest point with water. Leave it as it is for more than one

hour and conduct a water filling test in the presence of the Supervisor.

(2) Water-running test

The test shall be conducted in the presence of the Supervisor after connection to the drainage basin.

(3) The pumps must be thoroughly tested in accordance with instructions given in "Water supply facilities construction work".

19.3.5 Anti-sweat Covering and Painting:

(1) Should be carried out in accordance with instructions given in "Water supply facilities construction work".

(2) The thickness of anti-sweat covering shall be as follows:

Pipe diameter	Thickness (mm)
Under 40 mm	10
Over 50 mm	20

19.4 GAS SUPPLY AND GAS EQUIPMENT WORK:

Gas piping shall be made up to the scheduled governor position shown in the design drawing, and the pipe shall be plugged. The gas lead-in work from the gas main to the governor shall be a separate work.

19.4.1 Piping Material:

Steel pipe (galvanized steel) shall be used mainly as the piping material.

19.4.2 Piping Work:

(1) Piping shall comply correspondingly with the requirement provided in each item of this specification.

(2) Piping shall be graded properly. Its bottom and end shall be provided with the drain and the tees to be used for plug-stop as well as cleaning inside the pipe.

(3) Piping shall be laid at a clearance of 150 mm or larger from the electrical wire. If it has to be laid inevitably within that clearance, the electrical wire shall be covered with the porcelain tube or seggregated with the insulating partition.

(4) Piping shall be cocked off outside the building. Laying work to the indoor terminal shall be carried out by the separate contract.

19.4.3 Cover Coating of Pipeline:

(1) In case where the pipeline may break through or contact the floor and wall of corrosiveness and in case where it may be buried underground, it shall be covered with anti-corrosive coating made of asphalt jute winding. Other shielded areas shall be wound with anti-corrosion vinyl tapes.

(2) The exposed pipeline shall be undercoated by two layers for rust prevention and then finished with color paint by two layers.

19.4.4 Test:

After finish of the pipe laying work, pneumatic pressure test shall be conducted in the presence of the Supervisor by request of the gas supply enterpriser or by instruction of the Supervisor.

19.5 SANITARY FIXTURE WORK

19.5.1 Materials:

19.5.1.1 Pipes

a. Pipes attached to sanitary pottery shall be chrome-plated.

b. Refer to "Water supply facilities construction work" for other pipes than the listed above.

19.5.1.2 Valves, bibcocks and couplings

Refer to "Water supply facilities construction work" and "Drainage facilities construction work".

19.5.1.3 Sanitery pottery and accessories

a. Pottery shall be ordinary white pottery.

b. Details of anitary pottery and accessories shall be in accordance with drawings. All exposed portions of the accessories shall be chrome-plated.

c. All wood screws used on sanitary pottery and accessories shall be brass screws, whose exposed portions shall be chrome-plated.

d. The flushing system for urinals shall be of low tank system.

e. The flushing system for other closet shall be equipped with the flush valve.

f. Traps used for lavatory bowls and wash basins shall be chrome-plated.

g. A toilet paper holder shall be attached to each closet, and the holder shall be hard chrome-plated.

h. The mirror chamfered shall be 450 mm by 600 mm in size and 6 mm thick. Its back shall be given acid proof treatment. The mirror shall be firmly fitted to the wall with two chrome-plated brackets and rubber packings on both upper and lower sides.

i. Showers

The fixed type chrome-plated shower shall be furnished with the shower valve as its accessory.

19.5.2 Installation:

(1) Various apparatus to be installed must be correctly positioned according to detailed architecture drawings, under the supervision of the Supervisor.

(2) When installing an apparatus on a concrete or brick wall, use anchor bolts to be in good appearance.

(3) When wood bricks are used, apply preservative on them and attach the bricks firmly to the wall.

(4) When part of the pottery is embedded in concrete, an asphalt covering with a thickness of more than 3 mm must be provided over the entire contact surface of the pottery with the concrete or the cement mortar so as not to contact directly. With a pottery that pierces through the waterproof layer, the water layer shall be caused to make complate contact with the asphalt covering layer on the pottery.

(5) Installation of western style closets

In installing a western style closet, position it correctly, keeping the top surface as level as possible without leaving any shake.

