

**BENAZIR BHUTTO SHAHEED
INSTITUTE OF MANAGEMENT
SCIENCES DADU**

REVISED TENDER DOCUMENTS

**AIRCONDITIONING SYSTEM
AND ANCILLARY WORKS
RIGHT WING GROUND FLOOR
FOR
BENAZIR BHUTTO SHAHEED
INSTITUTE OF MANAGEMENT SCIENCE DADU**

PRINCIPAL ARCHITECT

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HVAC CONSULTANT

DESIGN-O-TECH
BUILDING SERVICES
DESIGN CONSULTANT
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Project No. DOT1117

SUKKUR, FEBRUARY 2020.

SECTION - 01

**AIR CONDITIONING AND ANCILLARY WORKS
RIGH WING GROUND FLOOR
FOR
BENAZIR BHUTTO SHAHEED
INSTITUTE OF MANAGEMENT SCIENCE DADU**

TENDER

(The tenderers are required to fill in all the blank spaces in the tender, memorandum & various schedules which form part of this tender)

To

BBSIMS C/O IBA COMMUNITY COLLEGE DADU,
PMU OFFICE, NAJAM COLONY,
DADU
SINDH

Dear Sirs,

1. Having examined the tender documents, conditions of contract, specifications, schedules, site conditions and addenda Nos._____ for the above named works, we, the undersigned offer to supply the whole of the said works in all respects in accordance with the said tender documents, conditions of contract, specifications, schedules, and addenda Nos._____ and in all respects in accordance with the conditions as far as applicable for the sum named in the memorandum or such other sum as may be ascertained in accordance with the said conditions of contract.

2. In consideration of your agreeing to examine this tender, we undertake if our tender is accepted:

- (a) to commence the work within the period named in the memorandum from written orders to commence and to complete whole of the works

comprised in the contract within the periods specified in the memorandum.

- (b) within fifteen days of your requiring us to do so to provide a surety or sureties (to be approved by you) to be jointly and severally bound with us in the sum named in the memorandum for the due performance of the contract under the terms of a performance bond on the form specified in the tender documents with such modifications as you may accept at any time before the expiration of that period.
- (c) to abide and fulfil all the terms and provisions of the said conditions of contract or in default thereof to forfeit and pay to you the sums of money mentioned in the memorandum.

3. The earnest money has been tendered as per details given in the memorandum, the full value of which is to be absolutely forfeited by you, without prejudice to any other rights and remedies which you may have, should we fail to commence the work or execute the performance bond, within the periods specified above, otherwise the said sum of earnest money shall be repaid by you when the performance and bond been duly entered into and executed by us on acceptance of our tender.

4. We hereby confirm that we have examined the contract documents and specifications, have inspected the site and have obtained all the information which may affect this tender. We understand that no claim will be admitted by you which may arise from our pleading ignorance of the nature of works. We further fully understand that the time is the essence of the contract.

5. We agree to abide by this tender for the period stated in the memorandum from the date of opening of the tenders and it shall remain binding upon us and may be accepted in full or part at any time before the expiration of that period.

6. Unless and until a formal agreement is prepared and executed, this tender, together with your written acceptance thereof and tender documents, shall constitute a binding contract between us and shall be deemed for all purposes to be the contract agreement.

7. We understand that certain information applicable to the contract which is the subject of this tender is set forth for ease of reference in the memorandum annexed hereto.

8. We understand that you are not bound to accept the lowest or any tender you may receive, and that you will not defray any expenses incurred by us in tendering.

Dated this-----day of-----2020

Signature-----

in the capacity of-----

duly authorised to sign tenders for and on behalf of

(Full Address)-----

Witness-----

Address-----

Occupation-----

MEMORANDUM

- | | |
|---|---|
| (a) Title of work to be endorsed on the sealed package of the tender. | Air Conditioning And Ancillary Works Right Wing Ground Floor For

BENAZIR BHUTTO
SHAHEED INSTITUTE OF
MANAGEMENT SCIENCE DADU
SINDH. |
| (b) Tendered price of the works. | Rs.-----

(Rupees-----

-----)

-----) |
| (c) Validity of tender. | 120 days from tender date |
| (d) Amount of earnest money. | 2% of total bid value |
| (e) Validity of earnest money guarantee. | 90 Days |
| (f) Details of Bank Draft/Pay Order for earnest money in the name of and payable to
"Sukkur IBA University" | ----- |
| (g) Percentage of retention money deduction on gross amount from running and final bills. | Ten percent |
| (h) Limit of retention money. | Ten percent of total contract cost |
| (i) Minimum amount of interim certificate. | Rs. 300,000.00 |
| (j) Period of interim certificate. | One Month |
| (k) Time within which payment to be made after certificate. | One Month |

(l)	Date of commencement from the written orders to commence.	Immediately
(m)	Time of completion from the written orders to commence.	
	1. All Piping/Ducting and Electrical Wiring etc.	08 Weeks.
	2. All Contractor supplied equipment and allied works	14 Weeks
	3. Painting, Flushing & Miscellaneous Works	Within 3 Weeks after completion Of respective installation.
	4. Testing, Commissioning, Operation, Balancing and handing over of complete systems.	Within 2 Weeks after installation work is completed
(n)	Period of maintenance.	12 months from the date of issuance of Certificate of Substantial Completion of Works .
(o)	Period of test run.	One Month
(p)	Amount of liquidated damages per day in case of non-completion in the periods specified in clause (m) hereof.	Rs. 10,000.00
(q)	Maximum amount of liquidated damages.	10% of total contract value
(r)	Amount of Performance Bond.	10% of total contract value
(s)	Amount of Mobilization Advance payable against furnishing of a Bank/Insurance Co. Guarantee.	Upto 15% of the total cost of materials and installation.
(t)	Against Bill of Landing of Imported Items.	25%
(u)	After equipment installation at Site as per As per Design Load.	25%
(v)	After testing and commissioning.	15%
(w)	After one month Test Run.	20%

(x) Amount of third party insurance
(minimum for any one accident for
loss of property and/or life). Rs.1,000,000.00

(y) Venue of arbitration. Sukkur

Dated this-----day of-----2020

Signature-----

in the capacity of-----

duly authorised to sign tenders for and on behalf of

(Full Address)-----

Witness-----

Address-----

Occupation-----

Item No.	Description	Qty.	Unit	Cost of Materials		Cost of Labour		Total Cost Col. 6+8
				Rate	Amount	Rate	Amount	
1	2	3	4	5	6	7	8	9
	Design, supply, installation, testing and commissioning of Heat and Cool Multi-Split type (Variable Refrigerant Flow VRF) Air conditioning system consisting of, but not limited to, the following equipment, material and devices. Please see the list of approved manufacturer.							
1	VRF OUTDOOR UNITS							
	A)Supply and installation VRF Outdoor Units with factory applied protection coating against corrosion, complete with automatic & safety controls, all accessories, 410A refrigerant charge, oil charge, complete in all respect as per given schedule and specifications. Outdoor Unit operating range should not be less than 52 degree centigrade dry bulb temperature. Select through software the outdoor unit at 52 degree centigrade for specified rating. (Software presentation would be need)							
	i) ODU#G-2 (12.5 TR)	1	Nos.					
	ii) ODU#G-7 (27.5 TR)	1	Nos.					
	iii) ODU#G-8 (17.5 TR)	1	Nos.					
	iv) ODU#G-9 (13 TR)	1	Nos.					
	v) ODU#G-10 (24 TR)	1	Nos.					
2	VRF INDOOR UNITS							
	A)Supply, installation, testing and commissioning of following types of FCUs complete with fan, fan motor, terminal box, thermostat, universal type remote controller, control valves, cleanable air filter,condensate lift pump, supports, hangers, accesories and appurtenences complete in all respect as per drawing and given schedule.							
	i)Casette type units							
	IDU 4-way Casseette type 1 TR	0	Nos.					
	IDU 4-way Casseette type 1.25 TR	0	Nos.					
	IDU 4-way Casseette type 1.5 TR	12	Nos.					
	IDU 4-way Casseette type 1.75 TR	10	Nos.					
	IDU 4-way Casseette type 2 TR	14	Nos.					
	IDU 4-way Casseette type 2.5 TR	8	Nos.					
	IDU 4-way Casseette type 2.75 TR	4	Nos.					
	IDU 4-way Casseette type 3 TR	0	Nos.					
	ii) Wired Controller complete with wiring and box concealed in wall.							

Item No.	Description	Qty.	Unit	Cost of Materials		Cost of Labour		Total Cost Col. 6+8
				Rate	Amount	Rate	Amount	
1	2	3	4	5	6	7	8	9
	a) Wired Individual	10	Nos.					
	b) Wired Grouped Controller (Minimum 4 units)	14	Nos.					
	iii) Wireless Remote Controller	24	Nos.					
3	REFRIGERANT PIPING (GAS AND LIQUID)							
	a) Refrigerant Piping. Supply and installation of hard drawn seamless following type and sizes Copper refrigerant piping with 3/8" aerofoam foamed insulation, piping kits, oil traps where necessary, complete with fittings and silver soldered joints. (all refrigerant piping shall be carried out under the supervision of VRF A/C equipment supplier). Pipes to be of KEMBLA / Australia.							
	TYPE L							
	1/4"	250	Rft					
	TYPE K							
	3/8"	270	Rft					
	1/2"	387	Rft					
	5/8"	361	Rft					
	3/4"	151	Rft					
	7/8"	94	Rft					
	1-1/8"	455	Rft					
	1-3/8"	127	Rft					
	1-5/8"	41	Rft					
	b) Pipe tray							
	i) 4"x4" insulated tray, Insulation thickness 3/8" bottom and vertical surfaces.	398	Rft					
	ii) 6"x4" insulated tray, Insulation thickness 3/8" bottom and vertical surfaces.	425	Rft					
	iii) 6"x4"tray covered	40	Rft					
	iv) 12"x4" tray covered	123	Rft					
	c) Different sizes of Y-Connections of liquid/gas piping	46	Sets					
	d) Unit rate of extra gas charging with supply.	55	kg					
	e) protection to exposed piping with canvas cloth, antifungus paint, and 28g G.I cladding.	130	Rft					
5	CONDENSATE DRAIN PIPING							

Item No.	Description	Qty.	Unit	Cost of Materials		Cost of Labour		Total Cost Col. 6+8
				Rate	Amount	Rate	Amount	
1	2	3	4	5	6	7	8	9
	Supply and installation of uPVC Class D condensate drain piping for VRF AC equipments upto drain points 1/4" felt insulation & 8 oz. canvas jacketing, painting & finishing.							
	1+1/2" dia	512	Rft					
	3/4" dia	639	Rft					
6	SHEET METAL DUCT WORK							
	The work includes supply & installation including cutting, fitting, fixing & cleaning, making wall opening, fixing wall & slab sleeve, hangers & supports etc. a) Rectangular Ducting GI sheet metal low pressure ducting including splitter dampers, take offs, elbows and other necessary fittings, wall/slab sleeves, connections with fan coil unit including neoprene coated flexible duct connectors, air devices and other equipment complete with all bracings, hangers, supports, access doors, leakage testing etc. and ready for operation in all respect.							
	26 Gauge (Rate Only)	0	Sqft.					
	24 Gauge	450	Sqft.					
	22 Gauge	0	Sqft.					
	20 Gauge	0	Sqft.					
	18 Gauge (Rate Only)	0	Sqft.					
7	THERMAL INSULATION ON AIR DUCTS							
	a) Supply and installation of 1" thick Fiberglass thermal insulation of 24kg/Cum for air ducts, plenum and sheet fabrications complete with vapour barrier fixing adhesive compound, self adhesive aluminium foil reinforcement tape, metal bands, 4 oz cloth jacketing above false ceiling, finishing and painting with 2 coats of Zahabiya ZSAC 10/55 antifungus fire retardant sealing adhesive, of ACI/Arabian Fiberglass/ Izocam / Johns-Manville / Kimmco / Owens Corning manufacture or approved equal.	0	Sqft.					
	b) Supply and installation of 1-1/2" thick Fiberglass thermal insulation of 24kg/Cum for air ducts, plenum and sheet fabrications complete with vapour barrier fixing adhesive compound, self adhesive aluminium foil reinforcement tape, metal bands, 4 oz cloth jacketing above false ceiling, finishing and painting with 2 coats of Zahabiya ZSAC 10/55 antifungus fire retardant sealing adhesive, of ACI/Arabian Fiberglass/ Izocam / Johns-Manville / Kimmco / Owens Corning manufacture or approved equal.	0	Sqft.					

Item No.	Description	Qty.	Unit	Cost of Materials		Cost of Labour		Total Cost Col. 6+8
				Rate	Amount	Rate	Amount	
1	2	3	4	5	6	7	8	9
	c) Supply and installation of 2" thick Fiberglass thermal insulation of 24kg/Cum for air ducts, plenum and sheet fabrications complete with vapour barrier fixing adhesive compound, self adhesive aluminium foil reinforcement tape, metal bands, 4 oz cloth jacketting above false ceiling, finishing and painting with 2 coats of Zahabiya ZSAC 10/55 antifungus fire retardant sealing adhesive, of ACI/Arabian Fiberglass/ Izocam / Johns-Manville / Kimmco / Owens Corning manufacture or approved equal.	0	Sqft.					
8	AIR DEVICES							
	Supply and installation of following types of Air Devices including connections with air ducts and support arrangements.							
	Fresh Air Grill							
	9"x9"	0	Nos.					
	16"x10"	0	Nos.					
	Exhaust Air Grill							
	9"x9"	15	Nos.					
	14"x12"	0	Nos.					
9	FANS							
	Supply and installation of following types of fresh air fans,Exhaust fans,transfer air fans,ventilation fans with support arrangements and electrical wiring and industrial dimmer or speed controller.							
	a)Exhaust Air fans,1000 cfm	2	Nos.					
	b)Exhaust Air fans,800 cfm	1	Nos.					
	b)Exhaust Air fans axil type ,200 cfm (glass window)	2	Nos.					
10	ELECTRICAL AND CONTROL WORKS							
	a) Supply and installation of all electrical wiring in conduit/cable tray from MCCs to respective inddor units.							
	1x3C-2.5 sq.mm	1320	Rft					
	b) Supply and installation of all electrical cabling from main to MCCs, to ODUs and all infrastructure cabling including burried in ground, riser with cable ladder.							
	1x4C-300sqmm CU/PVC/PVC CABLE (From main LT-Panel, located at ground to HVAC DB at Roof)	700	Rft					

Item No.	Description	Qty.	Unit	Cost of Materials		Cost of Labour		Total Cost Col. 6+8
				Rate	Amount	Rate	Amount	
1	2	3	4	5	6	7	8	9
	1x1C-150sqmm CU/PVC EARTH CABLE (From main LT-Panel, located at ground to HVAC DB at Roof)	700	Rft					
	1x4C-25sqmm CU/PVC/PVC CABLE (From HVAC DB to MCC-01)	128	Rft					
	1C-10sqmm CU/PVC EARTH CABLE (From HVAC DB to MCC-01)	128	Rft					
	1x4C-70sqmm CU/PVC/PVC CABLE (From HVAC DB to MCC-02)	46	Rft					
	1C-35sqmm CU/PVC EARTH CABLE (From HVAC DB to MCC-02)	46	Rft					
	1X4C-120sqmm CU/PVC/PVC CABLE (From HVAC DB to MCC-03)	160	Rft					
	1C-70sqmm CU/PVC EARTH CABLE (From HVAC DB to MCC-03)	160	Rft					
	1X4C-120sqmm CU/PVC/PVC CABLE (From HVAC DB to MCC-04)	97	Rft					
	1C-70sqmm CU/PVC EARTH CABLE (From HVAC DB to MCC-04)	97	Rft					
	1X4C-10sqmm CU/PVC/PVC CABLE (From MCC-01 to ODU -G2)	10	Rft					
	1C-4sqmm CU/PVC EARTH CABLE (From MCC-01 to ODU -G2)	10	Rft					
	1X4C-25sqmm CU/PVC/PVC CABLE (From MCC-02 to ODU -G10)	13	Rft					
	1C-10sqmm CU/PVC EARTH CABLE (From MCC-02 to ODU -G10)	13	Rft					
	1X4C-35sqmm CU/PVC/PVC CABLE (From MCC-03 to ODU -G7)	23	Rft					
	1C-16sqmm CU/PVC EARTH CABLE (From MCC-03 to ODU -G7)	23	Rft					
	1X4C-25sqmm CU/PVC/PVC CABLE (From MCC-04 to ODU -G8)	21	Rft					
	1C-10sqmm CU/PVC EARTH CABLE (From MCC-04 to ODU -G8)	21	Rft					
	1X4C-16sqmm CU/PVC/PVC CABLE (From MCC-04 to ODU -G9)	21	Rft					
	1C-6sqmm CU/PVC EARTH CABLE (From MCC-04 to ODU -G9)	21	Rft					
	c) Supply, installation & connection of the following MCB/MCCB DBs / ATS with all mounting accessories and as per specifications & drawings, complete in all respect/wall mounted.							
	i) 1200A 4POLE M.C.C.B (ADJ.) IN M.S BOX	1	Job					
	ii) AUTO TRANSFER SWITCH CONSIST OF 2x1200A 4POLE AC-1 TELEMACHNOQUE BRAND MAGNETIC CONTRACTOR WITH 2NOS. TIMERS (0-15 SEC.) PHASE EVERSIBLE & PHASE FAILURE RELAY ETC. ON WAPDA CONTACTOR WITH COMPLETE BY-PASS SYSTEM WITH M.O.R	1	Set					
	iii) Main LT-PANEL	1	Set					
	iv) MAIN HVAC DB	1	Set					
	v) MCCs							

Item No.	Description	Qty.	Unit	Cost of Materials		Cost of Labour		Total Cost Col. 6+8
				Rate	Amount	Rate	Amount	
1	2	3	4	5	6	7	8	9
	MCC-01	1	Set					
	MCC-02	1	Set					
	MCC-03	1	Set					
	MCC-04	1	Set					
	d) Cable Tray Perforated covered, exposed to outdoor environment.							
	1'-6" X 0'-4" G.I PERFORATED CABLE TRAY 16 S.W.G	550	Rft					
	1'-0" X 0'-6" G.I PERFORATED CABLE TRAY 16 S.W.G	128	Rft					
	e) Cable Ladder							
	1'-6" X 0'-6" CABLE Ladder	60	Rft					
	f) UPVC CLASS D PIPE BURRIED FOR MAIN POWER CABLE							
	i) Diameter 6 Inch	1400	Rft					
	ii) Diameter 4 Inch	1400	Rft					
	g) Electrical Manholes	12	Nos.					
	h) Control/ Communication Wiring	1320	Rft					
	j) Central Control Unit, with BMS with remote site monitoring. Remote Monitoring BMS should be with Energy Management system i.e. Power Data	1	Set					
11	Cost of testing, starting-up, commissioning, balancing, adjusting & handing over of complete system as per specifications.	1	Job					
12	Produce all electrical and control wiring, DB/MCC diagrams	1	Set					
13	Produce Shop drawings.	1	Set					
14	Produce as built drawings.	1	Set					
15	Essential Spare Parts (See Appendix I attached)	1	Lot					
16	Maintenance Tools (See Appendix II attached)	1	Lot					
17	Lifting/ Shifting/ Rigging of all Equipments of ACMV to specified locations	1	Job					
18	Providing necessary uniform, safety equipment (PPE) to workers throughout the project duration.	1	Lot					
19	Supply, installation, mini split air conditioner complete with gas charging, refrigerant piping, insulation, drain piping, electric and control wiring for following capacities for tropical region. (Brands: Mitsubishi/Toshiba/Hitachi. Origin:Japan)							
	Cassette Type							
	1.5 TON	5	Nos.					
	2.0 TON	5	Nos.					

Item No.	Description	Qty.	Unit	Cost of Materials		Cost of Labour		Total Cost Col. 6+8
				Rate	Amount	Rate	Amount	
1	2	3	4	5	6	7	8	9
20	Supply, installation, close control split A/C unit, dual system operation complete with gas charging, refrigerant piping, insulation, drain piping, electric and control wiring for following capacities for tropical region. Capacity 3TR. (Brands: Mitsubishi/Toshiba/Hitachi. Origin:Japan) OR Approved Equal	1	Set					
19	Training of technical operation and trouble shooting for electrical and mechanical Staff of HVAC equipment and software	1	Lot					
20	Service Toolkits for indoor AC units	3	sets					
TOTAL COST OF TENDER Rs.								

Item No.	Description	Qty.	Unit	Cost of Materials		Cost of Labour		Total Cost Col. 6+8
				Rate	Amount	Rate	Amount	
1	2	3	4	5	6	7	8	9
<p>NOTES</p> <p>1. The contract shall be awarded on item rate basis.</p> <p>2. The quantities listed above are generally approximate and are for the guidance of the tenderer only and shall not be taken as actual and correct quantities of work to be executed by the Contractor in fulfillment of his obligations under the contract. The Contractor shall work out the quantities from drawings and mention any deviation in quantities mentioned above. The Contractor shall be paid for the actual quantities of work executed by him ascertained by measurements in accordance, with the contract.</p> <p>3. The Employer may opt to supply any of the materials at site free of cost to the Contractor. The cost of such items shall be deleted from the contract cost. The Contractor shall be responsible for careful storage and consumption of these materials and he will be responsible for any loss or damage thereto. All surplus materials on completion of the installation shall be handed back to the Employer by the Contractor.</p> <p>4. The Employer may opt. to delete any item or increase the quantity of certain items. The cost of deleted items shall be deleted from the Contract cost. The rates quoted shall be firm for the duration of the Contract and the increased/decreased quantities of the items shall be adjusted as per rates quoted.</p> <p>5. (a) In case of air ducting work, the payment for ducting and duct thermal insulation whose rates are given on per square feet basis shall be on basis of the surface area of sheet metal duct. Reducers shall be measured at average size and bends, elbows, etc. at the centerline radius.</p> <p>(b) In case of piping and piping thermal insulation, the payment shall be on Rft basis measured at the centerline of piping at the rate given according to N.B. of piping.</p> <p>6. The work shall be executed in accordance with the drawings, including manufacturers' drawings and conform with the Tender Specifications complete in all respects as required and to the entire satisfaction of the Engineer/Consultants.</p>								

SECTION - 03
INSTRUCTIONS TO TENDERERS

01. DOCUMENTS

0101. The following is the list of tender documents issued to each prequalified tenderer:

1. Form of Tender and Memorandum.
2. Schedule of Item wise Prices or Bill of Quantities (for item rate contracts).
3. Instructions to Tenderers.
4. General Conditions of Contract.
5. Special Conditions of Contract.
6. Specifications.
7. Schedule of Quantities (for lump sum contracts).
8. Schedules.
9. Annexures:
 - A. Specimen of Tender Earnest Money Guarantee.
 - B. Form of Contract Agreement.
 - C. Form of Performance Bond.
 - D. Specimen of Mobilization Advance Bond.
 - E. List of Approved Insurance Companies.
10. Drawings.

0102. All prequalified tenderers are required to acknowledge receipt of the tender documents and confirm that they would be submitting their tender within the stipulated time.

02. TENDERERS TO BE CONVERSANT WITH THE DOCUMENTS

0201. The tenderers will be expected to read all the above documents and be conversant with their contents and when tenders are made it will be inherent in the signing of the tenders that all the documents have been read and understood. Any difficulty experienced in interpreting the documents may be communicated to the Employer and the Engineer in writing and should any written clarification be required it will be made available by the Engineer to all tenderers.

03. ADDENDA

0301. Addenda may be issued, prior to the date set for submission of tenders, to

clarify the tender documents or to effect modifications in the contract terms or designs of the works. Every addendum issued will be distributed to each prequalified tenderer to whom tender documents have been issued, and shall become a part of the tender documents. Receipt of each addendum must be acknowledged by the tenderer on the form issued with the addendum.

04. **DOCUMENTS TO BE SUBMITTED WITH TENDER AND GENERAL CONDITIONS APPLICABLE TO TENDER**

0401. The tenderer is required to complete:

(a) Form of Tender and Memorandum.

(b) The Schedule of Itemwise Prices (or Bill of Quantities), with every Item legibly priced in ink and with the columns added up to the exact total amount of the tender (both in words and figures).

0402. The tenderer shall return duly completed and as appropriate to the works following Schedules:

(a) For lump sum contracts, the Schedule of Item Rates upon which his tender has been based. This Schedule shall serve to determine any variations and omissions.

(b) For the purpose of assessing day work for labour and/or materials not covered in the above referred, Schedule of Labour Rates shall be completed. On this Schedule the tenderer shall indicate the net cost(s) of labour, together with the percentage(s) he wishes to be applied, to cover all charges, insurance, holidays, use of tools and tackle, over-heads and profit etc.

(c) The Schedule of Working Hours.

0403. The tenderer shall not make any alteration in the form of tender or to any other of the printed documents.

0404. Each tenderer should submit two copies of his detail quotation complete with necessary details, specifications, manufacturers' technical bulletins for the equipment quoted and manufacturers' capacity and performance guarantee certificates for all the main equipment, and any other plans or drawings required to explain his tender.

0405. The tenderer must only base his tender for supply of brand new equipment and stores of latest standard design and robust construction made according to the latest manufacturing practices.

0406. The tenderer shall quote against each item his minimum and final prices including where required, minimum foreign exchange requirements.

0407. The tenderer shall keep his tender firm and final in all respects and open for acceptance in full or in part for the period stated in the Memorandum from the date of tender opening.

0408. Tenders which are incomplete, conditional, obscure, or containing uncalled additions, erasures, alterations, over writings or irregularities may be rejected.

0409. The tenderer must return to the Consultant all the tender documents and drawings issued to him on or before the tender due date if he is not submitting his tender.

05. **SUBMISSION OF TENDER**

0501. The set of complete tender documents, drawings and addenda addressed to ----- must be delivered in person or sent by registered mail to-----

in plain sealed double package, the inner package endorsed on the outside with the words "Tender for ----- due on ----- at-----" so as to reach upto ----- on -----and the tenders will be opened at ----- on -----in the presence of those tenderers who may be present at the time of tender opening.

0502. The tenders may be modified, corrected or withdrawn at any time prior to the date set for receipt of tenders upon submission of a request in writing to that effect, signed in the same manner and by the same person(s) who signed the tender.

06. **INFORMATION TO ACCOMPANY TENDERS**

0601. Each tenderer should check that he has completed and/or supplied the following when submitting his tender:

	<u>Section-03</u>
	<u>Clause No.</u>
(a) Form of Tender and Memorandum.	0401
(b) Schedule of Itemwise Prices or Bill of Quantities.	"

(c)	Schedule of Item Rates. (for lump sum contracts)	0402
(d)	Schedule of Labour Rates.	"
(e)	Schedule of Working Hours.	"
(f)	Two copies of detail quotation, etc.	0404
(g)	Earnest Money.	07
(h)	Nomination of proposed surety/sureties.	0902
(i)	Tenderer's constitution.	14
(j)	Tenderer's official address.	15
(k)	Preliminary programme of works.	16
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07. **EARNEST MONEY**

0701. In order to secure the due performance by the tenderer of the obligations undertaken by him, the tender must be accompanied by a deposit as mentioned in the Memorandum.

0702. Each deposit must be made either:

(a) By a Pay Order or Demand Draft of a scheduled Bank in favour of the Employer.

(b) By a confirmed and irrevocable Guarantee, specimen annexed, of a scheduled Bank in favour of the Employer which should be valid for the period stated in the Memorandum from the date on which tenders are opened.

0703. No tender will be considered unless it is so secured. This deposit shall be refunded to the tenderers whose tender is not accepted on the expiration of the specified period of validity or at such earlier time as a tender shall have been accepted by the Employer and a Performance Bond furnished by the tenderer whose tender is

accepted.

0704. The earnest money provided by the tenderer whose tender is accepted shall be repaid or discharged when the Contract Agreement and Performance Bond have been duly entered into and executed by the tenderer and his surety.

0705. If the tenderer whose tender is accepted fails to provide a Performance Bond and execute the Contract Agreement at his own expense within fifteen days of being requested to do so, the full amount of his earnest money shall stand forfeited, without recourse, and shall be the absolute property of the Employer.

08. **QUANTITIES AND PRICING OF THE SCHEDULE OF ITEMWISE PRICES OR BILL OF QUANTITIES**

0801. The attention of the tenderers is particularly drawn to clause 34 of the General Conditions of Contract. The Bill of Quantities or Schedule of Itemwise Prices must be priced as it stands.

0802. The tenderers should note that:

In the event of there being a discrepancy between the "rate" and "amount" entered for any item in the Bill of Quantities or Schedule of Itemwise Prices, the "rate" will be taken as correct and the amount will be adjusted accordingly when the tender is being examined.

09. **FORMAL CONTRACT AND PERFORMANCE BOND**

0901. The tenderer whose tender is accepted will be required to enter into a Contract Agreement in accordance with clause 0501 of the General Conditions of Contract, and to provide a surety or sureties in accordance with clause 0502 of the General Conditions of Contract and to jointly execute a Performance Bond, specimens annexed.

0902. Tenderer shall submit with his tender the names and addresses of the proposed surety/sureties for the Performance Bond and particulars of the modifications (if any) which he would seek to make in the annexed specimen of the Performance Bond.

10. **TIME OF COMPLETION**

1001. The Contractor shall be required to complete the works progressively within the times stipulated in the Memorandum of the tender. Time shall be the essence of the contract.

11. **VISIT TO SITE**

1101. The tenderers should visit the site and satisfy themselves as to the accessibility thereof, the local conditions, the construction and occupation of the buildings, the full extent and nature of the operations, the conditions affecting the supply of labour, carriage, carting, unloading, storage and safe custody of materials, the scaffolding, tackle and tools necessary, the supply of light, power and water and the execution of the contract generally. Claims on the grounds of want of knowledge in such respects or otherwise shall not be admitted.

12. **SUPPLY OF MATERIALS BY THE EMPLOYER**

1201. The Employer reserves the right to supply any of the materials required for the execution of the works. The Contractor shall take deliveries of these goods at site, unpack, examine and store them, give receipt in detail and return all empty cases, packing, etc. from whence the materials were dispatched.

1202. The Contractor shall be responsible for safe storage and for any loss or damage caused to the materials handed over to him.

13. **INCLUSIONS AND INCIDENTALS**

1301. The tenderer will include for providing materials and incidentals which may be inferred from drawings and/or specifications, in order to ensure a complete and perfect installation although the same may not be expressly indicated or mentioned.

14. **CONSTITUTION OF ORGANIZATION TENDERING**

1401. The tenderer must deliver to the Employer with his tender, copies notarially authenticated of the documents defining the constitution of the company or firm by which the tender is submitted, so as to show by what persons and in what manner a contract may be entered into by the company or firm and what persons would be directly responsible for the due performance of the contract and can give valid receipt on behalf of the company or firm. The tender shall be signed only by such person(s).

1402. Any correction or alteration in the tender must be signed in full by the same person(s) who signed the tender for and on behalf of the tenderer.

1403. Tender must be signed or sealed or otherwise executed in such a manner that it will be binding on the tenderer. Tenders not so executed may be rejected.

15. **TENDERER'S ADDRESS TO BE SUPPLIED**

1501. The tenderer must give with his tender the address at which notice may validly be served on him. National Tax Number Certificate also to be supplied.

16. **PRELIMINARY PROGRAMME OF WORKS**

1601. Tenders must be accompanied by a preliminary Programme of Works consisting of a bar chart.

1602. The bar chart must show the order in which the tenderer proposes to construct the various parts of the works, and the dates on which it is proposed that the several principal operations or features will be started and completed.

17. **LAYOUT OF TEMPORARY WORKS**

1701. Tender must be accompanied by drawing(s) showing the tenderer's proposed layout of temporary works, including the layout of his construction camps, maintenance shops, store yards, offices, etc.

18. **CONSTRUCTIONAL PLANTS**

1801. The tender must be accompanied by a descriptive list of the major items of constructional plant which the tenderer proposes to use on the contract. The capacity, expected output, power and type of motive power must be given where applicable. The description must include details of the age, condition, location and ownership of each item or in the case of items proposed to be purchased, the expected delivery dates.

19. **LABOUR AND STAFF REQUIREMENTS**

1901. The tenderer must furnish separate lists of approximate number of labourers, semi-skilled workmen, skilled workmen, foremen, supervisors, engineers and staff that the tenderer proposes to employ during the period of construction.

1902. The tenderer must give the maximum electric power and daily water quantity which he will require during construction period.

20. **LIST OF PROPOSED SUB-CONTRACTORS**

2001. Tenders must be accompanied by a list stating those parts of the works or temporary works which the tenderer proposes to sub-let.

21. **SPECIFICATIONS**

2101. The Contractor shall execute the works with materials in accordance with the specifications or if not specified, in accordance with the latest British/American Standard Specifications or Codes of Practice. All materials which, in the opinion of the Engineer are unsound and/or do not meet with the above conditions shall be

immediately dismantled and/or removed from site by the Contractor at the request of the Engineer and replaced by appropriate approved material(s) without claim by or extra payment to the Contractor.

2102. The specifications are to be read in conjunction with the latest relevant British/American Standard Specifications and Codes of Practice. It shall be inherent in the interpretation of all clauses of the contract documents that wherever British Specifications or Codes are referred to they shall be deemed to be the British or American Specifications or Codes and vice-versa. Where differences or contradictions appear to arise between the British and American Specifications or Codes, these differences or contradictions shall be referred to the Engineer for a decision.

2103. When there is any deviation between any item or material offered and the above standards, the tenderer shall clearly draw attention to all such deviations and no such item or material shall be supplied by the Contractor without prior written approval of the Engineer.

22. **DRAWINGS**

2201. Unless expressly stated, drawings prepared by the Engineer or Consultant shall not be binding as to detail.

2202. All drawings accompanying the specifications, are to explain each other and are to be considered as a whole. Any work(s) indicated on the drawings and not specifically mentioned in the specifications and vice-versa are deemed to be included.

2203. The tenderer will, before tendering, carefully examine all drawings and specifications forming part of the tender and should any technical or other discrepancy appear, he will immediately inform the Engineer to obtain his ruling.

2204. The tenderer shall carefully check the sizes of the plant rooms and sufficiency of shaft, passage and trench sizes shown in the drawings for various installations and confirm that the offered equipment, systems, piping, ducting, wiring etc. can be installed in the respective spaces allocated for the same.

2205. Structural drawings and details can be inspected at the site upon written application being made to the Engineer.

23. **SHOP DRAWINGS**

2401. The tenderer is to include for the preparation of all shop drawings (working drawings) which will be required for the proper execution of the works. All working

drawings shall be submitted to the Engineer or Consultant for approval before executing the work.

24. **FINAL AS-INSTALLED DRAWINGS**

2401. After completion of the installation, the Contractor is to provide reproducible transparencies (quality to be approved by the Consultant) and three copies each of as-installed drawings showing runs and locations of all the plants, equipment, systems, piping, electric wiring, controls, components, etc. giving all necessary details of the work as actually installed including buried work.

25. **TRAINING OF EMPLOYER'S STAFF**

2501. The Contractor shall make suitable arrangement at his own cost to train the operational and maintenance staff of the Employer during the installation and maintenance periods according to the General Conditions of Contract.

26. **INSPECTION**

2601. The Employer reserves the right to arrange inspection of all the items prior to their dispatch through an Inspector appointed by the Employer. The inspection will be comprehensive for quality and quantity including supervision of packing and loading of inspected goods. The inspection charges will be borne by the Employer. The tenderer need not, unless otherwise stated, make any provision for the Inspector's fees in his tender. The Employer shall, however, not make any extra payment to the Contractor or his suppliers for any expense incurred by them in connection with the inspection.

27. **PRICES**

2701. The tenderer shall give a firm price for the supply of all items and materials (free delivery at site) and the cost of manufacture, fabrication, construction, assembly, installation, testing, commissioning and adjusting etc. to complete the works in working order in all respects.

2702. The Contractor shall be responsible, without additional charge to the Employer, for maintenance and servicing of the complete installation for the period of maintenance named in the Memorandum after the issue of Certificate of Substantial Completion by the Engineer. The Contractor shall during the period of maintenance, service the complete systems atleast once a month according to a schedule approved by the Engineer and carry out one complete annual servicing and overhauling of the complete systems near the end of the period of maintenance.

2703. In case of lump sum contracts (as specified in the tender documents), the tenderer shall give a total lump sum price for the complete works as specified and required and total price should be given without any extra or additional items or alternatives.

2704. Import of Equipment and Materials by the Employer.

(a) In case it is specified in the Schedule of Itemwise Prices or Bill of Quantities, that the Employer shall directly import some items required for the work, the tenderer shall quote his minimum prices for these items in foreign currencies on C&F Pakistan Port basis.

(b) The Employer shall establish irrevocable and confirmed letters of credit in favour of the Contractor's foreign suppliers and arrange clearances of these items at his own cost and deliver the same at site to the Contractor for completing the work.

(c) The tenderer shall give confirmed periods of shipments for the imported items and in case of any delay by the Contractor (or his suppliers), liquidated damages shall be imposed according to the conditions of contract.

(d) The Contractor shall be responsible for safe storage and any loss or damage caused to the imported items handed over to him by the Employer. All surplus items on completion of work shall be handed over to the Employer in good condition by the Contractor.

28. **PAYMENTS**

2801. Running payments in respect of the cost of the local items, equipment and materials and labour charges shall be made to the Contractor according to the progress of the work on the certificate of the Engineer in terms of the evaluations based on the break-up of the tender and of the percentages thereof. Retention money and other amounts shall be deducted from the gross amount of each Bill according to the terms of the contract. Not more than one running Bill would be submitted by the Contractor in one month and the minimum billing amount would be as named in the Memorandum.

29. **ACCEPTANCE**

2901. Promptly after opening of the tenders, the Employer will undertake a detailed study and appraisal of the tenders submitted. The Employer does not bind himself to award the contract to the lowest or to any tenderer but will take into careful

consideration the tenderer's price and other applicable factors. Once the Employer has arrived at a decision regarding the award of the contract, successful tenderer will be informed in writing of the Employer's intent to enter into a contract for the performance of the works. The successful tenderer will be required to attend the Office of the Engineer within a week of the date of receipt of such Notice of Award, with proper power of attorney for the purpose of entering into and executing a Contract Agreement in the form annexed in the tender documents with such alterations or additions thereto as may be required to cover the works.

30. **RIGHTS**

3001. The Employer reserves the right to reject any or all tenders without assigning any reason thereof, and to waive any formalities in the tenders received (such as deviation in the use and presentation of the specified tender documents and forms), if it appears to be in the best interests of the Employer to do so.

3002. The tender documents and drawings are the exclusive property of "Design-o-Tech", Consulting Engineers, and are subject to be recalled and must not be used, lent, copied or reproduced by anybody without their written permission.

SECTION - 04

GENERAL CONDITIONS OF CONTRACT

01. DEFINITIONS

0101. In construing the contract, these conditions, other documents and the interpretations, the following words and expressions shall have the meaning herein assigned to them, except where the subject or context otherwise requires.

0102. "Owner"/"Employer" means benazir bhutto shaheed institute of management science, and shall include their administrative and legal rep., assigns or successors.

0103. "Engineer" means The **PROJECT ENGINEER, BBSIMS DADU.** or such other person(s) appointed for this purpose by the Employer for the time being or from time to time to perform the duties set forth in clause 07 hereof and notified in writing to the Contractor.

0104. "Consultant" means **Design-o-Tech, Consulting Engineers,** and includes their duly authorized representatives or such other person(s) as may be appointed for this purpose by the Employer and notified in writing to the Contractor.

0105. "Engineer's Representative" means the person(s) for the time being or from time to time duly appointed by the Engineer to act under the instructions of the Engineer to perform the duties set forth in clause 08 hereof and notified in writing to the Contractor.

0106. "Contractor" means the tenderer whose tender has been accepted by the Employer and shall include his legal and personal representatives, successors and permitted assigns.

0107. "Contractor's Agent" means the person or Project Engineer duly appointed by the Contractor and approved by the Engineer to perform the duties set forth in clauses 1102 and 1103 hereof.

0108. "Main Contractor" means the Building Contractor appointed by the Employer to carry out the Building construction work.

0109. "Contract" means the Agreement contained in the Contract Agreement and the documents set out in the Contract Agreement as forming part thereof.

0110. "Contract Price" means the sum named in the paragraph of the tender subject to such additions thereto or deductions therefrom as may be made under the provisions of the contract.

0111. "Retention Money" means the sums retained pursuant to clause 36 hereof.

0112. "Site" means the site of the works and the lands, other places, building and erections thereon, over, under, in or through which the works are to be executed or carried out and any other land (inclusively) as aforesaid allotted by the Employer to the Contractor's use.

0113. "Works" means all the works to be executed in accordance with the contract and includes the whole of the works, materials, matters and things required to be done, furnished and performed by the Contractor under the contract.

0114. "Temporary Works" means all temporary works of every kind required in or about the construction, completion or maintenance of the works.

0115. "Programme of Works" means the programme of works submitted by the Contractor and approved by the Engineer pursuant to clause 09 hereof including any amendments thereto from time to time approved by the Engineer.

0116. "Material" includes all plants, equipment, instruments, materials, commodities, articles and things required to be furnished under the contract for incorporation in the works.

0117. "Constructional Plant" means all appliances, equipment, tools, instruments or things of whatsoever nature required in or about the execution, completion or maintenance of the works or temporary works but does not include materials or other things intended to form or forming part of the permanent works.

0118. "Specifications" mean the specifications included in the contract. The nomenclature of all the items in the Bill of Quantities or Schedules of Itemwise Prices, Rates and Quantities shall be read with and will include the detail description in the relevant parts of the specifications. In case there is no definite provision in the specifications, then British/American Standard Specifications and Codes of Practice shall be followed in the same order.

0119. "Drawings" mean the drawings referred to in the contract or specifications and any modifications of such drawings prepared by the Consultant and approved by the Engineer and such other drawings as may from time to time be furnished to the Contractor as approved by the Engineer.

0120. "Commissioning" means putting the complete plant and equipment into full operational service, and compliance with the specifications as set forth in these documents.

0121. "Tender Date" means the date by which the tenders are required to be delivered to the Employer.

0122. "State Laws" has the meaning assigned in clause 14 hereof.

0123. "Suspension Order" has the meaning assigned in clause 31 hereof.

0124. "Variation Order" means an order made pursuant to the provisions of clause 32 hereof.

0125. "Certificate of Completion" means a certificate given pursuant to the provisions of clauses 3005 and 3007 hereof.

0126. "Period of Maintenance" has the meaning assigned in clause 3501 hereof.

0127. "Approved" means approved in writing including subsequent written confirmation of previous oral approval, and "Approval" means approval in writing including such written confirmation.

0128. "Notice in Writing" has the meaning assigned in clause 42 hereof.

0129. "Month" means a calendar month.

0130. The singular includes the plural and vice versa. The masculine includes the feminine and vice versa. Words importing persons include firms, companies or other bodies corporate.

02. **EXTENT OF CONTRACT**

0201. The contract comprises the manufacture, supply, construction, assembly, installation, completion, testing, commissioning, adjusting and maintenance of complete works including supply of all materials, plants and equipment as per requirements of design contained in the contract drawings, specifications and documents.

0202. And except in so far as the contract otherwise provides, the provision of all labour, materials, constructional plant, temporary works and everything whether of a temporary, permanent or incidental nature required in and for such manufacture, supply, construction, assembly, installation, completion, testing, commissioning, adjusting and maintenance so far as the necessity for providing the same is specified in or can reasonably be inferred from the contract.

03. **ASSIGNMENT AND SUB-LETTING**

0301. The Contractor shall not assign the whole of the contract or any part thereof or any benefit or interest therein or thereunder without the prior written consent of the Employer.

0302. The Contractor shall not sub-let the whole of the contract. Except

where otherwise provided by the contract, the Contractor shall not sub-let any part of the contract without the prior consent of the Engineer (which shall not be unreasonably withheld) and such consent if given shall not relieve the Contractor from any liability or obligation under the contract and he shall be responsible for the acts, defaults and neglects of any sub-contractor, his agents, servants, or workmen as full as if they were the acts or defaults or neglects of the Contractor, his agents, servants or workmen. Provided always that the provision of labour on piecework basis shall not be deemed to be subletting under this clause.

04. **CONTRACT DOCUMENTS**

0401. The contract shall be read, construed and interpreted according to the English language and shall operate in conformity with the laws of the Islamic Republic of Pakistan.

0402. Except if and to the extent otherwise provided by the contract the provisions of these conditions of contract shall prevail over those of any other documents forming part of the contract. Subject to the foregoing the several documents forming the contract are to be taken as mutually explanatory of one another but in case of ambiguities or discrepancies the same shall be explained and adjusted by the Engineer who shall thereupon issue to the Contractor instructions directing in what manner the work is to be carried out. Provided always that if in the opinion of the Engineer compliance with these instructions is the cause of any expense which by reason of any such ambiguity or discrepancy the Contractor did not and had reason not to anticipate, the Engineer shall certify and the Employer shall pay such additional sum as may be reasonable to cover such expense.

0403. The drawings shall remain in the sole custody of the Engineer but two copies thereof shall be furnished to the Contractor free of cost. The Contractor shall provide and make at his own expense any further copies required by him.

0404. One copy of the drawings shall be kept by the Contractor on the site and the same shall at all reasonable times be available for inspection and use by the Engineer, Consultant, Engineer's Representative and by any other person authorised by the Engineer in writing.

0405. The Consultant/Engineer shall supply to the Contractor from time to time during the progress of the works such further drawings, specifications and instructions as shall be necessary for the purpose of the proper and adequate execution and maintenance of the works and the Contractor shall carry out and be bound by the

same. The Contractor shall give adequate notice in writing to the Engineer or the Consultant for issue of any such further drawings, specifications or instructions that the Contractor may consider necessary.

0406. The Contractor shall prepare at his own expense any shop drawings (working drawings) which will be required for the proper execution of the works or for interpretation of the Engineer's drawings for the use of his employees. The Contractor shall submit the shop drawings to the Consultant for approval before any work is carried out.

0407. The Contractor shall check all drawings immediately they are supplied to him and promptly notify the Engineer and Consultant if any errors or omissions are discovered.

0408. The contract drawings and such other drawings as may be furnished to the Contractor during the progress of the works shall be considered as illustrating the specifications. If the Contractor shall find any discrepancy in or divergence between the contract specifications, drawings and/or Bill of Quantities or Schedule of Quantities, he shall immediately refer the same in writing to the Engineer and specifically apply in writing for any necessary instructions from the Engineer in relation thereto.

0409. None of the documents hereinbefore mentioned shall be used by either of the parties hereto for any purpose other than the contract and neither the Employer nor the Contractor shall divulge or use except for the purpose of this contract any information in the priced Schedules of Item wise Prices or Item Rates or Bill of Quantities.

0410. The Contractor shall retain in his office all necessary drawings, data and calculations for the works in methodical manner and shall produce them whenever required by the Engineer, Consultant or Engineer's Representative.

05. **GENERAL OBLIGATIONS**

0501. The Contractor shall when called on to do so enter into and execute a Contract Agreement at his own cost in the form annexed with such modifications as may be approved by the Employer.

0502. The Contractor shall provide a surety or sureties approved by the Employer to be jointly and severally bound with the Contractor to the Employer for the due performance of the contract by the Contractor under the terms of a Performance Bond, specimen annexed and approved by the Employer in the amount specified in the Memorandum of the tender.

0503. The Contractor shall be deemed to have satisfied himself before

tendering as to the correctness and sufficiency of his tender and the rates and prices shall except in so far as it is otherwise expressly provided in the contract cover all his obligations under the contract and all matters and things necessary for the proper completion and maintenance of the works.

0504. The Contractor shall execute, complete and maintain the works in strict accordance with the contract to the satisfaction of the Engineer and the whole of the materials, plant, equipment and labour, other things to be provided by the Contractor pursuant to the contract and the mode, manner and speed of execution and maintenance of the works are to be of a kind and conducted in a manner to the satisfaction the Engineer.

0505. The Contractor shall comply and adhere strictly to the Engineer's instructions and directions on any matter (whether mentioned in the contract or not) touching or concerning the works. The Contractor shall take instructions and directions only from the Engineer or (subject to the limitations of clause 08) from the Consultant and Engineer's Representative.

06. **RETURN OF DOCUMENTS**

0601. The tender documents, specifications and drawings are to be returned by the tenderers to the Engineer without fail on the tender due date whether the tender is submitted or not.

07. **POWERS OF THE ENGINEER**

0701. The Contractor shall carry out the works under the directions of the Engineer and to his satisfaction. The directions and approvals given on site by the Consultant and Engineer's Representative shall be deemed by the Contractor as that of the Engineer (subject to the limitations of clause 08).

0702. The Engineer/Consultant's decision in respect of quality of materials and workmanship and interpretation of the specifications will be final and shall be accepted by the Contractor. Any other matters may be referred to arbitration by the Contractor if he wishes to dispute the Engineer's decision upon such matters.

0703. The Engineer may from time to time give further instructions and directions as may be necessary for the guidance of the Contractor and the proper execution of the works. The Engineer may alter the situation, or vary the form or character of any of the work in the contract or omit or add to the works.

0704. If any verbal instructions, directions or explanations involving a

variation are given to the Contractor or his Agent upon the works by the Engineer, Consultant or Engineer's Representative, such instructions, directions or explanations shall be confirmed in writing by the Contractor to the Engineer within seven days and, if not dissented from in writing by the Engineer to the Contractor within a further seven days, shall be deemed to be the Engineer's instructions.

0705. If compliance with the Engineer's instructions involve the Contractor in loss or expense beyond that provided for in or reasonably contemplated by the contract, then, unless such instruction were issued by reason of some breach of the contract by the Contractor, the amount of such loss or expense shall be ascertained by the Engineer and shall be added to the contract price.

0706. If within seven days after receipt of a written notice from the Engineer requiring compliance with the Engineer's instructions, the Contractor does not comply therewith, the Employer may employ and pay other persons to execute any work whatsoever which may be necessary to give effect to such instructions and all costs incurred in connection therewith shall be recoverable from the Contractor by the Employer as a debt or may be deducted by him from any monies due or to become due to the Contractor under the contract.

0707. Such variations, omissions or additions will not vitiate the contract and will be the subject of adjustment to the contract price if it is the cause of any difference in expense.

0708. The Engineer/Consultant will have the power to withhold the issue of any certificate for interim payment if the works are not being carried out to his satisfaction.

0709. In measuring, valuing, deciding or certifying, the Engineer is not intended to act as an arbitrator, but as an Engineer acts by his skill and from his knowledge of the facts and incidents connected with the contract and in so far as any facts are not within his own knowledge, the Engineer shall be at liberty to inform himself by inquiry of Consultant or any other person or as he may consider necessary. The Engineer shall at all times be considered to be aware of all facts necessary for him to form his own opinion, make his measurements or valuations, give his decisions and order, make his requisitions or give or refuse his certificate and he shall be at liberty to certify at such times and in such manner as in his discretion he may think proper and he shall not be bound to give any reason for or any particulars of his certificate or any reason for his not certifying.

08. **DUTIES AND POWERS OF THE ENGINEER'S REPRESENTATIVE**

0801. The duties of the Engineer's Representative are to watch and supervise the works and to test and examine any materials to be used or workmanship employed in connection with the works. He shall have no authority to relieve the Contractor of any of his duties or obligations under the contract, nor to make any variation order except as expressly provided in the contract, nor to order any work involving delay or any extra payment by the Employer.

0802. Subject as aforesaid the Engineer's Representative shall have any of the powers and authorities vested in the Engineer which the Engineer may for the time being have delegated in writing to the Engineer's Representative. The Engineer shall furnish to the Contractor a copy of all such written delegations of powers and authorities and also of any revocation thereof. Any written instruction or approval given by the Engineer's Representative to the Contractor within the terms of such delegations (but not otherwise) shall bind the Contractor and the Employer as though it has been given by the Engineer.

0803. Provided always as follows:

- (a) Failure of the Engineer's Representative to disapprove any work or materials shall not prejudice the power of the Engineer thereafter to disapprove such work or materials and to order the pulling down or breaking up thereof.
- (b) If the Contractor shall be dissatisfied by reasons of any decision of the Engineer's Representative he shall be entitled to refer the matter to the Engineer who shall thereupon confirm reverse or vary such decision.

09. **PROGRAMME OF WORKS**

0901. The Contractor shall within thirty days after the acceptance of his tender submit in writing:

- (a) For approval of the Engineer and Consultant a Programme of Works in the form of a bar chart showing the order of precedence and method in which he proposes to carry out the works, and
- (b) For the information of the Engineer and Consultant full particulars of the organization and staff by which he proposes to direct and administer his performance of the contract.

0902. The Programme which the Contractor is required to furnish shall be such as to allow the completion of the whole works by the completion date given in the Memorandum of the tender.

0903. The Programme shall cover the full period of works from the date of the acceptance of the tender to the completion of installation, commissioning, testing, adjusting and handing over of the complete works in working order. The Programme shall cover the sequence of work for all items showing separately in each case the time allowed for manufacturing, shipment, delivery to site, fabrication, construction, assembly, installation, testing, commissioning, adjusting, commencement of regular operation and handing over of the complete works in working order.

0904. The Programme should aim at completion of one fourth, one half and three fourths of the whole of the works before one fourth, one half and three fourths respectively of the whole time has elapsed.

0905. The Programme submitted by the Contractor shall be amended if any part or whole of it is not to the satisfaction of the Engineer and Consultant and it shall not be carried into effect until it has been approved (in an amended form if necessary) by the Engineer and Consultant.

0906. If the Engineer and Consultant under the provision of this clause require the Contractor to amend his Programme of Works, the Contractor shall not thereby be entitled to any adjustment in contract price or to any extension of time.

0907. The Contractor may at any time during the period of the contract submit to the Engineer and Consultant for their approval proposals for amending the Programme of Works. Such amendments shall not be carried out into effect unless they have been approved by the Engineer and Consultant.

0908. The Contractor shall furnish in writing such further information concerning his arrangements for the carrying out of the works and of the constructional plant or temporary works he intends to supply, use or construct and of his arrangements for the direction and administration of his performance of the contract as the Engineer or Consultant may from time to time require.

0909. The submission to or approval by the Engineer or Consultant of such Programme or the furnishing of such particulars or information shall not relieve the Contractor of any of his duties or responsibilities under the contract.

10. **LIQUIDATED DAMAGES FOR DELAY**

1001. If the Contractor shall fail to complete the works within the time prescribed by the clause 30 hereof then the Contractor shall pay to the Employer the sum stated in the Memorandum of the tender as liquidated damages for such default and not as a penalty for every day which shall elapse between the time prescribed by

clause 30 hereof and date of completion of the works subject to the maximum amount of liquidated damages stated in the Memorandum of the tender. The Employer may without prejudice to any other method of recovery deduct the amount of such damages from any moneys in his hands due to or which may become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the works or from any other of his obligations and liabilities under the contract. 1002. The Contractor shall be required to arrange shipments of imported items progressively as per the programme prescribed in the contract. Provided the Employer has established confirmed and irrevocable letters of credit in favour of the foreign suppliers of the Contractor in time in accordance with the contract, the shipment period(s) shall not be extended and in case any shipment is delayed, the completion period of the works will not be extended and the Contractor shall be liable to pay liquidated damages, as per clause 1001 hereof, for the delay he causes in the completion of the works.

1003. If before the completion of the whole of the works, any part of the works has been certified by the Engineer as completed pursuant to clause 3005 hereof and occupied or used by the Employer, the liquidated damages for delay shall, for any period of delay after such certification, be reduced in proportion which the value of the part so certified bears to the value of whole of the works.

1004. To ensure good progress during the execution of the works, the Contractor shall be bound to complete one fourth, one half and three fourths of the whole of the works before one fourth, one half and three fourths respectively of the whole time allowed in the contract has elapsed. In the event of the Contractor failing to comply with the Engineer's instructions for progressive completion within respective times, he shall be liable to pay liquidated damages, as per clause 1001 hereof, for the delay he causes.

11. **CONTRACTOR'S SUPERINTENDENCE, AGENT AND EMPLOYEES**

1101. The Contractor shall give or provide all necessary superintendence for the proper fulfilling of the Contractor's obligations under the contract.

1102. A competent and duly authorised Agent (Project Engineer or Representative) of the Contractor approved by the Engineer (which approval may at any time be withdrawn) and who shall have full authority to act for and bind the Contractor is to be constantly at the site of work and shall give his whole time to the superintendence of the works.

1103. The Agent shall receive on behalf of the Contractor directions and instructions from the Engineer or (subject to the limitations of clause 08) the Consultant or Engineer's Representative.

1104. Correspondence between the Contractor or the Agent and the Engineer, Consultant or the Engineer's Representative shall be in English.

1105. The Contractor shall provide and employ on the site for the purpose of or in connection with the contract:

- (a) Only such Engineers, Supervisors, technical assistants as are skilled and experienced in their respective callings and such sub-agents, foremen and leading hands as are competent to give proper supervision to the work they are required to supervise, and
- (b) Such skilled, semi-skilled and unskilled labour as is necessary for the proper and timely performance of the contract.

1106. The Engineer shall be at liberty to object to and require the Contractor to remove forthwith from the site the Agent or any other person employed by the Contractor or any sub-contractor who in the opinion of the Engineer mis-conducts himself or is incompetent or negligent in the proper performance of his duties or whose employment is otherwise considered by the Engineer to be undesirable and such person shall not be again employed for the purpose of or in connection with the contract without the written permission of the Engineer. Any person so removed shall be replaced immediately by a competent substitute approved by the Engineer.

12. **WATCH AND CARE OF WORKS**

1201. Except as otherwise specifically provided in the contract the Contractor shall make all arrangements for the security and protection of persons and property or for the safety or convenience of persons it is necessary or required by the Engineer or Engineer's Representative or by any duly constituted authority, and provide and maintain all lights and watching.

1202. From the commencement to the completion of the works the Contractor shall take full responsibility for the care thereof and of all temporary works, materials, constructional plant and other things brought on the site by the Contractor for the purposes of the contract and in case any damage loss or injury shall happen to the works or any such materials or constructional plant or other things from any cause whatsoever (save and except the excepted risks e.g. outbreak of war or act of invasion) he shall at his own cost replace, repair and make good the same so that at completion the works shall be in good order and condition and in conformity in every respect with

the requirements of the contract and the Engineer's instructions. In the event of any such damage loss or injury happening from any of the excepted risks the Contractor shall, if and to extent required by the Engineer and subject always to the provisions of clause 39, replace repair and make good the same as aforesaid at the cost of the Employer. The Contractor shall also be liable for any damage to the works occasioned by him in the course of any operation carried out by him for the purpose of complying with his obligations under clause 35 hereof but without prejudice to the provisions of this clause as to cases in which the cost of work shall be paid for by the Employer.

1203. The Contractor shall indemnify and keep indemnified the Employer against all losses and claims for injuries or damages to any person or any property whatsoever which may arise out of or in consequence of the performance of the contract and against all claims, demands, proceedings, damages, costs, charges and expenses, whatsoever in respect of or in relation thereto.

13. **PROTECTION OF WORKS AND MATERIALS**

1301. The Contractor shall be responsible for any damage caused by his operatives or agents to the buildings, works being executed under this contract, or the contents of the buildings, and shall make good such damage at his sole expense.

1302. The Contractor shall be responsible for arranging for such mechanical protection as he deems necessary to all or part of his works, plant or equipment or that supplied to him by the Employer liable to damage by weather, frost, traffic or other causes and until such time as the works shall be taken over by the Employer.

1303. Any such damage(s) as may occur through negligence of the Contractor, will be corrected and/or made good at his own expense.

14. **COMPLIANCE WITH STATUTES, REGULATIONS ETC.**

1401. The Contractor shall conform in all respects with the provisions of all Federal, Provincial and local laws, regulations or orders or other laws for the time being in force in Pakistan including all regulations and by-laws, if any, of local or other duly constituted authority within Pakistan which may be applicable to the performance of the contract and the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the works or any temporary works (which are herein referred to as "State Laws") and shall give all notices and pay all fees, charges, rates and taxes (collectively referred herein as fees) required to be given or paid thereby and shall keep the Employer indemnified against all penalties and liability of any kind for the breach of any of the same provided that

such fees, if not expressly included in the contract price, shall be added to the contract price.

15. **INSTRUMENTS AND TOOLS**

1501. The Contractor shall supply and maintain such sufficient instruments, tools and equipment for the use of his staff that are required to enable him to fulfil his obligations under the contract.

16. **SUPPLY OF PLANT, MATERIALS AND LABOUR**

1601. Except where otherwise specified the Contractor shall, at his own expense and risk, supply and provide all the constructional plant, temporary works, scaffolding and ladders etc., tools, instruments, materials for temporary and permanent works, labour (including the supervision thereof), transport to and from the site and in and about the site and other things of every kind required for the purposes of or in connection with the contract.

17. **ISSUED AND UNFIXED MATERIALS**

1701. Where the work provides for the use of any special description of materials to be issued by the Employer or if it is required that the Contractor shall use certain materials to be provided by the Employer, the Contractor shall be supplied with such materials as required from time to time to be used by him for purposes of the contract only, and the value of the full quantity of materials so supplied at the rate specified in the said schedule of materials may be set off or deducted from any moneys then due or thereafter become due to the Contractor under the contract or otherwise or from the retention money. All such materials supplied to the Contractor and all items imported for the works for which the Employer has made payment to the foreign suppliers, shall remain the absolute property of the Employer and shall not, on any account, be removed from the site of the work and shall at all times be open to inspection by the Engineer. Any such materials unused and in perfectly good condition at the completion or termination of the contract shall be returned to the Employer's stores if by a notice in writing the Engineer shall so require. The Contractor shall have no claim for compensation on account of any such materials so supplied to him being unused by him or for any wastage or damage to any such materials.

18. **SETTING OUT**

1801. The Contractor shall be responsible for the true and proper setting out of the works in relation to points, lines and levels of reference given by the Engineer in writing or at site and for the correctness of the position, levels, dimensions and

alignments of all parts of the works and for the provision of all necessary instruments, tools, appliances and labour in connection therewith. If, at any time during the progress of the works, any error shall appear to arise in the position, levels, dimensions or alignment of any part of the works, the Contractor on being required to do so by the Engineer, Consultant or the Engineer's Representative shall at his own expense rectify such error to the satisfaction of the Engineer, Consultant or the Engineer's Representative unless such error is based on incorrect data supplied in writing by the Engineer, Consultant or Engineer's Representative in which case the expenses of rectifying the same shall be borne by the Employer. The checking of any setting out or of any line or level by the Engineer, Consultant or the Engineer's Representative shall not in any way relieve the Contractor of his responsibilities for the correctness thereof. The Contractor shall carefully protect and preserve all bench marks, sight rails, slops, takes, battens, boards, stakes and other things used in setting out.

19. **LIGHTING**

1901. The Contractor shall provide sufficient lighting to ensure that in all places where work is in progress (particularly during night time):

- (a) Safe working conditions are provided for both the Contractor's personnel and personnel of the Engineer, Consultant and Engineer's Representative.
- (b) The works can be constructed in complete compliance with the contract.
- (c) A complete inspection of all works in progress can be made by the staff of the Engineer, Consultant and Engineer's Representative.

1902. The minimum intensity of illumination on ground or working surfaces to be provided for various operations or work areas shall be as approved by the Engineer.

20. **ELECTRIC AND WATER SUPPLY**

2001. The Employer shall arrange for the supply of metered electricity and metered water for the Contractor upto the site of work. The Contractor shall bear all expenses for connection and distribution to and about the site from these sources as well as for the consumption and directly pay all monthly consumption bills. All expenses, loss and damage suffered by the Contractor as a result of any interruption or breakdown of electric or water supply shall be borne by the Contractor.

21. **COORDINATION WITH OTHER CONTRACTORS**

2101. The Contractor shall arrange and administer the contract and the Programme of Work, incorporating the programme of Building construction and all

other services of the works so as to complete the works as a whole within the time stipulated in the contract.

2102. The decision of the Engineer shall be final and binding on the Contractor in case of dispute or difference of opinion arising between various contractors in relation to the responsibilities and scope of work required under mutual coordination.

22. **OPPORTUNITIES FOR OTHER CONTRACTORS**

2201. The Contractor shall in accordance with the requirements of the Engineer afford all reasonable opportunities for carrying out their work to any other contractors employed by the Employer and their workmen and to the workmen of the Employer and of any other duly constituted authorities who may be employed on or near the site for any work not included in the contract or of any contract which the Employer may enter into in connection with or ancillary to the contract. If, however, the Contractor shall, on the written request of the Engineer, make available to any such other contractor or to the Employer or to any such authority, any roads or ways for the maintenance of which the Contractor is responsible or permit the use by any such of the Contractor's scaffolding or ladders or tools or instruments or other plant on the site or provide any other service of whatsoever nature for any such, the Employer shall pay to the Contractor in respect of such use or service such sum as shall in the opinion of the Engineer be reasonable.

23. **BUILDER'S WORKS**

2301. The formation of channels, brick work etc. will be carried out free of charge for the Contractor by the Main Contractor unless otherwise specified.

2302. All shop drawings which may be necessary for the Main Contractor to carry out the above referred works shall be supplied to him by the Contractor.

2303. The Contractor is, however, responsible for the proper marking out of such work at site, for ensuring that all brackets and sleeves etc. are correctly built in and supply of templates if required. The Contractor will supply and fix foundation or anchor bolts or sleeves before concrete is poured.

2304. Provision and fixing of brackets, clips, supports, stays, sleeves, hangers etc. to be fixed to wood, iron, masonry, concrete or other such materials shall be the responsibility of the Contractor. Special application in writing must be made to the Engineer and approval received before any structural steel work is cut or drilled.

24. **INTERFERENCE WITH TRAFFIC AND ADJOINING PROPERTIES**

2401. All operations necessary for the execution of the works and for the construction of any temporary works shall so far as compliance with the requirements of the contract permits be carried on so as not to interfere unnecessarily or improperly with the public convenience or the access to use and occupation of public or private roads and foot paths or to or of properties whether in the possession of the Employer or of any other person and the Contractor shall save harmless and indemnify the Employer in respect of all claims, demands, proceedings, damages, costs, charges and expenses whatsoever arising out of or in relation to any such interference.

25. **SITE CLEARANCE**

2501. The Contractor shall at all times keep the site free from obstruction and shall at any time if directed by the Engineer or Engineer's Representative store or dispose off any constructional plant and surplus materials and clear away and remove from the site any wreckage or rubbish or temporary works no longer required.

2502. On the completion of the works the Contractor shall except and otherwise specifically provided, clear away and remove from the site all constructional plant, temporary works, surplus materials, wreckage and rubbish of every kind and shall reinstate and leave the whole of the site and the works clear and in a workman like condition to the satisfaction of the Engineer.

2503. In case of any failure on the part of the Contractor to comply with the provisions of this clause, the Engineer may by notice in writing to the Contractor require him to remove such constructional plants, temporary works, surplus materials, rubbish etc. from the site within the time specified in such notice and in the event of the Contractor failing to comply with any such notices, the Engineer may remove the same at the Contractor's expense or sell them by auction or private sale on account of the Contractor at his risk. Any receipts and the certificates from the Engineer as to the expenses of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the Contractor.

26. **LABOUR/WORKERS**

2601. The Contractor shall make all arrangements in connection with the recruitment, supervision, transport, accommodation and feeding during transport, quarantine and all other matters whatsoever in connection with the employment of labour and supervisory staff provided that the Contractor shall not recruit or attempt to recruit persons in the service of the Employer, Engineer, Consultant or Engineer's

Representative.

2602. Except as may be otherwise specifically stated the Contractor shall provide on the site an adequate supply of drinking and other water for the use of labour and supervisory staff.

2603. The Contractor shall at all times take all requisite precautions and use his best endeavors to prevent any riotous or unlawful behavior by or amongst the labourers and others employed by him or his sub-contractors for the purpose of or in connection with the contract and for the preservation of peace and the protection of the inhabitants and the security of property on or in the neighborhood of the site.

2604. In respect of all labour directly or indirectly employed by the Contractor for the performance of the works, he shall comply with or cause to be complied with, all rules framed by the Federal and Provincial Governments and any local body from time to time for the employment of labour including the protection of health and sanitary arrangements for the workers.

2605. The Contractor shall maintain at site proper attendance registers to record the attendance of his employees and submit a return in detail at the end of every week to the Engineer's Representative showing:

- (a) The numbers of several classes of labour employed by him on the works during the period,
- (b) Their working hours,
- (c) Details of any accidents during the period indicating extent of damage and injury, and
- (d) Details of constructional plant.

The Contractor's Agent shall show the attendance registers to the Engineer or Engineer's Representative whenever so instructed.

27. **FACTORY ACTS AND LABOUR LAWS**

2701. The Contractor shall, in relation to the works executed under this contract, comply with the provisions of the Factories Act 1937 and 1948 and West Pakistan Industrial and Commercial Employment (Standing Orders) Ordinance 1968 and other Federal and Provincial Laws concerning employment of workers, and statutory amendments or additions thereof, and any regulations or orders made thereunder affecting the works.

28. **DAY WORK**

2801. No works are to be executed as day work unless specifically ordered as

such, and if so ordered, day work sheets indicating name(s) of operatives, time and materials employed shall be submitted in triplicate for signature by the Engineer's Representative at or before the expiration of the week in which such day work shall have been carried out.

29. **MATERIALS AND WORKMANSHIP**

2901. All materials and workmanship shall be of the respective kinds described in the contract and in accordance with the Engineer/Consultant's instructions and approval and shall be subjected from time to time to such tests at such places and at such times as the Engineer/Consultant may direct. The Contractor shall provide such assistance, labour and materials as are required for examining, measuring and testing any work and the quality, weight or quantity of any material used and shall supply samples of materials before incorporation in the works for testing as may be selected and required by the Engineer/Consultant. The Contractor must submit samples of materials to the Engineer/Consultant for approval well before the same are required for the works. The Contractor shall carry out the work only with such materials which have been approved by the Engineer/Consultant.

2902. All samples shall be supplied by the Contractor at his own cost unless otherwise provided for in the contract.

2903. The Employer, Engineer, Consultant and Engineer's Representative and any person authorised by any of them shall at all times and for all purposes have access to the works and temporary works and to the site and to all factories, workshops and places where work is being prepared or where materials are manufactured or from where articles, machinery or equipment are being obtained for the works and the Contractor shall afford every facility for and every assistance in or obtain the right to such access.

2904. No work shall be covered up or put out of view without the approval of the Engineer or the Consultant and the Contractor shall afford full opportunity for the Employer, Engineer, Consultant or Engineer's Representative to examine and measure any work which is about to be covered up or put out of view and to examine foundations before permanent work is placed thereon. The Contractor shall give due notice to the Engineer's Representative whenever any such work or foundation is or are ready or about to be ready for examination and the Engineer's Representative shall as soon as practicable during normal working hours, attend for the purpose of examining and measuring such work or of examining such foundations.

2905. The Contractor shall uncover any part or parts of the works or make openings in or through the works or sources for detecting the cause of any defect, imperfection or fault in the works as the Engineer may from time to time direct and shall reinstate and make good after such uncovering, opening or searching to the satisfaction of the Engineer. If any part of the works has been covered up or put out of view after compliance with the requirements of clause 2904 and if the defect, fault or imperfection is one for which the Contractor is not liable under the contract the expenses of uncovering, openings or searching and reinstating and making good shall be borne by the Employer but in any other case all such expenses shall be borne by the Contractor and shall, if paid by the Employer, be recoverable from the Contractor by the Employer or may be deducted by the Employer from the moneys due or which may become due to the Contractor.

2906. The Engineer/Consultant shall have power to order in writing from time to time:

- (a) The removal from the site within such time or times as may be specified in the order of any materials which in the opinion of the Engineer/Consultant are not in accordance with the contract,
- (b) The substitution of proper and suitable materials, and
- (c) The removal and proper re execution (not withstanding any previous test` thereof or interim payment therefor) of any work which in respect of materials or workmanship is not in the opinion of the Engineer/Consultant in accordance with the contract.

30. **COMMENCEMENT, DELAYS AND COMPLETION**

3001. The Contractor shall commence work on the site within the period named in the Memorandum of the tender after the receipt by him of an order in writing to this effect from the Engineer and shall proceed with the same with due expedition and without delay and complete whole of the works within the period named in the Memorandum of the tender and the progress of the works should be as mentioned in the approved Programme of Works except maintenance of the works which shall be completed thereafter in the period named in the Memorandum.

3002. The shipment of the imported items shall be effected within the period named in the Memorandum of the tender provided the Employer has established confirmed and irrevocable letters of credit in favour of the foreign suppliers of the Contractor in time in accordance with the terms of the contract and the Contractor shall

be responsible for any delay on the part of his suppliers.

3003. Should the rate of progress of work be at any time in the opinion of the Engineer/Consultant too slow to ensure the completion of the works by the prescribed time or extended time for completion the Engineer/Consultant may so notify the Contractor in writing and the Contractor shall thereupon take such steps as the Contractor may think necessary and the Engineer may approve to expedite progress so as to complete the works by the prescribed time or extended time for completion.

3004. If in the opinion of the Engineer the works be delayed:

- (a) by force majeure, or
- (b) by consequences whether direct or indirect of war hostilities (whether war be declared or not), invasion, act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, civil war or disorder, or
- (c) by reason of any exceptionally inclement weather, or
- (d) by reason of civil commotion, local combination of workmen, strike or lockout affecting any of the trades employed upon the works, or
- (e) by reason of Engineer's instructions given in pursuance of clause 32 hereof, or
- (f) because the Contractor has not received in due time necessary instructions from the Engineer for which he shall have specifically applied in writing, or
- (g) by delay on the part of other contractors or tradesmen engaged by the Employer in executing work not forming part of this contract, or

the Contractor shall have been delayed or impeded or prevented whether by the Employer or otherwise howsoever in the completion of the works or any part thereof whether such delay or impediment, prevention occur before or after the time or extended time fixed for completion,

then provided the Contractor shall without delay have given to the Engineer notice in writing containing full and detailed particulars of his claim for an extension of time,

the Engineer shall on receipt of such notice but not otherwise grant to the Contractor from time to time in writing either prospectively or retrospectively such extension of the time fixed by the contract for the completion of the works or part thereof as may be reasonable. The Contractor shall do all that may reasonably be

required to the satisfaction of the Engineer to proceed with the works.