(6) Installation of urinals

Urinals with traps shall be attached to the wall at the right position and at the correct height. They should be connected to drainage pipes using wall flanges (for lead pipes) of closet accessory fittings and be bolted together.

(7) Heights of various apparatus and fixtures

The standard heights of various apparatus and fixtures are as follows:

a.	Height of urinal	From floor to the top of apron	530 mm
b.	Height of wash basin	From floor to the top of apron	720 mm
c.	Height of lavatory bowl	From floor to the top of apron	760 mm
d.	Height of janitor's sink	From floor to the top of apron	683 mm

19.5.3 Tests:

After completion of the installation of water supply and drainage apparatus, conduct tests, in the presence of the Supervisor, by running water through the system.

19.6 SEPTIC TANK EQUIPMENT WORK:

19.6.1 Method

Night soil individual treatment, long-time aeration system

19.6.2 Object of treatment (number of persons)

(1) 400 persons tank x 1

(2) 200 persons tank x 1

19.6.3 Night soil volume

0.05 m^3/person-day

19.6.4 Water Quality

(1) BOD of inflow water : 260 ppm

(2) BOD of outflow water : 90 ppm

19.6.5 Structure

Unit product made of FRP; with concrete foundation for preventing floating-up

(1) 400-person tank blower 1.5 kW, 415 V, 3ϕ x 2 units
(1 unit out of them is spare)

(2) 200-person tank blower 0.4 kW, 415 V, 3ϕ x 2 units
(1 unit out of them is spare)

19.6.6 Water discharge pump

50ϕ x 100 ℓ/min x 5 mAq x 0.75 kW x 4 units
(2 units out of them are spare)

19.7 VIBRATION PROTECTION AND SOUND PROOF WORK

19.7.1 Vibration Protection Support for Piping:

a. Vibration protection rubber

Use vibration proof rubber which meets the specifications given. The rubber should have mounting screws on both sides or else it should be of the suspension type vibration protection rubber both of which receive compression loads. The hardness, size and the number of rubber pieces shall be calculated based on loads supported, with the natural frequency of the vibration protection system set at 10 Hz (600 c/m). The rubber shall be selected from standard products of the manufacture. Their supporting intervals shall be as specified in 19.2.2 (11). For horizontally running piping, turnbuckle type hangers and suspension type vibration protection rubber should normally be used. For independent piping, provide hangers and vibration protection rubber at the middle of the suspension bolts. For vertical pipes, use, in principle, round vibration protection rubber pieces with screws on both sides. In both independent piping and piping laid in parallel with others, provide the pipes with supporting fixtures and place vibration protection rubber pieces between the fixtures and the support fittings fixed to the structure. Suspension and supporting work shall be conducted in accordance with Paragraph 19.2.2. A common support system must not be employed for vibration protection piping and non-vibration protection piping. Exercise care least any vibration protection portion should come into contact with the structure or a non vibration protection portion. Also, full attention must be paid to hanger bolts and the supporting positions, so that load will work vertically to the vibration protection rubber.

19.7.2 Vibration Protection Coupligns for Piping:

Use flexible joints for those portions of the piping which pass through the expansion joint of the structure. Furthermore, a flexible joint shall be used on the delivery side of the water pump in order not to allow pump's vibration to be transmitted to the piping after the pump. (The vibration through water shall also be isolated.) Expansion joints shall be provided for the pipings on the inlet side and outlet side of the elevated water tank and of the water reservoir.

19.7.3 Vibrationproof Foundation for Equipment:

Vibrationproof installation shall not be made for pumps. But blowers for elevated water tank and for septic tanks shall be installed with vibration protection made using slotted vibration isolating rubber pads. Pads to be used shall provide suitable distortion and allowable load in both installed state and running state.

SECTION 20

VENTILATION AND AIR CONDITIONING

20.1 GENERAL

20.1.1 Scope of Works:

(1) Cooling/heating source equipment installation work
  (a) Refrigerator (Water chilling unit)
  (b) Pump
  (c) Well water equipment work (including boring work)

(2) Air handling unit, air duct and piping work
  (a) Air handling unit
  (b) Air duct
  (c) Piping

(3) Ventilation work
  (a) Ventilating fan
  (b) Air duct

(4) Automatic control work

20.1.2 Separate Works:

(1) All electrical works except secondary wiring for refrigerator
(2) Plumbing
(3) Outer louver (For O.A inlet and exhaust)
(4) Door grille

20.1.3 Spare Parts:

Consumable material necessary for continuous one year operation such as refrigerant and one year operation such as lubrication oil for all rotating machines, etc., shall be supplied.