3005. As soon as in the opinion of the Engineer the works shall have been substantially completed and shall have satisfactorily passed any final test that may be prescribed by the contract (excluding any ambient related (such as summer/winter) tests specified in the Memorandum which would be normally conducted during the period of maintenance), the Engineer shall, on receiving a written undertaking by the Contractor to finish any outstanding work during the period of maintenance, issue to the Contractor a Certificate of Substantial Completion in respect of the works and period of maintenance of the works shall commence from the date of such certificate. Provided that the Engineer may give such a certificate with respect to any part of the works before the completion of the whole and shall upon the written application of the Contractor give such a certificate with respect to any substantial part of the works which has been both completed to the satisfaction of the Engineer and occupied or used by the Employer and when any such certificate is given in respect of part of the works, such part shall be considered as substantially completed and the period of maintenance of such part shall commence from the date of such certificate. Provided also that Certificate of Substantial Completion given in accordance with the foregoing provisions of any part of the works occupied and used as aforesaid shall not be deemed to certify completion of any ground or surfaces requiring reinstatement unless such certificate shall expressly so state.

3006. No certificate of completion shall be given nor shall the work be considered to be complete until the Contractor shall have removed from the premises on which the work has been executed all scaffolding, ladders etc., surplus materials and rubbish and cleaned off the dirt from those parts of the building where the work has been executed or of which he may have had possession for the purpose of the execution thereof, nor until the work shall have been measured and recorded by the Engineer's Representative and checked by the Engineer/Consultant which measurement shall be binding and conclusive against the Contractor. If the Contractor shall fail to comply with the requirements of this clause as to removal of scaffolding etc. and cleaning off the dirt on or before the date of completion of works the Engineer may at the expense of the Contractor remove and dispose off such scaffolding etc. and clean off such dirt as aforesaid and the Contractor shall forthwith pay to the Employer the amount of all expenses so incurred and the said amount shall be a debt due from the Contractor to the Employer, and the Contractor shall have no claim in respect of such

scaffolding etc. and surplus materials as aforesaid except for any such actually realised by the sale thereof.

3007. Subject to the provisions of clause 35 hereof the Engineer shall issue to the Contractor Certificate of Final Completion of Works on satisfactory completion of the period(s) of maintenance and when the Contractor shall have fulfilled all his obligations for the works under the terms of the contract.

31. **SUSPENSION OF WORKS**

3101. The Contractor shall on the written order of the Engineer (herein referred to as a "Suspension Order") suspend the progress of the works or any part thereof for such time or times and in such manner as the Engineer may consider necessary and shall during such suspension properly protect and secure the work so far as is necessary in the opinion of the Engineer. The extra cost including all wages to be paid on the site, salaries, depreciation and maintenance of plant, site and general overhead costs of the contract incurred by the Contractor in giving effect to any Suspension Order shall be borne and paid by the Employer unless such suspension is:

- (a) otherwise provided for in the contract, or
- (b) necessary for the proper execution of the work, or
- (c) by reason of weather conditions (or conditions due to weather conditions) affecting the quality of the works, or
- (d) by reason of some default on the part of the Contractor, or
- (e) necessary for the safety of the works or any part thereof.

Provided that the Contractor shall not be entitled to recover any such extra cost unless he gives notice in writing of his intention to claim to the Employer within fifteen days of the Suspension Order. The Engineer shall settle and determine such extra payment to be made to the Contractor in respect of such claim as shall in the opinion of the Engineer be fair and reasonable.

32. **VARIATIONS**

3201. The Contractor shall not make any variation in the works except in accordance with a written Variation Order.

3202. The Engineer may from time to time make any variation of the form, quality or quantity of the works or any part thereof as he may think necessary and for that purposes, by a written Variation Order may order the Contractor to do and the Contractor shall do any of the following:

- (a) Increase or decrease the quantity of any work included in the contract.
- (b) Omit any such work.
- (c) Change the character or quality or kind of any such work.
- (d) Change the levels, lines, position and dimensions of any part of the works.
- (e) Execute additional or substituted work of any kind necessary for the completion of the works.

3203. No Variation Order shall in any way vitiate or invalidate the contract but shall be taken into account in ascertaining the contract price.

3204. For the removal of doubt, it is declared that any increase or decrease of the estimated quantities set out in the Bill of Quantities ascertained by measurement in accordance with the provisions of clause 34 is not a variation within the meaning of this clause.

3205. The Engineer shall determine what adjustment (if any) of the contract price shall be made in respect of work done or omitted pursuant to a Variation Order. All such work shall be valued at the rates and prices set out in the Bill of Quantities or Schedules of Itemwise Prices and/or Item Rates if in the opinion of the Engineer the same shall be applicable. If the Bill/ Schedules do not contain any rate or price applicable to such work, then suitable rates and prices based upon the rates and prices contained in the Bill/Schedules shall be agreed between the Engineer and the Contractor or in default of agreement shall be fixed by the Engineer.

3206. If, by reason of any Variation Order, the rate or price contained in the Bill of Quantities or Schedules of Itemwise Prices and/or Item Rates for any item, is in the opinion of the Engineer rendered unreasonable or inapplicable then a suitable rate or price based upon the rates and prices contained in the Bill/ Schedules shall be agreed between the Engineer and the Contractor or in default of agreement shall be fixed by the Engineer.

3207. No adjustment of the contract price under clause 3205 or variation of rate or price under clause 3206 shall be made unless as soon as practicable and not later than sixty days from the date of the Variation Order notice shall have been given in writing:

- (a) By the Contractor to be Engineer of his intention to claim extra payment or a varied rate or price, and

- (b) By the Engineer to the Contractor of his intention to vary a rate or price as the case may be.

33. **CLAIMS**

3301. The Contractor shall send to the Engineer after the end of each month an account containing full and detailed particulars of all sums (other than those included in the monthly statements submitted by the Contractor pursuant to clause 3601) to which the Contractor may consider himself to have become entitled during that month and no claim for payment of any such sum shall be allowed which has not been included in such particulars provided that the Engineer may authorise payment to be made in respect of any claim notwithstanding the failure of the Contractor to comply with this condition if the Contractor has at the earliest practicable opportunity notified the Engineer that he intends to make such claims.

34. **MEASUREMENTS**

3401. In case of contract awarded on item rate basis, the Contractor shall be paid on basis of the actual quantities executed by him ascertained by measurement in accordance with clause 3403 at the unit prices quoted by him as incorporated in the contract. The quantities set out in the Bill of Quantities are estimated quantities only and they shall not be taken as actual and correct quantities of work to be executed by the Contractor in fulfillment of his obligations under the contract.

3402. In case of contract awarded on lump sum cost basis, the quantities set out in the Schedule of Quantities are estimated quantities only and they shall not be taken as the actual and correct quantities of work to be executed by the Contractor in fulfillment of his obligations under the contract. The Contractor shall be responsible for executing the complete works as specified and required in accordance with the contract. In such contract the operation of clause 3403 shall apply to "Variations" only.

3403. The Engineer shall, except as otherwise stated, ascertain and determine by measurement the value of works in accordance with the contract. He shall, when he requires any work to be measured, give notice to the Contractor's Agent who shall forthwith attend or send a qualified agent to assist the Engineer or Engineer's Representative in making such measurements and shall furnish all particulars required by either of them. Should the Contractor not attend or neglect or omit to send such Agent, then the measurement made by the Engineer or approved by him shall be taken to be correct measurement of the work. For the purpose of measuring any work to be measured by records, the Engineer's Representative shall prepare records month by

month of such work and the Contractor as and when called upon to do so in writing shall within fifteen days attend to examine and shall sign the same when so agreed and if the Contractor does not so attend to examine and agree with any such records they shall be taken to be correct. If after examination of such records the Contractor does not agree with the same or does not sign the same as agreed they shall nevertheless be taken to be correct unless the Contractor shall, within fifteen days of such examination lodge with the Engineer's Representative for decision by the Engineer notice in writing of the respects in which such records are claimed by him to be incorrect.

35. **MAINTENANCE AND DEFECTS**

3501. The expression "Period of Maintenance" shall mean the Period of Maintenance named in the Memorandum of the tender calculated from the date of substantial completion of the works certified by the Engineer in accordance with clause 3005 or in the event of more than one certificate having been issued by the Engineer under the said clause from the respective dates so certified.

3502. To the intent that the works shall at or as soon as practicable after the expiration of the period of maintenance be delivered upto the Employer in as good and perfect a condition (fair wear and tear excepted) to the satisfaction of the Engineer as that in which they were at the commencement of the period of maintenance, the Contractor shall execute all such work of repair, amendment, reconstruction, rectification, making good of defects, imperfection, shrinkages or other faults as may be required of the Contractor in writing by the Engineer during the period of maintenance or within thirty days after its expiration as a result of an inspection made by or on behalf of the Engineer prior to its expiration.

3503. All such work shall be carried out by the Contractor at his own expense if the necessity thereof shall in the opinion of the Engineer, be due to the use of materials or workmanship not in accordance with the contract or to neglect or failure on the part of the Contractor to comply with any obligation expressed or implied on the Contractor's part under the contract. If in the opinion of the Engineer such necessity shall be due to any other cause, the value of such work shall be ascertained and paid for by the Employer as if it were additional work.

3504. During the period of maintenance the Contractor shall if required by the Engineer in writing search for the cause of existence of any defect, imperfection or fault under the directions of the Engineer. Unless such defect imperfection or fault shall

be one for which the Contractor is liable under the contract, the cost of the work carried out by the Contractor in searching as aforesaid, shall be borne by the Employer. But if such defect, imperfection or fault shall be one for which the Contractor is liable as aforesaid the cost of the work carried out in searching as aforesaid shall be borne by the Contractor and he shall in such case repair, rectify and make good such defect, imperfection or fault at his own expense in accordance with the provisions of clause 35 hereof.

3505. (a) The Contractor shall be responsible during the period of maintenance for remedying without undue delay any defects or faults which may develop under the conditions provided for in the contract and under proper use and arising from faulty materials or design or workmanship. If it becomes necessary, for the Contractor to replace or remove any defective part of the plant or equipment under this clause the provisions hereof shall apply to the parts so renewed or replaced. If the Contractor, when called upon to do so, fails to remedy such defects within a reasonable time, the Employer is empowered to instruct other parties to carry out the work at the expense of the Contractor.

(b) Such action by the Employer will not prejudice any other right which the Employer may have against the Contractor in respect of such defect.

3506. In the event of any defect occurring or being discovered in the works during the period of maintenance and due to faulty materials or design or workmanship supplied by the Contractor the period of maintenance shall continue until the cause of the defect has been discovered and remedied to the satisfaction of the Engineer.

36. **STATEMENTS, CERTIFICATES AND PAYMENTS**

3601. The Contractor shall submit to the Engineer after the end of each month a statement showing the estimated contract value of the equipment and materials delivered at site and works executed upto the end of the month and the Contractor will be paid monthly on the certificate of the Engineer, the amount due to him subject to a retention of the percentage named in the Memorandum of the tender until the amount retained shall reach the "limit of retention money" if any, named in the said Memorandum (hereinafter called the retention money) provided always that no monthly interim certificate shall be issued for less sum than that named in the Memorandum of the tender.

3602. One half of the retention money shall become due and shall be paid to the Contractor when the Engineer shall certify in writing in accordance with clause

3005, that the works have been substantially completed and the other half shall be paid to the Contractor thirty days after the expiration of the period of maintenance notwithstanding that at such time there may be outstanding claims by the Contractor against the Employer. Provided always that if at such time there shall remain to be executed by the Contractor any works ordered during such period pursuant to clause 35 hereof the Employer shall be entitled to withhold payment until the completion of such works or so much of the second half of the retention money as shall in the opinion of the Engineer represent the cost of the works so remaining to be executed.

Provided further that in the event of different maintenance periods having become applicable to different parts of the works pursuant to clause 30 hereof the expression "expiration of the period of maintenance" shall for the purpose of this clause be deemed to mean the expiration of the latest of such periods.

3603. The Consultant shall verify the monthly bill submitted by the Contractor for interim payments and the Engineer's Representative shall take the requisite measurements for the purpose of verification of the bill. The Consultant shall verify the bill within fifteen days from the receipt of the bill along with requisite measurements. The Consultant shall make necessary adjustments in the bill.

3604. The Contractor shall submit all bills on the form prescribed by the Engineer and which can be obtained on application from the Engineer's Representative. The bills shall be prepared in quadruplicate in the name of the Employer and submitted to the Consultant for scrutiny and verification and onward transmission to the Engineer with their payment certificate.

3605. The Engineer/Consultant may by any certificate make any correction or modification in any previous certificate which shall have been issued by him and shall have power to withhold any certificate if the works or any part thereof are not being carried out to his satisfaction. The Engineer/Consultant shall also have powers to make adjustments by deductions for any correction or modification in any previous certificate from the subsequent bills.

3606. All intermediate payments against monthly certificates shall be regarded as payments by way of advance against the final payment only and not as payment for work actually done and completed and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be removed and taken away and reconstructed or re-erected or be considered as an admission of the due performance of the contract or any part thereof in any respect or the accruing of any claim nor shall it

conclude, determine or affect in any way the powers of the Engineer under the contract or any of them as to the final settlement and adjustment of the accounts or otherwise, or in any other way vary or affect the contract.

3607. The Contractor shall give in his tender firm price for the supply of equipment and materials (free delivery at site) and the cost of manufacture, fabrication, construction, assembly, installation, completion, testing, commissioning, adjusting, maintenance, etc. to complete the works in working order in all respects.

3608. The contract for the works shall be either on item rate basis or on lump sum cost basis as specified in the tender documents. The Contractor shall fill in the rates and prices in the Bill of Quantities or Schedule of Item wise Prices and Schedule of Item Rates and submit the same along with his tender for reference for making progressive payments against running bills to be submitted by the Contractor.

3609. No claim from the Contractor on account of fluctuations in the market rates will be entertained during the currency of this contract for any item of work executed under this contract.

3610. The final bill shall be submitted by the Contractor within two months of the completion of the works unless otherwise allowed by the Engineer. Failing the submission of the final bill the work will be got measured by the Engineer at the expense of the Contractor and the measurement so taken will be binding on the Contractor.

3611. The amount due to the Contractor under any certificate issued by the Engineer pursuant to this clause or to any other term of the contract shall be paid by the Employer to the Contractor within thirty days after such certificate has been delivered to the Employer.

3612. The payments due to the Contractor will be made either by credit to his account with his Bank or direct to him.

3613. Import of Equipment and Materials by the Employer.

(a) If specified in the Bill of Quantities or Schedule of Item wise Prices, the Employer may opt to import some equipment and materials on his own import license. The Contractor shall give his minimum C&F Pakistan Port prices for such items in foreign currencies in his tender.

(b) On award of the work the Contractor shall submit C&F cost proforma invoices in foreign currencies and supporting documents to the Employer thru the Engineer subject to the maximum of the foreign exchange amount quoted in his tender,

to enable the Employer to establish irrevocable letters of credit confirmed by respective foreign Banks in favour of each foreign Manufacturer/ Supplier of the Contractor.

(c) The payment shall be made to the foreign Manufacturer/ Supplier by the Bank on production of the following negotiable documents for each shipment:

- (1) Original invoice showing item wise prices.
- (2) Manufacturer/Supplier's Guarantee/Warranty as specified in the Special Conditions of Contract.
- (3) Packing List, bill of lading, receipt for ocean freight and other relevant shipping documents.

(d) The Contractor shall supply at least five complete sets of non-negotiable shipping documents to the Employer for each shipment well before the arrival of the ship at Pakistan Port to enable the Employer to take necessary action for arranging insurance and clearance of the consignment.

(e) The Employer shall arrange the insurance of the imported items from Manufacturer/Supplier's warehouse to site, clearance of the consignments at Pakistan Port and delivery to site at his cost. The Employer shall pay import license fees, all Bank charges, insurance premiums, import duty and surcharges, sales tax, Port Trust charges, octroi charges or any other Federal, Provincial or local surcharge, tax or levy etc. for the imported items.

(f) The Contractor shall assist the Employer for the insurance survey of the consignments. He shall inspect the consignment jointly with the Insurance Surveyor and Engineer's Representative and immediately send to the Employer and Engineer a report regarding the loss and/or damage to any item and the cost of replacement and/or repair thereof.

(g) The Employer shall hand over the imported items to the Contractor at site for completing the works. The Contractor shall be responsible for careful storage and consumption of these items and he will be responsible for any loss or damage thereto. All surplus items on completion of the work shall be handed over to the Employer by the Contractor. The Contractor shall also hand over all packing materials to the Employer. The Contractor shall maintain complete account of the receipt and consumption of the imported items handed over to him and submit the same to the Engineer for verification.

(h) The shipping period as required by the Employer and confirmed by the Contractor in his tender shall be the essence of the contract and any delay will be to the

Contractor's account. The Employer shall normally establish the letters of credit within one month of the receipt of the necessary documents from the Contractor duly approved by the Engineer and in case of any delay on the part of the Employer, the period beyond one month shall be added to the shipment period specified in the contract.

37. **INCOME TAX AND REIMBURSEMENTS**

3701. The Contractor shall be responsible for the payment of all Pakistan income tax, super tax and other taxes on income arising out of the contract and the rates and prices stated in the priced tender, Bill of Quantities and Schedules of Item wise Prices and Item Rates shall be deemed to cover all such taxes.

3702. The Contractor shall pay directly royalties, rent and other payment or compensation (if any) for getting any materials, plant, equipment, tools and instruments required for the works or temporary works.

3703. Any element of Federal, Provincial or local duty or tax inherent in the price of locally procured items required for the works or temporary works shall be deemed to be included in the rates and prices stated in the priced tender, Bill of Quantities and Schedules of Item wise Prices and Item Rates and will not be separately reimbursable.

38. **INSURANCES**

3801. **INSURANCE OF WORKS, ETC. - CONTRACTOR'S ALL RISK POLICY**

A. Without limiting his obligations and responsibilities under the contract, the Contractor shall insure in the joint names of the Employer and the Contractor against all loss or damage from whatever cause arising, other than the excepted risks, for which he is responsible under the terms of the contract and in such manner that the Employer and Contractor are covered for the period of contract and are also covered during the period of maintenance for loss or damage arising from a cause, occurring prior to the commencement of the period of maintenance, and for any loss or damage occasioned by the Contractor in the course of any operations carried out by him for the purpose of complying with his obligations for rectification of defects during the period of maintenance.

(a) The works for the time being executed to the estimated current contract value thereof with the materials for incorporation in the works at their replacement value including the replacement cost of all material supplied by the

Employer whether at a price or free.

(b) The Constructional plant and other things brought on the Site by the Contractor at the replacement value of such constructional plant and other things.

(c) The temporary works.

B. Such insurance shall on behalf of the Contractor be taken out by the Employer meeting with all the requirements of the Contractor's All Risk Policy approved by the Employer. The premium of all such policies shall be paid by the Employer on behalf of the Contractor to the Insurance Co. and the cost of taking out such Policies shall be deducted from the Contractor's Bills. However, the Contractor shall be responsible for all such insurance and risks as per Clause 1501, 1301, 1401, 1402 and 1601 for which the Policies shall be taken out by the Employer on Contractor's behalf.

3802. **DAMAGE TO PERSONS AND PROPERTY**

A. The Contractor shall indemnify and keep indemnified the Employer and the Consultant against all losses and claims for injuries or damage to any person or any property whatsoever, which may arise out of or in consequence of the construction and maintenance of the works and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto except any compensation or damages for or with respect to injuries or damage to persons in the adjoining properties or the said properties which are the unavoidable result of the execution or maintenance of the works in accordance with the contract.

B. The Contractor is not allowed to claim any personal liability for or with regard to any matter or thing which can be made binding hereby for the Employer, Employer's Representative or the Consultant from either the Employer, Employer's Representative nor from the Consultant or from any of his staff.

C. In the event of any claim being made against the Employer in respect of any matter for which the Contractor is liable under this Clause, the Employer or the Consultant's Representative shall promptly notify the Contractor, who shall at his own expense undertake all negotiations in connection with such claims and any litigation that may arise therefrom.

3803. The Employer will save harmless and indemnify the Contractor from and against all claims, demands, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the proviso to clause 3802 hereof.

3804. **THIRD PARTY INSURANCE**

A. Before commencing the execution of the Works the Contractor, but

without limiting his obligations and responsibilities under Clause 13 hereof, shall insure against his liability for any material or physical damage, loss or injury which may occur to any property, including that of the Employer, or to any person, including any employee of the Employer by or arising out of the execution of the Works or in the carrying out of the Contract, otherwise than due to the matters relating to adjoining properties referred to in the provision to Clause 13 hereof.

B. Minimum Amount Of Third Party Insurance

Such insurance shall be effected with an insurer and in terms approved by the Employer, and for at least the amount stated in the Memorandum of the Tender.

C. Provision To Indemnify Employer

The terms shall include a provision whereby, in the event of any claim in respect of which the Contractor would be entitled to receive indemnity under the policy being brought or made against the Employer and Consultant, the insurer will indemnify the Employer and the Consultant against such claims and any costs.

D. The Employer, shall on behalf of the Contractor take out these Insurance Policies and shall pay the Insurance Premium to the Insurance Co. This cost would be deducted from the Contractor's Bills.

The insurance that Contractor shall maintain in accordance with Clause 1401 and 1402 shall include, but not limited to the following:

(a) Comprehensive General Bodily Injury Liability Insurance.

(b) Broad form Property Damage Liability Insurance, including adjoining properties and existing factory premises.

(c) Automobile Bodily Injury and Property Damage Liability Insurance.

3805. INSURANCE AGAINST ACCIDENT, ETC. TO WORKMEN

A. The Contractor shall insure against such liability with an insurer approved by the Employer, and shall continue such insurance during the whole of the time that any persons are employed by him on the Works and shall, when required, produce to the Employer or the Consultant or the Employer's Representative, such policy of insurance and the receipt for payment of the current premium. Provided that if the Contractor fails to take out such a policy or keep it in force, the Employer shall take out such a policy on behalf of the Contractor and pay all premiums and the cost of taking out such a policy shall be deducted from the Contractor's Bills.

B. The Contractor (or his sub-contractor where applicable) shall effect insurances referred to in clauses 3801, 3804 and 3805 hereof or any other insurances

required under the contract with an insurer and in terms approved by the Employer (which approval shall not be unreasonably withheld) and the Contractor (or his subcontractor) shall whenever required produce to the Employer the policy or policies of insurance and the receipts for payment of current premiums.

C. If the Contractor shall fail to effect and keep in force the insurances referred to in clauses 3801, 3804, and 3805 hereof or any other insurances which he may be required to effect under the terms of the contract then and in any case the Employer may effect and keep in force any such insurance(s) and pay such premium(s) as may be necessary for that purpose and from time to time, deduct the amount so paid by the Employer as aforesaid from any moneys due or which become due to the Contractor or recover the same as debt due from the Contractor.

39. **SPECIAL RISKS**

3901. Notwithstanding anything in the contract contained, the Contractor shall be under no liability whatsoever whether by way of indemnity or otherwise for or in respect of destruction of or damage to the works (save to work condemned under the provisions of clause 2906 prior to the occurrence of any special risk hereinafter mentioned) or temporary works or to the property whether of the Employer or third parties or for the consequences whether direct or indirect of war hostilities (whether war be declared or not), invasion, act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, civil war or (otherwise than among the Contractor's own employees) riot, commotion or disorder (hereinafter comprehensively referred to as the "special risks") and the Employer shall indemnify and save harmless the Contractor against and from the same and against and from all claims, demands, proceedings, damages, costs, charges and expenses whatsoever arising thereout or in connection therewith and shall compensate the Contractor for any loss of or damage to the property of the Contractor used or intended to be used for the purpose of the contract (including property in transit to the site) and occasioned directly by special risks and for the purpose of this clause, the expression "property of the Contractor" shall include any constructional plant brought on to the site by the Contractor.

3902. If during the currency of the contract there shall be an outbreak of war which whether financially or otherwise materially effects the performance of the contract, the Contractor shall, unless and until the contract is terminated under the provision in this clause contained, use his best endeavours to complete the contract provided always that the Employer shall be entitled at any time after such outbreak of

war to terminate the contract by giving notice in writing to the Contractor and upon such notice being given, the contract shall (save as to the rights of parties under this clause and the operation of clause "Settlement of Disputes" hereof) terminate.

3903. If the contract shall be terminated under the provisions of clause 3902 hereof, the Contractor shall be paid by the Employer (in so far as such amounts or items shall not have already been covered by payments on account made to the Contractor) for all work executed prior to the date of termination at the rates and prices provided in the contract and in addition:

- (a) The amounts payable in respect of any preliminary items so far as the work or service comprised therein has been carried out or performed.
- (b) The cost of materials or goods reasonably ordered for the works or temporary works which shall have been delivered to the Contractor or of which the Contractor is legally liable to accept delivery, such material or goods becoming the property of the Employer upon such payment being made by him.
- (c) A sum to be certified by the Engineer being the amount of any expenditure reasonably incurred by the Contractor in the expectation of completing the whole of the works in so far as such expenditure shall not have been covered by the payments otherwise in the clause 3903 hereof.

3904. Provided always that against any payments due from the Employer under the clause 3903 hereof the Employer shall be entitled to be credited with any outstanding balance due from the Contractor and any other sums which at the date of termination were recoverable by the Employer from the Contractor under the terms of the contract.

40. **TRAINING OF EMPLOYER'S PERSONNEL**

4001. The Contractor shall make suitable arrangement at his own cost to train the operational and maintenance staff of the Employer during the installation and maintenance period at site, his office and workshop. The Contractor shall if so desired by the Employer, also arrange training facilities at his Manufacturers/Suppliers' offices and factories from whom the equipment and materials for the works are procured without any charge to the Employer for the training facilities, except for salaries, travelling and living expenses of the Employer's personnel which expenses shall be borne by the Employer.

41. **REMEDIES AND POWERS**

4101. If the Contractor shall become insolvent or have an order admitting a petition in insolvency made against him or shall present his petition in insolvency or

shall make an arrangement with or assignment in favour of his creditor or shall agree to carry out the contract under a committee of inspection of his creditors or (being a corporation) shall go into liquidation (other than voluntary liquidation for the purposes of amalgamation or reconstruction) or if the Contractor shall assign the whole of the contract or any part thereof without the consent in writing of the Employer first obtained or shall have an execution levied on his goods or if the Engineer shall certify in writing to the Employer that in his opinion the Contractor:

- (a) has abandoned the contract, or
- (b) without reasonable excuse has failed to commence the works or has suspended the progress of the works for fourteen days after receiving from the Engineer written notice to proceed, or
- (c) has failed to proceed with the works with due diligence, or
- (d) has failed to remove materials from the site or to pull down and replace work for fourteen days after receiving from the Engineer written notice that the said materials or work had been condemned and rejected by the Engineer, or
- (e) is not executing the works in accordance with the contract or is persistently or flagrantly neglecting to carry out his obligations under the contract, or
- (f) has to the detriment of good workmanship or in defiance of the Engineer's instructions to the contrary sub-let whole or any part of the contract,

then the Employer may after giving fourteen days notice in writing to the Contractor enter upon the site and expel the Contractor without releasing the Contractor from any of his obligations or liabilities under the contract or effecting the rights and powers conferred on the Employer or the Engineer by the contract and the Employer may himself complete the works or may employ any other contractor to complete the works and the Employer or such other contractor may use for such completion so much of the constructional plant, temporary works and materials which have been brought at site by the Contractor as the Employer or such other contractors may think proper and the Employer may at any time sell any of the said constructional plant, temporary works and unused materials and apply the proceeds of sale in or towards the satisfaction of the sums due or which may become due to him from the Contractor under the contract.

4102. The Engineer shall as soon as may be practicable after such entry and

expulsion by the Employer, fix and determine and shall certify what amount (if any) had at the time of such entry and expulsion been reasonably earned by or would reasonably accrue to the Contractor in respect of work then actually done by him under the contract and what was the value of any unused or partially used materials, any constructional plant and temporary works which have been taken over by the Employer on the site under clause 4101 hereof.

4103. If the Employer shall enter and expel the Contractor under this clause the Employer shall not be liable to pay to the Contractor any money on account of the contract until the expiration of the period of maintenance and thereafter until the costs of completion and maintenance, damages for delay in completion (if any) and all other expenses incurred by the Employer have been ascertained and the amount thereof certified by the Engineer. The Contractor shall then be entitled to receive only such sum or sums (if any) as the Engineer may certify would have been due to him upon due completion by him after deducting the said amount. If such amount shall exceed the sum which would have been payable to the Contractor on due completion by him then the Contractor shall upon demand pay to the Employer the amount of such excess and it shall be recoverable by the Employer as a debt due from the Contractor accordingly.

4104. The Contractor shall if so required by the Employer or Engineer within fourteen days of any of the events referred to in clause 4101 hereof assign to the Employer without further payment the benefit of any agreement for the supply of materials and/or for the execution of any works for the purpose of this contract but on the terms that a supplier or Sub-Contractor shall be entitled to make any reasonable objection to any further assignment thereof by the Employer and the Employer may pay the supplier or sub-contractor for any such materials supplied or works executed under such agreement (whether the same be assigned as aforesaid or not) before or after the said determination the amount due by such agreement in so far as it has not already been paid by the Contractor.

4105. If the Contractor shall fail duly to observe or perform any requirement instruction direction or order of the Engineer duly made or given in accordance with the contract or shall otherwise fail to fulfil any obligation imposed upon him by the contract the Employer may without prejudice to any other rights or remedies he may have, himself or by his servants or agents remedy such default and all expenses consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him or may be deducted by the Employer from any moneys due or which may

become due to the Contractor.

4106. In any case in which any of the powers conferred upon the Employer or the Engineer by clause 41 hereof shall have become exercisable and the same shall not be exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such power shall notwithstanding be exercisable in the event of any future case of default by the Contractor, for which the Contractor shall have rendered himself liable to pay compensation and liability of the Contractor for past and future compensation shall remain unaffected.

4107. In the event of any of the above courses being adopted by the Employer or the Engineer, the Contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advances on account of or with a view to the execution of the works or the performance of the contract.

42. **ISSUE OF NOTICES**

4201. Any notice to be given to the Contractor under the terms of the contract shall be served by sending the same by registered post to or delivering the same at the Contractor's principal office.

4202. Any notice to be given to the Employer under the terms of the contract shall be served by sending the same by registered post to or delivering the same at the Employer's principal office.

4203. Any notice to be given to the Engineer under the terms of the contract shall be served by sending the same by registered post to the Engineer's office.

43. **CONSTRUCTIONAL PLANTS**

4301. The Employer shall permit the Contractor the exclusive use of all constructional plants, temporary works and materials brought to the site by the Contractor in and for the execution, completion or maintenance of the works until the occurrence of any event which gives the Employer the right to exclude the Contractor and proceed with the completion of the works without him.

4302. The Contractor shall not remove any constructional plant, temporary works or materials or any part thereof from the site without the written consent of the Employer (which consent shall not be unreasonably withheld) when the same is no longer immediately required for the purpose of execution or completion of the works.

4303. If the Contractor fails to remove any constructional plant, temporary works or materials within such reasonable time after completion of the works as may be

granted to him by the Engineer, then the Employer may:

- (a) Sell by auction or private sale any such constructional plant, temporary works and materials as aforesaid on account of the Contractor at his risk, and
- (b) Return at the Contractor's expense and risk any hired plant or hire purchased plant to the person from whom the same was hired by the Contractor,

and after deducting, from any proceeds of sale the costs, charges and expenses of and in connection with such sale and in connection with return as aforesaid, shall pay the balance (if any) to the Contractor but to the extent that the proceeds of any sale are insufficient to meet all such costs, charges and expenses, the excess shall be deducted from any moneys due or which may become due to the Contractor or recover the same as a debt due from the Contractor. Any receipts and the certificates from the Engineer as to the expenses of any such return and the amount of proceeds and expenses of any such sale shall be final and conclusive against the Contractor.

4304. The Employer shall not, at any time, be liable for the loss or injury to any of the constructional plants, temporary works or materials which have been brought to the site by the Contractor.

4305. The Contractor shall, when entering into any sub-contract, incorporate in such sub-contract (by reference or otherwise), the provisions of this clause in relation to the constructional plants, temporary works and materials brought to the site by the sub-contractor in such a manner that the Employer shall have the same rights in respect thereof as if these were brought at site by the Contractor.

44. **GENERAL**

4401. If the Contractor or any of his sub-contractor agent or servant shall offer or give or agree to offer or give to any person any bribe, gift, gratuity or commission as an inducement grant or reward for doing or forbearing to do any action in relation to the contract or any other contract with the Employer or for showing or forbearing to show favour or disfavour to any person in relation to the contract or any other contract with Employer then the Employer may enter upon the site and expel the Contractor therefrom and the provisions of clause 41 hereof shall apply as if such entry and expulsion had been made pursuant to that clause. Notwithstanding, the Contractor shall indemnify the Employer against any liability resulting from such bribes, gifts, gratuities or commissions made or attempted by the Contractor or any of his sub-contractors agents or servants.

4402. Subject to any provision to the contrary contained in the contract, none

of the permanent work shall save as hereinafter provided be carried out during the night, or on Sundays or Public holidays without notification by the Contractor in writing to the Engineer and Engineer's Representative. If the Contractor in order to keep his programme of work as set in clause 09 hereof requires to carry on the work during night or on Sundays or Public holidays which he shall do at his entire expenses and risk without claiming any compensation or additional payment, he shall notify to the Engineer and Engineer's Representative the period during which he intends to do so to enable the Engineer's Representative to arrange proper supervision. Due to the weather conditions or to maintain continuity of the work, the Engineer's Representative may require the work to be continued during night or on Sundays or Public holidays and the Contractor shall make suitable arrangements in this respects without claiming any compensation or additional payment.

4403. All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the use of the Employer without reference to the actual loss or damage sustained and whether or not any damage shall have been sustained.

4404. In the case of a tender by partners, no change in the constitution of the firm shall be effected nor a new partner shall be added therein without the written approval of the Employer.

4405. The Contractor shall correspond with the Employer whenever necessary, through the Engineer.

4406. The Contractor shall save harmless and indemnify the Employer from against all claims and proceedings for or on account of infringement of any patent rights, designs, trade-mark or name or other protected rights in respect of any plant, machine, equipment, work or material used for or in connection with the works or temporary works or any of them and from and against all claims demands proceedings damages costs charges and expenses whatsoever in respect thereof or in relation thereto.

45. **SETTLEMENT OF DISPUTES**

4501. All questions and disputes between the parties to the contract other than those in which the decision certificate and/ or opinion of any person is expressed by the contract to be final and conclusive, shall be referred to the arbitration and final decision of a single arbitrator agreed and appointed by both the parties, or in case of disagreement, to the arbitration of two arbitrators one to be appointed by each party which arbitrators shall before proceeding with the reference, appoint an umpire.

4502. The arbitrator, the arbitrators, or umpire shall have power to open up, review and revise any certificate, opinion, decision, requisition or notice save in regard to the accepted matters referred in clause 4501 hereof, and to determine all matters in dispute which shall be submitted to him or them and of which notice shall have been given, and his/their award shall be final, conclusive and binding on the parties.

4503. Unless the parties otherwise agree such reference shall not take place until after the substantial completion or abandonment of the works or determination of the contract.

4504. The provisions of Arbitration Act 1940 and any statutory modification thereof and rules framed thereunder shall be deemed to apply to and be incorporated in this contract.

4505. The cost of every reference and award respectively shall be in the discretion of the arbitrator or arbitrators or the umpire, who shall determine the amount thereof, and shall direct by whom and to whom and in what manner the same shall be borne and paid.

4506. Reference to the Employer for arbitration shall be made in writing by the Contractor specifying clearly all such questions and disputes not later than three months after the completion of the works. Failure to make such a reference shall be deemed that the Contractor has waived all claims in this respect. The parties shall appoint the arbitrator/arbitrators within two months of such reference being made.

4507. The Employer and the Contractor hereby also agree that an arbitration under this clause shall be condition precedent to any other action at law. The venue of arbitration and any other action shall be the city named in the Memorandum of the tender.

46. **MOBILIZATION ADVANCE**

4601. The Employer at his sole discretion may allow advance payment of a sum of money as Mobilization Advance to the Contractor for the procurement and transport of Plants, Equipment and materials required for the works (inclusive of any temporary works). The decision of the Employer regarding non-payment or payment and the amount thereof shall be final and conclusive. The Employer shall recover the amount of the Mobilization Advance paid to the Contractor by proportionately deducting the same in installments, number to be fixed by the Employer, from the payments due to the Contractor against the running bills submitted by the Contractor and verified by the Engineer.

4602. The Contractor shall furnish an irrevocable and confirmed Bond, specimen annexed in the tender documents, from a scheduled Bank for the amount of the Mobilization Advance so that in case of any default by the Contractor as determined by the Engineer whose decision shall be final and conclusive in this respect, the Guarantor shall forthwith pay the outstanding amount of the Mobilization Advance to the Employer on demand and without any reference to the Contractor.

4603. The Employer at his sole discretion may allow the Contractor to furnish such a Bond from an approved Insurance Company instead of a scheduled Bank and the decision of the Employer shall be final and conclusive in this respect.

47. **PRICE VARIATIONS**

4701. Notwithstanding anything to the contrary stated in these conditions, the Employer may at his sole discretion allow variation (increase or decrease) in the prices and rates contained in the priced Bill of Quantities and Schedules of Itemwise Prices, Item Rates and Labour Rates provided the Engineer certifies that there has been a variation in any of the taxes, duties or charges leviable on any plant, equipment and materials required for the works by an act, rule or regulation (hereinafter collectively referred as "State Acts") of Federal or Provincial Governments or any Local Body or duly constituted Authority within Pakistan (hereinafter collectively referred as "State Bodies") or there has been a variation by a State Act in the basic wages or allowances or benefits payable to the labour or charges or contributions payable to any State Body by the Contractor. The variation may be made as a percentage of the relevant price or rate included in the contract or as a lump sum. The decision of the Employer shall be final and conclusive.

4702. The Contractor shall within a reasonable time of his becoming aware of any variation in the prices or rates due to a State Act, give notice thereof in writing to the Engineer stating that the same is given pursuant to this clause together with all information relating thereto to support his claim.

4703. The variation allowed by the Employer in prices or rates shall reflect the actual amount of variation payable by the Contractor and shall not include any profit margin or markup by the Contractor on the amount of the variation.

4704. The Contractor shall, for the purpose of this clause, keep such books of accounts and other documents as are necessary to show the amount of any increase claimed or any reduction available and shall allow inspection of the same by authorised representative of the Employer or Engineer and furnish any documents which the Employer or Engineer may require to verify his claim.

4705. Provided always that any increase so payable is not in the opinion of the Engineer, whose decision shall be final and conclusive, attributable to delay in the execution of the works by the Contractor.

4706. Notwithstanding any claim lodged by the Contractor for increase in prices or rates under this clause, the Contractor shall proceed diligently with execution of the works and complete it within the contract time prescribed by clause 30 hereof.

48. **SAFETY AND PROTECTIVE MEASURES**

4801. The Contractor shall take necessary and reasonable precautions to reduce and minimise the risk of injury to or loss of life of personnel in the execution of work. He shall comply with all applicable government safety and security laws, regulations and Ordinances as well as LUMS safety guide for contractors employees which is treated as part of the contract agreement.

4802. The Contractor shall furnish and issue approved safety helmets to all workmen and authorized personnel during the course of hazardous construction of all types, and safety goggles, belts, gloves and shoes whenever required.

4803. The Contractor shall provide for the handling of Gas cylinders and all other materials equipment in a manner that will not be dangerous to the health and safety of personnel. Cranes and Hoists to be used at Site should have the current test certificates available for inspection.

4804. The Employer's/Consultant's Representative may order immediate stoppage of work if in his opinion adequate safety measures have not been taken and if there is a danger to human life or injury and to works and adjoining properties. No compensation in terms of amount and time for such delays or loss if incurred shall be made to the Contractor.

4805. The Contractor shall provide well equipped First Aid Kits, duly approved by the Consultants Representative, to render first aid in case of any accidents or any other cause involving injury to any workmen. The Contractor shall have on site at least one man who is well experienced in giving first aid treatment. The cost of maintenance and giving first aid treatment shall be borne by the Contractor.

4806. Whenever in the opinion of the Consultant's Representative it is necessary for the protection of other personnel, the Contractor shall remove any of his employees found to be suffering from a contagious disease, either to hospital or permanently away from the Site area. Any contagious disease, when discovered, shall be immediately reported to the Consultant's Representative. The Contractor if required by the Consultant's Representative shall subject all his employees to regular medical examination and produce satisfactory evidence of their being free from any contagious

diseases.

49. **PROTECTION & COVERING UP**

4901. The Contractor shall properly cover up and protect until taken over by Employer any section or portion of the Works liable to damage or injury by exposure to the weather and shall take every reasonable precaution to protect any section or portion of the Works not taken over by Employer against damage from any cause. The protection & covering up not only includes his works but also those of the nominated sub-contractors or specialist contractors.

4902. All damages to any section or portion of the works that shall not have been taken over by Employer which shall arise from or be occasioned by any act of the Contractor or his nominated Sub-Contractor, or by failure of the Contractor to comply with any obligation imposed on him, shall be made good by and at the sole cost of the Contractor to the satisfaction of the Employer/ Consultant failing which Employer/Consultant shall have option to get all such works done at the cost of Contractor through other agency or agencies.

4903. The Contractor shall before all the works have been taken over indemnify the Employer in respect of all damage or injury occurring to any person or to any property (other than property forming part of the works) and against all actions, suits, claims, demands, costs, charges and expenses arising in connection therewith which shall be occasioned by the negligence of the Contractor or any Sub-Contractor, or by defective design (other than a design made, furnished or specified by the Employer and for which the Contractor has disclaimed responsibility in writing within a reasonable time after the receipt of the Consultant's instructions), materials or workmanship but not otherwise.

4904. If while the Contractor is on the site for the purpose of making good a defect, there shall occur any damage or injury to the works or to any other property or to any person, the Contractor's liability in respect thereof shall be the same as if the said damage or injury had occurred before any part of the works had been taken over.

4905. In respect of personal injury or damage to property conferring on a person other than the Employer the liability of the Contractor to the Employer for any such act or default shall not exceed the Contract price.

4906. In the event of any claim being made against the Employer arising out

of the matters referred to in and in respect of which the Contractor is liable under this Clause, the Contractor shall be promptly notified thereof and may at his own expense conduct all negotiations for the settlement of the same and any litigation that may arise thereof, the Employer shall not unless and until the Contractor shall have failed to take over the conduct of the negotiations or litigation make any admission which might be prejudicial thereto. The conduct by the Contractor of such negotiations or litigation shall be conditional upon the Contractor having first given to the Employer such reasonable security and shall from time to time be required by the Employer to cover the amount ascertained or agreed or estimated as the case may be, of any compensation, damages, expenses and costs for which the Employer may become liable. The Employer shall at the request of the Contractor, afford all reasonable assistance for any such purpose. The Contractor shall indemnify the Employer against all actions, suits, claims, amends, costs or expenses arising in connection with injuries (other than such as may be attributable to the Employer his agents or servants) suffered by persons employed by the Contractor or his Sub-Contractors on the Works, whether at common Law or under any Statutes in force at the date of the Contract dealing with the question of the liability of Employer for injuries suffered by employees.

50. **CONSTRUCTION SITE**

5001. Within the area, which is defined as the Site the Contractor shall carry out and perform the construction of the works, and subject to the approval of the Employer will be permitted to construct temporary buildings and works, which he may require for the construction of the works. If the Contractor wishes to use other land for camps or for other contract purposes, the Contractor shall make all necessary arrangements thereof and shall pay all rentals or other costs connected therewith.

The Site of the factory premises is however to be kept as clear as possible, to facilitate rapid progress of the work and no employees of the Contractor, unless authorised by the Employer/Consultant will be permitted to live on the site.

SECTION - 05

ANNEXURES

A. SPECIMEN OF TENDER EARNEST MONEY GUARANTEE

KNOW ALL MEN BY THESE PRESENTS that ----- (name and address) -----
- (hereinafter called the "Tenderer" which expression shall include its successors and
permitted assigns) and -----(name and address) ----- (hereinafter called
the "Guarantor" which expression shall include its successors and assigns) are jointly
and severally held firmly bound in the sum of Rs.----- (Rupees-----
-----only)
to ----- (name and address) ----- (hereinafter called the "Employer"
which expression shall include its successors, assigns and legal representatives).

WHEREAS the Tenderer has submitted the accompanying Tender dated -----
----- for ----- (hereinafter called
the "works") to the said Employer, and

WHEREAS the Employer has required as a condition for considering the said tender
that the Tenderer deposit with the Employer either by a Pay Order or Demand Draft of
a scheduled Bank in favour of the Employer or by a confirmed and irrevocable Guarante
tee (Bond) for an amount of Rs.----- (Rupees-----
-----only)
conditioned that in the event of failure of the Tenderer to abide by his Tender for a
period of ----- days from -----(date of opening of Tender) ----- and if
the Tender is accepted to execute the Contract Agreement for the said works and
furnish the required Performance Bond, the entire sum becomes payable immediately
to the Employer as liquidated damages and not as penalty for the Tenderer's failure to
perform.

NOW THE CONDITIONS OF THE above written Bond are such that:

1. If the Tenderer fails to abide by his Tender for the period mentioned and if
the Tender is accepted by the Employer then the Tenderer fails to sign the Contract
Agreement and provide a Performance Bond within ----- days of being requested
to do so in accordance with the conditions of tendering, the Guarantor hereby
unconditionally and irrevocably undertakes to pay forthwith the sum of Rs.-----

(Rupees-----
only) to the Employer within three days after a demand is made by the Employer without any question and without any reference of any nature whatsoever to the Tenderer and irrespective of any dispute existing between the Tenderer and the Employer in respect of the acceptance or rejection of the Tender and irrespective of the pendency of any dispute before any Arbitrator or in any Court of Law.

2. In the event of the Tenderer fulfilling the aforesaid obligations as certified by the Engineer who will be the sole and exclusive judge in this respect, this Guarantee will come to an end as the purpose would have been served.

3. The certificate of the Engineer that the Tenderer has failed to comply with the conditions or any of them herein mentioned shall be final, conclusive and binding on all the parties and the Employer will be entitled to demand forthwith from the Guarantor the aforesaid sum on the issuance of the said certificate.

4. That the liability of the Guarantor shall not be discharged until such time that a release has been granted to the Guarantor in writing under the signature of the Engineer.

5. That the liability of the Guarantor shall not be affected at any time by any forbearance or indulgence being given to the Tenderer or by his death or insolvency.

6. That the payment under this Bond shall be made by the Guarantor in the name of the Employer and a receipt issued by the Employer shall discharge the Guarantor from his liability to the Employer under this Bond.

7. That any notice or demand under this Bond may be made by the Employer and may be left at the Guarantor's address mentioned herein or at any changed address as may be communicated by the Guarantor to the Employer in writing against receipt of the Employer, or the said notice of demand may be sent by registered post to the Guarantor addressed as aforesaid and shall be deemed to have been given at the time

when it should have been delivered in due course of post and a certificate signed by the Employer that the envelope containing the notice was posted shall be conclusive.

8. This Bond shall remain in force upto ----- for the amount of Rs.-----
(Rupees -----only).

IN WITNESS WHEREOF the Guarantor and the Tenderer have signed and sealed
this Bond on this ----- day of -----.

Signed, sealed and delivered
delivered
by -----

Signed, sealed and
delivered
by -----

for and on behalf of

(Guarantor)

for and on behalf of

(Tenderer)

in the presence of

(name and designation)

in the presence of

(name and designation)

B. FORM OF CONTRACT AGREEMENT

THIS AGREEMENT made and entered at ----- on this -----
-- day of -----by and between -----(name and address)-----
---- (hereinafter called the "Employer" which expression shall include its successors,
assigns and legal representatives) of the one part and -----(name and
address) ----- (hereinafter called the "Contractor" which expression shall
include its successors, legal representatives and permitted assign) of the other part.

WHEREAS the Employer is desirous for the manufacture, supply, assembly,
construction, installation, completion, testing, commissioning, adjusting, balancing and
maintenance of certain works, viz., -----

(hereinafter called the "works") and has caused his Consultants, Design-o-Tech
Consulting, 624, 6th Floor, Mashriq Center, Stadium Road, Karachi, (hereinafter called
the "Consultant") to prepare specifications, schedules, and drawings detailing and
describing the works.

WHEREAS, under the procedure, tenders have heretofore been received by the
Employer for the works and the tender of the Contractor for the works has been
accepted by the Employer.

NOW THEREFORE, for and in consideration of the promises, covenants,
agreements hereinafter contained and to be performed by the parties hereto, the said
parties hereby covenant and agree as follows.

1. In this Agreement words and expressions shall have the same meaning as are
respectively assigned to them in the General Conditions of Contract hereinafter referred
to.

2. The following documents shall be deemed to form and be read and constructed as
part of this Agreement, viz.,
 - (a) The said Tender No.----- dated ----- and
Memorandum, as amended herein.
 - (b) The General Conditions of Contract.

- (c) The Special Conditions of Contract.
- (d) The Specifications.
- (e) The Drawings.
- (f) The Schedule of Itemwise Prices.
- (g) The Schedule of Quantities.
- (h) The Schedule of Item Rates.
- (i) The Schedules of labour rates and working hours.
- (j) The Instructions to Tenderers.
- (k) Addenda Nos. (if any).
- (l) The letter of Award of Work No.----- dated ----- and all related correspondence mentioned therein.
- (m) -----

3. In consideration of the covenants and agreements to be kept and performed by the Contractor, and for the faithful performance of this contract, and the completion of the works embraced therein, according to the specifications, drawings and conditions herein contained and referred to, the Employer shall pay and the Contractor shall receive and accept as full compensation for everything furnished and done by the Contractor under this Agreement, the contract price at the time and in the manner prescribed by the contract.

4. The Contractor, at his own proper cost and expense, shall do all work and furnish all labour, equipment, materials, tools, machinery and supplies for the manufacture, assembly, construction, installation, completion, testing, commissioning, adjusting, balancing and maintenance of the said works as outlined and described in the specifications, schedules and drawings except such equipment and materials which are to be furnished by the Employer.

5. The maintenance of a rate of progress in the works, which will result in its completion within the specified time, is an essential feature of this contract, and the Contractor agrees to proceed with all due diligence and care at all times to take full precautions to ensure the time of completion as defined herein. The said works shall be

started on the date shown in the Memorandum of the tender and the Contractor shall have the works called for under the contract fully completed within the times stated in the Memorandum of the tender except for maintenance which shall be completed in the period named in the said Memorandum after issuance of Certificate of Substantial Completion.

6. The term the "Consultant" in this Agreement and conditions of contract shall mean the said Design-o-Tech, or in the event of their dissolution or in any way ceasing to be the Consultant for the purpose of this contract, such other person(s) as may be nominated or appointed for this purpose by the Employer and notified in writing to the Contractor.

IN WITNESS whereof the parties hereto or herein have hereinto set their respective hands and seals on the day the month and the year first above-mentioned.

Signed, sealed and delivered
delivered
by -----

Signed, sealed and
delivered
by -----

for and on behalf of

(Employer)

for and on behalf of

(Contractor)

in the presence of

(name and designation)

in the presence of

(name and designation)

C. FORM OF PERFORMANCE BOND

THIS BOND is executed at ----- on this -----day of -----
- by -----(name)-----having its registered Office at -----(full address)-----

(hereinafter called the "Surety" which expression shall include its successors and assigns) and----- (name)-----whose registered Office is at -----
----- (full address)----- (hereinafter called the "Contractor" which expression shall include its successors and permitted assigns) in favour of -----
----- (name and address) ----- (hereinafter called the "Employer" which expression shall include its successors and assigns).

WHEREAS the Contractor by an Agreement which shall be signed between the Employer of the one part and the Contractor of the other part (hereinafter called the "contract") has agreed for the manufacture, supply, construction, assembly, installation, completion, testing, commissioning, adjusting, balancing and maintenance of certain works as therein mentioned viz.----- (hereinafter called the "works") in conformity with the provisions of the said contract.

AND WHEREAS one of the conditions of entering into Contract Agreement is that the Contractor shall provide to the Employer a Performance Bond in the sum of Rs.----- (Rupees -----
----- only) for due fulfillment of the contract.

AND WHEREAS, the Surety has agreed to give to the Employer this Performance Bond on the terms and conditions mentioned hereinafter.

NOW THEREFORE, THIS BOND WITNESSETH:

1. That the Contractor shall duly perform and observe all the terms, provisions, conditions, stipulations and his obligations contained in the contract according to the true purport, intent and meaning thereof or as may be determined by the Employer

who shall be the Sole Judge in the matter.

2. In the event of default being committed by the Contractor of which the Engineer shall be the sole exclusive judge, the Surety shall satisfy and discharge within three days after demand of all the damages sustained by the Employer on account of the default of the Contractor, as may be solely and exclusively determined by the Engineer, without any reference of any nature whatsoever to the Contractor and without any question whatsoever and whether or not the Contractor disputes his liability in respect thereof and whether or not any arbitration or Court case is pending in respect of the dispute.

3. That the liability of the Surety under this Performance Bond shall be upto the amount of Rs.------(Rupees -----

only)

and this Bond shall become null and void if the Contractor has carried out the works and also performed his obligations strictly in accordance with the contract to the full satisfaction of the Engineer, who will be the sole and exclusive judge to determine whether or not the Contractor has carried out the works and fulfilled his obligations in accordance with the contract.

4. The Engineer can complete that portion of the works, which the Contractor has not commenced or not satisfactorily executed, upto the amount of the Performance Bond, at the expense of the Surety.

5. That the liability of the Surety shall not be discharged until such time that a release has been granted to the Surety in writing under the signature of the Engineer.

6. No alteration in the terms of the said contract made by agreement between the Employer and the Contractor or in the extent or nature of the works to be executed thereunder and no allowance of time by the Employer or the Engineer under the said contract nor any forbearance or forgiveness in or in respect of any matter or thing

concerning the said contract on the part of the Employer or the Engineer shall in any way release the Surety from any liability under this Bond.

7. That the payment under this Bond shall be made by the Surety in the name of the Employer and a receipt issued by the Employer shall discharge the Surety from his liability to the Employer under this Bond.

8. That any notice or demand under this Bond may be made by the Employer and may be left at the Surety's address mentioned herein or at any changed address as may be communicated by the Surety to the Employer in writing against receipt of the Employer, or the said notice of demand may be sent by registered post to the Surety addressed as aforesaid and shall be deemed to have been given at the time when it should have been delivered in due course of post and a certificate signed by the Employer that the envelope containing the notice was posted shall be conclusive.

9. This Bond shall remain in force upto ----- for the amount of Rs.-----
(Rupees -----
only).

IN WITNESS WHEREOF the Surety and the Contractor have signed and sealed this Bond on the day the month and the year mentioned above.

Signed, sealed and delivered
delivered
by -----

Signed, sealed and
by -----

for and on behalf of

(Surety)

for and on behalf of

(Contractor)

in the presence of

(name and designation)

in the presence of

(name and designation)

Note:

The Surety may be a scheduled Bank or an approved Insurance Company.

D. SPECIMEN OF MOBILIZATION ADVANCE GUARANTEE

To

-----,
-----,
-----,
-----.

Dear Sirs,

WHEREAS you have entered into a contract with ----- (name and address) -----(hereinafter called the "Contractor" which expression shall include its successors and permitted assigns) for ----- (hereinafter called the "works").

AND WHEREAS at our request and at the request of the Contractor you have agreed to advance to the Contractor a sum of Rs.----- (Rupees-----

only) to be used by the Contractor for the procurement and transport of Plants, Equipment and materials for the said works (inclusive of any temporary works).

NOW THEREFORE we do hereby agree, undertake and guarantee:

1. That the Contractor shall use the advance amount of Rs.-----
-- (Rupees-----

only) for the purpose of procurement and transport of Plants, Equipment and materials for the works inclusive of any temporary works as defined in the Contract Agreement dated ----- entered into between you and the Contractor.

2. That the Contractor shall repay the above said advance amount to you either by getting the same deducted from his running bills as per the General Conditions of Contract or from his own resources.

3. In the event of the Contractor failing to utilize the advance for the purpose for which it has been given by you and/or the Contractor failing to make the payment of

the same to you as per the General Conditions of Contract, we hereby guarantee the payment of the amount of Rs.----- (Rupees-----

---only) or such other amount as may be outstanding against the Contractor within three days after demand made by you on us without any question or without any reference of any nature whatsoever to the Contractor and irrespective of existence of any dispute between you and the Contractor and irrespective of pendency of any dispute with the Contractor before any Arbitrator or any Court of Law.

4. That a demand certifying that the Contractor has failed to utilize the advance for the purpose for which it has been given and/or has failed to repay the same and signed by the Engineer will be conclusive against the Contractor and against us which certified demand shall not be questioned by us for any reason whatsoever and it would be sufficient authority for us to make the payment to you.

5. That our liability under this Guarantee shall stand reduced automatically to the extent of the adjustment made from the running bills of the Contractor and a certificate signed by the Engineer to this effect shall be conclusive and binding on us.

6. That the payment hereunder shall be made by us under this Guarantee in your name and a receipt issued by you shall be sufficient that the payment has been made to you hereunder.

7. That our liability under this Guarantee shall not be discharged until such time that a release has been granted to us in writing under the signature of the Engineer.

8. That no alteration in the terms of the said contract made by agreement between you and the Contractor or in the extent or nature of the works to be executed thereunder and no allowance of time by you or the Engineer under the said contract nor any forbearance or forgiveness in or in respect of any matter or thing concerning the said contract on your part or on part of the Engineer shall in any way release us from any liability under this Guarantee.

E. LIST OF APPROVED INSURANCE COMPANIES

1. Adamjee Insurance Company Ltd.
2. Alpha Insurance Company Ltd.
3. EFU General Insurance Ltd.
4. Habib Insurance Company Ltd.
5. Muslim Insurance Company Ltd.
6. New Jubilee Insurance Company Ltd.
7. National Insurance Corporation.

Notes

1. The Guarantor or Surety may be a scheduled Bank. If specified in the Tender Notice/Memorandum, the Guarantor or Surety may be from amongst above listed approved Insurance Companies.
2. All Guarantees or Bonds must be on requisite judicial stamp papers of required value, must be fixed with the seal of the Guarantor/Surety and signed by atleast two authorised Executives of the Guarantor/Surety and executed in a manner that the same are binding on the Guarantor/Surety/Tenderer/Contractor.
3. Any insurances required for the works shall be arranged from amongst above listed approved Insurance Companies.

SECTION - 06
SPECIAL CONDITIONS OF CONTRACT

01. **GENERAL CONDITIONS OF CONTRACT**

0101. The General Conditions of Contract shall be carefully studied by each tenderer before submitting his tender. Nothing stated herein shall waive any part of the General Conditions of Contract unless specifically stated herein. Where clauses of General Conditions of Contract are repeated in this section, it shall be only for calling special attention to them and/or as a further qualification, and it shall not mean as omitting any other clause or clauses of the General Conditions of Contract.

02. **SCOPE OF WORK**

0201. The accompanying specifications and drawings are intended to provide all Air Conditioning and ancillary works right wing ground floor for the Site and Building(s) referred in the specifications and drawings, and the contract on item rate cost basis is intended to provide all materials and labour necessary for manufacture, supply, construction, assembly, installation, completion, testing, commissioning, balancing and adjusting and maintenance of the complete mechanical systems and ancillary works, making them ready for operation in all respects and training of the Employer's personnel.

0202. (a) The general scope of work is detailed and shown in the BOQ/specifications and drawings. Furthermore included are all interconnecting piping, valves and fittings and electric wiring between and for various items of plant, equipment, controls and accessories.

(b) The Employer shall not be responsible for supply at site any Equipment and services.

0203. Within the general scope of work the following items are specifically included without limitation:

(a) All equipment stated in Bill of Quantity

(b) All refrigerant and condensate piping/air ducts/ associated electrical and control wiring etc.

(c) Painting of equipment, piping, etc. and system components and all other incidentals to make the mechanical systems and ancillary works installation complete and perfect and ready for operation in every respect.

(d) Commissioning, testing, balancing and adjusting of all the plants, equipment and systems except the equipment for which the Employer is responsible.

(e) Test run of the complete plants and systems in next summer after the completion of commissioning, balancing and adjusting of equipment and systems.

(f) Servicing and maintenance of complete installation during the period of maintenance.

0204. The Contractor shall give written guarantee that all the equipment and materials supplied under the contract shall be brand new, of robust construction and standard manufacture, and that the materials and workmanship will be of best class, will be installed in a practical and first class manner, that the plants and systems will be complete for satisfactory operation, nothing being omitted by way of labour and material required to make them so although not specifically shown or mentioned in the drawings or specifications, and that these will be delivered to the Employer in well working order, complete and perfect in every respect.

0205. The Contractor shall furnish all the required equipment, plants, devices, controls, etc. required to complete the works under applicable local codes or regulations.

0206. The specifications are to be read in conjunction with the latest relevant British/American Standard Specifications and British/American Standard Codes of Practice. It shall be inherent in the interpretation of the contract documents that wherever British Specifications or Codes are referred to, they shall be deemed to be the British or American Standard Specifications or Codes and vice versa. Where differences or contradictions appear to arise between the British and American Standard Specifications or Codes, these differences or contradictions shall be referred to the Engineer for a decision.

0207. In case any item or material offered deviates from the above standards, the tenderer shall clearly draw attention to all such deviations and no such item or material shall be supplied by the Contractor without prior written approval of the Engineer.

0208. The Contractor shall execute the works with materials in accordance with the specifications. All materials which in the opinion of the Engineer are not sound and/or do not meet with the above conditions, shall be immediately dismantled and/or removed from site by the Contractor at the request of the Engineer and replaced by appropriate approved materials without claim by or extra payment to the Contractor.

0209. The tenderer shall carefully check the sizes of the plant rooms, the pipe and duct passages and trenches, the pipe and duct shafts as shown in the drawings and confirm that his equipment, piping, ducting, wiring, etc. can be installed within the respective spaces allocated for the same.

03. **RESPONSIBILITIES OF THE EMPLOYER AND CONTRACTOR**

0301. The Employer shall not provide any equipment, stores, materials, etc. to the Contractor for the purpose of completing the works or temporary works except where otherwise specified in the contract.

The respective responsibilities of the Employer and the Contractor for the ancillary works shall be as detailed below.

0302. Builders Work.

(a) The Employer shall arrange all slab, beam and structural openings.

(b) The Contractor shall arrange all excavations, pipe trenches and backfilling, unless specified to be the Employer's responsibility.

(c) All wall openings, cuttings, chases, patching and making good shall be done by the Contractor. Only finishing and painting shall be arranged by the Employer after the Contractor had completed his work.

(d) All foundations for equipment mounting supplied by Contractor will be constructed by the Contractor who will also provide vibration isolators for isolation from the Building structure as required (and/or specified).

(e) The Contractor will supply and fix all necessary foundation and anchor bolts, concrete inserts, sleeves, brackets, clips, supports, stays, hangers, and hardware required for the complete installation. The Contractor shall supply and fix foundation and anchor bolts, concrete inserts and pipe sleeves before concreting. The Contractor will also be responsible for plugging of slab, wall and ceiling openings for all items and fittings where plugging has to be done by special plugs, screws or materials.

(f) The Contractor shall arrange for lifting of all equipment and materials to the respective plant rooms and locations. The Contractor will be responsible for any damage to the Building finishing. He shall ensure that no damage is caused to the structure.

0303. Electrical Work.

(a) The Contractor will be provided electric supply points, 380 volts, 3 phase, 4 wire alongwith two earthing points, in the Utility Area for water booster set and other electrically operated equipment.

(b) The Contractor shall be responsible for supply and installation of the complete onward electric wiring and earthing work for all plants, equipment and automatic controls. He shall also check and confirm that the specified ratings of the supply points meet the requirements of his plants and equipment.

(c) The responsibility of the Employer would be limited to provide the

electric supply points and earthing points as detailed above and shown in the drawings.

0304. The Employer will arrange without charge to the Contractor, the supply of electricity, water and fuel during the commissioning, starting, testing and adjusting of the complete plants and during the Test Runs. The Contractor shall be responsible for the supply of all other materials and labour required in this connection.

0305. It will be the responsibility of the tenderer to clearly mention in detail any other particular work excluded by him in his tender but necessary to complete the works in all respects for satisfactory, efficient and trouble free operation.

04. **COORDINATION**

0401. The Contractor shall acquaint himself fully with the requirements of the programme of work execution and the requirements of contractors. It shall be the responsibility of the Contractor to schedule his work so as to complete the work within the required time and without causing delay in the completion of the entire project.

05. **GUARANTEES**

0501. The Contractor shall guarantee the performance of the plant and equipment offered by him.

0502. The Contractor shall give to the Employer a written guarantee for the complete works against defective materials and faulty workmanship for the period of maintenance as specified in the Memorandum from the date of issue of Certificate of Substantial Completion by the Engineer. All defects of material or workmanship found in the work during the period of maintenance shall be removed and defective items replaced or repaired by the Contractor to the satisfaction of the Engineer without any additional cost to the Employer.

0503. The Engineer shall inform the Contractor in writing in what respect any portion of the works, installation is defective. If any defect be not remedied within reasonable time by the Contractor, the Employer may proceed to do the defect rectification work at the Contractor's risk and expense but without prejudice to any other rights which the Employer may have against the Contractor in respect of such defects.

0504. In case the replacements, repairs or renewals are of such a character as may affect the functionality of installation, the Engineer shall have the right to give to the Contractor within one month from such replacements, repairs or renewals notice in writing that a test be carried out to check the efficiency and performance of the system and it shall be the duty of the Contractor to ensure that the efficiency and performance

of the plant or equipment conform with the specified requirements.

0505. In the event of any defect of material or workmanship occurring or being discovered during the period of maintenance, the period of maintenance shall continue until the cause of the defect has been discovered and remedied to the satisfaction of the Engineer.

06. **MANUFACTURERS/SUPPLIERS' GUARANTEES/WARRANTIES**

0601. Manufacturer/Supplier's Guarantee/Warranty, specimen given below, for each equipment is an essential document to be supplied to the Employer before claiming payment for that equipment. The Guarantee/Warranty shall be duly sealed and signed by an authorised Executive of the Manufacturer/Supplier.

0602. (a) The Contractor may obtain the Guarantee/Warranty from the Manufacturer/Supplier and submit the same to the Engineer/Consultant before claiming payment for the equipment in his bill, or

(b) The Manufacturer/Supplier shall furnish the Guarantee/Warranty as an essential part of the documents submitted to the Bank to claim payment against the letter of credit established by the Employer.

0603. The form of Guarantee/Warranty shall be:

"We hereby guarantee that the stores supplied are produced new in accordance with the contract specifications and that the materials used whether or not of our manufacture are in accordance with the latest appropriate standard specifications, the contract specifications and of good workmanship throughout. We shall replace free of cost FOB Factory or repair any part of the equipment for either a period not exceeding 12 calendar months after it has been taken over on completion of installation as certified in the Completion Certificate issued by the Employer or a period of 24 calendar months from the date of despatch from our Factory, whichever is shorter, which would be found defective due to material or faulty workmanship or in any way not in accordance with the contract specifications.

Our responsibility shall be limited to replace/ repair any part or parts of the stores found to be defective in workmanship or material provided the equipment is operated and maintained by the Employer in accordance with the generally approved practices and provided the Employer informs us in writing as soon as such defect becomes apparent.

Our obligation shall be to replace or repair any part or parts found defective FOB Factory and we shall not be responsible for any consequential damage or liability. We shall also not be responsible for any work done, equipment or part(s) supplied or repaired by others or for any loss, damages or expenses arising from such work, equipment, part(s) or repairs.

Signature and Seal-----

Manufacturer/Supplier's Name and

Address-----

Date-----"

0604. Wherever guarantees of operating capacity and efficiency, proper functioning, durability and the like are called for and/or wherever it is specified that the manufacturer shall furnish necessary technical manuals, drawings, performance data, test certificates, etc. and shall supervise the starting up of the equipment and adjustments after installation and starting up, and etc., and maintain it for the required period and perform similar other duties and services, the Contractor shall be held responsible for performance of the specified services for the actual conditions of the installation and he shall be held responsible for any default on the part of his suppliers/manufacturers/principals.

07. **DRAWINGS, TECHNICAL DATA AND MANUALS TO BE SUPPLIED**

0701. The Contractor when preparing any detailed shop drawings shall carefully check for all clearances, field conditions, avoidance of any hindrance with architectural features and proper coordination with all other services of the Building. Each shop drawing submitted by the Contractor shall include a certificate by the Contractor that all related conditions on the site relevant to that particular installation had been checked and that no conflict existed. The Engineer/Consultant shall not approve any shop drawing submitted by the Contractor without such a certificate.

0702. Manufacturers' performance data, performance and other test certificates and shop drawings for all main equipment giving complete information regarding dimensions, materials and other details confirming the adequacy of the equipment to be supplied shall be submitted to the Engineer/Consultant for approval.

0703. All shop drawings etc. correct and conforming with the contract requirements, shall be submitted to the Engineer/Consultant sufficiently in advance of actual requirements to allow ample time for checking and approval and no claim for extension of the contract time will be considered by reasons of the Contractor's failure to submit the correct drawings etc. in time. The Contractor will submit eight copies of final corrected shop drawing for approval out of which 3 duly approved copies would be returned to him.

0704. The Contractor shall clearly point out the differences, if any, between

the details submitted and the requirements of the contract in covering letters sent with the submitted documents and drawings. He should also give reasons for his request for substitution so that if substitution is approved by the Engineer, necessary action may be taken for price adjustment. The Contractor will not otherwise be relieved of his responsibility for executing the works in accordance with the contract.

0705. After completion of the installation work, the Contractor is to provide reproducible transparencies (quality to be approved by the Consultant) and 3 copies each of as-installed drawings showing runs and location of all the plant, equipment, controls, piping, ducting, electric wiring, burried work, etc. giving all necessary details of the works as actually installed.

0706. Technical Manuals.

The Contractor shall supply seven sets of printed manufacturers' installation, commissioning, operation, servicing and maintenance manuals, technical catalogues and detail spare parts manuals in English language for all items for the guidance of the Employer's operators in operation, servicing and maintenance of the plants and equipment.

One set shall be supplied to the Consultant for scrutiny and approval well before shipment of the items by the manufacturers/suppliers.

Each set shall be hard bound in volumes as directed by the Consultant.

After approval by the Consultant, balance six hard bound sets shall be supplied to the Engineer simultaneously with or before the arrival of the items at site.

0707. In case of any question regarding the Contractor's responsibility for preparation and supply of any detail shop drawings, data, as-installed drawings, technical manuals, etc., the Engineer's decision shall be final and binding as to the requirements of the shop drawings, data, as-installed drawings, technical manuals, etc. for the works.

0708. The approval by the Engineer/Consultant of any submitted data, shop drawings, performance curves, test certificates for any item, arrangement and or layout shall not relieve the Contractor from any responsibility regarding the performance of the contract. Such approval shall not also relieve the Contractor from responsibility of error of any sort in the submitted data and shop drawings, etc.

1-0 GENERAL REQUIREMENTS

1-01 MATERIALS

All materials shall be of the highest grade, free from defects and imperfections, of recent manufacture and unused, and the classification and grades designated, conforming to the requirements of the latest issue of the appropriate specifications cited herein. All materials, supplies, and articles forming part of major equipment and not fabricated by the manufacturer of the equipment shall be the products of the recognized reputable manufacturers.

1-02 WORKMANSHIP

Workmanship and general finish shall be of the highest grade, in accordance with the requirements specified herein, and the best latest standard practice.

1-03 EQUIPMENT

- a) All equipment shall be manufactured by companies which have had at least ten years of previous experience in the design and manufacture of equipment of comparable type, capacity and operating conditions, unless otherwise approved by the Engineer.
- b) All equipment and materials supplied shall be from approved manufacturers who are adequately represented in Pakistan by an Agent since minimum last 5 years capable of providing installation commissioning and after sales service. All major equipment shall be imported directly from the manufacturers through their local agents. Import of these equipment through warehouses/Export Houses will not be accepted.
- c) All equipment shall be of latest manufacture, not older than the year in which this contract is awarded and shall bear year of manufacture stamped on the manufacturer's name plate duly certified by the manufacturer.
- d) When a manufacturer's product is specified by name, or equivalent, it shall be in the sole judgment of the Engineer as to acceptability of any product which is offered as equal to that specified.
- e) Where two or more units of the same class of equipment are furnished, product of the same manufacturer shall be used;

component parts of entire system need not be product of same manufacturer.

1-04 CHASES AND OPENINGS

The Contractor shall provide templates or details for chases and openings to be left in walls and partitions to accommodate work under HVAC scope of works, much prior the civil work executed at site, in case the Contractor failed to provide detail in time or in-sufficient details, all such works required to execute his work shall be executed by the HVAC Contractor at his own expense and arrangements, no compensation of whatsoever nature shall be made by the Client in this regard. All such works if executed by the HVAC Contractor shall obtain prior permission by the Engineer.

1-05 PROTECTION

The Contractor shall keep pipe, duct and other openings closed to prevent entry of foreign matter. All fixtures, equipment and apparatus shall be covered and protected against dirt, water, chemical or mechanical damage, before and during the construction period. All fixtures, apparatus, or equipment damaged including damaged shop coats of paint shall be restored to original conditions prior to Commissioning and also again prior to Final Acceptance. All bright finished shafts, bearing housings and similar items shall be protected until in service. No rust will be permitted.

1-06 CUTTING, PATCHING AND REPAIRING

Required (other than listed in clause 1-04) for proper installation and completion of HVAC works, including masonry work, concrete work, carpentry work, painting and re-painting shall be performed by skilled craftsmen in respective trades, at expense of the Contractor, Construction shall be cut only after obtaining written permission from the Engineer.

1-07 LINES, LEVELS AND SPACES

The Contractor shall check dimensions at the building site and establish lines and levels for work specified in Specifications. The Contractor shall check with work of other trades to ensure proper clearance of piping, ductwork, conduit and other items. Any deviations observed between drawings and actual construction shall be brought to the notice of the Engineer. The erection supervisor shall regularly inspect, during progress

of civil works, the areas allocated for installation of HVAC equipment and any conflict observed shall immediately be reported to the Engineer.

1-08 MACHINERY GUARDS

All moving parts of machinery shall be protected by strong guards to adequately protect all personnel working on or in the vicinity of equipment. Wherever possible, moving parts should be protected with guards supplied by the equipment manufacturer. All guards must be strongly attached to equipment and should be designed for easy removal for access, servicing, adjustment & maintenance.