Necessary spare parts for air filter shall be 10% of framing and 100% of filtering media and fan belt.

20.1.4 Inspection:

During installation work and after completion of work, apparatus, ducting, piping and accessories shall be tested to ensure functional operation.

Running test of refrigerator, air-handling units, fans and pumps shall be performed.

20.2 COOLING/HEATING SOURCE

20.2.1 Refrigerator:

Well water shall be utilized as the cooling/heating source, and chilled water shall be supplied from the gas-powered chiller installed in the machine room in a separate building.

20.2.2 Gas Powered Absorption Type Chiller:

(1) Capacity

The refrigerator must have following capacity.

a.	Cooling capacity	272,000 kcal/hr
b.	Refrigerant	Water and lithium bromide
c.	Chiller inlet temperature	12°C
d.	Chiller outlet temperature	7°C
e.	Condenser inlet temperature	26°C
f.	Condenser outlet temperature	36.4°C
g.	Chiller circulation water volume	910 ℓ/min
h.	Condenser circulation air volume	900 m^3/min
i.	Main motor	
	(a) Three phases induction motor	
	(b) Type	As per drawings
	(c) Rated input	11.5 kVA
	(d) Power source	415V x 3ϕ x 50 Hz

(2) General

a. An evaporator, absorber, 1st generator, 2nd generator, condenser, solution heat exchanger, gas combustion equipment, bleed air recovering equipment, canned motor pump, safety device, automatic capacity control device and other necessary accessories should be equipped with the machine.

b. The performance is to have sufficient capacity and to secure safety to satisfactorily realize the designed standards. The capacity controlling must cover stepless capacity adjustment.

(3) Automatic control system

Starting with light load and automatic operation with the rated capacity should be performed by automatically controlling the gas combustion rate with the thermostat located at the chilled water outlet.

(4) Operation control system

a. Method of starting and stopping

(a) For starting, the start button on the chiller operation panel shall be depressed after feeding chilled water and cooling water, and the gas monitor cock shall be opened after the prepurge end indicator lamp has lit up. Automatic operation starts as a result.

(b) For stopping, the stop button on the chiller operation panel shall be depressed and then the gas monitor - monitor cock shall be closed. All the equipment including chilled water pump and cooling water pump will stop automatically after a fixed length of time.

b. Following items should be prepared for the automatic safety device.

(a) Chilled water reducing and shut-off relay
(b) Refrigerant temperature relay
(c) First generator solution temperature, abnormal high pressure, abnormal liquid level drop relay
(d) Solution pump coil overheating and overcurrent relay
(e) Refrigerant pump coil overheating and overcurrent relay
(f) Blower overcurrent relay
(g) Air pressure drop relay
(h) Gas pressure drop relay
(i) Exhaust gas abnormally high temperature relay
(j) Misfire relay

(5) The devices contained in this equipment shall be as follows.

One unit each of evaporator, absorber, first generator, second generator and condenser; two units of solution heat exchanger; one refrigerant pump; one solution pump; one set of internal connecting piping and valves; one vacuum manometer; one set of automatic temperature controller (temperature controller, gas flow regulator valve, etc.); one set of gas combustion device (main burner for gas combustion, pilot burner, blower, etc.); one set of bleed recovery equipment; one operation panel; one set of security devices and instruments; lithium bromide solution of required volume; one set of bar thermometers; one set of sole plates; one tool box; one vacuum pump (for maintenance). Besides, one set of electrical parts such as lamps and fuses shall be prepared as spares.

(6) Structure

The evaporator and absorber shall be accommodated in a pair of cylinders, and heat transfer effect is increased by using copper fin tubes and copper bare tubes used for both of them.

20.2.2.1 Installation, insulation and painting of refrigerator

(1) Installation

The following item should be observed at installation of the refrigerator.

a. The admixture ratio of concrete foundation (150 mm) to be established on the floor should be 1:2.5:3.5.

b. Test on the air tightness will be performed after completing the on-site assembly in witness of the Supervisor.

(2) Insulation work

The first generator (body, smokestack, tube plate), first heat exchanger, solution piping and so forth shall be heat insulated with glass wool or rock wool (thickness 100 mm), and racking -- shall be made with stainless steel sheets (thickness 0.2 mm).

(3) Painting

The exposed iron parts shall be entirely coated with corrosion protection coating, and oil paint of the specified colors shall be applied in two coats.

(4) After assembling of the refrigerator at the factory, tests on the capacity, air tightness, noise and vibration should be performed at the trial operation. After this procedures, the machine will be delivered to the site. This installation work includes the delivery and operation adjustment.

20.2.3 Pumps:

20.2.3.1 Description of the pump

A. Chilled water pump

a.	Capacity	80ϕ x 910 ℓ/min x 34 m
b.	Motor	11 kW x 415V x 50 Hz x 3ϕ
c.	Type	Centrifugal pump
d.	Accessories	
	Pressure gauge	1 pc.
	Purge valve	1 pc.
	Funnel and cock for priming	1 set
	Coupling flange (with bolts)	2 sheets
e.	Quantity	2 units

B. Cooling water pump

a.	Capacity	100ϕ x 900 ℓ/min x 16 m
b.	Motor	3.7 kW x 415 V x 50 Hz x 3ϕ
c.	Type	Submarine motor pump
d.	Accessories	Pressure gauge 1
		Air bleeder valve 1
		Coupling flange (with bolts) 1 set
e.	Quantity	2 units

20.3 AIR CONDITIONING FACILITY

20.3.1 Air Conditioning Facility:

20.3.1.1 Air handling unit

A blower, cooler and air filter are built in the unit, and a motor is normally mounted on the casing. (As per design drawing)

(1) Operation of the blower is required to keep balanced rotating constantly without having any rolling. The material should be fine quality without any fault such as strain. The blower is driven by the motor by means of the V-belt, where vibration and noise to be generated should be weak. The noise generated by the blower should be as specified in 20.5.1.1(1) d(a) and less than 60 phon at the position of 1 m from the casing side.

(2) Cooler

a. Construction

(a) Cooling coil should have enough strength against interior water pressure, and should be required a little air resistance.

(b) Fins are plate type.
The connection of the fins with tube should be made mechanically or by plating method, so that heat transmission resistance of the contact may be minimum.

(c) Copper pipe and aluminum fins are used.
These should be fixed in a steel casing without leaving any bend.

(d) Header should be provided with taps for piping and air bent.

(e) After assembly at factory an air tightness test at 16 kg/cm^2 should be conducted.

b. Installation

Cooling coil should be mounted horizontally on a rack framed firmly.

(3) Air filter

The filter shall be removable, washable and reusable, using filtration material of chemical fibre of 5mm thickness for the standard type and same of 32 mm thickness for the high-efficiency type.

(4) Casing

The outer casing should be made with steel plate with thickness of more than 1.6 mm, and the outer surface should be melamine resin-baked finished. On the inner surface, 25 mm glass insulation board should be pasted in accordance with the instructions given by 20.7 is applied.

(5) Foundation and installation

In case of a floor installation, the air handling unit should be installed on a 150 mm thickness concrete foundation in accordance iwth the instructions given in 20.7. Canvas connections should be applied between the air inlet and the filter chamber, and also between the air outlet and the air outlet prenum chamber.

20.3.1.2 Enthalpy exchanger (Air to air)

a. Volume:

O.A. 8,470 m^3/hr

Ex.A 4,860 m^3/hr

b. Temperature exchange efficiency:

52 % and larger

c. Type:

As per design drawing.

d. Installation and others:

Shall correspond to 20.3.1.1 Air handling unit.

20.4 DUCT WORK AND PIPING

20.4.1 Duct Work:

(1) Rectangular duct

The duct should be made of galvanized steel sheet (JIS G3302) with the following specifications.

(a) Thickness and joints

Length of Long Side (mm)	Thick-ness (mm)	Connecting Flange		Rivet 4.5φ Pitch	Bolt 7.5φ Pitch
		Standard	Maximum Interval		
Under 450	0.6	L-25x25x3	3.6 m	65 mm	100 mm
460 ~ 1,000	0.8	L-30x30x3	2.7	65	100
1,010 ~ 1,750	1.0	L-40x40x3	1.8	65	100
1,760 ~ 2,500	1.2	L-40x40x5	1.8	65	100
Over 2,510	1.4	L-50x50x4	1.5	65	100

Care should be taken not to position the joint at pass-through section of the structure.