1-09 TOOLS

The Contractor shall supply in a toolbox, full set of tools suitable for maintenance of all components of the plant furnished by him including the electrical equipment, for use by the Employer after Final Acceptance.

1-10 SPARE PARTS

The spare parts for HVAC System shall be duplicates of the original parts furnished and interchangeable therewith.

1-11 ACCOUSTIC TREATMENT

The noise criteria for different areas stated in Special Provisions is to be obtained.

Sound measurements will be made at 5 feet above floor level in the area served and not more than 5 feet from the grilles, diffusers or other air devices being tested. The Contractor shall provide instruments for sound measurement.

Provision is to be made to minimize noise and vibration. However, different manufacturers' equipment have varying sound and vibration characteristics and it is, therefore, the responsibility of the Contractor to ensure that the requirements in these specifications are fully met by the equipment he is offering. If the Contractor has any requirements for additional vibration or sound isolation, these must be incorporated into the price quoted.

All equipment installed should not be audible inside the occupied areas and the Contractor must ensure that the equipment he is offering is quiet and

supplied with all necessary silencers to ensure satisfactory sound levels. Where silencers are required, these must be incorporated into the price quoted for such equipment, if these are not specified separately.

1-12 ACCESS PANELS

The Contractor shall mark locations of, and give sizes of, access panels required in false ceiling and wall paneling for adjustment and maintenance of HVAC Equipment, such as Dampers, Fire Dampers, valves, ceiling-hung equipment, etc. on sepias of reflected ceiling plans to be provided to him by the Engineer.

1-13 EQUIPMENT LIFTING

The Contractor shall be solely responsible for safe lifting of the equipment from the place of storage to location of final installation and finally on the respective foundations.

Prior to lifting the equipment the following procedures shall be adopted:

- a) Submit comprehensive insurance policy for the full value of the equipment to the Engineer from approved insurance company.
- b) Submit complete information of specialist firm of lifters/riggers to the Engineer and obtain approval.
- c) Submit complete procedure and equipment to be used for lifting the equipment in place. Identify on plans location of tripod, hoist, crane etc., that will transfer weight of the equipment to building and or adjoining structure and obtain approval.
- d) All the above to be completed with minimum one month before the date of lifting of the equipment.

2-0 EQUIPMENT

2-01 GENERAL

All equipment shall be of such overall dimensions, operating weights, service area requirements and configuration that it can be located where shown on the plans without any adverse effect on its performance and clearance requirements. Electrical input kW shall not exceed kW listed in Schedules. The Contractor shall estimate any change in other trades work, anticipated by offering alternate equipment, and its cost shall be included in the quoted price for HVAC Works.

Provision for clearance and service spaces shall be made around all Mechanical equipment as recommended by manufacturers.

All equipment supplied under this section shall be brand new, factory manufactured and factory assembled (unless otherwise specified) and complete in all respects. The type, characteristics, capacity ratings, component sections of all equipment shall be as scheduled. All equipment shall be tested at factory for performance before shipment. The manufacturer shall issue certificate along with test results.

All equipment furnished by the Contractor shall include vibration isolation mounting pads, anchor bolts, frames or any other mounting or supporting accessories.

All power driven equipment shall include motor drives and adjustable motor foundation bases and accessories.

All equipment shall be complete with all accessories necessary to serve the intended purpose, whether specified or not. All moving equipment/parts shall be provided with vibration isolators to prevent vibration to the structure of the building.

Equipment installed on roof or intermediate floors shall include suitable vibration isolators to prevent any vibration traveling to building structure.

All equipment shall be rated and tested according to the applicable standards listed in ASHRAE Handbooks (Latest Edition).

2-02 NOT IN USE

2-03 NOT IN USE

2-04 NOT IN USE.

2-05 PROPELLER FANS

Propeller Fans shall be three blade type of metal construction, mounted on steel mounting plate with Orifice ring.

Fans shall be direct driven and supplied complete with electric motor, backdraft dampers and anti-vermin screen.

The bearings shall be ball type permanently lubricated and sealed.

2-06 NOT IN USE

2-07 MULTI SPLIT (VRF) SYSTEMS

2-07.1 General

Specification for VRF Condensing Units:

- a. Variable refrigerant Flow (VRF) System, with R410 Refrigerant gas, having Air cooled Condensing unit suitable for installation at ground level, rooftop, wall hung, and or balcony/ledge mounting. A reliable system with all DC inverter Compressors having High Pressure Switch, Phase Protection, restart Relay, Self Diagnosis Function, Soft Starting. Having Brushless DC (BLDC) Concentration Electric Motor or better. Units shall be capable for reversible function as the outdoor component of an air-to-air heat pump system.
- b. Special Coating for protection against Corrosion for installation of worst coastal environments (near/ or on face of sea side) is required for each condensing unit. Post coated epoxy and anti-corrosive polyester (120 μm with a tolerance of +/- 20 μm) are recommended for Outdoor unit's parts such as brackets, panels (exterior), Screws, Heat Exchangers, fins and tubes Fan with Fan Motor, Grills. Subject to Engineer's approval.
- c. Average EER/COP in Cooling Mode for Condensing units from 8HP to 20HP to be minimum 4.0 or higher at standard operating conditions i.e. Outdoor temp. 35 deg. C DB/ 24 deg. C WB, Indoor temp. 27 deg. C DB/19 deg. C WB. The technical data must show the actual parameters in software selection report.
- d. Hermetically Sealed Scroll Inverter Compressors of latest Generation, having updated/available latest technologies to increase efficiencies,

technologies such as smart oil return and high pressure oil return or better are recommended /required in Compressors.

- e. Heat Exchangers to be Variable flow type for Heating and cooling mode for Optimum Performance in each mode.
- f. Power Emergency Operation: A System for Limiting power consumption of all AC units to be provided so that when electric power supply is shifted from normal to generators, a limit can be set for each outdoor unit power consumption resulting in limiting cooling capacity in each apartment.
- g. Wireless individual remote control to be provided for each indoor unit of each apartment. A central controller for each apartment to be provided.
- h. Condensing units Outdoor fan to be propeller Type with DC inverter motor with a min. static pressure of 100 Pa. Protection against Over heat and Fan Driver over Load. Preferred if the same capacity centrifugal fan is offered.
- i. All Condensing units to be installed in space designated for outdoor unit such as apartment balconies/roof top and or ledges etc. The units installed in balconies / ledges (and or where as advised by the Engineer) to be provided with suitable Air guides to make air discharge through vertical Louvers for side discharge.
- j. Units shall be used in a refrigeration circuit matched to ducted or duct-free heat pump fan coil units of various types as specified in the schedule/BOQ.
- k. The systems shall capable of one or a number of outdoor units connected via interconnecting refrigeration pipe work to multiple indoor units using simple Y, T or Header type branch pipe connectors. The systems shall have manufacturer standard component in addition to above, must be complete in all the necessary electronic controls board and control wiring to maintain the design room conditions without external controller.

- l. Manufacturer's Recommendation and approval to be provided for installation of Outdoor units before commencing installation work.
- m. All outdoor units are to be permanently marked with an identification number. The removable access panels are also to be marked with the same number.
- n. Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory installed pre-wiring, piping, controls, and the compressor.
- o. The outdoor unit shall have the full capacity control to meet the load fluctuation up to 130% and indoor unit individual control, however units shall must be selected strictly on minimum 100% operating capacity of indoor units.
- p. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components, the fan must be inverter driven variable speed propeller type fan.
- q. Compressor shall be isolated and have an acoustic wrap to assure quiet operation.
- r. Compressor compartment shall be isolated to allow performing diagnostics while the system is running.
- s. Outdoor fan(s) shall be direct-drive propeller type, and shall discharge air horizontally. Fans shall draw air through the outdoor coil.
- t. Outdoor fan motor(s) shall be totally-enclosed, inverter driven with permanently-lubricated ball bearings. Motor shall be protected by internal thermal overload protection.
- u. Shaft shall have inherent corrosion resistance.

- v. Fan blades shall be non metallic and shall be statically and dynamically balanced.
- w. Outdoor fan openings shall be equipped with non metallic protective grille over fan.
- x. The fan will be capable of overcoming a minimum of 100 Pascal of external static pressure, subject to the wind pressure at project site location, the outdoor shall be provided with guided fiber glass frame based out let must be customized to mount of non-returned air foil based damper, the Aluminum sheet (heavy gauge) self-closing damper shall be provided by contractor.
- y. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature operation.
- z. Motor shall be suitable for operation in an R-410A refrigerant atmosphere.
- aa. Compressor assembly shall be installed on rubber vibration isolators.
- bb. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
- cc. The capacity control of the outdoor units shall be inverter controlled and shall be determined electronically by sensing operational temperatures, pressures and ambient temperature and monitoring requirements for the indoor units.
- dd. The units shall be complete with electronic pulses based expansion valve(s), oil separator(s), high pressure switches, fan motor safety devices, over current relay, Refrigerant Cooled inverter overload protection, fuses, necessary solenoid valves, refrigerant shutoff valves, re-cycling guard timer and all necessary sensors for a safe and trouble free operation.

ee. Operating controls and safeties shall be factory selected, assembled, and tested.

The minimum control functions shall include the following:

- A time delay sequence is provided in the inverter control.
- Automatic outdoor-fan motor speed control.
- Diagnostics provided by inverter control.
- Compressor motor current and temperature protection.
- Outdoor fan failure protection (High Pressure Switch).
- Low pressure protection.
- Fusible plug to vent refrigerant safely in case of a fire.

ff. Refrigerant Line Lengths:

- Total Allowable Piping length = 1000m;
- Allowable maximum actual longest pipe length = 200m;
- Allowable height difference from outdoor to indoor units= 110m;
- Allowable height difference from indoor to indoor unit = 40m

gg. Special Features:

- Crankcase oil temperature regulation by inverter control.
- User activated forced defrost cycle.
- User activated refrigerant pump down cycle.
- Outdoor fan can be controlled to accommodate minimum external static pressure change.
- The access to the internal components for maintenance purposes shall be by removable panels.
- It shall be possible to connect up to 32 indoor units, capacity permitting, to one modular outdoor unit.
- The units shall be equipped with Auto Restart function, which allows the unit to start in the same mode prior to the power failure.

2-07.2 Standards

- a. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC.

- b. Units shall be evaluated in accordance with UL standard 1995 or latest.
- c. Units shall be listed in the CEC directory.
- d. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (Method 6061).
- e. Certificate of Acceptance for Test method B of ISO21207: Salt Contaminated condition + severe industrial or traffic environment, or approved equivalent.

2-07.3 Specification for VRF Indoor Units:

a) One way discharge Cassette

The unit casing shall be manufactured from galvanized steel plate and shall be fully insulated.

The fan shall be statically and dynamically balanced to ensure low noise and vibration free operation.

The heat exchanger coils shall be manufactured from copper tubes and aluminum fins.

It shall have electronic expansion valve to control refrigerant flow rate in response to the load variation in the conditioned space. The expansion valve shall be controlled by an integral computerized control system to maintain correct room temperature.

The low profile dedicated decoration panel ref shall be provided for each unit. The decoration panel shall incorporate the return air grille and supply air louvers. A facility shall be provided to automatically swing the supply air louvers or lock them at a desired angle between to ensure even distribution of the airflow.

A condensate lift pump shall be provided within the unit and shall be capable of discharging at a height of at least 310 mm above the drain outlet.

The condensate shall be drained from the unit using thermally insulated copper tube and run directly to the foul water drain as indicated.

The air filters shall be incorporated within the unit and shall be washable resin net type.

b) Two way discharge Cassette

The unit casing shall be manufactured from galvanised steel plate and shall be fully insulated.

The fan shall be of the dual suction multi blade type, statically and dynamically balanced to ensure low noise and vibration free operation. The heat exchanger coils shall be manufactured from copper tubes and aluminum fins.

It shall have electronic expansion valve to control refrigerant flow rate in response to the load variation in the conditioned space. The expansion valve shall be controlled by an integral computerized control system to maintain correct room temperature.

The low profile dedicated decoration panel ref shall be provided for each unit. The decoration panel shall incorporate the return air grille and supply air louvers. A facility shall be provided to automatically swing the supply air louvers or lock them at a desired angle between to ensure even distribution of the airflow.

A condensate lift pump shall be provided within the unit and shall be capable of discharging at a height of at least 310 mm above the drain outlet.

The condensate shall be drained from the unit using thermally insulated copper tube and run directly to the foul water drain as indicated.

The air filters shall be incorporated within the unit and shall be washable resin net type.

c) Four-way discharge ceiling Cassette

The unit casing shall be manufactured from galvanized steel plate and shall be fully insulated. Facility shall be provided for duct connection for introduction of the fresh air in the unit and branch ductwork from the unit.

The fan shall be of the propeller type, statically and dynamically balanced to ensure low noise and vibration free operation.

The heat exchanger coils will be manufactured from copper tubes and aluminum fins.

It shall have electronic expansion valve to control refrigerant flow rate in response to the load variation in the conditioned space. The expansion valve shall be controlled by an integral computerized control system to maintain correct room temperature.

The low profile dedicated decoration panel shall be provided for each unit. The decoration panel shall incorporate the return air grille and supply air louvers. A facility shall be provided to automatically swing the

supply air louvers or lock them at a desired angle to ensure even distribution of the airflow.

A condensate lift pump shall be provided within the unit and shall be capable of discharging at a height of at least 500 mm above the drain outlet.

The condensate shall be drained from the unit using thermally insulated copper tube and run directly to the foul water drain as indicated.

The air filters shall be incorporated within the unit and shall be mould resistant washable resin net type.

d) Under Ceiling and Floor/ceiling Mounted convertible unit

The unit casing shall be manufactured from heat resistant plastic, the casing colour shall be white. The back plate and the support frames shall be manufactured from galvanised steel plate.

The fan shall be cross flow type, statically and dynamically balanced to ensure low noise and vibration free operation.

The heat exchanger coils will be manufactured from copper tubes and aluminium fins.

It shall have electronic expansion valve to control refrigerant flow rate in response to the load variation in the conditioned space. The expansion valve shall be controlled by an integral computerized control system to maintain correct room temperature.

The condensate shall be drained from the unit using thermally insulated copper tube and run directly to the foul water drain as indicated.

The air filters shall be incorporated within the unit and shall be washable resin net type.

e) Low Profile LOW ESP Ducted type

The unit casing shall be manufactured from galvanized steel plate and shall be fully insulated. Facility shall be provided for duct connection for introduction of the fresh air in the unit and branch ductwork from the unit. The return air to the unit shall be through the Return bottom of the unit as standard. A facility shall be provided for alternative return air position through the back of the unit.

The fan shall be inverter driven to allow variable static pressures to suit the installation it shall also be statically and dynamically balanced to ensure low noise and vibration free operation.

The indoor units shall discharge conditioned air to the offices via insulated galvanised mild steel ductwork. The final connection to the supply air diffusers are to be made in flexible ductwork which shall be pre-insulated and shall be no longer than 0.5 m in length with no bends or offsets. The supply air diffusers are to be supplied by the HVAC Contractor.

If required a low profile dedicated decoration panel shall be available as an option. The decoration panel shall incorporate the return air grille. Alternatively a return air grille properly sized for minimum pressure drop at rated air volume can be supplied by others. The return air should be ducted back to the indoor unit in insulated galvanised sheet steel ductwork for accurate temperature control. The ceiling light fittings should not be used for return air.

The heat exchanger coils will be manufactured from copper tubes and aluminium fins.

It shall have electronic expansion valve to control refrigerant flow rate in response to the load variation in the conditioned space. The expansion valve shall be controlled by an integral computerized control system to maintain correct room temperature.

The condensate shall be drained from the unit using thermally insulated copper tube and run directly to the foul water drain as indicated.

When using the bottom return air configuration the air filters shall be incorporated within the unit and shall be mould resistant washable resin net type.

When using the rear return air configuration a separate filter frame with 25 mm glass fiber throwaway type filter shall be provided for on site installation. A blanking plate shall be provided for the bottom opening. This blanking plate must be removable for access to the internal components of the unit.

f) High ESP ducted type

The unit casing shall be manufactured from galvanised steel plate and shall be fully insulated. Facility shall be provided for duct connection for introduction of the fresh air in the unit and branch ductwork from the unit. The return air to the unit shall be through the back of the unit as standard.

The fan shall be inverter driven to allow variable static pressures to suit

the installation it shall also be statically and dynamically balanced to ensure low noise and vibration free operation.

The indoor units shall discharge conditioned air to the offices via insulated galvanised mild steel ductwork. The final connection to the supply air diffusers are to be made in flexible ductwork which shall be pre-insulated and shall be no longer than 0.5 m in length with no bends or offsets.

A return air grille properly sized for minimum pressure drop at rated air volume must be supplied by others. The return air should be ducted back to the indoor unit in insulated galvanised sheet steel ductwork for accurate temperature control. The ceiling light fittings should not be used for return air.

The heat exchanger coils will be manufactured from copper tubes and aluminium fins.

It shall have electronic expansion valve to control refrigerant flow rate in response to the load variation in the conditioned space. The expansion valve shall be controlled by an integral computerized control system to maintain correct room temperature.

The condensate shall be drained from the unit using thermally insulated copper tube and run directly to the foul water drain as indicated.

The air filters shall be incorporated within the unit and shall be mould resistant washable resin net type.

g) Wall mounted type

The unit casing shall be manufactured from heat resistant plastic. The casing colour shall be white. The back plate and the support frames shall be manufactured from galvanised steel plate.

The fan shall be cross flow type, statically and dynamically balanced to ensure low noise and vibration free operation.

The heat exchanger coils will be manufactured from copper tubes and aluminium fins.

It shall have electronic expansion valve to control refrigerant flow rate in response to the load variation in the conditioned space. The expansion valve shall be controlled by an integral computerized control system to maintain correct room temperature.

The condensate shall be drained from the unit using thermally insulated copper tube and run directly to the foul water drain as indicated.

The air filters shall be incorporated within the unit and shall be washable resin net type.

h) Controls (Indoor Units)

Provide a neutral color plastic material control system. Each control should have Liquid crystal display (LCD). Units shall be controlled with user friendly, wall mounted microprocessor based LCD, wired remote controller. The wired remote controller shall be slim having the following features.

- a) 24 hour ON / OFF timer in 1 hour interval.
- b) Test run mode.
- c) Self-diagnosis function.
- d) Operation indication.
- e) Room temperature display.
- f) Weekly programming.
- g) Child lock function.
- h) 3 speed fan control.
- i) Linear control of E.S.P/Airflow.
- j) Auto swing
- k) Clean filter indication

The wireless remote control should be available for all wall Mounted Type.

The system shall be microprocessor controlled to maintain precise room temperature and minimum power consumption. The controls system shall employ a genetic algorithm for temperature control, and shall have an accuracy of 0.9 °F (\pm 0.5 °C).

All of the following user interface accessories shall be compatible with the unit.

a. Local Controller (Wireless or Wired Remote Controller)

Either a wired or a wireless controller can be used to control the system. The wireless kits shall have a remote receiver not integral to the unit.

Wired remote controller shall communicate over two core shielded wire up to 1640ft/500m. It shall be capable of controlling groups of up to 8 indoor units. It shall be able to operate as a primary or secondary controller when two remote controllers are connected

to a single indoor unit or group. The system shall be able to be configured so that the return air (TA) can be sensed at the unit, at the remote controller or through a remote sensor. The local controller shall minimally be able to control On-OFF, set point, mode, and be able to display system generated error codes.

b. Central Controller

Central controller shall communicate over two core shielded wire up to 6562ft/2000m and use existing Indoor - Outdoor communication protocol to communicate. A Single Central Controller shall be capable of controlling up to 128 Indoor Units individually. It shall be able to create 4 Zones without any extra wiring. The Central Controller shall be equipped with digital input points for Force-OFF. It shall provide operation monitoring, and generate a digital output signal in response to an alarm. It shall be capable of restricting Local Remote Control operation. It shall be able to facilitate Indoor operation without local remote controller(s).

c. Advance Central Controller

d. The Advanced Central Controller shall be able to control up to 128 Indoor Units Individually. It shall also be able to create up to 128 Zones without any extra wiring. The Controller shall be equipped with digital input points for Force-OFF & External ON-OFF. It shall provide operation monitoring, and generate a digital output signal in response to an alarm. It shall be able to restrict Local Remote Control operation and allow Set Back temperature. It shall provide a web interface for remote monitoring, control, and scheduling. It shall be able to create up to 10 programs per day. It shall facilitate Indoor operation without local remote controller(s). It shall be capable of monitoring energy consumption for each tenant and generate monthly billing reports.

e. Emergency Power Operation:

f. A reliable system is to be provided for AC operation on low power consumption mode once the Power is shifted from normal to emergency backup. This is to be done through Central control of AC units with Computer based peak control option in the software.

g. Building Management Systems

The system shall be able to be controlled by BACnet, or Lon Works either directly or through an external gateway.]

BACnet and Lon Works shall be able to control: On / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation

BACnet and Lon Works shall be able to monitor: On / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation, Room temperature, Error status, Error code.

2-07.4 Refrigerant Piping Work

The copper pipe/tube used shall be of HVACR quality (ACR Grade) type "K", complying to ASTM B280 or approved equivalent. Copper fittings shall comply with B16.15, B16.18, B16.22, B16.24, B16.50, B1.20.1, WROT fitting meets NSF 61G. Bends shall be used of long radius of pre-formed bends.

Following Table contains the minimum recommended pipe Thickness for Each Size

Minimum Recommended Pipe Thickness												
Outer Diameter (mm)	6.35	9.52	12.7	15.88	19.05	22.2	25.4	28.58	31.8	34.9	38.1	41.3
Minimum thickness (mm)	0.8	0.8	0.8	0.99	0.99	0.99	0.99	0.99	1.1	1.21	1.35	1.43

Minimum Recommended closed cell foam Insulation for refrigerant Pipes as below Table or Better.

Diameter / Thickness (mm) (Normal condition)	Thickness (mm)	Thickness (mm)

TECHNICAL SPECIFICATIONS HVAC WORKS

	Diameter (mm)	Thickness (mm)	Cooling Zone (Case 1) (within AC space)	Non - Cooling Zone (Case 2) (non AC space)	(Bad Condition) Exposed to atmosphere piping
Gas	6.35	19	13	19	19
	9.52	19	13	19	25
	12.7	19	13	19	25
	15.88	19	13	19	25
	19.05	19	13	19	25
	22.22	19	13	19	32
	25.4	19	19	19	32
	28.58	19	19	19	32
	31.75	19	19	19	32
	38.1	25	19	25	32
	44.45	25	19	25	32
Liquid	6.35	9	9	9	9
	9.52				
	12.7~44.45	13	13	13	13

All copper pipe work shall be insulated with closed cell foam class 0 type insulation, of minimum thickness as scheduled above. Joints and headers must be insulated with the pre formed insulation supplied with these fittings. Insulation exposed to atmospheric conditions shall be externally protected with 1" Thick (24Kg/M3) Aluminum Foil wrapped Fiber glass insulation, Jacketing with 06 oz Canvas Cloth complete with antifungal paint. All insulation joints shall be made using adhesive and care should be taken that the every part of insulation is sealed to maintain a vapor barrier. The piping exposed to atmosphere shall be provided within removable heavy gauge G.I open-able piping tray, if installed on roof shall be installed minimum 3 inch above finish floor level.

The pipe work must be supported through its entire length according to good refrigeration practice. However the brackets must not be positioned

directly on the joints or headers. On horizontal pipe work the bracketing should be over the insulation to allow pipe movement due to contraction and expansions. The vertical pipe work shall be bracketed at no more than 2500 mm. The horizontal pipe work shall be bracketed at no more than 1500 mm.

The pipe work layout and the pipe sizing and layout shall must be approved according to the manufacturer standard, for minimum length and spacing of joint as well as the minimum thickness and type of pipe standard as mentioned above..

All installed pipe work lengths are to be accurately measured and recorded on the commissioning form. This information is required for accurate calculation of the additional refrigerant charge for the system. The weight of the additional refrigerant must also be recorded for future reference on laser printed Stainless steel sheet.

2-07.5 Installation

Welding and copper brazing must be carried out with flow of nitrogen through the pipes, recommended minimum gas pressure 0.02 MPa

Oxygen free nitrogen must be passed through the pipe work during all brazing of joints to prevent the formation of oxidization scale on the inside surface of the pipes.

All pipe work shall be clean, de-hydrated and sealed. Pipe work shall be stored under dry conditions. Any pipe work found to be stored without the end caps should be rejected. Where sections are cut from a new coil any remaining lengths must be re-sealed. During the installation if the system has to be left unattended for any purpose whatsoever, the openings in the systems must be securely sealed.

Pipe work fittings for branching off to indoor units must be Y, T or header type Branch joints as supplied by manufacture. No other fittings are acceptable like expansion Valve or devices. The positioning and installation of these joints shall be strictly in accordance to the manufacturer's specification.

The equipment shall be installed in line with the manufacturer's specification and design standard as listed below:

Piping, Y, T or header distributor size and wiring sizes to be carried out as per manufacturer's recommendations/standard. However, given sizes in

drawings are tentative and will be in the range of $\pm 10\%$.. Supplier to submit computerized selection with schematics.

Prior to finalization of equipment the specialist supplier must select the outdoor unit/indoor unit based on considering actual pipe lengths/fittings, levels and all other considerations required etc., based on manufacturer's software and submit selection to the Engineer.

2-07.6 Wiring

- All power and control wiring shall be based on manufacturers recommended. However minimum specifications are given below.
- Control cable or communication cable should be shielding type cable, with a cross section: 1.0~1.5 mm. sq., 2 core. All Indoor Outdoor Communication to be DC low Voltage Signal.
- Main power Cable Specification for Outdoor units to be based on larger value of Minimum circuit Amperes or Total over Current Amperes.
- Power supply to Each Outdoor Unit: (3 phase or Single Phase)
- Suitably sized Circuit Breaker with external isolator shall be made available for each outdoor unit. And all interconnecting suitably sized wiring shall be connected accordingly.
- Power Supply to Indoor Unit: (Single Phase)
- Suitable Sized Circuit Breaker with external isolator shall be made available for each looped System for all Indoor Units served from each outdoor Unit. And all interconnecting suitably sized wiring shall be connected accordingly.
- Control cable to the following specification shall be used: 2 or 3 core PVC shielded cable sized between 0.75 mm² and 1.5 mm².
- Control and power cables must not be installed along side each other as interference in the signal wiring caused by electrostatic and electromagnetic coupling can occur. And shall comply with Manufacturer's recommendations.
- The control cables shall be installed in conduits. Care must be taken to ensure that they are not tied together or packed tightly.

2-07.7 Installation, Pressure Testing, Evacuation and Commissioning & Testing

All supply of equipment, related pipe/insulation work and installation shall be carried out by the manufacturers authorized specialist

contractor/supplier.

After Installation of pipe work, and prior to sealing of insulation joints, pipe work should be pressure tested to 550 psi held for 24 hours and checked for leaks, vacuumed/dehydrated to -752 mm Hg and held at that setting for 1 to 4 hours depending on the pipe length. Supplier to submit detailed information for installation and commissioning procedures for approval after completion of installation.

Refrigerant isolation/shut-off valve on each indoor and outdoor unit shall be considered to be supplied with the units for emergency usage, in case leakage is detected.

A representative from manufacture or any other nominated factory trained engineer shall carry out the final refrigerant charging and the commissioning of the system; a copy must be submitted to Consultant/Engineer in line with manufacturer required parameter/figures to qualify for warranty.

All installation, testing and commissioning shall be done in strict accordance with the manufacturers recommendations. If required by the Engineer factory engineer shall visit the site and issue the certificate of all compliance(s) shall be in accordance with their recommendations.

All equipments, components shall have minimum five (5) years replacement warranty from the date of handing over.

All specialist suppliers must taking care of after sales service, trouble shooting and parts replacement arrangement within their quote to the contractor, without any extra cost to Client.

2-08 DX - SPLIT AIR-CONDITIONING UNITS

a) Air Cooled Condensing Units (CU-Units)

The condensing unit shall be of the vertical/horizontal discharge, air cooled type, suitable for outdoor installation and sized to deliver the required capacity matched to relevant DX-type indoor unit at specified ambient temperature. The condensing unit shall be of same manufacturer as the Indoor A.C. Unit.

The unit casing shall be constructed from galvanized sheet steel, zincphosphated and with a stoved enamel finish. All access panels and the unit casing shall be provided with thermal and acoustic insulation. All moving components such as compressors and condenser fan motors

shall be anti-vibration mounted to minimize the transmission of vibration and noise. The Condensing unit shall be of same manufacturer as the Indoor A.C. unit.

Condenser coils shall be made of seamless copper tubes mechanically expanded into aluminum fins and additionally protected with acrylic/epoxy coating.

Condenser fans shall be of direct drive, statically and dynamically balanced propeller type. Weatherproof fan motors suitable for outdoor use, permanently lubricated and provided with built-in thermal overload protection shall be used. Fans shall be mounted on rubber vibration dampers. All condensing units shall be weatherproof and capable of operating satisfactorily at high and low outdoor temperatures at full load.

Hermetically sealed reciprocating compressors shall be fitted with internal and external shock absorbers to minimize vibration and noise transmission. The compressor shall be fitted with a discharge line silencer and charged with the required quantity of oil for adequate lubrication circulated by means of an internal oil pump. Shut-off valves at supply and return connections on compressor shall be provided.

Internal overload protection located in the motor windings shall be provided. The electric motor shall meet the specifications as given under Section-7.

The units shall be complete with refrigerant piping consisting of insulated copper pipes and all necessary valves and filter driers from the unit to the air cooler. Suction and discharge pipes shall be equipped with pipe vibration dampers. Condensing units shall be factory pressure tested, evacuated and dehydrated.

The units shall be charged at site with refrigerant and installed on steel brackets of adequate strength fixed to the walls with expansion bolts.

b) Indoor Unit (AC-Units)

The DX-type Indoor units shall be elegant, cassette type, ceiling mounted. Fresh-air connection shall be provided on side or rear of the units, as specified or approved by the Engineer. All component parts shall be selected, manufactured and assembled by the same manufacturer as for outdoor Condensing unit.

Each unit shall be constructed so as to prevent drumming, distortion and vibration and shall enable ease of handling and replacement of sections.

The units shall include the following sections:

- Washable filters
- DX-type cooling coil
- Supply air fan and motor
- Thermostat microprocessor type with digital display and set point adjustment
- Automatic air swing mechanism
- Supply air plenum with adjustable grille
- Condensate drain pump (for cassette type units)
- Fresh-air intake duct (for cassette type units)

The casing frame shall comprise of galvanized sheet steel, zinc phosphate, with a stoved enamel finish and shall be provided with decorative cover with supply and return air grilles. The decorative cover and grille shall be of ABS thermoplastic polymer with smooth finish in approved colour.

Fan shall be statically and dynamically balanced centrifugal type with backwardly included or airfoil blades to suit the pressure and operating characteristics specified.

Fan housings shall be constructed from galvanized steel sheet. The casing shall be constructed to a truly volute form.

Shafts shall be cold finished, turned, and polished steel. Bearings shall be self aligning, permanently lubricated ball bearings.

All parts of fans and motors liable to deterioration shall be protected by paint or grease before delivery to site.

Filters with dust arrestance of 85% as per ASHRAE standards shall be provided. The filter media shall be washable, cleanable, reusable, chemical and moisture resistant, non-perishable, and flame resistant.

Cooling coils shall be manufactured from solid drawn seamless copper tube staggered in the direction of airflow. Tube return bends shall be copper and brazed to tube ends.

Fins shall be of continuous aluminum protected with acrylic / epoxy coating having extended collars for spacing and bonding mechanically to the tube.

Coils shall be air pressure tested to 20.6 bar while immersing the coil in

a tank of water after completion.

Tubes shall be expanded onto the fin collar by hydraulic pressure only. No part of the coil tube ends or headers shall be external to the section. Coils shall be suitably sealed with grommets where connections pass through the unit casing.

The air-cooler shall incorporate a galvanized drain pan with integral insulation. The pan shall be fitted with galvanized drain socket connections for attachment to drain points. A manometric trap should be supplied and installed by the installing contractor.

The coil shall be easily removable from the unit for maintenance and cleaning purposes.

The coil shall include a thermostatically controlled expansion valve.

Micro-processor based thermostat with integral 3 speed fan selector shall be supplied as part of the unit for floor standing type and wall mounted type for ceiling/wall type units.

3-0 FOUNDATIONS, SUPPORTS AND VIBRATION ISOLATION

3-01 GENERAL

All equipment piping and ductwork where used shall be mounted on or suspended from foundations and supports, all as specified, as shown and as required. All supports and foundations shall be seismic resistant for zone-2B as per Pakistan Building Code.

Contractor shall provide shop drawings, other information and templates for all concrete foundations as per recommendations of the manufacturer of the equipment. Information provided in equipment catalogue will not suffice and the Contractor shall prepare and submit foundation shop drawings for all equipment. Necessary integral steel framings, concrete-reinforcing rods welded to frame, anchor bolts, spring mountings, and neoprene pads, shall be provided by the Contractor. The Contractor shall coordinate with those doing the flooring work to ensure proper installation of all these elements.

Foundations and vibration isolation mountings for various equipment, piping and ductwork where used shall be as per requirements specified. Vibration isolators where used shall be of approved make.

Springs used for vibration isolation shall be single, open coil type and laterally stable, having a ratio of loaded height to mean coil diameter not greater than 1.25. To preclude possibility of spring coils "shortening" when motor starts or slows down, the springs shall be selected so that there remains when the spring is design loaded, a reserve deflection of between 25 and 30% of maximum deflection of free spring. When fully compressed, maximum stress in steel should not exceed yield stress of spring material. Springs shall be unhoused and held well clear of any part of suspended mass. Isolated system if supported on a flat slab type base, shall be held clear of supporting structure or pad by the minimum distance thought necessary for efficient housekeeping or 25 mm. Lower end of each spring shall be supported on a rigid, square steel base plate sufficiently thick to withstand the pressure exerted. All reinforced concrete inertia pads shall have a minimum 8 inches (200 mm) thickness. On all corners of inertia concrete pads and integral rigid structural steel bases supporting mechanical equipment, install angles with snubbers. These shall be built up from 3 thicknesses of neoprene waffle pad bonded with suitable adhesive

and fixed to angles.

All ceiling hung equipment having fans and motor as integral part of equipment shall have adequate vibration isolators.

Flexible duct connections, as specified elsewhere, shall be fitted wherever ducts cross building expansion joint, at suction and discharge end of each air handling unit, packaged unit and fan and wherever shown on the drawings. Supply grille of concealed ceiling-mounted fan coil unit shall also be connected to Fan-coil with flexible connection.

Details of all vibration isolators, flexible connections and base shall be submitted to the Engineer for approval.

3-02 MOUNTING OF EQUIPMENT

3-02.1 Floor or Roof Mounted Equipment:

All floor or roof mounted equipment shall be placed on at least 100mm concrete housekeeping pads, unless otherwise indicated. The pads shall be constructed on 25mm thick cork-sheet. Protective curbs shall be provided on all sides of the pad to protect the cork sheet edges. Special attention shall be given to the equipment at roof and intermediate floors and manufacturer's recommendations for prevention of vibration and noise travel to the structure shall be adopted. The foundation details shall be subject to the approval of the Engineer.

3-02.2 Wall Mounted Equipment:

All equipment installed through wall shall have 20 gauge galvanized sheet metal sleeve which shall remain in place permanently. Space between the sleeves and duct shall be packed with non combustible glass fiber insulation of minimum 24 kg/m³ density and sealed with sealant. Equipment installed through walls shall have supporting wall brackets.

3-02.3 Air Inlets/Outlets

All wall grilles/EA-OA louvers shall be fixed to wooden frames and not to the ceiling material/wall masonry. Metallic frames may be used with metallic frame false ceilings. Wooden wall frames shall be grouted and finished by HVAC Contractor.

3-02.4 Ceiling-Hung Equipment

All ceiling-hung equipment shall be hung from ceiling (concrete slab) and shall not rest on false ceiling.

3-03 VIBRATION ISOLATION:

Vibration isolation bases shall be provided and installed for all pumps to prevent the transmission of vibration to the building structure.

Where fans and motors are integral parts of factory assembled air handling units and the fans and motors are not spring isolated from the air handling unit, the entire unit shall be mounted on vibration isolators.

Inertia pads where indicated shall be reinforced cement concrete pad, at least 100 mm thick with 100mm steel channel all around to protect concrete edges. Reinforcing rods shall be welded to channel frame.

Floor mounted Fans with belt drives shall be mounted on continuous rails with sliding base for motor adjustment and fan-rails shall be mounted on vibration isolators as specified above. Where shown on Drawings, continuous rails shall be mounted on Inertia pads and pads shall be mounted on vibration isolators.

Flexible pipe connectors shall be installed in piping to prevent vibration and noise travel. Location and construction of these connectors are specified in Section "Piping, Fittings, Valves and Specialties."

4-0 NOTIN USE

5.0 PIPING AND SPECIALITIES

5.01 GENERAL

The Tender Drawings indicate generally routes of all piping and the Contractor shall provide all fittings and accessories necessary for satisfactory installation and operation of the systems.

All piping shall be grouped wherever practicable and shall be erected to present a neat appearance. Pipes shall be parallel to each other and parallel or at right angles to structural members of the building and shall give maximum possible headroom.