(b) Reinforcement

Thickness (mm)	Reinforcement Angle		Rivet 4.5φ Pitch
	Standard	Maximum Interval	
Under 0.6	L-25x25x3	1.8 m	65 mm
0.8	L-30x30x3	0.9	65
1.0	L-40x40x3	0.9	65
1.2	L-40x40x5	0.9	65
1.4	L-50x50x4	0.9	65

In case of that the length of long side is under 300 mm, standing seam may be utilized.

Height of Standing Seam	Interval of Standing Seam	Diameter of Rivet	Rivet Pitch
25 mm	0.9 m	4.5 mm	65 mm

(c) Metal parts and support metal parts

Duct Thickness (mm)	Support Angle	Metal Part		Support Metal Part Maximum Interval
		Steel Bar	Maximum Interval	
Under 0.6	L-25x25x3	9 mmφ	2.7 m	3.6 m
0.8	L-30x30x3	9	2.7	3.6
1.0	L-40x40x3	9	2.7	3.6
1.2	L-40x40x5	12	2.7	3.6
1.4	L-50x50x4	12	2.7	3.6

(2) Steel sheet round duct

(a) Thickness and joints

Diameter (mm)	Thickness (mm)	Connecting Flange		Rivet 4.5φ Pitch	Rivet 7.5φ Pitch
		Standard	Maximum Interval		
Under 300	0.5	L-25x25x3	3.6 m	65 mm	100 mm
310 ~ 600	0.6	L-25x25x3	3.6	65	100
610 ~ 900	0.8	L-30x30x3	2.7	65	100
910~1,250	1.0	L-40x40x3	1.8	65	100

Care should be taken not to position the joint at a passthrough section of the structure.

(b) Reinforcement

Diameter	Reinforcement Angle	Maximum Interval
610 ~ 900 mm	L-30x30x3	2.4 m
910 ~ 1,250	L-30x30x3	1.8

(c) Suspension metal part and support metal part

Diameter	Flat Bar	Metal Part	Support Metal Part Maximum Interval
Under 1,500 mm	25 x 3 m	9 mmφ	3.6 m

(3) Vibration protection and sound proof

(a) Vibration protected suspension

The duct passing through or passing directly under the floors of studios, sub-control room and machine rooms for air conditioning or ventilating (including sound attenuation room) should be suspended with vibration protected support at the part in accordance with 20.7.

For the duct passing through the parts other than the mentioned above, same vibration protected suspension is required, for the steel sheet duct, of which long side is over 500 mm.

(b) Vibration protection and sound proof duct

The vibration protection and sound proof duct specified in 20.7 should be employed when the ducts pass through walls, floors and ceilings of the studios, sub-control room or machine rooms. At the pass-through part other than the above mentioned, the insulation material's surface on the duct should be clamped with galvanized steel sheet with brim (25 mm) and mortar should be filled sufficiently. In case the duct has no insulated covered surface, same procedure should be taken after applying adiabatic material to the pass-through part. The pass-through part should be minimized, and the both ends should be connected with flange.

(c) Vibration protection of duct

For the pass-through part of duct at the inside of studios, rubber made flexible joint or double canvas connection with about 100 mm length should be used. In the latter case, insulation work should be applied for it in accordance with 20.4.3.

For the contact part between the duct and the blower or air handling unit, where the duct passes through, the vibration protection work as mentioned above should be performed.

20.4.2 Duct Accessories:

(1) Air control damper

a. The damper casing should be made of steel plate with thickness of over 2.0 mm having flanges at the both ends. The blade should be made with galvanized steel sheet over 0.6 mm thickness.

b. Operation of the damper should be precise without vibration. When it is opened, air resistance should be minimum.

c. At the pass-through part of the damper shaft on the side board of air duct, bearing should be provided.

d. The manual operated large sized damper should be operated by means of a handle. Smooth operation of the interlocking mechanism should be secured. For the manual operated small sized damper, an open-shut indicator made of cast iron or bronze should be provided.

e. The damper should not be provided at the pass-through part of the structure.

(2) Supply air grille and return air grille

a. Supply air grille

(a) The grille should be punched steel plate made or a fixed blade type grille having specified area.