All pipe drops shall be truly vertical. No joints shall be formed in the thickness of walls, floors or ceilings. the Contractor shall be responsible for ascertaining the thickness of plaster and other wall finishes, skirting heights, cill lengths and floor finishes.

Piping shall not pass in front of doorways or windows and shall be generally arranged so that its bottom is at least 75 mm (3 inches) above finished floor level and at least 25 mm (1 inch) from finished wall faces. Sufficient space shall be allowed for accessibility for servicing.

All drain piping shall pitch down in direction of flow. All drains from such

items as drip pans of air conditioners shall spill over and open sight drain, floor drain or other acceptable discharge points and terminated 150 mm (6 inches) above the drainage.

Approved pipe fittings shall be used and bending of pipes will not normally be allowed.

All 90° elbows used shall be of long radius type, except where space limitations restrict the use of long radius.

Piping shall not be installed passing through ductwork or directly under electric light fixtures.

5.02 REFRIGERANT PIPING AND SPECIALITIES

Refrigerant piping shall be copper tubing, type L for single split and K type for VRF / VRV units, bright annealed, dehydrated and sealed. Soft tempered tubing shall be used where bending is required and where flare joints are used. Hard drawn tubing shall be used where no bending is required and silver-brazed joints are used, and for all tubing larger than 19 mm (3/4 inch.). Copper tube joint shall be brazed, except joints on lines 19 mm (3/4 inch.) or smaller which may be flared. Fittings for flare joints shall be standard SF' forged brass flare-type with short shank flare units. Fittings for brazed joints shall be wrought copper or forged brass seat fittings. Cast seat type fittings will not be allowed for brazed joints.

Purge valves, 15mm, shall be packless diaphragm type refrigerant purging valves, mounted on a branch from the suction line before it returns to the condensing unit. Discharge from valve shall be provided with removable seal cap. Valves shall be forged brass, 35 kg/cm² working pressure.

Refrigerant charging valves, 15mm, shall be packless diaphragm type refrigerant charging valves mounted on a branch from the liquid line leaving the condensing unit valve inlet shall be forged brass, 35 kg/cm². Valves shall be rated at 35 kg/cm² working pressure.

Refrigerant dehydrator shall consist of a Steel cylinder filled with a suitable desiccant through which the refrigerant is passed. The desiccant shall be such that it will not plug, cake, dust, channel or breakdown, and shall remove both water and acids from the refrigerant. The dryer shall be so constructed that none of the desiccant will pass into the refrigerant lines. The dryer working pressure rating shall be 35 kg/cm². A dehydrator shall be provided in the liquid line to each evaporator and shall be piped with a three-valve by pass.

5.03 CONDENSATE DRAIN PIPING

All condensate drain piping including fittings shall be of Polypropylene Random (PPR) of PN-10 rating as manufactured by Dadex Eternit Ltd. Pakistan or approved equal.

5.04 MEASUREMENT AND PAYMENT

Measurement:

Measurement of acceptably completed works of this item will be made on the basis of actual running length in feet (metre) of piping along center line of pipe, and acceptably furnished, installed, tested and commissioned. No separate measurement will be made for fittings, accessories, flanges, welding, hangers, supports, roller supports, nuts, bolts etc.

Payment:

Payment will be made for acceptable measured quantity of piping on the basis of unit rate per feet (metre) length quoted in the Bill of Quantities. The unit rate shall include cost of all fittings, flanges, associated accessories, hangers, supports, nuts, bolts, welding etc. and shall constitute full compensation for all the works related to this item.

Measurement:

Measurement of acceptably completed works of this item will be made in the unit of LOT/JOB, acceptably furnished and where required installed, tested and commissioned.

Payment:

Payment will be made for acceptable measured number of respective items on the basis of lumpsum price per LOT/JOB quoted against the respective item in the Bill of Quantities, and shall constitute full compensation for all the works related to these item.

6.0 INSULATION

DUCT THERMAL INSULATION

01. No insulation shall be applied to any duct work or to any surface until all foreign matter has been removed from the surfaces to be insulated and until the duct work has been tested, made tight, cleaned out and made operable. All insulation shall be applied in a manner consistent with good practice and methods.

02. Insulation shall be continuous through floors, walls, partitions, etc. except when otherwise indicated or specified. Where the application of

insulation will cover nameplate attached to equipment, the insulation shall be recessed so as to expose the name or rating plate. Where space will not permit application of insulation in wall or slab chase, the chase shall be packed full of 85% magnesia, specified density mineral wool or fiberglass and protected with cover plates on both sides, as approved by the Engineer/Consultant.

03. Ducts shall be insulated as specified in the Schedule of Insulation.

04. The thermal conductivity (W/mK) at 24°C for fiberglass insulation minimum density 24 Kg per cum shall be not over 0.035 and for fire retardant self extinguishing type foamed polyurethane minimum density 40 Kg per cum not over 0.02.

05. The cold air duct insulation shall have 2 ply vapour barrier of .0007" aluminium foil and 30 lbs. natural kraft with internal fiberglass yarn reinforcement and flame retardent adhesive. The fiberglass insulation shall have factory fixed vapour barrier. The foamed polyurethane may have field applied vapour barrier fixed with Zahabiya Excel Bond ZGPA Special 7/223 or approved quality adhesive recommended by the insulation manufacturer. Great care will be exercised that vapour barrier is not damaged/pierced during installation and any damage will be repaired with the same quality of vapour barrier.

06. The insulation shall be firmly fixed on the ducting with approved quality adhesive compound approved by the Engineer/Consultant. Resin based adhesive compounds shall be used and mineral oil based adhesive shall not be used. Adhesive to be Zahabiya Excel Bond ZGPA Special 7/223, Foster 30-45, or approved equal. The adhesive shall cover atleast 25% duct area on the sides and top and 50% area on the bottom. All circumferential and longitudinal joints shall be lapped atleast 40mm and fully sealed with adhesive. Where necessary, the insulation shall be further mechanically secured to the ducts and atleast 25mm wide metal bands shall be applied at the corners so that the mechanical fastener does not pierce the insulation and vapour barrier.

07. The insulation shall be applied to the full length of the ducts including portions where internal sound absorber liner, etc. are fixed.

08. All access doors and removable panels shall be insulated and jacketed separately. The insulation jacket ends on the duct and door or panel shall be sealed with 50mm wide P.V.C. vapour seal self adhesive type tape to prevent damage to the insulation during use and servicing.

09. The insulated ducts, non exposed and exposed, within the Building shall have a jacket of 8 oz canvas properly fixed with the insulation with water

& vapour proof, washable anti fungus type Zahabiya Sealing Adhesive Coat ZSAC-10/55 and joints lapped atleast 40mm and sealed. The jacketing shall be immediately given two coats of same compound ZSAC-10/55 which is not to be diluted, except when essential with upto 5% demineralised water only.

10. External and weather exposed insulated ducting shall be further protected with an external jacket as specified in the Schedule of Insulation. The external jacket may be of 28g. G.I. or aluminium sheet or as approved.

11. The fiberglass duct insulation shall be of ACI/Arabian Fiberglass/Izocam/Johns-Manville/Kimco manufacture or approved equal. The fire retardent self extinguishing type foamed polyurethane insulation of Pak Insulations Ltd. manufacture or approved equal.

12. The tenderer shall confirm the type, density and thickness and supply complete technical details and manufacturer's technical bulletins for the duct insulation offered by him.

PIPE INSULATION

01. No insulation shall be applied to any system of piping or to any surface until all foreign matter has been removed from the surface to be insulated and until the piping has been tested, made tight, cleaned out and made operable. All insulation shall be applied in a manner consistent with good practice and methods. Sectional covering shall be applied with all end joints broken. All longitudinal joints shall be top and bottom but staggered between sections. Insulation shall be continuous through floors, walls, partitions, etc. except where otherwise indicated or specified. Where the application of insulation will cover nameplates attached to equipment, the insulation shall be recessed so as to expose the name or rating plate. Where space will not permit application of sectional insulation on pipes in a wall or slab chase, the chase shall be packed full of 85% magnesia, specified density mineral wool or fiberglass and protected with cover plates on both sides as approved by the Engineer/Consultant.

02. Piping shall be insulated with preformed/premoulded/foamed sections of type and thickness as specified in the Schedule of Insulation.

03. The insulation shall be of inorganic material bonded together by non-water soluble fire retardant resin, chemically neutral and not to cause or accelerate corrosion of steel, stainless steel, copper or aluminium, compatible with normal building materials, biologically inert not to breed or sustain molds, fungus, bacteria or rodents, water repellent and not to absorb moisture from ambient air, non-hygroscopic and non-capillary, not to crack or shrink while permitting

expansion and contraction of piping.

Insulation may be of following types:

Type	Material	Density Kg/m³	Temp. Range °C	Thermal Conductivity (K) W/mK
-----	-----	-----	-----	-----
I-1	Rockwool	100 or 120	(-) 150-750	50°C-0.041
I-2	Cellular Glass	128	0-480	50°C-0.052
I-3	Fiberglass	64 or 96	(-) 50-450	50°C-0.035
I-4	Flexible elastomeric foamed plastic	64	(-) 50-125	32°C-0.040
I-5	Foamed Polyurethane	45	(-) 30-100	25°C- 0.025

Types I-1, 2 & 3 shall be non-combustible as per ASTM E136-82.

Type I-4 to have flame spread rating of 25 or less and smoke developed rating of 50 or less as per ASTM E84-91, and self extinguishing as per ASTM E635.

Type I-5 shall be fire retardant self extinguishing type.

04. The chilled water piping insulation shall have 2 ply vapour barrier of .0007" aluminium foil and 44 lbs. natural kraft with fiberglass yarn reinforcement and flame retardant adhesive (Type ASJ). Type I-1, 2, 3 & 5 shall have factory applied vapour barrier forming a hinge along one side and an overlap along the other.

The field applied vapour barrier shall be fixed fully with the insulation, Venture Clad 1577CW (of Venture Tape manufacture), high puncture and tear resistant, 5 ply zero permeability absolute vapour barrier with self adhesive, temperature range (-) 30° to 120°C, complying with UL723 (25/50 Flame/Smoke Rating). Venture Clad to be applied wrinkle free and smooth finish with atleast 40mm overlap on both longitudinal and circumferential joints.

Great care will be exercised that the vapour barrier is not damaged/pierced during installation and any damage shall the repaired with the

same quality vapour barrier.

05. The insulation shall be fully fixed to the piping with approved adhesive compound recommended by the manufacturer and approved by the Engineer/Consultant. Resin based adhesive compounds shall be used and mineral oil based adhesive shall not be used. Adhesive to be Zahabiya Excel Bond ZGPA Special 7/223, Foster 30-45, or approved equal.

06. Each pipe shall be insulated separately with specified pipe insulation and gaps, if any, shall be filled with the same insulation material. All circumferential and longitudinal joints shall be sealed with atleast 50mm wide self-adhesive tape of approved quality. In case of chilled water piping, PVC impregnated canvas vapour seal tape or Polyethylene coated cloth high moisture resistant tape or Aluminium foil pressure sensitive tape shall be used. The tape shall be pressed down firmly to ensure an efficient seal and smoothed out to avoid any gaps and wrinkles.

07. The flexible foamed plastic insulation shall be thoroughly sealed with adhesive and all joints covered with 40mm wide self-adhesive PVC water proof tape of approved quality.

08. Where specified, the piping shall be insulated with 85% magnesia in layers not thicker than 25mm till the required thickness is achieved. 18g MS 20mm mesh wire netting shall be stretched over the piping, securely wired in place and then the first layer of insulation shall be applied. Each layer shall have wire netting. 15mm thick finish coat shall be mixed 50% by weight with Portland cement and troweled into wire netting to form smooth and hard finish. After full drying of the insulation a coating of hard setting compound shall be applied. It shall then be painted.

09. All specialities (valves, fittings, flanges, etc.) shall be insulated with thickness not less than adjoining straight pipe insulation thickness. In case of chilled/hot water piping, equal/ oversized sections of preformed insulation shall be used duly mitred and trimmed to tailor-fit the specialities. In case of rockwool or fiberglass pipe insulation, semi-rigid blanket of same material may be used instead of mitred sections for insulating the specialities. Loose scrap blanket insulation shall not be used for this purpose.

The insulation shall be fully covered with Venture Clad 1577/CW specified above to form a complete seal.

The valves and strainers shall be insulated separately from the adjoining straight pipe insulation and openable insulation boxes shall be formed

with 28g. G.I. or aluminium sheet cladding so that the valves and strainers can be easily serviced.

10. All insulated piping within the Building shall have a jacket of 8 oz canvas fixed with the insulation with water & vapour proof, washable, anti fungus type Zahabiya Sealing Adhesive Coat ZSAC-10/55 and joints lapped atleast 40mm and sealed. The jacketting shall be immediately given two coats of same compound ZSAC-10/55 which is not to be diluted, except when essential with upto 5% demineralised water only.

11. The insulated piping near the equipment and in plant rooms at levels 2m and below shall be further protected with a jacket of 28g G.I. or aluminium sheet.

12. Insulated piping burried in ground shall be protected as specified in the Schedule of Materials.

13. The hangers, guides, rollers, clamps, etc. shall not pierce the insulation. The insulation on steam and condensate return piping shall be protected by wooden saddles and on all other piping it shall be protected by metal shields. For piping insulated with fiberglass, etc. or foamed polyurethane insulation, the hanger shall be a full section of premoulded polymeric rigid foam Aerofix hanger with tape and self sealing tape of thickness equal to or greater than the main insulation.

14. The cellular glass insulation shall be of Pittsburgh Corning Foamglass, fiberglass insulation of ACI/Arabian Fiberglass/Izocam/Johns-Manville/Kimco manufacture or approved equal. The foamed polyurethane insulation and rockwool insulation of Pakistan Insulations Ltd. manufacture or approved equal. The flexible foamed plastic insulation to be of Armstrong/Aeroflex/Foamflex/Insulflex or approved equal.

15. The tenderer shall confirm the type and thickness of insulation offered and give complete technical details of insulation, vapour barrier, covering jacket, finishing and adhesive, and supply manufacturers' technical bulletins.

7.0 ELECTRICAL EQUIPMENT AND CONTROLS

7.1 Scope

- a) The Contractor shall supply all panel boards, starting equipment, circuit breakers, busses, isolators, conducting cables, wiring, conduits, etc, for the entire HVAC system except exclusions described in Clause 7.3 "Distribution and Control Scheme".
- b) The earthing system shall consist of supply and installation of earth connecting points, earthing leads and earth continuity conductor and running earth conductor all along the cable length. All material such as earth continuity conductors, earth connecting points, earthing lead and earth electrode including the installation material and accessories shall be supplied and installed by the Contractor upto the power cable terminating points provided by others.

7.2 General

All electrically operated equipment shall comply in all respects with the relevant B.S Standards including dimensional standards where these exist, except in so far as this Specification is at variance therewith.

All electrically operated equipment shall be so designed that it will continue to function without damage to itself or otherwise, if the voltage and/or frequency vary within the following tolerances:

Voltage: plus or minus TEN percent.

Frequency: plus or minus FOUR percent.

The entire installation shall be in accordance with the requirements and to the entire approval of the Electricity Department of the Government and the approval of the Employer/Employer's Representative.

All electrically operated equipment shall be suitable for continuous and prolonged operation in an ambient temperature 122°F (50°C). This temperature makes no allowance for local rises in air temperatures due to the operation of the equipment itself or of heat produced in or by adjacent equipment such as compressors, condensers or heaters. The maximum operating temperature in standards specified shall be observed. Allowance for local high ambient temperature shall be made by reducing the permitted rises of temperature above ambient.

7.3 Distribution and Control Scheme

- a) Interface of HVAC and Civil Contracts
Electrical Contractor shall provide power supply (Normal or Normal + Emergency) at MCCs, ACPs and DBs in HVAC Plant Room AHU Rooms & in each building. From these points onwards all electrical works related to equipment controlled from MCC, ACPs and DBs shall be done by HVAC Contractor. Connection of incoming cables terminated at MCCs, ACPs and DBs with respective panels shall be in scope of Electrical contractor.
- b) Electrical Contractor will provide earthing points at locations where power cables are terminated in HVAC Plant Room and AHU Rooms. All earthing work from these points onward for equipment controlled from these MCCs, ACPs and DB shall be done by HVAC Contractor.
- c) Loads such as small exhaust fans not controlled from ACPs will have power supply from Lighting and Power Distribution System which will be terminated at these fans by Electrical Contractor. HVAC Contractor shall make connections with fans.
- e) All control wiring for complete HVAC system shall be in scope of this contract.

7.4 Electrical Motors

Unless otherwise indicated in these Specifications or in the Schedules, all motors shall be totally enclosed, fan cooled, of squirrel cage construction and of approved manufacturer.

Insulation on all motors shall be equal to Class F with IP Class 55. All Motors shall be designed for continuous operation in the ambient temperature of 122°F (50°C).

All motors and accessories like, protection and control devices etc. shall comply in all respects with NEMA, current B.S. Standards and I.E.E. Regulations. Single-phase motors shall be capacitor start induction run construction, unless otherwise indicated or specified.

All motors shall be quiet operating guaranteed to fulfill specified requirements without producing any sound audible outside of plant rooms. All belt driven motors shall have adjustable bases and setscrews to maintain proper belt tension, with proper belt guards. Motors installed in the building should be super silent sleeve bearing type.

The starting current of all motors above 7.5 kW (10 HP) shall not exceed twice its rated full load current. For motor rating 7.5kW (10 HP) and below the starting current shall not exceed 7 times its rated full load current or one hundred amps per line, whichever is less.

Motors used with Frequency converters for variable speed application shall be suitable for use with the Frequency converter without any overheating at all operating speeds.

7.5 Motor Starters and Isolation

Each three-phase motor shall be provided with a protective automatic starter to disconnect the supply in case of:

- Failure of the supply
- Serious drop in voltage
- Flow of excess current
- Failure of any phase (single phasing)

All starters shall be properly derated for operation in an ambient temperature of 122°F (50°C).

Manual starters may be used for motors 1/2 HP rating and less and shall include thermal overload protection and disconnect switch. These should only be used when no automatic switching is intended.

DOL starters shall be used only on motors of 10 HP and less. Automatic Star-Delta starters shall be used for motors above 10 HP rating.

All motors, control gear and ancillary equipment shall be protected by H.R.C fuses or circuit breakers in addition to the protective starter mentioned above. Such fuses shall be part of the control gear. The isolator shall be integral with control gear.

Single phase motors shall be protected by circuit breakers with overload protection. Where several starters are mounted in a panel rack or bank, each starter shall have separate H.R.C fuses or circuit breaker isolator.

Where starter operating circuits and ancillary apparatus are energized by an auxiliary supply other than the main power circuit to the motor the isolator shall incorporate auxiliary contact to effectively isolate all poles of phases of such auxiliary supplies. Where necessary, two isolators shall be used.

All starters not in a central panel shall have a sheet metal enclosure with a removable lid and cover and necessary brackets for mounting on panel or wall. A clear schematic diagram of the starter circuit shall be fixed inside

the cover of each starter.

All magnetic starters subject to manual start shall have momentary contact start and stop buttons built into cover.

All magnetic starters subject to electrical interlock or automatic control shall have hand-off automatic switches built into cover.

All coils, cores, insulation, contacts and trippers to starters and relays and all parts subject to wear and arcing shall be renewable.

7.6 Power & Control Wiring

All power wiring from the point of supply as described in previous sections, to each equipment shall be carried out by the HVAC contractor. All control wiring from each equipment to Apparatus Control Panels shall also be in scope of HVAC Contractor.

All power wiring shall be executed as per specifications given under "Electrical Works".

All control wiring shall be executed as per specifications given under "Electrical Works" and as per instruction of the controls manufacturer.

7.7 HVAC Control Panels

a) Scope of Work

The work under this section consists of supplying, installing, testing, connecting and commissioning of all material and services of the complete HVAC Control Panels as specified herein.

The Contractor shall discuss the electrical layout with the Employer/Employer's Representative and co-ordinate at site with other services for exact route, location and position of the electrical lines and equipment.

The HVAC Control Panels shall also comply with other relevant provisions of the Bidding Documents.

The HVAC Control Panels shall comprise of Motor Control Centre (MCC) and Apparatus Control Panels (ACPs), (ECPs) as specified herein.

b) General

These Specifications shall be read in conjunction with "General Specification for Electrical Work" Section 8001 and specified for LT Switch Board Section 8132.

The HVAC Control Panels shall be sheet steel fabricated, floor/wall mounting, cubicle type, totally enclosed, dust and vermin proof. Panels shall be complete in all respect with material and accessories factory

assembled, tested and finished, all according to the specifications and to the normal requirements. The IP rating shall be IP 42 for indoor areas and IP 44 for outdoor and damp areas.

The HVAC Control Panels with all components and accessories shall be suitable for front operation only and shall:

- have a rated service short circuit breaking capacity I_{cs} 25 kA minimum at 415 VAC conforming to IEC 10947-2 unless stated otherwise or directed by the Employer/Employer's Representative.
- be provided with adequate clearance from live parts so that flashovers cannot be caused by switching, vermins, pests, etc.
- have all components rated for insulation class of 600 volt minimum.
- be designed for flush mounting of all instruments on the front side.
- have all incoming and outgoing connection from the top/bottom/rear as approved by Employer/Employer's Representative.
- have the components mounted so as to facilitate ease of maintenance from the front only.
- have common lamp test facility for all lamps
- be suitable for 415 VAC, 3 phase, 4 wire, 50 Hz system.
- Have wiring diagram in the pocket on the inside of each door of the panel.
- be labeled with stainless steel nameplate on the front side of door for each incoming and outgoing circuit.
- have doors grounded by flexible copper/strip

c) Applicable Standards/Codes

The latest editions of the following standards and codes shall be applicable for the materials specified within the scope of this Section:

IEC 60947-3 Low Voltage Switchgear and Control Gear-Switches,
Disconnectors, Switch-disconnectors & Fuse
Combination Units

IEC 60947-2 Low Voltage Switchgear & Control Gear-Circuit Breakers

IEC 60831 Power Capacitors

IEC 60439 Low Voltage Switchgear and Control gear Assemblies

IEC 60073 Colours for indicator lights and push buttons.

BS EN 60529 Specifications for degrees of protection provided
by enclosures (IP Code)

IEC 60044-1 Instrument Transformers - Current Transformers

IEC 60044-2 Instrument Transformers - Inductive Voltage Transformers

IEC 60051-1 Direct acting indicating analogue electrical measuring 2, 3, 5 & 8 Instruments and their accessories

BS 88 Cartridge fuses for voltage upto and including 1000 V a.c & 1500 V d.c

d) Sheet Metal Work

The HVAC control panel shall be fabricated, welded, grinded, finished with angle iron framework and cladded with 14 SWG MS sheet. It shall be suitably divided into panels and compartments for accommodating the required number of circuit components, instruments and accessories.

The Control Panel shall be supplied complete with foundation bolts and other installation materials as recommended by the manufacturer. Proper size cable clamping channels with galvanized steel clamps and brass cable glands respectively for unarmored and armored cables shall be provided.

All holes, cutout shall be tool or jib manufactured and free from burrs and rough edges. An earth bar of appropriate cross section shall be provided and connected to the bodies of all sections of the switchboard. Two external earth terminals shall be provided for main earth connection to the body of switchboard. The doors shall be earthed by means of flexible copper strip. Means shall be provided to limit the opening angle of doors to about 100°.

The cabling inside the switchboard shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, selecting and control equipment shall be suitably arranged and clearly labeled by means of flame proof material using indelible ink/markings indicating the rating of fuse, switches, etc. The nameplates provided on the front of panel shall be of flame retardant material preferably stainless steel. Use of plastic or any inflammable material shall not be permitted for nameplates.

All metalwork of the switchboards shall be cleaned down to bare shining metal phosphated and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of colour RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 100 microns.

e) Motor Control Centre (MCC) / Main HVAC Distribution Panel

The Contractor shall supply and install the Motor Control Centre (MCC) as specified or as required for the project.

Components shall be mounted in a logical order based on the sequence of operation; all components requiring frequent inspection shall be mounted between 2 ft. (0.6 m) and 6 ft. (1.8 m) above floor level.

The MCC shall contain the following equipment (but not limited to):

- Main Circuit Breaker on incoming line.
- Phase indication lamps on incoming line.
- Copper busbars with suitable porcelain or equivalent isolators.
- Circuit breakers for each outgoing circuit.
- ON/OFF Push button station one for each starter.
- Pilot lights, 3 for each starter, green for equipment operating, red for equipment not operating and amber for trip.
- Ammeter and if required with current transformer on incoming line, one for each phase.
- Ammeter and if required current transformer one for each starter.
- Starters (D.O.L. or Star-delta), soft starters, VFD
- Voltmeter with selector switch.
- Control Relays.
- Electronic voltage protection relays for under/over voltage, phase failure and phase reversal.
- Relays for interconnection with Fire Alarm Panel to switch off the relevant equipment on receiving signal from Fire Alarm Panel.
- Arrangement for interconnection with ELT-1 panel to ensure operation of one of the two stages of compressors of package units once power fed to MCC-HVAC is through backup generators.

f) Apparatus Control Panel (ACP)

Each equipment or their group not controlled from MCC shall have power controls at Apparatus Control panel, installed near the equipment or as required for the project.

The panel shall contain:

- Main Circuit Breaker on incoming line.
- Phase indication lamps on incoming line.

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- Copper busbars with suitable porcelain or equivalent isolators.
- Circuit breakers for each outgoing circuit.
- Starters (D.O.L. or Star-delta), soft starter, VFD
- ON/OFF Push button station one for each starter.
- Pilot lights, 3 for each starter, green for equipment operating, red for equipment not operating and amber for trip.
- Ammeter with selector switch and if required current transformer on incoming line.
- Ammeter and if required current transformer one for each starter.
- Voltmeter with selector switch.
- Control Relays.
- Electronic voltage protection relays for under / over voltage, phase failure and phase reversal.
- Relays for interconnection with Fire Alarm Panel to switch off relevant equipment on receiving signal from Fire Alarm Panel.
- Arrangement for interconnection with ELT-1 panel to ensure operation of one of the two stages of compressors of package units on power from backup generators.

g) Components

The HVAC panels shall be provided with all components as specified and as necessary for the satisfactory operation of the HVAC system. Typical specifications are given hereunder:

i) Bus Bars

The bus bars shall be made of 99.9% pure high conductivity electrolytic copper and shall be completely isolated and mechanically braced for the specified fault level. The phase identification of bus bars shall be by colours applied on full length of bus bars and these shall be red, yellow and blue for phases and black for neutral. The earth busbar shall be green.

The bus bars shall be triple pole. The neutral and earth shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise shall not exceed 30°C at rated current.

ii) Circuit breakers

The circuit breaker shall be triple pole, moulded case, manually operated type with front drive grip handle. ON-TRIP-OFF indication shall be provided on all circuit breakers. The circuit breakers shall have the following protections and setting range unless otherwise required for the project:

- Adjustable three pole manual reset thermal overload release of setting range 80 to 100% of rated current.
- Magnetic triple pole short circuit release having range according to manufacturer's standard range.

The incoming circuit breaker shall have two numbers each of potential free normally open and closed auxiliary contacts rated for 2 amp, 230 VAC. The incoming circuit breaker shall also have ON, TRIP and OFF indicating lamps. The circuit breaker shall have specified rupturing capacity, without the use of back-up fuses. Auxiliary release and trip coils shall be provided for desired operation and/or interlocking as required.

iii) Push Buttons

Push Buttons shall be momentary make/brake contact type (normally open/normally close). These shall be suitable for flush mounting. Push Buttons shall have round/square head. These shall have red and green colors for 'ON' 'OFF' switching operation respectively.

iv) Ammeters and Voltmeters

All ammeters and voltmeters shall be flush mounting, moving iron, spring controlled type. The front dimensions shall be 96 x 96 mm.

The Ammeters shall have appropriate measuring scales to suit the rated currents of connected equipment and shall indicate an accurate and readable value of the measured current. The Ammeters shall have appropriate over scale range to cater for the initial transient high starting currents.

The meters shall be of accuracy class 1.5 according to relevant IEC Standards suitable for connection to 5 Amps secondary of current transformers or directly through shunt. A red mark shall be provided at the working voltage on the scale of all voltmeters.

- v) Selector Switches
Ammeter and voltmeter selector switches shall be complete with front plate, grip handle, and R-Y-B and OFF position for ammeters and RY-YB-BR-RN and OFF position for voltmeter.
- vi) Air Break Contactors
The contactor shall be air break, triple pole, 400V AC suitable for the AC3 type of duty to be performed. The main contacts shall be silver tipped, butt type with double break per pole. Each contactor shall be provided with 230 VAC single phase operating coil, and minimum two normally open and two normally closed auxiliary contacts wired upto terminals. The number of working auxiliary contacts shall be provided according to the system requirements.
- vii) Indicating Lamps
Indicating lamps shall be suitable for flush mounting, complete with base, 230 volt incandescent lamp and shall have rosettes of suitable colour (green for ON, Red for OFF and Amber for TRIP).
- viii) Line up Terminals
Line up terminals wherever provided for control or power circuits shall be suitable for voltage and size of conductors.
The line-up terminals for controls shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.
- ix) Current Transformers
Air cooled, ring type current transformers shall be provided having transformation ratio as required. The current transformers shall be of suitable burden having accuracy class 1.0 and have 5 amps secondary.
- x) Load Break Switches
Triple pole rotary 500 Volts AC on-load isolating switches of current rating as specified shall be provided complete with front drive grip handle and front plate.
- xi) HRC Fuses
HRC fuses shall be provided complete with fuse bases, fuse etc. The fuses shall have a fusing factor as specified for class QI.

xii) Control Selector Switches

The selector switches for lights and other controls shall be rotary cam type, having required number of positions, complete with knob and front plate with position indication.

h) Labels

Each equipment on the panel shall be identified by a nameplate. Metallic nameplate with 6mm high etched letters shall be attached to the panel or integral with it. Lettering shall be cut into the plate to a depth of not less than 0.4 mm and shall show a contrasting colour produced by filling with enamel or lacquer. Painting of lettering directly on the surface of the plate or panel will not be permitted.

i) Outdoor Installation

All ACPs mounted outdoor or on roof shall be of weather proof construction minimum IP 54 rated suitable for operation at 50oC ambient temperature condition.

7.8 Local Isolating Switches

The Contractor shall provide additional local isolating switches for all HVAC equipment controlled through ACP when the equipment is remotely located and not visible from the main control panel (ACP).

7.9 Earthing

All HVAC equipment with electrical connection and all motor starting equipment panels shall have their frames, carcasses and all metal parts not normally carrying current, effectively and continually connected to the general mass of the earth. Each motor, starter, regulator and other components shall be separately connected to a main earth conductor which shall be directly connected at each end to the principal earth conductor. Not less than two principal earth conductors shall be used. Earth conductor sizes shall be as per I.E.E. regulations.

8-0 BUILDING MANAGEMENT & CONTROL SYSTEM (BMCS)**8-01 SCOPE OF WORK**

The work under this section consists of supply, installation, testing and commissioning of complete Microprocessor based Building Management & Control System stated herein and/or shown on drawings.

The Contractor shall nominate a specialized Building Management & Control sub-contractor to supply, install, test and commission the complete system.

The nominated sub-contractor shall be authorized agent of recommended Controls manufacturers and shall have been in this field for atleast 10 years.

The sub-contractor shall have trained staff with atleast 5 years experience in installation, testing and commissioning of such systems in high-rise buildings. The sub-contractor shall have established offices in major cities of the country and shall have a fully equipped training and service centre.

All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of authorized local agent with minimum of 5 years of installation experience with the manufacturer. Supervision, calibration and checkout of the system shall be by the trained engineers of the local agent. All labour, material, equipment and software necessary to meet the functional requirement of the system as specified herein shall be included in the scope of work. Drawings are diagrammatic only and all controls, materials, etc. not shown but necessarily required to meet the functional intent shall be provided without any additional cost to the Owner.

All wiring in connection with the Building Management & Control system shall be as per manufacturer's recommendations. The term "wiring" shall be construed to include furnishing of wiring conduiting, miscellaneous material and labour as required for mounting and connection of the electrical control devices. The control manufacturer shall furnish detailed wiring diagrams showing all sizes, electrical connections and control devices. Wiring diagram shall show all necessary interface connections for approval of the Engineer. Similarly drawings for all graphics to be generated for display shall be submitted by the control manufacturer for approval of the Engineer.

The contractor shall discuss the electrical control layout with the Engineer and coordinate at site with other services for exact route, location and position of electrical lines and equipment.

The contractor shall maintain diskette copies of all data files and application software for reload use in the event of a system crash or memory failure, including PCP and IRC programmes. One copy shall be delivered to the owner during training session, and one copy shall be archived in the controls manufacturer's local software vault.

The contractor shall provide, to the Engineer, access to the software of the system and details of password security up to the highest user level in order to permit listings to be changed on site.

The contractor shall provide a full set of flow charts or logic diagrams to show the software logic for all the performance requirements of each and every equipment. These charts/diagrams shall describe both the logical sequence and priority levels of all functional and sequential operations. The chart/diagrams shall provide sufficient information to demonstrate compliance with the design intent.

8-02 **GENERAL**

- 1) The controls shall conform to the applicable standards of NFPA, NEC, IEC and UL and the local electrical codes. All devices designed for or used in line voltage applications shall be UL listed.
 - a. All microprocessor based devices shall be Lon-Mark™, ULC, FCC Part 15, UL916 and ISO9000 listed.
 - b. All electrical environmental control and monitoring devices shall be UL429 and/or UL873 listed.
- 2) All electronic equipment shall conform to the requirements of FCC regulation Class B Part 15, Section 15 governing radio frequency electromagnetic interference and be so labelled.

8-03 **SYSTEM**

8-03.1 **CONTROL AND MONITORING**

The system shall comprise of:

- 1) Microcomputer based Plant Control Processors (PCPs), interfacing directly with sensors, actuators and environmental delivery systems (i.e. HVAC equipment, chillers, room sensors, electrical systems, etc.)

- 2) Electric/electronic controls and sensors and final control elements including control valves and actuators.
- 3) A two-wire peer communication network to allow data exchange from PCP to PCP at a minimum rate per second of one megabit.
- 4) Microcomputer based Intelligent Room Controllers (IRC's) interfacing with sensors, actuators and terminal equipment control devices.
- 5) All system components shall be fault tolerant.
 - Provide satisfactory operation without damage at 110% and 85% of rated voltage and at ± 3 Hz variation of line frequency.
 - Provide static, transient and short circuit protection on all inputs and outputs. Communication lines shall be protected against incorrect wiring, static transients and induced magnetic interference. Bus connected devices shall be a.c. coupled or equivalent so that any single device failure will not disrupt or halt bus communication.
 - Provides safeties to protect Control System against damage or malfunction due to voltage fluctuations.
- 6) All real time clocks and data file RAM shall be battery backed.

8-04 **REMOTE CONTROLLERS - HVAC CONTROL AND MONITORING**

8-04.1 **General**

Preference shall be given to products which are designed to VDE 871/875 to give a high probability for low electromagnetic interference rates and problem free installations.

The product circuit board shall be constructed using surface mounted technology.

Use of pre-programmed applications are preferred and these shall employ minimum engineering and simplify site commissioning by using an interactive operator interface with local language.

8-04.2 **Plant Control Processors (PCP) & Intelligent Remote Controller (IRC)**

The Plant Control Processors (PCPs) and Intelligent Remote Controller (IRCs) shall be 16-bit microprocessor based with EPROM operating system (O.S.). DDC programmes and data files shall be in non-volatile EEPROM or flash memory to allow simple additions and changes. Each PCP shall have an on-board real-time clock with battery backup of a minimum of 30 days for true stand-alone operation. This battery shall be of the non soldered

type and should be easily removable for maintenance purposes. The PCP shall monitor battery power and output an alarm if it should fall below a stated minimum level.

All PCPs / IRCs shall be fully standalone intelligent type. In the event of communication loss with the Operator Station, the PCPs / IRCs shall be fully operational. Master/Slave type of controllers shall not be acceptable.

PCPs shall be designed for complex DDC and energy management applications, peer-to-peer communications with other PCPs or optionally for coordination, management and data communication for sub-networks for IRCs. Software clocks will be acceptable provided the main PCP has a built in master clock with 30 days battery backup. Each PCP shall have a minimum of 256 Kbytes of battery-backed RAM memory, 512 Kbytes of OS EPROM and 256 Kbytes of Data File memory.

For PCPs with point capacity in excess of 36 points, each PCP shall be furnished with a built-in Portable Operators Terminal (POT) for operator readout of system variables, override control and adjustment of control parameters. For PCPs with point capacity of 36 points or less, each PCP shall be provided with a socket for a Portable Operators Terminal (POT). All POTs furnished, whether supplied as a built-in device in the large PCPs or as a portable tool for information retrieval in the small PCPs, shall conform to the specification under POT. IRCs shall not have POT but they shall be provided with connecting port suitable for hookup with laptop computer.

All PCPs shall have LEDs for continuous indication of peer bus communications, power and operational status. To facilitate maintenance, the following minimum diagnostic shall be provided to detect :

- 1) Main memory error
- 2) Internal communication bus problem
- 3) Controller malfunction

All PCPs shall have point trending capability for selective sampling of data from a maximum of 20 of its analog and digital points. Each PCP shall save up to 200 trend values. If memory becomes full, the earliest data shall be overwritten with new data so the most up-to-date values are always available. Trending display shall be available in both graphical plots or in tables, to be selected by the end-user. The trending capabilities of the PCP's shall be provided in addition to the trending functions at the Operator Station.

PCPs shall accept analog and digital inputs and outputs and pulse counting totalizers. All PCPs shall accept analog inputs of 0 to 10V dc, 0 to 20mA dc, 4 to 20mA dc.

PCPs shall be Underwriters Laboratories (UL) listed per UL Standards 916 PAZX and 864 UDTZ in an enclosure.

Each PCB shall have an RS232 serial interface to allow local interrogation via a lap top computer.

In the event of a total power loss at the PCB a watchdog relay housed within the PCB shall be de-energised giving indication of a fault condition.

Each PCP shall be provided with a minimum of 10% of its I.O. functions as spare capacity but not less than two. The type of spares shall be the same as the implemented I.O. functions on the PCP, but in no case shall these be less than two spare points of each I.O. function.

The operators terminal (OT) in PCP shall have a menu driven graphic display with a minimum of 6 lines, 34 characters per line. A maximum of 8 clearly marked keys to operator the unit. The OT shall display all information in approved language(s) descriptors. Short codes or technical addresses shall not be permitted. The display should be of the LCD type with a back light.

The OT should have a minimum of 3 levels of access:

- Level 1 : Read only without a password
- Level 2 : Read plus limited change with a password
- Level 3 : Read and make changes with a password

The OT should be capable of performing, but not limited to, the following functions :

- i) Trend Logging
- ii) Maintenance Alarms
- iii) Time Programmes
- iv) Data Point Override
- v) Real Time Clock

8-04.3 **PORTABLE OPERATOR'S TERMINAL**

1. Provide a Portable Operator's Terminal (POT) digital display, software, and interfaces to provide; uploading/downloading of Custom Application Controller (CAC) and Application Specific Controllers databases, monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and

overrides of all controller physical input/output points, and editing of controller resident time schedules. POT connectivity shall be via digital wall sensor connected to controller.

2. Connection of a POT to the Custom Application Controller or Application Specific Controller shall not interfere with normal network operation in any way, prevent alarms from being transmitted or centrally initiated commands from being executed.
3. If the POT cannot be used for both the CACs and ASCs, provide, in addition to the POT, the separate color display personal computer(s), software, and interfaces required to provide full POT functionality for both the CACs and ASCs.
4. Functionality of the POT connected to any CAC or ASC shall include:
 - a. Uploads and downloads of CAC and ASC Controller databases.
 - b. Uploads and downloads of CAC and ASC LonMark™ SNVT nci values.
 - c. Editing of LonMark™ SNVT nci values for minor equipment operational parameters (including minimum on/off and delay times, changeover values, minimum position set points, etc.). All such mechanical equipment editable nci values shall contain internal CAC and ASC Controller safety range limits to prevent accidental entry of out of range or invalid values.
 - d. Monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs and test overrides of nvi SNVTs.
 - e. Monitoring and overrides of all controller physical input/output points including timed overrides that automatically revert back to their normal value.
 - f. Display of digital sensor values including diagnostics and calibration.
 - g. Editing of controller time/date.
 - h. Editing and overrides of resident Controller time schedules.
 - i. LonMark™ information including program ID, Neuron ID, domain, subnet, and node.

8-04.4 PCP/IRC Programming

The application programme for the PCPs shall be programmed using graphical software. This software shall provide the operator with wiring terminations, schematic representations of plant, and hardware configuration of PCP giving details on the numbers and types of points used in the PCP. This information shall be given in a printed format.

Application Software: Controllers shall have Proportional Control Proportional plus Integral (PI) Control, Proportional plus Integral plus Derivative (PID) Control.

Time Proportioning Control and Floating Control algorithms all in its memory and all available for use by the user. The analog output of Proportional control, PI Control and PID control shall continuously be updated and output by the program. Between cycles the analog output shall retain its last value.

Time programs: An independent start and stop program time shall be provided for each system.

It shall be possible to assign independent start and stop times to any equipment connected to a controller. Outputs from this program are start/stop command signals to air handling, heating or cooling systems. etc.

Optimum Start: An independent optimum start program shall be provided for each piece of equipment or system.

The objective of this program is to minimize total energy consumption during the daily start-up of each heating/cooling system. The intention is to accomplish this by calculating a start time for each heating/cooling system which will bring its respective zone temperature to the boundary of the comfort zone at the time of occupancy start. This program shall also control auxiliary devices (i.e. dampers) as indicated herein to minimize energy consumption during the start-up period. It shall further provide variable algorithm factors (multipliers) to allow this program to be "fine tuned" to match the building's response.

Inputs to this program shall be space and outside air dry bulb temperatures, outside air dewpoint temperature, "occupied" or "unoccupied" status indication of the building or zone, and an indication of a standard or extended shutdown period. Separate multipliers shall be entered for summer and for winter. Outputs from this program are start

commands to air handling, heating, or cooling systems; and morning warm up and cool down damper control.

This program shall continuously monitor the space temperature and outside air temperature of each system specified to be under optimized start control. The control algorithm shall start the system up at the latest possible moment as necessary to cool the space up prior to schedule occupancy. The range is to be field programmable. Selection of warm up or cool down if required shall be accomplished automatically by the program. This program shall execute a maximum of one optimum start command per day for each point controlled from the program.

The optimum start program will provide a minimum ventilation "on" state when two conditions are both satisfied:

- Occupancy start time has been reached, and
- space temperature has reached the comfort zone (or, if one hour has passed without reaching comfort).

The initial set-up of this program shall be based on the control contractor's empirical, or theoretical, calculations considering the building construction, orientation, and mass. The program shall be structured such that job site tuning may be done by simple keyboard entry of one multiplier to the empirical formula results. Once the program is in operation it shall adjust its start time automatically based on a rolling average of the previous four start ups. This function will maintain a continuous update of the system multipliers.

Optimum Stop: An independent optimum stop program shall be provided for each system.

The objective of this program is to minimize total energy consumption during the daily shutdown of each heating/cooling system. The intent is to accomplish this by shutting down the system as much before the end of occupancy as possible, but not so early as to let the temperature drift out of the specified comfort range.

Inputs to this program shall be space and outside air dry bulb temperatures, and "occupied" or "unoccupied" status indication for the building or zone, and maximum shutdown advance. Outputs from this program are stop commands to air handling, heating, or cooling systems. This program shall continuously monitor the space temperature of each system specified to be under optimum stop control. If the space

temperature is at the full load end of the comfort range, the system will be shutdown at the programmed "end of occupancy" time. If the space temperature is somewhere within the comfort range, the shutdown time will be advanced. To prevent the occurrence of stuffiness and occupant discomfort due to inadequate ventilation for an extended period, the program shall accept a programmed limit of the earliest practical stop time.

OPTION

The optimum stop program shall use the space temperature and its drift rate to calculate lead time for shutdown. This drift rate shall be an input from the duty cycle program and shall be dynamic, i.e., continuously updated.

DUTY CYCLE

An independent duty cycle program shall be provided to periodically cycle air-handling equipment except at design load conditions. Cycling shall not occur when space temperatures are outside of assigned comfort limits.

The objective of the Duty Cycle program is to conserve electric energy (kWh) by cycling fan systems on and off that do not need to be left running continuously during the normal occupied periods. The intent is that this be accomplished by calculating off periods allowable to maintain space temperature in a specified comfort range, and translating this to on and off times.

Inputs for this program are fan status, space high dry bulb temperature, space low dry bulb temperature, maximum off percent, minimum off percent, and minimum off time. Outputs from this program are fan control. During occupancy, the Duty Cycle program shall calculate the OFF period, convert this to times for ON and OFF operations, and change the fan ON-OFF state at the proper time. Two-speed fans shall be reduced from fast to slow speed and then returned to fast speed.

If the Optimum Stop program is selected, Optimum Stop shall store high and low space temperature when the fan is shut off and shall calculate high and low temperature drift rates when the fan is turned on. The program shall calculate the off period based on the relationship between space temperature and the comfort range specified. The lowest space temperature indicates the heating need and is compared to the low comfort limit. A low comfort limit shall allow no off time, and a midcomfort

limit shall allow maximum off. A field programmed, fixed minimum off shall prevent unreasonably short off times. The program shall calculate the cooling off period using the highest space temperature and the high comfort limit. If the application is for heating and cooling, the shorter of the off times shall be used. If the application is for heating only or cooling only, either the heating or the cooling off time shall be used.

The start of occupancy shall be the start time of the Duty Cycle program. A load leveling offset period shall provide a way to specify when the off period occurs during a Duty Cycle period. This value shall be manually set using the Operator's Terminal.

The Duty Cycle program shall provide period selection within the following limitations:

- A. The fan will cycle no faster than the allowable number of starts per hour for the motor controlled.
- B. The fan will not cycle so slow (i.e., a long period) that a 25 to 30 percent off time cannot be achieved under light load with a maximum off time.
- C. The maximum off time percent shall give adequate ventilation.
- D. The minimum off time percent shall give a reasonable minimum off time (i.e., 3-5 minutes).

REDUCED OCCUPANCY

A separate, independent reduced occupancy program shall be provided for each system.

The objective of the reduced occupancy program is to provide minimal comfort conditions to occupants who must be in the building at other than normal occupancy hours. The intent is that this be accomplished by amending the control sequences for the system and allowing manual zone input.

Inputs for this program are zone occupancy switches, space temperature, and "occupied" and "unoccupied" times. Outputs are damper control, fan control, zone lock out, valve limit control.

The reduced occupancy program shall be activated any time a zone occupancy switch is energized during an "unoccupied" period. The program shall provide control within a reduced comfort range as specified and, as a minimum shall perform the following functions:

- A. Eliminate humidity control.
- B. Lock out zones on unoccupied floors.
- C. Provide a time out for energized zones. Positive action must be taken to re-energize the zone.
- D. Limit cooling coil valve to 50 % open.
- E. Provide sequenced operation of heating, ventilating and cooling to prevent simultaneously heating and cooling and make use of "free cooling" when possible.
- F. Close minimum outside air damper.

PARTIAL OCCUPANCY

An independent partial occupancy program shall be provided for each system.

The objective of the partial occupancy program is to allow use of a partially completed building and mechanical system to provide early move-in for the building owner. The intent is that this be accomplished through selective control on on-line mechanical equipment to provide minimum comfort conditions for isolated sections of the building. Additional control to be incorporated as the building is complete with minimum description of existing occupants.

EVENT PROGRAMS

Energy Management application programs and associated data files shall be in non-volatile or power backed RAM memory.

The Central Computer Console shall be provided with a programmer control function, implemented via keyboard or dedicated control panel, for use by programming and maintenance personnel. The ability to select and display the contents of any program accessible, general register or main memory location shall be provided. Provide for stopping or starting the execution of CPU instructions, allowing them to be stopped one at a time, and to manually alter the program execution counter. A bootstrap loader shall be callable permitting loading of the operating system from the disk or tape. Provide a feature to disable all programmer functions.

Furthermore the system shall also provide real time storage of all current field hardware point values, consumption and runtime values, logs, summaries, energy savings, graphics, special reports and historical data storage.

8-05 FIELD DEVICES**8-05.1 General**

Provide where indicate on the drawings or as specified, the microprocessor, electronic and/or electric control system components and sensing devices as required. The field devices shall be interfaced directly with the DDC Controller.

Input/Output sensors and devices shall be closely matched to the requirements of the DDC controllers for accurate, responsive and noise-free signal input/output. Control input response shall be of high sensitivity and matched to the loop gain requirements of precise and responsive control.

8-05.2 Temperature Instruments

- a) Temperature Sensor Immersion Type: The Sensors shall be resistance thermometer detector type with a range of minus 35 degree C to plus 260 degree C with an accuracy of plus or minus 0.1% at the reference temperature. It shall be provided with a separable copper monel or stainless steel well.
- b) Temperature Sensors Insertion Type : The sensor shall be rigid stem or averaging type as specified in the sequence of operation. It shall have nickel sensing element in a copper tube or with integral 4-20 mA converter with a temperature surging accuracy of $\pm 0.12\%$ at 0°C or better. Operating temperature range shall be 0°C to + 60°C with an accuracy of $\pm 0.2^\circ\text{C}$.
- c) Temperature Sensors Space Type: Sensor shall be with remote setpoint adjustment capability and temperature indication. It shall be provided with institutional type locking covers. The operating range shall be 0°C to + 60°C with an accuracy of $\pm 0.2^\circ\text{C}$.
- d) Combined humidity and temperature sensor: Space type sensor shall be with remote set point adjustment capability and with digital display. It shall be provided with institutional type locking cover. The operating range for temperature shall be 0°C to 60 °C with an accuracy of $\pm 0.2^\circ\text{C}$. Relative humidity sensor shall use non-saturating sensing elements. Operating range for humidity sensor shall be 10 to 90% with an accuracy of $\pm 2\%$ of full scale.
- e) Temperature Switches: Temperature switches shall have a repetition accuracy of plus or minus 1% of their operating range. Switch actuation shall be adjustable over the operating range. The switch

shall have snapaction form-C contacts rated for the application. Switch contacts shall be wiping contacts of platinum alloy, silver alloy or gold plated and shall have an adjustable differential setting.

The operating temperature range shall be 0 degree C to +60 degree C. The switches shall have provision of connecting remote set point adjustment arrangement.

- f) Temperature sensor for outside air: The sensor shall be weather proof type suitable for mounting in open and shall be provided with sun shield and splash proof housing. The operating range shall be -40°C to +130°C with an accuracy of $\pm 0.2^{\circ}\text{C}$.

8-05.3 **Humidity Instruments**

- a) Humidity Sensors: Relative humidity Sensors shall use non-saturating Sensing elements. Sensors shall have a range of 10 to 90% with an accuracy of plus or minus 2% of full scale.

8-05.4 **Pressure Instruments**

- a) Pressure Sensors: Pressure sensors shall withstand up to 150% of operating pressure. Pressure sensor accuracy shall be plus or minus 1% of full scale. Pressure sensors shall be either capsules, diaphragm, bellows, bourdon tube or solid state.
- b) Pressure Switches: Pressure switches/differential pressure switches shall have a repetitive accuracy of plus or minus 1% of their operating range and shall withstand upto 150% of operating pressure. Sensors shall be diaphragm or bourden tube. Switch operation shall be adjustable over the operating pressure range. The switch shall have a snap action form - 'C' contact rated for the application. Switch contacts shall be wiping contacts of Platinum Alloy, Silver Alloy, or gold plated and shall have an adjustable differential setting.

8-05.5 **Flow Instruments**

- a) Flow Meter:
Flow meter shall be electromagnetic type suitable for chilled water application. The flow meter shall be of robust construction with flanged connection neoperne liner. It shall be designed for PN-10 pressure class. It shall have sensor, signal convertor and local digital display. The flow meter shall also transmit signal for remote indication of flow on the DDC Controller. The electrode shall conform

AISI 316. The enclosure shall meet class IP-67. The accuracy shall be $\pm 0.5\%$. The power rating shall be 24VAC. Flow meter shall be of type MAGNA flow as manufactured by Danfoss or approved equal.

b) Flow Switch

Flow switches shall have a repetitive accuracy of plus or minus 1% of its operating range. Switch actuation shall be adjustable over the operating flow range. The switch shall have a snap action form - Contact rated for application. Switch contacts shall be wiping type of platinum alloy, silver alloy or gold plated and shall have an adjustable differential setting.

c) Variable Frequency Drive

Frequency converters shall be provided on variable speed secondary chilled/hot water pumps, VAV Air handling units, and basement exhaust fans. The converter shall be able to convert 3-phase AC voltage which varies up to 110% into a variable output voltage and frequency.

The voltage/frequency ratio shall be suitable for speed control of AHU fans. It should not be possible to set a constant voltage/frequency ratio to prevent damage to connected equipment and to optimize energy consumption. The converter shall regulate the output to adapt it continuously to the current flow so as to minimize energy consumption.

The frequency converter shall be compatible to the motor. It shall regulate the motor without load reduction and without the motor temperature becoming higher than under normal operation. It shall be able to supply the motor with a Sine shaped current and fully circular magnetic flux to obtain full motor torque at rated frequency, without the motor becoming warmer than a normal operation.

The frequency converter shall be suitable for operation between -10°C to +40°C temperature, and up to 85% relative humidity. Frequency converter shall have metal enclosure conforming to IP54 with detachable control panel suitable for mounting in the Central Control Panel. The frequency converter shall be supplied with RFI filters. The frequency converter shall be Danfoss VSD or approved equal.

8-05.6 **Smoke Detectors**

All smoke detectors mounted on the AHU return ducts shall be the duct mounted photoelectric type.

The detector shall sample the air passing through the AHU to provide early detection of a developing hazardous condition or fire. When smoke is detected by the detector at the return air duct, the AHU fan shall be shut down.

The detector head shall be housed in an integral housing with filter system for reduced maintenance and service. The detector head shall be accessible without removing the duct housing. The air velocity limits shall be 1.5 to 25.4 m./sec.

For reliability and safety considerations, the smoke detector shall comply to UL, FM, CSFM and BSA standards.

The detector shall feature:

- Tight metal die cast housing.
- Integral indicator lamps for power ON & ALARM.
- External indication for alarm operation mounted suitably so as to exactly locate which detector has activated.
- Permissible air speed-up to 16 m/sec.
- Accommodates ionization or photoelectric heads.
- Simple change-out of detectors heads; twist-in, twist-out.
- Easy to maintain.
- Powered outputs for remote LED and Sounder/Strobe.
- Air velocity rating from 300 to 4000 feet per minute (1.5 to 25.4 m./sec.)
- UL 268A Listed.
- Reset Time : 0.3 seconds (max.)
- Clear polycarbonate cover for convenient visual inspection of sampling tube filters.
- Rugged Noryl housing (mounting portion).
- Remote test station option.
- Easy and quick mounting to round or rectangular ducts from '1 to 12' (0.305 to 3.66 m.) wide.
- 3-Year Limited Warranty.

8-05.7 Fire Stats

Fire stats shall be line voltage insertion type set at 135°F (57°C) with manual reset push button located on the front cover. The construction of fire stat shall generally be similar to Insertion type temperature sensor specified in Clause 8-05.2.

8-05.8 Damper Actuators & Linkage

Actuators provided for valve or dampers shall be of sufficient capacity to operate the damper. Each actuator shall be proportional or two position as per sequence of operation and shall have enough torque to operate without over load conditions. Damper actuators shall be spring return type to operate the damper at original position on power failure. Actuators speed shall be so adjusted that it shall remain in step with the controller without hunting regardless of load variations.

8-05.9 Electronic Damper Position Indication

It shall be Visual scale indicating percent of travel and 2 to 10 V dc, feedback signal.

8-06 TRAINING OF OPERATIVE PERSONNEL

The contractor shall provide the services of a factory trained representative, free of cost, for a period of not less than 15 working days at the time the HVAC system is put into full operation, to instruct the owner's operating personnel in proper maintenance and operation of the system.

9-0 NOT IN USSE

10-0 INSTRUMENTS AND GAUGES

10-01 GENERAL

All necessary gauges, thermometers and other indicating and measuring instruments as required, specified and shown shall be furnished and installed by the Contractor.

Instruments shall include but not limited to the following:

- Pressure gauges
- Thermometers
- Testing and Maintenance instruments

10-02 TESTING AND MAINTENANCE INSTRUMENTS

The Contractor shall arrange required quantity of all testing and maintenance instruments, which shall include (but not limited to) the following:

1. Hot wire air velocity meter
2. Tachometer, Digital type
3. Manometer
4. Instrument for dry bulb temperature, wet bulb temperature and humidity measurement (Digital type)
5. Clip-on Ammeters
6. Direct reading water flow rate meter (portable differential meter) suitable for use with balancing valves specified under valves in Section 5.
7. Sound level measuring meter

The Contractor may withdraw these instruments after Final Acceptance.

11-0 PAINTING & IDENTIFICATION OF SERVICES

11-01 GENERAL

All material and labor for painting and identification of services shall be provided by the Contractor, as specified hereunder:

11-02 PAINTING

All steel work in connection with supports for pipes, ductwork etc. exposed to the elements shall be painted with two coats of an approved rust preventive paint.

All exposed metal surfaces of uninsulated pipework, hangers, brackets, valves etc. shall be painted with two under-coats and two finishing coats of enamel paint of approved color.

All machinery and equipment that have been painted in factory to the satisfaction of the Engineer shall have a finishing coat of paint before Final Acceptance if the factory paint is damaged during transportation, storage or installation.

Identification bands shall be painted on piping or on insulation at frequent intervals. Lettering shall be agreed with the Engineer.

All exposed insulation without cladding in the plant room shall be painted to approved colors with one undercoat and one finishing coat of enamel paint.

All steel pipework and other steel equipment specified to be insulated shall be thoroughly wire brushed to the satisfaction of the Engineer and painted with one coat of primer before insulation is applied.

All pipe hangers in concealed locations shall be given one coat of black asphalt paint before being concealed.

All steel pipes, cradles, vibration isolation rails that will be covered, partially covered, set in cement or fill, or not accessible when the installation is completed, shall be given two coats of black asphalt paint.

11-03 MANUFACTURER'S NAMEPLATES

A permanently attached nameplate made of brass or other corrosion resistant material shall identify each unit or equipment. Plates shall not be less than 3 inch x 1 inch in size. Plates shall bear information pertaining to unit as follows:

- System and unit designation from Schedule of Equipment.

- Manufacturer's name and address (only distributor's or Agent's name and address will not be accepted).
- Rated capacity
- Temperature, pressure or other limitations
- Electrical Data

11-04 IDENTIFICATION TAGS

The Contractor shall provide engraved brass tags for all valves, controls and instruments with distinguishing numbers corresponding to those shown on the "As Built" Drawings.

The tags shall be not less than 25 mm (1½ inch) in diameter with depressed black numbers of 12 mm (½ inch) height.

12-0 INSPECTION, TESTING AND COMMISSIONING

12-01 GENERAL

All mechanical and electrical equipment shall be subject to inspection and testing of materials, parts, equipment and workmanship of the plant during manufacture, assembling and erection and upon completion to demonstrate compliance with specifications, codes and standards and to ensure overall reliability of plant operation and performance.

For this purpose the Engineer shall, at all reasonable times, be allowed free and ready access to the Contractor's shop and the shops of his suppliers for the purpose of inspecting the specified equipment or any other parts, and obtaining information as to the progress of the work. Failure on the part of the Engineer at this or any other time, to discover or reject materials of work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

The whole of the works supplied under this Contract shall be subject to inspection and tests by the Employer or Engineer should he so require, during manufacturing erection and after completion.

Specific tests required for various items of the Plant, parts, materials and equipment should be in accordance with the corresponding clauses of the Specifications.

The Contractor shall submit to the Engineer, one month prior to the date of commencement of the tests, 3 (three) copies of the complete test procedures showing method and points of measurement as well as the method of calculation for his approval.

The Contractor shall supply all necessary testing instruments, which shall include, (but not limited to) the instruments listed in Section 10, "INSTRUMENTS AND GAUGES", and carryout any test of any kind on a piece of equipment, apparatus part of system or on a complete system if the Engineer requests such a test for determining specified or guaranteed data, as given in the Specifications or in the Schedule of Equipment. Contractor shall provide necessary skilled staff.

Any damage resulting from the test shall be repaired and/or damaged material replaced with intimation to the Engineer, all to the satisfaction of the Engineer, and at no extra cost to the Employer.

In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommenced after the adjustment or repairs have been completed.

All testing, balancing and final adjustment shall be in accordance with the provision of the applicable ASHRAE Standards, or other approved relevant standards.

12-02 **FACTORY TESTS**

The Engineer shall witness the factory tests of equipment as per the test procedures prepared by the manufacturer and approved by the Engineer. The testing of equipment shall include component testing (like pressure/leak testing of coils, pressure vessels, etc.) and complete Run tests to measure and verify the actual performance data with reference to the specified ratings. The manufacturer shall make necessary arrangements at factory to demonstrate such tests to the Engineer/Owner's representative and satisfy him that the equipment meet the required capacity and specified ratings.

12-03 **PRELIMINARY TESTS**

12-03.1 **General**

All equipment and parts of the system shall be tested to determine the specified and guaranteed data, and conformance to specified requirements, when operated independent of overall HVAC System, for noise, vibration, electrical data, air and water flow rates, temperatures, pressure and capacities.

12-03.2 **Ductwork**

All joints in ducts and at outlets shall be physically inspected for air leakage. All dampers shall be tested for proper operation.

The ductwork shall be pressure tested before application of insulation and total leakage shall not exceed 3%. The test pressure shall be 1 inch above the maximum pressure in the duct.

12-03.3 **Equipment**

All HVAC equipment shall be inspected for proper operation, noise and vibration. Tests shall be carried out with readings of temperature, pressure, RPM, ampere, voltage, flow rates, etc. to determine the Specified data.

12-03.4 **Electrical Equipment**

All electrical equipment shall be cleaned and adjusted on site before application of power. The following tests shall be carried out :

1. Wire and cable continuity tests
2. Insulation resistance tests, phase to phase and phase to earth, on all circuits and equipment, using 500 volts megger. The megger reading shall not be less than one meg. ohm.
3. Earth resistance between metallic conduit systems and earth must not exceed half (1/2) ohm.
4. Phasing out and phase rotation tests.
5. Operating tests on all protective relays to prove their correct operation before energizing the main equipment.
6. Operating tests on all starters, circuit breakers, etc.

12-04 **PRE-START & COMMISSIONING TESTS**

12-04.1 **Air Balancing**

All air handling and ventilating equipment, ductwork air inlet and outlets, air volume control dampers, and water valves shall be adjusted and balanced to deliver within 10% of the specified quantities indicated on the Drawings. Where the equipment for systems depend upon controls for proper operation, functioning and performance, the later shall be operated simultaneously with the equipment or system during tests.

If the air quantities cannot be delivered without exceeding the speed range of the sheaves or the available horsepower, the Engineer shall be notified before proceeding with the balancing of air distribution system.

Any addition/replacements required to meet the specified flow rates shall be the responsibility of the Contractor at his own cost.

12-04.2 **Commissioning Tests**

Upon completion of air and water balancing and when the whole HVAC System is substantially complete and ready for operation as specified, the Contractor shall carryout Commissioning Tests. Appropriate Seasons are not necessary for these Tests and the purpose of the tests is to start-up the whole HVAC System with manual and automatic controls and to put the whole HVAC plant in operation.

Equipment Tests as stated under Preliminary Tests shall be repeated during commissioning.

12-05 **PERFORMANCE TESTS**

All HVAC equipment shall be tested for performance after successful completion of Commissioning Tests to determine the Specified and

Guaranteed Data at Specified Operating Conditions as shown in Equipment Schedule, BOQ and Specifications. These tests shall be carried out during appropriate seasons when the Design Outside Conditions are met or approximated and when the building is fully sealed with glazing and door shutters. These performance tests shall continue for two months during summer and two months during winter.

The test data shall not deviate by more than five percent (5%) from the Guaranteed capacity data.

Temperature readings shall be taken for the entering and leaving air for each air handling unit. Should any part of the apparatus or system fail to meet the specification requirements, it shall be adjusted, repaired or replaced to the satisfaction of the Engineer by the Contractor at his own cost. The complete Commissioning Test shall then be repeated.

The date of commencement of the above said tests shall be subject to agreement with the Engineer.

12-06 RELIABILITY TRIAL TEST

After completing the above Preliminary Tests, adjustments, Commissioning Tests and Performance Tests. The Contractor shall carry out Reliability Trail Test for the whole system.

The trial tests shall last for a period of 15 consecutive days during which time the whole of the system shall operate continuously without adjustment or repair to the satisfaction of the Engineer.

Should any part of the apparatus or system fail to operate continuously as specified, it shall be adjusted, repaired or replaced to the satisfaction of the Engineer and the Reliability Trial Test shall be repeated for another 15 consecutive days.

Reliability Trial Tests should be carried out during appropriate seasons.

LIST OF DRAWINGS

Listed below are the drawings included in the specifications. The drawings show the location, general layout, plan and arrangement of the works and construction details of various features and structures of the works. The drawings do not intend to show the architectural, structural and other services details.

The drawings will be supplemented by additional drawings as required, including construction drawings and manufacturers' drawings for equipment as are required for construction and installation purposes. The drawings included in the specifications and any and all supplementary drawings form a part of the contract documents and the Contractor shall execute the works in accordance therewith.

The tenderer shall carefully check all drawings when working out his tender.

Drawing No.

TITLE

HVAC

DOT1117-H-02	GROUND FLOOR ZONING
DOT1117-H-05	GROUND FLOOR INDOOR UNIT LAYOUT
DOT1117-H-07	SECTION & DETAILS
DOT1117-H-08	H.V.A.C LAYOUT FOR OUT DOOR UNIT & REFRIGERANT PIPING AT ROOF
DOT1117-H-10	GROUND FLOOR AC DRAIN LAYOUT
DOT1117-H-14	SCHEMATIC DIAGRAM OF ODU G2 AND G7 (GROUND FLOOR)
DOT1117-H-16	SCHEMATIC DIAGRAM OF ODU G8 AND G9 (GROUND FLOOR)
DOT1117-H-17	SCHEMATIC DIAGRAM OF ODU G10 (GROUND FLOOR)
DOT1117-H-22	SCHEDULE OF EQUIPMENT
DOT1117-H-23	MISCELLANEOUS DETAIL

HVAC (ELECTRICAL)

DOT1117-E-01	H.V.A.C ELECTRICAL LAYOUT FOR OUT DOOR UNIT AT ROOF
DOT1117-E-02	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM
DOT1117-E-03	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM
DOT1117-E-04	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM
DOT1117-E-05	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM
DOT1117-E-06	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM
DOT1117-E-07	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM
DOT1117-E-08	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM
DOT1117-E-09	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM

**APPENDIX I TO
BILL OF QUANTITIES**

List of Essential Spare Parts

Bidder shall enter the total price of essential spare parts listed hereunder in the respective BOQ Item, "Essential Spare Parts".

S. No.	Description	Unit	Quantity	Rate	Amount
1.	Compressor (each Type)	Nos.	1		
2.	Main PCB	Nos.	5		
3.	Outdoor Fan PCB	Nos.	5		
4.	Inverter PCB	Nos.	5		
5.	Pipe Thermister, Outdoor	Nos.	2		
6.	Filter AC line	Nos.	2		
7.	Indoor PCB (each Type)	Nos.	5		
8.	Indoor Expansion Valve	Nos.	5		
9.	Pipe Thermister, Indoor	Nos.	5		

Total amount

**APPENDIX II TO
BILL OF QUANTITIES**

List of Maintenance Tools

Bidder shall enter the total price of Maintenance Tools listed hereunder in the respective BOQ item "Maintenance Tools"

S. No.	Description	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
1.	Open-end Spanners (all standard sizes from 1/4" to 1-1/2")	Set	1		
2.	Ring Spanners (all standard sizes from 1/4" to 1-1/2")	Set	1		
3.	Offset Box Wrenches (all standard sizes from 1/4" to 1-1/2")	Set	1		
4.	Combination Pliers (Insulated)	No.	1		
5.	Nose Pliers (Insulated)	No.	1		
6.	Multipurpose adjustable wrenches:				
	a) Size 4"	No.	1		
	b) Size 6"	No.	1		
7.	Steel Hammer with Wooden Handle				
	a) Size 1 lb.	No.	1		
	b) Size 2 lbs.	No.	1		
8.	Screw Drivers 'magnetic' (all standard lengths from 4" to 12")	Set	1		
9.	Philip Screw Drivers 'magnetic' (all standard lengths from 4" to 12")	Set	1		
10.	Grease Gun (pressure type)	No.	1		

S. No.	Description	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
11.	Oil can with pump (½ litre)	No.	1		
12.	Electric Air Blower, industrial type	No.	1		
13.	Bench Vice, 6" size	No.	1		
14.	Flat files (all sizes from 6" to 12")	Set	1		
15.	Karcher Machine (Make Karcher)	Set	1		

Total amount

(To be filled in by the Bidder)

**List of Recommended Manufacturers of
Equipment/Material and as offered by the Bidder**

1. Qualifications of Manufacturers of Equipment and Material

The local and imported equipment offered by the Bidders shall be of reputed manufacturers who have at least 10 (ten) years of proven experience in the design and manufacture of such equipment and have all testing facilities for testing of equipment strictly in accordance with the laid down standards and specifications.

2. Brand Names

Equipment and materials specified with a Brand Name have been named in order to establish a standard of performance and do not necessarily indicate a preference for a particular manufacturer or material.