(b) Air supply resistor

The blade should be made of thick steel plate, brass or alminium plate.

(c) Ceiling air diffuser

Steel, brass or alminium plate should be used.

(d) Mounting of grille

At the part on which the grille to be mounted, a shutter made of thin steel plate should be provided without spoiling the outside appearance, where air leakage should be prevented.

(e) Manufacturing of grille

The drawing should be approved by the Supervisor in charge.

b. Return air grille

(a) Grille

It should have specified effective area.

(b) Mounting

At backside of the part on which the grille to be mounted, a shutter should be provided and should be prevented air leakage from circumference part of the grille.

(c) Manufacturing

The manufacturing drawing should be approved by the Supervisor in charge.

c. Hood

The hood should be galvanized steel sheet made specified in JIS G3302, and the operating part should be reinforced with shape steel. The hood should have the shape and measurements enabling effective discharge of waste gas.

(3) Sound absorbing duct

a. Sound absorbing elblow

It should be made with galvanized steel sheet, and the outside part should be right angled while the inner part should be arc shaped. The acoustic lining should be applied. See design drawings for details of exterial appearance, dimensions, etc.

b. Sound absorbing chamber

The chamber should be made with galvanized steel sheet having specified measurements. The acoustic lining should be applied. When the measurement is not specified, the cross sectional measurement should be over two times of cross sectional measurement or diameter of the duct. The length should be over 1.5 times of

diagonal line or diameter of the duct. The nominal size is the inner measurement after applying the lining. See design drawings.

20.4.3 Insulation Work:

Supply, return and air intake ducts in each air conditioning system should be insulated as follows.

(1) Material

Rock wool insulation board or glass wool insulation board should be used.

(2) Works

a. Thickness of insulation material

Supply duct	Over 25 mm
Return duct	Over 25 mm
Air intake duct	Over 25 mm

b. Mounting of insulation material

On the surface of duct, one copper rivet should be soldered for each 200 cm^2. On them, the insulation material with specified thickness should be placed and be fixed by metal washers. After covering it with cotton cloth, primary painting in two times should be applied.

c. Mortar finish

The duct passing through the specified spaces should be covered by asphalt paper and be finished with 25 mm mortar plaster after applying the above mentioned insulation.

d. Others

For the part applied with acoustic lining, insulation is not required. The connecting part of adiabatic duct and acoustic lining duct should overlapped with the length of 100 mm. The end should be sticked to the duct's steel sheet with adhesive tape.

20.4.4 Painting:

(1) Duct

a. Duct with insulation, for the exposed part of adiabatic duct, vinyl paint with specified color should be applied in two times and for the concealed part, primary painting should be applied, in two times.

b. For the mortar finished part, primary painting should be applied, in two times.

c. Duct without insulation

Oil paint with specified color should be applied in two times.

d. Flat black paint should be applied on the interior surface of a duct, at the connection portion of the duct with an outlet or an inlet.

(2) Duct accessories

a. Air control damper

For the damper casing, anti-corrosive paint should be applied in two times. For the exposed part, oil paint with specified color should be additionally applied in two times.

b. Supply air grille and return air grille

(a) For the steel plate, melamine baked finish with specified color should be applied.

(b) For the alminium made, no painting is required.

(c) Shutters of the grilles should be painted with flat black paint.

c. Suspension metal parts and support metal parts

After removing rust, anti-corrosive paint should be applied in two times. For the exposed part, oil paint with specified color should additionally be applied in two times.

20.4.5 Piping:

20.4.5.1 Material

(1) Pipe and joint

a. The galvanized steel pipe specified in JIS G3452 (Steel pipe for piping) should be used.

b. The mariable cast iron pipe joints or steel pipe joints should be used. When dismantling is needed, flange joints should be used but union joints should not be used. The flange 10 kg/cm^2 should be employed.

(2) Valves

a. Sluice valve

For the diameter under 50 mm, bronze made screw type should be employed, while for over 65 mm, flange type having cast iron body and bronze made operating part should be used (10 kg/cm^2). Principally, outer screw type should be employed.

b. Check valve

The check valve should be of antishock type or equivalent. For other positions, bronze made screw type should be employed for the diameter under 50 mm, while for over 65 mm, flange type having cast iron body and bronze operating part should be employed (10 kg/cm^2).

c. Float valve

The body should be bronze made while the ball should be copper plate type. For the diameter over 40 mm, double valve flange type should be employed, while for under 32 mm, screw type should be used.

d. Safety valve

The valve shall be of flange type, steel-made structure except the element part made of bronze.