3. List of Manufacturers Recommended and as Offered

The names of manufacturers given below are to indicate the level of quality and performance anticipated by the Engineer/Employer. Other makes may be accepted provided the quality and performance of such equipment in the sole opinion of the Engineer are at least equal to or better than the equipment offered by the recommended manufacturer listed hereunder: -

S. No.	Equipment/Material	Recommended Manufacturer	Offered Manufacturer
1.	Air-Cooled Variable Refrigerant Volume / Flow (VRV / VRF) Multi-Split Unit	a) DAIKIN, THAILAND / JAPAN / BELGIUM b) MITSUBISHI, JAPAN c) LG, KOREA d) SAMSUNG, KOREA e) HITACHI, JAPAN / KOREA	
2.	Single / Mini Split Air-Conditioning Unit	a) LG, KOREA b) MITSUBISHI, THAILAND c) HITACHI, MALAYSIA d) GENERAL, MALAYSIA e) Daikin	
3.	Automatic Control System/BMS	a) SCHENIDER, USA b) JOHNSON CONTROL, USA c) HONEYWELL, USA	
4.	Flexible Joints for Equipment	a) TOZEN b) PROCO	
5.	Fresh and Exhaust Fans	a) GREENHECK, USA b) PENN BERRY, USA c) SYSTEM AIR, GERMANY d) LOREN COOK, USA	
6.	Exhaust Fans, (Propeller type)	a) CLIMAX, PAKISTAN b) PAK FAN, PAKISTAN c) MILLAT, PAKISTAN	
7.	Volume Dampers Air Inlets & Outlets	a) THERMEC, PAKISTAN b) SHAN INDUSTRIES, PAKISTAN c) STEEL CRAFT, PAKISTAN	

S. No.	Equipment/Material	Recommended Manufacturer	Offered Manufacturer
8.	Condensate Drain Piping (uPVC)	a) DADEX, PAKISTAN b) HEAPWORTH, UAE	
9.	Fiberglass piping Insulation, Duct Insulation & Acoustic lining	a) Aerofoam b) KNAUF	
10.	Insulation for Condensate Drain	a) Aerofoam b) KNAUF	
11.	Fire / Smoke Dampers	a) GREENHECK, USA b) PENN BERRY, USA c) RUSKIN, USA d) LOREN COOK, USA	
12.	Electrical Control Panels	a) LIBRA, PAKISTAN b) SIEMENS PAKISTAN c) SUNBEAM ENGINEERS, PAKISTAN d) ENGINEERS & ENGINEERING	
13.	Electrical Cables	a) PAKISTAN CABLES, PAKISTAN	
14.	Fixing Bolts	a) RAWL b) HILTI c) FISHER	
15.	Duct & Piping Support System	a) HILTI b) FISHER c) SIKLA	
16.	Refrigerant Copper Piping	a) KEMBLA/AUSTRALIA	
17.	Flexible Duct	a) ATCO b) SUPERLON	
18.	Variable Frequency Drive (VFD) HVAC Applications	a) DANFOS, DENMARK b) ABB, EUROPE c) SIEMENS, GERMANY d) SCHENIDER, EUROPE e) WEG, BRAZIL	

Signature & Seal of Bidder

M/S. BENAZIR BHUTTO SHAHEED INSTITUTE OF MANAGEMENT SCIENCES DADU

HVAC DRAWING (FOR TENDER) FEBRUARY 2020

STRUCTURE ENGINEERS:



LOYA ASSOCIATES
CONSULTING ENGINEERS & PROJECT PLANNER
189-C, BLOCK-2, P.E.C.H. SOCIETY

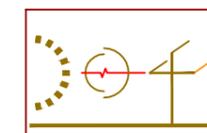
KARACHI-75400, PAKISTAN PH. 4535241
4535242

CIVIL BY:

Habib Fida Ali

4 CH. KHALIQUZZAMAN ROAD, KARACHI 75530
TEL: 5661683, 5661684, FAX: 92-21-5686891
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HVAC / MEP



DESIGN-O-TECH

BUILDING SERVICES DESIGN

624, 6th Floor
Mashriq Centre, Block-14
Gulshan-e-Iqbal, Karachi, Pakistan
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Email: info@design-o-tech.com
web: www.design-o-tech.com

LIST OF DRAWING (HVAC SYSTEM)

DOT1117-H-02	GROUND FLOOR ZONING
DOT1117-H-05	GROUND FLOOR INDOOR UNIT LAYOUT
DOT1117-H-07	SECTION & DETAILS
DOT1117-H-10	GROUND FLOOR AC DRAIN LAYOUT
DOT1117-H-14	SCHEMATIC DIAGRAM OF ODU G2 (GROUND FLOOR)
DOT1117-H-16	SCHEMATIC DIAGRAM OF ODU G7 (GROUND FLOOR)
DOT1117-H-17	SCHEMATIC DIAGRAM OF ODU G8, G9 (GROUND FLOOR)
DOT1117-H-22	SCHEDULE OF EQUIPMENT
DOT1117-H-23	MISCELLANEOUS DETAIL
DOT1117-E-01	H.V.A.C ELECTRICAL LAYOUT FOR OUT DOOR UNIT AT ROOF
DOT1117-E-02	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM



- LEGENDS:**
- ZONE G-1
 - ZONE G-2
 - ZONE G-3
 - ZONE G-4
 - ZONE G-5
 - ZONE G-6
 - ZONE G-7
 - ZONE G-8
 - ZONE G-9
 - ZONE G-10

GROUND FLOOR PLAN
SCALE : 1/32" = 1'-0"

SCOPE OF TENDER

REV.	DATE
Issued For FOR TENDER	
BENAZIR BHUTTO SHAHEED INSTITUTE OF MANAGEMENT SCIENCES DADU	
Drawing Title GROUND FLOOR ZONING	
Architect Habib Fida Ali 4 CH, KHALIOUZAMAN ROAD, KARACHI 75530 TEL: 566-1683, 566-1684, FAX: 52-21-5688891 E-MAIL: hif@habifidaali.com W: www.habifidaali.com	
Structural Engineers	Checked By S I HAQ
 LOYA ASSOCIATES CONSULTING ENGINEERS & PROJECT PLANNERS 100-C, ALFARQAN-2, J.I.C. SOCIETY GARDNER-75-460, PAKISTAN PH: 4686242	Drawn By A Z
	Scale 1/16"=1'-0"
MEP	Date FEB-2020
Revision No 2	Drawing No DOT1117-02



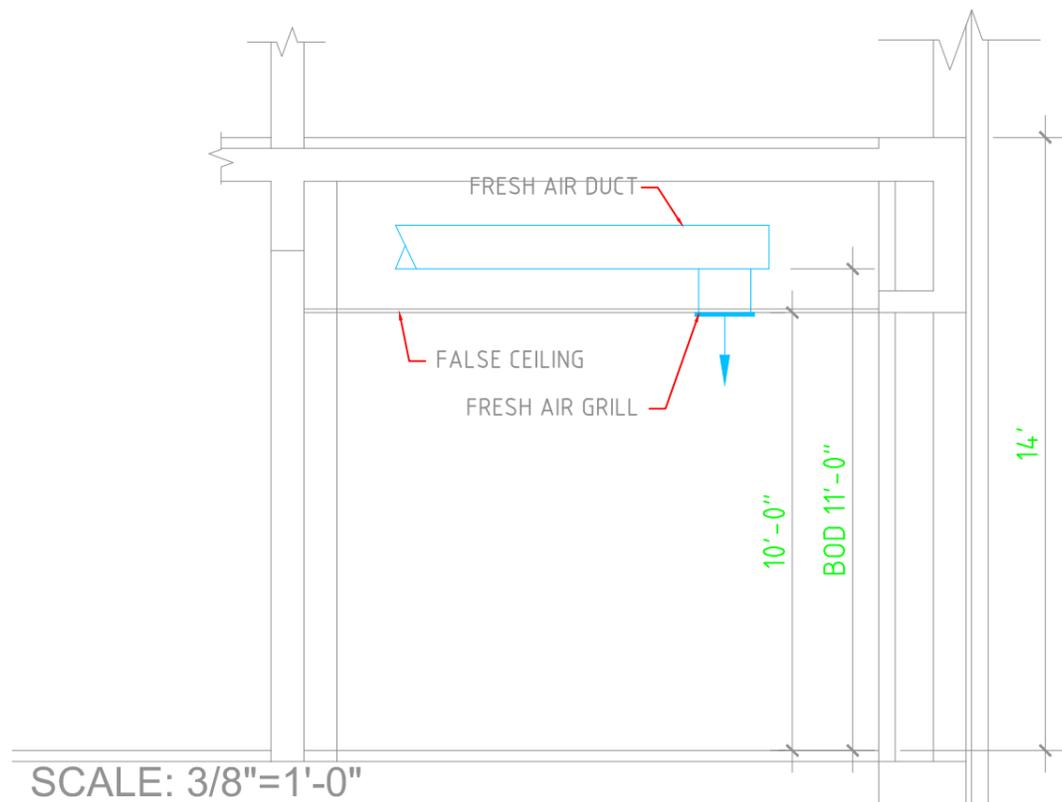
BUILDING SERVICES DESIGN
62A, 6th Floor
Madrasta Centre, Block-14
Gulshan-e-Iqbal, Karachi, Pakistan
Tel: (92-21) 3461159
Email: info@bssdesign.com
www.bssdesign.com



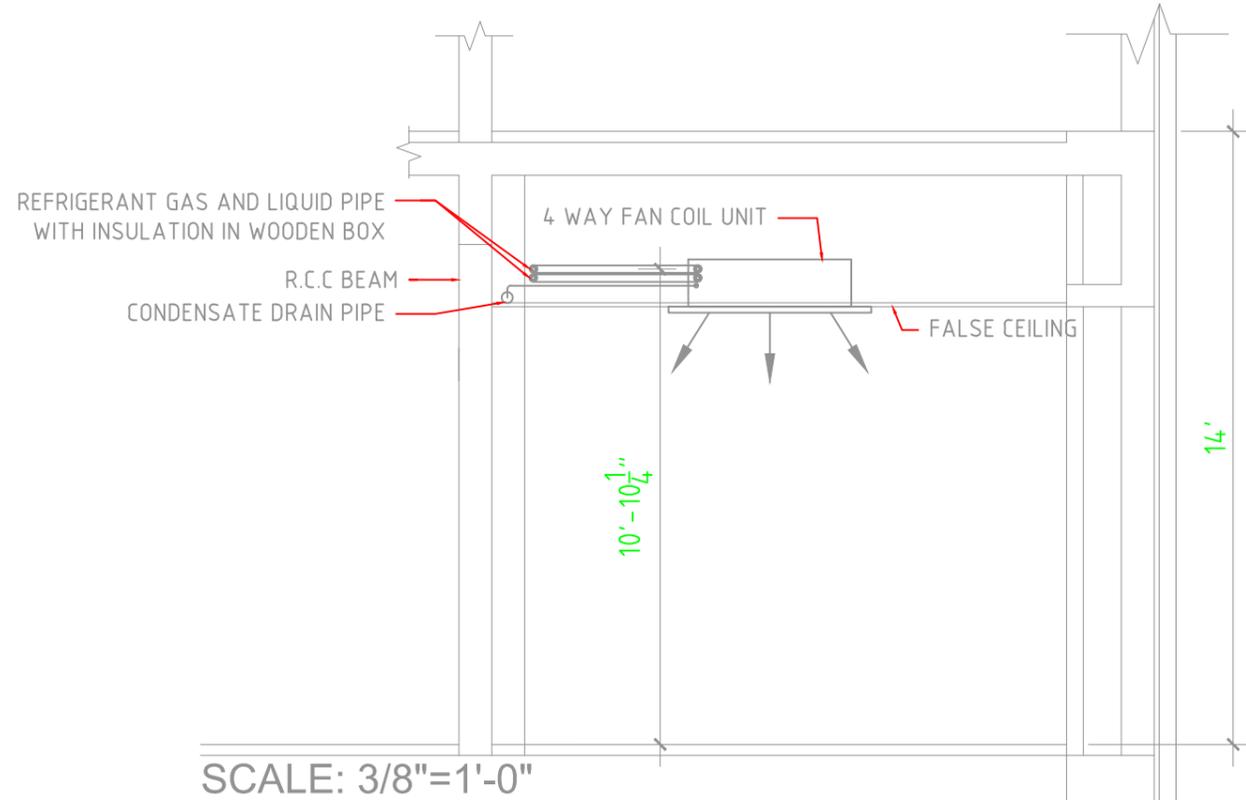
GROUND FLOOR

SCOPE OF TENDER

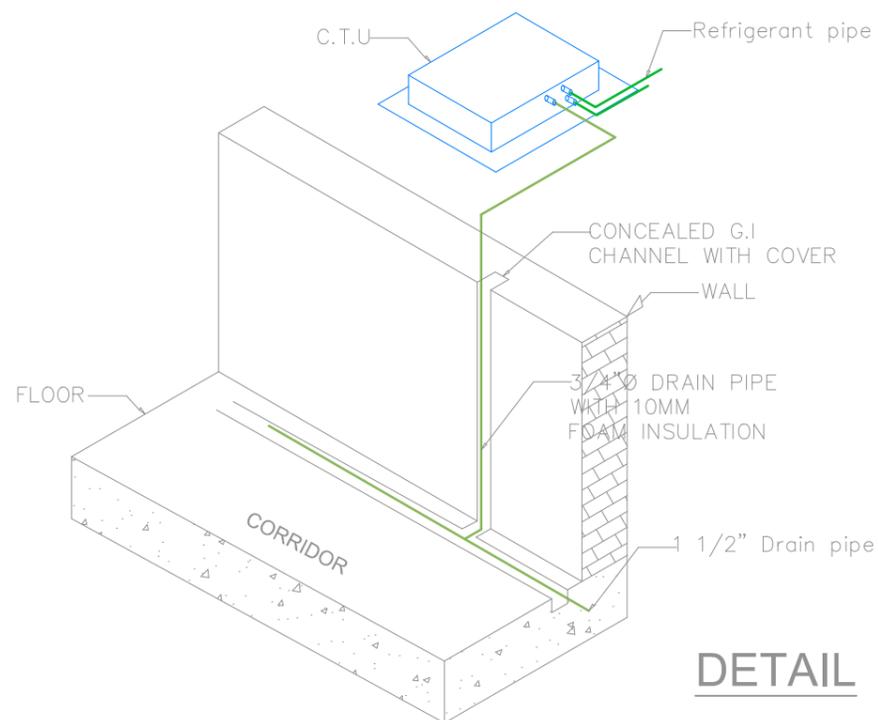
REV.	DATE
Issued For FOR TENDER	
BENAZIR BHUTTO SHAHEED INSTITUTE OF MANAGEMENT SCIENCES DADU	
Drawing Title GROUND FLOOR INDOOR UNITS	
Architect Habib Fida Ali 4 CH, KHALIQUZZAMAN ROAD, KARACHI 75530 TEL: 566-1683, 566-1684 FAX: 92-21-5686891 E-MAIL: info@habibfida.com W: www.habibfida.com	
Structure Engineers	Checked By S I HAQ
	Drawn By A Z
	Scale 1/16"=1'-0"
MEP	Date FEB-2020
	Revision No 2
	Drawing No DOT1117-05



SECTION -02



SECTION -01



DETAIL

REV.	DATE
Issued For	FOR TENDER
Drawing Title	BENAZIR BHUTTO SHAHEED INSTITUTE OF MANAGEMENT SCIENCES DADU
Architect	Habib Fida KHALIJUZZAMAN ROAD, KARACHI 75530 TEL: 5661683, 5661684 FAX: 52-21-5686891 E-MAIL: info@habibfida.com W: www.habibfida.com
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Checked By	S I HAQ
Drawn By	A Z
MEP	BUILDING SERVICES DESIGN 624, 6th Floor Madame Cama, Block-11 Gulshan-e-Iqbal, Karachi, Pakistan Tel: 36731348/173 Email: info@bsdgn-otech.com Web: www.bsdngr-habib.com
Scale	1/8"=1'-0"
Date	SEP-2017
Electrical Engineers	af Consulting Engineers A-785 SECTOR 14-B NORTH KARACHI PHONE NO. 351-9892252 CELL NO. 993-33242215 5AMX Email: info@afnet.com
Revision No	B
Drawing No	DOT1117-07

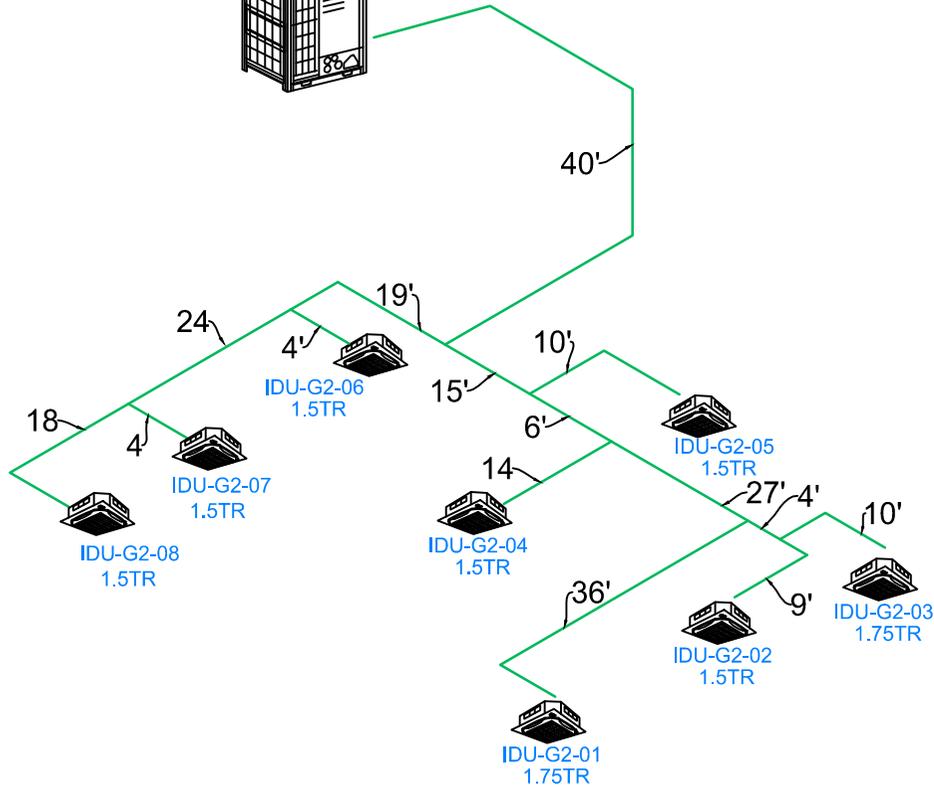
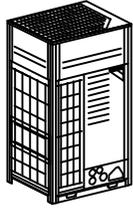


GROUND FLOOR

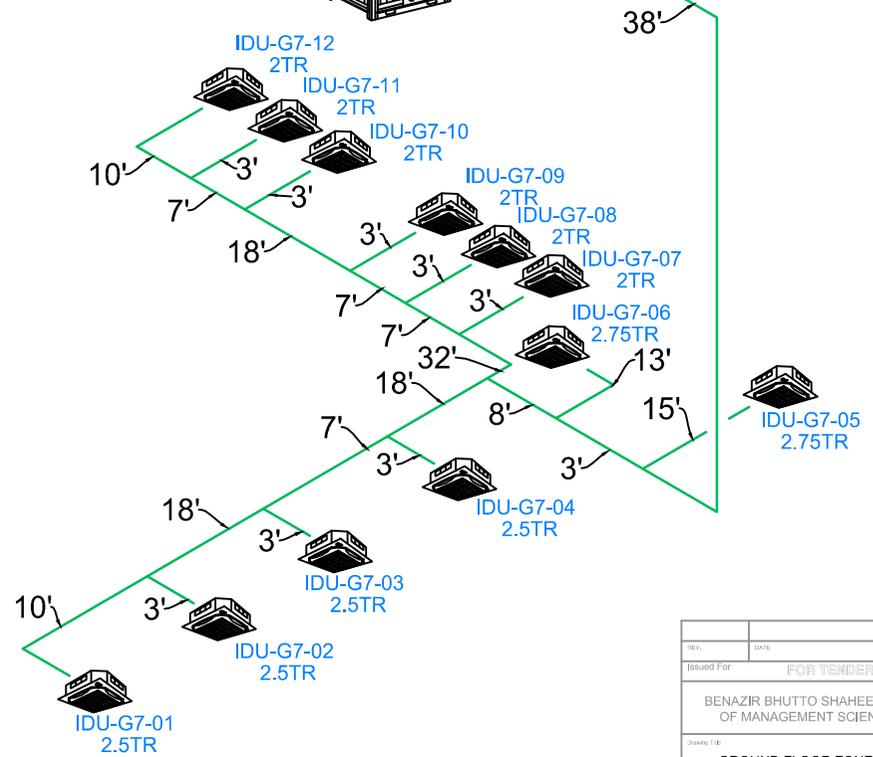
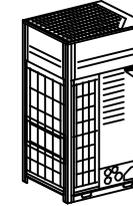
SCOPE OF TENDER

REV.	DATE
Issued For FOR TENDER	
BENAZIR BHUTTO SHAHEED INSTITUTE OF MANAGEMENT SCIENCES DADU	
Drawing Title GROUND FLOOR DRAIN LAYOUT	
Architect Habib Fida 4/CH1, KHALIOUZZAMAN ROAD, KARACHI 75530 TEL: 568-1683, 566-1684, FAX: 92-21-5688691 EMAIL: info@habidfida.com W: www.habidfida.com	
Scale: 1/16"=1'-0" Date: FEB-2020	Checked By: S I HAQ Drawn By: A Z Scale: 1/16"=1'-0" Date: FEB-2020
Revision No: 2 Drawing No: DOT1117-10	Building Services Design 624, 6th Floor Metrohouse Centre, Block-14 Gulshan-e-Hayat, Karachi, Pakistan Tel: 35021138/1113 Email: info@design-o-tech.com Web: www.design-o-tech.com

ODU#G-2 12.5TR



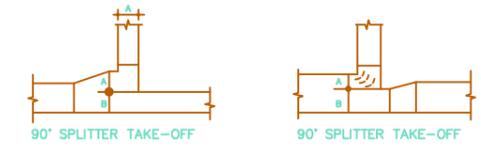
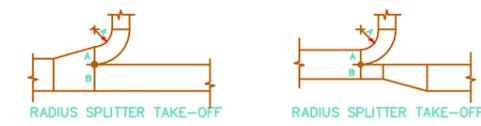
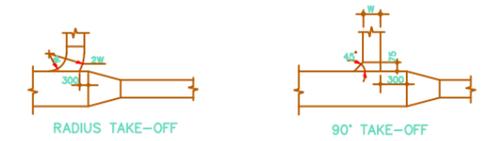
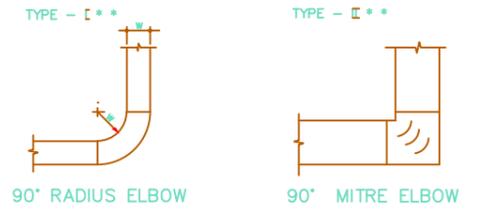
ODU#G-7 27.5TR



Rev:	Date:
Issued For:	FOR TENDER
BENAZIR BHUTTO SHAHEED INSTITUTE OF MANAGEMENT SCIENCES DADU	
Drawing Title: GROUND FLOOR ZONE # G2 AND G7	
Architect: Habib Fida Ali 4 CH. KHANJOUZAMAN ROAD, KARACHI 75303 TEL: 36012632/3601264 FAX: 36012636/36012637 E-MAIL: info@hfabidali.com WWW: www.hfabidali.com	
Designer/Engineer:	Checked By: S I HAQ
 LOYA ASSOCIATES CONSULTING ENGINEERS & ARCHITECTS 10-B, QURAN-2, JALALI ROAD KARACHI-75000, PAKISTAN	Drawn By: A Z
	Scale: NTS
DATE:	DATE: FEB-2020
 BUILDING SERVICES DESIGN 402, 4th Floor Northgate Centre, Block-14 Subcontinent Centre, Pakistan Tel: 37202124/3721175 Email: info@designo-tech.com www.designo-tech.com	Revision No: 2
	Drawing No: 00T1117-14

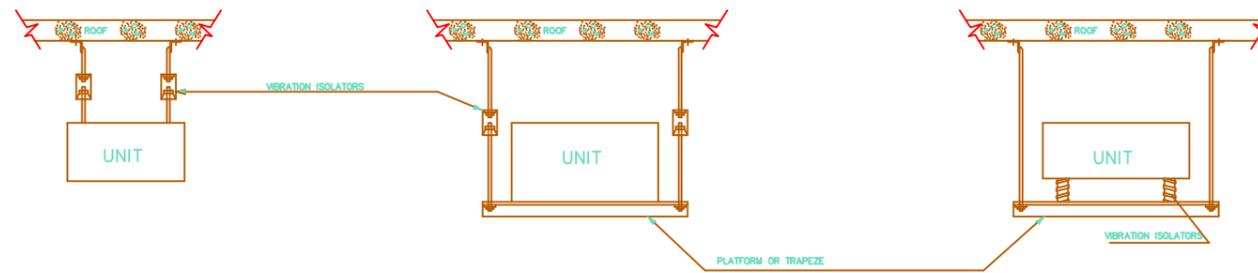
SCHEDULE OF VRF OUTDOOR/INDOOR DX-A/C UNITS												
OUTDOOR UNIT			INDOOR UNIT									
NAME	COOLING CAPACITY	ELECTRICAL CHARACTERISTICS	ZONE	FLOOR	UNIT TAG	TOTAL COOLING CAPACITY	SUPPLY AIR FLOW	FAN ESP	COOLING COIL ENTERING AIR		ELECTRICAL CHARACTERISTICS	REMARKS
TAG	TR	V/PH/HZ				TR	CFM	Pa	DB ° F	WB ° F	V/PH/HZ	
ODU-G2	12.50	380/3/50	G-2	GROUND	IDU-G2-01	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G2-02	1.5	450	-	72	63	220/1/50	Cassette type
					IDU-G2-03	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G2-04	1.5	450	-	72	63	220/1/50	Cassette type
					IDU-G2-05	1.5	450	-	72	63	220/1/50	Cassette type
					IDU-G2-06	1.5	450	-	72	63	220/1/50	Cassette type
					IDU-G2-07	1.5	450	-	72	63	220/1/50	Cassette type
					IDU-G2-08	1.5	450	-	72	63	220/1/50	Cassette type
ODU-G7	27.5	380/3/50	G-7	GROUND	IDU-G7-01	2.5	750	-	72	63	220/1/50	Cassette type
					IDU-G7-02	2.5	750	-	72	63	220/1/50	Cassette type
					IDU-G7-03	2.5	750	-	72	63	220/1/50	Cassette type
					IDU-G7-04	2.5	750	-	72	63	220/1/50	Cassette type
					IDU-G7-05	2.75	825	-	72	63	220/1/50	Cassette type
					IDU-G7-06	2.75	825	-	72	63	220/1/50	Cassette type
					IDU-G7-07	2	600	-	72	63	220/1/50	Cassette type
					IDU-G7-08	2	600	-	72	63	220/1/50	Cassette type
					IDU-G7-09	2	600	-	72	63	220/1/50	Cassette type
					IDU-G7-10	2	600	-	72	63	220/1/50	Cassette type
					IDU-G7-11	2	600	-	72	63	220/1/50	Cassette type
					IDU-G7-12	2	600	-	72	63	220/1/50	Cassette type
ODU-G8	17.5	380/3/50	G-8	GROUND	IDU-G8-01	2	600	-	72	63	220/1/50	Cassette type
					IDU-G8-02	2	600	-	72	63	220/1/50	Cassette type
					IDU-G8-03	2	600	-	72	63	220/1/50	Cassette type
					IDU-G8-04	2	600	-	72	63	220/1/50	Cassette type
					IDU-G8-05	2	600	-	72	63	220/1/50	Cassette type
					IDU-G8-06	2	600	-	72	63	220/1/50	Cassette type
					IDU-G8-07	2.75	825	-	72	63	220/1/50	Cassette type
					IDU-G8-08	2.75	825	-	72	63	220/1/50	Cassette type
ODU-G9	13	380/3/50	G-9	GROUND	IDU-G9-01	2.5	750	-	72	63	220/1/50	Cassette type
					IDU-G9-02	2.5	750	-	72	63	220/1/50	Cassette type
					IDU-G9-03	2.5	750	-	72	63	220/1/50	Cassette type
					IDU-G9-04	2.5	750	-	72	63	220/1/50	Cassette type
					IDU-G9-05	1.5	450	-	72	63	220/1/50	Cassette type
					IDU-G9-06	1.5	450	-	72	63	220/1/50	Cassette type
ODU-G10	24	380/3/50	G-10	GROUND	IDU-G10-01	2	600	-	72	63	220/1/50	Cassette type
					IDU-G10-02	2	600	-	72	63	220/1/50	Cassette type
					IDU-G10-03	1.5	450	-	72	63	220/1/50	Cassette type
					IDU-G10-04	1.5	450	-	72	63	220/1/50	Cassette type
					IDU-G10-05	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G10-06	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G10-07	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G10-08	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G10-09	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G10-10	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G10-11	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G10-12	1.75	525	-	72	63	220/1/50	Cassette type
					IDU-G10-13	1.5	450	-	72	63	220/1/50	Cassette type
					IDU-G10-14	1.5	450	-	72	63	220/1/50	Cassette type

REV:	DATE:
Issued For: FOR TENDER	
BENAZIR BHUTTO SHAHEED INSTITUTE OF MANAGEMENT SCIENCES DADU	
Drawing Title: SCHEDULE OF EQUIPMENT	
Author: Habib Fida  RAJABUZZAMAN ROAD, KARACHI 75330 PAKISTAN TEL: +92 21 35861100 WWW.HABIBFIDA.COM	
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Scale: 1:1	Date: FEB-2020
Revision No: 2	Sheet No: DOT1117-22
 BUILDING SERVICES DESIGN 10-B, ALFARUQI STREET, KARACHI TEL: +92 21 35861100 WWW.DESIGN-TECH.COM	

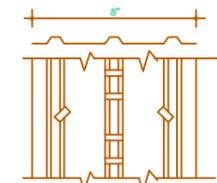
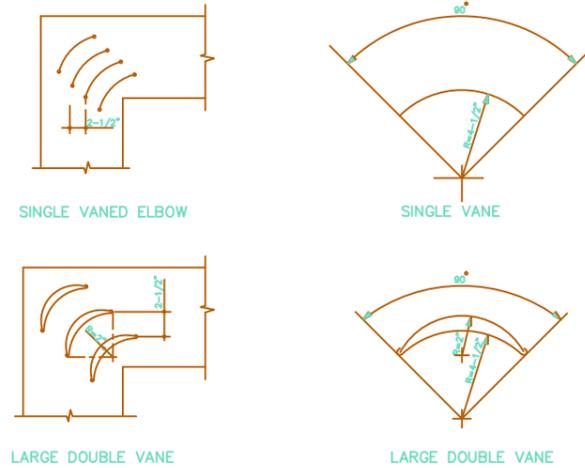


NOTES :-
SIZE A & B DIMENSIONS IN PROPORTION TO AIR QUANTITIES IN EACH LEG OF SPLIT.
NORMALLY TYPE - I SHALL BE USED TYPE - II ACCEPTABLE ONLY WHERE TYPE - I IS NOT POSSIBLE DUE TO SPACE CONSTRAINT

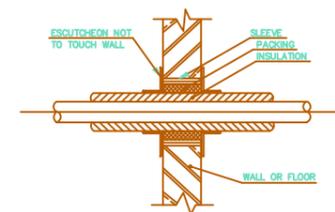
RECTANGULAR DUCT DETAILS



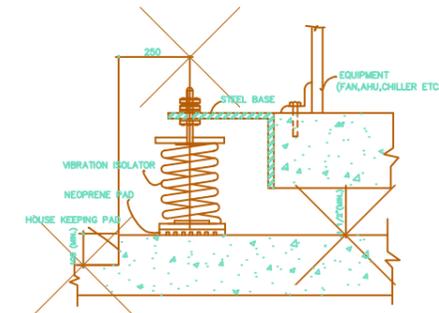
HVAC UNITS SUSPENSION (TYPICAL)



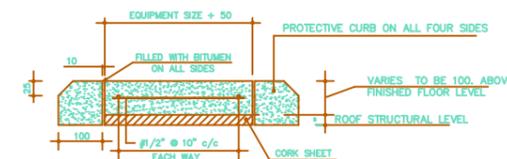
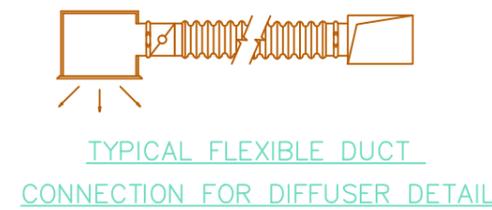
VANED ELBOW DETAILS



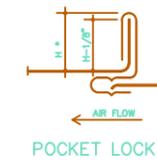
PIPE THRU WALL OR FLOOR



EQUIPMENT INSTALLATION WITH VIBRATION ISOLATOR



TYPICAL DETAIL OF CONCRETE PAD FOR EQUIPMENT (BY CIVIL CONTRACTOR)
NOTE-CORK SHEET SHALL BE SUPPLIED BY HVAC CONTRACTOR AND CONCRETE WORK



CROSS JOINTS
* DIMENSION 'H' AS PER TABLE IN SPECIFICATION

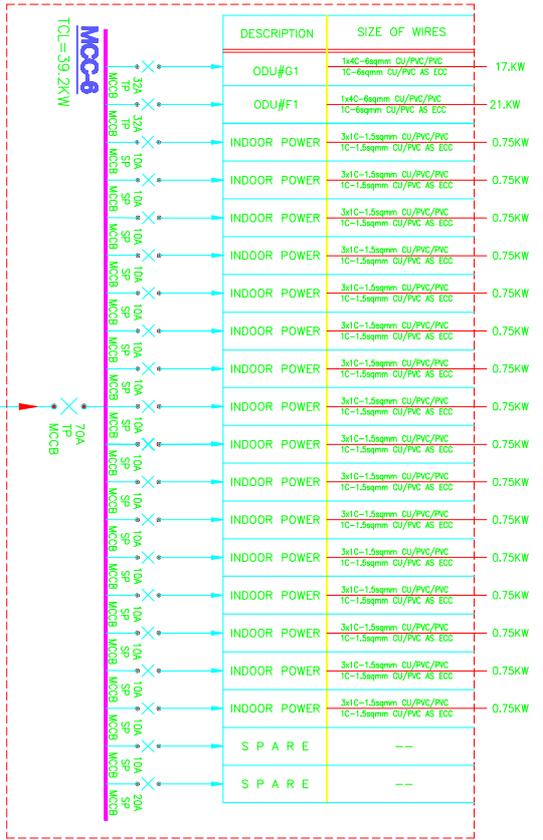
LONGITUDINAL SEAM

TYPICAL DUCT JOINTS

REV.	DATE
Issued For FOR TENDER	
BENAZIR BHUTTO SHAHEED INSTITUTE OF MANAGEMENT SCIENCES DADU	
Drawing Title MISCELLANEOUS DETAIL	
Architect Habib Fida KHALIQUZZAMAN ROAD, KARACHI 7530 TEL: 5661683, 5661684, FAX: 92-21-5686891 E-MAIL: info@habbfdad.com W: www.habbfdad.com	
Drawn By SIHAQ	Checked By SIHAQ
Scale NTS	Drawn By A Z
Date SEP-2017	Scale NTS
Revision No 0	Drawing No DOT1117-23
 LOYA ASSOCIATES CONSULTING ENGINEERS & PROJECT PLANNERS 189-C, BLOCK-2, F.I.C.I.A. SOCIETY KARACHI-75400, PAKISTAN PH: 03224143224	
 DESIGN-O-TECH BUILDING SERVICES DESIGN 624, 6th Floor Marquee Centre, Block-44 Suhrawardy Road, Karachi, Pakistan Tel: 021-2134891128 Email: info@design-o-tech.com web: www.design-o-tech.com	

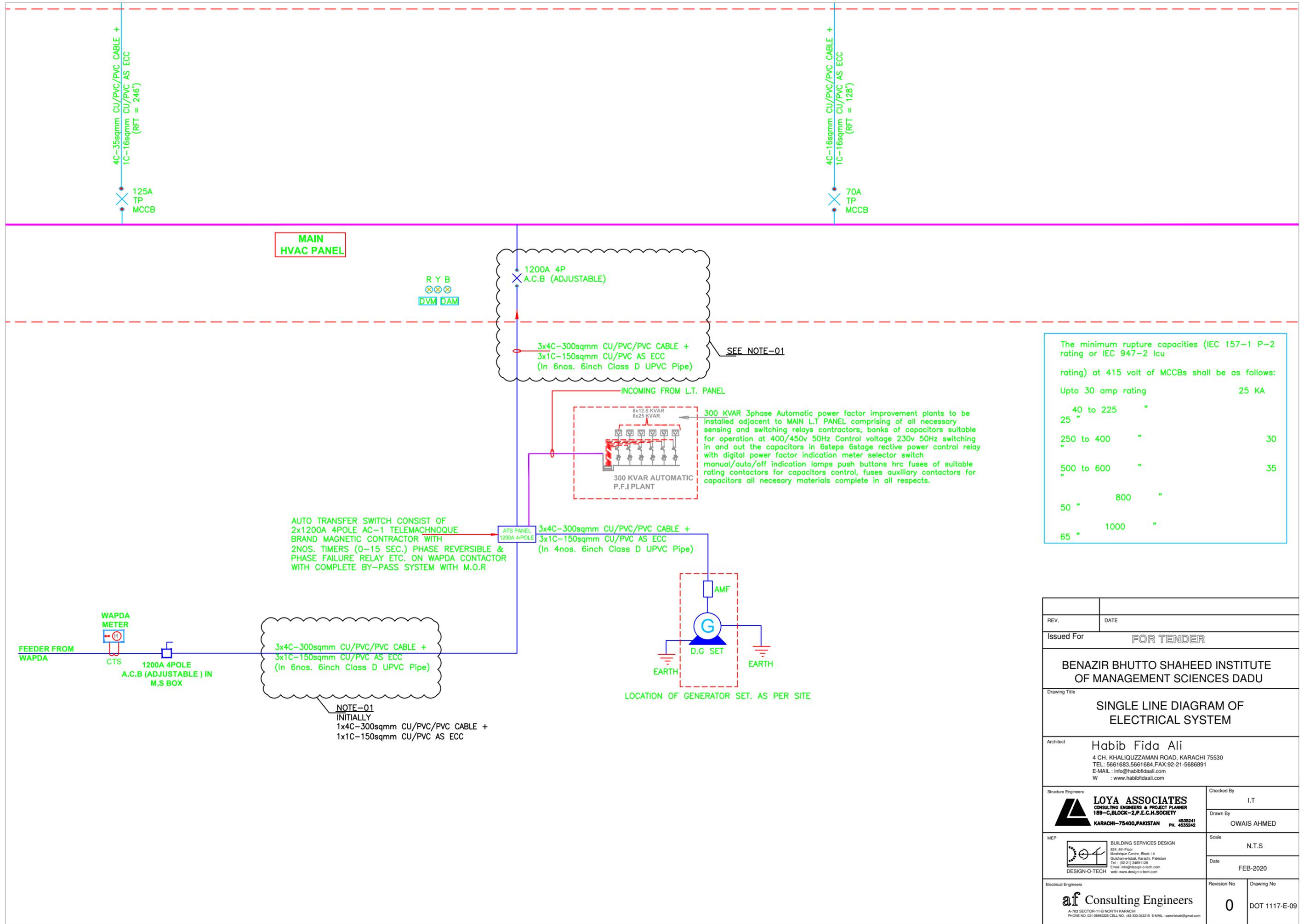


4C-35sqmm CU/PVC/PVC CABLE +
1C-16sqmm CU/PVC AS ECC
(RFT = 246)



4C-16sqmm CU/PVC/PVC CABLE +
1C-16sqmm CU/PVC AS ECC
(RFT = 128)

<p>FOR TENDER</p>	
<p>BENAZIR BHUTTO SHAHEED INSTITUTE OF MANAGEMENT SCIENCES DADU</p>	
<p>SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM</p>	
<p>Hebba Fida Ali Sr. Electrical Engineer 7411, H-8, Islamabad 0300-9999999 0300-9999999</p>	<p>LOYA ASSOCIATES 180-CALDER-ST-ALABAMA MOBILE-7600-4000000 FAX-7600-4000000</p>
<p>Consulting Engineers</p>	<p>0</p>
<p>DOT 11/17/2008</p>	<p>0</p>



The minimum rupture capacities (IEC 157-1 P-2 rating or IEC 947-2 Icu rating) at 415 volt of MCCBs shall be as follows:

Upto 30 amp rating	25 KA
40 to 225 "	"
250 to 400 "	30
500 to 600 "	35
800 "	"
1000 "	"

REV.	DATE
Issued For	FOR TENDER
Drawing Title	SINGLE LINE DIAGRAM OF ELECTRICAL SYSTEM
Architect	Habib Fida Ali 4 CH. KHALIOZZAMAN ROAD, KARACHI 75530 TEL: 5661683,5661684, FAX:92-21-5686891 E-MAIL: info@habibfidaali.com W: www.habibfidaali.com
Structure Engineers	LOYA ASSOCIATES CONSULTING ENGINEERS & PROJECT PLANNER 189-C, BLOCK-2, P.E.C.H. SOCIETY KARACHI-75400, PAKISTAN PH. 433241 PH. 433242
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Electrical Engineers	af Consulting Engineers A-783 SECTOR-11-B NORTH KARACHI PHONE NO. 021-36852205 CELL NO. +92-333-342215 E-MAIL: aamiraf@afmail.com
Checked By	I.T
Drawn By	OWAIS AHMED
Scale	N.T.S
Date	FEB-2020
Revision No	0
Drawing No	DOT 1117-E-09