20.4.5.2 Piping work

(1) General

a. Connection of pipe

Screw connection, flange connection and welding connection should be adopted.

(a) Taper screws should be used. When incrassant is required, it should be applied for only a plus screw. Lead red mixed firmly with vegetable oil can be used.

(b) Welding should be performed by a welder.

(c) Before connection work, the inside of pipe should be cleaned. After piping works, the ends of pipes should be temporarily plugged to prevent intrusion of foreign materials.

b. Support of pipe

All piping with over 34 mm diameter except for drainage which is not connected with a pump, should be suspended with vibration protection method or be supported in the same way. However, when pipings are supported by ceilings, floors or walls of the studios, sub-control room or machine rooms, the pipings should totally be vibration protected. For the vibration protection, follow the instructions given in 20.7 (Vibration protection · Sound proof works). The intervals of the support metal part are given below.

Diameter of Pipe	Under 50 mm	65 ~ 200 mm	Over 250 mm
Interval	1,800 mm	3,600 mm	5,400 mm

c. Pipe passing through the structure

A sleeve inserted should be removed after concrete work. The pipe should be covered by insulating cover and then be covered by steel sheet with collar. After these procedures, the pass-through section should be sufficiently filled with mortar from the both ends. Before fillings mortar, the position of pipe should be properly adjusted so that the load of pipe will not affect to the pass-through section directly. If necessary, support should be provided.

d. Flexible joint

(a) For expansion jointing parts of building, flexible joints should be employed.

(b) For the connecting part with equipment which generates vibration (refrigerator, pump, etc.), a flexible joint should be applied. The size should be used in accordance with 20.7.

e. Sealing plate, decorated cover

Principally, the pipings should be concealed. For the exposed part in a room, chrome plated sealing plate made of brass should be used for the pass-through section of ceiling, floor & wall. For the ends of piping insulation, chrome plated decorated cover made of brass should be used.

(2) Water piping work

a. Connection of pipe

When a flange is used, asbestos joint sheet with thickness under 1.5 mm of which main material is asbestos, or packing made of fine quality rubber should be used. For the surface of packing, vegetable oil mixed with lead red or graphite should be applied, but hard paint should not be applied.

b. Slope

Piping should be horizontally installed to prevent air trap. When it can't be installed horizontally, an automatic air release valve or cock can be provided subject to approval of the Supervisor.

c. Water pressure test

The pressure should be 8 kg/cm^2 at the checking proceeded after applying the pressure over 30 minutes.

20.4.5.3 Insulation work

(1) Chilled water piping insulation

a. Material

Insulation cover made of rock wool or glass wool should be used. Rings made of the material such as styrofoam which is free from deformation, shall be used for supporting fittings and suspension fittings.

b. Thickness of insulation material

Pipe Diameter	Under 32 mm	40 ~ 125	Over 150
Thickness of insulation material	30 mm	40	50

c. Mounting of insulation material

Insulation material with specified thickness should be mounted, and it should be fastened with galvanized wire with the count over 0.8 mm and then wind the water proof paper on it. Then it should be bandaged by cotton cloth with the doubled part over 15 mm, and primary painting should be applied in two times.

d. Insulation of flanges and valves

Same insulation with the straight pipe should be applied.

e. Outdoor piping

For outdoor pipings, the cotton cloth as mentioned above should be replaced with asphalt jute. After hardening the piled part by heating, it should be covered by galvanized steel sheet (thickness 0.4 mm) with soldered connection.

(2) Mounting of bands

For the insulated part, stainless steel or brass made chrome plated band should be mounted on the straight pipe with the gap of 2 m, the branching and curved parts. At the ends of insulation material, band with the same material should be mounted.

20.4.5.4 Painting

(1) Non-insulated part

Galvanized steel pipe

Oil paint with specified color should be applied in two coats after application of two coats of corrosion protection paint on welded areas, flaws and on areas where plating has been exfoliated.

(2) Insulated part

a. Galvanized steel pipe
After covering it with cotton cloth for extending, oil paint should be applied in two times.

b. Galvanized steel sheet covered part
Oil paint with specified color should be applied in two times.